

Shallow-Water Asterozoans of Southeastern Polynesia

II. Ophiuroidea

DENNIS M. DEVANEY¹

Abstract

The shallow water ophiuroids of southeastern Polynesia are represented by 40 species in 22 genera and 9 families reported herein. Ophiacanthidae is represented by one new species of *Amphilimna*, Ophiomyxidae by one species, Amphiuroidae by seven, including one new species of *Amphiura*, Ophiactidae by four species, Ophiotrichidae by six, including one new species of *Ophiothrix*, Ophiocomidae by 13, including one new species of *Ophiomastix*, Ophionereidae by one, Ophiodermatidae by five, including one new species of *Ophiopeza* and a new subspecies of *Ophiarachna megacantha*, and Ophiuridae by two species. New records are based, for the most part, on the 1967 "Pele" Expedition and 1970-71 "Westward Expedition to southeastern Polynesia. Species included are from depths less than 80 fathoms. A key is given for all species included.

INTRODUCTION

In 1967, an expedition to southeastern Polynesia was undertaken, sponsored, and supported by the National Geographic Society and the late Mrs. Mary E. King of Honolulu, Hawaii. The expedition was led by Dr. Harald A. Rehder, Smithsonian Institution, with participation by personnel from the Bernice P. Bishop Museum (Dr. D. M. Devaney) and Western Australian Museum (Dr. Barry R. Wilson). The converted Coast Guard ship "Pele", 83 feet in length, was used to collect benthic fauna by means of a box dredge, SCUBA, skin diving, and shore collecting. Work began at Tahiti, September 4, 1967, and subsequently islands in the Society, Tuamotu, Marquesas, Gambier, and Pitcairn groups were visited. Six hundred seventy two specimens of ophiuroids, representing 31 species, were collected from 84 stations and dredge hauls (Appendix, PELE Collections). The expedition terminated at Papeete, Tahiti, November 1, 1967.

A second major expedition, again sponsored and partially supported by the National Geographic Society, was conducted in 1970-71. This expedition was directed by Dr. John E. Randall, Bishop Museum ichthyologist, utilizing the 101-foot schooner "Westward", then owned by the Oceanic Foundation of Hawaii. Fishes and marine invertebrates were collected first at Washington Atoll, October 23, 1970. Further collections, mainly by SCUBA and skin diving, were made in the Society, Tuamotu, Gambier, Pitcairn, Rapan, Austral, Cook, and Marquesan groups. Bishop Museum, Smithsonian Institution, and Oceanic Found-

¹ Invertebrate Zoologist, Bernice P. Bishop Museum, Honolulu, Hawaii 96818.

dation furnished scientific staff and collectors. The expedition returned to Hawaii in May, 1971, after last visiting Nuku Hiva Island, Marquesas. The ophiuroid collections include nearly 220 specimens representing 27 species (Appendix, WES Collections).

In addition to those two major expeditions, other ophiuroids upon which this report is based come from several sources:

a) Dr. R. U. Gooding, conducting independent studies on the fauna associated with diademid sea urchins, provided the author with specimens and data on *Ophiosphaera insignis* from the Marquesas.

b) Collections of ophiuroids made by Dr. John E. Randall at Tahiti in 1967.

c) Reference to Dr. Randall's ophiuroids collected at Easter Island in 1968-69 (reported by Devaney, 1970).

d) A collection of ophiuroids made by Mr. Richard Sixberry from Anaa Atoll, Tuamotus, in 1969.

e) Specimens from Manihiki, Cook Islands, lent by the New Zealand Oceanographic Institute.

f) A collection made by the "Pele" in 1966 to Palmyra, Line Islands.

g) Ophiuroids from Fanning Island, Line Islands, made by a University of Hawaii team in January, 1970.

h) Specimens, also from Fanning Island, collected by Dr. Randall and Dr. and Mrs. A. H. Banner from a "Westward" cruise in November, 1968.

i) Specimens collected from various Polynesian areas over the past forty years and now deposited in Bishop Museum. (The above are included in the Appendix, MIS Collections).

Prior to the present study, the ophiuroid fauna of southeastern Polynesia was based on the following reports: H. L. Clark's (1917) account of the ophiuroids collected during the 1899-1900 and 1904-1905 "Albatross" Expeditions to the tropical Pacific forms the early basis. Thirteen species were included, from depths less than 500 fathoms, with the majority from shallow waters at stations from Easter Island, the Tuamotus, and Society Islands. These species included:

Name in H. L. Clark, 1917	Revised Name
<i>Ophiothrix demessa</i>	<i>Macrophiothrix demessa</i>
<i>Ophiothrix longipeda</i>	<i>Macrophiothrix longipeda</i>
<i>Ophiothrix trilineata</i>	no change
<i>Ophionereis porrecta</i>	" "
<i>Ophiocoma brevipes</i>	" "
<i>Ophiocoma erinaceus</i>	" "
<i>Ophiocoma insularia</i>	<i>Ophiocoma dentata</i>
<i>Ophiocoma insularia</i> var. <i>longispina</i>	<i>Ophiocoma longispina</i>
<i>Ophiocoma parva</i>	<i>Ophiocomella sexradia</i>
<i>Ophiocoma pica</i>	no change
<i>Ophiocoma scolopendrina</i>	" "
<i>Ophiomastix bispinosa</i>	<i>Ophiomastix variabilis</i>

*Ophiopezella spinosa**Ophiopeza spinosa*

Only two of the species, *Ophiocoma dentata* (as *O. insularia*) and its variety, *longispina*, were reported at Easter Island.

In addition to the "Albatross" report, there were a few scattered locality records for S. E. Polynesian ophiuroids by Koehler (1907) and H. L. Clark (1915). The latter author added three species to the list known from the Society Islands:

Amphipholis squamata

Ophiactis savingnyi

Ophiolepis cincta

A report by A. H. Clark (1954) listed ophiuroids from Raroia Atoll in the Tuamotu Archipelago but failed to add any new species. In Chevalier *et al.* (1968) only a single ophiuroid, *Ophiocoma scolopendrina*, determined by Prof. Cherbonnier, was listed from Mururoa Atoll, Tuamotus.

McKnight (1972) reported on echinoderms collected in the Cook Islands, Tahiti, and Fiji in 1965. Twelve ophiuroids are listed from the Cook Islands and Tahiti, of which three, from Manihiki, Cook Islands, would be new records: *Amphioplus caelatus* Ely, *Ophiocnida* sp., and *Distichophis* (sic *Distochophis*) *clarki* Ely. The specimens upon which these three species are based have been re-examined. The first is referred to *Amphioplus (Lymanella) bocki*, the second is a juvenile, and the third is referred to *Ophiopeza spinosa*.

Until the present report, only 17 species of ophiuroids have been noted from the geographical area under consideration, and these species are from the Society Islands (Tahiti), the Tuamotu Archipelago (Fakarava, Makemo, Mururoa, Raroia, Rangiroa), the Cook Islands (Palmerston, Rarotonga, Manuae, Mangaia, Mitiaro, and Manihiki), and Easter Island.

The present report extends the geographical limits of the known ophiuroid fauna of southeastern Polynesia to the Gambier, Marquesan, Pitcairn, Rapan, and Austral groups. From all localities 40 species in 22 genera and 9 families are now known. A list of these taxa is given below and includes five new species, and one new subspecies. Zoogeographical notes and tabular lists of this fauna as well as the sea stars from S. E. Polynesia have been presented recently (Devaney, 1973).

SYNOPSIS OF OPHIUROIDEA RECORDED

Ophiomyxidae

1. *Ophiomyxa australis* Lütken

Ophiacanthidae

2. *Amphilimna tanyodes* n. sp.

Amphiuridae

3. *Amphiodia* sp.
4. *Amphipholis squamata* (Della Chiaje)
5. *Amphioplus (Lymanella) bocki* Koehler
6. *Amphiura bountyia* n. sp.
7. *Amphiura macroscytalia* Murakami

8. *Amphiura velox* Koehler
 9. *Ophiocnida* sp.
- Ophiactidae
10. *Ophiactis brachyura* Döderlein
 11. *Ophiactis savignyi* (Müller and Troschel)
 12. *Ophiodaphne materna* Koehler
 13. *Ophiosphaera insignis* Brock
- Ophiotrichidae
14. *Macrophiothrix demessa* (Lyman)
 15. *Macrophiothrix longipeda* (Lamarck)
 16. *Macrophiothrix robillardi* (Loriol)
 17. *Ophiiothrix (Acanthophiothrix) purpurea* Martens
 18. *Ophiiothrix (Placophiothrix) westwardi* n. sp.
 19. *Ophiiothrix (Ophiiothrix) trilineata* Lütken
- Ophiocomidae
20. *Ophiarthrum elegans* Peters
 21. *Ophiocoma brevipes* Peters
 22. *Ophiocoma dentata* Müller and Troschel
 23. *Ophiocoma doederleini* Loriol
 24. *Ophiocoma erinaceus* Müller and Troschel
 25. *Ophiocoma longispina* H. L. Clark
 26. *Ophiocoma macroplaca* (H. L. Clark)
 27. *Ophiocoma pica* Müller and Troschel
 28. *Ophiocoma pusilla* (Brock)
 29. *Ophiocoma scolopendrina* (Lamarck)
 30. *Ophiocomella sexradia* (Duncan)
 31. *Ophiomastix stenozonula* n. sp.
 32. *Ophiomastix variabilis* Koehler
- Ophionereidae
33. *Ophionereis porrecta* Lyman
- Ophiodermatidae
34. *Ophiarachna affinis* Lütken
 35. *Ophiarachna megacantha erythema* n. subsp.
 36. *Ophiarachnella parvispina* H. L. Clark
 37. *Ophiopeza kingi* n. sp.
 38. *Ophiopeza spinosa* (Ljungman)
- Ophiuridae
39. *Ophiolepis cincta* Müller and Troschel
 40. *Ophiura kinbergi* (Ljungman)

DEPOSITION OF SPECIMENS

Type material has been deposited at BPBM, USNM, or WAM. Designation of type material will be found in the Material Examined and Localities Section

for each new species. Specimens other than types will be divided between the three institutions listed above with the largest share retained at BPBM.

ABBREVIATIONS

a. Institutions

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.

MCZ —Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.

b. Measurements

a.l. —arm length fms —fathoms

br —breadth ft. —feet

cm —centimeters m —meter(s)

d.d. —disc diameter mm —millimeter(s)

c. Others

Sta. —Station E —east (longitude)

No. —number W —west (longitude)

N —north (latitude) temp. —temperature

S —south (latitude)

KEY TO SOUTHEASTERN POLYNESIAN OPHIUROIDS

A key to the species of shallow water ophiuroids now known from southeastern Polynesia is presented below. Thirteen of the 40 species considered in the present report are not listed in Clark and Rowe's (1971) key to the shallow water Indo-West Pacific ophiuroids from which portions of the present key are adapted. These species include: *Amphilimna tanyodes*, *Amphiodia* sp., *Amphioplus* (*Lymanella*) *bocki*, *Amphiura bountyia*, *Amphiura macroscytalia*, *Ophiocnida* sp., *Ophiothrix* (*Placophiothrix*) *westwardi*, *Ophiocoma doederleini*, *Ophiocoma longispina*, *Ophiocoma macroplaca*, *Ophiomastix stenozonula*, *Ophiarachna megacantha erythema*, and *Ophiopeza kingi*.

- 1 Upper arm plates reduced and often fragmented, concealed in wet specimens by opaque skin which also covers the disc. *Ophiomyxa australis* Lütken
- 1' Upper arm plates clearly visible (rarely concealed by granules or thin skin); if the disc is covered with skin, the skin is either thin and semi-transparent or bears spinelets; usually the disc scales are distinct or covered with spinelets or granules 2
- 2 Upper arm spines beneath disc expanded, partially fused at their base, and compressed; two tentacle scales on proximal segments, with inner scale on lateral side of lower arm plate. *Amphilimna tanyodes* n. sp.
- 2' Upper arm spines beneath disc neither fused at their base nor expanded,

- although sometimes may be compressed; if two tentacle scales, the inner scale is on edge of lateral (side) arm plate 3
- 3 A pair of regular rounded or oblong infradental papillae at the apex of each jaw below the lowest tooth, which is usually wide and square... *Amphiuridae* 4
- 3' Apical papillae either multiple or single, rarely two, usually asymmetrical on some or all the jaws 10
- 4 A wide space or diastema between the infradental pair of papillae and the one (rarely two) distal oral papillae on each side, the latter arising from the edge of the adoral shield or very close to it at the distal end of the oral plate *Amphiura* 5
- 4' Oral papillae present down the sides of the oral plates in more or less continuous series with the infradental ones; at least two papillae on each side of the infradental pair (not counting the oral tentacle scale, which arises at a higher level in the mouth slit on the side of the oral plate) 7
- 5 Typically, six arms (rarely five or seven, sometimes three-armed, recently self-divided individuals); middle arm spine with tip blunt and more or less well developed lateral points..... *Amphiura velox* Koehler
- 5' Typically five arms; middle arm spine with tip tapering to point without lateral points 6
- 6 Lower arm spine beyond disc much longer than other spines and thickened *Amphiura macroscytalia* Murakami
- 6' Lower arm spine beyond disc only a little longer or equal to other spines and not thickened *Amphiura bountyia* n. sp.
- 7 Only three oral papillae present and no oral tentacle scale..... 8
- 7' Four oral papillae; disc without spinules; only three arm spines.....
..... *Amphioplus (Lymanella) bocki* Koehler
- 8 Disc with blunt spinules or granules of two sizes: aborally in each interradius a single large conical granule, additional smaller granules randomly over rest of upper side..... *Ophiocnida* sp.
- 8' Disc scaled but without spinules or granules 9
- 9 The three oral papillae all arising from the oral plate, the outermost one not operculiform (but wider than the second); oral papillae not capable of completely closing the oral slit..... *Amphiodia* sp.
- 9' Outermost oral papilla operculiform, at least twice as wide as the second one and arising partly from the edge of the adoral shield; oral papillae together able to close oral slit..... *Amphipholis squamata* (Della Chiaje)
- 10 Sexually dimorphic species, commonly occurring in pairs with a dwarfed male clasped upside down beneath the center of the larger female; mouth parts of females more or less modified, the papillae usually with more or less fringed or irregular edges; the oral shields somewhat sunken and reduced in size 11
- 10' Not sexually dimorphic; oral or tooth papillae with smooth edges; oral

shields not sunken and rarely reduced in size.....12

- 11 Disc scales and mouth parts of females obscured by granular dark-pigmented skin; tentacle scale rudimentary in adults; six or seven arm spines, the upper ones short; teeth irregular and rugose; frequently on regular sea urchins....
..... *Ophiosphaera insignis* Brock
- 11' Disc scales and mouth parts distinct; no dark skin; tentacle scale well developed in adults; four or five fairly long arm spines; teeth fairly regular, narrow and tapering; often on irregular sea urchins.....
..... *Ophiodaphne materna* Koehler
- 12 Teeth broad and square-tipped, with only a single papilla (or reduced tooth), if any, at the superficial end of the column of teeth; one or two (rarely three) distal oral papillae, usually well spaced from the apex of the jaw, particularly when single; one rounded tentacle scale.. *Ophiactis* 13
- 12' Teeth rounded or conical with one or many superficial papillae; oral papillae, if present, form a continuous series up the side of the jaw; often more than one tentacle scale, or if only one, usually elongated and may be pointed14
- 13 Normally two distal oral papillae each side (occasional jaws may have fewer); six or more arm spines proximally (five in smaller specimens); upper arm plates elliptical with a more or less distinct small median distal lobe often emphasized by a pair of dark spots, one on each side so that whole plate appears tri-lobed..... *Ophiactis savignyi* (Müller and Troschel)
- 13' One distal oral papilla; up to five arm spines; upper arm plates fanshaped throughout, only narrowly in contact; arms relatively short, only two or three times the d.d. *Ophiactis brachyura* Döderlein
- 14 No oral papillae, each jaw crowned with a more or less compact cluster of tooth papillae apically *Ophiotrichidae* 15
- 14' Oral papillae present on the sides of the jaws, together with either a cluster of tooth papillae or one or a few larger oral papillae apically.. 20
- 15 Upper arm plates rhombic or fan-shaped, the distal side continuously convex or with a median rounded angle, no extensive median straight edge transverse to the axis of the arm; arm plates not more than twice as wide as long and sometimes longer than wide; consecutive plates in contact for usually much less than half their total widths; adult size not exceeding 12 mm....16
- 15' Upper arm plates usually about twice as wide as long or longer, more or less broadly in contact, the distal side usually with straight (sometimes even concave) median part, usually at least half as wide as the whole plate (in small specimens of the subgenus *Placophiothrix* the distal side may be continuously curved); adult size with d.d. from 10 to 35 mm.....17
- 16 Upper arm plates wider than long; somewhere along arms an even number of dark stripes (usually two), the midline always with a pale stripe (sometimes the two median lines may fade out proximally, leaving a continuous broad light band; or proximally they may fuse together to form a median dark

- line); radial shields bare, widest part of shield distal to middle of its length; armament of side scales rather sparse, hardly concealing the limits of the scales, often almost naked above; arm spines rarely more than four times the corresponding segment in length. *Ophiothrix (Ophiothrix) trilineata* Lütken
- 16' Upper arm plates longer than wide; a medial dark line or band running along each arm above, sometimes more or less interrupted to form series of dark spots; radial shields quite large and bare, interrādial side of each usually more or less shortened so that widest part of shield may be at middle of its length or even proximal to this; armament of disc scales with more or less numerous acute elongate spines; arm spines, especially basal and uppermost ones, very long and needle-like. *Ophiothrix (Acanthophiothrix) purpurea* Martens
- 17 Arm length usually six to nine times d.d.; radial shields usually bare (except in specimens with d.d. less than 4 mm), rarely with a few stumps, contrasting sharply with the moderately large disc scales and their armament, which consists of spaced, fairly smooth spines, spinelets or spaced stumps (the latter most common in adults); scaling usually distinguishable; arm spines opaque; maximum d.d. to 15 mm. *Ophiothrix (Placophiothrix) westwardi* n. sp.
- 17' Arms at least ten times d.d. or more; radial shields usually with some or many thorny granules or short stumps similar to, but shorter than, the stumps on the rest of the rather puffy disc; stumps completely obscure the countless underlying scales (in *M. robillardi* the radial shields are often bare except peripherally); arm spines usually translucent; adult size large, d.d. commonly 15–20 mm, up to 35 mm. *Macrophiothrix* 18
- 18 Upper arm plates armed with easily detached low thorny stumps or rugose granules. *Macrophiothrix demessa* (Lyman)
- 18' Upper arm plates either quite smooth or with the surface of the plate itself rough in texture, but no stumps or granules. 19
- 19 Upper arm plates with acute, often prolonged, latero-distal angles; shape of plate trapeziform, with the distal edge either straight throughout or with a pair of very obtuse angles dividing it into a straight or slightly concave median part and two shorter lateral parts which are barely inclined proximally; widest part of the plate near or at the distal end; radial shields granule-covered; upper arm plates often spotted. *M. longipeda* (Lamarck)
- 19' Upper arm plates hexagonal, the distal edge bent backward at the sides so that the broadest part is set back from the distal end and may be at or near the middle of the plate; radial shields generally bare. *M. robillardi* (Loriol)
- 20 Both tooth papillae and oral papillae present, the former usually numerous but occasionally only two or three. *Ophiocomidae* 21
- 20' Only oral papillae present, usually only one apical papilla below the teeth,

- at most two or three.....33
- 21 Six-armed self-dividing form, size small, d.d. up to 7 mm but seldom exceeding 5 mm; disc with spaced granules and short spinules.....
.....*Ophiocomella sexradia* (Duncan)
- 21' Typically five arms; species reaching adult size of 10 mm or larger; disc naked (*Ophiarthrum* and juv. *Ophiocoma erinaceus*), granulated (*Ophiocoma*), or with spinules or spinules and granules mixed (*Ophiomastix*).....22
- 22 Disc covered at least above with a layer of rounded granules.. *Ophiocoma* 23
- 22' Disc scales either bearing more or less numerous spinelets, sometimes together with granules, or else lacking armament altogether and covered with a naked skin31
- 23 Similar number of arm spines on each side of arm segments beyond disc; upper arm spines not noticeably thickened.....24
- 23' Alternating number of arm spines, usually three and four on each side of same or adjacent segments beyond disc; upper arm spine thicker and often markedly longer than lower spines27
- 24 Upper arm plates with angular lateral margins, much broader along distal than proximal border; disc granules not closely packed around oral shield25
- 24' Upper arm plates with broadly rounded margins and not much broader along distal than proximal border; disc granules closely packed up to oral shield29
- 25 Arm spines quite fragile, hollow; three (seldom four) oral papillae on jaw angle; between segments eight and twelve, sometimes one to three consecutive segments on one or more arms, with the second (rarely third) from uppermost spine inflated toward tip; size small, rarely more than 8 mm d.d.....*Ophiocoma pumila* (Brock)
- 25' Arm spines not fragile, solid; four (sometimes five) oral papillae on each jaw angle; arm spines not inflated toward tip.....26
- 26 Disc variegated with yellowish lines and yellow spot on each side of arm base of disc; lower arm plates lighter along distal edge.....
.....*Ophiocoma pica* Müller and Troschel
- 26' Disc uniformly blackish (except in small, d.d. 3-4 mm specimens, which have small light color on each side of arm base of disc); lower arm plates near disc uniformly dark.....*Ophiocoma longispina* H. L. Clark
- 27 Four spines most commonly on each side of third arm segment.....
.....*Ophiocoma macroplaca* (H. L. Clark)
- 27' Three arm spines on each side of third arm segment.....28
- 28 Lower surface of arms, especially proximally, white or yellow-white, sometimes variegated but never all black.....
.....*Ophiocoma scolopendrina* (Lamarck)
- 28' Lower surface of arms, including proximal area, mostly or all black or dark brown*Ophiocoma erinaceus* Müller and Troschel

- 29 Length of second and third arm spines less than breadth of proximal upper arm plate; lower surface white or yellow-white.... *Ophiocoma brevipes* Peters
- 29' Length of second and third arm spines equal to or more than breadth of proximal upper arm plate; oral surface gray, brown, or variegated.....30
- 30 Arm spines conspicuously annulated dark and light; five (seldom four) arm spines on segment six..... *Ophiocoma doederleini* Loriol
- 30' Arm spines not annulated in color; four (seldom five) arm spines on segment six *Ophiocoma dentata* Müller and Troschel
- 31 Disc completely naked; uppermost spines similar to each other, none abruptly and markedly enlarged, although some may be widened at tip *Ophiarthrum elegans* Peters
- 31' Disc armed with spines or spinules and granules combined; a number of the uppermost arm spines more or less conspicuously forked, elongate, or thickened..... *Ophiomastix* 32
- 32 Armament consisting of more or less spaced spinelets or spines tapering sharply; one tentacle scale (sometimes one and two tentacle scales on segment one); narrow light bands on the arms at wide intervals usually extending onto the arm spine of the segment involved..... *Ophiomastix variabilis* Koehler
- 32' Armament consisting of more or less spaced spinelets and granules interspersed (specimens ca. 5 mm or smaller have many more spinelets than granules); two tentacle scales (number of segments with two scales increases with size of specimen); a very narrow dark transverse band of color across the distal end of each upper and lower arm plate..... *Ophiomastix stenozonula* n. sp.
- 33 Arms inserted below the disc; a pair of supplementary upper arm plates confined to lateral sides of upper plate..... *Ophionereis porrecta* Lyman
- 33' Arms projecting from and well fused to the edge of the disc; supplementary upper arm plates absent except in *Ophiolepis cincta*, where they form a continuous row in front of upper plate.....34
- 34 Disc, oral plates, and sometimes even the oral and adoral shields, densely granulated *Ophiodermatidae* 35
- 34' Disc scales naked, exposed..... *Ophiuridae* 39
- 35 Arm spines long and flaring, easily exceeding each arm segment in length *Ophiarachna* 36
- 35' Arm spines, except the lowest one, rarely as long as the segment and more or less appressed to the arm.....37
- 36 Arm spines banded dark and light; radial shields minutely visible or concealed by granules *Ophirachna affinis* Lütken
- 36' Arm spines not banded; radial shields all evident..... *Ophiacantha megacantha erythema* n. subsp.
- 37 Radial shields naked..... *Ophiarachnella parvispina* H. L. Clark
- 37' Radial shields concealed by granules..... *Ophiopeza* 38

- 38 Disc granules angular and centrally pitted; eight to 13 arm spines maximum (specimens from 3 to 8.5 mm d.d.).....*Ophiopeza spinosa* (Ljungman)
- 38' Disc granules rounded, not conspicuously pitted; six to nine arm spines maximum (specimens from 3 to 8.5 mm d.d.).....*Ophiopeza kingi* n. sp.
- 39 Second oral tentacle pore superficial, opening more or less outside the series of oral papillae; arm combs of spinules present distal to radial shields.....*Ophiura kinbergi* (Ljungman)
- 39' Second oral tentacle pore concealed within the oral slit when the jaws are closed; no arm comb*Ophiolepis cincta* Müller and Troschel

SYSTEMATIC ACCOUNT

OPHIOMYXIDAE

1. *Ophiomyxa australis* Lütken

Ophiomyxa australis Lütken, 1869: 45; Brock, 1888: 532 (in key); H. L. Clark, 1915, Pl. I, figs. 1-2; 1938, Pl. 13, figs. 1-2 (color); Mortensen, 1924: 111-113, Figs. 4, 5; A. M. Clark and Rowe, 1971: 78-79 (distribution), 92 (in key), Fig. 22a, Pl. 13, figs. 3-4.

Ophiomyxa brevispina Martens, 1870: 249; Döderlein, 1896: 298, Pl. XVII, figs. 27-27a; Koehler, 1927: 3; 1930: 48.

Ophiomyxa irregularis Koehler, 1898: 110; 1922: 17, Pl. 2, fig. 18, Pl. 5, figs. 1-2, Pl. 6, fig. 4, Pl. 92, fig. 2; 1930: 48.

Ophiomyxa robillardi Loriol, 1893 a:53-54, Pl. XXV, figs. 5-5d.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Anaa Atoll: PELE Sta. AN II, under large coral boulder with rubble and sand bottom in shallow pool, one specimen, d.d. 26 mm.

AUSTRAL ISLANDS—Raivavae: WES XVI, from base of attached live or dead coral, one specimen, d.d. 13 mm.

COOK ISLANDS—Rarotonga: WES IV, under boulder on rubble and sand, one specimen, d.d. 10 mm.

LINE ISLANDS—Palmyra Island: MIS IV, one specimen, d.d. 14 mm.

REMARKS

With the exception of the specimen from Palmyra, which is faded, the other three specimens showed a red or orange color when alive: both the Anaa and Rarotonga specimens had the disc red with several circular or oblong darker red spots; the Raivavae specimen had a ground color of orange with darker orange spots or blotches. The three specimens had the arms banded.

A. M. Clark (Clark and Rowe, 1971: 93) suggested that (a) the upper arm plates, each being divided into "two lateral plates with a median longitudinal suture

between," and (b) "less strongly serrated edges of the oral papillae" might be criteria which could differentiate *Ophiomyxa brevispina* from *O. australis*, based on specimens she examined from Amboina, Fiji, and Tonga. Among my material, the Rarotonga specimen shows that the upper arm plates for each segment are frequently as quoted above; but there are also segments in which a medial triangular plate is present; the Raivavae specimen has one or two triangular medial pieces more frequently than not; the largest specimen, from Anaa, has the basal segments with several lateral and medial upper arm plates per segment; farther out on the arm the number of pieces diminishes until only two lateral pieces or a small triangular medial piece plus the two lateral pieces remain. These three specimens suggest that there may be a positive correlation between the number of upper arm ossicles per segment and the increased size of the specimen; thus its use as a specific character is questionable. I also suspect that the degree to which the edge of the oral papillae is serrated might be somewhat variable and of dubious specific value.

Mortensen (1924) compared *Ophiomyxa brevirima* known from New Zealand with *O. australis* and give several morphological features of the latter species. He figured the upper and lower sides of the arm and mouth region as well as the characteristic double anchors which are embedded in the ovarian membrane.

The eastern limits of *Ophiomyxa australis* now extend to the Tuamotu Archipelago. Previous Pacific records include those from Tonga (Lyman, 1882), Fiji (H. L. Clark, 1915), Gilbert and Marshall Islands (Koehler, 1927, A. H. Clark, 1952).

OPHIACANTHIDAE

2. *Amphilimna tanyodes* n. sp.

Figs. 1-5

ETYMOLOGY: The specific name of this species (*tanyo*—Gr., long) refers to the considerable length of the arms.

MATERIAL EXAMINED AND LOCALITIES

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, haul 4, two specimens, d.d. 6 and 7 mm (PARATYPES, BPBM No. W 1904); haul 19, one specimen, d.d. 7 mm (HOLOTYPE, BPBM No. W 1903).

DESCRIPTION OF HOLOTYPE

Disc diameter 7 mm, arm length (longest arm to broken end) 96 mm; a.l.: d.d.=14: 1. Arms very slender.

Upper side of disc is fairly evenly covered with small, generally rounded, slightly rugose granules which extend to the disc edge where the covering becomes distinctly spiniform and more widely spaced (Figs. 1, 3). A series of two to four

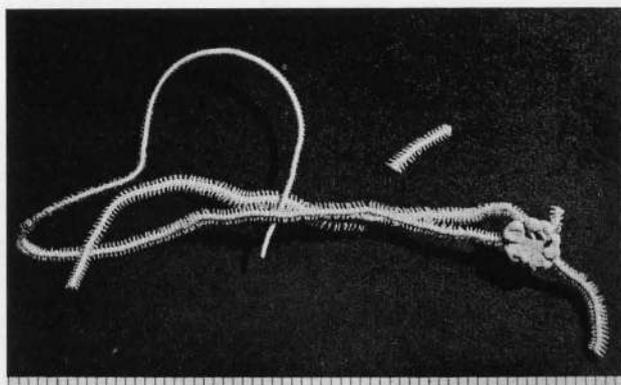


Fig. 1. *Amphilimna tanyodes*, Holotype, BPBM. No. W1903—Upper side.

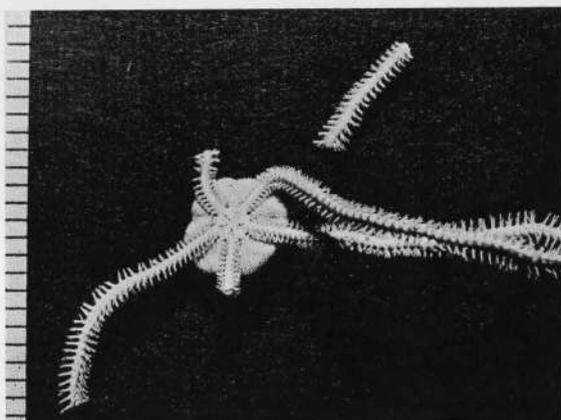


Fig. 2. *Amphilimna tanyodes*, Holotype—Lower side.

thicker, more elongated spinules with blunt tips occurs just beyond the distal end of the exposed radial shields and extends around the base of the arms (Fig. 3). The lower side of disc is covered with uniformly scattered spinules which extend nearly to the oral shields. There is an abrupt change in the nature of disc scales where the proximal arm spines occur next to the disc: here the disc scales are larger, extending to the genital apertures, with an evident demarcation between the interbranchial scales in this area and the scales in the interradial disc region bearing the spinules. The disc is markedly excavate radially, and the distal ends of the radial shields mark the midradial maximum size of the disc, while on either side of the arm base the disc expands interradially; a gap left by the incised radial portion of the disc edge exposes the upper arm plates, and reveals the upper arm plates. It is evident that the arms are inserted below and are partly overlain by the disc (Fig. 1).

A portion of each radial shield is exposed, about .75 mm long and .25 mm

broad, with some very fine scales separating each shield radially; distally they diverge and each has a slightly expanded rounded edge (Fig. 3).

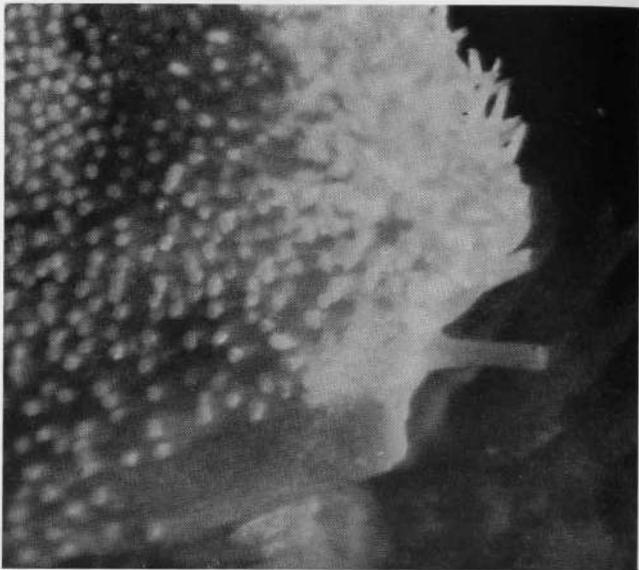


Fig. 3. *Amphilimna tanyodes*, Holotype—Edge of disc, granules and enlarged spinules next to radial shields.

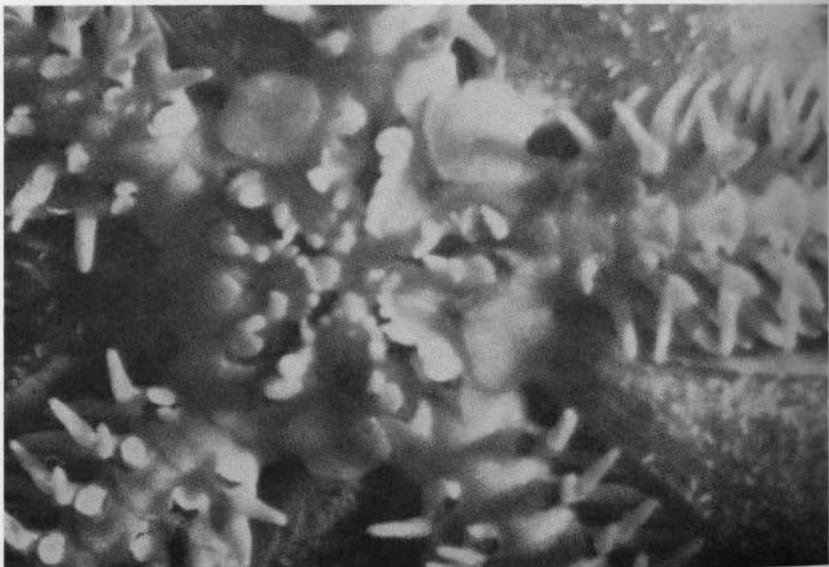


Fig. 4. *Amphilimna tanyodes*, Holotype—Lower side showing mouth region and proximal arm segments.

The oral shields are about as long as broad with rounded lateral sides tapering more rapidly inward to form a bluntly pointed edge and outward to form a broader margin. The adoral shields narrow rapidly inward where they meet in front of the oral shield and outward they slope around the first lateral arm plates and come in contact with the ventral arm shield (Fig. 4). They are widest medially.

There are two oral papillae attached along the edge of the adoral shield: the outermost is directed into the oral aperture with its adradial side touching the ventral arm shield and occurring along the interradian side of the outer buccal tentacle; the innermost papilla is quite large and squamiform (Fig. 5). There are four or five additional papillae attached to the oral plate: the outer of these the largest, elongated and tapering to a round tip, while the next three or four are smaller, irregular, generally rounded, and not spiniform. One or two of these small papillae may reach the jaw apex, resting above (oral to) the dental plate. The visible teeth are wedge-shaped, about as wide as long, with a median convexity at the tip.

The upper arm plates have the distal border broadly rounded, tapering proximally and somewhat broader than long on proximal segments, becoming longer than broad on distal segments. Each plate is just in contact, the lateral arm plates not separating them completely.

The lower arm plates have the distal side quite wide with margins extending to the base of the lower arm spine; on proximal segments the distal border is gently rounded, but becomes straight or slightly concave medially on segments farther out on the arm. The lateral sides of the plates are concave but broaden toward the proximal side which is narrower than the distal side. The lower arm plates are in contact for over half the length of the arm before the lateral plates separate them.

Usually two tentacle scales occur on the proximal segments: the outer one is



Fig. 5. *Amphilimna tanyodes*, Holotype—Oral angle in mouth region and proximal arm segments.

larger, located on the lower proximal edge of the lateral arm plate; the inner scale is about half the size of the outer scale and is attached to the lower arm plate midway along its lateral border; the inner scale diminishes in size distally and is found regularly only out to segments 9 to 11 and irregularly to segment 14; on one side of a proximal segment there are two small inner scales in addition to the outer scale and on another segment there are two large outer scales. The outer scale remains large and conspicuous out to the end of the arm; on proximal segments it is slightly longer than broad with a bluntly rounded tip; on distal segments it becomes relatively longer than broad, narrowing toward the tip. The scales do not overlap the base of the lower arm spine, but cover a large tentacle pore.

The arm spines are carried on the distal edge of the lateral arm plates. The upper arm spines on the segments beneath the disc and just beyond are quite modified. Segment 1 has two arm spines, the lower is unmodified, slightly thickened in the middle and tapering to a point while the upper is leaf-shaped, broad and compressed with a rounded terminal border and has three rib-like extensions passing along its length as if three spines were fused. Segments 2, 3, and 4 have the two lower spines unmodified, of similar size, both tapering to a blunt point. The next spine is flared and connected basally with an even more flared upper spine. The upper two spines of segments 3 and 4 are slightly larger than those of segment 2. Segment 5 has five spines with the upper three flared. There are six spines on segment 6, the lower three unmodified, the upper three flared but less than noted on proximal segments. Segment 7 is at the disc edge and carries six spines; the only modification of the upper spines is a slight compression or flattening. Segment 8 carries seven spines, none appearing altered, but all rather tapering to a point. Away from the disc there is a gradual increase in the length of the two next-to-lowest arm spines; these spines do not taper uniformly but have a narrowed neck and slightly expanded tip. The middle and lower spines are somewhat longer than the upper spines. In alcohol, these spines appeared translucent with a core of tissue inside, especially in the wider basal part. The upper spines are minutely serrated along the distal edge and around their tip. The maximum number of spines is seven on a few segments near the disc; there are fewer distally until only three are present on segments toward the arm tip.

Pigmentation: Basic color is whitish with the upper side of the disc also showing spots of lemon yellow; similarly colored on the upper side of the arms with one plate having yellow followed by two or three lighter plates giving a banded appearance to the arm. The yellow color does not continue over onto the lower side of the arms, nor is the mouth region or lower side of the disc yellow; rather they are uniformly white in color.

COMPARISON WITH OTHER SPECIMENS AND VARIATIONS

A. Tentacle scales. The smaller paratype has two tentacle scales regularly out to segment 10, irregularly to segment 17; the larger paratype has two tentacle scales regularly to segments 11 or 14; in both specimens the inner scale

diminishes and finally disappears on distal segments.

B. Disc cover. The larger paratype has the disc granules more closely packed than on the holotype, and along the disc margins both spinules and granules are intermixed; orally the disc is covered with more numerous spinules, but they still do not reach the oral shield; generally only two of the enlarged spinules are found on either side of the arm based at the disc edge.

C. Arm spines. In the smaller paratype, eight spines were noted as far as segment 14 and seven spines as far as segment 30; the modified leaflike upper spines are present to segment 8. In the larger paratype, eight spines occur on segments from the disc margin for some distance distally before dropping to seven; modified arm spines are present as far as the disc margin.

D. Oral papillae. The larger paratype has one side of a jaw with three similar-sized, narrow, elongate, blunt-tipped papillae proximal to the broader outer papilla attached to the adoral plate; these are followed by three smaller papillae, and at the apex of the jaw there are three granule-like papillae below the first tooth; if the outer of these is counted as an oral papilla, then this jaw edge has nine oral papillae. On the opposite side there are the two papillae attached to the adoral shield, then two elongate, blunt-tipped papillae followed by a gap and three granule-like inner papillae; the lower tooth on this jaw is quite small. On another jaw edge there is little difference in size and shape between the next-to-outermost and inner papillae. Typically it appears that at least six, often seven, and as many as nine oral papillae may be present. It is sometimes difficult to tell whether the broad squamiform outer papilla is attached to the adoral shield or to it and the oral plate; the inner papillae are definitely connected to the oral plate, although some apical papillae may be partially infradental (if attached to the dental plate).

DISCUSSION AND RELATIONSHIPS

In 1967, Thomas noted the presence of fused upper arm spines on proximal arm segments of *Amphilimna olivacea* (Lyman). He remarked that these modified spines "form thin flanges which extend into the genital slits" (p. 126). Further he stated that "similar fused spines occur in *Amphitarsus mirabilis* H. L. Clark, a species found in 320-430 m of water off the north and south coasts of Cuba."

Internal dissection of the peristomial, dental, and oral plates of *A. olivacea* convinced Thomas that this species more correctly belonged in the Ophiacanthidae rather than the Amphiuridae in which it had previously been placed (Verrill, 1899; Matsumoto, 1917; Fell, 1960).

In 1967 Schoener described two new species of *Amphitarsus* and redescribed and illustrated *A. mirabilis*. Like H. L. Clark (1941) she considered the modified upper arm spines beneath the disc to be a fusion of the genital and "basal winglike" side arm plates. One of her species, *A. spinifer*, was recently shown to be a young stage in the development of *Amphilimna olivacea* (Thomas and Schoener, 1972). In that paper, the authors consider that if the "winglike flanges" of *A. mirabilis* are fused arm spines then "it is almost certain, in view of other

similarities discussed by Schoener (1967) and Thomas (1967), that *Amphitarsus mirabilis* and *Amphilimna olivacea* are congeneric" (p. 2-3).

In response to my enquiry about *A. mirabilis*, Dr. Schoener kindly re-examined the type specimens. She noted (pers. comm.) that the enlarged plates are fused arm spines as Thomas (1967) mentioned, although, because of the condition of the specimens, it is difficult to see the fusion clearly in all cases.

Thomas (1967: 125) described the imperforate dental plate of *A. olivacea* which he considered similar to those of the ophiacanthid genera *Ophiacantha*, *Ophiothamys* (sic), and *Ophiomitrella* based on the descriptions of Murakami (1963).

However, the species now considered as *Amphilimna* (*olivacea*, *mirabilis*, *niki*, and *tanyodes*) show affinity to that group of Ophiacanthidae distinguished by Matsumoto (1917: 92-93) in which (a) the tentacle pores are very large and open, (b) the disc is covered with granules or spines, and (c) the radial shields are small. Genera in this group include *Ophiopora*, *Ophiotrema*, *Ophiambix*, *Ophiomedia*, *Ophiopristis*, and *Ophioprium*. A seventh genus, *Ophiodelas*, is included in the same part of the key covering that group by Fell (1960: 17). Fell (1961) described the genus *Glaciacantha* from the Antarctic which he related to *Ophiomedia*.

Amphilimna is easily distinguished from the above genera by possessing the modified, flared and fused upper arm spines on proximal segments. *Amphilimna* resembles *Ophiomedia* and *Ophioprium* in having the inner tentacle scale carried on the side of the lower arm plate on proximal segments.

Unfortunately Murakami (1963) did not describe nor figure the oral and dental plates of *Amphilimna* or the other ophiacanthid genera mentioned above. Further study will be necessary to show whether, and to what degree, these features are common to *Amphilimna* and these genera.

In view of the new characterization of the genus *Amphilimna* I present the following emended diagnosis:

A genus of Ophiacanthidae in which the upper arm spines on the proximal segments are fused and flared, lying adjacent or within the genital openings. Oral papillae are variable but the outer are larger and somewhat squamiform while the inner are smaller, one or two of which may be infradental. Arm spines four to ten. Radial shields exposed. Disc carrying spinules or spinules and granules. Disc notched at base of each arm. Tentacle pores large, with two or more tentacle scales on each side of proximal segments, inner one attached to lower arm plate, outer one often to side arm plate. Arms six or more times disc diameter. Upper and lower arm plates well developed, not separated by lateral arm plates at least on proximal arm segments.

Type species: *Ophiocnida olivacea* Lyman, 1869

Other included species: *Amphitarsus mirabilis* H. L. Clark, 1941

Amphitarsus niki Schoener, 1967

Amphilimna tanyodes n. sp.

The new species, *Amphilimna tanyodes*, differs morphologically from *A. olivacea*

in having (a) a granular rather than spiniform upper disc cover, (b) the modified upper arm spines divided into two or three flanges rather than only a single winglike extension, and (c) a larger outer, rather than inner, tentacle scale on proximal segments (the inner scale of *olivacea* is also attenuated unlike that of *tanyodes*). The first two criteria above also separate *A. tanyodes* from *A. niki* and a third difference is in the maximum number of arm spines: eight for *tanyodes* and four for *niki*. This does not appear to be a reflection of growth since both species are the same size (d.d. 6–7 mm).

Although *A. tanyodes* resembles *A. mirabilis* in the nature of the disc cover, with a granular upper surface and spinose lower side, there appear to be several differences as follows:

<i>A. tanyodes</i> (d.d. 6–7 mm)	<i>A. mirabilis</i> (d.d. 6 mm)
1. maximum arm spines, eight	1. nine
2. a.l.:d.d. ratio, 14+ : 1	2. 10:1
3. fused proximal upper arm spines, divided beyond base	3. undivided beyond base
4. arms banded dark and light	4. arms unbanded

The previously known species of *Amphilimna* now recognized are Western Atlantic forms while *A. tanyodes* is the first Pacific representative. *A. tanyodes* was dredged from 91 to 119 m. This depth is in the upper range for *A. olivacea* while *A. mirabilis* is known from 320–430 m and *A. niki* from 535 m.

In a recent paper by Devaney (1973), *Amphilimna tanyodes* was listed as “n. gen. et sp.” under the family Ophiacanthidae prior to its recognition as a new species of *Amphilimna*.

AMPHIURIDAE

3. *Amphiodia* sp.

MATERIAL EXAMINED AND LOCALITY

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH I, haul 1, two specimens, d.d. 2 mm (one specimen without disc).

DESCRIPTION

The largest specimen, which has the disc attached, shows the disc area quite swollen and in places ruptured with evident, well-developed gonads. The arms are quite long, at least 8 to 10 times longer than the disc before their breaking. The radial shields are approximately two times longer than broad, mostly in contact except proximally, where one or two elongate scales separate them. The disc has overlapping scales above and appears to be unscaled below. There are three oral papillae on each side: the outer is widest, flaring toward the tip; adjacent to this is a smaller middle one; slightly above the level of the outer two papillae is an elongate, infradental papilla at the jaw apex; there is no evidence of an inner oral (buccal) tentacle scale. The ventral shield is quite wide and

separates the adoral shields distally. Proximally the adoral shields appear separated slightly by a small gap. The oral shields are slightly longer than broad and have a distinct rounded distal lobe. The upper arm plates are about two times broader than long, with a broadly rounded distal border, and they are broadly in contact. The lower arm plates are as wide as long, with the distal border straight or slightly concave in the center. There appears to be only a single tentacle scale, occupying more than one-half the length of the lower arm plate. Even in the smaller specimen there are four arm spines beyond the third segment, continuing far out on the arm. The arm spines appear to taper to a point, but the tips are for the most part decalcified and it is not easy to tell. They also appear slightly expanded near their base.

REMARKS

In 1970, A. M. Clark reviewed the status of several amphiuroid genera and critically discussed their relationships. She restricted the genus *Amphiodia* to those species which showed the oral papilla arranged in a particular pattern: m, m, n,n -t (where the first m stood for the infradental papilla, the second m for the middle papilla attached to the oral plate, the n,n for the distal papilla attached to both the oral plate and adoral shield, and the -t for the absence of an internal oral tentacle scale). The species from the Marquesas shows this arrangement exactly on both specimens, and I have no hesitation in considering it as *Amphiodia*.

Of the ten species of *Amphiodia* sensu stricto considered by A. M. Clark (1970: 27) as valid—other than 23 from the east and west coasts of America—six

Table 1. Comparison of known Indo-West Pacific species with the Marquesan specimens of *Amphiodia* sp.

Species and author	Max. no. arm spines	Tentacle scales	Other differentiating characters; locality
<i>A. crassa</i> (Koehler, 1904)	5	1	Lower arm spine greatly thickened or enlarged; East Indies, Philippines
<i>A. debita</i> Koehler, 1922	3	2	Philippines
<i>A. dividua</i> Mortensen, 1933	3	2	Normally hexamerous; thorny projections outside each radial shield; Mauritius
<i>A. frigida</i> (Koehler, 1897)	3	2	Scales on lower side of disc; near Ceylon
<i>A. minuta</i> H. L. Clark, 1939	3	1	Maldives
<i>A. obtecta</i> Mortensen, 1940	3	1	Pair of thorny projections distal to each pair of radial shields; Persian Gulf
<i>A. sp.</i>	4	1	Marquesas

are from Indo-West Pacific localities, three are from the north Pacific, and one is from West Africa. In Table 1, I have compared the known Indo-West Pacific species with the Marquesan specimens.

Only three of the above species, *A. crassa*, *minuta*, and *obtecta*, have a single tentacle scale like the Marquesan specimens, and only one species, *A. crassa*, has more than three arm spines compared to the four noted for the Marquesan species.

The Marquesan species approaches *A. microplax* Burfield (1924) in a) the shape of the upper arm plates, b) size and shape of the lower arm plates, c) nature of the oral and adoral shields as figured by Mortensen (1940: 91, Figs. 16a-b). However, *A. microplax* is distinguished from *Amphiodia* s.s. by the presence of a modified upper row of lower disc scales with edges as spinular processes, and placed in the subgenus *Amphispina* by A. M. Clark (1970). No such modification of the disc scales is noted on the disc of the Marquesan specimen.

I hesitate assigning a specific name to the Marquesan specimens due to their poor condition, as they have a great deal of decalcification evident. Although the larger of the two specimens is obviously an adult, I would prefer to have a larger series of adequately preserved specimens before designating a name.

This species of *Amphiodia* is the first to my knowledge known from the eastern part of the Indo-West Pacific region.

4. *Amphipholis squamata* (Della Chiaje)

Asteria squamata Della Chiaje, 1828: 74.

Amphipholis squamata: H. L. Clark, 1946: 202; A. M. Clark, 1970: 29-30; A. M. Clark and Rowe, 1971: 80-81 (distribution), 99 (in key).

Axiognathus squamata: Thomas, 1966: 831; A. M. Clark, 1970: 29-30.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Anaa Atoll: MIS XXIV, one specimen, d.d. 1.5 mm.

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH VIII, haul 7, one specimen, d.d. 1 mm.

RAPAN ISLANDS—Rapa: WES XXIV, from algal washings, one specimen, d.d. 1 mm.

REMARKS

H. L. Clark (1915) reported this pan-tropical, cosmopolitan ophiuroid from the Society Islands. It was somewhat surprising that it was not taken at more than three of the present collecting sites.

Amphipholis squamata was reported clinging to the arms of undetermined ophiocomid brittle stars by H. L. Clark (1921: 107) at Mer Island, Torres Strait, but he considered this a chance occurrence. Ely (1942: 38) observed a similar association frequently with individuals of *Ophiocoma* found under boulders in Hawaii, and he considered this to be more than coincidental. My own observations in Hawaii support Ely, as I have found *A. squamata* among the arm spines of

both *Ophiocoma dentata* and *O. erinaceus* although this species is not restricted to this habitat.

5. *Amphioplus* (*Lymanella*) *bocki* Koehler

Amphioplus bocki Koehler, 1927: 6-9, Figs. 3-4; A. M. Clark, 1970:52-53.

Amphioplus (*Lymanella*) *laevis*: A. M. Clark and Rowe, 1971: 102 (pt.).

Amphioplus caelatus Ely; McKnight, 1972: 38.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XVIII, from *Halimeda* algal mat, one specimen, d.d. 3.5 mm.

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: PELE Sta. RL I, hauls 3-5, three specimens, d.d. 4 to 6 mm; haul 6, three specimens, d.d. 3 to 4 mm.

COOK ISLANDS—Manihiki: MIS XXV, six specimens, d.d. 3 to 4 mm.

REMARKS

Koehler described *Amphioplus bocki* from Fiji (Viti-Levu, Namuka, récif barrière) based on three specimens. In 1940, Mortensen tentatively included *A. bocki* as a "probable" synonym of *A. laevis* Lyman. A. M. Clark (1970) agreed with Mortensen but stated: "Koehler describes the arm spines of *bocki* as blunt-tipped whereas in . . . *A. laevis* the slender spines are more or less sharp" (p. 53). In 1971, the same author (in A. M. Clark and Rowe) concludes: "I can find no good reason for maintaining *bocki* as distinct, the apparently longer arms being correlated with the more nearly intact state of Koehler's type-material than that which has been referred to *laevis*" (p. 102).

Koehler (1927) considered *A. bocki* in relation to other species in the genus. He noted that *A. laevis* resembled *A. bocki* in having the outer oral papilla separated from the next innermost one, but differed in having the larger tentacle scale smaller than that in *A. bocki*, as well as having shorter arms relative to the disc diameter. These two latter characters appear somewhat insignificant.

A. M. Clark has given some details regarding the shape of the upper arm plates, especially their distal edge, in comparing *A. laevis* and *A. bocki*. *A. laevis* was re-examined and distinguished as having "rather irregular dorsal arm plates with some suggestion of a median angle in the distal sides" (1970: 53, Fig. 9w). In 1971 (in A. M. Clark and Rowe: 102, Fig. 48c), it was stated that for *A. laevis* the distal edges were "slightly undulating" and "trilobed". In *A. bocki*, however, the distal edge is nearly continuously straight or slightly rounded and convex, a condition quite evident in the Polynesian specimens at hand.

I have found that the arm spines are bluntly pointed, similar to Koehler's description for *A. bocki*, and the middle spine is the widest.

Koehler also recorded the length: breadth ratio for the radial shields of *A. bocki* as 4: 1. The photograph of his specimen shows a ratio of 3.2 to 3.9: 1, however. The ratios for the Polynesian specimens are:

Tahiti	—1.9: 1
Rangiroa	—2.3 to 2.6: 1
Manihiki	—2.9 to 3.1: 1

While these ratios are less than those for Koehler's type specimen of *A. bocki*, I believe that they are within the range of variation for that species.

The length of the radial shield: disc radius ratio has been another criterion separating species of *Amphioplus*. Koehler's type of *A. bocki* has a ratio of nearly 1:2. For the Polynesian specimens:

Tahiti	—1: 3.3
Rangiroa	—1: 2.6 to 3.3
Manihiki	1: 2.7 to 3.3

Koehler described the breadth: length ratio of the upper arm plates for the type of *A. bocki* as almost 2:1. Polynesian specimens show:

Tahiti	2.0: 1
Rangiroa	—2.0 to 2.1: 1
Manihiki	—1.2 to 1.8 :1

The upper arm plates of the Manihiki specimens are relatively longer than broad, compared to the other Polynesian specimens and the type of *A. bocki*. Further, the Manihiki specimens have plates with a more roundly convex distal angle.

All the Polynesian specimens show a well-marked marginal row of scales on the disc.

The mouth shields show a small to moderate distal lobe on the Polynesian specimens, characteristic of *A. bocki*.

The Manihiki specimens were listed by McKnight (1972) as *A. caelatus* Ely. This species is known previously only from the small (d.d. 2 mm) type specimen collected in Hawaii. It differs from *A. bocki* in lacking a marginal row of projecting disc scales and in having shorter arms (a.l.: d.d.=4:1 vs. 8 to 14:1 for *A. bocki*).

A. M. Clark (Clark and Rowe, 1971:102) mistakenly reported that the Gilbert Islands rather than Fiji was the type locality for *A. bocki*; the former location is where H. L. Clark (1917) had reported *A. laevis*.

6. *Amphiura bountyia* n. sp.

Figs. 6-7

ETYMOLOGY: The new species is named after the British ship "H.M.S. Bounty", the vessel that the mutineers took to Pitcairn Island (the type locality) in 1790 and which was sunk just off the coast.

MATERIAL EXAMINED AND LOCALITIES

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, hauls 2 and 3, seven specimens, d.d. 3 to 4 mm (PARATYPES, BPBM No. W 1912); haul 5, one specimen, d.d. 3 mm (PARATYPE, WAM); haul 20, one specimen, d.d.

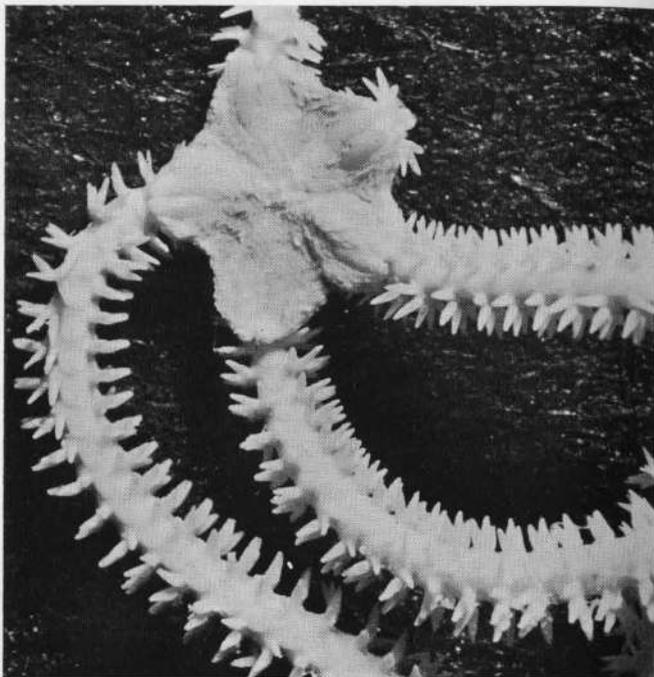


Fig. 6. *Amphiura bountyia*, Holotype—Upper side of disc and proximal arm segments.

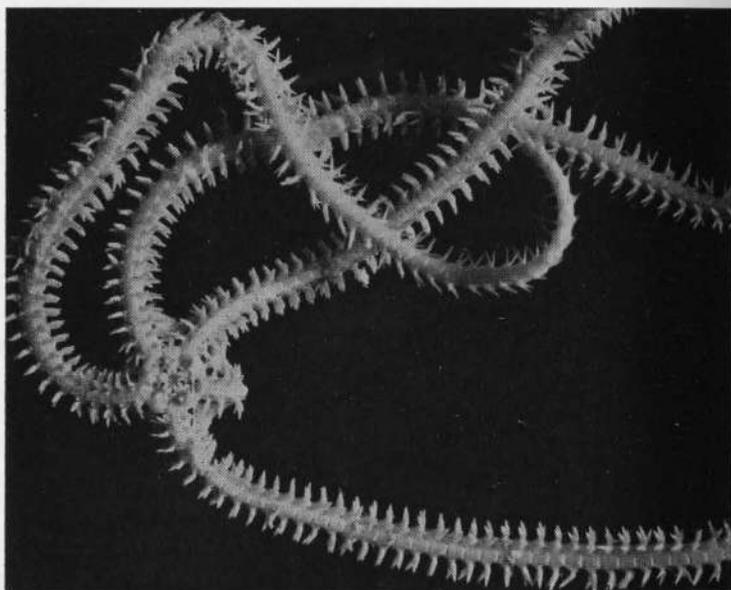


Fig. 7. *Amphiura bountyia*, Holotype—Lower side.

2.5 mm (HOLOTYPE, BPBM No. W 1910); PELE Sta. PIT VII, haul 4, two specimens, d.d. 2 and 3.5 mm (PARATYPES, USNM).

DESCRIPTION OF HOLOTYPE

Disc diameter 2.5 mm, arm length 22+ mm (broken at tip), five arms, broadest near middle. Disc covered by fine scales with no evidence of primary plates. Lower surface of disc with small scales evident up to the oral shields. Radial shields generally elongate, three to four times longer than wide, and may be joined along their distal half or separated by elongate scales more than half their length; scales at the proximal end of the radial shields and between them are somewhat larger than those of the rest of the disc.

Oral shields slightly broader than long, spear-shaped, with a very slight medial distal lobe, greatest breadth near middle or just distal to middle. Adoral shields widest distally but separated by ventral arm shield, narrowing along inner side of oral shield, and either barely in contact or slightly separated proximally.

Outer oral papillae adjacent to adoral shield and oral plate, scale-like, somewhat longer than broad, tapering to a blunt point, and occurring just over the inside portion of the buccal tentacle pore. Oral plate sunken between outer oral papilla and infradental papilla. Pairs of infradental papillae large, thick, slightly rugose, tapering inward, and widely separated. Oral tentacle scale conspicuously above (aboral to) level of infradental papillae, located between the outer and infradental papillae, and having an inner radial projection.

Lower arm plates near the disc and on proximal segments, longer than broad with concave or medially notched distal edge, gradually broadening from proximal to distal end of plate, with greatest breadth near, but not at, the distal end.

A single, small tentacle scale with a broadly rounded or bluntly pointed tip, about half the length of the lower arm plate. Tentacle pore quite large.

Upper arm plate near the disc about as long as broad, with rounded lateral sides and distal edge; plates contiguous on proximal parts of arm. There are four arm spines next to the disc, increasing to five a few segments beyond, then dropping to four farther out on arm, until distally, only three rather acute spines; distally the lower spine tapers acutely and is longest; proximally the arm spines are shorter and equal, about the length of one segment.

REMARKS AND COMPARISON WITH OTHER SPECIMENS

Amphiura bountyia belongs to that group of *Amphiura* referred to *Mon-amphiura* by Fell (1962). *A. bountyia* is characterized by the following:

- a. A single tentacle scale half or less than half the length of the lower arm plate.
- b. Fine disc scaling above and below on the disc without evidence of primary plates.
- c. Elongate, narrow radial shields, contiguous one-fourth to one-third their distal length, but separated by scales proximally.

Ratio, length : breadth=2.8 to 4.2 : 1 ($n=8$, $\bar{x}=3.6$: 1)

Ratio, length : disc radius=1 : 1.5 to 2.4 ($n=6$, $\bar{x}=1$: 1.9)

d. Oral shields spear-shaped, normally just slightly broader than long (rarely as broad as long), with greatest breadth about the middle of the shield or slightly distad, and with an evident but not prominent medial lobe.

e. Normally five arm spines from the disc edge some distance beyond, dropping to four farther out; one specimen with six spines irregularly but less frequent than five (see below). The lowest spine only a little longer than the next lowest spine and upper spine; proximally, slightly longer than segment length, becoming relatively longer on distal segments; the middle spine (where there are five in a row) is the shortest. Spines minutely thorny along edges, somewhat depressed, but not noticeably flattened, tapering to a blunt point.

Arm Spine Sequence

Holotype	Segment	1	2	3	4	5	to 20	21 to 50	51	to broken end	
		2	3	4	4	5		4	3		
PIT VI, haul	Segment	1	2	3	4	5	6	7	8 to 12	13	14 to 21
5 (d.d 3 mm)		2	3	4	5	5	5	6	5	6	5
		22 to 24		25 to 46			47 to end				
		6		4			3				

Larger specimens do not show the presence of six arm spines, however, and the presence of six spines cannot be considered a reflection of growth. It is assumed that in the case of the PIT VI, haul 5 specimen, the presence of six spines is a case of individual variation within a typically five-spined (maximum) species.

f. Outer oral papilla thin, wide, either with a rounded free end or tapering and spiniform. The infradental papillae are thick and taper to a blunt point. The inner oral tentacle scale is thin and shelf-like, with an expanded bluntly pointed internal projection.

g. The lower arm plates are longer than broad, with a notched or slightly concave medial distal edge.

h. The upper arm plates are about as wide as long in the proximal and middle part of the arm, only slightly tapering proximally, with nearly parallel lateral edges; an opaque medial distal triangular area is frequently noticeable.

Over 60 species were assigned by Fell (1962) to his genus *Monamphiura*. In addition, several of the species he listed as "Incertae sedis" (p. 12), based on those species whose descriptions were not available to him, belong to this group. These include: *Amphiura brevispina* and *A. muelleri* Marktanner-Turneretscher, 1887, *A. leptobrachia* and *A. macraspis* Murakami, 1942, and *A. modesta* Studer, 1882.

For those species of this large group whose descriptions have been available to me (including all those reported from the Indo-West Pacific region), I find that *A. bountyia* resembles most closely *A. dejectoides* H. L. Clark 1939, known from the

Arabian coast. This latter species differs from *A. bountyia* in having the upper arm plates much wider than long and the radial shields separated along their entire length.

The description of *A. luetkeni* Duncan, by Lorient (1893b) from Amboina Bay, resembles that for *A. bountyia* insofar as the lower arm plates are slightly notched on the distal border. However, Lorient reported six arm spines on his 6 mm specimen, with the upper one a little longer than the others. In these respects his specimen differs from *A. bountyia*. However, the above-mentioned characters differ from Duncan's original description of *A. luetkeni* reported from the Sea of Korea, and I suspect that Lorient's specimen is another species.

Amphiura bountyia would key out closest to *A. constricta* using either Lyman's (1882) or H. L. Clark's (1946) key to the species of *Amphiura*. Based on specimens of *A. constricta* in the BPBM collection from South Australia, I note that this species differs from *A. bountyia* in having much larger tentacle scales, fewer and coarser disc scales with the primaries evident, and the upper arm plates wider than long.

There is also some similarity to Balinsky's (1957) *A. inhacensis*, but in that species the upper arm plates are distinctly broader than long, the oral tentacle scale appears smaller than in *A. bountyia*, and the infradental papillae have a broader, more rounded tip.

A. bountyia is now known only from the waters off Pitcairn Island, and individuals were obtained by dredging in depths from 25 to 70 fathoms (46 to 128 meters).

7. *Amphiura macroscytalia* Murakami

Amphiura macroscytalia Murakami, 1943a: 176-177, text-figs. 5A-C.

MATERIAL EXAMINED AND LOCALITIES

RAPAN ISLANDS—Ilots de Bass: WES XXXIV, four specimens, d.d. 0.9 to 1.3 mm.

REMARKS

The four specimens from Ilots de Bass are very close to Murakami's *A. macroscytalia* described from Palau. Two characteristics which ally the Ilots de Bass and Palau specimens are (a) the shape and development of the lower arm spines and (b) the presence of a transparent area in the mid-proximal part of the lower arm plates. The only feature which suggests possible taxonomic separation is the nature of the upper arm spines: Murakami simply stated that for *A. macroscytalia* these spines—not considering the modified lower ones—were "subequal and about as long as a joint". His figure of two adjacent arm segments in side view does not show the compressed nature of the spines as observed in the Ilots de Bass material. Further, instead of tapering uniformly to a blunt point, the upper arm spines of the Ilots de Bass specimens are narrow at the base, broaden in the middle, and taper towards the tip. However, Murakami's des-

cription is based on a specimen 3 mm in d.d., whereas the largest Polynesian specimen is only 1.3 mm, less than half the size of the original specimen.

In the two smallest specimens from Ilots de Bass, the elongation of the lower spine is not as well defined as in the other two; in the latter, the lower spine becomes very long and inwardly curved and is up to three or more times longer than the adjacent arm spines. In addition, it is thicker and has a blunt tip. These arm spines reach their greatest elongation near the middle of the arm. The increase in the length of the lower arm spine begins at the disc edge and increases to a maximum at segment 10, then it gradually decreases distally. The maximum number of arm spines for Murakami's specimens was 5 or 6, while there is a maximum of 5 spines for those from Ilots de Bass. Murakami reported that his specimens came from "off Gasupan, west lagoon, 20 meters"; this is off the west central side of Babelthup between the barrier reef and the island. Unfortunately there is little I can add regarding the habitat of the Ilots de Bass specimens, as they were found at the bottom of a collecting bag among miscellaneous debris, pebbles, and other ophiuroids, from a depth between 25 and 50 feet.

The only known localities for *A. macroscytalia* are now Palau in the west Pacific and Ilots de Bass.

8. *Amphiura velox* Koehler

Amphiura velox Koehler, 1910: 292, 293, Pl. 15, fig. 6, Pl. 16, fig. 5; H. L. Clark, 1938: 216-217; 1946: 196; Mortensen, 1940: 74-75, Figs. 7a-c; Domantay and Domantay, 1966: 9, 21-23, fig. 3; A. M. Clark and Rowe, 1971: 80-81 (distribution), 97 (in key).

Amphiura sexradiata Koehler, 1930: 100-101, Pl. XVIII, figs. 1-2; A. M. Clark and Rowe, 1971: 80-81, 97.

MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH VIII, haul 6, 50+ specimens, d.d. 2.5 to 5 mm; PELE Sta. NH IX, haul 1, 16 specimens, d.d. 2 to 5 mm.

REMARKS

The specimens agree quite closely with Koehler's description and figures of the type specimens of *A. velox* from the Aru Islands (134°10'E, 5°43'S, off Wokam at 40 m), and they support most of Mortensen's (1940) additional comments and figures of this species based on specimens from the Persian Gulf. The Marquesan specimens show the middle arm spines with the tip rather blunt and with lateral projections more or less developed.

In the sample from Sta. NH IX, one 5-rayed specimen was found, and there were several 6-rayed specimens without any indication of division, the rays being similar size and shape. Furthermore, there were several which showed definite regeneration, with three larger and three smaller rays. In the sample from Sta. NH VII, there is a large specimen with seven rays and at least two specimens with

only three rays. Slightly more than half of the specimens examined with six rays showed no signs of regeneration while the other specimens did.

With the above consideration in mind and the lack of any positive morphological characters which can be used to separate *A. velox* and *A. sexradiata*, it seems best to unite the two species as provisionally done by Mortensen. Thus the criterion of self-dividing vs. non self-dividing, considered by both Mortensen and A. M. Clark (*in* Clark and Rowe, 1971) to distinguish the two species, is no longer tenable in light of the numerous Marquesan specimens examined.

Amphiura velox then is a normally hexamerous species which has a wide distribution but rather narrow bathymetric range and habitat. Localities and certain features of its habitat are listed in Table 2.

At both Marquesan stations the specimens were found primarily in the basal mud and sand packed around the mytilid bivalve *Amygdalum* sp.

Aberrant asexual reproduction was noted in two specimens from Sta. NH VIII: attached like a Siamese twin to the upper side of a larger (d.d. 2 mm) individual is a smaller one, the two being united disc to disc. The larger specimen has six rays but it is not clear whether the smaller one has five or six.

Table 2. Localities and certain features of the habitat of *Amphiura velox*.

Locality and Author	Depth, Substrate, Collecting Method
Aru Islands (see above) (Koehler, 1910)	40 meters; calcareous rocky bottom; dredged
N. W. coast of Australia (H. L. Clark, 1938)	
a) Lagrange Bay	a) 5-7 fathoms; dredged
b) North Head, near Beagle Bay	b) among rocks and sponges; 5-rayed specimen; skin-diver
Persian Gulf (Mortensen, 1940)	
a) East of Kharg Island	a) 12.5 meters; corals, stones; seine
b) Stiffe's Bank	b) 33 meters; coral-gravel; Petersen-grab
Gulf of Thailand (Koehler, 1930)	no data
Philippines, Coron Bay, Palawan (Domantay and Domantay, 1966)	shallow coral reef, from coral head
Marquesas Islands	11-23 fathoms; small stones, broken shell, and sand; gray mud, many mytilids, worm tubes

9. *Ophiocnida* sp.

McKnight (1972: 38) lists *Ophiocnida* sp. among those ophiuroids which he examined from Manihiki Atoll in the Northern Cook Islands.

The specimen was loaned to me and I found the following features: d.d. 2 mm; arms all broken; with a maximum of only four segments. The disc has 2 sizes of granules or blunt spinules: aborally in each interradius there is a single large

conical granule; additional smaller granules occur randomly over the aboral surface. There are no tentacle scales, and brown podia are evident in the exposed pores. There are three oral papillae to each side, plus a larger infradental papilla at the apex. The adoral shields are large and meet in front of the oral shields, which are slightly broader than long.

The specimen is quite obviously a juvenile, and specific determination will require additional and larger specimens. According to the label, the specimen was collected at a depth of 31 meters in Manihiki Lagoon.

OPHIACTIDAE

10. *Ophiactis brachyura* Döderlein

Ophiactis brachyura Döderlein, 1898: 485-486, Pl. XXXVII, figs. 2-2a; H. L. Clark, 1918: 298 (in key), 302; A. M. Clark and Rowe, 1971: 82-83 (distribution), 104 (in key).

MATERIAL EXAMINED AND LOCALITIES

RAPAN ISLANDS—Ilots de Bass: WES XXXIV, one specimen, d.d. 1.9 mm.

LINE ISLANDS—Washington Island: MIS VI, one specimen, d.d. 2.0 mm.

REMARKS

There is some difficulty in deciding where to place small ophiactids taxonomically. The two 6-rayed specimens from Ilots de Bass and Washington Island share those key characters given by A. M. Clark (*in* Clark and Rowe, 1971) for *O. brachyura*. However, a review of Döderlein's original description for this species, first reported from the East Indies, reveals even more similarity: in the Ilots de Bass specimen the arms are only three times the disc diameter, and there are short conical spinules at the base of several pairs of radial shields; the Washington Island specimen has a few spinules at the disc edge and upper interradial region.

There are a few variations from the original description, however: Döderlein reported his specimen as being greenish-gray above and yellowish below; the two Pacific specimens are brownish above and yellowish below. He further noted that the middle arm spines were longer and heavier than the outer ones; the Pacific specimens show the middle spines thicker but about the same length.

Döderlein reported that his small (d.d. 1.8 mm) specimen came from the sponge *Spongodes*; the Washington Island specimen was recovered from fouling on an old anchor, while the specimen from Ilots de Bass was among debris in a collecting bag.

11. *Ophiactis savignyi* (Müller and Troschel)

Ophiolepis savignyi Müller and Troschel, 1842: 95.

Ophiactis savignyi: Ljungman, 1867a: 323; H. L. Clark, 1946: 210; A. M. Clark

and Rowe, 1971: 82-83, 103, Fig. 31b, Pl. 14, fig. 4; McKnight, 1972: 38.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XVIII, from base of coral with sponge, five specimens, d.d. 1.9 to 4.8 mm.

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: PELE Sta. RL I, haul 1, one specimen, d.d. 2.1 mm.

MARQUESAS ISLANDS—Fatu Hiva: PELE Sta. FH I, haul 2, one specimen, d.d. 2.0 mm. Hatutu: PELE Sta. HU II, haul 1, one specimen, d.d. 2.5 mm.

Nuku Hiva: PELE Sta. NH VI, under and with short tufts of coralline algae, six specimens, d.d. 2 to 5 mm. Ua Pou: PELE Sta. UP IV, five specimens, d.d. 2 to 4 mm. Tahuata: PELE Sta. TH X, haul 3, three specimens, d.d. 1.6 to 2 mm; PELE Sta. TH X, haul 4, three specimens, d.d. 1.1 to 3.5 mm; PELE Sta. TH X, hauls 9, 10, or 11, one specimen, d.d. 3 mm.

GAMBIER ISLANDS—Aukena: PELE Sta. GA V, under rocks with algae, one specimen, d.d. 2.5 mm.

RAPAN ISLANDS—Rapa: WES XXXI, associated with purple sponge, many specimens, d.d. to 7 mm.

REMARKS

Ophiactis savignyi is a cosmopolitan warm water species often gregarious and associated with algae or sponges. It has been reported from practically every Indo-West Pacific region (A. M. Clark and Rowe, 1971), and southeastern Polynesia is no exception. In addition to the records in this paper, McKnight (1972) reports *O. savignyi* from Manihiki in the northern Cook Islands. There are still no records from the Pitcairn group, but further collecting will probably reveal this species there.

12. *Ophiodaphne materna* Koehler

Ophiodaphne materna Koehler, 1930: 129-132, Pl. XVI, figs. 3-8; H. L. Clark, 1938: 270; 1939: 31, 82-83; 1946: 212; Mortensen, 1933: 183; A. M. Clark, 1967a: 42, Fig. 2b; A. M. Clark and Rowe, 1971: 78-79 (distribution), 103 (in Key), Fig. 32b.

MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Tahuata: PELE Sta. TH I, haul 3, six specimens, d.d. 0.7 to 3 mm; hauls 3 to 7, five specimens, d.d. 0.6 to 2.9 mm; haul 4, ten specimens, d.d. 0.6 to 1.8 mm; PELE Sta. TH IX, haul 1, four specimens, d.d. 0.5 to 1.3 mm; haul 2, 23 specimens, d.d. 0.5 to 3.0 mm; PELE Sta. TH X, haul 13, two specimens, d.d. 0.6 and 3.4 mm; WES XLIV, six specimens, d.d. 0.9 to 3.2 mm. Ua Pou: PELE Sta. UP II, haul 1, 11 specimens, d.d. 0.6 to 1.5 mm; haul 2, seven specimens, d.d. 0.6 to 3 mm.

REMARKS

Until now, *Ophiodaphne materna* was known from the East Indies (Koehler, 1930), northwestern Australia (H. L. Clark, 1938), and the southeast coast of Arabia (H. L. Clark, 1939). The numerous specimens collected at Marquesan localities now reported were almost wholly taken on or with *Clypeaster* sea urchins. In several cases the ophiuroids were over or adjacent to the mouth of the sand dollars. In all cases, they were somewhere on the lower side of their hosts. This is the first time that this epizoic condition (commensalism or phoresis) has been reported for *Ophiodaphne*, although there is circumstantial evidence which suggests that such a relationship probably occurred with H. L. Clark's 1938 and 1939 material: (a) He reported (1938) *O. materna* off the Broome area of Australia where a single "young specimen" was dredged in 5-8 fathoms. In this same collecting area Clark also reported taking specimens of *Clypeaster telurus* during 1929 and 1932. (b) Clark's 1939 report, based on the John Murray Expedition, lists one specimen of *O. materna* from Sta. MB II, October 28, 1933, at a depth of 29 meters (15 fathoms). Mortensen (1948a) records two species of *Clypeaster*, *C. reticulatus* and *C. rarisipina*, from the same station (actually there were at least three MB II stations, a, b, c; only MB II (c) was at a depth of 29 meters). At this station two young specimens of *C. reticulatus* and 60 of *C. rarisipina* were reported.

In the Marquesas, at stations where *O. materna* was taken, three species of *Clypeaster* were also found. Mr. Julian Fell, University of Maine, kindly identified these as *C. humilis* (Leske), *C. leptostracon* A. Agassiz and Clark, and *C. reticulatus* (Linnaeus). At all sites where *O. materna* was found, either or both *C. leptostracon* and *humilis* were present and both species were observed as hosts although in low frequency. At only one station (UP-II, haul 2) were live *C. reticulatus* (2) and the ophiuroid found. However it was another sand dollar, *C. humilis*, found at the same site that was observed harboring the specimens of *O. materna*. Although *Clypeasters* were collected from at least 32 sites in the Marquesas, the commensal ophiuroid was associated with these sea urchins at nine of these sites (28%).

Not only is *Ophiodaphne materna* epizoic but it exhibits the apparent sexual dimorphism characterized by Mortensen (1933) in which the female and male are adjoined mouth to mouth, the male being the smaller of the two. More than a single pair of ophiuroids were found frequently under a single *Clypeaster* host, and the host specimen (*C. humilis*) collected at WES LXIV with a length of 55 mm, breadth of 46 mm, carried six individuals, only two of which were paired.

In small specimens of *O. materna* examined (d.d. 0.8 mm), the outer buccal (oral) tentacle pore is excluded from the oral slit and there is a semicircular scale along the abradial side of the pore. The arm spines, with the exception of the upper ones on the distal segments, have the ends modified into a thorny tip. The upper spines on the last few distal segments are modified with a single terminal hook. There is no sign of tentacle scales.

A larger specimen (d.d. 1.6 mm) reveals the oral arm shield having migrated into the distal part of the mouth slit; the buccal tentacle scale is enlarged and alongside the distal abradial edge of the mouth slit. By this size there has been a proliferation of disc scales which hide the peripheral disc plates. Development of tentacle scales on proximal segments is evident.

Although there is a striking resemblance between small specimens of *O. materna* and Mortensen's (1933) *Nannophiura lagani* (another epizoic ophiuroid, associated with the sand dollar *Laganum depressum*, from the East Indies), especially in the nature of the disc plates and presence of hooked distal arm spines, there are features which separate the two species. First, in *N. lagani*, with a d.d. little more than 0.5 mm, Mortensen's figure distinctly shows the oral slits but no evidence of the buccal tentacle pore excluded from the slit, as noted for *O. materna* of even a larger size. Second, in *O. materna* but not *N. lagani*, the adoral shields meet broadly in front of the oral plates. Third, there appears to be a minute opening on the proximal lateral edge of each oral shield in small specimens of *O. materna*, which may be the genital openings; Mortensen said there were no genital openings on *N. lagani*.

Thus, in contrast to Mortensen's consideration, I believe that *Nannophiura lagani* probably represents the young or males of a species similar to *Ophiodaphne materna*, rather than representing it.

In separating *Amphilycus scripta* (another epizoic—on *Echinodiscus bisperforatus*—dimorphic species) from *Ophiodaphne materna*, A. M. Clark (in Clark and Rowe, 1971: 103) stated that *O. materna* has the disc scales ungrooved. Yet close examination of the scales of the larger Marquesan specimens shows them finely grooved. Each radial shield of the larger specimens is grooved over the whole surface, whereas in specimens of *A. scripta* from Zanzibar, kindly sent to me by A. M. Clark, only a narrow area along the inner border of each shield is grooved. Another marked difference between the two species as adults is the shape of the upper arm plates: in *A. scripta* these plates are very broad and short with extensions of the lateral arm plates separating each one; in *O. materna* the plates are more rounded and in contact. Further, the tentacle scale of *A. scripta* is noticeably attached to the lateral arm plate, while in *O. materna* it lies along the side of the lower arm plate for some distance. I consider the two species quite distinct, and Mortensen's (1948b: 409) comment, "... I think the genus *Amphilycus* identical with Koehler's genus *Ophiodaphne*" appears untenable in light of the above differences and those noted by A. M. Clark (1967a).

13. *Ophiosphaera insignis* Brock

Ophiosphaera insignis Brock, 1888: 526; Koehler, 1904: 116–117, Figs. 95–96; 1930: 125–128, Pl. XVI, fig. 13, Pl. XVII, figs. 1–4; H. L. Clark, 1915: 287; A. M. Clark and Rowe, 1971: 82–83 (distribution), 103 (in key); Cherbonnier and Guille, 1972: 279–282, Fig. 1A–E.

MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Tahuata: MIS XX, from nine specimens of *Echinothrix diadema*, five specimens, two pairs plus one. Ua Pou: MIS XXI, from six host diadematid sea urchins, two specimens. Ua Huka: WES XLIIIa, from washings of four diadematid sea urchins, five specimens, d.d. 1.2 to 6.5 mm. Nuku Hiva: WES XLb, from formalin washings of seven *Echinothrix diadema* mainly, but at least one *E. calamaris*, one specimen.

REMARKS

Koehler (1930) pointed out that there are few grounds for maintaining *Ophiosphaera insignis* in the family Ophiotrichidae as originally considered by Brock and more recently by Fell (1960) in his key to the ophiuroid genera. Koehler considered the species as a member of the family Amphiuridae with some hesitation, and recently A. M. Clark and Rowe (1971) have placed it in the family Ophiactidae.

Cherbonnier and Guille (1972) recently suggested that *O. insignis* belongs in the Ophiocomidae after examination of three specimens from the coast of Madagascar. They based this on the "ornementation de la mâchoire et la forme des piquants, il doit prendre place dans les Ophiocomidae dont le disque ne porte ni épines, ni granules, c'est-à-dire près du genre *Ophiarthrum*" (p. 282). However, species of *Ophiarthrum*, in contrast to *Ophiosphaera* show alternation of the number of arm spines, as do all members of the scolopendrina group of *Ophiocoma* and species of *Ophiomastix*, with the upper arm spine longest and largest. Species of *Ophiarthrum* also have tentacle scales and the tips of the teeth hyaline, features absent in *Ophiosphaera*. Future critical studies of *Ophiosphaera* are anticipated to show its proper taxonomic position.

I am most grateful to Dr. R. U. Gooding for allowing inclusion of several of his Marquesan records in this report. Further for comparative purposes he lent me two specimens of *O. insignis* which he collected off the east coast of Malaya from the peristome of *Diadema setosum*. Dr. Gooding has been making a careful survey of the ento- and ecto- fauna of diadematid sea urchins and informed me that he found *O. insignis* only in the Marquesas Islands in S. E. Polynesia.

At Amboina, Brock's (1888) type specimens of *O. insignis* were found on an actinometrid crinoid. Otherwise specimens are known from sea urchins. In the Gulf of Thailand, Koehler (1930) found the ophiuroid associated with *Toxopneustes pileolus*, and at Amboina with *Diadema*. Cherbonnier and Guille's Madagascar specimens were found on the spines of *Tripneustes gratilla*. The Marquesan specimens were associated with diadematid sea urchins.

The specimens I examined from Tahuata and Ua Huka revealed the previously known dimorphic habits of this species (Mortensen, 1933: 179-184). Such a condition is undoubtedly beneficial to an organism with symbiotic habits.

With the exception of one deep record (Koehler, 1930, Kei Islands, 245 m),

Ophiosphaera insignis is known from less than 150 m; the Marquesan specimens were collected above 25 m.

OPHIOTRICHIDAE

14. *Macrothrix demessa* (Lyman)

Ophiothrix demessa Lyman, 1861: 82.

Ophiothrix mauritiensis Lorient, 1893a: 38–39, Pl. XXIV, figs. 5a–d.

Macrothrix hirsuta Müller and Troschel; A. M. Clark, 1952: 209–210.

Macrothrix mossambica Balinsky, 1957: 18–20, Fig. 7, Pl. 3, figs. 11, 12.

Amphiothrix demessa: H. L. Clark, 1946: 217.

Macrothrix demessa: A. M. Clark, 1968: 289–291, Figs. 3e, f, 4h, 5h, 7e;

A. M. Clark and Rowe, 1971: 82–83 (distribution), 114 (in key), Fig. 37f, Pl. 16, fig. 7.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Manihi Atoll: PELE Sta. MA V, two specimens, d.d.

11 mm. Takaroa Atoll: PELE Sta. TA I, three specimens, d.d. 10 to

11.5 mm. Tatakoto Atoll: PELE Sta. TK III, one specimen, d.d. 9 mm.

Anaa Atoll: PELE Sta. AN IV, two specimens, d.d. 7 and 10 mm.

GAMBIER ISLANDS—Timoe: WES LIV, one specimen, d.d. 9 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT IIIa, one specimen, d.d.

6.5 mm; PELE Sta. PIT VI, haul 12, one specimen, d.d. 16 mm; haul 21, one

specimen, d.d. 13 mm; PELE Sta. PIT VII, haul 1, one specimen, d.d.

14 mm; haul 4, one specimen, d.d. 15 mm; PELE Sta. PIT VIII, haul 2, three

specimens, d.d. 7 to 8 mm; haul 3, two specimens, d.d. 7 and 7.5 mm.

Oeno: PELE Sta. ON I, one specimen, d.d. 8 mm.

REMARKS

Considerable color variation was noted in the live specimens. The Manihi specimens had the arms banded with violet and white, and the disc was violet and white as well. One of the Tatakoto specimens showed a faint medial light line down the upper side of the arms. The larger specimen from Anaa had small distinct areas of brownish red on the upper side of the arm, between wider areas of blue and white, while the disc was blue and white also. One of the larger Pitcairn specimens was bright yellow, but the color faded upon preservation. Several other Pitcairn specimens showed narrow reddish bands of color on the upper arm plates.

In addition to the present material, specimens reported as *M. demessa* (or a synonym) are known from several Pacific localities. Reports from the Gilbert Islands include those by Lyman (1861, 1865), Koehler (1927), and A. H. Clark (1954); the southern Marshall Islands by Koehler (1927), and Tahiti by H. L. Clark (1917).

New records in this report are from the Tuamotus, Gambier, and Pitcairn Island groups. There are records of this species from Hawaii (Ely, 1942; A. H. Clark, 1949).

15. *Macrophiothrix longipeda* (Lamarck)

Ophiura longipeda Lamarck, 1816: 544.

Ophiothrix longipeda: Müller and Troschel, 1842: 113; H. L. Clark, 1921: 110, Pl. 15, fig. 5 (colored), Pl. 33, fig. 1; 1917: 439; Koehler, 1907: 334.

Macrophiothrix longipeda: H. L. Clark, 1938: 288; 1946: 221; A. M. Clark, 1966: 648; 1968: 300-302, Figs. 3m-o, 4p-r, 71 m; A. M. Clark and Rowe, 1971: 82-83 (distribution), 114 (in key).

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XIV, in sand buried under boulder, one specimen, d.d. 17.5 mm; MIS XVI, one specimen, d.d. 8 mm; MIS XVII, four specimens, d.d. 10 to 18 mm; MIS XVIII, at base of coral head, two specimens, d.d. 11 and 12 mm; WES XIII, under boulder, one specimen, d.d. 12 mm.

Huahine: WES XII, in sand under coral boulder, one specimen, d.d. 13 mm.

TUAMOTU ARCHIPELAGO—Anaa Atoll: PELE Sta. AN II, under boulders buried in sand, two specimens, d.d. 18 and 22 mm.

LINE ISLANDS—Fanning: MIS VII, in sand, disc not recovered by digging, one specimen, d.d. ?.

AUSTRAL ISLANDS—Tubuai: WES XIX, under boulder in sand, deeply buried, one specimen, d.d. 22 mm.

COOK ISLANDS—Rarotonga: WES I, two larger specimens deep in sand under coral boulders; smaller specimen under boulder on sand, d.d. 7, 18 and 19 mm.

REMARKS

Many of the larger specimens were found deeply buried in sand or gravel under boulders. Generally only the arms were exposed, the disc being some distance beneath the surface. The arms are quickly withdrawn upon agitation, and frequently all but a single ray will autotomize near the disc. At Rarotonga and Tahiti I noted the smaller specimens (d.d. to 12 mm) less secretive and not as deeply buried as the larger ones, but rather just beneath boulders on sand or at the base of coral.

Koehler (1907), H. L. Clark (1915, 1917), and A. M. Clark (1968) reported this species from the Society Islands (Tahiti). It was also reported from Samoa (Koehler, 1907), the Gilbert Islands (Lyman, 1861; Koehler, 1927), and Fiji (Koehler, 1927). A questionable record was given by Lyman (1882) from Tonga. The present collections extend the distribution of *M. longipeda* to the Tuamotu, Austral, and southern Cook Islands. McKnight (1972) also records it from the

southern Cooks, Tahiti, and Fiji.

16. *Macrophiothrix robillardi* (Loriol)

Ophiothrix robillardi Loriol, 1893a: 39-41, Pl. XXIV, figs. 3-3d.

Macrophiothrix robillardi: A. M. Clark, 1966: 649; 1968: 305, text figs. 3s, 4x, 6c, 7q; A. M. Clark and Rowe, 1971: 82-83 (distribution), 114 (in key), Figs. 35g, 37c.

MATERIAL EXAMINED AND LOCALITIES

COOK ISLANDS—Rarotonga: MIS XXVIII, one specimen, d.d. 13 mm.

REMARKS

It is solely because of the large geographical gap between the only reported specimens of this species from Mauritius and the present record from the Cook Islands that I hesitate in assigning the name *M. robillardi*. I am somewhat surprised that we did not meet with this distinctive species during our Westward expedition to Rarotonga, and the only ophiotrichid recovered there was *M. longipeda*. The bare radial shields and lack of dark spots on the upper arm plates of *M. robillardi* allow no confusion between it and *M. longipeda*.

I have compared specimens of *M. robillardi* from the Mauritius Institute with the Rarotongan specimen. The Mauritius specimens often show a narrow white line down the center of the arms above, and these arm plates are sometimes longitudinally fractured. The Rarotongan specimen, while lacking a conspicuous light line, has the upper plates fractured.

According to the label the Rarotongan specimen was collected at night off the reef.

17. *Ophiothrix (Acanthophiothrix) purpurea* Martens

Ophiothrix purpurea Martens, 1867: 346; Döderlein, 1896: 296, Pls. XIV, fig. 12, XVII, fig. 23; Koehler, 1922: 261-262, Pls. 58, figs. 3-4, 101, fig. 6.

Placophiothrix purpurea: H. L. Clark, 1939: 86; A. M. Clark, 1952: 209.

Ophiothrix (Acanthophiothrix) purpurea: A. M. Clark, 1966: 648; A. M. Clark and Rowe, 1971: 86-87 (distribution), 112 (in key), Figs. 35d, 36, Pl. 15, figs. 4, 11.

Ophiothrix fallax Loriol, 1893a: 47-48, Pl. XXV, figs. 2a-2e.

Ophiothrix lepidus Loriol, 1893a: 45-46, Pl. XXV, figs. 1-1f; Koehler, 1922: 246-248, Pl. 36, fig. 5, Pl. 100, fig. 3.

Ophiothrix lorioli Döderlein, 1896: 297, Pl. XIV, figs. 13a-b, Pl. XVII, figs. 24-24a.

MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH VIII, haul 6, two specimens, d.d. 2 and 3.5 mm; WES XXXIX, one specimen, d.d. 6.5 mm. Tahuata: PELE Sta. IX, haul 1, one specimen, d.d. 2 mm; PELE Sta. TH X, haul

1, 70 specimens, d.d. 2 to 13 mm; PELE Sta. TH X, haul 3, six specimens, d.d. 2.5 to 5.5 mm; hauls 3, 4, 5, 6 or 7, one specimen, d.d. 3.5 mm; haul 4, six specimens (one 3.5 mm specimen with two parasitic gastropods attached to arm), d.d. 2.5 to 5 mm; haul 6, four specimens, d.d. 3 to 5 mm; haul 7, 10 specimens, d.d. 3 to 7 mm; haul 8, two specimens, d.d. 3.5 and 8 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, hauls 2 and 3, two specimens, d.d. 4 and 8.5 mm; haul 17, one specimen, d.d. 5.5 mm (with parasitic gastropods attached to disc); PELE Sta. PIT VI, haul 19, one specimen, d.d. 5.5 mm (with parasitic gastropods attached to disc).

REMARKS

Considerable variation in such morphological features as shape of the radial shields, nature of the disc armament, and pigmentation has resulted in lumping of several nominal species by H. L. Clark (1938) and A. M. Clark (1952) under *O. purpurea*. The quantity of material, especially from the Marquesas Islands, supports this decision, although for the most part specimens from this area reflect the "*purpurea*" phenotype rather than the "*lepidus*" phenotype as described by Koehler in 1922. In the Hawaiian Islands, A. H. Clark (1949) reported *O. lepidus hawaiiensis* as a new subspecies. I have examined his specimens and others collected from branched black coral. Comparison between the S. E. Polynesian and Hawaiian specimens seems to support the subspecific ranking proposed by A. H. Clark for the Hawaiian form.

With the exception of the single specimen from Nuku Hiva collected May 15, 1971, which was associated with a small unidentified antipatharian at 35 feet, all other specimens were recovered from dredge hauls at depths from 23 to 40 fathoms (Marquesas) or 25 to 65 fathoms (Pitcairn). At one Marquesan station (Sta. TH X, haul 1) the dredge was packed with this species of ophiuroid, many of which were ripe individuals.

One brittle star from the Marquesas and two from Pitcairn were infected by ectoparasitic styliferid gastropods. Similar occurrences have been reported with certain other ophiotrichids: Koehler (1904) reported one to several specimens of parasitic gastropods in the genus *Stylifer* attached at the genital slits of the host *Ophiothrix crassispina*. He mentions the color of the parasites as almost white or pink. Another styliferid gastropod was noted by the same author on *O. deposita* (p. 146). In 1905, Koehler also reported parasitic gastropods associated with *O. stelligera*.

Several of the specimens from the Pitcairn hosts are attached near the genital openings, but one is also found out on the arm. The color of the gastropods from the Pitcairn specimens is white with purple wavy lines from the apex of the shell to the aperture.

18. **Ophiothrix (Placophiothrix) westwardi** n. sp.
(Figs. 8-14)

MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH III, under coral and lava boulders, five specimens, d.d. 12 to 14.5 mm; PELE Sta. NH IV, one specimen, d.d. 12.5 mm (PARATYPE, WAM); PELE Sta. NH VIII, hauls 1, 2, 3, or 4, one specimen, d.d. 6 mm; PELE Sta. NH IX, haul 1, three specimens, d.d. 11 to 14 mm; PELE Sta. NH XV, haul 1, one specimen, d.d. 2.5 mm (PARATYPE, BPBM No. W 1930); WES XXXV, one specimen, d.d. 10.5 mm (PARATYPE, USNM); WES XXXVIII, one specimen, d.d. 4.5 mm; WES XLa, one specimen, d.d. 12 mm. Ua Pou: PELE Sta. UP II, haul 2, one specimen, d.d. 6 mm; PELE Sta. UP IVa, under boulders and in corals, six specimens (PARATYPES, WAM, d.d. 3 and 7 mm; USNM, d.d. 8 and 9 mm; BPBM No. W 1932, d.d. 9 and 18 mm); PELE Sta. UP IVb, nine specimens, d.d. 4 to 13.5 mm (PARATYPES, BPBM No. W 1931). Hatutu: PELE Sta. HU II, haul 1, arm only. Fatu Hiva: PELE Sta. FH I, haul 2, one specimen, d.d. 3.5 mm, plus arm of larger specimen; PELE Sta. FH III, five specimens (PARATYPES, WAM, d.d. 6 and 10.5 mm; USNM, d.d. 7 and 10 mm; BPBM No. W 1934); PELE Sta. FH V, under or among coral, one specimen, d.d. 10 mm (HOLOTYPE, BPBM No. W 1905). Tahuata: PELE Sta. TH 1, haul 1, one specimen, d.d. 10 mm; haul 8, one specimen, d.d. 2 mm (PARATYPE, WAM); PELE Sta. TH III, one specimen, d.d. 12 mm; PELE Sta. TH IX, haul 2, one specimen, d.d. 6.5 mm (PARATYPE, BPBM No. W 1933); PELE Sta. TH X, haul 3, one specimen in "Ophiopterion" stage, d.d. 0.9 mm (PARATYPE, BPBM No. W 1935); haul 4, one specimen, d.d. 6 mm (PARATYPE, BPBM No. W 1936); haul 7, two specimens, d.d. 4 and 6 mm (PARATYPES, BPBM No. W 1937); haul 13, two specimens, d.d. 4.5 and 5 mm (PARATYPES, USNM); haul 14, one specimen, d.d. 7 mm (PARATYPE, BPBM No. W 1938). Ua Huka: WES XLIIIb, one specimen, d.d. 14 mm (PARATYPE, BPBM No. W 1939).

LINE ISLANDS—Christmas Island: MIS Xa, four specimens, d.d. 5 to 8.5 mm.
Washington Island: MIS VI, four specimens, d.d. 6 to 6.5 mm.

DESCRIPTION OF HOLOTYPE

Disc diameter 10 mm, arm length (complete) 90 mm; arm length: disc diameter=9:1.

Upper side of disc centrally, interradially, and between adjacent pairs of radial shields covered by low, spaced conical stumps with one, two, or three short thorns at their tip; a few (2 to 20) lower, more granular stumps occur along the interradiial or outer edges of the radial shields. The conical stumps occur on large conspicuous scales, with one to several stumps per scale; at the disc periphery, scales are along the distal interradiial border of the radial shields (Figs. 8, 9).

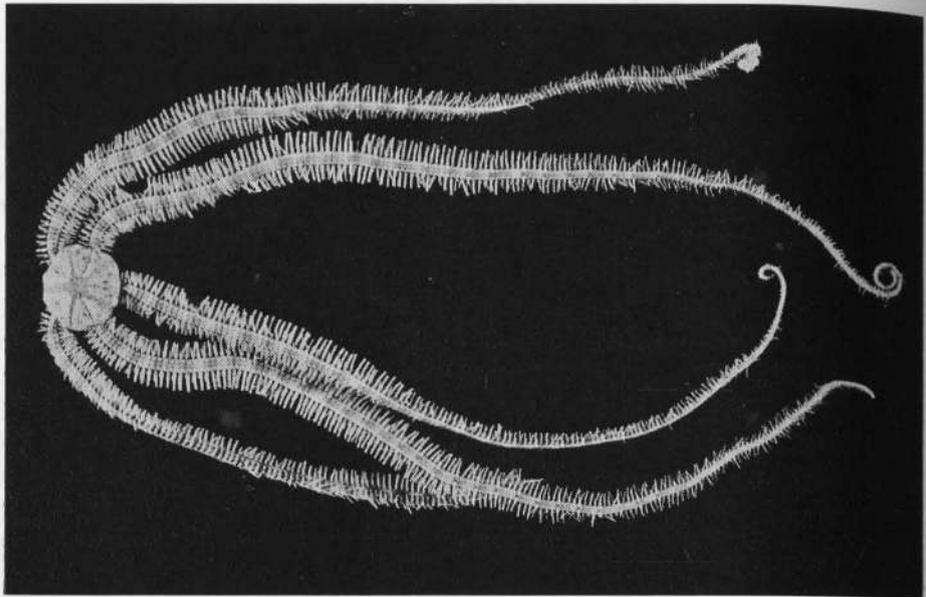


Fig. 8. *Ophiothrix (Placophiothrix) westwardi*, Holotype, BPBM No. W1905—Upper side.

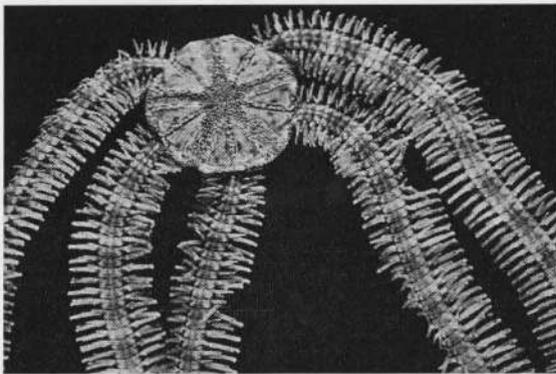


Fig. 9. *Ophiothrix (Placophiothrix) westwardi*, Holotype—Upper side of disc and proximal part of arms.

Radial shields large, nearly bare and more or less triangular; each is 3.5 mm long measured along the radial line; each pair is separated by scales bearing a few conical stumps, except at the distal end where enlarged shield projections may or may not be in contact; the space between adjacent pairs of shields is about the same distance as the maximum width of each shield (2 mm) measured near the distal edge (Fig. 9).

Lower side of disc much more closely covered by tapering conical stumps, between 0.15 and 0.20 mm long, frequently having a monofid sharp tip, less

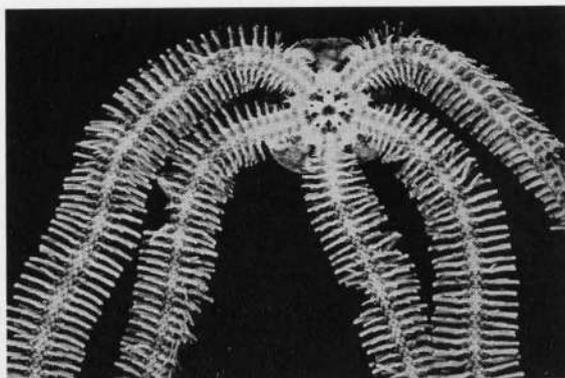


Fig. 10. *Ophiothrix (Placophiothrix) westwardi*, Holotype—Lower side with disc and proximal part of arms.

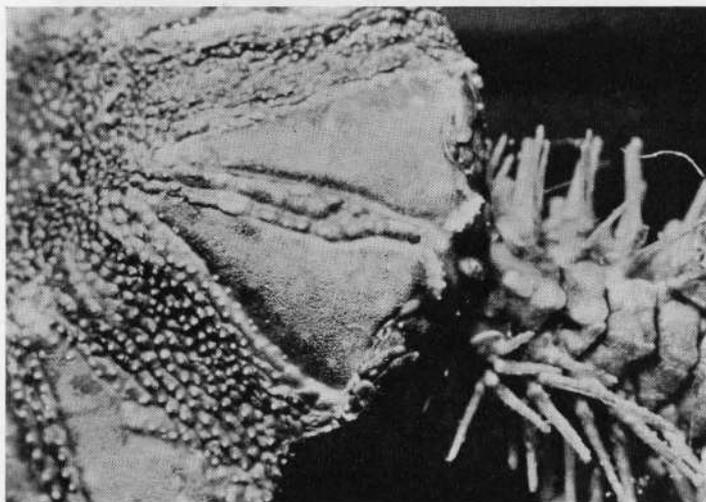


Fig. 11. *Ophiothrix (Placophiothrix) westwardi*, Paratype, BPBM No. W1931—Portion of disc with radial shields, proximal arm plates and spines, d.d. 11.5 mm.

commonly with two, three, or rarely four thorns; each stump is about three times longer than its diameter; those extending toward the oral shield, but not reaching it, are longer (to 0.3 mm), tapering to acute bifid tips (Fig. 10).

The disc is not inflated, and is broadest interradially, slightly indented radially but not noticeably excavated.

The oral shields are slightly broader than long (1.1×0.9 mm) with an inner medial rounded projection and outer, lateral borders broadly rounded; the greatest breadth occurs about the center of the plate; the madreporite plate is larger and more irregular than the other shields. The adoral shields are con-

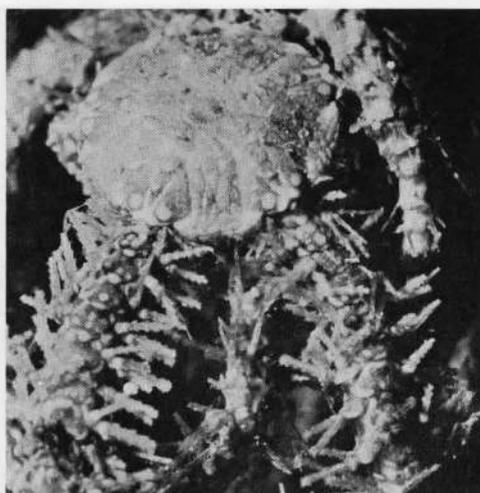


Fig. 12. *Ophiothrix (Placophiothrix) westwardi*, Paratype, BPBM No. W1931—
Upper side showing disc and arms, d.d. 3.5 mm.

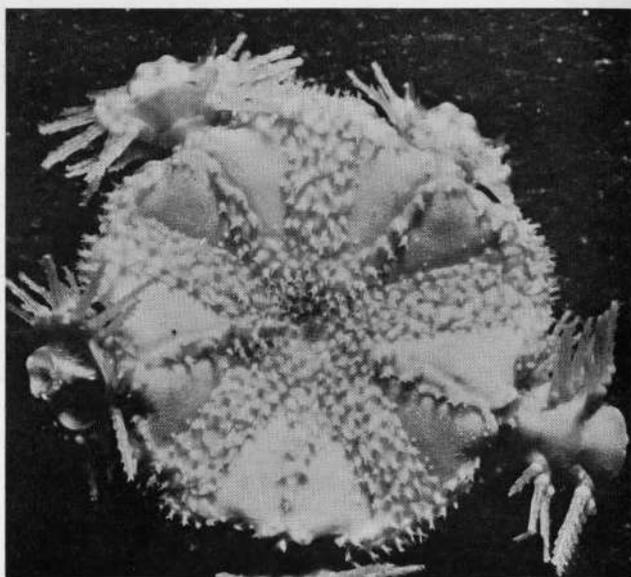


Fig. 13. *Ophiothrix (Placophiothrix) westwardi*, Paratype, BPBM No. W1936—
Upper side of disc with arms broken, d.d. 6 mm.

finned mainly to the inner radial part of the oral shield, and have an interradial projection which allows them to either just contact one another within, or be separated by a narrow band of tissue running between them and the oral shield; the adorals are broadly in contact with the first lateral arm plates but are

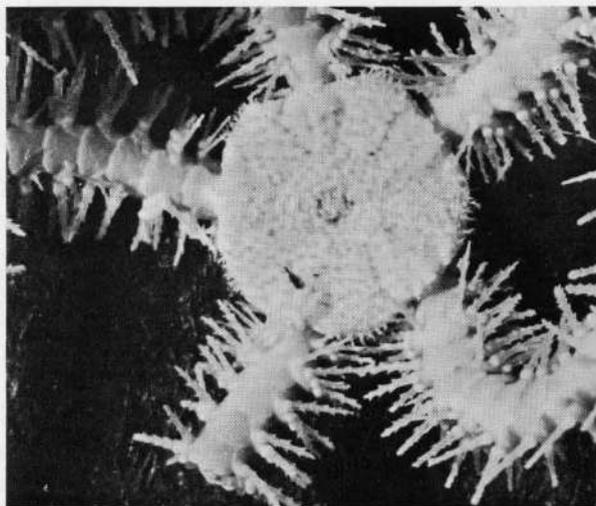


Fig. 14. *Ophiothrix (Placophiothrix) westwardi*, Paratype, BPBM No. W1930—
Upper side, d.d. 2.5 mm.

separated from the ventral arm shield.

Twelve to 16 dental papillae occur on each jaw, with outer semicircular rows of four or five and an irregular number of four to six centrally. The teeth are square cut at the tip.

The oral plate has an oral tentacle scale located in a large depression below the adoral shield and adjacent to the ventral shield; radially, below the ventral shield, is a small oblong aperture with a restricted elongate channel leading to a larger central opening that tapers towards the cluster of dental papillae.

The first and second lower arm plates are longer than wide, with a rounded distal margin, straight lateral sides, and a concave proximal border; neither plate carries a tentacle scale; beyond segment 2 the shape of the plates is altered and the distal margin becomes concave while the proximal edge is nearly straight; farther out on the arm the distal margin is less concave but not convex, although the proximal margin may become convex; the length: breadth ratio for segment 10, 12:15; segment 20, 12:16; segment 30, 14:16 (where 20=1 mm). Beyond segment 2 or 3 there is a well-defined tentacle scale, broad at its base and narrowing to an acute tip; it is placed at the margin of contact between the lateral and lower arm plate; the tentacles are papillated and occupy a position distal to the tentacle scale and first and second lower arm spines.

The upper arm plates are much broader than long; near the disc the outer edge has a slightly enlarged medial portion which remains as a slightly convex projection on an otherwise nearly straight line; the lateral sides are widest in the distal half of the plate and taper proximally, with more than one-half of the proximal border adjacent to the distal border of the preceding plate. Length to

breadth ratios for selected plates include: first fully developed plate next to disc, 11:24; tenth, 14:34; twentieth, 14:35; thirtieth, 14:34 (20 units=1 mm). The upper plates become relatively longer than broad progressively toward the arm tip. On several arms in the proximal half or more, the upper plate is fragmented longitudinally, usually into two pieces near the center of the plate.

Five to seven arm spines occur beyond the disc edge; third from upper spine longest in proximal part of arm, slightly over 2 mm; longer spines just a little wider distally than at base, hardly tapering; the spines are depressed with thorns along each side, more closely set along distal portion of shaft; the tip is blunt and thorny, slightly wider than the shaft; somewhat opaque at tip, less so but not translucent basally; lowest arm spines with proximal hook at tip and two to four equal or shorter teeth proximal to tip.

Radial shields rose and light pink in color with purple blotches; disc scales similar; arms above, purple or rose or both in a series of one to four segments, giving banded appearance to arms; below, arms rose color with series of underarm plates being more or less rose and light cream, giving distinct banded appearance; mouth region light; spines light to pink at base, with less color toward tips.

COMPARISON WITH OTHER SPECIMENS

Numberous specimens of this species were taken (50+) from various stations in the Marquesas. These specimens ranged in size from 0.9 mm to 18 mm in disc diameter. The smallest specimen shows the thin webbing between the arm spines or "Ophioptron" condition.

(a) Disc cover. Specimens from the dredge hauls frequently have the disc beset with definite spinules rather than the low granular cover as noted on the holotype and other specimens from shallow water. In the smallest dredged specimens, even the radial shields appear equally covered with spinules (Fig. 14), and it is only by a size of d.d. 4 or 5 mm that the radial shields are nearly or completely bare (Fig. 13). It appears that the deeper water representatives of *Ophiothrix westwardi* reveal a growth change in the density, position, and relative size of the disc cover. The smaller specimens appear to have the radial shields covered by scales, and trifold disc spinules are apparent; as the radial shields increase in size, scales bearing spinules are sluffed off, leaving all or nearly all of the radial shields naked (Figs. 13, 14). Mono or bifid spinules, quite densely packed, are characteristic of the medium and larger sized specimens. Trifold or quadrifold spinules are not so common on these specimens but were noted on smaller specimens. In contrast to the above condition, a few of the dredged specimens and nearly all the shallow water specimens have a reduction in spinulation and the appearance of a more granular disc cover (Figs. 9-11). An intermediate condition was noted for a 4 mm specimen from PELE Sta. TH X, haul 7, at 32 fathoms.

(b) Pigmentation. The ground or base color is some shade of violet blue or rose or pink. The upper arm plates may have a few defined spots or patterns of

light and darker pigment. Sometimes a series of two to four plates are lighter than following plates and the arms appear banded; other times the plates are uniform in color. The lower side is lighter, sometimes nearly all white or with narrow bands of dark color, or the border of the arm plates may be slightly darker than the center. A few of the medium sized specimens from Sta. UP IV have a light line down the center of the arm, and the line is less than one-third the width of the plates.

(c) Upper arm plates. In many of the medium and larger sized specimens, fracturing of the upper arm plates longitudinally was noted (Fig. 11). The break is usually central. Specimens less than 10 mm do not have the arm plates broken.

(d) Lower arm plates. There is a very regular concavity in the center of the distal edge of these plates.

REMARKS

When A. M. Clark (1966) redefined the genus *Ophiothrix*, she established the subgenus *Placophiothrix* for a group of predominantly Indo-West Pacific species characterized by having: a) wide-spaced coarse disc stumps, spinelets or spines; b) bare radial shields; c) arms less than 10 times the disc diameter; d) broad, opaque, blunt-tipped arm spines; e) broad upper arm plates in contact with the median part of the proximal and distal edges straight, their length to breadth ratio between 1:1.6–2.0; f) the disc diameter commonly between 10–15 mm with a maximum of 20 mm.

The present species, *O. westwardi*, falls within the limits set forth above. Compared to other species included by A. M. Clark in the subgenus *Placophiothrix*, *O. westwardi* appears as the only one with the lower arm plates having the distal border concave. In a key to Indo-West Pacific species of *Placophiothrix* (A. M. Clark and Rowe, 1971), the new species comes closest to *Ophiothrix* (P.) *fumaria*. However, descriptions of *O. fumaria* reveal several differences from *O. westwardi*. There is a reduction in the number of spinelets in the oral interradial area of the disc for *O. fumaria*, whereas this area is more or less densely covered with spinelets in *O. westwardi*. For *O. fumaria* the upper arm plates are fan-shaped, have a rounded distal margin, and the breadth to length ratio is less than for *O. westwardi*. In *O. fumaria* the two arm spines below the upper one are thorny only along the distal one-third of the shaft, while the rest is smooth and these spines appear to be twice or more than twice as long as the next lower arm spine in *O. fumaria*. In *O. westwardi* these spines are thorny along the entire shaft and the third arm spine is less than twice the length of the lower spine.

There is also some similarity between *O. westwardi* and *O. albolineata* described by H. L. Clark (1938). The latter species, based on a single 11 mm specimen from Lord Howe Island, was characterized by having the lower arm plates more or less elliptical or even circular, with the width and length nearly equal. This feature as well as pigmentation, can separate it from *O. westwardi*.

19. *Ophiothrix (Ophiothrix) trilineata* Lütken

Ophiothrix trilineata Lütken, 1869: 58, 100; H. L. Clark, 1921: 115, Pl. 16, figs. 4-6 (colored), Pl. 33, figs. 4-5; A. M. Clark, 1966: 642, 647, Fig. 1d, Pl. X, fig. 3; A. M. Clark and Rowe, 1971: 84-85 (distribution), 111 (in key).

Placophiothrix trilineata: H. L. Clark, 1938: 315; 1946: 226.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Takaroa Atoll: PELE Sta. TA I, three specimens, d.d. 4.5 to 6 mm.

LINE ISLANDS—Fanning Island: MIS VIII, two specimens, d.d. 5.5 and 6.5 mm.

REMARKS

A characteristic feature of this species is the pigmentation of the upper side of the arms: in the three specimens from Takaroa, two show the upper side of the arms with a central light line bordered by narrow dark lines which again are bordered by lighter color; the other specimen shows this same pigmentation on the distal half of the arm, but proximally the central light line fades out until there is only a thicker dark central line surrounded by light color; this color pattern extends up through the middle of the radial shields. The basic ground color of the specimens is violet.

O. trilineata was reported previously from the Tuamotus by H. L. Clark (1917) where a total of 34 specimens was collected at Makemo and Fakarava Atolls. His specimens ranged from 3 to 6 mm in size. A. H. Clark (1954) reported a specimen from Raroia Atoll. Additional Pacific records include the Marshall Islands (Koehler, 1927; A. H. Clark, 1952), Gilbert Islands (Koehler, 1927; A. H. Clark, 1954), Tonga (Lyman, 1882), Samoa (Lütken, 1869—Type locality), and Fiji (Koehler, 1927).

H. L. Clark (1915: 115) gives some details as to the habitat of this species at Mer, Torres Strait, and Balinsky (1957: 30) recorded it among species from the infralittoral fringe on coral reefs at Inhaca, Moçambique. The Fanning Island specimens were collected in coral, but there are no details with my Tuamotu specimens except to note that they were collected together in a coral dominated habitat.

OPHIOCOMIDAE

20. *Ophiarthrum elegans* Peters

Ophiarthrum elegans Peters, 1851: 463; H. L. Clark, 1921: 139, Pl. 13, fig. 1 (color); A. M. Clark and Rowe, 1971: 86-87 (distribution), 121 (in key).

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XI, one specimen, d.d. 9.5 mm; MIS XII, from broken coral, four specimens, d.d. 13-15 mm; MIS XV, in coral and coral rubble, two specimens, d.d. 8 and 11 mm; MIS XVII, two specimens; MIS

XVIII, in live coral, three specimens; PELE Sta. TI VI, two specimens.

AUSTRAL ISLANDS—Raivavae: WES XVII, under boulders, one specimen, d.d. 13.5 mm. Rurutu: WES XXI, under boulder on sand, one specimen, d.d. 12 mm.

COOK ISLANDS—Rarotonga: WES I, common under coral boulders on white sand with *Ophiocoma dentata*, nine specimens, d.d. 14–21 mm; WES II, in coral, one specimen, d.d. 14.5 mm; WES V, on sand under boulders, one specimen, d.d. 17 mm. Manuae: WES VII, under dead coral, one specimen, d.d. 14.5 mm.

REMARKS

The collection of *Ophiarthrum elegans* at Tahiti was no surprise since H. L. Clark (1915, 1921) had already reported it from there. Its presence in the Australs (Rurutu and Raivavae) as well as the southern Cooks (Rarotonga and Manuae) extends the distribution of this widespread ophiocomid species. Except for regenerating rays, the pigmentation of the arms reveals well-defined banding with terra cotta and light yellowish or whitish in the above localities where it was collected or observed alive. The dark red color is very fugaceous in alcohol or formalin. An attempt was made to get the specimens from Rarotonga (March 4, 1967) to spawn by placing nine specimens together in a bucket overnight. Unfortunately, after 14 hours in which the specimens remained viable, no spawning was noted, although the gonads appeared ripe upon dissections.

21. *Ophiocoma brevipes* Peters

Ophiocoma brevipes Peters, 1851: 466; H. L. Clark, 1921: 129–130, Pl. 13, fig. 7, Pl. 34, figs. 3, 4; Devaney, 1970: 12 (in key), 13, 14, 18, 19; A. M. Clark and Rowe, 1971: 86–87 (distribution), 119 (in key); McKnight, 1972: 39, 43.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: PELE Sta. RL II, one specimen, d.d. 9 mm. Manihi Atoll: PELE Sta. MA V, under low *Porites* coral heads on sand, two specimens, d.d. 6.5 and 9.5 mm. Puka Puka Atoll: PELE Sta. PP IV, under attached low heads of *Porites* coral with sand, eight specimens, d.d. 5 to 7 mm (gonads appear ripe). Anaa Atoll: PELE Sta. AN IV, one specimen, d.d. 10.5 mm.

PITCAIRN GROUP—Oeno: PELE Sta. ON I, under low flattened *Porites* coral attached to hard substratum with medium fine sand beneath coral, two specimens, d.d. 9 and 10.5 mm. Pitcairn Island: WES LVI, under boulder on sand, one specimen, d.d. 8.5 mm.

COOK ISLANDS—Rarotonga: WES I, two specimens, d.d. 13 mm.

REMARKS

Ophiocoma brevipes has a broad Indo-Pacific range, but the exact limits are

not clearly defined owing to a confusion between this species and *O. dentata* (Devaney, 1970). The original specimens came from the east African coast (Peters, 1851). Indian Ocean records also include those by Smith (1876), Martens (1870), and Walter (1885). Domantay and Domantay (1966) record the species from the Philippines.

Specimens I have examined indicate the dispersal of *O. brevipes* to many Pacific localities. In southeastern Polynesia there are records from the Tuamotus by H. L. Clark (1917) and A. H. Clark (1954), while McKnight (1972) recently reported specimens from the Cook Islands. The present material includes *O. brevipes* from additional Tuamotu and Cook Islands while establishing it in the Pitcairn group for the first time.²

The bathymetric range for *O. brevipes*, based on previous and present records, shows depths from the littoral fringe to 50 meters (A. H. Clark, 1949, and personal records from Hawaii). Most specimens are found between the intertidal zone to a depth of 5 meters. The only specimen from Pitcairn Island was from a depth of 50 feet.

A rather specific habitat was noted for *O. brevipes* on the reef flats of atolls: characteristically, individuals were found under low heads of *Porites* coral attached partially to the reef surface but beneath which sand could accumulate. From one to several specimens were collected in such a habitat, on or within the sand beneath the coral. However, the specimens taken at Rarotonga and at Pitcairn share a habitat similar to that noted for the species in the Hawaiian Islands. Here individuals were found under basalt or dead coral boulders which cover a sandy substratum. In several instances this species was observed partially buried in the sand, and because of the light, variegated pigmentation of the aboral surface of the disc and arms, specimens were difficult to see.

Ely (1942) found only one or two individuals at a time occurring together, similar to my observations in Hawaii but different from the reef flat situation on atolls where a more gregarious habit was observed.

In contrast to many species of *Ophiocoma* I have observed (*dentata*, *erinaceus*, *wendtii*, *echinata*, *pica*, *pusilla*), *O. brevipes* does not exhibit a posture—when released in water above the substratum—in which the arms extend vertically above the disc. Instead, the arms of *O. brevipes* coil horizontally, similar to that which I have noted in *Ophionereis porrecta* and *O. reticulata*. H. L. Clark (1938, 1946) reported that *Ophiocoma brevipes* had the habit of bringing in and folding the arms closely around the disc as individuals were observed in holes or depressions among coral or coralline algae.

² Maria Codoceo R., Museo Nacional de Historia, Santiago, Chile kindly informed me that she has collected *O. brevipes* at Easter Island. This information was reported at the Jornadas Hidronomicas at Santiago, Oct. 1973. This is the first record of the species at Easter Island.

22. *Ophiocoma dentata* Müller and Traschel

Ophiocoma dentata Müller and Traschel, 1842: 99, Pl. VII, figs. 3, 3a; Devaney, 1970: 12-18, Figs. 17-19, 21, 34; A. M. Clark and Rowe, 1971: 86-87 (distribution), 119 (in key); McKnight, 1972: 39, 43.

Ophiocoma insularia Lyman, 1861: 80; Ely, 1942: 57, Fig. 17, Pl. 13a.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XV, one specimen, d.d. 6 mm; MIS XVIII, in or under coral head, two specimens, d.d. 10 and 13 mm.

TUAMOTU ARCHIPELAGO—Anaa Atoll: PELE Sta. AN IV, under large boulder, one specimen, d.d. 13.5 mm; MIS XXIV, one specimen, d.d. 3 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT IIIa, at base of coral head, one specimen, d.d. 2.5 mm; PELE Sta. PIT IV, shore, one specimen, d.d. 17 mm; PELE Sta. PIT IV, 20-30 ft., under basalt boulder on sand, six specimens, d.d. 11 to 22 mm; PELE Sta. PIT V, two specimens, d.d. 4 mm; PELE Sta. PIT VI, haul 4, one specimen, d.d. 4 mm; haul 25, one specimen, d.d. 14 mm; WES LVI, under rock on sand bottom near reef, three specimens, d.d. 4.5 to 11.5 mm; WES LXI, four specimens, d.d. 9 to 17 mm. Oeno Island: PELE Sta. ON I, under large flattened pieces of coral boulders, five specimens, d.d. 9.6 to 14.5 mm.

RAPAN AND AUSTRAL ISLANDS—Rapa: WES XXIII, under large boulder slabs on sand, three specimens, d.d. 18 to 23.5 mm; WES XXV, under brown-algal covered basalt boulders on sandy bottom, two specimens, d.d. 14 and 15 mm; WES XXVIII, under boulder, one specimen, d.d. 30 mm. Ilots de Bass: WES XXXIV, under boulder in sand channel, six specimens, d.d. 6 to 22 mm. Tubuai: WES XIX, under boulders, five specimens, d.d. 5.5 to 22 mm. Rurutu: WES XXII, under boulders on rubble and sand, three specimens, d.d. 16 to 22 mm.

COOK ISLANDS—Rarotonga: WES I, under coral boulders on sand, six specimens, d.d. 21 to 27.5 mm.

REMARKS

Ophiocoma dentata is a cosmopolitan Indo-West Pacific species. Besides Indian Ocean areas there are a number of Pacific Ocean records (A. M. Clark and Rowe, 1971). Lyman's (1861, 1865) specimens (as *Ophiocoma insularia*) were from Hawaii and the Gilbert Islands. H. L. Clark (1917) records specimens from Easter Island and Tahiti. Benham (1911) reported *Ophiocoma brevipes* from the Kermadec Islands, but this is based on a specimen of *O. dentata*, judging from the large size and color. New records in this report include Rapa, the Australs, and Cook Islands. Records of *O. dentata* from Pitcairn and Easter Island were given previously (Devaney, 1970). In S. E. Polynesia *O. dentata* is notably absent from my collections at the Marquesas Islands.

Specimens of *O. dentata* collected in the S. E. Polynesian areas have the

same habitat as those found in Hawaii. This species is usually found where lava or coral boulders cover a sandy or pebbly substratum. A. H. Clark (1950) reported *O. dentata* (as *insularia* var. *variegata*) from Cocos-Keeling Islands "under stones and fallen coral in the shallow pools over the middle portions of the barrier."

The ectocommensal polynoid worm *Hololepidella nigropunctata*, associated with *O. dentata* in Hawaii (Devaney, 1967), was not observed with this host in S. E. Polynesia but was found with the related *O. doederleini* (below).

O. dentata is commonly found between 1 and 10 meters in depth. H. L. Clark (1939) reported a small specimen (d.d. 3.5 mm) from 73–165 meters off Zanzibar, and during the 1967 expedition the "Pele" dredged a small specimen (4 mm) from 91–110 meters off Pitcairn Island.

23. *Ophiocoma doederleini* Loriol

Ophiocoma doederleini Loriol, 1899: 30–31, Pl. III, figs. 2a–2d; Koehler, 1905: 60; 1922: 312, 321–322, Pl. 72, figs. 1–3; Devaney, 1970: 11–18, Figs. 18, 20, 22.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Anaa Atoll: PELE Sta. AN IV, under dead coral head with some sand, one specimen, d.d. 11 mm.

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH VI, one specimen, d.d. 17 mm (with commensal polynoid, *Hololepidella nigropunctata*). Fatu Hiva: PELE Sta. FH III, under flat rock on sandy substratum, two specimens, d.d. 21 mm (one specimen with commensal polynoid); PELE Sta. FH V, under and among coral, five specimens, d.d. 13 to 22 mm (one specimen with commensal polynoid).

AUSTRAL ISLANDS—Rurutu: WES XXII, under boulders on sandy bottom, three specimens, d.d. 15 to 21 mm.

COOK ISLANDS—Rarotonga: WES V, on sand under boulder, one specimen, d.d. 19 mm.

REMARKS

Both the reticulated and spotted disc color varieties collected at the Marquesas Islands were reported by Devaney (1970). The spotted variety was found at Anaa and Rarotonga. One of the Marquesan specimens from "Pele" Sta. FH V had wavy lines through the predominant gray disc background color.

A commensal polynoid identified as *Hololepidella nigropunctata* was associated with *O. doederleini* in the Marquesas. At Eniwetok, Marshall Islands, where both *O. doederleini* and *O. dentata* have been collected, neither has been reported as a host for *H. nigropunctata*, while in Hawaii, where *O. dentata* is the primary host (Devaney, 1967) *O. doederleini* does not occur. In the Marquesas *O. dentata* is apparently absent as well as is a secondary host in Hawaii, *O. brevipes*,

and *O. doederleini* replaces both as the primary host for the polynoid.

The habitat for *O. doederleini* is similar to that of *O. dentata*, beneath limestone or basalt boulders on relatively clean sand.

Previous records for *O. doederleini* were given by Devaney (1970). New records include Rurutu and Rarotonga. Its presence in the Central Pacific (Marshall Islands) as well as the Western Indian Ocean (Mauritius and Amirantes Islands) reflects a spotty but widespread distribution which will become more complete as greater emphasis is placed on an examination of the shallow, concealed, sublittoral fauna.

24. *Ophiocoma erinaceus* Müller and Troschel

Ophiocoma erinaceus Müller and Troschel, 1842: 98; Lorient, 1893a: 21 (bibliography up to this date); H. L. Clark, 1921: 127; Devaney, 1970: 34 (in key), 36-38; A. M. Clark and Rowe, 1971: 86-87 (distribution), 119 (in key); McKnight, 1972: 39, 43.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XIII, two specimens, d.d. 9 and 10 mm; MIS XV, in coral and coral rubble, three specimens, d.d. 6 to 12.5 mm; MIS XVII, one specimen (ripe), d.d. 22 mm; MIS XVIII, in live coral head, two specimens, d.d. 8 and 9 mm; MIS XIX, in *Pocillopora meandrina* coral head, three specimens, d.d. 8 to 9 mm. Bora Bora: WES XI, in dead *Pocillopora* or *Acropora* coral, one specimen, d.d. 15 mm. Huahine: WES XII, in branches of *Pocillopora meandrina* coral, three specimens, d.d. 8.5 to 14 mm.

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: PELE Sta. RL II, two specimens, d.d. 12 and 18 mm. Manihi Atoll: PELE Sta. MA II, under limestone boulder, one specimen, d.d. 12 mm; PELE Sta. MA IV, from live and dead coral, three specimens, d.d. 13 to 14 mm; PELE Sta. MA V, three specimens, d.d. 16 to 17 mm. Takaroa Atoll: PELE Sta. TA I, beneath or among branches of *Pocillopora* coral, five specimens, d.d. 6 to 11 mm. Puka Puka Atoll: PELE Sta. PP I, one specimen, d.d. 15 mm; PELE Sta. PP III, three specimens, d.d. 5.5 to 11 mm; PELE Sta. PP IV, two specimens, d.d. 8 and 19 mm. Tatakoto Atoll: PELE Sta. TK I, one specimen, d.d. 9 mm; PELE Sta. TK III, two specimens, d.d. 13 and 15 mm. Anaa Atoll: PELE Sta. AN I, four specimens, d.d. 9 to 14 mm; PELE Sta. AN II, from corals and rubble, five specimens, d.d. 11 to 19 mm; PELE Sta. AN IV and V, ten specimens, d.d. 5 to 18 mm.

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH III, four specimens, d.d. 20 to 24 mm; PELE Sta. NH IV, one specimen, d.d. 19 mm; PELE Sta. NH VI, one specimen, d.d. 10.5 mm; PELE Sta. NH X, one specimen, d.d. 27 mm;

- WES XXXVI, one specimen, d.d. 20.5 mm. Ua Pou: PELE Sta. UP IVa, six specimens, d.d. 6 to 24 mm; PELE Sta. UP IVb, five specimens, d.d. 2 to 19 mm. Hiva Oa: WES XLI, one specimen, d.d. 24 mm. Fatu Hiva: PELE Sta. FH III, four specimens, d.d. 15 to 23 mm; PELE Sta. FH V, five specimens, d.d. 3.5 to 22 mm; WES XLV, one specimen, d.d. 8 mm.
- PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT IV, within *Pocillopora* coral, three specimens, d.d. 14 to 15 mm; WES LIX, one specimen, d.d. 4 mm. Oeno Island: PELE Sta. ON I, from dead coral, one specimen, d.d. 7.5 mm.
- AUSTRAL ISLANDS—Raivavae: WES XVI, inside dead coral head overgrown with algae, one specimen, d.d. 13 mm.
- COOK ISLANDS—Rarotonga: WES IV, one specimen, d.d. 12 mm.

REMARKS

Ophiocoma erinaceus occurs throughout the Indo-West Pacific, and H. L. Clark (1921) and A. M. Clark and Rowe (1971) give the geographic limits of this species. Sachet (1962) listed this species from Clipperton Island in the Eastern Pacific, based on a redetermination of the specimen identified as *O. scolopendrina* by A. H. Clark (1939). In southeastern Polynesia, H. L. Clark (1971) and A. H. Clark (1954) reported *O. erinaceus* from the Tuamotus, and recently McKnight (1972) reported it from the Cook Islands (Palmerston).

Ophiocoma erinaceus is commonly found in branches of live or dead coral or in rubble. It appears able to occupy many areas where a solid substratum is available and is less common on sandy bottoms. H. L. Clark (1921) characterized the habitats of *O. erinaceus* and *O. scolopendrina* and used this as an important reason for maintaining them as separate species: the latter occupies a higher level on the shore commonly uncovered at ordinary low tides; the former occurs farther out on the reef flat. A. H. Clark (1950) reported *O. erinaceus* as fairly common under stones and coral boulders. In Hawaii, I collected very young specimens of *O. erinaceus* (d.d. 1.0–2.8 mm) from the base of the alga *Sargassum polyphyllum* in November, 1964.

25. *Ophiocoma longispina* H. L. Clark

Ophiocoma insularia var. *longispina* H. L. Clark, 1917: 441.

Ophiocoma longispina: Devaney, 1970: 18–24 (includes bibliography), Figs. 25, 28, 30–35.

MATERIAL EXAMINED AND LOCALITIES

- TUAMOTU ARCHIPELAGO—Manihi Atoll: PELE Sta. MA IV, from living or dead coral, one specimen, d.d. 9 mm. Anaa Atoll: PELE Sta. AN IV or V, one specimen, d.d. 10 mm.
- GAMBIER ISLANDS—Mangareva: WES XLIX, from dead coral, one specimen, d.d. 10.5 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VIII, haul 4, one specimen, d.d. 9 mm.

RAPAN AND AUSTRAL ISLANDS—Rapa: WES XXIII, common beneath boulders or within rubble, six specimens, d.d. 8 to 15 mm; WES XXVI, under basalt slab with sand and rubble beneath, one specimen, d.d. 14 mm; WES XXX, under boulders, two specimens, d.d. 10.5 and 11 mm. Ilots de Bass: WES XXXIV, from *Pocillopora meandrina* coral head, two specimens, d.d. 3 and 3.5 mm. Raivavae: WES XVI, beneath overturned table *Acropora*, and from base of attached coral, four specimens, d.d. 7 to 9 mm.

COOK ISLANDS—Rarotonga: WES IV, one specimen, d.d. 8 mm.

REMARKS

The specimens from Ilots de Bass are the first juveniles I have recognized, and a description of several features is given below. Initially, the two small specimens were considered as small *Ophiocoma pica*, as they were collected with two specimens of that species in the same head of *Pocillopora meandrina*, and because of the presence of a patch of white or yellow at the base of the arms over the radial shields (which is also a character of *O. pica*). In larger specimens of *O. longispina* the light pigment patches are absent over the radial shields while remaining in specimens of *O. pica*. I was able to separate the small specimens of *O. longispina* from *O. pica* on the basis of differences in the size of disc granules and their extent over the disc: in both specimens of *O. longispina* the granules average 37 microns in diameter, while the specimen of *O. pica* (d.d. 2 mm), smaller than either of *O. longispina*, had larger and slightly more widely spaced granules averaging 45 microns in diameter. Another difference separating the two species was the number of segments carrying two tentacle scales: the 3.5 mm specimen of *O. longispina* had two scales as far as segment 20 (two rays examined) while the 3 mm specimen had two scales to segments 14 or 15; in contrast the 2 mm specimen of *O. pica* had no segments with two scales.

Furthermore, the arm spines appear more tapering and not as thick on segments near the disc in *O. longispina* as in *O. pica* for the small sizes. The arm-length to disc-diameter ratio is greater in *O. longispina* than in *O. pica*, and I noted the presence of two to four granules on each side of the base of the oral shields in *O. longispina*, while these were absent in the small *O. pica*.

Ophiocoma longispina appears to be one of the few shallow-water ophiuroids confined to the S. E. Polynesian area, although further collecting in the coral environment in sublittoral Indo-West Pacific areas may extend its distribution. The species was first described by H. L. Clark from Easter Island as a variety of *Ophiocoma dentata* (as *O. insularia*). In 1970, I reviewed the taxonomy of this species, recognizing its specific rank after comparing specimens from Easter Island and that reported herein from Pitcairn Island. In the present report its range is extended to the southern Tuamotus, Gambier, Rapan, Austral, and southern Cook Islands.

The habitats of *O. longispina* appear somewhat diversified when it is an adult. It is found under boulders on a rubble bottom, and within or under dead coral much as I have noted for *Ophiocoma erinaceus*. The presence of the two juvenile specimens from Ilots de Bass together with a juvenile and adult specimen of *O. pica* within a head of live coral suggest that individuals may undergo a shift of habitat with growth, as no adults have been taken from live coral. The specimen from Anaa Atoll was mixed with several specimens of *O. erinaceus*, suggesting the close habitat selection of these two species.

26. *Ophiocoma macroplaca* (H. L. Clark)

Ophiacantha macroplaca H. L. Clark, 1915: 200, Pl. I, figs. 6-7.

Ophiocoma erinaceus Müller and Troschel; H. L. Clark, 1921: 127 (Hilo, Hawaii); A. H. Clark, 1949: 49 (USNM No. E 7064).

Ophiocoma scolopendrina (Lamarck); Ely, 1942: 52 (Maui, Lahaina, MCZ No. 4515); A. H. Clark, 1949: 52-53 (except specimens from "Albatross" stations 3828 and 3982, which are *Ophiacantha bisquamata*, and from "Albatross" stations 3876 and 4146, which are *Ophiocoma pusilla*, based on re-examination).

Ophiomastix asperula Lütken; A. H. Clark, 1949: 48.

Ophiocoma macroplaca: Devaney, 1970: 33-37.

MATERIAL EXAMINED AND LOCALITIES

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, haul 4, one specimen, d.d. 3 mm; PELE Sta. PIT VII, haul 4, two specimens, d.d. 7 and 13 mm.

RED SEA—British Museum specimen; 7-10-69, Strait of Tirau, Gordon Reef, Sta. 2A-22, triangular dredge 30-45 fathoms, one specimen, d.d. 9.5 mm.

REMARKS

In 1970 I established the characteristics and reviewed the taxonomy of *Ophiocoma macroplaca* previously known only from the Hawaiian Islands. It was therefore with some interest that I recovered three specimens from dredge hauls off Pitcairn Island. These specimens showed one consistent feature not noted in others examined, notably that the pigmentation, which is a dark reddish brown and tan when alive, faded quickly upon preservation, leaving only faint banding on the arms. One other feature, noted on the 7 mm specimen only, differs from the morphometrics of the Hawaiian (and Red Sea) specimens. On this specimen there are three and four arm spines on the third segment of the arms, whereas in all others, segment 3 carries only four arm spines.

Even more surprising was the discovery of *macroplaca* from the Red Sea. Thanks to A. M. Clark of the British Museum, a specimen tentatively labeled as "*Ophiomastix* sp. ? *elegans* Brock" was placed at my disposal during my review of the genus *Ophiomastix*. This specimen conforms in nearly all features with comparable specimens of *Ophiocoma macroplaca* from Hawaii. The specimen

does show a few elongated bluntly pointed granules toward the center of the disc, and marginally a few of the granules are more sharply tapered. As I pointed out in my 1970 paper, the presence of such variations in the disc granulation, although not typical for *macropilaca*, is characteristic of the type specimen and has been noted in a few additional Hawaiian specimens.

With the exception of the type specimen, which was collected beneath a stone on a shore reef, *Ophiocoma macropilaca* has been taken from depths exceeding 5 meters. Specimens taken by the "Albatross" in 1902 (A. H. Clark, 1949, as *O. scolopendrina*) were from stations around the Hawaiian Islands ranging from 26 to 95 meters. The specimens from Pitcairn extend the depth at which this species was taken to 110 meters.

Bottom samples from the Hawaiian and Pitcairn stations consisted of coral, shell, gravel, and sand. My own collection of this species in Hawaii to 55 meters has been from the base of corals, primarily *Pocillopora* spp., and less commonly from coral rubble.

27. *Ophiocoma pica* Müller and Troschel

Ophiocoma pica Müller and Troschel, 1842: 101; H. L. Clark, 1921: 127, Pl. 13, fig. 8 (color); Devaney, 1970: 19, 20, 21 (in key), 22, 24, 25, Figs. 23-24, 27; A. M. Clark and Rowe, 1971: 86-87 (distribution), 118 (in key); McKnight, 1972: 39, 44.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XIX, from *Pocillopora meandrina* coral head, two specimens, d.d. 10 and 13 mm.

TUAMOTU ARCHIPELAGO—Manihi Atoll: PELE Sta. MA IV, from living and dead coral, two specimens, d.d. 7 and 11.5 mm; PELE Sta. MA V, one specimen, d.d. 3 mm. Rangiroa Atoll: PELE Sta. RL II, from *Pocillopora* coral heads, three specimens, d.d. 13 to 17.5 mm (one specimen released eggs after capture). Puka Puka Atoll: PELE Sta. PP III, from *Pocillopora meandrina* coral head, three specimens, d.d. 6 to 13 mm. Tatakoto Atoll: PELE Sta. TK III, in *Pocillopora* coral head, two specimens, d.d. 5 mm. Anaa Atoll: PELE Sta. AN I, from *Pocillopora meandrina* coral, one specimen, d.d. 8.5 mm; PELE Sta. AN II, in crevice in pool on reef, one specimen, d.d. 14 mm; PELE Sta. AN IV or V, six specimens, d.d. 7 to 11 mm; MIS XXII, under stones and coral rubble, one specimen, d.d. 14.5 mm.

GAMBIER ISLANDS—Mangareva: WES L, from *Pocillopora meandrina* coral head, two specimens, d.d. 12.5 and 13.5 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT IV, primarily from *Pocillopora* coral heads, 10 specimens, d.d. 8 to 16.5 mm; PELE Sta. PIT VIII, haul 2, one specimen, d.d. 12 mm; WES LVII, from coral head, one specimen, d.d. 5 mm; WES LIX, three specimens, d.d. 2 to 14 mm; WES LX, two

specimens, d.d. 4.5 and 11.5 mm; WES LXI, seven specimens, d.d. 4 to 9 mm; WES LXIV, from head of *Pocillopora* coral, one specimen, d.d. 11 mm. Oeno Island: PELE Sta. ON I, from *Pocillopora* coral, one specimen, d.d. 8 mm; WES LV, three specimens, d.d. 15 to 17 mm.

RAPAN ISLANDS—Ilots de Bass: WES XXXIV, from *Pocillopora meandrina* coral, two specimens, d.d. 2 and 13 mm. Rapa: WES XXXIII, in coral head of *Pocillopora meandrina*, two specimens, d.d. 4 and 6 mm.

COOK ISLANDS—Manuae: WES VII, under dead coral, one specimen, d.d. 15 mm.

LINE ISLANDS—Washington Island: MIS VI, one specimen, d.d. 3.5 mm.

REMARKS

Ophiocoma pica is another wide-ranging Indo-West Pacific form, with specimens reported from East Africa through the Red Sea to the Tuamotu Archipelago (H. L. Clark, 1917), Society Islands (H. L. Clark, 1915), and other southeastern Polynesian localities (Devaney, 1970). McKnight (1972) adds this species to the Cook Island (Mangaia) fauna.

There are specimens in the Bishop Museum collection from the Line Islands and the material from the Gambier, Rapan, Austral, and Cook Islands (Manuae) reported herein are new records.

The coral-dwelling nature of *O. pica* has been noted previously (Devaney, 1970), and its association with *Pocillopora meandrina* especially in S. E. Polynesia was evident. The conspicuous absence of this ophiuroid at the Marquesas may be linked to the absence of *Pocillopora meandrina* at that locality, but an obligatory association has not yet been demonstrated between the ophiuroid and the coral. The presence of young specimens within the branches of *P. meandrina* suggests that young settling individuals may be attracted to this "habitat" or substratum preferentially. Adult specimens may be found in other corals or non-coral habitats.

A comparison of the small specimen of *O. pica* and small specimens of *O. longispina* from Ilots de Bass has been made (see p. 157).

28. *Ophiocoma pusilla* (Brock)

Ophiomastix pusilla Brock, 1888: 499.

Ophiocoma pusilla: H. L. Clark, 1921: 131 (and Pl. 13, fig. 9, color, as *O. scolopendrina*); Devaney, 1970: 19–22, 25–28, Figs. 26, 29; A. M. Clark and Rowe, 1971: 86–87 (distribution), 118 (in key).

Ophiocoma scolopendrina (Lamarck); A. H. Clark, 1949 (pt.): 52.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Manihi Atoll: PELE Sta. MA V, one specimen, d.d. 5 mm (gonads ripe). Puka Puka Atoll: PELE Sta. PP III, two specimens, d.d. 4 and 5 mm. Anaa Atoll: PELE Sta. AN I, under loose live coral, one

specimen, d.d. 2.5 mm; PELE Sta. AN IV or V, one specimen, d.d. 3 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, haul 4, three specimens, d.d. 3.5 to 6 mm; haul 10, one specimen, d.d. 3 mm; haul 23, three specimens, d.d. 4 to 4.5 mm; PELE Sta. PIT VII, hauls 2 or 3, one specimen, d.d. 6 mm (disc pattern reticulated); PELE Sta. PIT VIII, haul 2, one specimen, d.d. 5 mm; WES LXIV, from head of *Pocillopora*, one specimen, d.d. 4 mm.

RAPAN AND AUSTRAL ISLANDS—Ilots de Bass: WES XXXIV, from attached coral shelf, one specimen, d.d. 4.5 mm. Rurutu: WES XX, from base of broken dead coral head, one specimen, d.d. 5 mm; WES XXII, beneath boulder, one specimen, d.d. 5.5 mm.

COOK ISLANDS—Rarotonga: WES III, under attached dead coral head, one specimen, d.d. 4 mm.

REMARKS

The systematic position of this species was reviewed recently (Devaney, 1970). At that time I reported the presence of *O. pusilla* at the Tuamotus and at Pitcairn. The records in the present paper from Ilots de Bass, Rurutu, and Rarotonga are new and extend the range of this species. Habitat and bathymetric considerations were included in my 1970 paper.

Recently, confirmation of this species in Hawaiian waters was made, based on a specimen collected with black antipatharian coral, either *Antipathes grandis* or *A. dichotoma*, off Lahaina, Maui, at a depth of 200 feet (BPBM collection). Two additional specimens, reported as *Ophiocoma scolopendrina* by A. H. Clark (1949: 52) from "Albatross" stations around Hawaii, also were re-examined, and they are *O. pusilla* (USNM Nos. E 7093 and E 7086).

29. *Ophiocoma scolopendrina* (Lamarck)

Ophiura scolopendrina Lamarck, 1816: 544.

Ophiocoma scolopendrina (Lamarck); H. L. Clark, 1921: 125; 1915: 293, Pl. 14, figs. 10–11; 1917: 442; Devaney, 1970: 33, 34 (in key), 35, 37; A. M. Clark and Rowe, 1971: 86–87 (distribution), 119 (in key), Pl. 17, figs. 3, 4; McKnight, 1972: 39, 44.

Ophiocoma variabilis Grube, 1857: 342; 1860: 31, Pl. 1, figs. 4, 4a.

Ophiocoma molaris Lyman, 1861: 79; 1865: 87.

Ophiocoma alternans Martens, 1870: 251 (East Indies); Lyman, 1874: 225.

Ophiocoma scolopendrina scolopendrina (Lamarck); Djakonov, 1930: 245.

Ophiocoma scolopendrina var. *alternans* Martens; Loriol, 1893b: 407.

Ophiocoma scolopendrina "forma *monolepis*" H. L. Clark, 1926: 187.

Ophiocoma schoenleini Müller and Troschel, 1842; A. H. Clark, 1954: 260 (based on re-examination of specimens).

Ophiocoma wendti Müller and Troschel, 1842; Koehler, 1922: 328 (USNM Cat.

No. 40948, based on re-examination); Hertz, 1927: 118 (Berlin Museum, based on re-examination).

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XII, from broken coral, one specimen, d.d. 18 mm.

TUAMOTU ARCHIPELAGO—Manihi Atoll: PELE Sta. MA V, nine specimens, d.d. 13 to 22 mm. Takaroa Atoll: PELE Sta. TA I, four specimens, d.d. 11 to 19 mm. Anaa Atoll: PELE Sta. AN II, under coral rubble at littoral fringe, five specimens, d.d. 15 to 25 mm.

LINE ISLANDS—Washington Island: WES LXVII, under coral rock, one specimen, d.d. 19.5 mm.

REMARKS

Ophiocoma scolopendrina has been reported from many Indo-West Pacific localities, and while confused with *O. erinaceus*, *O. occidentalis*, and *O. macroplaca*, which are closely related species (Devaney, 1970), there is good evidence that it has a wide distribution. It has been taken at many Pacific localities, including the Marshall Islands, Fiji, Gilbert (Koehler, 1927), and Line Islands (H. L. Clark, 1925). In S. E. Polynesia there are records of *O. scolopendrina* from the Society Islands (H. L. Clark, 1915), Tuamotus (H. L. Clark, 1917; Chevalier *et al.*, 1968), and Cook Islands (McKnight, 1972). Records from the Hawaiian Islands are erroneous (Devaney, 1970).

Ophiocoma scolopendrina has been shown to occupy a restricted environment among dead coral rubble and coarse sand in the intertidal zone (H. L. Clark, 1921; A. H. Clark, 1950; Magnus, 1962), especially in reef flat areas of atolls or barrier reef platforms. The species is often found in large aggregations and as many as 50 specimens per square meter have been recorded (Macnae and Kalk, 1962: 100). Magnus (1962, 1964) provided evidence which indicated that *O. scolopendrina* depends upon the ebb and flow of the tide for its food. Specimens observed and collected at Manihi Atoll in 1967 revealed the specialized habit of testing and feeding at the air-water interface with two or three arms exposed and extended while the rest of the animal is concealed. The other Tuamotu specimens as well as one from Washington Island (Line Islands) were taken in similar habitats.

It has not been established whether the young of this species is also restricted to the littoral zone. Koehler (1905) reports *O. scolopendrina* from depths of 9 to 278 meters. At least one specimen (d.d. 7 mm) collected at Palmyra Island (Line Islands) was dredged from 130–150 fathoms off a sandy bottom (BPBM collection).

30. *Ophiocomella sexradia* (Duncan)

Ophiocnida sexradia Duncan, 1887: 92, Pl. VIII, figs. 10–11 (Mergui Islands,

Indian Ocean); Koehler, 1907: 313 (Tahiti).

Ophiocoma parva H. L. Clark, 1915: 292, Pl. 14, figs. 8-9 (Torres Strait); 1917: 442 (Tuamotu Islands); 1921: 132, Pl. 13, fig. 4 (color); 1925: 92 (leeward Hawaiian Islands, Wake, and Palmyra); 1938: 331-332 (Australia and Lord Howe Island); Ely, 1942: 60, Figs. 18a-b (Hawaiian Islands); Tokioka, 1953: 143 (Tokara Islands); Balinsky, 1957: 27 (Mozambique); Endean, 1957 (Australia).

Amphiacantha sexradia (Duncan); Matsumoto, 1917: 178; Koehler, 1905: 33 (East Indies); 1930: 113-114 (Gulf of Thailand, Philippines, Kei Islands).

Ophiocomella parva (H. L. Clark); A. H. Clark, 1939: 5-7, Pl. I, figs. 1, 2; Parslow and Clark, 1963: 42-43.

Ophiocomella clippertoni A. H. Clark, 1939: 7, Pl. I, figs. 1, 2; 1949: 54, 71; 1952: 296, 299 (Marshall Islands); 1954: 260 (Saipan).

Ophiocomella schultzi A. H. Clark, 1941: 481-483 (Canton Island); A. M. Clark and Rowe, 1971: 117, Figs. 38c, e.

? *Ophiomastix sexradiata* A. H. Clark, 1952: 296 (Marshall Islands); A. M. Clark and Rowe, 1971: 86-87, 118, Figs. 38a-b.

Ophiocomella sexradia (Duncan); Parslow and Clark, 1963: 42-43; A. M. Clark, 1967b: 151-152; Devaney, 1970: 31; A. M. Clark and Rowe, 1971: 86-87 (distribution), 118 (in key), Figs. 38d, f; McKnight, 1972: 39, 44 (Cook Islands).

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: WES XV, from coral head, one specimen, d.d. 2 mm.

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: PELE Sta. RL II, under coral block on white sand, six specimens, d.d. 3 to 4 mm. Puka Puka Atoll: PELE Sta. PP III, at base of live coral, four specimens, d.d. 2.5 to 4 mm; PELE Sta. PP IV, under 4 to 12 inch diameter, low, live *Porites* coral heads attached to substratum but with sand beneath, four specimens, d.d. 3.5 to 5 mm. Anaa Atoll: MIS XXIII, one specimen, d.d. 2 mm.

GAMBIER ISLANDS—Aukena Island: PELE Sta. GA V, under rocks, two specimens, d.d. 3 and 4 mm. Mangareva: WES LIII, one specimen, d.d. 4 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, haul 4, three specimens, d.d. 3.5 to 4 mm; haul 11, one specimen, d.d. 3 mm. Oeno Island: PELE Sta. ON I, under flat *Porites* coral on pavement bottom with some trapped fine sand, 17 specimens, d.d. 2.5 to 5 mm (14 specimens with six rays, 2 with seven, 1 with three).

AUSTRAL ISLANDS—Rurutu: WES XXI, beneath boulder, one specimen, d.d. 3 mm.

COOK ISLANDS—Manuae: WES VIIb, one specimen, d.d. 3.5 mm.

REMARKS

If this is truly a single Indo-Pacific species, then the zoogeographic range is extensive. Locality records are given in the synonymy section above.

A. M. Clark (*in* Clark and Rowe, 1971: 118) comments that the presence of small hexamerous ophiocomids in the western Indian Ocean and Red Sea, within the range of *Ophiocoma valenciae*, invalidates the contention that these specimens represent one or more species distinct from this five-armed species of *Ophiocoma*. However, it has been reported (Devaney, 1970) that there are no valid records of any five-rayed species of *Ophiocoma* in the pumila group from the eastern Indian Ocean or central Pacific Ocean. Yet there occur six-rayed (less frequently seven- and rarely five-rayed) ophiocomellids in these regions rarely reaching a size greater than 6 mm. Together with morphological criteria already established by A. M. Clark (*in* Parslow and Clark, 1963) and Devaney (1970), the distributional records support the conclusion that *Ophiocomella sexradia* is a valid taxon in the Indo-West Pacific.

Of 50 specimens of *O. sexradia* noted above from S. E. Polynesia, 43 (86%) have six rays, 2 (4%) have seven rays, 5 (10%) have three, and none has five rays. A majority of the six-rayed specimens shows three of the arms regenerating.

The specimens from Tahiti and Rurutu have the arms banded green and white and the disc green. These specimens also show the upper arm spines longest, similar to the condition noted for A. H. Clark's type of *Ophiomastix sexradiata*, as well as having tentacle scales on segments 1 and 2, and having the lower arm plates sometimes only slightly bell shaped. The other Polynesian specimens are more or less tan or brown and white in color, and the upper arm spine is either longer than the next lowest spine or the same length.

Ophiocomella sexradia appears to occupy habitats within the coral reef environment. The original specimens of *Ophiocoma parva* were found "... on the under surface of rock fragments or in the crevices of sponges and coral" (H. L. Clark, 1915: 292). A. H. Clark (1941) reported *Ophiocomella schultzi* from the lagoon on Canton Island. Hawaiian records include reports of *O. sexradia* (as *O. clippertoni*) from coral on the reef at Waikiki (A. H. Clark, 1949). I have collected specimens from the base of the alga *Sargassum polyphyllum* in a tide pool on a reef platform at Makua, Oahu, October 1964. This species was found under attached, low-growing heads of *Porites* coral at both the Tuamotu and Oeno localities. While *Ophiocoma brevipes* lived on or in the sand in this habitat, *Ophiocomella sexradia* appeared to be on the undersurface of the coral itself and within crevices.

The records in the present report extend the distribution of *O. sexradia* to the Gambier, Austral, and Pitcairn island groups.

31. *Ophiomastix stenozoneula* n. sp.

Figs. 15-20

ETYMOLOGY

steno- (Gr.), narrow; *zoneula* (Gr.), belt, girdle: because of the narrow, dark

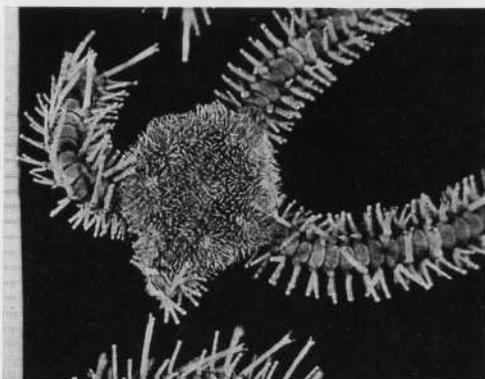


Fig. 15. *Ophiomastix stenozonula*, Holotype, BPBM No. W1906—Upper side and lateral view of broken arm.



Fig. 16. *Ophiomastix stenozonula*, Holotype—Lower side and portions of broken arms.

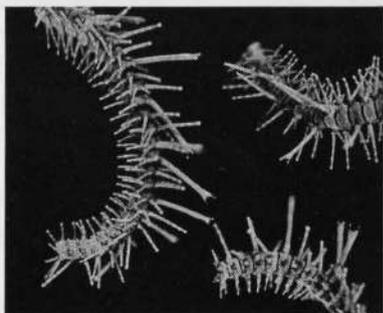


Fig. 17. *Ophiomastix stenozonula*, Holotype—Lateral and upper sides of broken arms showing modified arm spines.

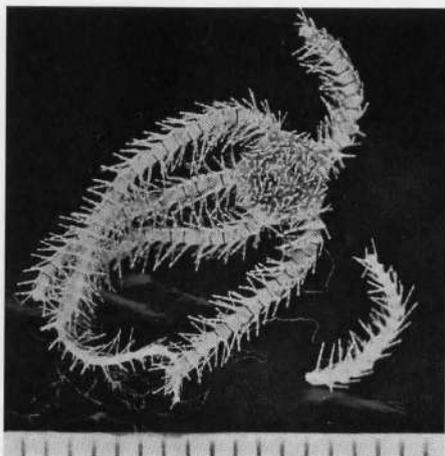


Fig. 18. *Ophiomastix stenozoneula*, Paratype, USNM—Upper side.

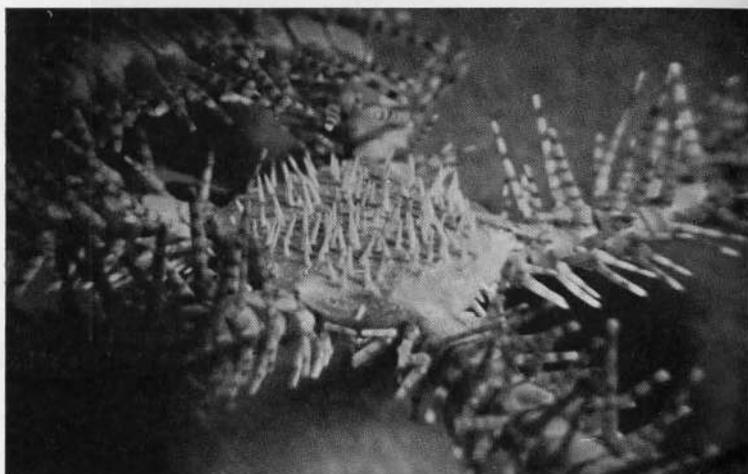


Fig. 19. *Ophiomastix stenozoneula*, Paratype, WAM—Upper and side of disc in lateral view.

pigment band on the distal edge of the arm plates.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XV, in coral and coral rubble, one specimen, d.d. 11.5 mm (PARATYPE, BPBM No. W 1907); MIS XVIII, from live head of purplish-blue coral, one specimen, d.d. 3.5 mm (PARATYPE, BPBM No. W 1908); MIS XIX, in *Pocillopora meandrina* coral, one specimen, d.d. 4 mm (PARATYPE, WAM). Huahine: WES XII, in branches of dead *Pocillopora meandrina* coral, one specimen, d.d. 7 mm (PARATYPE, BPBM No.



Fig. 20. *Ophiomastix stenozonula*, Paratype, WAM—Mouth area.

W 1909).

TUAMOTU ARCHIPELAGO—Anaa Atoll: PELE Sta. AN I, in coral rubble at base of vertical shelf, one specimen, d.d. 11 mm (HOLOTYPE, BPBM No. W 1906) and another specimen, under loose live coral head, d.d. 4.5 mm (PARATYPE, USNM).

DESCRIPTION OF HOLOTYPE

Disc diameter 11 mm, arms all broken.

Upper side of disc covered with many small conical granules and spinules, the latter four to five times longer than thick, more widely spaced than granules, and often tapering to relatively acute tip; frequently, small pits in disc scales where spinules have been removed. Orally, from the ambitus the number of granules diminishes and spinules are more common, forming a narrow V-shaped band while leaving interradial area with exposed scales out to the genital aperture and oral shield. No granules at distal edge of oral shield or along interradial edge of genital openings. No integument obscuring disc or arms.

Radial shields covered.

Oral shields longer than broad, with maximum breadth distal to middle of shield, narrowing inward to form broadly rounded inner edge; madreporite shield with outer central depression, otherwise similar to other oral shields; small gap between oral shield and first lateral arm plate.

Adoral shields triangular, with inner radial edge slightly rounded or convex where it abuts buccal tentacle scale; outer, radial edge touching ventral shield.

Three of four oral papillae on each side of jaw; outer one widest with slight distal projection; inner two or three papillae more elongate and tapering,

similar to dental papillae; one or two smaller subdental papillae occurring at apex of jaw.

Buccal tentacle scale contiguous with both adoral and ventral shields, projecting inward under part of outer oral papilla.

Seven to nine dental papillae at each jaw, including three in two rows.

Lower teeth wide with truncated hylinated tips.

Lower arm plates broader than long; distal half of plates broad but with one-half or less of distal edge touching proximal edge of adjacent plate; arm plates narrowing beneath tentacle scales.

Upper arm plates broadly fan shaped from proximal edge outward and more rounded along distal border. Truncation of lateral borders of some plates where upper arm spine encroaches at irregular intervals. From disc to midpart of arm, the upper arm plates are 1.7 to 2 times broader than long.

Three and four arm spines on each side of the lateral arm plates on segments beyond disc. Proximal ten segments have an arm spine sequence which is given in Table 3. A few sides with five arm spines beyond segment 10 but more frequently an irregular alternation of three and four spines which drops to only three on distal part of the arm. Upper (fourth, or near disc sometimes, fifth) arm spines quite long and tapering from segment 9, and occurring on many segments irregularly beyond middle of arm; many of these upper spines show a deep bi- or, less frequently, trifurcation at the tip of the spine; the tip is also more compressed than the thicker stem of these modified spines. Frequently the upper spines on opposite sides of a segment are modified, but only rarely are two spines on the same side of adjacent segments so modified, although they may carry the same number (four) of spines. The modified spines are considerably longer and thicker than the other upper spines, and much more so than the lower spines in the same row. At the middle of the arm the modified spines may equal five segments in length.

Two tentacle scales regularly occur on segments 1 to 15 (three sides) and out to segment 19 on one side; farther out on arm, only one spear-shaped scale

Table 3. Arm spine sequence (segments 1 to 10), *Ophiomastix stenozonula*.

Ref. No.	Disc Diam.	Segment Number									
		1	2	3	4	5	6	7	8	9	10
WAM	4	3	3	4	4	3/4	3/4	3/4	3/4	3/4	3/4 ^a
USNM	4.5	3	3	4	4	4/5	4/5	4/5	4	4	4 ^b
BPBM W1909	7	3	3	4	4	4/5	5	4/5	4/5	4/5	5/4 ^c
BPBM W1906	11	3	3/4	4	4/5	4/5	5	5	4/5	4/5	4/5
BPBM W1907	11.5	3	3	3/4	4	4/5	5	5/4	4	4/5	4/5

^a numbers indicate (number of) arm spines occurring on each side of the particular segment; i.e., 3/4 indicates that both 3 and 4 spines occur on this segment, with 3 more common than 4.

^b 3/4 alternation on opposite sides of the same segment begins at segment 11.

^c 3/4 alternation on opposite sides of the same segment begins at segment 15.

with sharp tip. Inner scale where two occur is smaller than outer one.

Pigmentation: basic color brown (in alcohol) with tan and having the following pattern: Disc above mostly brown with a few patches lighter interradially and over the radial shields, but not uniform; scales, granules, and spinules brown or tan color with some of the spinules banded. Upper arm plates from disc to beyond middle of arm generally uniform brown although every two five segments may be lighter tan; on the very distal edge of the arm plates is a narrow much darker brown band which continues uninterruptedly onto the proximal part of the following lateral arm plates and around the arm, stopping at the edge of the lower arm plates. However, the same dark or a slightly lighter narrow band also occurs on the distal edge of these lower arm plates. Arm spines are quite noticeably banded away from their base, which is brown, but the modified, enlarged and furcated upper arm spines show little banding except toward the tip, which, like nearly all the other spines, is very light. Oral side much lighter than aboral, with exception of the narrow dark band along distal edge of lower arm plates; tentacle scales somewhat darker than rest of lower arm plate; mouth region light tan although slightly darker tan in center of oral shields and along adoral shields; oral part of disc similar to aboral side in color.

COMPARISON WITH OTHER SPECIMENS AND VARIATIONS

a. Disc cover. In the other three smallest specimens there is a much greater proportion of disc spinules to granules, with very few of the latter between the widely spaced spinules (Figs. 18 and 19). The larger specimen from Tahiti (d.d. 11.5 mm) compares well with the holotype in having numerous granules between the well spaced spinules. A random assortment of 9 granules and 18 spinules was examined from the large Tahiti specimen. The spinules averaged 103 microns in diameter ($r=88-175$) and 462 microns in height ($r=225-600$). The granules averaged 90 microns in diameter ($r=75-113$) and 125 microns in height ($r=100-175$).

b. Tentacle scales. The five paratypes were compared with the holotype for the maximum number of arm plates carrying two tentacle scales on each side of the arm segments beginning with the first segment beneath the disc.

The data in Table 4 suggest that the number of segments with two tentacle

Table 4. Tentacle scales, *Ophiomastix stenoazonula*.

Ref. No.	Disc Diameter (mm)	No. of Arm Segments with 2 Tentacle Scales
BPBM W1908	3.5	1 or 2
WAM	4	2
USNM	4.5	3 or 4
BPBM W1909	7	10 or 11
BPBM W1906	11	15 to 19
BPBM W1907	11.5	11

scales tends to increase as the individual becomes larger.

c. Arm spines. The larger specimen from Tahiti shows no evidence of furcation or enlargement of the tip of the upper arm spines. However, the longest complete arm has only 13 segments and a separate arm portion shows a maximum of only 16 segments (based on the number of segments with two tentacle scales). In the holotype, segments 9 to 14 show the beginning of the modified upper arm spines. None of the smaller specimens show modification of the upper spines; rather, they tend to be elongate and the tip tapers. In the specimen from Huahine (d.d. 7 mm) preserved in alcohol, a transparent epithelial envelope covers the distal one-fourth of the upper spines. Although no furcation is noted, there is some lateral distortion of the spines near their tip, suggesting possible later division. Until more specimens have been examined, it is not possible to indicate to what degree *Ophiomastix stenozonula* exhibits the modification of the tip of the upper arm spines.

The sequence for the number of arm spines occurring on the first 10 segments is given in Table 3 for the holotype and four paratype specimens examined.

d. Oral and dental papillae. With the exception of the larger specimen from Tahiti which has three oral papillae on the jaws, the other three small paratypes have three or four oral papillae on each side of the jaws, with three being most common (Fig. 20). In the 4 and 4.5 mm specimens, four to six dental papillae were noted, without any subdental papillae at the jaw apex. The 3.5 mm specimen has only two or three dental papillae.

e. Oral shields. The oral shields of the larger Tahiti specimen were 1.5 times longer than broad, while those of the smaller specimens were just slightly longer than broad.

f. Dental plates. Two dental plates were dissected from the large Tahiti specimen. These plates are unusual in having an incomplete septum between the upper (aboral) tooth foramen. In other respects the plates have the lower septa thin and compressed, between 27 and 30 per cent of the total length occupied by the dental papillae area, and a length: breadth ratio of 2.3-2.4 : 1.

Two dental plates were also dissected from the Huahine specimen. Both showed extremely narrow vertical septa dividing the upper teeth foramina. It is thus not difficult to see how the septum may be completely resorbed in larger specimens as indicated in the Tahiti specimen (above). The length : breadth ratio of the dental plates for the Huahine specimen was 2.2-2.3 : 1.

g. Oral plates. In the dissected specimens from Tahiti and Huahine (see above), these plates have well-defined ridges and grooves on the abradial surface, with one of the ridges projecting into the mid-central portion of the distal border of the plate.

h. Pigmentation. The smallest specimen (d.d. 3.5 mm) has the disc spinules all white. Orally the color is nearly uniform light whitish tan. The arm spines are noticeably banded with narrow brown and wider white areas. The nar-

row dark band is evident over the arm. This band is characteristic in all the specimens (Figs. 15–18).

REMARKS

Ophiomastix stenozonula is closely allied to an undescribed species of *Ophiomastix* from the Marshall Islands (Devaney, in preparation) and *O. mixta* Lütken, best revealed by the presence of a large number of both disc granules and moderately long spinules intermixed. The new species, *O. stenozonula*, can be separated from the above by: (a) lacking the granules which occur at the distal end of the oral shields and along the interradial border of the genital openings; (b) having the dental plate with a very narrow to incomplete upper interforaminal septum; (c) having strongly furcated tips of the enlarged upper arm spines, at least in some specimens (in *O. mixta* the tips of the spines may be somewhat flattened but no furcation has been noted); (d) having a different pigmentation pattern, especially the narrow dark band at the end of the arm plates (the nearly complete loss of pigment which occurs in preserved specimens of *O. mixta* does not occur in *O. stenozonula*); and (e) having fewer segments with two tentacle scales on each side for specimens of similar size.

This is only the second species of *Ophiomastix* reported from southeastern Polynesia and is known only from the southern Tuamotus and Society Islands. *Ophiomastix variabilis*, the other species from this region, has a much greater range in the Indo-West Pacific.

32. *Ophiomastix variabilis* Koehler

Ophiomastix variabilis Koehler, 1905: 69–71, Pl. VI, fig. 16, Pl. XVI, figs. 3–4; 1930: 202–203; H. L. Clark, 1915: 296; 1921: 134 (in key), 138; Murakami, 1943a: 201; A. M. Clark and Rowe, 1971: 86–87 (distribution), 121 (in key with notes; see below).

Ophiomastix bispinosa H. L. Clark, 1917: 442–443, Pl. II, figs. 1–2; 1921: 134 (in key), 138; 1932: 207; 1946: 250; Murakami, 1943a: 197–198; Endean, 1957: 245; A. M. Clark and Rowe, 1971: 86–87 (distribution), 120–121 (in key with notes; see below), Fig. 39a–d (of holotype); McKnight, 1972: 38.

non *Ophiomastix bispinosa* H. L. Clark; A. H. Clark, 1952: 296–297 (re-examined: USNM No. E 7327, two specimens are *Ophiomastix ornata* Koehler, all other specimens are *Ophiomastix palaoensis* Murakami).

Ophiomastix notabilis H. L. Clark, 1938: 337–338, Fig. 27; 1946: 248 (in key), 250; A. H. Clark, 1954: 261, Balinsky, 1957: 25 (in key), 27; A. M. Clark and Rowe, 1971: 120 (considered synonym of *O. bispinosa*), Figs. 54a–c (mouth region of holotype).

Ophiomastix asperula Lütken; Döderlein, 1896: 290, Pl. XV, figs. 9a–b; Burfield, 1924 (according to A. M. Clark and Rowe, 1971: 120).

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: WES XIV, with broken piece of coral, one specimen, d.d. 4 mm.

RAPAN AND AUSTRAL ISLANDS—Rapa: WES XXX, in limestone crevice against lava boulder, one specimen, d.d. 7.5 mm. Ilots de Bass: WES XXXIV, from base of attached coral head in crevice, one ray of specimen (whole animal observed). Raivavae: WES XVI, in attached live or dead coral, one specimen, d.d. 5 mm.

COOK ISLANDS—Aitutaki: WES X, one specimen, d.d. 7 mm.

REMARKS

Extensive variation in external features (hence the name) has led to confusion regarding the taxonomic status of *Ophiomastix variabilis*. Only recently have suggestions been proposed which lead to its correct position (A. M. Clark and Rowe, 1971). My own examination of Koehler's type specimens of *O. variabilis* from the Siboga expedition and comparison with the type specimens of *O. bispinosa* and *O. notabilis*, together with the specimens described by A. H. Clark (1954) as *O. notabilis* from the Gilbert Islands and Saipan, convince me that these specimens are conspecific. The additional specimens reported herein from S. E. Polynesia help in further clarifying the taxonomic position of this species. A few of the more important characters are discussed as follows:

a) disc cover—as noted in Koehler's original description, there is a considerable range in the size, density, and even shape of the disc spines in different individuals of *O. variabilis*. H. L. Clark's unique type of *O. bispinosa* shows rather wide-spaced spines on the upper side of the disc; a feature of these spines is the very acute drawnout tip which is represented to some extent in A. M. Clark and Rowe's (1971, Fig. 39b) illustration of the upper side of part of the disc of this specimen. This feature is also noted for the disc spines of several of the type specimens of *O. variabilis* and is evident in my S. E. Polynesian specimens as well as A. H. Clark's (1954) specimens of *O. notabilis*. The specimen from Rapa (7.5 mm) shows more abundant disc spines than the type of *O. bispinosa*, and the spines occur orally although are reduced in size and number nearly to the oral shields; on the upper side of the disc the spines measure 0.4 to 0.5 mm in length. Several of the other S. E. Polynesian specimens share this feature.

b) oral shields—The S. E. Polynesian specimens have these plates about as long as broad and oval, similar to the type of *O. bispinosa* and several of the types of *O. variabilis*. However, the type specimen of *O. variabilis* from Siboga station 60 has the oral shields distinctly longer than wide, which is also characteristic of a 8.5 mm specimen from Onotoa Atoll, Gilbert Islands, reported as *O. notabilis* by A. H. Clark (USNM No. E 8074) in 1954.

c) arm spines—A characteristic feature of *O. variabilis* from S. E. Polynesia is the shape of the enlarged upper arm spines. Even in a small (4 mm) specimen,

these spines are distinctly larger than those in the same row, definitely swollen, and have a rounded tip. Often there is an indication of longitudinal striations on these spines and in the specimen from Aitutaki, a gelatinous epithelial covering over these spines gives them an even more swollen appearance.

H. L. Clark characterized *O. bispinosa* as having two and three arm spines. Re-examination of that type specimen revealed one ray with four arm spines alternating with three spines on several segments beyond the disc. The present S. E. Polynesian specimens show the presence of two arm spines most frequently on the proximal segments and only rarely on distal arm segments, where three and four arm spines are much more common. Usually where four spines occur, the upper is modified as the enlarged and swollen type. However, this can also happen to the upper spine of segments with only three arm spines.

d) pigmentation—The presence of distinct, narrow, light bands on the arms at wide intervals is quite characteristic. The light band usually extends onto the arm spines of the segment involved. Several of the S. E. Polynesian specimens have other arm spines more or less banded with dark brown and lighter, with the exception of the upper modified swollen spines which may be uniform in color or darkly spotted. The disc spines are equally variable: on some specimens they are uniformly white, dark brown, or even banded. The light arm bands are apparent on the type specimen of *O. bispinosa* when placed in alcohol. The ground color of the disc may be completely brown or nearly black, or there may be irregular portions with streaks of white.

e) tentacle scales—The Rapan specimen has two tentacle scales on five sides of segment 1 and one scale on the other sides. The other S. E. Polynesian specimens have only a single scale on each side of segment 1. Although Koehler stated that his specimens of *O. variabilis* had two tentacle scales on segment 1, my examination of these specimens showed that one or more sides of the Siboga specimens from Banda, station 60, and station 93 had one and two tentacle scales on segment 1 (only one side of the specimen from station 93 bears two tentacle scales). Thus one, two, or one *and* two tentacle scales may be present on segment 1 of this species.

f) size—The specimens from S. E. Polynesia reach a size of 7.5 mm. Those from the Gilbert Islands and Saipan reported by A. H. Clark (1954) as *O. notabilis* are known to reach a size of 8.5 mm, similar to the maximum size of Koehler's Siboga *O. variabilis*. The type of *O. notabilis* was reported as 13 mm, while Balinsky (1957) reported his specimen from Mocambique as 14 mm. H. L. Clark's (1932) specimen of *O. bispinosa* from the Great Barrier Reef was the largest recorded, at 15 mm.

g) habitat—*Ophiomastix variabilis* appears to be a very secretive species and not at all common; there are no records of more than one specimen being collected from a single collecting station. My own observation of this species underwater revealed it inhabiting small crevices well back in attached coral or limestone and accessible only by breaking loose the substratum (these observations

were based on diurnal collecting and it may be that the species is more active and less concealed at night).

h) The specimen from Aitutaki (7 mm) has well developed gonads.

With the evidence that *O. bispinosa* and *O. notabilis* are more than likely conspecific with *O. variabilis*, it is apparent that this relatively uncommon form is widespread in the Indo-Pacific. In the east the species is known from the Tuamotus (H. L. Clark, 1917) and northern Cooks (McKnight, 1972). The present report finds it at Rapa and Ilots de Bass, eastern and southern records as well as the southern Cooks and Tahiti. It is present along the northwestern and eastern tropical coasts of Australia (H. L. Clark, 1932), the East Indies (Koehler, 1905, 1930), the Gilbert and Marianas Islands (A. H. Clark, 1954) and Tonga (A. M. Clark and Rowe, 1971: 120). In addition to Balinsky's (1957) east African record, the species is reported by A. M. Clark and Rowe (1971) from several additional Indian Ocean localities.

OPHIONEREIDAE

33. *Ophionereis porrecta* Lyman

Ophionereis porrecta Lyman, 1860: 260; 1865: 147, Figs. 14, 15; A. M. Clark, 1953: 80-81; A. M. Clark and Rowe, 1971: 88-89 (distribution), 122 (in key).

Ophiodesmus degeneri A. H. Clark, 1949: 46-48, Figs. 17a-b.

Ophionereis degeneri: A. M. Clark and Rowe, 1971: 88-89, 122.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XIII, one specimen, d.d. 10 mm; MIS XVIII, one specimen, d.d. 3 mm.

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: PELE Sta. RL I, haul 6, one specimen, d.d. 6.5 mm. Manihi Atoll: PELE Sta. MA IV, from live or dead coral, one specimen, d.d. 5.5 mm; PELE Sta. MA V, one specimen, d.d. 12 mm. Tatakoto Atoll: PELE Sta. TK III, two specimens, d.d. 7 and 8.5 mm. Anaa Atoll: PELE Sta. AN II, arm of specimen; PELE Sta. AN IV, six specimens, d.d. 5.5 to 11 mm. Takaroa Atoll: WES XLVIII, one specimen, d.d. 10 mm.

MARQUESAS ISLANDS—Nuku Hiva: PELE Sta. NH XI, haul 8, one specimen, d.d. 5 mm. Fatu Hiva: PELE Sta. FH I, haul 1, one specimen, d.d. 6 mm; haul 2, two specimens, d.d. 1 and 3 mm; PELE Sta. FH V, under and among coral, one specimen, d.d. 10 mm. Tahuata: PELE Sta. TH I, haul 2, two specimens, d.d. 0.9 and 1.1 mm; hauls 3 to 7, two specimens, d.d. 4.5 mm; PELE Sta. TH X, haul 3, three specimens, d.d. 3 to 4.5 mm; haul 4, six specimens, d.d. 3.5 to 7 mm; haul 6, two specimens, d.d. 2 and 3 mm; haul 7, two specimens, d.d. 4.5 and 6 mm; hauls 9, 10, or 11 one specimen, d.d. 6 mm; haul 13, four specimens, d.d. 3 to 5.5 mm; haul 14,

one specimen, d.d. 1.7 mm.

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, hauls 2 and 3, two specimens, d.d. 3.5 and 5 mm; haul 4, two specimens, d.d. 5.5 and 10.5 mm; haul 8, seven specimens, d.d. 4 to 14 mm; haul 10, one specimen, d.d. 12 mm; haul 12, two specimens, d.d. 4 and 6 mm; haul 19, four specimens, d.d. 3 to 11 mm; haul 20, four specimens, d.d. 7 to 8 mm; haul 21, one specimen, d.d. 4 mm; haul 23, two specimens, d.d. 9.5 and 10.5 mm; haul 25, one specimen, d.d. 6 mm; PELE Sta. PIT VII, haul 1, six specimens, d.d. 5 to 8.5 mm; hauls 2 and 3, two specimens, d.d. 7 mm; haul 4, three specimens, d.d. 4.5 to 10 mm; PELE Sta. PIT VIII, haul 2, one specimen, d.d. 9 mm.

REMARKS

This is the only species of *Ophionereis* known east of the New Hebrides, although at least ten Indo-West Pacific species are recognized (A. M. Clark and Rowe, 1971).

Aside from H. L. Clark's (1917) report of *Ophionereis porrecta* from the Tuamotus, I am unaware of other southeastern Polynesian records until now. The specimens from Pitcairn and the Marquesas were dredged from depths between 36 and 128 meters. Those from the Society and Tuamotu Islands were taken in shallower water.

OPHIODERMATIDAE

34. *Ophiarachna affinis* Lütken

Ophiarachna affinis Lütken, 1869: 33–34; H. L. Clark, 1909: 128; 1915: 299, Pl. 18, figs. 1–2; Koehler, 1904: 76; 1922: 333, 335, Pl. 4, fig. 1; 1930: 271–272, Pl. XIV, fig. 1; Lorient, 1893b: 411; A. M. Clark and Rowe, 1971: 88–89 (distribution), 123 (in key), Fig. 42a (mouth area).

Ophiarachna clavigera Brock, 1888: 495–496.

? *Ophiarachna mauritiensis* Lorient, 1893a: 32–33, Pl. XXIV, figs. 1–1e; H. L. Clark, 1909: 128; Koehler, 1922: 333, 335; A. M. Clark and Rowe, 1971: 88–89 (distribution), 123–124 (in key).

MATERIAL EXAMINED AND LOCALITIES

AUSTRAL ISLANDS—Rurutu: WES XXI, under boulder in sand and rubble, three specimens, d.d. 15 to 19 mm.

COOK ISLANDS—Aitutake: WES X, under boulder in rubble, one specimen, d.d. 14 mm.

REMARKS

Although I have not been able to compare my specimens directly with any which have previously been described as *Ophiarachna affinis*, I have had the

opportunity to examine examples from Fiji, in the collection of Mr. Peter Beveridge at the University of the South Pacific. The Polynesian and Fiji specimens reveal that some or all of the radial shields are minutely exposed rather than being completely covered.

The Austral and Cook Island specimens have the distal edge of the lower arm plates trimmed with dark. A. M. Clark (*in* Clark and Rowe, 1971: 123) remarks on this feature as being characteristic of one of the color forms of *O. affinis*. Also, the specimens have the tendency for dark and light color to appear at intervals of several segments on the upper side of the arms, as described by A. M. Clark. One of the Rurutu specimens (d.d. 15 mm) is unusual in having a definite reddish cast with white punctuations on the disc. The arm spines are characteristically banded.

The Polynesian specimens show not only elongation of some of the lower arm spines but also their terminal enlargement into rounded blunt thickened clubs.

35. *Ophiarachna megacantha erythema* n. subsp.

Figs. 21, 22

MATERIAL EXAMINED AND LOCALITIES

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI, haul 21, one specimen, d.d. 22 mm (PARATYPE, BPBM No. W 1940).

RAPAN ISLANDS—Ilots de Bass: WES XXXIV, under boulders on sand, seven specimens, d.d. 7.5 to 25 mm (HOLOTYPE, BPBM No. W 1941, d.d. 17.5 mm, and PARATYPES, BPBM No. W 1942).

DESCRIPTION

The specimens at hand agree in most respects with H. L. Clark's (1938, 1946) accounts of *Ophiarachna megacantha* reported from the southern Queensland coast off eastern Australia. However, there appears to be enough variation in pigmentation and a few morphological features which warrant at least sub-specific separation of the southeastern Polynesian specimens.

The specimens from both Pitcairn and Ilots de Bass show a predominance of reddish-orange color (hence the subspecific name) when alive. This pigmentation fades rather quickly in alcohol, and even formalin-preserved specimens which were later dried have faded somewhat. The disc of the two smallest specimens (d.d. 7.5 and 11 mm) has light yellowish markings in the interradial portions. These are nearly absent in a 12 mm specimen, and in the larger specimens there may be only a few flecks of light color or the whole disc may be reddish-orange. The smaller specimens also show wide-spaced narrow (one to two plates) bands of yellow separated by five to six plates which are reddish. In larger specimens the basal part of the arm may have slightly varying shades of reddish-orange, but the pronounced light narrow bands are restricted to the distal parts of the rays (Figs. 21, 22). The banding is apparent on both sides of the arms. The

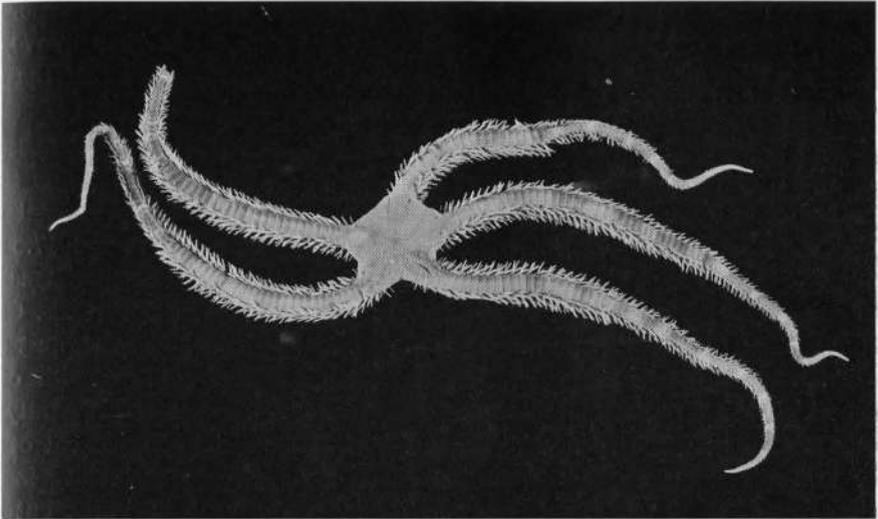


Fig. 21. *Ophiarachna megacantha erythema*, Holotype, BPBM No. W1941—Upper side.

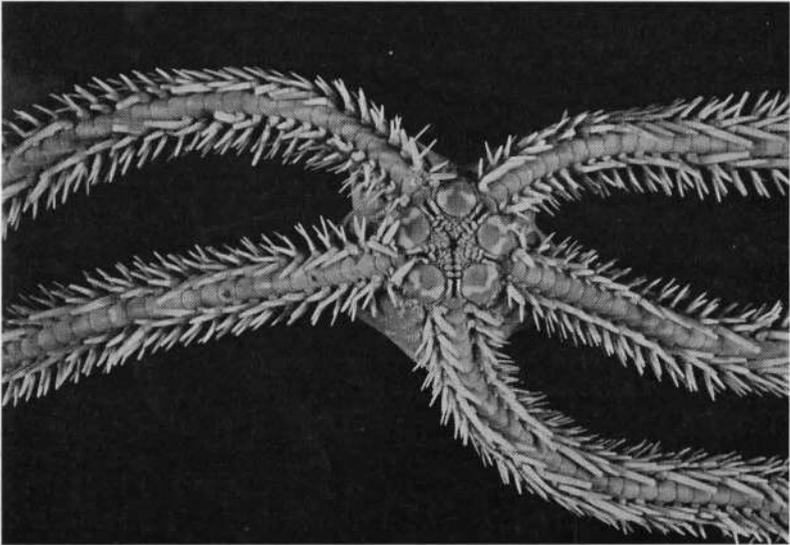


Fig. 22. *Ophiarachna megacantha erythema*, Holotype—Lower side.

distal edge of the wide upper arm plates generally shows several small light yellowish dots and these may be irregular and infrequent on the middle part of the plates as well. A similar color pattern is often found on the lower arm plates, although a few plates may have light color spots along the lateral edges also. In H. L. Clark's (1938) description of *Ophiacantha megacantha* he points out that the lateral margins of both the upper and lower arm-plates were "narrowly white",

a feature which is not evident in the Polynesian specimens. He also described the color of the dry holotype as having "disk uniformly light gray above, . . . upper arm-plates at base of arm gray" and in 1946 (p. 254) noted that the disc of a 27 mm specimen was "uniform dark brown."

There is an apparent modification of the lower arm spines with increase in size. The two largest specimens (one from Pitcairn and one from Ilots de Bass) have the lower spines beyond the disc greatly elongated, with the distal end expanded and compressed. To a lesser degree this is evident in the 17.5 mm holotype (Fig. 22) as well as a 12 mm specimen. In the smaller specimens the lower spines differ from the upper spines only in their greater length. H. L. Clark mentioned that the large 27 mm specimen of *O. megacantha* had the lowest arm spines " . . . up to 7 mm in length, but do not show that contrast with other spines which is so marked in the holotype" (1946: 254). One of his paratypes, slightly smaller than the 15 mm holotype, failed to show the enlargement of the lower arm-spines. It appears then that there can be some variability in the modification of the lower arm spines of *O. megacantha* from Australia, but this is not so apparent in the Polynesian specimens, where the degree of modification appears directly correlated with increase in size.

An examination of the number of arm spines on various segments reveals the following for the Polynesian specimens:

- a) there are normally two arm spines on the sides of segment 1, with the lower spine flattened and tapering
 - b) segment 2 has three spines
 - c) segment 3 may have three, four, or three and four spines
 - d) segment 4 usually carries four spines, but three also occur
 - e) on the fifth segment, four and five spines were present even in the 7.5 mm specimen
 - f) in a 12 mm specimen, six spines were found irregularly alternating with five spines from segment 6 to 14
 - g) four and five spines were found as far as segment 11 in the 7.5 mm specimen and as far as segment 35 in the 11 mm specimen
 - h) five and six spines were present from segments 8 to 29 in the 17.5 mm specimen
 - i) seven spines were noted on a few sides of segments 9 to 12 in the 25 mm specimen; in the 22 mm specimen from Pitcairn the maximum number of spines was six and was limited to a few segments beyond the disc margin
 - j) distally on the arms nearly to the tip, four arm spines are very common; there may be some alternation of three and four spines on the most distal segments
- The holotype of *O. megacantha* was characterized by having either four or five arm spines, whereas a larger 27 mm specimen had six spines on some of the basal joints. Based on the Pitcairn and Ilots de Bass specimens, it appears that a maximum of six spines is common on some basal segments of specimens 12 mm or larger, and sometimes as many as seven spines may occur in larger specimens.

All of the Polynesian specimens have the oral shields broader than long. H. L. Clark reported that the holotype of *O. megacantha* had these plates "as wide as long or wider" (1938: 342).

Three other species of *Ophiacantha* share the features of exposed radial and supplementary oral shields with *O. megacantha*. These species are *O. affinis* Lutken, 1859², *O. robillardi* Lorient, 1893a, and *O. ohshimai* Murakami, 1943b. Of these, only *O. robillardi* resembles *O. megacantha* in lacking annulated arm spines. The former species, however, differs from *O. megacantha* by having (a) the oral shields longer than broad, (b) only three arm spines toward the middle of the arm, with the length of the arm spines being nearly equal, and (c) a brown color with the arms annulated by gray quite regularly. Lorient described *O. robillardi* from Mauritius, and the type is the only reported specimen. Recently A. M. Clark relegated H. L. Clark's *Ophiocoma delicata* to *Ophiarachna* and placed a 21 mm specimen from the Solomon Islands in this taxa (Clark and Rowe, 1971: 124, Pl. 20, figs. 5, 6). This species while having the arm spines unbanded, has a variegated disc and arm pattern, the radial shields covered, and apparently a maximum of five arm spines. The latter three characters are quite different from *O. megacantha*.

Two of H. L. Clark's original Australian specimens of *O. megacantha* were collected from a depth of 23 fathoms (42 m), 25 miles southeast of Double Island Point, Queensland (ca. 26°S, 153°E). The other specimens were collected off Lindeman Island, Mackay, Queensland (20°27'S, 149°E), the smaller of the two being dredged.

The Pitcairn Island specimen of the new subspecies was also dredged, from 30 to 45 fathoms (55 to 82 m), while the Ilots de Bass specimens were found, several at a time, under boulders on sand at a depth of 5 to 8 fathoms (9 to 15 m).

36. *Ophiarachnella parvispina* H. L. Clark

Ophiarachnella parvispina H. L. Clark, 1925: 93-94, Pl. X, figs. A, B; A. M. Clark and Rowe, 1971: 88-89 (distribution), 125 (in key).

MATERIAL EXAMINED AND LOCALITIES

AUSTRAL ISLANDS—Raivavae: WES XVI, at base of attached coral, one specimen, d.d. 7 mm.

COOK ISLANDS—Manuae: WES VII, under dead coral, one specimen, d.d. 6 mm. Rarotonga: WES III, one specimen, d.d. 7.5 mm; WES IV, one specimen, d.d. 7.5 mm.

REMARKS

The specimens at hand have been compared with the type and previously only

² *O. affinis* has previously been characterized by having the radial shields concealed, but see p. 176.

recorded specimen of this species from Wake Island in the north central Pacific. The southeastern Polynesian specimens agree in all essential features with the type specimen, especially in the deep depression in the center of the radial shields. An additional specimen was collected by the author at Eniwetok, Marshall Islands, at the depth of 60 ft. beneath coral on the seaward side between Rigili and Giriinien islets (specimen deposited in Eniwetok Marine Biological Laboratory collection).

37. *Ophiopeza kingi* n. sp.

Figs. 23-25

ETYMOLOGY: The species is named for the late Mrs. Mary E. King, enthusiastic patroness of marine biological expeditions in the Pacific directed from her ship "Pele".

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Anaa Atoll: MIS XXII, one specimen, d.d. 2.9 mm (PARATYPE, BPBM No. W 1943). Anuanuraro Atoll: WES XLVI, one specimen, d.d. 7 mm (PARATYPE, BPBM No. W 1944). Puka Puka Atoll: PELE Sta. PP III, one specimen, d.d. 7 mm (PARATYPE, BPBM No. W 1945).

PITCAIRN GROUP—Pitcairn Island: PELE Sta. PIT VI haul 8, one specimen, d.d. 8.5 mm (PARATYPE, BPBM No. W 1946); haul 23, four specimens, d.d. 8.5 to 9 mm (PARATYPES, USNM and BPBM No. W 1947); PELE Sta. PIT VII, hauls 2 and 3, six specimens, d.d. 4.5 to 8.5 mm (HOLOTYPE, BPBM No. W 1948 and PARATYPES, BPBM No. W 1949); haul 4, two specimens, d.d. 8 mm (PARATYPES, WAM).

DESCRIPTION OF HOLOTYPE

Disc diameter 8.5 mm, arm length 45 mm. Disc covered with small closely packed rounded or slightly polygonal granules extending to the oral shields. Radial shields covered by granules.

Oral shields heart-shaped with blunthy pointed internal angle; slightly broader than long. Granules covering any signs of supplementary oral shields. Adoral shields widest distally, distal side against the ventral arm shield; internal portion of adorals covered by small granules which continue up to apex of jaws; these granules are same size and shape as the disc granules.

Buccal (oral) tentacle scale beneath outer oral papilla which is the widest; eight or nine oral papillae along each side, somewhat flattened, bluntly pointed.

Ventral shield much broader than long with projecting lateral edges. Lower arm plates with convex distal border about as long as broad on proximal segments. Two tentacle scales, inner longest, longer than broad, with rounded or bluntly tapering tip and about one-third the length of the lower arm plate; outer scale just covering base of lowest arm spine. Eight or nine arm spines on a few

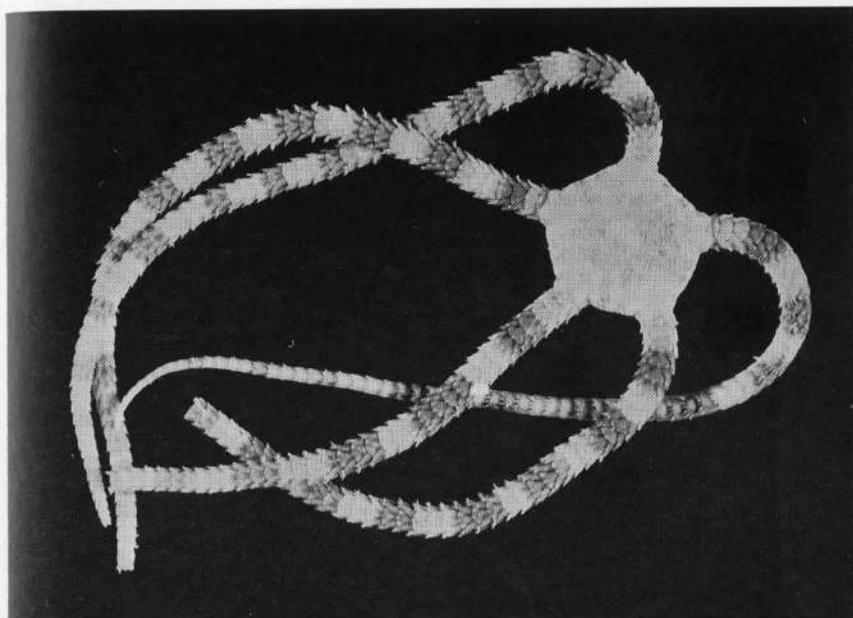


Fig. 23. *Ophiopeza kingi*, Holotype, BPBM No. W1948—Upper side.

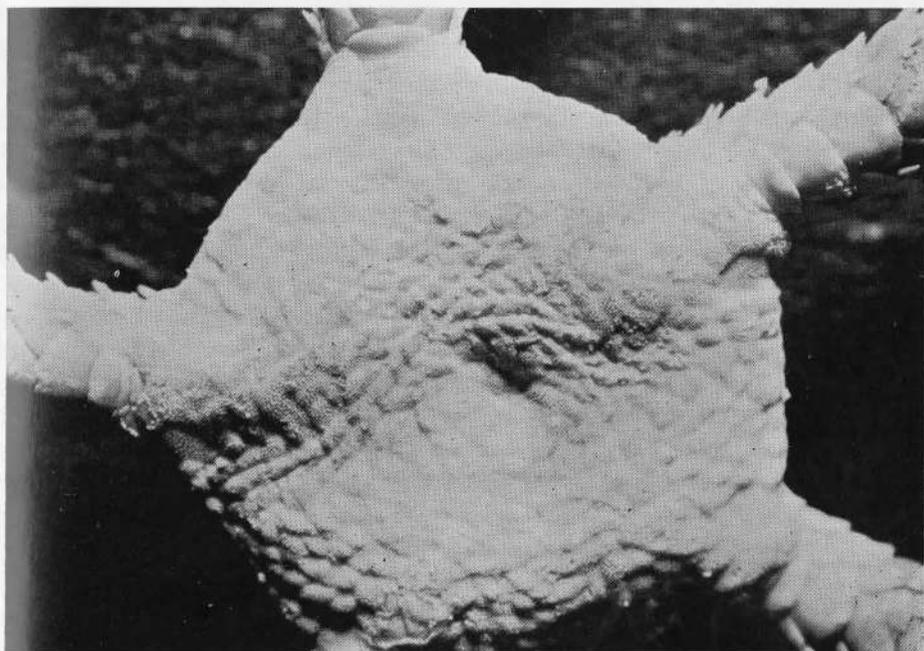


Fig. 24. *Ophiopeza kingi*, Holotype—Upper surface of disc.

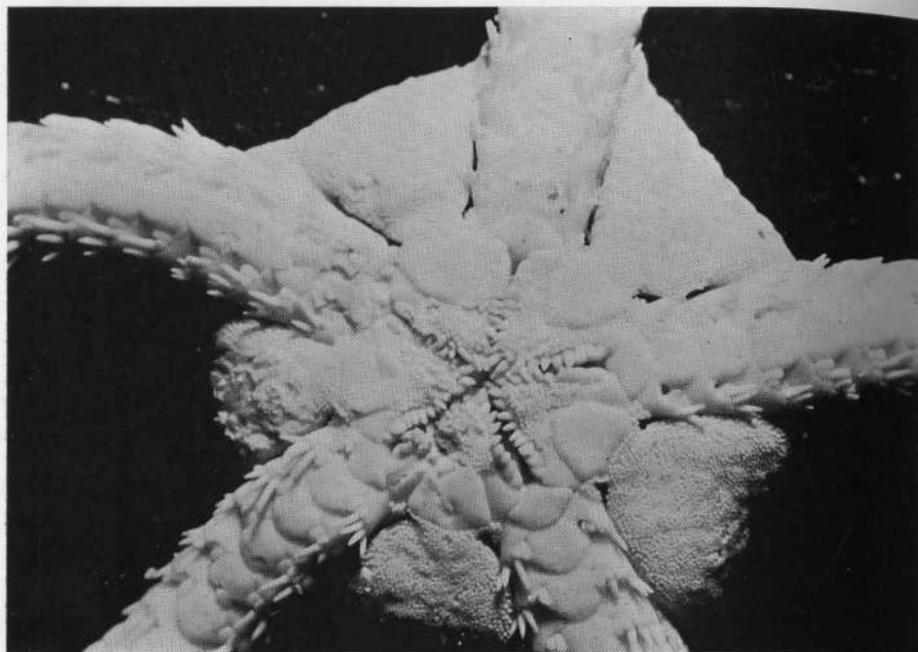


Fig. 25. *Ophiopeza kingi*, Holotype—Lower side, disc, and proximal part of arms.

proximal segments beyond the disc margin; lowest arm spine longest, a little shorter than the lower arm plate; other spines equal in length.

Upper arm plates with gently rounded distal border curving to the broadest lateral edge which is near the distal end of the plate; plates tapering proximally with about one-half of the maximum width exposed proximally. Upper arm spines not coming up over the lateral edges of the upper arm plates. Middistal border of the upper plates sometimes irregular with two small bumps, so center part may appear slightly concave.

Ground color of disc tan and the arms are broadly banded, light tan and brown. There are often three light areas along the distal edge of the upper arm plates, the lateral two separated from the center one by darker spots. The proximal lateral edges of the upper arm plates are often outlined in a darker shade of tan or brown. The arm spines are often lighter than the lateral arm plates proximally but darker toward the tip. The lower arm plates, tentacle scales, lower side of the disc, and mouth plates are light colored.

The holotype was collected with five additional specimens off the coast of Pitcairn Island by dredging at a depth of 82 to 110 meters.

COMPARISON WITH OTHER SPECIMENS AND VARIATIONS

The smallest specimen from the same lot has a d.d. of 4.5 mm. It differs from the type basically in pigmentation, with the disc having irregular brownish

areas near the center and the distal border of the upper arm plates with two large white spots, one narrower dark spot, and the central portion of the plate darker than for the holotype. There are a maximum of only seven arm spines on a few proximal arm segments. The upper arm plates near the disc are more rapidly tapering and relatively longer than wide compared to the holotype.

Another large specimen from the same lot (d.d. 8 mm) is dark brown and shows two or three distal light spots on the upper arm plates. There is a maximum of eight arm spines.

There is some variability in the degree of covering of the supplementary oral shields: the specimen from Puka Puka Atoll has four of the shields partially covered; one of the Pitcairn specimens from Sta. PIT VII, haul 4 (d.d. 8 mm) has all the supplementary plates covered, while the other 8 mm specimen has four of them partially covered and one fully concealed; the specimen from Anuanuraro Atoll has all the supplementary shields uncovered.

Dissection of the Anuanuraro specimen revealed apparently ripe gonads.

The smallest specimen, that from Anaa Atoll, d.d. 2.9 mm, has a light colored disc with tan and lighter arm banding. The granules are nearly rounded and contiguous but with some evidence of the disc scaling below. There is no depression in the center of each granule on the upper side of the disc, but some of the granules on the lower side of the disc are pitted except for those on the oral frame, which are merely rounded. A maximum of six arm spines is present on segments beyond the disc margin. The longest ray has 21 segments and is complete. There is no evidence of supplementary oral shields, but the oral shields are exposed. A few granules occur between the arm spines and distal part of the lateral arm plates on some of the proximal segments, but there are no accessory spinules.

REMARKS

The new species was compared with *Ophiopeza spinosa* from several south-eastern and central Pacific localities. Another specimen from the Mauritius Institute and from that locality, tentatively determined as *Ophiopeza dubiosa* Lorient, also appears to be an example of *O. spinosa*. A good example of *O. fallax* from the Mauritius Institute also was compared with the new species. *Ophiopeza kingi* can be separated from *O. spinosa* and *O. fallax* by a difference in the size and nature of the disc granules: in *O. spinosa* and *O. fallax* the granules are deeply pitted centrally and are definitely polygonal, whereas they are not pitted and are more rounded in *O. kingi*; b) in *O. spinosa* and *O. fallax*, but not *O. kingi*, the upper one or two arm spines cover a part of the upper arm plate at a size of 5 mm or larger; c) the upper arm plates are differently shaped; d) the maximum number of arm spines differs: in *O. kingi*, at d.d. 8 to 9.5 mm there are typically eight or nine spines, rarely 10; for *O. spinosa* or *O. fallax* of similar size, 12 or 13 spines are typical.

Ophiopeza kingi has the same number of arm spines as *Ophiopeza dubiosa*

(Loriol, 1893a), described on the basis of a single specimen collected at Mauritius with a d.d. of 8 mm. However, the oral shields of *O. dubiosa* are longer than broad, in contrast to those of *O. kingi* which are broader than long. The lower arm plates of *O. dubiosa* are slightly longer than broad; those of *O. kingi* are as broad as long on the proximal segments. *O. dubiosa* was described as having the supplementary oral shields small but uncovered. In *O. kingi*, although the holotype has all the supplementary plates concealed by granules (Fig. 25), there are other specimens which have one or more of these plates uncovered.

In addition to the type specimen of *O. dubiosa* from Mauritius described by Loriol, Koehler (1927, 1930) listed this species among specimens from the Marshall and Gilbert Islands as well as Kei Islands, respectively. Although no details were given in these reports, the Marshall and Gilbert Islands specimens have been re-examined and prove to be good examples of *O. spinosa* (see p. 186).

38. *Ophiopeza spinosa* (Ljungman)

Ophiarachna spinosa Ljungman, 1867a: 305.

Ophiopezella spinosa: H. L. Clark, 1909: 119-120; 1915: 304; Koehler, 1927: 5.

Ophiopeza spinosa: A. M. Clark, 1968: 313; A. M. Clark and Rowe, 1971: 88-89 (distribution), 127 (in key).

Distochophis clarki Ely, McKnight, 1972: 38.

MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XI, one specimen, d.d. 6 mm; MIS XII, from broken coral, two specimens, d.d. 7 mm. Huahine: WES XII, from base of dead coral, one specimen, d.d. 7 mm.

TUAMOTU ARCHIPELAGO—Manihi Atoll: PELE Sta. MA V, one specimen, d.d. 8.5 mm. Anaa Atoll: PELE Sta. AN IV, three specimens, d.d. 5.5 to 7 mm.

MARQUESAS ISLANDS—Ua Pou: PELE Sta. UP IV, one specimen, d.d. 4 mm. Fatu Hiva: PELE Sta. FH V, one specimen, d.d. 3 mm.

COOK ISLANDS—Manihiki Atoll: MIS XXVI, one specimen, d.d. 3 mm; MIS XXVII, one specimen, d.d. 9.5 mm.

REMARKS

Small specimens from the Marquesas and Cook Islands (d.d. 3-4 mm) were compared with larger specimens from Tahiti, the Cook Islands, Manihi, and specimens in the Bishop Museum from Eniwetok (Marshall Islands) and Samoa.

a) disc cover—even at a small size the disc granules are polygonal and angular, with a noticeable central depression; they are quite small and usually closely packed.

b) supplementary oral shields—the 3 mm specimen from Fatu Hiva has these all partially uncovered; the 3 mm specimen from Manihiki has three completely

uncovered, one partially covered by granules, and one fused to the madreporite plate; the 4 mm specimen from Ua Pou has one totally uncovered, two partially, and two completely covered by granules; the 6 mm specimen from Tahiti has four uncovered and one completely covered by granules; the 8.5 mm specimen from Manihi has all uncovered.

c) arm spines

Locality:	Fatu Hiva	Manihiki	Ua Pou	Tahiti	Manihi
Disc Diam.	3 mm	3 mm	4 mm	6 mm	8.5 mm
Max. No. spines	7	7	8	12	12
No. spines seg. 1	3	3	3	4-5	4-5
No. spines seg. 2	4	3-4	3	4-5	5

A secondary series of smaller spines was noted on basal segments of the two small specimens from the Marquesas and the small Manihiki specimen. None of the other specimens examined had these spines. The irregular occurrence of the secondary row of arm spines was noted by A. M. Clark (*in* Clark and Rowe, 1971: 127). This character was also noted by that worker in several other genera of Ophiidermatidae, including *Distichophis clarki* Ely (1942).

Ely characterized *Distichophis* by having only a pair of peristomial plates, unusual for the Ophiidermatidae (Matsumoto, 1917). Recent dissection of a 4 mm specimen from Kaneohe Bay, Oahu and a 4.5 mm specimen from Kahului, Maui, which agree quite well with Ely's *D. clarki*, reveal triple peristomial plates in three and four of the five interradial angles respectively. In these cases the lateral plates meet broadly within, excluding a smaller medial plate. The other angles have the medial plate reduced or absent. Two specimens of *Ophiopeza spinosa* from Tahiti (d.d. 6 mm) and Eniwetok (d.d. 8 mm) also revealed very evident triple peristomial plates, with the lateral pair large and excluding the medial smaller plate internally.

A. M. Clark (*in* Clark and Rowe, 1971: 127) distinguished *Distichophis clarki* from *Ophiopeza* in a key by nothing:

"Marginal plates of disc enlarged and convex, covered with appreciably larger granules than the rest of the disc" (for *Ophiopeza*)

vs.

"Margin of disc unspecialized, the plates underlying the granules not enlarged or convex" (for *D. clarki*)

The small specimens of *Ophiopeza spinosa* (d.d. 3-4 mm) show very little enlargement of the marginal plates or overlying granules; upon removal of the granules, a row of enlarged marginal scales was observed in the 4 mm specimen from Ua Pou. The 4 mm specimen from Kaneohe, Oahu, also showed very little marginal plate or granule enlargement; upon removal of the granules, however, a row of enlarged marginal plates (scales) was noted.

Therefore, as there are no generic criteria to separate the two taxa, *Distichophis clarki* should be referred to *Ophiopeza*.

The shape of the disc granules—which in the Hawaiian specimens are more rounded than polygonal, and usually without noticeable central depressions—is one way to separate the Hawaiian specimens from typical *Ophiopeza spinosa*. Also Hawaiian specimens have the secondary arm spines more consistently developed, appear to reach a smaller maximum size (5 mm), and are generally more lightly pigmented (having less pronounced dark bands on the proximal part of some of the upper arm plates, but having more or less small dark spots on some of these plates) than typical *O. spinosa*. The Hawaiian form is now best considered as *Ophiopeza spinosa clarki*, a subspecies restricted to the Hawaiian Island group.

Examination of two specimens identified as *Distichophis clarki* from Manihiki Atoll (listed as *Distochophis clarki* by McKnight, 1972), shows that they are typical examples of *O. spinosa*.

Two of several specimens from Niue Island, east of Tonga, examined at the Dominion Museum, Wellington, are unusual in having scattered spinules among the granules, especially along the disc margin.

O. spinosa was reported from the Society Islands by H. L. Clark (1909; 1915; 1917) and Tuamotus (H. L. Clark, 1917). In addition the species is known from many central and west Pacific localities. I have examined a 4.5 mm specimen from the Mauritius Institute, labeled "*Ophiopezella dubiosa*" which agrees wholly with *Ophiopeza spinosa*. This would be the second record of *O. spinosa* from the Indian Ocean (the first record, that of A. M. Clark and Rowe, 1971: 91, 127, from the Maldivé Islands) unless Lorient's *O. dubiosa* from Mauritius is a synonym as I am inclined to believe.

Koehler (1927) listed both *O. dubiosa* and *O. spinosa* from the Gilbert and Marshall Islands but gave no specific details. The specimens determined as *O. dubiosa* were re-examined in cooperation with the Göteborgs Natural Historie Musee. The specimens are decidedly within the specific range of *O. spinosa*. Unfortunately the specimens determined by Koehler as *O. spinosa* could not be located and there is no way to see how he distinguished these from his *O. dubiosa*.

OPHIURIDAE

39. *Ophiolepis cincta* Müller and Troschel

Ophiolepis cincta Muller and Troschel, 1842: 90; H. L. Clark, 1946: 272–273; A. M. Clark and Rowe, 1971: 90–91 (distribution), 129 (in key), Fig. 46c (upper side of proximal arm segment); McKnight, 1972: 38, 44.

MATERIAL EXAMINED AND LOCALITIES

AUSTRAL ISLANDS—Raivavae: WES XVI, at base of attached live or dead coral, one specimen, d.d. 10.5 mm.

COOK ISLANDS—Manuae: WES VII, under dead coral head, one specimen, d.d. 6.5 mm. Rarotonga: WES III, under attached dead coral head, one specimen, d.d. 8.5 mm.

REMARKS

This species was reported from the Society Islands by H. L. Clark (1915) and McKnight (1972). We now can include the Austral and Cook Islands among the localities where *Ophiolepis cincta* is found in S. E. Polynesia.

40. *Ophiura kinbergi* (Ljungman)

Ophioglypha kinbergi Ljungman, 1867b: 166; Lyman, 1882: 33, Pl. IV, fig. 7; Koehler, 1905: 22.

Ophiura kinbergi: H. L. Clark, 1911: 37, 47 (in key), Fig. 9; 1946: 270; ? Matsumoto, 1917: 268, 271, Fig. 73a-c; A. H. Clark, 1949: 55 (Hawaiian Islands); 1952: 298 (Marshall Islands); A. M. Clark and Rowe, 1971: 90-91 (distribution), 128 (in key), Figs. 46a-b, Pl. 22, figs. 5-6.

MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: PELE Sta. RL I, hauls 3-5, one specimen, d.d. 5 mm; haul 6, one specimen, d.d. 3 mm.

REMARKS

The larger specimen has very indistinct disc plates and, with the exception of the radial shields, they cannot be clearly defined but appear quite flat; the smaller specimen shows the disc plates quite clearly, and they are low and flat, but the series of smaller plates surrounding the larger plates as shown by A. M. Clark and Rowe (1971: 129, Fig. 46b) is not very evident.

In 1911, H. L. Clark (p. 47) mentions for *O. kinbergi* the "middle arm spine... the *shortest* at tip of arm." In the larger Tuamotu specimen this feature is sometimes evident, or the middle spine may be as long as the others; in the smaller specimen only one broken ray is present with distal segments and here the middle spine is often the shortest.

Matsumoto (1917: 268, Fig. 73b) reported that for *O. kinbergi* the oral shields "are wider within than without." Yet both Lyman (1882, Pl. IV, fig. 7) and A. M. Clark and Rowe (1971: 129, Fig. 46a) show the oral shields wider without than within, a condition which is shared by the two Rangiroa specimens.

I compared the Tuamotu specimens with a 6 mm specimen from Keehi Lagoon, Oahu, taken at a depth of 42-58 fathoms (BPBM No. W 1610). The Hawaiian specimen agrees well with the figures in A. M. Clark and Rowe (1971) for *O. kinbergi*, and there are no major differences between it and the Tuamotu specimens. In the eastern Indo-Pacific, *O. kinbergi* has been reported from the Hawaiian Islands (A. H. Clark, 1949) at depths from 29 to 298 m on white sand, coral and/or broken shell and rocky bottom. A specimen was also reported by

A. H. Clark (1952) from Rongelap Atoll lagoon in the Marshall Islands. The two specimens from Rangiroa lagoon are the first reported from Southeastern Polynesia.

ACKNOWLEDGEMENTS

The National Geographic Society which sponsored and supported the expeditions in 1967 and 1970-71, and the governments of French Polynesia and the Cook Islands made our visits to their areas most pleasant and successful. I am especially grateful to Drs. Barry Wilson, Western Australian Museum, Harald A. Rehder, Smithsonian Institution, and Tom Richert, Honolulu, for collecting during the 1967 "Pele" cruise. Dr. John E. Randall added to the collections of ophiuroids during his ichthyological pursuits in 1970-71. Crew members of both expeditions contributed their time as diving assistants and collectors. Individuals responsible for collection of specimens have their names listed as initials in the Appendix for appropriate collecting stations. I wish to thank the New Zealand branch of UNESCO and the Royal Society of New Zealand for the opportunity to present biogeographical data during the International Symposium on the Oceanography of the South Pacific at Wellington in February, 1972. Mr. D. G. McKnight and other staff members of the New Zealand Oceanographic Institute were very helpful in reviewing this paper during its preparation as well as being gracious hosts during my visit to New Zealand.

REFERENCES

- Balinsky, J. B. 1957. The Ophiuroidea of Inhaca Island. *Ann. Natal Mus.* 14(1):1-35.
- Benham, W. B. 1911. Stellerids and Echinids from the Kermadec Islands. *Trans. Proc. N. Z. Inst.* 43:140-163.
- Brock, J. 1888. Die Ophuiridenfauna des indischen Archipels. *Z. Wiss. Zool.* 47:465-539.
- Burfield, S. T. 1924. A new species and a new variety of Ophiuroid with notes on a collection of the Ophiuroidea from the Sudanese Red Sea. *Ann. Mag. Nat. Hist., Series 9*, 13:144-154, 2 figs.
- Cherbonnier, G., and A. Guille. 1972. Redescription et position systematique de l'Ophiure *Ophiosphaera insignis* Brock (Echinoderme). *Bull. Mus. National d'Hist. Nat. (Zool.)* 24 ser. 3, No. 30:279-282, 1 fig.
- Chevalier, J. P., M. Denizot, J. L. Mongin, Y. Plessis, and B. Salvat. 1968. Étude géomorphologique et bionomique de l'Atoll de Mururoa (Tuamotu). *Cahiers du Pacifique* 12:1-144, pls. 1-24.
- Clark, A. H. 1939. Echinoderms (other than Holothurians) collected on the Presidential Cruise of 1938. *Smithson. Misc. Coll.* 98(11):1-18.
- . 1941. A new brittlestar of the genus *Ophiocomella* from Canton Island. *J. Wash. Acad. Sci.* 31(11):481-483.
- . 1949. Ophiuroidea of the Hawaiian Islands. *Bull. Bernice P. Bishop Mus.* 195:1-133.
- . 1950. Echinoderms from the Cocos-Keeling Islands. *Bull. Raffles Mus.* 22:53-67. 1 pl.
- . 1952. Echinoderms from the Marshall Islands. *Proc. U.S. Natl. Mus.* 102:265-303.
- . 1954. Records of Indopacific Echinoderms. *Pac. Sci.* 8(3):243-263.

- Clark, A. M. 1952. The "Manihine" Expedition to the Gulf of Aquaba. 1948-1949. VII. Echinodermata. Bull. Br. Mus. (Nat. Hist.) Zool. 1:203-214, 2 pls.
- . 1953. A revision of the genus *Ophionereis* (Echinodermata, Ophiuroidea). Proc. Zool. Soc. (London) 123(1):65-94, 12 figs., 3 pls.
- . 1966. Notes on the family Ophiotrichidae (Ophiuroidea). Ann. Mag. Nat. Hist., Series 13, 9:637-655, 1 fig., 2 pls.
- . 1967a. Echinoderms from the Red Sea. Part 2. (Crinoids, Ophiuroids, Echinoids, and more Asteroids.) Sea Fish. Res. Stn. Haifa Bull. 41:26-58, 5 figs.
- . 1967b. Variable symmetry in fissiparous Asterozoa. In N. Millott (Editor), Echinoderm Biology. Symp. Zool. Soc. Lond. 20:143-157, 1 fig.
- . 1968. Notes on some tropical Indo-Pacific Ophiotrichids and Ophiodermatids (Ophiuroidea). Bull. Br. Mus. (Nat. Hist.) Zool. 16:277-322, 10 figs., 1 pl.
- . 1970. Notes on the family Amphiuroidae (Ophiuroidea). Bull. Br. Mus. (Nat. Hist.) Zool. 19:1-81, 11 figs.
- Clark, A. M., and F. W. E. Rowe. 1971. Shallow water Indo-West Pacific Echinoderms, pub. British Museum (Nat. Hist.). 234 p., 100 figs., 31 pls.
- Clark, H. L. 1909. Notes on some Australian and Indo-Pacific Echinoderms. Bull. Mus. Comp. Zool. Harv. Univ. 52:107-135, 1 pl.
- . 1911. North Pacific Ophiurans in the collection of the United States National Museum. Proc. U.S. Natl. Mus. 75:1-302, 144 figs.
- . 1915. Catalogue of recent ophiurans. Mem. Mus. Comp. Zool. Harv. Univ. 25:165-376, 20 pls.
- . 1917. Report on the scientific results of the expedition to the tropical Pacific, in charge of A. Agassiz, on the U. S. Fish Commission Steamer 'Albatross', from Aug., 1899-Mar., 1900. XVIII. Report on the scientific results of the expedition to the East tropical Pacific in charge of A. Agassiz, by the U. S. Fish Commission Steamer 'Albatross', Oct., 1904-Mar., 1905. XXX. Ophiuroidea. Bull. Mus. Comp. Zool. Harv. Univ. 61:420-453, 5 pls.
- . 1918. Brittle-stars, new and old. Bull. Mus. Comp. Zool. Harv. Univ. 62:265-338, 8 pls.
- . 1921. The Echinoderm fauna of Torres Strait. Publs. Carnegie Instn. (Marine Biol.) 10:vi+223, 38 pls.
- . 1925. Echinoderms (other than sea-stars) of the tropical central Pacific. Bull. Bernice P. Bishop Mus. 27:89-112, 2 pls.
- . 1926. Notes on a collection of Echinoderms from the Australian Museum. Rec. Aust. Mus. 15:183-192, 1 fig.
- . 1932. Echinodermata (other than Asteroidea) of the Great Barrier Reef Expedition, 1928-1929. Scient. Rep. Gt. Barrier Reef Exped. 4:197-239, 9 figs., 1 pl.
- . 1938. Echinoderms from Australia. Mem. Mus. Comp. Zool. Harv. Univ. 55:viii+596, 63 figs., 28 pls.
- . 1939. Ophiuroidea. Scient. Rep. John Murray Exped. 6:29-136, 62 figs.
- . 1941. Reports of the scientific results of the Atlantic expeditions to the West Indies, under the joint auspices of the University of Havana and Harvard University. The Echinoderms (other than Holothurians). Mem. Soc. Cubana Hist. Nat. 15(1):1-154, pls. 1-10.
- . 1946. The Echinoderm Fauna of Australia. Publs. Carnegie Instn. 566:1-567.
- Delle Chiaje, S. 1828. Memorie sulla storia e notomia delgi animali senza vertebre del Regno di Napoli. Napoli 3:xx+231, pls. xxxi-xlix.
- Devaney, D. M. 1967. An ectocommensal polynoid associated with Indo-Pacific echinoderms, primarily ophiuroids. Occas. Papers B. P. Bishop Mus. 23:287-304, 5 figs.
- . 1970. Studies on Ophiocomid brittlestars. I. A new genus (*Clarkcoma*) of Ophio-

- cominae with a re-evaluation of the genus *Ophiocoma*. *Smithson. Contrib. Zool.* 51:1-41, figs. 1-50.
- . 1973. Zoogeography and faunal composition of Southeastern Polynesian asterozoan echinoderms. *In*, *Oceanography of the South Pacific, 1972*. Pub. by New Zealand branch of UNESCO, Wellington, p. 164-171.
- Djakonov, A. M. 1930. Echiniden, Ophiuriden und Asteriden gesammelt von Prof. P. J. Schmidt bei den Riu-Kiu Inseln im Jahre 1926-27. *Zool. Jb.* 59:233-252.
- Döderlein, L. 1896. Bericht über die von Herrn Prof. Semon bei Amboina und Thursday Island gesammelten Ophiuroidea. *In* Semon, *Zoologische Forschungsreisen in Australien und dem Malayischen Archipel*. *Denkschr. Med.-Naturwiss. Ges. Jena* 8:279-300, pls. 14-18.
- . 1898. Ueber einige epizoisch-lebende Ophiuroidea. *In* Semon, *Zoologische Forschungsreisen in Australien und dem Malayischen Archipel*. *Denkschr. Med.-Naturwiss. Ges. Jena* 8:483-488, 1 pl.
- Domantay, J. S., and C. R. Domantay. 1966. Studies on the classification of Philippine littoral Ophiuroidea (brittle stars). *Philipp. J. Sci.* 95:1-77, 7 figs., 2 pls.
- Duncan, P. M. 1887. On the Ophiuridae of the Mergui Archipelago, collected for the Trustees of the Indian Museum, Calcutta, by Dr. J. Anderson. *J. Linn. Soc. London Zool.* 21:85-106, figs. 28-40, pls. viii, ix and xi.
- Ely, C. A. 1942. Shallow water Asteroidea and Ophiuroidea of Hawaii. *Bull. Bernice P. Bishop Mus.* 176:1-163, 18 figs., 13 pls.
- Endean, R. 1957. The biogeography of Queensland's shallow water echinoderm fauna (excluding Crinoidea), with a re-arrangement of the faunistic provinces of tropical Australia. *Aust. J. Mar. Freshwater Res.* 8:233-273, 5 figs.
- Fell, H. B. 1960. Synoptic keys to the genera of Ophiuroidea. *Zool. Publ. Victoria Univ. Wellington* 26:1-44, 6 figs.
- . 1961. New genera and species of Ophiuroidea from Antarctica, *Trans. Roy. Soc. N. Z.* 88(4):839-841.
- . 1962. Revision of major genera of Amphiuroid Ophiuroidea. *Trans. Roy. Soc. N. Z. (Zool.)* 2(1):377-402.
- Grube, A. E. 1857. Diagnosen einiger neuen Echinodermen. *Arch. Naturgesch.* 1857:340-344.
- . 1860. Beschreibungen neuer oder weniger bekannter Seesterne und Seeigel. *Nova Acta Acad. Caesar. Leop. Carol.* 27:1-50, 3 pls.
- Hertz, M. 1927. Die Ophiuriden der deutschen Tiefsee-Expedition. I. *Wiss. Ergebn. dt. Tiefsee-Exped. "Valdivia"* 22(3):59-122, 7 figs., pls. 6-9.
- Koehler, R. 1897. Echinodermes recueillis par l'Investigateur dans l'Océan Indien. I. Les Ophiures de Mer Profonde. *Ann. Sci. Nat. Zool. Series* 8, 4:277-372.
- . 1898. Echinodermes recueillis par l'Investigateur dans l'Océan Indien. II. Les ophiures littorales. *Bull. Scient. Fr. Belg.* 31:55-124, pls. ii-v.
- . 1904. Ophiures nouvelles ou peu connues. *Mém. Soc. Zool. Fr.* 17:54-119, 98 figs.
- . 1905. Ophiures littorales. *Siboga Exped.* 45b:1-142, 18 pls.
- . 1907. Revision de la collection des ophiures du Muséum d'Histoire Naturelle de Paris. *Bull. Scient. Fr. Belg.* 41:279-351, pls. 10-14.
- . 1910. Astéries et ophiures des îles Aru et Kei. *Abh. Senckenb. Naturforsch. Ges.* 33:265-295, pls. 15-17.
- . 1922. Ophiurans of the Philippine Seas. *Bull. U. S. Natl. Mus.* 100(5):x+486, 103 pls.
- . 1927. Ophiures recueillis aux îles Gilbert, Marshall, et Fiji. *Göteborgs K. Vetensk. o. Vitterh-Samh. Handl.* 33(3):1-13, 1 pl.
- . 1930. Ophiures recueillis par le docteur Th. Mortensen dans les mers d'Australie et

- dans l'Archipel Malais. Vidensk. Meddr. Dansk Naturh. Foren. 89:1-295, 22 pls.
- Lamarck, J. B. P. A. de.** 1816. Histoire naturelle des animaux sans vertèbres, Paris. Ed. I. 2:522-568 (Stellerides).
- Ljungman, A.** 1867a. Ophiuroidea viventia hue usque cognita enumerat. Öfvers. K. Vetensk. Akad. Förh. 1866(9):303-336.
- . 1867b. Om nagra nya arter af Ophiurider. Öfvers. K. Vetensk. Akad. Förh. 1866(6):163-166.
- Loriol, P. de.** 1893a. Catalogue raisonné des Echinodermes recueillis par M. V. de Robillard à l'Île Maurice. III. Ophiurides et Astrophytides. Mem. Soc. Phys. Hist. Nat. Genève 32(3):1-63, pls. 23-25.
- . 1893b. Echinodermes de la Baie d'Amboine. Revue Suisse Zool. 1:359-426, pls. xiii-xv.
- . 1899. Notes pour servir à l'étude des Echinodermes. VII. Mem. Soc. Phys. Hist. Nat. Genève 33(2):1-34, pls. 1-3.
- Lütken, C. F.** 1859. Additamenta ad historiam Ophiuridarum. Beskrivelser af nye eller hidtil kun ufuldstændigt kjendte Arter af Slangestjerner. Anden Afdeling, K. danske Vidensk. Selsk. Skr., Series 5, 5:177-271.
- . 1869. Additamenta ad historiam Ophiuridarum. Beskrivende og kritiske Bidrag til kundskab om Slangestjerner. Tredie Afdeling. K. Danske Vidensk. Selsk. Skr., Series 5, 8:24-109, 3 figs.
- Lyman, T.** 1860. Descriptions of new Ophiuridae belonging to the Smithsonian Institution and to the Museum of Comparative Zoology at Cambridge. Proc. Boston Soc. Nat. Hist. 7:193-204.
- . 1861. Descriptions of new Ophiuridae. Proc. Boston Soc. Nat. Hist. 8:75-86.
- . 1865. Ophiuridae and Astrophytidae. Mem. Mus. Comp. Zool. Harv. Univ. 1:vi+200, 18 figs., 2 pls.
- . 1869. In L. F. de Pourtalès, Preliminary report on the Ophiuridae and Astrophytidae dredged in deep water between Cuba and the Florida reef... Bull. Mus. Comp. Zool. Harv. Univ. 1(10):309-354.
- . 1874. Ophiuridae and Astrophytidae new and old. Bull. Mus. Comp. Zool. Harv. Univ. 3(10):221-272.
- . 1882. Report on the Ophiuroidea dredged by H. M. S. Challenger, 1873-1879. Challenger Repts. Zool. 5(4):1-386, 48 pls.
- Macnae, W., and M. Kalk.** 1962. The fauna and flora of sand flats at Inhaca Island, Mocambique. J. Anim. Ecol. 31:93-128, 5 figs.
- Magnus, D. E. B.** 1962. Über das "Abwieden" der Flutwasser-oberfläche durch den Schlangenstein *Ophiocoma scolopendrina* (Lamarck). Verh. Dtsch. Zool. Ges. Wien 45:471-481.
- . 1964. Gezeitenströmung und Nahrungsfiltration bei Ophiuren und Crinoiden. Helgolaender Wiss. Meeresunters. 10(1-4):104-117.
- Marktanner-Turneretscher, G.** 1887. Beschreibung neuer Ophiuriden und Bemerkungen zu Bekannten. Ann. Naturh. Mus. Wien 2:291-316, pls. 12, 13.
- Martens, E. von.** 1867. Ueber ostasiatische Echinodermen. Fortsetzung. Arch. Naturgesch. 33:106-119, pl. iii.
- . 1870. Die Ophiuriden des indischen Oceans. Arch. Naturgesch. 36:245-262.
- Matsumoto, H.** 1917. A monograph of Japanese Ophiuroidea arranged according to a new classification. J. Coll. Sci. Imperial Univ. Tokyo 38:1-408, 100 figs., 7 pls.
- McKnight, D. G.** 1972. Echinoderms collected by the Cook Islands Eclipse Expedition. New Zealand Oceano. Instit. Rec. 1(3):37-45.
- Mortensen, T.** 1924. Echinoderms of New Zealand and the Auckland-Campbell Islands. II. Ophiuroidea. Vidensk. Meddr. Dansk Naturh. Foren. 77:91-177, pls. 3, 4.

- . 1933. Biological observations on ophiurids, with descriptions of two new genera and four species. Vidensk. Meddr. Dansk Naturh. Foren. 93:171-194, 7 figs., pl. 7.
- . 1940. Echinoderms from the Iranian Gulf. Asteroidea, Ophiuroidea and Echinoidea. Dan. Scient. Invest. Iran., Part 2:55-110, 14 figs., 2 pls.
- . 1948a. Report on the Echinoidea of the Murray Expedition. II. Irregular Echinoidea. Scient. Rep. John Murray Exped. 9:1-15, 1 pl.
- . 1948b. Monograph of the Echinoidea. IV (2). Clypeastroidea. Copenhagen. 1-471, 256 figs., 72 pls.
- Murakami, S.** 1942. Ophiurans of Izu, Japan. J. Dept. Agric. Kyushu Imperial Univ. 7(1):1-36, 12 figs.
- . 1943a. Report on the Ophiurans of Palau, Caroline Islands. J. Dept. Agric. Kyushu Imperial Univ. 7(4):159-204.
- . 1943b. Report on the Ophiurans of Yaeyama, Ryukyu. J. Dept. Agric. Kyushu Imperial Univ. 7(5):205-219.
- . 1963. The dental and oral plates of Ophiuroidea. Trans. Roy. Soc. N. Z. 4(1):1-48, 7 pls.
- Müller, J., and F. H. Troschel.** 1842. System der Asteriden, Braunschweig: xx+134 pp., 12 pls.
- Parslow, R. E., and A. M. Clark.** 1963. Ophiuroidea of the Lesser Antilles. Stud. Fauna Curacao Caribb. Ids. 15:24-50.
- Peters, W.** 1851. Übersicht der von ihm an der Küste von Mossambique eingesammelten Ophiuren, unter denen sich zwei neue Gattungen befinden. Bericht K. Preuss. Akad. Wiss. 1851:463-466.
- Sachet, M. H.** 1962. Monographie Physique et Biologique de L'Île Clipperton. Ann. l'Inst. Oceanog., n.s., 40(1):1-107.
- Schoener, A.** 1967. Two new species of *Amphitarsus* (Ophiuroidea) from the western North Atlantic. Breviora, No. 269:1-9, figs. 1-3.
- Smith, E. A.** 1876. Descriptions of two new species of *Ophiocoma*. Ann. Mag. Nat. Hist., Series 4, 18(1):39-40.
- Studer, T.** 1882. Übersicht über die Ophiuriden, welche während der Reise S.M.S. "Gazelle" um die Erde 1874-76 gesammelten wurden. Abh. K. Preuss. Akad. Wiss. 1882:1-37, 3 pls.
- Thomas, L. P.** 1966. A revision of the tropical American species of *Amphipholis* (Echinodermata: Ophiuroidea). Bull. Mar. Sci. Gulf Caribb. 16:827-833.
- . 1967. The systematic position of *Amphilimna* (Echinodermata; Ophiuroidea). Proc. Biol. Soc. Wash. 80:123-130, figs. 1-9.
- Thomas, L. P., and A. Schoener.** 1972. Growth changes in *Amphilimna olivacea* (Lyman) and the systematic status of *Amphitarsus spinifer* Schoener. Breviora 387:1-9, figs. 1-2.
- Tokioka, T.** 1953. Invertebrate fauna of the intertidal zone of the Tokara Islands. V. Echinodermata. Publs. Seto Mar. Biol. Lab. 3:144-148, 3 figs., pl. 7.
- Verrill, A. E.** 1899. Report on the Ophiuroidea collected by the Bahama Expedition in 1893. Bull. Labs. Nat. Hist. Univ. Iowa 5(1):1-86, 8 pls.
- Walter, A.** 1885. Ceylons Echinodermen. Zeitschr. f. Naturwiss. Jena 18:365-384.