

# Deep-Sea Echinoderms of New Zealand

By

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## Abstract

A TOTAL of 91 archibenthal and abyssal species can now be recorded from New Zealand coastal seas, 42 of them not previously known from deep water, and 32 of them new to the fauna. Six families of asteroids are recorded for the first time from New Zealand—namely, Benthoplectinidae, Pterasteridae, Korethrasteridae, Solasteridae, Brisingidae and Zoroasteridae. Genera not previously recorded from New Zealand are: *Plutonaster*, *Dipsacaster*, *Benthopecten*, *Cheiraster*, *Anthenoides*, *Pseudarchaster*, *Hippasteria*, *Pteraster* (sub-genus *Apterodon*), *Peribolaster*, *Crossaster*, *Brisingenes*, *Zoroaster*, *Cosmasterias*, *Amphiodia*, *Ophiuraster*, *Ophiuroglypha*, *Paramaretia*; also *Aspidocidaris*, a sub-genus of *Goniocidaris*. The deep-water fauna includes species restricted to New Zealand as well as species occurring in the north Pacific, Hawaii, Indonesia, south-east Australia and the Southern Ocean (Indian Ocean and Antarctic). It is interpreted as a mingling of endemic and cosmopolitan elements, shelf-forms occasionally descending the continental slope, and abyssal forms occasionally reaching the shelf. Relatively steep submarine profiles facilitate the mingling of deep-water and shallow-water groups, and individual species tend to have a wide bathymetric range. An echinoid, *Pseudechinus flemingi* sp. nov., is recorded from both living and Pleistocene examples.

## INTRODUCTION AND ACKNOWLEDGMENTS

OFF Cape Palliser, where the Cook Strait shelf is barely two miles broad, the sea-floor drops over a thousand fathoms in the course of twelve miles' surface-sailing. Working over these waters, a deep-sea research team led by Professor L. R. Richardson and Mr. J. A. F. Garrick has succeeded in taking echinoderms and other animals from depths as great as 1,300 fathoms. These investigations are being supported by a research grant of the University of New Zealand. Other expeditions led by Mr. G. A. Knox, Dr. R. K. Dell, Dr. Elizabeth Batham, Mr. J. A. F. Garrick and Mr. J. C. Yaldwyn have obtained echinoderms from 100 to 400 fathoms at various stations on the New Zealand coast. General accounts of these expeditions have been given by Yaldwyn (1957) and Knox (1957). A survey of the echinoderm fauna beyond the continental shelf is given here, with diagnoses of new forms, more detailed accounts, with half-tone illustrations, being planned for subsequent publication. I wish to express my gratitude to the leaders and members of the various expeditions for the opportunity of studying their collections, and also to the institutions which gave the expeditions practical or financial support; these include the N.Z. Oceanographic Institute (D.S.I.R.), the Marine Department, the National Committee on Oceanography, the Portobello Marine Biological Station, and the Victoria University of Wellington. For their assistance in obtaining overseas publications I am greatly indebted to Miss M. Wood and Mrs. J. W. Brodie, of the Royal Society of New Zealand, and to the Library staff of Victoria University.

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## CHECKLIST OF NEW ZEALAND DEEP-SEA ECHINODERMS

Note: Species new to the fauna are given in bold-face type.

*Abyssal Species, 1,000 Fathoms or Deeper.*

Ophiuroidea	<i>Ophiozonella stellata</i> (Lyman)
<b>Ophiacantha levispina</b> Lyman	<i>Ophiocten hastatum</i> (Lyman)
<b>Ophiactis abyssicola</b> (M. Sars)	Holothuroidea
<i>Amphiophiura ornata</i> (Lyman)	<i>Enypiaster eximia</i> Théel
<i>Ophiomastus tegulitius</i> Lyman	

*Abyssal Species, 300-1,000 Fathoms*

Asteroidea	<b>Ophiuroglypha irrorata</b> (Lyman)
<i>Psilaster acuminatus</i> Sladen	<i>Ophiomisidium irene</i> Fell
<b>Plutonaster knoxi</b> sp. nov.	<i>Ophiomastus tegulitius</i> Lyman
<b>Benthopecten pentacanthus</b> sp. nov.	<b>Ophiomastus admiral</b> sp. nov.
<b>Cheiraster richardsoni</b> sp. nov.	<i>Ophiozonella stellata</i> (Lyman)
<b>Pseudarchaster garricki</b> sp. nov.	Echinoidea
<b>Pteraster (Apterodon) bathami</b> sp. nov.	<i>Goniocidaris umbraculum</i> Hutton
<b>Crossaster japonicus</b> (Fisher)	<i>Ogmocidaris benhami</i> Mortensen
Ophiuroidea	<i>Araeosoma thetidis</i> H. L. Clark
<i>Gorgonocephalus chilensis</i> (Philippi)	<i>Asthenosoma gracile</i> Agassiz
<i>Astrothamnus benhami</i> (Bell)	<b>Phormosoma bursarium</b> Agassiz
<i>Ophiocreas longipes</i> Mortensen	<i>Phormosoma rigidum</i> Agassiz
<i>Ophiomyxa brevissima</i> H. L. Clark	<b>Pseudechinus flemingi</b> sp. nov.
<b>Ophiacantha imago</b> Lyman	<b>Paramaretia multituberculata</b> Mortensen
<b>Ophiacantha yaldwyni</b> sp. nov.	<i>Spatangus multispinus</i> Mortensen
<b>Ophiacantha vepratrica</b> Lyman	<b>Brissopsis oldhami</b> Alcock
<i>Ophiacantha vilis</i> Mortensen	Holothuroidea
<b>Ophiactis abyssicola poa</b> Lyman	<i>Holothuria lactea</i> Théel
<i>Ophiactis abyssicola cuspidata</i> Lyman	<i>Ankyroderma marenzelleri</i> Théel
<b>Amphiura angularis</b> Lyman	<i>Pannychia moselyi</i> Théel
<i>Amphiura heraldica</i> Fell	<i>Trochostoma violaceum</i> Théel
<i>Amphiura norae</i> Benham	<i>Trochostoma albicans</i> Théel
<i>Amphiura hinemoae</i> Mortensen	Crinoidea
<b>Amphiodia destinata</b> Koehler	<i>Pentametrocrinus semperi</i> (P. H. Car-
<i>Amphipholis squamata</i> (Delle Chiaje)	penter)
<i>Ophiocoma bollonsi</i> Farquhar	<i>Thaumatometra alternata</i> (P. H. Car-
<i>Ophiura rugosa</i> (Lyman)	penter)

*Archibenthal Species, 100-300 Fathoms*

Asteroidea	Ophiuroidea
<i>Astropecten primigenius</i> Mortensen	<i>Astroporpa wilsoni</i> Bell
<i>Astropecten dubiosus</i> Mortensen	<i>Astrothorax waitei</i> (Bell)
<i>Psilaster acuminatus</i> Sladen	<i>Astroceras elegans</i> (Bell)
<i>Persephonaster neozelanicus</i> Mortensen	<i>Astrobrachion constrictum</i> (Farquhar)
<b>Dipsacaster magnificus</b> (H. L. Clark)	<b>Ophiacantha rosea</b> Lyman
<i>Luidia neozelanica</i> Mortensen	<b>Ophiacantha abyssicola otagoensis</b>
<i>Odontaster benhami</i> (Mortensen)	var. nov.
<i>Mediaster sladeni</i> Benham	<b>Ophiacantha vepratrica</b> Lyman
<b>Hippasteria trojana</b> sp. nov.	<i>Ophiacantha vilis</i> Mortensen
<b>Anthenoides granulosus</b> Fisher	<i>Ophiactis hirta</i> Lyman
<i>Pentagonaster pulchellus</i> Gray	<i>Ophiactis profundi novaezealandiae</i>
<i>Echinaster farquhari</i> Benham	Mortensen
<i>Henricia compacta</i> (Sladen)	<i>Ophiactis resiliens</i> Lyman
<b>Peribolaster lictor</b> sp. nov.	<i>Amphiura heraldica</i> Fell
<b>Crossaster japonicus</b> (Fisher)	<i>Amphiura norae</i> Benham
<b>Brisingenes delli</b> sp. nov.	<i>Amphiura pusilla</i> Farquhar
<b>Zoroaster spinulosus</b> Fisher	<i>Amphiura hinemoae</i> Mortensen
<i>Sclerasterias mollis</i> (Hutton)	<i>Amphiura aster</i> Farquhar
<b>Allostichaster insignis gymnoplax</b>	<i>Amphipholis squamata</i> (Delle Chiaje)
var. nov.	<i>Amphioplus longirima</i> Fell
<b>Cosmasterias dyscrita</b> H. L. Clark	<i>Ophiocentrus novaezealandiae</i> Gislén
	<i>Placophiothrix aristulata</i> (Lyman)
	<i>Ophiocoma bollonsi</i> Farquhar

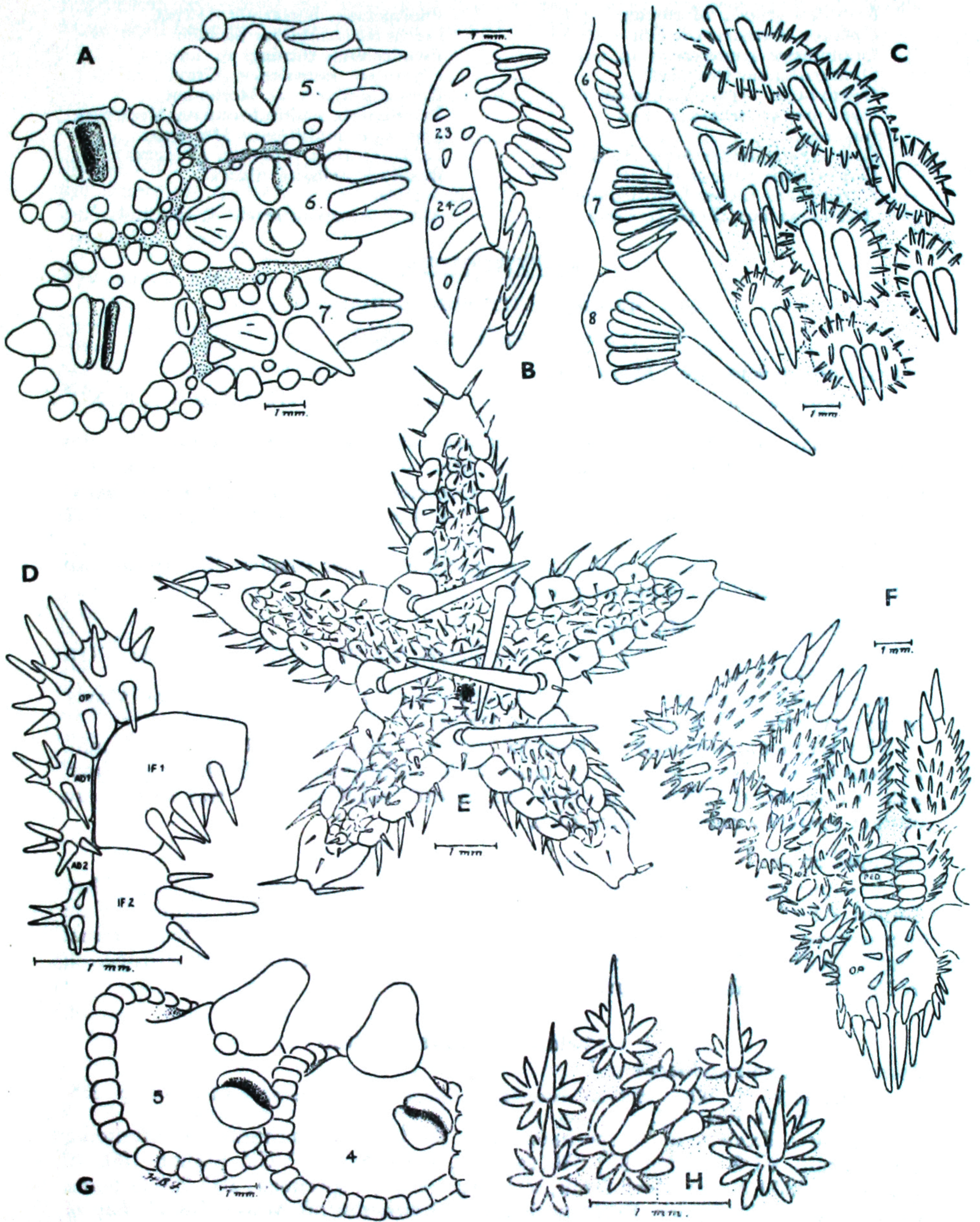


PLATE 1  
 A, G, *Hippasteria trojana* sp. nov.; A, adambulacrals 5 to 7 and associated structures; G, superomarginals 4 and 5. B, *Anthenoides granulosis* Fisher, adambulacrals 23 and 24, showing enlargement of subambulacral spines. C, *Plutonaster knoxi* sp. nov., adambulacrals 6 to 8, and adjoining structures. D, E, *Benthopecten pentacanthus* sp. nov.; D, oral, adambulacrals and inferomarginal plates; E, aboral aspect of holotype. F, H, *Cheiraster richardsoni* sp. nov.; F, oral, adambulacrals, intermediate and inferomarginal plates; H, four single and one double paxillar florets, with an abactinal pectinate pedicellaria.

*Pectinura gracilis* Mortensen  
*Ophiura chathamensis* Fell  
*Ophiuraster symmetricus* sp. nov.  
*Ophiomisidium irene* Fell  
*Ophiomastus tegulitius* Lyman  
*Ophiomastus stellamaris* Fell  
Echinoidea  
*Goniocidaris umbraculum* Hutton  
*Goniocidaris parasol* sp. nov.  
*Ogmocidaris benhami* Mortensen  
*Araeosoma thetidis* H. L. Clark

*Phormosoma bursarium* Agassiz  
*Pseudechinus huttoni* Benham  
*Pseudechinus flemingi* sp. nov.  
*Clypeaster australasiae* (Gray)  
*Peronella hinemoae* Mortensen  
*Paramaretia multituberculata* Mortensen  
*Spatangus multispinus* Mortensen  
*Echinocardium cordatum* (Pennant)  
*Brissopsis oldhami* Alcock  
Crinoidea  
*Argyrometra mortenseni* A. H. Clark

## ASTEROIDEA

### Family ASTROPECTINIDAE

#### *Astropecten* Gray, 1840

##### *Astropecten primigenius* Mortensen

Mortensen, Th. 1925. *Vid. Medd. dansk. naturh. For.*, 79, p. 272-4, Figs. 2-3, Pl. XII, Figs. 1-2.

MATERIAL EXAMINED: Six specimens, from the following stations—250-300 fathoms, Canyon B, off east Otago, Dom. Mus. Station B.S.191, 1 specimen; 150 fathoms, Cook Strait, VUZ Station 98, 2 specimens; 105 fathoms, Mernoo Bank, Station 1, Chatham Island Exped. 1954; 61 fathoms, Mernoo Bank, Station 2, 2 specimens.

Mortensen's type was from 30 fathoms (north of Cuvier Island). The species has not hitherto been taken from deep water.

##### *Astropecten dubiosus* Mortensen

Mortensen, Th. 1925. *Vid. Medd. dansk. naturh. For.*, 79, p. 269-72, Fig. 1, Plate XII, Figs. 3-4.

MATERIAL EXAMINED: 1 specimen taken by the *Alert*, 113-120 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.208.

The specimen resembles the holotype, but is a little larger, R40 mm, r 9 mm. It exhibits the same features as those which distinguished the holotype from *Astropecten imbellis* Sladen, so that Mortensen's belief that the two species are distinct seems to receive confirmation.

##### *Astropecten* sp.

A young individual R 6 mm from 400 fathoms, off Mayor Island, Dom. Mus. Station B.S. 210, is insufficiently developed for identification. The terminal plate carries three prominent spines, much more robust than any developed on the marginal plates. The record seems to imply the existence of one other species of *Astropecten* in New Zealand abyssal waters.

#### *Psilaster* Sladen, 1885

##### *Psilaster acuminatus* Sladen

Sladen, W. P., 1889. Rpt. on Asteroidea. *Challenger Sci. Rslts.*, Zoology, 30, p. 225, Pl. 40, Figs. 1-2.

MATERIAL EXAMINED: 32 specimens from the following localities: 430 fathoms, Cook Strait, VUZ Station 97; 380 fathoms, Cook Strait, VUZ Station 100, 10 specimens; 380 fathoms, Cook Strait, VUZ Station 96, 1 specimen; 200-250 fathoms, Cook Strait, VUZ Station 10, 1 specimen; 270 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.209, 1 specimen; 100-150 fathoms, Cook Strait, VUZ Station 15, 1 specimen; 113-120 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.208, 3 specimens; 124 fathoms, Bay of Plenty, NP Station 6, 13 specimens.

REMARKS: The species was originally taken by the *Challenger* at Station 167, in 150 fathoms, north-west of Stephen's Island, and also off eastern Australia in 950 fathoms, and off South Africa, depth not stated. It is present in the Chatham Islands.

Expedition collections, but from shelf stations only; other specimens from the Cook Strait shelf have previously been recorded (Fell, 1952, p. 6).

### *Plutonaster* Sladen, 1885

The genus, not previously recorded from New Zealand or Australia, is characterized as follows: Disc large, the intermediate actinal plates in several series, of which the innermost continue to about the middle of the arm. Marginals of both series well developed. Furrow spinelets forming a comb. No pedicellariae. Madreporite covered by paxillae.

*Plutonaster knoxi* sp. nov. Plate 1, Fig. C, holotype.

**DIAGNOSIS:** Each marginal plate of both series carries one prominent, robust spine, this spine being surrounded by small spiniform granules. Adambulacral armature comprising a furrow-comb of about 8 uniform spines, outside of which is a single large subambulacral spine. Actinal intermediate plates carrying 1-3 large spines, in addition to a general coating of small spinules.

**MATERIAL EXAMINED:** About 30 specimens (some of them greatly damaged) from the following localities: 330 fathoms, Station 41, Chatham Islands 1954 Expedition; 61 fathoms, Station 2, Mernoo Bank, Chatham Islands Expedition.

**REMARKS:** This notable addition to the New Zealand fauna is one of the interesting discoveries of the expedition in 1954 led by Mr. George Knox. The full description, with photographic half-tone illustrations, will appear in the official report of the Chatham Islands Expedition. As can be seen from the diagnosis, the species resembles the North Atlantic *Plutonaster bifrons* (Wyville Thomson) and, like it, is distinguished from other species of the genus by having only a single large spine on each marginal plate of both series. The adambulacral armature also resembles that of *P. bifrons*. The two species are distinguished, however, by the armature of the actinal intermediate plates. In *P. bifrons* the actinal intermediate plates carry in addition to minute spinules, a single large spine, whereas in *P. knoxi* there are from one to three large spines, these spines intergrading into the coating of spinules in the case of the distal intermediate plates.

**HOLOTYPE:** In the Canterbury Museum, R105 mm, r 33 mm.

### *Persephonaster* Alcock, 1891

*Persephonaster neozelanicus* Mortensen

Mortensen, Th. 1925. *Vid. Medd. dansk. naturh. For.*, 79, p. 415, Fig. 70.

**MATERIAL EXAMINED:** Five specimens from the following archibenthal stations—155 fathoms, Station 40, Chatham Islands 1954 Exped., 2 specimens; 150 fathoms, Cook Strait, VUZ Station 98, 2 specimens; 100 fathoms, Mernoo Bank, Station 1, Chatham Islands Expedition, 1 specimen.

**REMARKS:** The species is very common on the Cook Strait continental shelf, from 40 fathoms and deeper (see Fell, 1952), but has not hitherto been taken in deep water. It would appear to be a typical shelf species which occasionally lives on the upper fringe of the continental slope. It seems unlikely that the species will be found in the abyssal fauna.

### *Dipsacaster* Alcock, 1893

Although recorded from Australia (on the basis of a single individual) *Dipsacaster* has not hitherto been taken in New Zealand waters. The genus may be characterized briefly as follows: The margin of the ray defined by the inferomarginals, which project beyond the superomarginals. Actinal intermediate areas large, crossed by fasciolar grooves. No pedicellariae. Madreporite large, covered by paxillae.

**Dipsacaster magnificus** (H. L. Clark)

*Lonchotaster magnificus* Clark, H. L., 1916. *Endeavour* Rpt., p. 30, Pl. 6; *Dipsacaster magnificus* Fisher 1919. Bull. 100, U.S. Nat. Mus., 3, p. 150.

**MATERIAL EXAMINED:** 25 specimens taken by Mr. F. Abernethy, honorary collector to Victoria University Zoology Department, at a depth of 55–63 fathoms in Cook Strait, 10 miles E. by S. of Cape Campbell. Colour in life, salmon-pink above, marginals paler salmon, underside cream.

**REMARKS:** The holotype, hitherto unique, was taken by the *Endeavour* in the Great Australian Bight between 80–100 fathoms. The discovery of a relatively large population on the Cook Strait shelf, only a few miles from an area which had previously been trawled extensively, was a considerable surprise. Although *D. magnificus* has not yet been taken in deep water off New Zealand, it should probably be regarded as a deep water species, in view of its distribution. Like *Psilaster*, *Gorgonocephalus*, and other genera with a comparable range, it may well be an archibenthal type which occasionally ascends the slope to the continental shelf, provided the distance is not great.

**Family LUIDIIDAE*****Luidia* Forbes, 1839*****Luidia neozelanica* Mortensen**

Mortensen, Th. 1925. *Vid. Medd. dansk. naturh. For.*, 79, p. 278–81, Figs. 5–6, Pl. XII, Fig. 5.

**MATERIAL EXAMINED:** Seven specimens from archibenthal stations, as follows: 100–150 fathoms, Cook Strait, VUZ Station 15, 6 individuals (fragmentary); 124 fathoms, Hauraki Gulf, NP Station 6, fragments.

The species has also been taken from various shelf stations between Hauraki Gulf and east Marlborough at depths from 35 fathoms and below. In addition to the deeper station cited above, the *Ikatere* took it at Stations NP 8 (40–125 fathoms) and NP 9 (60–100 fathoms), both in the Bay of Plenty.

**Family BENTHOPECTINIDAE**

No representatives of this family have hitherto been recorded from New Zealand waters. The familial characters include alternation in the position of the superomarginal and inferomarginal plates, and the restriction of the papulae to definite areas ("papularia") at or near the bases of the arms. The tube feet have a small sucking disc. As the name suggests, the family is essentially a deep water group. The genera occurring in New Zealand waters may be distinguished as follows:

An unpaired interradial marginal plate present	.....	.....	.....	.....	<i>Benthopecten</i>
No unpaired interradial marginal plate	.....	.....	.....	.....	<i>Cheiraster</i>

***Benthopecten* Verrill, 1884**

***Benthopecten pentacanthus* sp. nov.** Plate 1, Figs. D, E (holotype).

**DIAGNOSIS:** Superomarginals each carrying two spines, one of which is enormously enlarged on each of the five unpaired interradial superomarginal plates. Abactinal intermediate plates each carrying one, or occasionally two similar, spinules. Inferomarginals each carrying one erect spine, plus one or two secondary spinules. The unpaired inferomarginal carrying three larger and two smaller spines. Adambulacral armature of three furrow spines and two subambulacral spines. Oral plates each with four furrow spines, the median one enlarged, plus two suboral spines.

**MATERIAL EXAMINED:** Two specimens, both from the same locality, depth 400 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.210, 28/2/1957, R. K. Dell.

**REMARKS:** Both specimens are juvenile forms, as evidenced by their smaller size, and the fact that neither pedicellariae nor actinal intermediate plates are developed. *Benthopecten styracius* Fisher, from Macassar Strait, would seem to be the species most closely related, and differences in the number of furrow spines (7–8 in *B. styracius*) and in the oral armature, could well be due merely to immaturity of the New Zealand material. However, Fisher expressly draws attention to the fact that *B. styracius* has only one spine on each superomarginal, whereas *B. pentacanthus*, despite its immaturity, already has two. Again, in *styracius* there are two inferomarginal spines, of which the uppermost is the longer, whereas in *pentacanthus* there are usually three inferomarginal spines, the lowermost being the largest. Another Pacific species, *Benthopecten polyctenius* Fisher, is somewhat similar, but lacks the five giant spines of the unpaired superomarginals.

**HOLOTYPE:** In the Dominion Museum, Wellington. R 5 mm, r 2 mm.

### *Cheiraster* Studer, 1883

*Cheiraster richardsoni* sp. nov. Plate 1, Figs. F, H, holotype.

**DIAGNOSIS:** Abactinal paxillae of both disc and arms having an enlarged central spine. Enlarged subcircular pectinate pedicellariae present on the abactinal surface, on the actinal intermediate areas, and occasionally also on the interbrachial marginal angle.

**DESCRIPTION:** Abactinal paxillae of disc and arms comprising 8–15 short spinules surrounding the central, enlarged vertical spine, in either a single or a double circle. Several enlarged pectinate pedicellariae on the abactinal surface of the disc (in the holotype there are three). Superomarginal plates forming a conspicuous border, each one broader than long, bearing a dense coat of erect spinules, and the interbrachial ones carry in addition a small erect spine occasionally. In the holotype there are 32 superomarginals in an interbrachial arc. from arm-tip to arm-tip. Inferomarginals broader than long proximally, but becoming longer than broad in the distal part of the arm. The proximal ones carry two (occasionally one or three) erect spines, on the outer surface, as well as the coating of erect spinules.

Actinal intermediate areas small, in the holotype not extending beyond the fourth adambulacral and second inferomarginal. Each intermediate plate bears one enlarged and several small spinules, except for the two interradiial plates, which instead each carry five finger-like spines forming the comb of the pectinate pedicellaria. Adambulacral plates with a furrow prominence, bearing 6–8 furrow spines and 5–6 similar spines on the outer margin, together with one enlarged subambulacral spine. Oral plates each carrying about 9 furrow spines, the inner three much enlarged, especially the innermost one. The four suboral spines form a linear series on the actinal surface of the plate, the proximal one enlarged.

**MATERIAL EXAMINED:** The unique holotype, from 400 fathoms, Cook Strait, VUZ Station 87.

**REMARKS.** *Cheiraster richardsoni* falls in Fisher's grouping of species with an enlarged central paxillar spine, present on both disc and rays. From *C. niasicus* Ludwig it is distinguished by having pectinate pedicellariae on the abactinal surface, and from *C. pilosus* Alcock it differs still more, since there are apparently no pedicellariae at all in that species (see Fisher, 1919, p. 195). From *C. inops* it differs by having paxillae as numerous on the disc as on the arms, and by possessing pedicellariae. One other species, *C. trullipes* (Sladen) is comparable, as it has large subcircular actinal intermediate pectinate pedicellariae—however, *C. trullipes* falls in the grouping of species which lack the enlarged central paxillar spine.

**HOLOTYPE:** In the Department of Zoology, Victoria University of Wellington. R 31 mm, r 9 mm.

### Family ODONTASTERIDAE

#### *Odontaster* Verrill, 1880

*Odontaster benhami* (Mortensen)

*Peridontaster benhami* Mortensen, Th. 1925. *Vid. Medd. dansk. naturh. For.* 79, p. 288–91, Fig. 8, Pl. XII, 12–13. *Peridontaster benhami*, Fell, H.B. *Zoo. Pubs.* V.U.C. 18, p. 7, 1952.

**MATERIAL EXAMINED:** Twelve individuals from archibenthal stations, as follows: 250–300 fathoms, Canyon B, off east Otago, Dom. Mus. Station B.S. 191, 8 specimens; 250–300, Cook Strait, VUZ Station 22, 1 specimen; 150 fathoms, Cook Strait, VUZ Stations 98 (2 juvenile specimens) and 99 (1 juvenile.)

**REMARKS:** Other material seen includes 7 specimens from VUZ Station 55, on the Cook Strait shelf, 40–100 fathoms. Mortensen's holotype was taken from 20 fathoms in Foveaux Strait, and the species has otherwise been reported once, namely from 40 fathoms off east Canterbury (Fell, 1952, p. 7).

As Fisher (1940) was led to conclude that *Peridontaster* Koehler is a synonym of *Odontaster* Verrill the nomenclature of the species is here amended accordingly.

### Family GONIASTERIDAE

Until now three genera of Goniasteridae have been recorded from New Zealand waters, namely *Mediaster*, *Pentagonaster* and *Nectria*. Three more genera can now be added to the fauna, namely *Pseudarchaster*, *Hippasteria* and *Anthenoides*. In view of this major change in the representation of Goniasteridae the following key to the genera may be useful.

1. Body covered by a membrane which obscures the outlines of the underlying plates and granules; inferomarginals projecting beyond the superomarginals	.....	.....	.....	.....	.....	.....	.....	<i>Anthenoides</i>	
Body not covered by a membrane which obscures the plates below; both marginal series similar	.....	.....	.....	.....	.....	.....	.....		2
2. Paxillae on the abactinal surface	.....	.....	.....	.....	.....	.....	.....		3
No abactinal paxillae	.....	.....	.....	.....	.....	.....	.....		5
3. Abactinal plates with an elevated tabula, crowned with enlarged granules	.....	.....	.....	.....	.....	.....	.....	<i>Nectria</i>	
Abactinal plates with unspecialized paxillae	.....	.....	.....	.....	.....	.....	.....		4
4. An unpaired (but not recurved) median tooth to each pair of mouth-plates	.....	.....	.....	.....	.....	.....	.....	<i>Pseudarchaster</i>	
No median unpaired tooth	.....	.....	.....	.....	.....	.....	.....	<i>Mediaster</i>	
5. No abactinal or marginal spines; terminal marginal plates enlarged	.....	.....	.....	.....	.....	.....	.....	<i>Pentagonaster</i>	
Abactinal and marginal spines present; terminal marginal plates not enlarged	.....	.....	.....	.....	.....	.....	.....	<i>Hippasteria</i>	

### *Pseudarchaster* Sladen, 1885

Abactinal plates paxilliform, extending far along the arm in several series, usually more than one series reaching the terminal plate. An unpaired median but not recurved tooth common to each pair of oral plates. Adambulacral armature comprising a palmate group of furrow-spines and a co-ordinate group of subambulacrals. Numerous actinal intermediate plates. Marginal plates thick, robust, paired, with fasciolar grooves between them.

*Pseudarchaster*, though widely distributed, has not hitherto been discovered in New Zealand or Australia ("*Pseudarchaster*" *boardmani* Livingstone, of New South Wales, must be referred to *Mediaster*, as H. L. Clark (1946) has already shown). One deep-water species can be recorded from Cook Strait, and, by an unusual coincidence, a second sublittoral species has become known at the same time from the same area. For the sake of clarity both species will be diagnosed here, though only one of them is so far known from below the continental shelf.

Superomarginals, inferomarginals and actinal intermediate plates bearing granules, without enlarged spinules. Abyssal	.....	.....	<i>P. garricki</i>
Superomarginal plates bearing granules, but inferomarginal and actinal plates bearing both granules and coarse spines. Sublittoral	.....	.....	<i>P. abernethyi</i>

*Pseudarchaster garricki* sp. nov. Plate 3, Figs. G, K, holotype.

**DESCRIPTION:** Abactinal paxillae in crowded hexagonal or polygonal groups, largest on the disc, comprising usually about 7 polygonal granules closely arranged around a central polygonal granule, and with small angular grains filling in the outer margins of the paxilla.



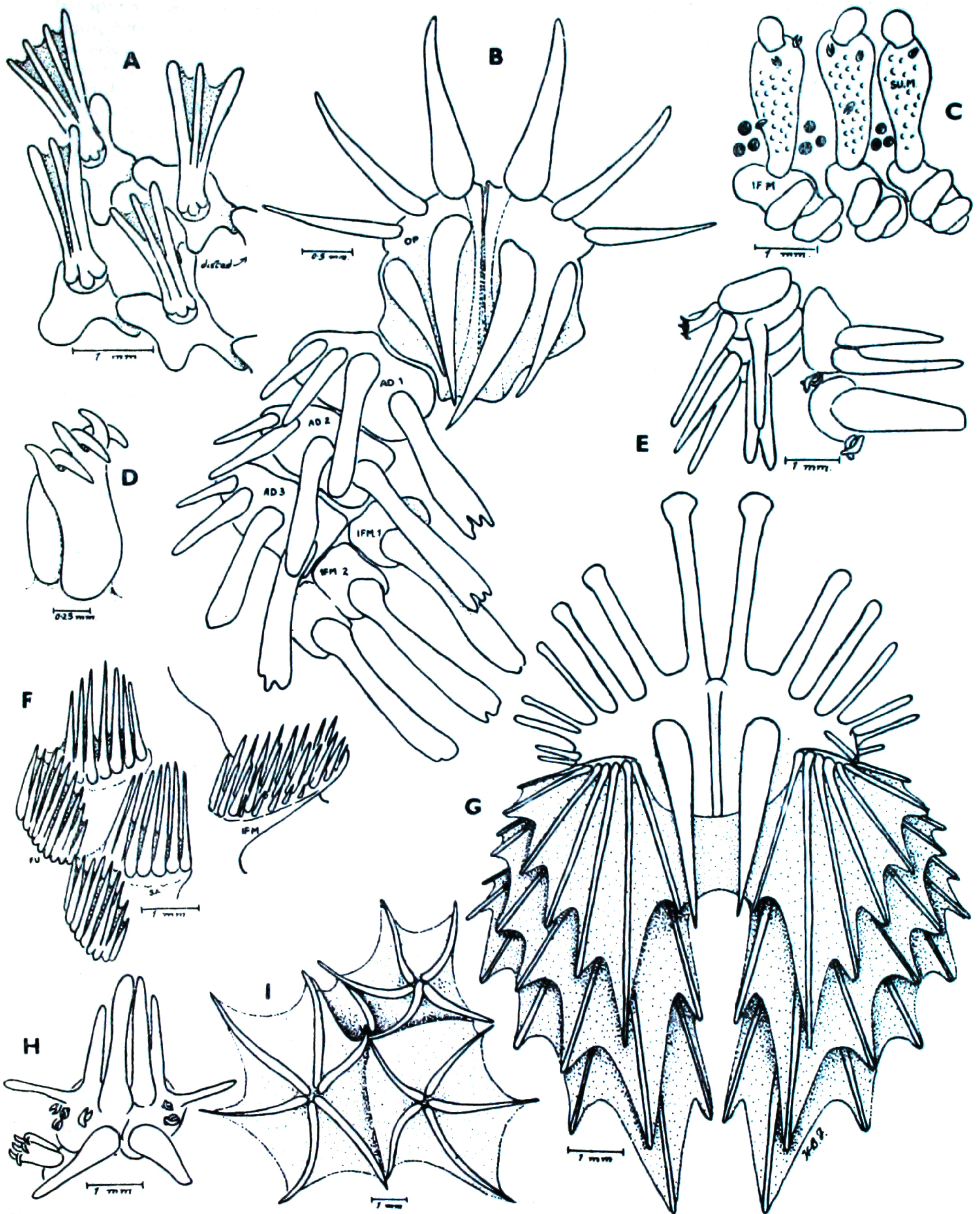


PLATE 2

A, B, *Peribolaster lictor* sp. nov.; A, abactinal skeleton and armature, midway along arm of holotype; B, oral, adambulacral and inferomarginal plates. C, *Allostichaster insignis* var. *gymnoplax* var. nov., superomarginal and inferomarginal plates. D, E, H, *Cosmasterias dyscrita* H. L. Clark; D, unguiculate (felipedal) pedicellaria from oral plate; E, adambulacral and actinolateral plates and their armature; H, oral plate, oriented so that the distal suboral spines are lowermost. F, *Crossaster japonicus* (Fisher), adambulacral plates and one inferomarginal, showing armature. G, I, *Pteraster (Apterodon) bathami* sp. nov.; G, oral plates and first three adambulacral wings, showing armature; I, paxillar spinules and webs of aboral surface.

Marginals broad and short, the proximal ones about four times as broad as long. About 40 marginals from the interradius to an arm-tip. Both supermarginals and inferomarginals covered in a uniform, dense granulation of more or less hexagonal granules. No scales or spinules on any of the marginals. Adambulacral plates with an armature of 5 or 6 truncate, compressed furrow-spines, and 7 or 8 truncate subambulacral spines, similar to the furrow spines, but not compressed. Distad to these is another line of finer spines, 4-5 in number. These form a postadambulacral fasciole, in conjunction with a still finer series of spines carried on the proximal margin of the proximal intermediate plate. The intermediate plates otherwise bear only granules, with no enlarged spines.

**MATERIAL EXAMINED:** Only the holotype, which is from 550 fathoms in Cook Strait, VUZ Station 101.

**REMARKS:** *P. garricki* is apparently distinguished from all other species of *Pseudarchaster* by the complete absence of spines or spinules from the uniformly granulated marginals and actinal intermediate plates.

**HOLOTYPE:** In the Department of Zoology, Victoria University of Wellington. R 82 mm, r 26 mm. Rays 5. Colour in life, orange above, cream below.

*Pseudarchaster abernethyi* sp. nov. Plate 3, Figs. I, J, holotype.

**DESCRIPTION:** Abactinal paxillae in crowded hexagonal or polygonal groups, largest on the disc, tending to become transversely rectangular at the bases of the arms. On the disc the paxilla comprises usually about 30 granules, the central ones more markedly polygonal than the outer ones, which tend to be rounded, and are packed less tightly. Marginals broad and short, the proximal ones about three times as broad as long. About 42 marginals from the interradius to the arm-tip. The supermarginals covered in a rather fine, more or less uniform granulation, somewhat coarser toward the outer edge, and with the fascioles between the plates formed by finer granules in linear series. The inferomarginals densely covered in a scaly granulation, with occasional lanceolate, flattened spines directed distally from short stalks. Adambulacral plates with an armature of 3-6 (usually 4 or 5) cylindrical truncate furrow-spines, and about 12-16 truncate, cylindrical or compressed subambulacral spines; one of the subambulacral spines is usually much expanded into a flattened, or bifurcate, or sometimes lanceolate spine. Postambulacral fascioles indistinct. Intermediate plates armed with irregular granules, spines and occasional enlarged lanceolate spines, the borders defined by delicate spinules, arranged too irregularly to form obvious fascioles.

**MATERIAL EXAMINED:** Fourteen specimens, including the holotype, from 55-63 fathoms, 10 miles E. by S. of Cape Campbell, March, 1957. Coll. F. Abernethy.

**REMARKS:** From *P. garricki* this species is easily distinguished by the spines on the inferomarginal and actinal plates. *P. abernethyi* does present some close parallels to some other species, however. In particular it appears to fall close to *P. parelii* (Düben & Koren), a circumpolar north Pacific and north Atlantic species. To judge by Fisher's (1911) account, *P. parelii* has smaller paxillae, since the larger ones described by him have only half the number of granules found in *P. abernethyi*; this difference is further confirmed by Plate 31 in Fisher's book, a photographic plate which is clear enough to enable the granules in the paxillae to be counted. The material of *P. abernethyi* at my disposal shows considerable variation, especially as regards the adambulacral and actinal intermediate armature, but all specimens agree in having the larger type of paxilla which is present in the holotype. I therefore regard this as a primary diagnostic character. *Pseudarchaster discus* Sladen, from the Magellanic area, also invites comparison, but here again the paxillae are even smaller, having only "about a dozen" polygonal granules, according to Sladen (1889, p. 111). From *P. dissonus* Fisher the absence of bivalved postadambulacral pedicellariae provides a distinguishing feature, and the furrow-spines of *P. dissonus* are sharp, not truncate.

**HOLOTYPE** In the Department of Zoology, Victoria University of Wellington. R 110 mm, r 32 mm. Rays five. Colour in life, orange above, the actinal surface cream.

### *Mediaster* Stimpson, 1857

#### *Mediaster sladeni* Benham

Benham, W. B., 1909. *Rec. Cant. Mus.* 1 (2), p. 94-7, Pl. VII.

**MATERIAL EXAMINED:** Thirteen specimens from the following archibenthal stations: 250-300 fathoms, Canyon B, off east Otago, Dom. Mus. Station B.S. 191,

2 specimens; 125 fathoms, Chatham Rise, Station 51 of the Chatham Islands 1954 Expedition, 11 specimens.

The species is known also from the Cook Strait shelf as a somewhat rare form at depths greater than 40 fathoms. Benham's holotype was a unique specimen from 25–30 fathoms off Oamaru, and apparently the species has not been recorded from any other locality till now. The Chatham Rise material presents some considerable variation in form, and this will be illustrated photographically in the official report of the Chatham Islands Expedition.

### *Hippasteria* Gray, 1840

*Hippasteria trojana* sp. nov. Plate 1, Figs. A, G, holotype.

**DIAGNOSIS:** Large pentagonal body, defined by conspicuous, naked marginal plates, each of which carries one prominent conical spine, 35 or 36 marginals in the entire interbranchial arc from arm-tip to arm-tip. There may be one or two large bivalved pedicellariae on the more proximal supermarginals and inferomarginals, and exceptionally there may be two subequal spines instead of one. The abactinal plates carry a single erect conical spine or a large bivalved pedicellaria, and they are surrounded by smaller platelets or granules. Actinal area large, with numerous large bivalved pedicellariae, each surrounded by a circle of granules. The pedicellariae form a row parallel to each furrow margin, on the adjoining intermediate plates. Adambulacral armature comprising 3 robust furrow-spines, which are flattened distally, and 1 to 3 robust, erect subambulacral spines, the number depending upon the size of the adambulacral pedicellariae. Typical patterns are illustrated in Fig. A, which shows the 5th to 7th adambulacral plates of a ray of the holotype.

**MATERIAL EXAMINED:** The unique holotype, taken at a depth of 220 fathoms on the Chatham Rise, at Station 6 of the Chatham Islands 1954 Expedition. The full description and photographic figures of this species will be given in the official report of that expedition.

**REMARKS:** *H. trojana* resembles *H. spinosa armata* Fisher in having naked marginals armed with 1 or 2 spines and pedicellariae, but differs in having 3 furrow-spines (as against a single one in *H. spinosa armata*), and 1–3 subambulacral spines (as against 1 only). From *H. heathi* and *H. falklandica*, both described by Fisher, the New Zealand form is at once distinguished by the marginal plates, which are inconspicuous and granulated in the two species named, and carry up to 5 spines. The species to which *H. trojana* appears most closely related is the one which is most remotely situated, in the Atlantic Ocean—namely, *H. phrygiana* (Parelius). Both species have conspicuous, naked marginals; *H. phrygiana* 2–3 furrow-spines, not unlike the condition in *H. trojana*. However, a specimen of *H. phrygiana* in my collection can be distinguished by its blunt, cylindrical furrow-spines, which are not at all flattened distally. *H. phrygiana* also tends to have more than one spine on each marginal plate, whereas this is exceptional in *trojana*. A still more striking difference is the complete absence of pedicellariae from the marginals in *H. phrygiana*. It does seem evident, though surprising, that the New Zealand species is closer to the Atlantic species than to the Pacific or Magellanic ones, and it may appropriately take the specific name *trojana*, the Phrygians and Trojans having been close allies (Iliad, Bk. 2).

Although no living species of *Hippasteria* has hitherto been recorded from Australia or New Zealand, it is relevant to note that a fossil form, *Hippasteria antiqua* Fell, was described from upper Cretaceous sediments in Canterbury (Fell, 1956), only 600 miles west of the position in which the living species has been found. *Hippasteria antiqua* carries a single robust conical spine on each superomarginal. The condition of the adambulacrals and inferomarginals cannot be determined, but one obvious difference from *H. trojana* lies in the prominent carinal abactinal plates, lacking from the latter species.

**HOLOTYPE:** In the Canterbury Museum, Christchurch. Rays five, R 105 mm, r 62 mm.

*Anthenoides* Perrier, 1881

Body covered by a membrane which is superficially smooth and rather thick, obscuring the underlying granules during life, though these become visible after drying. Secondary small abactinal plates on either side of the median carinal series. Actinal intermediate areas large, the intermediate plates polygonal. Adambulacral armature comprising a furrow-comb, plus granules or subambulacral spines and pedicellariae. No abactinal or actinal spines.

This striking Indo-Pacific genus, though new to the fauna of New Zealand, is already known to be represented in Western Australia, where a small species, *A. dubius* H. L. Clark, has been taken. The New Zealand representative, on the other hand, is a large and handsome form, rivalling *Dipsacaster magnificus*.

*Anthenoides granulatus* Fisher Plate 1, Fig. B.

Fisher, W. K., 1919. *Bull. U.S. Nat. Mus.*, p. 328, Pl. 88 and 94.

**MATERIAL EXAMINED:** One specimen, taken in 270 fathoms, off Mayor Island, Bay of Plenty, by Dr. R. K. Dell, at Dom. Mus. Station B.S.209. It is now in the collection of the Dominion Museum, No. Z Ech. 567.

**REMARKS:** The specimen, the only one so far discovered in New Zealand waters, appears to be an adult and has 31–33 marginals in either series, from the IR to the arm-tip. The holotype of the species was taken in 265 fathoms off Mollucca Islands. The New Zealand specimen has relatively longer arms, R 135 mm, r 50 mm,  $R = 2.6 r$  (as against  $R = 2r$  in the holotype); this difference is, however, probably due to the greater size of the New Zealand specimen, for in other respects there is close agreement.

The marginals are densely granulated, with coarser granules on the lateral margins of the proximal inferomarginals. The ambitus is defined by the projecting inferomarginals alone. The pedicellariae are largest on the proximal adambulacral plates, and smallest on the abactinal plates, where they resemble cleft granules. The adambulacral armature is characteristic of the species as described by Fisher, comprising (a) a furrow-comb of 6–9 uniform, delicate spines, deeply placed in the narrow furrow, (b) 2 or 3 coarse sub-ambulacral spines, one or two of which become enlarged on the distal half of the arm, (c) scattered granules and pedicellariae. The enlargement of the subambulacral spines on distal adambulacral plates, though mentioned by Fisher (1919), was not figured by him, and so an illustration of the condition in the New Zealand specimen is given here (Fig. B). From *A. epixanthus* Fisher, of Hawaii, the present specimen differs in possessing abactinal pedicellariae and in its adambulacral armature.

The presence of this Indonesian sea-star in the Bay of Plenty gives further ground for regarding the area as falling within the Aupourian marine province, where northern elements of the fauna are most evident.

*Pentagonaster* Gray, 1840*Pentagonaster pulchellus* Gray

Gray, J. E., 1840. *Ann. Mag. Nat. Hist.* VI, p. 280.

**MATERIAL EXAMINED:** Although this beautiful sea-star is well-known from quite shallow water, 3–40 fathoms, it has not previously been taken from the continental slope. Seven specimens now in the Dominion Museum were taken by Dr. R. K. Dell from the edge of Canyon A, off East Otago, at Dom. Mus. Station B.S.189 in 120 fathoms. Dell (personal communication) considers it not unlikely that they had fallen into the canyon, as some shelf mollusca were found to be living under similar circumstances.

**Family OREASTERIDAE**  
***Asterodiscus* Gray, 1847**

***Asterodiscus truncatus* Coleman**

Coleman, H. L., 1911. *Mem. Aust. Mus.* 4, p. 699, Pl. 83.

Powell, A. W. B., 1937. *Trans. Roy. Soc. N.Z.*, 67, p. 78, Pl. 16.

**MATERIAL EXAMINED:** Three specimens, two of them in the Dominion Museum, all received by courtesy of Dr. Powell. None of them are from deep water, but the species is included here because it occurs in deep water (47–200 fathoms) off the east Australian coast and in the Great Australian Bight, and it is highly probable that deep-water examples from New Zealand will be discovered. The New Zealand specimens all come from the Hauraki region, Powell's first specimen being from west of Hen and Chicken Islands, in 29 fathoms.

Although H. L. Clark (1946) stated that nothing is recorded as to the colour of the species in life, Powell (1937) had in fact given a careful description, "ground colour of the abactinal surface chrome, heavily blotched with vermilion; larger tubercles and superomarginal plates mauve to dull purple; ground colour of actinal surface chrome with vermilion abactinal patches encroaching slightly at the margins; larger tubercles mauve, ambulacral regions pale grey to mauve". The colour of dried material which I have seen is a dark reddish-brown, dull yellow below.

**Family ECHINASTERIDAE**

***Echinaster* Mueller & Troschel, 1840**

***Echinaster farquhari* Benham**

Benham, W. B., 1909. *Rec. Cant. Mus.* 1 (2) p. 98–100, Pl. VIII.

**MATERIAL EXAMINED:** Two deep-water specimens, one of them from 330 fathoms, the other from 290 fathoms, from Stations 41 and 59 respectively, of the Chatham Islands 1954 Expedition.

**REMARKS:** Other specimens have recently been taken by F. Abernethy on the Cook Strait shelf. The species has, until now, been known only from Benham's holotype specimen, from Otago, 18–28 fathoms.

***Henricia* Gray, 1840**

***Henricia compacta* (Sladen)**

*Cribrella compacta* Sladen, W. B., 1889. Rpt. on Asteroidea. *Challenger* Sci. Rslts., Zoology, 30, p. 543, Pl. XCVI 1–2, Pl. XCVIII 3–4. *Henricia compacta* Mortensen, Th. Vid. Medd. dansk. naturh. For., 79, p. 307–8.

**MATERIAL EXAMINED:** Five specimens from the following stations of the Chatham Islands Expedition, 1954: 280 fathoms, Chatham Rise, Station 7, 1 specimen; 220 fathoms, Chatham Rise, Station 6, 4 specimens.

**REMARKS:** The holotype was taken by the *Challenger* in 275 fathoms, at Station 166, west of Cape Farewell.

**Family PTERASTERIDAE**

This deep-water group, though widely distributed, has not previously been recorded from New Zealand. The familial characters include the following features:

Abactinal surface roofed over by a membrane, supported by the elongated paxillae, enclosing a supradorsal brood-chamber, within which the eggs develop. Water is drawn in through numerous small pores on the actinal surface and expelled through a central opening on the abactinal surface, termed the osculum.

*Pteraster* Mueller and Troschel, 1842

Adambulacral armature comprising a transverse comb, united by a web. Tube-feet in two series.

Subgenus *APTERODON* Fisher, 1940

Marginal oral spines not united in a web.

*Pteraster* (*Apterodon*) *bathami* sp. nov. Plate 2, Figs. G, I, holotype.

**DIAGNOSIS:** Body thick and cushion-like, flat below, rounded above, subpentagonal or pentagonal-star-shaped in outline, the arm-tips turned upwards. Supradorsal membrane reticulated and bristling with the exposed tips of the paxillar spines, which support it; the paxillae usually having five (sometimes four or six) paxillar spines, the central spine not projecting, and not evident. Prominent central osculum, surrounded by a web. Adambulacral spines 6, the innermost one third as long as the outermost and the intermediate ones of proportionately varying lengths, all united in a web which adheres to the spine of the actinolateral membrane. Tube-feet in two series. Oral plates carrying 8 furrow spines, the innermost largest, the spines decreasing regularly in size from within outwards. The inner three spines are flat and spatuliform with an expanded tip, the others more slender but also flat. Suboral spine robust, recurved, sharply tapering from a broad base to an acuminate hyaline tip, longer than the innermost furrow spine of the oral plate.

**MATERIAL EXAMINED:** The holotype, also photographs of a second specimen taken at the same station as the holotype, from 250–300 fathoms, off east Otago, Dom. Mus. Station B.S.191, Drs. E. Batham and R. K. Dell.

**HOLOTYPE:** In the Dominion Museum, Ech. 517, R 42 mm, r 28 mm. The paratype, held at the Portobello Marine Biological Station is a little larger, R 49 mm, r 35 mm.

**COLOUR AND BEHAVIOUR:** Dr. Elizabeth Batham was able to keep the paratype alive at Portobello for two days, and has kindly supplied the following information: The colour in life was deep cream, or pale warm yellow, Munsell YR–Y 8/6, a uniform colouring without patterning. The osculum opened to a maximum diameter of about six millimetres for an interval of approximately 5 seconds, once every 1–2 minutes. As it opened, the disc rose up as a whole, becoming depressed again as the osculum closed, i.e., the opening and closing of the osculum is not just a local sphincter action, but involves the body as a whole. Particles of azocarmine pipetted over the osculum were vigorously squirted away as it opened, confirming that it is exhalant. During the observations, which extended over about 30 minutes, the temperature of the sea-water rose from 8.7° C to 8.9° C, but there was no obvious change in the respiration rate. The tube-feet at the tips of the arm were about twice as long as those along its length (about 1 cm long at the arm-tip).

**REMARKS:** *Pteraster bathami* appears to be rather closely related to *P. myonotus* Fisher, from the Philippines, 74–279 fathoms (Fisher, 1919, p. 458). It differs as follows: The paxillae of *P. bathami* lack the central spine of *P. myonotus*, so that the reticular areas have a smooth floor; the areas also tend to be pentagonal rather than hexagonal, since there are five paxillar spines usually, not 6 (plus 1 central) as in *myonotus*. The adambulacral combs regularly comprise 6 spines in *P. bathami* (not 5), and the oral spines are more flattened. Fisher examined 8 specimens of *P. myonotus*, apparently none exceeding R 28 mm, r 24 mm, whereas both New Zealand specimens are much larger, and have relatively longer arms. If the New Zealand specimens were merely older examples of Fisher's species, one might well expect the arms to be relatively longer, and the number of adambulacral spines to be increased to 6—but it is extremely improbable that the number of paxillar spines would decrease with age, or that the central paxillar spine would be retracted. The best course is then to regard the New Zealand form as representing a separate species, closely related to the Philippines one.

From Australia H. L. Clark (1916) has described *Pteraster tetracanthus*, a species which evidently falls in *Apterodon* since no membrane connects the oral spines. This species is stated to have four adambulacral spines, and only four

oral spines; the pentagonal outline and narrow adambulacral armature result in relatively wide oral intermediate areas. All these characters distinguish the species from the New Zealand form.

### Family KORETHRASTERIDAE

This family, usually regarded as transitional between the Pterasteridae and the Solasteridae, has not hitherto been recorded from Australasian seas. It may briefly be characterized as follows:

Abactinal side with paxillae formed by very long spines not covered by a supradorsal membrane. No actinolateral membrane. Marginal paxillae not enlarged. No oral interradial plates. Spines of the adambulacrals forming together with those of the lower marginals a single transverse series, not united in a web. Usually five-rayed.

### *Peribolaster* Sladen, 1889

Abactinal surface bearing cruciform plates whose lobes overlap, or are connected by intermediate plates, to form an open network of large quadrangular meshes. On the centre of each primary plate is a boss which carries a fascicle of delicate spinelets enclosed in united membranous sheaths. No pedicellariae.

The genus has hitherto been recorded from California, from Chile and from Antarctica.

*Peribolaster lictor* sp. nov. Plate 2, Figs. A, B, holotype.

**DIAGNOSIS:** Body pentagonal-stellate, the rays truncate, flat below, rounded above. Abactinal armature of 3 (occasionally 4) slender spines, each about 2 mm long, in a fascicle, borne on a cruciform or occasionally triradiate plate. The lobes of these plates either overlap or less frequently overlies a small intermediate plate which carries no spines. Inferomarginal plates each carry one flattened spatulate spine. No actinal intermediate plates. Adambulacral plates not exactly opposite inferomarginals, each carrying a transverse row of flattened spines, decreasing in size toward the furrow. Oral plates each with three furrow-spines, the median one largest, and two recurved robust sub-oral spines. Tube-feet biserial.

**MATERIAL EXAMINED:** Eight specimens from 130 fathoms, Station 34, Chatham Islands Expedition.

**HOLOTYPE:** In the Canterbury Museum, R 22 mm, r 9 mm.

**REMARKS:** The species is easily distinguished from the other species with biserial tube-feet by having a total of five oral spines, of which two are sub-oral. In *P. macleani* Koehler there are four oral spines, one of them being sub-oral, and in *P. biserialis* Fisher there are four oral spines, all of them furrow-spines. In regard to the flattened or spatulate character of the inferomarginal spines *P. lictor* approaches *P. macleani*; the latter is an antarctic form. *Peribolaster lictor* is so called in reference to the bundles of rod-like spines which it carries.

### Family SOLASTERIDAE

This family is here recorded for the first time from New Zealand, though it is already known in Australia, and a deep-water species was taken by the Challenger north of the Kermadec Islands. The family may briefly be diagnosed as follows:

Disc relatively large, bordered by marginal paxillae and carrying more or less prominent paxillae on the abactinal surface. Actinal interradial plates present. Adambulacral armature in two linear series at right angles to each other.

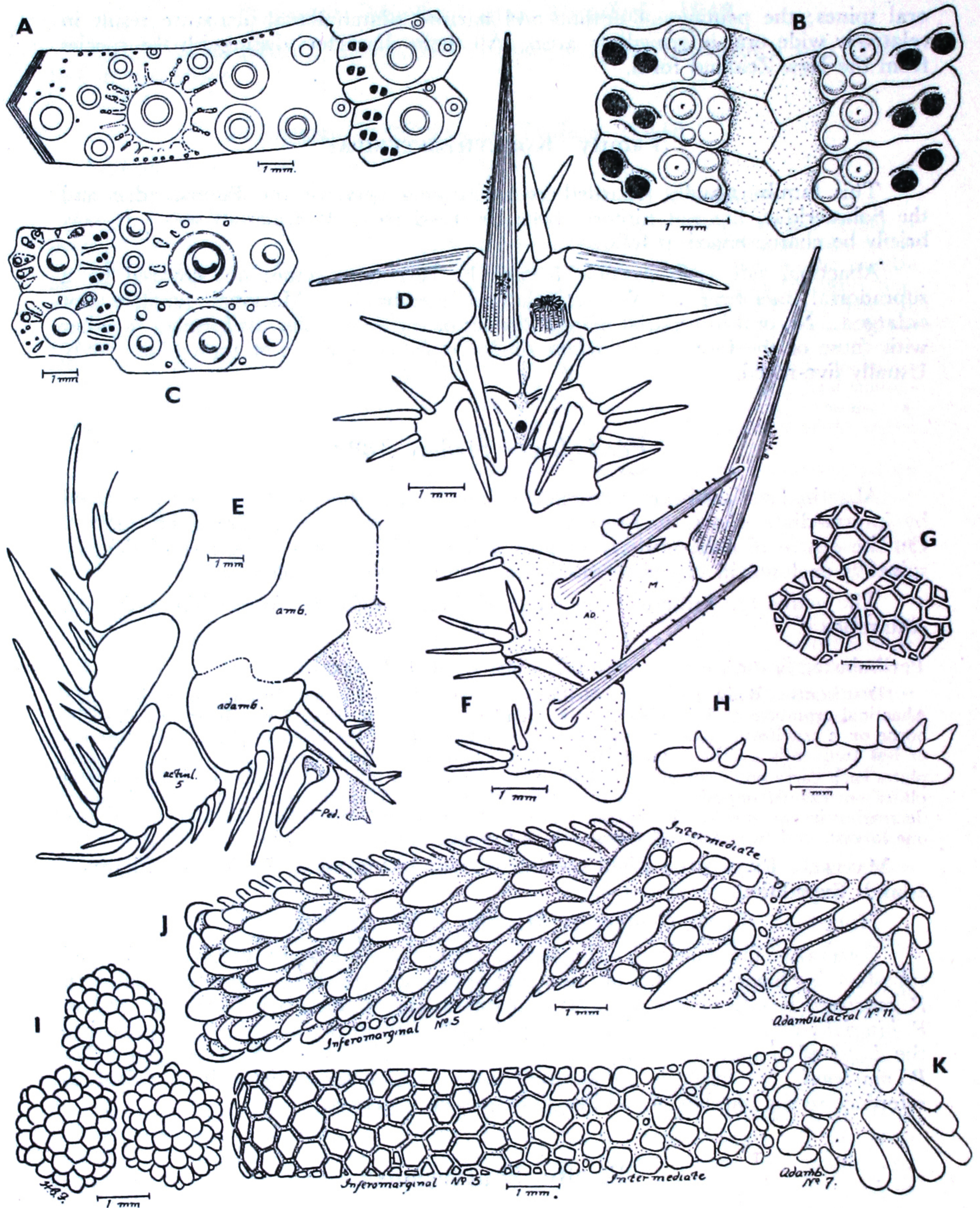


PLATE 3

A, C, *Pseudechinus flemingi* sp. nov.; A, aboral plates of holotype, 52 mm h.d.; C, ambital plates of immature syntype, 26 mm h.d. B, *Goniocidaris (Aspidocidaris) parasol* sp. nov.; ambulacral plates. D, F, H, *Brisingenes delli* sp. nov.; D, oral and adjoining adambulacral plates; F, adambulacral and marginal armature, genital region of arm, distal border uppermost; H, costal plates. E, *Zoroaster spinulosus* Fisher, ambulacral, adambulacral and adjoining actinolateral series, showing armature and giant straight pedicellaria. G, K, *Pseudarchaster garricki* sp. nov.; G, abactinal paxillae; K, inferomarginal 5, adambulacral 7 and intermediate plates. I, J, *Pseudarchaster abernethyi* sp. nov.; I, abactinal paxillae; J, inferomarginal 5, adambulacral 11, and intermediate plates.



***Crossaster* Mueller & Troschel, 1840**

A single row of marginal paxillae. Actinal intermediate plates extending only part of the way along the arm.

***Crossaster japonicus* (Fisher). Plate 2, Fig. F.**

*Solaster japonicus* Fisher, W. K., 1911. *Bull.* 76, U.S.N.M., p. 330.

*Crossaster japonicus* Djakonov, A. M., 1950. *Morskije Zvesdi Morei S.S.S.R.*, p. 74, Fig. 25.

*Crossaster multispinus* Clark, H. L., 1916. *Endeavour Rpt.*, Dept. Trade and Customs, Fisheries, N.S.W. 4, p. 66-7, Pl. XVIII, Figs. 5-6.

**MATERIAL EXAMINED:** Seven specimens, from the following stations: 320 fathoms, Chatham Rise, Station 58, Chatham Islands Expedition, 2 specimens; 280 fathoms, Chatham Rise, Station 7, Chatham Islands Expedition, 2 specimens; 220 fathoms, Chatham Rise, Station 6, Chatham Islands Expedition, 2 specimens; 50-200 fathoms, Cook Strait, VUZ Station 54, 1 specimen.

**REMARKS:** Fisher (1911) did not figure his material, but his description agrees extremely well with my material, save only that all my specimens have 11 rays, as against 10 or 9 for his. There are 28-29 marginals, separated by less than their own width in a regular series, their spinelets numerous (about 30), the peripheral spinelets shortest, all spinelets shorter than the adambulacral ones. The adambulacral armature comprises a furrow-series of about 9 webbed spinelets and a subambulacral series of 7 webbed spinelets, the latter rather longer than the furrow-series. In my material the spinelets are more closely united in the web than Djakonov (1950) shows in his East Siberian material, but this is possibly due to difference in mode of preservation. The oral plates have about 15 webbed marginal spinelets and about 9 webbed suboral spinules.

H. L. Clark (1916) has described *C. multispinus* from 150-230 fathoms off Tasmania, on the basis of four specimens, all of them 11-rayed like the New Zealand form. In general appearance the Tasmanian species resembles the New Zealand one, but the number of spinelets is less (6-8 furrow-spines, 7-9 subambulacral spines). The oral armature is similar. There are only about 16 marginal paxillae. Clark's material comprised smaller individuals than mine, R 40 mm, r 20 mm, as against R 85 mm, r 42 mm in a typical specimen from Chatham Islands Station 7. I believe therefore that the differences are due to age, and that the New Zealand and Tasmanian forms will be found to be identical, and that all should be referred to Fisher's *C. japonicus*, which is evidently a wide-ranging Pacific species.

**COLOUR:** The Cook Strait specimen, according to notes made from life by Professor L. R. Richardson, was orange-pink. The specimens from Station 6 of the Chatham Islands Expedition were a marbled translucent white and pink, when observed alive by Mr. G. A. Knox. All are faded to dull fawn-grey in alcohol.

**Order FORCIPULATA****Family BRISINGIDAE**

This family is new to the New Zealand fauna, although it is known from Australia by a single species. It may be diagnosed as follows:

Tube-feet in two series. Rays more or less constricted at the base, usually numerous, sharply demarcated from the small central disc, and usually deciduous when handled. Abactinal skeleton of rays restricted to basal part. Long, slender marginal spines encased in skin, with numerous small adherent crossed pedicellariae.

***Brisingenes* Fisher, 1917**

Papulae on the disc restricted to a ring about the margin, two papulae opposite the base of each arm.

The genus was founded to accommodate two species known only from the

Buton Strait, Celebes, at a depth of 559 fathoms (Albatross Station 5648). Its occurrence in New Zealand waters is therefore of considerable interest.

**Brisingenes delli** sp. nov. Plate 3, Figs. D, F, H, holotype arm, paratype disc.

**DESCRIPTION:** Disc covered with fine, conical, sharp granules about 20 to the square millimetre. Margin of disc rounded. Madreporite conspicuous, marginal, on a raised plate. Anus central surrounded by about 10 small spinules, twice as large as the granules of the disc. Rays 14, long (at least 200 mm in the holotype, paratype disc 25 mm in diameter). The genital region swollen, occupying about 30 mm of the arm's length, beginning about 30 mm from the base. Costae 15-17, of overlapping rectangular plates each carrying 2 or 3 triangular pointed granules. Proximal adambulacral plates about as broad as long, carrying 2 proximal furrow-spinules, one proximal accessory subambulacral spine, one distal furrow-spine, and one primary subambulacral spine on the distal half of the plate. Occasionally the accessory subambulacral enters the furrow, making three proximal furrow-spinules. The typical arrangement at the base of the arm is, by Fisher's formula (Fisher, 1919, p. 510):

$$\frac{i + I}{ii + 1} \quad \text{or, less frequently,} \quad \frac{i + I}{iii + 1}$$

Further out on the arm the number of furrow-spinules is reduced to a single distal and a single proximal spine. At the base of the arm a lateral spine occurs opposite every third adambulacral; further out one is opposite every alternate adambulacral. The lateral and subambulacral spines are thickly spattered with minute crossed pedicellariae, looking like sand-grains adhering to the spines. The oral plates carry 1 actinostomial spine, a large, laterally directed proximal furrow-spine, a smaller distal furrow-spine, one long, slender, fluted suboral spine near the midline, and one short suboral spine near the distal furrow-spine.

**MATERIAL EXAMINED:** Arms and discs of about five individuals, all taken by Dr. R. K. Dell at Dom. Mus. Station B.S.209, in 270 fathoms off Mayor Island, Bay of Plenty.

**HOLOTYPE:** An arm which, with a paratype disc, and also the rest of the material, is in the Dominion Museum Wellington.

**REMARKS:** *Brisingenes delli* is distinguished from *Brisingenes mimica* Fisher by having only 14 (as against 16) arms, and only 15-17 (as against 25-30) costae. The adambulacral armature is also distinctive. From *Brisingenes anchista* it is distinguished by the number of costae (40 in *anchista*), and by the adambulacral armature, the number of arms being the same in both species. Fisher (1919) points out that *Brisinga bengalensis* Alcock and Wood-Mason and *Brisinga gunnii* Alcock are 14-rayed forms whose exact systematic position is uncertain; they must therefore be considered as potential species of *Brisingenes*. Both of these forms have an entirely different adambulacral armature (see Fisher, 1919, p. 534) from the New Zealand material, and more numerous costae.

### Family ZOROASTERIDAE

A family of deep-water asteroids, already recorded from Australia but not hitherto known from New Zealand. The familial characters include:

Rays five, long, stiff, tapering, with longitudinal series of abactinal plates, among which the carinals are prominent and carry a prominent spine. Primary plates prominent on the disc. Adambulacral plates of alternating large and small types, the large type projecting into the furrow like a keel, a keel on one side of the furrow occurring opposite a small adambulacral plate on the other side. Pedicellariae straight, never crossed.

### *Zoroaster* Wyville Thomson, 1873

Plates of arm forming transverse, as well as longitudinal series, each plate covered by numerous small spinules or papillae, and usually bearing one enlarged spine. Mouth deep-set. Pedicellariae numerous, often large.

**Zoroaster spinulosus** Fisher. Plate 3, Fig. E.

*Zoroaster spinulosus* Fisher, W. K., 1906. *Bull. U.S. Fish Commission*, 23 (3) p. 1102-4, Pl. 24, 41, 42.

? *Zoroaster macracantha* Clark, H. L., 1916. *Rpt. Dept. Trade and Customs, Fisheries N.S.W.*, 4, p. 68-9, Pl. 28.

**MATERIAL EXAMINED:** Two specimens, partly fragmented, from the following stations of the Chatham Islands 1954 Expedition: 280 fathoms, Chatham Rise, Station 7; 220 fathoms, Chatham Rise, Station 6.

**REMARKS:** The spinules and papilliform granules of the arm-plates are apparently somewhat more attenuated and elongate than in Fisher's material, but in other respects the specimens agree closely with *Zoroaster spinulosus*. The species is especially distinguished by the adambulacral armature, and by the presence of one enlarged slender spinule on each of the plates between the superomarginals and the adambulacrals. These features are illustrated in Fig. E which was drawn from a section of the arm taken at the base in the individual from Station 7. The giant straight pedicellariae are a prominent feature of the spine adjoining the innermost (furrow-)spine. My material also appears to be conspecific with H. L. Clark's (1916) *Zoroaster macracantha*, from the Great Australian Bight, 250-450 fathoms. It agrees in particular in having a boss only on every second carinal plate in the distal part of the arm. As in Clark's material, the spines are nearly all lacking from these carinal tubercles. I consider that the characters by which he distinguished *macracantha* from *spinulosus* are variable and unreliable, and he indicates that in separating the Australian form he was influenced by the lack of material from the region between Australia and Hawaii (where *Z. spinulosus* occurs). That lacuna is now partly filled. The New Zealand material appears to be intermediate between the Australian and the Hawaiian types, but the differences are trivial and not of specific value. As I have not handled Clark's or Fisher's material the proposed synonymy given above has been prefixed by a question mark.

Opportunity will be taken in the official report of the Chatham Islands Expedition of giving photographic illustrations of the New Zealand specimens.

## Family ASTERIIDAE

*Sclerasterias* Perrier emend. Fisher, 1924*Sclerasterias mollis* (Hutton)

*Asterias mollis* Hutton, F. W., 1872. *Cat. Echin. N.Z.* p. 4.

*Sclerasterias mollis* Fisher, W. K., 1924. *Bull. Inst. Oceanogr.* 444.

**MATERIAL EXAMINED:** Although more than a hundred specimens have already been recorded from the Cook Strait shelf at depths less than 100 fathoms (Fell, 1952, p. 12), only ten deep-water specimens have been received. This is the first evidence that the species is archibenthal.

200-300 fathoms, Cook Strait, VUZ Station 51, 1 juvenile; 150 fathoms, Cook Strait, VUZ Station 98, 6 specimens; 150 fathoms, Cook Strait, VUZ Station 99, 1 juvenile; 130 fathoms, Chatham Islands Expedition Station 34, 1 specimen; 120 fathoms, off east Otago, Dom. Mus. Station B.S.189, 1 specimen.

*Allostichaster* Verrill, 1914*Allostichaster insignis* (Farquhar, 1895)

*Stichaster insignis* Farquhar, H. *Trans. N.Z. Inst.* 27, p. 203, Pl. 13 (1).

var. *gymnoplax* var. nov. Plate 2, Fig. C, holotype.

**DIAGNOSIS:** Resembling *Allostichaster insignis*, but differing from the typical form in having the broad superomarginal plates almost completely naked. The only armature they carry is a tubercle at the upper end of the plate, and two or three small pedicellariae. The granulated surface of the superomarginals (diagnostic of *Allostichaster*) is thus exposed naturally. Three papulae form a triangle between the naked lower ends of adjoining plates.

The armature of the inferomarginals comprises two flattened spines. The adambulacrals are as usual diplacanthid, and occasional monacanthid actinal intermediate plates are seen. These features are all illustrated in the figure.

**MATERIAL EXAMINED:** A single individual, R 35 mm, from 120 fathoms, off east Otago, edge of Canyon A, Dom. Mus. Station B.S.189, 14/8/1955, R. K. Dell. The holotype is in the Dominion Museum.

**REMARKS:** The specimen has only five arms, instead of the usual six, and only one madreporite. These characters would have led me to conclude that it is not fissiparous, were it not for the fact that two rays are only half as long as the other three. It is probable that the animal has undergone fission, but has not yet re-duplicated the madreporite in preparation for the next division. One further ground for caution before considering that the specimen represents a distinct species is the fact that Benham (1909) records a specimen of *A. insignis* from off Otago, having the spines "less numerous than in typical specimens"—without more exact details, unfortunately; he also received a specimen with only five arms and no madreporite. The evidence thus seems to favour extending the diagnosis of *A. insignis* to include *gymnoplax* as a varietal form. Should it later be found to be a well-defined form, the varietal name will be available for specific ranking.

### *Cosmasterias* Sladen, 1889

The genus is new to the fauna, but proves to be represented by the same species as in Australia. A diagnosis follows:

Abactinal plates forming more or less well-defined longitudinal series. Actinal plates in two or more series, not overhung by spines of the inferomarginals. Adambulacrals plates diplacanthid. Large, straight, unguiculate (felipedal) pedicellariae present.

*Cosmasterias dyscrita* H. L. Clark. Plate 2, Figs. D, E. H.

Clark, H. L., 1916. *Endeavour* Rpt., Dept. of Trade, Customs, Fisheries, N.S.W., 4, p. 71-2, Pl. 29, figs. 1-2.

**MATERIAL EXAMINED:** Fragments of about 3 individuals, from 130 fathoms, Station 34, Chatham Islands Expedition.

**REMARKS:** The holotype of this species was taken by the *Endeavour* in 200 fathoms, south of Gabo Island, Victoria, and until now no other specimen was known. As Clark has given only photographic illustrations of the whole animal, I am obliged to rely entirely upon his careful description in making the identification. The oral plates (Fig. H) carry four spines, namely an inner and an outer furrow-spine and a proximal and distal sub-oral spine. Small pedicellariae and large unguiculate pedicellariae occur on or beside these plates. The characteristic appearance of the unguiculate (or felipedal, as Verrill and Clark term it) pedicellaria is shown in Fig. D. The armature of the adambulacrals plates is illustrated in Fig. E, occasional unguiculate pedicellariae occurring on the furrow margin. Smaller crossed pedicellariae are scattered among the spines. The actinolateral series carry either one or two prominent, coarse spines.

## OPHIUROIDEA

### Family GORGONOCEPHALIDAE

#### *Gorgonocephalus* Leach, 1815

##### *Gorgonocephalus chilensis* (Philippi)

Mortensen, Th. *Vid. Medd. dansk naturh. For.* 77, p. 109, Pl. IV (1).

**MATERIAL EXAMINED:** A fragment of an arm from 500-600 fathoms, Cook Strait, VUZ Station 75, brown mud. The specimen does not differ from corresponding material from the Cook Strait shelf. The species is evidently rare, as only one other specimen (a large one) has been brought in over the past fifteen years. It was

entangled in a net at 40 fathoms. I now think it likely that the species is abyssal, but occasionally ascends the Cook Strait canyon to the shelf above.

### *Astroporpa* Oersted & Luetken, 1856

*Astroporpa wilsoni* Bell, 1917.

Fell, H. B., 1951. *Zoo. Pub. Vict. Univ.*, 13, p. 4.

**MATERIAL EXAMINED:** A single specimen from 150 fathoms, off Mercury Bay, Coromandel, adhering to a gorgonid, *Paracis* sp.

### *Astrothorax* Doederlein, 1911

*Astrothorax waitei* (Benham)

*Astrotoma waitei* Fell, H., 1952. *Zool. Pub. Vict. Univ.* 18, p. 13.

**MATERIAL EXAMINED:** Numerous specimens from shelf stations in Cook Strait, and also the following ones from deeper waters: 200–300 fathoms, Cook Strait, VUZ Station 51, 1 juvenile; 216 fathoms, 20 miles west of Hokitika, Westland, H. W. Wellman, 1 specimen; 150 fathoms, Cook Strait, VUZ Station 98, 4 specimens; 130 fathoms, Station 34, Chatham Is. Expedition, 1 specimen.

**REMARKS:** The species is probably androphorous, as a number of individuals carry a much smaller individual adhering to the disc, in the same way as Mortensen (1936) has recorded for *Astrochlamys bruneus* Koehler.

As indicated above, this species ought to be referred to *Astrothorax*, a fact already pointed out by Döderlein (1927), though overlooked in subsequent records. The girdle hooklets bear one secondary tooth, whereas in *Astrotoma* secondary teeth are lacking.

### *Astrothamnus* Matsumoto, 1915

*Astrothamnus benhami* (Bell)

*Astrotoma benhami*. Mortensen, Th., 1924. *Vid. Medd. dansk naturh. For.*, 77, p. 104–6, Pl. IV (6–7).

**MATERIAL EXAMINED:** None.

This species is still known only from the original type material taken in 300 fathoms off North Cape, by the *Terra Nova*. The presence of 3 or more secondary teeth on the girdle hooklets, and thorny granules scattered among the disc granules, indicates that the species should be transferred to *Astrothamnus*.

### Family TRICHAsteridae

#### *Astroceras* Lyman, 1879

*Astroceras elegans* (Bell)

Mortensen, Th. 1924. *Vid. Medd. dansk naturh. For.*, 77, p. 107, Pl. VI (3).

**MATERIAL EXAMINED:** One specimen, 60–100 fathoms, N.P. Station 9, Bay of Plenty.

The species is also known from Discovery Station 934, 92–98 metres, north of New Zealand (Mortensen, 1936, p. 241), from east of North Cape, 70 fathoms (Bell, 1917), and off Three Kings, Capt. Bollons, 60 fathoms, Mortensen (1924, p. 108).

Although all of these records are from the outer part of the shelf, it is highly probable that the principal home of the species is on the deeper slope, beyond 100 fathoms.

### Family ASTROSCHEMATIDAE

#### *Ophiocreas* Lyman, 1879

*Ophiocreas longipes* Mortensen

Mortensen, Th. 1924. *Vid. Medd. dansk naturh. For.*, 77, p. 102–4, Fig. 2, Pl. III

**MATERIAL EXAMINED:** None.

Mortensen's unique holotype stems from 300 fathoms, off Three Kings Islands.



The species was taken by the *Challenger* at Station 214, off the Philippine Islands, in 500 fathoms.

Mr. J. C. Yaldwyn recorded that the arms were pink in the two specimens obtained from Station 56.

***Ophiacantha imago* Lyman**

Lyman, T., 1882. *Challenger* Ophiuroidea, p. 186, Pl. 25 (4-6).

**MATERIAL EXAMINED:** Three specimens, all from a deep-water haul, 550 fathoms, Cook Strait, VUZ Station 83.

The species is viviparous. The arms of young individuals can be seen protruding from the genital clefts. In alcohol the specimens are pure white, but colour notes from life made by Mr. J. C. Yaldwyn state that the specimens were all pink when brought to the surface.

***Ophiacantha yaldwyni* sp. nov. Plate 4, Figs. F, H, I, holotype.**

**DIAGNOSIS:** Similar to *Ophiacantha truncata* Koehler, but having rhomboidal mouth-shields, shorter arm-spines and shorter oral papillae.

**DESCRIPTION:** Disc carrying thorny granules, about 12 to the square millimeter, not densely packed but permitting the outlines of the disc scales to be seen between them, usually one granule to each disc scale. Disc, arm and mouth-plates all invested in skin, making the borders between the plates somewhat indistinct when dried. Oral papillae 5 to 9, very irregularly arranged, with spiniform and leaf-shaped papillae indiscriminately mingled and crowded, some spines encroaching upon the adoral plates. Oral shields small, transversely rhombic, an angle within and without. Adoral plates rectangular, meeting broadly within, and resting upon the first lateral arm-plate without. Ventral arm-plates pentagonal, an obtuse angle within, the distal borders more or less rounded. Tentacle-scale single, prominent on the first arm-joint, smaller on the second, very minute or lacking on the third and fourth joints, and lacking from the rest of the joints. Lateral arm-plates not meeting above on the basal joints, but meeting very narrowly below, somewhat prominent, carrying 6 thorny spines, the upper ones longer than an arm-joint, the lower ones shorter. Further out on the arm all the spines become relatively shorter, forming a close, robust comb shorter than the arm-joint at that level. Dorsal arm-plates of the so-called "cup-shaped" form at the base of the arm, broadly in contact, with a narrow proximal border, long concave lateral borders, and a broad convex distal border; they are a little longer than broad at the base of the arm, as also further out. The basal one or two dorsal plates carry two or three granules in a transverse row along the distal margin, these two plates having a somewhat different shape from the rest of the basal dorsal arm-plates. Genital cleft longer than three arm-joints.

**HOLOTYPE:** In the Department of Zoology, Victoria University of Wellington; R approximately 25 mm, r 5 mm.

**MATERIAL EXAMINED:** The holotype from 550 fathoms, Cook Strait, VUZ Station 75. Mr. J. C. Yaldwyn recorded that the colour in life is pink. The specimen, with other ophiuroids, was taken from crevices in a rock fragment from the sea-floor.

***Ophiacantha rosea* Lyman. Plate 4, Figs. J, K.**

Lyman, T. 1882. *Challenger* Ophiuroidea, p. 184, Pl. 25.

**MATERIAL EXAMINED:** 275 fathoms, Canyon A ENE of Otago Heads, *Alert* Station 54.13, E. Batham, 2/3/54. The specimen is in the collection of the Portobello Marine Station, Otago.

The specimen, recorded by Dr. Batham as pink when taken, is a large one, R ca 70 mm, r 9 mm. It differs from Lyman's Pl. 25 in having fewer and blunter and broader outer oral papillae (Fig. J). The length of the 11 arm-spines differs a little from Lyman's account, being, in terms of the length of a segment, .5, 3.5, 3.5, 3.5, 3, 2.8, 2.5, 2.2, 2, 1.5, 1.5 respectively as taken from upper to lower. The dorsal spines of the disc also appear to be longer than in Lyman's (somewhat obscure) illustration. The differences may be regarded as relatively trivial.

This large, deep-water species was originally taken by the *Challenger* in 310 fathoms off the Crozets (S. Indian Ocean), in 420-775 fathoms off Japan, and in 175 fathoms off southern Chile. Its occurrence in New Zealand waters is therefore not surprising, and indeed it may prove to be cosmopolitan. It has not yet been reported from Australia.

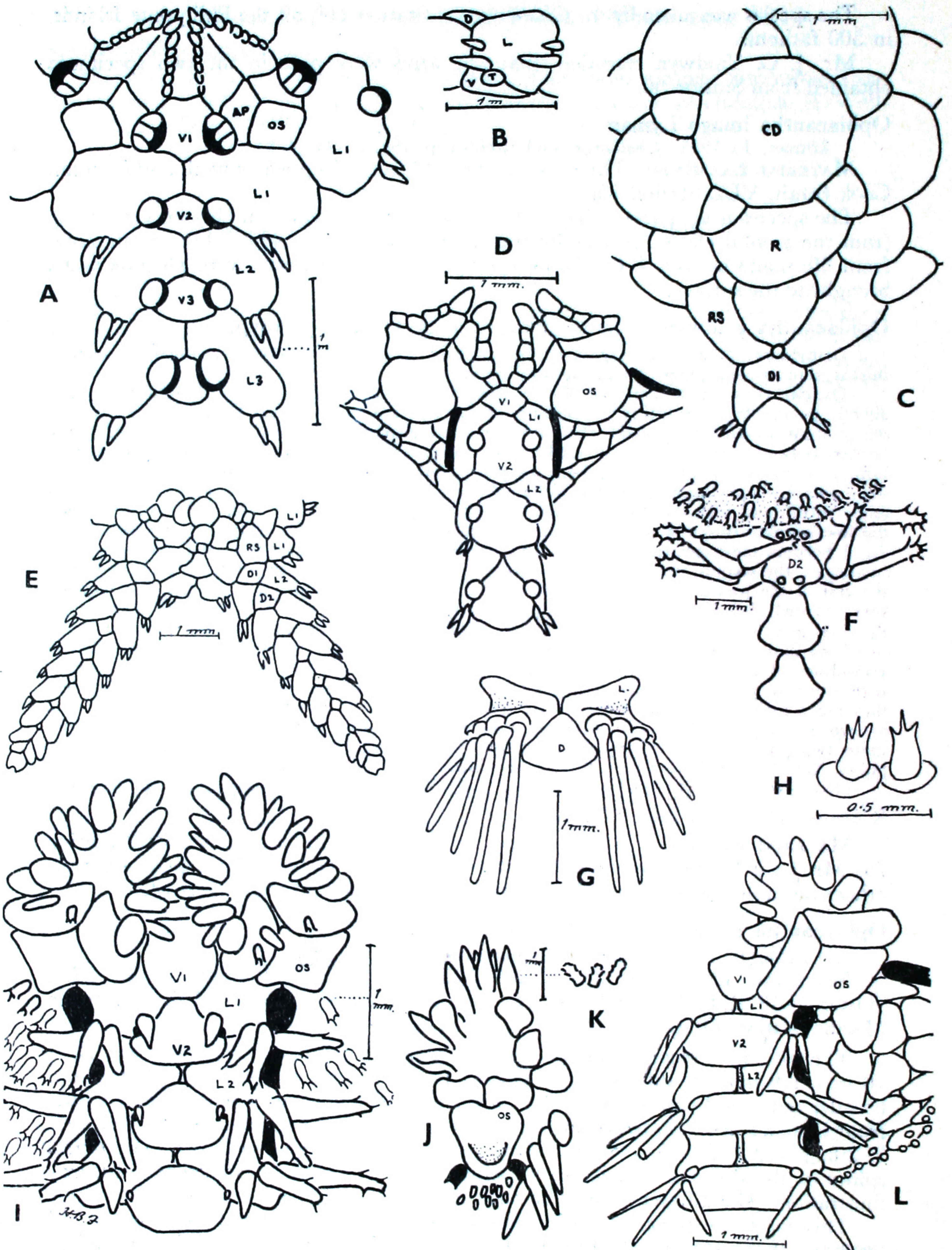


PLATE 4

A, E, *Ophiuraster symmetricus* sp. nov.; A, adoral and E, aboral aspect. B, C, D, *Ophiomastus admiral* sp. nov.; B, lateral aspect of arm; C, aboral and D, adoral aspects. F, H, I, *Ophiacantha yaldwyni* sp. nov.; F, aboral aspect; I, adoral aspect; H, spinules from upper side of disc. G, L, *Ophiacantha abyssicola obagoensis* var. nov.; G, aboral aspect of arm-joint; L, adoral aspect. J, K, *Ophiacantha rosea* Lyman; J, jaw-region and K, spinules from upper surface of disc.



**Ophiacantha abyssicola** G. O. Sars var. *otagoensis* var. nov. Plate 4, Figs. G, L, holotype.

**DIAGNOSIS:** Differing from the typical form in having transversely rhombic oral shields, which lack the distal lobe.

**HOLOTYPE:** In the Portobello Marine Station, Otago.

**MATERIAL EXAMINED:** 3 specimens from 275 fathoms, Canyon A off Otago Heads, Alert Station 54·13, E. Batham.

**REMARKS:** The difference in the oral shields is the only significant one I can observe in the material, when it is compared with Mortensen's (1928) account of the North Atlantic form. It does not seem sufficient for establishing a new species, even though the geographical separation is that of the globe itself; for, as is now becoming increasingly evident, deep-sea ophiuroids tend to have very widespread distribution patterns.

Since the species has not hitherto been taken in the Pacific, it is desirable to list the features that have influenced me in assigning the Otago material as *O. abyssicola*, and these are illustrated in Figs. G, L. The dorsal arm-plates have the form that Mortensen (1928) calls "cup-shaped"; the ventral plates are very broad; the disc is finely granulated above and laterally, but the plates are naked on the lower surface; there is a single round tentacle-scale; three oral papillae, of which the outer one is somewhat widened; the disc diameter is ca. 5 mm.

**Ophiacantha vepratrica** Lyman

Lyman, T. 1882. *Challenger* Ophiuroidea, p. 182, Pl. 13.

**MATERIAL EXAMINED:** Two individuals, one from 300 fathoms, the other from 260 fathoms, from Stations 5 and 52 respectively of the Chatham Islands 1954 Expedition.

The holotype was taken by the *Challenger* at Station 171, in 600 fathoms off the Kermadec Islands. The presence of the species in New Zealand waters was therefore to be expected.

**Ophiacantha vilis** Mortensen

Mortensen, Th. 1924. *Vid. Medd. dansk naturh. For.*, 77, p. 114, Fig. 7.

**MATERIAL EXAMINED:** Six specimens from the following stations: 600 fathoms, Cook Strait, VUZ Station 75, 1 specimen; 400 fathoms, NE of Mayor Island, Bay of Plenty, Dominion Museum Station B.S.210, 1 specimen; 200–300 fathoms, Cook Strait, VUZ Station 51, 4 specimens.

The holotype was from Cook Strait, 200 fathoms (Mortensen, 1924).

**Ophiactis** Luetken, 1856

**Ophiactis abyssicola** (M. Sars)

*Amphiura abyssicola* M. Sars. 1861. *Oversigt Norges Echin.*, p. 18.

**MATERIAL EXAMINED:** Nine specimens; 1,300 fathoms, Cook Strait, VUZ Station 58, 8 specimens (arms pink in life, J. C. Yaldwyn); 1,200–1,300 fathoms, Cook Strait, VUZ Station 56, 1 specimen.

var. *poa* Lyman: 22 specimens from 600 fathoms, Cook Strait, VUZ Station 75 (2 individuals) and 550 fathoms, Cook Strait, VUZ Station 83, 20 individuals; these were taken from burrows in hard mud brought up from the sea-floor. The colour was recorded as pink. They differ from var. *cuspidata*, which occurs with them, in having many more spines on the disc, and lacking the prominent primary plates.

var. *cuspidata* Lyman: 2 specimens, one each from 400 fathoms, Cook Strait, VUZ Station 87, and 550 fathoms, Cook Strait, VUZ Station 83. This form has been recorded from 600 fathoms, Tasman Sea, 400 miles NW of Wellington (Fell, 1951, p. 3), and from *Challenger* Stations 170 and 171, 520–600 fathoms, off the Kermadec Islands. The Cook Strait specimens were pink when taken.

**Ophiactis hirta** Lyman

Lyman, T., 1882. *Challenger* Ophiuroidea, p. 118-9, Pl. 20.

Mortensen, Th., 1924. *Vid. Medd. dansk naturh. For.*, 77, p. 126.

**MATERIAL EXAMINED:** Three specimens, all six-armed; 200-300 fathoms, Cook Strait. VUZ Station 51, 1 specimen; 150 fathoms, Cook Strait, VUZ Station 98, 2 specimens.

**Ophiactis profundus** var. **novaezelandiae** Mortensen

Mortensen, Th., 1924. *Vid. Medd. dansk naturh. For.*, 77, p. 128-31, Fig. 13.

**MATERIAL EXAMINED:** 8 specimens—130 fathoms, Station 34, Chatham Islands 1954 Expedition, 3 specimens; 100 fathoms, Island Bay shelf, 5 specimens.

The holotype was from Cook Strait, 120 fathoms, and the *Discovery* took the species at *Discovery* Station 941, 128 metres, also in Cook Strait.

**Ophiactis resiliens** Lyman

Lyman, T., 1882. *Challenger* Ophiuroidea, p. 115, Fig. 20.

**MATERIAL EXAMINED:** Four specimens, two of them from the Island Bay shelf at ca. 100 fathoms (Fell, 1952, p. 22) and two from VUZ Station 55, at 40-100 fathoms in Cook Strait.

Mortensen (1924, p. 124) records the species from 120 fathoms in Cook Strait.

**Amphiura Forbes, 1842****Amphiura angularis** Lyman

Lyman, T., 1882. *Challenger* Ophiuroidea, p. 134-5, Pl. 24.

**MATERIAL EXAMINED:** Three specimens which I take to be of this species, from 550 fathoms, VUZ Station 83, Cook Strait.

**REMARKS:** R 30 mm approximately, r 3 mm. The disc is rather strongly indented at the interradii, without spines, the scales imbricating above but, save at the ambitus, the disc is more or less naked below. The outer oral papilla is spiniform, erect, the inner pair scale-like. The adoral plates are barely contiguous within. Oral shield triangular, the apex proximad. Radial shields about one-third r, twice as long as broad, divergent proximad, their outer margins convex, their inner margins straight, separated by a narrow wedge of 7 or 8 scales. Dorsal arm-plates transversely elliptical, broadly in contact on the proximal half of the arm. Ventral plates quadrangular. Two tentacle-scales at the base of the arm, elsewhere one only. Five to six subequal arm-spines, which are no longer than a segment, and form an erect comb.

The type locality of this species is *Challenger* Station 150, in 150 fathoms, off Kerguelen Islands. The New Zealand material seems to resemble the Kerguelen form so closely as to warrant regarding both as of the same species. *Amphiura angularis* has not previously been reported from Australasia.

**Amphiura heraldica** Fell.

Fell, H. B., 1952. *Zoo. Pubs. Vict. Univ.*, 18, p. 16-18, Figs. 5-7.

**MATERIAL EXAMINED:** Three specimens, two of them from 350 fathoms, Canyon C, off east Otago (E. Batham), the other one from 300 fathoms, off east Otago, Dom. Mus. Station B.S.190.

The holotype was from *Discovery* Station 2733, Chatham Rise, west of Chatham Islands, in 300 metres.

**Amphiura norae** Benham

Benham, W. B., 1909. *Rec. Cant. Mus.* 1 (2), p. 104-5, Pl. 10.

**MATERIAL EXAMINED:** Sixteen specimens, from the following archibenthal stations: 300 fathoms, Chatham Rise, Station 5, Chatham Islands 1954 Expedition, 1 specimen; also from the same expedition, 290 fathoms, Station 59 (2 individuals), and 260 fathoms, Station 52 (4 individuals); 154 fathoms, Milford Sound, N.Z.

Oceanographic Institute Station A 319, 5 specimens; 113–120 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.208, 1 specimen; 145 fathoms, off Cape Kidnappers, *Kotuku* Station 3, J. A. F. Garrick, 2 specimens.

As no specimens of *Amphiura abernethyi* Fell appear in the deep-water collections, it is still not possible to establish the relationship between it and *A. norae*. It is possible that *A. abernethyi* is a larger, more robust and more fully developed form of *A. norae*, perhaps confined to the continental shelf.

### *Amphiura pusilla* Farquhar

Farquhar, H., 1897. *J. Linn. Soc. Lond. Zool.*, 26, p. 191, Pl. 14.

**MATERIAL EXAMINED:** Twelve specimens—ca. 275 fathoms, Canyon A, east of Otago Heads, E. Batham, 3 specimens; 150 fathoms, Cook Strait, VUZ Station 98, 4 specimens; 120 fathoms, Cook Strait, NW of Mana Island, Dom. Mus. Station B.S.197, 5 specimens.

### *Amphiura hinemoae* Mortensen

Mortensen, Th., 1924. *Vid. Medd. dansk naturh. For.*, 77, p. 148–50, Fig. 24.

**MATERIAL EXAMINED:** Three specimens from 400 fathoms, NE of Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.210.

The species was originally described on the basis of 2 specimens taken in 55 fathoms off White Island, Bay of Plenty. It has since been taken on other shelf localities off the South Island (Fell, 1952, p. 15), from as far south as Dusky Sound. This is the first record of the species as an abyssal form, and it is desirable to indicate certain atypical features of the new material, making its identification not entirely clear. In particular the radial shields are relatively larger and more exposed in the deep-water specimens, and the six primary plates are not at all prominent. I do not feel that the evidence warrants our establishing a separate species for the form. One specimen has the outer oral papilla distinctly spiniform—thus showing that the difference between *Amphiura hinemoae* and the North Pacific *A. seminuda* Ltk. & Mrtsn. is not so great as Mortensen (1924) believed.

### *Amphiura aster* Farquhar

Farquhar, H., 1901. *Trans. N.Z. Inst.*, 33, p. 250.

**MATERIAL EXAMINED:** 260 fathoms, Canyon A, off east Otago, *Alert* Station 54.17, 3 juvenile specimens.

Of the material seen, only the largest specimen (disc 4 mm in diameter) shows the characteristic arrangement of the tentacle-scales. The smaller ones show no tentacle-scales at all. All specimens have the disc incompletely scaled, especially below, where it is almost naked. The external lobe is lacking from the oral shield. All these differences, however, are probably an expression of immaturity.

## *Amphiodia* Verrill, 1899

This amphiuroid genus has not hitherto been recorded from New Zealand, though a species is recorded from Torres Strait in Australian waters. The genus is characterized as follows:

Oral papillae three or four in number, subequal; radial shields divergent; disc covered by scales, without any specially distinguished marginal scales, and without disc-spines.

### *Amphiodia destinata* Koehler

Koehler, R., 1922. *Sci. Rpts. Australasian Antarctic Exped. 1911–14*, Ser. C, 8 (2), p. 32 Pl. 79.

**MATERIAL EXAMINED:** 12 specimens from three stations: 400 fathoms, Cook Strait, VUZ Station 87, 4 specimens; 290 fathoms, NW of White Island, Bay of Plenty, Dom. Mus. Station B.S.203, 7 specimens; 270 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station, B.S.209, 1 specimen.

REMARKS: The specimens from Station 87, Cook Strait, agree in most respects with Koehler's description. His material was from 350 fathoms, off the Australian quadrant of Antarctica, and the species has not till now been reported from beyond Antarctica. The largest specimen I have before me is 10 mm across the disc, and has 6 arm-spines on basal segments. The others from Station 87 have 6, occasionally 7, arm-spines. Koehler's type had only 5 arm-spines, but this character may depend on age. On the basal segments two or three spines of a cluster may be slightly recurved, not merely the second lowest spine, as stated to be the case in Koehler's material. However, Pl. 79 of Koehler's work (Koehler, 1922) seems to show more than one recurved spine on the basal segments. The Bay of Plenty specimens have a disc diameter of 7 mm or less, and differ in having the proximal spines less recurved proximad, whilst some of the middle joints of the arms have the second lowest spine recurved weakly distad.

It is possible that this New Zealand form is not identical with the Antarctic one.

### *Amphipholis squamata* (Delle Chiaje)

For synonymy see Mortensen, Th., 1924. *Vid. Medd. dansk naturh. For.*, 77 p. 161-2.

MATERIAL EXAMINED: Five deep-sea examples from three stations: 300 fathoms, Canyon A, ENE Otago Heads, 2 specimens; 200-300 fathoms, Cook Strait, VUZ Station 51, 2 specimens; 150 fathoms, Cook Strait, VUZ Station 98, 1 specimen.

## *Amphioplus* Verrill, 1899

### *Amphioplus longirima* Fell

Fell, H. B., 1952. *Zool. Pubns. Vict. Univ.*, 18, p. 18-19, Figs. 8-10.

The holotype was from *Discovery* Station 2733, Chatham Rise, in 300 metres, and no additional material has since been taken.

## *Ophiocentrus* Ljungman, 1867

### *Ophiocentrus novaezelandiae* Gislén

Gislén, T., 1926. *Göteborg Kgl. Vetensk. Handl.* 4, 30.

MATERIAL EXAMINED: One specimen from Station NP 6, 124 fathoms, Bay of Plenty.

The species has also been taken from shelf localities in Cook Strait, 40-50 fathoms (Mortensen, 1936, p. 288 and Fell, 1952, p. 23).

## Family OPHIOTHRICIDAE

### *Placophiothrix* H. L. Clark, 1938

#### *Placophiothrix aristulata* (Lyman)

*Ophiothrix aristulata* Lyman, T., 1882. *Challenger Ophiuroidea*, p. 223-4, Pl. 21.

MATERIAL EXAMINED: Four specimens from 200-300 fathoms, Cook Strait, VUZ Station 51.

The species was originally described from off South Africa and off eastern Australia (*Challenger* Stations 142, 161, 163), but it has since been found to have a widespread distribution from Aden to New Zealand. This fine species is pink in life, like so many of the deep-water ophiuroids; among the deep-water forms of New Zealand it is rivalled in size only by *Ophiocoma bollonsi*, from which it is at once distinguishable by its large ring of radial shields and the spines which stand on the disc.

## Family OPHIOCOMIDAE

*Ophiocoma* L. Agassiz, 1835*Ophiocoma bollonsi* Farquhar

Farquhar, H., 1908. *Trans. N.Z. Inst.* 40, p. 108.

**MATERIAL EXAMINED:** Numerous specimens, including the following from deep-water stations: 250–350 fathoms, Cook Strait, VUZ Station 53, 2 specimens; 250–300 fathoms, off east Otago, Dom. Mus. Station B.S.191, several specimens; 200–300 fathoms, Cook Strait, VUZ Station 51, 2 specimens; 150 fathoms, Cook Strait, VUZ Station 98, 2 specimens.

Other material is from VUZ Stations 49, 55 and 15, at depths of 70, 40–100, and 100–150 fathoms respectively, all from Cook Strait. Professor L. R. Richardson noted that specimens from Station 49 were rich reddish-brown; the colour is retained in preservation. It is evident that the species is by no means so rare as was formerly believed.

## Family OPHIOLEPIDIDAE

*Ophiura* Lamarck, 1816*Ophiura chathamensis* Fell

Fell, H. B., 1952. *Zool. Pubs. Vict. Univ.*, 18, p. 25–8, Figs. 15–18.

**MATERIAL EXAMINED:** 113–120 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.208, 3 specimens; 60–100 fathoms, off Mayor Island, Dom. Mus. Station B.S.207, 6 specimens.

The holotype was from *Discovery* Station 2733, Chatham Rise, 300 metres. The specimens from Station B.S.207 have the tentacle-pore at the margin of the lateral plate, instead of within the plate, as in the holotype. The species is presumably widely distributed on the New Zealand continental slope and shelf.

*Ophiura rugosa* (Lyman)

*Ophioglypha rugosa* Lyman, T., 1882. *Challenger Ophiuroidea*, p. 68–9, Pl. 3.

The holotype was taken by the *Challenger* at Station 169, off East Cape, in 700 fathoms. No examples have been found in our collections.

*Ophiecten* Luetken, 1854*Ophiecten hastatum* Lyman

Lyman, T., 1882. *Challenger Ophiuroidea*, p. 82–3, Pl. 9.

**MATERIAL EXAMINED:** None.

The species was recorded by Lyman from *Challenger* Station 168, in 1,100 fathoms, off Cape Kidnappers. It has not yet been taken in Cook Strait, but is to be expected.

*Ophiuroglypha* Hertz, 1926*Ophiuroglypha irrorata* (Lyman)

*Ophioglypha irrorata* Lyman, T., 1882. *Challenger Ophiuroidea*, p. 47–8, Pl. 5.

**MATERIAL EXAMINED:** About 50 specimens: 550 fathoms, Cook Strait, VUZ Station 83, 2 specimens; 435 fathoms, Cook Strait, VUZ Station 77, 5 specimens; 430 fathoms, Cook Strait, VUZ Station 97, 1 specimen; 400 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.210, 3 specimens; 380 fathoms, Cook Strait, VUZ Station 96, about 30 specimens; 360 fathoms, Cook Strait, VUZ Station 41, 11 specimens; 50–200 fathoms, Palliser Bay, VUZ Station 54, 1 specimen.

The material presents much variation in the pattern of the plates of the dorsal side of the disc.

*Ophiuraster* H. L. Clark, 1939

A deep-sea genus established by H. L. Clark for a single species, *O. perissus* H.L.C. from off Aden, in 1,100 fathoms. It has not since been reported, and the species here referred to the genus is evidently new. The generic characters include:

The first lateral arm-plate enlarged, so as to meet its fellow of the adjoining arm, thus ringing the disc with a circle of radial and lateral plates, the disc not clearly demarcated from the arms. Oral shield small, lying proximal to the contiguous laterals. Tentacle-pores large, close together, near the ventral mid-line.

The structures which Clark (1939) called "radial shields" in his description of the type species are evidently the enlarged first lateral arm-plates, as can be inferred from his diagrams.

*Ophiuraster symmetricus* sp. nov. Plate 4, Figs. A, E, holotype.

**DESCRIPTION:** Disc circular in outline, with what appears to be a deep interradial notch; this notch, however, is really the space between the first lateral plates of adjoining arms. Aboral surface of the disc completely covered by scales, of which the imbricating primaries occupy the central region; beyond these lie the five pairs of polygonal radials, which are broadly contiguous. Interradially the radial shields are separated by a single prominent scale, and a few smaller scales are wedged between the primaries and the radial and interradial plates. The first pair of laterals make up the greater part of the oral surface of the disc, and also define the ambitus. The oral shields are small and transversely rhombic, distally wedged between the first laterals, proximally wedged between the adoral plates. The small adoral plates are broadly contiguous within, and separated without from the ventral plates by the large tentacle-pore, which carries three scales on its interradial margin. The oral plates each carry 6-7 oral papillae, in linear series, largest at the apex.

**ARMS:** Upper arm-plates rhombic, declining rapidly distad, so that the distal arm-joints have none. The first upper arm-plate adjoins the radial shields and also the second upper arm-plate. The other upper arm-plates are widely separated. On the holotype there are only 7 upper arm-plates as against 10 lateral arm-plates. The lateral arm-plates are broadly contiguous above and below, except on the two basal joints. Each carries one larger and one smaller arm-spine, both arm-spines close together, conical in form, distally directed. The lower arm-plates are small; they vary in shape, and are nowhere contiguous. The basal tentacle-pore carries 3 tentacle-scales, and others each carry one, relatively large, circular scale, attached to the corresponding lateral arm-plate.

**COLOUR IN SPIRIT:** White.

**HOLOTYPE:** In the Dominion Museum, Wellington. R 5 mm, r 2 mm.

**MATERIAL EXAMINED:** A single specimen, from 400 fathoms, NE of Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.210, R. K. Dell, 28/2/1957.

**REMARKS:** *Ophiuraster symmetricus* differs from *O. perissus* H. L. Clark in having three tentacle-scales on the basal arm-joint (instead of one only), in lacking the peripheral ring of plates within the ring of first lateral plates, and in its more regular arrangement of the aboral disc-scales. There is no "notch" at the interradial junction of the first laterals in *O. perissus*.

Attention may be drawn to the resemblance between *Ophiuraster* and *Ophiomidas* Koehler, both genera having the first lateral arm-plates similarly developed. The similarity extends also to the large, round tentacle-scales, the arm-spines and the adoral plates. The genera are easily distinguished by the first tentacle-pore, which is internal in *Ophiomidas*, external in *Ophiuraster*, differences which would lead to their classification, under Matusmoto's (1915) proposals, in the sub-families Ophiolipidinae and Ophiomastinae respectively. It would appear that Matsumoto's distinction of these two subfamilies is rather unnatural (though convenient) since it leads to the separation of forms which may well prove to be nearly related.

*Ophiomisidium* Koehler, 1914*Ophiomisidium irene* Fell

Fell, H. B., 1952. *Zool. Pubs. Vict. Univ.*, 18, p. 28-30, Figs. 21-22.

**MATERIAL EXAMINED:** Nineteen specimens, as follows: 300 fathoms, Chatham Rise, Station 5, Chatham Islands 1954 Expedition, 1 individual; 130 fathoms, Station

34, Chatham Islands Expedition, 2 individuals; 300 metres, Chatham Rise, *Discovery* Station 2733, holotype and 15 other specimens (Fell, 1952).

**REMARKS:** The species has now been taken in three separate hauls by two expeditions, and in each case from a station within 300 miles of the Chatham Islands. The nature of the bottom has been varied—fine grey mud, fine green sand, and fine sand and gravel. It is improbable that a deep-water form could be restricted to so small an area as the Chatham Islands region, and it may be suggested that the apparent restriction of the species to that area is really due to some difference in the bottom-sampling techniques. In forthcoming deep-water investigations in Cook Strait it is hoped to secure some samples of sand or mud for more detailed examination in the laboratory, since this minute form is especially liable to be overlooked at the time of collection.

### *Amphiophiura* Matsumoto, 1915

#### *Amphiophiura ornata* (Lyman)

*Ophioglypha ornata* Lyman, T., 1882. *Challenger Ophiuroidea*, p. 61–2, Pl. 6.

**MATERIAL EXAMINED:** None.

The holotype of the species is from *Challenger* Station 216, at 2,000 fathoms, north of New Guinea, but Lyman (1882, p. 296) also recorded the species from Station 165, in 2,600 fathoms, 900 miles west of Cape Farewell. This station borders the New Zealand region, where the species may therefore be expected to occur.

### *Ophiomastus* Lyman, 1878

#### *Ophiomastus tegulitius* Lyman

Lyman, T., 1882. *Challenger Ophiuroidea*, p. 100–1, Pl. 8.

**MATERIAL EXAMINED:** None.

The holotype of the species is from *Challenger* Station 165, in 2,600 fathoms, 900 miles west of Cape Farewell. Further examples were taken at Station 166, in 275 fathoms, 199 miles north-west of Cape Farewell, so that the species is to be expected in Cook Strait.

#### *Ophiomastus stellamaris* Fell

Fell, H. B., 1952. *Zool. Pubs. Vict. Univ.*, 18, p. 30–2, Figs. 23–7.

**MATERIAL EXAMINED:** The holotype and 10 other specimens, from *Discovery* Station 2733, in 300 metres, Chatham Rise; no other specimens have since been taken; the remarks made above, under *Ophiomisidium irene*, may well apply in this case also.

#### *Ophiomastus admiral* sp. nov. Plate 4, Figs. B, C, D, holotype.

**DESCRIPTION:** Disc pentagonal, tumid above. The centrodorsal is extremely large. It is surrounded by 5 small interradials, then the 5 primary radials. Two other interradial plates lie on the inter-radial axis of symmetry. One other radial plate occurs distal to the primary radial, wedged between the two radial shields at the base of the arm. The lower surface of the disc is mainly covered by the very large, obcordate oral shield; beyond this plate lie relatively few, and rather irregular, plates. The conspicuous genital clefts are equal in length to the first arm-joint, and lie beside it. The adoral plates meet narrowly within; distally, they meet both the first lateral and first ventral arm-plates. The oral angle is relatively wide and gaping, the 5 papillae flattened, square, adjoining one another so closely as to form a continuous series, the proximal and distal ones larger than the intervening ones. The upper arm-plates are fan-shaped, with a right-angled proximal apex and a rounded distal border, about as broad as long, not contiguous. The lateral arm-plates meet very narrowly above and below beyond the two basal arm-joints. They carry two conical spines, the lower one the larger, though scarcely half as long as its arm-joint. The ventral arm-plates are pentagonal, a little longer than broad, with an acute proximal angle, a broad convex distal margin, and concave lateral margins, within which the tentacle-pore is placed on either side. The single, large, round tentacle-scale is carried on the adjoining margin of the lateral plate.

**MATERIAL EXAMINED:** Four specimens including the holotype, all from 400 fathoms, Cook Strait, VUZ Station 87. Two poorly preserved juvenile ophiuroids from 300 fathoms, off east Otago, Dom. Mus. Station B.S.190, possibly belong to the same species.

**HOLOTYPE:** In the Department of Zoology, Victoria University of Wellington. R 15 mm, r 2.5 mm. Colour in alcohol white, colour in life probably pink (a mixed collection of ophiuroids from this station was so described, J. C. Yaldwyn).

**REMARKS:** *Ophiomastus admiral* differs from *O. secundus* Lyman in that the arm-spines are not subequal, the disc contains a number of plates other than the primaries, and the oral papillae are separate. The two species agree in having a single large tentacle scale. *O. admiral* differs from *O. tegulitius* Lyman in having one large tentacle-scale (instead of two small ones). From *O. stellamaris* Fell the species differs in having two lateral (instead of one ventral) arm-spines, and the tentacle-scales are relatively and absolutely smaller, despite the fact that the body is larger than in *O. stellamaris*.

### *Ophiozonella* Matsumoto, 1915

#### *Ophiozonella stellata* (Lyman)

*Ophiozona stellata* Lyman, T., 1882. *Challenger* Ophiuroidea, p. 22-3, Pl. 11.

**MATERIAL EXAMINED:** None.

The holotype of the species was from *Challenger* Station 168, in 1,100 fathoms, off Cape Kidnappers, at the southern end of the Kermadec Trench. The species was also taken at Station 169, in 700 fathoms off East Cape. It is therefore to be expected in Cook Strait.

## ECHINOIDEA

### Order Cidaroida

#### Family CIDARIDAE

### *Goniocidaris* Agassiz & Desor, 1847

#### *Goniocidaris umbraculum* Hutton

Hutton, F. W., 1879. *Cat. Echin. N.Z.*, p. 10.

**MATERIAL EXAMINED:** Thirty individuals, from the following deep-water hauls: 250-300 fathoms, Cook Strait, VUZ Station 53, 1 specimen; 200-300 fathoms, Cook Strait, VUZ Station 51, 2 specimens; 50-200 fathoms, Cook Strait, VUZ Station 54, 22 specimens.

The species has previously been recorded as ranging from Cook Strait to Foveaux Strait, at depths of 40-60 fathoms (see Fell 1954, pp. 40-41).

### Subgenus *Aspidocidaris* Mortensen, 1928

Basal disc on primary radioles more or less developed, and terminal disc usually well developed, often forming large round discs which cover the whole apical side. Secondary spines flattened, with a straight-cut end.

The subgenus has not hitherto been reported from New Zealand. One species, *Goniocidaris (Aspidocidaris) australiae* Mortensen, is known from Australia, three occur in the Indonesian-Philippines region, and two others in Japanese waters. The New Zealand form is apparently different from any of those.

*Goniocidaris (Aspidocidaris) parasol* sp. nov. Plate 3, Fig. B, Plate 5, Fig. b; (both holotype).

**DIAGNOSIS:** Test flattened above and below, the sides arched, ambitus rounded, apical system ca. half h.d., peristome one third h.d. Ambulacra weakly sinuate, ca. 16% IA. At the ambitus about seven amb plates occur opposite an IA plate. Interporiferous area 3-4 times broader than the poriferous area. Pores oblique. Marginal tubercles in vertical linear series.



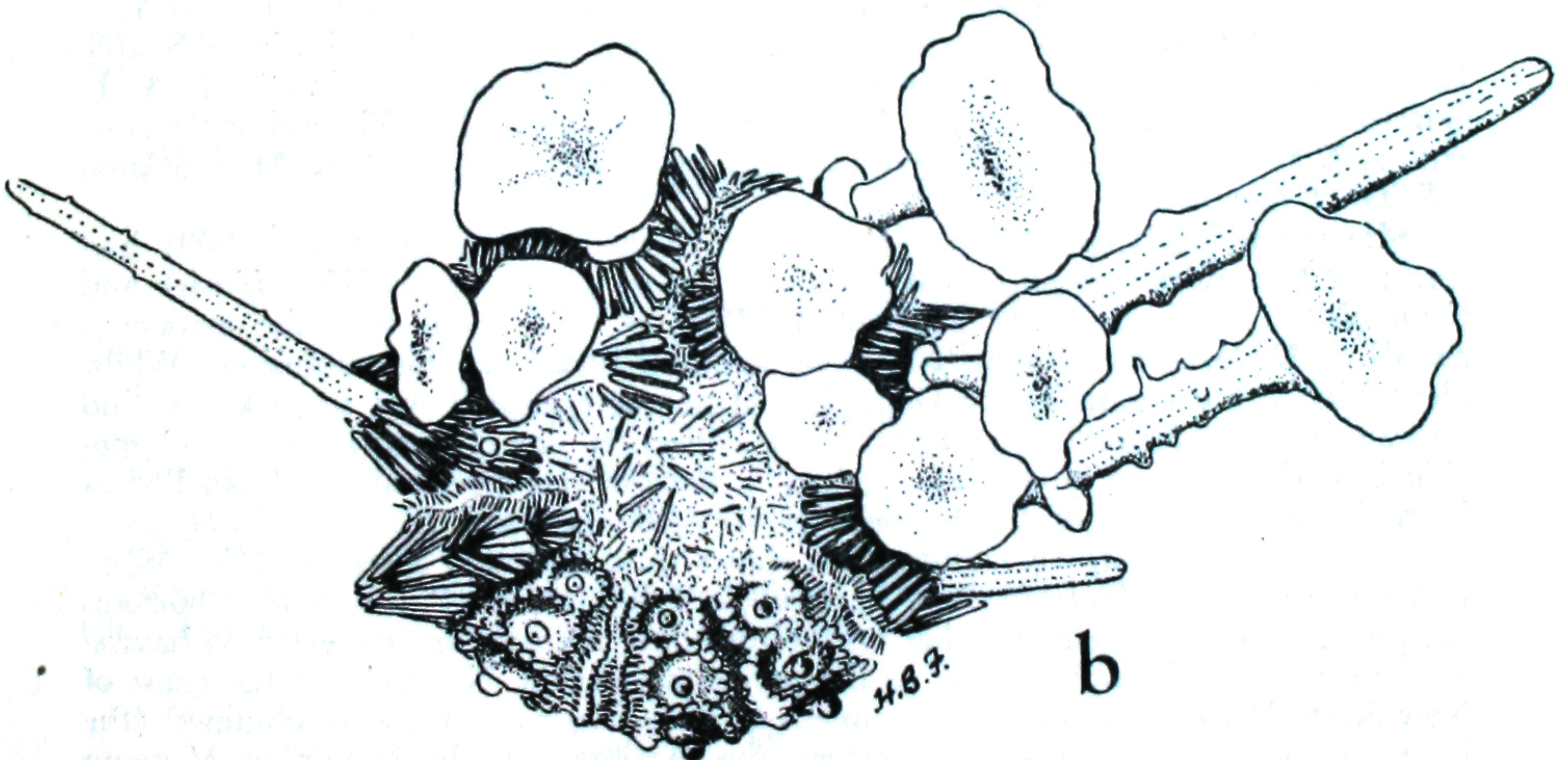
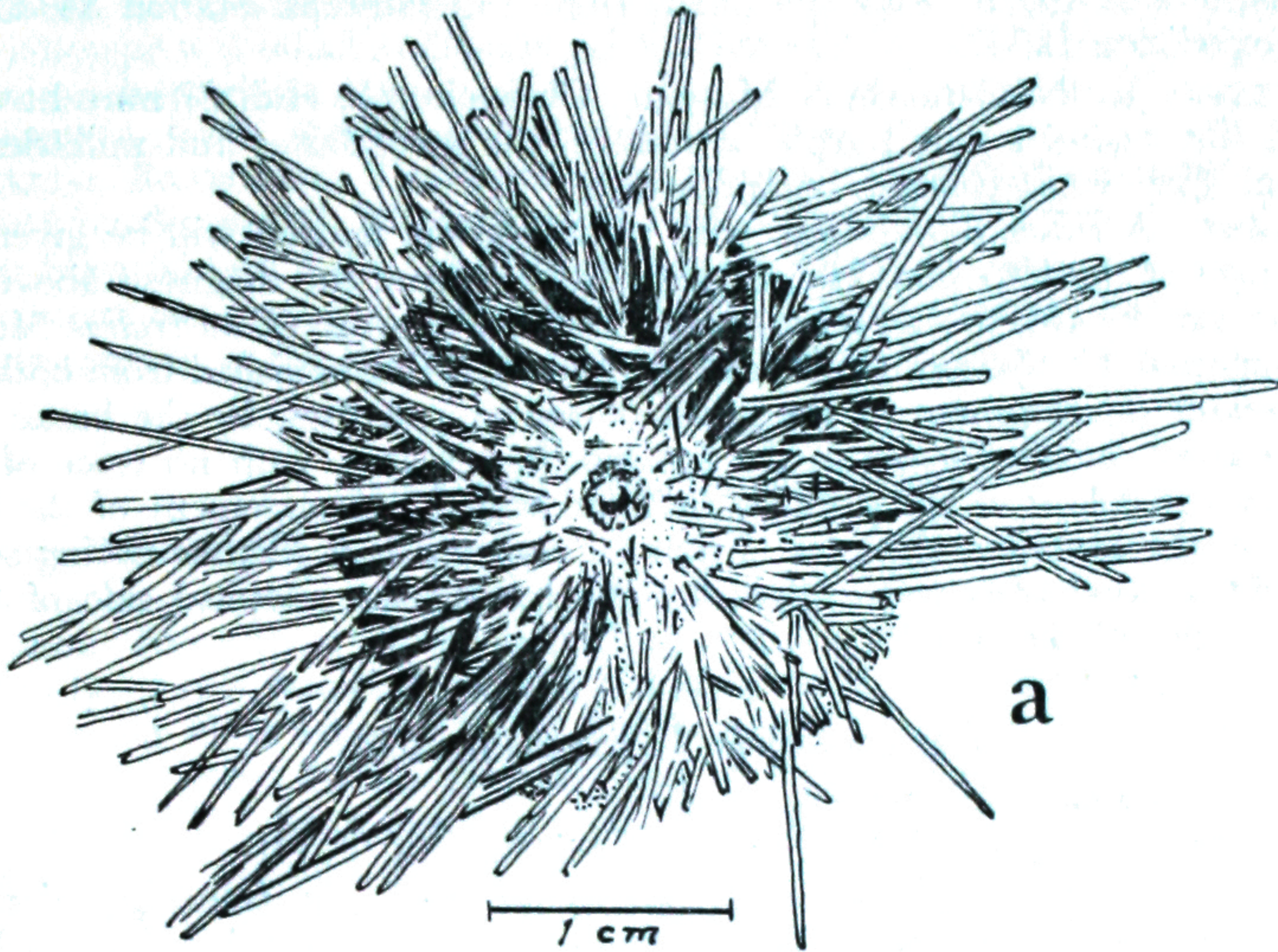


PLATE 5

a, *Pseudechinus flemingi* sp. nov., immature paratype of ca. 25 mm h.d., showing relatively long primary spines at that stage. b, *Goniocidaris (Aspidocidaris) parasol* sp. nov., holotype, partly denuded. Both echinoids to the same scale, as shown.

Internal tubercles 2 or 3 to each plate, in more or less vertical linear series. The median area is sunken, completely naked, and forms a conspicuous, vertical furrow, weakly sinuous but not following a zig-zag course, and with no abrupt changes in its width from plate to plate. About 7 IA plates. Primaries cylindrical, slender, developing a wide distal disc in the case of the adapical radioles; the disc is somewhat excentric, the adapical side being larger. In the adult, a fully-formed disc is almost as large as the apical area, and about 15 to 20 such discs may be present, forming a complete shielding system over the aboral surface. Oral primaries more or less spearhead-shaped, with lateral teeth sometimes evident near the base.

**MATERIAL EXAMINED:** Five specimens from 130 fathoms, Station 34, Chatham Islands Expedition 1954.

**HOLOTYPE:** In the Canterbury Museum, Christchurch, H.d. 27 mm, ht. 17 mm. Colour in life, radioles pale purple or mauve, the secondaries and miliaries a rich red-brown. Test, when cleaned, creamy white.

**REMARKS:** A fuller description, with photographic figures, will be given in the official report of the Chatham Islands Expedition. From the diagnosis above, it will be evident that the two species most similar to *G. parasol* are *G. australiae* Mortensen and the Japanese *G. clypeata* Döderlein. *G. parasol* is distinguished from both species by the greater development in the adult of the apical discs, by the broad, almost straight, sunken, naked furrow in the interporiferous area, with no trace of zig-zag furrows, by the colour of the primary radioles, and the arrangement of the internal tubercles on the ambulacral plates. From *G. clypeata* it is further distinguished by lacking the deckled edge to the disc, and by having the adapical side of the disc larger than the abapical side.

### *Ogmocidaris* Mortensen, 1921

#### *Ogmocidaris benhami* Mortensen

Mortensen, Th., 1921. *Vid. Medd. dansk naturh. For.*, 73, 151.

**MATERIAL EXAMINED:** Seventy-five specimens from the following deep-water stations: 400 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S.210, 1 large individual (h.d. 30 mm, longest primaries 70 mm), and several juveniles; 290 fathoms, Chatham Rise, Station 59, Chatham Islands Expedition 1954, 1 specimen; 270 fathoms, off Mayor Island, Bay of Plenty, Dom. Mus. Station B.S. 209, 10 specimens; 200 fathoms, S. of Cape Kidnappers, *Kotuku* Station 5, J. A. F. Garrick, 1 specimen; 124 fathoms, Bay of Plenty, Station N.P.6, 56 specimens; same region, N.P.9, 2 specimens; 113-120 fathoms, off Mayor Island, Dom. Mus. Station B.S.208, 1 specimen.

Mortensen (1921, p. 151) drew attention to the fact that Benham (1909) had confused *Porocidaris elegans* Agassiz (now referred to the genus *Histocidaris*) and *Ogmocidaris benhami*; later Mortensen (1928, p. 76) noted that the erroneous record of *Histocidaris elegans* from New Zealand rested on this confusion. Whilst identifying echinoderms at the Dominion Museum recently I was surprised to find two specimens of *Histocidaris elegans* in the collection, one of them labelled "*Ogmocidaris benhami*", the other "*Porocidaris*". Both of the specimens were labelled as from "300 miles east of Cape Farewell, in 1,100 fathoms, *H.M.S. Challenger*". Reference to the *Challenger* Station list shows that, although a station (No. 165c) was worked "334 miles from Cape Farewell, in 1,100 fathoms", it was not a bottom-sample, and no echinoids or other bottom-dwelling animals are recorded as having been taken. On the other hand, at the preceding station, No. 164, off the coast of New South Wales, a number of specimens of *Porocidaris elegans* were obtained (the holotype included). Probably, therefore, the specimens at the Dominion Museum were derived from New South Wales, and the error in locality on the labels arose from a previous error in writing 165c instead of 164. It is not known how this *Challenger* material came to be deposited at the Dominion Museum, but it may be inferred that some exchange was negotiated when the vessel was in Wellington. A large pycnogonid in the museum of the Department of Zoology, Victoria University, is believed to have been acquired from the *Challenger* in this way.

Order **Echinothurioida**Family **ECHINOTHURIIDAE***Phormosoma* Wyville Thomson, 1874**Phormosoma rigidum** Agassiz

Agassiz, A., 1881. *Challenger* Echinoidea, p. 104, Pl. 12.

**MATERIAL EXAMINED:** None.

The holotype was taken at *Challenger* Station 169, in 700 fathoms, off East Cape.

**Phormosoma bursarium** Agassiz

Agassiz, A., 1881. *Challenger* Echinoidea, p. 99, Pl. 10.

**MATERIAL EXAMINED:** Two specimens from the Chatham Islands Expedition 1954, one from Station 41, 330 fathoms ("rich, saturated red-purple", G. A. Knox), the other from Station 6, in 220 fathoms, on the Chatham Rise.

The species has not been recorded from New Zealand before, but as it is known to be wide-ranging in the Pacific, its occurrence was to be expected.

*Araeosoma* Mortensen, 1903**Araeosoma thetidis** (H. L. Clark)

*Asthenosoma thetidis* Clark, H. L. 1909. *Bull. Mus. Comp. Zool.*, 52, p. 134.

**MATERIAL EXAMINED:** Four individuals; also a large, isolated primary hoof, believed to be of this species, from 400 fathoms, Cook Strait, VUZ Station 87; 100–130 fathoms, off Plate Island, Bay of Plenty, coll. F. J. Shirley of the *Zuyder Zee*, 5/6/1957, 1 specimen; 40–125 fathoms, Bay of Plenty, N.P.8, 2 specimens and 60–100 fathoms, N.P.9, 1 large specimen, h.d. 180 mm.

This large and striking species, of a deep red-purple colour, was first taken by the *Terra Nova* in 70 fathoms, off North Cape, see Mortensen (1921).

*Asthenosoma* Grube, 1868**Asthenosoma gracile** Agassiz

Agassiz, A., 1881. *Challenger* Echinoidea, p. 89, Pl. 17.

**MATERIAL EXAMINED:** None.

Recorded from *Challenger* Station 169, in 700 fathoms, off East Cape.

Order **Temnopleuroida**Family **TEMNOPLEURIDAE***Temnopleurus* L. Agassiz, 1841" **Temnopleurus reynaudi** " Agassiz.

Agassiz, A., 1881. *Challenger* Echinoidea, p. 107.

**MATERIAL EXAMINED:** None.

Recorded from *Challenger* Station 166, in 275 fathoms, 199 miles north-west of Cape Farewell. This record needs investigation.

*Pseudechinus* Mortensen, 1903**Pseudechinus huttoni** Benham

Benham, W. B., 1908. *Ann. Mag. Nat. Hist.* 8, p. 104.

**MATERIAL EXAMINED:** Nine specimens from deep water, as under: 250–300 fathoms, off E. Otago, Dom. Mus. Station B.S.191, 7 specimens; 120 fathoms, off E. Otago, edge of Canyon A, Dom. Mus. Station B.S.189, 2 specimens.

The species has previously been recorded from shelf stations.

*Pseudechinus flemingi* sp. nov. Plate 3, Fig. A (holotype), B; Plate 5, Fig. a, paratype.

**DIAGNOSIS:** Test hemispherical, the oral side rather flattened in the adult stage. Primary ambulacral tubercles contiguous throughout the ambulacrum; enlarged secondary tubercles form a vertical series adradial to the primaries, but these tubercles are much smaller than the primaries. Primary interambulacral tubercles not contiguous; enlarged secondary tubercles lie on either side of the primary, on the admedial side about 2 larger ones and 2 or 3 smaller ones, on the adradial side 2-6 usually arranged in horizontal series of 2 or 3, either one series or two such series occurring on alternating plates. The miliary tubercles are scattered thinly on the surface, but around the primary tubercle they form linear series, which are feebly united by sculptured ridges into a radiating pattern of spokes. On immature specimens a similar pattern is seen investing the primary tubercle of each ambulacral plate also, but this later disappears (compare Figs. A and C, Plate 5). Oculars all exsert. Primary spines 20 to 30 mm long.

**HOLOTYPE:** Test h.d. 52 mm, ht. 29 mm, in the Dominion Museum, Wellington.

**MATERIAL EXAMINED:** Over 300 specimens (but mostly juveniles, many of them broken) from the following deep-water stations: 250-300 fathoms, Canyon B, off east Otago, Dom. Mus. Station B.S.191, 16/8/1955, holotype specimen and one other smaller individual; 330 fathoms, Station 41, Chatham Islands 1954 Expedition, about 300 specimens; 260 fathoms, Station 52, Chatham Rise, Chatham Islands 1954 Expedition, 5 specimens; 220 fathoms, Station 6, Chatham Rise, Chatham Islands 1954 Expedition, 5 specimens; also other material from 30 to 94 fathoms from Mernoo Bank and Station 29, in the Chatham Islands area.

Colour in life (and in spirit), the spines a brilliant orange-red, or deep salmon tint, with white tips. These are normally so densely matted as to obscure the underlying test but this, when denuded, is seen to be a rich rose-red with paler rose tubercles. The species is the most brilliantly coloured echinoid so far discovered in the New Zealand fauna, and is much brighter than *Pseudechinus albocinctus* (Hutton), a species which it otherwise much resembles.

**REMARKS:** In the form of the test, the general preponderance of red colours, the white-tipped spines, and the arrangement of the tubercles in vertical and horizontal rows, *Pseudechinus flemingi* agrees closely with *P. albocinctus*. The two species are otherwise very different in appearance because the spines in *albocinctus*, though white-tipped, do not exceed 12 mm in length, and do not obscure the test, and their dull reddish-brown colour contrasts with the brilliant orange-red or deep salmon colour of *flemingi*. Obvious differences in the denuded test are the absence of the radiating sculpture from *albocinctus*, and the presence of weak crenulation on the primary tubercles of *albocinctus*. In the adult stage *flemingi* also presents weak admedian grooves on aboral interambulacral plates. No other species of *Pseudechinus* is at all closely related.

The presence of the weak radial sculpture and the admedian interambulacral grooves is a Temnopleurid character not hitherto reported from any species of *Pseudechinus*, and provides welcome evidence that the genus is correctly placed in the family *Temnopleuridae*. It is desirable to state here, however, that a careful examination of very young specimens of *Pseudechinus albocinctus* and *Pseudechinus novaezelandiae* from South Island stations has revealed faint traces of such radiating sculpture on the test plates. This disappears long before maturity is reached.

*Pseudechinus flemingi* occurs in Castlecliffian (Pleistocene) sediments near Wanganui, and has been known to me for some time through specimens collected by Dr. C. A. Fleming of the New Zealand Geological Survey. The fortunate discovery of living examples enables a recent specimen to be selected as the holotype.

**Order Clypeasteroida****Family CLYPEASTERIDAE*****Clypeaster* Lamarck, 1801*****Clypeaster australasiae* (Gray)**

*Echinanthus australasiae* Gray 1851. *Proc. Zool. Soc. Lond.*, p. 34.

**MATERIAL EXAMINED:** Three specimens, two of which possibly are from beyond the continental shelf: Station N.P.8, 40–125 fathoms, Bay of Plenty, 2 specimens; 60–100 fathoms, N.P.9, Bay of Plenty, 1 specimen.

All material so far recorded from New Zealand has been from this area (see Fell, 1949, p. 345).

**Family LAGANIDAE*****Peronella* Gray, 1855*****Peronella hinemoae* Mortensen**

Mortensen, Th., 1921. *Vid. Medd. dansk naturh. For.*, 73.

**MATERIAL EXAMINED:** Seven specimens from the same two stations, N.P.8 and N.P.9 given under *Clypeaster australasiae* immediately above.

**Order Spatangoida****Family SPATANGIDAE*****Spatangus* Gray, 1825*****Spatangus multispinus* Mortensen**

Mortensen, Th., *Vid. Medd. dansk naturh. For.*, 79, p. 413.

**MATERIAL EXAMINED:** Sixty-three specimens from deep water, apart from shelf specimens which are not listed: 435 fathoms, Cook Strait, VUZ Station 77, fragments; 400 fathoms, Cook Strait, VUZ Station 96, 1 small specimen; 250–350 fathoms, Cook Strait, VUZ Station 53, 30 specimens; 330 fathoms, Station 41, Chatham Islands 1954 Expedition, 1 specimen; 290 fathoms, Chatham Rise, Station 59, Chatham Islands 1954 Expedition, 2 specimens; 280 fathoms, Chatham Rise, Station 7, 18 specimens; 260 fathoms, Chatham Rise, Station 52, 10 specimens; 220 fathoms, Chatham Rise, Station 6, 1 specimen.

**REMARKS:** Until now, the only specimen for which a precise locality and depth had been recorded was one taken in 20 fathoms off Cape Campbell (Fell, 1952, p. 35); Mortensen's type was received by him without details. It is now evident, from the rich material listed above, that the species is decidedly a deep-water one, and that the odd specimens we have received from the Cook Strait shelf are probably derived from the deep-water population near at hand. As Mortensen (1951) points out, *Spatangus multispinus* is closely related to *S. raschi* Lovén, of European seas, differing mainly in having the test more flattened on the aboral side.

***Paramaretia* Mortensen, 1950*****Paramaretia multituberculata* Mortensen**

Mortensen, Th., 1950. *Vid. Medd. dansk naturh. For.*, 112, p. 160.

**MATERIAL EXAMINED:** Twenty-five specimens, and fragments of others, from the following deep-water stations: 330 fathoms, Station 41, Chatham Islands 1954 Expedition (specimens are visible in a colour film made at this station, though they are not represented in the collection submitted); 280 fathoms, Chatham Rise, Station 7, Chatham Rise, Chatham Islands 1954 Expedition, 2 specimens; 260 fathoms, Chatham Rise, Chatham Islands 1954 Expedition, 2 specimens; 155 fathoms, Station 40, Chatham Islands 1954 Expedition, 21 specimens.

REMARKS: This is a new record for New Zealand, the species having previously been taken only in Bass Strait. Photographs of the New Zealand form will be given in the official report of the Chatham Islands 1954 Expedition. The "large, but fragmentary Palaeopneustid echinoid" mentioned as having been taken at *Discovery* Station 2733 (Chatham Rise) (Fell 1952, p. 2) proves to be this species. An unbroken specimen was later sent to me for identification by the *Discovery* authorities, but was unfortunately broken in transit. The identification, however, is beyond doubt.

Family LOVENIIDAE  
*Echinocardium* Gray, 1825

*Echinocardium cordatum* (Pennant)

*Echinus cordatus* Pennant, T., 1777. *British Zoology*, 4, p. 58, Pl. 34.

MATERIAL EXAMINED: Numerous specimens of which 11 are from stations beyond the continental shelf: 154 fathoms, Milford Sound, N.Z. Oceanographic Institute Station A319, 5 specimens; 130 fathoms, Milford Sound, N.Z. Oceanographic Institute Station A320, 6 specimens.

Family BRISSIDAE  
*Brissopsis* L. Agassiz, 1840

*Brissopsis oldhami* Alcock

*Brissopsis oldhami* Alcock, 1893. *J. Asiatic Soc. Bengal*, 62, p. 174, Pl. 8 (7-8).

*Brissopsis zealandiae* Mortensen Th., 1921. *Vid. Medd. dansk naturh. For.*, 73, p. 193, Pl. 6, 33-34.

MATERIAL EXAMINED: About 300 specimens from the following stations: 550 fathoms, Cook Strait, VUZ Station 101, about 30 specimens; 430 fathoms, Cook Strait, VUZ Station 97, 5 specimens; 435 fathoms, Cook Strait, VUZ Station 77, very abundant—about 200 specimens brought back to land; 400 fathoms, Cook Strait, VUZ Station 87, several specimens; 380 fathoms, Cook Strait, VUZ Station 96, 40 specimens; 380 fathoms, Cook Strait, VUZ Station 100, several specimens; 250-350 fathoms, Cook Strait, VUZ Station 53, 2 juvenile forms; 200-250 fathoms, Cook Strait, VUZ Station 10, 9 specimens; 50-200 fathoms, Cook Strait, VUZ Station 54, 2 juvenile specimens; 330 fathoms, Station 41, Chatham Islands 1954 Expedition, 23 juvenile specimens; 260 fathoms, Station 52, Chatham Rise, Chatham Islands 1954 Expedition, 3 juvenile specimens.

REMARKS: Until now the genus *Brissopsis* has been recorded from New Zealand on only two occasions, one as *Brissopsis luzonica*, collected by the *Challenger* at Station 168, 1,100 fathoms, off Cape Kidnappers (Agassiz, 1881, p. 189), the other by Mortensen (1921), as *Brissopsis zealandiae*, at a depth of 75 metres, off Bare Island (holotype and one paratype). The very rich material now at our disposal makes it desirable to reassess the systematic status of the earlier records.

First, as regards "*Brissopsis luzonica*", it can be stated that this probably rests upon an error of identification. Following the recent discovery of large numbers of *Brissopsis oldhami* Alcock at Cook Strait abyssal stations, with no sign of other species, it appeared possible that the *Challenger* record might have been based on the latter species. Accordingly I forwarded two Cook Strait specimens to Miss A. M. Clark at the British Museum of Natural History and asked if they could be compared with the *Challenger* specimens of "*B. luzonica*" from Station 168. Miss Clark kindly located the *Challenger* material. There proved to be only a single specimen which, Miss Clark writes (personal communication 28/11/1957) "is very small and very broken. The apical system remains in one piece and although there are only 6 or 7 pore-pairs in the posterior petals they appear to form a straight, rather than sinuous

line, the two petals diverging. I think you can say it is not *luzonica*". The condition described by Miss Clark recalls that found in the young stage of *B. oldhami*.

*Brissopsis zealandiae* was established by Mortensen (1921) on the basis of two small specimens, said to be distinguished from *B. oldhami* in having 5 (instead of 4) ambulacral plates cut by the subanal fasciole, the posterior petals more divergent, an elevated periproct, smaller size, and small genital pores; the photograph of the holotype also indicates a more compact test, with steeper anterior and posterior faces, than in *B. oldhami*. After examining the very large sample of *Brissopsis oldhami* from Cook Strait, including specimens of a wide range of size, I have come to the following conclusions. (1) In most specimens it is difficult to decide exactly how many plates enter the subanal fasciole, but in those specimens where the outlines are quite distinct, the character is variable—either 4 or 5 ambulacral plates are involved with about equal frequency, and sometimes 4 plates plus a minute portion of a fifth plate. (2) The posterior petals are divergent in the size-range corresponding to that of Mortensen's types, but they become successively less so with increasing size (i.e., age). (3) The periproct may be elevated or not, according to the specimen. (4) There is no sharp distinction in size—the large specimens corresponding to Alcock's form intergrade imperceptibly with the smaller stages corresponding to Mortensen's. From VUZ Station 77 every stage from 10 mm to 80 mm length form one homogeneous population. (5) The size of the genital pores varies, though they are always relatively large in adult stages. In the small stages corresponding to Mortensen's material the pores are sometimes very small, but this scarcely means anything more than that they are juvenile stages of a large species. (6) Shape—here there appeared to be a hiatus between my material and Mortensen's type. However, Mortensen (1951, p. 397) mentioned that a second specimen was sent to the Dominion Museum. As this was not figured by him, I applied to Dr. R. K. Dell for permission to examine it. To my surprise it proves to have precisely the same shape as that normal for all my young stages of *oldhami*, and I am now convinced that Mortensen's holotype was abnormal in that one regard. Also the subanal region of the syntype had not been denuded, and it is difficult to distinguish reliably how many plates enter the fasciole unless this is done. It is therefore clear that Mortensen's original description must have been based mainly on the holotype only. In view of the evidence here assembled I conclude that *Brissopsis zealandiae* is a synonym of *B. oldhami* Alcock, and that all New Zealand specimens of *Brissopsis* so far seen are to be referred to the latter species. Photographs of the new material will be included in the official report of the Chatham Islands 1954 Expedition.

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