

# ECHINOIDEA, ASTEROIDEA, AND OPHIUROIDEA FROM DEPTHS EXCEEDING 6000 METERS

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## ECHINOIDEA

### Irregularia

#### POURTALESIIDAE

*Pourtalesia* sp., ? *aurorae* Koehler 1926.

Textfig. 1.

*Pourtalesia aurorae* KOEHLER 1926, pp. 43-48, pls. 105<sub>1-8</sub>, 121<sub>3</sub>.

Galathea St. 495. Banda Trench, 5°26'S, 130°58'E, 7250-7290 m. - Many small fragments.

This record represents the hitherto deepest made find of any Echinoid, but unfortunately the specimens were so badly damaged in the trawl that only a heap of small, deep violet fragments are left. The fragments are of a Pourtalesiid with subanal rostrum, but otherwise nothing definite can be said about the shape of the specimens when intact. The size may have been about 3-5 cm. The number of specimens can not be stated, but besides a fragmentary subanal rostrum there are also fragments of two periprocts. A number of smooth primary spines, up to 7 mm long, are preserved and there are numerous secondary, very small spines of about 0.7 mm in length. A few large ophicephalous pedicellariae (fig. 1 *a, b*) and also a few rostrate ones (fig. 1 *c, d*) were found on the subanal rostrum. The ophicephalous pedicellariae have valves about 0.6 mm long and provided with 4 teeth. One of these pedicellariae appeared to be 4-valved because one of the valves was bifurcate. The valves of the rostrate pedicellariae are about 0.2 mm.

The ophicephalous pedicellariae show that the fragments belong to a species of *Pourtalesia*, but they are, on the other hand, somewhat different from those hitherto known, viz. from *P. miranda* A.Ag. (incl. *P. wandeli* Mrtsn), *P. jeffreysi* Wyv. Th., *P. alcocki* Koehler, and *P. laguncula* A.Ag., the ophi-

cephalous pedicellariae of these species all having a large number of teeth. Ophicephalous pedicellariae are unknown in the other species of *Pourtalesia* described, but among these *P. tanneri* A.Ag. have rostrate pedicellariae different from those of the present species; and *P. hispida* A.Ag., the rostrate pedicellariae of which would seem to be like those of the present fragments, have primary spines with min-

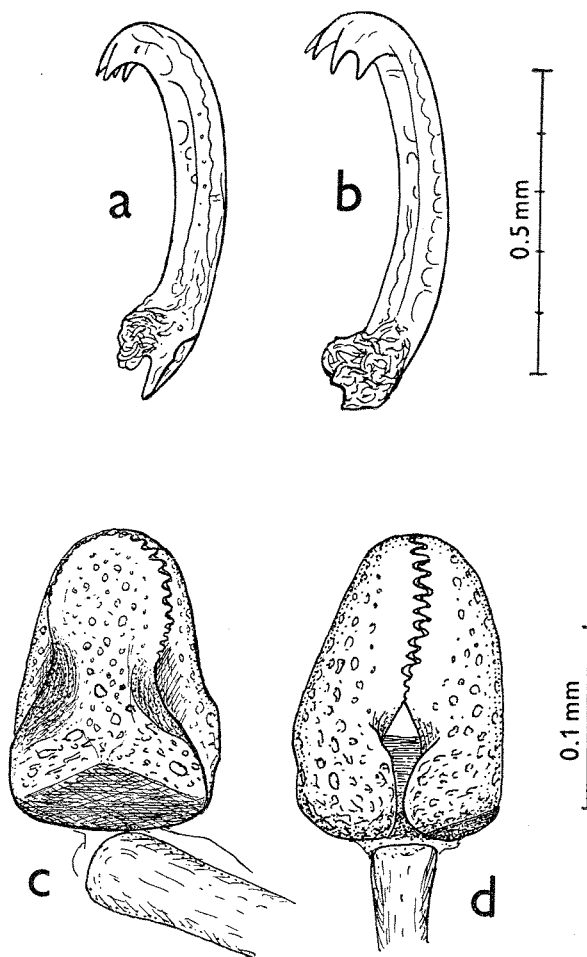


Fig. 1. *Pourtalesia* sp., ? *aurorae* Koehler. *a-b*, valves of ophicephalous pedicellariae. *c-d*, rostrate pedicellariae from subanal rostrum.

ute thorns whereas those of the present species are smooth. *P. debilis* Koehler have both rostrate pedicellariae and primary spines as those of the Galathea fragments, but its colour is stated to be "gris clair" (in alcohol), whereas the present fragments have retained their deep violet colour also in alcohol.

Then *Pourtalesia aurorae* Koehler remains, and it is very unfortunate that ophicephalous pedicellariae are not known from this species, since the Galathea fragments seem to agree with it in other characters. The rostrate pedicellariae and the primary spines are similar and so is the colour, which in fresh specimens of *P. aurorae* was recorded to be 'reddish-brown' and "d'un violet très foncé" in alcoholic specimens. The affinity of the present fragments with KOEHLER'S *Pourtalesia aurorae* would thus seem probable, and I record them, therefore, with a query under this name. Only a possible future knowledge of the ophicephalous pedicellariae of good specimens of *P. aurorae* can, however, decide whether the Galathea specimens actually belong to this species.

#### Distribution:

*Pourtalesia aurorae* has been recorded from three localities in the Antarctic Sea, about 63°-65°S. and 95°-102°E., at depths of 440 to 1690 m, whereas the Galathea specimens were taken in the Banda Sea at a depth of about 7270 m. The species has a very wide bathymetrical distribution – provided that the identification is correct – although not extraordinarily wide, since e. g. the Atlantic *P. miranda* A.Ag. has a range from about 500 to 5860 m.

## OPHIUROIDEA

### OPHIOLEPIDAE

#### *Ophiura loveni* (Lyman 1878)

Textfig. 2. Pl. 1, figs. 5-10.

*Ophiuroglypha loveni* LYMAN 1878 p. 80 pl. 4<sub>109-111</sub>.

*Ophiuroglypha loveni* LYMAN 1882 p. 53 pl. 8<sub>1-3</sub>.

Galathea St. 658. Kermadec Trench, 35°51'S., 178°31'W., 6660-6720 m. – 177 specimens.

The specimens vary in diameter of disk from 8 mm to 18 mm, and most of them measure 14-15 mm. Only a few specimens had some of the arms preserved, and the distalmost tip of the arms is always

missing. Probably nearly complete arms measured 45 mm, both in a specimen 11 mm in disk diameter and in another one 16 mm in disk diameter. The longest detached arm measures 58 mm. The shape of the disk varies from pentagonal with the sides concave to circular.

These specimens clearly belong to the species *O. loveni* described by LYMAN, 1878, on specimens collected by the Challenger Expedition in the southern Indian Ocean at depths from 2510 to 4755 m. The present large series of specimens shows, however, a fairly wide range of variation. This variation is partly illustrated by the accompanying figures, fig. 2 *a* and *d*. Fig. 2 *a* shows the oral aspect of a specimen, 15 mm in disk diameter, which agrees fairly well with the somewhat larger type-specimen figured by LYMAN in 1878, pl. 4<sub>109-111</sub>. The Galathea specimen has the ventral interradiar area covered by numerous small scales as has the type, and also its dorsal side agrees with that of the type, being covered with even more numerous and smaller scales than orally. The second specimen figured here, fig. 2 *d*, has fewer and therefore also larger scales both orally and aborally; and other specimens may have still fewer scales.

The shape of the oral plates varies from pentagonal with the inner sides concave, as the left one of fig. 2 *a*, to broad oval, as in fig. 2 *d*. Oral plates of a distinctly broad arrowhead shape may also be found, but these probably are abnormal. The adoral plates follow the inner angle of the orals, and consequently the jaw plates vary in shape from rhomboidal to triangular. The number of mouth papillae is usually 6 or 5, but there may be 7 or, as an abnormality, only 3 small, scattered ones. Very often 2 or 3 of the basal mouth papillae are fused together into one large papilla so that the number of papillae becomes 5 or 4, and exceptionally only 3. One distal, large and triangular tooth is the rule, but there may be 2 smaller teeth. The shape of the ventral arm plates is also varying; the second plate may thus vary from completely square to nearly triangular. From the fourth or fifth plate the shape becomes broad oval with a peak inwards. Usually only the first two ventral arm plates are in contact, but also as many as 5 plates may be contiguous, as shown in fig. 2 *e*. The number of arm spines proximally is 5 or, more commonly, 6. None of the arm spines of the present specimens are modified into hooks. The number of tentacle scales in the proximal pores varies from 3 to 8, and is generally the same on either side of the pore, but may be fewer on the

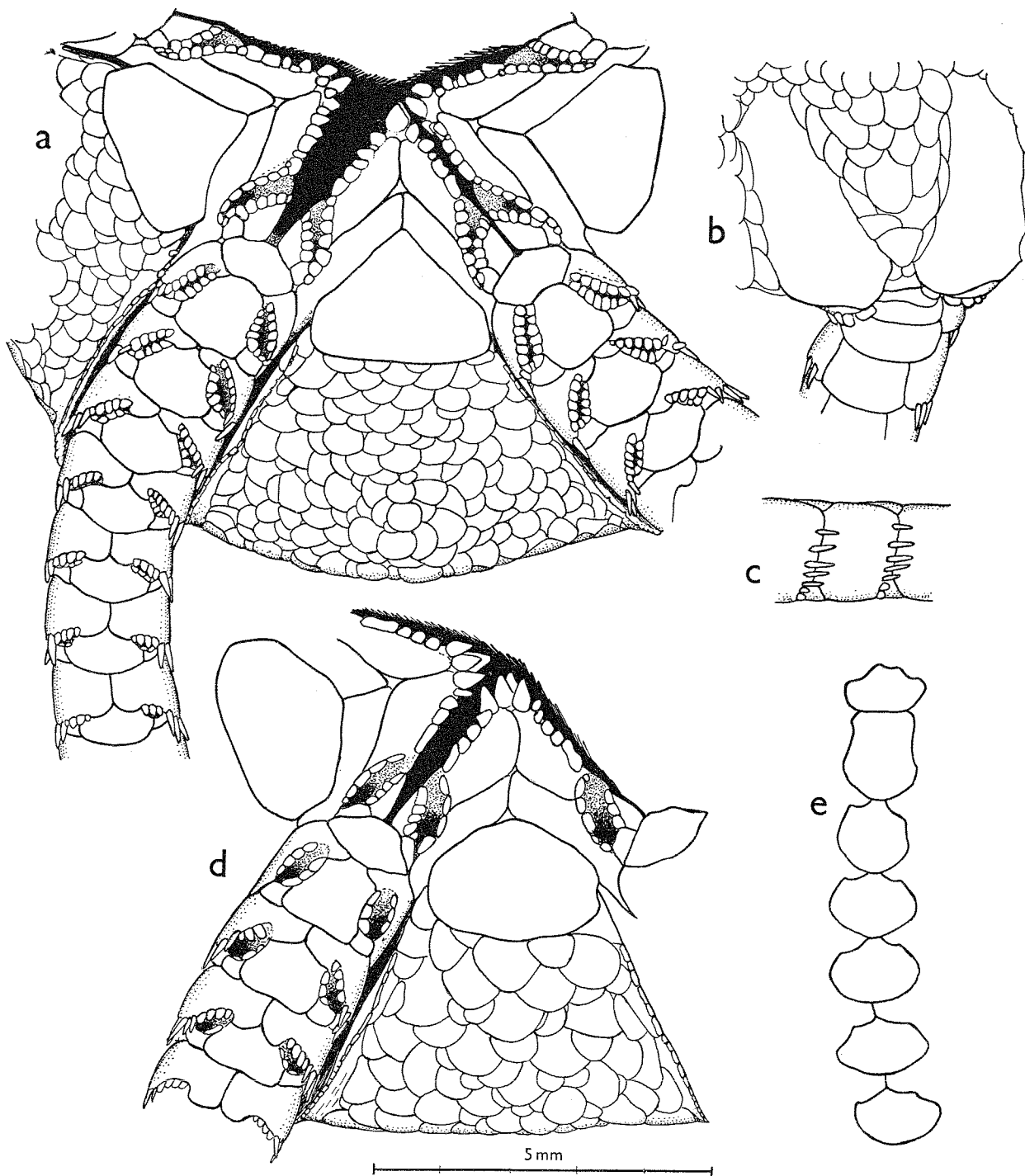


Fig. 2. *Ophiura loveni*. *a*, oral aspect of a typical specimen; *b*, radials and armbase of same; *c*, arm of same seen from the side. *d*, oral aspect of a specimen with large interradii scales and oral plates of a rather unusual shape. *e*, ventral armplates of a specimen in which rather many of them are contiguous.

inner side, where also sometimes only 1 scale is present. The shape of the radial plates varies from long oval, as in fig. 2*b*, to equilaterally triangular. The primary plates are not always easily distinguished, and sometimes they are pushed out as far as the radials. The wedge of scales separating the radial plates (cf. fig. 2*b*) usually comprises a fairly

large number of subequal scales, but one scale may be considerably larger than the others, triangular, and almost alone filling up the wedge.

The colour of the specimens when alive was greyish.

Some of the specimens contained 1 mm large embryos.

Those of the present specimens which have fairly large and few scales on the dorsal side and in the ventral interradius are intermediate between the typical *O. loveni* and LYMAN's *O. irrorata*, the type of which was taken off S. Africa at a depth of 3475 m (LYMAN 1878 p. 73 pl. 4<sub>106-108</sub>; 1882 p. 47 pl. 5<sub>7-9</sub>). Since the days of the Challenger Expedition a great number of deep-sea ophiuroids from widely scattered localities in the oceans have been referred to *Ophiura irrorata*, and some authors have also regarded a number of later described species as synonyms only of this species. Curiously enough, however, *O. loveni* has never been mentioned among the possible synonyms. MORTENSEN in 1933 p. 86 gives a list of the synonyms, and incidentally points out that H. L. CLARK, and KOEHLER (in his latest papers) went too far in including also KOEHLER's *O. mundata* among them.

MORTENSEN mentions, as one of the characters of *O. irrorata*, the peculiar "extra plate at each outer corner of the ventral plates in the basal part of the arm". This plate is found also in the present material, and is indicated in LYMAN's figure of *O. loveni*, 1882 pl. 8<sub>1</sub>, though not in his figure from 1878. It is found, however, in a specimen of *O. loveni* from the Challenger St. 146, identified by LYMAN, which I have had for comparison. MORTENSEN sees in this plate the excessively developed distal tentacle scale; but in the present material the plate itself often bears one or a few tentacle scales, as shown in the portrayed specimens.

The Challenger specimens of *O. loveni* and those collected by the Galathea differ from the type of *O. irrorata* in having more numerous and smaller scales on the dorsal side and in the ventral interradius. Of the species referred as synonyms to *O. irrorata*, the following two, *O. orbiculata* (Lyman), from the Eastern Pacific, and *O. involuta* (Koehler), from the Indian Ocean, agree with *O. irrorata* in the size of the scales, while *O. integra* (Koehler) and *O. figurata* (Koehler), both from the Antarctic Atlantic, and *O. irrorata* var. *polyacantha* Mortensen, from the North Atlantic, agree with *O. loveni*, and *O. tumulosa* (Lütken & Mortensen), from the Eastern Pacific, is intermediate. It is evident that *O. loveni* is at least very closely related to *O. irrorata*, and possibly it cannot be kept specifically distinct. At present, however, I have thought it best to record the specimens collected by the Galathea under the name of *O. loveni*, to which identification there can be no objection.

#### Distribution:

*O. loveni* undoubtedly is widely distributed in the deep-sea. The Challenger specimens were from the southern Indian Ocean, and the nominal species which in the above are considered belonging to *O. loveni* were taken in the Atlantic, in the Antarctic part and near Greenland respectively. One of the Challenger localities was south of Australia, and the Galathea specimens were taken near that area, north of New Zealand. The bathymetrical range of *O. loveni* is from about 2500 to about 6700 m. *Ophiura irrorata* to which *O. loveni* may eventually be referred has a bathymetrical range of from 400 to 5870 m.

#### Ophiuroid indet.

Galathea St. 650, Kermadec Trench, 32°20'S., 176°54'W., 6620 m. – An arm-fragment.

When the trawl came up from this station an arm-fragment of an ophiuroid was found in the meshes. It is the distal part of an arm and is thus quite unidentifiable. Its mention here is justified only by the great depth from which it came.

## ASTEROIDEA

### PORCELLANASTERIDAE

#### *Eremicaster pacificus* (Ludwig 1905).

*Porcellanaster pacificus* LUDWIG 1905 pp. 89-92, pl. 6<sub>28-29</sub>.

*Eremicaster pacificus* FISHER 1911 pp. 29-31, pl. 2<sub>1-3</sub>.

*Eremicaster pacificus* MADSEN 1951 pp. 76-78, fig. 1. (With list of literature).

Galathea St. 465. Java Trench, 10°20'S., 109°55'E., 6930-7000 m. – 5 juvenile specimens.

Galathea St. 650. Kermadec Trench, 32°20'S., 176°54'W., 6620 m. – 3 specimens.

The five juvenile specimens from the Java Trench range in size from R. 8 mm with r. 4 mm to R. 14 mm with r. 6 mm; R/r thus varying from 2 to 2.3. The number of superomarginal plates in these specimens is 6 (or 5). None of the superomarginals bear spines. The two adambulacral spines are placed on the aboral half of the plates. The number of adambulacral plates is 10 to 12. The jaws bear, besides the single spine on the tip, from 1 to 3 small spines on either side. The dorsal side may be pro-

## PTERASTERIDAE

### *Hymenaster bleqvadi* n. sp.

Textfig. 3. Pl. 1, figs. 1-3.

Galathea St. 658, Kermadec Trench, 35°51'S., 178°31'W., 6660-6720 m. – 38 specimens.

vided with rather many small spines placed centrally and interradially, but may also be almost completely naked (without the surface showing signs of having been rubbed). The ventrolateral plates are naked. The characters of these specimens thus correspond to the specimens described by LUDWIG in 1907 under the name of *Porcellanaster vicinus* var. *inermis*.

The specimens from the Kermadec Trench measure: R. 25 mm, r. 8 mm; R. ab. 29 mm, r. 10 mm; and R. 30 mm, r. 9 mm; R/r thus about 3. The number of superomarginal plates varies from 9-10 in the smallest specimen to 11 in the other two. Spines are present on all the superomarginals of the arms (apart from the distalmost one in some instances), but not on the two innermost plates in the arm angle. These spines are all broken off now, but appear to have been fairly slender. The ventrolateral plates are naked. The jaws have besides the single spine on the tip two spines on either side placed at about equal intervals. The two adambulacral spines are fair-sized and placed on the aboral half or two thirds of the plates. The dorsal side of the three specimens bear small spines centrally and interradially, either very small slender ones up to about 0.2 mm in length, or slightly more robust ones up to about 0.4 mm in length. The number of adambulacral plates is 18-20.

#### Remarks:

In my paper of 1951 I gave reasons for considering LUDWIG'S *Porcellanaster vicinus* only a synonym of his *P. pacificus*. The specimens taken by the Galathea confirm this view.

#### Distribution:

*Eremicaster pacificus* is a cosmopolitan deep-sea species. It has previously been collected in many localities in the Eastern Pacific from the Bering Sea to off Peru, and in the Mid-Atlantic, ab. 10° N., 26°W. The finds of the species in the Kermadec and Java Trenches therefore are not surprising. Its bathymetrical range was previously recorded as from 1550 to 5780 m. Now it is known to occur at least as far down in the deep-sea as about 7000 m. The species is the hitherto deepest found sea-star. The family to which it belongs, the Porcellanasteridae, is also the most exclusively deep-sea group of all sea-stars, none of its members hitherto being known from depths less than about 1000 m.

#### Diagnosis:

Species of *Hymenaster* of almost pentagonal shape and with pointed arms. The disk fairly low, with well defined, but not markedly raised paxillar radial areas. Supradorsal membrane fairly tough, fibrous, raised by the paxillar spines in low uniformly spaced protuberances. The spiraculæ of the paxillar area small, numerous and scattered. The paxillae in 4 radial rows; each paxilla with a circle of 4-7 spines. The actinolateral spines in the proximal half of the radii almost touching those of the neighbouring radius, and in the distal half of the arms reaching to the margin of the disk. One or two adambulacral spines. Jaw plates broad with 1-2 (3) suboral and 3-4 marginal spines.

#### Type-locality:

Galathea St. 658, Kermadec Trench, 6660-6720 m.

As type is selected a specimen with R. 44 mm and with 2 adambulacral spines. Figs. 3a and 3c are of the type-specimen. The type is kept in the Zoological Museum of Copenhagen.

#### Description:

The size of the 38 specimens varies from R. ab. 15 mm to R. 75 mm. Only a few of the specimens are comparatively well preserved, otherwise the material is very badly damaged. The form appears markedly stellate when the interradiial membrane is contracted and the supporting actinolateral spines bent towards the disk; but when the interradiial membrane is extended the form becomes almost pentagonal with the pointed arms not produced very much and the sides only slightly concave. R/r is about 1.5. The disk is fairly low, 17 mm high in a specimen with R. 65 mm. The radial paxillar areas are well defined, but not much raised. The radius of the paxillar area of the disk is about 16 mm in a specimen with R. 65 mm, and about 14 mm in a specimen with R. 60 mm. The proximal width of the radial paxillar areas is in the former specimen about 17 mm and varies in the latter specimen from 15 to 18 mm. The supra-dorsal membrane is fairly tough, fibrous and crisscrossed by narrow musclebands connecting the tips of the paxillar spines, which

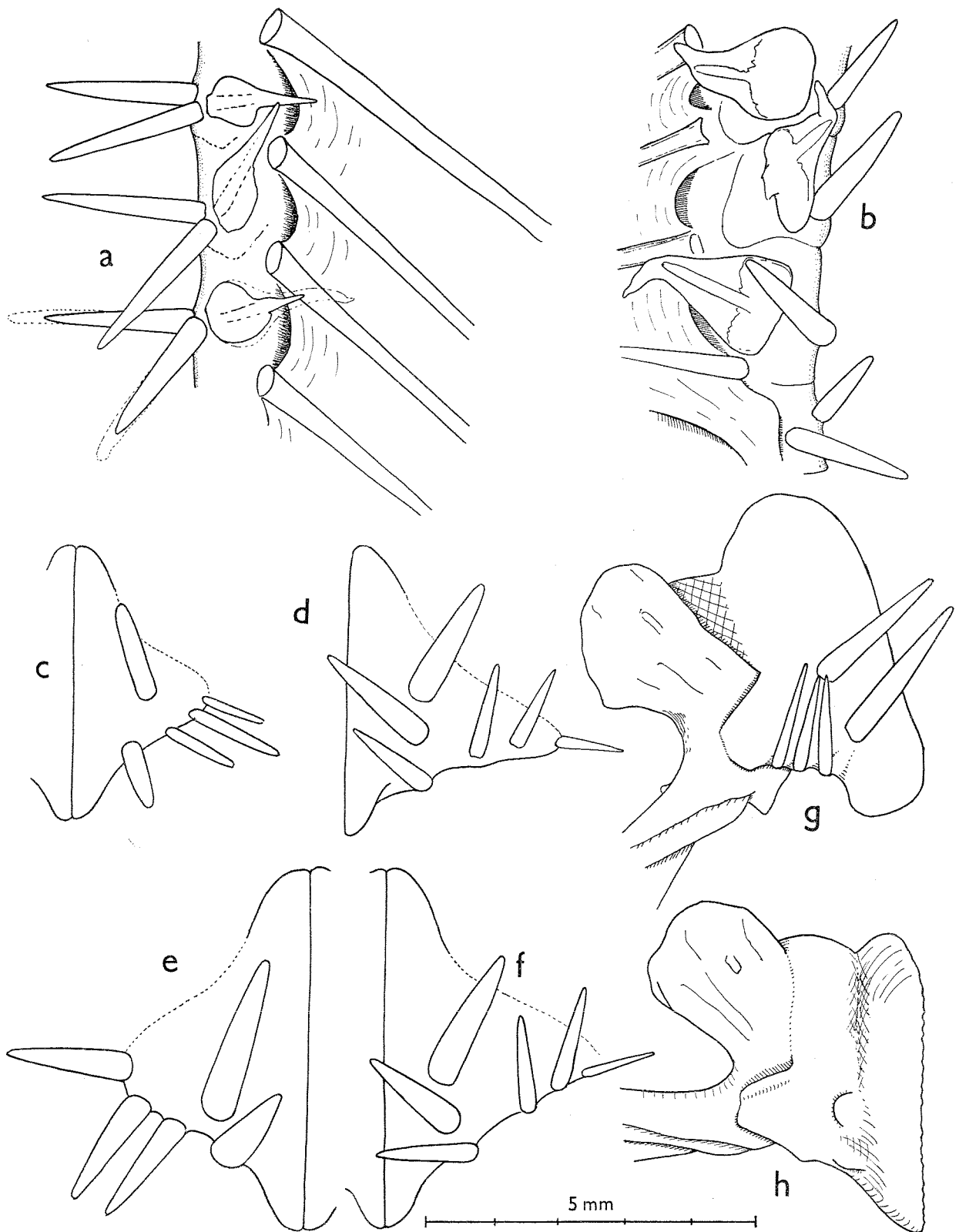


Fig. 3. *Hymenaster bleqvadi* n. sp. *a*, fourth to sixth adambulacral of the type-specimen (R. 44 mm). *b*, first to fourth adambulacral of a specimen with R. 65 mm. The adambulacral spines are portrayed naked while the aperture-papillae are shown clothed in their sacculi. *c*, mouth-plate of the type-specimen, with the oral margin in the plane of the drawing. *d*, mouth plate of the specimen with R. 65 mm, shown with the edge of the suture in the plane of the drawing; *e-f*, two mouth plates of the same specimen shown with oral margin in the plane of the drawing. *f* shows the same plate as *d*. *g*, mouth plate of a medium-sized specimen dissected free and shown directly from the side; *h*, the same plate shown with the oral margin in the plane of the drawing.

form fairly low protuberances spaced uniformly over the area. The interradial membrane is provided with spiraculae extending in single or, more often, double rows about half way out between the actinolateral spines and sometimes right to the margin.

There are 4 radial paxillar rows. Each paxilla bears a crown of usually 5 or 6 spines, but varying from 4 to 7. There is no central spine. The length of the paxillar spines varies in one of the larger specimens from 3 to 5 mm. The shaft of the paxillae is short, and their bases are connected by long and slender processes. The oscular valves are large and contain 10 to 15 spines, measuring in the larger specimens up to 8 mm in length. The paxillae forming the valves carry further on their distal side about 4 shorter spines which extend into the supradorsal membrane.

The ambulacra appear petaloid in some specimens but are not at all so in others. The actinolateral spines number about 40-45 in the largest specimens. In the more or less contracted specimens at hand the proximal third to half of these spines almost touch each other, but none of them actually join the neighbouring ones in the midline. Spines nos. 9 to 14 are the largest and measure in the large specimens up to 19 mm.

The adambulacral plates (fig. 3*a-b*) each bears an aperture papilla of which the calcareous part, about 2-2½ mm long, consists of a broad oval, scale-like portion with an acicular tip and is invested in a membrane extending beyond the tip as a slight sacculus. The adambulacral armature consists in addition of usually 2 adambulacral spines in a transverse row, about one fourth longer than the plates and with a sacculus which may be much prolonged. The superficial (ventral) one of these two adambulacral spines is often slightly larger than that deepest in the furrow, which latter may be sabre-shaped. Some specimens are slightly aberrant in having only 1 adambulacral spine. The large specimen with R. 65 mm (fig. 3*b*) thus has 1 adambulacral spine on all the plates apart from the first one, which bears 2 spines, but then there is no aperture papilla, which is otherwise always present on this plate.

The mouth plates are broad and have a broad free margin. Usually there are three slender and fairly small marginal spines rather close together on the distal half or third of the free margin, and besides there may be a somewhat larger marginal spine placed midway between the others and the tip of

the jaws. This latter spine may, however, be absent, or moved to the surface of the mouth plate – it may then be regarded as a suboral as well as a marginal spine. In row with this spine there is on the surface of the mouth plate 1 or 2, often fairly stout spines. The marginal spines, however, sometimes are just as large and stout. The combined mouth plates form a high and narrow keel.

All the specimens have had most of their outer skin rubbed off in the trawl, but there are traces of violet skin on the oral surface of some, so that it may be supposed that the specimens were violet when alive.

A few small prosobranchs and calcareous fragments of what was probably a bivalve were found in the stomachs of a few of the specimens.

#### Remarks:

More than 50 species have been named in this genus of deep-sea sea-stars since WYVILLE THOMSON in 1873 described the first one. Many of the species have been described on much damaged specimens and most of them are recorded from single localities only. I was rather reluctant, therefore, to describe the present specimens as another new species, but I have been unable to identify them with any of the previously described species of *Hymenaster*.

The new species is distinguished by the combination of its characters; and especially the low number of radial rows of paxillae is unusual for the genus.

#### *Freyella mortenseni* n. sp.

Textfigs. 4-5. Pl. 1, fig. 4.

Galathea St. 653, Kermadec Trench, 32°09'S. 176°35'W., 6140-6160 m. – Fragments of arms of one specimen.

Galathea St. 654, Kermadec Trench, 32°10'S., 175°54'W., 5850 m. – 2 fragmentary specimens and detached arms.

#### Diagnosis:

Species of *Freyella* with 6 deciduous arms. R. about 30 r, or more ( $\geq 180$  mm). Disk covered with somewhat irregularly polygonal plates, each with about 5-9 spinelets. Genital region of arms with similar plates, 4-6 across and each with 1-5 spinelets. Actinostomal plates with two marginal spines, one on the outer oral corner and one on the corner adjacent to the first adambulacralia, and with a single, slightly larger, suboral spine with truncate enlarged tip. Adambulacral plates with one aboral

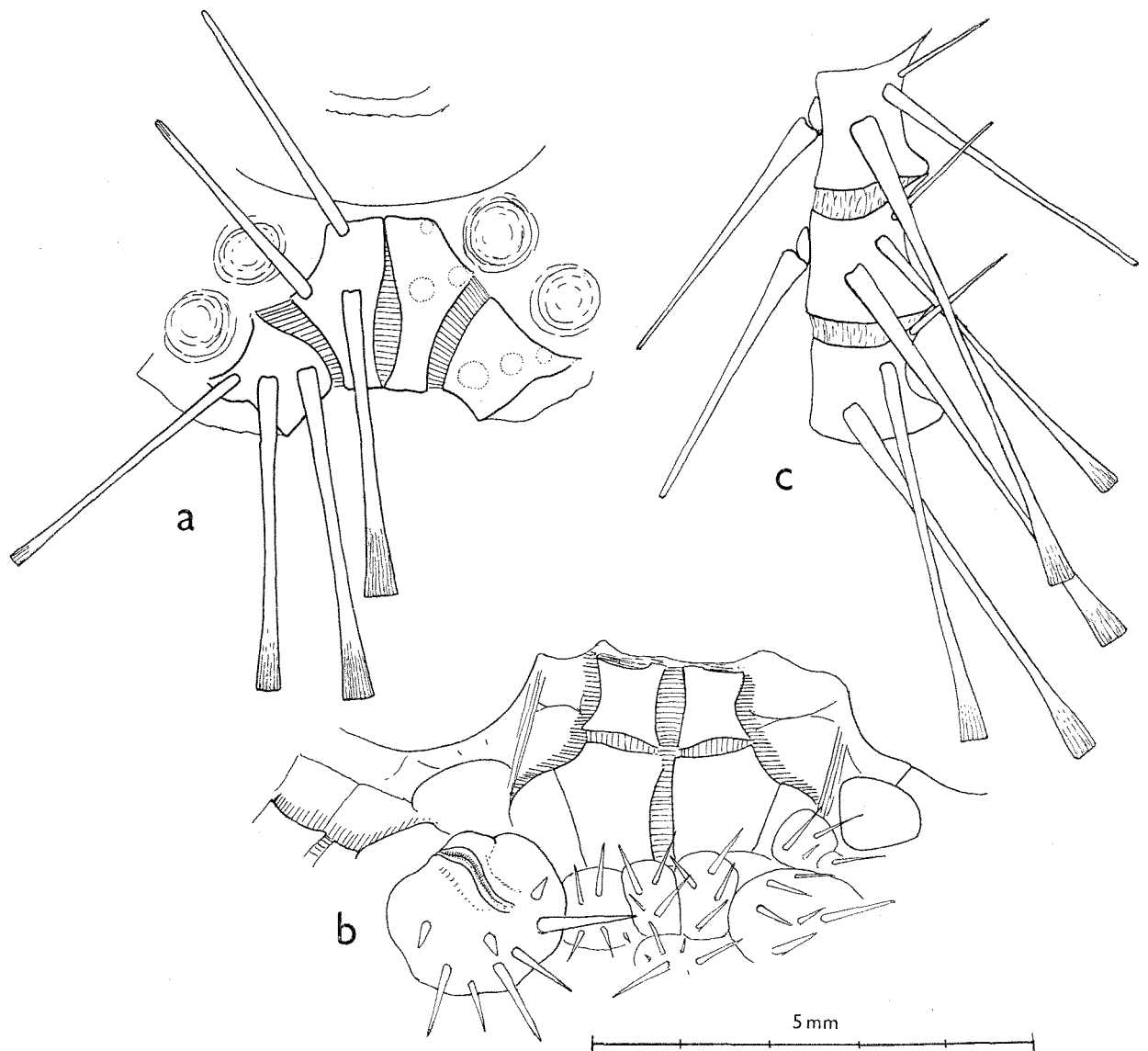


Fig. 4. *Freyella mortenseni* n. sp., type-specimen, *a*, mouth plates and the first adambulacralia, with the spine armature reconstructed on the basis of the spines preserved on different plates. *b*, part of disk from above, showing the madreporite and some of the spinous dorsal plates, besides part of the actinostomal ring and the first pairs of ambulacral plates where these have been laid bare because the covering plates have been rubbed off. *c*, adambulacral plates nos. 5-7 with their spine armature and adjacent marginalia.

furrow spine and, in the proximal part of the arms, 2 subambulacral spines in an oblique row. Distally only one subambulacral spine, and most distally also the furrow spine disappears. A small marginal plate, with a spine similar to the subambulacral ones, present at all adambulacral plates apart from the innermost 4-6. Subambulacral and marginal spines of the innermost plates usually with truncate enlarged ends.

#### Type-locality:

Galathea St. 654, Kermadec Trench, 5850 m. The type is preserved in the Zoological Museum of Copenhagen.

#### Description:

The material from St. 653, ab. 6150 m, consisting of detached arms only, would not alone have allowed a definite decision as to its taxonomic position. It is fortunate, therefore, that additional material of the same species was collected at St. 654, including also a specimen which, though fragmentary, was well enough preserved for a sufficient description and thus for deciding that a new species was represented. This specimen, selected as the type, consists of a disk of a diameter of 11 mm with four arms preserved while the two other arms are lost. The arms preserved are in succession; two of them



are long ones, measuring up to 110 mm without the missing distal part, while the other two, alternately placed, are small, regenerating. From St. 654 there is, besides some detached arms, also an additional fragmentary specimen consisting of 3 long arms connected by the dorsal skin of their disk and thus representing half an animal. The longest detached arm measures without the missing tip about 180 mm. The genital region of the large arms of the type begins 2-3 mm outside the disk, is 8 mm long and measures where broadest 5 mm. In some of the detached arms the genital region measures 13 mm. The gonads open proximally.

The disk is covered by a number of thin, irregularly polygonal scales, the largest of which are up to about 1.5 mm in diameter. Each plate bears from about 5 to 9 acicular and fairly long spinelets, up to about 1 mm long. Similar scales are found also on the dorsal side of the proximal part of the arms. In the genital area they number 4 to 6 across the arms, are often irregularly hexagonal, and provided with from only 1 to about 5 spinelets, up to 1.5 mm or slightly more in length. Dorsal scales with 1-3 spinelets are found also just outside the genital region, but not far outside they seem to disappear altogether, the arms then being covered with a thin skin with scattered pedicellariae, or with the pedicellariae collected in transverse bands.

The actinostomal plates completely separate the adambulacralia of adjacent arms and are, from oral margin to outer margin, about twice as long as wide. They bear on their oral margin, on the corner at the ambulacral furrow, a slender spine of a length of about 3 mm, and a similar one on their furrow margin, at the aboral corner adjacent to the first adambulacralia. The actinostomal plate bears further at the middle of its surface a single suboral spine a little longer than the marginal spines and measuring  $3\frac{1}{2}$ -4 mm, i. e. of about twice the length of the oral plates. This spine has the outer end enlarged and truncate.

The adambulacral plates are proximally in the arms slightly broader than long (about 1.5-2 mm), but increase gradually outwards of the genital region to a length of about 5 mm, or slightly more, by a width of only 1 mm. The adambulacral armature consists in the proximal half of the arms of a furrow spine on the aboral end of the plate and of two subambulacral spines in an oblique row, ranging in the most proximal plates from the furrow spine to the adoral outer corner, but on the longer plates outside the genital region only occupying the distal

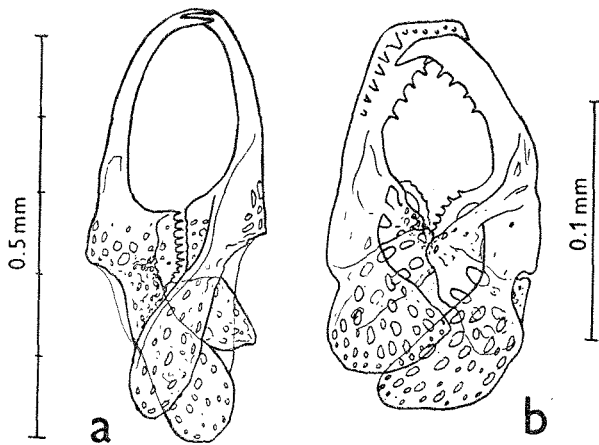


Fig. 5. *Freyella mortenseni* n. sp. Pedicellariae, a from the oral area and b from an arm.

half of the plates. In the distal half of the arms there is only a single subambulacral spine on the middle of the adambulacral plate or somewhat more aborally; and most distally in the arms also the furrow spine disappears.

The subambulacral spines measure up to about 5 mm or, exceptionally, 6 mm in length. Those on the first plates, including those of the genital region, are usually both truncate enlarged at the end, though the inner one may be acicular. Distally in the arms however, they become all very slender and acicular. The furrow spines reach in the proximal part of the arms across the furrow, measuring about 2.5 mm, but outside the genital region they decrease in length, becoming mere spinelets before they eventually disappear completely.

A very small marginal plate is present aborally of or close to the middle of all the adambulacral plates except the innermost 4-6. This small plate carries a spine similar to the neighbouring subambulacral ones. A superficial inspection of the arms thus seems to show on each ambulacral plate 3 or, distally, 2 spines, the dorsal of which, however, is the marginal one.

All the spines have been invested in a membranous sheath carrying numerous pedicellariae; those of the actinostomal plates fairly large and with curved valves (fig. 5a) those of the subambulacral spines smaller and with peculiar triangular valves (fig. 5b). Pedicellariae similar to the lastmentioned ones are found also on the dorsal skin of the arms beyond the genital region and seem mostly collected in transverse bands.

#### Remarks:

Six other species described of *Freyella* have the same small number of arms, viz. 6, as *F. mortenseni*,

and like this species they belong to the deep-sea fauna, most of them having a known bathymetrical range down to depths between 4000 and 5000 m. They show the following differences from *F. mortenseni*:

*F. mexicana* A. H. Clark 1939 differs, among other characters, in having 9-12 spines on the actinostomal plates.

*F. tuberculata* Sladen, *F. sexradiata* Perrier, and *F. giardi* Koehler all have a single spine only on the plates of the dorsal side of the genital area, and besides they have a different spine armature on the actinostomal plates.

*F. benthophila* Sladen and *F. oligobrachia* (H. L. Clark) both have a few spinelets on each of the plates of the genital area as has *F. mortenseni*. They differ, however, in having two spines on the oral

margin of the actinostomal plates and no spine on the furrow margin adjacent to the first adambulacralia. Incidentally I fail to see how it is possible to keep *F. oligobrachia* specifically distinct from *F. benthophila*.

LITERATURE cited:

- FISHER, W. K., 1911. Asteroidea of the N. Pacific I. -Bull. U. S. Nat. Mus. 76.  
KOEHLER, R. 1926. Echinoidea. - Australasian Antarctic Expd. C. 8.  
LUDWIG, H. 1905. Asteroidea. «Albatross» Expd. - Mem. Mus. C. Z. 32.  
LYMAN, TH. 1878. Ophiuridae. "Challenger". - Bull. Mus. C. Z. 5.  
— 1882. Ophiuroidea. - "Challenger" Expd. Zool. 5.  
MADSEN, F. JENSENIUS 1951. Asteroidea. - Swedish Deep-Sea Expd. Zool. 2.  
MORTENSEN, TH. 1933. Ophiuroidea. - "Ingolf" Expd. 4.