

THE OPHIOLEUCIDAE (OPHIUROIDEA)

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ABSTRACT

The ophiuroid genus *Ophiernus* (fam. Ophioleucidae) is revised on basis of a material from all three oceans. Five species are recognized, all of them bathyal-abyssal: 1) the Atlantic - Indo-West Pacific *O. vallincola* Lyman, 1878 (syn. *O. abyssalis* Koehler, 1906); 2) *O. alepidotus* n.sp. known hitherto only from the East Atlantic; 3) *O. adpersus* Lyman, 1883, with two subspecies, the Atlantic - Indo-West Pacific *O. adpersus adpersus* and the East Pacific

O. adpersus annectens Lütken & Mortensen 1899 (syn. *O. polyporus* Lütken & Mortensen, 1899); 4) the East Pacific *O. seminudus* Lütken & Mortensen, 1899; and 5) the antiboreal-subantarctic *O. quadripinus* Koehler, 1907. The three first-mentioned species are characteristic by the possession of a series of bristlelike spines dorsal to the usual arm spines, while such supplementary arm spines are lacking in the two last-mentioned species.

The family Ophioleucidae was erected by Matsmoto (1915: 83) for *Ophioleuce* and other related ophiuroids which were formerly referred to the Ophiopidae but are distinguished by having the arms inserted ventral to the disk and by being more or less beset with granules. The Ophioleucidae further have adpressed arm spines, a single series of teeth, a continuous series of oral papillae, and, in common with the Ophiopidae, the second tentacle pore within the oral slit.

Seven genera are recognized at present. Two of them, *Ophiernus* Lyman, 1878, and *Bathylepta* Belyaev & Litvinova, 1972, are known from depths exceeding 3000 m, while the others (*Ophioleuce*, *Ophiocirce*, *Ophiopallas*, *Ophiopyren*, and *Ophiotrochus*) are restricted to sublittoral-bathyal depths.

Bathylepta Belyaev & Litvinova, 1972
(Fig. 1)

Bathylepta resembles the bathyal Indo-Pacific *Ophiotrochus* in having rudimentary dorsal arm plates, but differs in having narrow elongate (instead

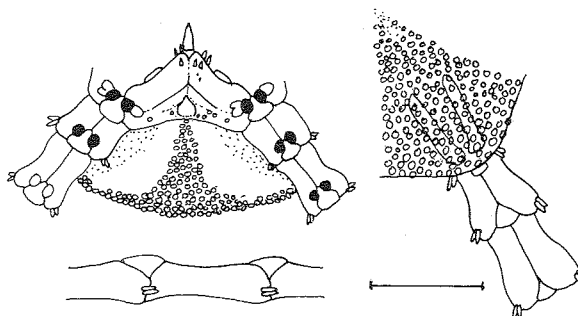


Fig. 1. *Bathylepta pacifica* Belyaev & Litvinova. Type redrawn from Belyaev & Litvinova 1972, fig. 5. Scale: 1 mm.

of circular) radial shields, smaller oral shields, and shorter and fewer arm spines.

The holotype of the only species known, *B. pacifica* Belyaev & Litvinova (1972: 15, fig. 5), measures 4.2 mm in disk diameter and is the largest of several specimens recorded from six widely scattered Pacific localities at depths of 5363 to 8006 m. It has a rather juvenile appearance. The ventral arm plates are very small and the arm pores lack tentacle scales.

Bathylepta is not represented in the »Galathea« material which on the whole comprises few animals of such small size.

Ophiernus Lyman, 1878

Lyman (1878: 122) erected *Ophiernus* for his new species *O. vallincola*, and six other species have subsequently been described, viz.: 1) the well-defined *O. adpersus* Lyman, 1883; 2) *O. abyssalis* Koehler, 1896, which is synonymous with *O. vallincola*; 3) *O. seminudus* Lütken & Mortensen, 1899, noted by its authors as perhaps identical with *O. vallincola*, but in fact distinct; 4) *O. annectens* Lütken & Mortensen, 1899, which is here considered a subspecies of *O. adpersus* with which species Lütken & Mortensen had also suspected it identical; 5) *O. polyporus* Lütken & Mortensen, 1899, which is merely a form of *O. adpersus annectens*; and 6) *O. quadrispinus* Koehler, 1907.

The supplementary list of West Indian ophiurans identified by Lyman, which was included in Koehler's paper (1914), also lists an *Ophiernus fasciculatus*, but this is a lapse for *Ophioglypha fasciculatus*.

The many specimens of *Ophiernus* known by now have nearly all been identified with one or the other of Lyman's well-defined species, *O. vallincola* and *O. adpersus*.

The present revision is based on 93 specimens collected by the »Galathea« in seven dredgings in the Atlantic, Indian, and Pacific Oceans, and an additional 24 specimens from widely scattered localities in all three oceans, including authoritative material of Lütken & Mortensen's three species, and specimens identified by H.L. Clark, Hertz, and Koehler. Most specimens are unfortunately very damaged, having the arms broken and the disk distorted and ruptured. The accompanying drawings are therefore often in part reconstructed.

One new species, *O. alepidotus*, is described.

The disk in *Ophiernus* is covered with a more or less thick skin beset with granules to a varying degree (sometimes wholly naked?). The granules may completely hide the thin disk scales when such are present, but the radial shields are usually naked and conspicuous. The arms are more or less flattened and in some species widened proximally. They taper into a whiplike end and are in full-grown specimens 7-9 times as long as the disk diameter. Also charac-

teristic is that the 3-6 proximalmost dorsal arm plates are abortive and a triangular area to each side of them covered with a naked skin only. The arms consequently may be presumed to be very flexible at their attachment to the disk.

The dorsal arm plates are contiguous and when fully developed subrectangular and covering practically the whole width of the arm. The ventral arm plates are similarly contiguous. Those of the arms are rather subpentagonal with a curved distal edge and a narrow, handlelike proximal part, those enclosed in the disk are more broadly in contact with each other and more deeply incurved by the pores. In some species the lateral arm plates form a prominent more or less sharp lateral edge to the arm, but they may also be simply rounded. The ventral surface of each lateral arm plate is about as wide as the corresponding ventral arm plates except in the species where the arms are widened proximally, in which case the lateral arm plates are up to twice as wide. There are 2 (-4) short arm spines placed at the outer end of a faint ridge stretching from the pore to the lateral edge of the plate. Some species are further distinguished by having dorsal to the usual arm spines an additional 15-20 slender, bristlelike spines in a close-set series stretching on each lateral arm plate between its proximal corner and the upper lateral arm spine (Pl. VIII). The bristlelike supplementary arm spines are distally directed and closely adpressed in a kind of furrow along the thickened lateral edge. They are up to twice as long as the joints.

The oral shields are usually rounded triangular with a broad distal lobe, but vary much in shape in different individuals. Their length in medium-sized specimens is about 1.5-2 times that of a joint.

The adoral plates broadly separate the oral shields from the lateral arm plates and meet, or almost meet, interradially. The exposed part of the oral plates is prominent. There are about 8 (6-10) oral papillae to either side of the jaw and in larger specimens usually a few at the apex, below the teeth. The papillae on the oral plates are fairly small, blunt and usually cylindrical, those on the adoral plates (at the second tentacle pore) broad and flattened; and the distal and largest oral papilla is for half its width attached on the ventral arm plate.

The teeth seem very variable individually and therefore cannot be used taxonomically. They may be cylindrical or club-shaped, or more or less flattened and lanceolate or square. There are 4 teeth in specimens about 10 mm in d.d., 5 at a d.d. of about

15 mm, 6 at a d.d. of about 20 mm, and up to 8 in larger specimens.

The tentacle pores of the first pair within the disk are provided with 3 (-4) distal scales of which one (-2) is borne on the ventral arm plate, one (the largest one) jointly on the ventral and lateral arm plates, and one (-2) on the lateral arm plate. At the following pores the tentacle scales gradually shift to a proximal position on the lateral arm plate. Near the disk margin the number of tentacle scales falls to two and their contour becomes lanceolate. The tentacle pores within the disk area are large, and the tentacle scales cover them only incompletely. In some species the pores of the arms are fairly small and in fullgrown specimens completely covered by the tentacle scales. In other species, however, the arm pores may be almost as large as those within the disk and have but small tentacle scales.

The number of joints enclosed in the disk is 2 in specimens about 6 mm in disk diameter, 3 at a d.d. of 8 mm, 4 at 12-15 mm, 5 at 16-20 mm, 6 at 20-22 mm, and 7 at 22 mm.

The gonads are usually visible through the skin and its thin scales. Six or more may be seen along the long genital slit, and a few may be visible through the radial shields when these are large and naked. This, however, is not shown in any of the accompanying drawings.

The peristomial plates are thin and single. The vertebral ossicles are delicate and with thin wings.

Hertz (1927: 112, fig. 7) was the first to call attention to the peculiar, very slender, long, glassy spines which were present in a series on the lateral arm plates dorsal to the usual arm spines in the two species of *Ophiernus* she examined, *O. adspersus* and *O. vallincola*. She compared these long, slender spines to fin rays and suspected them having been

joined by a fine integument. They are, however, free of each other, at least as far as I can judge.

John & A.M. Clark (1954: 159, fig. 12), independently of Hertz, described the fine glassy bristles on the lateral arm plates in some West Indian specimens of *O. adspersus* which included two of Lyman's original specimens. Dr. A.M. Clark has kindly informed me that also the holotype of *O. vallincola* possesses these secondary arm spines.

Supplementary bristlelike arm spines are further found in the authoritative material available to me of Lütken & Mortensen's *O. annectens* and their *O. polyporus*, but not in their *O. seminudus*. Supplementary bristlelike arm spines are also absent in Koehler's *O. quadrispinus*, as confirmed by examination of the original specimens (kindly made by Dr. A.S. Clarke, the Royal Scottish Museum).

The possession of these peculiar additional arm spines is thus not a common generic character in *Ophiernus*, as Hertz with good reason had suspected. That they were overlooked by the earlier authors is well understandable as they are disclosed only by a fairly high magnification under a dissecting microscope. They are also often lost, but their place of attachment is then seen as a straight line of double pores. It is unknown what purpose the fans of bristlelike spines serve. Perhaps they have some function in the feeding behaviour, and it may be noted that the species which possess them are also those with small arm pores, while the species without them have the proximal arm pores as large as those within the disk.

The stomach contents, when examined, mostly consisted of an unidentifiable detritus. Sand-incrusted foraminiferans almost as long as the diameter of the disk have been seen in some stomachs. An *Ophiernus alepidotus* contained a small bivalve, and an *O. seminudus*, measuring 17 mm in d.d., the 14-mm-long chelifer of a crab.

Key to the species of *Ophiernus*

- 1 a. A close-set series of long bristlelike spines present on each lateral arm plate dorsal to the usual arm spines. Tentacle pores on the arms small 2
- 1 b. No bristlelike supplementary arm spines. Tentacle pores on the arms fairly large and only incompletely covered by the tentacle scales. (Arms never widened outside the disk. Radial shields subcircular to suboval, about half the disk radius in length. Granulation always feeble) 5
- 2 a. Arms distinctly widened and flattened proximally for a length up to twice the disk diameter (the lateral arm plates wider than the ventral ones). Disk wholly covered with overlapping scales dorsally as well as ventrally. Radial shields about half or more the disk radius in length. Granulation well developed (*adspersus* Lyman) 4

- 2 b. Arms not widened outside disk (the proximal lateral arm plates not wider than the ventral ones). Disk scaling more or less deficient. Radial shields not exceeding half the disk radius in length. Granulation feeble 3
- 3 a. Disk with overlapping scales (more or less hidden by the skin) around the radial shields and in larger specimens also interradially, but central dorsal disk with a naked skin only. Radial shields almost circular *vallincola* Lyman
- 3 b. Disk without scales dorsally as well as ventrally, except along genital slits. Radial shields suboval *alepidotus* n.sp.
- 4 a. Radial shields suboval to rounded triangular, not much more than half the disk radius in length and not contiguous in the pair *adpersus adpersus* Lyman
- 4 b. Radial shields rounded triangular, usually exceeding half the disk radius in length and often contiguous in the pair. Some of the proximal joints possibly with extra pores between the lateral and ventral arm plates *adpersus annectens* Lütken & Mortensen
- 5 a. Dorsal side of disk deficiently scaled centrally. Proximal joints with 2-3 arm spines *seminudus* Lütken & Mortensen
- 5 b. Disk wholly covered with scales dorsally as well as ventrally. Proximal joints with 3-4 arm spines *quadrspinus* Koehler

While the present paper was in press, new records of *Ophiernus*, including the description of a new species, were published by N. M. Litvinova, 1975: Ophiuroids ... of the R/V "Akademik Kurchatov" ... (In Russian). - Trudy Inst. Okeanol. **100**: 196-204. *Ophiernus adpersus* is recorded from the Caribbean region, *O.*

vallincola from the Indian Ocean and (but this evidently concerns a specimen of *O. seminudus*) from off northern Chile. The new species, *O. belyaevi*, is based on specimens from the Peru-Chile region and is identical with *O. adpersus annectens* Lütken & Mortensen in my sense.

Ophiernus vallincola Lyman (Fig. 2)

O. vallincola Lyman, 1878: 122, pl. 6 figs 170-172; 1882: 32, pl. 24 figs 16-18, pl. 38 figs 6-9.

O. abyssalis Koehler, 1896: 242; 1909: 143, pl. 28 figs 3-4.

O. vallincola, H.L. Clark 1923: 365; 1939: 134.

O. vallincola, Hertz 1927: 144.

Material: (d.d. = disk diameter):

East Atlantic

S.W. of Ireland, 48°04'N, 12°40'W. 4000 m.

("Thor" St. 178, 1906). - 7 specimens, d.d. 11-16 mm.

Off South Africa, Walvis Bay (Fisheries Survey of S. Africa). - 2 specimens, d.d. 8-10 mm.

Indian Ocean

Off East Africa, 1°48'N, 45°52'E. 1644 m. ("Valdivia" St. 257). - 2 specimens, d.d. 14-15 mm.

West Pacific

"Galathea" St. 491. Macassar Strait, 4°56'S, 117°39'E. 1560 m, muddy clay. - 2 specimens, d.d. 14-20 mm.

The holotype of *O. vallincola*, d.d. 9 mm, came from the East Atlantic near the Azores, 1830 m, and Lyman further recorded several specimens from two abyssal dredgings in the southern Indian Ocean.

Koehler based his *O. abyssalis* on a specimen, d.d. 9.5 mm, from the Bay of Biscay, 1674 m, and later recorded some specimens from east of the Azores. The characters by which Koehler distinguished *O. abyssalis* from *O. vallincola* were a closed ring of radial shields and longer ventral arm plates. The first difference, however, as can be seen in his fig. 3, pl. 28, 1909, is merely the condition in a dried specimen where the dorsal side is distorted due to the absence of scales centrally; the other difference too is explained by a dried specimen being compared with one in alcohol.

Koehler (1909) noted that Lyman's material of *O. vallincola*, in view of the great distance separating the localities, might comprise two species, viz., the Atlantic one identical with *O. abyssalis* and an Antarctic one which Koehler considered representing the true *O. vallincola*. Mortensen (1927; 1933) accepted this conclusion. Koehler, however, might not have erected his *O. abyssalis* had he remembered that the type locality of *O. vallincola* was in fact also in the northeastern Atlantic.

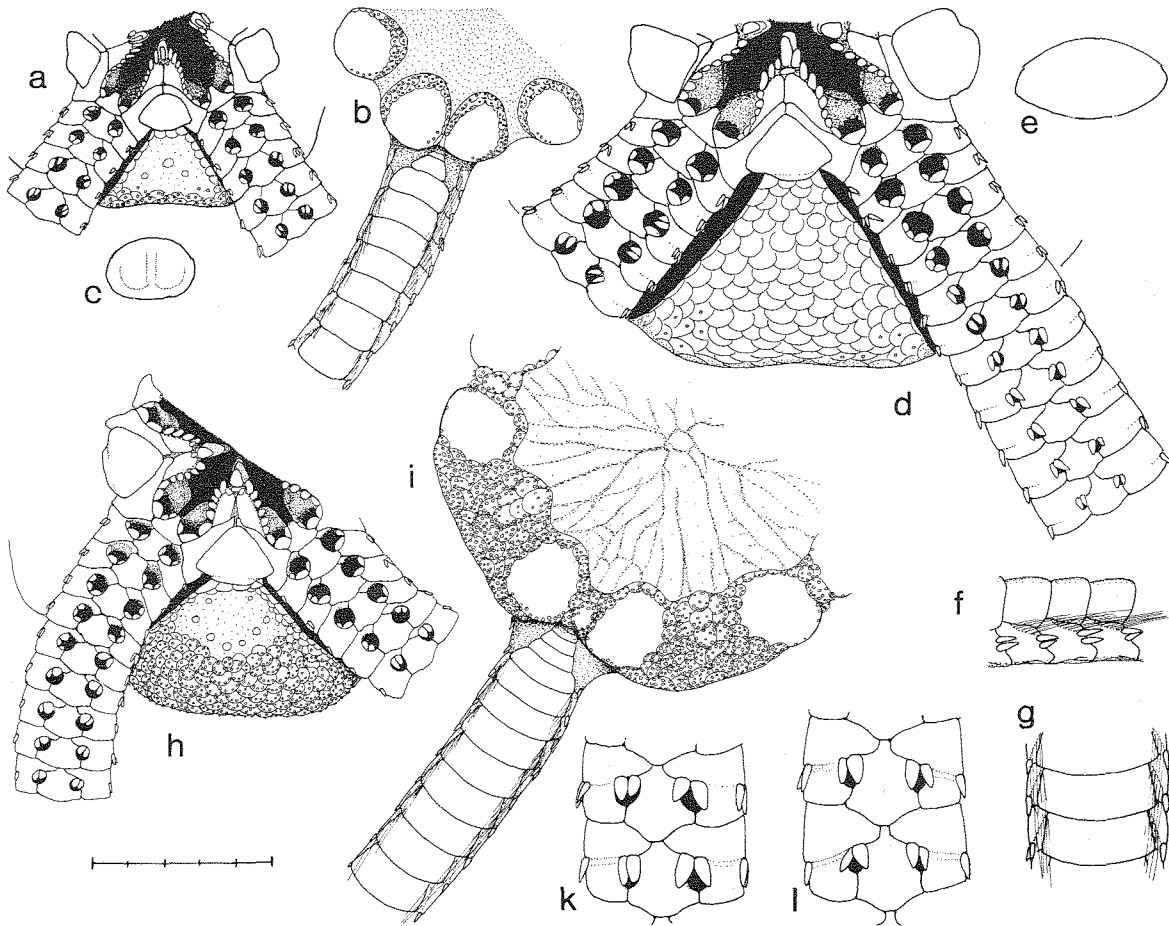


Fig. 2. *Ophiernus vallincola* Lyman. a-c: specimen d. d. 9 mm, South Africa; c, cross section of proximal part of arm. d-g: specimen d. d. c. 19 mm, "Galathea" St. 491, Macassar Strait; e, cross section of proximal part of arm; f-g, arm joints Nos 10-12 in dorsal and lateral view. h-k: specimen d. d. 14 mm, "Thor" St. 178, N. E. Atlantic; k, arm joints Nos 19-20. l: arm joints Nos 14-15 of specimen d. d. 13 mm, "Thor" St. 178. Scale: Figs a-i, 5 mm. Figs k-l, 2.5 mm.

Hertz (1927: 114) recorded *O. vallincola* from three dredgings off East Africa. She found that the material from one dredging fitted the type description, that from another Lütken & Mortensen's description of *O. seminudus* from the East Pacific, while that from the third was intermediate. She therefore concluded that *seminudus* was a synonym of *vallincola*, which also Lütken & Mortensen (1899: 109) had thought possible. H.L. Clark (1939: 134), who examined the type material of both species, was reluctantly compelled to agree with Hertz that *O. vallincola* and *O. seminudus* were identical. This assumption was also followed by Madsen (1951: 116) in a zoogeographical discussion. Hertz and Clark evidently based their considerations on the scaleless central dorsal disk, which is characteristic for both species, and the considerable variation in the shape of the oral shields. *O. seminudus*, however, lacks additional bristlelike arm spines and

therefore is in fact clearly distinct from *O. vallincola*.

The 13 available specimens of *O. vallincola* have disk diameters from 8 to 20 mm. The recorded maximum size is 21 mm.

The medium-sized specimens, d.d. 11-16 mm, from southwest of Ireland (Fig. 2 h-k) agree with the type descriptions of both *O. vallincola* and *O. abyssalis*, apart from that both Lyman and Koehler overlooked the supplementary bristlelike arm spines. The small specimens from off South Africa, d.d. 8-10 mm (Fig. 2 a-c), have a less developed disk scaling, the proximal dorsal arm plates are yet only about twice as wide as long, and the arms are hardly flattened, being proximally about three fourth as high as wide.

The smaller specimen, d.d. 14 mm, from "Galathea" St. 491, in the region of the Malay Archipelago

from where *O. vallincola* was not known previously, agrees in general appearance with the Atlantic medium-sized specimens. The granulation seems very feeble but may be worn. The larger specimen, d.d. 20 mm (Fig. 2 d-g), has a more extensive disk scaling, the naked central dorsal area being less than the disk radius in diameter, and the whole ventral area is covered with scales. The inner part of the arms in this large specimen is markedly flattened, and the proximal arm plates are more than three times as wide as long.

Among the species possessing supplementary bristlelike arm spines, *O. vallincola* is distinguished by the almost circular radial shields and the scaleless central dorsal disk. These characters become especially prominent when the specimens are dried. The thick, naked, cross-wrinkled dorsal skin then becomes a thin membrane of a more or less dark brownish colour, and the radial shields together with the marginal disk scales appear as a white annulet.

The radial shields are about half the disk radius in size in a small specimen (d.d. 8 mm) and about a third the disk radius in a large specimen (d.d. about 20 mm). The disk scales are very thin, fairly uniform in size, rather small, and overlap. A small (young) specimen has only a single row of scales around the radials. A medium-sized specimen may have a wedge of 1-3 rows of scales between the radial shields and 5-7 rows of scales interradially. With growth the scaling also extends farther in on the disk, and a large specimen eventually may have 5-6 rows of scales within the ring of radial shields.

The oral shields are rounded triangular, with a broad distal lobe, but never with a distinct prominence.

There are 6 to 10 oral papillae on each side of the jaw, rather independently of the size of the specimens. The 4-8 papillae on the adoral plate are nearly always peglike and up to about twice as long as wide, but sometimes all the oral papillae on one or more of the jaws are flattened like the 2-3 distal ones at the adoral plate.

The arms, which are almost round in small specimens, with growth gradually become more flattened, so that in large specimens they are proximally almost twice as wide as high. They remain rounded laterally (never develop a sharp outer edge) but with age become faintly keeled both dorsally and ventrally. The dorsal arm plates in the large specimens often show a distal notch in the midline. The width of the arms at base is about 1/5 the disk diameter, and

does not increase outside the disk, at least not markedly so.

The lateral arm spines are peglike and never exceed half the joint in length. There are 2 lateral arm spines in the main part of the arm and usually 3 proximally, but sometimes 4 on one or more joints as, e.g., in the small South African specimens at hand. There are up to about 20 supplementary, dorsal, bristlelike arm spines in each series, and the longer ones are more than twice as long as the joint.

Granules are usually fairly uniformly spaced on the disk scales and marginally on the radial shields, but never form a close covering. The specimens at hand from Macassar Strait have only few granules, and Lyman (1878: 123) found a granulation wholly wanting in many specimens.

O. vallincola is known to occur in the eastern Atlantic, from south of Ireland to off South Africa; in the Indian Ocean, from the Arabian Sea to the Antarctic part; and in the western Pacific in the region of the Malay Archipelago. The recorded bathymetrical range is 840 - 4065 m.

Ophiernus adpersus adpersus Lyman (Fig. 3)

O. adpersus Lyman, 1883: 236, pl. 3, figs 19-21; 1914: 151 (in Koehler, 1914).

O. adpersus, Koehler 1897: 316; 1899: 32; 1904: 20; 1907a: 251; 1922: 440; 1930: 280.

O. adpersus, H.L. Clark 1911: 95, fig. 34; 1915: 347; 1939: 133; 1941: 107.

O. adpersus, Hertz 1927: 112, fig. 7, pl. 9, fig. 10.

O. adpersus, John & A.M. Clark 1954: 159, fig. 12.

Not *O. adpersus*, Madsen 1971: 164, = *O. alepidonotus* n.sp.

Material:

West Atlantic

West Indies, off Dominique, 610 m. ("Blake" St. 185). - 1 specimen, d.d. 14 mm, paratype.

Indian Ocean

"Galathea" St. 324. Bay of Bengal, 6°38'N, 96°00'E. 1140 m, Globigerina ooze. - 1 specimen, d.d. 13 mm.

West Pacific

"Galathea" St. 489. Bali Sea, 7°38'S, 116°08'E. 1160 m, dark clay. - 1 specimen, d.d. 16 mm.

Three miles S.W. of Tucuran, Mindanao, c. 550 m. (Th. Mortensen 1914). - 1 specimen, d.d. 22 mm.

Sulu Sea, 1750 m. ("Albatross" St. 5127). - 1 specimen, d.d. 12 mm.

Lyman recorded *O. adpersus* from several dredgings in the Caribbean region, 291-1884 m. Subsequently the species has been recorded also from the eastern Atlantic near the Cape Verdes, ca. 1200 m (Koehler 1907), and from many localities in the northern Indian Ocean and in the western Pacific.

Lütken & Mortensen (1899: 109) suspected that their *O. annectens* from the tropical East Pacific might be the same species as *O. adpersus*, and other authors have taken this identity for granted. But the East Pacific *annectens*, as discussed below, must at least be treated as a distinct subspecies.

The present material of *O. adpersus adpersus* comprises only 5 specimens, but from different local-

ities representing the whole known range of distribution. The disk diameter is from 12 to 22 mm (the largest size recorded).

One specimen, d.d. 14 mm (Fig. 3 a-d), belongs to Lyman's original material and agrees in detail with his description of the holotype of 13 mm in d.d. There are, e.g., similarly up to about 8 granules per mm. Lyman only overlooked the bristlelike spines present dorsal to the usual lateral arm spines.

The other specimens, from the Indian Ocean (Fig. 3 g-h) and Malay Archipelago (e-f), differ slightly from the West Atlantic specimens described by having smaller granules, 12-16 per mm, and a more extensive granulation. Thus, in a specimen from the Bali Sea, d.d. 16 mm, only a small spot on each radial shield remains naked.

As characters distinguishing *O. adpersus* from *O.*

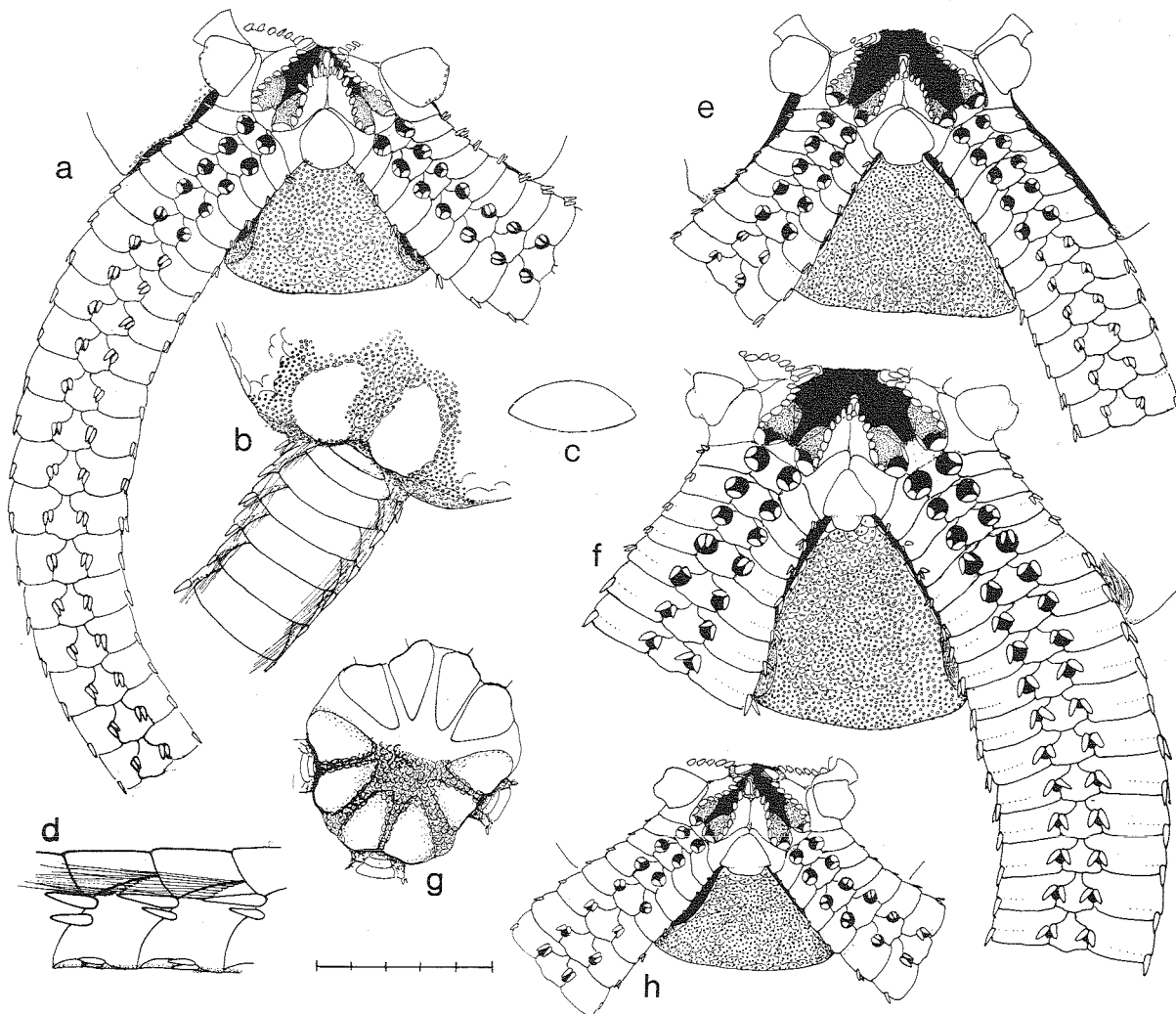


Fig. 3. *Ophiurnus adpersus* Lyman. a-d: specimen d. d. 14 mm, "Blake", W. Indies; c, cross section of proximal part of arm; d, arm joints Nos 10-11 in lateral view. e: specimen d. d. 16 mm, "Galathea" St. 489, Bali Sea. f: specimen d. d. 22 mm, the Philippines. g-h: specimen d. d. 13 mm, "Galathea" St. 321, Bay of Bengal. Scale: Fig. g, 10 mm. Figs a-c, e-f, h, 5 mm. Fig. d, 2.5 mm.

vallincola, Lyman mentioned the wide arms and the different mouth angles. The latter character is subject to considerable individual variation and of no reliable taxonomic value. The wide arms, however, distinguish *O. adspersus* from all other known species of *Ophiernus*. At base the arms are only slightly broader than in *O. vallincola*, about 1/4 against 1/5 the disk diameter, but outside the disk the arms become widened, markedly so in large specimens, for a distance equalling or somewhat exceeding the disk diameter. In large specimens the arms are proximally about 2.5 times as wide as high and have an almost flat underside.

The widening of the arms proximally is correlated with a widening of the lateral and dorsal arm plates, while the ventral arm plates, as in the other species, diminish gradually in size towards the arm tip. In large specimens the ventral surface of the lateral arm plates a little outside the disk margin reaches a width of up to twice that of the ventral arm plates. The corresponding dorsal arm plates become 3-4 times as wide as long in specimens 13-14 mm in d.d. and about 4 times as wide as long in a specimen 22 mm in d.d. The lateral arm plates form a sharp lateral edge to the arm. The arms are proximally lens-shaped in cross section, and in large specimens fairly distinctly keeled both dorsally and ventrally.

There are two lateral arm spines and sometimes three proximally, the dorsalmost one about half as long as the joint, the ventral one slightly shorter. As in *O. vallincola* there is on each lateral arm plate a dorsal series of up to about 20 bristlelike spines almost twice as long as the joint.

The radial shields in *O. adspersus adspersus* differ from those in *O. vallincola* by being rather egg-shaped in contour or rounded triangular, with the interrarial marginal corner somewhat protruding. Their length is about 2/3 of the disk radius, and they are just separated in each pair.

The complete covering of the disk with small overlapping scales and the uniform fairly dense granulation also distinguish *O. adspersus* from *O. vallincola*.

The oral shields usually are rounded triangular, about as wide as long, and with a distal lobe which may be more prominent than in *O. vallincola*, but they may also be broadly egg-shaped. The adoral plates are just in contact interradially. Their proximal part usually is fairly broadly exposed, but may also be almost covered by the oral shield. There are 8 (7-10) oral papillae on each side of the jaw.

O. adspersus adspersus is known from the Atlantic, the West Indian region and near the Cape

Verdes; the northern Indian Ocean; and the western Pacific, from the Malay Archipelago to Japan. The recorded bathymetrical range is 291-3652 m.

Ophiernus adspersus annectens

Lütken & Mortensen

(Fig. 4)

O. annectens Lütken & Mortensen, 1899: 107, pl. 5, figs 4-6.

O. polyporus Lütken & Mortensen, 1899: 109, pl. 5, figs 7-9.

O. polyporus, H.L. Clark 1913: 212.

O. adspersus, H.L. Clark 1913: 212.

O. annectens, H.L. Clark 1917: 452.

Material:

East Pacific

Near Galapagos, 0°57'30"S, 89°03'30"W, 770 m. ("Albatross" St. 3402). - 4 specimens, d.d. 12-13 mm, paratypes of *O. annectens*.

Panama Bay, 7°09'30"N, 81°08'30"W, 1000 m. ("Albatross" St. 3356). - 1 specimen, d.d. c. 13 mm, paratype of *O. polyporus*.

Tres Marias Isl., 21°19'N, 106°24'W, 1245 m. ("Albatross" St. 3425). - 1 specimen, d.d. 7 mm, paratype of *O. polyporus*.

"Galathea" St. 745, Gulf of Panama, 7°15'N, 79°25'W, 915 m. - 10 specimens, d.d. 8-c.13 mm.

Lütken & Mortensen themselves noted that their *O. annectens* from the tropical East Pacific, near the Galapagos Islands, was "very closely related to *O. adspersus*, perhaps really the same species". Also a comparison undertaken by H.L. Clark (1911: 95) of the holotype of *O. adspersus* and some paratypes of *O. annectens* failed to show any distinguishing characters.

The present paratypes of *O. annectens* possess (overlooked by Lütken & Mortensen) the bristlelike supplementary arm spines characteristic of *O. adspersus* and some other species of *Ophiernus*. There may be three of the usual lateral arm spines proximally (in the holotype only two), and the upper one is with a length almost that of the joint longer than in the examined Atlantic - West Pacific specimens of *O. adspersus*. The granulation is dense, composed of up to 15 small granules per mm, thus similar to that observed in the examined West Pacific specimens of *O. adspersus*, but finer than in the Atlantic specimens.

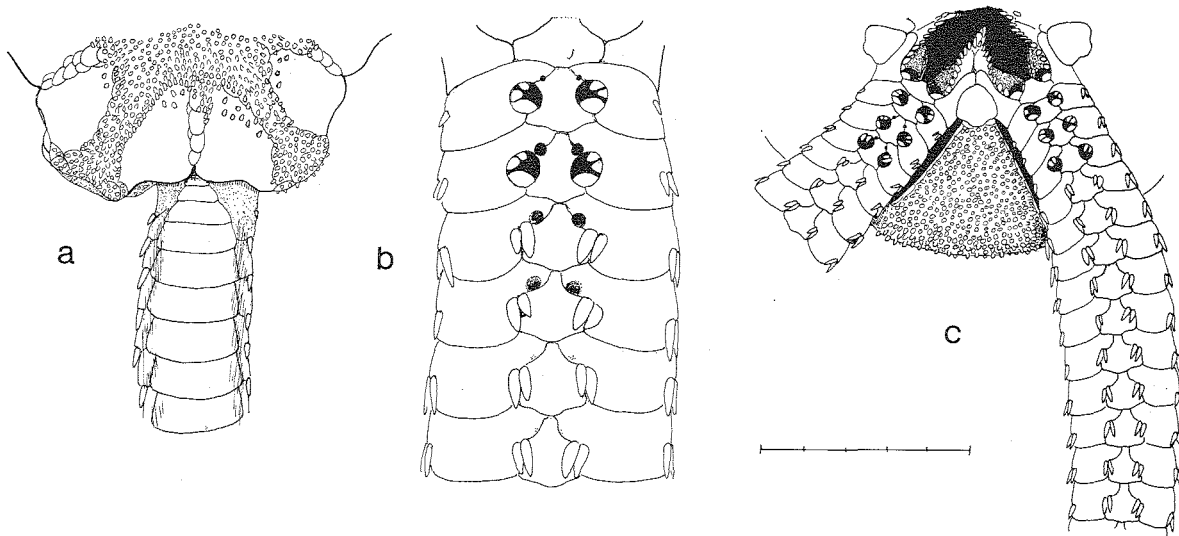


Fig. 4. *Ophiernus adspersus annectens* Lütken & Mortensen. a, c: specimen d. d. 11 mm, "Galathea" St. 745. b: proximal part of a detached arm of another specimen. Scale: Figs a, c, 5 mm. Fig. b, 2.5 mm.

Lütken & Mortensen mention that the most important difference between their *O. annectens* and *O. adspersus* is found in the radial shields. In the holotype of *O. annectens*, d.d. 13 mm, the radial shields have the form of an almost right-angled triangle and are wholly naked, while in the holotype of *O. adspersus* they are pearshaped and with granules on their inner part. But the slightly different extent to which granules occur on the radial shields can be of no taxonomic importance, and some West Pacific specimens of *O. adspersus* have radial shields of the same triangular shape as in the holotype of *O. annectens*. Thus *O. annectens* as described and figured by Lütken & Mortensen does not show any definite characters distinguishing it from *O. adspersus*. However, in the four available paratypes of *O. annectens* the radial shields are more conspicuous than in the holotype, slightly broader, with their distal side as long as the radial side, their interradian marginal corner more protruding, and further wholly contiguous in each pair, only with their joint margins covered by a narrow series of small scales.

My reason for considering Lütken & Mortensen's *O. annectens* a distinct subspecies of *O. adspersus* is the above described appearance of the radial shields in part of their material, belonging to the same sample as the holotype, and the evident affinity of this material with some other East Pacific populations of *Ophiernus* which differ more from the Atlantic - West Pacific *O. adspersus* and by Lütken & Mortensen were described as another new species, *O. polyporus*.

Lütken & Mortensen recorded *O. polyporus* from four dredgings between the Gulf of Panama and Southern California. The holotype, d.d. 14 mm, is distinguished by having, for about half the arm length, an additional pair of pores situated proximal to the tentacle pores, between the ventral and lateral arm plates; and the disk is almost wholly covered by the triangular, naked radial shields, which are three fourths as long as the disk radius, in each pair in contact for their whole length and also in contact interradianly or only separated by a narrow line of scales. The middle part of the ventral disk is described as lacking scales and being covered only with granules; but in the two available paratypes of *O. polyporus* the disk is scaled beneath the granulation also ventrally. The paratypes also possess the characteristic supplementary bristlelike arm spines. One of the paratypes of *O. polyporus*, d.d. 13 mm, has radial shields corresponding to those described from the holotype of *O. annectens*, and, as noted, four paratypes of this latter have radial shields like those in the holotype of *O. polyporus*.

The presence of extra arm pores similarly is not a decisive specific character. Lütken & Mortensen note (p. 111) that in one of their specimens of *O. annectens* they "found some few small pores and depressions, corresponding to the pores in *O. polyporus*", and that one of their specimens of *O. polyporus* "has the pores much smaller than usual". H.L. Clark (1913) recorded a number of *Ophiernus* from off Southern California and found that a large adult was a typical *O. adspersus*, while the other specimens

from the same dredging had the characteristic pores of *O. polyporus*, but sometimes on only a few joints and possibly very small. Clark thus came in serious doubt as to whether *O. polyporus* was a valid species, but considered his material too poor to decide "whether the presence of a few pores is indicative of hybridization or whether the presence and number of pores is a matter of individual diversity".

The form of the radial shields and the extent to which extra pores are developed evidently vary individually. The available paratypes of *O. polyporus* and *O. annectens* show, on the other hand, a difference in their granulation which was not specified by Lütken & Mortensen. The two paratypes of *O. polyporus* thus are beset with coarse, rather conelike granules, about twice as high as wide (about 8 per mm), while the four paratypes of *O. annectens*, from the same sample as the type, are beset with small, rounded granules (up to 15 per mm). A somewhat similar difference in the granulation was observed between the West Atlantic *O. adpersus* and the otherwise indistinguishable specimens from the Indian Ocean and the West Pacific; the difference in the granulation found in the various populations therefore may probably safely be considered infraspecific, only distinguishing different populations.

The ten specimens of *Ophiernus* from "Galathea" St. 745 in the Gulf of Panama are all rather damaged. Only one has the disk partly preserved, and in this specimen the granulation is composed of conelike granules as in the examined paratypes of *O. polyporus*, and the radial shields are like those described from the holotype. However, only four of the ten specimens show, on but a few joints within the disk area, the characteristic extra pores. The pores are best developed in a detached arm, Fig. 4b, being distinct on the first three joints, especially on Nos 2 and 3, while joint 4 shows a pair of distinct depressions at the same places and joints 5 and 6 gradually disappearing indications thereof. The pores may also be differently developed on the different arms in the same specimen, e.g. showing pores in only one of the arms (Fig. 4c).

The available material indicates that what has been described by Lütken & Mortensen from the Eastern Pacific as *O. annectens* and *O. polyporus* are the extreme variations of one and the same species. The form represented by the type of *O. annectens* is morphologically indistinguishable from the Atlantic - West Pacific *O. adpersus*. But the form described as *O. polyporus* is clearly different. Probably we have here a case of a species in evolution.

O. adpersus annectens is known from the East Pacific between about Guadalupe and the Galapagos Islands, 770-1245 m.

***Ophiernus alepidotus* n.sp.**
(Pl. VIII, Fig. 5)

Ophiernus adpersus, Madsen 1971: 164, not Lyman 1883.

Material:

East Atlantic

"Galathea" St. 110. 12°05'S, 13°08'E, 975 m, clay. - 25 specimens, d.d. 12-22 mm.

"Atlantide" St. 120. 2°09'N, 9°27'E, 260-650 m, mud. - 1 specimen, d.d. 22 mm.

Diagnosis: Species of *Ophiernus* with bristlelike spines dorsal to the usual two lateral arm spines. Arms gradually tapering. Radial shields suboval, less than half the disk radius in length. Disk devoid of scales except along genital slit. Granulation feeble.

Holotype: Specimen in alcohol, d.d. c. 18 mm. Pl. VIIIA-b. Zoological Museum, Copenhagen.

Type-locality: Off Luanda, West Africa, 975 m. "Galathea" St. 110.

The above "Atlantide" specimen, an armless disk of an *Ophiernus* with suboval radial shields, was identified as an *O. adpersus* (Madsen 1971) because I overlooked that the thick cross-wrinkled skin did not hide any disk scales. This character only came to my attention when I examined the similar and better preserved "Galathea" specimens from the same geographical region. But the lack of disk scales, together with a different appearance of the arms, shows that we are dealing with a different and hitherto undescribed species.

O. alepidotus n.sp. possesses the same supplementary bristlelike arm spines characteristic for *O. vallincola* and *O. adpersus*. The arms are at base about 1/5 as wide as the diameter of the disk and taper gradually. They are perhaps slightly more flattened proximally and slightly more keeled than in similar-sized *O. vallincola*, but otherwise identical. There are two lateral arm spines less than half as long as the joint; the upper one usually slightly the larger.

The disk is completely without scales dorsally, and also the ventral side is naked, scales being present only along the genital slit and distal to the oral

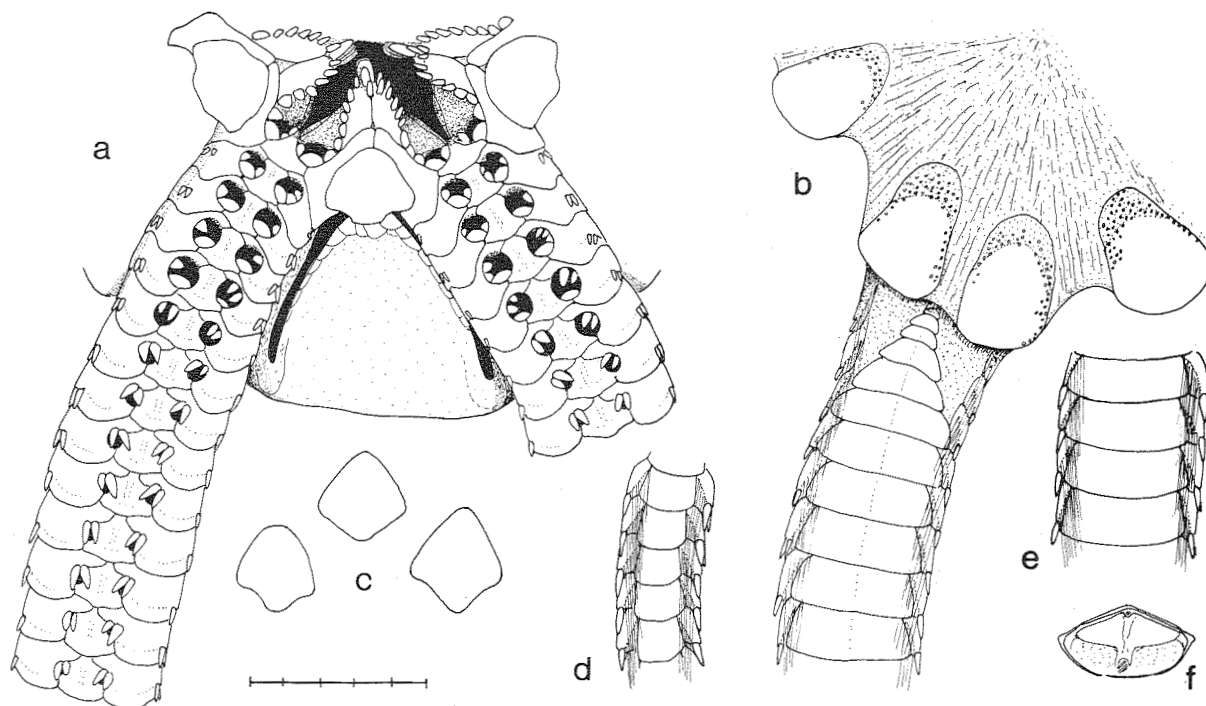


Fig. 5. *Ophiernus alepidotus* n. sp., "Galathea" St. 110. a-b, d-f: specimen d. d. c. 20 mm; d, distal arm joints; e, arm joints Nos 12-15; f, cross section of proximal part of arm. c: oral shields of different specimens. Scale: 5 mm.

shields. These may, as in the specimen Fig. 5a, be more rounded inwards than usual in *O. vallincola*, but may also be indistinguishable from those in that species. The armature of oral spines is also similar. In ventral aspect only the naked interrarial area distinguishes *O. alepidotus* specifically.

The radial shields are suboval or rounded triangular, about 1.5 times as long as broad, and thus different from the subcircular ones in *O. vallincola* and more like those sometimes found in *O. adspersus*. But their size, slightly less than half the disk radius in length, is rather as in *O. vallincola*. The granulation is very feeble, with granules occurring only on the inner marginal parts of the radial shields.

In dried specimens the skin becomes a thin dark brownish membrane, and the absence of scales, which distinguishes *O. alepidotus* from all other hitherto described species of *Ophiernus*, becomes very conspicuous.

O. alepidotus is known only from the tropical East Atlantic, 300 m (?)–975 m.

***Ophiernus seminudus* Lütken & Mortensen**
(Fig. 6)

Lütken & Mortensen 1899: 105, pl. 5, figs 10-12;
H.L. Clark 1917: 453.

Material:

East Pacific

"Galathea" St. 716. Off Costa Rica, 9°23'N, 89°32'W, 3570 m, dark, muddy clay. - 44 specimens, d.d. 8-16 mm.

"Galathea" St. 724. Gulf of Panama, 5°44'N, 79°20'W, 2950-3109 m, dark clay and stones. - 10 specimens, d.d. 11-21 mm.

Off Ecuador, 1°07'N, 80°21'W, 2880 m. ("Albatross" St. 3398). - 4 specimens, d.d. 11-19 mm, paratypes.

Lütken & Mortensen noted about this species from the tropical East Pacific that it was very closely related to Lyman's *O. vallincola* from the Atlantic and perhaps the same species. Hertz (1927: 114) took this identity for granted, and when Clark (1939: 134) recorded *O. vallincola* from the Arabian Sea, he stated that he was reluctantly compelled to agree with this point of view.

The present material, including some of Lütken & Mortensen's original specimens, shows, however, that *O. seminudus* is clearly distinct from *O. vallincola* in having only the usual 2-3 peglike lateral arm spines, and no supplementary bristlelike ones.

The 11 specimens from "Galathea" St. 724, d.d. 11 to 21 mm (the largest size recorded), are very

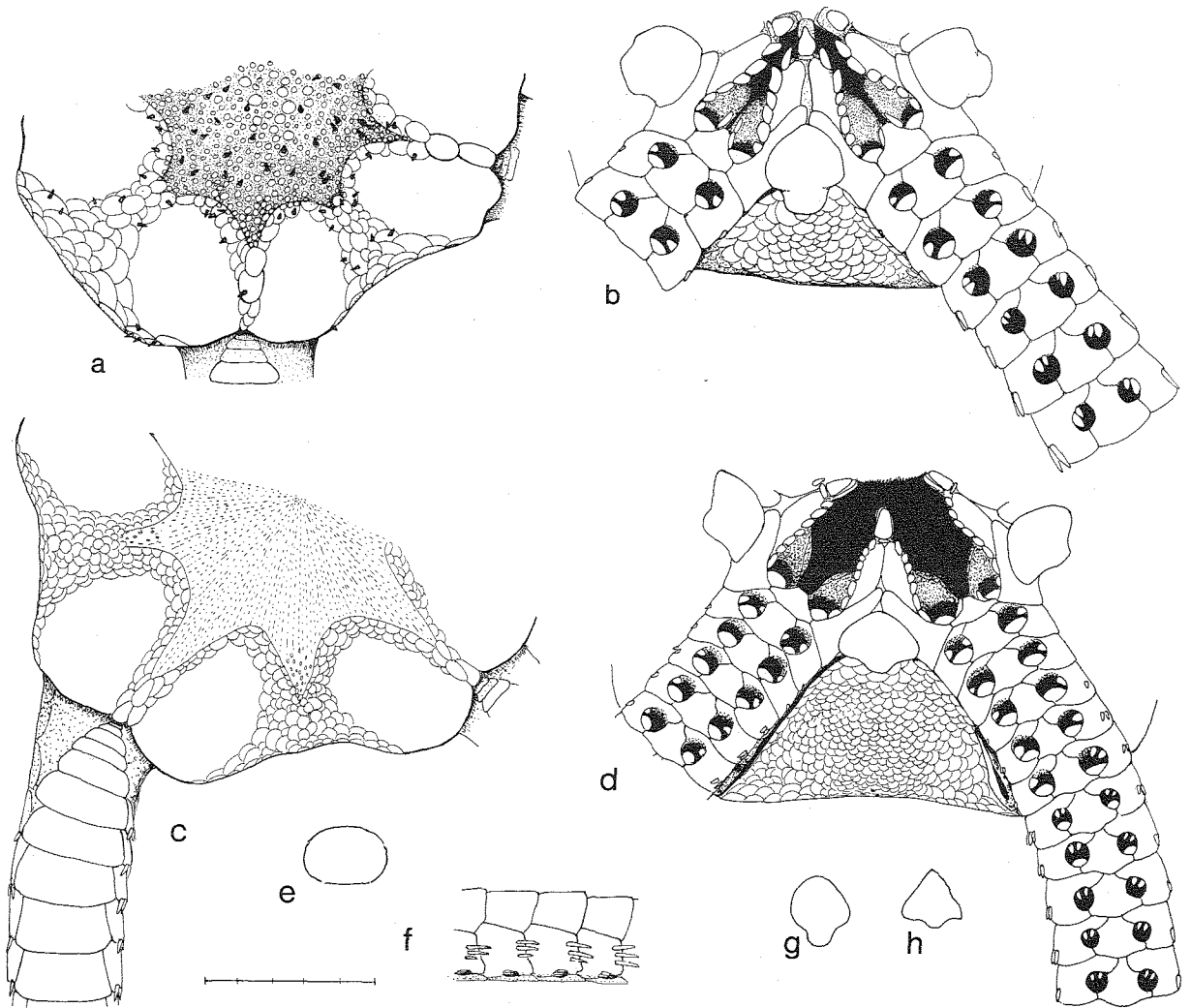


Fig. 6. *Ophiernus seminudus* Lütken & Mortensen. a-b: specimen d. d. 8 mm, "Galathea" St. 716. c-f: specimen d. d. 19 mm, "Galathea" St. 724; e, cross section of proximal part of arm; f, arm joints Nos 7-10. g: oral shield of specimen d. d. 17 mm, "Galathea" St. 724. h: oral shield of a paratype, d. d. 19 mm. Scale: Figs a-b, 2.5 mm. Figs c-h, 5 mm.

feebly granulated, and some seem devoid of any granules at all. They thus agree with those described by Lütken & Mortensen. Some specimens are like the holotype provided with scattered small scales centrally on the disk, but, e.g., the specimen shown in Fig. 6c has scales only marginally and around the radial shields.

All the 44 specimens from "Galathea" St. 716, d.d. 8-16 mm, have uniformly spaced, small scales centrally on the disk and are further distinguished by having minute spines scattered over the dorsal side, each attached to its own scale.

Except for the absence of the supplementary, bristlelike spines on the lateral arm plates, *O. seminudus* resembles *O. vallincola* very much. In medium-sized specimens of both species the arms at

base are about 1/5 as wide as the disk diameter, only little flattened and with rounded lateral sides. But the tentacle pores of the arms are as large as those within the disk area.

Ophiernus seminudus is known only from the tropical East Pacific, 2412-4082 m.

Ophiernus quadrispinus Koehler (Fig. 7)

Koehler 1907c: 146; 1908: 601, pl. 11, figs 102-103.

Material:

Off Cape Point, South Africa (Cape Point N. 86°E. 43 miles), c. 1700-1900 m, grey mud (Fisheries Survey of S. Africa). - 1 specimen, d.d. 6 mm.

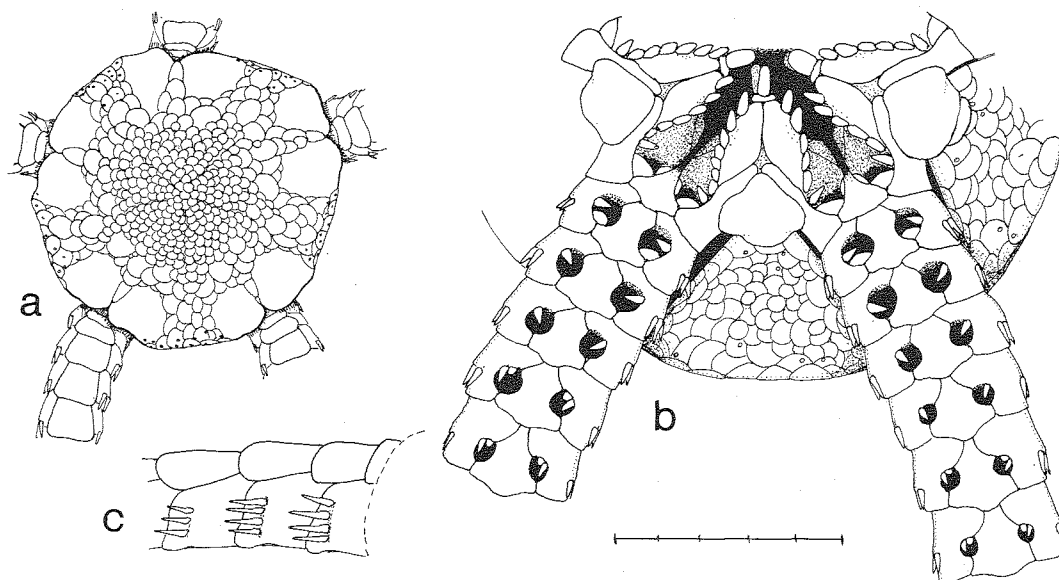


Fig. 7. *Ophiernus quadrispinus* Koehler. Specimen d. d. 6 mm, South Africa. Scale: Fig. a, 5 mm. Figs b-c, 2.5 mm.

Koehler based *O. quadrispinus* on four specimens, d.d. 11.5-18 mm, from the Atlantic sector of the Antarctic, 3250 m, and mentioned as the main distinguishing characters a fully scaled disk, not widened arms and 4 arm spines proximally. The present, small specimen shows these characters, and is further distinguished by the absence of the supplementary, bristlelike arm spines found in some species of *Ophiernus*. A reexamination of Koehler's original specimens kindly performed for me by Dr. A.S. Clarke, Royal Scottish Museum, Edinburgh, confirmed that these too were without supplementary, bristlelike spines.

The arms in the specimen at hand are 5 times the disk diameter of 6 mm, round in cross section and with yet only subquadrangular dorsal arm plates. The proximal arm pore is provided with two scales, the usual flat, broad one borne jointly on the ventral and lateral arm plates and a longer spiniform one on the lateral arm plate. The following two pairs of pores, at the disk margin, have only the spiniform tentacle scale, while the more distal pores have also a second, smaller scale proximal to the spiniform one.

The radial shields are subcircular, slightly less than half the disk radius in diameter, and may be just contiguous distally. The marginal dorsal disk scales are fairly large and overlap, while those of the central part are inconspicuous, hardly overlap and do not extend over the interradial lines where the mesenteries are attached. The whole central area is sunken in the present dried condition, but evidently a thick

skin has concealed the central scales in the living specimen. A small number of granules are found scattered interrally on the ventral side and marginally on the dorsal side. There are 4, sometimes 5 arm spines on the proximal arm joints, and 3 more distally.

The present, small *Ophiernus* specimen differs from Koehler's larger specimens of *O. quadrispinus* in that the median papilla on the adoral plates and the outer tentacle scales are spiniform. But this may be only a juvenile character; at least the other differences observed are all attributable to the younger age of the specimen at hand.

Ophiernus quadrispinus is recorded from the Southern Atlantic, off Cape Point, South Africa, and near the South Orkneys, 1700-3250 m. It may be closely related to *O. seminudus* from the East Pacific.

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