

West African Ophiuroids

by

F. JENSENIUS MADSEN

ZOOLOGICAL MUSEUM, COPENHAGEN.

CONTENTS

Introduction.....	151
Zoogeographical remarks.....	153
List of Stations.....	156
Taxonomic part.....	158
Key to the families.....	158
Gorgonocephalidae.....	159
Ophiomyxidae.....	160
Ophiacanthidae.....	161
Ophioleucidae.....	164
Amphiuridae.....	165
Ophiactidae.....	206
Ophiothrichidae.....	212
Ophiocomidae.....	220
Ophiochitonidae.....	225
Ophiodermatidae.....	225
Ophiolepididae.....	230
Summary.....	239
References.....	239
Index, including synonyms.....	242

INTRODUCTION

This paper reports on the ophiuroids collected by the Atlante Expedition 1945-1946 and on the other northern and tropical West African ophiuroid material represented in the Zoological Museum of Copenhagen including, e.g., that collected by the Galathea Expedition in 1950.

The paper at the same time is a catalogue of the shallow-water species of ophiuroids presently known from tropical West Africa. The literature references given comprise the original descriptions, possible important synonyms, and recent literature with good descriptions and more complete references. Only the references dealing with tropical West African materials, given separately under the heading West African records, have been attempted complete.

The keys consider only the tropical littoral-sublittoral species (0-100 m). They have been included in the hope that the paper then may be of service to the marine ecologist, and they are based on easily observable characters, as far as possible. Difficulties are usually unavoidable in the case of juvenile specimens, the identification of which may require knowledge of growth series. When dealing with juveniles it is useful to remember that the appearance of the dorsal arm plates change with growth, those in the juveniles corresponding to the distal ones in the full-grown specimens. The characters used in the keys concern the proximal part of the arms in medium-sized or larger specimens.

An illustration is usually more informative than even a detailed description, and, therefore, a number of sketches, also of some species which have been illustrated before, are given. The sketches have often been based on dried specimens, and usually the drying of some specimens in a sample will greatly help in identifying the species.

Some knowledge of the life-habits of the different groups of ophiuroids will also facilitate identification. Burrowing forms will probably be amphiuroids. Ophiocomids and ophiolepidids are generally found exposed on the open bottom. Ophiothrichids, e.g., occur on all kinds of bottom, crawling on plants and sponges or hiding among stones as well as exposed on the open bottom. Ophiactids always live hidden, e.g. in the crevices in stones or shells. On the whole, the littoral forms hide from view under stones or among plants or lie buried in the bottom. However, comments on biology have been considered outside the scope of the present report.

The tropical West African ophiuroids have been dealt with by primarily KOEHLER (e.g. 1914a and 1923) and more recently by A. M. CLARK and CHERBONNIER, who were also responsible for identification of a number of the ophiuroids listed from the region by LONGHURST (1958).

The list A. M. CLARK (1955: 19) gave of the tropical West African shallow-water ophiuroids (0-100 m) comprised 43 species, and CHERBONNIER (1957, 1963) and TOMMASI (1967) have added a few more. Some of the previously listed species fall, however, into synonymy, as far as I can judge. But 4 new species are described here. The specific names which have been used for tropical West African ophiuroids are all included in the index and, if considered synonyms, with information of the species to which they have been referred.

MARKTANNER-TURNERETSCHER (1887) described two new species of ophiuroids said to be from West Africa, and further recorded West African specimens of three otherwise West Indian species, one of which was new. All the specimens were from the same collection and the locality was given as 0°7'N, 23-25°W. This, however, is in the Mid-Atlantic with great depths, so that there must be some error. H. L. CLARK (1915) interpreted the locality as respectively "Near Cape Verde Islands", "East of St. Paul's Rock" and "Mid-Atlantic"; and KOEHLER (1914a: 275) and A. M. CLARK (1955: 19) both disregarded MARKTANNER-TURNERETSCHER'S records in their surveys of the West African ophiuroids.

One of the species in question, *Ophiocoma marmorata* Marktanner-Turneret-

scher, 1887 (p. 303, pl. 12, figs. 16-17) is definitely distinct from the yet only known West African species of the same genus in having two tentacle scales and elongated oval oral shields.

The other new species stated to be West African, *Amphiura mülleri* Marktanner-Turneretscher, 1887 (p. 300, pl. 13, figs. 25-26) was described as close to *A. josephinae* Ljungman, 1871. It may be this species which itself is here considered identical with *A. grandisquama* Lyman, 1869.

Ophiactis ljunghmani, which MARKTANNER-TURNERETSCHER, (1887: 297) described on a specimen from Haiti, is evidently synonymous with *O. quinqueradia* Ljungman, 1871, with which it was also stated to be closely related. The West African specimen (M.-T., pl. 12, fig. 11) that was included in the species, was suggested by KOEHLER (1914a: 185) to be a five-armed specimen of *O. savignyi* (Müller & Troschel).

The two other West Indian species of which MARKTANNER-TURNERETSCHER reported West African specimens are *Ophionereis reticulata* Say (M.-T., 1887: 301) and *Ophiothrix angulata* Say (M.-T., 1887: 307). The *Ophionereis* specimen was five-armed and thus cannot belong to the only species of *Ophionereis*, *O. sexradia* Mortensen, 1936, hitherto recorded with certainty from West Africa. The *Ophiothrix* specimen, on the other hand, might well belong to the later described West African species, *O. congensis* Koehler.

In all, approximately fifty species of littoral-sublittoral ophiuroids are known from tropical West Africa. The South African fauna comprises a similar number, while the European fauna comprises about 30 species. By comparison the tropical West Atlantic (West Indian) fauna is much richer, comprising more than a hundred littoral-sublittoral species of ophiuroids.

The recently described new shallow-water ophiuroids from tropical West Africa have mostly been burrowing forms collected by the bottom grab. The half a dozen unnamed species enumerated by LONGHURST (1958: 99-100) were likewise obtained during bottom sampling and at least some of them may be presumed to be identical with later described species. Probably not many species remain undiscovered in the region.

ZOOGEOGRAPHICAL REMARKS

An analysis of the tropical West African ophiuroid fauna was given by TOMMASI (1967). His lists of species from the neighbouring faunistic regions include, however, not only the littoral-sublittoral species but also such which are bathyal or even abyssal without this being indicated. The following summarized zoogeographical survey of the tropical West African shallow-water fauna of ophiuroids may still, therefore, be of interest.

The study confirms that the northernmost limit of the endemic tropical West African ophiuroid fauna lies just south of Cape Blanco, about 20°N, while the southernmost limit may lie near Cape Frio, about 18°S. About half the species presently recorded from the region, from depths less than a hundred meters, appear endemic.

Their known bathymetrical range is generally from the littoral or shallow sublittoral to depths of 60-100 m, and about a fourth of them may be found in the lower tidal zone. They are:

<i>Ophiacantha angolensis</i>	<i>Amphioplus suspectus</i>
<i>Amphiura atlantidea</i>	<i>Ophiophragmus acutispina</i>
<i>Amphiura ungulata</i>	<i>Amphipholis nudipora</i>
<i>Amphiura senegalensis</i>	<i>Amphipholis bananensis</i>
<i>Amphiura (Acrocnida) semisquamata</i>	<i>Ophiactis lütkeni</i>
<i>Amphioplus congensis</i>	<i>Ophiothrix nociva</i>
<i>Amphioplus cincta</i>	<i>Ophiothrix congensis</i>
<i>Amphioplus occidentalis</i>	<i>Ophiopterion atlanticum</i>
<i>Amphioplus archeri</i>	<i>Ophiarachnella africana</i>
<i>Amphioplus aurensis</i>	<i>Ophiura (Dictenophiura) skoogi</i>
<i>Amphioplus aciculatus</i>	<i>Ophiolepis affinis</i>

A few of these species are very closely related to Mediterranean – Atlantic species, e.g. *Amphiura (Acrocnida) semisquamata* to *A. (A.) brachiata*, *Ophiactis lütkeni* to *O. balli*, and *Ophiura (Dictenophiura) carnea skoogi* to *O. c.carnea*. The two latter species also have close South African relatives in *Ophiactis carnea* and *Ophiura (Dictenophiura) c. anoidea*. *Amphioplus congensis* has also a close South African relative, *A. integra*.

Amphiura atlantica which is known from South Africa besides from tropical Africa, may be mentioned in connection with the above listed species.

Five of the other remaining species of ophiuroids occurring in shallow depths off tropical West Africa, between Cape Blanco and Cape Frio, likewise appear restricted to the warm region but are also known from the western Atlantic, where they may be found down to 500 m, while off West Africa they are only recorded from depths less than 100 m. They are:

<i>Amphilimna olivacea</i>	<i>Ophiocoma pumila</i>
<i>Ophiostigma abnorme</i>	<i>Ophiolepis paucispina</i>
<i>Ophiactis lymani</i>	

A few of the supposedly endemic tropical West African ophiuroids may also be closely related, if not in reality identical, to West Indian forms. *Ophiolepis affinis*, e.g., is difficult to distinguish from the West Atlantic *O. elegans*.

The warm water ophiuroid fauna also includes a species which, besides being ampho-Atlantic, is distributed in the Indian Ocean and Western Pacific as well:

Amphiura grandisquama

And one species that is circumtropical:

Ophiactis savignyi

One more species is attributed a world-wide distribution in the warm regions, besides being known from the whole East Atlantic and the Mediterranean:

Amphipholis squamata

A few of the amphi-Atlantic species may also have close relatives or be identical with Mediterranean forms. Thus *Ophiactis lymani* is near *O. virens*, and *Amphiura grandisquama* is represented by *A. apicula*.

A number of the other ophiuroids belonging to the tropical West African fauna have a distribution including the Mediterranean-Atlantic region (possibly reaching as far north as the English Channel). They are:

<i>Astrospartus mediterraneus</i>	<i>Ophiopsila aranea</i>
<i>Ophiomyxa pentagona</i>	<i>Ophiopsila guineensis</i>
<i>Ophiacantha setosa</i>	<i>Ophioderma longicaudum</i>
<i>Amphiura incana</i>	<i>Ophionereis sexradia</i>
<i>Amphiura (Acrocnida) brachiata</i>	<i>Ophiura grubei</i>
<i>Ophiothrix cotteai</i>	

Some of these species have also close relatives in the West Indian region. Thus *Ophiomyxa pentagona* is related to *O. flaccida*, and *Ophioderma longicaudum* is hardly distinguishable from *O. cinereum*.

The circumtropical *Ophiactis savignyi* occurs in the Mediterranean, in the eastern part, as an immigrant through the Suez Canal.

A few of the tropical West African ophiuroids are hitherto recorded only from the Cape Verde-Cape Blanco area and their zoogeographical status is therefore uncertain. They are *Dougaloplus libera*, *Ophiarachnella semicincta* and *Ophioconis vivipara*.

The remaining ophiuroids reported off tropical West Africa in depths less than a hundred meters have a wide distribution in the East Atlantic, from South Africa to Iceland and Lofoten including the Mediterranean, and they also have a wide bathymetrical range reaching down into bathyal depths. They owe their occurrence off tropical West Africa to the upwelling and are known there only from depths exceeding about 20 m and are rarely recorded from depths less than about 50 m. They are:

<i>Amphiura chiajei</i>	<i>Ophiothrix fragilis</i>
<i>Amphiura filiformis</i>	

If the subspecies *skeoogi* and *anoidea* prove untenable also *Ophiura (Dictenophiura) carnea* should be ranged in this zoogeographical group. The already mentioned, probably circumtropical *Amphipholis squamata* has a wide East Atlantic distribution too.

The ophiuroid fauna in the deeper sublittoral (100-400 m) off tropical West Africa includes most of the species with a distribution comprising the Lusitanian-

Mediterranean region, and a few of the amphii-Atlantic and supposedly East Atlantic species.

Other species that have been recorded from the deeper sublittoral off tropical West Africa are: *Cryptopelta brevispina*, *Ophioscolex purpureus*, *Ophiacantha smitti*, *O. valenciennesi*, *Ophiernus adpersus*, *Amphiura lorioli*, and *Ophiactis balli*. Species that may be expected to be found there are, e.g., *Asteronyx loveni*, *Ophiacantha abyssicola*, *O. bidentata*, *Ophiomitrella clavigera*, *Amphiura sarsi*, *Amphilepis norvegica*, *Histocampia duplicata* (*Amphiactis d.*), *Ophiactis abyssicola*, *Ophiothrix maculata*, *Ophiopleura aurantiaca*, *Ophiura texturata*, *O. albida*, *O. flagellata*, and *Ophiomusium lymani*.

As might be expected, the species common to tropical West Africa and the Mediterranean usually have been described first on Mediterranean material. *Ophiopsila guineensis* Greeff, however, was first known from West African specimens. In the present paper, *Amphiura incana*, originally described by LYMAN on a South African specimen, is recorded for the first time from the Mediterranean; and the Mediterranean *Amphiura apicula* described by CHERBONNIER (1963) is found to be identical with LYMAN'S *Amphiura grandisquama* from the Atlantic.

LIST OF STATIONS

The Atlantide Stations at which Ophiuroids were obtained are:

- St. 39, San Pedro Bay, St. Vincent, 10.12.45, 22 m, 50 m, 50–41 m, sand, corals, foraminifera.
- St. 40, Off San Pedro Bay, 11.12.45, 60 m, 40 m, foraminifera, sand, stony.
- St. 43, Bay of Praia, 13.12.45, 22 m, dark, grey, muddy sand.
- St. 44, 10°22' N, 16°22' W, 17.12.45, 41 m, 49 m, 55 m, br. sand, shells.
- St. 45, 9°23' N, 15°07' W, 18.12.45, 34 m, fine, yellow sand.
- St. 49, 7°29' N, 13°38' W, 30.12.45, 74–79 m, muddy sand.
- St. 51, 7°14' N, 12°57' W, 31.12.45, 108 m, 104 m, sand, greenish mud.
- St. 52, Monrovia, tidal zone, rocks, 3.1.46.
- St. 53, Off Port Marshall, 4.1.46, 12 m.
- St. 54, 6°05' N, 10°25' W, 8.1.46, 22 m, coarse sand.
- St. 56, 6°01' N, 10°26' W, 8.1.46, 50 m, mud.
- St. 57, 5°59' N, 10°26' W, 8.1.46, 62 m, muddy sand.
- St. 58, 5°50' N, 10°30' W, 8.1.46, 95 m, muddy sand.
- St. 60, 5°06' N, 9°34' W, 9.1.46, 78 m, sand, mud.
- St. 63, 4°17' N, 7°11' W, 11.1.46, 135 m, muddy, coarse sand.
- St. 65, 4°24' N, 7°05' W, 11.1.46, 78 m, muddy sand.
- St. 66, 4°27' N, 7°07' W, 11.1.46, 66 m, mud.
- St. 68, 4°38' N, 6°18' W, 12.1.46, 80–84 m, 90 m, mud.
- St. 70, 4°50' N, 2°49' W, 15.1.46, 65 m, 60 m, mud, calc. polyzoans.
- St. 72, 4°52' N, 1°42' W, 23.1.46, 24 m, muddy sand.

- St. 73, 4°50' N, 1°40' W, 23.1.46, 33 m, sand, little mud.
 St. 75, 4°44' N, 1°36' W, 23.1.46, 46 m, muddy sand.
 St. 77, Accra, 26.1.46, tidal zone.
 St. 85, 5°37' N, 0°38' E, 30.1.46, 50 m, 40 m, 30 m, 28 m, greyish mud.
 St. 86, 5°45' N, 0°57' E, 31.1.46, 17 m, 15 m.
 St. 98, 5°56' N, 4°26' E, 15.2.46, 100 m.
 St. 100, 6°06' N, 4°29' E, 15.2.46, 29 m.
 St. 101, 5°59' N, 4°36' E, 15.2.46, 17 m.
 St. 102, 5°34' N, 4°50' E, 16.2.46, 29 m, 27 m.
 St. 106, 3°55' N, 6°08' E, 18.2.46, 53 m, 55-58 m, 78-88 m, mud.
 St. 109, Dowes Island, Niger Delta, 21.2.46, 15 m, sand.
 St. 110, Creek, Bonny River, opp. Opobo, Niger Delta, 21.2.46, 8 m, 16 m, grey, soft mud.
 St. 111, Off Bonny River, 22.2.46, 20 m.
 St. 112, 4°12' N, 7°05' E, 22.2.46, 19 m, clayish mud.
 St. 113, 4°05' N, 7°09' E, 22.2.46, 32 m.
 St. 116, 4°01' N, 7°56' E, 23.2.46, 66 m, mud.
 St. 120, 2°09' N, 9°27' E, 1.3.46, 650-260 m, mud.
 St. 122, 1°29' S, 8°50' E, 4.3.46.
 St. 123, 2°03' S, 9°05' E, 5.3.46, 50 m, 50-49 m, 49 m, mud, sand, shells, coral.
 St. 125, 5°02' S, 11°14' E, 7.3.46, 55 m, shells.
 St. 126, Anchorage Île de Bulikoko, 25 miles up Congo River, 8.3.46, mangrove.
 St. 129, 6°02' S, 12°20' E, 15.3.46, 12 m, muddy sand.
 St. 131, 5°38' S, 12°08' E, 15.3.46, 26 m, 27 m, sandy mud.
 St. 136, 8°30' S, 13°14' E, 18.3.46, 45 m, 42 m, mud.
 St. 141, Off Freetown, 9.4.46, 15 m.
 St. 145, 9°20' N, 14°15' W, 13.4.46, 32 m.
 St. 146, 9°27' N, 14°48' W, 13.4.46, 51 m, 50 m.
 St. 147, 9°28' N, 14°58' W, 14.4.46, 45 m.
 St. 151, 10°40' N, 16°44' W, 16.4.46, 65 m, 86 m, coarse sand.
 St. 153, 10°49' N, 16°39' W, 16.4.46, 42 m.
 St. 156, Off Bathurst, 24.4.46, 18 m, bluish mud, oyster shells.
 St. 157, Off Bathurst, 24.4.46, 14 m, bluish mud, oyster shells.
 St. 158, Off Bathurst, 24.4.46, greyish muddy sand, shells.
 St. 160, Off Bathurst, 24.4.46, 14 m, grey, very fine sand.
 St. 161, Off Bathurst, 24.4.46, 18 m, very fine sand.
 St. 161, Off Bathurst, 24.4.46, 18 m, very fine sand.
 St. 163, 13°43' N, 17°23' W, 25.4.46, 65 m, 76-89 m, 90 m.

Data for stations of other expeditions etc., are given in the lists of material of the species.

TAXONOMIC PART

Key to the families of ophiuroids from tropical West Africa

- 1a. The disk clothed by a thick skin without definite scales except for the radial shields. The arms rolled into vertical coils. The arm spines ventral and pointing downward: Suborder Euryalae..... 2
- 1b. The disk and arms usually covered by plates or scales. The arm spines lateral and pointing outward or toward the arm tip. The arms always unbranched: Suborder Ophiurae..... 3
- 2a. The arms branched and with hook-shaped spines Gorgonocephalidae, p. 159
(2b. The arms unbranched.....Asteronychidae)
- (3a. The arms coiling vertically. The disk covered with heavy plates and the arms very stout.....Hemieuryalidae)
- 3b. The arms moving horizontally..... 4
- 4a. The plates of disk and arms concealed by a thick naked skin. The dorsal arm plates more or less rudimentary.....Ophiomyxidae, p. 160
- 4b. The plates of disk and arms easily visible, if not covered by spines or granules. The dorsal arm plates well developed..... 5
- 5a. The jaw with a dense cluster of spines (tooth papillae or dental papillae) at its apex..... 6
- 5b. The jaw with one or two infradental papillae at its apex accompanied by a series of spines (teeth) deeper in the mouth..... 7
- 6a. The jaw with a continuous series of marginal oral papillae to either side besides the apical vertical cluster of spines. The disk with granules or naked. The arm spines erect and smooth.....Ophiocomidae, p. 220
- 6b. No oral papillae. The jaw with only the compact oval cluster of small apical spines. The disk usually with spines or thorns. The arm spines erect and often thorny and glassy.....Ophiothrichidae, p. 212
- 7a. Two paired infradental papillae at the apex of jaw. The teeth deeper in the mouth large and squarish. The arms slender and usually very long. The arm spines short and erect.....Amphiuridae, p. 165
- 7b. A single unpaired infradental papilla at the apex of jaw..... 8
- 8a. Disk and arms firmly fused together. The arm spines usually small and closely adpressed. The oral papillae in a continuous marginal series..... 9
- 8b. The disk overlays the arms. The arm spines usually erect..... 10

- 9a. The disk plates largely concealed by a covering with granules, both dorsally and ventrally. Ophiidermatidae, p. 225
- 9b. The disk plates usually naked, and distinct even if bearing spinelets.
 Ophiolepididae, p. 230
- 10a. A wide gap separates a large and squarish apical infradental papilla from 1–2 lateral oral papillae. The disk possibly with spinelets. The arm spines short and erect. Ophiactidae, p. 206
- 10b. The oral papillae in a continuous marginal series. 11
- 11a. The disk plates naked. 11
- 11b. The disk with articulated spinelets or granules. 12
- 12a. The arms robust. The arm spines slender and more or less erect.
 Ophiochitonidae, p. 225
- (12b. The arms slender and very long. Amphilepidae)
- 13a. The arm spines numerous, long, and projecting. Ophiacanthidae, p. 161
- 13b. The arm spines few, small, and adpressed. Ophioleucidae, p. 164

GORGONOCEPHALIDAE

Astrospartus mediterraneus (Risso)

Euryale mediterraneus Risso, 1826: 274.

Gorgonocephalus arborescens L. Agassiz, 1839: 11, pls. 4–5.

Astrophyton arborescens, LUDVIG 1879: 552.

Astrospartus mediterraneus, DÖDERLEIN 1911: 50, 73; TORTONESE 1965: 212, fig. 100.

West African records: MORTENSEN 1925: 184; CADENAT 1938: 355; LONGHURST 1958: 99; BUCHANAN 1958: 31; CHERBONNIER 1962: 5; TOMMASI 1967: 523.

Material:

“Atlantide” St. 163. – 6 spec.

“Dana” St. 1115, 35°30'N. 6°19'W., 125 m, 20.9.1921. – 6 spec.

The specimens are from 19 to 52 mm in disk diameter and the largest one has – in its preserved state with the arms curved in – an entire diameter of about 20 cm. The largest size recorded in the literature is 80 mm in d.d.

Distribution: *Astrospartus mediterraneus* is known in the East Atlantic from off Portugal to Ghana, in 65 to 265 m, and is found in the Mediterranean as far east as the Adriatic, in 40 to 188 m. It is associated with octocorals.

OPHIOMYXIDAE

Ophiomyxa pentagona (Lamarck)

Fig. 1

Ophiura pentagona Lamarck, 1816: 546.

Ophiomyxa pentagona, MÜLLER & TROSCHEL 1842: 108; TORTONESE 1965: 217, fig. 101.

West African records: *Ophiomyxa flaccida*: STUDER 1883: 29.

O. pentagona: KOEHLER 1907a: 302; LONGHURST 1958: 99.

Material:

“Atlantide” St. 40. – 1 spec.

St. 60. – 1 spec.

The lateral oral spines form a continuous series with the apical one and are like this broad and with a serrate, glassy margin. Dorsal arm plates are wanting and the ventral arm plates have a deep distal notch. The specimen from St. 40 (Canary Is.), 11 mm in disk diameter, has 3–4 lateral oral spines, and agrees well with Mediterranean specimens. The other specimen, from off Liberia, d.d. about 5 mm and arms 20 mm long, has 4–6 lateral oral spines. The species grows to at least 25 mm in d.d.

Distribution: *Ophiomyxa pentagona* is known from a few localities in the East Atlantic from the Bay of Biscay to off Liberia in depths from 35 to 235 m, and is common in littoral-sublittoral depths in the whole Mediterranean.

The West Indian littoral-sublittoral *O. flaccida* (Say, 1825) seems to be a very close relative.

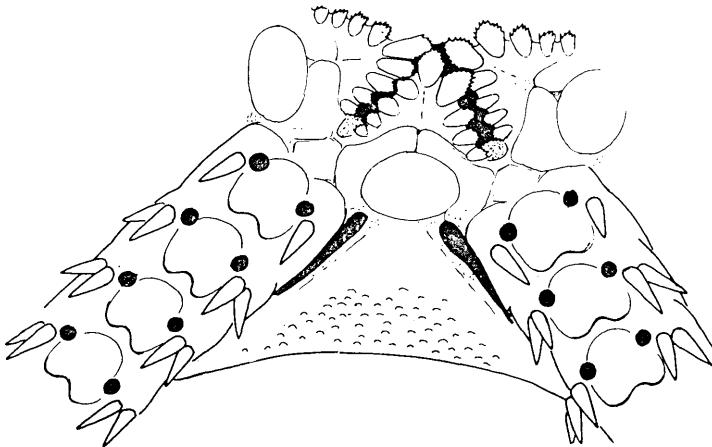


Fig. 1. *Ophiomyxa pentagona* (Lamarck). “Atlantide” St. 60, d.d. 5 mm.

OPHIACANTHIDAE

- 1a. The lateral arm spines in the proximal joints within the region of the genital slits fused flange-like together. The disk plates with slender, pointed spines. The radial shields narrow and naked. The inner one of the two tentacle scales spiniform. *Amphilimna olivacea*, p. 163
- 1b. The lateral arm spines all free of each other. 2
- 2a. The radial shields very prominent and with thorny spinelets. The other dorsal disk plates possibly with spinelets too. The ventral arm plates about as broad as long and with a distal notch. *Ophiacantha setosa*, p. 161
- 2b. The radial shields not especially conspicuous. The whole dorsal disk uniformly covered with short spinelets with 1 (-3) long thorns. The ventral arm plates are somewhat broader than long and with a slightly convex distal margin. *Ophiacantha angolensis*, p. 162

Ophiacantha setosa (Retzius).

Fig. 2 a

Asterias setosa Retzius, 1805: 30.*Ophiacantha setosa*, MÜLLER & TROSCHEL 1842: 106, pl. 8, fig. 2; CHERBONNIER 1962: 5, pl. 1. fig. A-C.

West African records: KOEHLER 1907a: 291; LONGHURST 1958: 99; CHERBONNIER 1962: 5; TOMMASI 1967: 525.

Material:

- "Atlantide" St. 49. - 4 spec.
 St. 68. - 17 spec.
 St. 163. - 1 spec.

The specimens measure from 2 to 9 mm in disk diameter, with the arms in medium-sized specimens about 9 times as long. The largest specimen appears to be senescent, having an abnormal number of oral spines proximally on the jaws. The species is otherwise stated to grow to 12 mm d.d.

Distribution: *Ophiacantha setosa* is known from several sublittoral and a few bathyal finds (50 to 1480 m) in the Eastern Atlantic from the Bay of Biscay to off Angola, and in the Western Mediterranean.

LONGHURST (1958: 99) recorded the related *Ophiacantha smitti* Ljungman from Sierra Leone, 118 m, but the possibility that a confusion with *O. setosa* has taken place must be considered. *Ophiacantha smitti* was described by LJUNGMAN (1871: 621) on a specimen, 3 3/4 mm disk diameter, from off Portugal, 1420 m, and the type was re-described by KOEHLER (1926: 25, pl. 5, figs. 3-4).

Ophiacantha angolensis Koehler.

Fig. 2 b

Ophiacantha angolensis Koehler, 1923: 6, pl. 1, figs. 4–5.*Ophiacantha angolensis*, CHERBONNIER 1962: 6, pl. 1, fig. D.*Ophiacantha angolensis inermis* Mortensen, 1936: 255.West African records: *O. angolensis*: KOEHLER 1923: 6; CHERBONNIER 1962: 6; TOMMASI 1967: 525.*O. angolensis inermis*: MORTENSEN 1936: 255.

Material:

"Atlantide" St. 125. – 1 spec.

The disk diameter is about 3 1/2 mm and the arms 20 mm long. The largest specimen on record was 5 mm in d.d. The present specimen agrees with the type in that the short stumps which uniformly cover the dorsal disk end in 3 very long thorns. MORTENSEN distinguished a var. *inermis* with disk stumps with only a single point, but CHERBONNIER (1962) rightly considers this character insufficient for maintaining a separate subspecies.

Distribution: *Ophiacantha angolensis* is known from about six localities between the Ivory Coast and Port Alexandre, Angola, in 55 to 200 m.

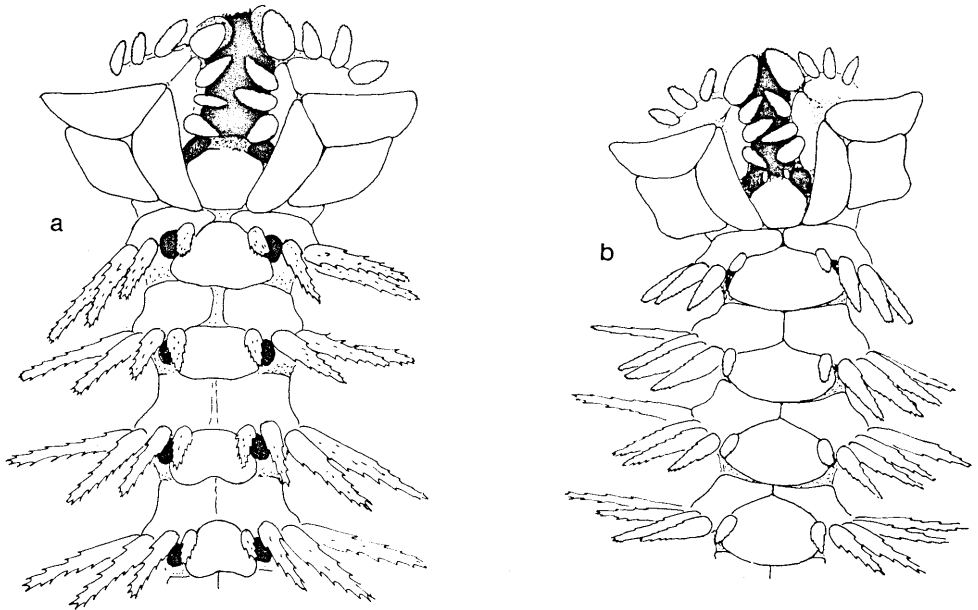


Fig. 2. a, *Ophiacantha setosa* (Retzius). "Atlantide" St. 49, d.d. 4 mm. b, *Ophiacantha angolensis* Koehler. "Atlantide" St. 125, d.d. 3 mm.

Ophiacantha abyssicola G. O. Sars.

Ophiacantha abyssicola G. O. Sars, 1871: 8.

Ophiacantha abyssicola, GRIEG 1893: 24, pl. 1, figs. 6-10.

Material:

Off Las Palmas, Gran Canaria, 60–150 m, Mortensen leg. 25.3.1930. – 1 spec.

La Luz, Gran Canaria, 180 m, Mortensen leg. 2.4.1930. – 3 spec.

The specimens measure merely $1\frac{1}{2}$ to 3 mm in disk diameter, while the recorded maximum size is 8 mm.

Distribution: *Ophiacantha abyssicola* is a North Atlantic sublittoral-abyssal species (35–3510 m), known from the whole “warm” area south of the Wyville Thomson Ridge, from southern Greenland to Cape Hatteras in the western part and from Lofoten to the Canary Is. (the above record) in the eastern part. Most finds have been made in bathyal depths.

The species was previously recorded with a slight doubt from off Morocco by MORTENSEN (1925: 180).

Amphilimna olivacea (Lyman).

Fig. 3

Ophiocnida olivacea Lyman, 1869: 340.

Amphilimna olivacea, VERRILL 1899: 318. pl. 42, figs. 1–1a; CHERBONNIER 1962: 12, pl. 4, figs. A–D; THOMAS 1967: 123, figs. 1–6.

West African records: LONGHURST 1958: 99; CHERBONNIER 1962: 12; TOMMASI 1967: 538.

Material:

“Atlantide” St. 57. – 2 spec.

St. 68. – 1 spec.

St. 70. – 4 spec.

The specimens are from 3 to 12 mm in disk diameter, and the arms are, e.g., 85 mm long by a d.d. of 10 mm. The recorded maximum size is about 14 mm d.d. The arrangement of the spines on the mouth frame shows some diversity even on jaws in the same specimen. Apically the jaw usually bears 3 conical spines (infra-dental papillae) subequal in size or with the median one twice as large as the lateral ones and almost as large as the rather square teeth deeper in the mouth. Sometimes the median one of the apical spines is absent and the jaw armature be-

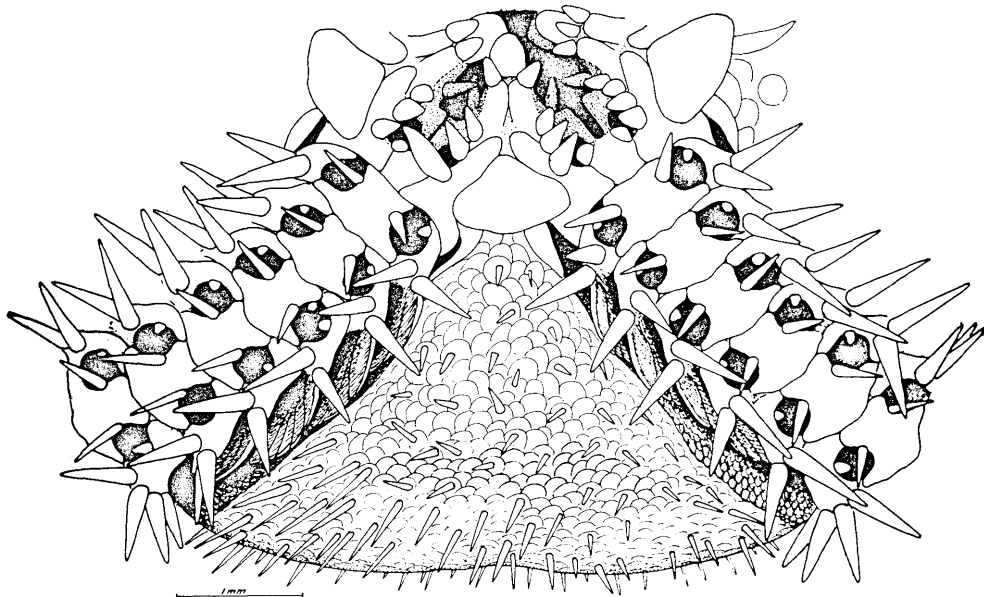


Fig. 3. *Amphilimna olivacea* (Lyman). "Atlantide" St. 57, d.d. 9 mm.

comes amphiuroid-like, with 2 infradental papillae. There is a short gap between the apical infradental spines and the 3 (2–4) lateral oral spines borne on the adoral plate. The lateral oral spines usually increase in size toward the distal mouth angle and the spine here may approach the arm spines in appearance.

Distribution: *Amphilimna olivacea* is a sublittoral – upper bathyal, amphi-Atlantic species (60–490 m), recorded in the East Atlantic from Liberia to Angola and in the West Atlantic from Massachusetts to Uruguay.

OPHIOLEUCIDAE

Ophiernus adpersus Lyman

Ophiernus adpersus Lyman, 1883: 236, pl. 3, figs. 19–21.

Material:

"Atlantide" St. 120. – 1 spec.

The single successful sublittoral-bathyal trawling (260–650 m) of the Atlantide Expedition included a damaged disk, about 22 mm in diameter, of this tropical Atlantic and Indo-West Pacific deep-sea species (300–3650 m).

AMPHIURIDAE

- 1a. A wide gap separates the apical pair of infradental papillae from the lateral oral papillae. *Amphiura*, p. 165
- 1b. The oral papillae form a continuous, marginal series. 2
- 2a. One of the oral papillae, usually the distal one, at least twice as broad as the other ones together. 3
- 2b. None of the oral papillae broader than the other ones together. 4
- 3a. The disk with scattered, blunt, not articulated spines. Two spiniform tentacle scales. *Ophiostigma*, p. 200
- 3b. The disk without spines. *Amphipholis*, p. 202
- 4a. The disk plates naked and smooth. Two tentacle scales. Four oral papillae. *Amphioplus*, p. 167
- 4b. Some disk plates with spines or spine-like thickened. 5
- 5a. The disk with articulated spines. Five oral papillae. Tentacle pores, except proximal pair, with only one scale. *Dougaloplus*, p. 206
- 5b. Marginal disk plates partly thickened into spiniform tubercles. Three oral papillae. One tentacle scale. *Ophiophragmus*, p. 199

? *Amphiodia* sp. A. M. Clark 1955. A. M. CLARK (1955: 36, fig. 13) described from Ghana, 13 m, a large amphiuroid without disk (estimated d.d. 8 mm) under this name, at the same time noting its resemblance with the West Atlantic *Ophiophragmus limicola* Lütken. It resembles *Ophiophragmus acutispina* in having three oral papillae and single tentacle scales, but differs in that the arm plates, dorsal as well as ventral, are longer than broad. The species it represents is not included in the present material.

Some specimens of *Ophionereis* (fam. Ophiochitonidae) may turn up in the key under *Amphioplus* but can be distinguished by having supplementary plates laterally to the dorsal arm plates. Specimens of *Amphilimna* (fam. Ophiacanthidae) may turn up in the key under *Dougaloplus* but are distinguished by having two tentacle scales, the inner one of which is elongated spiniform.

Amphiura

- 1a. Ventral and marginal disk scales thickened into pointed cones, higher than their basal diameter: subgenus *Acrocnida*. 2
- 1b. Ventral and marginal disk scales smooth, at least never simulating spines: subgenus *Amphiura*. 3

- 2a. The proximal tentacle pores with two scales but following ones with only the outer scale. All arm spines spiniform. *brachiata*, p. 171
- 2b. The proximal tentacle pores usually with only a single scale, the inner one. Median arm spines compressed. *semisquamata*, p. 172
- 3a. Tentacle scales present. Disk fully scaled. 4
- 3b. Tentacle scales absent (at most a minute one at a few pores). 7
- 4a. A single, large, leaf-shaped scale at each tentacle pore. . . *grandisquama*, p. 177
- 4b. Two tentacle scales. 5
- 5a. Dorsal arm plates fan-shaped. 6
- 5b. Dorsal arm plates broadly oval. The arm spines compressed and blunt *incana*, p. 173
- 6a. All the arm spines straight, spiniform. *chiajei*, p. 167
- 6b. The arm spines proximally in the arms hook-shaped. *atlantidea*, p. 169
- 7a. Next ventralmost arm spine axe-shaped tipped. Ventral side of disk deficiently scaled. 8
- 7b. All the arm spines with a simple, pointed or blunt extremity. 9
- 8a. Two distal oral papillae to either side of jaw, a spiniform one and a scale-like one. *filiformis*, p. 179
- 8b. One distal, spiniform papilla to either side of jaw. *atlantica*, p. 181
- 9a. The arm spines simple, pointed. Disk fully scaled. *senegalensis*, p. 182
- 9b. Ventralmost arm spine long, with truncate extremity. Disk deficiently scaled ventrally. *ungulata*, p. 183

The South African *Amphiura capensis* Ljungman, 1867, was recorded from Senegal and Angola by KOEHLER (1914b: 190), but a re-examination undertaken by MORTENSEN (1933b: 350) showed the Senegal specimens to be *Ophiactis africana* (= *O. lütkeni*) and the Angola specimen an *Amphipholis*.

Two other South African species, *Amphiura acutisquama* A. M. Clark, 1952, and *A. simonsi* A. M. Clark, 1952, were included in the key TOMMASI (1967: 529) gave for the West African species of *Amphiura*. However, neither of these seem known as yet from the tropical region.

Amphiura chiajei Forbes.

Figs. 4, 5 a

Amphiura chiajei Forbes, 1843: 151.*Amphiura chiajei*, MORTENSEN 1927: 212, figs. 117, 120.*Amphiura rancureli*, Tommasi 1967: 530, fig. 1.West African records: *A. chiajei*: MORTENSEN 1936: 287; LONGHURTS 1958: 99.*A. rancureli*: TOMMASI 1967: 530.

Material:

"Atlantide" St. 49. – 4 spec.

St. 60. – 3 spec.

St. 63. – 1 spec.

St. 65. – 1 spec.

St. 66. – 1 spec.

St. 70. – 8 spec.

St. 85. – 8 spec.

St. 116. – 5 spec.

St. 120. – 2 spec.

St. 136. – 44 spec.

"Galathea" St. 87, 6°21'S. 12°05'E., 50 m, V.G., 8.12.1950. – 1 spec.

St. 124, 12°20'S. 13°40'E., 45 m, V.G., 20.12.1950. – 1 spec.

St. 125, 12°20'S. 13°40'E., 60 m, V.G., 20.12.1950. – 1 spec.

St. 132, 17°13'S. 11°27'E., 201 m, P.G., 22.12.1950. – 1 spec.

The specimens measure up to 11 mm in disk diameter, the recorded maximum size of the species, and agree well with European samples. The single, scale-like lateral oral papilla, which is roundish in young specimens, becomes very wide with age, corresponding to the condition in the specimen from the Ivory Coast for which TOMMASI, (1967: 530) erected the species *A. rancureli*. TOMMASI himself also noted that his new species might be just an individual variation of *A. chiajei*. Whether the oral papillae of either side of the furrow touch each other or not is merely a question of the degree of jaw closure over the mouth opening (compare Figs. 4 and 5a).

A. chiajei is further characterized by its broad, rather fan-shaped dorsal arm plates, by its two large tentacle scales which when opened form an angle of about 90° with each other, and by the simple, spiniform arm spines. There are up to 8 arm spines on some of the proximal arm joints in the largest specimens, d.d. 11 mm, but only 4 in specimens about 5 mm in d.d.

The tentacle scales are still developed at only the most proximal pores in specimens 2 1/2 mm in d.d., cf. Fig. 4, with the outer scale on the lateral arm plate appearing before the inner one on the ventral arm plate.

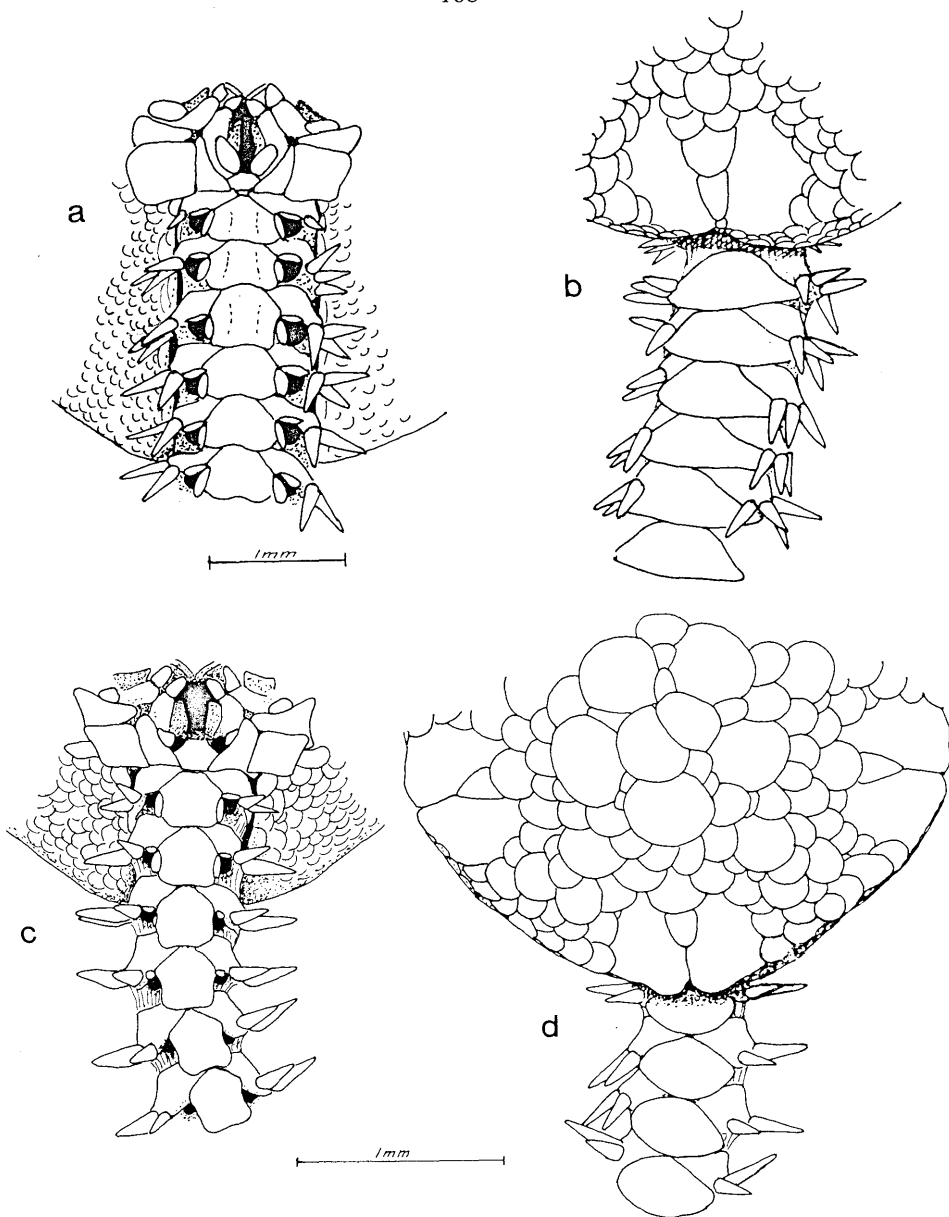


Fig. 4. *Amphiura chiajei* Forbes. a-b, "Atlantide" St. 49, d.d. 5 mm. c-d, "Atlantide" St. 50, d.d. 2½ mm.

Distribution: *Amphiura chiajei* is an East Atlantic and Mediterranean species with a bathymetrical range from about 10 to 1200 m. Its northermost limit lies at Trondheim Fjord, Norway, and the Faroes, while the southernmost record is the Galathea St. 132, just north of Cape Frio. All finds off West Africa have been made in depths exceeding about 40 m.

Amphiura atlantidea n.sp.

Figs. 5b, 6

Material:

"Atlantide" St. 57. – 2 spec.

St. 58. – 1 spec.

St. 68. – 1 spec.

Diagnosis: A species of *Amphiura* resembling *A. chiajei*, but distinguished by having enlarged, hook-shaped, inward curved arm spines on the proximal arm joints in the disk area and slightly smaller tentacle scales.

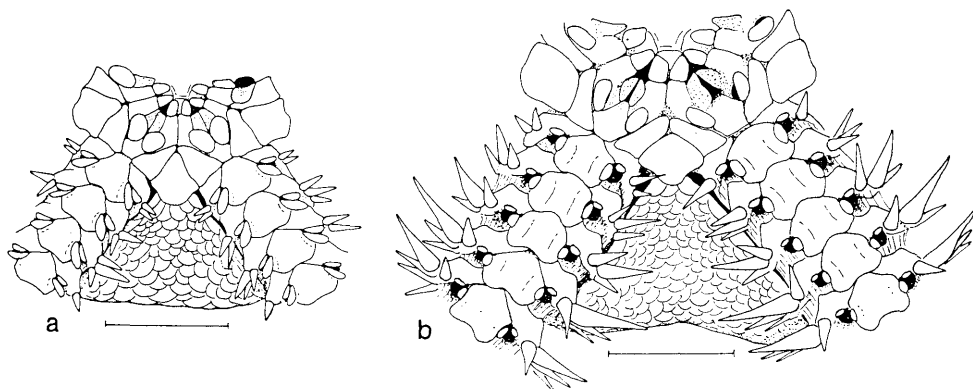


Fig. 5. a, *Amphiura chiajei* Forbes. "Atlantide" St. 85, d.d. 3½ mm. b, *Amphiura atlantidea* n.sp., juvenile paratype, d.d. 5 mm.

As type is chosen the specimen from St. 68 with a disk diameter of 11 mm and about 80–90 mm long arms. One of the specimens from St. 57 is of similar size, but fragmented. The other specimen in that sample and the one from St. 58 are young, 5 mm in d.d., and also fragmentary.

Type-locality: "Atlantide" St. 68, off the Ivory Coast, 90 m.

In dorsal aspect the specimens appear indistinguishable from the type-species of *Amphiura*, *A. chiajei*. The dorsal arm plates, e.g., are similarly fan-shaped. But in ventral aspect the new species is immediately distinguished in the case of large specimens by the spine-armature on the joints in the disk area, where the lateral of the 2–3 arm spines are distinctly hook-shaped, with the point of the hook turned toward the mouth. The lower of these lateral hook-shaped spines increases in size from the proximal arm joint to joints nos. 6–7, at the disk margin, where it reaches about twice the length of the joint itself. Outside the disk area all the arm spines are simple, spiniform, and proximally in the arms the next lowermost spine is slightly the stoutest and longest, about a third longer than the joint. In the smaller specimens, d.d. 5 mm, the arm spines in the disk area are not yet distinctly hook-shaped, but they

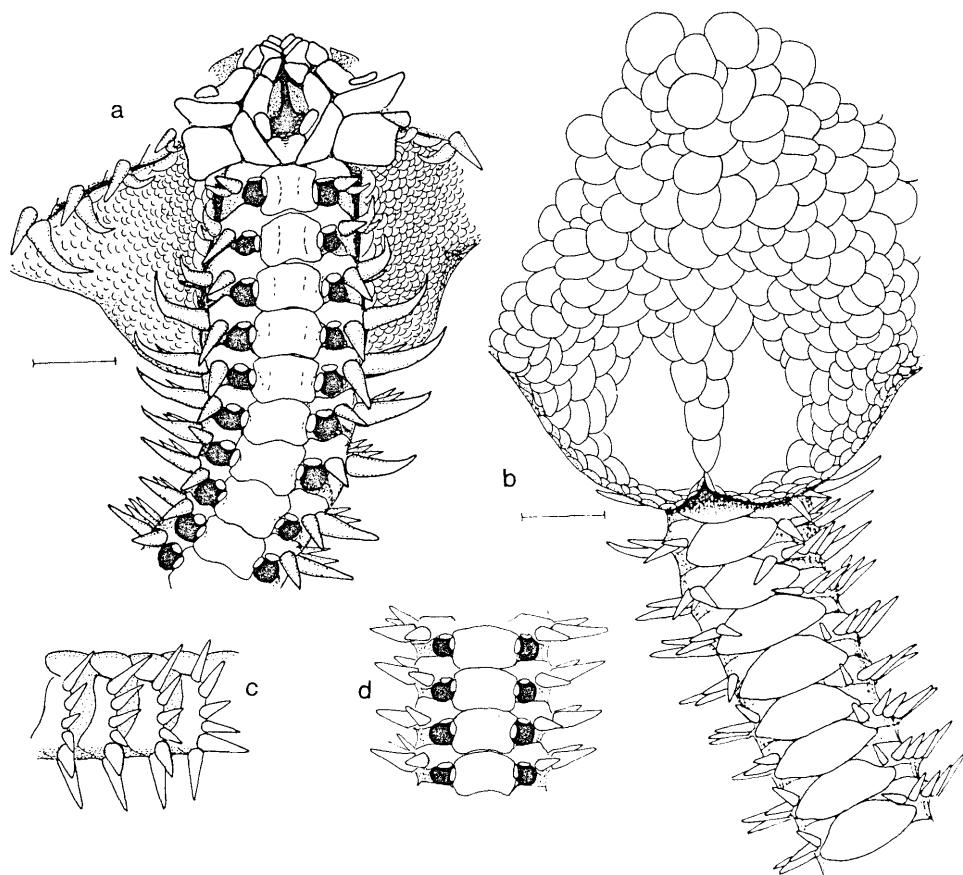


Fig. 6. *Amphiura atlantidea* n.sp. Type-specimen, "Atlantide" St. 68, d.d. 11 mm. c, armjoints nos. 12-15. d, armjoints nos. 18-21.

are longer and more pointed than in similar-sized *A. chiajei* (cf. Fig. 5). Proximally in the free part of the arms in the specimens 11 mm in d.d. the arm spines number 6-7 and on some joints 8, while they are 5 in number in the specimens 5 mm in d.d. This is one spine more than is generally found in similar-sized *A. chiajei*, but not outside the variation in that species.

The proximal arm plates are of the same shape as in *A. chiajei* and have the same lateral keels. The two tentacle scales are, when opened, placed at a right angle to each other as in *A. chiajei*, but they are slightly smaller. The smaller size of the tentacle scales is the only other character besides the shape of the arm spines by which the new species *A. atlantidea* differs from *A. chiajei*. As in *A. chiajei*, only the outer one of the tentacle scales is developed in the distal part of the arms, and as in this species the ventral disk scales in the large specimens are slightly thickened.

Distribution: The localities from which *Amphiura atlantidea* is represented are off the Ivory Coast and Liberia, in 62, 90 and 95 m depth.

Amphiura (Acrocnida) brachiata (Montagu).

Fig. 7 d

Asterias brachiata Montagu, 1804: 84.*Acrocnida brachiata*, GISLÉN 1926: 15; MORTENSEN 1927: 218, fig. 123.

Material:

"Atlantide" St. 161. – 1 spec.

The specimen measures 6 mm in diameter of disk while the maximum size of the species is 13 mm d.d. There are two tentacle scales on the proximal 7–8 (in one arm, 9) arm joints, and the outer tentacle scale persists until about joint no. 20.

Because of its spine-like ventral and marginal disk scales *A. brachiata* has been included in *Ophiocnida* Lyman, 1865. When VERRILL (1899) revised this genus, he transferred it to his *Amphiocnida* which he said (1899: 317) he had been inclined to consider as a subgenus of *Amphiura*. Finally GISLÉN (1926) removed *brachiata* from *Amphiocnida* s.str. (= *Ophiocentrotus* LJUNGMAN, 1867) and made it the type of his *Acrocnida* which was characterized by its spinosity caused merely by its conically thickened scales, while the other species in *Amphiocnida* had articulated disk spines. However, I do not think that the spiny appearance of the disk scales alone is sufficient reason for maintaining *Acrocnida* as a genus distinct from *Amphiura* s.str. with which *A. brachiata* otherwise agrees in all main characters. MORTENSEN (1936: 287) for example, considered *Acrocnida* so closely related to *A. chiajei* that he suspected it was perhaps derived from this species or one like it. He was especially struck by the resemblance between the ventral arm plates in *Acrocnida*, where two longitudinal furrows separate a median keel from two lateral keels, and those in large specimens of *A. chiajei* where a similar condition is observed. But more important is the almost identical appearance of the oral skeleton.

Besides *A. brachiata*, GISLÉN (1926) included in his *Acrocnida* *A. neapolitana* (M. SARS, 1857), which is merely an individual variation of *A. brachiata*, and *A. semisquamata* (KOEHLER, 1914). The two species, *brachiata* and *semisquamata*, are very closely related. In both species it is only at the proximal pores that tentacle scales are developed, and the main distinguishing character is whether it is the inner or the outer tentacle scale that persists at the pores a little out on the arms. Tentacle scales are absent altogether in the most juvenile specimens which, therefore, are unidentifiable if present alone in a sample.

In *A. brachiata*, specimens of 4 mm or more in d.d., there are two tentacle scales at the most proximal pores, an inner one on the ventral arm plate and an outer one on the lateral arm plate. A little further out on the arms the pores have only the outer scale, and for the greater length of the arm there are no tentacle scales at all.

In *A. semisquamata* the proximal pores have typically only a single tentacle scale, the inner one at the ventral arm plate. Tentacle scales are not developed as far out on the arm as in *A. brachiata*, and it is only in large specimens that some pores may have two scales.

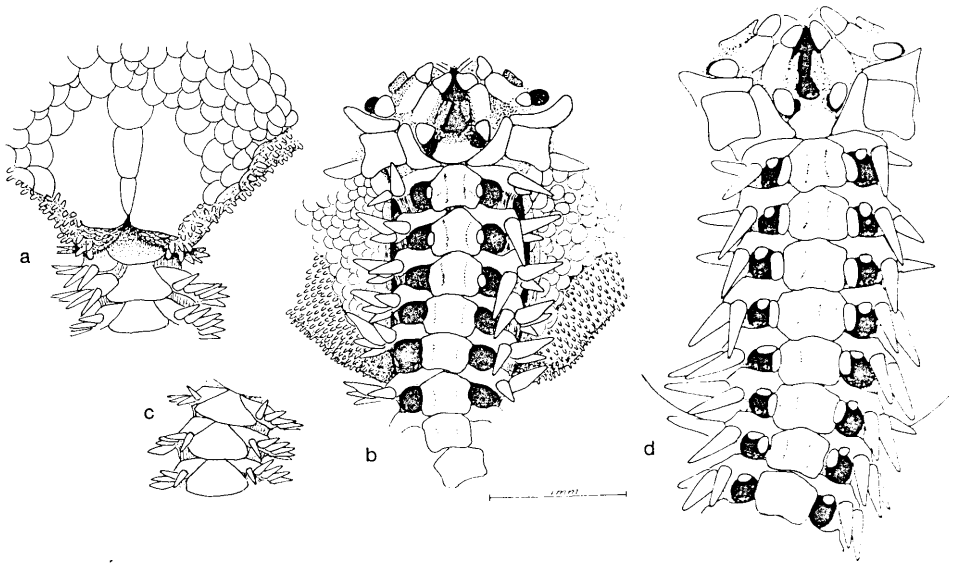


Fig. 7. a-c, *Amphiura (Acrocnida) semisquamata* (Koehler). "Atlantide" St. 110, d.d. 4½ mm. c, arm oints nos. 18-20. d, *Amphiura (Acrocnida) brachiata* (Montagu). "Atlantide" St. 161, d.d. 6½ mm

The two species may be distinguished too by the arm spines. In *A. brachiata* they always seem to be simple and blunt, while in *A. semisquamata* the next ventralmost one is compressed and slightly oblique.

GISLÉN (1926: 14) listed a lower number of arm spines in *semisquamata* than in *brachiata* as a distinguishing character, but this does not hold good when equal-sized specimens are considered. GISLÉN further stated that the ventral side of the disk is naked in *semisquamata*; but this is a lapse the reason for which escapes me.

MORTENSEN (1925: 181) recorded some juvenile amphiuroids from the Atlantic Coast of Morocco as *Amphiocnida* sp. The occasional tentacle scale found in these specimens is the outer one, and they are therefore referable to *A. brachiata*.

Distribution: *Amphiura (Acrocnida) brachiata* is a N.E. Atlantic-Mediterranean littoral-sublittoral species (1-40 m). It is known from off the European coast as far north as the Skagerrak and occurs off the African coast as far south as off Gambia. Further south it becomes replaced by *A. semisquamata*.

Amphiura (Acrocnida) semisquamata (Koehler).

Fig. 7 a-c

Amphiocnida semisquamata Koehler, 1914b: 187, pl. 8, figs. 17-19.

Acrocnida semisquamata, GISLÉN 1926: 10.

West African records: *Amphiocnida semisquamata*: KOEHLER 1914a: 187.

Acrocnida semisquamata: CADENAT 1938: 359; CHERBONNIER 1957: 167; LONGHURST 1958: 100; TOMMASI 1967: 540.

Material:

"Atlantide" St. 86. – 1 spec.

St. 109. – 8 spec.

St. 110. – 16+40 spec.

St. 111. – 1 spec.

"Galathea" St. 84, 6°17'N. 12°12'E., 22 m, P.G., 8.12.1950. – 1 spec.

St. 122, 12°20'S. 13°40'E., 20 m, V.G., 20.12.1950. – 1 spec.

The largest specimens are 5–6 mm in disk diameter, and a single detached disk measures $7\frac{1}{2}$ mm, corresponding to the maximum size in KOEHLER's material. Some specimens agree perfectly with the original description in having 6 arm spines and a single tentacle scale at the proximal pores. In general, specimens measuring up to 5–6 mm in d.d. have only a single (inner) tentacle scale on the first 4–6 arm joints and exceptionally on as many as 10 joints. But a few of the larger specimens have two tentacle scales (an outer one besides the usual inner one) on some joints. Smaller specimens less than 3 mm in d.d. may still be without any tentacle scales at all.

In the proximal part of the arms the second arm spine from the ventral side has a characteristic broadened appearance, its aboral side being flange-like drawn out; two or three of the median arm spines are rather similar, while the ventralmost and the dorsal spines are spiniform.

Distribution: *Amphiura (Acrocnida) semisquamata* is known from Sierra Leone to Angola (12°S) in 5 to 80 m.

Amphiura incana Lyman.

Figs. 8–10

Amphiura incana Lyman, 1879: 20, pl. 11, figs. 285–287.

Amphiura sculpta A. M. Clark, 1955: 47, fig. 22.

West African records: *A. incana*: MORTENSEN 1936: 286.

A. mediterranea?: MORTENSEN 1925: 185.

A. sculpta: A. M. CLARK 1955: 47; CHERBONNIER 1957: 167; LONGHURST 1958: 99.

Material:

"Atlantide" St. 39. – 10 spec.

St. 43. – 8 spec.

St. 44. – 1 spec.

St. 75. – 1 spec.

The largest specimen, the one from St. 75, measures 6 mm in disk diameter, while the other specimens are only $\frac{1}{2}$ to 3 mm in d.d. The largest size recorded is 8 mm in d.d.

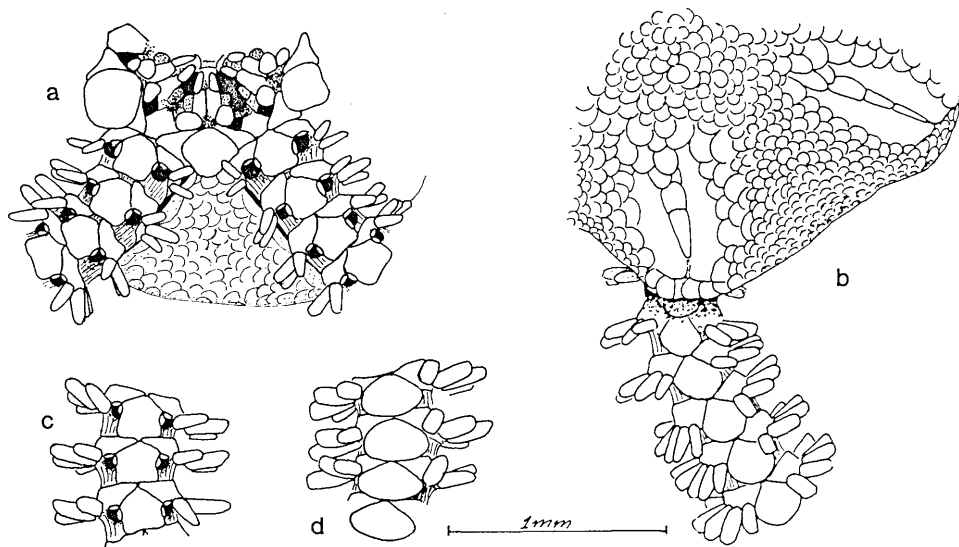


Fig. 8. *Amphiura incana* Lyman. "Atlantide" St. 39, d.d. ca. 3 mm. c-d, armjoints nos. 18-20.

A. incana was originally described on specimens from South Africa, and the species is common in the Cape region in 15-100 m depth. MORTENSEN (1936: 286) recorded the species from Annobon, off tropical West Africa, on the basis of some young specimens, and the slightly smaller "Atlantide" specimens from the Cape Verdes are similar to these.

LYMAN (1879: 20) described the dorsal arm plates in the type of *A. incana*, 7 mm in d.d., as "small, narrow, squarish with rounded corners; narrow within, broader without". But this description applies only to the most proximal dorsal arm plates. An available specimen from the type-locality Simons Bay, similarly 7 mm in d.d., and with 8 arm spines, shows that a little out on the arms, from about the free arm joint no. 10, the dorsal arm plates become broadly oval, almost twice as wide as long, and are equally wide. Another character worth noting is that the two tentacle scales form a very obtuse angle with each other.

The young "Atlantide" specimens (Fig. 8) agree with similar sized South African specimens. Their distal oral papilla is roundish, not wide as in the type-specimen figured by LYMAN; but this is merely due to their younger age, as a comparison with growth series of *A. chajei* shows. Some specimens are slightly abnormal in having two instead of one single distal oral papilla on some jaw sides, either a minute scale-like one distal to the usual oral papilla or two equally sized rather large ones. There are up to 5 arm spines on the most proximal arm joints.

The specimen (Fig. 9) from "Atlantide" St. 75 off Ghana, d.d. 6 mm, has up to 8 arm spines on the proximal free arm joints, 7 on the joints no. 10-15, 4 in the main part of the arm and 3 more distally. The ventralmost arm spine is conical but the next ventralmost one, and, in the proximal part of the arms, also a few of the

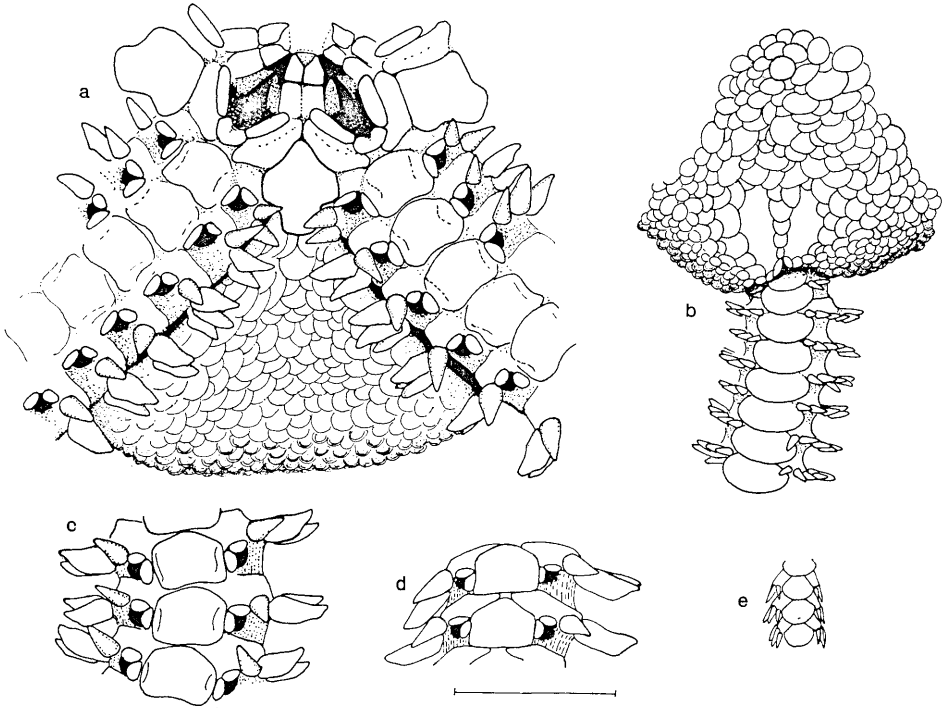


Fig. 9. *Amphiura incana* Lyman. "Atlantide" St. 75, d.d. 6 mm. c-d, armjoints nos. 9-10; e, armjoints nos. ca. 30. Scale: a, c-e, 1 mm. b, 2 mm.

median ones, are greatly compressed, with sharp distal and proximal edges, and are somewhat oblique. The dorsal arm plates are broadly oval already on the first free arm joints where in similar-sized South African specimens they may be rounded pentagonal as in the younger specimens. The ventral disk scales near the margin are slightly more coarse and thickened than in the South African specimens.

The two Ghana specimens, d.d. $4\frac{1}{2}$ mm and up to 6 arm spines, for which A. M. CLARK (1955: 47) erected the species *A. sculpta*, have broadly oval dorsal arm plates from the first free arm segments as the "Atlantide" Ghana specimen, but they do not have the arm spines similarly compressed and they differ further in having a very distinct rosette of radially grooved primary plates. The primary rosette may be retained, however, to very different sizes in some species of ophiuroids; and a considerable diversity in the degree to which the arm spines are compressed is also known in some species. Although they differ slightly from South African specimens of *A. incana* the discussed Ghana specimens, in my opinion, shall have to be referred to that species. Their number of arm spines is also the same when similar-sized specimens are compared.

A specimen, d.d. 5 mm, from the sample from Cape Blanco which MORTENSEN (1925: 185) recorded as *A. mediterranea*?, is also an *A. incana*, I think, since its dorsal arm plates are shaped like those in similar-sized Bay of Guinea specimens. However,

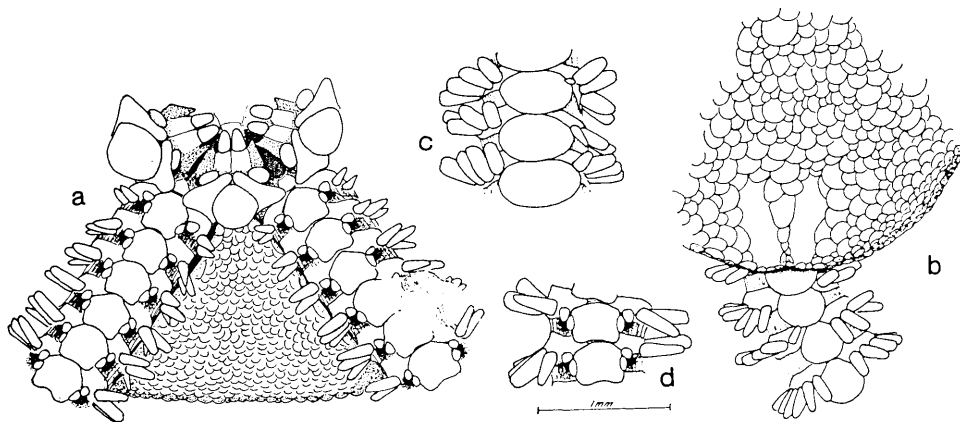


Fig. 10. *Amphiura incana* Lyman. Castiglione, Algeria, d.d. 5 mm. c-d, armjoints nos. ca. 20.

this specimen is distinguished by the outer tentacle scale being much larger than the inner one.

In my opinion *A. incana* is also represented by a specimen, d.d. 4 mm, from the Atlantic coast of Morocco, and by a specimen, d.d. 5 mm, from Algeria (Fig. 10) which was identified as *A. mediterranea* by TH. MORTENSEN and recorded under that name in DIEUZEIDE (1940:40).

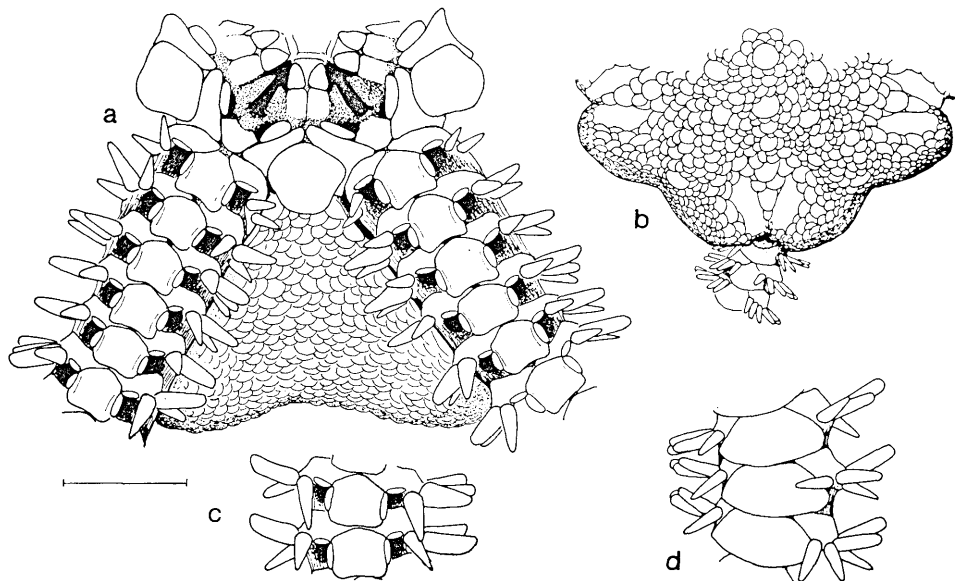


Fig. 11. *Amphiura mediterranea* Lyman. Off Alexandria, ca. 100 m, d.d. ca. 6½ mm. c-d, armjoints nos. 19-20. Scale: a, c-d, 1 mm. b, 2 mm.

LYMAN (1882: 123) placed *A. incana* and *A. mediterranea* side by side in his key to *Amphiura* and stated as differences that *incana* had a coarser ventral scaling, wider under arm plates and thicker arm spines. Better distinguishing characters, however, are offered by the dorsal arm plates which are broadly oval in *A. incana* but broadly fan-shaped in *A. mediterranea*, as in *A. chiajei*, and the two tentacle scales which are slightly smaller in *A. incana* and form an obtuse angle with each other while in *A. mediterranea* they are placed at a right angle to each other, again as in *A. chiajei* (compare Figs. 10 and 11).

When LYMAN (1882: 142) erected the species *A. mediterranea* he confined himself to stating that it differed from *A. chiajei* in that its arm spines were short, blunt, and present in a slightly larger number, up to 9 by a d.d. of 11 mm. But actually this is an exhaustive description since in all other characters *A. mediterranea* is very similar to *A. chiajei*.

Distribution: *Amphiura incana* is known from scattered localities along the whole West African coast, round the Cape of Good Hope to Durban, and from the Western Mediterranean (the above record), in 10 to 110 m depth.

The related *Amphiura mediterranea* Lyman, 1882, is known from moderate depths from scattered localities in the Mediterranean and is not hitherto recorded with certainty outside this area.

***Amphiura grandisquama* Lyman.**

Fig. 12

Amphiura grandisquama Lyman, 1869: 334.

Amphiura josephinae Ljungman, 1871: 631.

Amphiura longispina Koehler, 1898: 52, pl. 9, figs. 45–46.

Amphiura grandisquama guineensis Mortensen, 1936: 269, fig. 10.

Amphiura apicula Cherbonnier, 1957: 200, figs. 1–3.

West African records: *Amphiura josephinae*: LYMAN 1882: 131.

Amphiura longispina: KOEHLER 1906: 278.

Amphiura grandisquama: KOEHLER 1914a: 190; CHERBONNIER 1962: 11; TOMMASI 1967: 532.

Amphiura grandisquama guineensis: MORTENSEN 1936: 269; LONGHURST 1958: 99.

Material:

“Atlantide” St. 125. – 1 spec.

“Galathea” St. 49, 0°00'N. 6°31'E., 42 m, 29.11.1950. – 1 spec.

The “Galathea” specimen, 3 mm in disk diameter, agrees with the specimen from the same area and similar depth described as a separate subspecies, *A. gran-*

disquama guineensis, by MORTENSEN (1936). The "Atlantide" specimen, d.d. $1\frac{1}{3}$ mm, is also similar.

The Bay of Guinea specimens differ from the typical West Atlantic *A. grandisquama* (cf. MORTENSEN, 1933c; fig. 19) e.g. in having finer disk scales. Besides other minor differences mentioned by MORTENSEN (1936), it may be noted that the Bay of Guinea specimens have less curved ventral arm spines than the examined West Atlantic specimens, and more rounded dorsal arm plates, as broad as or just slightly broader than long; and rounded oval tentacle scales while these are pointed in the West Atlantic specimens. The noted differences may be due to age, however, the available West Atlantic specimens being slightly the largest, up to 6 mm in d.d.

The differences mentioned, except for the smaller disk scales, are mainly those by which LJUNGMAN'S *Amphiura josephinae* differs from *A. grandisquama*. LJUNGMAN (1871: 631) also noted that his new species might prove synonymous with that species. KOEHLER (1926: 9, pl. 2, figs. 8-9), when redescribing the type-specimen concluded, however, that the two species were distinct though nearly related. The type-locality of *A. josephinae* is the Josephine Bank, west of Cape Vincent, Portugal, 300 m, and the species was also recorded from the Cape Verdes by LYMAN (1882: 123).

I consider MORTENSEN'S *Amphiura grandisquama guineensis* the same form as LJUNGMAN'S *A. josephinae* and I believe that *Amphiura apicula* CHERBONNIER, 1957 (p. 200, figs. 1-3) from the Mediterranean, 15-70 m, should also be included. I do not think, however, that the characters by which the East Atlantic specimens seem to differ from the typical West Atlantic ones are sufficient for maintaining a separate subspecies.

Distribution: The type-locality of *Amphiura grandisquama* is in the West Indian region, 325 m, and the species is also recorded from widely scattered localities in the Atlantic, from the Azores in the North to Gough Island in the South, from the Indian Ocean and from the Philippine region in the West Pacific. Most recorded finds are from bathyal depths, between 200 and 1635 m, but some finds in the Bay of Guinea are in sublittoral depths as shallow as about 20 m.

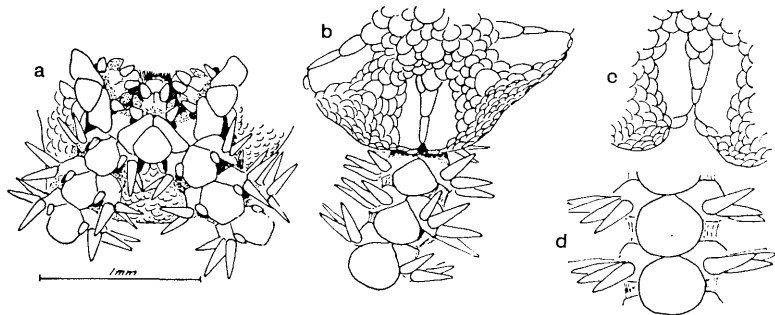


Fig. 12. *Amphiura grandisquama* Lyman. a-b, "Atlantide" St. 125, d.d. $1\frac{1}{3}$ mm. c-d, "Galathea" St. 49, d.d. 3 mm. Radial shields and armjoints nos. 11-12.

Amphiura filiformis (O. F. Müller).

Figs. 13–14

Asterias filiformis O. F. Müller, 1776: 285.*Amphiura filiformis*, LÜTKEN 1858: 56, pl. 2, fig. 11; MORTENSEN 1927: 214, fig. 120, 3–5.*Amphiodia ascia* Mortensen, 1936: 290, fig. 24.West African records: *Amphiodia ascia*: MORTENSEN 1936: 290; LONGHURST 1958: 99.*Amphiura filiformis*: CHERBONNIER 1962: 9; 1963: 182; TOMMASI 1967: 532.

Material:

"Atlantide" St. 49. – 5 spec.

St. 51. – 1 spec.

St. 58. – 5 (2+3) spec.

St. 60. – 2 spec.

St. 65. – 1 spec.

St. 66. – 1 spec.

St. 70. – 1 spec.

St. 123. – 1 spec.

St. 136. – 1 spec.

"Galathea" St. 88, 6°24'S. 12°01'E., 75 m, V.G., 8.12.1950. – 3 spec.

St. 89, 6°26'S. 11°56'E., 100 m, P.G., 9.12.1950. – 1 spec.

St. 117, 12°15'S. 13°32'E., 60 m, 20.12.1950. – 8 spec.

St. 120, 12°20'S. 13°40'E., 27 m, V.G., 20.12.1950. – 1 spec.

The disk diameter in these specimens ranges from 3 to 4½ mm, but the species grows to 10 mm d.d. About half the material was obtained in bottom samples.

A characteristic feature in *A. filiformis*, which it shares, however, with e.g. *A. atlantica*, is that the next ventralmost arm spine in the free arm outside the disk area is compressed and axe-shaped widened distally, while the third and frequently also the fourth arm spine from the ventral side has the tip drawn out into a distally directed hyaline hook. The number of arm spines in the specimens about 4 mm in d.d. may be up to 7, on scattered joints 8, but there may also be only 4–5.

The oral armature in *A. filiformis* typically consists (in addition to the proximal pair of infradental papillae) of two distal oral papillae on either jaw side; a conspicuous spiniform one on the oral plate, or on the border of the adoral plate; and a much smaller, scale-like one on the adoral plate. This oral armature distinguishes *A. filiformis* from *A. atlantica* in which there is only a single distal oral papilla, the spiniform one, to either jaw side.

The sample of 8 specimens from "Galathea" St. 117, d.d. 2½–3¾ mm and up to 6 arm spines, includes, however, some specimens which are abnormal in their oral armature. Only one specimen in the sample, 3½ mm in d.d., has the typical

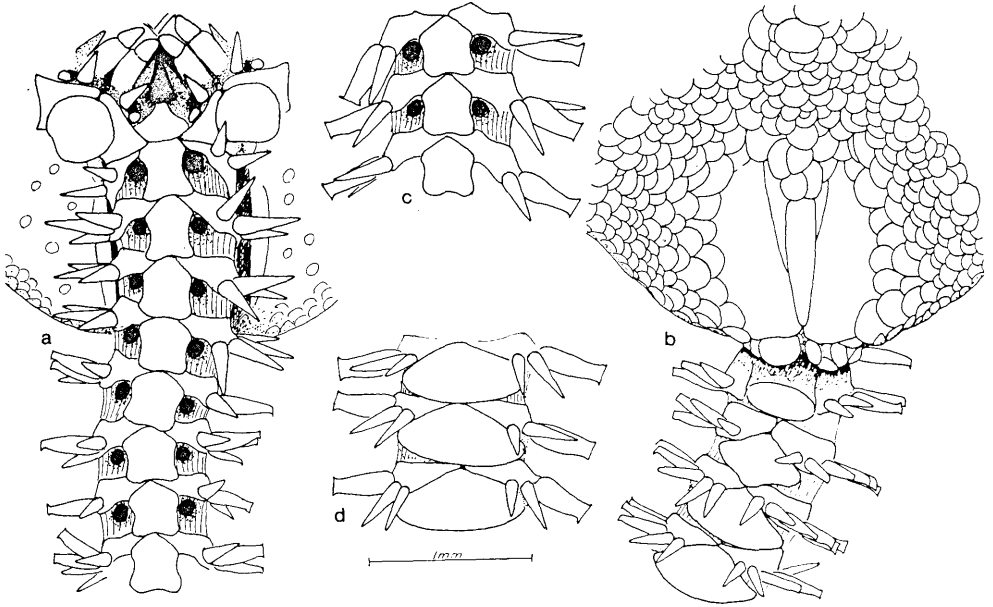


Fig. 13. *Amphiura filiformis* (O. F. Müller). "Atlantide" St. 65, d.d. ca. $7\frac{1}{2}$ mm. c-d armjoints nos. 23-25.

filiformis arrangement of the distal oral papillae on all its jaws, while the distal oral scale is missing on some jaws in one specimen and on all jaws in five others. These latter specimens, if having been present alone, thus would have been identified as *A. atlantica*. Finally the remaining specimen, $3\frac{1}{2}$ mm in d.d., shows a diverse oral armature on different jaws (cf. Fig. 14). One jaw has, to one side, the typical armature of a spiniform distal oral papilla accompanied by a more distal scale; on the other side, however, the scale is missing. And on the other jaws in this specimen the usual position of the oral papillae has been reversed, the spiniform one being placed most distally on the adoral plate and the here rather coarse scale being placed on the oral plate below the oral tentacle scale. If this latter condition alone had been observed, a new species might erroneously have been erected.

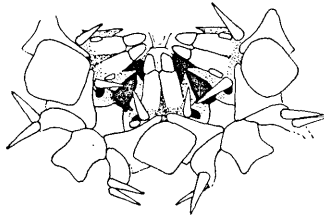


Fig. 14. *Amphiura filiformis* (O. F. Müller). "Galathea" St. 114, d.d. $3\frac{1}{2}$ mm. Abnormal oral armature.

The nominal species, *Amphiodia* (or *Amphiura*) *ascia* which MORTENSEN (1936) by a peculiar lapse erected on two specimens from Angola, is as already pointed out by CHERBONNIER (1962: 10) simply the same as *A. filiformis*.

Distribution: *A. filiformis* is an East Atlantic and Mediterranean species, which ranges from Iceland and the Trondheim Fjord, Norway, to Angola, in 5 to 1200 m. The West African finds have been made exclusively in depths exceeding about 40 m.

Amphiura atlantica Ljungman.

Fig. 15

Amphiura atlantica Ljungman, 1867: 321; KOEHLER 1926: 4, pl. 1, figs. 4, 6-9.

Amphiura dilatata Lyman, 1879: 26, pl. 11, figs. 314-316.

Amphiura atlantica, MORTENSEN 1933c: 449, figs. 17-18.

West African records: LONGHURST 1958: 99.

Material:

"Atlantide" St. 163. - 2 spec.

"Galathea" St. 90, 6°34'S. 11°45'E., 200 m, P.G., 9.12.1950. - 2 spec.

The "Atlantide" specimens from off Senegal, 70 m, are about 3 mm in disk diameter and the "Galathea" specimens from off Congo River, are about 5 mm. The largest recorded specimens were about 7 mm in d.d.

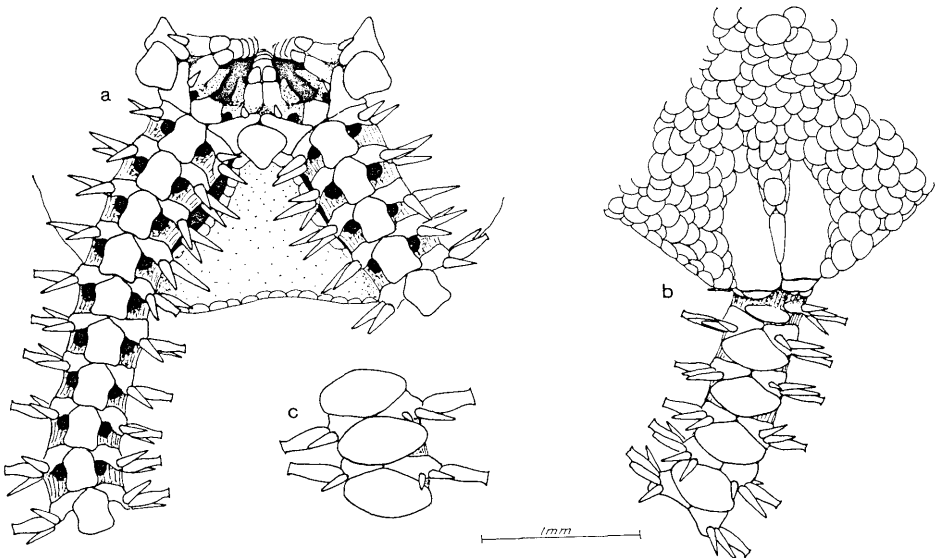


Fig. 15. *Amphiura atlantica* Ljungman. "Atlantide" St. 163, d.d. ca. 3 mm. c, armjoints nos. 23-25.

A. atlantica resembles closely *A. filiformis*. The most easily perceived difference is in the oral armature, *A. atlantica* having only a single distal, spiniform oral papilla. Other differences are a slightly smaller number of arm spines in *A. atlantica*, never more than 4–6 by a d.d. of 5 mm, while there are often 6–7 arm spines in similar-sized *A. filiformis*, and that the ventral arm plates have a nearly straight or only faintly incurved outer edge in *A. atlantica* while they are distinctly incurved in *A. filiformis*.

The disk is ventrally without scales in one of the "Atlantide" specimens but somewhat scaled in the other one. A very minute tentacle scale is found at scattered pores as was the case in specimens described from St. Helena, the type-locality, by MORTENSEN (1933c: 449).

Similar axe-shaped arm spines as characterizes *A. atlantica* and *A. filiformis*, are found in the North Atlantic *Amphiura fragilis* Verrill, 1885 (syn. *A. denticulata* Koehler, 1898). The oral armature in *A. fragilis* resembles *A. atlantica* while the number of arm spines is rather like in *A. filiformis*. *A. fragilis* differs, however, from both other species in that the outer edge of the ventral arm plates is slightly convex.

Distribution: *Amphiura atlantica* is known from the Eastern Atlantic, from Senegal to South Africa, in 30 to 480 m depth. HERTZ (1926) has recorded a var. *gaussi* from the Antarctic, 380 and 2450 m.

Amphiura senegalensis n. sp.

Fig. 16

Material:

"Atlantide" St. 163. – 1 spec.

Diagnosis: A species of *Amphiura* with a single distal, spiniform oral papilla to either side of jaw, no tentacle scales, and the disk completely scaled on both sides (the group *Nullamphiura* Fell, 1962). The radials small, narrow, and contiguous only distally. The oral shields broadly rhomboid. The dorsal arm plates rather pear-shaped; the ventral arm plates narrow and with a straight or slightly incurved distal edge. Four simple, pointed arm spines.

Type-locality: "Atlantide" St. 163, off Senegal, 65–89 m.

The unique type measures 3½ mm in disk diameter and the arms have been at least 6 times as long. There are four arm segments within the disk area, and the proximal arm segments, to about no. 10, bear 4 arm spines. The specimen is evidently still juvenile, the primary plates being distinct and the dorsal arm plates separate.

The species appears distinguished from the other *Amphiura* species in FELL's *Nullamphiura* primarily by the broadly rhomboid oral shields and the small and rather narrow radial shields. It differs distinctly from *A. filiformis* and *A. atlantica* in its

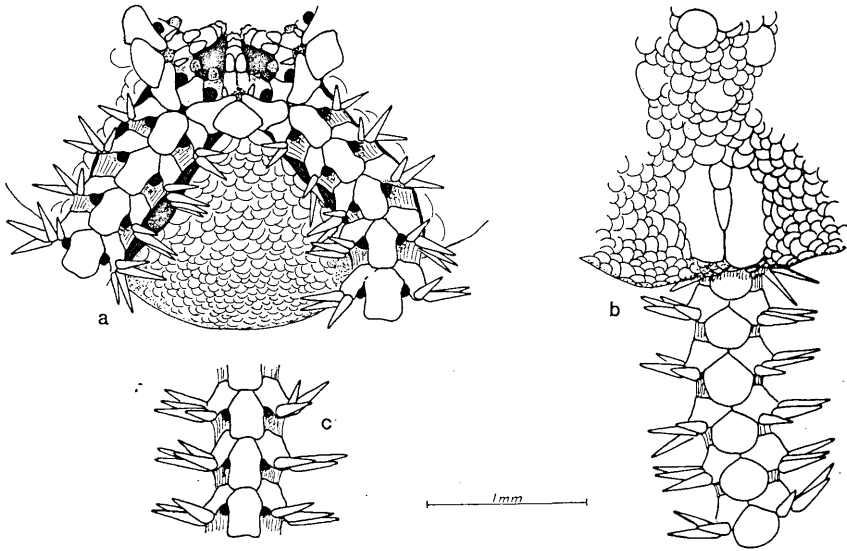


Fig. 16. *Amphiura senegalensis* n.sp. Type-specimen, "Atlantide" St. 163, d.d. 3½ mm. c, armjoints nos. 9-10.

fully scaled disk, simple, pointed arm spines and more roundish dorsal arm plates. It resembles considerably, however, the *A. digna* described by KOEHLER (1907a: 274, pl. 19, figs. 20-21) on a similar-sized specimen, d.d. 4 mm, from the Cape Verde region in 2325 m depth (? = *A. abyssorum* Norman, 1876, see MORTENSEN, 1933a: 62). The only differences to be deduced from the description are that the disk in *A. digna* is only partially scaled ventrally and the dorsal arm plates are broadly oval and contiguous. The present specimen also resembles in the shape of the dorsal arm plates and other characters, the *A. sarsi* described by LJUNGMAN (1871: 630) on specimens from off Portugal, 50-600 m. The 5-6 arm spines in *A. sarsi* are, however, partly axe-shaped and the disk was deficiently scaled ventrally. The possibilities that the present specimen is either 1) simply a juvenile *A. sarsi* which has not yet developed the axe-shaped spines, or 2) an *A. digna* which has retained its juvenile characters to a rather large size, cannot be entirely excluded.

Amphiura ungulata n. sp.

Fig. 17

Material:

"Atlantide" St. 54. - 1 spec.

St. 109. - 10 spec.

Diagnosis: A species of *Amphiura* with a single distal, spiniform oral papilla on either side of jaw, no tentacle scales, and the disk covered with small scales dorsally

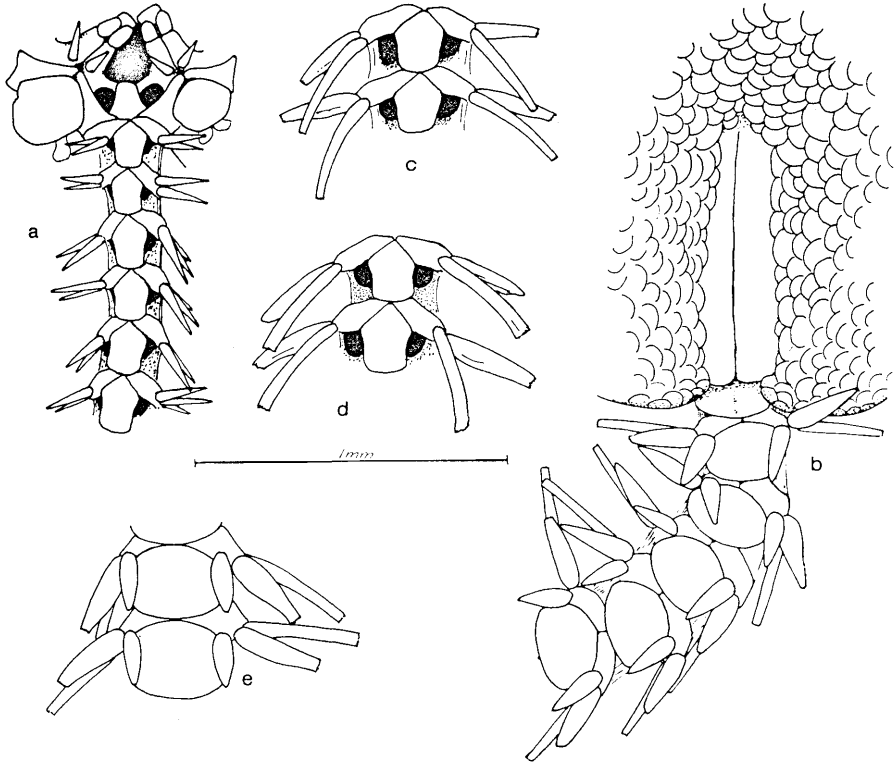


Fig. 17. *Amphiura ungulata* n.sp. Type-specimen, "Atlantide" St. 54, d.d. ca. $3\frac{1}{2}$ mm. c, armjoints nos. 15-16; d-e, armjoints nos. 25-26.

but naked ventrally (the group *Icalia* Fell, 1962). The radial shields narrow and contiguous; the dorsal arm plates transversely oval and just contiguous. Three arm spines, the ventral one almost twice as long as the joint, slender, cylindrical and with an abrupt flat tip (the spine having a hoof-like appearance), the median one somewhat shorter and heavier, slightly compressed and with a few distal hook-like thorns, and the dorsal and shortest one lanceolate.

Type-locality: "Atlantide" St. 54, off Liberia, 22 m.

The specimen from St. 54 chosen as type has a disk diameter between 3 and 4 mm and is, although much distorted and with only the proximal part of the arms left, as well preserved as any one at hand. Both samples were taken with the bottom grab and unfortunately all specimens were dried.

The specimens from St. 109 are 2-4 mm in d.d., their disk is often missing, and the arms are all broken but may have been at least 6 times the d.d.

I believe the present species is distinguished from all other species in FELL's *Icalia* by its slender, hoof-shaped ventral arm spines.

These spines as well as the wholly contiguous radial shields also distinguish the species from all the other tropical West African *Amphiura* species.

Distribution: The two localities at which *Amphiura unguularis* were taken are off Liberia and in the Niger Delta, in 22 and 15 m depth.

Amphiura lorioli (Koehler).

Fig. 18

Ophiactis lorioli KOEHLER, 1897: 328.

Ophiactis lorioli, KOEHLER 1899: 41, pl. 6, figs. 46–47.

Amphiura (Amphioplus) lorioli, KOEHLER 1904: 91, pl. 15, fig. 11.

Amphiura ceramis H. L. CLARK, 1939: 58, figs. 14–15.

Amphiura lorioli, A. M. CLARK 1970: 23, fig. 4c.

Material:

“Atlantide” St. 120. – About 30 spec.

The specimens measure from 3 to 6 mm in diameter of disk and have arms from about 15 to 35 mm long. The jaws bear a pair of infradental papillae and usually two distal, rounded oral papillae to either side; the general appearance of the specimens is, however, rather unusual for an amphiurid. The disk scales are large, the arms rather short, and the whole skeleton in the smaller specimens is white and with a peculiar shine. There are two rounded tentacle scales and three pointed, rather conical arm spines.

The specimens are conspecific with those from the bathyal Indian Ocean described by KOEHLER (1897) as a new species of *Ophiactis*, *O. lorioli*, because of their robust appearance, although their oral armature was that of an amphiurid. KOEHLER (1904), when correcting the lapse, referred *lorioli* to the subsection *Amphioplus* of *Amphiura*, and it was also retained here by FELL (1962: 17), while A. M. CLARK (1970) ranged it in *Amphiura* sensu stricte. A. M. CLARK (1970: 23) further showed that the *Amphiura ceramis* erected by H. L. CLARK (1939) was the same species as KOEHLER'S *lorioli*, and described in more detail the diversity in the oral armature which both KOEHLER (1904) and H. L. CLARK (1939) had also noted.

The present specimens usually have two distal oral papillae on either side of jaw, separated from the infradental one by a wide gap which, however, may be almost filled in by the oral tentacle scale. The distalmost oral papilla is borne partly on the adoral plate and partly on the first arm plate; the other papilla, which can be up to twice as large, is borne partly on the adoral and partly on the oral plate, or on the oral plate alone. Sometimes a jaw bears three lateral oral papillae which then may form a nearly continuous row with the infradental one, the additional oral spine hiding the higher placed oral tentacle scale from view to a varying degree.

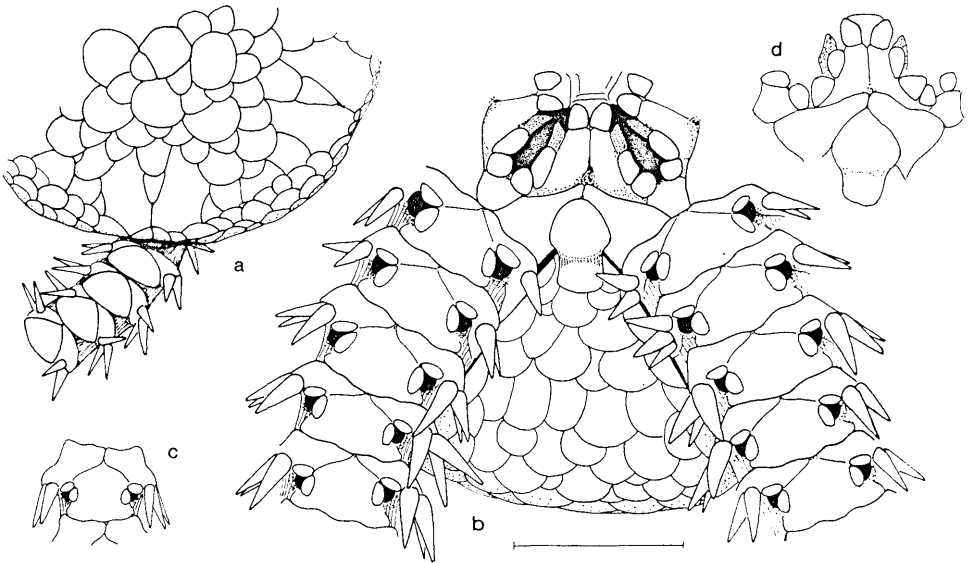


Fig. 18. *Amphiura lorioli* (Koebler). "Atlantide" St. 120. a-c, d.d. 5 mm. d, d.d. 6 mm. c, arm-joint no. 15. Scale: a, 2 mm. d, 1 mm.

The peculiar shine which characterizes especially the smaller specimens at hand was also noted by H. L. CLARK (1939: 60) who described the arms in his specimens as having "a porcelain lustre". However, with increasing size this lustre evidently is lost, first the dorsal disk plates and then more and more of the dorsal arm plates become dull greyish.

KOEHLER's and H. L. CLARK's specimens were up to 7 mm in d.d. and had somewhat broader dorsal arm plates than are found in the smaller "Atlantide" specimens. The ventral arm plates, on the other hand, appear slightly broader in the latter specimens than in the former ones.

The oral shields vary somewhat in shape. The distal lobe may be narrower than the main part as in the specimens figured by KOEHLER and H. L. CLARK; but it may also be equally wide with the two parts separated by a marked constriction. The oral shields in the larger specimens are bent and are adpressed distally, as was the case in KOEHLER's and H. L. CLARK's specimens. In the smallest specimens, however, the oral shields have a flat surface.

The dorsal side of disk in the specimens 3 mm in d.d. is covered almost exclusively by the primary and radial plates; the dorsal disk plates are also few and large in the specimens 6 mm in d.d.

Amphiura lorioli is, as noted by H. L. CLARK (1939: 60), related to "that irregular section of the genus *Amphiura* of which *diomedae* is the outstanding representative". This section includes a number of nominal deep-sea species which may show some diversity in the oral armature, which sometimes have a porcelain-like finish, and which grow to at least 15 mm in disk diameter. The recorded specimens of *O. lorioli*

evidently are juveniles and additional material of the species in question is needed for a satisfactory taxonomic evaluation of them.

Distribution: The "Atlantide" find off Spanish Guinea, in 650–260 m, is the first Atlantic record of *Amphiura lorioli*. Otherwise the species is known from several localities scattered over the Indian Ocean as far south as Zanzibar, at depths between 250 and 2500 m.

Amphioplus

The West African *Amphioplus* all have two tentacle scales when full-grown. *A. aciculatus* Mortensen, 1936, said to be characterized by having only one tentacle scale, was described from juvenile specimens.

- | | |
|--|---|
| 1 a. Tentacle scales large, the inner one about as long as lateral side of ventral arm plate. Disk fully scaled. | 2 |
| 1 b. Tentacle scales small, the inner one distinctly shorter than lateral side of ventral arm plate. | 4 |
| 2a. Next ventralmost arm spine with axe-shaped extremity. Distal lobe of oral shield very narrow. Ventral arm plates about as broad as long. . . <i>cincta</i> , p. 191 | |
| 2b. All arm spines simple, spiniform. | 3 |
| 3a. Ventral arm plates broader than long. Inner tentacle scale reaching beyond distal corner of ventral arm plate. Distal part of oral shield shorter than proximal part. Oral papillae in a close row. <i>congensis</i> , p. 188 | |
| 3b. Ventral arm plates about as broad as long. Inner tentacle scale not reaching beyond distal corner of ventral arm plate. Distal part of oral shield about as long as proximal part. The distal oral papilla separated from the others by a short gap. <i>archeri</i> , p. 193 | |
| 4a. Next ventralmost arm spine with axe-shaped extremity. Disk deficiently scaled ventrally. <i>occidentalis</i> , p. 192 | |
| 4b. Next ventralmost spine simple, pointed or more or less hook-shaped. Disk fully scaled. | 5 |
| 5a. Distal oral papilla about twice as broad as proximal ones. Oral shields with acute proximal margin, distal part shorter than proximal part. Arm spines spiniform. <i>aurensis</i> , p. 194 | |
| 5b. Distal oral papilla small. Oral shield with rounded proximal margin; distal part about as long as proximal part. | 6 |
| 6a. Next ventralmost and following arm spines with a terminal, distally directed hook. Dorsal arm plates semicircular with almost straight proximal margin. <i>suspectus</i> , p. 198 | |
| 6b. Next ventralmost arm spine with a terminal hook or, in large specimens, hook-shaped. Dorsal arm plates broadly oval. <i>aciculatus</i> , p. 195 | |

Amphioplus congensis (Studer).

Figs. 19–20

Amphioplus congensis Studer, 1882: 19.*Amphiura resecta* Koehler, 1911: 16, pl. 2, figs. 10–12.*Amphioplus ailsaclarki* Cherbonnier, 1957: 167, figs. 2–3.West African records: *Amphiura congensis*: STUDER 1882: 19.*Amphioplus congensis*: KOEHLER 1914a: 199; CADENAT 1938: 360; A. M. CLARK 1955: 40; LONGHURST 1958: 100; CHERBONNIER 1962: 12; 1963: 183; TOMMASI 1967: 537.*Amphiura resecta*: KOEHLER 1911: 16.*Amphioplus ailsaclarki*: CHERBONNIER 1957: 167; 1962: 12; LONGHURST 1958: 100.

Material:

"Atlantide" St. 72. – 2+2 spec.

St. 75. – several spec.

St. 85. – 5+1 spec.

St. 86. – 6 spec.

St. 101. – 1 spec.

St. 111. – 1 spec.

St. 112. – 1 spec.

St. 131. – 7 spec.

St. 136. – 1+3 spec.

St. 156. – 3 spec.

"Galathea" St. 41, 5°45'N. 0°45'E., 10 m, P.G., 26.11.1950. – Arm fragments.

St. 44, Ghana, off River Volta, 40 m, P.G., 26.11.1950. – 1 spec.

St. 53, 4°00'N. 9°12'E., 11 m, 1.12.1950. – 3 spec.

St. 61, off Bota, Victoria, 5–9 m, 1.12.1950. – 1 spec.

St. 86, 6°18'N. 12°07'E., 40 m, V.G., 8.12.1950. – 16 spec.

The specimens range from about 1 to 9 mm in disk diameter, and it has thus been possible to study and illustrate the growth changes. The specimens are mostly very damaged; the disk is often missing, and some samples consist only of arm fragments. About half the samples were obtained with bottom grabs.

Medium-sized specimens, from a d.d. of 5 mm and arms of 50 mm, show the typical appearance with flattened arms with broad, pentagonal ventral arm plates and very broad, slightly fan-shaped dorsal arm plates. The ventral arm plates are just contiguous. In a few cases they appear separated but evidently this is caused by the contraction of the oral frame when the disk is cast off. The dorsal arm plates are broadly contiguous. In the distal part of the arms, however, the arm plates are not much broader than long, and in the most distal part both dorsal and ventral ones are separated.

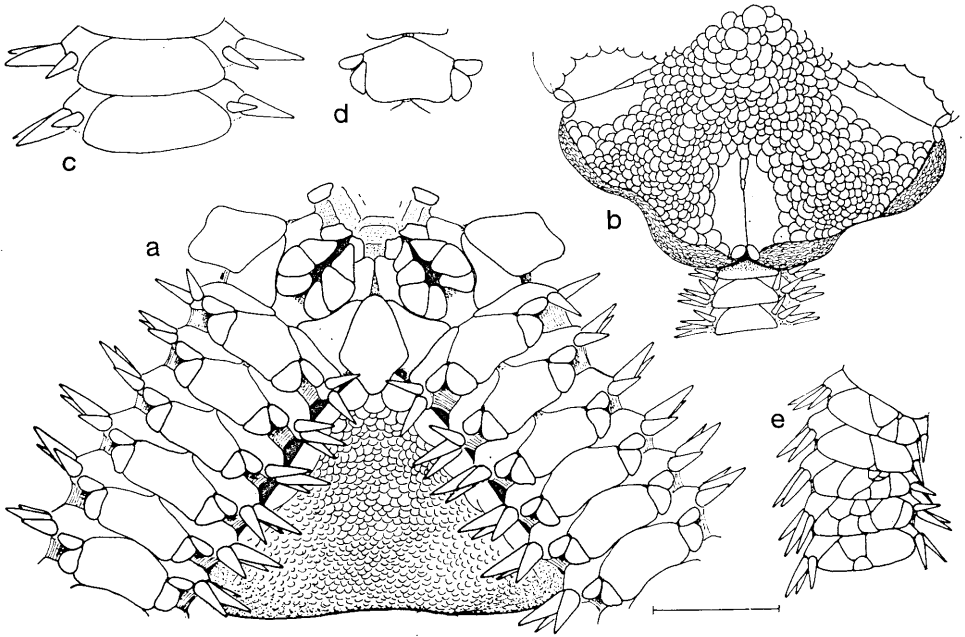


Fig. 19. *Amphipplus congensis* (Studer). a-d, "Atlantide" St. 112, d.d. ca. 7 mm. c-d, armjoints ca. no. 20. e, "Atlantide" St. 131, d.d. 8½ mm, armjoints nos. 25-30. Scale: a, c-d, 1 mm; b, e, 2 mm.

Characteristic of the species are the two large tentacle scales of which the inner one reaches a short distance beyond the distal edge of the arm plate at which it is attached. Most distally in the arms the tentacle scales are less developed and at the pores on the outmost joints there is only a single scale or none at all.

Another specific characteristic is the continuous row of four oral papillae (in the full-grown specimens) with the third one about twice as large as the fourth and smallest one.

The dorsal as well as ventral arm plates in the larger specimens are often fragmented on a varying number of joints, sometimes regularly subdivided by a median fracture and sometimes more irregularly divided.

The number of arm spines in medium-sized specimens, e.g. 7-8 mm in d.d., may be 5 on as many as about six of the most proximal arm joints outside the disk area, but is usually 4 on the first 10-20 free joints and 3 more distally. The arm spines are conical, spiniform; and the median, or next ventralmost one, which is the stoutest, is often slightly oblique. Specimens as large as 5 mm in d.d. may have only 3 spines on all arm joints.

The dorsal and ventral sides of the disk are well marked from each other. The ventral disk scales are very small, and the dorsal scales, excepting the usually distinct primary ones, not very much larger. The radial shields in each pair are contiguous for at least half their length and are about half as long as the disk radius.

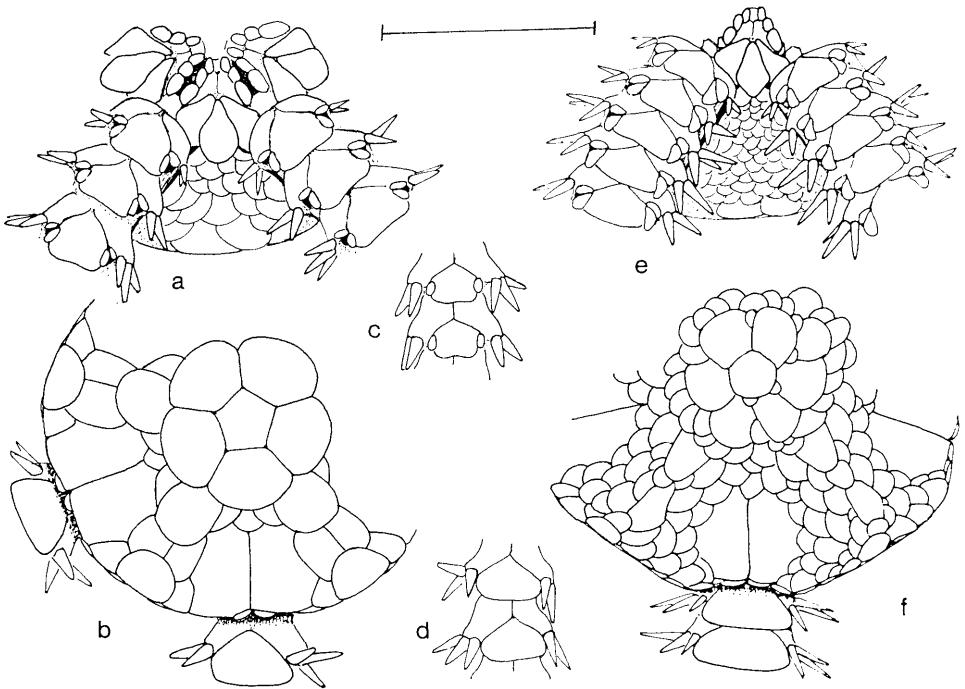


Fig. 20. *Amphioplus congensis* (Studer). a-d, "Atlantide" St. 136, d.d. 2 mm. c-d, armjoints nos. 16-17. e-f, "Atlantide" St. 75, d.d. 4 mm. Scale: a-d, 1 mm. e-f, 2 mm.

KOEHLER (1911: 17) noted that his species *A. resecta* (= *congensis*) showed resemblance to the South African *Amphiura integra* Ljungman, 1867, which has only shorter arms and blunt, rather club-shaped dorsal arm spines. A. M. CLARK (1955: 41) suggested as a further difference that the third oral papilla is not enlarged in *A. integra*. But actually some examined specimens of that species do have an oral armature very like that in *A. congensis*. The first mentioned difference, however, may be sufficient for distinguishing the two species.

Amphioplus ailsaclarki described by CHERBONNIER (1957: 167, figs. 2-3) on a specimen, d.d. 8 mm, from Sierra Leone, and also recorded (1962) from Cabinda, Congo, can be no more than a simple synonym of *A. congensis*. The only character apparently distinguishing it is that the oral papillae do not form a continuous row, but show a gap between the third and fourth papillae. But this may be merely a result of the widely expanded mouth frame in the single specimen described by CHERBONNIER (1957, fig. 3).

The primary rosette still occupies most of the disk in specimens up to about 2 mm in d.d. and is usually also well distinct in the full-grown ones.

Distribution: *Amphioplus congensis* is known from Gambia to Angola (Quissembo) in depths from the littoral zone down to 100 m.

Amphioplus cincta (Koehler).

Fig. 21

Amphiodia cincta Koehler, 1914a: 197, pl. 8, figs. 13-14, 20.

Amphioplus cincta, A. M. CLARK 1955: 42, fig. 18.

West African records: *Amphiodia cincta*: KOEHLER 1914a: 197.

Amphioplus cincta: A. M. CLARK 1955: 42; CHERBONNIER 1957: 167; BUCHANAN 1958: 19; CHERBONNIER 1962: 11.

Material:

"Atlantide" St. 52. - 1 spec.

St. 53. - 5 spec.

St. 77. - 2 spec.

St. 160. - 1 spec.

"Galathea" St. 41, 5°45'N. 0°95'E., 10 m, P.G., 26.11.1950. - 1 spec.

The largest specimens at hand lack the disk, which, however, may have exceeded 5 mm in diameter. *A. cincta* shares with *A. occidentalis* the axe-tipped next ventral-most arm spine on the proximal free arm joints, but differs in having the ventral side of disk armed with small overlapping scales. *A. cincta* is further distinguished by a more marked gap between the distal, small oral papilla on the adoral plate and the three close-set proximal ones on the oral plate. The oral shield and espe-

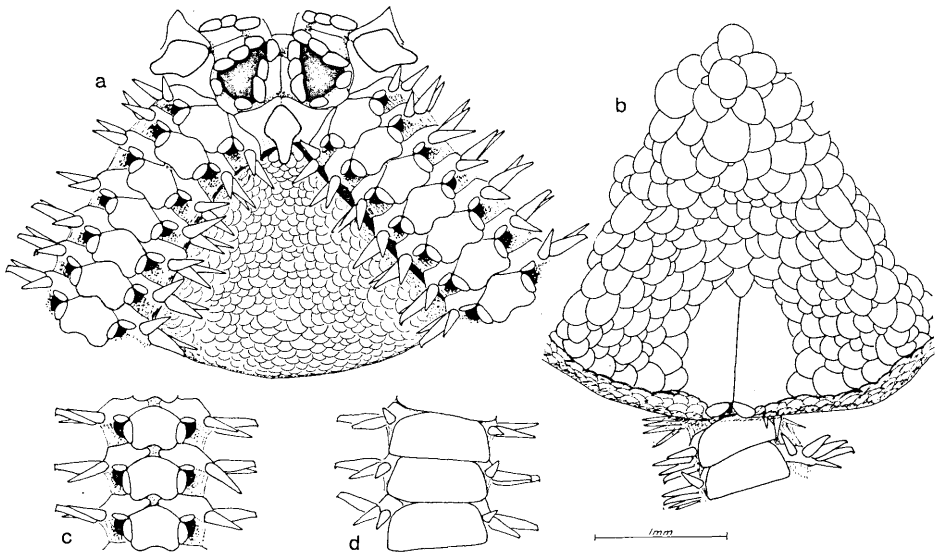


Fig. 21. *Amphioplus cincta* (Koehler). "Atlantide" St. 160, d.d. ca. 5 mm. c-d, armjoints nos. 18-20.

cially the distal lobe is also narrower than in *A. occidentalis*. Further the distal lateral corners of the dorsal arm plates are less rounded in *A. cincta* than in *A. occidentalis*.

The number of arm spines in a specimen from "Atlantide" St. 53 with d.d. 4 mm and at least 30 mm long arms, is 5 on the first five free arm joints, 4 on the next 20 joints (about a third of the arm length) and 3 more distally.

Distribution: *Amphioplus cincta* is recorded from a number of localities from Sierra Leone to Congo in depths from the tidal zone to 22 m.

Amphioplus occidentalis Koehler.

Fig. 22

Amphioplus occidentalis Koehler 1914a: 201, pl. 7, figs. 5-8.

West African records: KOEHLER 1914a: 201; MORTENSEN (in MONOD) 1928: 481; LONGHURST 1958: 100.

Material:

- "Atlantide" St. 53. - 2 spec.
- St. 86. - arm fragments
- St. 131. - 1 spec.
- St. 158. - 1 spec.

The somewhat damaged specimens have a disk diameter of 3 to 4 mm and agree with KOEHLER's description of the slightly larger type-specimens. One specimen has 5 oral papillae on some jaw sides; there being two papillae, instead of one, at the adoral plate.

The species is easily distinguished from the other tropical W. African species of *Amphioplus* by the naked ventral disk area. Apart from that character and, e.g., some slight differences in the oral armature, it is very similar to *A. cincta*. Both

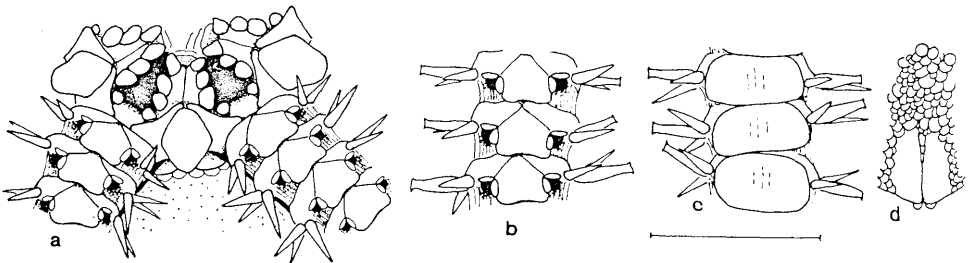


Fig. 22. *Amphioplus occidentalis* Koehler. "Atlantide" St. 158, d.d. ca. 4 mm. b-c, armjoints nos. 11-13. Scale: a-c, 1 mm. d, 2 mm.

species are distinguished from the other species in that the median arm spine on the proximal free arm joints (or second arm spine from the ventral side if more than 3 spines are present) is slightly flattened and has an axe-shaped tip. Further out on the arms the median arm spine has a fine, terminal, distally directed hook.

Distribution: *Amphioplus occidentalis* is hitherto known only from Gambia to Congo, in 10 to 72 m depth.

Amphioplus archeri A. M. Clark.

Fig. 23

Amphioplus archeri A. M. Clark, 1955: 43, figs. 19–20.

Material:

Dakar, 3–4 m, Sudan Exp. 10.4.1927. – 1 spec.

“Galathea” St. 61, Bota, Cameroon, 8–9 m, 1.12.1950. – 1 spec.

The Dakar specimen has measured about $6\frac{1}{2}$ mm in disk diameter, but the disk is now lost. The “Galathea” specimen has a regenerating disk of 2 mm in diameter, and the original disk has been about twice as large. The first twenty arm joints in the small specimens bear 4 arm spines and the distal joints bear 3 spines. The first two free arm joints in one arm of the large specimen bear 6 spines, but otherwise the first 20 arm joints in this specimen bear 5 spines while all the other preserved ones (about 90) have 4 spines.

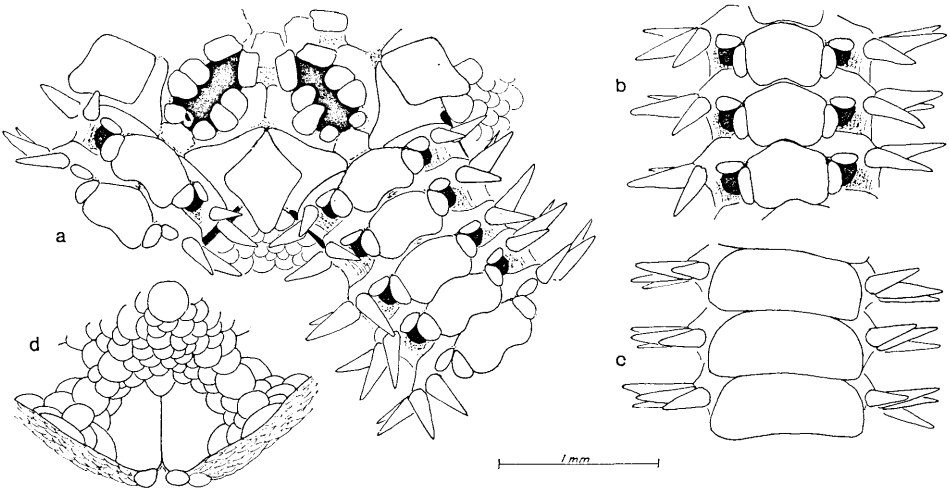


Fig. 23. *Amphioplus archeri* A. M. Clark. a–c, Dakar, 3–4 m, d.d. $6\frac{1}{2}$ mm. b–c, armjoints nos. 19–21. d, “Galathea” St. 61, regenerating disk, original d.d. ca. $3\frac{1}{2}$ mm.

The arms in this species resemble considerably those of *A. cincta*, apart from the fact that all the arm spines are simple, spiniform while the median ones are axe-shaped in *A. cincta*.

Distribution: *Amphioplus archeri* is known from a few localities from Dakar to Cameroon in depths of 3 to 9 m.

Amphioplus aurensis A. M. Clark.

Fig. 24

Amphioplus aurensis A. M. Clark, 1955: 41, fig. 17.

West African records: A. M. CLARK 1955: 41; LONGHURST 1958: 100; BUCHANAN 1958: 28, 45; TOMMASI 1967: 537.

Material:

“Atlantide” St. 49. – 1 spec.

St. 75. – 2 + 7 spec.

“Galathea” St. 44, Off River Volta, Ghana, 40 m, P.G. 26.11.1950. – 1 spec.

The specimens range from 1½ mm to 3 mm in disk diameter and have arms up to 45 mm long. TOMMASI records specimens 5 mm in d.d. Generally the preserved specimens of *Amphioplus* lack the disk, but *A. aurensis*, judging from the present material, is less apt to lose the disk than the other species.

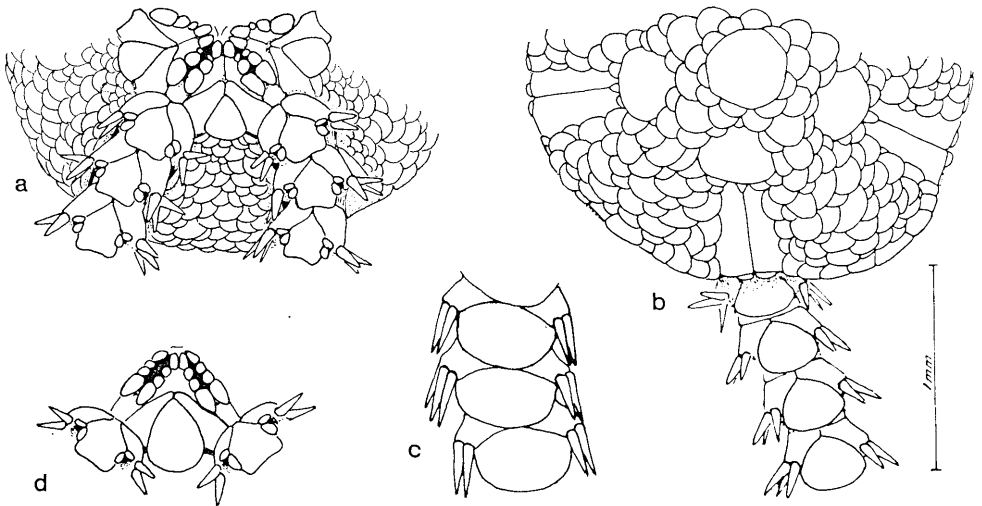


Fig. 24. *Amphioplus aurensis* A. M. Clark. a-b, “Atlantide” St. 75, d.d. 2 mm. c, “Atlantide” d.d. 3½ mm, armjoints no. ca. 15. d, “Galathea” St. 44, d.d. 2¾ mm.

The species is distinguished from all the other West African *Amphioplus* by having the distal oral papilla about twice as large as the median ones, and by having pear-shaped oral shields with a very short distal part.

Distribution: *Amphioplus aurensis* is known from Sierra Leone to Cameroon in 8 to 75 m depth.

Amphioplus aciculatus Mortensen.

Figs. 25–26

Amphioplus aciculatus Mortensen, 1936: 296, fig. 27.

Amphioplus stratus Cherbonnier, 1963: 183, fig. 1 A-D.

West African records: *Amphioplus aciculatus*: MORTENSEN 1936: 296.

Amphioplus stratus: CHERBONNIER 1963: 183.

Material:

“Atlantide” St. 75. – Arm fragment

“Galathea” St. 41, 5°45'N. 0°45'E., 10 m, P.G., 26.11.1950. – 1 spec.

St. 44, Off river Volta, Ghana, 40 m, P.G., 26.11.1950. – 1 spec.

St. 86, 6°18'S. 12°07'E., 40 m, V.G., 8.12.1950. – 1 spec.

St. 87, 6°21'S. 12°05'E., 50 m, V.G., 8.12.1950. – Arm fragments

St. 121, 12°20'S. 13°40'E., 20 m, V.G., 20.12.1950. – 3 spec.

St. 122, 12°20'S. 13°40'E., 20 m, V.G., 20.12.1950. – 1 juvenile spec. + arm fragment of adult.

St. 123, 12°20'S. 13°40'E., 35 m, V.G. 20.12.1950. – 1 juvenile spec.

Almost all the material was obtained in bottom grabs, indicating that this is a deeply burrowed species; and a few samples contain only arm fragments. The disk is lost in all the specimens except in a juvenile one, 2½ mm in disk diameter. The largest specimens can be estimated, however, to have had a d.d. of about 10 mm.

The presence of specimens of different sizes has made it possible to follow how in this species the median arm spines in the proximal part of the arms progressively change from simple, acicular ones in the smallest specimens, d.d. 2-2½ mm, to angular bent hooks in the large specimens of 8–10 mm d.d. Thus it became evident that the species *Amphioplus stratus* described by CHERBONNIER (1963: 183) has been based merely on an older specimen of the species *A. aciculatus* which MORTENSEN (1936: 296) had described on two juvenile specimens, d.d. about 2 mm, with still only one tentacle scale at each pore.

The single intact specimen present, “Galathea” St. 123, is with a d.d. of about 2½ mm slightly larger than the types of *A. aciculatus* and a little further advanced in development. The primary rosette is not especially conspicuous, and there are

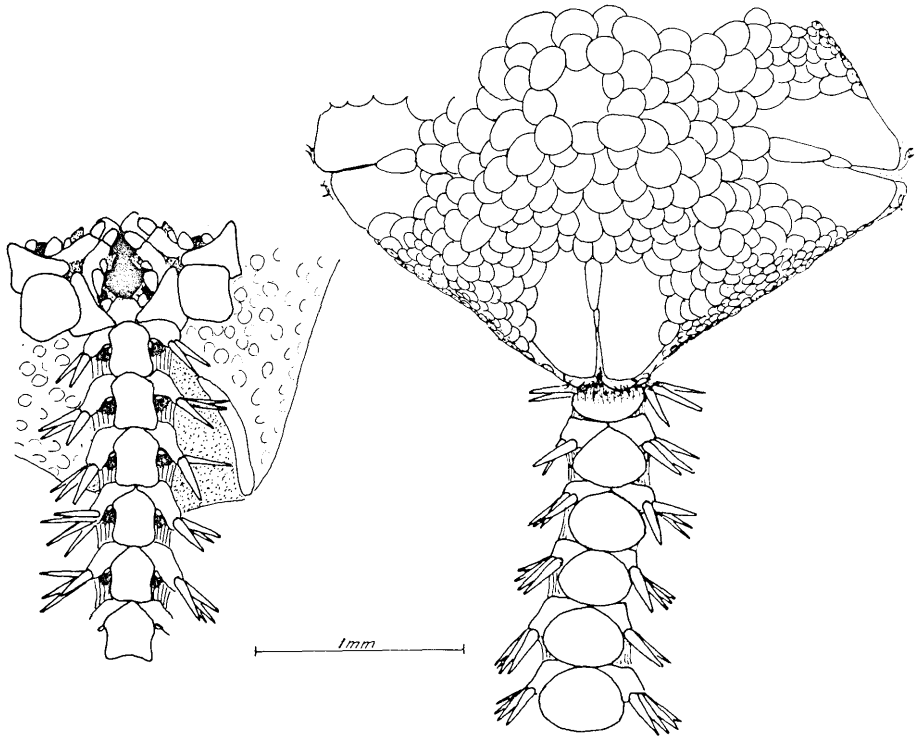


Fig. 25. *Amphioplus aciculatus* Mortensen. "Galathea" St. 123, d.d. ca. $2\frac{1}{2}$ mm.

two tentacle scales at the first pair of pores in one arm. The radial shields are separated for more than half their length by a wedge of 2–3 scales placed in a series and they gape slightly from each other distally. The characteristic thorny scales at the outer ends of the radial shields are fairly conspicuous. The arm spines, up to 4 in number, are all simple and pointed as in the types.

CHERBONNIER'S *A. stratus*, $4\frac{1}{2}$ mm in d.d., agrees with the types of *A. aciculatus* in having thorny scales outside the radial shields, a character not found in any other West African *Amphioplus*, and has similarly shaped dorsal arm plates. The radial shields are completely separated by a series of 4 scales while they were only partly separated in the smaller types of *A. aciculatus* and the small "Galathea" specimen. The radials are contiguous, however, in all the other West African *Amphioplus* where the disk is known.

A. stratus differs from the types of *A. aciculatus* in having two tentacle scales and in having the next ventralmost arm spine serrate on its distal edge and bent terminally into a small, hyaline hook. The above described small "Galathea" specimen shows, however, that the first difference is due to age alone, and two other of the available specimens show that the same applies to the latter difference. Thus the median arm spines are merely tipped with a minute distally directed hyaline thorn in a slightly smaller specimen from the "Galathea" St. 41, about 3 mm in d.d.,

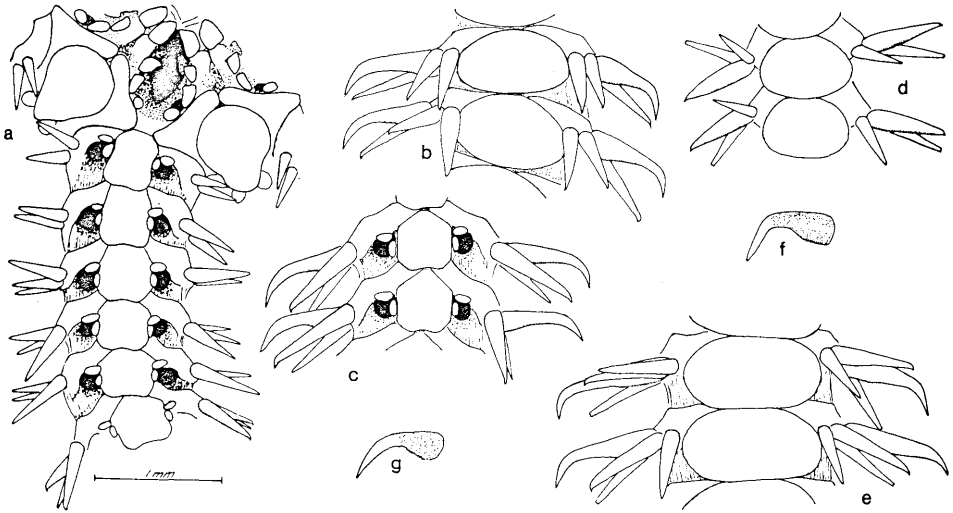


Fig. 26. *Amphiopius aciculatus* Mortensen. a-d, "Galathea" St. 121, d.d. ca. 8½ mm. b-c, arm-joints nos. 19-20; d, distal armjoints. e, "Atlantide" St. 75, loose arm of larger specimen, medially. f-g, lateral arm spines from arm fragments from "Galathea" Sts. 86 and 87.

while in a slightly larger specimen from the "Galathea" St. 44, d.d. about 5-6 mm, not only the next ventralmost arm spine but also the third and most proximally in the arms even the fourth arm spine have a serrate distal edge and terminal hook. In still larger specimens, d.d. about 8-10 mm, the next ventralmost and 1-2 following arm spines are developed, in part of the arms, as strong, distally directed hooks. In these specimens the arm spines may number up to 8 on one or another of the proximal free arm joints. The median arm spines are about 1½ times as long as the joint.

The arm spines in a large specimen are, e.g., developed as follows. The first four free arm joints bear 7 arm spines of which the median ones, the ventralmost one and the two most dorsal ones excepted, have a serrate distal edge and a small, terminal, distally directed hook. The 5th to 7th free arm joints bear 6 arm spines of which the next ventralmost one becomes gradually more pronouncedly hooked. From the 8th free arm joint the arm spines are 5 in number and the next-ventralmost one is now developed as a strong hook, the distal half or so being tapering, hyaline and bent almost angularly on the basal, swollen part. Far out on the arms where the number of arm spines is 3 only, the median arm spine is still hook-like. Distally in the arms, however, it becomes straight and with but a small, terminal hook.

The dorsal arm plates which are roundish in the small specimens become broadly oval in the large ones. The ventral arm plates in the larger specimens are about as broad as long, except for the third one which is longer than broad.

There are 4 lateral oral papillae - inclusive of the infradental papilla thus 5 oral papillae to a jaw side - in the large specimen, 10 mm in d.d., and those at the oral plates may be rounded instead of pointed as in the type of *A. stratus*.

Distribution: *Amphiopius aciculatus* is known from Gambia to Angola (Lobito) in depths from 10 to 64 m.

Amphioplus suspectus n. sp.

Fig. 27

Ophionephthys sp., A. M. CLARK 1955: 45.? *Ophionephthys* sp., TOMMASI 1967: 540.

Material:

"Atlantide" St. 160. - 1 spec.

Diagnosis: A species of *Amphioplus* resembling *A. aciculatus* (only the disk is unknown), but distinguished in that the dorsal arm plates in the proximal part of the arms are subcircular with an almost straight proximal edge.

Type-locality: "Atlantide" St. 160, off Bathurst, 14 m.

The single available specimen is a fairly large one. The diameter of the disk may have been about 8 mm, but the disk is now lost. In oral aspect the specimen is very similar to equal-sized specimens of *A. aciculatus*, but the lateral oral papillae are more rounded, and the third ventral arm plate is not different from the other ones. The median arm spines are not as strongly hooked as in *A. aciculatus*, but have their whole distal edge serrate and have only a short terminal, distally directed hook; they are thus similar to the median arm spines in smaller specimens of *A. aciculatus*. The arm spines are also shorter than in this species; being only slightly longer than the joint. The number of arm spines is 7 on two or three joints at the disk margin, 6 on the following about 10 joints, and drops to 3 more distally. All the arm spines, except for the ventralmost one, have a terminal hook. In the proximal part of the arms the dorsal arm plates are subcircular with an only slightly convex proximal edge and sharp proximal corners, but farther out on the arms they become broadly oval.

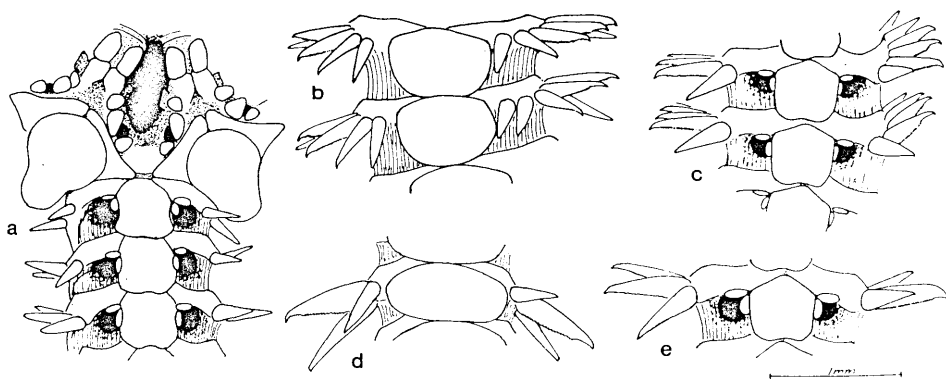


Fig. 27. *Amphioplus suspectus* n.sp. Type-specimen. "Atlantide" St. 160, d.d. 8 mm (or more). a, oral armature; b-c, armjoints nos. 18-19; d, armjoint no. ca. 70; e, armjoint no. ca. 40.

Some Ghana specimens belonging to this species were described by A. M. CLARK (1955: 45) but because of the absence of disks she refrained from naming the species, listing it as *Ophionephthys* sp. However, even without a disk, the species appear very characteristic and easily identifiable, and I have considered it best, therefore, to attach a name to it.

Distribution: *Amphioplus suspectus* is known from a few localities from Gambia to Ghana in depths from 14 to 64 m.

Ophiophragmus acutispina (Koehler).

Fig. 28

Amphiodia acutispina Koehler, 1914a: 195, pl. 7, figs. 11-14.

West African records: *Amphiodia acustipina*: KOEHLER 1914a: 195; MORTENSEN 1936: 290; A. M. CLARK 1955: 36; LONGHURST 1958: 100; BUCHANAN 1958: 28; CHERBONNIER 1962: 14.

Ophiophragmus acutispina: TOMMASI 1967: 535, fig. 2.

Material:

- “Atlantide” St. 51. – 1 spec.
 St. 56. – 1 spec.
 St. 60. – 1 spec.
 St. 66. – 3 spec.
 St. 70. – 2 spec.
 St. 72. – 1 spec.
 St. 75. – 2 spec.
 St. 85. – 1 spec.
 St. 98. – 2 spec.
 St. 101. – 1 spec.
 St. 113. – 1 spec.
 St. 116. – 1 spec.
 St. 129. – 1 spec.
 St. 136. – 1 spec.
- “Galathea” St. 44, Off River Volta, Ghana, P.G. 40 m, 26.11.1950. – 3 spec.
 St. 75, 5°41'S. 11°38'E., P.G., 201m, 7.12.1950. – 1 spec.
 St. 76, 5°42'S. 11°40'E., P.G., 105 m, 7.12.1950. – 1 spec.
 St. 77, 5°43'S. 11°45'E., P.G., 79 m, 8.12.1950. – 2 spec.
 St. 117, 12°15'S. 13°32'E., P.G., 60 m, 20.12.1950. – 1 spec.
 St. 122, 12°20'S. 13°40'E., V.G., 20 m, 20.12.1950. – 1 spec.

Most of the specimens were collected with the bottom grab. They range in size from minute ones to some that may have had a disk about 8 mm in diameter. The longest arms present may have measured 100 mm or more. Specimens with the disk

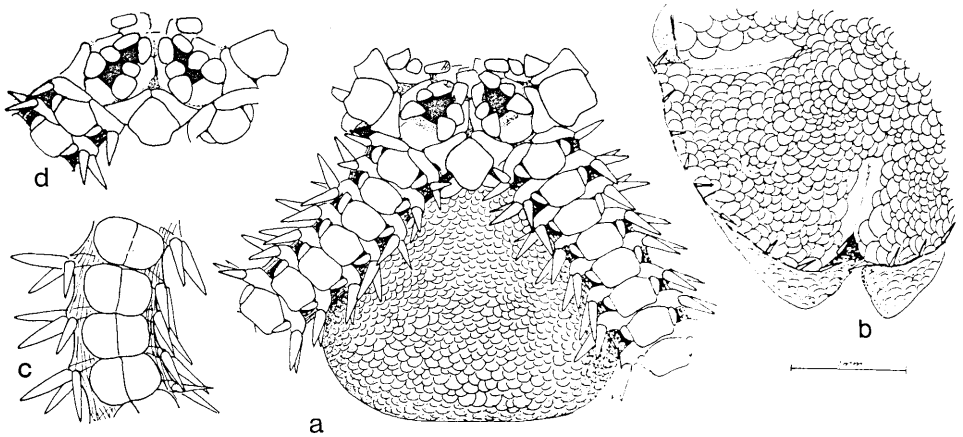


Fig. 28. *Ophiophragmus acutispina* (Koehler). a-c, "Atlantide" St. 72, d.d. 6 mm. c, armjoints nos. 18-21. d, "Galathea" St. 76, d.d. ca. 8 mm.

intact were present only from "Atlantide" Sts. 55 and 66 and "Galathea" St. 117.

The disk is covered with very small scales ventrally and only slightly larger ones dorsally and there is a well defined edge around the periphery. Full-grown specimens have a small number of the marginal scales enlarged into small, sometimes forked spines, but in some specimens as large as d.d. 4 mm these "spines" may be yet just discernible. The radial shields are small, less than half the disk radius, narrow, and completely contiguous.

Because of the spiniform marginal plates the species is referable, as TOMMASI notes, to *Ophiophragmus* rather than to *Amphiodia*. Also when the disk is missing, it is easily recognized by the three large oral papillae to each side of the jaw, and even arm fragments are easily recognized by the single, broad but short tentacle scale. There are 3 pointed arm spines.

Distribution: *Ophiophragmus acutispina* is known from Sierra Leone to Angola (Lobito) in depths from 10 to 200 m.

The genus is circumtropical and includes, e.g., a number of West Atlantic species, among which the nearest relation of the present species may be *O. septus* (Lütken), easily distinguished, however, by having 2 tentacle scales.

Ophiostigma abnorme (Lyman).

Fig. 29

Ophiocnida abnormis Lyman, 1878: 227, pl. 2, figs. 37-39.

Ophiostigma africanum Lyman, 1879: 41, pl. 13, figs. 368-370.

Amphipholis instructa Koehler, 1906: 275, pl. 18, figs. 15-16.

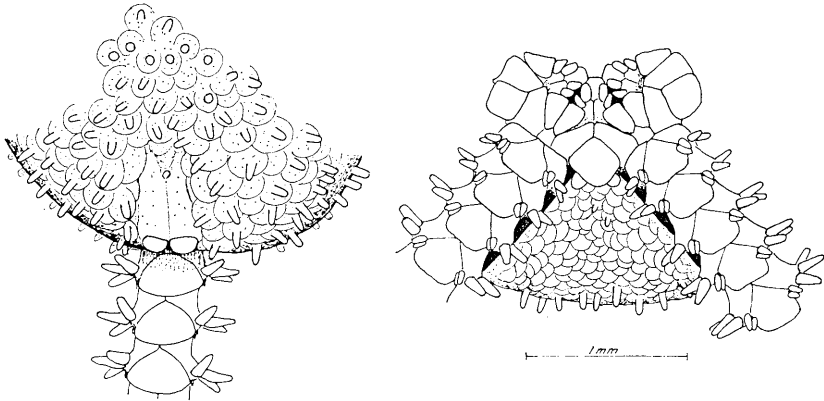


Fig. 29. *Ophiostigma abnorme* (Lyman). "Atlantide" St. 147, d.d. 3 mm.

West African records: *Ophiostigma africanum*: LYMAN 1879: 41; KOEHLER 1909: 168.

Amphipholis instructa: KOEHLER 1906: 275.

Ophiocnida abnormis: KOEHLER 1914a: 186.

Ophiostigma abnorme: MORTENSEN 1936: 293; A. M. CLARK 1955: 38; LONGHURST 1958; BUCHANAN 1958: 28; TOMMASI 1967: 539.

Material:

- "Atlantide" St. 39. — 6 spec.
- St. 40. — 13 spec.
- St. 44. — 3 spec.
- St. 147. — 3 spec.
- St. 151. — 1 spec.
- St. 153. — 2 spec.

The present specimens range from $1\frac{1}{2}$ to 3 mm in disk diameter and have 6–8 times as long arms. The largest size recorded is 4 mm d.d.

The species is primarily recognizable by the small, blunt spines which occur scattered ventrally on the disk and near the interradial margin and, in larger specimens, also scattered over the whole dorsal side. The radials in the larger specimens are narrow and join each other for most of their length (in smaller specimens they may be rather equitriangular). The oral shields are pear-shaped or rhomboid. There are 3 arms spines.

The two tentacle scales are small and spiniform, a characteristic which, even when the disk is lacking, distinguishes this species from *Amphipholis squamata* which has rounded oval tentacle scales but otherwise a very similar oral aspect as well as similar dorsal arm plates.

Distribution: *Ophiostigma abnorme* is an amphi-Atlantic sublittoral species. LYMAN (1878) originally described it on specimens from the West Atlantic, the Mexican Gulf, 185 m, and KOEHLER (1914a) then recorded the species from tropical West Africa. MORTENSEN (1936) noted that LYMAN's *Ophiostigma africanum* from the Cape Verdes was the same species, and a further synonym is KOEHLER's *Amphipholis instructa*, likewise described on specimens from Cape Verdes. Off tropical West Africa the species is known from the Cape Verdes to Saô Thomé in depths from 35 to 80 m. It is further recorded from Ascension, 16–27 m.

Amphipholis

- 1a. No tentacle scales.....*nudipora*, p. 203
 1b. Two tentacle scales..... 2
 2a. Oral shields rhombic, about as broad as long.....*squamata*, p. 202
 2b. Oral shields distinctly longer than broad.....*bananensis*, p. 205

Amphipholis squamata (Delle Chiaje).

Fig. 30

Asterias squamata Delle Chiaje, 1829: 77, pl. 34, fig. 1.

Amphipholis squamata, MORTENSEN 1927: 221, fig. 125.

Axiognathus squamatus, THOMAS 1966: 831.

West African records: KOEHLER 1914a: 194; A. M. CLARK 1955: 38; LONGHURST 1958: 100.

Material:

"Atlantide" St. 49. – 3 spec.

St. 51. – 1 spec.

St. 75. – 2 spec.

St. 146. – 1 spec.

St. 151. – 1 spec.

"Galathea" St. 4, 22°19'N. 17°05'W., 62 m, 2.11.1950. – 10 spec.

St. 74, 5°41'S. 11°32'E., 291 m, P.G., 7.12.1950. – 1 spec.

St. 91, 6°35'S. 11°42'E., 301 m, P.G., 10.12.1950. – 1 spec.

Gorée, Senegal, 20 m, Thorsen leg. 1952. – 2 spec.

Several localities in the region of the Canary Islands (Gran Canaria, Tenerife, Lanzarote), from the tidal zone to about 100 m. Mortensen leg. 1930, Thorson leg. 1947 and 1952. – Many specimens.

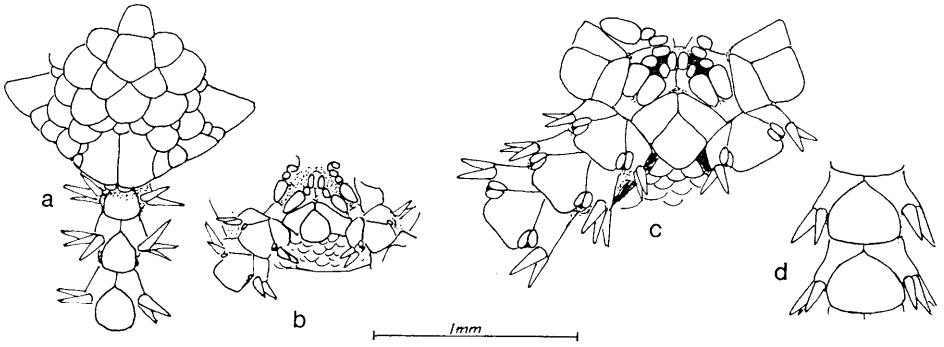


Fig. 30. *Amphipholis squamata* (Delle Chiaje). a-b, "Atlantide" St. 151, d.d. 1 mm. c-d, "Atlantide" St. 75, d.d. 2 mm. d, armjoints nos. 15-16.

The specimens range from less than 1 mm to about 3½ mm in disk diameter. The largest size recorded in the literature is about 5 mm d.d. The larger specimens from tropical West Africa agree well with specimens from the Mediterranean from where the species was originally described. The smallest specimens, up to 1 mm in d.d., may yet have no tentacle scales developed for the whole or most of the arm length.

The rosette of primary plates always found in the smallest specimens is still distinct in a specimen from the "Atlantide" St. 75 about 2 mm in d.d., but cannot be discerned in the other similar-sized specimen from the same sample.

According to THOMAS (1966) this species which for almost a hundred years has been regarded as the typical representative of the genus *Amphipholis* Ljungman, 1867, shall have to be removed therefrom and made the type of a new genus, *Axiognathus* Thomas, 1966 (p. 831) while *Amphipholis* is reserved for the tropical West Atlantic *A. januarii* Ljungman, 1867. It is indeed regrettable if the well known name combination *Amphipholis squamata*, found in hundreds of papers and textbooks, shall have to be abandoned, and following A. M. CLARK (1970: 31) I therefore retain it, at least provisionally.

Distribution: *Amphipholis squamatus* is attributed a worldwide distribution in littoral-bathyal depths (0-740 m) of the warm and temperate regions, but a revision is needed to decide whether this is really correct. The species occurs, however, besides in the Mediterranean, at least in the whole East Atlantic from Iceland in the north to South Africa.

Amphipholis nudipora Koehler.

Fig. 31

Amphipholis nudipora Koehler, 1914a: 193, pl. 8, figs. 15-16.

Amphipholis nudipora, A. M. CLARK 1955: 39, fig. 15.

Nullopholis nudipora, FELL 1961: 12.

West African records: KOEHLER 1914a: 193; MORTENSEN 1936: 293; A. M. CLARK 1955: 39; LONGHURST 1958: 100; BUCHANAN 1958: 19, 24; CHERBONNIER 1963: 186; TOMMASI 1967: 533.

Material:

- “Atlantide” St. 49. – 1 spec.
 St. 58. – 1 spec.
 St. 66. – 1 spec.
 St. 72. – 1 spec.
 St. 75. – 1 spec.
 St. 85. – 1 spec.
 St. 98. – 1 spec.
 St. 100. – 1 spec.
 St. 101. – 1 spec.
 St. 110. – 1 spec.
 St. 111. – 1 spec.
 St. 151. – 1 spec.
 St. 156. – 1 spec.
 St. 157. – 1 spec.
 St. 163. – 1 spec.
- “Galathea” St. 53, 4°00'N. 9°12'E., 11 m, 1.12.1950. – 3 spec.
 St. 61, off Bota, Victoria, Cameroon, 8–9 m, 1.12.1950. – 1 spec.
 St. 80, 5°42'S. 12°01'E., 30 m, P.G., 8.12.1950. – 2 spec.
 St. 81, 5°42'S. 12°03'E., 20 m, P.G., 8.12.1950. – 2 spec.
 St. 88, 6°24'S. 12°01'E., 75 m, V.G., 8.12.1950. – 1 spec.
 St. 89, 6°26'S. 11°56'E., 100 m, P.G., 9.12.1950. – 1 spec.
 St. 117, 12°15'S. 13°32'E., 60 m, 20.12.1950. – 1 spec.
 St. 122, 12°20'S. 13°40'E., 20 m, V.G. 20.12.1950. – 2 spec.

Most of the specimens have been collected with the bottom-grab. Usually the disk is lost, but it is preserved intact in three cases, viz. the specimen from the “Atlantide” St. 49, d.d. 2 mm, one of those from the “Galathea” St. 122, d.d. 3 mm, and

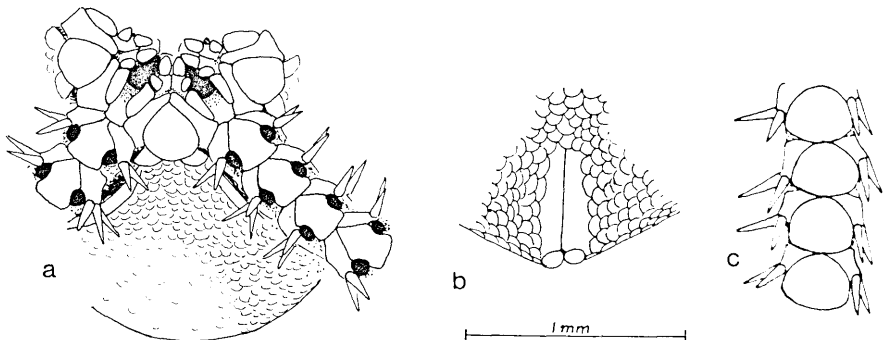


Fig. 31. *Amphipholis nudipora* Koehler. “Atlantide” St. 49, d.d. ca. 3 mm. d, armjoint no. ca. 20.

one of those from the "Galathea" St. 117, d.d. 4 mm. The two first-mentioned specimens show the incomplete dorsal skeleton proximally in the arms as figured by A. M. CLARK (1955, fig. 15b), indicating that the disk is regenerating and has not yet reached the diameter of the previously lost one.

Characteristic for the species, and convenient in identifying the loose arms, would seem to be the yellowish spots on the lateral arm plates (cf. e.g. TOMMASI 1967: 534).

Distribution: *Amphipholis nudipora* is known from tropical West Africa from Gambia to Lobito, Angola, in depths between about 5 and 250 m.

Amphipholis bananensis Koehler.

Fig. 32

Amphipholis bananensis Koehler, 1911: 14, pl. 2, figs. 3-4.

Amphipholis clypeata Koehler, 1914a: 191, pl. 7, figs. 16-17.

West African records: *Amphipholis bananensis*: KOEHLER 1911: 14; LONGHURST 1958: 100; TOMMASI 1967: 534.

Amphipholis clypeata: KOEHLER 1914a: 19; A. M. CLARK 1955: 38; LONGHURST 1958: 100.

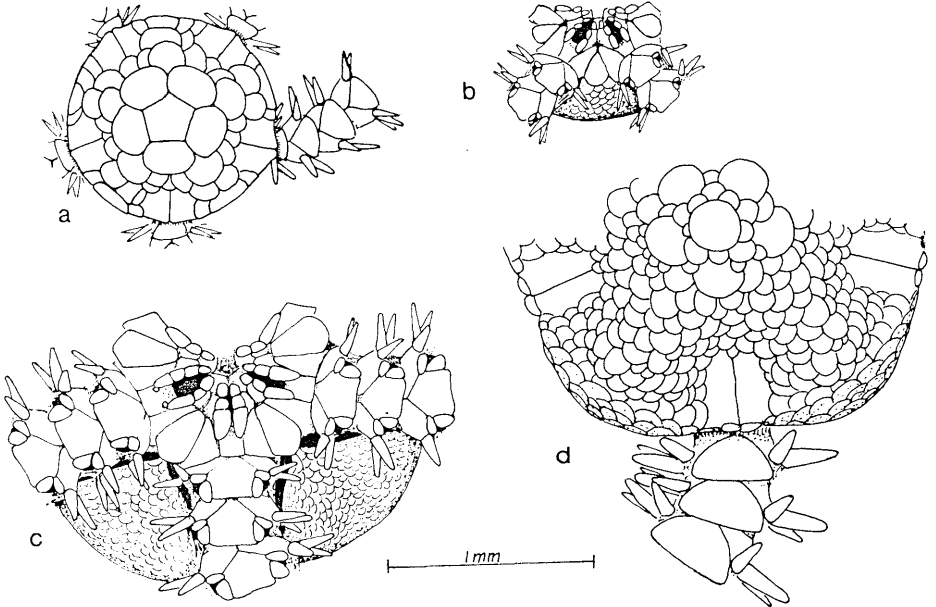


Fig. 32. *Amphipholis bananensis* Koehler. "Galathea" St. 38; a-b, d.d. 1 mm. c-d, d.d. 2 mm.

Material:

- "Galathea" St. 37, Christiansborg, Accra, rockpool, 24.11.1950. – Several spec.
 St. 38, Teshi, 16 km E. of Accra, rockpool, 24.11.1950. – 2 spec.

The present specimens measure from 1 to $2\frac{1}{4}$ mm in disk diameter and have 3 to 14 mm long arms. The largest size recorded in the literature is 4 mm in d.d.

KOEHLER (1914a: 191) described his *Amphipholis clypeata* from Angola without making any reference to the *A. bananensis* he had described (1911: 14) from the Congo. However, when she recorded *A. clypeata* from the Gold Coast, A. M. CLARK (1955: 38) suggested that it might possibly be the same as *A. bananensis*, and TOMMASI (1967: 534) simply considered the two species synonymous.

A few of the larger specimens at hand are peculiar in having, in some jaw angles, an extra, minute oral papilla distally to the broad papilla at the adoral plate.

Distribution: *Amphipholis bananensis* is known from the Ivory Coast to Angola (Quissembo) in littoral depths.

Dougaloplus libera (Koehler).

- Ophiocnida libera* Koehler, 1907b: 312, pl. 11, figs. 22–23.
Dougaloplus libera, A. M. CLARK, 1970: 33.

West African records: KOEHLER 1907b: 312.

This six-armed species with 4 arm spines is known only from the original specimens, 3 mm in disk diameter, from St. Vincent, the Cape Verde Islands. H. L. CLARK (1915: 259) listed it in the genus *Amphilimna*, and TOMMASI (1967: 538) included it in a key to the West African species of that genus, but noted that the generic position might be wrong. MATSUMOTO (1917: 178) had also referred the species to his *Amphiacantha*, renamed *Dougaloplus* by A. M. CLARK (1970).

OPHIACTIDAE

Ophiactis

- 1a. Radial shields large, about a third of the disk diameter, and continuous distally. Scattered, conical spines on disk plates. Two lateral oral papillae. Six (or five) arms. *savignyi*, p. 207
- 1b. Radial shields inconspicuous and separate. One lateral oral papilla. 2
- 2a. Six arms. The disk usually bears a small number of slender spines, characterized by a hyaline extremity. *lymani*, p. 208
- 2b. Five arms. The disk may bear a number of conical spines. *lütkeni*, p. 210

Ophiactis savignyi (Müller & Troschel).

Fig. 33

Ophiolepis savignyi Müller & Troschel, 1842: 95.*Ophiactis savignyi*, KOEHLER 1914a: 184, pl. 7, fig. 15, pl. 10, figs. 1-3.West African records: *Ophiactis krebsi*: GREEFF 1882: 153.*Ophiactis savignyi*: KOEHLER 1914a: 184: A. M. CLARK 1955: 36.

Material:

"Atlantide" St. 39. - 3 spec.

St. 141. - 1 spec.

St. 147. - 4 spec.

"Galathea" St. 49, 0°00'N. 6°32'E., 42 m, 29.11.1950. - 20 spec.

The specimens range from hardly 1 mm to about 5 mm in diameter of disk and all have at least a few spines on the dorsal disk margin. Smaller specimens have 4-5 arm spines and larger ones have 5-6. The present specimens are all six-armed, while a small percentage of the West African ones recorded by KOEHLER (1914a) and A. M. CLARK (1955) were five-armed.

The number of lateral oral papillae in the West African specimens is typically two, but three oral papillae may occur on one or other jaw, and in a few cases there seem to be only a single distal oral papilla.

Distribution: *Ophiactis savignyi*, which originally was described from the Red Sea, has a circumtropical distribution in littoral-sublittoral depths. Its habit of hiding in crevices and clinging to other objects also makes it especially apt to be distributed with drift-material or ships. It is a rather variable (polymorphic) species that has been described under quite a number of different names. Off West Africa it is hitherto

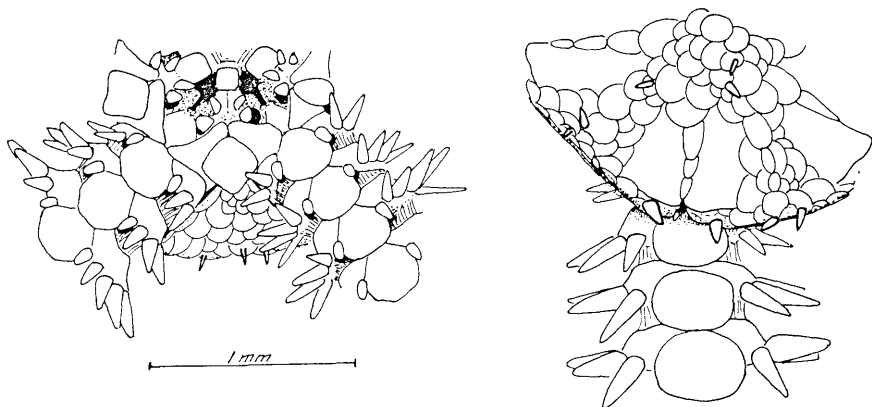


Fig. 33. *Ophiactis savignyi* (Müller & Troschel). "Atlantide" St. 39, d.d. 2 mm.

recorded from only a few localities, from the Cape Verdes to Annobon off Gabon, but since it is known from South Africa (the Indian Ocean coast) it shall probably be found along the whole West African coast south of the Tropic of Cancer. In the Mediterranean it occurs in the eastern part as an immigrant from the Red Sea through the Suez Canal.

Ophiactis lymani Ljungman.

Fig. 34

Ophiactis lymani Ljungman, 1871: 629.

Ophiactis lymani, KOEHLER 1926: 24, pl. 5, figs. 1–2; MORTENSEN 1933b: 442, fig. 15:

A. M. CLARK 1955: 35, fig. 12.

West African records: *Ophiactis lymani*: KOEHLER 1909: 172; A. M. CLARK 1955: 35; BUCHANAN 1958: 28; CHERBONNIER 1962: 14; TOMMASI 1967: 527.

Ophiactis mülleri: KOEHLER 1914a: 184, pl. 7, figs. 9–10.

Material:

“Atlantide” St. 40. – 1 spec.

St. 43. – 1 spec.

St. 44. – 1 spec.

St. 70. – 14 spec.

St. 85. – 1 spec.

St. 146. – 15 spec.

St. 147. – 4 spec.

St. 151. – 1+1 spec.

St. 153. – 1 spec.

“Galathea” St. 37, Christiansborg, Accra, rockpool, 24.11.1950. – 1 spec.

(?“Galathea” St. 44, Cape Verdes Island, 37 m. – 1 juvenile).

The specimens range from 1 to 2½ mm in d.d. They are all six-armed and in varying stages of regeneration after division. The disk spines are characterized by their hyaline point, and, when present, make the species easily identifiable. Some specimens have a small number of such spines scattered ventrally as well as marginally on the disk, but most specimens have only a few spines in each radius, marginally at the arms, and apparently disk spines may be totally absent. The ventral arm plates usually have a slightly concave distal margin, but this margin may also be convex as described by MORTENSEN (1933b) in specimens from St. Helena. The oral plates in all specimens are more or less rounded pentagonal and about as long as broad. The dorsal arm plates may remain separate also proximally in the arms in specimens up to 1½ mm in d.d.

O. lymani was originally described by LJUNGMAN (1871) on a specimen from Virgin Island in the Lesser Antilles. Photographs of the type-specimen were pub-

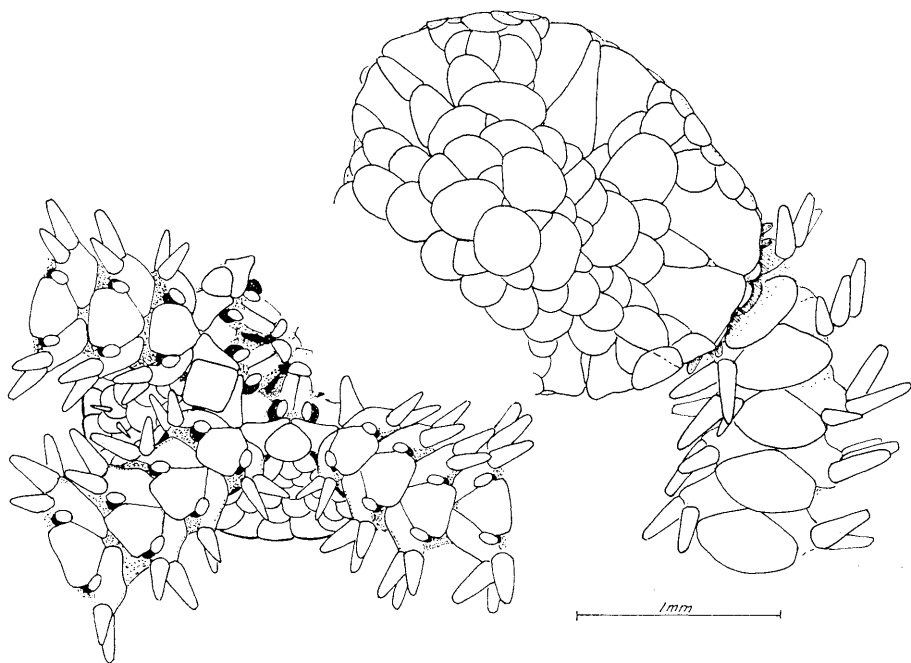


Fig. 34. *Ophiactis lymani* Ljungman. "Atlantide" St. 85, d.d. 2 mm.

lished by KOEHLER (1926) and a drawing of its ventral arm plates was published by MORTENSEN (1933b, fig. 16d). The West African specimens seem to agree well enough with the West Indian one.

MORTENSEN (1933b: 444) questions whether KOEHLER's *O. lymani* (1909) from the Cape Verdes is really this species. The drawings published of the specimen appear, however, so inexact that little importance can be attached to them. The locality does not contradict the identification, and actually one of the present specimens does have two oral papillae in one mouth angle instead of the usual single one. A juvenile *Ophiactis* was collected by the "Galathea" at the Cape Verdes, 37 m, and, although it cannot be definitely identified, is thought to be an *O. lymani*.

The West African specimens recorded by KOEHLER (1914a: 184, pl. 7, figs. 9-10) as representing the West Indian *O. mülleri* Lütken, belong, as noted by A. M. CLARK (1955) to *O. lymani*. The two species are clearly distinct, and it was probably by a mere lapse of the pen that KOEHLER attached the wrong name to his African material.

Distribution: *Ophiactis lymani* is an amphi-Atlantic sublittoral species. It is a very small species of a secretive habit as is characteristic of the genus, but, nevertheless, it is known from a number of finds off tropical West African from the Cape Verdes to northern Angola (0-90 m) and from St. Helena (10-110 m), while in the West Atlantic it is known only from the Virgin Islands.

The Mediterranean *Ophiactis virens* (M. Sars, 1857) is a near relative of *O. lymani*, as discussed by KOEHLER (1914b) and A. M. CLARK (1955: 36), and it may be difficult to distinguish the two forms. The proximal dorsal arm plates are rather fan-shaped in the adult *O. lymani*, while they are broadly oval in *O. virens*, and the radials are usually comparatively larger in *O. lymani* than in *O. virens*. A. M. CLARK (1955: 36) notes as a further difference that *O. virens* has a bare skin towards the oral shields, but actually some Mediterranean specimens examined have had a complete ventral scale-covering.

Ophiactis lütkeni Marktanner-Turneretscher.

Fig. 35

(? = *Ophiactis carnea* Ljungman, 1867: 324).

Ophiactis lütkeni Marktanner-Turneretscher, 1887: 298, pl. 12, figs. 7-8.

Ophiactis africana Koehler, 1911: 17, pl. 3, figs. 4-5.

Ophiactis lütkeni, A. M. CLARK, 1955: 34, fig. 11.

West African records: *Ophiactis lütkeni*: MARKTANNER-TURNERETSCHER 1887: 298; A. M. CLARK 1955: 34; CHERBONNIER 1957: 116; 1962: 15.

Ophiactis africana: KOEHLER 1911: 17; 1914a: 182; CADENAT 1938: 359.

Amphiura capensis pars: KOEHLER 1914a: 190 (the Senegal specimens).

Material:

"Atlantide" St. 110. - 1 spec.

St. 123. - 1 spec.

St. 136. - 2 spec.

"Galathea" St. 38, Teshi, 16 km E. of Accra, 0-1 m, 24.11.1950. - 1 spec.

St. 125, N.W. of lighthouse, Lobito, Angola, V.G., 60 m, 20.12.1950.
- 1 spec.

Dakar, Brinkmann leg., 21.1.1906. - 1 spec.

Belgian Congo, Darteville leg., 1938. - 1 spec.

Ambrizette, Angola. - 6 spec.

Joal, Senegal, 4-5 m, Thorson, leg. 31.3.1952. - 2 spec.

Between Gorée and Tiaroye, Senegal, 15-20 m, Thorson leg., 5.4.1952. - About 30 spec.

Gorée, Senegal, 20 m, Thorson leg., april 1952. - About 50 spec.

The material consists of specimens ranging from juveniles 0.2 mm in disk diameter to fully grown ones with a d.d. of 5 mm. Specimens from the same lot may show great diversity in the number of disk spines. Thus in the lot from Ambrizette there are all gradations from specimens completely devoid of disk spines to specimens with a dense spine covering. In the two large samples from Gorée nearly all specimens are either wholly without disk spines or with only a few marginal ones near the arms. Less than one tenth of the specimens in these samples have a fair

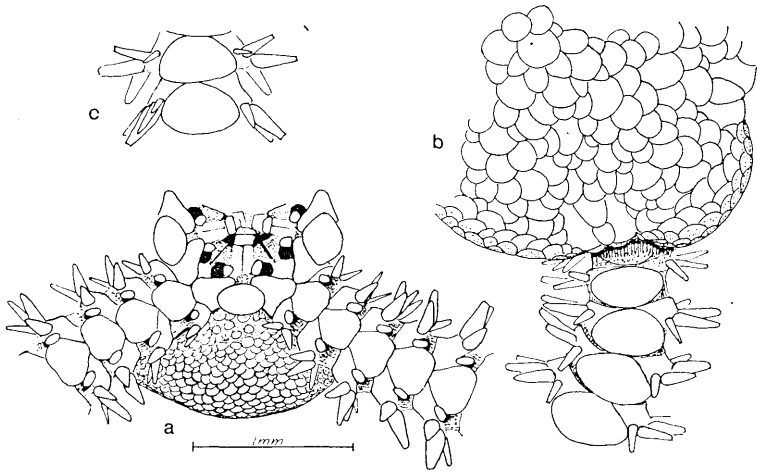


Fig. 35. *Ophiactis lütkeni* Marktanner-Turneretscher. "Galathea" St. 125, d.d. 2¾ mm. c, arm-joints nos. 19-20.

development of spines on the margins and the ventral side of the disk. Other specimens from Senegal, however, have densely spined disks. The number of spines present is not correlated with the size of the specimens, and the material thus confirms A. M. CLARK's conclusion (1955: 34) that KOEHLER's *O. africana* (the spiny form) is the same as MARKTANNER-TURNERETSCHER's *O. lütkeni*.

The number of spines on the proximal arm plates is usually 5, but it may be only 4 even in full-grown specimens.

The characteristic appearance of the arm skeleton in full-grown specimens with the broadly oval and contiguous dorsal plates is shown in KOEHLER's fig. 4, pl. 3 (1911) while the appearance of the dorsal arm skeleton in younger specimens is shown in A. M. CLARK's fig. 11 b (1955). In juvenile specimens the dorsal arm plates are rather subtriangular.

In living specimens the arms are annulated, e.g. with one darker joint alternating with four lighter joints.

Ophiactis lütkeni has a close relative in the North East Atlantic sublittoral-bathyal *O. balli* (Thomson, 1840). Juvenile specimens of the two species are probably hardly distinguishable but adult specimens are easily separated by, e.g., the arm skeleton. The dorsal arm plates in *O. balli* are rather subtriangular (fan-shaped) even in full-grown specimens and thus are only in narrow contact with each other. The lateral arm plates are consequently more conspicuous in *O. balli* than in *O. lütkeni*. The oral plates are rounded triangular and relatively larger in *O. balli*, while they are broadly oval and relatively smaller in *O. lütkeni*.

Ophiactis lütkeni (*O. africana*) is also, as discussed by MORTENSEN (1933b: 345) very closely related to the South and East African *O. carnea* Ljungman, 1867. A slightly finer dorsal scaling on the disk and slightly smaller radials seem to be the only character by which *O. lütkeni* differs from *O. carnea*, and I do not think it

possible to distinguish the two forms with any certainty in the case of specimens of unknown origin. A slight deficiency in the ventral disk scaling proximally may be found in West African as well as in South African specimens.

Distribution: *Ophiactis lütkeni* is recorded from the tropical West African coast from Dakar to Lobito, Angola, in depths down to 20 m, and whether it can be kept specifically distinct from the South African *O. carnea* remains doubtful.

***Ophiactis balli* (W. Thomson, 1840).**

This species is listed by LONGHURST (1958: 99) from the Gambia–Cameroon area, 300 m, and TOMMASI (1967: 528) records it from S. of Great Bassam, Ivory Coast, 40 m.

TOMMASI states that *O. balli* differs from *O. lütkeni* in having “épines brachiales avec une dentelure à leur extrémité” while the latter is “sens dentelure”. I fail to find this difference in the material available to me; the arm spines in both species appear slightly thorny at higher magnification. The differences between the two species are mentioned above under *O. lütkeni* and I doubt whether the shallow water West African specimens recorded as *O. balli* is really also of that species.

Distribution: *Ophiactis balli* is a sublittoral-bathyal Eastern North Atlantic species, which is known from as far north as the Faroes and the Trondheim Fjord and as far south as the Bay of Guinea. Most records are from depths exceeding 100 m and down to about 1800 m. The hitherto shallowest known occurrence is at 30 m in the English Channel.

OPHIOTHRICHIDAE

- 1a. The arm spines free of each other..... *Ophiothrix*, p. 212
- 1b. The arm spines connected by a thin skin..... *Ophiopteron*, p. 215

Ophiothrix

- 1a. Radial shields except for a series of marginal granules naked or at most with a few, scattered spinelets. The dorsal arm plates always naked..... 2
- 1b. Radial shields densely, or sparsely but evenly covered with spinelets..... 3
- 2a. The dorsal arm plates broader than long and with a slightly concave distal edge. The disk densely covered with granular-like spinelets.... *cotteaui*, p. 214
- 2b. The dorsal arm plates about as broad as long and with the distal edge protruding..... *fragilis*, p. 213

- 3a. The radial shields as well as the dorsal disk plates sparsely covered with stumpy spinelets, possibly intermingled with somewhat larger spines. The proximal dorsal arm plates fan-shaped and with some spinelets. *.nociva*, p. 216
- 3b. The radial shields as well as the dorsal disk plates densely covered with uniform spinelets. The dorsal arm plates rather hexagonal and naked.
 *congensis*, p. 217

Ophiothrix fragilis (Abildgaard).

Fig. 36 c

Asterias fragilis Abildgaard, 1789: 28, pl. 98.

Ophiothrix fragilis, MORTENSEN 1927: 174, fig. 98.

West African records: *Ophiothrix rubra*: STUDER 1883: 24.

Ophiothrix fragilis: KOEHLER 1907b: 332 (f. *lusitanica*); 1914a: 209; MORTENSEN 1925: 179, 184; CADENAT 1938: 357; CHERBONNIER 1962: 16; TOMMASI 1967: 542.

Ophiothrix quinquemaculata: CHERBONNIER 1962: 18.

Material:

"Atlantide" St. 39. – 4 spec.

St. 44. – 3 spec.

St. 60. – 1 spec.

St. 68. – 6 spec.

St. 111. – 3 spec.

St. 126. – 1 spec.

St. 151. – 14 spec.

St. 153. – 2 spec.

St. 161. – 1 spec.

"Galathea" St. 4, 22°19'N. 17°05'W., 62 m, 2.11.1950. – 1 spec.

La Luz, Gran Canaria, 180 m, Mortensen leg. 2.4.1930. – 1 spec.

Off Las Palmas, Gran Canaria, 150–60 m, Mortensen leg. 28.5.1930. – 1 spec.

Los Christianos, Tenerife, tidal zone, Thorson leg. March 1947. – 1 spec.

Between Gorée and Tiaroye, Senegal, 15–20 m, Thorson leg. April 1952. – 4 spec.

Off Gorée, Senegal, 20 m, Thorson leg. April 1952. – 2 spec.

O. fragilis is one of those polymorphic species of *Ophiothrix* which LYMAN (1876) aptly characterized as "the despair of the specific zoologist". The specimens here recorded under the name of *O. fragilis* are rather diverse and actually the material contains all those specimens of *Ophiothrix* that I have been unable to refer to any of the three fairly well defined species known from the littoral-sublittoral Tropical West Africa: *O. cotteai*, *O. congensis*, and *O. novica*.

All specimens fall, however, within the usually accepted variation in *O. fragilis*, with one exception, viz. one of the specimens from the "Atlantide" St. 39, 3 mm in d.d. and with 20 mm long arms. This specimen is distinguished by a complete absence of any spines or spinelets from the disk and by having the interradial ventral areas devoid of plates. The oral skeleton and the shape of both ventral and dorsal arm plates are, however, as in typical *O. fragilis*. It may be distinguished as a forma *nuda*, nov. f.

Specimens rather referable to f. *echinata* sensu KOEHLER (1924) and ranging from about 1 to 14 mm in d.d., are represented from the "Atlantide" Sts. 44, 60, 68, 111, 151, and 153. Some of these, e.g. some large ones from Senegal with d.d. up to 14 mm, do not have the keeled dorsal arm plates as is usually characteristic for *O. fragilis*.

A few specimens, from "Atlantide" Sts. 60 and 151, might have tentatively been separated from the other material and identified with *O. quinquemaculata* (Delle Chiaje) from the Mediterranean. However, a detailed study by GUILLE (1964) has shown that this form may also easily be included in the polymorphic *O. fragilis*.

Specimens rather referable to f. *lusitanica* sensu KOEHLER, 1924, and with d.d. up to 7 mm, are represented from "Atlantide" Sts. 39, 68, 126, 153, and "Galathea" St. 4.

Distribution: *Ophiothrix fragilis* is an East Atlantic littoral-sublittoral species. Its northernmost occurrence is at Lofoten and Iceland. It is common in the Mediterranean, and along West Africa it extends southwards at least to Lüderitz Bay and possibly to the Cape. Off tropical West Africa it occurs mostly at depths of more than 20 m. Otherwise its bathymetrical distribution is from the tidal zone to 1250 m.

Ophiothrix cotteau (de Loriol).

Fig. 36 a-b

Ophiocnemis cotteau de Loriol, 1900: 84, pl. 7, fig. 11.

Ophiothrix indigna Koehler, 1906: 296, pl. 19, figs. 22-26.

Ophiothrix gracilis Koehler, 1911: 19, pl. 1, figs. 1-4.

West African records: *Ophiocnemis cotteau*: DE LORIO 1900: 84.

Ophiothrix gracilis: KOEHLER 1906: 296; 1914a: 209; MORTENSEN 1925: 184; CADENAT 1938: 357.

Ophiothrix cotteau: A. M. CLARK 1955: 49; LONGHURST 1958: 99; CHERBONNIER 1962: 15; TOMMASI 1967: 542.

Ophiothrix indigna: LONGHURST 1958: 99.

Material:

"Atlantide" St. 85. - 2 spec.

St. 141. - 1 spec.

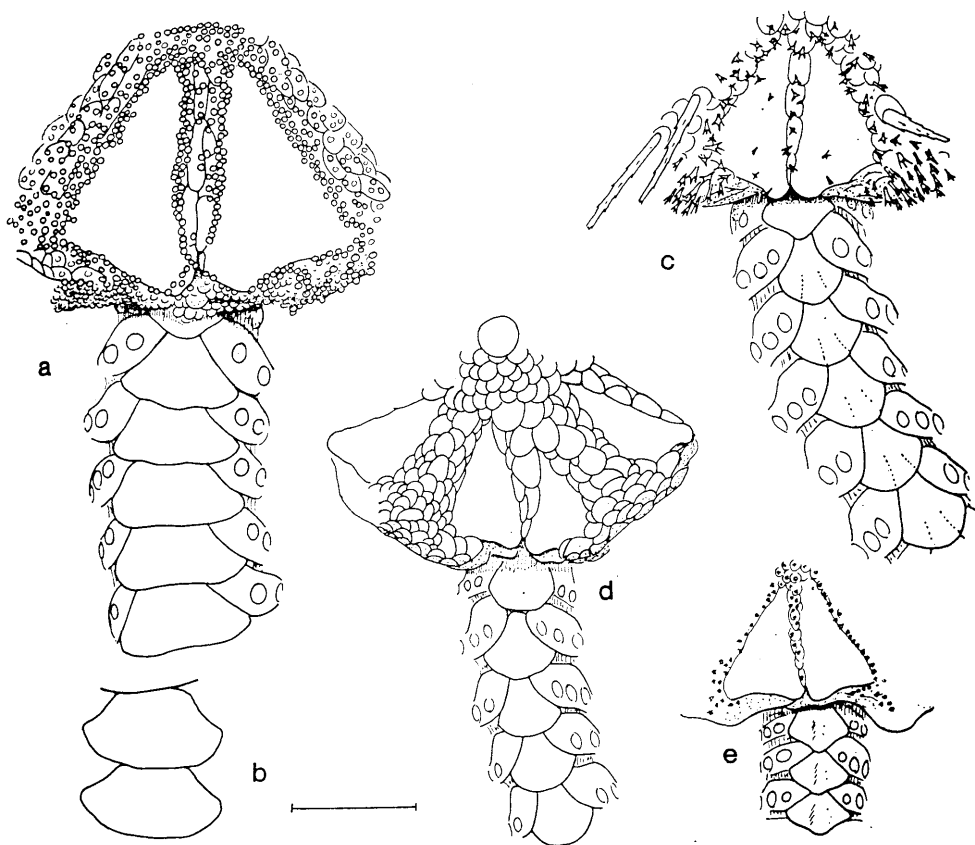


Fig. 36. a-b, *Ophiothrix cotteau* (de Loriol). Cap Blanco, d.d. 6 mm. b, armjoints nos. 19-20. c, *Ophiothrix fragilis* (Abildgaard). "Atlantide" St. 60, d.d. 4½ mm. d, *Ophiothrix fragilis* f. *nuda*, n.f., "Atlantide" St. 39, d.d. 3 mm. e, *Ophiothrix maculata* Ljungman. "Dana" St. 4020, d.d. 14 mm. Scale: a-d, 1 mm; e, 4 mm.

The largest specimen from St. 85 measures 7 mm in disk diameter and has 30 mm long arms. The specimen from St. 141 is juvenile.

A. M. CLARK (1955) pointed out the identity of KOEHLER's *O. gracilis* with DE LORIOI's *O. cotteau*. As a further synonym may be added *Ophiothrix indigna*, described by KOEHLER (1906) on three specimens from the Azores and Madeira. The specimen from the Azores had broadly oval dorsal arm plates proximally in the arms while they are rather fan-shaped and with acute lateral ends in the described specimens of *O. cotteau* (inclusive of *gracilis*). The Azores specimen of *O. indigna*, d.d. 13 mm, is, however, about twice as large as any of the other specimens, and more distally in its arms the dorsal arm plates are shaped like in these. The smaller specimen from Madeira, d.d. 8 and 9 mm, which KOEHLER included in his *O. indigna* were also stated to have their dorsal arm plates shaped like the distal ones in the large specimen. Evidently the described large specimen of *O. indigna* represents

the full-grown *O. cotteai*. *O. indigna* was also reported from Tropical West Africa by LONGHURST (1958).

Distribution: *Ophiothrix cotteai* is known from the region of the Azores and off Portugal (a specimen in the Zool. Mus., Copenhagen) and from along the West African coast as far south as Loanda, Angola, in depths from the tidal zone to 370 m. It is the only species with a West African–Lusitanian distribution which is not also known from the Mediterranean.

***Ophiothrix maculata* Ljungman.**

Fig. 36 e

Ophiothrix maculata Ljungman, 1871: 623.

Ophiothrix inducta Koehler, 1906: 298, pl. 19, figs. 17–19.

Material:

“Dana” St. 4020, 33°12'N. 9°00'W., 114 m, 31.3.1930. – 4 spec.

The identity of KOEHLER's *O. inducta* from the Canary Is., 410 m, with LJUNGMAN's *O. maculata* from the Josephine Bank off Portugal, 200 m, was discovered by MORTENSEN (1927: 173) after a re-examination of LJUNGMAN's specimen.

The present specimens measure 14, 8, 5, and 2 mm in diameter of disk and have arms 85, 25, 20, and 12 mm long. The large one with 8–9 arm spines proximally agrees nicely with KOEHLER's description of his *O. inducta*.

O. maculata shows some resemblance to *O. cotteai* in the large, naked radial plates and the uniform disk armature, which here, however, is formed by small, thorny spinelets. Those near the disk margins are about $\frac{1}{3}$ mm high and half as broad, and those on the main part of the disk are somewhat shorter, being not higher than broad. The dorsal arm plates in *O. maculata* differ also from those in *O. cotteai* in being rather rhombic and having a somewhat protruding distal edge.

In the bare radials and the shape of the dorsal arm plates *O. maculata* also resembles *O. fragilis*, and no doubt it is near this variable species. A difference is that the dorsal arm plates in *O. maculata* are not raised into a knob distally as is typical of *O. fragilis*.

Distribution: *Ophiothrix maculata* is known hitherto only from the mentioned localities, between S.E. of Portugal and the Canaries, in 114 to 410 m.

***Ophiothrix nociva* Koehler.**

Fig. 37 a–b

Ophiothrix nociva Koehler, 1907b: 335, pl. 13, figs. 43–45.

Ophiothrix tomentosa Koehler, 1914a: 210, pl. 10, figs. 9–10.

West African records: *Ophiothrix nociva*: KOEHLER 1907b: 335.

Ophiothrix tomentosa: KOEHLER 1914a: 210; A. M. CLARK 1955: 48; LONGHURST 1958: 99; BUCHANAN 1958: 28; TOMMASI 1967: 544.

Material:

“Atlantide” St. 70. – 9 spec.

St. 102. – 1 spec.

St. 123. – 1 spec.

St. 145. – 1 spec.

The specimens range from 2 to 5 mm in diameter of disk.

A. M. CLARK (1955: 48) noted the possibility that the *O. tomentosa* described by KOEHLER (1914a) was but a synonym of his *O. nociva* of 1907b. The oral aspect of the two described specimens is the same and the difference in the dorsal spine armature might be due to age, *O. nociva*, d.d. 5½ mm, being the full-grown form, and *O. tomentosa*, d.d. 4 mm, a younger form in which larger spinelets have not yet appeared among the thorny stumps covering the disk plates, and in which there are still only a few spinelets on the radials.

The “Atlantide” specimens all represent, in their spine armature lacking larger spinelets among the stumps, the same form as *O. tomentosa*. The shape of the dorsal arm plates proximally in the arms changes gradually with age, from rather oval in longitudinal direction or roundish in the smaller specimens (as in KOEHLER’s *O. tomentosa*, 1914a: 210, pl. 10, fig. 9) to rather fan-shaped in the larger ones (as in KOEHLER’s *O. nociva*, 1907b: 335, pl. 13, fig. 43). The material thus confirms that the two nominal species are age variations of one and the same.

Distribution: *Ophiothrix nociva* is known from Tropical West Africa from Guinea to Congo in depths from 25 to 65 m.

Ophiothrix congensis Koehler.

Fig. 37 c-e

Ophiothrix congensis Koehler, 1911: 21, pl. 1, figs. 5–7, pl. 2, fig. 15.

West African records: KOEHLER 1911: 21; 1914a: 208; CADENAT 1938: 358; A. H. CLARK 1955: 48; LONGHURST 1958: 99; CHERBONNIER 1962: 15; 1963: 186.

Material:

“Atlantide” St. 44. – 12 spec.

St. 141. – Arm fragments.

St. 147. – 2 spec.

St. 151. – 3 spec.

St. 153. – 10 spec.

“Galathea” St. 50, 0°00’N. 6°32’E., 5–8 m, 29.11.1950. – 2 spec.

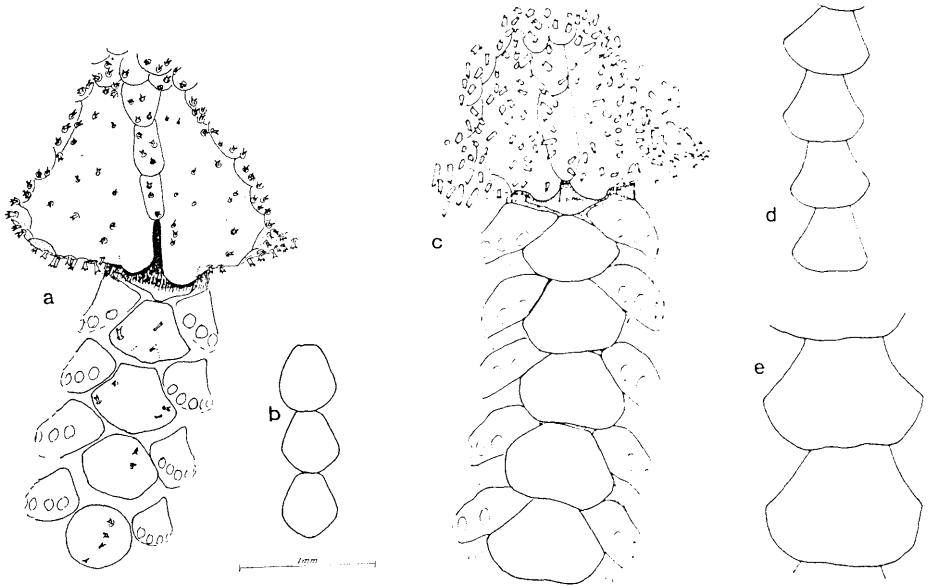


Fig. 37. a-b, *Ophiothrix nociva* Koehler. "Atlantide" St. 70, d.d. $4\frac{1}{2}$ mm. b, armjoints nos. 18-20. c-e, *Ophiothrix congensis* Koehler. c-d, "Atlantide" St. 44, $4\frac{1}{2}$ mm. d, armjoint no. ca. 25. e, "Atlantide" St. 144, d.d. 10 mm, armjoint no. ca. 25.

The specimens range from 2 to 12 mm in diameter of disk and have arms from 4 to 5 times as long. The species is primarily distinguished by the uniform, small, and thorny spinelets which fairly densely cover the radials as well as the disk plates and also extend to the ventral side. The naked and rather broadly hexagonal dorsal arm plates are in broad contact and have a straight or slightly concave distal margin. The arm spines in larger specimens number e.g. 9 proximally, 5 in the main part of the arms and 3 more distally. The median ones are slightly club-shaped.

Distribution: *Ophiothrix congensis* is known from Guinea to Loanda, Angola, in depths from the tidal zone to 65 m.

Ophiopteron atlanticum Koehler.

Fig. 38

Ophiopteron atlanticum Koehler, 1914a: 212, pl. 10, figs. 6-7, 11-12.

Ophiopteron atlanticum, CHERBONNIER 1957: 163, fig. 1.

West African records: KOEHLER 1914a: 212; CADENAT 1938: 358; A. M. CLARK 1955: 49; CHERBONNIER 1957: 163; LONGHURST 1958: 99; TOMMASI 1967: 541.

Material:

- “Atlantide” St. 44. – 2 spec.
 St. 141. – 12 spec.
 St. 145. – about 40 spec.
 St. 146. – 1 spec.
 St. 147. – 8 spec.
 St. 153. – 5 spec.

The largest specimen measures 8 mm in diameter of disk, which is about twice the size of the hitherto largest specimens described, and has arms about 25 mm long. The smallest specimens present are about 2 mm in d.d., and have arms twice as long, while the arms in specimens with a d.d. of 4 mm are three times as long.

Specimens up to about 4 mm d.d. still have a dorsal disk armature consisting solely of minute, bajonet-formed spinelets which are crowded on the interradiial plates, but absent or found only scatteredly on the radials and the centrodorsal plate. In somewhat larger specimens a few spines reaching a size about $\frac{2}{3}$ that of the arm spines are intermingled interradially and the largest specimens bear in each interradius about half a hundred of such spines, each clad in a sheath of skin, while bajonet-shaped spinelets occur only marginally and spiniform spinelets only ventrally.

The large specimen, 8 mm d.d., has up to 9 arm spines proximally. The 5 dorsal ones are long and united by the characteristic web, while the 4 ventral ones are free and decrease in length towards the ventral side with the ventralmost one being a mere spinelet. The free arm spines, except for the ventralmost one, have a slightly

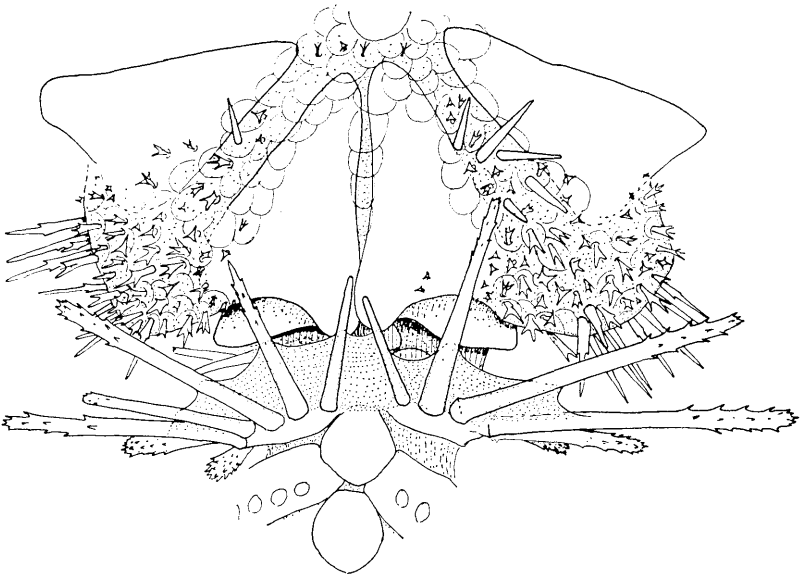


Fig. 38. *Ophiopteron atlanticum* Koehler. “Atlantide” St. 45, d.d. $4\frac{1}{2}$ mm.

enlarged and much thorny extremity resulting in an appearance similar to a spike mace.

In the best preserved specimens, d.d. 4 mm or more, the web uniting the arm spines on the first arm-joint outside the disk is seen to continue across the arm and unite the arm spines from each side.

Distribution: *Ophiopterion atlanticum* is known from Senegal to about Loanda, Angola, in depths from 11 to 64 m.

OPHIOCOMIDAE

- 1a. A single leaf-shaped tentacle scale at each pore, except on the most proximal joints where there may be two or three such scales. The disk uniformly covered with granular-like spines. *Ophiocoma*, p. 200
- 1b. Two tentacle scales, the inner one of which much elongated. The two enlarged tentacle scales on each joint crossing each other in the arm mid-line. The disk scales naked. *Ophiopsila*, p. 221

Ophiocoma pumila Lütken.

Fig. 39

Ophiocoma pumila Lütken, 1859: 248, pl. 4, figs. 5a-d.

West African records: GREEFF 1882: 156; KOEHLER 1907b: 326; 1914a: 208; A. M. CLARK 1955: 50.

Material:

"Galathea" St. 50, 0°00'N. 6°32'E., 5-8 m, 29.11.1950. - 6 spec.

The specimens measure 8-17 mm in disk diameter. The arms are banded. The arm spines, up to 6 in number, are slightly shorter, slightly more flattened and end more bluntly than in most West Indian specimens. This was also the case in the W. African specimens recorded by A. M. CLARK (1955) and no other difference is apparent.

Distribution: *Ophiocoma pumila* is a littoral-sublittoral species with a tropical ampho-Atlantic distribution. It occurs in the West Atlantic from Bermuda to Brazil and in the East Atlantic in the Bay of Guinea. A. M. CLARK (1955: 50) states that the species is also known from the Cape Verde Islands, the original record of which is unknown to me. The West African records are from the tidal zone to about 10 m, while the species ranges down to 375 m in the East Atlantic.

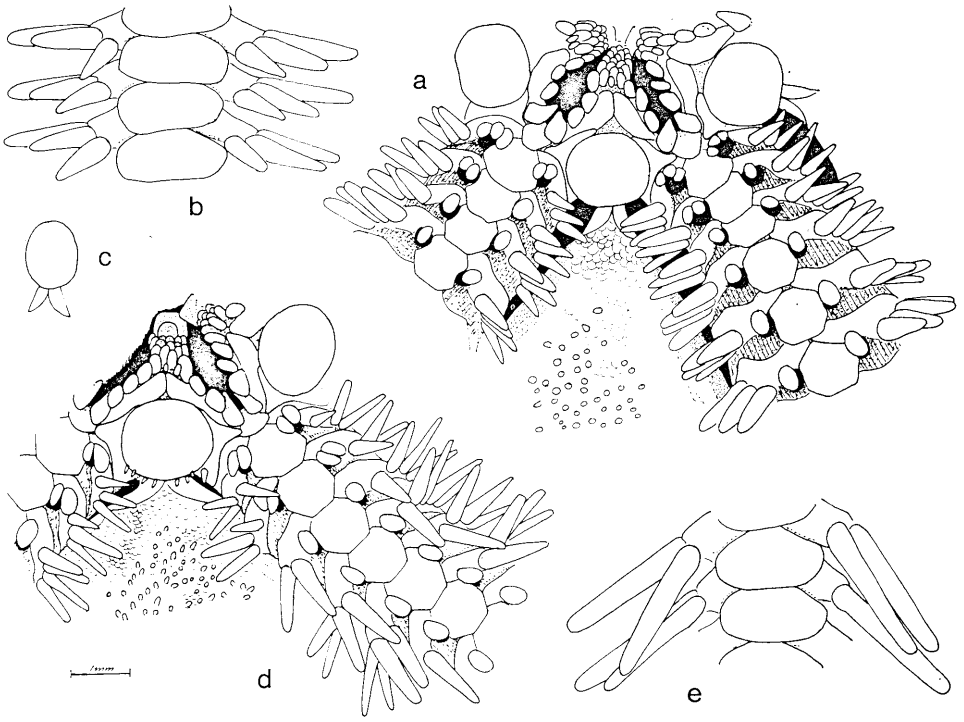


Fig. 39. *Ophiocoma pumila* Lütken. a-b, "Galathea" St. 50, d.d. 16 mm. b, armjoints nos. 15-17; c, "Galathea" St. 50, d.d. 8 mm, oral shield. d-e, type-specimen, St. Thomas, d.d. 15 mm. e, armjoints nos. 15-16.

Ophiopsila

- 1a. The arm spines, except for the longer ventral one, flattened and blunt and not overlapping each other. Inner tentacle scale about as long as the arm joint. Dorsal arm plates, in main part of arm in larger specimens, rounded subquadrangular. *aranaea*, p. 222
- 1b. The arm spines slender (the dorsal ones may be somewhat flattened) and never overlapping each other. Inner tentacle scale distinctly longer than the arm joint. Dorsal arm plates, in main part of arm in larger specimens, transversely oval. *guineensis*, p. 223
- 1c. The latero-ventral arm spines slender, cylindrical; the latero-dorsal ones broadly flattened and overlapping. Inner tentacle scale almost twice as long as the arm joint. Dorsal arm plates, in main part of arm in larger specimens, subquadrangular. *annulosa*, p. 223

Ophiopsila aranea Forbes.

Fig. 40

Ophiopsila aranea Forbes, 1845: 149, pl. 14, figs. 1–7.*Ophiopsila platispina* Koehler, 1914a: 206, pl. 8, figs. 10–11.*Ophiopsila aranea*, KOEHLER 1924: 343; MORTENSEN 1927: 180, fig. 101.West African records: *Ophiopsila aranea*: KOEHLER 1924: 344.*Ophiopsila platispina*: Koehler 1914a: 206; MORTENSEN 1936: 261; TOMMASI 1967: 549.

Material:

Dakar, 10 m, Brinkmann leg. 21.2.1906. – 1 spec.

Annobon, 18–30 m, Discovery Exp. 1927. – 3 spec.

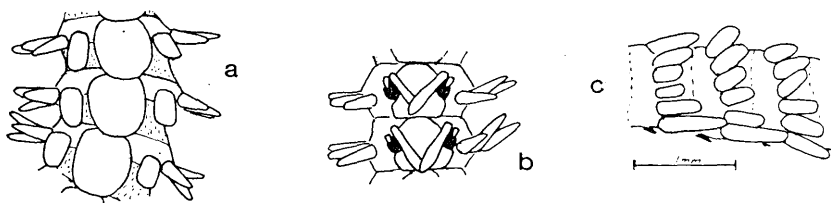


Fig. 40. *Ophiopsila aranea* Forbes. Annobon, 18–30 m. a, d.d. 8 mm, armjoints nos. 14–16; b-c, d.d. 6 mm, armjoint no. ca. 15.

The specimen from Dakar is 5 mm in diameter of disk, has 30 mm long arms, and bears up to 7 arm spines on some joints. It agrees with the description which KOEHLER (1914a) gave of the similar-sized type specimen of his *O. platispina* and shows the same vivid colour scheme, the disk being marmorated reddish brown, blackish, and whitish, and the arms reddish brown and banded in black for every fifth joint or so. This colour scheme, thought to be characteristic for *O. platispina*, is also shown, however, in some specimens in samples of *O. aranea* from the Mediterranean and the English Channel. Just as flattened arm spines as are found in the tropical West African specimens are also found in some specimens in typical *O. aranea* samples. In all examined characters *O. platispina* falls within the variation found in samples of *O. aranea*, and I therefore consider it synonymous with this species.

KOEHLER (1924: 344) also lists Saô Thomé in his survey of the distribution of *O. aranea*, which means perhaps that he has now regarded his own *O. platispina* as a synonym of this species.

MASSÉ (1963) discussed the characters distinguishing the Mediterranean *Ophiopsila* species, *aranea*, *annulosa*, and *guineensis*. He pointed out that the number of arm spines usually used alone as key characters was insufficient as such. Some of the largest specimens I have examined of *O. aranea*, d.d. about 12 mm, also had up to 10 arm spines on some joints, while the middle-sized specimens about 6 mm

in d.d. had only about 7 arm spines. The arm spines in each series are never so broadly flattened that they overlap as is the case in *O. annulosa*. The arms in the larger specimens are about 7 times the d.d.

Distribution: *O. aranea* is distributed in the whole Mediterranean sublittoral and is known in the Atlantic from as far north as the western end of the English Channel, as far west as the Azores, and as far south as Annobon in the Bay of Guinea. It is found in depths between 10 and 185 m.

Ophiopsila annulosa (M. Sars).

Ophianoplus annulosa M. Sars, 1857: 79, pl. 1, figs. 2–7.

Ophiopsila annulosa, MASSÉ 1963: 168, figs. b, e, and h.

West African records: KOEHLER (1914a: 206) mentions from Sinoe, Liberia, an arm of an *Ophiopsila* having the characters of *O. annulosa* and 11 arm spines.

O. annulosa grows to 15 mm in disk diameter and has arms about 10 times as long. The number of arm spines is about 10 in medium-sized specimens, d.d. about 10 mm, and may reach 12 in larger specimens. The only material of this species available to me is some arms of a large specimen from off Faro, Portugal, 32 m, "Dana" St. 4134, 10.6.1930. They show the colour scheme probably characteristic of the species, being banded with about 6 whitish joints alternating with 3 brownish ones.

Distribution: *O. annulosa* is known from the Western Mediterranean and some scattered localities in the East Atlantic from Plymouth to Morocco, and probably occurs also off Liberia. Its bathymetrical range is from 10 to 100 m.

Ophiopsila guineensis Koehler.

Fig. 41

Ophiopsila guineensis Koehler, 1914a: 203, pl. 8, figs. 1–4, and 7–8.

Ophiopsila guineensis, MASSÉ 1963: 168, figs. a, d, and g.

West African records: KOEHLER 1914a: 203; MORTENSEN 1925: 185; 1936: 260; CADENAT 1938: 362; A. M. CLARK 1955: 50; LONGHURST 1958: 99; BUCHANAN 1958: 30; TOMMASI 1967: 546.

Material:

"Atlantide" St. 40.— 1 spec.

St. 49.— 2 spec.

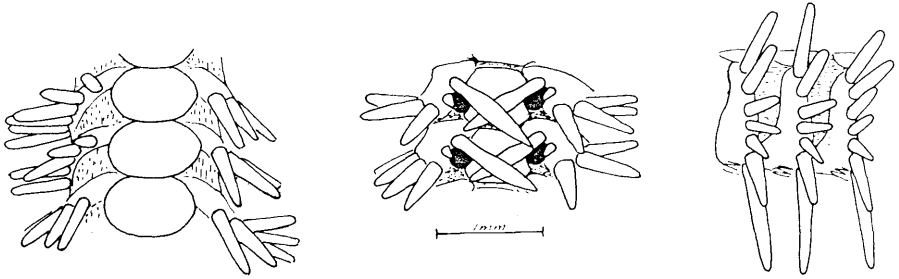


Fig. 41. *Ophiopsila guineensis* Koehler. "Atlantide" St. 56, d.d. ca. 8 mm, armjoint no. ca. 15.

- St. 56.— 9 spec.
- St. 70.— 1 spec.
- St. 73.— 1 spec.
- St. 75.—13 spec.
- St. 85.— 1 spec.
- St. 106.—10 spec.
- St. 116.— 1 spec.

"Galathea" St. 4, 22°19'N. 17°05'W., 62 m, 2.11.1950. — 1 spec.

St. 44, off River Volta, Ghana, P.G., 40 m, 26.11.1950. — 1 spec.

Off La Luz, Gran Canaria, 40, 100, and 175 m, Mortensen leg. 1930. — 7 spec.

The specimens range from 2 to 12 mm in diameter of disk, and the larger ones have arms at least 90 mm long. The arms are about 7 times the d.d. in the middle-sized intact specimens examined. Only the specimens about 8 mm or more in d.d. show the specific characteristic of broadly oval dorsal arm plates proximally in the main part of the arms. Such specimens are present only from "Atlantide" Sts. 56, 75, 85, 106, and 116. In the remaining specimens, d.d. 2–7 mm, the dorsal arm plates in the main part of arm are still roundish. The specimens can be identified with certainty, however, by their slender arm spines and characteristic colour scheme. The disk is usually leopard-spotted, and the arms have laterodorsal dark patches, sometimes for almost every joint, sometimes fairly regularly for every second joint. Scattered dorsal arm plates also bear a pair of dark spots.

The number of arm spines are up to 12 and 13 respectively in two specimens measuring 9 and 10 mm in d.d. Otherwise the highest number of arm spines are between 8 and 11 in the larger specimens at hand. One specimen with d.d. 12 mm thus has 8 arm spines. Specimens 3–6 mm in d.d. may also have up to 8–11 arm spines.

Distribution: *Ophiopsila guineensis* is recorded from tropical West Africa as far south as Annobon, and its occurrence in the Mediterranean, near Marseille, was shown by MASSÉ (1963: 167). MORTENSEN (1925: 185) recorded *O. guineensis* from Cap Blanc, and a revision I have undertaken shows that the material of *O. aranea* listed by MORTENSEN (1925: 179) from off Morocco ("Vanneau" St. XI, 32°32'N.,

110 m) includes also a few juvenile *O. guineensis*. Two *Ophiopsila* specimens collected at "Dana" St. 4095, off Positano near Napoli, 90 m, in 1930, 8 and 10 mm in d.d. and up to 8 and 9 arm spines, belong to *O. guineensis*. Furthermore, a single specimen from the Eastern Mediterranean, near Alexandria, 20–50 m, found among a lot of *O. aranea* identified by MORTENSEN (1937: 9) is, in my opinion, this species too. It is 7 mm in d.d. and has 10 arm spines.

The range of depth of *O. guineensis* is from 18 to 110 m.

OPHIOCHITONIDAE

Ophionereis sexradia Mortensen.

Fig. 42

Ophionereis sexradia Mortensen, 1936: 288, fig. 28.

West African records: *Ophionereis sexradia*: MORTENSEN 1936: 288.

Ophionereis dubia?: LYMAN 1882: 161.

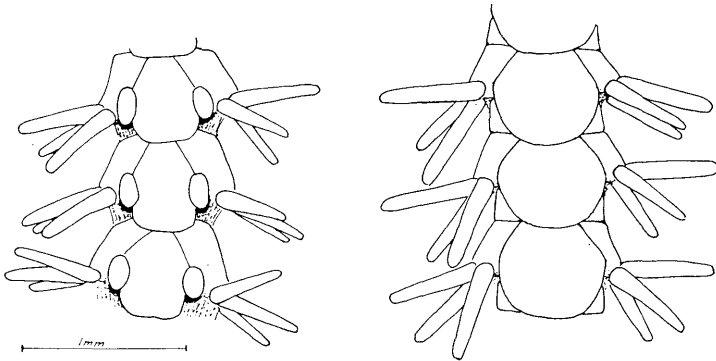


Fig. 42. *Ophionereis sexradia* Mortensen. Annobon, 18–30 m, d.d. 4 mm, armjoints nos. 13–16.

This six-armed species was described by MORTENSEN on some specimens from Annobon, 18–30 m. A. M. Clark (1953: 71) found that the six-armed "Challenger" specimen from the Canary Islands, 130 m, which LYMAN (1882) with a query identified with MÜLLER & TROSCHEL's *Ophiolepis dubia* was the same species. The species is known only from these two localities.

A five-armed *Ophionereis* specimen was recorded from West Africa by MARK-TANNER-TURNERETSCHER (1887: 301) and identified as the otherwise West Atlantic *O. reticulata* Say, 1825.

OPHIODERMATIDAE

- 1a. Genital clefts undivided..... 2
- 1b. Genital clefts subdivided into proximal and distal openings. The disk, except for possible naked radial shields, completely granule-covered in young speci-

- mens, dorsally as well as ventrally. The oral shields naked in adult specimens and undivided. Two tentacle scales *Ophioderma*, p. 226
- 2a. The disk completely granule-covered dorsally as well as ventrally. The oral shields undivided. 3
- 2b. Radial shields, and possibly also a number of the dorsal marginal plates naked. The oral shields naked and subdivided into a larger proximal and a smaller distal part. Two tentacle scales *Ophiarachnella*, p. 229
- 3a. Two tentacle scales. The arms less than 3 times the disk diameter. The arm spines at least half as long as the joint. The teeth large and rounded and with a hyaline edge. *Ophioconis*, p. 230
- 3b. A single tentacle scale. The arms more than 3 times the disk diameter. The arm spines very short. The teeth small and conical. *Cryptopelta*, p. 228

***Ophioderma longicaudum* (Retzius).**

Fig. 43

Asterias longicauda Retzius, 1805: 28.

Ophioderma guineense Greeff, 1882: 156.

Ophioderma longicauda guineense, KOEHLER 1914a: 173, pl. 9. figs. 1-3.

Ophioderma longicauda, KOEHLER 1921: 88, fig. 58.

West African records: *Ophioderma longicauda*: KOEHLER 1907b: 281; KOEHLER 1911: 13.

Ophioderma guineense: GREEFF 1882: 156.

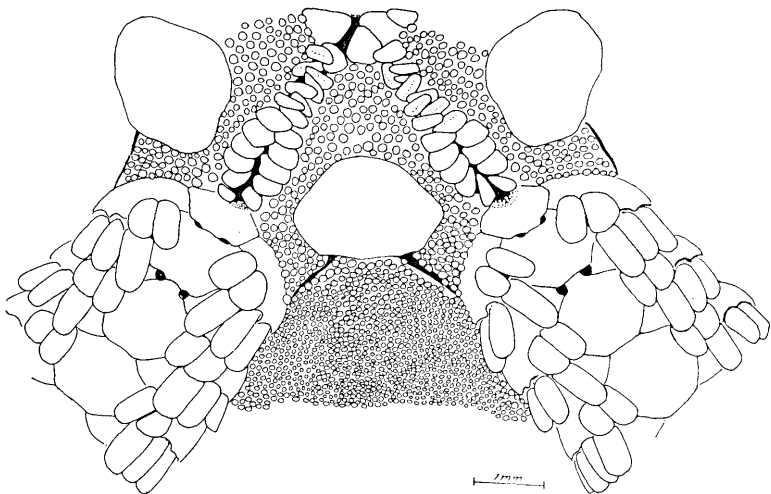


Fig. 43. *Ophioderma longicaudum* (Retzius). Dakar, d.d. 21 mm.

Ophioderma longicauda guineense: KOEHLER 1914a: 173; MORTENSEN 1936: 301; A. M. CLARK 1955: 50.

? *Ophioderma appressa*: KOEHLER 1914a: 175; CADENAT 1938: 361; CHERBONNIER 1962: 19.

Material:

Canary Islands, several localities, 0 to about 100 m. – Many spec.

Dakar, Sudan Exped., littoral, January 1928. – Several spec.

Between Gorée and Tiaroye, Senegal, 15–20 m, Thorson leg. February–March 1952.
– 6 spec.

Annobon, Discovery Exped. – 2 juveniles.

The largest specimen measures 30 mm in disk diameter and has about 150 mm long arms. Some other specimens about 25 mm in d.d. have also about 150 mm long arms and in the larger specimens the arms may reach about 6 times the d.d. The largest size recorded is 440 mm in total diameter (specimens in the sample on which GREEFF (1882) based his *O. guineense*).

The general appearance of *O. longicaudum* changes somewhat with age. Small specimens, less than 9 mm in d.d., have the dorsal side of the disk completely covered with granules as a rule, while larger specimens usually have a naked patch on some or all the radial shields. But some specimens even as large as 15–20 mm in d.d. may have the dorsal disk completely granule-covered.

The ventral side of the disk is also completely granule-covered in the smallest specimens, but from a size of about 7–8 mm in d.d. the oral shields become naked, the madreporic region first. The adoral plates, like the oral and interradiial ones remain granule-covered in all specimens.

The subdivision of the dorsal arm plates which is so characteristic of many large specimens of *O. longicaudum* is usually not found in the smaller ones; and one of the Dakar specimens have all arm plates undivided even at a size of 23 mm d.d. The shape of the ventral arm plates is somewhat variable too, as discussed and illustrated by KOEHLER (1914a), the distal margin usually being slightly convex, but in middle-sized and larger specimens sometimes concave.

The number of arm spines ranges from 6–7 in the small specimens, 6 mm in d.d., to 10–12 in the large specimens of 30 mm d.d. and 150 mm long arms. The many arm spines, 14, in the large type specimens (arms up to 220 mm) of GREEFF's *O. guineense*, thus falls within the variation to be expected.

Ophioderma is a littoral-sublittoral, circumtropical genus with about twenty recognized species. The greater part is American and 11 species are West Atlantic. The East Atlantic fauna includes with certainty, besides *O. longicaudum*, only the South African *O. leonis* Döderlein, 1910. The records of the otherwise East American *O. appressum* (Say, 1825) from West Africa by KOEHLER (1914a: 17) from Gorée and Ambrizette, CADENAT (1938: 361) from Senegal, and CHERBONNIER (1962: 19) from off Rio Cuanza, Loanda, are, in my opinion, somewhat doubtful.

The full-grown West Atlantic *O. appressum* always has granule-covered radial shields and undivided dorsal arm plates, but since these features are shown also by many large specimens of *O. longicaudum*, it may be suspected that such have formed the bases for the West African records of *O. appressum*. One character by which possible West African specimens of *O. appressum* might be distinguished would have been an absence of granules from the adoral plates, but neither KOEHLER nor CHERBONNIER make any reference to that character.

O. leonis Döderlein, recorded from Lüderitz Bay and southwards, is, in adult specimens at least, easily distinguished from *O. longicaudum* by the absence of granules from the adoral plates as well as from the oral shields, like in large *O. appressum*. The whole dorsal side of the disk in *O. leonis* is also always completely granule-covered as in *O. appressum*, and these two species are perhaps closely related.

O. longicaudum has, as noted by KOEHLER (1914a: 175), a close relative in the West Atlantic *O. cinereum* Müller & Troschel, 1842 (syn. *O. antillarum* Lütken, 1856), and specimens of the two forms seem indistinguishable if their place of origin is unknown. In this key to the species of *Ophioderma*, ZIESENHENNE (1955: 187) states as a distinguishing character that the arms are banded in *O. cinereum* but not so in *O. longicaudum*. Actually, however, *O. longicaudum* generally has greyish banded blackish arms.

Distribution: *Ophioderma longicaudum* is a littoral-sublittoral species (0-100 m) which is common in the whole Mediterranean and the neighbouring Atlantic. The northernmost recorded occurrence hitherto was off Bretagne, but a specimen in the Zool. Mus. Copenhagen is stated to come from the eastern end of the English Channel, off Calais. Off West Africa it occurs at least as far south as Annobon in the Bay of Guinea, and the record from off Rio Cuanza, Loanda, of an *O. appressum* probably in reality also refers to *O. longicaudum*. *O. longicaudum* is known too from the Azores.

A near relative (perhaps the same species) is the West Atlantic *O. cinereum* Müller & Troschel, known from Florida to Brazil in about 0 to 200 m.

Cryptopelta brevispina (Ludwig).

Fig. 44 b

Ophioconis brevispina Ludwig, 1880: 61, pl. 4, fig. 3.

Cryptopelta brevispina, TORTONESE 1965: 263, figs. 121-122.

West African records: *Cryptopelta brevispina*: CHERBONNIER 1966: 701.
? *Cryptopelta aster*: TOMMASI 1967: 545.

This is a rarely found species. The type-specimen was collected near Naples and one other specimen is recorded from the same region, in 150 m. A third specimen

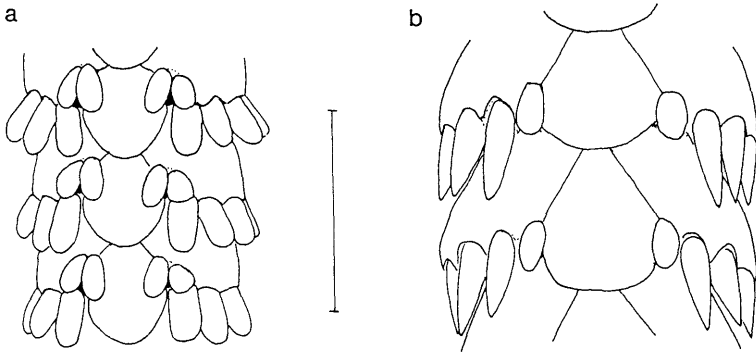


Fig. 44. Ventral view of proximal free armjoints. a, *Ophioconis vivipara* Mortensen. Type-specimen. b, *Cryptopelta brevispina* (Ludwig). "Vanneau" St. XLIV, 34°54'N, 7°45'W., 145 m.

was recorded from off the Atlantic coast of Morocco, 40 m, by MORTENSEN (1925: 182) and a fourth specimen from Angola, 150 m, by CHERBONNIER (1966: 701). Further, the three specimens of *Cryptopelta* which TOMMASI (1967: 545) recorded from Ghana, 150 m, may be the same species, although TOMMASI chose to identify them with the South African *C. aster* (Lyman, 1879).

TOMMASI (1967: 545) notes that the two species, *C. aster* and *C. brevispina*, will probably prove to be synonymous. He rightly considers the differences to be deduced from the descriptions of little taxonomic importance. But a further, and perhaps more important difference shown in the figures of the equal-sized (11 mm d.d.) type-specimens of *C. aster* and *C. brevispina*, is that the proximal arm plates are definitely broader than long in the former, but only little broader than long in the latter.

Ophiarachnella

- 1a. All dorsal disk plates, except for the radial shields, covered with granules *semicincta*, p. 229
 1b. A number of marginal dorsal disk plates, besides the radial shields, naked *africana*, p. 230

Ophiarachnella semicincta (Studer).

Pectinura semicincta Studer, 1883: 4, pl. 1, figs. 1a–d.

West African records: STUDER 1883: 4; KOEHLER 1907a: 249.

This species is known only from the Cape Verde Islands in about 70–100 m.

Ophiarachnella africana Koehler.

Ophiarachnella africana Koehler, 1914a: 178, pl. 9, figs. 8–9 and 17.

West African records: KOEHLER 1914a: 178; CADENAT 1938: 362.

The species is known only from the type-locality off Cameroon (littoral depth?) and from the Cape Verde Islands.

Ophioconis vivipara Mortensen.

Fig. 44 a

Ophioconis vivipara Mortensen, 1925: 185, pl. 33, figs. 1a–b.

West African records: MORTENSEN 1925: 185; CADENAT 1938: 361.

This species is hitherto known only from two localities off Cape Blanco, about 20–300 m. It is closely related to the sublittoral Mediterranean–North East Atlantic *O. forbesi* (Heller, 1863), and it lay near at hand to suspect as TORTONESE does (1965: 263) that it is simply synonymous with that species. A re-examination of two of MORTENSEN's original specimens, 5 mm in disk diameter and 14 mm long arms, and comparison with an equal-sized Mediterranean specimen of *O. forbesi* ("Thor" St. 17, 1908, 27°49'N., 23°27'E., 55 m) supports, however, that *O. vivipara* is a separate form, at least a distinct subspecies. The arm spines in *O. vivipara* are blunt and about half as long as the joint, while in *O. forbesi* they are pointed and about as long as the joint.

HERTZ's *Ophiurodon grandisquama* var. *nueva* (1927: 114, pl. 9, figs. 11–12) from Madeira, littoral, is evidently the same species as *O. forbesi*.

OPHIOLEPIDIDAE

- 1a. Dorsal side of disk with large scales, each of which surrounded by a regular ring of smaller scales. No distinct combs of spines at arm bases. Supplementary latero-dorsal arm plates present. Ventral arm plates contiguous. Second tentacle pore inside the mouth slit. Two large outer tentacle scales, and at the proximal pores possibly also a very small inner scale. *Ophiolepis*, p. 234
- 1b. The dorsal side of disk covered with small scales in no definite arrangement. Distinct combs of spines at the arm bases. No supplementary dorsal arm plates. Ventral arm plates separate. Second tentacle pore at the corner of the mouth slit. More than three tentacle scales at the proximal pores but only a single one farther out on the arms. *Ophiura*, p. 231

Ophiura

- 1a. The spine combs on the disk to either side of the arms separated by the first dorsal arm plate which itself bears a secondary arm comb to each side, facing the ordinary arm combs: subgenus *Dictenophiura* . . . *carnea skoogi*, p. 233
- 1b. No secondary arm combs: subgenus *Ophiura* p. 231
- 2a. The arm comb composed of fairly few, less than a dozen, well developed spines. The dorsal arm plates triangular and only the most proximal ones contiguous. The ventral arm plates very small and the lateral arm plates meeting broadly in the arm mid-line *grubei*, p. 231
- 2b. The arm comb composed of numerous (e.g. 30) slender spines. The dorsal arm plates broadly hexagonal and contiguous. The ventral arm plates well developed, and the proximal ones separated by pairs of distinct pore-like pits in the arm mid-line. *texturata*, p. 232

Ophiura grubei Heller.

Fig. 45

Ophiura grubei Heller, 1863: 431, pl. 2, figs. 13–16.*Ophiocten africanum* Koehler, 1923: 15, pl. 1, figs. 6–7.West African records: *Ophiocten africanum*: KOEHLER 1923: 15.? *Ophiura grubei*, CADENAT 1938: 361.*Ophiura africana*: A. M. CLARK 1955: 50; CHERBONNIER 1957: 170; LONGHURST 1958: 100; BUCHANAN 1958: 28; CHERBONNIER 1962: 19; TOMMASI 1967: 547.

Material:

"Atlantide" St. 49. – 1 spec.

St. 123. – 1 spec.

St. 145. – 1 spec.

St. 147. – 10 spec.

St. 163. – 5 spec.

Dakar, Brinkmann leg. 1906, Thorson leg. 1952. – 5 spec.

Las Palmas, Gran Canaria, 40–55 m, 100 m, Mortensen leg. 1930. – 10 spec.

Tenerife, 35 and 60 m, Thorson leg. 1947. – 3 spec.

The specimens measure from 1 to 6½ mm in diameter of disk. The arms are e.g. about 15 mm by a d.d. of 5 mm.

MORTENSEN (1933b: 391), after having re-examined the type-specimen of KOEHLER's *Ophiocten africanum*, noted its close affinity to HELLER's *Ophiura grubei* from the Mediterranean, and TORTONESE (1965: 275) considered it very possible that the two forms were the same species. An *Ophiura* from the western Mediterranean was

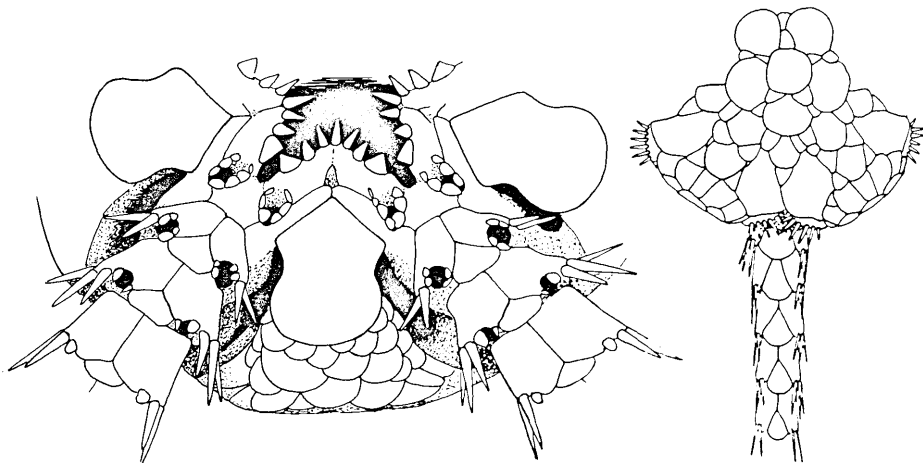


Fig. 45. *Ophiura grubei* Heller. "Atlantide" St. 163, d.d. ca. 4 mm.

also recorded as *O. africana* by CHERBONNIER (1958: 35). A comparison of the present West African specimens with specimens of the Mediterranean *O. grubei* confirms that they are conspecific.

Distribution: *Ophiura grubei* is recorded scatteredly from the whole Mediterranean and from the African Atlantic coast as far south as Port Alexander, Angola, in depths from 10 to 350 m.

Ophiura texturata Lamarck.

Ophiura texturata Lamarck, 1816: 542.

Ophiura texturata, LÜTKEN 1859: 36, pl. 1, fig. 1.

Material:

"Galathea" St. 4, 22°19'N. 17°05'W., 62 m, 2.11.1950. – 2 spec.

The two specimens are juveniles, 2–4 mm in disk diameter, and correspond to those described from the Atlantic coast off Morocco by MORTENSEN (1925: 182, pl. 34, fig. 3a–c) as *Ophiura* sp. They are especially distinguished by the centro-dorsal plate being still very conspicuous and rather conical. Although numerous adult specimens of *O. texturata* were taken in the same area (the hitherto southernmost record of that species), MORTENSEN stated that his specimens were not *O. texturata* juveniles, basing this conclusion on a comparison with juvenile *O. texturata* from Limfjorden, Denmark. A re-examination of the Limfjord specimens with a d.d. about 3 mm, also shows that these have comparatively longer arms and more dorsal disk

plates developed than the West African ones. However, other juvenile *Ophiura* specimens examined from the North Sea, Madeira, and Sicily, which can belong to no other species than *O. texturata*, agree with the West African ones, and these are therefore considered juvenile *O. texturata* too. The Limfjord specimens possibly are atypical and older than the other specimens of corresponding size.

Distribution: *Ophiura texturata* is a littoral-sublittoral North East Atlantic-Mediterranean species (0–300 m) occurring as far north as Lofoten and as far south as Cape Blanco.

Ophiura (Dictenophiura) carnea skoogi (Koehler).

Fig. 46

Ophiura skoogi Koehler, 1923: 11, figs. 10–11.

West African records: *Ophiura skoogi*: KOEHLER 1923: 11.

Dictenophiura skoogi: MORTENSEN 1936: 340.

Dictenophiura carnea: CHERBONNIER 1962: 19; TOMMASI 1967: 547.

Material:

“Atlantide” St. 60.— 2 spec.

St. 98.— 1 spec.

St. 106.—10 spec.

St. 116.— 4 spec.

“Galathea” St. 89, 6°26'S. 11°56'E., 100 m, 8.12.1950. — 1 spec.

The specimens range from juveniles to individuals measuring 7 mm in diameter of disk and having about 18 mm long arms.

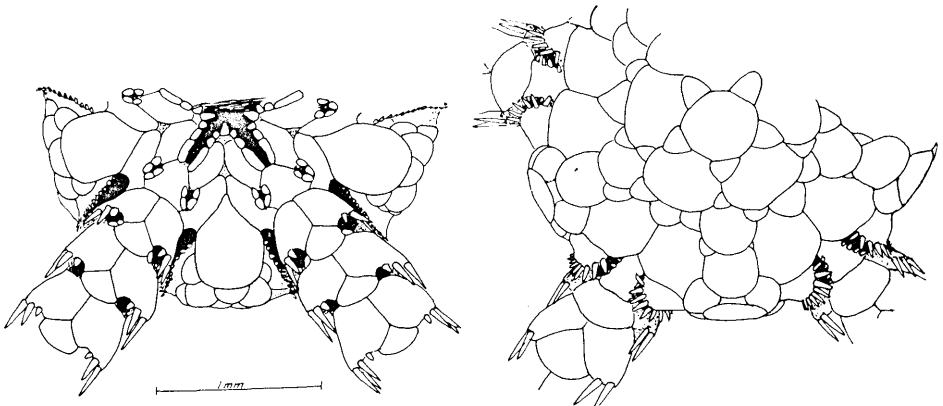


Fig. 46. *Ophiura (Dictenophiura) carnea skoogi* (Koehler). “Atlantide” St. 98, d.d. 2½ mm.

MORTENSEN (1936: 340) expressed some doubt about the specific validity of KOEHLER's *Ophiura skoogi* in relation to M. SARS's *O. carnea*, and CHERBONNIER (1962: 19) regarded it simply as the same species. The juvenile African specimens present seem indistinguishable from North East Atlantic specimens of *O. carnea*, but all the full-grown ones, 6–7 mm in d.d. and 15–18 mm long arms, are distinguished by their more swollen dorsal and lateral arm plates. This, as MORTENSEN (1936: 340) also found, is the only really noticeable difference, but perhaps may be sufficient for maintaining *O. skoogi* as a distinct West African subspecies of *O. carnea*.

Ophiura carnea M. Sars, 1857 (LÜTKEN 1859: 41, pl. 1, figs. 6a–b) is the type-species of H. L. CLARK's *Dictenophiura* (1923: 361), but, as remarked by MORTENSEN (1933a: 82) this genus does not seem very well founded, and I think that it can at most be retained as a convenient subgenus. Some of the larger specimens in the present material do not show the usually characteristic median furrow on the innermost dorsal arm plate, which H. L. CLARK considered a main distinctive generic character (he erroneously assumed that the plate was subdivided into two).

Distribution: *Ophiura (Dictenophiura) carnea skoogi* is known from off tropical West Africa from Dakar to Port Alexander, Angola, in depths from 55 to 110 m. The nominate species *O. carnea* occurs in sublittoral-bathyal depths (40–1260 m) in the North East Atlantic from the Faroes and the Trondheim Fjord in the north to the Cape Verde Islands in the south, and is recorded scatteredly from the whole Mediterranean. Off South Africa it is represented by the subspecies *O. anoidea* H. L. Clark.

Ophiolepis

- 1a. The disk of a smooth appearance. Radial shields fairly large. Generally only a single series of large plates interradially between the primaries and radial shields. The arms rather carinate. The two to four arm spines placed close together..... *affinis*, p. 234
- 1b. The larger disk plates unevenly thickened. Radial shields often fairly small and like sunken. Generally three series of larger plates interradially on the dorsal side. The three arm spines very short and placed with some distance between each other..... *paucispina*, p. 237

Ophiolepis affinis Studer.

Fig. 47

Ophiolepis affinis Studer, 1883: 6, pl. 1, fig. 3.

Ophiolepis affinis, KOEHLER 1914a: 175, pl. 9, figs. 15–16, 20.

West African records: STUDER 1883: 6; KOEHLER 1914a: 175; CHERBONNIER 1957: 170; LONGHURST 1958: 100; CHERBONNIER 1963: 186; TOMMASI 1967: 546.

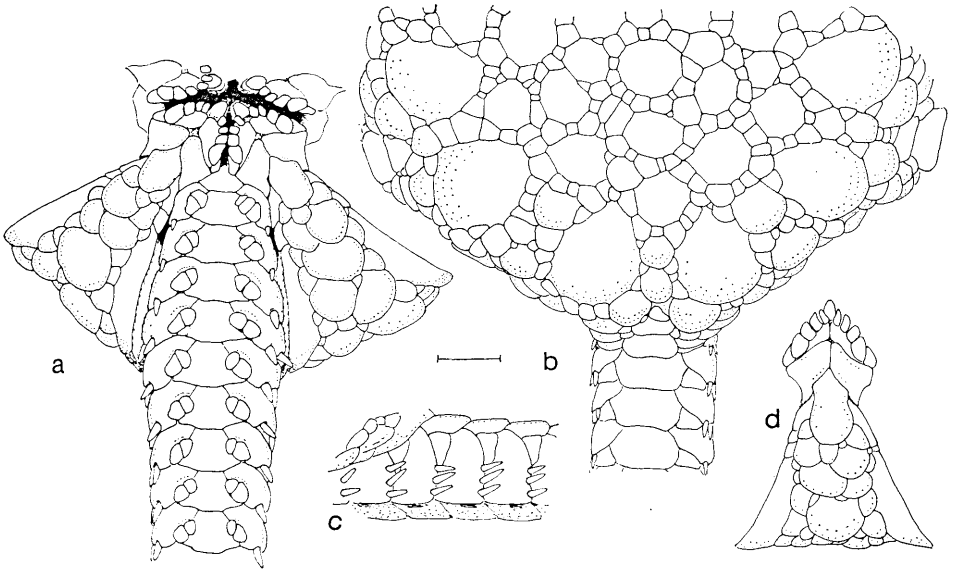


Fig. 47. *Ophiolepis affinis* Studer. a-c, "Atlantide" St. 44, d.d. 9 mm. d, "Atlantide" St. 45, d.d. 8 mm.

Material:

- "Atlantide" St. 44. - 1 spec.
- St. 45. - 7 spec.
- St. 49. - 20 spec.
- St. 60. - 17 spec.
- St. 70. - 1 spec.
- St. 145. - 2 spec.
- St. 146. - 2 spec.

The smallest specimens measure $3\frac{1}{2}$ mm in diameter of disk and have 6-8 mm long arms. The specimen with the largest d.d., 16 mm, has about 50 mm long arms, and another specimen, 15 mm in d.d., has about 60 mm long arms.

The number of large plates interradially on the disk, between the primary plates and the radial shields, generally seem to be limited to a single series; and this may be the character by which *O. affinis* is most easily distinguished from the other West African species, *O. paucispina*. The number of interradiial ventral disk plates is also smaller than it is in *O. paucispina*. The radial shields and the other marginal plates often bulge slightly, especially in younger specimens, though not so much as is characteristic of *O. paucispina*.

The dorsal arm plates are broader than long in the large specimens, and those of the largest specimens may have the distal margin slightly concave. In the larger specimens a varying number of the latero-dorsal arm plates may be subdivided into

two. The arms are slightly carinated, and this is probably the best character to distinguish the East Atlantic *O. affinis* from the closely related West Atlantic *O. elegans* Lütken in which the arms are flattish rounded dorsally.

The number of arm spines is 2 in most of the 37 specimens from Sts. 49 and 60, ranging from 6 to 16 mm in d.d.; only some of them have 3 arm spines on scattered joints. The specimens from the other samples, ranging in size to about 12 mm d.d., have mostly 3 arm spines, and a few may have 4 arm spines on one or another of the proximal joints.

Large specimens may have a similarly broad but very low tentacle scale at the inner margin on some of the proximal pores, in addition to the two large outer tentacle scales.

The oral shields vary somewhat in shape and also in relative size in different specimens. They are usually rather elongated pentagonal, about twice as long as broad, with an inward angle and straight sides, but the lateral sides may be distinctly curved in and the outer part almost circular in outline.

The arms are banded, the disk is usually dark with a light patch in the middle but may be light coloured and have minute dark spots.

Ophiolepis affinis is, as noted by STUDER when he described the species, near LÜTKEN'S *O. elegans* from the West Indies. The type specimen of this species from St. Thomas, 2 m, has not been illustrated before, and a drawing of it is, therefore, included here (Fig. 48). It measures 9 mm in d.d. and has arms about 25 mm long. KOEHLER (1914a) discussed the relationship between *O. affinis* and *O. elegans* in more detail. He noted that the distinguishing character mentioned by STUDER, 2 versus 4 arm spines, was insufficient alone, and pointed out a number of other

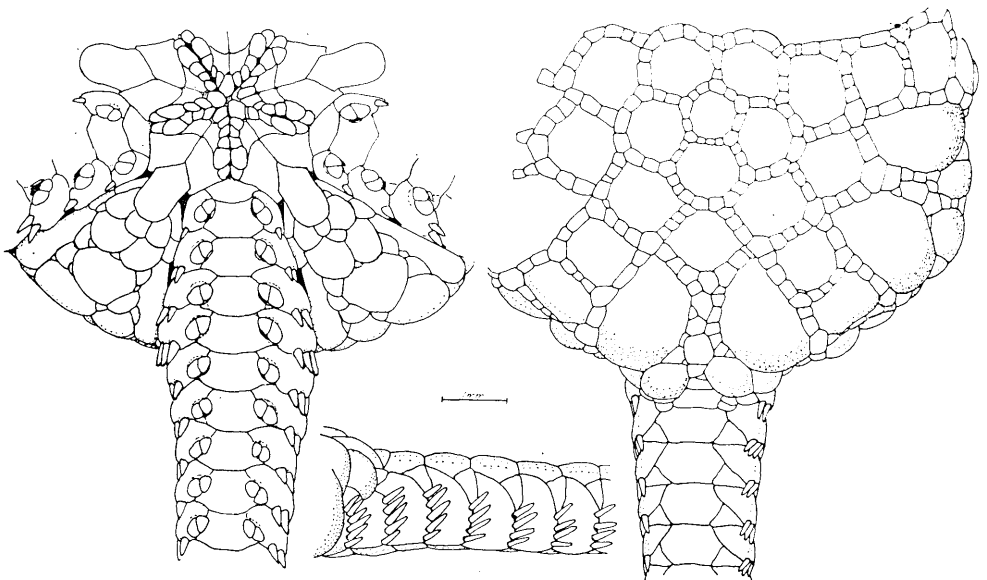


Fig. 48. *Ophiolepis elegans* Lütken. Type-specimen, St. Thomas, d.d. 9 mm.

minute differences. Some of the characters enumerated by KOEHLER are however, also individually variable. The two forms may be distinguished as follows: the arms are slightly carinate in *O. affinis* while they are only flattish rounded in *O. elegans*; the number of arm spines is usually 2–3 in *O. affinis*, but is 4 in *O. elegans*; the dorsal arm plates are slightly broader and have more rounded corners in *O. affinis* than in *O. elegans* where they are rather sharply hexagonal.

Distribution: *Ophiolepis affinis* is recorded from a number of localities off Tropical West Africa between Sierra Leone and the Congo in depths from 7 to 110 m.

The related *O. elegans* is known from South Carolina to the Virgin Islands in depths down to about 75 m.

Ophiolepis paucispina (Say).

Fig. 49

Ophiura paucispina Say, 1825: 149.

Ophiolepis paucispina, LÜTKEN 1859: 204, pl. 2, fig. 2.

Ophiolepis paucispina, KOEHLER 1914a: 177, pl. 9, fig. 14.

West African records: GREEFF 1882: 183; KOEHLER 1914a: 117; A. M. Clark 1955: 50.

Material:

Dakar, tidal zone, Sudan Exp. Jan. 1928. – Many spec.

“Galathea” St. 50, 0°00' N. 6°32' E., 5–8 m, 29.11.1950. – 1 spec.

Puerto de la Cruz, Tenerife, on algae, Thorson leg. 1947. – 2 spec.

Joal, Senegal, 4–5 m, Thorson leg. 31.3.1952. – 1 spec.

Between Gorée and Tiaroye, 15–20 m, Thorson leg. 16.4.1952. – 1 spec.

The largest specimens are 7 mm in disk diameter and have arms about 22 mm long, and this appears to be the largest size known. The two specimens from Tenerife are juveniles, d.d. hardly 3 mm, arms 6–8 mm, with the scales surrounding the dorsal disk plates just beginning to develop, but are identifiable by the comparatively large number of ventral disk scales. The oral shields in the one specimen are all about as broad as long, in the other they are slightly longer than broad. The “Galathea” specimen is a juvenile too, d.d. 2 mm, arms 5 mm, and corresponds to the second Tenerife specimen.

The disk plates are smaller and therefore slightly more numerous in this species than in *O. affinis*. Therefore an additional series of dorsal plates to each side of the interradial series develops in *O. paucispina*, while even the largest specimens of *O. affinis* have only a single interradial series of larger secondary plates.

The number of arm spines is 2 in the juvenile specimens, but 3 in the larger ones and sometimes 4 on a number of the proximal joints. In this respect there would

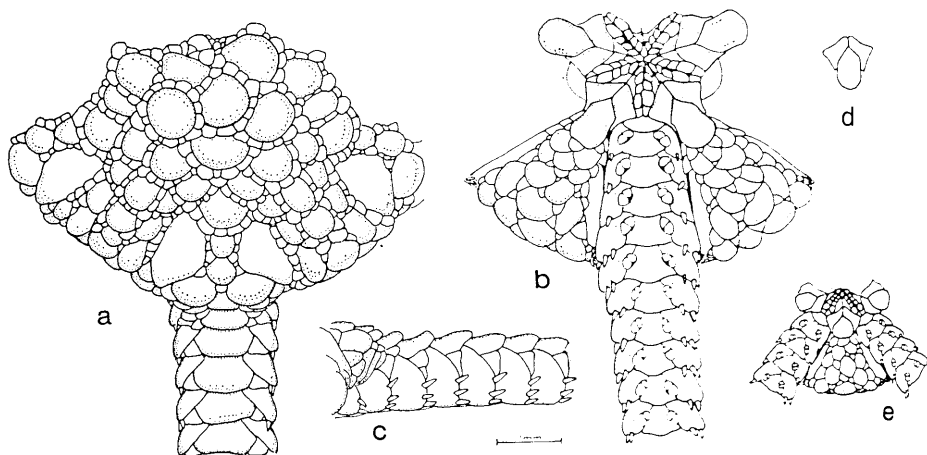


Fig. 49. *Ophiolepis paucispina* (Say). a-c, Dakar, d.d. ca. 7 mm. d, Dakar, d.d. 5 mm, oral shield. e, Tenerife, d.d. 3 mm.

appear to be a difference from the West Indian populations in which the number of arm spines is stated to be 1-2. However, an examination of a West Indian material showed that although the usual number of arm spines was 2 only, there were specimens with 3 arm spines on some joints and e.g. one specimen, 6 mm in d.d., with 4 and scatteredly even 5 arm spines on as many as the eight most proximal free joints.

It would seem that the oral shields in the West African full-grown specimens are slightly narrower than in West Indian specimens, but no differences have been found by which it would be possible to state with certainty whether a given specimen came from the West or the East Atlantic.

The arms are banded. The larger disk plates are usually lighter in colour than the surrounding scales, and each plate may be provided with a dark spot. Or some of the larger plates are uniformly dark while others in the same specimen are uniformly lightly coloured.

Distribution: *O. paucispina* is an amphi-Atlantic species, which is known off West Africa from the Canary Islands to just south of the equator, in depths from 4 to 30 m, and is otherwise distributed in the littoral-sublittoral West Atlantic from Bermuda to Brazil.

SUMMARY

The report gives a revised survey of the ca. fifty species of ophiuroids known from littoral-sublittoral depths (0–100 m) off tropical West Africa. Four new species are described, *Amphiura atlantidea*, *A. senegalensis*, *A. ungulata*, and *Amphioplus suspectus*.

The distribution of the species is discussed. About one fourth of them occur also in the Mediterranean, and the hitherto unrecorded occurrence here of *Amphiura incana* Lyman, 1879, and *Amphiura grandisquama* Lyman, 1869, (= *A. apicula* Cherbonnier, 1957) is noted.

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INDEX

The index contains the genera and species discussed. The specific names are followed by that of the genus to which the species is referred; or, in the case of synonyms, by the name of the species with which it is considered identical.

- abnorme*, *Ophiostigma* 200
abyssicola, *Ophiacantha* 163
abyssicola, *Ophiactis* 156
abyssorum, *Amphiura* 183
aciculatus, *Amphioplus* 195
Acrocrida: *Amphiura* 171
acutispina, *Ophiophragmus* 199
acutisquama, *Amphiura* 166
adpersus, *Ophiernus* 164
affinis, *Ophirolepis* 234
africana, *Ophiarachnella* 230
africana: *Ophiactis lütkeni* 210
africana: *Ophiura grubei* 231
africanum: *Ophiostigma abnorme* 200
ailsaclarki: *Amphioplus congensis* 188
albida, *Ophiura* 156
Amphiacantha: *Dougaloplus* 206
Amphiactis: *Histampia* 156
Amphilimna 163
Amphiconida: *Acrocrida* 172
Amphiodia 165
Amphiodia: *Amphiura* 179
Amphiodia: *Ophiophragmus* 199
Amphioplus 187
Amphipholis 202
Amphipholis: *Ophiostigma* 200
Amphiura 165
angolensis, *Ophiacantha* 162
angulata, *Ophiothrix* 153
annulosa, *Ophiopsila* 223
anoidea, *Ophiura carnea* 234
antillarum: *Ophioderma cinereum* 228
apicula: *Amphiura grandisquama* 178
appressum, *Ophioderma* 227
aranea, *Ophiopsila* 222
arborescens: *Astrospartus mediterraneus* 159
archeri, *Amphioplus* 193
ascia: *Amphiura filiformis* 181
aster, *Cryptopelta* 228
Astrospartus 159
atlantica, *Amphiura* 181
atlanticum, *Ophiopteron* 218
atlantidea, *Amphiura* 169
aurantiaca, *Ophiopleura* 156
aurensis, *Amphioplus* 194
Axiognatus: *Amphipholis* 202

balli, *Ophiactis* 212
bananensis: *Amphioplus* 205
bidentata, *Ophiacantha* 156

brachiata, *Amphiura (Acrocrida)* 171
brevispina, *Cryptopelta* 228

capensis: *Amphipholis sp.* 166
capensis: *Ophiactis lütkeni* 210
carnea, *Ophiactis* 211
carnea, *Ophiura (Dictenophiura)* 233
ceramis: *Amphiura lorioli* 185
chiajei, *Amphiura* 167
cincta, *Amphioplus* 191
cinereum, *Ophioderma* 228
clavigera, *Ophiomitrella* 156
clypeata: *Amphipholis bananensis* 205
congensis, *Amphioplus* 188
congensis, *Ophiothrix* 217
cotteau, *Ophiothrix* 214
Cryptopelta 228

denticulata: *Amphiura fragilis* 182
Dictenophiura, *Ophiura* 233
digna, *Amphiura* 183
dilatata: *Amphiura atlantica* 181
diomedea, *Amphiura* 186
Dougaloplus 206
dubia: *Ophioneis sexradia* 225
duplicata, *Histampia* 156

echinata: *Ophiothrix fragilis* 214
elegans, *Ophirolepis* 236
Euryale: *Astrospartus* 159

filiformis, *Amphiura* 179
flaccida, *Ophiomyxa* 160
flagellata, *Ophiura* 156
forbesi, *Ophioconis* 230
fragilis, *Amphiura* 182
fragilis, *Ophiothrix* 213

gaussi, *Amphiura atlantica* 182
Gorgonocephalus: *Astrospartus* 159
gracilis: *Ophiothrix cotteau* 214
grandisquama, *Amphiura* 177
grandisquama: *Ophioconis forbesi* 230
grubei, *Ophiura* 231
guineensis, *Ophiopsila* 223
guineensis: *Amphiura grandisquama* 177
guineensis: *Ophioderma longicauda* 226

Histampia 156

- Icalia: Amphiura* 184
incana, Amphiura 173
indigna: Ophiothrix cotteau 214
inducta, Ophiothrix maculata 216
inermis: Ophiacantha angolensis 162
instructa: Ophiostigma abnorme 200
integra, Amphioplus 190
- januarii, Amphipholis* 203
josephinae, Amphiura grandisquama 178
- krebsi: Ophiactis savignyi* 207
- leonis: Ophioderma* 228
libera, Dougaloplus 206
limicola, Ophionephthys 165
ljungmani: Ophiactis quinquenqueredia 153
longicaudaum, Ophioderma 226
longispina: Amphiura grandisquama 177
lorioli, Amphiura 185
loveni, Asteronyx 156
lusitanica: Ophiothrix fragilis 213
lymani, Ophiactis 208
lymani, Ophiomusium 156
lütkeni, Ophiactis 210
- maculata, Ophiothrix* 216
marmorata, Ophiocoma 152
mediterranea, Amphiura 176
mediterraneus, Astrospartus 159
mülleri: Ophiactis lymani 208
- nociva, Ophiothrix* 216
norvegica, Amphilepsis 156
nudipora, Amphipholis 203
nuda, Ophiura fragilis f. 214
nueva: Ophiocanis forbesi 230
Nullamphiura: Amphiura 182
Nullopholis: Amphipholis 203
- occidentalis, Amphioplus* 192
olivacea, Amphihilma 163
Ophiactis 206
Ophiacantha 161
Ophianoplus: Ophiopsila 223
Ophiarachnella 229
Ophiernus 164
ophiocnemis, Ophiothrix 214
Ophiocnida: Amphihilma 163
Ophiocnida: Dougaloplus 206
Ophiocnida: Ophiostigma 200
Ophiocoma 220
Ophiocanis 230
Ophiocanis: Cryptopelta 228
Ophioceten: Ophiura 231
- Ophioderma* 226
Ophiolepis 234
Ophiolepis: Ophiactis 207
Ophiomyxa 160
Ophionephthys: Amphioplus 198
Ophionereis 225
Ophiophragmus 199
Ophiopteron 218
Ophiopsila 221
Ophiostigma 200
Ophiothrix 212
Ophiura 231
- paucispina, Ophiolepis* 237
Pectinura: Ophiarachnella 229
pentagona, Ophiomyxa 160
platispina: Ophiopsila aranea 222
pumila, Ophiocoma 220
purpureus, Ophioscolex 156
- quinquemaculata: Ophiothrix fragilis* 213
quinqueradia, Ophiactis 153
- rancureli: Amphiura chiajei* 167
resecta: Amphioplus congensis 188
reticulata, Ophionereis 225
rubra: Ophiothrix fragilis 213
- sarsi, Amphiura* 183
savignyi, Ophiactis 207
sculpta, Amphiura 173
semicineta, Ophiarachnella 229
semisquamata, Amphiura (Acrocnida) 172
senegalensis, Amphiura 182
setosa, Ophiacantha 161
sexradia, Ophionereis 225
simonsi, Amphiura 166
skoogi: Ophiura carnea 233
smitti: Ophiacantha 161
sp., Amphiodia 165
sp., Ophionephthys: Amphioplus suspectus 198
squamata, Amphipholis 202
stratus, Amphioplus 195
suspectus, Amphioplus 198
- texturata, Ophiura* 232
tomentosa: Ophiothrix nociva 216
- ungulata, Amphiura* 183
- valenciennesi, Ophiacantha* 156
virens, Ophiactis 210
vivipara, Ophiocanis 230