Videnskabelige Meddelelser

fra

Dansk naturhistorisk Forening i København

Bind 93.

Med 23 Tavler og 194 Figurer i Teksten.

København.
I Kommission hos C. A. Reitzel.
1932—33.

Videnskabelige Meddelelser

fra

Dansk naturhistorisk Forening i København

Bind 93.

Med 23 Tavler og 194 Figurer i Teksten.

København.
I Kommission hos C. A. Reitzel.
1932—33.

Redaktionen af dette Bind er besørget af Dr. phil. *Th. Mortensen.*

Bianco Lunos Bogtrykkeri A/S — København.

Indhold.

Side.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. LX—LXVII.

LX. *Th. Mortensen.* On an extraordinary Ophiurid, Ophiocanops fugiens Koehler. With remarks on Astrogymnotes, Ophiopteron, and on an Albino Ophiocoma. (Med Tavle I og 16 Figurer i Texten) 1

LXI. *Hans A. Kreis.* Freilebende marine Nematoden von den Sunda-Inseln. II. Oncholaiminæ 23

LXII. *J. Hofker.* Foraminifera of the Malay Archipelago. (Med Tavle II—VI og 35 Figurer i Texten) 71

H. Boschma. Ligella, a nomen nudum. Correction to Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16. LV. Rhizocephala 169

LXIII. *Th. Mortensen.* Biological Observations on Ophiurids, with descriptions of two new genera and four new species. (Med Tavle VII og 7 Figurer i Texten) 171

LXIV. *K. Stephensen.* Some new Copepods, parasites of Ophiurids and Echinids. (Med 7 Figurer i Texten) 197

LXV. *Th. Mortensen.* Echinoderms of S. Africa. (Asteroidea and Ophiuroidea). (Med Tavle VIII—XIX og 91 Figurer i Texten) 215

LXVI. *Th. Mortensen.* The Echinoderms of St. Helena (other than Crinoids). (Med Tavle XX—XXII og 29 Figurer i Texten) 491

LXVII. *Torsten Gislén.* A small Collection of Crinoids from St. Helena. (Med Tavle XXIII og 9 Figurer i Texten) 475

Det foreliggende 93. Bind af *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i København* danner Fortsættelsen af Bindene 73, 75, 77, 79, 81, 83, 85, 87, 89 og 91, og indeholder udelukkende Afhandlinger baserede paa Materiale indsamlet under Dr. Th. Mortensen's Pacific Expedition 1914—16, Den danske Expedition til Kei-Øerne 1922 og Dr. Th. Mortensen's Java—S. Africa Expedition 1929—30.

Omkostningerne ved Publikationen af dette Bind, saavel som af de 10 foregaaende Bind, er afholdt af et til dette Formaal af Rask-Ørsted Fondet bevilget Beløb.

Idet Serien af disse "Papers" hermed afsluttes, beder jeg Direktionen for Rask-Ørsted Fondet modtage min hjerteligste Tak for den storslaaede Bevilling, som har muliggjort Publicationen af denne lange Række Afhandlinger.

København, i October 1933.

DR. TH. MORTENSEN.

The present volume 93 of *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i København* forms the continuation of volumes 73, 75, 77, 79, 81, 83, 85, 87, 89 and 91, and contains exclusively papers dealing with material collected during Dr. Th. Mortensen's Pacific Expedition 1914—16, The Danish Expedition to the Kei Islands 1922, and Dr. Th. Mortensen's Java—S. Africa Expedition 1929—30.

The expenses of the publication of this volume, as of the 10 preceding volumes, are supplied by an amount granted for this purpose by the Rask-Oersted Fund.

In concluding herewith the series of these "Papers" I beg to tender my most cordial thanks to the Board of Directors of the Rask-Oersted Fund for the magnificent grant which has made possible the publication of this long series of papers.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LX.

On an extraordinary Ophiurid, Ophiocanops fugiens Koehler.

With remarks on Astrogymnotes, Ophiopteron, and on an Albino Ophiocoma.

(With Plate I.)

By

Th. Mortensen.

1. *Ophiocanops fugiens* Koehler.

Pl. I. Figs. 2—3.

This strange little Ophiurid was described by Koehler, 1922, in his report on the "Ophiurans of the Philippine Seas and adjacent Waters" collected by the "Albatross" during her investigations in those seas in 1907—1910 (Bull. U. S. Nat. Museum 100. Vol. V. p. 26. Pl. 2. figs. 4—17). There was only a single specimen in rather poor condition. Koehler gave a fairly detailed description of it, accompanied by a number of photographic figures; but partly on account of the difficulty of making really good figures of such a small, rather distorted form, and particularly because of the reproduction in coarse half-tone, these illustrations are, indeed, very poor so that it is impossible therefrom to get more than a faint idea of the extraordinary structure of this Ophiurid.

In the collection of Ophiurids from the Malay region and from the Australian Seas, placed in the hands of Koehler for reporting on, were found two specimens of *Ophiocanops fugiens*, mentioned on p. 51 of Koehler's memoir "Ophiures recueillies par le Dr. Th. Mortensen dans les Mers d'Australie et dans l'Archipel Malais" (Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16. LIV. Vid.

Medd. Dansk Naturh. Foren. Bd. 89, 1930). He gives no new information of the species, beyond the fact that one of the specimens carries some white globules on the disk and on the base of one of the arms. The specimens were found off Jolo (Sulu Islands) at a depth of 25 fathoms.

When examining these two specimens after the return of the collection from Koehler, I was struck by various peculiar features not mentioned in Koehler's description of 1922. The specimens had, unfortunately, been dried so it was very difficult to make out with full certainty the features observed. As it might be concluded with a fair degree of certainty from the long, winding arms that the Ophiurid must have been found clinging to some coral, I looked over all the Gorgonians and Antipatharians collected during my researches off Jolo and other places in the Philippine Seas in 1914, as also those collected later on in 1922 on the Danish Expedition to the Kei Islands and during my researches in the Bali-Sea in 1929, in the hope of finding more specimens. I was so fortunate as to find two more specimens on an Antipatharian from off Jolo, both clinging to the coral with the arms wound very tightly around the thicker branches; on account of their dark colour they were almost indistinguishable on the coral, a most perfect case of concealment. One of the specimens was in a rather poor state of preservation, but the other, although the arms were badly broken, was in a quite good state, so that it was possible to study the structure of the arms by means of sections.

A most conspicuous feature of this Ophiurid is the very small size of the disk (Pl. I. figs. 2—3). It looks much more like an Ophiurid which has thrown off its disk and has not yet begun regeneration, only the skin having just covered the wound. This is, however, not at all the case. Both the shape of the adoral plates and the complete development of the armspines as well as the fully formed dorsal side of the arms on the proximalmost joints prove definitely that the disk never was larger and is, indeed, all it should be. As a matter of fact this Ophiurid can hardly be said to have a disk, at least it has no ventral interradii, as also the bursæ are entirely lacking, as well seen by Koehler.

The adoral shields are, as stated by Koehler, very large (Fig. 1), with the adoral border reenteringly curved; on the edge of the "disk" they bend over, passing vertically halfway towards the dorsal side.

The mouth shields I find to be entirely absent, except the madreporite, which is very conspicuous, almost as large as an adoral plate; it is situated vertically on the edge of the "disk", reaching up to the dorsal side. The vertical furrow observed by Koehler in the madreporite is no constant or real character; in one of my specimens the madreporite is entire, in another there is a vertical furrow, sure enough, but it is evidently due to a fracture. The white globules mentioned by Koehler (Op. cit. 1930) as occurring on the dorsal side of one of the specimens are found on this one specimen only, not on the two additional specimens. The five globules on the disk are not at all regularly arranged. Dorsal and ventral armplates are, as observed by Koehler, entirely absent.

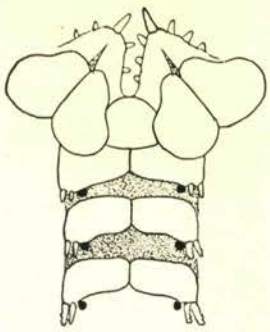


Fig. 1. Part of oral side of *Ophiocanops fugiens*. × 22.

The armspines are generally five in number, as stated by Koehler, but sometimes there may be 6, and in the proximal part of the arm there are only 4. Koehler, however, overlooked a very important fact, viz. that the uppermost spine, which is the longest of them,

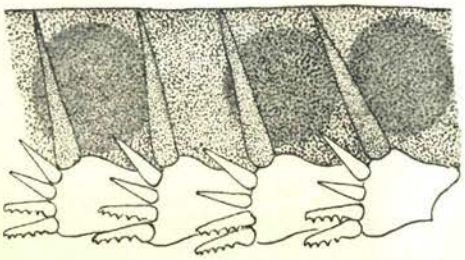


Fig. 2. Part of arm of *Ophiocanops fugiens*, side view, showing the long, uppermost spine imbedded in the skin, the two lowermost spines transformed into hooks. The three dark, round bodies are gonads. × 30.

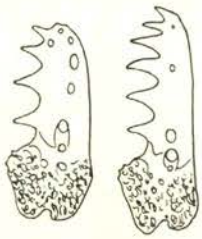


Fig. 3. The two lowermost armspines of *Ophiocanops fugiens*. × 90.

is upwards directed and imbedded in the skin of the dorsal side of the arm (Fig. 2) raising it up, so that there is formed a large space along the dorsal side of the arm to accommodate the genital organs, much as we find it in the Trichasterids, with the important difference that in the latter the supporting bars

are plates in the skin on the dorsal side of the arm, not armspines as in *Ophiocanops*. Already from the very first joint the upper armspine is thus upwards prolonged — proof that there is no possibility of the disk having been originally larger, but been lost and not yet regenerated. The two lowermost spines are transformed into hooks

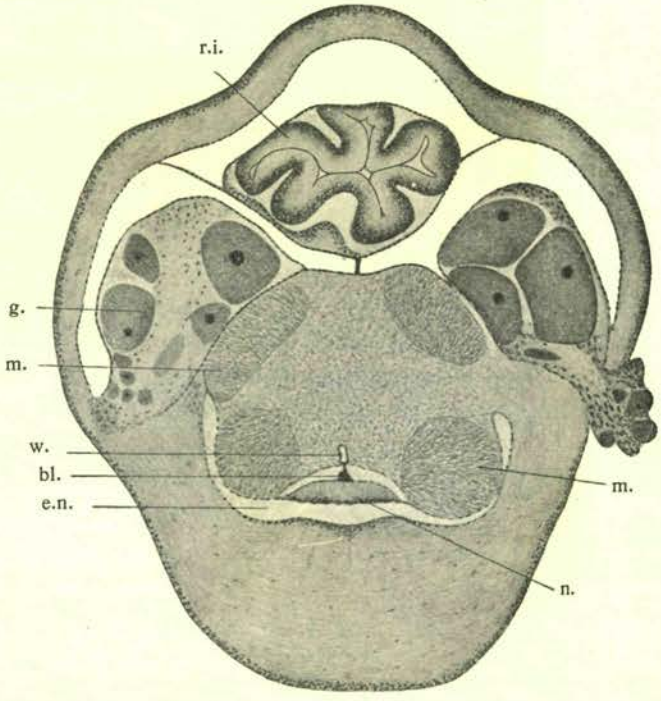


Fig. 4. Transverse section of arm of *Ophiocanops fugiens*. bl. blood vessel; e.n. epineural canal; g. gonad; m. intervertebral muscle; n. nerv; r.i. radial intestine; w. water vessel. On the right side is seen the exterior opening of the gonad. × 85.

with several teeth (Fig. 3); the designation "compound hooks" used by Koehler for these transformed spines is not very appropriate, each consisting, of course, only of a single spine. According to Koehler it would appear that all the spines are thus transformed; this is, however, not the case, it is only the two lowermost which are hook-shaped, these two also being slightly longer than the two following ones, which are simple, conical. The tubefeet are very small, but apparently present all along the arm.

One of the most extraordinary features of this Ophiurid is the

arrangement of the gonads, which is quite unique among Ophiuroids. By the diminutive size of the disk it has simply no room for the gonads or bursæ, these latter being entirely absent. The gonads are lodged in the widened dorsal space of the arms, but not, as in the Trichasterids and Astroschematids, as long tubes issuing from the

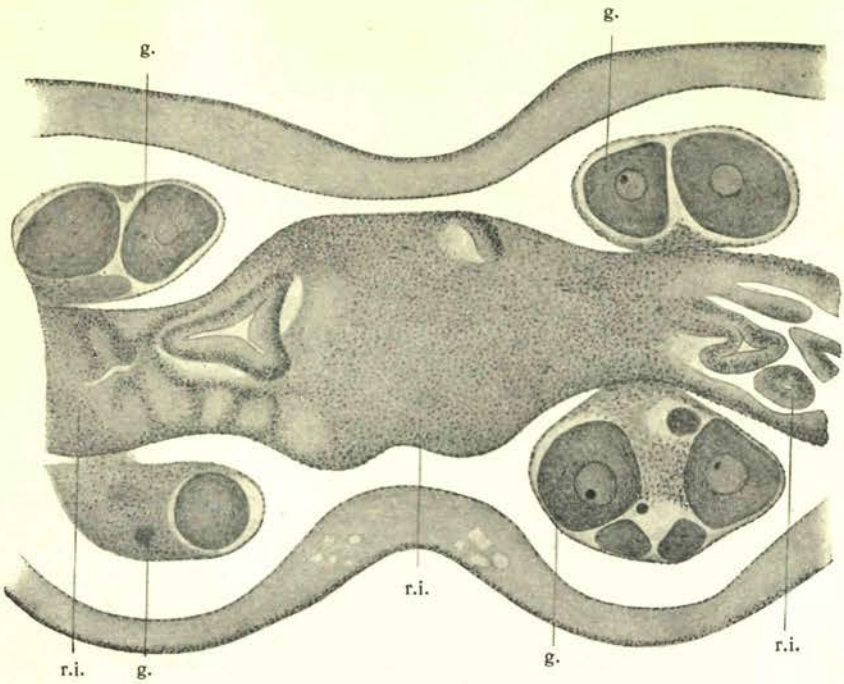


Fig. 5. Horizontal longitudinal section through arm of *Ophiocanops fugiens*, showing two pairs of gonads, g. The fact that the arm was not quite straight accounts for the different aspect of the radial intestine, r.i., at the ends and in the middle of the section. × 75.

base of the arms. **The gonads of Ophiocanops are lying as a series of small isolated organs along each side of the arm, each opening separately on the side of the arm** (Figs. 2, 4—6). In general there is one pair of gonads to each joint, lying between the enlarged upper armspines; but this is not constant, there being rather often some irregularity in the arrangement, the gonads lacking here and there. They continue far out in the arm, about two thirds of its length.

There is, however, another no less extraordinary feature in the

anatomy of this Ophiurid. By the very small size of the disk it would seem rather enigmatical how the very small stomach for which there is room in the disk could provide nourishment enough for the long and relatively thick arms and the long series of gonads situated there. Evidently the animal also realised that this was asking too much, and so it solved the problem in a way equally unique in the whole

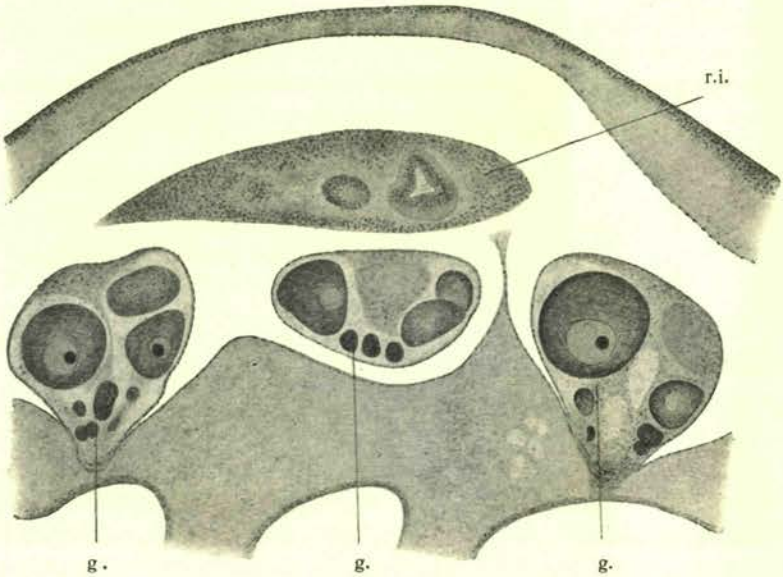


Fig. 6. Sagittal section through arm of *Ophiocanops fugiens*, showing three consecutive gonads, g. The arm not being quite straight accounts for the fact that the middle gonad shows no indication of opening outwards, as do the two other gonads. The section is of course, not in the median line, which accounts for the fact that the radial intestine has merely been touched. × 75.

class of the Ophiurids as is the arrangement of the gonads. **The stomach continues as a sort of radiating intestine out in the arms, in the dorsal space, above the genital organs, at least as far out as the gonads are found,** viz. about the two thirds of the arm (Figs. 4—6). As seen from the figures its walls are rather much folded, the absorbing surface being thereby much enlarged. It is suspended in a horizontal mesentery. — It would have been highly desirable to have made sections of the disk for tracing the issue of these radiating intestines from the stomach; but with the scanty material at hand this was not possible — and the fact that the stomach

does send such a radiating branch out into each arm has been established with full certainty. Undoubtedly also other anatomical features of interest will be found, when once sufficient and well preserved material will be at hand. But that is for the future.

In some of the transverse sections a pair of bodies are found lying within the intestine, much looking like the eggs in the gonads (Fig. 7). There can be no doubt that this must be a parasite, probably a Protozoan.

For the question of the systematic position of *Ophiocanops* it is essential to see to what type the vertebræ belong. The character of

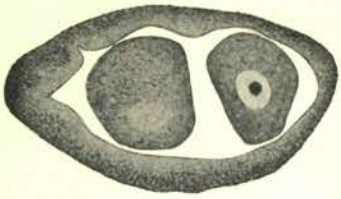
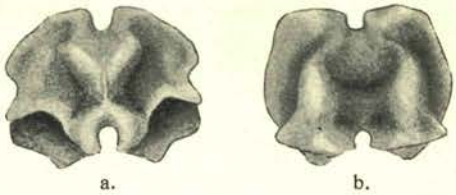


Fig. 7. Transverse section of radial intestine of *Ophiocanops fugiens*, showing two parasites (?) in its lumen. × 100.



a. b.

Fig. 8. Vertebra of *Ophiocanops fugiens*, the proximal (a) and distal (b) articulating surface. × 100.

the articulation is not very clear, their small size making it still more difficult to make out clearly their structure. As seen from fig. 8 it is of the streptospondylous type, found in the Euryalids, though somewhat modified. This then would indicate it to belong to the Euryalids — but the question is not quite so simple. Matsumoto finds some of the Ophiomyxids to have streptospondylous articulation, the "articular peg" lacking. And even in the Ophiacanthids streptospondylous vertebræ may be found. Thus, whereas all Euryalids, so far as known, have typical streptospondylous vertebræ, not all forms with streptospondylous vertebræ are Euryalids.

Against the relation to the Euryalids speaks the arrangement of the armspines which is distinctly of the Ophiurid type. It seems then clear that *Ophiocanops* cannot belong to the Euryalids. Koehler refers it to the Ophiomyxids, which was quite natural by the then available knowledge of its structure. But the facts now made known of the extraordinary arrangement of its gonads and of the continuation of the stomach out into the arms, two features entirely unique in the whole class of Ophiurids, indicate that it should rather form a family

of its own. The peculiar character of the disk, the ventral interradii being completely absent, also mark *Ophiocanops* as a quite unique type. It seems to me, therefore, that the natural course will be to regard it as forming a separate family, **Ophiocanopidæ** n. fam. Probably it is a branch from the Ophiomyxids, but so extraordinarily specialised as to stand quite apart in the whole of the Ophiurid class.

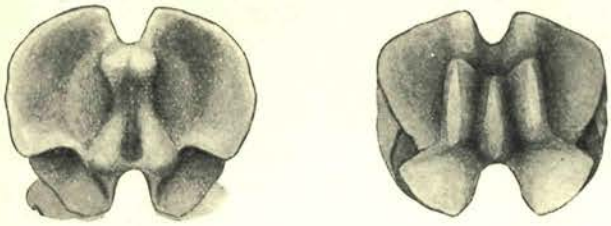
2. *Astrogymnotes catasticta* H. L. Clark.

In 1914 H. L. Clark described in his paper on the Echinoderms of the Western Australian Museum (Rec. W. Austral. Mus. I. p. 153. Pl. XXII) a peculiar Ophiurid, *Astrogymnotes catasticta*, with 7 rather broad, flat arms, apparently belonging to the *Astroschematinæ*, though possessing both true tentacle scales and usual Ophiurid armspines, and in spite of the arms being much shorter than usual among Astroschematids. Both dorsal and ventral plates were stated to be absent. Also the madreporite is stated to be lacking. The unequal development of the arms in some of the specimens showed reproduction by fission to be normal for the species. It came from off Jurien Bay, West Australia, 80—100 fathoms.

In 1930 Döderlein in his report on "Die Ophiuriden d. deutschen Tiefsee-Expedition. 2. Euryalae", p. 394, Taf. III. figs. 7—7. b., gives some additional information, based on a specimen, a paratype, placed at his disposal by H. L. Clark; the main new facts disclosed are the presence of ventral plates, against Clark's statement, and the presence of madreporites in several interradii. Like Clark he thinks that *Astrogymnotes* belongs to the family of the Trichasterids, "daran ist kein Zweifel", but because of the tentacle scales and the true "Seitenstacheln" he makes it the type of a separate subfamily *Astrogymnotinæ*.

In his memoir "Ophiures recueillies par le Dr. Th. Mortensen dans les Mers d'Australie et dans l'Archipel Malais" Koehler described a new genus and species of Ophiomyxids, *Ophiovesta granularis*, with usually 6 arms and propagating by self-division. On studying this Ophiurid after the return of the collection from Koehler I found this supposed new genus and species to be identical with *Astrogymnotes catasticta*. There is not a single character by which to distinguish them. But further I have come to the result that *Astrogymnotes* is **not** an Euryalid, and, therefore, does not belong to the family of the Trichasterids.

The main proof of this lies in the character of the vertebræ, which are not of the streptospondylous type common to all Euryalids, but of the zygospondylous type, though slightly modified (fig. 9). This fact together with the character of the armspines and the presence of true tentacle scales proves that it belongs to the true Ophiurids, not to the Euryalids. The question is then to what family of the true Ophiurids *Astrogymnotes* belongs. Koehler, as said, referred his genus "*Ophiovesta*" to the Ophiomyxidæ, regarding it as the nearest related to the genus *Neoplax*. That Koehler was right in referring it to the Ophiomyxidæ seems to me beyond doubt; whether *Neoplax* is its



a. b.

Fig. 9. Vertebræ of *Astrogymnotes catasticta*, proximal (a) and distal (b) articular surface. × 100.

nearest relation may rather be doubted, *Neoplax* being on the whole so closely related to *Ophiomyxa* that it is, perhaps, questionable whether it can be kept separate from that genus. *Astrogymnotes* would seem to be not specially related to *Ophiomyxa;* but to find out which of the Ophiomyxids is its nearest relation would require a more detailed study of the whole of the *Ophiomyxidæ*, which is out of the scope of the present investigation. I shall, therefore, have to be content with the statement that *Astrogymnotes* belongs to the Ophiomyxids, not to the Trichasterids or even at all to the Euryalids.

As already said Clark states the ventral arm plates to be entirely absent, but Döderlein (Op. cit. p. 394, fig. 23) figures some small, oval plates, not occurring regularly on every joint, which he regards as the ventral plates. Both these statements are erroneous. When treated with hypochlorite of sodium so that the rather thick covering skin becomes dissolved, very distinct ventral plates are found to be present, and quite regularly on every joint. They are of a rather peculiar shape, as seen in fig. 10, with a deep median notch in the distal edge, the outer

corners forming a pair of broad, prominent lobes. The middle of the plate is somewhat thickened and elevated, almost as a hump. This becomes the more conspicuous through the remarkable colour pattern of the ventral side of the arm — yellowish spots on a darkbrown ground, the spots assuming the shape of lateral and ventral plates, but not really corresponding to these plates. The figure quoted in Döderlein's work, reproduced here in fig. 11, represents the colour pattern, not the real plates. The true shape of the plates

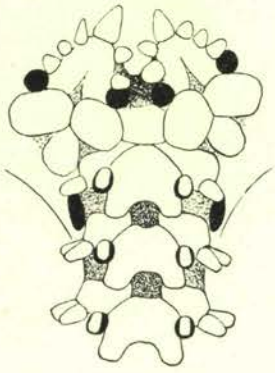


Fig. 10. Part of oral side of *Astromnogytes catasticta*, cleaned, so as to show the outlines of the plates distinctly. × 20.

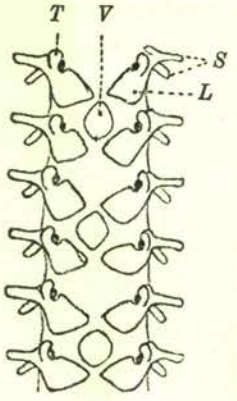


Fig. 11. Part of ventral side of arm of *Astrogymnotes catasticta*, after Döderlein (Op. cit. 1930. p. 394). The apparent plates are the spots of light colour in the skin, not corresponding to the real plates. L. apparent lateral plates; S. armspines; T. tentacle scales; V. apparent ventral plates.

is seen in the figure here given (fig. 10). As I have a cotype of *A. catasticta* in hand, (received from the Western Australian Museum) this statement is not merely a suggestion but a real fact, ascertained by the study of that specimen. The specimens from off Jolo have the same pattern, only the light spots are somewhat smaller; also the specimens themselves are smaller than the Australian specimens.

The gonads lie in the disk attached in the normal way to the bursæ, which remain separate, not fusing, as they do in most Euryalids.

The remarkable fact that it is the ventral side of disk and arms which is so conspicuously coloured gets its explanation through the — no less remarkable — fact that this Ophiurid has the peculiar

habit of turning the underside out when clinging to the Antipathids on which it lives (— or, at least, on which I found the species (off Jolo), together with *Ophiocanops fugiens*). Three specimens are found together clinging tightly to a branch of the *Antipathes*, all with the dorsal side against the branch, and the ventral side turned out. Another specimen is sitting attached with only one arm, the disk and the other arms hanging free out from the branch. The other specimens at hand are lying free. It is not easy to understand why it does turn the underside out, and one cannot help wondering what its food may be (one specimen opened had the stomach empty); but in any case the pattern of the underside serves to conceal the animal in a most admirable way on the coral on which it lives.

3. On the genus *Ophiopteron*.

In 1888 Ludwig published, in Zeitschr. f. wiss. Zool. Bd. XLVII, a paper on "Ophiopteron elegans, eine neue wahrscheinlich schwimmende Ophiuridenform", describing a very peculiar Ophiurid allied to *Ophiothrix*, but differing from that genus in having the armspines united by a fine membrane so as to form a fine web. These webs so strikingly look like swimming apparatus that Ludwig very naturally was led to suppose that this must be a swimming Ophiurid, a suggestion which has been very generally accepted, and *Ophiopteron* has ever since been mentioned in literature as a swimming Ophiurid.

During my various expeditions to the Indo-Pacific regions (in 1900, 1914, 1922, and 1929) I have repeatedly had opportunities of observing living specimens of *Ophiopteron* and have been intent on studying its habits and seeing it swim.

If it does swim, it is clear that there would only be two ways of doing it: either by quick movements of the arms or by a rapid waving movement of the "fins". The first method I think absolutely excluded. That would require a strongly developed arm-musculature, but the musculature is by no means specially developed, no more than in a normal *Ophiothrix*. And its habits are also like those of *Ophiothrix* in general; it creeps into crevices in shells, corals, or stones, and sits there concealed. When removed from its concealment and set free in a dish with water, its movements are very sluggish — nothing like the quick movements of e. g. an *Ophiura texturata*. I think then, I may confidently assert that *Ophiopteron elegans* does not and can-

not swim by means of strong, active arm movements[1]). It is also clear that for swimming in this way the arrangement of the webs, vertically on the arms and so close together as to cover each other more or less completely, would be a rather poor invention.

With the other way of swimming, by means of rapid waving movements of the "fins" in the way of some Polychætes, and more particularly the way in which e. g. *Branchipus* moves its numerous close-set, broad legs, matters may lie differently.

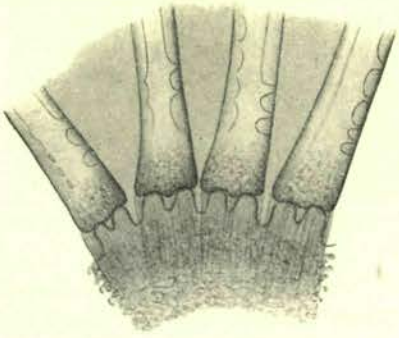


Fig. 12. Part of web of *Ophiopteron elegans*, showing the articulation of the "fin rays" with the lateral plate and their muscles. × 90.

It is a necessary requirement that, if *Ophiopteron* does swim in this way, there must be some strong muscles developed at the base of the spines forming, so to speak, the "fin rays". This is also the case. As shown in fig. 12, each "fin ray" has a very well developed bundle of muscles at its base, attached to the lateral plate that carries the "fin"; further the articulation of the spine to the lateral plate is formed by well developed condyles, much more developed than those of a normal *Ophiothrix*. It can also be concluded from the varied position of the "fins" in preserved specimens that *Ophiopteron elegans* does move its "fins" actively. Thus it is evident that there is a possibility of *Ophiopteron* swimming actively in this way, by quick waving movements of the "fins", in the same way as swims e. g. *Branchipus*. It is true, I have never observed it swimming in this way either, but having found the muscles of the "fin rays" and their articulation to be so well developed, I dare not deny the possibility of its swimming, would rather think it probable that it does so, since there must be some reason for such specialised structures. But further observations on living specimens, under good laboratory conditions, are required

[1]) This I have stated already in my Report on the Danish Expedition to the Kei-Islands, 1922 (Vid. Medd. Dansk Naturh. Foren. Bd. 76, 1923, p. 61).

for settling the question how *Ophiopteron* uses its "fins", and whether it can really swim by means of them.

In the year 1912 I received, among some other Echinoderms taken in the Formosa Strait (23°8′ N. 117°30′ E. 24 fathoms) by Captain E. Suenson of the cable-steamer of the Great Northern Telegraph Company, a number of specimens of various sizes of *Ophiothrix striolata* Grube. The smaller of them were found to have their armspines united by skin, and to be identical with Koehler's *Ophiopteron puncto-coeruleum* ("Siboga"-Ophiuroidea II. p. 114. Pl. XII. 5—7; XV. 6). I came then to the result that *Ophiopteron puncto-coeruleum* was nothing but the young *Ophiothrix striolata* — but I had then no time to go deeper into the matter or to publish anything about it. In 1921 H. L. Clark in his splendid work "The Echinoderm Fauna of the Torres Strait" p. 114 comes to the same result stating that a "very notable and puzzling feature of this species (*O. striolata*) is the presence in young specimens of a membrane on the arm-spines on the basal part of the arm, as in *Ophiopteron*. The degree to which this membrane is developed differs in different individuals; it is often very thin and easily ruptured, but it may be as thick and as complete as could be asked. I think *Ophiopteron puncto-coeruleun* Koehler ... is based on the young of *Ophiothrix striolata*, but there is not sufficient material at hand to permit a final decision. If such should be the case, the status of *Ophiopteron* and its relation to *Ophiothrix* would require a careful investigation. As usual in such cases, abundant material of all ages is urgently needed."

Koehler, in his paper "Ophiures recueillies aux îles Gilbert, Marshall et Fiji" (Göteborgs Kgl. Vetensk. och Vitterhets-Samhälles Handlingar, 4. Ser. 33. 3. 1927, p. 12—13) objects to this suggestion by Clark that the considerable size of *O. puncto-coeruleum*, up to 6 mm diameter of disk, is against its being only the young of *O. striolata*, from which it differs also in the coloration, the blue colour being in the form of small spots, not of striæ as in *striolata*.

On looking over the Ophiurids worked out by Koehler in his last memoir "Ophiures recueillies par le Dr. Th. Mortensen dans les Mers d'Australie et dans l'Archipel Malais" (1930), after they had been returned to the Copenhagen Museum, I was very struck by the resemblance of *Ophiopteron gratum* Koehler (of which I had taken a specimen in the Amboina Bay) to *Ophiothrix nereidina* (Lamarck),

the suggestion lying at hand that it would be the young *Ophiothrix nereidina*, like *Ophiopteron puncto-coeruleum* being the young *Ophiothrix striolata*. Then I thought it my duty to take up the question for a closer investigation.

On comparing the above mentioned specimens of *Ophiopteron puncto-coeruleum* from the Formosa Strait with undoubted specimens of *Ophiothrix striolata* from the same locality I again come to the result that the only difference between them is the presence of webs in the former, the armspines being united by a thin membrane, which is absent in *O. striolata*, the spines there being free. I would particularly emphasize, against Koehler, that there is no difference in the coloration, the adult *O. striolata* having small blue spots besides the blue lines, just as it is found in *Ophiopteron puncto-coeruleum*, these spots being even more numerous in the adult *striolata* than in the young *Ophiopteron*. I may add that these small blue spots are particularly numerous in some specimens from off Jolo, identified by Koehler himself as *O. striolata* (with which identification I quite concur).

Thus there cannot be any doubt that *Ophiopteron puncto-coeruleum* is only the young *Ophiothrix striolata*, the webs being a character of youth, gradually disappearing with age. In quite young specimens, recently metamorphosed, the webs are found on all the armjoints, to the very tip; such is also the case in specimens up to a size of ca. 2.5 mm diameter of disk and with arms ca. 10 mm long. A specimen of 4 mm diameter of disk shows the webs in so much of the arms that is preserved, somewhat more than half their length. In a specimen of 6 mm diameter of disk the webs are distinct only on 2—3 of the basal joints, some rags hanging here and there on the spines farther out on the arm, but in a much better preserved specimen of the same size, from 26°42′ N. 121°19′ E. 43 fathoms (3. VI. 1894, Schönau) the web is distinct, between the two uppermost spines, as far out as the 10th—15th joint, but not on all joints, it having disappeared on some joints here and there in between the others with the web distinct. Finally in a specimen of 8 mm diameter of disk the web is still fairly distinct on the first free armjoint, whereas in another specimen of the same size no traces at all are seen of the web.

The transition from the young, webbed specimens to the larger unwebbed is thus easy enough to follow. The matter is, however, not

quite so simple. On closer inspection it is seen that the armspines, particularly on the basal joints, of the young specimens are branched (Fig. 13), whereas those of the larger, non-webbed spec-

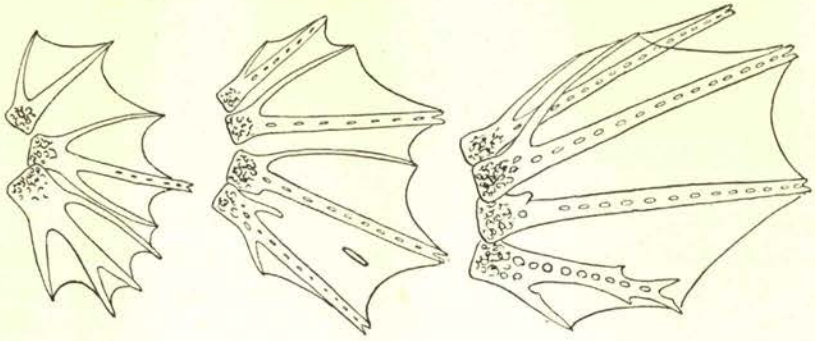


Fig. 13. Webs of young *Ophiothrix striolata*, showing transformation of the spines; in b. is seen part of a branch of the lowermost spine, still lying isolated in the membrane, the resorption not being complete. × 90.

imens are unbranched. How does then this transformation from the branched to the simple spines take place? Also this can be easily traced on the material in hand. It is seen that one of the branches takes the lead, growing thicker and longer, the other branches being gradually reduced so as to appear as thin side-branches on the main spine, to be ultimately completely resorbed (Figs. 13. a—c.).

Such branching spines I find also in the young specimens of another *Ophiothrix* represented in the same material (Figs. 14—15). Also here it is easy to follow the transformation to the spine of the adult, which takes place simply through the stronger growth of the median branch, the other branches being gradually reduced to mere side-thorns on the main stem, but they are not completely resorbed as is the case in *Ophiothrix striolata*. These armspines are also connected

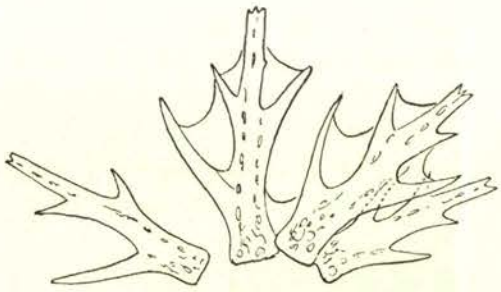


Fig. 14. Armspines of a young *Ophiothrix koreana*. × 125.

by a fine membrane, only to a smaller extent than in *O. striolata*, so that I did not immediately observe it; also it disappears at a much earlier stage than in *O. striolata*. As for the species to which these young specimens should be referred, I have hardly any doubt that it is *Ophiothrix koreana* Duncan; at least, I do not see any character by which it could be distinguished from that species — only I have not a quite complete series from the quite young specimens to the larger ones. But it may then be taken as almost certain that also *Ophiothrix koreana* passes through an *Ophiopteron*-stage, only much less developed than that of *O. striolata*.

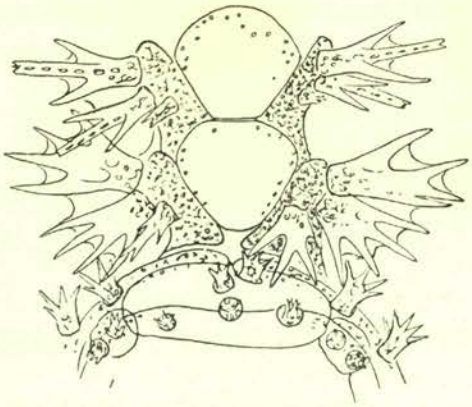


Fig. 15. Part of arm and disk, dorsal side, of young *Ophiothrix koreana*. × 100.

Through these observations we get the solution also of the problem, to which Ophiurid belongs the remarkable young post-embryonal stage of an Ophiurid with branching spines from the Gulf of Panama, figured by Eigil Nielsen in his paper "Ophiurans from the Gulf of Panama, California and the Strait of Georgia" (Papers from Dr. Th. Mortensen's Pacific Exped. 1914—16. LIX. Vid. Medd. Dansk Naturh. Foren. Bd. 91. 1932. p. 342). It is suggested there that it must be either of an *Ophiocoma* or an Ophiothrichid, more probably the latter. Seeing its very close resemblance to the young *Ophiothrix koreana* (Fig. 15) there can be no doubt any more that it does also belong to an *Ophiothrix*, and as only one species of *Ophiothrix* is known from the Gulf of Panama, *O. spiculata* (Le Conte), it is certain that it is the young of this species. The possibility that it might belong to the only other Ophiothrichid at all common in the Gulf of Panama, *Ophiothela mirabilis* Verr., I must regard as excluded. There is nothing to recall an *Ophiothela* in this young Ophiurid.

Eigil Nielsen did not figure or notice any membrane connecting the branches of the armspines in this young *Ophiothrix spiculata*. On reexamining the specimen I find, however, that such mem-

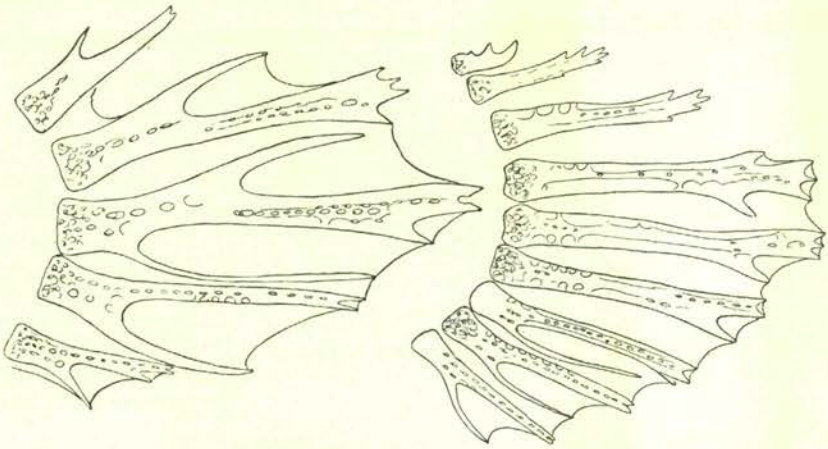
branes do exist, to about the same extent as in *Ophiothrix koreana*. Thus, also *Ophiothrix spiculata* passes through an *Ophiopteron*-stage.

As already stated I was struck by the resemblance with *Ophiothrix nereidina* (Lamk.) of the specimen from Amboina identified by Koehler as *Ophiopteron gratum* Koehler. On a careful comparison of this specimen with *Ophiothrix nereidina* I fail to find a single character by which to distinguish them. The very characteristic colour of *O. nereidina*, particularly the white transverse line on the broad armplates, as also the characteristic arrangement of the disk plates, devoid of spines, the shape of the armspines — everything is exactly alike in both. Furthermore I find among the specimens identified by Koehler himself as *Ophiothrix nereidina* one specimen, of 4 mm diameter of disk and the arms already of considerable length, with the spines of the basal joint partly distinctly connected by a membrane.

Thus, also *Ophiothrix nereidina* passes through an *Ophiopteron*-stage. Another question is, whether it is really *Ophiopteron gratum* which is the young of *Ophiothrix nereidina*. The thing is namely that I doubt very much whether Koehler's identification of the said young specimen from Amboina as *Ophiopteron gratum* was correct. *Ophiopteron gratum* is described by Koehler as having a dark blue band along the dorsal midline of the arm, which is not found in the said specimen or in *O. nereidina*. On the other hand Koehler does not mention for *O. gratum* the white transverse band on the dorsal armplates so characteristic of *O. nereidina* (and the said young specimen from Amboina) — and it is scarcely possible that Koehler could have overlooked that, as also the figure Pl. 60. 3 of Koehler's report on the "Albatross" Philippine Ophiurans does not show it; and even though these figures are anything but clear, on account of the reproduction in coarse half-tone, they could hardly have failed to show traces of this white transverse band, had it really been present. Further there are only 6 armspines in the Amboina specimen (as in *O. nereidina*) whereas *O. gratum* is stated to have 8 armspines.

Therefore, I do not think that *Ophiopteron gratum* belongs to *Ophiothrix nereidina*, but rather to another species, and I think I can say which species. The colour of *Ophiopteron gratum* recalls that of *Ophiothrix Martensi* Lyman to a very striking degree, and there is nothing else in the description of *Ophiopteron gratum* which does not suit *Ophiothrix Martensi;* also the number of the armspines is

the same. On examining now the younger specimens of *O. Martensi* in my material from the Kei Islands, identified by Koehler himself (— and quite correctly —) as *Ophiothrix Martensi*, I find their arm-spines in the proximal part of the arms so conspicuously webbed that I can only wonder that Koehler did not observe it. In a specimen of 3.5 mm diameter of disk the spines on the 5—6 proximal joints are very distinctly webbed, and even up to the 15th joint there are distinct traces of the skin connecting the spines. The same is the case in a



a. b.

Fig. 16. Webs of young *Ophiothrix nereidina* (a) and *O. Martensi* (b). a. × 90; b. × 48.

specimen of 5 mm diameter of disk, whereas in a specimen of 6 mm diameter the connecting membrane has very nearly disappeared. Accordingly also *Ophiothrix Martensi* has an Ophiopteron-stage, and there can hardly be any doubt that *Ophiopteron gratum* is nothing but the young *Ophiothrix Martensi*. To this same species evidently belongs also *Ophiopteron gymnatum* M'Intosh (The Marine Fauna of the Mergui Archipelago, collected by James J. Simpson and R. N. Rudmose Brown. Proc. R. Phys. Soc. Edinburgh. XVIII. 1911, p. 167). Koehler (Op. cit. 1922. p. 304) thinks that species entirely different from his *Ophiopteron gratum*, particularly because of the different arrangement of the disk scales in the interradii. This difference, however, is certainly due to age only, Koehler's type of *O. gratum* being 2 mm in diameter of disk, M'Intosh's specimen being 5 mm in diameter. The only apparently

real difference would seem to be this that the adoral plates are narrower, more linear in *O. gymnatum*, more triangular in *O. gratum*. By the otherwise complete agreement between these two "species" I cannot recognise this little difference — if real — as of specific value, and I cannot doubt that also *Ophiopteron gymnatum* is nothing but the young *Ophiothrix Martensi*.

In both *O. nereidina* and *O. Martensi* the spines are branched in the webbed stage as in *O. striolata* (Fig. 16).

As it has thus been proved beyond any reasonable doubt that *Ophiopteron puncto-coeruleum* is only the young *Ophiothrix striolata*, that *Ophiopteron gratum* and *Ophiopteron gymnatum* are both of them only the young *Ophiothrix Martensi*, further that the young *Ophiothrix nereidina* is likewise an "*Ophiopteron*" and that also the young of the species *Ophiothrix koreana* and *spiculata* have the spines webbed like an *Ophiopteron*, only to a smaller degree than usual in *Ophiopteron*, the question naturally arises: are then all *Ophiopteron*-species only young ones of *Ophiothrix*-species? If so, the genus *Ophiopteron* itself cannot be maintained, of course. Another question also naturally arises: do all *Ophiothrix*-species pass through an *Ophiopteron*-stage in their post-embryonal development?

Besides the three above named *Ophiopteron*-species four more species have been described, viz. *O. elegans* Ludwig, the genotype, *O. atlanticum*[1]) Koehler, *O. alatum* A. H. Clark, *O. Sibogae* Koehler, and *O. vitiense* Koehler. The species *atlanticum*, *alatum*, and *Sibogae* being known to me only from the descriptions, not by actual observation, I shall not try to decide the question of their true value. As for *Ophiopteron elegans* I think it quite certain that it never transforms into a simple *Ophiothrix*. I have taken quite a number of specimens of this species in various parts of the Malay Archipelago, the largest nearly 7 mm diameter of disk. Even in the largest of them there is no sign of any reduction of the webs, which continue to the very point of the arms. Further the larger of the specimens are sexually mature. The same holds good of *Ophiopteron vitiense* Koehler.

[1]) It is evidently due to a lapsus memoriæ that Koehler (Op. cit. 1927) mentions a species *Ophiopteron africanum*. No *Ophiopteron*-species has ever been described under that name. No doubt he means the *Ophiopteron atlanticum*, which he describes in his report on the Echinoderms in "Beiträge z. Kenntniss d. Meeresfauna Westafrikas", Hamburg. 1914.

In these two species we also find the very noteworthy character that the webs on the basal joints unite in the dorsal midline. (This likewise holds good of *O. Sibogæ*.)

I thus come to the result that the genus *Ophiopteron* must be maintained for at least the species *elegans* and *vitiense* (— if the latter species is really distinguishable from *O. elegans*, which may perhaps be doubted).

The question whether all *Ophiothrix*-species pass through an *Ophiopteron* stage must be answered in the negative. It is certain e. g. that *Ophiothrix fragilis* has no *Ophiopteron*-stage, and this may probably hold good for several other species — but it is no less probable that many other species of *Ophiothrix* besides the above named do pass through an *Ophiopteron*-stage. Which of them — that is for future research. Attention should here be paid to the question whether there might herein be a basis for subdividing the large genus *Ophiothrix*.

Whether the young *Ophiopteron*-stages of the various *Ophiothrix*-species use their "fins" actively for swimming can, of course, only be decided through actual observation of the living specimens. But it does not seem very probable that they do so, because the muscles of the spines are not specially developed. Another thing is that they may perhaps serve as a floating apparatus for the young Ophiurid, which would seem not improbable. However, the fact that the above mentioned *Ophiopteron*-stages of *Ophiothrix koreana* were found in all sizes on the bottom, even quite small, just metamorphosed specimens, does not speak for the webs being of much use for keeping the young Ophiurid floating for any longer period. And also other Ophiurids with no special adaptations for a pelagic life, as e. g. various *Ophiura*-species are often found pelagic for quite a while after metamorphosis. It may well be suggested that in such cases the extended tubefeet serve to augment the floating capacity of the young Ophiurid.

In connection with these remarks on *Ophiopteron* I may recall the fact that the two Ophiomyxid genera *Ophiozyzygus* H. L. Clark and *Ophiohymen* H. L. Clark have also the armspines united by a thin membrane, not only vertically but also horizontally, the uppermost spines being united from joint to joint. That the webs in these forms have no function as swimming apparatus I think rather certain,

as also Clark in describing these forms (North Pacific Ophiurans. Bull. U. S. Nat. Mus. 75. 1911, p. 275—278) does not make any such suggestion.

4. An Albino *Ophiocoma scolopendrina* (Lamarck).

Pl. I. Fig. 1.

Anybody who has been walking along a tropical beach will have observed that from every crevice, from below every old coral block or any other hiding place within the tide limits Ophiurids are extending their arms, moving them gently in a snake-like way, probably in search of food, while the body of the Ophiuran remains concealed within the hiding place. Particularly by rising tide the Ophiurans stretch out their arms, which they then move more lively than else, as if enjoying the return of the water after having been lying more or less dry during low tide. Among the several forms of Ophiurids that lead this sort of life various species of *Ophiothrix* and *Ophiocoma*, with their very long arms, are particularly conspicuous.

One afternoon in October 1929, when walking along the beach at Cannoniers Point, a few miles to the North of Port Louis, Mauritius, I noticed among the numerous black or variegated arms of *Ophiocoma* and *Ophiothrix* thus extending from under stones some perfectly white arms of a large Ophiurid. The stone lying loose I could fortunately secure the specimen without damaging it. It proved to be an *Ophiocoma*, and I naturally thought thus to have discovered a new species of *Ophiocoma*, a white *Ophiocoma* being hitherto quite unknown. During the following time I was very eagerly on the look out for more specimens of this white *Ophiocoma* — but I never found another specimen.

On examining now the said specimen I find it to agree in every character, excepting the colour, so closely with *Ophiocoma scolopendrina* (Lamk.) that there cannot be any reasonable doubt but that it belongs really to that species, being only an albino specimen. As *O. scolopendrina* is normally to a various degree mottled with white on a blackish ground colour, it is not so very extraordinary that in the said specimen the white colour has become absolutely predominating (only near the point of two of the arms there is a slight indication of dark colour). But even so this case is, so far as I know, unique and I have, therefore, thought it well worth describing.

Explanation of the Plate.

Plate I.

Fig. 1. Albino specimen of *Ophiocoma scolopendrina* (Lamk.), aboral side. - 2—3. *Ophiocanops fugiens* Koehler. Oral (2) and aboral side (3).

All figures natural size.

13.—6.—1932.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LXI.

Freilebende marine Nematoden von den Sunda-Inseln.

II. Oncholaiminae.

Von

Dr. **Hans A. Kreis**

(Zoologische Anstalt, Universität, Basel).

Die Untersuchung der Vertreter der Familie „*Oncholaiminae*" Filipjev 1916 hat gezeigt, dass es notwendig ist, die ganze Familie monographisch zu bearbeiten. Wir haben uns deshalb mit den verschiedenen Forschern in Verbindung gesetzt, um das notwendige Material möglichst vollständig zu erhalten. Gleichzeitig wurde Herr Dr. Th. Mortensen von unserem Vorgehen in Kenntnis gesetzt, und wir sind mit ihm übereingekommen in der vorliegenden Arbeit, welche in die Untersuchungen seiner Pacific-Expeditionsberichte eingereiht werden soll, nur in abgekürzter Form die Diagnosen der gefundenen Arten niederzulegen, in Anbetracht der Tatsache, dass die Monographie ihrem Abschluss entgegengeht und in absehbarer Zeit dem Drucke übergeben wird. Aus diesem Grunde werden auch alle Figuren weggelassen, und nur die wichtigsten Artmerkmale zusammengestellt. Auch die ausführlicheren Massangaben sind hier nicht berücksichtigt worden.

Im ganzen wurden 58 Arten gefunden, welche sich auf 17 Genera verteilen, von denen 8 für die Wissenschaft neu sind. Die folgende Uebersicht gibt Auskunft über die Verbreitung der gefundenen Arten. Die Fundortliste wurde bereits im ersten Teil der Nematoden niedergelegt.

Aus der Zusammenstellung ergibt sich, dass im Ganzen 899 Nematoden untersucht worden sind, welche sich auf 328 Weibchen, 196

	0	1	2	3	4	5	6	7	8	9	10	11
1. Filipjevia meridionalis			+									
2. Pelagonema keiense			+									
3. — anoplum												+
4. Pseudopelagonema elegans					+				+	+	+	
5. — filiformis		+										
6. Pelagonemella javaensis							+					
7. Doryonchus typicus												+
8. Mononcholaimus filiformis									+			
9. — elegans											+	
10. — setosus											+	
11. — keiensis			+									
12. — papillatus			+									
13. — tasmaniensis												
14. — labiatus							+					+
15. — parasetosus											+	
16. — conicaudatus		+										
17. — bandaensis			+									+
18. Dioncholaimus brevicavatus												
19. Paroncholaimus parvus												
20. — ocellatus												
21. — elongatus									+			
22. Pseudoparoncholaimus ditlevseni							+					
23. — longissime-caudatus												
24. Viscosia glabra												
25. — paridentata			+									
26. — crassa							+					
27. — pseudoglabra										+		
28. — carnleyensis			+									
29. — carnleyensis v. tropica			+									
30. — keiensis			+		+							
31. — meridionalis	+				+		+	+	+	+		+
32. — leptolaima			+									
33. — brachylaima												
34. — bandaensis												
35. — isotonchula							+					
36. — nuda		+										
37. — macrorhopalocerca							+					
38. — dubiosa							+					
39. Meroviscosia longicaudata												
40. Oncholaimus brevisetosus				+					+			
41. — elegans				+								
42. — keiensis			+									+
43. — longicavatus												
44. — viridis								+				
45. — rapax		+										
46. Pseudoncholaimus elegans									+			
47. Oncholaimium brevicaudatum												
48. — cobbi												
49. — longicaudatum												
50. Prooncholaimus keiensis			+									
51. — ornatus		+							+		+	+
52. — obtusicaudatus												
53. — longisetosus		+										
54. Adoncholaimus nudus												
55. — meridionalis												
56. — papillatus												
57. — bandaensis											+	
58. Cacolaimus papillatus							+					

3	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	♀	♂	juv.	Total
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..		2	..	2
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	4
	+	+	+	..	..	..	..	..	..	+	+	..	+	+	..	+	..	..	+	+	..	..	29	15	31	75
	+	+	..	..	..	..	..	..	..	..	..	+	..	..	..	+	+	..	+	+	+	..	19	12	24	55
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	2
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	+	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	5	3	2	10
	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	1	..	1	2
	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	12	3	5	20
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	3	..	2	5
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	2
	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	..	..	+	13	8	24	45
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	2	..	6
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	13	4	4	21
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
	+	..	..	..	..	..	..	..	+	..	+	..	..	..	..	..	..	..	..	..	..	..	..	1	22	23
	+	..	..	..	..	..	..	..	+	..	..	+	..	..	..	..	..	..	..	..	+	+	4	6	21	31
	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	9	9
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	6	9
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	14	14
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	1	..	1	2
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	1	3
	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	2	..	1	3
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	2
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
	+	+	+	..	..	..	..	..	..	+	+	+	+	+	+	+	+	..	+	+	+	..	143	98	74	315
	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	3
	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	3
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	5	14	28
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	6
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	4
	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	4	4
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	2
	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	+	..	..	..	..	..	3	2	7	12
	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	..	+	..	..	..	..	..	19	12	18	49
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	2	6	8
	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	6	1	4	11
	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	1	..	2	3
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	..	+	+	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	+	..	..	7	2	9	18
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	1	..	..	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	7	4	15	26
	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	2	2	2	6
	..	..	..	..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	..	..	1	3	1	5
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	3	22	31
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
																							328	196	375	899

Männchen und 375 juvenile Tiere verteilen, i. e. prozentual ausgedrückt haben wir:

♀	36.5 %
♂	21.8 -
juv.	41.7 -

Die Sexualziffer, i. e. die durchschnittliche Zahl der Männchen, welche auf 100 Weibchen kommen, ist 60.

Die Verteilung der Arten ist wie folgt:

1.	Viscosia meridionalis	39.5 %
2.	Pseudopelagonema elegans	8.4 -
3.	— filiformis	6.1 -
4.	Pseudoncholaimus elegans	5.5 -
5.	Mononcholaimus labiatus	5.0 -
6.	Paroncholaimus ocellatus	3.4 -
7.	Adoncholaimus bandaensis	3.4 -
8.	Viscosia nuda	3.1 -
9.	Adoncholaimus nudus	2.8 -
10.	Paroncholaimus parvus	2.5 -
11.	Mononcholaimus bandaensis	2.3 -
12.	— setosus	2.2 -
	Total...	84.2 %

Die restlichen 15.8 % verteilen sich auf die übrigen 46 Arten. Aus der obigen Zusammenstellung erhält man den Eindruck, es sei *Viscosia meridionalis* die Leitform der *Oncholaiminae* des Molukken-Gebietes; vermutlich gehört die Art auch zu den Leitformen des gesammelten Gesamtmaterials.

Basel, September 1932.

Filipjevia meridionalis n. sp.

♂ 0.787—0.808 (0.799); a = 24.6—27.4 (26.0); β = 4.2—4.4 (4.3); γ = 7.4—7.6 (7.5).

Körper nicht sehr schlank, nach vorne auf $^1/_3$ der grössten Breite verschmälert, nach hinten rel. langgezogen. Cuticula zweischichtig; innere Schicht deutlich geringelt. Vorderende flach. Vermutlich 6

sehr wenig entwickelte Lippen. 4 oder 6 kurze Borsten. Mundhöhle $^1/_{12}$—$^1/_{12.5}$ der Oesophaguslänge, länglich rechteckig, ohne Zähne. Seitenorgan klein, spaltförmig.

Oesophagus ohne Besonderheiten, mit einer Cardia, welche eine Art „Valvular-Apparat" besitzt.

Schwanz langgezogen, am Ende mit membranöser Kappe und 3 langen Borsten.

♂ Geschlechtsapparat: Hoden unpaarig; Spicula sehr lang, bogenförmig gekrümmt, proximal becherartig erweitert, dann in der Mitte sehr dünn, mit einer Art „Velum"; distal spitz endend. Gubernaculum gabelförmig, paarig.

Verwandtschaft: die Unterschiede zu *Filipjevia arctica* Ditl. (12) liegen in der Verschiedenheit des Spicularapparates, wo z. B. bei der Ditlevsen'schen Art das Gubernaculum fehlt.

Verhältnisse am Hinterende: Schwanzlänge 5; Breite am Hinterende 0.2; Spicula 3.5; Gubernaculum 0.9.

Vorkommen: Mo. 2; 13.

Pelagonema keiense n. sp.

♀ 2.706—2.973 (2.839); α = 32.9—36.6 (34.8); β = 7.4—9.2 (8.3); γ = 15.0—18.1 (16.1); V = 36—41.4 % (38.7 %).

Körper nicht sehr schlank, nach vorne nicht ganz 4mal verschmälert gegenüber der grössten Breite; Hinterende langgezogen. Cuticula glatt, dünn. Vorderende mit 6 schwach entwickelten Lippen und 10 Kopfborsten. Mundhöhle mehr als 2mal länger denn breit, $^1/_{8.5}$—$^1/_9$ der Oesophaguslänge, ohne Zähne. Basis mit Cuticularverstärkung. Seitenorgan kreisrund, mit Drüsenverbindung.

Oesophagus kurz, am Ende etwas aufgeblasen, in der Mitte vom Nervenring umgeben. Porus der Ventraldrüse auf der Höhe des Nervenringes. Rectum = anale Breite.

Schwanz langgezogen, mit deutlichem Endkolben und 2 Terminalborsten.

♀ Geschlechtsapparat: Ovarien paarig, nicht zurückgeschlagen. Vulva hinter dem ersten Körperdrittel, in den Körper eingesenkt.

Verwandtschaft: im Bau des Vorderendes am *Pel. angusticavatum* Kreis (19), in dem des Hinterendes an *Pel. simplex* Cobb (7) erinnernd.

Verhältnisse am Hinterende: Schwanzlänge 5.5; Breite am Hinterende 0.3.

Vorkommen: Mo. 2.

Pelagonema anoplum n. sp.

♀ 1.574—1.726 (1.650); α = 40.4—42.1 (41.3); β = 4.5—4.8 (4.65); γ = 14.2—14.5 (14.35); V = 59.6—60.4 % (60.0 %).

Körper schlank, am Vorderende mehr als 5mal gegenüber der grössten Breite verschmälert. Cuticula glatt. Seitenfelder schmal, mit hellglänzendem Granula. Longitudinalmuskulatur sehr stark entwickelt. Vorderende mit 6 ganz undeutlichen Lippen. Borsten und Papillen fehlen. Mundhöhle langgestreckt, im Verhältnis zur Oesophaguslänge aber sehr klein bleibend ($^1/_{27}$). Seitenorgan taschenförmig.

Oesophagus lang, schlank, mit breitem Nervenring in seiner Mitte. Ventraldrüse postoesophagal; Porus excretorius am Nervenring. Rectum = anale Breite.

Schwanz an *Pel. simplex* Cobb (7) erinnernd, mit kugelig angeschwollenem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig; vermutlich nur das vordere Ovar zurückgeschlagen. Vulva hinter der Körpermitte.

Verwandtschaft: durch den Bau des Vorderendes lässt sich die Art gut von *Pel. simplex* Cobb (7) abtrennen. Auch ist ihr Schwanz kürzer als bei der Vergleichsspecies.

Verhältnisse am Hinterende: Schwanzlänge 5.3—6; Breite am Hinterende 0.18—0.33.

Vorkommen: Mo. 11.

Pseudopelagonema n. g.

Typ.: *Pseudopelagonema elegans* n. sp.

Würmer mit fadenförmigem Körper, dessen Vorderende stark verschmälert ist. Ausser den Lippen am Vorderende keine Bewaffnung. Mundhöhle sehr klein, ohne Zähne, doch deutlich zweiteilig. Seitenorgan becherförmig. Oesophagus sehr langgestreckt. Hinterende verlängert. Weiblicher Geschlechtsapparat paarig angeordnet. Spicula ohne Gubernaculum.

Das Genus schliesst sich eng an *Pelagonema* Cobb (7) an, unter-

scheidet sich aber durch die sehr kleine Mundhöhle und vor allem durch das Auftreten von Männchen von der Cobb'schen Gattung, welche vermutlich ovipar sich fortpflanzt.

2 Arten: *Pseudopelagonema elegans* n. sp.
— *filiformis* n. sp.

Pseudopelagonema elegans n. sp.

♀ 1.818—2.428 (2.083); α = 50.4—58.7 (54.3); β = 4.1—4.7 (4.4);
γ = 15.3—16.2 (15.7); V = 54.1—60.6 % (57.6 %).
♂ 1.692—2.530 (1.977); α = 55.4—70.2 (60.7); β = 3.9—7.5 (5.3);
γ = 10.3—13.0 (11.3).

Körper sehr schlank, beim Männchen in der Regel schlanker gebaut. Dagegen ist die Verengerung des Vorderendes beim Weibchen $^1/_6$, beim Männchen nur $^1/_4$ der grössten Breite. Cuticula dick. Vorderende mit 6 schmalen Lippen. Papillen und Borsten fehlen. Mundhöhle sehr klein, beim Weibchen $^1/_{45}$—$^1/_{68}$, beim Männchen $^1/_{37}$—$^1/_{48}$ der Oesophaguslänge, zweiteilig, da der vordere Teil ausgebuchtet ist. Zähne fehlen. Seitenorgan sehr klein, $^1/_5$ der entspr. Breite.

Oesophagus langgestreckt, sehr schmal. Nervenring vor der Mitte, sehr breit. Ventraldrüse weit hinter dem Oesophagusende liegend. Porus excretorius direkt postoesophagal. Rectum = anale Breite.

Schwanz beim Männchen etwas eleganter gebaut als beim Weibchen. Endkolben schwach. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, symmetrisch. Vulva wenig hinter der Körpermitte. Eier langgestreckt.

♂ Geschlechtsapparat: Hoden einfach. Spicula fast gerade, proximal geknöpft, distal spitz. Gubernaculum fehlt. Ringmuskulatur kräftig entwickelt.

Verhältnisse am Hinterende: Schwanzlänge ♀ 7.2—8.1; ♂ 9—10; Breite am Hinterende 0.18—0.22 resp. 0.15—0.33; Spicula 1.1.

Vorkommen: Mo. 4; 8—10; 12—16; 23; 24; 26; 27; 29; 32; 33.

Pseudopelagonema filiformis n. sp.

♀ 2.630—2.858 (2.745); α = 66.0—89.6 (80.6); β = 5.3—6 (5.6);
γ = 20.6—22.3 (21.4); V = 52.8—56 % (54.4 %).
♂ 2.532—3.348 (2.817); α = 86.6—110 (94.9); β = 5.4—5.8 (5.6);
γ = 18.6—21.7 (20.6).

Körper sehr schlank, fadenförmig, beim Männchen auf $^1/_4$, beim Weibchen auf $^1/_5$ der grössten Breite am Vorderende verschmälert. Cuticula glatt, beim Männchen dicker als beim Weibchen. Vorderende mit 6 flachen papillenlosen Lippen. Mundhöhle klein, mit Vestibulum-artigen Vorderteil, beim Weibchen $^1/_{51}$—$^1/_{67}$, beim Männchen $^1/_{48}$—$^1/_{54}$ der Oesophaguslänge. Zähne fehlen. Seitenorgan becherförmig, $^1/_2$ der entspr. Breite.

Oesophagus sehr lang und schmal. Erweiterung erst weit postneural. Nervenring in der Mitte. Ventraldrüse weit postoesophagal gelegen, beim Männchen in der Lage stark variierend. Porus excretorius gerade hinter dem Nervenring. Rectum etwas länger als die anale Breite.

Schwanz allmählich abnehmend, mit deutlichem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig. Vulva etwas hinter der Mitte. Eier lang, dickschalig.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula plumper als bei *Ps. elegans*, proximal griffartig ausgebildet; vor dem Distalende etwas erweitert. Gubernaculum fehlt.

Verwandtschaft: die Unterschiede zu *Ps. elegans* liegen in der Breite, in der Verschiedenartigkeit des Seitenorganes, der Lage des Porus excretorius und der Länge des Schwanzes.

Verhältnisse am Hinterende: Schwanzlänge ♀ 6.9—7.4; ♂ 7.2—8.3; Breite am Hinterende 0.25—0.3 resp. 0.21—0.37; Spicula 1.1.

Vorkommen: Mo. 1; 12; 14; 15; 25; 29; 30; 32—34.

Pelagonemella n. g.

Typ.: *Pelagonemella javaensis* n. sp.

Kleine, schlanke Würmer. Vorderende mit Lippen und Borsten. Mundhöhle langgestreckt, unbewaffnet. Oesophagus mit einem echten Endbulbus. Hinterende langgezogen. Nur 1 Spiculum ohne Gubernaculum. Weibchen unbekannt.

Durch das Auftreten des Endbulbus am Oesophagus ist die Gattung scharf von *Pelagonema* Cobb (7) abgetrennt.

Pelagonemella javaensis n. sp.

♂ 2.230—2.411; a = 58.8—60.4; β = 10.1—11.5; γ = 15.1—16.3.

Körper langgestreckt, vorne mehr als $^1/_5$ der entspr. Körperbreite verjüngt, hinten allmählich schmäler werdend. Cuticula glatt. Vorderende mit 6 hohen Lippen. 10 Borsten, $^1/_3$—$^1/_4$ der entspr. Breite. Mundhöhle lang, schmal i. e. 4mal länger als breit, $^1/_6$—$^1/_7$ der Oesophaguslänge. Zähne fehlen. Seitenorgan elliptisch, grösser als die halbe entspr. Breite.

Oesophagus kurz, fast zylindrisch, hinten zu einem deutlichen Bulbus anschwellend. Nervenring etwas vor seiner Mitte. Ventraldrüse präneural; Porus excretorius in der Höhe der Mundhöhlenbasis.

Schwanz zuerst kegelförmig, dann fast zylindrisch, am Ende des 3. Viertels eingeschnürt, um zu einem mächtigen Endkolben anzuschwellen. Alle Drüsen liegen im Schwanzinnern.

♂ Geschlechtsapparat: Hoden einfach. 1 Spiculum, schwach gebogen, proximal etwas verschmälert. Gubernaculum fehlt.

Verhältnisse am Hinterende: Schwanzlänge 5.75; Breite am Hinterende 0.5; Schwanzkolben 1.4; Spiculum 0.84.

Vorkommen: Mo. 6.

Doryonchus n. g.

Typ.: *Doryonchus typicus* n. sp.

Kleine Nematoden von plumpem Körperbau und langgezogenem Hinterende. Cuticula sehr fein geringelt. Vorderende mit Lippen und Borsten. Mundhöhle einfach, mit lanzenförmigem Zahn, welcher an der Basis der Mundhöhle entspringt.

In gewissen Beziehungen steht das Genus nahe bei *Mononcholaimus* Kreis (18), ist aber durch die Ausbildung der charakteristischen Mundhöhlenbewaffnung deutlich von ihr abgetrennt.

Doryonchus typicus n. sp.

juv. 0.952; a = 22; β = 5.4; γ = 6.8.

Körper nach vorne sehr stark verschmälert ($^1/_5$ der grössten Breite); hinten allmählich an Breite abnehmend. Cuticula zweischichtig; Innenschicht sehr fein geringelt. Vorderende mit 6 wenig gewölbten Lippen und 6 langen, fast die halbe Breite erreichenden

Borsten. Mundhöhle kurz, $^1/_{14}$ der Oesophaguslänge, kelchförmig mit einem lanzenförmigen, langen Ventralzahn, dessen Basis an der Mundhöhlenbasis liegt und dessen Vorderende in eine feine Spitze ausläuft. Seitenorgan fehlt.

Oesophagus vorne bis in die Mundhöhlenmitte reichend, allmählich anschwellend. Nervenring etwas hinter der Mitte. Cardia lang dreieckig. Rectum = $^1/_2$ anale Breite.

Schwanz sehr lang; die 2 ersten Drittel sind kegelförmig, das letzte bleibt gleich breit. Am Ende 3 lange Terminalborsten.

Verhältnisse am Hinterende: Schwanzlänge 5.2; Breite am Hinterende 0.13.

Vorkommen: Mo. 11.

Mononcholaimus filiformis n. sp.

♀ 2.284—2.337 (2.304); α = 79.8—95.0 (89.0); β = 7.2—7.3 (7.2); γ = 13.6—15.9 (14.9); V = 49.9—51.4 % (50.6 %).
♂ 2.399; α = 97.1; β = 7.4; γ = 14.9.

Körper fadenförmig, vorne nur auf die Hälfte der grössten Breite verschmälert. Cuticula glatt, dünn. Vorderende mit 6 schwachen Lippen. Borsten und Papillen fehlen. Mundhöhle lang, $^1/_{14}$—$^1/_{16}$ der Oesophaguslänge, mit geschichteten Wänden. Ventralzahn nicht auffallend gross. Seitenorgan fast kreisförmig, $^1/_4$ der entspr. Breite.

Oesophagus ganz allmählich breiter werdend. Nervenring etwas hinter der Mitte. Ventraldrüse am Ende des Oesophagus liegend. Porus excretorius gerade hinter dem Nervenring. Rectum = anale Breite.

Schwanz verlängert, sehr allmählich verjüngt, nur beim Männchen mit deutlichem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig. Vulva in der Körpermitte. Eier langgestreckt.

♂ Geschlechtsapparat: Hoden einfach; Spicula schwertförmig, fast gerade. Gubernaculum und anale Bewaffnung fehlen.

Verwandtschaft: gegenüber *Mon. elegans* Kreis (18, 20) und *Mon. viscosus* Allgén (3) sind die Hauptunterschiede in der Struktur des Vorderendes und des Spicularapparates zu suchen.

Verhältnisse am Hinterende: Schwanzlänge ♀ 10.5; ♂ 13; Breite am Hinterende 0.4 resp. 0.5; Spicula 1.4.

Vorkommen: Mo. 8; 14; 24.

Mononcholaimus elegans Kreis.

Kreis 1924, 29.

♀ 2.509; $\alpha = 51$; $\beta = 7.3$; $\gamma = 13$; V = 46.1 %.

Gegenüber dem Weibchen der Nordsee länger werdend. Zur Genusdiagnose ist beizufügen, dass das Vorderende nicht 6, sondern 10 Borsten besitzt. Anscheinend fehlt das Seitenorgan. Mundhöhle $^1/_{14.5}$ der Oesophaguslänge.

Verhältnisse am Hinterende: Schwanzlänge 7.7; Breite am Hinterende: 0.33.

Vorkommen: Mo. 10; 24.

Mononcholaimus setosus n. sp.

♀ 1.673—1.964 (1.857); $\alpha = 40.8$—48.0 (45.0); $\beta = 5.8$—6.4 (6.2); $\gamma = 10.2$=12.4 (11.6); V = 43.5—52.1 % (47.8 %).

♂ 1.784—1.857 (1.821); $\alpha = 51.2$—56.6 (53.8); $\beta = 6.0$—6.1 (6.05); $\gamma = 11.9$—12.1 (12.0).

Körper schlank, besonders beim Männchen, nach hinten langgezogen. Cuticula dünn, glatt. Vorderende mit 6 deutlichen Lippen und 10 langen Borsten ($^1/_4$ der entspr. Breite). Mundhöhle lang und schmal, $^1/_{13}$—$^1/_{17}$ der Oesophaguslänge. Dorsalwand hinten an der Aussenkante einen kleinen Vorsprung aufweisend. Ventralzahn gross, langgestreckt. Seitenorgan klein, elliptisch.

Oesophagus ohne Besonderheiten. Nervenring hinter der Mitte gelegen. Ventraldrüse langgestreckt, postoesophagal. Porus excretorius auf der Höhe des Nervenringes. Rectum = anale Breite.

Schwanz langgezogen, allmählich schmäler werdend, mit schwachem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, etwas asymmetrisch. Vulva in der Körpermitte. Eier langgestreckt, dünnwandig.

♂ Geschlechtsapparat: Testis einfach. Spicula fast gerade; Gubernaculum fehlt; keine anale Bewaffnung.

Verwandtschaft: durch die Ausbildung des Vorderendes und des männlichen Geschlechtsapparates gut von *Mon. elegans* Kreis (18) abzutrennen.

Verhältnisse am Hinterende: Schwanzlänge ♀ 8.7; ♂ 7—7.5; Breite am Hinterende; 0.4; Spicula 1.17.

Vorkommen: Mo. 10; 25.

Mononcholaimus keiensis n. sp.

♀ 1.521; $a = 37.1$; $\beta = 4.9$; $\gamma = 11.4$; V = 49.4 %.

Körper vorne $^1/_3$ der grössten Breite, nach hinten allmählich enger werdend. Cuticula glatt, dünn. Vorderende abgerundet, mit 6 Lippen. Borsten und Papillen fehlen. Mundhöhle langgestreckt, $^1/_{13.5}$ der gesamten Oesophaguslänge. Dorsalwand in der hintern Hälfte an der Aussenseite eine scharfe Einknickung aufweisend. Ventralzahn gross. Seitenorgan elliptisch, $^1/_4$ der entspr. Breite.

Oesophagus normal. Nervenring etwas hinter der Mitte. Ventraldrüse postoesophagal. Porus excretorius hinter dem Nervenring gelegen. Rectum nicht ganz anale Breite.

Schwanz allmählich verjüngt, mit deutlichem Endkolben; Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, etwas asymmetrisch. Vulva in der Körpermitte.

Verwandtschaft: die Art zeigt Beziehungen zur der fraglichen Art *Mon. glaberoides* Allgén (5), unterscheidet sich aber durch den viel kürzeren Schwanz und die Struktur des Vorderendes.

Verhältnisse am Hinterende: Schwanzlänge 5.9; Breite am Hinterende: 0.37.

Vorkommen: Mo. 2.

Mononcholaimus papillatus n. sp.

♀ 1.706; $a = 37.9$; $\beta = 4.4$; $\gamma = 14.3$; V = 55 %.

Körper am Vorderende ganz allmählich an Breite abnehmend; hinten rel. breit bleibend. Cuticula dick, glatt. Vorderende mit 6 deutlich abgesetzten, Papillen tragenden Lippen. Mundhöhle lang, schmal, $^1/_{12}$ der oesophagalen Länge. Ventralzahn nicht auffallend gross. Seitenorgan klein, elliptisch, $^1/_{4.5}$ der entspr. Breite.

Oesophagus etwas vor der Mitte vom Nervenring umfasst. Ventraldrüse nicht gefunden. Rectum = $^2/_3$ anale Breite.

Schwanz allmählich sich verjüngend, mit deutlich abgesetztem Endkolben, welcher $^1/_5$ des Schwanzes einnimmt. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, etwas asymmetrisch. Vulva wenig hinter der Körpermitte.

Verwandtschaft: durch das Auftreten von Lippenpapillen von den andern *Mononcholaimen* deutlich sich unterscheidend.

Verhältnisse am Hinterende: Schwanzlänge 4.1; Breite am Hinterende 0.28; Schwanzkolben 0.8.

Vorkommen: Mo. 2.

Mononcholaimus tasmaniensis (Allgén).

Allgén 1927: *Mononcholaimus elegans* Kreis var. *tasmaniensis*.
Kreis 1929: *Mononcholaimus tasmaniensis* (Allgén).

♀ 1.503; $\alpha = 38.8$; $\beta = 5.5$; $\gamma = 12.1$; V = 44.8 %.

1927 (1) wurde die Art unter dem Namen *Mononcholaimus elegans* Kreis var. *tasmaniensis* von Allgén beschrieben. Dem Forscher lagen damals 2 junge Tiere vor. Wir haben 1929 (20) die Varietät zur Art erhoben. Es ist gelungen im vorliegenden Material ein reifes Weibchen zu finden.

Körper schlank, vorne 3mal verschmälert gegenüber der Breite am Oesophagushinterende. Cuticula glatt. Vorderende abgerundet, mit 6 flachen Lippen und 10 Borsten, welche $^1/_5$ der entspr. Breite sind. Mundhöhle verlängert, $^1/_{13}$ der Oesophaguslänge. Ventralzahn gross, vorne bis an die Borsten reichend. Seitenorgan elliptisch, $^1/_4$ der entspr. Breite.

Oesophagus normal. Rectum = $^3/_4$ anale Breite.

Schwanz kegelförmig verlängert, mit dorsalwärts verschobenem Ausfuhrporus der präanalen Drüsen.

♀ Geschlechtsapparat: Ovarien paarig. Vulva vor der Körpermitte. Eier gross, dünnwandig.

Verwandtschaft: die Unterschiede zu *Mon. elegans* Kreis (18, 20) sind:

1. plumperer Körper: $\alpha = 38.8$ gegenüber 51.6—66.2.
2. kürzerer Schwanz: 6.4 gegenüber 7.8—8.4.
3. grössere Mundhöhle: $^1/_{13}$ gegenüber $^1/_{16}$—$^1/_{17}$ der Oesophaguslänge.

Verhältnisse am Hinterende: Schwanzlänge 6.4; Breite am Hinterende 0.3.

Vorkommen: Mo. 25.

Mononcholaimus labiatus n. sp.

♀ 1.530—1.587; $\alpha = 30.3$—31.4; $\beta = 5.8$—6.7; $\gamma = 14.7$—15.7; V = 47.3—47.7 %.
♂ 1.395—1.564; $\alpha = 40.6$—43.3; $\beta = 6.3$—6.4; $\gamma = 15.2$.

Körper beim Männchen schlanker als beim Weibchen, dafür aber beim Weibchen am Vorderende stärker verschmälert; nach hinten allmählich sich verjüngend. Cuticula glatt, dünn. Vorderende mit 6 stark entwickelten Lippen, von denen jede eine Borste trägt. Mundhöhle deutlich zweiteilig: der breitere vordere Teil beträgt $^1/_3$ der gesamten Mundhöhle und ist ausgebuchtet und durch einen Cuticularring vom hintern Teil getrennt. Dieser zeigt verdickte Wände. Mundhöhle = $^1/_{11.5}$—$^1/_{12.5}$ der Oesophaguslänge. Ventralzahn gross, in die Mitte des ersten Teiles ragend. Seitenorgan?

Oesophagus normal, etwas hinter der Mitte vom Nervenring umgeben. Ventraldrüse postoesophagal; Porus excretorius auf der Höhe des Nervenringes. Cardia verlängert, dreieckig. Rectum = anale Breite.

Schwanz allmählich an Breite abnehmend, mit schwachem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, symmetrisch. Vulva vorgewölbt, etwas vor der Körpermitte. Eier langgestreckt, dünnschalig.

♂ Geschlechtsapparat: Hoden einfach, fast bis zur Cardia reichend. Spicula wenig gebogen. Proximalende schwach erweitert, distal spitz endend. Gubernaculum fehlt. Prä- und postanal je 5 lange Borsten.

Verwandtschaft: durch die Ausbildung des Vorderendes sofort von den andern Arten des Genus zu unterscheiden.

Verhältnisse am Hinterende: Schwanzlänge ♀ 4.5—5; ♂ 5.1—5.2; Breite am Hinterende: 0.33—0.37 resp. 0.3—0.32; Spicula 1.1.

Vorkommen: Mo. 6; 11; 23; 32; 35.

Mononcholaimus parasetosus n. sp.

♀ 1.748—2.029 (1.886); α = 43.4—52.0 (47.1); β = 6.2—6.8 (6.4); γ = 11.4—13.2 (12.3); V = 49.6—53.9 % (51.7 %).

♂ 1.721—1.748 (1.735); α = 51.7—55.2 (53.5); β = 5.7—5.9 (5.8); γ = 11.6.

Körper schlank, beim Männchen etwas eleganter als beim Weibchen. Cuticula glatt, dünn. Vorderende mit 6 schwachen Lippen, dahinter 10 Borsten, welche $^1/_4$ der entspr. Breite sind. Hinter den Lippen eine deutliche Einschnürung. Mundhöhle lang, schmal, $^1/_{14}$—$^1/_{16}$ der Oesophaguslänge. Ventralzahn breit, pyramidenförmig, in Lateralansicht lang und schlank, weit nach vorne ragend. Seiten-

organ länglich-elliptisch, $^1/_3$ der entspr. Breite beim Weibchen, fast kreisförmig und $^1/_4$ der entspr. Breite beim Männchen.

Oesophagus erst nach dem Nervenring deutlich anschwellend. Dieser liegt etwas hinter der Mitte. Ventraldrüse nicht gefunden. Cardia mit Cuticularverstärkung. Rectum = anale Breite.

Schwanz langgestreckt, mit schwachem Endkolben. Drüsen vermutlich präanal.

♀ Geschlechtsapparat: Ovarien paarig. Vulva etwas hinter der Körpermitte. Eier auffallend langgestreckt, dünnschalig.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula fast gerade. Gubernaculum fehlt. Präanal 3, postanal 2 Borsten.

Verwandtschaft: gegenüber *Mon. elegans* Kreis (18, 20) und *Mon. setosus* n. sp. sind die wichtigsten Unterschiede im Vorderende und im männlichen Geschlechtsapparat zu suchen.

Verhältnisse am Hinterende: Schwanzlänge ♀ 7.2—8.3; ♂ 8.2—8.3; Breite am Hinterende: 0.33—0.4 resp. 0.35—0.4; Spicula 1.2.

Vorkommen: Mo. 10.

Mononcholaimus conicaudatus n. sp.

juv. 1.337; $\alpha = 62$; $\beta = 4.45$; $\gamma = 22.5$.

Körper sehr schlank, vorne halb so breit wie der grösste Durchmesser. Cuticula sehr dünn. Vorderende mit 6 flachen, papillenlosen Lippen und 10 Kopfborsten, $^1/_3$—$^1/_4$ der entspr. Breite. Mundhöhle deutlich zweiteilig, an *Mon. labiatus* n. sp. erinnernd. Vordere Hälfte breit; Mundhöhle $^1/_{21}$ der Oesophaguslänge. Ventralzahn in die Hälfte des vorderen Teiles reichend. Seitenorgan fast kreisförmig, $^1/_5$ der entspr. Breite.

Oesophagus fast zylindrisch. Nervenring etwas hinter seine Mitte. Ventraldrüse langgestreckt, postoesophagal. Porus excretorius 3.5 Mundhöhlenlängen postanteriad. Rectum = anale Breite.

Schwanz konisch, abgerundet, mit verstärkter Endcuticula. Drüsen präanal.

Verwandtschaft: der typische Bau des Schwanzes unterscheidet die Art von den übrigen Vertretern des Genus.

Verhältnisse am Hinterende: Schwanzlänge: 4.7; Breite am Hinterende: 0.5.

Vorkommen: Mo. 1.

Mononcholaimus bandaensis n. sp.

♀ 1.552—1.686 (1.616); α = 39.1—44.6 (41.1); β = 4.7—5.3 (5.1); γ = 13.4—14.2 (13.8); V = 49.5—54.3 % (51.3 %).

♂ 1.389—1.715 (1.507); α = 40.6—47.7 (43.3); β = 4.8—5.1 (4.9); γ = 12.8—13.8 (13.3).

Körper beim Männchen in der Regel schlanker als beim Weibchen. Cuticula glatt, dünn, mit feinen Sandpartikelchen, und Teilstücken von Diatomeen und Protozoen, ähnlich wie bei *Viscosia viscosa* (Bast.) (6), behaftet. Vorderende mit 6 niederen Lippen und 6 Papillen. Mundhöhle rel. kurz, $^1/_{11}$—$^1/_{16.5}$ der Oesophaguslänge; Wände mit sockelartigen innern Vorsprüngen in der hintern Hälfte. Ventralzahn gross. Seitenorgan elliptisch, $^1/_3$ des entspr. Durchmessers.

Oesophagus normal. Nervenring schmal, knapp vor dem 2. Oesophagusdrittel liegend. Ventraldrüse postoesophagal; Porus excretorius postneural. Cardia langgestreckt. Rectum = $^3/_4$ anale Breite.

Schwanz allmählich an Breite abnehmend, mit schwachem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig. Vulva in der Körpermitte. Eier langgestreckt.

♂ Geschlechtsapparat: Hoden unpaar. Spicula fast gerade, proximal schwach geknöpft, distal spitz. Gubernaculum und Analbewaffnung fehlen.

Verwandschaft: es sind gewisse Beziehungen zu *Mon. keiensis* n. sp. festzustellen; doch fehlen dieser Art die Kopfpapillen, ausserdem ist die Mundhöhle bei *Mon. bandaensis* durchschnittlich kleiner.

Verhältnisse am Hinterende: Schwanzlänge ♀ 5.1—5.4; ♂ 6—6.5; Breite am Hinterende 0.23—0.25 resp. 0.27—0.3; Spicula 1—1.2.

Vorkommen: Mo. 2; 11; 32.

Dioncholaimus n. g.

Typ.: *Dioncholaimus brevicavatus* n. sp.

Kleine, rel. schlanke Würmer. Vorderende nur mit Lippen versehen. Mundhöhle klein, becherförmig, mit 2 kleinen Zähnen, dorsal und ventral gelegen. Seitenorgan? 1 Spiculum mit kleinem Gubernaculum. Hinterende konisch, mit fingerförmig verengtem Endtubus. Weibchen unbekannt.

Das Vorhandensein von nur 2 Zähnen in der Mundhöhle lässt vielleicht darauf schliessen, dass das Genus eine Zwischenstellung zwischen *Mononcholaimus* Kreis (18) und den dreizähnigen Gattungen der Familie einnimmt.

Dioncholaimus brevicavatus n. sp.

♂ 2.981; $a = 38.2$; $\beta = 6.1$; $\gamma = 19.6$.

Das Vorderende des Körpers beträgt nur $^1/_6$ der grössten Breite. Die Cuticula ist glatt, dick. Vorderende mit 6 Lippen. Papillen und Borsten fehlen. Mundhöhle becherförmig, zu $^2/_3$ im Oesophagus eingebettet, sehr klein, i. e. $^1/_{27}$ der Oesophaguslänge. Es sind ein Dorsal- und ein Ventralzahn vorhanden, welche sich fast am Vorderende der Höhle befinden. Am vordern Ende der Mundhöhle ist eine Art Reibflächenmuskulatur zu sehen. Seitenorgan fehlt.

Oesophagus allmählich breiter werdend, vor der Mitte vom Nervenring umfasst. Rectum etwas kleiner als anale Breite.

Schwanz allmählich an Breite abnehmend, mit fingerförmigem Endtubus, welcher eine kurze Borste besitzt. Von den 3 Schwanzdrüsen liegen 2 präanal und eine postanal.

♂ Geschlechtsapparat: Hoden sehr lang gestreckt. 1 Spiculum, das distal dorsal abgebogen ist. Gubernaculum stäbchenförmig. Gerade hinter dem After eine kleine Papille.

Verhältnisse am Hinterende: Schwanzlänge 3; Breite am Ende 0.15; Spiculum 0.65; Gubernaculum 0.23.

Vorkommen: Mo. 12.

Paroncholaimus parvus n. sp.

♂ 3.501; $a = 46.6$; $\beta = 4.9$; $\gamma = 106.5$.

Körper schlank, vorne auf die Hälfte der grössten Breite verschmälert, hinten abgerundet. Cuticula glatt, mit zerstreuten Borsten. Längsmuskulatur gut entwickelt. Vorderende abgeplattet; 6 Papillen tragende, flache Lippen; 10 kurze Borsten ($^1/_6$ der entspr. Breite). Mundhöhle lang, schmal, $^1/_{11}$ der Oesophaguslänge. Dorsalzahn klein, an der Mundhöhlenbasis. Subventralzähne vor der Mundhöhlenmitte, klein. Seitenorgan kreisförmig, $^1/_8$ der entspr. Breite.

Oesophagus am Vorderende breiter als am Nervenring, welcher etwas hinter dem ersten Oesophagusdrittel liegt. Ventraldrüse lang-

gestreckt, postoesophagal. Porus excretorius $3^1/_2$ Mundhöhlenlängen hinter dem Vorderende. Cardia mit Cuticularverstärkung. Darm Ueberreste von Arthropoden enthaltend, wie Kieferapparate, Borsten, was für die räuberische Lebensweise des Tieres spricht. Rectum fast anale Breite.

Schwanz sehr kurz, abgerundet, ähnlich wie bei *Paronch. arcticus* Kreis (19). Drüsen anscheinend rudimentär.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula bogenförmig gekrümmt, proximal geknöpft, distal spitz. Gubernaculum messerartig mit fingerförmigem Distalende. Radialmuskulatur kräftig. Anale Bewaffnung fehlt.

Verwandtschaft: von *Paronch. parapapilliferus* Micol. (24) durch kürzere Spicula und Fehlen der Analbewaffnung leicht abzutrennen.

Verhältnisse am Hinterende: Schwanzlänge 0.7; Spicula 1; Gubernaculum 0.6.

Vorkommen: Mo. 14; 22; 24.

Paroncholaimus ocellatus n. sp.

♀ 2.085—3.088 (2.635); α = 45.1—60.5 (50.8); β = 5.8—7.2 (6.6); γ = 26.6—31.3 (28.6); V = 52.1—53.2 % (52.7 %).

♂ 2.388—2.945 (2.757); α = 67.7—79.1 (73.5); β = 6.4—7.6 (6.9); γ = 26.5—27.7 (27.3).

Körper beim Männchen bedeutend schlanker als beim Weibchen, dafür aber am Vorderende nicht so stark an Breite abnehmend ($^1/_2$ gegenüber $^1/_3$). Hinterende breit abgerundet. Cuticula glatt, mit zerstreuten Borsten. Seitenfelder aus drei Reihen hexagonaler Zellen sich zusammensetzend. Vorderende mit 6 undeutlichen Lippen. 10 kurze Borsten, $^1/_4$—$^1/_6$ der entspr. Breite. Mundhöhle rel. klein, $^1/_{16}$—$^1/_{20}$ der Oesophaguslänge, mit schmalen hinten zusammenneigenden Wänden. Der kleine Dorsalzahn liegt hinter den beiden andern Zähnen; er ist beim Weibchen gleich gross wie diese, beim Männchen kleiner. Die Spitzen der Submedianzähne liegen auf der Höhe der Kopfborsten. Seitenorgan kreisförmig, $^1/_{6.5}$—$^1/_7$ der entspr. Breite, beim Weibchen weiter nach hinten verrückt denn beim Männchen.

Oesophagus normal. Nervenring in der Mitte gelegen. Dahinter eine Pigmentanhäufung ohne Linse, welche als rudimentärer Ozellus zu betrachten ist. Ventraldrüse gross, elliptisch, postoesophagal. Porus nicht ganz 2 Mundhöhlenlängen hinter dem Vorderende. Cardia langgestreckt. Rectum etwas grösser als die anale Breite.

Schwanz verlängert, breit abgerundet. Vermutlich beim Weibchen keine, beim Männchen nur eine präanale Drüse. Der ganze Drüsenapparat ist stark reduziert.

♀ Geschlechtsapparat: Ovarien paarig; Vulva etwas hinter der Körpermitte.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula rechtwinklig gebogen. Proximalende knopfartig, Distalende spitz. Gubernaculum kelchförmig, mit posteriadem und anteriadem Fortsatz; 1 kleine präanale Papille.

Verwandtschaft: durch das Auftreten des Ozellus und die Ausbildung des Spicularapparates von den bekannten Arten leicht abzutrennen.

Verhältnisse am Hinterende: Schwanzlänge ♀ 2.65—3.55; ♂ 2.4—3.5; Breite am Hinterende 0.37—0.46 resp. 0.29—0.33. Spicula 0.96—1.4; Gubernaculum 0.47—0.53.

Vorkommen: Mo. 14; 22; 25; 34; 35.

Paroncholaimus elongatus n. sp.

juv. 1.200—1.638; a = 23.8—26.7; β = 3.9—4.3; γ = 9.4—10.6.

Körper ziemlich plump, vorne durchschnittlich auf $^1/_3$ der grössten Breite verschmälert. Cuticula dick, mit zerstreuten Borsten. Muskulatur sehr stark entwickelt, zerfallend in Längs- und Radialmuskulatur. Vorderende mit 6 flachen papillentragenden Lippen. 10 Kopfborsten, $^1/_4$—$^1/_5$ der entspr. Breite. Mundhöhle lang, $^1/_{10}$—$^1/_{11.5}$ der Oesophaguslänge einnehmend. Ventral- und Submedianzahn auf fast gleicher Höhe stehend; Dorsalzahn an der Basis der Mundhöhle. Seitenorgan elliptisch, $^1/_4$ der entspr. Breite, vor dem Dorsalzahn liegend.

Oesophagus normal. Nervenring breit, in der Mitte gelegen. Ventraldrüse postoesophagal; Porus excretorius 3 Mundhöhlenlängen postanteriad. Rectum = anale Breite.

Schwanz verlängert, mit schwachem Endkolben. Ob Drüsen oder nur Drüsenschläuche vorhanden sind, konnte infolge des fettglänzenden Granula nicht mit Sicherheit festgestellt werden.

Verwandtschaft: zeigt gewisse Beziehungen zu *Par. donsi* Allgén (4), sofern seine Beobachtungen richtig sind.

Es sei beigefügt, dass bei einem Exemplar im Hinterteile des Darmes Protozoen im Zweizellstadium zu sehen waren. Vermutlich handelt es sich hier um *Haplosporidiidae* Caull. (13).

Verhältnisse am Hinterende: Schwanzlänge 4.8—5.1; Breite am Hinterende 0.33—0.35.

Vorkommen: Mo. 8; 26; 32.

Pseudoparoncholaimus n. g.

Typ.: *Oncholaimus filicaudatus* Ditlevsen (11) 1926.

Mittelgrosse, schlanke Würmer, welche dadurch charakterisiert sind, dass sie einen langen fadenförmigen Schwanz besitzen. Vorderende mit Lippen und 10 Borsten. Mundhöhle mit 3 Zähnen, deren Anlage die gleiche wie bei *Paroncholaimus* Filipjev (14) ist. Seitenorgan elliptisch bis kreisförmig. Weiblicher Geschlechtsapparat paarig, ohne Röhrenorgan. Spicula gross; Gubernaculum fehlt. Anale Bewaffnung des Männchens fehlend oder vorhanden. Schwanzdrüsen = 0.

Das Genus steht sehr nahe bei *Paroncholaimus* Fil. (14), unterscheidet sich aber, abgesehen von dem fadenförmigen Schwanze, durch das Fehlen des Gubernaculums von der genannten Gattung.

3 Arten: *Pseudoparoncholaimus filicaudatus* (Ditlevsen).
— *ditlevseni* n. sp.
— *longissime-caudatus* n. sp.

Pseudoparoncholaimus ditlevseni n. sp.

♀ 5.884—6.146 (6.015); α = 48.3—59.8 (54.1); β = 6.8—7.9 (7.3); γ = 2.85; V = 39.9 %.
♂ 4.941; α = 57.3; β = 6.3; γ = ? (abgerissen).

Der schlanke Körper ist am Vorderende beim Weibchen $^1/_4$, beim Männchen $^1/_3$ der grössten Körperbreite und wird nach hinten in einen langen fadenförmigen Schwanz ausgezogen. Die dünne Cuticula trägt am vordern Teile einige zerstreute kurze Borsten. Vorderende mit sehr undeutlichen Lippen. Papillen fehlen. 10 Kopfborsten, welche $^1/_4$—$^1/_5$ der entspr. Breite einnehmen. Die langgestreckte Mundhöhle wird beim Weibchen $^1/_{12.5}$—$^1/_{14}$, beim Männchen $^1/_{13.5}$ der gesamten Oesophaguslänge. Beide Mundhöhlenwände sind mehr schichtig. Der Dorsalzahn befindet sich am Hinterende des 2. Mundhöhlendrittels, während die beiden ventro-medianen Zähne im 2. Viertel der Höhle liegen und sehr klein bleiben. Das elliptische Seitenorgan erreicht ca. $^1/_4$ der entspr. Breite.

Oesophagus ohne Besonderheiten. Nervenring in der Mitte.

Ventraldrüse langgestreckt. Ihr Porus befindet sich um $1^1/_2$ Mundhöhlenlängen hinter dem Vorderende. Rectum = analer Durchmesser.

Schwanz fadenförmig, mit sehr kurzem kegelförmigem Basalteil.

♀ Geschlechtsapparat: Ovarien paarig, zurückgeschlagen, kurz.

♂ Geschlechtsapparat: ein langes, gebogenes Spiculum ohne accessorisches Stück. Vor dem After 2 Papillen, von denen die vordere rudimentär bleibt. Dazu tritt eine stark entwickelte anale Muskulatur.

Verwandtschaft: in gewissen Beziehungen ähnelt die Art *Onch. filicaudatus* Ditl. (11), unterscheidet sich aber vor allem durch den männlichen Geschlechtsapparat, sowie die anatomischen Verhältnisse des Vorderendes.

Verhältnisse am Hinterende: Schwanzlänge ♀ 46; Breite am Hinterende 0.06; Spiculum 2; 1. Papille ♂ 4; 2. Papille ♂ 2.5.

Vorkommen: Mo. 6.

Pseudoparoncholaimus longissime-caudatus n. sp.

juv. 3.485; $\alpha = 56.6$; $\beta = 6.3$; $\gamma = 2.95$.

Die Unterschiede zur vorhergehenden Art liegen vor allem im Bau der Mundhöhle, welcher eine scharfe Trennung der beiden Species erlaubt.

Der Körper ist schlank, hinten langgezogen, fadenförmig. Die Cuticula bleibt dünn und besitzt vorne zerstreute Borsten. Das Vorderende weist undeutliche Lippen, ohne Papillen auf. 10 Kopfborsten, welche $^1/_4$ der entspr. Breite erreichen. Die Mundhöhle ist dreimal länger als breit. Ihre Wände sind dreischichtig. Der kleine Dorsalzahn liegt am Beginn des letzten Mundhöhlendrittels. Die beiden andern Zähne sind mächtiger entwickelt als bei der vorigen Art und sind am Beginn des 2. Mundhöhlendrittels zu sehen. Seitenorgan bohnenförmig, nicht ganz $^1/_4$ der entspr. Breite besitzend. Porus der Ventraldrüse etwas mehr als 3 Mundhöhlenlängen hinter dem Vorderende. Rectum = anale Breite.

Schwanz länger als $^1/_3$ der gesamten Körperlänge, fadenförmig.

Vorkommen: Mo. 35.

Viscosia glabra (Bast.).

syn. *Oncholaimus glaber* Bastian 1865.
de Man 1890.
Filipjev 1918, 22.
Micoletzky 1924.

♀ 1.679; $\alpha = 32.5$; $\beta = 6.1$; $\gamma = 8.6$; V = 51 %.

Zur Beschreibung von de Man 1890 (22) ist nur wenig beizufügen. Die Mundhöhle ist $^1/_{14}$ der Oesophaguslänge; das Seitenorgan wird gross, becherförmig, $^1/_3$ der entspr. Breite. Der an Stelle der Borsten auftretende 2. Papillenkreis ist auch hier festzustellen. Der Porus der Ventraldrüse liegt $4^1/_2$ Mundhöhlenlängen postanteriad.

Vorkommen: Mo. 32.

Viscosia paridentata n. sp.

♀ 2.661—2.718 (2.689); a = 34.1—44.1 (39.0); β = 7.0—7.1 (7.05); γ = 13.5—15.0 (14.2); V = 41.4—45 % (43.2 %).

Körper schlank erscheinend, vorne nicht ganz 3mal gegenüber der grössten Breite verschmälert. Cuticula glatt, dünn. Vorderende mit 6 Lippen, welche je eine Papille aufweisen. 10 Borsten, $^1/_4$ der entspr. Breite. Mundhöhle langgestreckt, mit dicken Wänden, $^1/_{6.5}$—$^1/_{7.5}$ der Oesophaguslänge. Alle drei Zähne gleich gebaut, etwas vor der Mundhöhlenmitte gelegen. Seitenorgan vermutlich weit vorne gelegen (offene Ellipse?).

Oesophagus rel. kurz. Nervenring in der Mitte. Ventraldrüse postoesophagal. Porus excretorius am Oesophagushinterende, rosettenartig ausgebildet. Cardia gross, dreieckig. Rectum = $^2/_3$ anale Breite.

Schwanz langgezogen, mit schwachem Endkolben. Drüsen sehr wahrscheinlich postanal gelegen.

♀ Geschlechtsapparat: Ovarien paarig. Vulva wenig vor der Körpermitte.

Verwandtschaft: die Gleichartigkeit der Zähne und die Ausbildung des Porus excretorius sind für die Art typisch und unterscheidet sie von den andern Vertretern des Genus.

Verhältnisse am Hinterende: Schwanzlänge 5.8; Breite am Hinterende 0.3.

Vorkommen: Mo. 2.

Viscosia crassa n. sp.

♀ 1.611—2.235 (1.923); a = 19.6—20.9 (20.3); β = 3.8—5.2 (4.5); γ = 17.9—21.8 (19.9); V = 57.8—59 % (58.4 %).

Körper plump, vorne auf $^1/_5$ der grössten Breite verjüngt; hinten kegelförmig. Cuticula glatt. Vorderende mit 6 flachen, papillenlosen Lippen. Dahinter 10 kurze Borsten, $^1/_{10}$ der entspr. Breite.

Mundhöhle becherförmig, $^1/_{13}$ der Oesophaguslänge. Dorsalwand hinten schmal; Ventralwand hinten verbreitert. Dorsalzahn klein, hinter dem 1. Drittel der Höhle gelegen; Submedianzahn säulenförmig; Ventralzahn gross, ans Ende des 1. Fünftels der Mundhöhle reichend. Seitenorgan gross, becherförmig, $^1/_3$ des entspr. Durchmessers.

Oesophagus erst hinter dem Nervenring erweitert. Dieser liegt etwas vor der Mitte. Ventraldrüse kurz, zwischen Oesophagushinterende und Nervenring gelegen. Porus excretorius $^1/_6$—$^1/_{7.5}$ Mundhöhlenlängen postanteriad. Rectum = $^3/_4$ anale Breite.

Schwanz kurz, kegelförmig, mit grossem Endkolben.

♀ Geschlechtsapparat: Ovarien paarig, etwas asymmetrisch. Vulva hinter der Körpermitte. Eier gross, dünnschalig.

Verwandtschaft: im Bau der Mundhöhle an *Visc. langrunensis* (de Man) (22) erinnernd, durch den plumpen Körperbau aber sofort von allen Arten zu unterscheiden.

Verhältnisse am Hinterende: Schwanzlänge 2.5; Breite am Hinterende 0.25; Schwanzkolben 0.5.

Vorkommen: Mo. 6; 23.

Viscosia pseudoglabra n. sp.

♀ 1.728; $\alpha = 36.7$; $\beta = 5.5$; $\gamma = 8.1$; V = 49.9 %.

Lage des Nervenringes: 55.5 %.

Die Unterschiede zu *Visc. glabra* (de Man) (22) ergeben sich aus der folgenden Zusammenstellung.

	Viscosia glabra (de Man.)	Viscosia pseudoglabra
Kopfbewaffnung	2 Papillenkreise	1 Papillenkreis
Seitenorgan.....	$^1/_3$ entspr. Breite	$^1/_4$ entspr. Breite
Mundhöhle:		
Länge : Breite.....	1 : 2	1 : nahezu 3
Länge : Oesophaguslänge.	1 : 14	1 : 13
Porus excretorius	$4^1/_2$ Mundhöhlenlängen postanteriad	8 Mundhöhlenlängen postanteriad
Schwanzlänge ♀.....	11	8.5
Breite am Hinterende ♀.	0.4	0.2

Vorkommen: Mo. 10.

Viscosia carnleyensis (Ditlevsen).

Oncholaimus carnleyensis Ditlevsen 1921.

juv. 1.882; $\alpha = 45.9$; $\beta = 5.3$; $\gamma = 6.75$.

Der Beschreibung von Ditlevsen (10) haben wir nichts beizufügen. Die Mundhöhle erreicht $^1/_{14}$ der Oesophaguslänge. Das elliptische Seitenorgan ist $^1/_3$ der entspr. Breite. Das Hinterende ist etwas länger als bei der Ditlevsen'schen Art. Da das Tier aber noch jung ist, kann γ nicht ausschlaggebend sein.

Vorkommen: Mo. 2.

Viscosia carnleyensis (Ditlevsen) var. *tropica* n. var.

♀ 1.300; $\alpha = 35.3$; $\beta = 6.0$; $\gamma = 6.9$; V = 48.6 %.

Da die vorliegende Art im Bau des Vorderendes der *Visc. carnleyensis* so vollkommen gleicht, sich aber durch α (35.3 gegenüber 63.5) und die Schwanzlänge (10.5 gegenüber 9 anale Breite) vom Typus unterscheidet, muss sie vorläufig als Varietät der Ditlevsen'schen Art angesehen werden. Dem Vorderende sind 6 sehr flache und kleine Lippen eigen. Papillen und Borsten fehlen. Mundhöhle $^1/_{13}$ der Oesophaguslänge. Seitenorgan klein, elliptisch. Oesophagus normal. Nervenring etwas hinter seiner Mitte. Porus excretorius auf der Höhe des Nervenringes. Rectum = $^2/_3$ der analen Breite. Schwanz langgezogen, mit schwachem Endkolben. Ovarien paarig, zurückgeschlagen. Vulva wenig vor der Körpermitte.

Verhältnisse am Hinterende: Schwanzlänge 10.5; Breite am Hinterende 0.25.

Vorkommen: Mo. 2; 5.

Viscosia keiensis n. sp.

♂ 3.440; $\alpha = 76.1$; $\beta = 6.2$; $\gamma = 13.1$.

Körper sehr schlank, vorne ganz allmählich verschmälert, hinten langgezogen. Cuticula glatt. Vorderende mit 6 deutlichen Lippen und 6 Papillen. Mundhöhle klein, $^1/_{19}$ der Oesophaguslänge. Ventralzahn gross, weit nach vorne ragend. Die beiden andern Zähne liegen im 2. Mundhöhlendrittel; der Submedianzahn ist säulenförmig. Seitenorgan elliptisch, $^1/_5$ der entspr. Breite.

Oesophagus normal. Nervenring etwas vor seiner Mitte. Ventraldrüse postoesophagal, etwas postneural ausmündend.

Schwanz langgestreckt, mit schwachem Endkolben. Drüsen präanal.

♂ Geschlechtsapparat: Hoden einfach. Spicula schwach gebogen, proximal deutlich geknöpft, distal spitz. Gubernaculum fehlt. Vor dem After 3 papillenartige Borsten, ebenso 3 solche Borsten postanal. Kopulationsmuskulatur sehr stark entwickelt.

Verwandtschaft: das Vorderende erinnert an *Visc. pseudoglabra* n. sp., zeigt aber eine kleinere Mundhöhle; ausserdem ist der lange Schwanz für die Art charakteristisch.

Verhältnisse am Hinterende: Schwanzlänge 9.1; Breite am Hinterende 0.14; Spicula 1.14.

Vorkommen: Mo. 2.

Viscosia meridionalis n. sp.

♀ 1.652—1.892 (1.779); a = 32.9—38.2 (35.9); β = 5.7—6.2 (5.9); γ = 7.4—9.5 (8.35); V = 49—52.5 % (50.4 %).

♂ 1.415—1.743 (1.592); a = 31.1—42.5 (38.5); β = 5.2—6.9 (5.9); γ = 8.2—9.6 (8.9).

Körper rel. schlank, beim Weibchen fast 4mal, beim Männchen nicht ganz 3mal schmäler als die grösste Breite. Hinterende langgezogen. Cuticula glatt, dünn. Vorderende mit 6 Lippen. Papillen und Borsten scheinen zu fehlen. Mundhöhle langgestreckt, $^1/_{11}$—$^1/_{14.5}$ der Oesophaguslänge erreichend. Ventralzahn auffallend lang, fast ans Vorderende der Höhle reichend. Dorsal- und Submedianzahn klein, hinter dem ersten Mundhöhlendrittel gelegen. Seitenorgan elliptisch, $^1/_4$—$^1/_{4.5}$ der entspr. Breite.

Oesophagus normal. Nervenring etwas hinter seiner Mitte gelegen. Ventraldrüse postoesophagal. Porus excretorius direkt hinter dem Nervenring. Rectum etwas mehr als halbe Analbreite.

Schwanz allmählich sich verjüngend, mit schwachem Endkolben, beim Weibchen durchschnittlich länger als beim Männchen. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, symmetrisch. Vulva in der Körpermitte. 1—4 Eier.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula kurz, fast gerade, proximal wenig erweitert; in ein Muskelfutteral eingebettet. Gubernaculum fehlt. Je 1 sehr kleine prä- und postanale Papille, welche vermutlich funktionslos sind.

Verwandtschaft: steht in Beziehung zu *Viscosia carnleyensis* (Ditl.) (10) durch die Ausbildung der Mundhöhle und zeigt ausserdem gewisse Aehnlichkeit mit *Visc. linstowi* (de Man) (23).

Verhältnisse am Hinterende: Schwanzlänge ♀ 8.4—10.5; ♂ 7.3—9.8; Breite am Hinterende: 0.17—0.2 resp. 0.18—0.25; Spicula 1.

Vorkommen: Mo. 0; 4; 6—9; 11—16; 23—30; 32—34.

Viscosia leptolaima n. sp.

juv. 0.923—1.062; α = 30—32.3; β = 4.2—4.9; γ = 10.2—12.3.

Körper nicht sehr schlank, vorne auf $^2/_5$ der grössten Breite verjüngt. Cuticula glatt. Vorderende 6 flache Lippen, mit je 1 kleinen Papille. Dahinter 6 (10?) sehr kurze Borsten, $^1/_8$—$^1/_9$ der entspr. Breite. Mundhöhle schmal, $^1/_{9.5}$—$^1/_{10}$ der Oesophaguslänge. Ventralzahn sehr gross; Dorsalzahn klein; Submedianzahn stumpf, kegelförmig. Seitenorgan elliptisch, $^1/_3$ der entspr. Breite.

Oesophagus etwas hinter der Mitte vom Nervenring umfasst. Ventraldrüse postoesophagal. Porus excretorius nicht gefunden. Rectum etwas länger als die anale Breite.

Schwanz etwas verlängert, mit schwachem Endkolben. Drüsen präanal.

Verwandtschaft: es bestehen gewisse Beziehungen zu *Visc. stenolaima* Fil. (17) und *Visc. carnleyensis* Ditl. (10). Die Unterschiede liegen im Vorderende.

Verhältnisse am Hinterende: Schwanzlänge 4.2—4.4; Breite am Hinterende 0.2.

Vorkommen: Mo. 2.

Viscosia brachylaima Filipjev.

Filipjev 1925.

juv. 1.488—2.038; α = 25.9—27.4; β = 4.4—4.9; γ = 10.9—12.1.

Körper nicht sehr schlank. Cuticula glatt. Vorderende mit 6 flachen Lippen. 10 Borsten, $^1/_4$—$^1/_5$ der entspr. Breite. Mundhöhle = $^1/_{12}$—$^1/_{14.5}$ der Oesophaguslänge. Ventralwand deutlich zweischichtig, hinten nach Innen abgebogen. Ventralzahn gross bis an die Kopfborsten reichend. Die beiden andern Zähne liegen etwas hinter der Mundhöhlenmitte. Seitenorgan gross, flach elliptisch, fast $^1/_3$ der entspr. Breite.

Oesophagus normal. Nervenring in der Mitte. Ventraldrüse klein, postoesophagal. Porus excretorius 3 Mundhöhlenlängen postanteriad. Rectum = anale Breite.

Schwanz allmählich verschmälert, mit verlängertem Endkolben. Drüsen präanal. Zu bemerken ist, dass zwischen dem Längsmuskelschlauch und dem Darm zahlreiche Sporonten parasitischer Protozoen vorhanden waren, welche vermutlich zu *Myxosporidia* Btli. zu rechnen sind.

Verhältnisse am Hinterende: Schwanzlänge 3.7—4.5; Breite am Hinterende 0.13—0.19.

Vorkommen: Mo. 24.

Viscosia bandaensis n. sp.

juv. 1.103—2.116; α = 41.2—51.6; β = 4—6; γ = 10.3—17.8.

Körper: schlank, nach vorne erst präneural deutlich an Breite abnehmend. Cuticula glatt, dünn. Vorderende mit 6 undeutlichen Lippen. Anscheinend 6 kurze Borsten, $^1/_5$—$^1/_6$ der entspr. Breite. Mundhöhle lang, $^1/_{14}$—$^1/_{15}$ der Oesophaguslänge, mit Ventralwand, welche viel stärker als die Dorsalwand gebaut ist. Ventralzahn gross, über die Kopfborsten hinausreichend. Die beiden andern Zähne gleichen in ihre Anlage denen von *Visc. brachylaima* Fil. (17). Seitenorgan elliptisch, $^1/_4$ der entspr. Breite.

Oesophagus erst postneural sich erweiternd. Nervenring etwas hinter seine Mitte. Die lange Ventraldrüse ist postoesophagal. Porus excretorius $2^1/_2$ Mundhöhlenlängen postanteriad. Cardia sehr langgezogen. Rectum = anale Breite.

Schwanz verlängert, mit schwachem Endkolben. Drüsen präanal.

Verwandtschaft: durch die Ausbildung des Vorderendes unterscheidet sich die Art von *Visc. brachylaima* Fil. (17) und *stenolaima* Fil. (17) sehr deutlich.

Verhältnisse am Hinterende: Schwanzlänge: 4.1—6.5; Breite am Hinterende 0.14—0.25.

Vorkommen: Mo. 16.

Viscosia isotonchula n. sp.

♀ 1.972; α = 40; β = 7.4; γ = 15.5; V = 50.8 %.

Körper schlank, vorne $^1/_3$ der grössten Breite. Cuticula glatt. Vorderende mit 6 schwach entwickelten papillenlosen Lippen,

während sie bei *Visc. paridentata* n. sp. Papillen aufweisen. 10 Borsten, lang, $^1/_3$ der entspr. Breite. Mundhöhle lang, $^1/_{7.5}$ der Oesophaguslänge. Wände einfach. Alle 3 Zähne sind gleich gebaut, stehen aber an Grösse denen von *Visc. paridentata* weit zurück und reichen wenig über die Mundhöhlenmitte hinaus. Seitenorgan gross, elliptisch, $^1/_2$ der entspr. Breite.

Oesophagus regelmässig anschwellend. Nervenring schmal, hinter der Mitte gelegen. Porus excretorius vermutlich in der Höhe des Nervenringes. Rectum = $^1/_2$ anale Breite.

Schwanz allmählich sich verjüngend, mit schwachem Endkolben und ventral mit einer kurzen Endborste.

♀ Geschlechtsapparat: Ovarien paarig. Vulva in der Körpermitte.

Verwandtschaft: die Unterschiede zu *Viscosia paridentata* n. sp. wurden bereits hervorgehoben.

Verhältnisse am Hinterende: Schwanzlänge 4.4; Breite am Hinterende 0.26.

Vorkommen: Mo. 6.

Viscosia nuda n. sp.

♀ 1.759—1.939 (1.870); α = 34.2—43.1 (38.8); β = 5.8—6.2 (6.0); γ = 7.1—8.1 (7.5); V = 48.7—49.2 % (49.0 %).

♂ 1.625—1.931 (1.763); α = 44.7—45.3 (45.1); β = 5.2—6.0 (5.7); γ = 7.3—8.0 (7.6)

Körper beim Männchen etwas schlanker als beim Weibchen, dessen präoesophagaler Teil eleganter gebaut ist. Hinterende langgezogen. Cuticula glatt. Vorderende an *Visc. carnleyensis* (Ditl.) (10) erinnernd, mit 6 flachen, unbewaffneten Lippen. Borsten fehlen. Mundhöhle lang, schmal, $^1/_{13}$—$^1/_{17.5}$ der Oesophaguslänge. Dorsalwand stärker ausgebogen als die Ventralwand. Der kleine Dorsalzahn liegt etwas vor der Mundhöhlenmitte; Submedianzahn spitz, kegelförmig; Ventralzahn gross, fast an das Vorderende reichend. Seitenorgan flach, elliptisch, $^1/_3$ der entspr. Breite.

Oesophagus allmählich breiter werdend. Nervenring hinter seiner Mitte. Ventraldrüse postoesophagal; Porus excretorius vermutlich in der Höhe des Nervenringes ausmündend. Der Darm zeigt an seinem Hinterende Drüsen, welche mit der Subepidermis in Verbindung

stehen und vermutlich der innern Sekretion dienen. Rectum kaum anale Breite.

Schwanz sehr langgezogen, mit schwach entwickeltem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig. Vulva in der Körpermitte. Eier lang, dickschalig.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula wenig gebogen. Gubernaculum fehlt. Präanal eine sehr kleine Papille.

Verhältnisse am Hinterende: Schwanzlänge ♀ 12.1—12.5; ♂ 13—13.5; Breite am Hinterende 0.2—0.25 resp. 0.23—0.25; Spicula 1.3—1.9.

Vorkommen: Mo. 1; 15.

Viscosia macrorhopalocerca n. sp.

juv. 0.982; $a = 37.8$; $\beta = 5.1$; $\gamma = 14.0$.

Körper schlank, ganz allmählich nach vorne sich verjüngend. Cuticula glatt, dünn. Vorderende mit 6 flachen Lippen. 10 Kopfborsten, $^1/_4$—$^1/_5$ der entspr. Breite. Dahinter ist das Vorderende leicht eingeschnürt. Mundhöhle 3mal länger als breit, $^1/_7$ der Oesophaguslänge. Wände dünn, vorne stark zusammenneigend. Ventralzahn gross, nicht bis zu den Borsten reichend; Dorsalzahn klein; Submedianzahn auffallend schwach entwickelt. Seitenorgan nicht gefunden.

Oesophagus etwas vor seinem 2. Drittel von Nervenring umfasst. Ventraldrüse nicht gefunden. Rectum grösser als die anale Breite.

Schwanz regelmässig abnehmend, mit grossem Endkolben. Drüsen präanal.

Verwandtschaft: gehört in die Nähe von *Visc. stenolaima* Fil. (17), unterscheidet sich aber davon durch das Fehlen der Kopfpapillen, die langen Borsten und die Ausbildung des Hinterendes.

Verhältnisse am Hinterende: Schwanzlänge 4.37; Breite am Hinterende 0.37.

Vorkommen: Mo. 6.

Viscosia dubiosa n. sp.

juv. 2.856; $a = 46.7$; $\beta = 5.5$; $\gamma = 14.5$.

Körper schlank, vorne auf fast $^1/_4$ der grössten Breite verjüngt; hinten langgezogen. Cuticula rel. dick. Längsmuskulatur auffallend

stark entwickelt. Vorderende mit 6 sehr flachen, papillentragenden Lippen. Mundhöhle rel. klein, $^1/_{19}$ der oesophagalen Länge. Dorsalwand viel schwächer als die Ventralwand. Ventralzahn sehr gross, fast die ganze Mundhöhlenbreite an der Basis einnehmend; wenig hinter seinem Vorderende die beiden andern Zähne, von denen der Submedianzahn obeliskartig gebaut ist. Seitenorgan fast kreisförmig, $^1/_{3.5}$ der entspr. Breite.

Oesophagus etwas vor der Mitte vom Nervenring umgeben. Porus excretorius direkt hinter dem Nervenring. Rectum wenig länger als die anale Breite.

Schwanz langgezogen, mit schwachem Endkolben. Drüsen präanal.

Verwandschaft: die Art nimmt eine Zwischenstellung *Visc. keiensis* n. sp. und *Visc. pseudoglabra* n. sp. ein.

Verhältnisse am Hinterende: Schwanzlänge 6.1; Breite am Hinterende 0.19.

Vorkommen: Mo. 6.

Meroviscosia n. g.

Typ.: *Meroviscosia longicaudata* n. sp.

Mittelgrosse, schlanke Würmer. Vorderende mit Lippen, Papillen und Borsten. Mundhöhle langgestreckt mit rudimentärer Dorsalwand. Ventralzahn gross. Seitenorgan sehr gross. Hinterende verlängert. Ovarien paarig. Männchen unbekannt.

Im äusseren Habitus an *Viscosia* de Man (22) anschliessend, aber durch den Bau der dorsalen Mundhöhlenwand deutlich von der de Man'schen Gattung abgetrennt.

Meroviscosia longicaudata n. sp.

♀ 2.653; $\alpha = 40.4$; $\beta = 5.5$; $\gamma = 9.3$; V = 50.7 %.

Körper schlank, vorne nicht ganz 4mal gegenüber der grössten Breite verschmälert; hinten in einen langen Schwanz ausgezogen. Cuticula dick, mit zerstreuten Borsten. Vorderende mit 6 undeutlichen Lippen, mit je einer Papille. 10 Kopfborsten, $^1/_6$ der entspr. Breite. Mundhöhle langgestreckt, $^1/_{15}$ der Oesophaguslänge. Dorsalwand rudimentär entwickelt. Der fehlende Wandteil wird durch die Verlängerung des Dorsalzahnes gebildet. Ventralwand normal. Ven-

tralzahn gross, über die Mundhöhlenmitte ragend. Submedianzahn klein. Seitenorgan gross, becherförmig, fast $^1/_2$ des entspr. Durchmessers, mit deutlicher Sensilla.

Oesophagus vorne dorsal verlängert. Nervenring in der Mitte. Ventraldrüse ?. Porus excretorius vermutlich hinter dem Nervenring. Rectum kaum anale Breite.

Schwanz langgestreckt, erstes Drittel konisch, dann gleich breit bleibend, ohne deutlichen Endkolben.

♀ Geschlechtsapparat: Ovarien paarig, etwas asymmetrisch infolge Verkürzung des Hinterastes. Vulva in der Körpermitte, mit deutlicher Vulvulardrüse.

Verhältnisse am Hinterende: Schwanzlänge 10; Breite am Hinterende 0.14.

Vorkommen: Mo. 15.

Oncholaimus brevisetosus n. sp.

juv. 0.972—1.497; α = 39.5—52.1; β = 7.5—9.1; γ = 9.9—13.0.

Die Art ist ausgezeichnet durch den Bau des Vorderendes, welches ausser ganz rudimentären Lippen noch 10 sehr kurze Borsten aufweist. Auf der Höhe der Mundhöhlenmitte ist der Kopf leicht eingeschnürt. Mundhöhle $^1/_{10}$—$^1/_{14}$ der Oesophaguslänge. Ventralzahn mächtig entwickelt; Dorsalzahn klein, ebenso der Submedianzahn. Seitenorgan nahezu kreisförmig, $^1/_6$ des entspr. Durchmessers.

Oesophagus normal. Nervenring in der Mitte. Ventraldrüse langgestreckt. Porus excretorius $2^1/_3$ Mundhöhlenlängen postanteriad. Rectum = anale Breite.

Schwanz kegelförmig, langgestreckt, mit deutlichem Endkolben. Drüsen vermutlich im Schwanzinnern.

Verwandtschaft: die Art zeigt im Vorderende gewisse Anklänge an *Onch. dujardini* de Man (21).

Verhältnisse am Hinterende: Schwanzlänge 5.8; Breite am Hinterende 0.4.

Vorkommen: Mo. 3; 9.

Oncholaimus elegans n. sp.

♀ 2.763; α = 67.4; β = 6.2; γ = 39.5; V = 66.1 %.

Körper langgestreckt, doch wenig verjüngt. Das Vorderende hat noch die halbe grösste Breite. Cuticula glatt, mit zerstreuten Bor-

sten. Vorderende mit 6 deutlichen Lippen, 6 Papillen und 10 langen Borsten, welche $^1/_2$ des entspr. Durchmessers betragen, an *Onch. rugosus* Schuurmans-Stekhoven (26) erinnernd. Hinter den Borsten eine deutliche Einschnürung. Mundhöhle rel. gross, $^1/_{13.5}$ der Oesophaguslänge. Dorsalzahn klein; Submedianzahn keulenförmig, Ventralzahn sehr gross, über den Borstenkreis hinausragend. Seitenorgan elliptisch, $^1/_{4.5}$ der entspr. Breite.

Oesophagus normal. Nervenring etwas vor der Mitte. Porus excretorius nicht ganz 2 Mundhöhlenlängen postanteriad. Rectum = analer Durchmesser.

Schwanz kurz, fast zylindrisch, an *Onch. longidentatus* Schuurman-Stekhoven (26) erinnernd. Drüsen im Schwanzinnern.

♀ Geschlechtsapparat: Ovarien kurz. Vulva am Ende des 2. Körperdrittels. Eier langgestreckt, dünnwandig. Röhrenorgan sackartig.

Verhältnisse am Hinterende: Schwanzlänge 2.5; Breite am Hinterende 0.5.

Vorkommen: Mo. 3.

Oncholaimus keiensis n. sp.

♀ 2.431—2.481 (2.456); α = 26.9—32.9 (29.9); β = 6.7;
γ = 12.0—15.6 (13.8); V = 44.9 %.

Körper gegenüber der grössten Breite am Vorderende 3mal verschmälert, nach hinten allmählich verjüngt. Cuticula glatt, dick, mit zerstreuten Borsten. Vorderende mit 6 gut entwickelten papillenlosen Lippen, welche ein Cuticulargerüst als Stützapparat besitzen. 10 nicht sehr lange Kopfborsten erreichen $^1/_4$ des entspr. Körperdurchmessers. Mundhöhle mehr als doppelt so lang denn breit, mit geschichteten Wänden, $^1/_7$ der Oesophaguslänge einnehmend. Alle Zähne klein, auf gleicher Höhe stehend, an die Bewaffnung von *Onch. campylocercus* de Man (21) und *Onch. aequedentatus* Schuurmans Stekhoven (27) erinnernd. Seitenorgan vor den Kopfborsten liegend.

Oesophagus hinter der Mitte vom Nervenring umfasst. Ventraldrüse in der Mitte zwischen Nervenring und Vorderende ausmündend. Rectum = $^1/_2$ anale Breite.

Schwanz langgezogen, mit deutlichem Endkolben.

♀ Geschlechtsapparat: das Ovar ist postvulvar entwickelt. Röhrenorgan noch nicht ausgebildet.

Verhältnisse am Hinterende: Schwanzlänge 5.9; Breite am Hinterende 0.4.

Vorkommen: Mo. 2; 11.

Oncholaimus longicavatus n. sp.

juv. 1.208—1.861 (1.605); α = 29—34.9 (32.2); β = 5—5.5 (5.3); γ = 12.7—14.6 (13.6).

Körper vorne und hinten nur allmählich verschmälert. Cuticula dünn. Vorderende mit 6 schwachen Lippen ohne Papillen. Vermutlich nur 6 sehr kleine Borsten. Mundhöhle lang, schmal, $^1/_{10}$—$^1/_{11}$ der Oesophaguslänge. Ventralzahn gross, bis zu den Kopfborsten reichend. Von den beiden andern Zähnen ist vor allem der Submedianzahn sehr klein. Seitenorgan elliptisch, $^1/_4$ des entspr. Durchmessers.

Oesophagus hinter der Mitte vom Nervenring umfasst. Ventraldrüse postoesophagal. Porus excretorius in der Mitte zwischen Nervenring und Oesophagushinterende. Rectum = anale Breite.

Schwanz zuerst kegelförmig, dann gleich breit bleibend, mit schwachem Endkolben. Drüsen präanal.

Verhältnisse am Hinterende: Schwanzlänge 4.5; Breite am Hinterende 0.25.

Verwandtschaft: vermutlich in die Nähe von *Onch. gåsoënsis* Allgén (2), *Onch. tenuicaudatus* Allgén (5) und *Onch. chilkensis* Stewart (28) gehörend.

Vorkommen: Mo. 27.

Oncholaimus viridis Bastian.

Bastian 1865.

♂ 3.079; α = 34.1; β = 5.8; γ = 17.9.

Von der von Bastian (6) festgestellten Art war das Männchen bisher unbekannt. Sie wurde 1911 und 1921 von Ditlevsen (9, 10) wieder aufgefunden. Auch Allgén (5) gibt sie in juvenilen Tieren von den Campbell-Inseln an. Starken Schwankungen unterlegen sind nach Vergleich der Masse die Werte von α, β und γ. Im Vergleich zum Hinterende tritt ein gewisser Dimorphismus bei den beiden Geschlechtern auf, wie dies auch bei andern *Oncholaimus*-Arten der Fall ist.

Körper mässig schlank, nach vorne nicht ganz 3mal gegenüber der grössten Breite verschmälert. Die Cuticula ist glatt und zeigt

zerstreute Borsten. Das Vorderende weist 6 schwache papillenlose Lippen auf. Dahinter ist ein Kranz von 6 Borsten. Die Mundhöhle ist mehr als doppelt so lang denn breit und nimmt $^1/_{10}$ der Oesophaguslänge ein. Ventralzahn breit, pyramidenförmig, bis an die Borstenansatzstelle reichend. Die beiden andern Zähne sind klein, doch gut entwickelt. Seitenorgan schwer sichtbar, vermutlich elliptisch.

Oesophagus vorne mit Cuticularverstärkung. Nervenring etwas vor der Mitte. Cardia gross. Darmepithel aus 2 Zellreihen bestehend. Ventraldrüse postoesophagal. Porus excretorius etwas hinter der Mundhöhle gelegen.

Schwanz zuerst kegelförmig, dann gleich breit bleibend, mit schwachem Endkolben. Drüsen präanal.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula fast gerade, proximal geknöpft. Gubernaculum fehlt. Gut entwickelte Analmuskulatur. 3 präanale Borsten.

Verhältnisse am Hinterende: Schwanzlänge 4.2; Breite am Hinterende 0.2; Spicula 1.5.

Zu erwähnen ist noch, dass das Tier mit Infusorien, vermutlich mit *Vorticella*, behaftet gewesen ist.

Vorkommen: Mo. 7.

Oncholaimus rapax n. sp.

♀ 3.318; $a = 32.9$; $\beta = 5.9$; $\gamma = 17.7$; V = 71.9 %.
♂ 2.858—3.045; $a = 35.2$—36.1; $\beta = 5.2$—6.0; $\gamma = 15.2$—16.3.

Körper langgestreckt, doch rel. plump. Beim Männchen ist das Vorderende rascher verjüngt als beim Weibchen. Cuticula glatt, mit vereinzelten Borsten und einer geschichteten Subcuticula. Muskulatur besonders stark in den Seitenfeldern entwickelt, welche aus 2 Zellreihen zusammengesetzt sind. Vorderende mit 6 papillenlosen Lippen. 10 starke Borsten, $^1/_4$—$^1/_6$ der entspr. Breite einnehmend. Mundhöhle rel. lang, $^1/_{10}$—$^1/_{11}$ der Oesophaguslänge. Wände auffallend stark gebaut. Ventralzahn breit, pyramidenförmig, in die Höhe der Borsten reichend. Die beiden andern Zähne ragen etwas über die Mundhöhlenmitte. Seitenorgan flach, elliptisch, $^1/_3$—$^1/_4$ der entspr. Breite.

Oesophagus mit breitem Lumen am Hinterende. Nervenring etwas vor der Mitte liegend. Ventraldrüse postoesophagal; Porus excretorius 2 Mundhöhlenlängen postanteriad. Cardia gross, breit.

Darm normal, bei einem Exemplar Nematodenlarven enthaltend, was für die räuberische Lebensweise der Art spricht. Rectum nicht scharf abgetrennt.

Schwanz beim Weibchen regelmässig abnehmend, beim Männchen zuerst breit konisch, dann verlängert; Endkolben schwach. Vermutlich sind die Drüsen zurückgebildet, da kein Ausfuhrkanal mehr vorhanden ist. 1 kurze Terminalborste.

♀ Geschlechtsapparat: Ovarien nach vorne entwickelt. Vulva weit hinten gelegen. Eier länglich-oval, dickschalig. Röhrenorgan sackartig, mit kolbigem Hinterende.

♂ Geschlechtsapparat: Hoden langgestreckt, aus flachen Zellen aufgebaut. Spicula nur wenig gekrümmt, proximal leicht geknöpft, distal spitz. Gubernaculum fehlt. Analbewaffnung aus 4 prä- und 2 postanale Borsten bestehend.

Verwandschaft: die Art zeigt Beziehungen zu *Onch. viridis* Bast. (6), unterscheidet sich aber durch den Bau der Mundhöhle, die Schwanzlänge und den männlichen Geschlechtsapparat von der Vergleichs-Species.

Verhältnisse am Hinterende: Schwanzlänge ♀ 4.9; ♂ 4.7—5.2; Breite am Hinterende 0.21 resp. 0.23—0.25; Spicula 1.3—1.65.

Vorkommen: Mo. 1; 25; 29; 30.

Pseudoncholaimus n. g.

Typ.: *Pseudoncholaimus elegans* n. sp.

Die Gattung ist zu den typischen Oncholaimen zu rechnen, unterscheidet sich aber in erster Linie von *Oncholaimus* Duj. dadurch, dass das Weibchen kein Röhrenorgan aufweist, welches der Dujardin'schen Gattung eigen ist. Im übrigen sind Unterschiede zu *Oncholaimus* nicht festzustellen, weder im Bau des Vorderendes, noch im Bau der Geschlechtsorgane beider Geschlechter.

Pseudoncholaimus elegans n. sp.

♀ 2.839—3.316 (3.001); α = 46.6—54.1 (50.5); β = 6.6—7.3 (7.0);
γ = 23.6—25.5 (24.6); V = 73.4—76.7 % (74.6 %).
♂ 2.632—2.741 (2.691); α = 57.8—69.3 (62.7); β = 6.3—6.8 (6.6);
γ = 24.3—28.7 (26.6).

Körper schlank, beim Weibchen länger, dafür etwas plumper gebaut. Verjüngung des Vorderendes beim Männchen auf $^1/_2$, beim

Weibchen auf $^2/_5$ der grössten Breite. Hinterende bei beiden Geschlechtern verschieden. Cuticula dick. Muskulatur gut entwickelt. Vorderende abgerundet, hinter den Lippen eingeschnürt. 6 papillentragende Lippen; 10 Borsten, $^1/_{4.5}$—$^1/_5$ der entspr. Breite. Mundhöhle langgestreckt, $^1/_{12}$—$^1/_{14}$ der oesophagalen Länge erreichend. Dorsalwand etwas länger als die ventrale. Ventralzahn vor die Kopfborsten reichend, Dorsalzahn in der Mundhöhlenmitte, ebenso der Submedianzahn. Seitenorgan becherförmig, $^1/_4$ des entspr. Durchmessers, mit deutlicher Sensilla.

Oesophagus am Vorderende etwas aufgeschwollen. Nervenring schmal, etwas vor der Mitte. Ventraldrüse postoesophagal; Porus excretorius etwas hinter der Mundhöhle. Rectum nicht vom Darm abgetrennt.

Schwanz beim Weibchen länger als beim Männchen. Beim Männchen ist das 1. Fünftel konisch, die übrigen Fünftel bleiben gleich breit. Endkolben kaum entwickelt. Schwanzdrüsen rudimentär.

♀ Geschlechtsapparat: Ovarien postvulvar. Vulva mit langer Vagina, weit hinten gelegen. Eier gross, dickschalig. Röhrenorgan fehlt.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula schwach gebogen, schwertförmig. Gubernaculum fehlt. Präanal eine kleine Papille.

Verhältnisse am Hinterende: Schwanzlänge ♀ 4.2—4.8; ♂ 3.5—4; Breite am Hinterende 0.2—0.22 resp. 0.2; Spicula 1—1.1.

Vorkommen: Mo. 9; 25; 28; 30.

Oncholaimium brevicaudatum n. sp.

♂ 2.686—2.755 (2.721); α = 51.7—54.1 (52.9); β = 5.0—5.1 (5.05); γ = 48.0—54.0 (51.0).

Körper sehr schlank; vorne dagegen nur auf die Hälfte der grössten Breite verschmälert, hinten kegelförmig. Cuticula dünn, mit zerstreuten Borsten. Vorderende mit 6 Lippen, 6 Papillen und 10 Borsten, welche $^1/_{3.5}$ der entspr. Breite einnehmen. Mundhöhle stark an *Onch. appendiculatum* Cobb (8) erinnernd, 2mal so lang als breit, $^1/_{12}$—$^1/_{13}$ der Oesophaguslänge erreichend. Dorsalzahn klein, in der Mitte der Mundhöhle inseriert; Ventralzahn gross; Submedianzahn rel. klein, in gleicher Höhe wie der Dorsalzahn gelegen. Seitenorgan elliptisch, $^1/_4$ der entspr. Breite.

Oesophagus ohne Eigentümlichkeiten. Nervenring vor seiner Mitte. Ventraldrüse direkt postneural gelegen. Porus excretorius hinter der Mundhöhle. Rectum nicht ganz anale Breite.

Schwanz kurz, erste Hälfte kegelförmig, dann kurz zylindrisch, mit leicht angeschwollenem Endkolben. Drüse präanal. 2 Terminalborsten.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula lang, fast gerade, proximal wenig erweitert. Spicula-Retractor sehr gut entwickelt. Anale Bewaffnung sich zusammensetzend aus:

1. 2 Submedianborsten, welche $^1/_2$ Afterbreite präanal liegen;
2. „Röhrenorgan" (nach Cobb: „erectile appendicule" (8)) deutlich, mit sekretorischer Funktion, direkt hinter 1) liegend;
3. 2 kleinere, borstenbesetzte Sekretionskanäle, welche der Cobb'schen Art fehlen;
4. um den After herum 2 lange Submedianborsten;
5. postanal 3 weitere lange Borsten und
6. 1 ventrale Papille am Vorderende des Schwanzkolbens, welche bei *Onch. appendiculatum* Cobb (8) am Ende des Schwanzkegels steht.

Verwandtschaft: die Unterschiede zur Cobb'schen Art sind bereits erwähnt worden.

Verhältnisse am Hinterende: Schwanzlänge 1.5; Breite am Hinterende 0.25; Spicula 2.

Vorkommen: Mo. 31.

Oncholaimium cobbi n. sp.

♀ 3.452—3.723 (3.589); a = 32.4—38.1 (35.9); β = 7.4—7.7 (7.5); γ = 36.2—38.1 (36.9); V = 65,9—68.4 % (66.9 %).

♂ 3.452; a = 40; β = 6.9; γ = 46.7.

Der nicht sehr schlanke Körper verjüngt sich nach hinten beim Weibchen rascher als beim Männchen. Die Cuticula ist dünn. Das abgerundete Vorderende zeigt 6 papillenlose Lippen und dahinter einen Kranz von 10 kurzen Borsten, welche $^1/_5$ der entspr. Breite einnehmen. Die breite Mundhöhle erreicht beim Weibchen $^1/_{12.5}$—$^1/_{13.5}$, beim Männchen $^1/_{12}$ der Oesophaguslänge. Der grosse Ventralzahn reicht über die Kopfborsten hinaus. Dorsal- und Submedianzahn auf gleicher Höhe. Seitenorgan elliptisch, $^1/_4$ der entspr. Breite, mit deutlich entwickelter Sensilla.

Der Oesophagus wird etwas vor der Mitte vom Nervenring umfasst. Die Ventraldrüse liegt weit postoesophagal, während ihr Porus weit nach vorne, nur wenig hinter die Mundhöhle verrückt ist. Cardia gross. Darm mit regelmässig angeordneten Granula-Häufchen. Rectum = anale Breite.

Schwanz beim Weibchen fingerförmig, nicht angeschwollen, beim Männchen kegelförmig. Schwanzdrüse präanal.

♀ Geschlechtsapparat: Ovarium unpaarig, nach vorne entwickelt. Das Röhrenorgan setzt sich zusammen aus:

Rosette, Efferentus uteri, Osmosium, Efferentus entericus und moniliforme Drüsen.

♂ Geschlechtsapparat: einfacher, langgestreckter Hoden. Spicula kurz, gekrümmt, ohne Gubernaculum. Analmuskulatur sehr gut entwickelt. Anale Bewaffnung bestehend aus: 6 präanale, submediane Borsten, 3 präanale Sinnesborsten, 10 postanale, submediane Borsten und 1 postanale, fast am Schwanzende liegende Papille.

Verhältnisse am Hinterende: Schwanzlänge 2.5; Breite am Hinterende ♀ 0.3, ♂ 0.25; Spicula 1.5; Schwanzpapille 1.5.

Vorkommen: Mo. 27.

Oncholaimium longicaudatum n. sp.

♀ 3.797; $\alpha = 33.1$; $\beta = 7.9$; $\gamma = 10.8$; V = 68.7 %.

Der rel. plumpe Körper ist nach vorne gegen 5mal verschmälert im Vergleich zur grössten Breite. Hinten langgezogen. Cuticula glatt, dick, mit zerstreuten Borsten. Vorderende mit 6 undeutlichen Papillen tragenden Lippen. 10 kurze Kopfborsten ($^1/_5$ der entspr. Breite). Mundhöhle langgestreckt, mit dreischichtigen Wänden. Ventralzahn breit, pyramidenförmig; Dorsalzahn klein; Submedianzahn höckerartig. Seitenorgan oval, auffallend gross, i. e. $^1/_3$ der entspr. Breite, mit gut entwickelter Sensilla.

Oesophagus: Lumen am Vorderende schwach kutikularisiert. Ventraldrüse direkt am Oesophagushinterende. Porus excretorius 2 Mundhöhlenlängen hinter dem Vorderende. Darmepithel aus unregelmässigen Zellen zusammengesetzt. Darm durch Drüsenzellen mit der Subcuticula in Verbindung. Rectum ungefähr anale Breite.

Schwanz erstes Siebentel kegelförmig, dann gleich schmal bleibend, mit schwachem Endkolben.

Der nicht sehr schlanke Körper verengert sich am Vorderende auf $^1/_5$ der grössten Breite und besitzt hinten bei beiden Geschlechtern einen verschieden ausgebildeten Schwanz. Die glatte Cuticula hat keine Borsten, dagegen am Vorderende seitliche Sekretkanäle. Das Vorderende zeigt ausser 6 schwachen Lippen keine Bewaffnung. Die lange Mundhöhle ist $^1/_9$—$^1/_{11}$ der Oesophaguslänge. Ihre Wände sind geschichtet. Der sehr grosse Ventralzahn weist eine stark verlängerte Ventralleiste auf. Dorsalzahn klein, Submedianzahn säulenförmig. Seitenorgan weit vorne gelegen, kreisförmig, mit deutlicher Röhrenbildung, in Verbindung mit Drüsen stehend; $^1/_5$ der entspr. Breite.

Oesophagus von regulärem Bau. Nervenring ungefähr in der Mitte gelegen. Ventraldrüse langgestreckt; Porus excretorius beim Weibchen 2, beim Männchen 4 Mundhöhlenlängen hinter dem Vorderende. Cardia klein.

Schwanz des Weibchens kegelförmig, mit schwachem Endkolben und 2 kleinen Terminalborsten. Beim Männchen ist das erste Drittel kegelförmig, dann wird der Schwanz plötzlich verjüngt. Alle Drüsen liegen präanal.

♀ Geschlechtsapparat: Ovarien paarig, symmetrisch. Vulva etwas hinter der Körpermitte. Vaginalmuskulatur gut entwickelt. Eier gross, dünnschalig. Röhrenorgan paarig, bestehend aus dem Efferentus uteri, der Rosette, dem Verbindungsrohr, das in den Efferentus entericus geht, welcher einerseits mit der Vulva in Verbindung steht, anderseits beide Aeste miteinander verbindet.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula lang, schlank, proximal wenig erweitert, distal spitz. Gubernaculum einfach, stäbchenförmig. Direkt vor dem After eine kleine Papille.

Verwandtschaft: gehört in den Kreis *Ad. araliensis* Fil. (16) und *Ad. fuscus* Bast. (16), unterscheidet sich aber vor allem durch die Ausbildung des Vorderendes.

Verhältnisse am Hinterende: Schwanzlänge ♀ 4.2; ♂ 3; Breite am Hinterende 0.3 resp. 0.2; Spicula 2; Gubernaculum 0.3.

Vorkommen: Mo. 27.

Adoncholaimus meridionalis n. sp.

♀ 5.301—5.396 (5.349); α = 30.1—32.9 (31.5); β = 6.5—6.8 (6.65);
γ = 18.2—18.8 (18.5); V = 53.8—56.3 % (55.1 %).
♂ 5.560—6.146 (5.853); α = 32.3—36.5 (34.4); β = 6.6—7.6 (7.1);
γ = 19.0—19.6 (19.3).

2. Drittels liegend. Die beiden andern Zähne stehen dahinter auf gleicher Höhe. Seitenorgan elliptisch, $^1/_5$ der entspr. Breite.

Oesophagus normal. Nervenring etwas vor der Mitte gelegen. Ventraldrüse postoesophagal. Porus excretorius nicht gefunden. Rectum etwas länger als die anale Breite.

Schwanz sehr kurz, einem abgestumpften Kegel gleichend, am Ende mit 2 papillenartigen Erhebungen. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien unpaarig, zurückgeschlagen, prävulvar. Vulva weit nach hinten gerückt.

Verhältnisse am Hinterende: Schwanzlänge 1.8; Breite am Hinterende 0.58.

Vorkommen: Mo. 33.

Prooncholaimus longisetosus n. sp.

juv. 1.447; $\alpha = 39.3$; $\beta = 5.0$; $\gamma = 18.6$.

Körper rel. schlank, nach vorne nur ganz allmählich verengt. Cuticula glatt; Subcuticula mit deutlicher Trabekelzeichnung. Vorderende mit 6 flachen papillenlosen Lippen; dahinter ein Kranz von 10 Borsten, welche $^1/_3$ der entspr. Breite einnehmen. Mundhöhle becherförmig, $^1/_{12}$ der Oesophaguslänge. Dorsalkante mit deutlicher Einknickung in der hinteren Hälfte. Ventralzahn gross; die beiden andern Zähne bleiben klein und stehen auf gleicher Höhe. Seitenorgan fast kreisförmig, $^1/_4$ der entspr. Breite, mit deutlicher Sensilla.

Oesophagus regelmässig anschwellend. Nervenring etwas hinter seiner Mitte. Ventraldrüse postoesophagal. Porus excretorius nicht gefunden. Darm und Rectum mit Protozoenparasiten infiziert, welche vermutlich zu *Coelosporidium* gehören.

Schwanz allmählich sich verjüngend. Endkolben schwach entwickelt. Drüsen präanal.

Verhältnisse am Hinterende: Schwanzlänge 3.7; Breite am Hinterende 0.4.

Vorkommen: Mo. 1.

Adoncholaimus nudus n. sp.

♀ 2.255—2.345 (2.300); $\alpha = 20.3$—23.3 (21.9); $\beta = 5.9$—6.2 (6.0);
$\gamma = 15.4$—17.1 (16.3); V = 52.0—53.6 % (52.7 %).

♂ 2.099—2.132 (2.115); $\alpha = 21.3$—27.4 (24.3); $\beta = 5.9$—6.3 (6.1);
$\gamma = 19.0$—26.0 (22.5).

Medianfeldern. Vorderende mit 6 flachen Lippen und 10 Kopfborsten ($^1/_5$ der entspr. Breite). Mundhöhle rel. lang, $^1/_{10}$—$^1/_{12}$ der Oesophaguslänge. Ventralzahn gross, bis an die Kopfborsten reichend. Die beiden andern Zähne stehen an der Basis des Ventralzahnes. Seitenorgan flach-elliptisch, $^1/_4$ der entspr. Breite.

Oesophagus hinter dem Nervenring, welcher etwas hinter der Mitte liegt, deutlich anschwellend. Ventraldrüse postoesophagal; Porus excretorius $2^1/_2$ Mundhöhlenlängen hinter dem Vorderende. Rectum = anale Breite.

Schwanz: beim Weibchen etwas kürzer als beim Männchen, mit schwachem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: ein zurückgeschlagenes prävulvares Ovar. Vulva weit hinten gelegen. Eier dünnschalig.

♂ Geschlechtsapparat: Testis langgestreckt. Spicula fast gerade, proximal trichterförmig erweitert, distal ist die Ventralleiste kürzer als die dorsale. Die Spicula sind in ein Muskelfutteral eingebettet, ähnlich wie bei *Pr. eberthi* (Fil.) (14). Gubernaculum stäbchenförmig, langgestreckt. 4 präanale kurze Borsten. Radialmuskulatur gut entwickelt.

Verwandtschaft: gegenüber *Pr. eberthi* (Fil.) (14) sind die hauptsächlichsten Unterschiede, Körperlänge, α ♀ und γ ♀♂, sowie die Ausbildung des Spicularapparates.

Verhältnisse am Hinterende: Schwanzlänge ♀ 3.7—4.1; ♂ 4.5—4.7; Breite am Hinterende: 0.17—0.28 resp. 0.3; Spicula 2.7—3.0; Gubernaculum 0.9.

Vorkommen: Mo. 1; 9; 11; 12; 15; 16; 23; 33.

Prooncholaimus obtusicaudatus n. sp.

♀ 2.222; $\alpha = 31.9$; $\beta = 6.4$; $\gamma = 49.2$; V = 79.3 %.

Das einzige zur Verfügung stehende Weibchen war schlecht erhalten infolge Schrumpfung des Körpers zwischen Oesophagushinterende und Ovarialanlage.

Körper gleichmässig verjüngt, sodass Vorder- und Hinterende nahezu gleich breit sind. Cuticula glatt, mit angedeuteter Trabekelzeichnung. Vorderende mit deutlichen Lippen und vermutlich nur 6 sehr kurzen Borsten ($^1/_{13}$ der entspr. Breite). Mundhöhle gross, $^1/_{10.5}$ der Oesophaguslänge. Ventralzahn sehr breit, am Ende des

♀ Geschlechtsapparat: 1 kurzes prävulvares Ovar. Rosette rudimentär. Efferentus uteri langgestreckt. Efferentus entericus und moniliforme Drüsen vorhanden.

Verhältnisse am Hinterende: Schwanzlänge 8.6; Breite am Hinterende 0.65.

Vorkommen: Mo. 23.

Prooncholaimus keiensis n. sp.

juv. 2.111; $a = 42.9$; $\beta = 5.6$; $\gamma = 10.9$.

Körper schlank, vorne $^1/_3$ der grössten Breite, hinten langgezogen, aber nicht fadenförmig. Cuticula glatt, dünn. Trabekelzeichnung nur am Hinterende erkennbar. Vorderende verlängert. 6 schwach entwickelte Lippen. 10 Kopfborsten, $^1/_{4.5}$ der entspr. Breite. Mundhöhle $^1/_{13}$ der Oesophaguslänge, an *Proonch. megastoma* (Eberth) (24) erinnernd. Wände nach hinten verdickt. Dorsalzahn sehr klein, weit vorne gelegen; Ventralzahn säulenförmig; Submedianzahn pyramidenförmig. Seitenorgan elliptisch, $^1/_4$ der entspr. Breite.

Oesophagus normal, etwas vor der Mitte vom Nervenring umgeben. Ventraldrüse postoesophagal; Porus excretorius 3 Mundhöhlenlängen hinter dem Vorderende. Rectum = anale Breite.

Schwanz langgezogen, zuerst kegelförmig; Endkolben kaum ausgebildet, mit 2 langen Borsten. Schwanzdrüse jedenfalls präanal.

Verwandtschaft: es bestehen Beziehungen zu *Pr. megastoma* (Eberth) (24) und *Pr. eberthi* (Fil.) (14), doch sind Mundhöhlenbildung und Schwanzlänge für die Art typisch.

Verhältnisse am Hinterende: Schwanzlänge 6.3; Breite am Hinterende 0.2.

Vorkommen: Mo. 2.

Prooncholaimus ornatus n. sp.

♀ 2.171—2.755 (2.384); $a = 17.2$—29.4 (25.0); $\beta = 5.7$—6.8 (6.3); $\gamma = 16.9$—20.3 (18.9); V = 73.5—75.5 % (74.7 %).

♂ 1.993—2.013 (2.003); $a = 30.7$—37.3 (34.0); $\beta = 5.8$—6.5 (6.2); $\gamma = 17.5$—18.0 (17.8).

Körper beim Männchen schlanker als beim Weibchen, dagegen an beiden Enden nicht so stark verjüngt ($^1/_3$ gegenüber $^1/_4$ der grössten Breite.). Cuticula glatt, mit zerstreuten Borsten. Subcuticula mit sehr schön entwickelter Trabekel-Ornamentierung in den Seiten- und

2. Drittels liegend. Die beiden andern Zähne stehen dahinter auf gleicher Höhe. Seitenorgan elliptisch, $^1/_5$ der entspr. Breite.

Oesophagus normal. Nervenring etwas vor der Mitte gelegen. Ventraldrüse postoesophagal. Porus excretorius nicht gefunden. Rectum etwas länger als die anale Breite.

Schwanz sehr kurz, einem abgestumpften Kegel gleichend, am Ende mit 2 papillenartigen Erhebungen. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien unpaarig, zurückgeschlagen, prävulvar. Vulva weit nach hinten gerückt.

Verhältnisse am Hinterende: Schwanzlänge 1.8; Breite am Hinterende 0.58.

Vorkommen: Mo. 33.

Prooncholaimus longisetosus n. sp.

juv. 1.447; $a = 39.3$; $\beta = 5.0$; $\gamma = 18.6$

Körper rel. schlank, nach vorne nur ganz allmählich verengt. Cuticula glatt; Subcuticula mit deutlicher Trabekelzeichnung. Vorderende mit 6 flachen papillenlosen Lippen; dahinter ein Kranz von 10 Borsten, welche $^1/_3$ der entspr. Breite einnehmen. Mundhöhle becherförmig, $^1/_{12}$ der Oesophaguslänge. Dorsalkante mit deutlicher Einknickung in der hinteren Hälfte. Ventralzahn gross; die beiden andern Zähne bleiben klein und stehen auf gleicher Höhe. Seitenorgan fast kreisförmig, $^1/_4$ der entspr. Breite, mit deutlicher Sensilla.

Oesophagus regelmässig anschwellend. Nervenring etwas hinter seiner Mitte. Ventraldrüse postoesophagal. Porus excretorius nicht gefunden. Darm und Rectum mit Protozoenparasiten infiziert, welche vermutlich zu *Coelosporidium* gehören.

Schwanz allmählich sich verjüngend. Endkolben schwach entwickelt. Drüsen präanal.

Verhältnisse am Hinterende: Schwanzlänge 3.7; Breite am Hinterende 0.4.

Vorkommen: Mo. 1.

Adoncholaimus nudus n. sp.

♀ 2.255—2.345 (2.300); $a = 20.3$—23.3 (21.9); $\beta = 5.9$—6.2 (6.0);
$\gamma = 15.4$—17.1 (16.3); V = 52.0—53.6 % (52.7 %).

♂ 2.099—2.132 (2.115); $a = 21.3$—27.4 (24.3); $\beta = 5.9$—6.3 (6.1);
$\gamma = 19.0$—26.0 (22.5).

Der nicht sehr schlanke Körper verengert sich am Vorderende auf $^1/_5$ der grössten Breite und besitzt hinten bei beiden Geschlechtern einen verschieden ausgebildeten Schwanz. Die glatte Cuticula hat keine Borsten, dagegen am Vorderende seitliche Sekretkanäle. Das Vorderende zeigt ausser 6 schwachen Lippen keine Bewaffnung. Die lange Mundhöhle ist $^1/_9$—$^1/_{11}$ der Oesophaguslänge. Ihre Wände sind geschichtet. Der sehr grosse Ventralzahn weist eine stark verlängerte Ventralleiste auf. Dorsalzahn klein, Submedianzahn säulenförmig. Seitenorgan weit vorne gelegen, kreisförmig, mit deutlicher Röhrenbildung, in Verbindung mit Drüsen stehend; $^1/_5$ der entspr. Breite.

Oesophagus von regulärem Bau. Nervenring ungefähr in der Mitte gelegen. Ventraldrüse langgestreckt; Porus excretorius beim Weibchen 2, beim Männchen 4 Mundhöhlenlängen hinter dem Vorderende. Cardia klein.

Schwanz des Weibchens kegelförmig, mit schwachem Endkolben und 2 kleinen Terminalborsten. Beim Männchen ist das erste Drittel kegelförmig, dann wird der Schwanz plötzlich verjüngt. Alle Drüsen liegen präanal.

♀ Geschlechtsapparat: Ovarien paarig, symmetrisch. Vulva etwas hinter der Körpermitte. Vaginalmuskulatur gut entwickelt. Eier gross, dünnschalig. Röhrenorgan paarig, bestehend aus dem Efferentus uteri, der Rosette, dem Verbindungsrohr, das in den Efferentus entericus geht, welcher einerseits mit der Vulva in Verbindung steht, anderseits beide Aeste miteinander verbindet.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula lang, schlank, proximal wenig erweitert, distal spitz. Gubernaculum einfach, stäbchenförmig. Direkt vor dem After eine kleine Papille.

Verwandtschaft: gehört in den Kreis *Ad. araliensis* Fil. (16) und *Ad. fuscus* Bast. (16), unterscheidet sich aber vor allem durch die Ausbildung des Vorderendes.

Verhältnisse am Hinterende: Schwanzlänge ♀ 4.2; ♂ 3; Breite am Hinterende 0.3 resp. 0.2; Spicula 2; Gubernaculum 0.3.

Vorkommen: Mo. 27.

Adoncholaimus meridionalis n. sp.

♀ 5.301—5.396 (5.349); α = 30.1—32.9 (31.5); β = 6.5—6.8 (6.65); γ = 18.2—18.8 (18.5); V = 53.8—56.3 % (55.1 %).

♂ 5.560—6.146 (5.853); α = 32.3—36.5 (34.4); β = 6.6—7.6 (7.1); γ = 19.0—19.6 (19.3).

Körper langgestreckt, rel. schlank. Verschmälerung am Vorderende nicht ganz $^1/_4$ der grössten Breite. Cuticula glatt, mit zahlreichen zerstreuten Borsten. Vorderende mit 6 papillenlosen Lippen. Kopfborsten $^1/_4$—$^1/_5$ der entspr. Breite. Kopf auf der Höhe der Seitenorgane deutlich eingeschnürt. Mundhöhle gross, breit, $^1/_{10}$—$^1/_{13}$ der Oesophaguslänge. Ventralzahn klein, hinter der Mundhöhlenmitte gelegen. Die beiden andern Zähne sind weit nach vorne verschoben. Seitenorgan $^1/_6$ des entspr. Durchmessers, kreisförmig-elliptisch.

Oesophagus ohne Eigentümlichkeiten. Nervenring etwas vor der Mitte. Ventraldrüse gross, postoesophagal gelegen. Porus excretorius 3—4 Mundhöhlenlängen hinter dem Vorderende. Rectum ca. $^1/_2$ anale Breite.

Schwanz: erstes Drittel kegelförmig, beim ♂ besser entwickelt als beim ♀. Endkolben schwach ausgebildet. 2 Terminalborsten. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, zurückgeschlagen. Zahl der Eier bis 28. Vulva etwas hinter der Körpermitte. Röhrenorgan bestehend aus: 1. Osmosium, gefächert; 2. Efferentus entericus, aus flachen Zellen aufgebaut, mit Cuticulargerüst in der Höhe der Vagina; 3. Rosette aus 18—20 Elementen aufgebaut; 4. Efferentus uteri, kurz bleibend; 5. Efferentus principalis langgestreckt und 6. moniliforme Drüsen: 9—12.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula sehr lang, Proximalende erweitert, distal spitz endend, mit deutlichem Velum. Gubernaculum dreiteilig, bestehend aus 2 Flügeln und 1 Verbindungsplatte. Analmuskulatur kräftig entwickelt.

Verwandtschaft: in gewissen Beziehungen an *Ad. fuscus* (Bast.) (6, 16) erinnernd, sich aber durch das Vorderende und das Röhrenorgan der Art unterscheidend.

Verhältnisse am Hinterende: Schwanzlänge ♀ 3; ♂ 3.3; Breite am Hinterende: 0.25 resp. 0.2; Spicula 2.75; Gubernaculum 0.5.

Vorkommen: Mo. 26.

Adoncholaimus papillatus n. sp.

♀ 2.243; $a = 30.3$; $\beta = 6.6$; $\gamma = 17.6$; V = 49.0 %.
♂ 1.902—2.374 (2.172); $a = 29$—33.9 (31.1); $\beta = 5.5$—6.4 (6.0);
$\gamma = 18.8$—20.6 (19.6).

Die Verengerung des Körpers am Vorderende beträgt nicht ganz $^1/_4$ der grössten Breite; nach hinten allmählich schmäler werdend. Cuticula glatt, dünn. Vorderende mit 6 schwachen, Papillen tragenden Lippen. Borsten = 0. Mundhöhle lang, schmal, $^1/_9$—$^1/_{11}$ der Oesophaguslänge. Ventralzahn gross, weit nach vorne ragend. Dorsalzahn klein; Submedianzahn sehr schwach entwickelt. Seitenorgan kreisförmig vertieft, wie bei *Ad. nudus*.

Oesophagus normal entwickelt. Nervenring um die Mitte herum gelegen. Ventraldrüse verlängert. Porus excretorius 2 Mundhöhlenlängen hinter dem Vorderende. Rectum = anale Breite.

Schwanz zuerst kegelförmig, dann plötzlich verjüngt, mit schwachem Endkolben. Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, symmetrisch. Vulva etwas vor der Mitte. Röhrenorgan noch unentwickelt gewesen.

♂ Geschlechtsapparat: Hoden einfach, zurückgeschlagen. Spicula nicht stark verlängert, schwach gebogen. Gubernaculum stabförmig. Präanal 5, postanal 6 submediane Borsten. Postanalmuskulatur gut entwickelt.

Verhältnisse am Hinterende: Schwanzlänge ♀ 3.25; ♂ 3.2; Breite am Hinterende 0.2 resp. 1; Spicula 1.3; Gubernaculum 0.4.

Vorkommen: Mo. 21; 27.

Adoncholaimus bandaensis n. sp.

♀ 4.239—5.088 (4.555); α = 30.5—32.7 (31.7); β = 6.1—7.0 (6.4);
γ = 12.7—16.5 (14.4); V = 46.8—52.7 % (50.1 %).
♂ 4.489—4.608 (4.560); α = 30.5—36.0 (33.5); β = 6.4—6.9 (6.7);
γ = 13.7—14.7 (14.1).

Körper vorne gegenüber der grössten Breite 3mal verschmälert, nach hinten sich allmählich verjüngend. Cuticula glatt, mit zerstreuten Borsten, Subcuticula mehrschichtig. Längsmuskulatur sehr gut entwickelt. Vorderende mit 6 schwachen papillenlosen Lippen und 10 Kopfborsten. Mundhöhle $^1/_{10.5}$—$^1/_{12.5}$ der Oesophaguslänge, gross und lang. Ventral- und Submedianzahn annähernd gleich entwickelt. Dorsalzahn fast an der Basis der Mundhöhle gelegen. Seitenorgan gross, elliptisch, $^1/_4$ der entspr. Breite.

Oesophagus normal; Nervenring etwas vor der Mitte gelegen. Ventraldrüse klein; Porus excretorius 2 Mundhöhlenlängen hinter dem Vorderende. Cardia stumpf, dreieckig. Rectum = anale Breite.

Schwanz beim Weibchen allmählich an Breite abnehmend, beim Männchen mit vorderem Kegel; das letzte Drittel ist verschmälert. Alle Drüsen präanal.

♀ Geschlechtsapparat: Ovarien paarig, zurückgeschlagen. Vulva in der Körpermitte. Vulvarmuskulatur gut entwickelt. Eier gross, doppelschalig. Röhrenorgan sich aus grossen Rosetten, dem Efferentus entericus und uteri zusammensetzend.

♂ Geschlechtsapparat: Hoden langgestreckt. Spicula lang, dünn, Proximalende handgriffartig, Distalende gerade abgeschnitten. Gubernaculum fehlt; dagegen tritt ein Velum auf. Kopulationsmuskulatur gut entwickelt.

Verhältnisse am Hinterende: Schwanzlänge ♀ 4.4; ♂ 4.1; Breite am Hinterende 0.19 resp. 0.15; Spicula 1.6.

Vorkommen: Mo. 10.

Cacolaimus n. g.

Typ.: *Cacolaimus papillatus* n. sp.

Schlanke, kleine Würmer. Kopf durch eine plötzliche Verdickung der Cuticula am Hinterende der Mundhöhle scharf abgesetzt. Vorderende mit Lippen, Papillen und Borsten. Mundhöhle gross, mit dünnen Wänden; Dorsalwand rudimentär. Ventralzahn gross. Seitenorgan ? Hinterende verlängert kegelförmig.

Vermutlich steht die Gattung nahe an *Nudolaimus* Allgén (2), wo ebenfalls ein Zerfall der Mundhöhle eingetreten ist.

Cacolaimus papillatus n. sp.

juv. 1.788; $\alpha = 48.5$; $\beta = 5$; $\gamma = 16.2$.

Körper schlank, doch vorne nicht ganz in die halbe grösste Breite verschmälert. Cuticula zuerst dünn, dann plötzlich an der Mundhöhlenbasis verdickt, dreischichtig, mit zerstreuten Borsten. Vorderende mit 6 Lippen, welche eine borstenartige Papille tragen. 10 kurze Borsten, $^1/_7$ der entspr. Breite. Mundhöhle becherförmig. Ventralwand dünn, lang, Dorsalwand verkümmert. Ventralzahn mächtig entwickelt. Dorsalzahn mit verlängerter Ventralleiste. Submedianzahn breit, pyramidenförmig. Seitenorgan ?

Oesophagus normal, am Vorderende dorsal verlängert. Nervenring etwas hinter der Mitte. Ventraldrüse postoesophagal. Der Porus

liegt in der Höhe des Nervenringes. Rectum etwas grösser als die anale Breite.

Schwanz verlängert, mit schwachem Endkolben und einer kleinen Terminalborste.

Verhältnisse am Hinterende: Schwanzlänge 4.5; Breite am Hinterende 0.17.

Vorkommen: Mo. 7.

Literaturverzeichnis.

1. Allgén, C.: Freilebende marine Nematoden von der Küste Tasmaniens. Zool. Anz. 73 1927.
2. — Neue freilebende marine Nematoden von der Westküste Schwedens. Zool. Jhrb. Syst. 57 1929.
3. — Ueber einige neue oder wenig bekannte Brachwasser-Nematoden von der Litoralzone des Oeresunds. Zool. Anz. 88 1930.
4. — Ueber eine neue Art des Genus Paroncholaimus Filipjev, P. donsi, von der Insel Roest (Lofoten-Archipel). ibid. 97 1932.
5. — Weitere Beiträge zur Kenntnis der marinen Nematodenfauna der Campbellinsel. Mag. f. Naturvid. 70 1932.
6. Bastian, H. C.: Monograph on the Anguillulidae, or Free Nematoids, Marine, Land, and Freshwater; with Descriptions of 100 New Species. Trans. Linn. Soc. London 25 1865.
7. Cobb, N. A.: Tricoma and other new Nematode Genera. Proc. Linn. Soc. N. S. W. 8 1893.
8. — The demanian vessels in nemas of the genus Oncholaimus; with notes on four new Oncholaimus. Journ. Wash. Acad. Sc. 29 1930.
9. Ditlevsen, Hj.: Danish freeliving Nematodes. Vid. Medd. Dansk Nat. Foren. København 63 1911.
10. — Marine free-living Nematodes from the Auckland and Campbell Islands. ibid. 73 1921.
11. — Free-living Nematodes. The Danish Ingolf-Expedition. 4 1926.
12. — Free-living marine Nematodes from Greenland Waters. Medd. om Grønland 23 Suppl. 1928.
13. Doflein, F.: Lehrbuch der Protozoenkunde. Jena 1916.
14. Filipjev, I. N.: Freilebende marine Nematoden aus der Umgebung von Sebastopol. Acad. Sc. Russie. II 1918.
15. — Encore sur les Nématodes libres de la Mer Noire. Act. Inst. Agron. Stauropolitani I 1922.
16. — Revision der Gattung Adoncholaimus. Zool. Anz. 58 1923.
17. — Les Nématodes libres des mers septentrionales appartenant à la famille des Enoplidae. Arch. f. Naturg. A 91 1925.

18. Kreis, H. A.: Zur Kenntnis der freilebenden marinen Nematoden. Schr. f. Süsswasser- u. Meereskunde 1924.
19. — Die freilebenden marinen Nematoden der Spitzbergen-Expedition von F. Römer und F. Schaudinn im Jahre 1898. Mitt. Zool. Mus. Berlin 14 1928.
20. — Freilebende marine Nematoden von der Nordwest-Küste Frankreichs (Trébeurden: Côtes du Nord). Capita Zoologica 2 1929.
21. de Man, J. G.: Contribution à la connaissance des Nématodes marins du Golfe de Naples. Tijd. Nederl. Dierk. Ver. 3 1878.
22. — Quatrième note sur les Nématodes libres de la Mer du Nord et de la Manche. Mém. Soc. Zool. France 3 1890.
23. — Nématodes libres. Rés. Voyage du S. Y. Belgica. 1904.
24. Micoletzky, H.: Weitere Beiträge zur Kenntnis freilebender Nematoden aus Suez. Sitzb. Akad. Wiss. Wien. Math.-nat. Kl. I 132 1924.
25. — Freilebende marine Nematoden von den Sunda-Inseln. I. Enoplidae Vid. Medd. Dansk Nat. Foren. 87 1930.
26. Schuurmans-Stekhoven, J. H.: Oekologische und morphologische Notizen über Zuiderseenematoden. I. Ztschr. Oek. u. Morph. d. Tiere 20 1931.
27. Schuurmans-Stekhoven, J. H. & Adam, W.: The freeliving marine Nemas of the Belgian Coast. Mém. Mus. Roy. d'Hist. Nat. 49 1931.
28. Stewart, F. H.: Report on a collection of free-living nematodes from the Chilka Lake on the Coast of India. Rec. Ind. Mus. 10 1914.

Separate copies ready from the press 25. XI. 1932.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LXII.

Foraminifera of the Malay Archipelago.

By

Dr. J. Hofker.

(The Hague, Holland).

(With Plates II—VI.)

Contents.

	Page
Short account of the Results	71
List of the Species	73
A New Method for Making Slides of Foraminifera	74
Family I, Ammodiscidae	75
Family II, Reophacidae	76
Family III, Textulariidae	78
Family IV, Miliolidae	93
Family V, Peneroplidae	105
Family VI, Lagenidae	108
Family VII, Buliminidae	118
Family VIII, Anomalinidae	120
Family IX, Rotaliidae	123
Family X, Amphisteginidae	137
Family XI, Camerinidae	138
On some Material of St. 58 and 62	163

Short account of the Results.

The present report deals with the Foraminifera collected by Dr. Th. Mortensen during the Danish Expedition to the Kei-Islands in 1922.

This expedition visited Amboina, the Kei-Archipelago, Banda,

Macassar, the Java-Sea and the Sunda-Strait. Thus several localities were explored, where the Siboga-Expedition did not collect at all or only in passing. The Foraminifera, as obtained by the author, were already selected from the rough material. This is the reason, why especially the small forms probably have been lost. Yet a very rich material was left in the hands of the author, who begs to express his thanks for this to the leader of the expedition, Dr. Th. Mortensen.

General geographical remarks have not been made yet, as the third part of the Siboga-Foraminifera first has to give information of the remaining groups. Yet the reader will easily find, that even now a sharp contrast is to be found between the eastern and the western part of the Archipelago of East-India. Especially in the eastern part of the region the Foraminifera show a nearly fossil (Tertiary) habitus, as a whole.

The *Textulariidae* are thought to be closely allied to some *Anomalinidae*.

Textularia immensa Cushman was found to possess labyrinthic chambers, being thus related to the genus *Textulariella*. Trimorphism was stated in *Bigenerina nodosaria*, whereas *Tritaxia tricarinata* appeared to be a real *Clavulina*. It is probable that most records of *Haplostiche dubia* are dealing with *Clavulina Bradyi*, as the typical differences between these two species do not really exist. Trimorphism was found in *Quinqueloculina reticulata*, and *Q. Kerimbatica* var. *philippinensis* Cushman was shown to be one of the generations. The same can be said about *Q. curta*, *Q. albatrossi* Cushman being one of the forms. Special study has been made of *Massilina alveoliniformis*, which seems to be a real *Schlumbergerina*. The bionomics were studied of *Nodosaria vertebralis* and it was stated that several species can be gathered under that name: *N. Flintii*, *N. vertebralis* var. *albatrossi* Cushman, *N. spirostriolata* Cushman, while a form of *Marginulina philippensis* Cushman may be the microspheric generation. The microspheric generation of *Lingulina grandis* was found, as also of *Cristellaria italica*. The first chambers of microspheric *Cristellaria costata* turned out to be marginuline. Trimorphism was found in *Truncatulina praecincta*, and the embryonic apparatus of *Gypsina plana* was made known, as well as the fact that the chambers communicate by means of real foramina, contrary to the investigations of Miss Lindsey's. *G. plana*, *G. inhearens* and *G. vesicularis* are synonyms. *Pulvinulina*

lateralis and *P. menardii* were thouroughly analysed, the latter being trimorphic.

An attempt was made to give a more correct systematic place to the genera of the Families of the *Rotaliidae* as well as of those of the *Nummulitidae*. A new species was created in the latter group, *Operculina heterosteginoides*, and it was shown that in the *Nummulitidae* no sharp limitation of the so-called genera can be given, all species having the generic characteristics of the genus *Camerina*. "*Operculina*" *venosa* is analysed, being a real species with true trimorphism, and a very beautiful example of trimorphism was found in *Heterostegina operculinoides*, the B-form being operculine, the A_1-form having incomplete secondary chambers, the A_2-form being heterostegine. Special attention has been given to the genus *Cycloclypeus*; it was made probable, that both fossil and recent specimens belong to a single species in the Indian Archipelago.

I have to call special attention to the fine figures, which illustrate this work. They were all made, after my sketches with Abbe's Mirror, by my wife, for which great aid I am very thankful.

A new method to make slides in a very short time has been described too.

List of the Species.

I. Family Ammodiscidæ.

1. Ammodiscus incertus (d'Orbigny).

II. Family Reophacidæ.

2. Reophax ammobaculitiformis nov. nom.

III. Family Textulariidæ.

3. Textularia gramen d'Orbigny.
4. Textularia stricta Cushman.
5. Textulariella immensa (Cushman).
6. Textularia rugosa (Reuss).
7. Textularia goësii Cushman.
8. Textularia trochus d'Orbigny.
9. Textularia agglutinans d'Orbigny.
10. Bigenerina nodosaria d'Orbigny.
11. Clavulina tricarinata (Reuss).
12. Clavulina Bradyi Cushman.

IV. Family Miliolidæ.

13. Cornuspira foliacea (Philippi).
14. Quinqueloculina reticulo-striata Cushman.
15. Quinqueloculina reticulata (d'Orbigny).
16. Quinqueloculina bicostata d'Orbigny.
17. Quinqueloculina curta Cushman.
18. Massilina alveoliniformis Millet.
19. Spiroloculina depressa d'Orbigny.

V. Family Peneroplidæ.

20. Peneroplis pertusus Forskål.
21. Archaias discoideus (Flint).
22. Praesorites orbitolitoides Hofker.
23. Orbitolites marginalis Lamarck.
24. Orbitolites duplex Carpenter.
25. Alveolinella Quoyi (d'Orbigny).

VI. Family Lagenidæ.

26. Nodosaria vertebralis (Batsch).

27. Lingulina grandis Cushman.
28. Cristellaria italica (Defrance).
29. Cristellaria costata (Fichtel et Moll).
30. Cristellaria orbicularis (d'Orbigny).

VII. Family Buliminidæ.

31. Rectobolivina columellaris (Brady).

VIII. Family Anomalinidæ.

32. Carpenteria utricularis (Carter).
33. Carpenteria proteiformis Goës.
34. Sporadotrema cylindricum (Carter).
35. Polytrema miniaceum (Pallas).
36. Homotrema rubrum (Lamarck).
37. Placopsilina cenomana d'Orbigny.

IX. Family Rotaliidæ.

38. Truncatulina praecincta (Karrer).
39. Baculogypsinoides spinosus Yabe et Hanzawa.
40. Calcarina Spengleri (Gmelin).
41. Planorbulina larvata Parker et Jones.
42. Gypsina inhaerens (Schultze).
43. Pulvinulina lateralis (Terquem).
44. Pulvinulina menardii d'Orbigny.
45. Rotalia Schroeteriana (Parker et Jones).
46. Rotalia calcar (d'Orbigny).
47. Rotalia pulchella d'Orbigny.
48. Polystomella craticulata (Fichtel et Moll).

X. Family Amphisteginidæ.

49. Amphistegina radiata Fichtel et Moll.

XI. Family Camerinidæ.

50. Operculina venosa (Fichtel et Moll).
51. Operculina complanata (Defrance).
52. Operculina heterosteginoides new species.
53. Heterostegina operculinoides Hofker.
54. Heterostegina suborbicularis d'Orbigny.
55. Cycloclypeus carpenteri Brady.

A New Method of Making Slides of Foraminifera.

The normal method of making slides was to grind the shells after boiling them in canada-balsam; with this method several difficulties, however, turn up: the balsam may become too hard, and may split in the most critical moment; or too much balsam is added, and consequently the grinding affords more time than necessary, as the balsam may be very resistant; or when boiling, the shell may burst; etc.

I found the following method very adequate for the purpose, and much more easy in use and shorter in time.

In an alluminium vessel a portion of paraffine, melting-point 58° C., is melted till boiling, then the test is put into it, in dry state, or washed in ricinus-oil. The ricinus-oil dissolves in hot paraffine, but does not fuse with it, when cold.

After a short time all air has escaped, and a slide is heated; the shell is put on the slide with some paraffine, and ground down to the middle, on a grinding stone, with the aid of ricinus-oil. The oil is

removed with a stick. The slide is heated again, and the shell replaced in the hot paraffine, in order to remove all the oil.

Once more the shell is mounted on the slide, with paraffine, ground side down, and with some more care the shell is ground.

The paraffine may be removed with xylol, or the slide may be enclosed in canada-balsam directly, as the xylol of the canada-balsam solution will solve the paraffine soon.

Beautiful results were attained with this method in those cases, in which the canal system was to be studied. The slide is ground down as usual, and then is laid in a concentrated muric acid bath, till all chalk-material is dissolved. The paraffine may occasionally be coloured by means of oil of bones in order to make the preparations more distinct.

The advantages of the method are:

The paraffine sticks better to the slide; the hardness of the paraffine is always the same; the grinding processes take a shorter time, and the result is quite safe, as the paraffine does not split; boiling paraffine fills the inner holes of the tests much better than canada-balsam does.

I. Family *Ammodiscidæ*.

Ammodiscus incertus (d'Orbigny).

(Textfig. 1.)

Operculina incerta d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères" p. 49, pl. 6, figs. 16, 17.

Ammodiscus incertus H. B. Brady, Rep. Voy. Challenger, Zool. Vol. 9, 1884, p. 330, pl. 38, figs. 1—3. — Flint, Rep. U. S. Nat. Mus. 1897 (1899), p. 278, pl. 23, fig. 2. — Cushman, Bull. 71, U. S. Nat. Mus. part 1, 1910, p. 73, figs. 95, 96 a, b (in text); Bull. 104, U. S. Nat. Mus., part 1, 1918, p. 95, pl. 39. — Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 62, pl. 5, figs. 1, 2.

Ammodiscus tenuis H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 51; Rep. Voy. Challenger, Zool. vol. 9, 1884, p. 332, pl. 38, figs. 4—6. — Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 279, pl. 23, fig. 1.

Found only at two stations:

St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; depth 196 m.; 6 specimens.
St. 46; 2.V.'22; 5°47′20″ S., 132°13′ E.; depth 300 m.; 16 specimens.

I cannot give any more data about the finer structure of the shell, than is already known; in St. 7 the shells were built up with sand-grains, in St. 46 on the contrary they were mainly built up with sponge-

spicules. When examining the specimens, we see several shells begin with a relatively small proloculum, known as microsphere, some others begin with a very large proloculum, and are known as megalospheric (Fig. 1). These microspheric prolocula, however, do not show the habitus, usual for a zygote, having formed a kind of cyst round the protoplasm, only communicating with the exterior by a narrow opening, the first foramen. The diameter of those prolocula is larger, than we would expect for a microspheric zygote: 24 × 40 μ. The foramen is unusually wide, and the tubiform next chamberpart forms such an

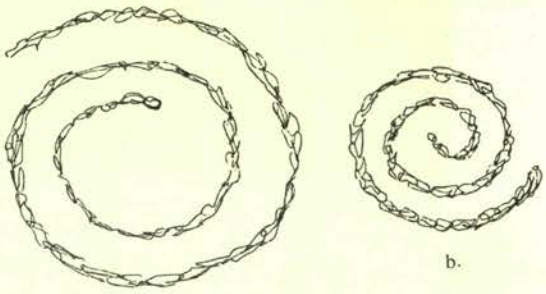


Fig. 1. *Ammodiscus incertus*. a.: megalospheric embryonic part with large proloculum; × 30. b.: would-be microspheric embryonic part; × 200.

unit with the proloculum that one cannot distinguish any border between these two parts of the shell. So it is very probable, that this proloculum formed part of a larger embryo, with a neckchamber, thus being not at all microspheric, but the A_1-form of the species. This would be in coincidence with the fact, that those would-be microspheric specimens are in all collections, I know, more abundant than the megalospheric ones. In this case, the microspheric form of *Ammodiscus* would yet be unknown as such. Investigations with much more material may solve this important question.

II. Family ***Reophacidæ.***

Reophax ammobaculitiformis nov. nomen.

(Textfig. 2.)

Ammobaculites reophaciformis Cushman, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 440, figs. 12—14; Bull. 100, U. S. Nat. Nus., vol. 4, 1921, p. 92, pl. 11, fig. 3, pl. 14, fig. 3.

This species was found in the material of:

St. 11; 9.IV.'22; Toeal; depth 20 m. It was here very common, and found in two forms, one large and with large proloculum, the other small, with more distinct sutures. It was found in another station too:

St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; several specimens.

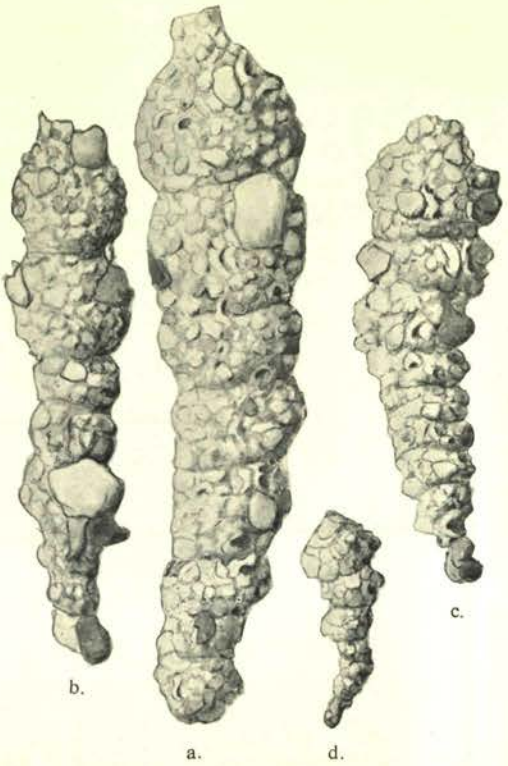


Fig. 2. *Reophax ammobaculitiformis*. × 28.
a.: Forma A_2; b., c.: forms with small megalospheric prolocula; d.: young specimen with very small proloculum, probably microspheric.

I could study this material on slides as well as on the total shells. The species shows the characteristics of *Reophax scorpiurus* (Fig. 2), but it is somewhat larger, and is in any case not identical with the *Reophax scorpiurus*, described in my work on the Foraminifera of the Ammontatura. (Publ. Stat. Zool. Napoli, vol. XII, 1932, pp. 77—80, textfigs. 9—11).

Reophax scorpiurus shows in most cases a set of first chambers, slightly curved; the same phenomenon is found in many species of *Textularia;* but this cannot be a characteristic, important enough to put the species into the genus *Ammobaculites*. I believe that this

has been done by Cushman, when he created his species *Ammobaculites reophaciformis;* a comparison with his description as well as with his figures showed me, that his *Ammobaculites reophaciformis* and my specimens from the Kei-Expedition must be identical. I mean that the genus *Ammobaculites* must contain only those species in which the first part of the shell, especially in the generations with a small proloculum, forms a closely coiled spiral. The genus *Reophax* undoubtedly is a related form, showing the tendency to be curved, especially in the microspheric generation, but never becoming really spirally coiled up. I am aware of the somewhat artificial limitation of these two genera, but until we know more about their bionomics we must accept this limitation. In this way I believe that it will be better to name the species occurring in the Indo-Pacific and the Philippine regions *Reophax*, rather than *Ammobaculites*, as the first chambers show a curved, not a spiral arrangement. It is possible, that the genus will turn out to be only a geographic variety of *Reophax scorpiurus*.

III. Family ***Textulariidæ.***

Textularia gramen d'Orbigny.

Textularia gramen d'Orbigny, Foram. Foss. Vienne, Paris, 1846, p. 248, pl. 15, figs. 4—6.

The species is not common in this area:

St. 20; 14.IV.'22; Doe-Roa Bassin; depth 50 m.; 2 specimens.
St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; 8 specimens.

Textularia stricta Cushman.

(Plate I, figs 1, 2; Textfigs. 3—4).

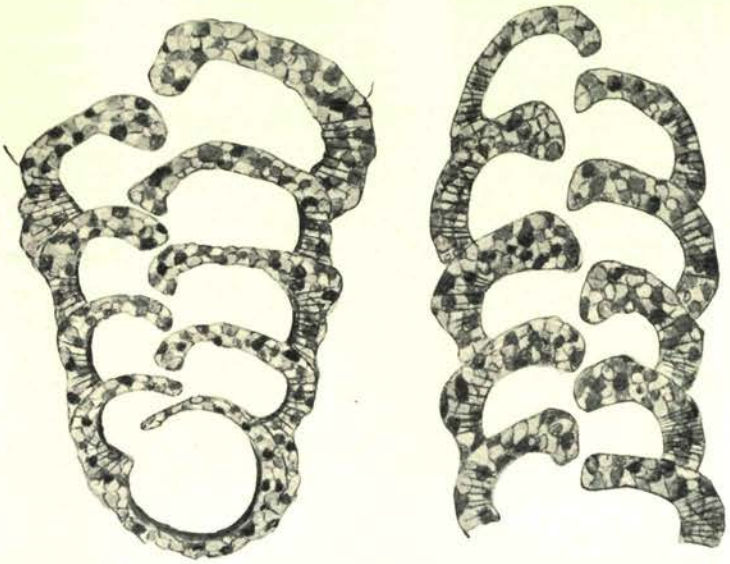
Textularia stricta Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 11, figs. 13a, b (in text); Bull. 100, U. S. Nat. Mus., 1921, p. 107, pl. 21, fig. 1.
Spiroplecta sagittula, var. *fistulosa* Chapman, Trans. New Zealand Inst., vol. 38, 1905 (1906), p. 87, pl. 3, fig. 4.

Abundant material was gathered by the Kei-Expedition at the following stations:

St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; depth 196 m.; very abundant.
St. 46; 2.V.'22; 5°47′20″ S., 132°13′ E.; depth 300 m.; 4 microspheric specimens.
St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; common.

The species was found by the Kei-Expedition only in the sea between the Wahr-group and the Nuhu-Roa-group. Cushman described

it from the sea near Japan, and from the Philippines. It has been found by Sidebottom at the coast of East Australia, and Chapman has mentioned it under the name of *Spiroplecta* from New Zealand. The species therefore seems to be typical of the Australian and Philippine regions, not occurring, as far as we know now, in the western part of the East-Indian Archipelago.



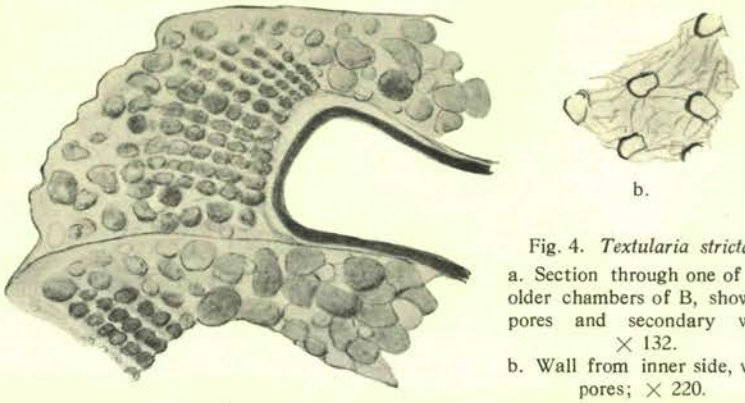
a. b.

Fig. 3. *Textularia stricta*. a. Forma A, section, × 120. b. Forma B, section, × 27.

The dimorphism of the species has been suggested by Sidebottom, according to Cushman (l. c., 1921, p. 108) as follows: "Cushman's species appears to be identical with the forms recorded and figured by Chapman from Great Barrier Island, New Zealand, 110 fathoms, under the names *Spiroplecta sagittula* (Defrance) and *S. sagittula*, var. *fistulosa* Brady. It is a very large form,..... The early structure is in our experience usually, if not invariably, spiroplectine, and Cushman's figure suggests a spiroplectine form, though his description contains no reference to this feature. But the Dart specimens are of a megalospheric Textularian type, and this would seem to be proof of dimorphism. The species deserves to be carefully worked out."

This wish can be fulfilled now, as I was able to study a relatively large material of this remarkable species.

In this material only two forms could be distinguished, a large microspheric one, of a length of up to 7 mm., and a much more common one, of a length of only 3 mm. The microspheric generation begins with a spiral set of chambers, soon followed by the biserial one. That series of chambers is very large, up to 40 and more. The diameter of these chambers increases very slowly, the end-chambers are rounded,



a. b.

Fig. 4. *Textularia stricta.*
a. Section through one of the older chambers of B, showing pores and secondary wall. × 132.
b. Wall from inner side, with pores; × 220.

the aperture is a narrow slit at the inner suture of the last formed chamber.

The megalospheric individuals show a very large proloculum, of about 130 μ diameter (Fig. 3); this proloculum is followed by a series of chambers, showing directly the typical biserial arrangement, thus having no trace of a spiral growth. The wall between the proloculum and the second chamber is very thin, those between the other chambers are much thicker.

The other characteristics of the megalospheric form are those of the microspheric one, except for the length of the whole shell.

Both forms have several characteristics in common.

Even the first formed chambers show a very typical porosity of the walls, which is found in other *Textulariidae* too. These pores (Fig. 4b) are, like those found in some species of *Truncatulina*, relatively large openings, separated by opaque chalk-substance; chemical and optical analysis showed me, that the primary wall of *Textularia stricta*

is a real chalk-wall; after this wall has been finished, chalk-material, mingled with other material, is added to form the secondary thickening of the wall; the pores are found too in the secondary thickening. Only in the walls forming the surface of the shell these pores are to be found; in the walls between the chambers (sutural walls) no pores are formed (Fig. 4a). The apertural lip is formed by a gradual thickening of the sutural wall towards the aperture. The apertures of the succeeding chambers are not situated in a single plane; on sectioning a specimen in such a way that the two series of chambers are visible, one reaches first the right series of foramina and after some time the left one. This arrangement is found in all real *Textulariidae* and must have an important systematical meaning. We know this arrangement already in the family of the *Tinoporidae*, and it is a very remarkable fact, that the *Textulariidae* and the *Tinoporidae* show quite the same structure of the pores, as well as the tendency to develop the later formed chambers in another plane than the spiral one. The place of the aperture, a narrow slit at the inner suture of the chamber, is found in both families too. As it is obvious that forms as *Truncatulina* belong to the *Tinoporidae*, *Tr. variabilis* shows to be a very striking link between those spiral forms and forms of the Textularian type. I am sure that further investigations will show a very close relation between these two groups, in this way removing the *Textulariidae* from the isolated position, in which they are standing now.

In the first formed sets of chambers, in fullgrown specimens, a secondary wall of a brown chitinous substance is added at the inner side of the wall (Fig. 4a); this secondary wall, found too in some forms of the *Tinoporidae* (*Sporadotrema*), has no pores. It is tempting to suggest the *Textulariidae* to be nothing but freeliving *Tinoporidae* of the type of *Homotrema*, *Polytrema* or something like that. Especially in older specimens the first formed chambers show a wearing away of the side walls due to the movements of the animal. I suggest that this phenomenon stands in some connection with the forming of the chitinous inner walls in those chambers.

Textulariella immensa (Cushman).

(Pl. II, figs. 11 and 12; Textfig. 5.)

Textularia immensa Cushman, Proc. U. S. Nat. Mus., vol. 44, 1913, p. 633, pl. 79, fig. 2; Bull. 100, U. S. Nat. Mus., pt. 4, 1921, p. 118, pl. 24, figs. 4 a, b.

Found in 9 specimens, all megalospheric, in the material from station: St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; several specimens.

Description of Cushman's (1921):

"Test large and broad, rhomboid, very much flattened, chambers low and long; wall thick, of rather coarse angular sandgrains, imbedded in an unusually large amount of light gray cement; aperture consisting of a series of small openings running from the inner margin of the apertural face to the highest point at the distal end of the test, about 20 in number; color gray. Length up to 6 mm.; breadth up to 4 mm.; thickness 0,5 mm."



Fig. 5. *Textulariella immensa*. Section through a whole shell; × 33.

This description agrees in all points with the material, I found at this Kei-station. Cushman found it in the Philippines, very rare, but at the same depth.

When sectioning these particular shells, I found that the first formed chambers were typically textularine; but the fifth chamber formed at its apertural face secondary walls protruding in the hole of the chamber, making the chamber labyrinthic, as in the genus *Textulariella*. As no microspheric form could be found in the rare material, no other data on the systematic place of this species were afforded.

The test is built of rather coarse material, sandgrains, foraminiferal shells and a large amount of sub-fossil Foraminifera, filled up with glauconite. The first megalopheric chamber measures 110 μ.

Textulariella rugosa (Reuss).

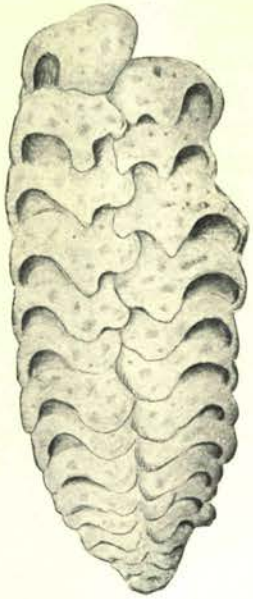
(Textfigs. 6 and 7.)

Plecanium rugosum Reuss, Sitz. Akad. Wiss. Wien, vol. 59, 1869, p. 453, pl. 1. figs. 3 a, b.

Textularia rugosa H. B. Brady, Rep. Chall., Zool., vol. 9, 1884, p. 363, pl. 42, figs. 23, 24. — Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 625, pl. 47, figs. 7—9. — Cushman, Bull. 100, U. S. Nat. Mus., p. 114, pl. 23, figs. 3, 4.

The species was found only at a single station of the expedition:

In the neighbourhood of Waling, Banda, depth 20 m.; 11.VI.'22; 12 specimens, all megalospheric.



a.



b.

Fig. 6. *Textulariella rugosa*. × 28. a: sideview. b: apertural side.

Most of the specimens are of a large type, measuring about $2^1/_2$ mm. They show the typical characteristics of the "*Textularia rugosa*", with the outgrowths or alar prolongations of the chambers, the simple aperture, the smooth surface, etc. But when sectioning some tests, I found that the inner characteristics were much more complicated than those of ordinary *Textularia*. On a median longitudinal section one finds the structure of the normal textularian shell; the chamber-walls in the neighbourhood of the foramen are thickened as usual. But when the section has been traced more tangentially, one observes rows of secondary chamberlets arranged in horizontal layers.

On a transverse section septa are found, running from the outer walls to the interior of the chambers, nearly up to the inner walls,

thus dividing the lumen of the chambers into four or five (in the older chambers into two or three) secondary chamberlets, making the chambers labyrinthic (Fig. 7).

I noted only megalospheric shells, and thus I cannot give more data on the relationship of these shells, as it is possible that the first

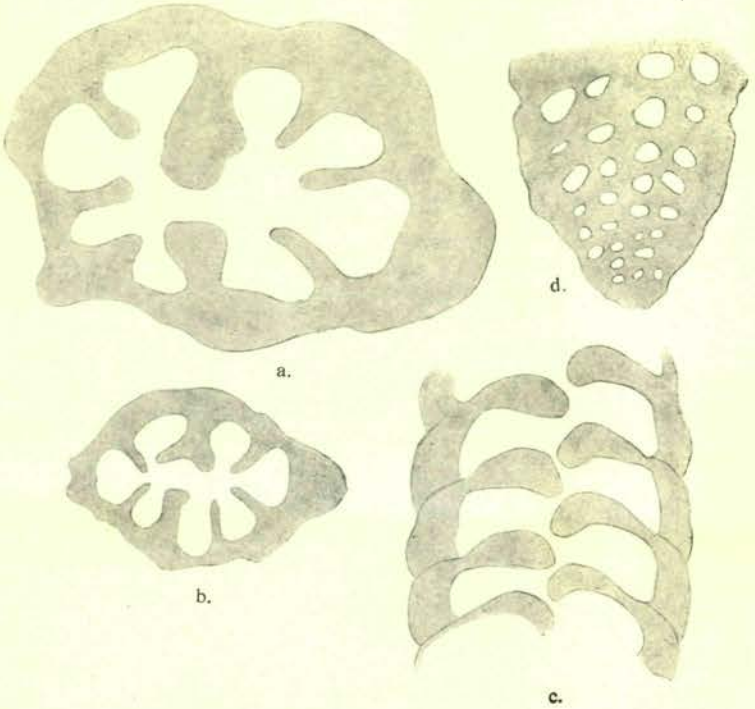


Fig. 7. *Textulariella rugosa*. a: transverse section through the apertural end; × 60. b: idem through the first chambers; × 160. c: longitudinal section, median; × 33. d: longitudinal section, tangential; × 33.

chambers of the microspheric shells of labyrinthic forms are simple. Yet I am of the opinion, that the occurrence of labyrinthic shells in megalospheric specimens is characteristic enough to lead to the conclusion that the form must belong to the genus *Textulariella*. This fact is of even more interest, as thus two species of this genus, otherwise known almost exclusively as fossil, are found in the eastern part of the East Indian Archipelago. The species is, however, of a much more simple structure than the fossil species are in most cases.

Textularia goësii Cushman.

Textularia sagittula Defrance, var., Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, pl. 5, figs. 150—158.

Textularia trochus H. B. Brady (part), Rep. Voy. Challenger, Zool., Vol. 9, 1884, p. 366, pl. 43, fig. 17, pl. 44, figs. 1—3.

Textularia goësii Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 15, figs. 24 a, b; Bull. 100, p. 113, pl. 21, fig. 3.

St. 62; 15.V.'22; 5°29′25″ S., 132°50′ E.; depth 290 m.; 3 specimens.

Brady mentions the fact that specimens under favorable conditions show a labyrinthic structure of the inner part of the chambers. I found only traces of a somewhat rough inner surface of the chamber-walls. Yet the outer habitus of the shell is nearly identical with *Textulariella barettii*, which possesses real labyrinthic chambers. The material was too small for making investigations about the bionomics of the species; I call the special attention of other investigators to this remarkable species.

Textularia trochus d'Orbigny.

Textularia trochus d'Orbigny, Mém. Soc. géol. France, Vol. 4, 1840, p. 45, pl. 4, figs. 25, 26. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 366, pl. 43, figs. 15, 16, 18, 19.

This very flat species was found only at a single station, from which bottom-sand was selected by the author; it was:

St. 11; 9.IV.'22; Off Toeal; depth 20 m.; only few specimens. The material was not large enough for a closer study of the specimens.

Textularia agglutinans d'Orbigny.

Textularia agglutinans d'Orbigny, in De La Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères", p. 136, pl. 1, fig. 17, 18, 32—34. — Hofker, Pubbl. Staz. Zool. Napoli, vol. XII, 1932, p. 91, textfig. 16.

The species was found at the following stations:

St. 11; 9.IV.'22; Off Toeal; depth 20 m.; common.

St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; some specimens.

Bigenerina nodosaria d'Orbigny.

(Pl. II, figs. 3 and 4, 15 and 16; textfigs. 8 and 9.)

Bigenerina nodosaria d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 261, pl. 11, figs. 9—11; Modèles, 1826, No. 57. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 369, pl. 44, figs. 14—18. — Cushman, Bull. 71, U. S.

Nat. Mus., pt. 2, 1911, p. 27, figs. 46—48 (in text); Bull. 100, pt. 4, p. 125. pl. 26, fig. 2.

Occurrence of the species in the material of the Danish Expedition:
St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; depth 300 m.; 16 specimens.
St. 58; 12.V.'22; 5°29′ S., 132°36′ E.; depth 290 m.; abundant.
St. 64; 26.VII.'22; 5°51′ S., 106°22′ E.; depth 36 m.; abundant.



Fig. 8.

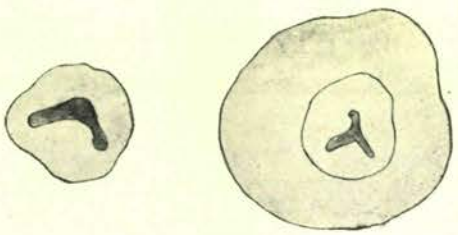


Fig. 9.

Fig. 8. *Bigenerina nodosaria*. Section through forma A_2; × 44.

Fig. 9. *Bigenerina nodosaria*. Two forms of mouths; × 44.

This fine *Bigenerina* shows a very wide variation, due to the difference in generation as well as in the material used for the agglutination. In some localities one finds specimens with very fine sandgrains on the tests, in other localities, however, one meets only with a very rough surface. Yet the inner structure, especially the inner habitus of the chambers is in those cases the same, so that the establishing of a distinct species for those rough forms is of no value. Millet has described the species from this region (Journ. Roy. Micr. Soc. 1899, p. 564) and mentions the fact, which I could also state, that the smooth form is relatively rare, whereas the rough form, "equivalent to the *B. agglutinans* of d'Orbigny, ...occurs at several Stations."

More remarkable is the fact, that the way of agglutination is

in some degree characteristic for special generations of the species. I found that, in all the material, the microspheric forms were always rough, while especially the A_2-form was smooth. The kind of agglutination is thus a factor of the geographical circumstances, as well as of the inner agents. (The same has been found in *Reophax scorpiurus*, see my work on the Forams. of the Ammontatura: Pubbl. Staz. zool. di Napoli, vol. 12, 1932, pp. 77—80).

In this large material I could note three different forms.

B-form (Pl. II, figs. 15, 16). The shell begins with a very small proloculum, followed by a set of 8—12 textularine chambers; the uniserial chambers gradually increase in diameter, the breadth of the 7th chamber being three times that of the first uniserial chamber. The aperture of the last chamber of an outgrown test is triangular. In most cases the textularine part of the test is sharply separated from the uniserial part. The surface is covered with large sandgrains and foraminiferal shells. Length of the total test up to 3 mm.

A_1-Form (Pl. II, fig. 3). Test long and narrow, consisting of a textularine part of 6—8 chambers, followed by 8—10 uniserial chambers. The proloculum has an inner-diameter of about 45 μ, and the uniserial chambers scarcely increase in breadth, the last formed chamber being not yet double as broad as the first one. In most cases the wall was finely agglutinated, and smooth. Length of the total shell: up to 2 mm.

A_2-Form (Pl. II, fig. 4). Test short and thick, stoutly built. First part consisting of a truncate, not well defined textularian end, formed by a large proloculum (90 μ diameter), followed by a set of only three textularian chambers. The uniserial chambers (5 or 6) are broad and stout, all nearly of the same breadth. The wall is always smooth, and finely agglutinated. Length of the shell up to $1^1/_2$ mm.

Bigenerina nodosaria has been found by Millet in several stations of the Archipelago; Cushman found it in the Philippines; Brady mentions it especially from the northern Hemisphere.

Clavulina tricarinata (Reuss).

(Pl. II, fig. 10; textfigs. 10—14.)

Textularia tricarinata Reuss, Verst. Böhm. Kreid., pt. 1, 1845, p. 39, pl. 8, fig. 60.
Tritaxia tricarinata Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 228, pl. 12, figs. 1, 2. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 389,

pl. 49, figs. 8, 9. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 61, figs. 98 a, 99 (in text); Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 145, pl. 28, figs. 2 a, b.

In the Kei-material the species occurred only at two stations:

St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; 15 specimens, all of megalospheric generation.

St. 59; 12.V.'22; 5°28′ S., 132°36′ E.; depth 385 m.; 3 specimens, all megalosph.

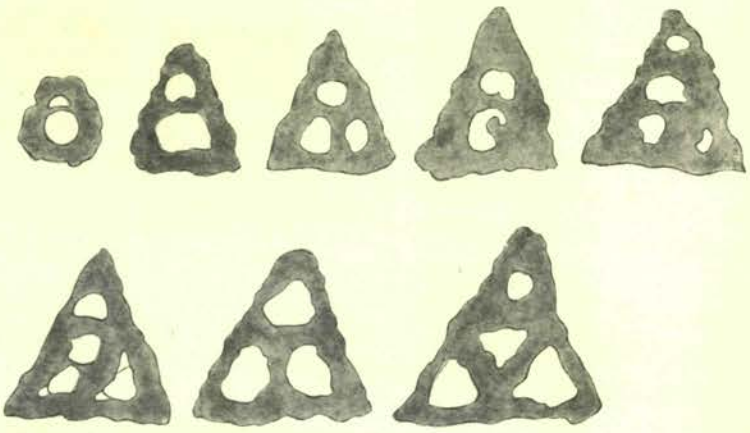


Fig. 10. *Clavulina tricarinata.* Succeeding sections through the apical end of the shell, showing the apparent verneuiline growth of the chambers; × 38.

This species, in all hitherto known collections of recent material very rare, occurred in the material at hand in some quantities, so that I could take the opportunity of studying it more closely. All specimens examined turned out to be megalospheric. They begin with a relatively large proloculum (Figs. 12 b, 13 a), succeeded by three chambers situated in a single plan, from which chambers the first one was connected with the proloculum (Fig. 13a). This stage of development shows the verneuiline arrangement of the chambers (Fig. 12a). But then the growth of the chambers becomes uniserial so that 11 of the 14 or 15 chambers are arranged in a straight series (Fig. 13b). Each of these chambers possesses three edges, hanging down and thus overlapping the former chamber, at the place where the angles of the whole shell are found. In consequence in a transverse section one may see the mouth of the next chamber, together with the three edges of the former one (Fig. 11). This probably was the

structure (Fig. 10), which led Brady to the idea that this species did belong to the cretaceous genus *Tritaxia*. But, when considering the

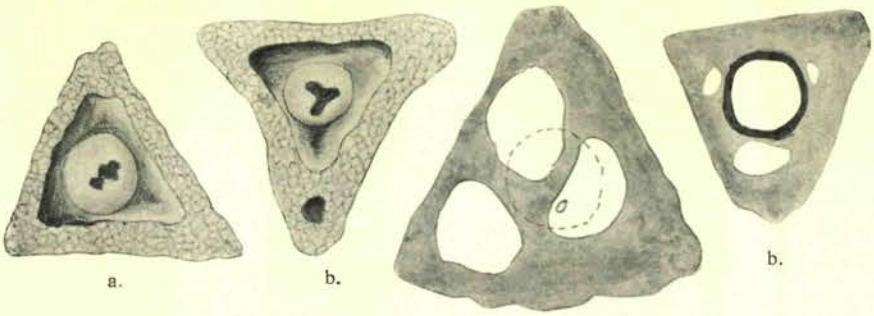


Fig. 11. Fig. 12.

Fig. 11 a—b. *Clavulina tricarinata*. Chambers shown from within, with foramen to the foregoing chamber; × 38.

Fig. 12. *Clavulina tricarinata*. a: Section through the three chambers of the verneuiline part of the shell. b: Section through the embryonic chamber of the same test. Both × 100.

"Key to the genera" of the family of the *Verneuilinidae*, given by Cushman (The Foraminifera, 1928, p. 121) one can only come to

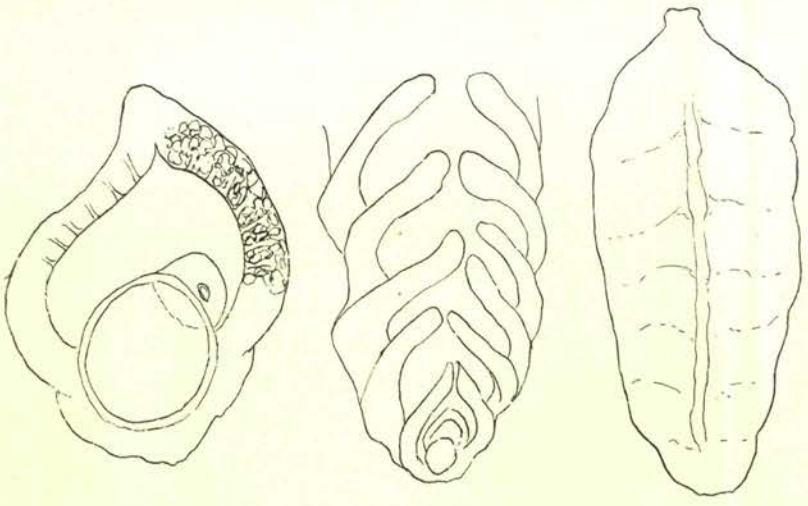


Fig. 13. *Clavulina tricarinata*. a: longitudinal section through the first part of the shell; × 52. b: longitudinal section through nearly total shell; × 28. c: total shell; × 28.

the result that it must belong to the genus *Clavulina*, when knowing the characteristics of this species.

In the early chambers the wall shows the coarse pores, found in other Textularians too (Fig. 13a).



Fig. 14. *Clavulina tricarinata*. Section through the shell on Pl. II, fig. 10; × 28.

Fully outgrown specimens show a very remarkable aperture; when young the aperture is a round opening on the top of a volcano-like neck, while in adult tests the aperture is trilobate, as it has been found by Cushman for some fossil forms, especially *Clavulina trilaterata* Cushman (see the beautiful account in Bull. 41, of the Division of Geology of Tennessee, 1931, p. 22, pl. 2, figs. 1—3). It is very probable, that the recent form is very closely allied to that fossil *C. trilaterata*, but as we do not yet know anything about the microspheric form of *C. tricarinata*, an identification is not yet possible.

Clavulina tricarinata reaches a length of 1.5—2.5 mm. It has been found at several localities in the Philippines by Cushman. It is possible, that Millet's record of *Tritaxia lepida* in reality refers to the same species; in that case it has been found already in the East-Indian Archipelago, in the same region.

Clavulina bradyi Cushman.

(Plate II, figs. 5—9, 14; textfigs. 15 a—e.)

Clavulina cylindrica H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 396, pl. 48, figs. 32—38.

Clavulina bradyi Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 73, figs. 118a, b, 119 (in text). — Bull. 100, 1922, p. 155, pl. 31, fig. 4.

This remarkable species occurred in the material from several localities, both in the neighbourhood of the Kei-Islands:

St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; 196 m., 24 megalospheric, 4 microspheric specimens.

St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; 290 m., 27 megalospheric; 1 microspheric.

The species has been described by several authors in a different way. The description of Brady (1884) is as follows:

"Well-developed specimens of *Clavulina cylindrica* closely resemble *Haplostiche soldanii*, not only in contour, but in shell-texture. These

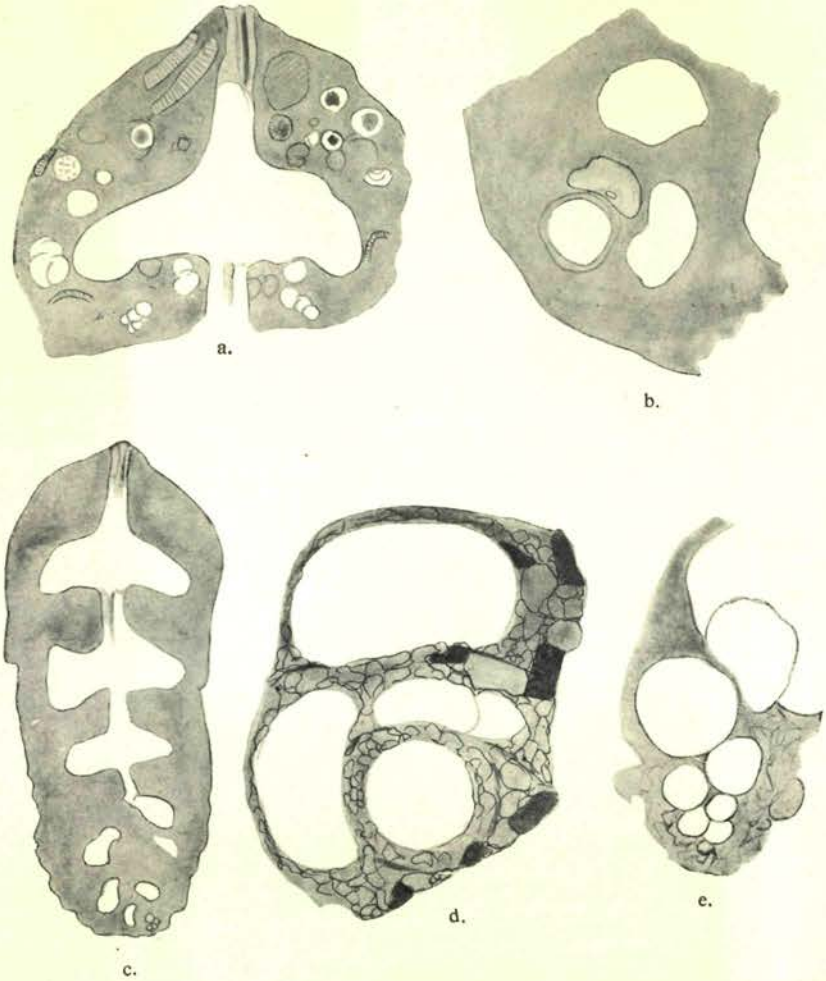


Fig. 15. *Clavulina bradyi*. a: Section through the last formed chamber of forma B, × 100. It shows the ridges of the mouth and the foraminiferal shells in the wall. b: Section through the first chambers; × 100. c: Section through forma B. d: Section through the first chambers of forma A; × 132. e: Section through the first set of chambers of forma B; × 132.

two species often abound in the same locality, especially amongst the coralsands of the tropics, and very frequently the orifice furnishes

the only external character by which they can be distinguished the one from the other. In the lituoline test the aperture is either simple or labyrinthic, whilst in perfect specimens of *Clavulina cylindrica* it is always valvular. The longitudinal section of either organism at once reveals its affinity; but the external character referred to is of interest from a morphological point of view, and of value as affording a ready means of diagnosis.

The walls of the test are thick, and in the ovate and rounded forms the septation is entirely concealed by their massive development; but in the more elongate cylindrical varieties the thickening is less conspicuous, and the septation of the uniserial line of segments is indicated by slight external depressions."

The description of Cushman's (1911) on the contrary:

"Test stout, cylindrical, the early triserial portion not well shown exteriorly, the later uniserial portion of few chambers, large, distinct, with well-defined, depressed sutures; wall arenaceous, composed of a mixture of coarse and fine material, but usually with a smooth exterior; aperture circular, often at the end of a short neck, usually with a single valvular tooth; colour light gray. Length up to 5 mm."

I will add a description of the material of this expedition, after the thorough study I have made of it:

Test stout, cylindrical, with nearly equal ends, the younger one slightly broader than the older. The early triserial portion, with typical verneuiline arrangement of the chambers, not shown exteriorly; the later uniserial portion consisting of only three or four chambers, with slight external depressions as sutures. Wall arenaceous, composed of a mixture of coarse and fine material, mainly foraminiferal shells and fractures of them (Fig. 15a). Exterior smooth, in such a way, that the shells are not visible from without. Aperture in younger specimens circular, with a single tooth, in older specimens, however, the aperture is labyrinthic, as several edges on the inner wall of the mouth anastomose (Pl. II, fig. 8). Especially the microspheric form (Pl. II, fig. 14) possesses this remarkable characteristic. In most cases the aperture is found at the end of a short tubular neck. The colour of the shells was invariably gray. Length of the microspheric specimens up to 5 mm.; the megalospheric form measures up to 2 mm.

As is shown here, the only typical exterior difference between *Clavulina bradyi* and *Haplostyche dubia*, the form of the aperture,

does not exist in reality, as *Clavulina* shows the complicate mouth too. I am sure that different authors have described a *Clavulina* as *Haplostiche*, and certainty can only be obtained in this case (as well as in others) by means of sections.

The microspheric embryonic apparatus was very difficult to study, as I found that especially in the thick wall of the microspheric generation the amount of whole shells of other Foraminifera was considerable, and thus the study of the minute embryo was nearly impossible. Yet at the end of my investigations I prepared a very good slide, giving the total apparatus, showing the typical verneuiline chambers (Fig. 15e). The megalospheric apparatus consists in a proloculum of 90 μ diameter, followed by a triserial verneuiline set of chambers, which show the aperture of the typical textularian habitus (Fig. 15d): a fine oval slit at the inner suture of the chamber. The chambers of the uniserial row possess a totally surrounding wall, so that the walls between two chambers are double, as is always the case in the textularian species.

IV. Family *Miliolidae.*

Cornuspira foliacea (Philippi).

Orbis foliaceus Philippi, Enum. Moll. Siliciae, vol. 2, 1844, p. 147, pl. 24, fig. 26.
Cornuspira foliacea Carpenter, Parker et Jones, Introd. Foram., 1862, p. 68, pl. 5, fig. 16. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 199, pl. 11, figs. 5—9. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 24, pl. 1, fig. 1, pl. 2, fig. 1; Bull. 100, U. S. Nat. Mus, pt. 4, 1921, p. 387, pl. 77, fig. 1.

Only a single specimen at station 58: 5°29′ S., 132°37′ E.; depth 290 m.

Cushman mentions the species from several localities in the Indian Archipelago: Gulf of Tomini, Macassar strait, both at considerable depth.

Quinqueloculina reticulo-striata Cushman.

(Pl. II, figs. 17—19; Pl. III, figs. 1—4; textfigs. 16 a—c.)

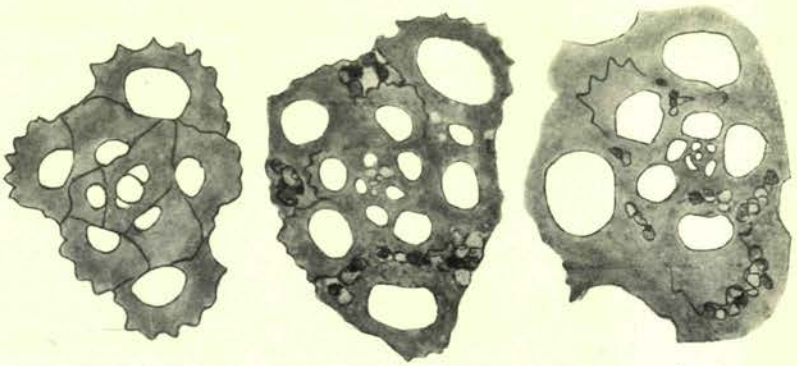
Quinqueloculina kerimbatica, var. *reticulo-striata* Cushman, U. S. Nat. Mus., Bull. 100, p. 437, pl. 89, figs. 1a—c.

This species was found at three stations:
St. 64; 26.VII.'22; 5°51′ S., 106°22′ E., depth 35 m.; several specimens.
St. 71; 28.VII.'22; 5°40′ S., 106°08′ E.; depth 54 m.; common.
St. 107; 5.VIII.'22; 5°47′ S., 106°7′ E.; depth 49 m.; several specimens.

These stations, all in the Java-Sea, are situated closely together, so that the similarity in material is not very surprising.

The species was described by Cushman from several stations in the Philippines, Japan and the north of Borneo. His description is as follows:—

"Test with peripheral faces rather squarely truncate and ornamented by longitudinal narrow costae, the sides of the chambers with oblique areolae; the apertural end contracted and terminating in a



a. b. c.

Fig. 16. *Quinqueloculina reticulo-striata*. a: Forma A; section; × 38. b: Forma B, section through the specimen, figured Pl. III, figs. 1, 2; × 38. c: Central part of that section; × 132.

short cylindrical neck, and thin phialline lip with a bifid tooth.". I was first inclined to name this species a variety of *Q. reticulata;* but the study of the inner structure showed me that megalospheric as well as microspheric specimens, with the same typical characteristics occurred. This is the reason why I made of Cushman's variety a distinct species, as in any case two of the three generations could be described; the material was not large enough to analyse the three generations. It is especially the B-form, which shows the characteristics mentioned by Cushman (Pl. III, figs. 1—4); the A-form shows more the habitus of *Q. costata* d'Orbigny (Pl. II, figs. 17—19), as it was described by Cushman (U. S. Nat. Mus., Bull. 71, p. 49, pl. 15, fig. 1):

"Test about twice as long as wide, elliptical or narrowly oval, chambers tumid, peripheral margin broadly rounded, sutures distinct but not deeply depressed, surface ornamented by numerous longitudinal, rather remote lines, apertural end exserted, with a slight

neck tapering gradually from the peripheral curve, aperture broadly elliptical, basal end of the chamber broadly rounded, apertural end much darker than the remainder of the test. Length about 1 mm."

This species has been figured exhaustively by Heron-Allen and Earland (Trans. Zool. Soc., vol. XX, pl. 44, figs. 13—17) under the name of *Q. striata* (d'Orbigny). All these forms, I believe, form a single species, since I found in the Kei-material that the microspheric generation of Cushman's *Q. reticulo-striata* corresponds with a megalospheric one, which shows us all the characteristics of the striate form of the "Planches inédites", which form may best be called *Q. costata.* But, as the microspheric form shows the most typical features in Foraminifera, one may call the whole species with the name given to the microspheric generation.

Short description of *Quinqueloculina reticulo-striata* Cushman:

Forma A.

Test nearly twice as long as broad, chambers with the form of a banana. Aperture on a short neck. Tooth slightly bifid. Surface with longitudinal costae or rather striae, somewhat irregularly shaped. Proloculum relatively large, 91 μ, with long neck-chamber, surrounded by 5 chambers, later on three chambers are added to these five, so the fullgrown individual possesses 8 chambers. Walls of the chambers thick; striae in section deep. Length of the shell: 1.4 mm.

Forma B.

Test $1^1/_2$ × the breadth. Costae more irregularly shaped than those of the A-form. They anastomose in some cases, forming a structure similar to that of *Q. reticulata*. These ribbles are filled up, when the next chamber is built, by somewhat clearer substance, here and there by foreign material. This particularity gives rise to a typical characteristic in a transverse section (see the figures 16 a—c). The microsphere is surrounded by 4 sets of chambers, each set consisting of 5 chambers. Length up to 2mm.

Quinqueloculina reticulata (d'Orbigny).

(Pl. III, figs. 5—7; textfig. 17.)

Triloculina reticulata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, no. 9.
Quinqueloculina reticulata Karrer, Sitz. Akad. Wiss. Wien, vol. 44, 1861, p. 449, pl. 2, fig. 5. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 55, pl. 16, figs. 1—3.

Miliolina reticulata Parker, Jones and Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 249, pl. 8; fig. 18. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 177, pl. 9, figs. 2—4. — Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 214, textfig. 25, pl. 2, fig. 62.

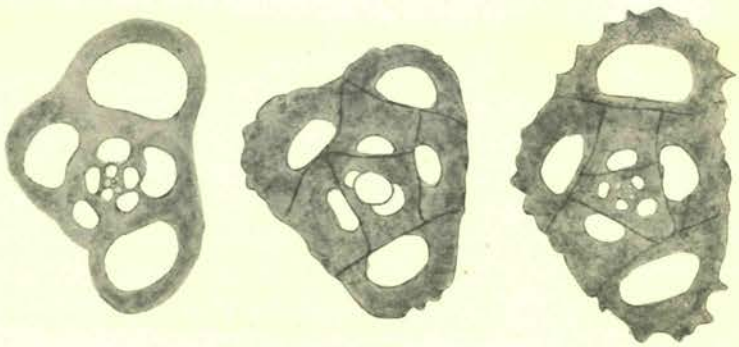
Quinqueloculina Kerimbatica var. *Philippinensis* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 438, pl. 89, fig. 2, 3; textfig. 34.

Found at the following stations:

St. 20; 14.IV.'22; Doe-Roa Bassin; depth 50 m.; rare.
St. 64; 26.VII.'22; 5°51′ S., 160°22′ E.; 35 m.; very abundant.
St. 71; 28.VII.'22; 5°40′ S., 106°08′ E.; 54 m.; rare.
St. 83; 30.VII.'22; 6°42′ S., 105°17′ E.; 45 m.; common.
St. 85; 31.VII.'22; 5°53′ S., 105°34′ E.; 25 m.; rare.
St. 107; 5.VIII.'22; 5°47′ S., 106°7′ E.; 49 m.; abundant.

Three forms could be distinguished in the abundant material, forming a true trimorphous species. It is not necessary to describe them, as they are already known as different species, for the A_1- and the B-forms are described very thouroughly by Cushman under the name of *Q. kerimbatica*, var. *Philippinensis*, and A_2 cannot be distinguished from normal *Q. reticulata* d'Orbigny.

A_2, with the larger proloculum and the smallest size, shows one set of 5 chambers, followed by two others. The walls are not as thick



a. b. c.

Fig. 17. *Quinqueloculina reticulata*. a: Section through the central part of B; × 100. b: Section through A_2; × 38. c: Section through B; × 38.

as those of *Q. reticulo-striata*. The embryonic apparatus possesses a large neck-chamber.

A_1 shows a somewhat smaller proloculum, but the number of the chambers is the same.

B, the largest form, shows the strongly built, yet not irregular reticulation of the walls, described by Cushman for his variety. 4 sets of chambers surround the microsphere.

The form has been described from the Philippines, and thus seems to be common in this region. It is not quite sure, whether the *Q. reticulata* of other localities in the world are in reality identical with the Indo-Malayan species.

Quinqueloculina bicostata d'Orbigny.

(Pl. III, figs. 8—12; textfig. 18.)

Quinqueloculina bicostata d'Orbigny, in: de la Sagra, Hist. Fis. Pol. Nat. de Cuba, 1839, p. 195, pl. 12, figs. 8—10. — Cushman, U. S. Nat. Mus., Bull. 71, p. 47, pl. 13, fig. 1.

Quinqueloculina bicarnata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 302, no. 35. — Terquem, Mém. Soc. France, sér. 3, vol. 1, pl. VII (XII), figs. 10a—c. — Cushman, U S. Nat. Mus., Bull. 100, 1921, p. 428, pl. 86, figs. 2, 3; pl. 100, fig. 7.

Occurrence in the Kei-material:

St. 20; 14.IV.'22; Doe-Roa Bassin; depth 50 m.; rare.
St. 46; 5°51′ S., 106°22′ E.; depth 35 m.; abundant.
St. 71; 5°40′ S., 106°08′ E.; depth 54 m.; rare.
St. 107; 5.VIII.'22; 5°47′ S., 106°7′ E.; depth 49 m.; abundant.

The species, which is very typical, was named by Cushman in his work on the Philippines *Q. bicarinata;* why he did so, is not very clear, as Terquem's figures are mostly very schematical and incorrect, thus giving only cause to confusion, and d'Orbigny's name was a nomen nudum. The description, given by Cushman of *Q. bicostata* is suitable too to the form, found in the East Indian Archipelago; Cushman's words, regarding his *Q. bicarinata:* "It is always short and broad, ... " do not agree with his fig. 7 of pl. 100. I found too, that some specimens show a slightly striate surface, as was stated by Cushman for his *Q. bicarinata.*

Thus the specimens found in the Java-Sea and those described by Cushman from the Philippines belong to the same species. But, as mentioned above, I cannot find any reason for not naming them *Quinqueloculina bicostata* d'Orbigny.

The material was not large enough for ascertaining a well founded trimorphy; this is why I shall describe only two forms, A and B.

Forma A (Pl. III, figs. 9 and 10). Test elongate, one side showing

4 chambers with protruding costa in the middle, the other side showing 3 chambers, flat. Each chamber developing two costae so that the margins of the shell show two costae each. Aperture slightly produced, with a tooth which is not prominent, and simple or somewhat bifid (Pl. III, fig. 11). First chamber relatively large, with narrow neck-chamber, followed by only a single coil of chambers, 5 in total. Diameter of the first chamber 110 μ. Length of the shell up to 1 mm., breadth 0.75 mm. (Textfig. 18c). The surface of the test is smooth or with an indication of fine longitudinal striation.

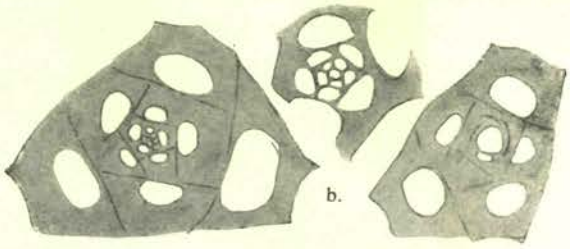


Fig. 18. *Quinqueloculina bicostata*. a: Section through B; × 28. b: Central part of section through B; × 100. c: Section through A; × 28.

Forma B (Pl. III, fig. 8). Test nearly as long as broad, the one side showing 4 chambers with protruding costa in the middle, the other showing 3 chambers, flat. Each chamber developing two sharp costae, so that the margins of the shell show two costae each. Aperture very slightly produced, with large tooth always bifid (Pl. III, fig. 12), prominent and visible in sideview. First chamber 12 μ in diameter, without neckchamber, followed by a set of 5 chambers. In total 5 of these sets are formed (Textfigs. 18 a, b). Surface of the test smooth or striate.

In both forms the walls of the last formed chambers are thick.

This species seems to be characteristic of the tropical Pacific, occurring especially in the western part of that region.

Quinqueloculina curta Cushman.

(Pl. III, figs. 13—25; textfigs. 19—20.)

Miliolina cuvieriana Millet, Journ. Roy. Micr. Soc., 1898, p. 505, pl. 12, figs. 2 a, b.
Quinqueloculina disparalis d'Orbigny, var. *curta* Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 49, pl. 14, fig. 2; fig. 2; fig. 30 (in text).
Quinqueloculina curta Cushman, Bull. 100, U. S. Nat. Mus., 1921, p. 426, pl. 100, figs. 1, 2.

Quinqueloculina albatrossi Cushman, Bull. 100, U. S. Nat. Mus., 1921, p. 435, pl. 85, figs. 4a—c.

This species occurred in large quantities at several stations; especially at St. 78, Sunda-Str., depth 30 m., 29.VII.'22, it was very abundant (6°25′ S., 105°41′ E). Other localities are:

St. 79; 29.VII.'22; 6°28′ S., 105°38′ E.; Sunda-Str.; depth 47 m.; abundant.
St. 83; 30.VII.'22; 6°42′ S., 105°17′ E.; depth 45 m.; common.

I will first give a short description of the three forms found at St. 78.

Forma A_1. Small shells (relatively), showing in section a small megalospheric proloculum of about 170 μ diameter, followed by 6 or 7 chambers, mostly 4 or 5 chambers forming the outer coil. The chambers show three costae and besides at the beginning of each chamber some finer costae. All other parts of the wall are smooth. The walls are relatively thick.

Mouth with two lateral toothlike prominences, and a large bifid tooth. Length of the whole shell up to 1.5 mm.

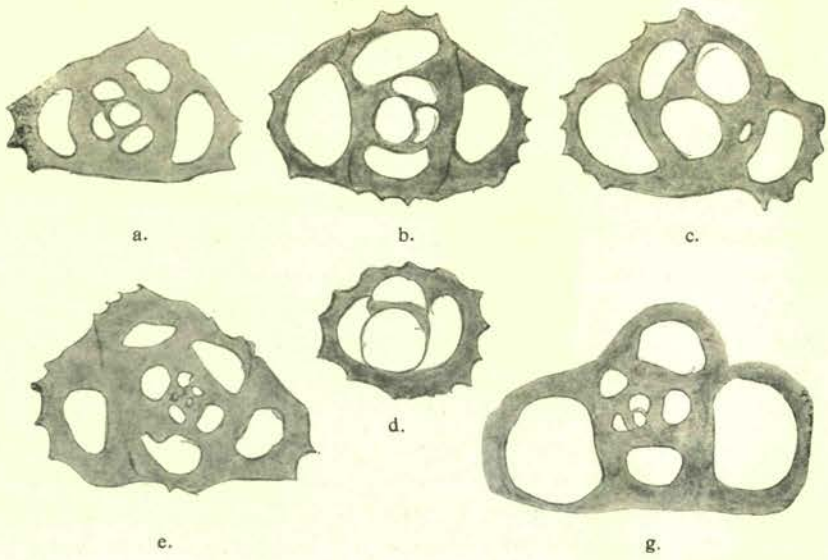
Forma A_2. Even the four-chambered stages show, together with three or four larger costae on the outer walls of the chambers, many finer longitudinal ribs. First chamber relatively large, about 350 μ diameter. The adult shell shows 4 or 5 chambers in the last coil, with many costae and some fine striae at the inner margin of the later chambers. These striae are directed transversally to the costae and to the long axis of the shell. The tooth is, even in younger shells, largely bifid and the mouth shows the toothlike prominences. Length up to 2.5 mm.

Forma B. This large form (in case the shells are outgrown) shows on the section that it is microspheric, with a diameter of the first chamber of 11.5 μ. All 5 chambers from the last coil show three or four distinct costae, and at both ends of the chambers, even in the younger specimens, the chamberwall shows transverse striae.

In young specimens the tooth is simple or bifid, in older ones the tooth grows more and more complicated, the two ends of the fork meeting together and leaving a round opening between. The wall of the mouth is complicated in the same way, secondary teeth are formed and at the end a mouth of several openings is found. Length, when outgrown, up to 3.5 mm.

The two megalospheric forms are identical with Cushman's *Q. curta*,

whereas his *Q. albatrossi* must be my B-form; the transverse striae, but still more the very typically shaped tooth, are very convincing. In many miliolids the value of the tooth as a systematic characteristic



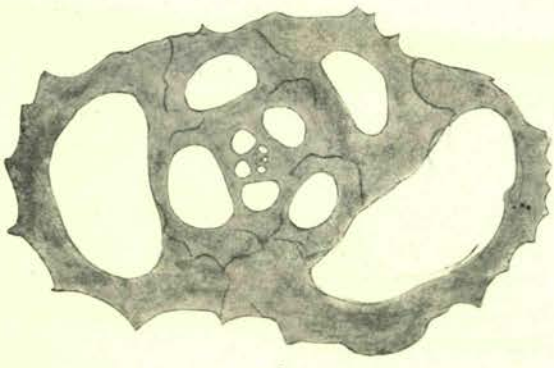


Fig. 19. *Quinqueloculina curta*. a: Section through forma A_1, shell of Pl. III, figs. 13, 14; × 20. b: Section through forma A_1, shell of Pl. III, figs. 15, 16; × 20. c: Section through forma A_2, shell of Pl. III, figs. 21, 22; × 20. d: Section through forma A_2, shell of Pl. III, figs. 23—25; × 20. e: Section through young specimen of forma B, shell of Pl. III, figs. 17—20; × 20. f: Section through an outgrown specimen of forma B; × 25. g: Central part of the section; × 88.

has been discussed lately. It is very probable that the uncertainty in this respect is due to the fact of the microspheric generation in nearly all Foraminifera being the producer of the larger quantity of chalk-material (in many Foraminifera the forming of pillars, proliferations and other deposits of secondary material is a special charac-

teristic in the microspheric form), the deposit of extraordinary chalk-material in the neighbourhood of the mouth leads in this generation to the building of even the cribrate mouth of the latter. So especially in this generation difference of tooth building may be evident, and a closer analysis of the different forms of the teeth in the different generations of one and the same species must, I think, lead again to a greater estimation of the tooth as systematic characteristic.

In the case of *Q. curta* we can say that the tooth, being only in

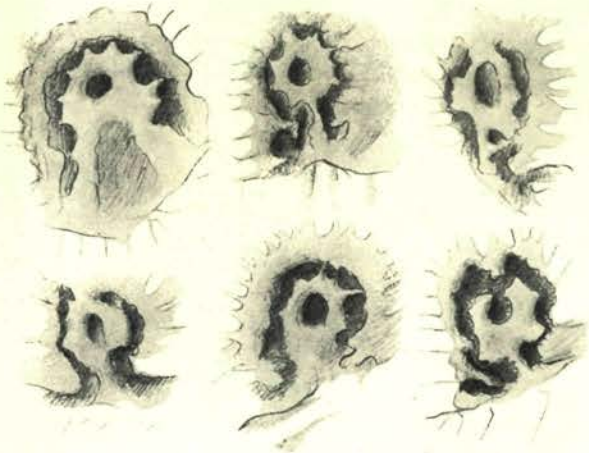


Fig. 20. *Quinqueloculina curta*, forma B. Several mouths with the complicated teeth; × 54.

the second chamber simple, becomes in the A-forms bifid, while the mouth-margin forms secondary toothlike prominences. In the B-forms the tooth gets at the end of the development of the shell (the two ends of the tooth melting together) a central mouth-opening, surrounded by secondary openings, leading to a cribrostome, as is known only in some differentiated forms, such as *Schlumbergina*, *Hauerina*, and *Trillina*.

In the Malayan and Philippine Archipelagos the species *Q. curta* has been traced several times already. It was mentioned by Millet under the name of *Miliolina cuvieriana* d'Orbigny sp., though his figure of the tooth shows a difference from that species. It was found by Millet near Segaar, on New Guinea. Cushman mentions it from southern Luzon, Sulu Sea, Mindanao and other localities in the Philip-

pines, from 18—500 fathoms. So it seems to be a very characteristic species especially in these Archipelagos. In the sample St. 78 the three groups of forms (B, A_1 and A_2) were nearly equal in abundance. I found 103 specimens which were outgrown microspheric shells; 143 specimens showed to be A_2, or young B; 300 shells were young specimens and A_2. So we can say, that the abundancy of the three forms was nearly equal. That is the more striking, as in many Foraminifera especially the B-form is rare. It may be that the lifetime of B is not much longer than that of the A-forms in *Q. curta*, or that a local factor gave rise to the abundant fusion of microgametes, or it is possible that the method of collecting had something to do with the abundancy of B.

Massilina alveoliniformis Millet.

(Textfigs. 21—22.)

Massilina alveoliniformis Millet, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, figs. 5—7. — Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, pt. 2, p. 584, pl. 45, fig. 15, 1915. — Cushman, Carnegie Inst. Washington Publ. 311, p. 69, 1922; Publ. 342, p. 64, 1924; U. S. Nat. Mus., Bull. 104, pt. 6, p. 39, 1929; U. S. Nat. Mus., Bull. 161, pt. 1, 1932, p. 30, pl. 8, figs. 3a, b.

Spiroloculina asperula H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, p. 152, pl. 8, figs. 13, 14, 1884. — Cushman, Proc. U. S. Nat. Mus., vol. 59, p. 72, 1921.

Massilina asperula Cushman, U. S. Nat. Mus., Bull. 100, vol. 4, p. 447, 1921.

Quinqueloculina variabilis d'Orbigny, Ann. Sci. Nat., vol. 7, p. 301, no. 15, 1826.

The description of Cushman, l. c. 1932, is:

"Test much compressed, nearly circular; early chambers quinqueloculine, later ones in a single plane, periphery rounded, chambers distinct; wall of sandgrains, with a porcellaneous lining to the chambers; aperture very slightly exserted. Length 1 mm.; breadth 0.9 mm.; thickness 0.25 mm."

The original description of Millet is as follows:

"Test elliptical, chambers tubular, the earlier ones arranged irregularly around the long axis, the later ones in a spiroloculine series, periphery rounded, aperture terminal, radiate or cribrate, obscured by sand-grains. Texture arenaceous. Length 1.40 mm."

My relatively large material, from only a single station (no. 64, 26.VII.'22, 5°51′ S., 106°22′ E., depth 35 m.; 3 specimens were found at St. 107), shows me that Millet's description is quite correct,

and I do not understand, why Cushman altered this description. For the test of fullgrown specimens is elliptical and not nearly circular; the early chambers are not arranged in a quinqueloculine series in the specimens, that I examined, but in a constant octoloculine series, which gives one the idea of an irregularity; the later chambers are spiroloculine in all fullgrown specimens, a porcellaneous lining to the chambers can only be found in the first formed sets of chambers,

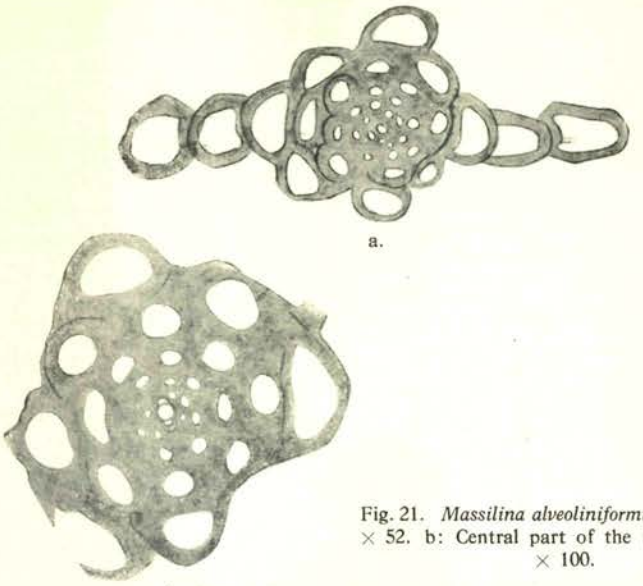


Fig. 21. *Massilina alveoliniformis.* a: Section; × 52. b: Central part of the same section; × 100.

according to secondary growth; the aperture is not very slightly exserted, and is cribrate by the accumulation of sand-grains; in the case, when the aperture becomes the foramen to the following chamber, the foramen is widened by the absorption of the sand and shows a toothlike structure. At the end the length of fullgrown specimens is invariably more than 1 mm.

Knowing all these data, one comes to the conclusion, that Cushman's description is much more incorrect than that of Millet.

I therefore believe that the only good description is that of Millet, and that Cushman must have dealt with another species, or with some aberrant specimens.

But the very conspicuous character of the arrangement of the chambers is a factor, which is worth a closer examination.

In the megalospheric forms the embryonic apparatus consists in a subglobular proloculum, followed by a long neckchamber, forming nearly a whole coil, thus being sectioned two times by a transverse section. In megalo- as well as in microspheric specimens the next chambers are arranged in such a way, that eight chambers are visible

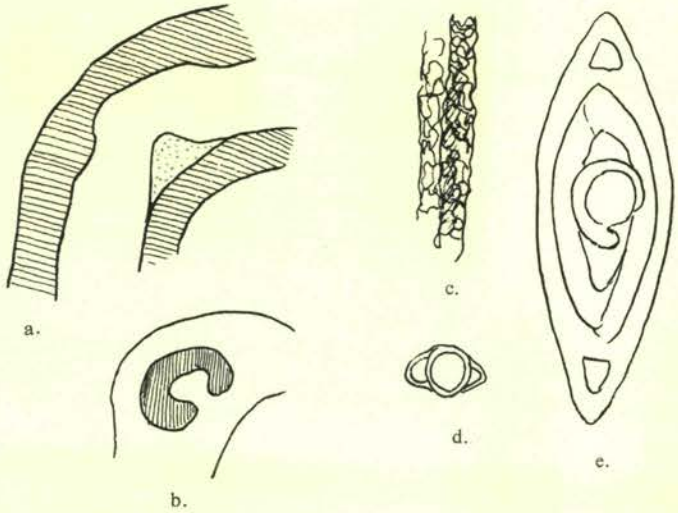


Fig. 22. *Massilina alveoliniformis*. a: Foramen with tooth, longitudinal; × 192. b: Foramen, transverse section; × 192. c: Wall between two chambers. d: Transverse section through the embryonic apparatus. e: Longitudinal section through the embryonic apparatus with the next chambers. c, d and e: × 220.

from without. No trace of a quinqueloculine arrangement can be found; this remarkable characteristic is in the family of the *Milliolidae* only found in the genus *Schlumbergerina* Munier-Chalmas. Millet has mentioned this fact, when saying: "It may be regarded as a dimorphous form of *Miliolina alveoliniformis*, the earlier chambers, as shown by fig. 6, having all the characteristics of that species." So I am inclined to believe that *Schlumbergerina alveoliniformis* and *Massilina alveoliniformis* are so closely related to one another, that they belong to the same genus, *Schlumbergerina*, if not to the same species. It is possible, that this species only under special conditions reaches its full size, showing the formation of the spiroloculine chambers. The

latter ones are, moreover, not quite spiroloculine, as the arrangement of these chambers is not that of a real *Spiroloculina*, the chambers not lying in a single plane, but showing a typical irregularity in the arrangement on transverse section.

But what about the name of this species? In *Schlumbergerina* the chambers of the first coils are quinqueloculine; in the species, which we are regarding now, one may with some good will regard the arrangement of the first coil of chambers as quinqueloculine too; but in that case, the species had to be called *Schlumbergerina alveoliniformis;* this name is already preoccupied, and it would have been easy enough to create a new name, but for the fact that specimens hitherto known as *Schlumbergerina alveoliniformis* may be tests, the imperfectness of which is due to outer circumstances. In this case the name of *Schlumbergerina alveoliniformis* would suit both forms; later investigations will clear this matter; till that time I will name this species *Massilina alveoliniformis.*

Spiroloculina depressa d'Orbigny.

Spiroloculina depressa d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 298.
Spiroloculina limbata H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, p. 150. pl. 9, figs. 15—17. — Hofker, Pubbl. Staz. Zool. Napoli, vol. 12, pt. 1, 1932, pp. 100—103.

It was found at the following localities:
St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; common.
St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; rare.
St. 64; 26.VII.'22; 5°51′ S., 106°22′ E.; depth 26 m.; very abundant.
St. 83; 30.VII.'22; 6°42′ S., 105°17′ E.; depth 45 m.; common.
St. 108; 5.VIII.'22; 5°44′ S., 105°56′ E.; depth 54 m.; several specimens.
St. 110; 5.VIII.'22; 5°25′ S., 105°3′ E.; depth 12 m.; several specimens.

The species occurs in the whole Archipelago.

V. Family ***Peneroplidæ.***

Peneroplis pertusus Forskål.

Nautilus pertusus Forskål, Descr. Animale, 1775, p. 125, no. 65.
See for further literature my work on the Siboga-Foraminifera: Siboga-Reports, IVa, Part II, 1930, p. 138.
In several of the stations the species was found; I could only state the different data I published in that paper.

It was found at the following stations :

St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; few.
St. . .; 21.VII.'22; Toeal, surface, on weeds; very abundant.
St. 64; 26.VII.'22; 5°51′ S., 106°22′ E.; 35 m.; some specimens.
St. 107; 5.VIII.'22; 5°47′ S., 106°7′ E.; 49 m.; common.
St 110; 5.VIII.'22; 5°25′ S., 105°53′ E.; 12 m.; several specimens, filled up with glauconite.
St. 116; 7.VIII.'22; 5°57′ S., 106°34′ E.; 22 m.; few.

Archaias discoideus (Flint).

Peneroplis pertusus (Forskål) var. *discoideus* Flint; Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 304, pl. 49, figs. 1, 2. — Cushman, Publ. 291, Carnegie Inst., Wash., 1919, p. 69; Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 76, textfigs. 13—16, pl. 18, fig. 20; pl. 19, figs. 1—3.
See for further synonomy Siboga-Reports, Vol. IV a, Part II, 1930, p. 147.

I cannot add new data to what I published in my Siboga-Report, as the material consisted only in 4 specimens from station Toeal, seaweeds. The species seems to be very rare in the Archipelago.

Praesorites orbitolitoides Hofker.

Praesorites orbitolitoides Hofker, Siboga-Reports, Monograph IV a, 1930, pt. II, p. 149, pl. 55, figs. 8, 10, 11, pl. 57, figs. 4, 6, pl. 58, figs. 3, 14.

Only in a single station of the Kei-Expedition the species has been found in 8 specimens:
St. 64; 26.VII.'22; 5°51′ S., 106°22′ E.; depth 35 m.

The other occurrence in the Archipelago, from the Siboga, is in the Saleyer-islands; Flint and myself found it in the Mexican Gulf.

Orbitolites marginalis Lamarck.

Orbitolites marginalis Lamarck, see Hofker, Siboga-Reports, Mon. IV a, II, 1930, p. 153, pl. 61, fig. 1, pl. 55, fig. 9, pl. 57, fig. 3, pl. 59, pl. 61, figs. 1, 2, 7.

This species was found in the stations:
9.III.'22; Saparoea-Bay; depth 18—25 m.; abundant.
St. 10; 6.IV.'22; Off Doelah; depth 50 m.; one specimen.
St. 11; 9.IV.'22; Off Toeal; depth 20 m.; several young specimens.

The species seems to be rare in the Archipelago.

Orbitolites duplex Carpenter.

Orbitolites, type *duplex*, Carpenter, Phil. Trans., 1856, p. 120, pl. 5, fig. 10; pl. 9, fig. 10.
Orbitolites duplex, Carpenter, Rep. Challenger, "Orbitolites", 1883, p. 25, pl. 3,

figs. 8—14, etc. For further literature see my Siboga-Report, where some critical remarks are given: Siboga-Reports, Monogr. IV a, II, 1930. p. 155, pl. 57, figs. 5, 7, pl. 60, pl. 61, fig. 6, pl. 62, fig. 10.

21.VII.'22; Toeal; on seaweeds from the surface.

Very beautiful material, containing all forms, which I described in the Siboga-Report, was found at station Toeal. No other samples gave this species. The three forms were obtained in the following proportions: 2 of B; 38 of A_1; 12 of A_2.

The species seems to be confined to the eastern part of the Indian Archipelago.

Alveolinella Quoyi (d'Orbigny).

Alveolina Quoyi d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 306.
Alveolinella Quoyi (d'Orbigny) Hofker, Siboga-Reports, Foraminifera, pt. II, 1930, p. 166, pl. LXIII, LXIV.
Oryzaria boscii Defrance, Dict. Sci. Nat., vol. 16, 1820, p. 104.
Alveolina boscii d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 306, no. 5, Modèles, 50. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 222, pl. 17, figs. 7—12. — Chapman, Journ. Roy. Micr. Soc., 1908, p. 151—153, pls. 2, 3. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1916, p. 98, pl. 39, fig. 30. — Bull. 100, U. S. Nat. Mus., 1921, pt. 4, p. 487, pl. 99, figs. 2—5.

This species was found in several stations:
9.III.'22; Saparoea-Bay; depth 18—25 m.; 6 A_1, 12 A_2, 2 B.
21.II.'22; Amboina-Anchorage; depth 90 m.; 1 young specimen.
St. 10; 6.IV.'22; Off Doelah; depth 50 m.; 1 young specimen.
St. 11; 9.IV.'22; Off Toeall; depth 20 m.; 4 young specimens.
St. 20; 14.IV.'22; Doe-Roa Bassin; depth 50 m.; 2 young specimens.
St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; 6 specimens.
9.VI.'22; Banda Neira; depth 13 m.; 8 young specimens.
Off Waling; 20 m. depth; 35 young specimens.
Off Samaloea, Makassar; 35 m.; 1 young specimen.
St. 64; 26.VII.'22; 5°51′ S., 106°22′ E.; depth 35 m.; 1 young specimen.

I have given an exhaustive description of this species in my Siboga-work, and my investigations on the material of the Kei Exped. confirm all my accounts. In the former work I gave an analysis of the structure of the genus *Alveolina* too, bringing the structure of the mouth and apertures under some new light. Yet a new Dutch publication (with summary in English), having the pretention of being a monograph of the genera *Fasciolites* and *Neo-Alveolina*, does not mention my work, and is based on the old standpoints, ignoring totally the modern views on trimorphism as well as on the structure of the Forami-

niferal shell in general. I mean: De Genera Fasciolites en Neo-Alveolina in het Indo-Pacifische Gebied, by L. A. J. Bakx. In case the author had kept abreast of the current of modern literature, he would not have given as specific characteristics: diameter of the chambers, number of convolutions, relation between length and breadth of the test! He would have known, that these characteristics in the *Alveolinidae* are subject to large variation in the different generations of one and the same species.

As other characteristics the author mentions the diameter of the shell(!) and the diameter of the embryonic aparatus, thus ignoring all data about trimorphism! It will be obvious, that with such views a good and real systematic knowledge of the *Alveolinidae* can never be established, and thus we can abstain from a closer review of the work. It has been published in: Verhandelingen van het Geol. Mijnbouwk. Gen. voor Nederland en Kolonien. Geol. Ser., vol. 9, pt. 3, p. 205—266, 1932.

VI. Family *Nodosaridæ*.

Nodosaria vertebralis (Batsch).

(Plate IV, figs. 1—13; textfigs. 23 a—d.)

Nautilus (*Orthoceras*) *vertebralis* Batsch, Conch. des Seesandes, 1791, p. 3, pl. 2, figs. 6a, b.

Nodosaria vertebralis H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 514, pl. 65, fig. 35; pl. 64, figs. 11—14. — Egger, Abh. kön. Bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 344, pl. 11, fig. 36. — Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 312, pl. 57, fig. 5. — Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 144. — Cushman, Bull. 71, U. S. Nat. Mus., 1913, p. 60, pl. 32, fig. 1. — Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1922, p. 211, pl. 38, figs. 2, 3; pl. 40, fig. 2; Bull. 104, 1923, p. 86, pl. 14, fig. 6.

Nodosaria raphanistrum (Linnaeus), var. *obsoleta* Goës, Bull. Mus. Comp. Zool., vol. 29, 1896, p. 63, pl. 6, fig. 3. — Cushman, Bull. 104, U. S. Nat. Mus., 1923, p. 84, pl. 15, fig. 4.

Nodosaria seminuda Reuss? Cushman, Bull. 104, U. S. Nat. Mus., 1923, p. 84, pl. 15, fig. 2.

Nodosaria Flintii Cushman, Bull. 104, U. S. Nat. Mus., 1923, p. 85, pl. 14, fig. 1.

Nodosaria obliqua H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 513, pl. 64, figs. 20—22. — Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, 1894, p. 70, pl. 12, figs. 691, 692. — Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 311, pl. 57, fig. 4. — Cushman, Bull. 71, pt. 3, 1913, p. 59, pl. 25, fig. 5; Bull. 100, 1922, p. 210, pl. 38, fig. 1.

Nodosaria vertebralis (Batsch), var. *albatrossi* Cushman, Bull. 104, U. S. Nat. Mus., 1923, p. 87, pl. 15, fig. 1.

Nodosaria spirostriolata Cushman, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 656; Bull. 100, p. 212, pl. 38, fig. 4.

Marginulina philippensis Cushman, Bull. 100, U. S. Nat. Mus., 1922, p. 257, pl. 53, figs. 2, 3 a, b.

Material has been found at the following stations:

St. 6; 4.IV.'22; 5°32′ S., 132°36′30″ E.; depth 210 m.; 21 specimens.
St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; depth 196 m.; 16 specimens.
St. 46; 2.V.'22; 5°47′20″ S., 132°13′ E.; depth 300 m.; 19 specimens.
St. 48; 3.V.'22; 5°40′10″ S., 132°21′ E.; depth 263 m.; 55 specimens.
St. 50; 4.V.'22; 5°34′ S., 132°25′40″ E.; 233 m.; 13 specimens.
St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; some small specimens.

So this species has been traced only in the strait between Tajando-Wahr and Noehoe-Roa in the Kei-Islands. In the Pacific the species and its forms have been found, according to Cushman, Brady and others, on the West-coast of North America, Hawaiian-Islands, Philippines, and in the Atlantic Ocean: Caribbean Sea, north-eastern coast of the United States, Cape Cod, Gulf of Mexico, Bermuda, Brazil, Canaries, west coast of Africa, Azores. Thus the species is typical of tropical and subtropical seas.

The synonymy of this beautiful species of *Nodosaria*, one of the largest of recent forms, is very confusing and I will try to throw some light over the question.

At first all large specimens with longitudinal costae have been gathered under the name of *N. vertebralis*, or under that of *N. obliqua*. Two differences have been mentioned by several authors regarding these two species: *vertebralis* shows relatively few costae, *obliqua* many more of them; in *vertebralis* the sutures between the chambers have been filled up with clear shell-material, and in *obliqua* this is not the case to such a degree.

In 1922 Cushman created a species *N. spirostriolata*, with non calcareous sutures, many costae, arranged somewhat spirally along the shell; he saw 8 specimens, in the Philippines. In reality this species was a form of his later created species: *N. flintii*, in which he has gathered most of the specimens hitherto described as *N. obliqua*. Here at first he points out the fact that the number of the costae increases with the diameter of the shell. The varieties *obsoleta* and *seminuda* of Goës show only differences in the outgrowth of the costae, due to environmental circumstances probably, and without any systematic value. Most specimens of Batsch's *N. vertebralis* have been united by Cushman under the new variety *albatrossi*.

We will now compare Cushman's description of *N. vertebralis* (1913) with that of *N. vertebralis* var. *albatrossi* (1923).

N. vertebralis (1913)	*N. vertebralis* var. *albatrossi* (1923)
Test elongate, slender, tapering; straight or very slightly arcuate.	Test elongate, gradually tapering, often slightly curved.
	Proloculum often being of greater diam. than those immediately following.
Chambers comparatively short, numerous, little inflated.	Chambers numerous, distinct, not inflated, except those near the apertural end.
Sutures of clear shell material appearing darker than the opaque portions.	Sutures broad, of clear shell material, not depressed except near the apertural end.
Surface ornamented with longitudinal costae.	Wall ornamented by numerous longitudinal costae, typically 15—18 in the adult, continuous from one chamber to another, sharp at the periphery, broader at the base.
Apical end usually with a short spine.	Initial end of the test with a short spine.
	Aperture slightly extended, radiate.
Length up to 6 mm.	Length up to 8 mm.

This summary of the characteristics shows us no difference at all between these two forms, and so I believe that only the fact that Batsch's figure is somewhat indistinct (like all figures of that period, having been made without mirror or photograph) has been the reason for giving new names in this case as well as in that of *N. flintii*. So, if we state that *N. obliqua* = *N. vertebralis*, and that *N. obliqua* = *N. flintii*, there remains the fact that differences exist between *N. vertebralis* and *N. obliqua*, and the third form, *N. spirostriolata* remains too. Before solving this question I will describe the Kei-material, keeping in mind that the material derives from nearly the same locality

and having at my disposal 126 specimens, all of them in beautiful state of preservation of the shell. The only fact to regret is that no young stages have been gathered, as the finer material of the expedition has not come into my hands.

Stations 6 and 7 (see Pl. VI, figs. 1—7).

7 specimens of about 8 to 10 mm. length, beginning with small proloculum of about 60 μ diameter, rounded, with small point. Individuals are always dentaline and show 8 costae. A much larger number of specimens begin with a chamber with a diameter of about 1 mm., and attain a length of even 20 mm.

They form straight shells and the chambers become longer and longer at the end of the shell. The shorter chambers at the beginning show the typical hyaline sutures, the longer ones at the end show deep sutures without secondary chalk material. The costae of the shells show invariably the number 10.

Several smaller shells of the secondarily mentioned type show a much smaller first chamber and increase gradually in diameter, while those with largest initial chamber invariably diminish their diameter at first. In St. 7 several microspheric specimens were found, of the marginuline type, and several unilocular parts, the beginnings of the A_2-form.

In station 50 very large individuals of the second type were found, attaining a length of even 3 cm.

St. 48. The richest material. Three specimens with small proloculum, which has been broken off. The specimens are not arcuate, but straight, and show at the beginning 4 costae, the number of which increases as the diameter becomes larger, up to 8 costae. Shells up to 12 mm. Most of the individuals belong to the second type, beginning with a large proloculum of about $^1/_2$—1 mm. diameter. Those with smaller proloculum ($^1/_2$ mm.) show 6—8 costae, increasing to 10, those with larger proloculum show 8 costae, increasing to 12 and even more. The latter show a remarkable reduction of the hyaline shell material.

St. 46. This station shows the most differentiated material, as here four types can be traced.

1) Small arcuate individuals (up to 12 mm.) with 6—8 costae. Proloculum 40—60 μ diameter.

2) Larger, straight individuals, some of them beginning with a small chamber of about 1 mm., increasing gradually in diameter.

6—8 costae; most of these shells with larger proloculum of even $1^1/_2$mm. diameter, showing 10—12 costae and the forming of nearly separated end-chambers; with spine.

3) Individuals, slightly arcuate, with large proloculum (1—$1^1/_2$ mm. diameter), without any spine. Proloculum with 14—20 costae, showing

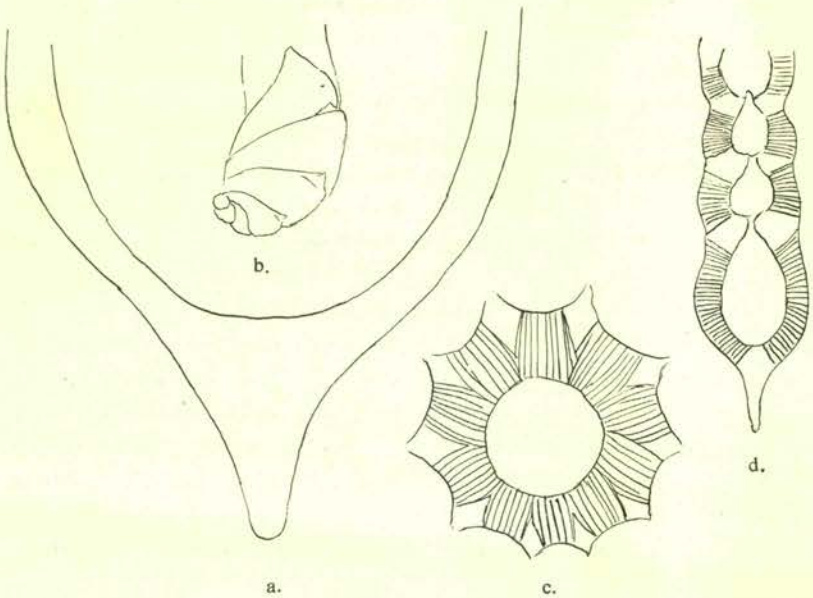


Fig. 23. *Nodosaria vertebralis*. a: Forma A_2. section through the initial part; × 51. b: Forma B, section through the initial part; × 51. c: Transverse section; × 30. d: Longitudinal section; × 8.

no secondary chalk in the sutures, and the costae arranged somewhat spirally along the shell.

4) Three small, arcuate specimens, showing but little secondary chalk, beginning with proloculum of 60 μ with large spine, gradually increasing in diameter, showing 12—18 costae.

Some typical specimens proved to be young of the form with small megalospheric proloculum; 2 specimens obviously belonged to *Marginulina philippinensis* Cushman, but were outgrown in the form without beginning part.

I am convinced that these different forms should be named, according to Cushman's nomenclature: 1) *N. obliqua*, 2) *N. vertebralis*, 3) and 4) *N. spirostriolata*.

With respect to *Nodosaria scalaris* my investigations lead to the following remarks. Cushman could trace in the Philippine material numbers of Marginulinae, some of which he describes as megalospheric (not to be distinguished from some of our individuals) for instance *M. philippinensis* and *M. costata*. These are probably partly the microspheric forms of the here described *Nodosariae* too. The small individuals are undoubtedly the A_1-generation, the larger forms nothing but A_2, with a proloculum being an end-chamber of A_1. *N. obliqua* is nothing else than A_1 of *N. vertebralis*. But there remains some probability, that the multicostate form, found at St. 46, is a different variety ("species" cannot be the word, as we know nothing about a different microspheric form), probably due to some abnormal circumstances.

So I distinguish only a single species, *Nodosaria vertebralis* (Batsch), and a variety, *Nodosaria vertebralis* var. *spirostriolata* Cushman; it is probable that we ought to name *Nodosaria : Marginulina*, as the microspheric form has been described under that name.

Description of *Nodosaria* (*Marginulina*!) *vertebralis* (Batsch):

Straight or slightly arcuate shells, with many chambers, ornamented with longitudinal costae. The chambers are nearly as long as broad and possess a thick wall. In many shells the sutures between the chambers are filled up with clear shell material.

Forma B. Known as *Marginulina philippensis* and some forms of *Marginulina costata*. Proloculum 12 μ, typically microspheric. A single coil, followed by cristallarian (robuline) set of chambers. The last formed chambers, however, show no marginal carina, are inflated, and with regular costae, the former chamber with numerous bosses. End-chamber with 12—14 costae. Aperture radiate. Length 2—2$^1/_2$ mm.

Forma A_1. Known as *Nodosaria flintii* Cushman and as *Nodosaria obliqua* H. B. Brady. Proloculum 40—60 μ in diameter, with a relatively stout spine. Chambers, except the end-chambers, not easily distinguishable, as the sutures are filled up with hyaline chalk. Test elongate, "gracefully tapering, somewhat curved". Costae at first 4—6, later on up to 8. In some cases the individuals are not curved. Aperture radiate. Length up to 15 mm.

Forma A_2. Known as *Nodosaria vertebralis* or as *N. vertebralis* var. *albatrossi* Cushman. First chamber with diameter up to 1.5 mm. Later chambers somewhat smaller and not so robust; sutures filled up with hyaline chalk. End-chambers with 10—12 costae, beginning

with 8 costae. Shell straight, elongate. Length up to 30 mm. Aperture radiate.

I can add to this description that the walls of megalospheric shells are very thick. The inner structure is typically nodosarian, with relatively elongate mouth at each chamber, but totally absorbed in the thick secondary chalk-mass of the suture. In transverse section the costae show to consist of hyaline matter too, and the pores are seen at the base of the costae fusing together, so that these costae are not developed when the primary wall has been formed, and are totally secondary in origin.

Lingulina grandis Cushman.

(Pl. V, figs. 6 and 7; Textfigs. 24—25.)

Lingulina grandis Cushman, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 656; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 215, pl. 43, figs. 1 a, b.

The description of Cushman's reads as follows:

"Test large, compressed, early portion and in some specimens all

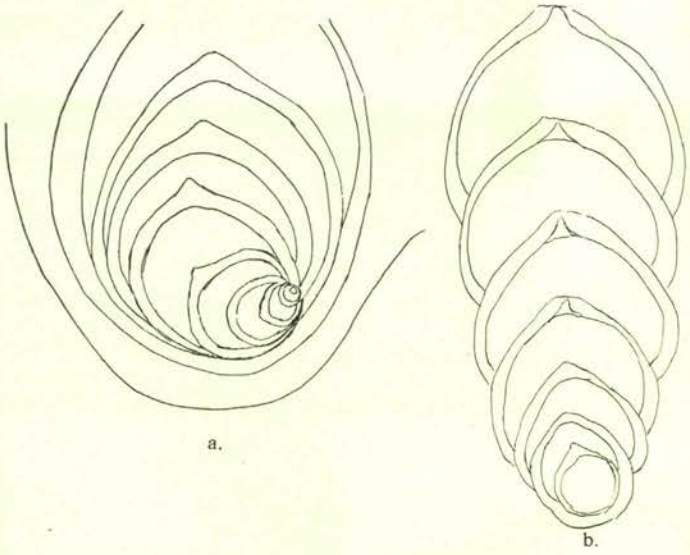


Fig. 24. *Lingulina grandis*. a: Section through the specimen: Pl. V, fig. 6; × 44. b: Section through the specimen: Pl. V, fig. 7; × 15.

but the final chamber distinctly keeled; chambers about 8 in number, broad and short, somewhat inflated; sutures depressed, not noticed

on the keel; walls smooth and shining, yellowish-brown or reddish-brown in colour; aperture a very elongate slit, extending half the width of the test. Length up to 6 mm.; width 3 mm."

In the material the species was found at the following stations:
St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; depth 196 m.; 5 specimens.
St. 46; 2.V.'22; 5°47′2″ S., 132°13′ E.; depth 300 m.; 2 specimens.
St. 53; 9.V.'22; 5°36′ S., 132°55′ E.; depth 85 m.; 1 specimen.

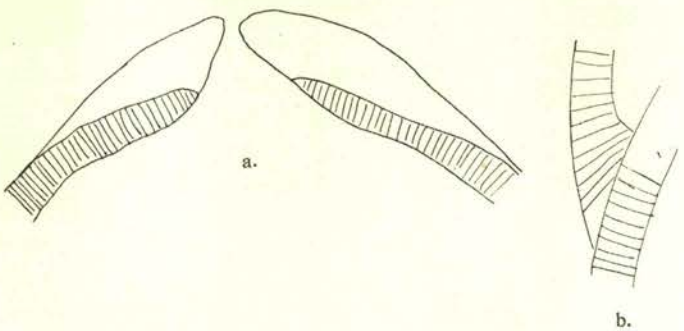


Fig. 25. *Lingulina grandis*. a: Mouth, longitudinal section; × 58. b: Fusion of two chamber-walls; × 58.

The species has been found by Cushman in the Sibuko-Bay at Borneo and in the Philippines, but it was always rare. It seems to be a species of the eastern part of the Archipelago.

At station 7 I met with a microspheric specimen, possessing 15 chambers, the first formed of which were spirally arranged, as is known of other species of *Lingulina* too. The habitus of this specimen was somewhat more slender than that of the megalospheric ones, the length 8 mm.

The reddish-brown colour, mentioned by Cushman, is due to remains of the protoplasm, and not a characteristic of the species. Clean specimens have a yellow colour. Young specimens with only three chambers are oval in transverse section, without the carinate sides.

Cristellaria italica (Defrance).

(Pl. V, figs. 1—5.)

Saracenaria italica Defrance, Dict. Sci. Nat., vol. 32, 1824; p. 177; vol. 47, 1827, p. 344; Atlas Conch., pl. 13, fig. 6.

Cristellaria italica Parker, Jones and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, pp. 21, 32, pl. 1, figs. 41, 42.

For further literature see: Cushman, Bull. 100, U. S. Nat. Mus., 1921, p. 125, pl. 35, figs. 2, 5—7.

The description of Cushman's in the work cited above is as follows: "Test stout, trihedral, triangular in cross section, early chambers close-coiled, later ones uncoiling but short, not extending back to the earlier volutions; sutures somewhat depressed; wall smooth; face of the lastformed chamber nearly triangular."

I found this species at a single station, at station 7, between Wahr and Noehoe-Roa, at a depth of 196 m. 16 specimens were found, two of which turned out to be microspheric. This number is relatively large, as the species is a rare one.

The material was not large enough for an analysis of the three forms; yet a dimorphism could be stated, hitherto unknown in this species.

Forma B. This is the larger form, measuring nearly 3 mm. in length, with 15 chambers following the proloculum. The breadth of the shell does not increase at the same rate as is the case in the megalospheric form. This is the reason why the test is not so stout in this generation.

Forma A. This stout form begins with a megalosphere with a diameter of about 140 μ. The next chamber is much smaller and is situated on the sidewall of the proloculum. The following chamber is much larger, but the chambers do not increase at the same rate, in this way not overgrowing the former ones. The apertures of the chambers are found on the dorsal ridge of the shell.

This species has already been stated by Cushman (Bull. 100, U.S. Nat. Mus., 1921, p. 252, pl. 51, fig. 2) from several localities in the East-Indian Archipelago: off Sibuko-Bay, Borneo; Gulf of Tomini, Celebes; Gulf of Boni; Macassar-Strait.

Millet (Journ. Roy. Micr. Soc., 1903, p. 256) mentions it as a very rare species in the Archipelago, and found it at a single station, in the same region of the Kei-Archipelago.

Cristellaria costata (Fichtel et Moll).

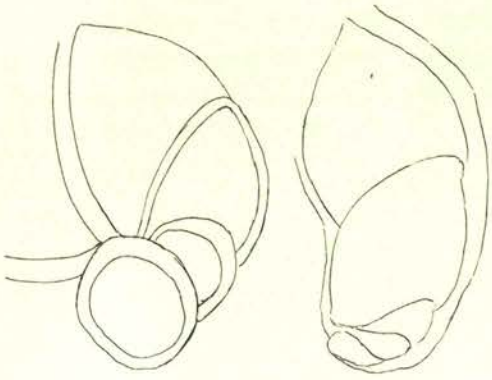
(Pl. V, figs. 8 and 9; Textfig. 26.)

Nautilus costatus Fichtel et Moll, Test. Micr., 1803, p. 47, pl. 4, figs. g—i.
Robulina costata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 289, no. 13.

Cristellaria costata Parker et Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 113, no. 19. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 555, pl. 71, fig. 8. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 75, pl. 34, fig. 4. — Bull. 100, U. S. Nat. Mus., pt. 4, 1921, p. 239, pl. 46, fig. 4. pl. 47, fig. 1.

Cristellaria costata (Fichtel et Moll), var. *subdecorata* Cushman, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 659; Bull. 100, p. 241, pl. 47, figs. 4, 5.

This species occurred in the material in abundancy only at station 7. Two forms of the 20 studied specimens could be distinguished, the



a. b.

Fig. 26. *Cristellaria costata*. a: Forma A, section through the initial part; × 135. b: Forma B; section through the initial part; × 135.

one corresponding with *Cristellaria costata*, the other with Cushman's variety *subdecorata*. They could be distinguished not only by their decoration of the shell, but also by the diameter of it. An examination of the inner structure told me, that they could be distinguished too by the diameter of the proloculum, the normal form being megalospheric, the variety invariably microspheric.

It is possible that the other varieties known will turn out to be only generations of this single species, but the material was not large enough to state this supposition. It is a pity that no investigation has been made of the inner structure of these other varieties.

The first chambers of the microspheric shells show the peculiarity of being arranged in a very slowly coiling spiral, not only in this species but also in other ones of the genus *Cristellaria*. This characteristic points to the possibility that this genus might descend from a form

closely related to *Nodosaria* or something like that (*Marginulina*?). This would be in agreement with the fact that genera such as *Marginulina* are geologically older than *Cristellaria*.

Cristellaria orbicularis (d'Orbigny).

Robulina orbicularis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 288, pl. 15, figs. 8, 9.
Cristellaria orbicularis H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 549, pl. 69, fig. 17. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 67, pl. 36, figs. 4, 5; Bull. 100, p. 224.

In the material this variable species occurred only at two stations:
St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; 196 m.; several specimens.
St. 46; 1.V.'22; 5°48′30″ S., 132°14′ E.; depth 270 m.; some large specimens.

The material was not large enough for studying the bionomics of the species; it was, however, found, that the large specimens possess the larger proloculum too, which is found also in the genus *Nodosaria*. Large size thus is no criterium for the microspheric generation in this group. The first quantity of protoplasm determines the size of the outgrown shell.

This statement is of some importance, as several authors seem to have made conclusions as to the microspheric form in Foraminifera only from the size of the shell of some of the specimens; this conclusion must be wrong in the group of the *Nodosariidae*.

VII. Family ***Buliminidae.***

Rectobolivina columellaris (H. B. Brady).

(Textfigure 27.)

Sagrina columellaris H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 64; Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 581, pl. 75, figs. 15—17.
Siphogenerina columellaris Egger, Abh. k. bayr. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 316, pl. 9, figs. 28, 31, 33. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 104, pl. 47, figs. 2, 3; Bull. 100, U. S. Nat. Mus., vol. 4, p. 276, pl. 56, fig. 1.

This species, typical of the Australian region, has been found at the only station, from which bottom-material was available to the author, and in which it occurred in some abundancy. St. 62; 15.V.'22; 5°29′ S. 132°50′ E.; depth 290 m.

This material was a typical globigerina-ooze.

Megalospheric as well as microspheric specimens were found; the megalospheric specimens were the most common. It is a remarkable fact, that the microspheric form begins with a large set of 14 chambers, arranged in the biserial way, whereas the megalospheric specimens, especially those of the A_2-generation, possess only 2 or 3 bolivine chambers. This phenomenon is found in the same way in the parallel genus *Bigenerina*, where I described it in the species *Bigenerina nodosaria*. This peculiarity, that the microspheric forms (and the A_1-forms too) attain much later the typical uniserial stage than the forms beginning with a large proloculum, must be due to a factor, which can scarcely be generic. It must be a function of the volume of the initial protoplasm, influenced in accordance to Rhumbler's law of growth.

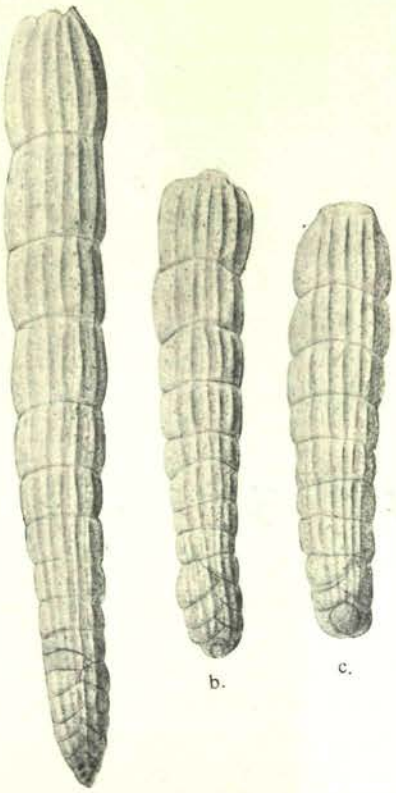


Fig. 27. *Rectobolivina columellaris*; × 80. a: Forma B. b: Forma A_1. c: Forma A_2.

A very peculiar characteristic of *Rectobolivina* is the internal tube in the uniserial chambers. It can be found also along the inner wall of the chambers, in the bolivine part of the shell, and thus it is not a characteristic of the uniserial part of it. Only in that part it becomes more striking as the foramina are found in the centre of the apertural faces of the chambers and as the tube unites these foramina. But not only in the biserial chambers of *Rectobolivina* the tube can be found, running along the inner chamberwall; in *Bolivina* it runs likewise along the inner walls. Consequently the tube does not form a generic characteristic of *Rectobolivina*, as has already been pointed out by Cushman (The Foraminifera, 1928, p. 249).

We know nothing about the use or the meaning of this tube. It

may be a structure to prevent airbubbles to escape through the aperture; in this case *Bolivina* as well as *Rectobolivina* would belong to the pelagic Foraminifera; the distribution of these genera is a support of this supposition. Most of the specimens showed the fine striate surface of the shell, mentioned by Heron-Allen and Earland for their *Sagrina striata* (Schwager). I believe that this species is rather a variety of *S. columellaris*.

VIII. Family *Anomalinidae.*

This rotaliform group of Foraminifera consists of several genera, always showing the following characteristics:

First stage (in the lower forms the whole shell) formed by a nearly flat spiral, with well developed umbilicus, but never with extra foramina, opening into the space of this umbilicus. In this way all chambers show only two real foramina, the one opening into the foregoing chamber, the other into the next one. The pores are always large (*Anomalina baltica* does not belong to these "*Anomalinidae*") and show the tendency of anastomosing. Higher forms develop wildgrowing chambers.

Key to the different genera.

1a...shell completely spirally developed ..... "*Anomalina*".
1b...test with some more wildgrowing chambers ..... *Cibicidella.*
1c...test with wildgrowing chambers, mostly attached to a substratum.... 2.
2a...all chambers attached ..... *Placopsilina.*
2b...some of the chambers, especially the rotaline set, attached, the other chambers growing in a more or less tree-like spiral, mostly branched ..... *Polytreminae*, 3.
2c...most chambers in a spiral set, some later formed chambers, however, in a short spiral with very long axis; chambers very voluminous ..... *Carpenteria.*
3a...most species reddish coloured; chambers very voluminous, as in *Carpenteria*, but the tree branched..... *Sporadotrema.*
3b...branches much finer; foramina grown out into "pillars"; between the openings of those hollow pillars are seen the pores; some forms with the habitus of a volcano..... *Polytrema.*
3c...short trunks or crusts of dark red colour; surface with well defined areolae, with pores ..... *Homotrema.*

Carpenteria utricularis (Carter).

Polytrema utriculare Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 17, 1876, p. 211, pl. 13, figs. 11—17.

Carpenteria utricularis (Carter), Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 176.
Carpenteria monticularis Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 19, 1877, p. 211, pl. 13, figs. 9—12.
Ramulina herdmanni, Dakin, Ceylon Oyster Fisheries, Suppl. Rep., pt. 5, 1906, p. 236, pl. 1, figs. 1—6, textfigs. p. 227.

For further records as well as for further details see: Hofker, Siboga-Reports, Mon. 4 a, 1930, pt. 2, pp. 126—130, pl. 50, pl. 52, figs. 1—5, 8, 9.

The fact, that the different so-called species, joined by me to a single one, were found together at nearly all the stations, gave me the proof, that my thoughts about this matter in 1930 were right. I found the species at:

St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; depth 196 m.; abundant, in all forms.
St. 25; 16.IV.'22; 5°34′20″ S., 132°51′ E.; 50—70 m.; some specimens.
St. 53; 9.V.'22; 5°36′ S., 132°55′ E.; depth 85 m.; common, in all forms.
Banda, some specimens.

The species was found all over the Archipelago.

Carpenteria proteiformis Goës.

Carpenteria balaniformis, var. *proteiformis* Goës, Kon. Svensk. Vet. Akad. Handl., vol. 19, 1882, p. 94, pl. 6, figs. 208—214; pl. 7, figs. 215—219.
Carpenteria proteiformis H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 679, pl. 97, figs. 8—14. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 49, pl. 20, fig. 2, pl. 21, fig. 1; Bull. 100, vol. 4, 1921, p. 361, pl. 73, figs. 2, 3; Hofker, Siboga-Reports, Mon. 4 a, pt. 2, 1930, p. 130, pl. 52, figs. 6, 8, pl. 51, figs. 1, 4, 5, 7; pl. 46, fig. 5.

I have found the species at:
St. 10; 6.IV.'22; Off Doelah; depth 50 m.; a single specimen.
St. 53; 9.V.'22; 5°35′ S., 132°55′ E.; depth 85 m.; abundant.

The species seems to be confined to the eastern part of the Archipelago.

Sporadotrema cylindricum (Carter).

Polytrema cylindricum Carter, Ann. Mag. Nat. Hist., ser. 5, vol. 5, 1880, p. 441, pl. 18, fig. 1. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 720.
Sporadotrema cylindricum Hickson, Trans. Linn. Soc., London, 1911, p. 447, pl. 30, figs. 3—7, pl. 31, figs. 10—17, pl. 32, figs. 21, 22, 24, 29, 32, 33. — Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, pt. 2, p. 729, 1915. — Hofker, Siboga-Reports, Mon. 4 a, pt. 1, 1927, pp. 22—24, pl. 8, figs. 2, 5, 6, pl. 9, figs. 1—4, 6, pl. 10, figs. 1—10, 12, 13.

I found this species in well developed specimens at the following stations:
St. 53; 9.V.'22; 5°36′ S., 132°55′ E.; depth 85 m.; 7 specimens.
3.III.'22; Bay of Amboina; depth 50—90 m.; 15 specimens.

The species seems to be confined to the eastern part of the Archipelago, the most western point in which it has been recorded being 117 degrees E.

Polytrema miniaceum (Pallas).

For literature see: Hofker, Siboga-Reports, Mon. 4a, pt. 1, 1927, p. 27, for details: l. c., pp. 27—31, pl. 12, pl. 13, figs. 1—7, pl. 14, figs. 1—11.

This very common, and nearly cosmopolitic species was found at:
St. 15; 10.IV.'22; S. of Doe-Roa; depth 40 m.; very abundant.
St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; some specimens.
St. 25; 16.IV.'22; 5°34′20″ S., 132°55′ E.; depth 85 m.; common.
St. 53; 9.V.'22; 5°36′ S., 132°55′ E.; depth 85 m.; 5 specimens.
St. 60; 14.V.'22; S. of Doe-Roa; depth 25 m.; some specimens.
Waling, Banda; depth 75—90 m.; 3 specimens.
3.VI.'22; Banda; 100 m.; several specimens.

Though the species is a cosmopolitic one, in the East Indian Archipelago it is confined to the eastern part. In the western part it is replaced by the very similar species *Homotrema rubrum*.

Homotrema rubrum (Lamarck).

Millepora rubra Lamarck, Animaux sans vertèbres, vol. 2, 1826, p. 202.

See for further literature, as well as for further details: Hofker, Siboga-Reports, Mon. 4 a, 1927, pt. 1, pp. 31—33, pl. 13, figs. 8, 9, pl. 14, figs. 12—20, pl. 15.

The species was found at the following stations:
11.II.'22; Banda-Lontor; depth 25 m.; some specimens.
9.VI.'22; Banda-Neira; 13 m.; several specimens.
St. 103; 4.VII.'22; 6°5′ S., 105°42′ E.; depth 52 m.; several specimens.

This species is found in the whole Archipelago, and is not confined to the eastern part.

Placopsilina cenomana d'Orbigny.

Placopsilina cenomana d'Orbigny, Prodr. Pal., vol. 2, 1850, p. 185, no. 758. — Cushman, Bull. 100, U. S. Nat. Mus., 1921, p. 95. — Hofker, Siboga-Reports, Mon. 4 a, pt. 2, 1930, p. 124, pl. 40, fig. 9, pl. 49, figs. 1—8, 10, 11.

Haddonia torresiensis Chapman, Journ. Linn. Soc. London, Zool., vol. 26, 1898, p. 453.

Material was found at a single station: Ambon, on the anchorage, on a stone. This is the same locality, mentioned in my Siboga-paper.

IX. Family *Rotaliidae.*

In the preface to the description of the *Rotaliidae* of the Siboga-Expedition, I tried to give a systematical account of the group (Siboga-Rep., Mon. IVa, pt. I, 1927, p. 34). Now I can give a much more detailed opinion on the matter, as my studies have given many data, which throw new light on it. I refer especially to the following investigations:

Hofker, J., 1927, Siboga-Reports, Mon. IVa, pt. I, pp. 35—42: *Rotalia;* pp. 42—52: *Calcarina, Baculogypsina;* pp. 52—57: *Polystomella.*

Hofker, J., 1926, Nat. Maandblad, Maastricht, vol. 15, no. 2, pp. 14—17: *Calcarina calcitrapoides.*

Hofker, J., 1927, Nat. Maandblad, Maastricht, vol. 16, no. 9, pp. 126—128: *Pulvinulina Binkhorsti.*

Hofker, J., 1928, Contrib. Cushman Lab., vol. 4, pt. 3, pp. 80—83: *Faujasina.*

Hofker, J., 1930, Zoology of the Faroes, vol. IIa, pp. 13—20: *Truncatulina lobatula.*

Hofker, J., 1931, Nat. Maandblad, Maastricht, vol. 20, no. 9, pp. 126—130: *Cymbalopora radiata.*

Hofker, J., 1932, Pubbl. Staz. Zool. Napoli, vol. 12, pt. 1, pp. 136—140: *Anomalina baltica;* pp. 128—130: *Globorotalia;* pp. 130—133: *Epistomina.*

Hofker, J., 1933, this publication, p. 126: *Truncatulina praecincta;* pp. 132—135: *Pulvinulina lateralis, P. menardii.*

I do not believe that it is yet time to give a totally new system, with new, unfamiliar names, as Cushman (The Foraminifera, 1928) has given already, since we lack in many cases data on the inner structure of the different species. I have therefore in nearly all cases preserved the old names, and will give here only a short account of my opinions, as they result from these investigations. When studying all those species, beginning in the microspheric as well as in the megalospheric forms with a closely coiled spiral, one finds as a matter of importance that some of those species show, even in the beginning of the test, large pores, whereas in other species only very narrow pores can be found. All species, belonging to the group of the *Tinoporidae* (Siboga-Rep., pt. I, 1927, pp. 3—33) show wide pores too, but in the megalospheric, especially the A_2-generation, the embryonic apparatus is of the raspberry-type.

Polystomella, *Rotalia*, show very narrow pores, just as it is the case within the *Nummulitidae*, distinguishable from the *Rotaliidae* by their marginal chord. But *Calcarina* on the other hand shows a typical rotaline growth, combined with wide pores, which is a very constant characteristic in recent as well as in fossil species of *Calcarina* and *Baculogypsina*. In *Rotalia* and in *Polystomella* the canal system consists in the umbilical system, together with the interseptal system, while in *Calcarina* the canals form a typical umbilical system, and the interseptal system is especially found in the spines, so that we may speak of a spinal canal system.

Not only in the higher forms of the rotaline Foraminifera this difference of pores is found, but equally in the lower forms.

All typical species of *Pulvinulina* show very fine pores; the chambers show in this genus the normal foramina, but besides these foramina exist openings into the umbilical space, most highly developed in the closely allied species *Anomalina baltica*. It is possible, on the other hand, that the more primitive genus *Cymbalopora* shows the more primitive type of communication of the chambers with the umbilical space too, but its agglutination makes its systematic place somewhat uncertain. Some other more primitive rotaline genera, such as *Truncatulina* and *Discorbis*, show in all cases in which they have been studied very wide pores and a total lack of any communication of the chambers with the umbilical space. This fact must be of high importance, considering the following facts.

Through the canal system as well as through the wide pores protoplasm can find its way, whereas through the fine pores only assimilatic processes may take place, as Rhumbler has pointed out already years ago. All Foraminifera with fine pores show a well developed canal system: *Rotalia*, *Polystomella*, *Nummulitidae*, while the lower forms with small shells, showing fine pores, have a large opening of the chambers into the umbilicus. The only exception is found in the *Calcarinidae*, in which large pores are combined with a well developed canal system. In my work on the Foraminifera of the Ammontatura (1932) I have already dealt with the genus *Epistomina*, and shown that this genus belongs likewise in the group of the *Rotaliidae;* it shows the fine pores, with the opening of the chambers into the exterior by means of an extra foramen on the ventral side. In this way we can easily divide the group of the *Rotaliidae* into two parts, those with

large and those with fine pores, the *Calcarinidae* being considered as deriving from those with large pores, but having developed a canalsystem, a genetic factor of all *Rotaliidae*, but only developed in the cases, in which the protoplasm probably needs a larger communication with the outer world. With these thoughts in mind, the following key will show the natural relationships of the different genera of the *Rotaliidae:*

Family *ROTALIIDAE.*

Foraminifera with perforate wall, and early chambers spirally arranged, at least in the microspheric form.

1a....pores large ..... Sub-Family: *Orbitorotalininae.*
1b....pores fine ..... Sub-Family: *Rotalininae.*

ORBITOROTALININAE.

1a....rotaline troughout, without canals ..... *Truncatulina.*
1b....in A_2 with raspberry type of embryo..... *Tinoporininae.*
1c....rotaline, with canalsystem ..... *Calcarininae.*

TINOPORININAE.

1a....chambers with two extra foramina to the marginal side, chambers in a single plane..... *Planorbulina.*
1b....chambers not in a single plane..... 2.
2a....chambers in a median layer, with lateral ones.. *Orbitoides*, and allies.
2b....chambers in a globular arrangement in the beginning, later growing in radiate directions..... *Tinoporus.*
2c....chambers wild growing, mostly attached forms..... *Gypsina.*

ROTALININAE.

1a....no canals at all ..... *Praerotalininae.*
1b....with canals ..... *Rotalininae.*

PRAEROTALININAE.

1a....chambers opening into the umbilicus..... *Pulvinulina.*
1b....chambers opening at the ventral side with extra foramen... *Epistomina.*
1c....chambers opening into the umbilicus with long simple canals.. "*Anomalina*" *baltica.*

ROTALININAE.

1a....chambers in a trochoid spiral, umbilical and interseptal canal system *Rotalia* (including *Dictyoconoides*).
1b....chambers in a planispiral, two umbilical canal systems.. *Polystomella* (including *Faujasina*).

Truncatulina praecincta (Karrer).

(Pl. VI, figs. 3—6; Textfig. 28).

Rotalia praecincta Karrer, Sitz. Ber. Akad. Wiss. Wien, vol. 58, 1868, p. 189, pl. 5, fig. 7.

Truncatulina praecincta H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 667, pl. 95, figs. 1—3. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 39, pl. 26, fig. 2, textfig. 42; Bull. 100, p. 318. — Millet, Journ. Micr. Soc., 1904, p. 494.

I have found this typical species only at two stations:
St. 7; 5.IV.'22; 5°38′30″ S., 132°26′ E.; depth 196 m.; very abundant.
St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; very abundant.

Cushman has found the species in the Philippines, and even in some abundancy at several stations; he mentions the fact that the tests attain in his material a large size, which fact I stated too. I had the fortune that the large material was abundant enough for studying the bionomics, as well as the finer structure.

I will first quote the description given by Cushman (1915): "Test free, ventral side strongly convex, dorsal side but slightly so; comparatively large, peripheral margin bluntly rounded; chambers very numerous, about twelve in the last-formed whorl, short and broad, especially on the dorsal side where four or more whorls may be visible, slightly oblique; sutures and periphery marked by clear shell material often appearing as distinct ridges most marked towards the umbilicus, remaining portion of surface finely but distinctly punctate, aperture a narrow slit on the inner margin of the chamber ventrally from the peripheral margin. Diameter up to 1.5 mm."

Nothing is said about the difference between the two generations, known at that period; so I found it my task to try to throw more light on the matter, as the genus *Truncatulina* has some importance with regard to the systematic place, as we will show.

In the material three very well distinguishable forms were found; they can be distinguished by their diameter as well as by their development of secondary chalk-material.

Forma B. Diameter up to 2 mm. Dorsal side covered by a thick layer of secondary chalk, so that only the last formed chambers are visible. The centre of the dorsal side is covered with imperforate material, while the marginal chambers show at their centres the large pores, characteristic of the genus *Truncatulina*. The number

of the chambers of the last coil is 24. At the ventral side the chambers of the last-formed whorl are visible, but not at all distinctly; especially in the centre of the ventral side the surface is covered by a smooth, thick layer of chalk-material. In this way only

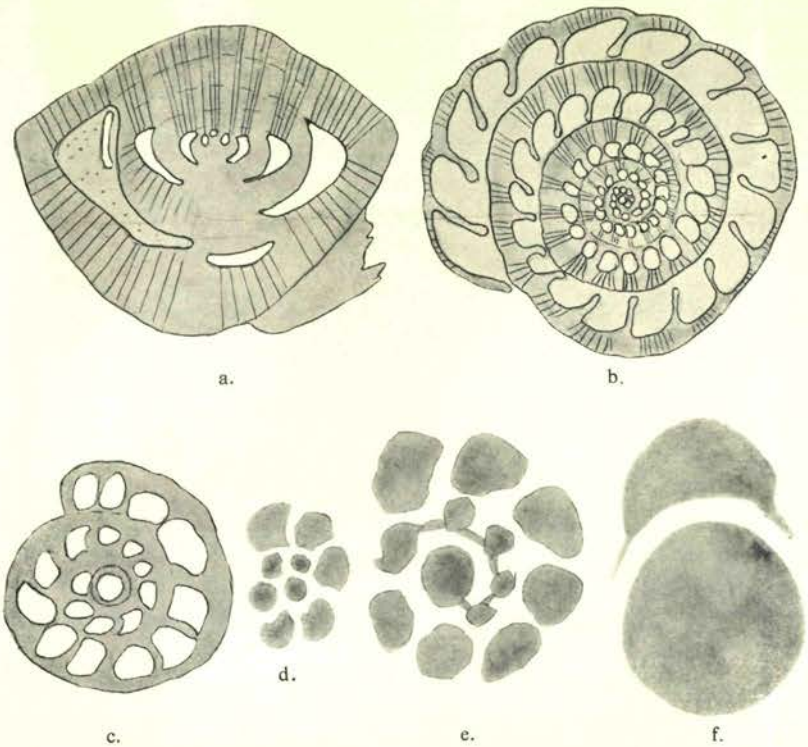


Fig. 28. *Truncatulina praecincta*. a: Transverse section through A_1. b: Longitudinal section through A_1. c: Longitudinal section through A_2. a, b, c: × 28. d: Embryonic part of B. e: Embryonic part of A_1. f: Embryonic part of A_2. d, e, f: × 250.

the peripheral parts of the chamber-sutures at the ventral side are visible. The first chamber is a typical microsphere, of a diameter of 12 μ.

Forma A_1. This form is only distinguishable from the preceeding one by the somewhat smaller diameter of the shell, the more distinct form of the sutures; the pores are likewise more visible from without. The first chamber is larger than that of the B-form, diameter 30 μ.

Forma A_2. Most individuals are of this generation. On the dorsal

side of these small shells (diameter of the shell only 1 mm.), the sutures of nearly all chambers are visible. These sutures are of an opaque, white substance, and are not prominent, so that the surface remains entirely smooth. On the ventral side the chambers of the last-formed coil are visible, even up to the centre. The sutures become broader towards the umbilicus, and are curved; the umbilicus is filled up by the same opaque shell-material. The test consists of two or three whorls of chambers, the first chamber being a large megalosphere of 60—80 μ diameter.

The shell is built of thick walls, penetrated by the large pores, known from the *Tinoporidae* too. The chambers are arranged in a nearly flat spiral, but the ventral alar prolongations of those chambers overlap the ventral side nearly totally. On the dorsal as well as on the ventral sides the pores are formed; the walls of the chambers, the sutural walls too, are not double. The aperture is a very narrow slit at the ventral edge of the apertural face of the last formed chamber, running from the dorsal side of the margin to the middle of the ventral side. A very small lip is usually found too. The chambers show no other foramina, neither into the umbilical space, nor into a canal-system. The umbilicus is totally filled up by a porous material as well as by the ventral prolongations of the chambers.

Baculogypsinoides spinosus Yabe et Hanzawa.

Baculogypsinoides spinosus Yabe et Hanzawa, Sci. Rep. Tohoku Imp. Univ., ser. 2, Geol., vol. 14, no. 1, 1930, p. 45, pl. 2, fig. 7, pl. 9, fig. 13.

Baculogypsina tetraedra Hofker, Forams. Siboga-Expedition, Reports, Mon. 4a, 1927, p. 48, pl. 23, pl. 24, figs. 1—7, 9.

A *Baculogypsina meneghinii* var. *tetraedra* has been described by Silvestri (Atti Pont. Acad. Rom. Nuovi Lincei; vol. 58, sess. 2, 1925, p. 72, textfigs. 6, 7). According to this description the first chambers of *Baculogypsina*, as described by Sacco, would possess a raspberry type of the embryo. As the other generations, especially the microspheric form, have not been analysed by Silvestri, and the existence of a good rotaline canal system has not been traced, I myself believe that the genus *Baculogypsinoides* has been erected somewhat preliminarily. I am sure, that a serious analysis of the inner structure of the tests of fossil specimens only can solve this question. But in the dim light of our recent knowledge, one must separate fossil

Baculogypsina, as described by Silvestri, being a planorbuline species, from the recent *Baculogypsinoides*, being a rotaline Foraminiferum.

The species occurred at several stations, but never in large quantities.

9.III.'22; Saparoea-Bay, depth 18—25 m.
St. 10; 6.IV.'22; Off Saparoea; depth 50 m.
St. 11; 9.IV.'22; Off Toeal; depth 20 m.
St. 20; 14.IV.'22; Doe-Roa Basin; depth 50 m.
St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; 100 m.
St. 53; 9.V.'22; 5°36′ S., 132°55′ E.; 85 m.
St. 67; 27.VII.'22; 5°51′ S., 106°22′ E.; depth 35 m.; here only 1 incomplete specimen.

In the Siboga-material the species occurred mainly in the eastern part of the Archipelago. Except the somewhat doubtful (fossil?) specimen of St. 67, the material of the Kei-Expedition once more was found in the eastern part.

Calcarina spengleri (Gmelin).

Nautilus Spengleri Linnaeus, Syst. Nat., ed. 13, (Gmelin) 1788, p. 3371, no. 10.
Calcarina Spengleri d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 276, no. 4.
For other literature see e. g.: Hofker, Siboga-Reports, Mon. 4 a, pt. I, p. 45, pl. XXI, figs. 3—6, 8—10; pl. XXII.

The Kei-Expedition found this tropical species at the following stations:
11.II.'22; near Banda-Lontor; depth 25 m.; abundant.
9.VI.'22; Banda-Neira; depth 13 m.; common.
11.VI.'22; near Waling Banda; depth 20 m.; very abundant.
...II.'22; Amboina; between the branches of sea-weeds; some specimens.

All the three forms, that I met with in the Siboga-material, were found in the Kei-material too. The species does not seem to be very common in the Archipelago, and the two expeditions found it mainly in the eastern part.

Planorbulina larvata Parker et Jones.

Planorbulina vulgaris d'Orbigny, var. *larvata* Parker et Jones, Ann. Mag. Nat. Hist., ser. 3., vol. 5, 1860, p. 294.
Planorbulina larvata Parker et Jones, Philos. Trans., vol. 155, 1865, p. 379, pl. 19, figs. 3 a, b.

Linderina Brugesi Schlumberger, Bull. Soc. Géol. France, sér. 3, vol. 21, 1893, p. 118.

See for further details: Hofker, Siboga-Reports, Mon. 4a, pt. I, 1927, pp. 6—8, pl. 1 and 2.

The species occurred at the following stations:

St. 7; 5.IV.'22; 5°38′3″ S., 132°26′ E.; depth 196 m.; a single specimen.
St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; abundant.
St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; several specimens.
9.VI.'22; Banda Neira; depth 13 m.; several specimens.

The species is typical for the eastern part of the Archipelago.

Gypsina inhaerens (Schultze).

(Plate V, figs. 10—12; Textfig. 29.)

Acervulina inhaerens Schultze, 1854, Ueber den Organismus der Polythalamien, etc., p. 68, pl. 6, fig. 12.

Gypsina inhaerens H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 718, pl. 102, figs. 1—6.

Polytrema planum Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 17, 1876, p. 211, pl. 13, figs. 18, 19.

Gypsina vesicularis (Parker et Jones) Carter, Ann. Mag. Nat. Hist., 1877, ser. 4, vol. 19, p. 173.

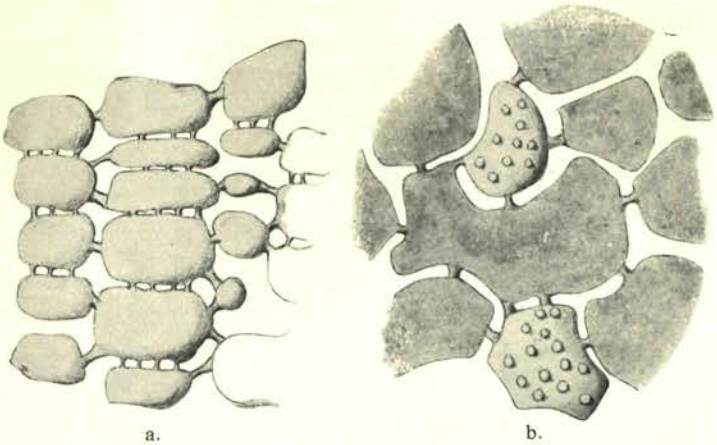
See for further references: Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, pt. 2, 1915, pp. 723—725; Hofker, Siboga-Reports, Mon. 4a, pt. I, 1927, p. 9, pl. 3.

In my Siboga-Report I mentioned the investigation of Miss Lindsey, 1913, "On Gypsina plana Carter, and the Relations of the Genus", Trans. Linn. Soc. London, Zool., ser. 2, vol. 16, pp. 45—51, and expressed some doubt about the opinion of this author that the chambers do not communicate with each other otherwise than by means of the pores (her "foramina"). Moreover she did not describe the embryonic apparatus, thus leaving many uncertainties with regard to the true systematic place of the species. Prof. Sydney Hickson of Cambridge had the kindness to send me some of the material that Miss Lindsey studied, collected by Prof. J. Stanley Gardiner off Mauritius, 100 fathoms. The Kei-Expedition furnished more material from the following localities:

Off Kombir Banda; 6.VI.'22; depth 70—90 m.; several specimens on coral. St. 15; 10.IV.'22; S. off Doe-Roa; depth 40 m.; several specimens. I studied the material with my canada balsam method,

in order to obtain further data about the structure of the test; the embryonic apparatus was studied by means of sections, by loosing the tests from their substrate, after having boiled them with NaOH, and by solving the test with acetic acid.

I came to the conclusion that the thin walls of the later formed chambers are the cause of Lindsey's mistake; each chamber communicates with the neighbouring chambers by means of several foramina, just as it was found by me in the so-called *G. vesicularis* of my



a. b.

Fig. 29. *Gypsina inhaerens*. a: Transverse section, canadabalsam-preparation; × 135. b: Horizontal section, showing the pores as well as the foramina; canadabalsam-preparation; × 135.

Siboga-Report. In my material several specimens occurred, which could not be distinguished from those, described in my Siboga work; they showed the planorbuline embryonic apparatus, figured l. c., pl. 3, figs. 5, 8. But what about the large specimens, growing wildly, covering the corals like calcareous algae, which were called by Lindsey *Gypsina plana*? It was found that a large, flat colony, spread out on a flat piece of coral, showed 6 or 7 very large embryonic apparates of the raspberry type, surrounded by a set of chambers, identical with *Gypsina vesicularis* of the Siboga-material; later on the chambers become more irregular, larger and more bloated up, with thin walls. It is therefore very probable, if not certain, that the individuals described in the Siboga-Monograph are generation A_1, and those known as *G. plana*, described by Lindsey, are colonies of generation A_2, of

one and the same species; as we do not know the microspheric form, the nomenclature of the species is yet somewhat uncertain. Colony-forming species of larger attached Foraminifera are not uncommon, especially in the *Carpenteria*-group. It is probable that the real *Gypsina* belongs to that group rather than to the *Planorbulinidae*. But only the knowledge of the microspheric form can give us certainty on this important systematic point.

The species seems to have been found only in the eastern part of the Archipelago. It has been found too in abundancy on the east coast of Africa.

Pulvinulina lateralis (Terquem).

(Plate VI, figs. 6 and 7; Textfig. 30.)

Rosalina lateralis Terquem, Mém. Soc. Géol. France, sér. 3, vol. 1, 1878, p. 25, pl. 2, figs. 11 a—c.

Pulvinulina lateralis H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 689, pl. 106, figs. 2, 3. — Egger, Abh. kön. Bayr. Akad. Wiss. München, II. Cl., vol. 18, 1893, p. 413, pl. 18, figs. 48—50. — Millet, Journal Roy. Micr. Soc., 1904, p. 497. — Cushman, Proc. Boston Soc. Nat. Hist., vol. 34, 1908, p. 31, pl. 5, figs. 11, 12. — Sidebottom, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 53, no. 21, 1909, p. 5, pl. 2, fig. 6, pl. 13, figs. 1, 2. — Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, pt. 17, 1915, p. 714, pl. 53, figs. 6—11. — Cushman, Bull. 100, U. S. Nat. Mus., pt. 4, 1921, p. 336, pl. 69, figs. 2 a—c.

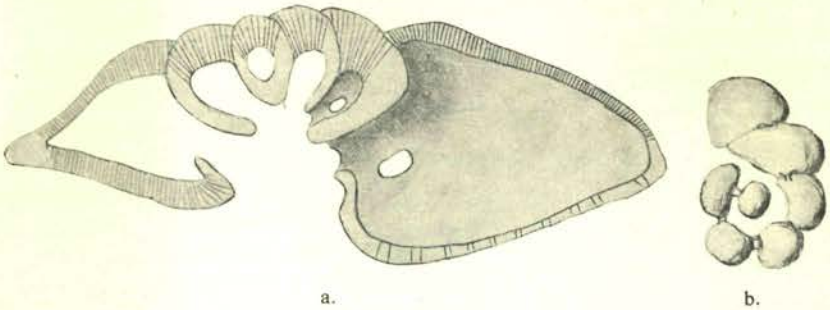
This species was found only at a single station of the expedition: 9.VI.'22; Banda Neira; depth 13 m. It occurred here, however, in some abundancy.

The species occurs especially in the Indo-Pacific region, but only rarely the various authors found it in abundancy in their samples. I have therefore made a more minute study of the somewhat large material from Banda Neira. Yet I found only megalospheric specimens, all of the same generation.

At the dorsal side the test is thick, and pierced by fine pores. The sutures of this side are hyaline, but not predominant. At the ventral side the umbilicus is wide, and the chamberwalls are equally pierced by fine pores, except the apertural face of the last formed chamber, which is formed by a thin, very hyaline wall, in which large, peculiar round openings are found. The aperture itself is a relatively narrow slit at the suture of the chamber, opening mainly into the

umbilicus. When the next chamber will be formed, the aperture is narrowed unto an oval foramen, leading into that next chamber. But a ventral part of the aperture remains likewise, forming a lasting connection with the umbilicus. In this way each chamber of the shell is connected with the two adjacent chambers as well as with the umbilical hole. The first set of chambers is typically rotaline, with a somewhat oval proloculum.

The species has been found by Cushman off Darvel Bay, Borneo,



a. b.

Fig. 30. *Pulvinulina lateralis*. a: The first set of chambers; × 103. b: Transverse section, × 80, showing the foramina and the communications with the umbilicus.

by Millet at a point between Java and Borneo (Bawean). It seems to be confined to the eastern part of the Archipelago.

Pulvinulina menardii (d'Orbigny).

(Plate IV, figs. 16 and 17; Textfig. 31 a—c.)

Rotalia menardii d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 273, no. 26; Modèles, 1826, no. 10.

Pulvinulina menardii Owen, Journ. Linn. Soc., London, vol. 9, 1867, p. 148, pl. 5, fig. 6. — Cushman, Bull. 100, U. S. Nat. Mus., pt. 4, p. 333, pl. 66, figs. 1 a—c.

This species is typical for Globigerina-ooze. It was found at several stations.
St. 44; 30.IV.'22; 5°39′ S., 132°23′ E.; depth 268 m.; few.
St. 46; 2.V.'22; 5°47′20″ S., 132°13′ E.; depth 300 m.; some specimens.
St. 58; 12.V.'22; 5°29′ S., 132°37′ E.; depth 290 m.; abundant.

This species has been clearly defined by the several authors, so that no mistake in determination can take place. When studying a large material one observes two kinds of tests, differing in the aspect of the ventral side.

Forma A. At the ventral side in the region of the umbilicus, the

wall shows a large amount of tubercules. Umbilicus relatively narrow, chambers swollen at the ventral side, margin lobated, wall thick, proloculum relatively large.

Forma B. At the ventral side tubercules are not developed. Wall nearly smooth, with a very well developed marginal flange. Ventral side somewhat more flattened than that of the other form. Umbilicus very wide, as is the ventral part of the aperture. Total shell larger and more flattened.

Between these two extremes a number of intermediate forms

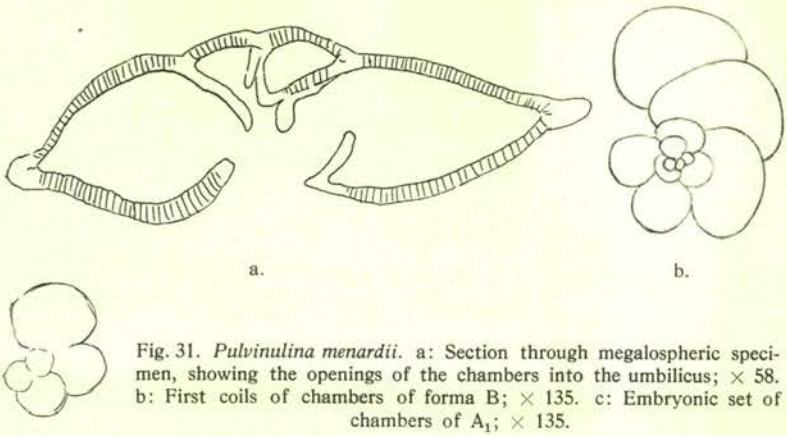


Fig. 31. *Pulvinulina menardii*. a: Section through megalospheric specimen, showing the openings of the chambers into the umbilicus; × 58. b: First coils of chambers of forma B; × 135. c: Embryonic set of chambers of A_1; × 135.

are found; while in the typical B-form the proloculum is very small ($12\,\mu$), the prolocula of the intermediate forms are of a somewhat larger size ($\pm 25\,\mu$). These intermediate forms thus are the A_1-generations, the extreme being the A_2-generation.

In my paper on the fossil species *Pulvinulina Binkhorsti* from the limestone of Maestricht I described also three forms, with quite the same characteristics and differences. The only difference between these two species is the somewhat larger growth of the later chambers of the recent form. In that paper I pointed out that the typical characteristic of the genus *Pulvinulina* is afforded by the ventral part of the aperture, opening into the space of the umbilicus. In *Pulvinulina menardii* I found this characteristic just the same. It is very probable that these two species are one and the same, the differences being due to environmental circumstances.

It is a noteworthy fact that the Foraminifera of the East Indian Archipelago and those of the Senonian of Maestricht show a striking resemblance.

Rotalia schroeteriana Parker et Jones.

Rotalia schroeteriana (Parker et Jones, MS.), Carpenter, Introd. Foram., p. 213, pl. 13, figs. 7—9. — Hofker, Siboga-Rep., Mon. 4a, Forams., 1927, p. 39, pls. 18, 19, 21, figs. 1, 2, 7, 11, 13.

Most of the specimens described in the Siboga-Report were found by other investigators on the East coast of Borneo. The Kei-Expedition afforded a beautiful material from the following localities:

St. 71; 28.VII.'22; 5°40′ S., 106°08′ E.; 54 m.; common.
St. 78; 29.VII.'22; 6°25′ S., 105°41′ E.; 30 m.; abundant.
St. 79; 29.VII.'22; 6°28′ S., 105°38′ E.; 47 m.; abundant.
St. 83; 30.VII.'22; 6°42′ S., 105°17′ E.; 45 m.; few.
St. 85; 31.VII.'22; 5°53′ S., 105°34′ E.; 25 m.; few.
St. 110; 5.VIII.'22; 5°25′ S., 105°53′ E.; 12 m.; abundant.

So the species seems to be limited to the western part of the Archipelago.

Rotalia calcar (d'Orbigny).

Calcarina calcar d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 276, no. 1; in De La Sagra, Hist. Phys. Pol. Nat. Cuba, 1839, p. 93, pl. 5, figs. 22—24.
Rotalia calcar H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 709, pl. 108, figs. 3, 4? — Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 69, pl. 28, fig. 2, pl. 29, fig. 2. — Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 250, pl. 71, figs. 3a, b. — Hofker, Forams. Siboga-Expedition, Reports, Mon. 4a, pt. I, p. 37, pl. XVII.

The species occurred only at a single station, from 21.VI.'22; off Toeal, on seaweeds. Here, however, it was very abundant, in hundreds of specimens. In my Siboga-Report I gave several data on the inner structure, as well as on the bionomics of this species, so that I may here refer to that report.

Rotalia pulchella d'Orbigny.

Calcarina pulchella d'Orbigny, Foram. Cuba, 1839, p. 92, pl. 5, figs. 16—19.
Rotalia pulchella Parker et Jones, 1865, Phil. Trans., vol. 155, p. 387. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 710, pl. 115, figs. 8a, b. — Hofker, Forams. Siboga-Expedition, Reports, Mon. IVa, 1927, p. 1, p. 37, pl. 16, figs. 7—10.

The species occurred only at a single station:

St. 110; 5.VIII.'22; 5°25′ S., 105°53′ E.; depth 12 m.; 12 specimens.

No new data have been found concerning this typical Indo-Pacific and very rare species.

Polystomella craticulata (Fichtel et Moll).

Nautilus craticulatus Fichtel et Moll, Test. Micr., 1803, p. 51, pl. 5, figs. h—k.
Polystomella craticulata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 284, no. 3. — H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 739, pl. 110, figs. 16, 17. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 34, pl. 19, fig. 4.

This species occurred at only 3 stations:

Saparoea-Bay; 9.III.'22; 18—25 m.; only 6 microspheric specimens of considerable size.

St. 107; 5.VIII.'22; 5°47′ S., 106°7′ E.; depth 49 m.; several megalospheric specimens.

St. 11; 9.IV.'22; Off Toeal; depth 20 m.; microspheric as well as megalospheric specimens.

Polystomella craticulata was found in the Siboga-material at several points of the Indian Archipelago; Cushman has mentioned it from a large number of localities of the Philippines (U. S. Nat. Mus., Bull. 100, p. 368), all of shallow water.

In my Siboga-Report I described exhaustively the inner structure of the megalospheric generation. I found in the Siboga-material only young microspheric shells, here I had the fortune of finding several adult microspheric specimens with a much larger diameter and consequently different characteristics, which I will try to analyse now.

While in young microspheric shells the umbilical region is rather small, in respect to that of the megalospheric generation, in older individuals the umbilicus becomes a large area, as the later chambers do not produce such long alar prolongations, as is usual in the *Polystomellidae;* the umbilical area is penetrated by numerous umbilical canals, which run straight to the surface, in a direction vertically to the plane of coiling. These umbilical canals do not anastomose, and they begin in the spiral canal. This canal runs at both sides of the first coils of chambers, and continues running in this way till the last formed chambercoil, along the edges of the alar prolongations. From these two spiral canals are originating the forked canals, running vertically to the umbilical ones, just between two succeeding chambers

of the same coil, and at first in the direction of the marginal surface of the test. But, since the next coil of chambers is built just on the openings of the forked canals (which fork before they reach the surface), these canals will open into the chambers of the next coil, at the ventral sides. Only in exceptional cases the forked chambers will continue their ways and open into another coil of chambers. Thus the chambers show at their ventral sides the stolone-like communications with the forked canals, a row of foramina to the next chamber of the same coil, a row of foramina coming from the preceeding chamber; in a horizontal section the foramina, being situated in a single plane, give the idea of a system of canals running vertically to the forked canals.

Once more we have shown here that the canal system of *Polystomella* resembles that of the other *Rotaliidae* in all cardinal points, the only difference being the doubleness of the system, due to the planospiral development of the shell. Thus the only difference between the *Rotaliidae* and the genus *Polystomella* is the planispiral arrangement of the latter. But as we find an intermedial genus in *Faujasina*, we cannot understand, why authors have created a distinct family for this genus *Polystomella*. The inner structure of the family of the *Nonionidae* of Cushman's shows it to be a very good rotaline group, having nothing to do with *Polymorphinidae* or with *Peneroplidae*. We ought to create as few families in the Foraminifera as even possible, in order not to lose the survey on the systematical relations of the different genera.

X. Family ***Amphistigenidae.***

Amphistegina radiata Fichtel et Moll.

Nautilus radiatus Fichtel et Moll, Test. Micr., 1798, p. 58, pl. 8, figs. 8a—d.
Amphistegina radiata Chapman, Proc. Zool. Soc., London, 1895, p. 45, pl. 1, figs. 8—10, 12.
Amphistegina lessonii d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 304, no. 3, pl. 17, figs. 1—4.
Amphistegina lessonii var. *radiata* (Fichtel et Moll) Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, pt. 2, 1915, p. 736.

For further details about this synonymy, one may consult my Siboga-Report, pt. 2, 1930, p. 76, and the plates.

This species is one of the most abundant in the tropical seas. It has been found at the following localities:

11.II.'22; Banda-Lontor; depth 25 m.; very abundant.
9.III.'22; Saparoea-Bay; depth 18—25 m.; 4 specimens.
St. 15; 10.IV.'22; South of Doe-Roa; depth 40 m.; several specimens.
St. 19; 14.IV.'22; Off Toeal; depth 20 m.; 4 specimens.
St. 20; Doe-Roa Basin; depth 50 m.; common.
St. 24; 15.IV.'22; 5°37′ S., 132°56′ E.; depth 100 m.; some specimens.
Banda Neira; depth 13 m.; very abundant.
11.VI.'22; near Waling Banda; 20 m.; very abundant.

All forms, which I analysed in the Siboga-material, I found too at the stations Banda Neira, Lontor and Waling, so that my conclusions seem to be quite right. Especially in the eastern part of the Archipelago the species seems to be very common, whereas in the western part it is totally wanting.

XI. Family *Camerinidae.*

Outlines of a new classification.

The family of the *Nummulitidae*, or as it has been called by Cushman (The Foraminifera, 1928, p. 208) that of the *Camerinidae*, is characterised by a bilateral and planispiral test, involute or, especially in the later coils, evolute. The chamber-walls are calcareous and perforate; canal system showing a marginal chord, found at the outer margin of the shell, giving rise to two interseptal canals between the sutural walls, which give off branches to the surface of the shell. From these branches arises likewise a system of canals, directed vertically to the sutural walls, and running underneath the lateral chamberwalls; in the case of these canals reaching the sutural wall of the next chamber a secondary chamberwall will be formed.

From the description given above appears that I do not follow most authors in including the genera *Archaeodiscus* and *Nummulostegina* in the family of the *Nummulitidae*, as they seem to lack a marginal chord canal system. Therefore I will deal only with the so-called genera *Camerina*, *Assilina*, *Operculinella*, *Operculina*, *Heterostegina*, *Spiroclypeus*, *Heteroclypeus* and *Cycloclypeus*. I intend to show that these groups do not have differences great enough to bear the names of different "genera". This statement is of a very great importance, as the same procedure can also be applied to other groups of Foraminifera. It forms a typical illustration of the fact that characteristics of only generic value are used in foraminiferology as specific

ones, those possessing only specific value have been given that of a genus, and so on.

I will give first an analysis of the different genera mainly recent, as fossil ones are, with some exceptions, only insufficiently known for this purpose. In this attempt to analyse the genera of the *Camerinidae* the recent descriptions given by Cushman in his handbook on the Foraminifera of 1928 will be used as a basis.

Camerina (formerly *Nummulites*) (p. 212): "Test lenticular, planispiral, bilaterally symmetrical, involute; wall perforate, calcareous, with a secondary skeleton and complicated canal system; aperture simple at the base of the apertural face, median." This description does not give us a single detail on the structure of the canal system, thus leading to the erroneous supposition that forms like *Nonion* could find a place in this genus; in this way it will be clear that a more detailed description of the canal system is indispensable. The canal system has been described exhaustively in my Siboga-Report, I. The only difference between that of *Camerina* and that of *Operculina* consists in the gradually higher development of the canal system of the latter. In *Camerina* the marginal chord consists of a basal canal, with a small number of canals in the marginal part of the chord; in *Operculina* that number has increased in some forms, as in the microspheric form of *O. complanata*. This only gradual difference is not important enough, however, to base on it the existence of two different genera, as will be evident, when we quote Cushman's description of the genus *Operculinella* (p. 212): "Test lenticular and involute in the young, bilaterally symmetrical, in the adult with a broadly flaring complanate border; chambers simple, aperture at the base of the apertural face, median."

The broadly flaring border in *Operculinella* is only to be found in the B- and in older A_1-forms, not in the A_2-form; in this way it is not a generic character, and cannot be used as such. The other characteristics are those of *Camerina*! Therefore I must oppose to Cushman, when stating in another work: "If this species," (speaking of *O. venosa*) "as it certainly seems, is an *Operculina*, instead of a species of *Nummulites*, it means that there are to-day no living species of the latter genus, which suddenly became so abundant in the Eocene. As other genera of that period represented by complex tests, such as *Orthophragmina* and *Lepidocyclina*, have become extinct, it is not

strange that *Camerina* may also have died out." (U. S. Nat. Mus., Bull. 100, p. 383). But *Orthophragmina* and *Lepidocyclina* are no *Camerinidae* at all, and it will be a question of taste, whether genera like *Tinoporus* are *Lepidocyclinae* or not. The genus *Operculinella* must be cancelled from the approved genera, as it is a real *Camerina*, with a somewhat high development of the marginal chord system in some of the forms. (See under *Operculina venosa*, p. 146).

Assilina (p. 212): "Test similar to *Camerina* but the test flattened, the chambers usually not completely involute so that the earlier coils are not covered, or with the wall very thin so that the earlier coils are visible from the exterior."

In this description, one can easily point out a remarkably weak spot viz.: "or the wall very thin etc." For here very clearly is mentioned the fact, that the character "test flattened etc." cannot be regarded as a valuable characteristic. This character is not a generic one, as can be shown in *Operculina* too, where it may be developed or not in the same species; thus the genus *Assilina* must be dropped as soon as possible, and the forms must be united with *Camerina*.

Operculina (p. 213): "Test bilaterally symmetrical, planispiral, complanate, usually all the coils visible from the exterior, earlier coils so[illegible] involut[illegible]; wall calcareous, perforate, smooth or ornamented with bosses; aperture single, at the base of the apertural face, median."

When we compare this description with that of *Assilina*, we cannot find any great difference between the two genera. The only difference, not mentioned by Cushman, consists of the somewhat more complicated marginal chord system in *Operculina*. But, as we have already pointed out, this characteristic is of no generic value. Therefore no real difference exists between *Operculina* and *Assilina*, and we are obliged to unite these two genera. But, as we have stated *Assilina* to be a real *Camerina*, we must unite *Operculina* with *Camerina* too; in this way all forms with marginal chord, must be united into the one genus *Camerina*, in all the above cases, in which simple chambers are developed. In the systematic part of this chapter I will, however, retain the old names, in order to avoid all confusion.

In what connection to the just mentioned genera do the more complex ones *Heterostegina*, *Spiroclypeus*, *Heteroclypeus* and *Cycloclypeus* stand?

In my Siboga-Report, part I, I was inclined to unite this species with *Operculina complanata*, as certain megalospheric specimens of the latter are much like the involute *O. venosa;* I am sure that several authors have been led astray by this likeness. Yet the material of the Kei-expedition has taught me that a distinct species, showing the typical characteristics of *O. venosa* in the microspheric as well as in the megalospheric forms, occurs in the eastern part of the Malayan Archipelago. It was found at the following stations:—

Bay of Saparua, 9.III.'22, depth 18—30 m.; 15 specimens.
Amboina, 21.II.'22, depth 85 m.; some specimens.
St. 10, off Doelah, depth 50 m.; abundant.
St. 11, off Toeal, depth 20 m.; abundant.
St. 20, Doe-Roa Basin, depth 50 m.; abundant.

Cushman has mentioned the species from several stations in the Philippines; Chapman from the Great Barrier Reef.

The without doubt trimorphic organism is characterised by the lack of any indication of tubercules on the walls of the chambers, the relative large number of chambers in a whorl, but mainly by the alar prolongations of the chambers, which are identical with what we can find in many species of *Camerina*.

In the microspheric form, B, the shell begins with a narrow spiral, of about six convolutions, with regularly built alar prolongations, and is followed by a widely outspread flange, built up by the last coil. The centre of the shell is occupied by a large hyaline mass of chalk, formed by a single pillar, beginning at the first chamber. In the later convolutions, the sutures of the chambers are relatively broad, and the sutural canals are somewhat spreadening in the thick walls, thus, since they are surrounded by clear shell-substance, forming a fine dentine structure of the sutures. The strongly developed marginal chord is found as in the other *Camerinidae*. In this way, the microspheric form of this species can be described as a real *Camerina*, with a flangelike last whorl.

The megalospheric forms with a small proloculum, A_1, followed by a small second chamber (thus with a small embryonic apparatus) begins with a spiral, which gradually increases in diameter, without forming the flange. In this way the shell becomes still more like a Nummulite, differing only in the possession of an umbilical knob of hyaline material, now formed by the congruence of different pillars

suborbicularis, where in some forms the alar prolongations already show a tendency to divide into secondary chamberlets. When I give here the name *Spiroclypeus* the rank of a genus, it is only since we are lacking real data about the structure of the so-called lateral chambers.

Heteroclypeus (p. 214): "Test similar to *Heterostegina* in the young but the chambers becoming annular in the later development."

This genus has no value at all, because in many species of *Cycloclypeus* the early coils of chambers in B and A_1 show the spiral development; as I stated, this development is a function of the volume of the first chambers more than of the inner constitution; it may be in some cases a specific characteristic, but has no generic value at all.

Cycloclypeus (p. 214): "Test in the microspheric form like *Heterostegina* in the early stages, later with the chambers becoming annular, divided by radial portions into rectangular chamberlets, the test discoidal and much compressed".

This genus, which cannot be separated from the former, as appears from a comparison of the two descriptions, has been extensively analysed in the description on pp. 153—159. I came to the conclusion, that the forming of annular chambers cannot form a characteristic important enough for establishing a whole genus.

In this way we come to the conclusion, that the different genera *Camerina*, *Assilina*, *Operculinella*, *Operculina*, *Heterostegina*, *Spiroclypeus*, *Heteroclypeus* and *Cycloclypeus* in reality belong to a single genus. According to the rules of nomenclature this very important genus must be called *Camerina*.

Operculina venosa (Fichtel et Moll).

(Plate V, figs. 13—16; Textfig. 32.)

Nautilus venosus Fichtel et Moll, Test. Micr., 1798, p. 59, pl. 8, figs. e—h.
Nummulites venosa Chapman, Proc. Zool. Soc. London, 1895, p. 47.
Operculina venosa Chapman, Proc. Roy. Soc. Victoria, vol. 26, 1913, p. 173.
Amphistegina cumingii Carpenter, Philos. Trans. 1859, p. 32, pl. 5, figs. 13—17.
Nummulites cumingii H. B. Brady, Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 749, pl. 112, figs. 11—13; textfig. 22. — Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 166. — Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 39, pl. 14, fig. 6. — Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 739. — Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 383.

I cannot agree with the erroneous idea of Krynen's, that the first coil of chambers of the microspheric form can be called an embryonic one, since we know that in all living Foraminifera the embryo of the microspheric generation consists of the first chamber only. The fact that this first winding is formed by simple chambers, must lead to the conclusion that *Spiroclypeus* descends from a heterostegine ancestor. But the lack of simple chambers in the megalospheric forms (except those of the embryo) represents a characteristic of more evident generic value. I must point out the latter fact, as Krynen seems to have neglected it, saying on p. 104: "Then follows the discussion of the horizontal section; this resembles a similar section of *Heterostegina*. Both display the same spiral form, the same structure of primary and secondary chambers, and both also display a maximum of three windings."

In dealing with *Cycloclypeus*, I will show that the lack of primary chambers cannot be claimed as a character of generic value in the *Camerinidae*. A much more typical characteristic is found in the lateral chamberlets of *Spiroclypeus*. This characteristic does not occur in any other group of *Camerinidae;* it has nothing to do, as far as we know now, with other circumstances than the inner genetics of the animal; therefore we can consider it as of high generic value. No forms with partial development of the lateral chambers in some of the generations have been found hitherto. Therefore the genus *Spiroclypeus*, only known from the Tertiary of the East Indies, may be an aberrant, but distinct genus. Yet I must call the attention of palaeontologists to the possibility that the so-called secondary chamberlets of *Spiroclypeus* may not be homologous with those known from the *Tinoporidae*, because the structure of the outer shell leads to the idea that these secondary chamberlets are nothing but the subdivided "*alar prolongations*". A more detailed study of the lateral parts of the shell will give us the key to this most important question. It is very probable that Boussac (Développement et Morphologie de quelques Foraminifères de Priabona; Bull. Soc. Géol. France, ser. 4, vol. VI, pp. 93—97) is right in believing that we have here to do with alar prolongations. In case this supposition is right, one comes to the only possible conclusion, that *Spiroclypeus* is nothing else than the involute habitus of some *Heterosteginae*, just as we know such involute forms in *Camerina*, *Operculina* and even in *Heterostegina*

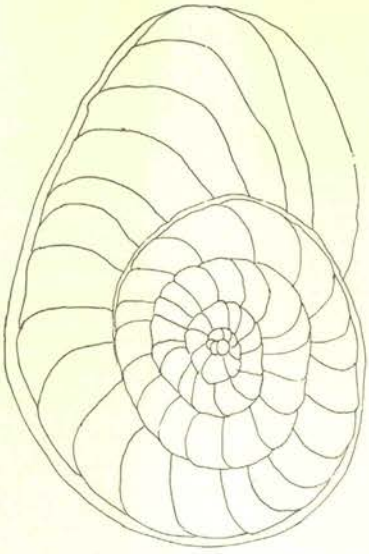
Heterostegina (p. 213): "Test similar to *Operculina*, the early chambers simple, later ones divided into chamberlets; aperture consisting of a row of rounded openings on the narrow apertural face."

As I have already described in my Siboga-Monograph, Part I, in some forms of *Operculina* secondary foramina occur; this consequently cannot be a generic characteristic of *Heterostegina*. Only the forming of the secondary chamberlets can be taken into consideration. I showed too, that the forming of the secondary chamber walls is due to an outgrowth of the interseptal canals vertically to the sutures, and it is therefore that we may consider the canal system as of more classificatory value than the chamber walls themselves. In *Operculina heterosteginoides* I found a beginning of secondary interseptal canals (as we may call the canal system, vertically directed to the sutural canals) but no outgrown septa in either A or B forms. In *Heterostegina operculinoides* on the other hand, in the microspheric form the canal system shows the development of *O. heterosteginoides*, in the A_1-form a development of incomplete septa is found, in A_2 the septa are totally formed, in connection with the typical heterostegine development of the secondary canals. In *Heterostegina suborbicularis* the development of the secondary walls corresponds with the description of Cushman's. With these data known, one does not have any certainty, where to draw the limit between the genera *Operculina* and *Heterostegina*, and therefore I prefer to drop the only applicable characteristic of the genus *Heterostegina:* the forming of the secondary chamberlets, especially as they occur together with simple chambers in a single species, *O. heterosteginoides*. *Heterostegina* is a *Camerina* with the tendency to form secondary canals. In all forms moreover the first formed chambers are of the simple type. We may consider the species with secondary canal system as a subgenus of *Camerina*, but no more than that.

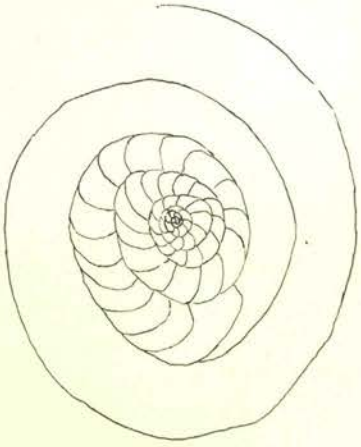
Spiroclypeus (p. 213): "Test somewhat similar to *Heterostegina* but more accelerated, the curved chambers divided into chamberlets beginning after the proloculum, lateral chambers and pillars developed at each side of the test."

We know something more about this fossil genus through the investigations of Krynen (Het genus *Spiroclypeus* in het Indo-Pacifische gebied, with summary in English; Verh. Geol.-Mijnbouwk. Genootsch. voor Ned. en Kol. geol. ser., vol. IX, part II, pp. 77—112).

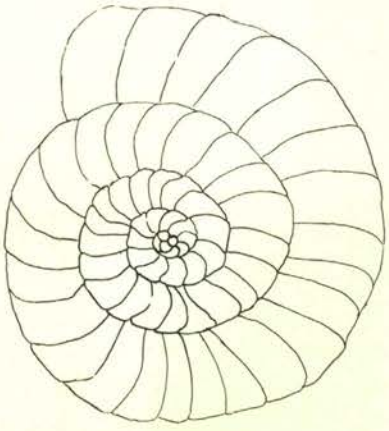
in the centre; between these pillars fine lamellae of porous material remain. The pillars never form a single one in this way.



a.



b.



c.

Fig. 32. *Operculina venosa*. a: Forma A_2, section; × 15. b: Forma B, section; × 20. c: Forma A_1, section; × 20.

The third form, beginning with a large embryonic apparatus, shows only typical nummulitic characteristics. This A_2-form shows a spiral with gradually increasing diameter, no real flange, and no

secondary chalk-material at the umbilicus; the alar prolongations are running unto the umbilical region, and show even the typical irregularity of growth, found in many *Camerinae*, viz. that the alar prolongations do not run quite to the umbilicus, but to a point somewhat aside of it. The total habitus thus is that of *Camerina*.

This latter statement is of very great importance from a systematical point of view. For it is doubtless a fact that *Operculina venosa* shows such typical nummulitic features, that it must be regarded as a matter of taste, whether the species should be called a *Camerina* or an *Operculina*. But, as the microspheric form shows the flangelike outgrown chambers, which may be regarded as a characteristic of *Operculina*, one will be inclined to name the species *Operculina*. I myself am sure that the differences between *Camerina*, *Operculina* and *Operculinella* are not of a generic value, and all these forms must be regarded as real *Camerina*. It was Yabe, who established the genus *Operculinella* (Sci. Rep. Tohoku Imp. Univ., ser. 2, geology, vol. 4, 1918, p. 122), dealing with *Operculina cumingii* Carpenter, which is identical with *Operculina venosa* (Fichtel et Moll). But in later works this author shows some doubt of the value of this genus (Yabe and Hanzawa, Sci. Rep. Tohoku Imp. Univ., ser. 2, geology, vol. 11, no. 3, 1929, p. 185) though Cushman regarded it as a valuable genus in 1928 (Foraminifera, p. 212). How incorrect works on fossil forms sometimes are, is, however, proved by the quoted work by Yabe and Hanzawa, as the shells called *Operculina venosa*, figured Pl. XXI, fig. 9, are undoubtedly *Operculina complanata*, as the typical characteristic of *O. venosa*, the involute chambers, is totally lacking! The actual knowledge of the structure of *Operculina venosa*, as given here, makes it very probable that it does not descend directly from the *Camerinidae* of the tertiary epoch, but that it is an involute form of *Operculina*, which is again a complanate *Camerina*. So I do not believe that the real *Operculina venosa* occurs as a fossil. I myself described some forms of *Operculina complanata* (Siboga, I), as *O. venosa*, thus claiming the identity of *O. venosa* with *O. complanata*. In the material of the Danish expedition I found these forms also. This identification was wrong, as I found now; some megalospheric forms of *O. complanata* show, it is true, involute chambers, but they ought to have alar prolongations, without secondary chalk-deposit, for being a real *O. venosa*. The microspheric forms of the two species are quite different, as we

know now. That of *O. venosa* is involute, with a tendency to complanate form; that of *O. complanata* is complanate throughout.

Why there should be a special genus for the species *O. venosa*, is not clear, as *Operculina complanata* differs from it only by a single valuable character, the complanate alar prolongations.

In a recent paper, C. M. B. Caudri states to have found specimens of *Operculinella venosa* in tertiary deposits (De Foraminiferen-Fauna van eenige Cycloclypeus-houdende Gesteenten van Java; Verh. Geol. Mijnbouwk. Genootschap voor Nederland en Kolonien, geol. ser., vol. IX, p. 3). This would prove the occurrence of this species in former periods; but, as I could ascertain in a large material from the Bay of Popoh, megalospheric forms of *Operculina complanata* in fossil deposits too show a tendency to form involute chambers; thus it seems necessary to review the data on fossil forms in the light of our recent investigations on the undoubtedly clearer and better preserved recent material.

It is moreover a fact that tertiary deposits in the Malayan Archipelago show a striking identity with the recent deposits, so that it will be possible to analyse these fossil forms with quite the same methods, with which recent forms are studied. The importance of an exact knowledge of the recent Malayan forms will be evident.

Operculina complanata (Defrance).

For literature see my Siboga-Report, part I, p. 61.

One has to consider that in the synonymy the name of *Operculina venosa* must be of the value of a species.

I have nothing to add to my description given in the Siboga-Report. The species occurred in the material of the Kei-Expedition at the following stations:

Saparua-Bay, 9.III.'22, depth 20—30 m.; a single specimen.
Amboina, 21.II.'22, depth 90 m.; abundant.
Banda Neira, 9.VI.'22, depth 13 m.; rare.
Off Banda, 3.VI.'22, depth 75—90 m.; common.
Samalona, Makassar, 28.VI.'22, depth 35 m.; abundant, all forms.
St. 64, 5°51′ S., 106°22′ E., 26.VII.'22, depth 35 m.; abundant.
St. 79, 5°57′ S., 105°57′ E., Sunda strait, depth 30 m.; few.
St. 77, 6°22′ S., 105°44′ E., depth 30 m.; common.
St. 78, 6°25′ S., 105°41′ E., depth 30 m.; abundant.

St. 83, 6°38′ S., 105°17′ E., depth 45 m.; very abundant; all forms.
St. 85, 31.VII.'22, 5°53′ S., 105°34′ E., depth 25 m.; abundant.
St. 89, 31.VII.'22, 5°57′ S., 105°32′ E., depth 18 m.; abundant.
St. 103, 4.VIII.'22, 6°5′ S., 105°42′ E., depth 52 m.; few.
St. 107, 5.VIII.'22, 5°47′ S., 106°7′ E., depth 49 m.; few.

Operculina complanata occurs in the Malayan Archipelago in the neighbourhood of Sunda strait, Amboina, Djampea, Sulu-islands, Banda-Sea, Bay of Balik-Papan. It seems to be a widely distributed species, but it has not been found in the Kei-Archipelago.

Operculina heterosteginoides nov. spec.

(Plate VI, figs. 1 and 2; textfig. 33.)

This species, which in some records has been described as only a variety of *Operculina Bartschi* Cushman, has been separated from the other forms, since I could ascertain that microspheric and megalospheric specimens occur in the same locality, and since the various descriptions do not mention the very typical characteristics, found by me in the material. In case the new characteristics are not the result of a more accurate study, the new species shows a very limited distribution, as it was not found in the Siboga material, and in the Danish material it occurs only at a single station: St. 83, 30.VII.'22; 6°42′ S. 105°17′ E.; depth 45 m.; 30 specimens.

In this material only two forms could be distinguished, B and A_2. Under these circumstances our description cannot be exhaustive, since one must bear in mind that the *Camerinidae* are normal Foraminifera, showing trimorphism; only a larger material may give us data about the third megalospheric form.

The two forms of this new species can be distinguished only by the fact, that the diameter of B is somewhat larger than that of A: diameter of B: 5.5 mm., that of A: 3.5 mm. The B-form shows a more considerable development of knobs of secondary chalk-material, especially in the central part of the shell. The microsphere measures 15 μ, the megalospheric embryonic apparatus has a diameter of 96 μ.

The species is characterised by the fact that the canal system shows a development like that found in *Heterostegina operculinoides*, described in my Siboga Report (Part I, p. 68). In all *Operculinidae* the interseptal canals show a tendency to form branches to the sur-

face, opening at the sutures. In the microspheric form of *Heterostegina operculinoides* these branches form a short canal, running underneath the wall of the next formed chamber, blindly, and surrounded by a mass of secondary chalk, thus forming the beginning of a secondary chamber wall. The wall of the chamber itself is somewhat thickened at the place, where the sidebranch of the canal system protrudes into the lumen of the next chamber, so that the pores in that wall are bent aside. This makes an impression, as if the chamber wall is ornamented by small streams of chalk, beginning at the canal branches, and ending near the middle of the next chamber[1]).

This description, given for the microspheric form of *Heterostegina operculinoides*, can be applied without any alteration for our new species of *Operculina*, and this was the reason, why I named this species *Operculina heterosteginoides*.

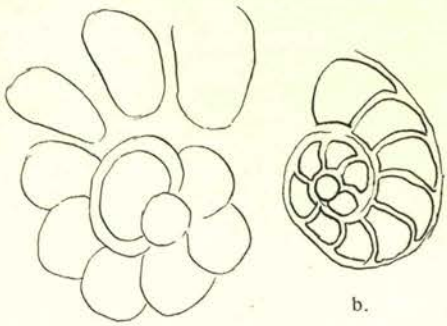


Fig. 33. *Operculina heterosteginoides*. a: Section through the central part, forma A; × 132. b: Section through the central part of forma B; × 198.

Especially in the microspheric form the centre of the shell is ornamented by a highly developed system of chalk-knobs, as is also characteristic of the genera of *Heterostegina*, as well as of *Operculina* (viz. *bartschi*).

Operculina heterosteginoides is a very interesting species with respect to our interpretation of systematics of the *Camerinidae*, as given in the introduction to the whole group.

[1]) Another characteristic of *Operculina heterosteginoides* is the shape of the whole shell; the chambers of the first whorls are quite those of *Operculina complanata;* but in later formed coils the chambers are widening rapidly, and the sutures, which in *Operculina complanata* form an angle of about 90 degrees with the marginal chord of the former winding, begin to decrease more and more. In this way the shell is lengthened in the direction of the outer end of the last formed chamber, thus giving rise to a shape, which may be defined as marginuline.

Heterostegina operculinoides Hofker.

(Textfig. 34.)

In my Siboga-Report, Part. I, pp. 67—69, pl. 34, 35, figs. 1, 2, 4, 5, I described this remarkable species from localities east of Borneo, north of Celebes, and from the Kei-Archipelago.

The Kei-expedition gathered it from the neighbourhood of Banda as well as from the Kei-Archipelago; from Banda, 3.VI.22, depth 75—90 m., from Kei, St. 53, 9.V.'22, 5°36′ S., 132°55′ E., depth 85 m.

The species seems to be confined to the eastern part of the Archipelago, as is the case of many other specialised Foraminifera. In my Siboga-Report I described two generations of this species, which was thus an incomplete description, as I pointed out that only when the three forms found in Foraminifera have been described, a species can be regarded as fully described. In the Kei-material, however, I was able to find the three forms together in the same sample; so I demonstrated that no doubt can exist about the fact that these different forms, the one having the habitus of an *Operculina* with somewhat more highly differentiated canal-system, the other with the typical features of the genus *Heterostegina*, with secondary chamberlets, belong together.

I found that the secondary chamberlets were due to a stronger development of the canals too, the walls being a function of the chalk-secretion of the canal-protoplasm. This somewhat hypothetical conclusion was very beautifully confirmed, when I studied the A_1-form of the species, found at the same locality, St. 53, showing a somewhat smaller proloculum; the secondary chamber walls in this form showed to be all only incompletely developed! In this way the development of the secondary chamber walls of the A_1-form lies between that of A_2 and B! It was found that the canal system also showed a development at an intermediate rate. This discovery is of great importance, in respect of the trimorphism in general, as well as in regard to our knowledge of the influence of the development of the canal system on the development of the secondary chambers in the *Camerinidae*. This discovery still has another importance with respect to systematics, as we find here that the characteristics of the genera *Operculina* and *Heterostegina* are of no generic value, being found in a single species! This statement becomes the more striking, since we have found in our material a variety of typical *Operculina*, showing the features of the B-form of

Heterostegina operculinoides. A total revision of the genera *Operculina*, *Heterostegina* and *Cycloclypeus* is therefore urgently needed, as given in the introduction to this group.

We can give now a new description of the species *Heterostegina operculinoides* as follows:—

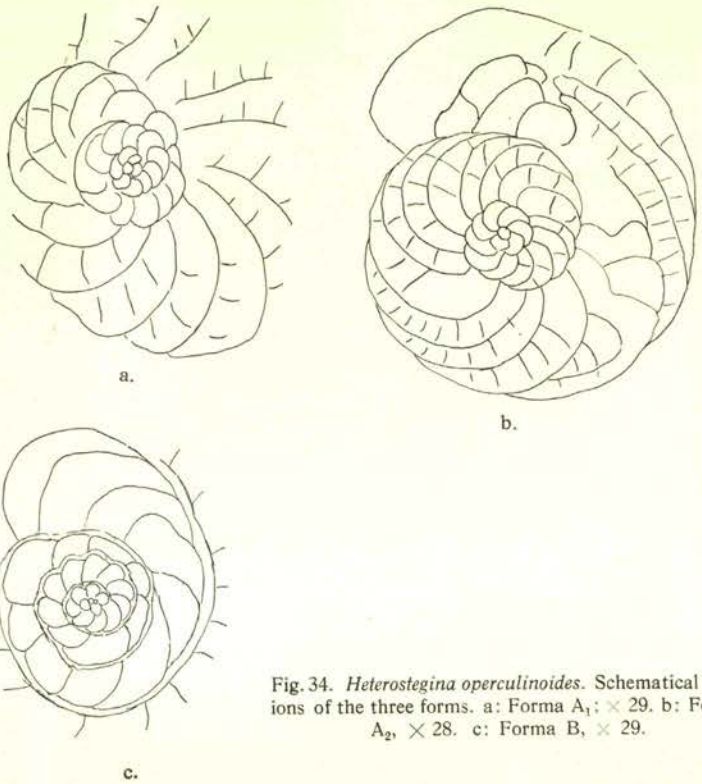


Fig. 34. *Heterostegina operculinoides*. Schematical sections of the three forms. a: Forma A_1: × 29. b: Forma A_2, × 28. c: Forma B, × 29.

Forma A_1: Beginning with a small proloculum, followed by a second chamber, together representing the embryonic apparatus; the size of this embryonic apparatus, however, does not differ very much from that of the A_2-form, just as it is the case with all other species of the operculine group. The embryo is followed by a set of 19 simple, operculine chambers; all following chambers show the building of secondary chamber walls, sometimes leading to completely outgrown secondary walls, but in most chambers only giving rise to incomplete secondary

walls, not reaching the sutural wall of the following chamber. On the junction of the walls, where several canals join and open at the surface of the shell, a deposit of secondary chalk-material is heaped up, thus forming little knobs of chalk, at regular intervals. These knobs form a typical granulation on the shell-surface.

Forma A_2: Beginning with a somewhat large embryo, followed by a set of 7 simple, operculine chambers; after these chambers the real heterostegine chambers are formed. The first formed chambers of this set do not show any development of alar prolongations, as is the case in *Heterostegina suborbicularis*. The whole set of heterostegine chambers shows a remarkable irregularity of growth, especially of the secondary chamber walls.

Forma B: All chambers are of the simple type, which may be called the operculine type; yet only the first 25 chambers, following the microspheric embryonic chamber, can really bear the name of operculine: the later formed chambers show the typical outgrowths of the canal system, described by me in my Siboga-Report, giving rise to the building of little prominences on the sutural walls, the first indices of the secondary walls, found in the A-forms.

Thus in *Heterostegina operculinoides* the B-form shows the most primitive characteristics: 25 operculine chambers, no forming at all of secondary walls. The A_1-form is not so primitive, having only 19 operculine chambers, and showing the beginning of the building of secondary chamber walls. The third form, A_2, shows the most differentiated characteristics, with only 7 operculine chambers, and the forming of real secondary chamberlets. Indeed, this species, the "missing link" between the socalled "species" *Operculina* and *Heterostegina*, gives us one of the most striking examples of trimorphism, hitherto known.

The forming of the pillars, so characteristic of the *Heterosteginae*, can easily be analysed in this species. The pillars arise in the neighbourhood of the openings of the canals; when the wall of the shell grows thicker, these pillars grow thicker too; especially in the centre of the shell the pillars join, and are only separated by the narrow lines of pores, rests of the strata of pores found between the pillars, when the wall is thin. These lamellae of porous shell material are opaque and thus similar to thin walls, surrounding spaces filled with hyaline chalk-material.

Heterostegina suborbicularis d'Orbigny.

Heterostegina suborbicularis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 305.
Heterostegina depressa d'Orbigny, 1839, Foraminifera; Hist. Phys., Pol. et Nat. de l'île de Cuba, Paris, p. 122, pl. VII, figs. 24, 25.
For further literature: Hofker, Foraminifera of the Siboga-Expedition, Part I, 1927, p. 70, pl. XXXV, XXXVI, figs. 3, 6—12.

This species has been found in several samples of the expedition:
Near Banda Neira, 9.VI.'22, depth 13 m.; abundant, but merely young specimens.
Waling, Banda, 11.VI.'22, depth 20 m.; very abundant, mostly small specimens.
Gat van Lontor, 11.II.'22, depth 25 m.; very abundant, with several microspheric specimens.
Amboina, 21.II.'22, depth 85 m.; rare.
Doe Roa Basin, 14.IV.'22, depth 40 m., rare.
5°47′ S., 106°7′ E., 49 m.; small specimens.
Anchorage Banda, 3.VI.'22, depth 75—90 m.; several specimens, most of them microspheric.

When we compare these stations with those, at which the species was found during the Siboga-cruise, we find the localities to be nearly the same. It is a peculiar fact that the other allied species, *Het. operc.* and *Cycl.* are found in that same region.

I have nothing to add to my description, given in the Siboga-Report.

Cycloclypeus.

The synonymy of the genus *Cycloclypeus* has been much discussed in recent literature. As *Cycloclypeus* is one of the forms, which are very much studied with respect to scientific foraminiferology, a critical analysis of the recent and fossil forms, especially of the indopacific ones, will be of interest. The genus has been separated as such from the older one, *Heterostegina*, by Carpenter. When we regard the two microspheric forms of *Heterostegina* and *Cycloclypeus*, the young stages are found to be identical. In *Heterostegina* all chambers show the marginal chord at one side, and later chambers are divided into chamberlets. In *Cycloclypeus* on the other hand only the older chambers are heterostegine, showing the marginal chord; but then chambers become overlapping to such a degree that the two sides of the chamber finally reach each other. At this stage of growth the chambers become annular and the marginal chord is lost. So the only difference between the

genera *Heterostegina* and *Cycloclypeus* lies in the widening of the chambers, or in the fact that in the formula of Rhumbler's $y = aq^x$, q has increased in *Cycloclypeus*. As in all Foraminifera the B-form has the factor q much larger than the A-form, especially the A_2-form, but as in B the factor a is of the smallest value, in the A-forms of *Cycloclypeus* the annular chambers will be reached in a much shorter time than in B and so the character „annular chambers" will be fixed in the B-form. But in consequence of the law of Rhumbler which has been stated in all groups of Foraminifera studied in this respect, forms with small megalospheric embryonic apparatus (A_1) will show a smaller q than those with the larger ones. Thus in the forms (due to trimorphism!) with small embryonic apparatus the number of heterostegine chambers will be larger than that of the A_2-form. In consequence we get the following formula for the genus *Cycloclypeus:*

$$\begin{aligned} B&: y_{\text{first ann. chamber}} = 12 \cdot 1{,}6^{xB} \\ A_1&: y_{\text{f. ann. ch.}} = 80 \cdot 1{,}2^{xA_1} \\ A_2&: y_{\text{f. ann. ch.}} = 12 \cdot 1{,}7^{xA_1} \end{aligned}$$

consequently:

x in B is relatively large (e.g. 30)
x in A_1 is smaller (e.g. 8)
x in A_2 is smaller once more (e.g. 2).

But it will be evident that especially in the B-form the value of x will be of some constancy between the limits of the species. In A-forms the factor of the variation of the volume of the embryo will be of much more influence on the value of x and consequently, as that value is influenced by outer circumstances as well as by the place of the individual, in the A-series x will show much more variation, but within the limits of the species too. In this way one will easily admit that only the B-forms will be of value in the case that the value of x has been taken into consideration as a systematic character. But, as we have already pointed out, some variation in x is possible even in the B-form, as the factor q is always controlled by outer circumstances.

In the Indian Archipelago fossil *Cycloclypei* have been described in large numbers, mostly, however, of megalospheric form, and as authors, especially older ones, did not have any knowledge of bionomics, many so-called species have been created; some authors (Rutten e.g.)

have published figures indicated as microspheric, which are in reality megalospheric A_1.

Microspheric forms of *Cycloclypeus*, in literature:

van der Vlerk, 1925, pl. 4, fig. 37.
Cycloclypeus neglectus Martin; *x* 22.
Caudri, 1932, pl. 2, fig. 16.
Cycloclypeus neglectus var. *Eidae* Tan; *x* 25.
Caudri, 1932, pl. 2, fig. 13.
Cycloclypeus neglectus var. *indopacifica* Tan(?); *x* 26.
Caudri, 1932, pl. 2, fig. 20.
Cycloclypeus carpenteri (fossil); *x* 23.
Hofker, 1927, pl. 37, fig. 8.
Cycloclypeus carpenteri (recent); *x* 19.
Hofker, 1927, pl. 37, fig. 3.
Cycloclypeus carpenteri (recent); *x* 21.

Caudri, 1932, p. 196, mentions a microspheric form of *Cycloclypeus annulatus*, in which the number *x* was "more than 20".

The small form, described by Moebius (1880) from Mauritius as *Heterostegina tuberculata*, is probably microspheric (pl. 12, fig. 6), the first chamber, however, measures 40, which is too large to be a microspheric one. So I do not know whether Moebius figured this form correctly or not, as in his description he does not mention the cyclical chambers. The heterostegine part of the chambers has the number of 22.

We can say then that *x*, in all known pacific "species", living and fossil, lies between 19 and 26; since, as we have seen, *x* is a function of *q*, and *q* is a factor determined by inner as well as outer influences, in the genus *Cycloclypeus* x_B gives no data of systematic value. In respect to x_B the genus *Cycloclypeus* would continue only as a single species.

Fossil tertiary *Cycloclypei* have been described by Martin, Douvillé and van der Vlerk in former years. These authors came to the conclusion that three species could be distinguished: *C. communis* Martin, *C. annulatus* Martin and *C. neglectus* Martin. Rutten, van der Vlerk and Caudri came to the conclusion that *C. communis* and *C. annulatus* were only varieties. Caudri distinguished another form:

C. reticulatus, but concluded, that surface-characters, such as granulations and annules could never form specific characteristics, as forms showing granulations are not always *C. annulatus*, etc. In my Siboga monograph I likewise found that pillars are of no systematic value in the *Camerinidae*. Caudri and Tan Sin Hok therefore distinguished different species, but only on inner characters, mainly characters of the embryonic apparatus of the megalospheric forms and the number of heterostegine chambers. Tan created several "varieties" of the two groups of forms, *neglectus* and *annulatus*. Caudri likewise distinguishes these two groups, giving now the old names to quite different forms, as the characteristics are not those of Martin (outer characteristics) but those of Tan (inner structure). Thus the genus *Cycloclypeus* in older publications is divided into several species called *communis*, *annulatus*, *neglectus*, etc. and in modern literature it is divided into other "species" as to their limits, but with the old indications.

Tan Sin Hok believes that the several "species" he distinguished show stratigraphical limits too. Caudri comes to the conclusion that the facts are not so simple.

I am, after the study of a large material from the classic deposit at Popoh (tertiary), in which limestone all different forms are found together, convinced that the confusion is due to the trimorphy of the species and that the whole question is of the simplest.

Caudri has analysed already the different forms, one can distinguish at Popoh. She mentions the following would-be species from this locality:

Cycloclypeus annulatus Martin.
Cycloclypeus annulatus Martin var. *Martini* van der Vlerk.
Cycloclypeus neglectus Martin var. *transiens* Tan.
Cycloclypeus neglectus Martin var. *indopacifica* Tan.

The limestone of Popoh contains very large, unbroken shells of the fragile *Cycloclypei*. Other Foraminifera and algae lend to this fauna the same aspect, which can be found in the samples in which *C. carpenteri* now occurs in the Malayan region. This is the reason why I am sure that the limestone of Popoh contains nearly exclusively Foraminifera, which lived there together: it is autochthone. The Foraminifera belonging to the genus *Cycloclypeus* found in this

locality lived here; so it will be obvious that, in analogy with recent species, they will show the different generations one can meet with in a species (B, A_1, A_2). A very large specimen with highly developed annular thickenings of the shell (9 annules) with a diameter of 38 mm., proved to be microspheric, with 23 heterostegine chambers. Several large shells, showing only granulations, in the way of "*C. communis*", were found to possess the irregular embryonic apparatus, described by Caudri for this locality. But I found too, that this irregularity is due to polyembryonism described by me already in recent *Cycloclypeus carpenteri*. They are described by Caudri under the name of *C. annulatus*.

A third form, indicated by Caudri as var. *Martini* van der Vlerk, small shell, with prominent umbo and only a single annular thickening, proved to have a relatively large embryonic apparatus of normal form. One or two heterostegine chambers follow. A fourth form, indicated as *C. neglectus* var. *transiens*, is in most instances somewhat larger, up to 8 mm. diameter, showing much more typically outgrown "pillars" and a much smaller diameter of the embryonic apparatus, followed by 7—10 heterostegine chambers. I also found Caudri's var. *Eidae* Tan in the material, but could not distinguish her var. *indopacifica* Tan.

What is the meaning of this horrible accumulation of species and varieties of a single genus in a piece of autochthone limestone of the diameter of one's fist?

We have already pointed out, that in *Cycloclypeus* different forms may be found at the same locality; in *C. carpenteri* we find the following forms (Siboga):

1) B-form, *x* very large (20).
2) A_1-form, *x* moderately large (7—9).
3) A_2-form, *x* small (2).
4) Univalent plural forms.

I have no intention of giving different names to these generations and abnormal forms 1—4!

In the limestone of Popoh we find 4 forms too:

1) B-form, *x* very large (23) called *C. annulatus*.
2) A_1-form, *x* moderately large (7—9), called var. *Eidae* including var. *indopacifica* of *C. neglectus*.

3) A_2-form, *x* small (2), called var. *Martini* v. d. Vlerk of *C. neglectus*.
4) Univalent plural forms, called *C. annulatus* or *C. communis*.

In Popoh the only difference between the *Cycloclypei* of that fossil locality and recent *C. carpenteri* seems to be, according to Caudri and other palaeontologists:

1) A somewhat other habitus of the later chamberlets;
2) A somewhat different shape of the megalospheric apparatus;
3) A higher development of secondary chalk-material in some of the Popoh forms.

But when considering these characters one can set forth the following remarks:

To 1) The habitus of the chamberlets is a function of two other factors: the surface tension, and the osmotic behaviour of the protoplasm. These two factors are largely influenced by outer circumstances, therefore they cannot form a specific character.

To 2) The different shape of the megalospheric apparatus is, as I have already mentioned in the preface, a function of inner as well as of outer circumstances, especially of surface-tension. Recent material of *C. carpenteri* likewise shows differences of the megalospheres to such a degree, that it is in all ways comparable with the differences supposed to exist between *C. carpenteri* and the tertiary forms.

To 3) A higher development of secondary chalk material is a function of the salt concentration of the water, as demonstrated by the development of chalk in shallow water forms in recent seas.

In consequence of these considerations, we cannot infer a real specific difference between recent *C. carpenteri* and the fossil "species". Only facial differences, leading to a selection of jordanonts, have taken place in the species *C. carpenteri*, the only exactly known species of the so-called "genus" *Cycloclypeus*.

I already mentioned the fact that the only real difference between *Cycloclypeus* and *Heterostegina* consists in another relation of the values in the formula $y = aq^x$. This characteristic, however, cannot be regarded as of generic value! It is a nearly simple genetic characteristic! Thus one must conclude, that the genus *Cycloclypeus* has no right of existence and Moebius was right in calling his "species" (local form) *Heterostegina tuberculata*. It is, by the way, a remarkable fact that this variety shows no differences at all from some of the A_1 individuals of the Popoh locality.

When considering the tertiary *Cycloclypeus* of Popoh as a local form of the only recent species, known as *Cycloclypeus carpenteri*, we are dealing with it in a very normal biological way, as we now know that every Linnean species in reality is a population of jordanonts and pure lines. Thus we must consider the species as a heap of jordanonts. This is the fact when dealing with the different jordanonts, now occurring in the different regions of the earth. But the different jordanonts, occurring during succeeding geological periods and selected by climatological and other influences of medium of these different periods, likewise may belong to such a population, called a linneont. It is only to this population that we give a Latin name according to Linnean nomenclature. Not only differences of climatological nature, which have not been so different in the tropical area as those of recent time, but especially differences in salt concentration are of an enormous influence on the Foraminiferal life.

But the other living organisms in the neighbourhood of the species are of importance too, as we now know that they can influence the growth by means of radiations. In this way circumstances in the tertiary were not identical with those of the present day in the Malayan seas. Since jordanonts of a Linnean species are selected to form different geographical forms, which are distinguishable even in *Cycloclypeus carpenteri*, we have no right to deny the occurrence of the selection of jordanonts within the species by means of historical (geological) factors. *Cycloclypeus carpenteri* thus forms a very good instance for this biological phenomenon. Yet we must not be too bewildered with this new aspect of the problem, as we know several other Foraminifera from the same locality of Popoh, yet occurring in recent Malayan seas (*Operculina complanata*, *Polystomella craticulata*, *Gypsina globulus*, *Carpenteria*, *Miliolidae*).

Cycloclypeus carpenteri Brady.

(Textfig. 35.)

Cycloclypeus Carpenter, Philos. Trans., vol. 146, 1856, p. 555, pl. 30, figs. 1 and 3; Introduction Forams., 1862, p. 292.

Cycloclypeus carpenteri H. B. Brady, Quart. Journ. Micr. Soc., vol. 2 L, 1881, p. 67; Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 751.

Cycloclypeus guembelianus H. B. Brady, Quart. Journ. Micr. Soc., vol. 21, 1881, p. 66; Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 751, pl. 111, figs. 8 a, b.

Later literature one can find in: Hofker, Siboga-Rep., Mon. IV a, pt. I, pp. 71—74, pl. 24, fig. 1; pl. 37; pl. 38, figs. 1—9, 12, 13.

Material has been found at the following stations:

St. 15; 10.IV.'22; depth 5—20 m.; south of Doe-Roa; 3 micr., 25 macr.; 18 with one embryon; 6 with 2 embryons, 2 of which not in single plane; 3 with 3 embryons.

St. 16; 12.IV.'22; 5°32′20″ S., 132°37′ E.; depth 50 m., 3 micr.; 18 macr.; all except 2 with only one embryonal apparatus; 2 individuals showed the growth in 2 planes vertically to each other.

St. 18; Doe-Roa strait; depth 40 m.; 3 micr.

St. 26; 16.IV.'22; 5°38′ S., 132°55′20″ E.; depth 90 m., abundant.

St. 27; 17.IV.'22; two miles N. of Elat; depth 60—70 m.; 5 micr.

St. 53; 9.V.'22; 5°36′ S., 132°55′ E.; depth 85 m.; 6 macr.

I have given an exhaustive description of the species in my Siboga-Report. No further data have been found except for the finer structure of the "pillars". These structures have been formed of hyaline chalk-substance by the living protoplasm. The individuals, now known to be of the type called by Rhumbler univalent plural individuals, especially show the pores of the embryonic portion running to the surface in narrow bundles, thus forming a kind of honeycomb structure. In some specimens this structure is so prominent that one gets the idea of looking at a mass of lateral chambers when examining a tangential section. All these individuals appear to be of the univalent plural type, I mentioned already in my Siboga-monograph. They can be distinguished by their diameter in adult forms, but in the young ones by the fact, that the centre of the disc shows a somewhat irregular umbilicus, due to the two or more centra from which the forming of secondary chalk begins.

In the samples of station 18 and 27 no megalospheric forms have been found. I think that this is due to the way in which those gatherings have been procured.

At station 15 and 16 the dredge has been used, in 18 too, but in

27 the trawl. At station 26 the species occurred in great numbers, I am informed by Dr. Mortensen.

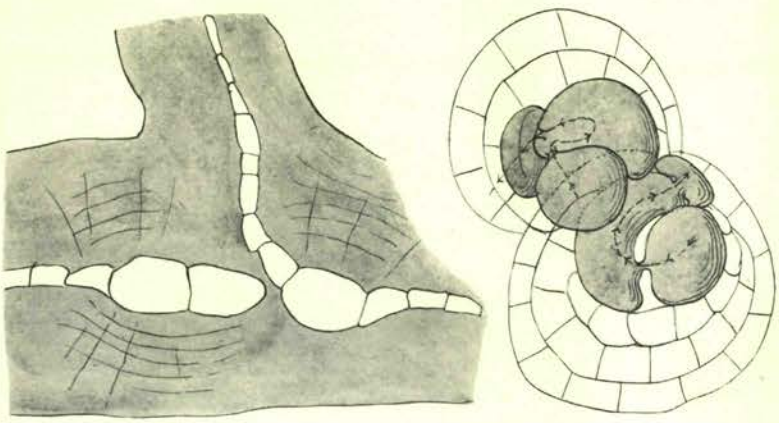
In the collection of station 16 several individuals showed a diameter of 12 and more mm. Though I mentioned in my Siboga-report that the larger individuals of 12 mm. diameter are always plural, most individuals of this size at station 16 appear to be univalent with one embryo. At station 15 the case was as I have described it in my Siboga-report, but the fact is that at station 16 the normal megalospheric individuals may grow out until they have reached a diameter of 12 mm.

In the Siboga-material *Cycloclypeus carpenteri* has been found at several other stations. A very rich material was gathered at station 49a of that expedition, 8°23′5″ S. 119°4′6″ E., at station 152, N.W.-coast of Waigeu-island, and at station 154, 0°7′2″ N. 130°25′5″ E. In the neighbourhood of the Kei-islands some specimens have been gathered likewise by the Siboga-expedition. In the Malayan Archipelago two centres of distribution thus can be found, the one in the Banda-sea, the other N. of Waigeu. Cushman (1921, p. 387) mentions *Cycloclypeus* from the Strait of Buton in the Malayan Archipelago and from three other stations in the S.E. part of the Philippines. Brady (1884, p. 752) mentions it from Kandavu, Fiji islands; at the Samoa-group Cushman did not find the species. Carpenter mentioned it from off Borneo. So we can say, that *Cycloclypeus carpenteri* has been found between 115° E. and 185° E. and 10° N. and 20° S., but avoiding precisely the Australian shelf.

The material gathered in 1899, by the Siboga-expedition in the western part of the Banda-sea, that of the Kei-expedition near the Kei islands in the eastern part of the Banda-sea, the material (1899) of Waigeu, showed all the same occurrence of polyembryonism. Cushman too mentions it from Romblom (Philippines) when he says: "At station D 5179 where the species was not so abundant, there are specimens which have a secondary portion due to a secondary outgrowth from near the centre, so the specimens become composed of three most equal portions, one of these, however, usually at a greater angle, so that the original plane of the surface can be seen."

I analysed several specimens with those "secondary outgrowths". It was found, that all were megalospheric and polyembryonic. But when one examines a transverse section through the centre, one becomes aware of the fact that the arrangement of the two embryos

was, in their youth, not the same. It is a well known fact, that in the larger *Camerinidae*, such as *Cycloclypeus*, especially in the megalospheric forms, transverse sections show an inequilateral development of growth. In this way the shell shows a convex and a concave side, though the difference of these two sides is very small. Thus a dorsal and a ventral side have been developed probably due to the influence of gravitation. In respect to the voluminous embryonic apparatus the



b. a.

Fig. 35. *Cycloclypeus carpenteri*. Analysis of the specimens with "secondary outgrowth"; × 38. a: Specimen, treated with acetic acid, showing the two embryos at the base of the outgrowth. The one gives rise to a complete shell, the other only to a half one. b: Section through such an abnormal specimen, showing that the flat part of the complex shell is composed by two individuals, and the secondary outgrowth by a part of one of these individuals.

flange of circular chambers is obliged to hang down, since the animal is lying on the bottom of the sea. In case some embryos fuse with their pseudopodia to form a single plural shell, they are mostly in a state of growth, in which the flanges of circular chambers have not yet developed, as I have noted in my Siboga-report. But we always find in these cases that the flange formed by these associated embryos is bent down in one direction. In all cases, in which a secondary outgrowth is formed, it was found, however, that the embryonic apparates were differently orientated, the one with a ventral face dorsally in respect to that of the other one. So it turns out, that the dorso-ventral difference in the individual must be a character fixed in the individual before the forming of circular chambers takes place, and the dorso-

ventral polarity may be a character of inheritance in *Cycloclypeus carpenteri*. There is some possibility that this character is in correlation with the direction of coiling of the first sets of chambers. For in all cases, when I analysed these shells, I found the three first chambers in the same orientation in plural univalent shells, whereas in bivalent shells with outgrowths the coiling was opposite. But analysis of these bivalent forms taught me something more. In univalent shells, the two or more partners seem to share their portion of the shell equally. But in bivalent forms one partner forms the flatter part, whereas the other forms the part that makes the sharper angles with its neighbouring flanges, having formed nothing but that part, not even interfering in the arrangement of the normally outgrown partner. Only the secondary chalk-growth has been intermingled at the place of the union, the growth of the chambers has not been influenced. These conclusions do not agree with the exact analysis Rhumbler has given of the species *Orbitolites complanata*. In this species it was found that univalent forms with two embryos are only formed in the case that the axes of growth of the individuals do not cut each other. When the axes of growth, however, cut, the shell is always a bivalent one. Older individuals may fuse likewise.

In *Cycloclypeus carpenteri*, however, only embryonic individuals fuse. The fusing is as in *Orbitolites* a frequent one. In most cases univalent individuals are formed. Only when the direction of coiling is not the same (and consequently the dorsal side of the one is the ventral side of the other) bivalent shells arise.

From some stations material has come to hand after the manuscript had been finished. They showed the following species.

Station 62:

Nodosaria obscura Reuss. 1 specimen.
Bolivina Karreriana, var. carinata Millet. 1 specimen.
Nodosaria pyrula d'Orbigny. 1 specimen.
Clavulina tricarinata (Reuss). Some specimens.
Cristellaria tricarinella Reuss. 1 specimen.
Uvigerina tenuistriata Reuss. Some specimens.
Uvigerina aculeata d'Orbigny. 1 specimen.

Siphogenerina raphanus (Parker et Jones). Some specimens.
Anomalina ammonoides (Reuss). 1 specimen.
Spiroloculina grateloupi d'Orb. Some specimens.
Ammodiscus incertus (d'Orbigny). 1 specimen.
Textularia vertebralis Cushman. 5 specimens.
Cyclammina cancellata H. B. Brady. 1 specimen.
Hyperammina elongata H. B. Brady. Frequent.
Lagena striata (d'Orbigny). 1 specimen.
Cristellaria italica (Defrance). 3 specimens.
Textularia trochus d'Orbigny. 3 specimens.
Rectobolivina columellaris (H. B. Brady). Very abundant.
Nodosaria soluta Reuss. Few.
Nodosaria communis d'Orbigny. Some specimens.
Uvigerina pygmaea d'Orbigny. 2 specimens.
Polimorphina soriora Reuss. 1 specimen.
Polymorphina elegantissima Parker et Jones. 1 specimen.
Ramulina globulifera d'Orbigny. 1 specimen.
Several Globigerinidae in large quantities.

The material of this station showed the habitus of a deepsea-ooze, with a very large number of *Globigerinidae*. Most specimens were, however, found in only very few specimens; they therefore were not studied. The station 62 is of a depth of only 290 m., and shows the same aspect of the bottom as the Ammontatura at Naples, as there too the deepsea-sedimentation has been found in a depth of only 250 m. But in both stations the bottom is in a condition of geological movement; it is probable, that this is the reason, why these peculiar bottom-faunas are found here.

Globigerinidae of the Stations 58 and 62.

In the material of the Kei-Expedition only from 2 stations mud has come in the hands of the author. These samples, however, contained a large amount of *Globigerinidae*, most of which were also found at the Philippines by Cushman. I will give here only a list of the species; I intend to give a more detailed analysis of these species in the third part of the Siboga-monograph, which is now being worked out.

Species found at the two stations:

Globigerina bulloides d'Orbigny.
— cretacea d'Orbigny.
conglobata H. B. Brady.

Globigerina sacculifer H. B. Brady.
— aequilateralis H. B. Brady.
Orbulina universa d'Orbigny.
Sphaeroidina dehiscens Parker et Jones.
Pullenia obliquiloculata Parker et Jones.

Explanation of the Plates.

Plate II.

Figs. 1, 2: *Textularia stricta;* × 20.
1: forma B.
2: forma A.
— 3, 4: *Bigenerina nodosaria;* × 44.
3: forma A_1.
4: forma A_2.
— 5—9: *Clavulina Bradyi*, forma A.
5—7, 9: several specimens; × 20.
8: apertural face; × 38.
— 10: *Clavulina tricarinata;* × 20.
— 11, 12: *Textularia immensa;* × 15.
11: side view.
12: apertural face.
— 14: *Clavulina Bradyi;* forma B; × 20.
— 15, 16: *Bigenerina nodosaria;* × 44. Forma B.
15: from St. 64; 16: from St. 7.
— 17, 18: *Quinqueloculina reticulo-striata;* forma A; × 38.
— Å 19: The same, forma A, mouth; × 73.

Plate III.

Figs. 1—4: *Quinqueloculina reticulo-striata*, forma B.
1, 2: small shell; × 38.
3: mouth; × 73.
4: outgrown shell; × 38.
— 5—7: *Quinqueloculina reticulata.*
5: shell of forma A_2; × 38.
6: shell of forma B; × 38.
7: shell of forma A_1; × 38.
— 8—12: *Quinqueloculina bicostata.*
8: forma B; × 38.
9 and 10: forma A; × 38.
11: mouth of A; × 38.
12: mouth of B; × 38.

Figs.13—25: *Quinqueloculina curta.*
13, 14: total shell of forma A_1; × 20.
15, 16: another shell of forma A_1; × 20.
17—19: normal specimen of forma B; × 20.
20: specimen of B, apertural face; × 38.
21, 22: fullgrown specimen of A_2; × 20.
23—25: young shell of A_2× 20.

Plate IV.

Figs. 1—7: *Nodosaria vertebralis*, all specimens from St. 7; × 51.
1—5: Specimens of the A_1-generation, showing 4—8 costae in the early parts.
6: loosened last chamber of A_1, with 10 costae, giving rise to the first chamber of A_2.
7: Forma B, with marginuline type.
— 8—13: *Nodosaria vertebralis*, from other localities.
8: another B-form, initial part only; × 51.
9—11: specimens of forma A_2, enlarged only × 7.
12: total shell of forma A_1; × 7.
13: initial part of the specimen, figured in fig. 12, enlarged × 51.
— 14—15: *Massilina alveoliniformis*, two megalospheric shells; × 27.
— 16—17: *Pulvinulina menardii.*
16: microspheric specimen; ventral side; × 20.
17: megalospheric specimen; ventral side; × 20.

Plate V.

Figs. 1—5: *Cristellaria italica.*
1: microspheric form; × 20.
2: section of the same specimen; × 38.
3 and 4: megalospheric form; × 20.
5: section; × 38.
— 6—7: *Lingulina grandis.*
6: microspheric specimen.
7: megalospheric form. Both × 15.
— 8—9: *Cristellaria costata.*
8: microspheric form; × 15.
9: megalospheric form; × 44.
—10—12: *Gypsina inhaerens.*
10: embryonic apparatus with surrounding chambers, from the ventral side; × 44.
11: colony on coral; × 7.
12: colony on shell; natural size.
—13—16: *Operculina venosa.*
13: B-form, whole shell; × 8.
14: central part of the same; × 20.

15: A_1-form, whole shell; × 20.
16: A_2-form, whole shell; × 20.

Plate VI.

Figs. 1—2: *Operculina heterosteginoides.*
1: forma B; × 26.
2: forma A; × 26.
— 3—5: *Truncatulina praecincta.*
3: forma A_2; dorsal view.
4: forma A_2; ventral view.
5: forma B; ventral view; all × 36.
— 6—7: *Pulvinulina lateralis.*
6: ventral side.
7: dorsal side. Both figures × 36.

Separate copies ready from the press: 25.—II.—1933.

Ligella, a Nomen Nudum.

Correction to

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16. LV. Rhizocephala.

By

H. Boschma (Leiden).

In the paper cited above, which appeared in Vidensk. Medd. fra Dansk naturh. Foren., Bd. 89, 1931, I mentioned the names *Ligella gracilis* and *L. affinis* as hosts of the parasite *Chlorogaster gracilis* (Kr.). In doing this I repeated the error made by Smith in his monograph of the Rhizocephala (1906), who wrote: "*Peltogaster sulcatus*. Hosts, *Pagurus cuanensis* and *chiracanthus* from Danish and Norwegian Seas, and *Ligella gracilis* and *affinis* from Valparaiso" (p. 109). In his studies on the Rhizocephala Smith has made use of the material of the Copenhagen Zoological Museum, the statement quoted here refers therefore to the material which I have examined afterwards. This material consists of three small vials, each with a few parasites detached from their hosts. The labels in these vials read as follows:

Ligella gracilis Kr. mit entwick. Embryonen. E Paguro forcipe? Valparaiso Marts 1841.

Ligella gracilis mit ausgebildeten Embryonen. In Paguro forcipe? Callao April 1841.

Ligella affinis Kr. E Paguro forcipe. Valparaiso.

Undoubtedly these specimens are, at least partially, the identical ones to which Krøyer refers in his paper in Overs. K. Dansk. Vidensk. Selsk. Forh. of 1855, in which he mentions specimens of *Peltogaster gracilis* from Chili. In some of these parasites the mantle cavity contains larvae, a fact also recorded by Krøyer.

When reading the labels of the material it is evident that *Ligella* is meant as the name of the parasite, and that *Pagurus forceps* is given as the name of the hosts of the parasites. In compiling the data of the

material in my paper cited above I must have acted under the influence of Smith's statements in regarding the name *Ligella* as that of the hosts of the parasites.

Dr. Waldo L. Schmitt directed my attention to the fact that the name *Ligella* is unknown in carcinological literature. The error was detected by Dr. Mary J. Rathbun in the course of her editorial work on crustacean papers. After I had received Dr. Schmitt's letter I wrote to Dr. K. Stephensen to ascertain whether more data on the genus *Ligella* could be found in the catalogues of the Copenhagen Museum. In his answer Dr. Stephensen wrote me that in all probability the name *Ligella* is a nomen nudum, as among the crustacean material of the Copenhagen Museum there are several cases of specimens which had been named by Krøyer, but which never have been described in literature. The hosts of the parasites, however, still are present among the material of the Copenhagen Museum, and Dr. Stephensen had the kindness to send these to Professor H. Balss for identification. These hosts belong to the species *Eupagurus forceps* (M.-Edw.), so that Krøyer's identification of the hermit crabs was correct.

In all probability Krøyer had the intention to describe the parasites of *Eupagurus forceps* as *Ligella gracilis* and *L. affinis*, and therefore he provisionally put these names on the labels. In Krøyer's papers dealing with Rhizocephala only the name *Peltogaster gracilis* is mentioned for the animals dealt with here, so that the species has to keep this name, which in recent time has been changed into *Chlorogaster gracilis*, as the parasites belong to the small gregarious forms of the old genus *Peltogaster*.

The specimens labelled *Ligella affinis* do not differ in any respect from those to which the name *L. gracilis* has been given. Moreover they bear a strong likeness to the european species *Chlorogaster sulcatus* (Lillj.), but the specimens do not afford sufficient characteristics for deciding whether *C. sulcatus* should be united with *C. gracilis* or not.

The name *Ligella* being merely a nomen nudum it is not necessary to mention in future this name in the synonymy of the genus.

Finally I want to express my thanks to all the investigators mentioned above for the part they have taken to elucidate this question.

Separate copies ready from the press 25. IV. 1933.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LXIII.

Biological Observations on Ophiurids, with Descriptions of two New Genera and four New Species.

By

Th. Mortensen.

(With Plate VII.)

Of the very extensive material of Ophiurids, which I have collected during my various expeditions, mainly to the Indo-Pacific region, quite a considerable part has been reported on in the series "Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16", viz. in No. XX (Vid. Medd. Dansk Naturh. Foren., Bd. 77, 1924) the Ophiuroidea of New Zealand and the Auckland-Campbell Islands, by the present author, in No. LIV (Vid. Medd. Bd. 89, 1930) those from Australia and the Malay Archipelago by R. Koehler, in No. LIX (Vid. Medd. Bd. 91, 1931) those from the American West Coast by Eigil Nielsen, whereas I have treated the Euryalids in the paper "Studies on Indo-Pacific Euryalids" (in Vid. Medd. Bd. 96, 1933). The material collected on my expedition in 1929—30 at S. Africa and at St. Helena has been worked out and will be published shortly. There is, however, still a considerable amount of material from the Japanese and Hawaiian Seas, the Bali Sea, and Mauritius, which has not been dealt with. Prospects of having this material worked up in a near future are very small, as all my working power from now on will be claimed by work on my Monograph of the Echinoidea. I have, therefore, thought it preferable to publish separately some biological observations relating to these collections, which seem to me of more general interest. In

"Paper" No. LX (Vid. Medd. Bd. 93, 1931) "On an extraordinary Ophiurid, *Ophiocanops fugiens* Koehler, with Notes on Ophiopteron, Astrogymnotes, and on an Albino Ophiocoma", some such observations were given. In the present paper I shall give some more observations, including descriptions of various new forms, viz.:

I. On a new symbiotic Ophiurid, *Nannophiura lagani* n. g., n. sp.
II. A new self-dividing Amphiurid, *Amphiodia dividua* n. sp.
III. An extraordinary mode of copulation among Ophiurids; with description of *Amphilycus androphorus* n. g., n. sp.
IV. Some new cases of viviparity among Ophiurids; with description of *Ophionereis vivipara* n. sp.

I. A new symbiotic Ophiurid, *Nannophiura lagani* n. g., n. sp.

During the investigations carried out in the Java Sea and the Sunda Strait in July—August 1922 (The Danish Expedition to the Kei Islands 1922) I found on a large specimen of a *Laganum* (which may, for the present at least, be designated as *Laganum depressum* L. Agassiz) some specimens of a very small Ophiurid, living on the underside of the sea-urchin, between its spines. The brittle-star was moving with great agility between the spines — like a monkey in the trees of a tropical forest — winding its arms round the spines; it was quite difficult to remove the Ophiurid from the spines without injuring it. I observed that particularly the ends of the arms of the brittle-star were exceedingly movable, recalling a monkey's prehensile tail, and in good accordance herewith the microscopical examination revealed the fact that the distal part of the arms is broad and flattened and the spines partly transformed into hooks (fig. 2 d—e), a very fine adaptation to this, so to speak, arboreal life. The prehensile distal part of the arms rolls up towards the dorsal side. When removed from the sea-urchins the brittle-stars were crawling along the sides of the dish; the tubefeet of this species thus, evidently, must be very adhesive, though they are quite short.

The specimens preserved in situ on the sea-urchin are, all of them, sitting mouth downwards, thus turning away from the sea-urchin. It is evident, therefore, that the Ophiurid does not seek its food on the skin of the Echinoid like a parasite; probably it merely seeks

shelter here on the underside of the large, flat Echinoid, its food apparently consisting only in detritus, whirled up by the ciliary currents produced by the skin on test and spines of the sea-urchin.

This is the smallest of all Ophiurids hitherto known, a real pygmy, of microscopical size, the disk being only ca. 0.5 mm in diameter. That this is really the full size of the species may safely be concluded from the fact that none of the more than 30 specimens preserved exceed that size. — Another epizoic Ophiurid, likewise of very small size, was described by Döderlein (Über einige epizoisch lebende Ophiuroidea. Semon's Forschungsreisen. Jen. Denkschr. VIII. 1898. p. 486. Taf. XXXVII. 4—4b) under the name of *Ophiophthirius actinometræ*, found living on the cirri of a Comatulid from Amboina (*Actinometra solaris* — now *Comatula solaris* Lamk.). It is, however, somewhat larger, 0.7—0.8 mm in diameter of disk.

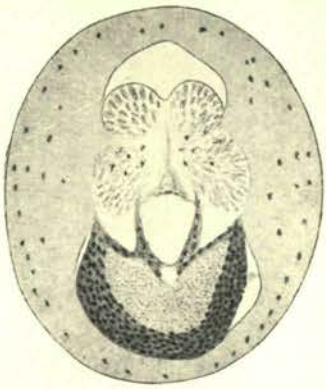


Fig. 1. Transverse section of arm of *Nannophiura lagani* n. sp., showing the enormous development of the radial nerve. The histological details otherwise not very distinct in the section. × 350.

I expected beforehand to find this curious brittle-star to be either viviparous or to propagate through autotomy. Neither is, however, actually the case. The fact that all the specimens have only 5 equally developed arms at once shows that it does not practise autotomy; that it is not viviparous is shown by the anatomical investigation — not one of the several specimens, opened directly or sectioned, contains young ones, as also the fact that the species has no bursæ would be rather incompatible with viviparity. I was, however, rather astonished to be unable to discover, either directly or on the sections, any trace of gonads. This must mean that July—August was not its breeding season. By the very small size of the species it is quite intelligible that no traces of the gonads can be found outside the breeding season; it is quite possible, indeed, that the gonads are only found when the breeding season begins, not existing outside that season.

An interesting fact was observed on the sections, viz. that the radial nerves are exceedingly strongly developed (textfig. 1; Pl. VII.

fig. 1), in accordance with the special adaptation of the arms as prehensile organs.

This interesting little Ophiurid represents a new genus, which I shall name:

Nannophiura n. g.

This genus is characterized by its disk covering being made up only of the large primary plates, a central and five radial plates; in the edge between the latter a single marginal plate. Edge of disk high, vertical, there being no real ventral interradii. No genital slits. Mouth papillæ rather rudimentary, but of the Amphiurid type. Ventral and dorsal arm plates well developed. No tentacle scales beyond the first. In distal part of arms the spines partly transformed into hooks.

Genotype: *Nannophiura lagani* n. sp.

Nannophiura lagani n. sp.

Diameter of disk scarcely exceeding 0.5 mm; arms ca. 3 mm long. Mouth papillæ only rather indistinctly developed; still, it seems beyond doubt that they are of the Amphiurid type, there being a pair of small infradental papillæ and a somewhat larger outer papilla, the latter joining the rather conspicuous, elongate scale on the abradial side of the first tentacle pore. The jaws are slightly sunken. Adoral shields well developed, joining proximally; in the angle between them is seen the small triangular buccal shield, outside which is seen the outline of the marginal plate. Examining the disk from the edge, which is rather high, vertical, one sees that the buccal shield is bending over, continuing half way to the dorsal side, towards the marginal plate of the dorsal side, which, however, it does not reach, a small plate being intercalated between them (fig. 2c); this little plate is all that is left of the ventral interradii. Genital slits absent — as also proved by the sections.

The first ventral plate is rather large, triangular; the following ones all widely separated, with an angle proximally, the sides straight and the outer edge distinctly convex; they are distinctly longer than broad. No trace of a tentacle scale beyond the first pore; tubefeet, however, are present and distinguishable almost to the end of the arms. The dorsal armplates are well developed, widely separated, with an obtuse inner angle, sides straight and distal edge convex; they are

about equally broad and long, occupying the whole width of the arm. The lateral plates are slightly swollen distally, carrying three short spines of rather clumsy shape. In the distal part of the arms the middle one is transformed into a much curved hook (fig. 2 d, e).

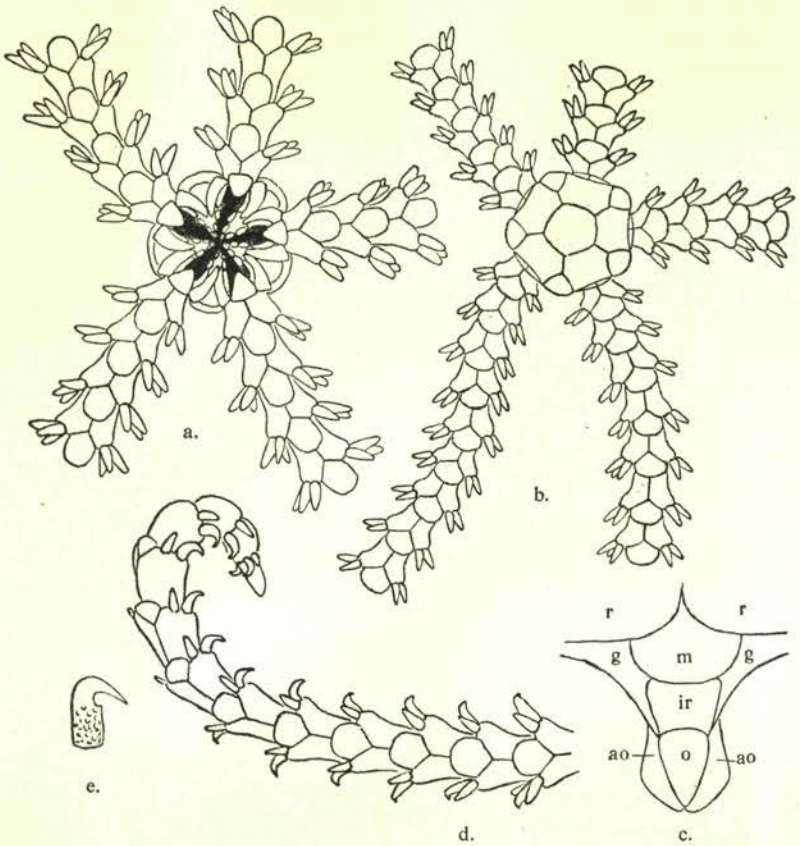


Fig. 2. *Nannophiura lagani* n. sp. Oral (a) and aboral side (b). × 30. Side view of disk, in an interradius (c). × 125. ao. — adoral plate; g. — genital scale; ir. — interradial plate; m. — marginal plate; o. — buccal shield; r. — radial plate. Distal part of arm, from the ventral side, curving upwards (d). × 50. Hook (e). × 125.

Dorsal side of disk wholly occupied by a rosette of primary plates, viz. a rounded-pentagonal central plate and 5 hexagonal radial plates; in the corner between each two radials is a triangular marginal plate, which curves downwards to meet the buccal shield. There is no trace of radial shields; a pair of very small plates situated above the base of the arms appear to represent the genital scales (fig. 2 c, g).

Colour in life yellowish white.

Besides in the above-mentioned locality in the Sunda Strait (105°34′ E., 5°57′ S., 31 meters) a very large specimen of the same *Laganum* carrying several specimens of the Ophiurid among its spines was found in another locality in the Sunda Strait (105°34′ E., 5°53′ S., 25 meters). On a third, smaller specimen of the same *Laganum*, from 105°44′ E., 6°8′ S., 29 meters, none of the Ophiurids are found.

Concerning the affinities of this remarkable little Ophiuran there is some uncertainty; but the arrangement of its mouth papillæ indicate it to be an Amphiurid. The character of its disk-covering somewhat recalls the *Ophiophthirius* of Döderlein mentioned above, to which it has, however, quite evidently no nearer relation, the latter being an Ophiothrichid, whereas *Nannophiura* has all the appearances of being an Amphiurid. The strong reduction of disk-covering found in both these epizoic forms is no doubt a consequence of the reduction in size, not directly of their mode of life.

II. On a new self-dividing Amphiurid, *Amphiodia dividua* n. sp.

In the lagoon inside the coral reef at Cannoniers Point, Mauritius, wide areas of very shallow depth, lying dry at low tide, are covered by small green algæ, their threads inextricably interwoven so as to form a very close carpet, which retains the water like a sponge; the specimens living in this carpet thus are not in danger of drying up during low tide. In this carpet a characteristic biocoenosis is found, of numerous small Synaptids (*Chiridota*), Enteropneusts (*Ptychodera flava* Eschscholtz), Planarians, Nemerteans, Annelids, and three species of small Ophiurids, two of them, *Amphipholis squamata* and the *Ophionereis vivipara* described below, being viviparous, the third, *Amphiodia dividua*, propagating through autotomy. It lies at hand to suggest that the peculiar habitat of these Ophiurans has some connection with their mode of propagation. It must be pointed out, however, that the *Chiridota* living under these same circumstances is not viviparous.

Within the large family of the Amphiurids (— not counting the Ophiactids, which H. L. Clark and Koehler, erroneously in my opinion, include in the Amphiurid family —) propagation through

autotomy has never been recorded hitherto. It would seem, however, that the *Amphiura sexradiata* described by Koehler in his memoir "Ophiures rec. par le Dr. Th. Mortensen dans les mers d'Australie et dans l'Archipel Malais" (Papers from Dr. Th. Mortensen's Pacific Exped. 1914—16. LIV. Vid. Medd. Dansk Naturh. Foren. 89. 1930. p. 100, Pl. XVIII. 1—2) is likewise self-dividing (Koehler does not say anything about it, remarking only that three of the arms are smaller than the three others). In my forthcoming report on the "Ingolf" Ophiurids it is shown that *Amphipholis Torelli* Ljungm. propagates through self-division (besides being, apparently, also viviparous). These are the only cases known, so that propagation through self-division, as well as the existence of 6 arms, is, at any rate, very exceptional within the family of the Amphiurids. The species here described is therefore of considerable interest, the more so as it offers some other unusual features also.

Diameter of disk scarcely exceeding 2 mm, arms up to 25 mm long, fairly robust. The infradental papillæ are rather large, distinctly larger than the lateral mouth papillæ, which are usually erect (more so than shown in the figure). Buccal shields elongate-oval, distinctly longer than broad, rounded within, but with a nearly straight outer edge. Adoral shields well developed, joining proximally, and with a distinct outer lobe separating the first lateral plate from the buccal shield. First ventral plate rather large, hexagonal, about as broad as long; the following ones distinctly longer than broad, merely contiguous, with an acute inner angle and the distal edge strongly convex. Two small tentacle scales. Dorsal armplates rounded triangular, broader than long, occupying the whole breadth of the arm; they are rather broadly contiguous in the proximal part of the arm, farther out merely touching each other and being quite semilunar in shape (fig. 3 c). Three short, equal-sized, somewhat flattened arm spines, none of them hook-shaped in the distal part of the arms. Disk covered, on both sides, by very uniform, small, but distinct scales, of the same size all over, there being no trace of primary plates. The disk covering has a distinctly shining appearance, due to the fact that the scales are quite thin, simply perforate plates, not consisting of a complicated meshwork as is the usual structure of disk scales in Ophiuroids. The radial shields are very narrow, elongate, contiguous in their whole length; they are nearly half the length of the disk radius. Outside

each radial shield there is a prominence terminating in two or three hyaline thorns. — Colour of the live, as well as of the preserved specimens, a pure white.

The species was by no means as common as the two other abovementioned Ophiurids occurring in the locality described; in all only some 6 specimens were found.

The nearest relation of the present species is the *Amphiodia digitula*

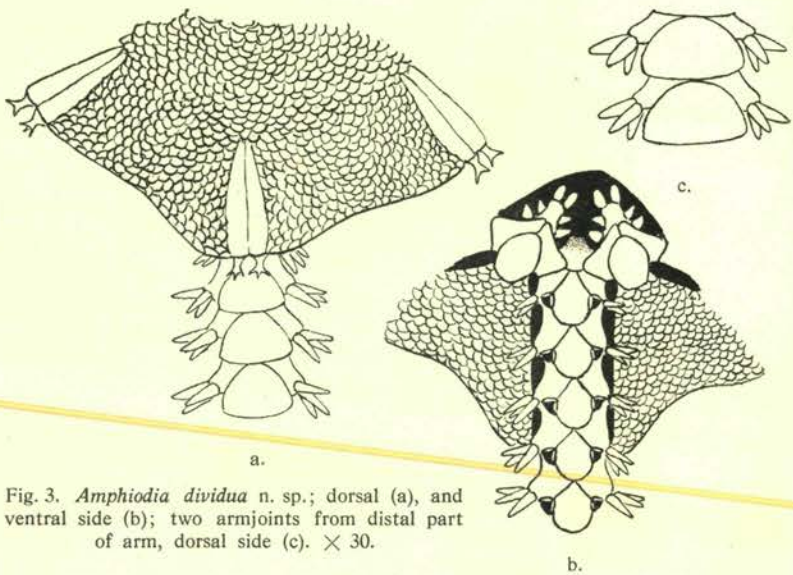


Fig. 3. *Amphiodia dividua* n. sp.; dorsal (a), and ventral side (b); two armjoints from distal part of arm, dorsal side (c). × 30.

from Japanese Seas, described by H. L. Clark in his "North Pacific Ophiurans", p. 162, fig. 70; in this latter species there is a similar thorny process outside each radial shield, a character not known in any other species of *Amphiodia* (whereas something similar is found in the species *Amphioplus pectinatus* described in my report on the S. African Ophiurids). Apart from this single character *Amphiodia digitula* differs very strikingly from the Mauritian species, so that the relation between these two species is by no means close.

III. An extraordinary mode of copulation in Ophiurids; with description of *Amphilycus androphorus* n. g., n. sp.

In his memoir on the Ophiurans of the Australian and Malayan seas, quoted above, Koehler describes a peculiar new form, *Ophio-*

daphne materna, which carries a young one on its oral side, mouth against mouth, the arms of the adult and the young alternating (cf. Op. cit. p. 129, Pl. XVI. 3—8). He found the same to be the case with *Ophiosphæra insignis* Brock (Op. cit. p. 128, Pl. XVI. 13; XVII. 4).

From the fact that they carry their young in this way, Koehler very naturally concludes that both of these Ophiurids are viviparous. This conclusion, however, is not based on actual observation of the embryos lying within the mother specimen, no specimen having been opened by Koehler. The specimens examined by Koehler had all been dried and thus were not very fit for anatomical study, but, fortunately, I had retained one specimen of each of the species, and these two specimens could be used for anatomy. They gave the proof that both species are not at all viviparous. Both specimens are females, and both contain large ovaries with a great number of quite small eggs. Both species accordingly must have free swimming embryos — whether of typical *Ophiopluteus*-shape is, of course, impossible to ascertain. But that the embryos are free swimming must be regarded as an indisputable fact — and this fact leads to the remarkable, but no less certain, conclusion that there would be no certainty at all that the young ones, which specimens of the two said species carry on their mouths, are their own brood; on the contrary, there is overwhelming probability that they are not their own young ones. Any adult specimen which the metamorphosed young one happens to meet would thus be adopted as its stepmother. A somewhat analogous case would be that of young ones being not infrequently found attached to the arms of the adults of other Ophiurans, e.g. *Ophiothrix fragilis* and *Ophiopholis aculeata* (cf. my forthcoming report on the "Ingolf" Ophiuroidea); but in *Ophiosphæra* and *Ophiodaphne* it has evidently become a normal condition, and in all the specimens the small specimen is found attached, as said above, over the mouth of the adult, the specimens turning mouth against mouth.

It is of interest to note that in two cases I have found *Ophiosphæra* epizoic on Echinoids, viz. on *Toxopneustes pileolus* (Gulf of Siam, II. 1900) and on *Diadema setosum* (Amboina, II. 1922). In the first case I noticed that the Ophiurid was found with its mouth side turning away from the test of the sea-urchin. Also with the specimens found on *Diadema* this seems to have been the case; I noticed the fact that the young one is white, contrasting thus very strongly with the adult

which is black, also on the oral side and along the underside of the arms. Both in *Ophiosphæra* and *Ophiodaphne* the arm spines in the distal part of the arms are transformed into hooks.

During a short stay in Lourenzo Marquez (Delagoa Bay, Portuguese East Africa) in the beginning of September 1929, on the way from Durban to Mauritius, I paid a visit to Polana Beach, the famous bathing

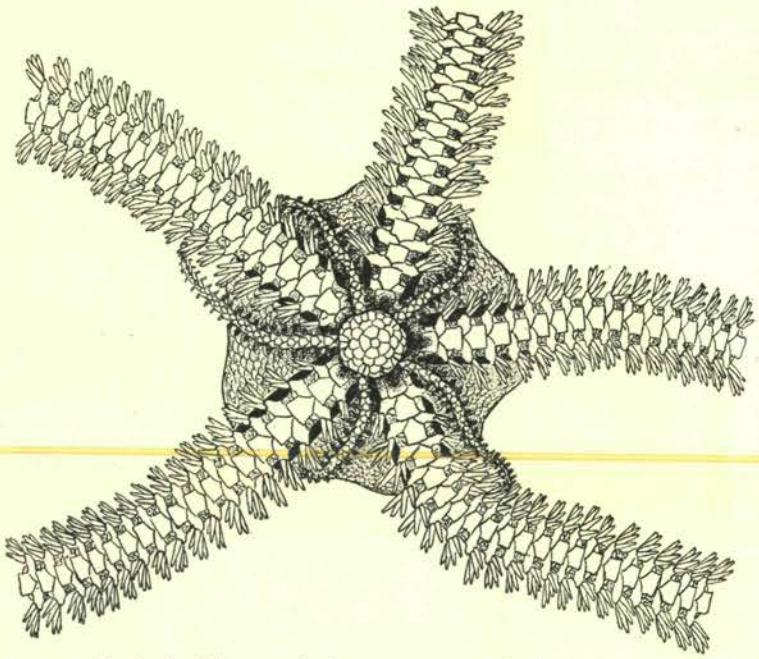


Fig. 4. *Amphilycus androphorus* n. g., n. sp. Oral side. × 12.

resort. On the immense areas of flat, sandy ebb-strand lying dry at low tide a very interesting fauna exists, a biocoenosis of species adapted in various ways to life under such conditions. Among these was particularly the flat Echinoid *Echinodiscus bisperforatus* Leske, usually wholly covered with sand, but the place where it was hidden being recognizable by two depressions in the sand, corresponding to the slits in its test. On picking up the sea-urchins, I found almost invariably on their underside some small Ophiurids which, like *Ophiosphæra* and *Ophiodaphne*, were carrying a small one over their mouth, the latter being without exception so placed that its arms alternated with those of the adult (fig. 4), and always with its mouth against

the mouth of the latter. The adult Ophiuran, on the other hand, was always found with its mouth side turning downwards, away from the sea-urchin. The Ophiurids were usually found attached near the slits of the sea-urchin, more rarely near its mouth; they were clinging rather tightly to the sea-urchin, not letting go their hold when the sea-urchin was washed to get rid of the sand. Here again, as is the case with *Nannophiura*, the Ophiurid mainly seeks shelter under the sea-urchin, not taking its food from the sea-urchin; it must feed mainly on the detritus whirled up by the ciliary currents produced by the skin and spines of the sea-urchin.

On finding this interesting little Ophiurid I very naturally thought — as did Koehler in the cases of *Ophiosphæra insignis* and *Ophiodaphne materna* — that it must be viviparous. The anatomical study of it proved, however, that, like the two other above mentioned Ophiurids, which carry their young in the same way, it is not viviparous. In all the ca. 20 specimens examined I find the ovaries to contain a fairly large number of eggs of moderate size, whereas not one of the specimens contains embryos.

The fact that the species is not viviparous leads to the conclusion that — as in *Ophiosphæra* and *Ophiodaphne* — there must be a stage in which the embryo is free-swimming, be it now that its development is direct or that it passes through a pelagic larval-stage. In either case there would be no certainty at all that the young one could really be the offspring of that specimen to which it ultimately attached itself — so that in these three species it would be customary for the adult to nurse any child that found its way to it, be the child its own or that of other parents.

The extraordinary fact, however, was that all the ca. 20 specimens at hand proved to be females. This would seem to indicate that this species might perhaps be parthenogenetic — or that, perhaps, the small specimen carried by each adult were not the young one, but the male! This idea, that the small specimen might be the male, and that we would have here, not a case of brood-protection, but a case of copulation, must, of course, seem exceedingly improbable beforehand — copulation being otherwise unknown among Echinoderms, excepting alone the seastars *Archaster typicus* M.Tr. and *Archaster angulatus* M.Tr., in which a sort of copulation takes place, the male lying on the dorsal side of the female, placed so that their arms alter-

nate, as observed first by Boschma[1]) for *A. typicus* and later on by myself for *A. angulatus*[2]).

By the very small size of the young specimen — they do not exceed 1 mm in diameter of disk — direct anatomical examination would offer some difficulty, so I decided to have the question examined by means of sections.

The sections (— which Mr. I. Lieberkind very kindly undertook to make for me —) showed the idea, though ever so extraordinary, that the young ones might in reality be the males, to come true.

The small specimens carried over their mouths by the adult specimens are the males. We have thus here a most extraordinary case of copulation, hitherto entirely unknown in Ophiurids, and differing from the only other known case of copulation among Echinoderms, that of *Archaster*, in being not temporary as in the said seastar, but constant — a continuous erotic embrace, the female, evidently, carrying its male throughout life, as may be concluded from the fact that all the specimens found had a male attached to it; also the youngest specimen, only 2 mm diameter of disk (— the largest size found is 5 mm diameter of disk —), has its male attached to it in the usual way.

After having thus ascertained, by means of sections, that the supposed young one is in reality the male, I also tried, by direct anatomical observation to ascertain the male character of the small specimens. It proved to offer no particular difficulty — a pair of male gonads, full of sperm, being found to occupy each interradius, causing it to protrude quite conspicuously so that the outline of the disk of the male is distinctly sinuate, very different from the circular outline of the female (textfig. 5; Pl. VII. fig. 2).

[1]) H. Boschma. Über einen Fall von Kopulation bei einer Asteride (*Archaster typicus*). Zool. Anz. Bd. LVIII. 1923.

[2]) Th. Mortensen. Contributions to the study of the Development and Larval forms of Echinoderms. I—II. Mem. Ac. Copenhague. 1931. 9. Ser. IV. p. 28.

F. Jeffr. Bell (Proc. Zool. Soc. London, 1901, p. 276) has suggested that the clinging together of two specimens of *Astrophyton* (*Astroboa*) *clavatum* observed by him might be a sort of copulation. This is entirely without foundation. Gorgonocephalids, where living together in numbers, as is very often the case, cling to each other as to any other object — Gorgonids or the like — to which they can attach themselves. (Cf. my paper, "Observations on some Echinoderms from the Trondhjem Fjord". Kgl. Norske Vidensk. Selskab. 1923. 3. p. 15).

Having ascertained thus that the apparent young ones of this brittle-star from Polana Beach (— described below under the name of *Amphilycus androphorus* n. g., n. sp. —) are in reality the males, I very naturally expected that the same might be the case with *Ophiosphæra insignis* and *Ophiodaphne materna*, since I had already found that these two were not viviparous either. My expectation came true — in these two species also the supposed young ones are

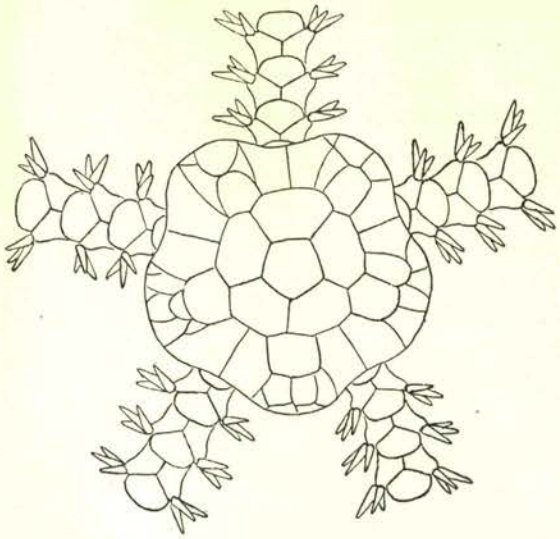


Fig. 5. *Amphilycus androphorus*, male specimen; dorsal side. × 40.

the males, the interradii being filled up by a pair of testes, full of spermatozoa. The species-name "*materna*" given by Koehler to *Ophiodaphne* is thus not very appropriate, the species, so far from being an affectionate mother nursing its young in a self-sacrificing manner, being a passionate mistress living in continuous close embrace with its male lover, and leaving its brood wholly to take care of itself.

Thus all these three cases of supposed brood-protection have turned out to be cases of copulation, the small male being carried by the much larger female in exactly the same way, its mouth against the mouth of the female, and their arms alternating. At the same time we have here a very conspicuous sexual dimorphism, both in regard to size — the male being really a pygmy in comparison with the female — and shape (see description below), likewise very

rarely met with in Echinoderms, and not at all known hitherto in Ophiurids. It is true, Studer (Über Geschlechtsdimorphismus bei Echinodermen. Zool. Anzeiger. 1880) describes sexual dimorphism in *Ophionotus hexactis* (E. A. Smith), and Koehler (Revision de la Collection des Ophiures du Mus. d'hist. nat. Paris. Bull. Sci. France & Belgique. XLI. 1904, p. 322) suggests that sexual dimorphism exists also in *Ophiacantha vivipara* Ljungm. But both these statements are erroneous (cf. my paper "On Hermaphroditism in viviparous Ophiurids". Acta Zool. I. 1920. p. 11 and 16). — The difference in colour between the male and female specimens of *Ophiothrix Petersi* Studer referred to by Studer (Op. cit.) as a possible sexual dimorphism can scarcely be recognized as a true sexual dimorphism — at most as a difference in colour between males and females, if the difference in the colour of the arms noted by Studer be really constant. That the colour of the ripe male and female gonads, seen through the thin skin, is different, is, of course, a simple consequence of one containing sperm, the other eggs, and to call this sexual dimorphism is nonsense.

One cannot help wondering how the specimens can feed, the male thus covering the mouth of the female, and with its mouth turned towards the mouth of the female. Evidently this offers no difficulty, however, to these brittle-stars. The fact which I observed already in 1900 on the specimen of *Ophiosphæra insignis* found on *Toxopneustes pileolus*, that it was turning its mouth away from the surface of the sea-urchin, must lead to the suggestion that it would feed on detritus only, whirled into the mouth by the ciliary currents of its (or the sea-urchin's) skin. There is room enough for such currents to enter the mouth of the brittle-star. In *Ophiosphæra* and *Ophiodaphne* the arm-spines are more or less erect, so that the mouth openings of the two specimens are not directly in contact; in *Amphilycus androphorus* the jaws and adoral shields of the female are conspicuously sunken along the midline so as to form a channel leading to its mouth; but here also the male does not sit to tightly that its mouth directly touches the mouth of the female — often it is also placed slightly excentrically. The little food required by the pygmy male it can evidently also get by means of the ciliary currents — the idea that it might seek its food from the female as a parasite is, however, perhaps not directly to be discarded, since sections (Pl. VII. fig. 2) show its oesophagus to be remarkably muscular, suggesting that it may act as a sort of sucking pump. Its stomach is well developed.

The affinities of this Ophiurid of Polana Beach are not very clear. The characters of the dorsal side of the female recall some species of *Amphipholis*, e. g. *Amph. violacea* (Lütken), but the mouth papillæ are not very clearly of Amphiurid character, the infradental papillæ being poorly developed, often unequal or even only one of them present. I think it probable that it is a somewhat modified Amphiurid, the irregularity in its mouth papillæ being due to its being only a detritus eater. That it must be made the type of a new genus I think indisputable; I shall name it:

Amphilycus n. g.[1])

Mouth papillæ three to each side of jaw, recalling *Amphipholis*, but with finely serrate edges, and the infradental papillæ usually unequally developed. The jaws sunken along the midline. Armspines transformed into hooks in the distal part of the arms. Dimorphic, the male being much smaller than the female and differing in shape from the latter.

Genotype:

Amphilycus androphorus n. sp.

Diameter of disk up to 5 mm, its outline circular, arms ca. 4 times the diameter of the disk. Mouth papillæ usually somewhat irregular; the infradental papillæ are often unequally developed, sometimes only one of them distinct; only rarely are they found so distinctly developed as shown in the figure, but I think this is to be regarded as the typical condition. The outer mouth papilla is very broad, with the edge unsharp, like ciliated; the middle papilla is small and usually not distinctly limited against the outer one; but here again I think that the condition shown in the figure is the typical one, the mouth papillæ being thus of the *Amphipholis*-type. The buccal shields are small, rhomboidal, with a more or less pronounced distal lobe; the adoral plates are very broad, without a distal lobe. They are, together with the jaws, conspicuously sunken along the midline, the arms rising distinctly above the level of the mouth angles. First ventral plate broad, sloping rather abruptly down into the mouth-slit; the following ventral plates subquadrangular, with a very obtuse angle within; the proximal ones more or less distinctly contiguous, farther out they are more or less

[1]) ὁ λύκος — the hook.

widely separated. Only one, large tentacle scale. Dorsal armplates broad, semilunar, merely in contact or narrowly separated in the

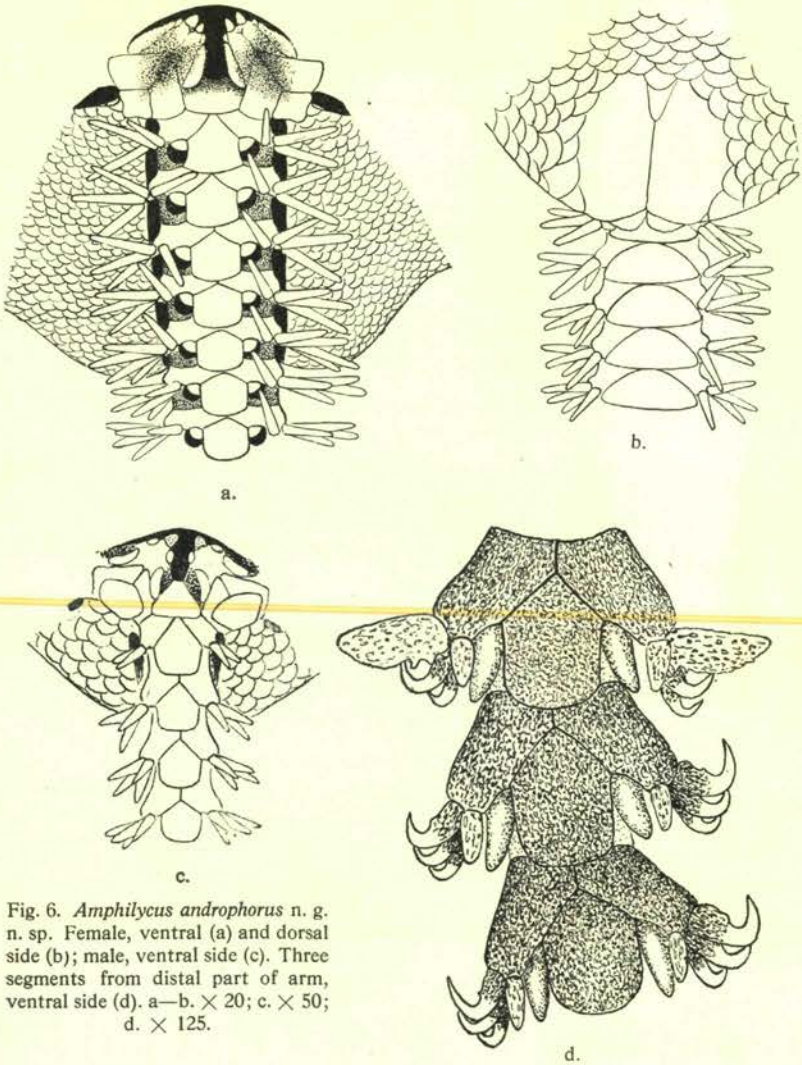


Fig. 6. *Amphilycus androphorus* n. g. n. sp. Female, ventral (a) and dorsal side (b); male, ventral side (c). Three segments from distal part of arm, ventral side (d). a—b. × 20; c. × 50; d. × 125.

basal part of the arm; they occupy nearly the whole width of the arm. 5 rather long, simply cylindrical armspines. In the distal part of the arms the spines (here only 4) are partly transformed; whereas the

lowermost spine remains simple, the second from below assumes the shape first of a broad plate, then of a hook; also the two uppermost spines are transformed into hooks. There are thus in the distalmost part of the arms 3 hooks to each lateral plate (fig. 6 d) — an excellent adaptation to the mode of life of the brittle-star. It is very noteworthy that the radial nerve is very strongly developed in the distal part of the arm, forming a large ganglion in each segment, much as is the case in *Nannophiura lagani*. The tentacle scale is not developed in the distal part of the arm.

The disk is covered with scales of moderate size, among which the rosette of the 6 primary plates remains fairly distinct; also along each interradial midline the scales are slightly enlarged, whereas those around the radial shields are not enlarged. The radial shields are contiguous, except at the proximal end, where a scale is wedged in between them; they are rather broad and quite conspicuous, almost half as long as the disk radius. The ventral interradii covered all over with uniform scales somewhat smaller than those of the dorsal side.

The colour of the live specimens was, on the oral side, a reddish purple quite like that of the Echinoid; on the dorsal side the colour was grayish-blue. In the preserved specimens (alcohol, dry) the colour has completely disappeared.

On some of the specimens a semi-parasitic *Eulima* was found.

The male (figs. 5, 6 d), which does not reach a larger size than 1 mm diameter of disk, differs very conspicuously from the female in several features. The mouth papillæ are very small, except the outermost one, which is broad and represents the tentacle scale of the first tubefoot. It does seem, however, that in the male, too, the mouth papillæ are in reality of the *Amphipholis* type. The buccal shields differ very conspicuously from those of the female, being about twice as broad as long and with a rounded proximal and a straight distal side. The ventral armplates are, in the main, like those of the female, but then there is no tentacle scale. The dorsal armplates differ rather conspicuously in shape from those of the female and are distinctly separate. Arm spines 4; the distal joints have only 3, then 2 spines, one of them transformed into a hook.

It is quite evident that the male resembles *Nannophiura* in several features. I think it probable that this is due in the main to both being

so small, partly also to affinity, both being Amphiurids, and partly to similar habit, both being epizoic.

IV. Some new viviparous Ophiurids; with description of *Ophionereis vivipara* n. sp.

In my paper "On hermaphroditism in viviparous Ophiurids" (Acta Zoologica. I. 1920) I raised the number of truly viviparous Ophiurids from 9, as recorded by Ludwig in his paper "Brutpflege bei Echinodermen" (Zool. Jahrbücher. Suppl. VII. 1908)[1]), to 20. Out of these 20 species no less than 16 were shown to be hermaphroditic, whereas up to that time only one species of Ophiurids was known to be hermaphroditic, viz. *Amphipholis squamata.*

Since the publication of that paper a few more Ophiurids have been shown to be viviparous. H. L. Clark in his report on the Echinoderm Fauna of South Africa (Annals S. African Museum. XIII. 1923. p. 324) states *Ophiomitrella corynephora* H. L. Clark to be viviparous. He has not investigated its sexual characters; I find, however, this species to be also a proterandric hermaphrodite (cf. my forthcoming report on the S. African Echinoderms)[2]). In my report on the Echinoderms of New Zealand and the Auckland-Campbell Islands II. Ophiuroidea (Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16. XX. Vid. Medd. Dansk Naturh. Foren. Bd. 77) I have shown *Ophiomyxa brevirima* H. L. Clark to be viviparous, but not hermaphroditic, and *Amphiura annulifera* Mrtsn. to be viviparous and hermaphroditic. In an Appendix to Parts III—V of the Echinoderms of New Zealand and the Auckland-Campbell Islands (Papers from Dr. Th. Mortensen's Pacific Exped. XXIX. Vid. Medd. Dansk Naturhist. Foren. Bd. 79. 1925. p. 391) attention is called to the fact that Farquhar already in 1898 had discovered this *Ophiomyxa*, as also *Pectinura cylindrica* (Hutton), to be viviparous. It is further

[1]) Ludwig lists 12 species as viviparous, but three of them are shown to be not truly viviparous, young ones being only occasionally, by mere chance, found attached to them.

[2]) In the same report Clark suggests (p. 318) that also *Gorgonocephalus "chilensis"* (i. e. *G. pectinatus* Mrtsn.) is viviparous, since he has found young specimens attached to the disk of the adult. That this has nothing to do with viviparity is quite certain, as shown by the facts recorded in my paper "Observations on some Echinoderms from the Trondhjem Fjord" (Kgl. Norske Vidensk. Selsk. Skrifter 1923. 3. p. 13—16).

of the type where the nuclei lie scattered irregularly all through the yolk. The young ones are found in various stages of development in the same specimen, and only few at a time. This evidently means that the breeding goes on without interruption.

This is the first viviparous species of the genus *Ophionereis* made known. That it is also a tropical species is noteworthy, viviparous forms being not very common among tropical Ophiurids of the littoral

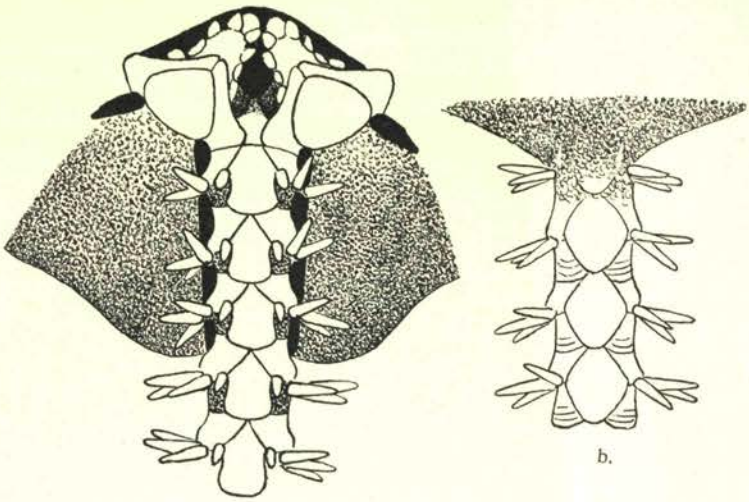


Fig. 7. *Ophioneris vivipara* n. sp. Oral (a) and dorsal side (b). × 30.

region; as a matter of fact, this is only the fourth such species made known (not counting the cosmopolitan *Amphipholis squamata*), the three others being *Cryptopelta granulifera* H. L. Clark, *Amphiura Stimpsoni* Ltk., and *Ophioconis vivipara* Mrtsn. (the latter known only from the subtropical coast of N.W. Africa).

In my paper of 1920, quoted above, I pointed out the remarkable fact that so large a percentage of the viviparous Ophiurids are also hermaphroditic, the more remarkable since hermaphroditic Ophiurids are otherwise quite unknown. It will be of interest to see how this matter stands now, with the considerably larger number of viviparous Ophiurids now made known.

We may first enumerate all the known viviparous Ophiurids, with their sexual character.

in *Cr. granulifera* the young ones are all in the same stage of development and rather numerous, so that the bursæ may be quite crammed with them.

4. *Ophionereis vivipara* n. sp.

In the above described locality at Cannoniers Point, Mauritius, this little Ophiurid occurred in good numbers, together with *Amphipholis squamata* and *Amphiodia dividua*, in the carpet of green algæ covering the sandy bottom at shallow depth lying dry at low tide. The species has the curious habit of folding its arms together over the disk when touched — like somebody holding his hands over his head to prevent being hurt.

I may first give a description of this new species.

Diameter of disk up to 3 mm; arms ca. 5 times the diameter of disk. Mouth papillæ usually four to each side of jaw, usually somewhat erect, those at the apex slightly the larger. Buccal shields rounded triangular; adoral shields well developed, joining proximally, and with a distinct outer lobe separating the first lateral plate from the buccal shield. First ventral plate rather elongate, narrow, the second broadly contiguous with it. The following ventral plates merely touching each other, distinctly longer than broad, with an acute inner angle and the outer edge slightly convex. One large, oval or obtuse tentacle scale. Dorsal armplates somewhat elongate rhomboidal, contiguous, though not broadly so. Supplementary dorsal plates large, usually with some distinct concentric lines in the distal part. Three slender armspines, scarcely as long as an armjoint. Disk on both sides covered by a close coat of very minute scales, among which no larger primary plates are distinguishable. Radial shields exceedingly small, narrow, or not at all distinguishable. — The colour of the live specimens (partly well preserved in alcohol) is generally a large, more or less dense spot of reddish-brown on the middle of the disk, often somewhat star-shaped, with a prolongation towards the base of each arm; narrow bands of the same colour on each 4—6 joints on the arms. The ground-colour white.

This species is *hermaphroditic*. As a rule, there is only one gonad, placed interradially, at each bursa, and it appears to be the more general condition that in one interradius both gonads are male (Pl. VII. fig. 3). But this is not constant; sometimes there is only one male gonad, sometimes three. The eggs are large, yolky; the cleavage is

Indo-Pacific are really viviparous like the Atlantic specimens, I applied to Dr. H. Engel of the Amsterdam Museum, asking him to lend me the "Siboga" specimens for examination, which he very kindly did. Although these specimens have been dried and are thus not fit for anatomical investigation, I could ascertain that two of them have young ones inside. This is a very satisfactory confirmation of the identity of the Indo-Pacific and the Atlantic specimens claimed by Koehler, and which I can see no reason to doubt.

2. *Amphipholis misera* Koehler.

In the Bali-Sea (7°29′ S. 114°49′ E., 240 m.) I took a specimen (10.IV.1929) which must evidently be referred to *Amph. misera*. It is of considerable interest in being the host of a large Crustacean (probably a Copepod) lying in its body cavity (or bursa?) and filling out a whole interradius, even extending it considerably. In a neighbouring interradius it has a fairly large young one, the species being thus viviparous. The testes I find well developed, lying adradially to the bursal slit as in *Amph. squamata* — but I cannot find any ovaries at the radius prepared out for making a microscopical preparation. This would seem to indicate a partial castration caused by the parasite. But in any case, the presence of a young one in a bursa and at the same time of well developed testes shows that the specimen is hermaphroditic.

Amphipholis misera is very closely related to *Amph. squamata* and perhaps not a distinct species.

3. *Cryptopelta granulifera* H. L. Clark.

Some specimens of this species I collected on the coral reef off Cannoniers Point, Mauritius. The species is viviparous and hermaphroditic. I could not find any regularity in the arrangement of the female and male gonads, the latter being few and small, placed now here, now there along the genital slits. — The embryos are all of the same age; they may be rather numerous, up to ca. 25 in each bursa.

In the closely related, South African species, *Cryptopelta aster*, which is also viviparous and hermaphroditic, the arrangement of the male gonads is likewise quite irregular, there being now one or two at the abradial side of a bursa, now none, and the position of the male organs among the female ones is likewise without any regularity. As

recorded there that also *Pectinura gracilis* Mrtsn. is viviparous, and that both these *Pectinura* species are hermaphroditic. In my paper "Echinodermes du Maroc et de Mauretanie" (Bull. Soc. Sc. Nat. du Maroc. V. 1925. p. 186) I have further shown *Ophioconis vivipara* Mrtsn. to be viviparous; whether it is a proterandric hermaphrodite or it has separate sexes could not be ascertained for want of sufficient material.

D. M. Fedotov, in his paper "Zur Morphologie einiger typischen, vorzugsweise lebendiggebärenden Ophiuren" (Trav. Laborat. Zool. & Station Biologique Sebastopol. Acad. Sc. Leningrad. Sér. II. 6. 1925), makes known that *Amphiura Stepanovii* (known only from the Black Sea) is viviparous and a proterandric hermaphrodite.

In my forthcoming report on the Ophiuroidea of the "Ingolf" Expedition observations are recorded, which make it probable that *Amphipholis Torelli* Ljungman is also viviparous (besides being self-dividing); about its sexual characters no definite information could be given. Further, in my forthcoming report on the Ophiurids of S. Africa it is shown that *Ophiomitrella hamata* Mrtsn. is viviparous and a proterandric hermaphrodite, and further that *Cryptopelta aster* (Lyman) is viviparous and hermaphroditic.

I can here add four new cases of viviparity in Ophiurids.

1. *Amphiura iris* Lyman.

This species, originally found by the "Challenger" off Japan, then by the "Siboga" in the Malay Archipelago, was shown by Koehler to occur also in the Atlantic (Ophiures du "Travailleur" & "Talisman", p. 278); the species thus, although only rarely met with, must have a cosmopolitan distribution in the deep-sea (its known bathymetrical distribution is ca. 300—1600 meters). A specimen from off the W. Coast of N. Africa (Cape Bojador), ca. 700 meters, at my disposal proves to be viviparous, having a large young one in each bursa. Regarding its sexual characters I can only state that the gonads appear to be all female, which need not mean that it has separate sexes; it is quite possible that, like *Amphiura borealis* and *Amph. Stepanovii*, it may be a proterandric hermaphrodite. Only a rich material of the species, and in various sizes, can afford the solution of the problem.

Wishing very much to ascertain whether the specimens from the

1. *Ophiomyxa vivipara* Studer. Sexes separate.
2. — *brevirima* H. L. Clark. Sexes separate.
3. *Ophiacantha imago* Lyman. Sexes separate.
4. — *marsupialis* Lyman. Sexual character unknown.
5. — *vivipara* Ljungman. Proterandric hermaphrodite.
6. — *anomala* G. O. Sars. Hermaphroditic.
7. *Ophiomitrella clavigera* (Ljungman). Proterandric hermaphrodite.
8. — *corynephora* H. L. Clark. Proterandric hermaphrodite.
9. — *hamata* Mrtsn. Proterandric hermaphrodite.
10. *Amphiura magellanica* Ljungman. Hermaphroditic.
11. — *capensis* Ljungman. Hermaphroditic.
12. — *constricta* Lyman. Hermaphroditic.
13. — *borealis* (G. O. Sars). Proterandric hermaphrodite.
14. — *Stimpsoni* Lütken[1]). Hermaphroditic.
15. — *annulifera* Mrtsn. Hermaphroditic.
16. — *Stepanovii* Tschernjawsky. Proterandric hermaphrodite.
17. — *iris* Lyman. Uncertain; ?proterandric hermaphrodite.
18. *Amphipholis squamata* (D. Ch.). Hermaphroditic.
19. — *japonica* Matsumoto. Hermaphroditic.
20. — *sobrina* Matsumoto. Hermaphroditic.
21. — *patagonica* Ljungman. Hermaphroditic.
22. — *misera* Koehler. Hermaphroditic.

(— *Torelli* Ljungman. Uncertain; viviparity not definitely ascertained.)

23. *Ophionereis vivipara* Mrtsn. Hermaphroditic.
24. *Cryptopelta aster* (Lyman). Hermaphroditic.
25. — *granulifera* H. L. Clark. Hermaphroditic.
26. *Pectinura cylindrica* (Hutton). Hermaphroditic.
27. — *gracilis* Mrtsn. Hermaphroditic.
28. *Ophioconis vivipara* Mrtsn. Uncertain. ?Proterandric hermaphrodite.
29. *Ophiotjalfa vivipara* Mrtsn. Uncertain. ?Proterandric hermaphrodite.

[1]) This is the *Amphiura vivipara* H. L. Clark mentioned in my paper of 1920; it has been found to be identical with the species described by Lütken as *Amphiura Stimpsoni* (cf. H. L. Clark 1933, Handbook of the littoral Echinoderms of Porto Rico and the other West Indian Islands. Sci. Surv. Porto Rico and the Virgin Islands. XVI. 1. p. 45).

30. *Stegophiura nodosa* (Ltk.). Hermaphroditic.
31. — *vivipara* Matsumoto. Hermaphroditic.
32. *Ophionotus hexactis* (E. A. Smith). Hermaphroditic.

Thus, out of 32 viviparous Ophiurids 3 species are known to have separate sexes, 25 to be hermaphroditic, the sexual character of the remaining 4 being not yet definitely ascertained. Even if all the 5 above named species of *Amphipholis* be reduced to one, *Amph. squamata*, (which, perhaps, they will ultimately be) there remain 21 species, which are definitely shown to be both viviparous and hermaphroditic — against 3 which have separate sexes. It seems evident that this must mean something — but what it means is not easy to tell. Why it should be especially advantageous for viviparous Ophiurids to be hermaphroditic does not seem very evident; but the fact that out of the 32 (28) viviparous species, the sexual character of which is definitely known, 90 % are hermaphroditic, only 10 % have separate sexes, shows that there must be some special reason why hermaphroditism should be specially connected with, or directly a consequence of, viviparity. Since, of the three viviparous species with separate sexes, two belong to *Ophiomyxa*, apparently one of the most primitive of Ophiurids, it would seem that the hermaphroditism has been acquired gradually among the more specialized forms.

The fact that out of the 25 hermaphroditic species 6 are proterandric hermaphrodites does not help to explain why the viviparous species should have adopted hermaphroditism. The simultaneous hermaphroditism would seem to facilitate self-fertilization, and one might fancy that this were the object of the adoption of hermaphroditism by the viviparous species; but the proterandrism again would seem to have the purpose of preventing self-fertilization.

The whole matter seems very problematic. I cannot offer a solution, must be content with pointing out that here is an interesting problem seeking its explanation.

Plate VII.

Fig. 1. Sagittal section through *Nannophiura lagani* Mrtsn. × 115.
m. mouth; n. radial nerve; st. stomach.

- 2. Part of horizontal section through male specimen of *Ophiolycus androphorus* Mrtsn. × 60. st. stomach; t. testis.

- 3. Horizontal section through *Ophionereis vivipara* Mrtsn. × 35.
b. Bursa; e. embryo, lying within the bursa; o. ovary; t. testis.

NB. By a mistake the number of figure 1 has been omitted on the plate It is, of course, the uppermost figure.

Separate copies ready from the press 26. IV. 1933.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LXIV.

Some new Copepods, parasites of Ophiurids and Echinids.

By

K. Stephensen.

The present paper deals with 5 new species of Copepods, 4 of them parasites of Ophiurids (2 endoparasitic, 2 ectoparasitic), and 1 species parasitic in Echinids (*Phormosoma* spp.).

The material was found by Dr. Th. Mortensen during his work with the brittle-stars and Echinoids; I wish to tender my most sincere thanks to Dr. Mortensen for having placed this very interesting material at my disposal.

I. Copepoda from Ophiurids.

By far the greatest interest is connected with the two endoparasitic species, not only for their rather strange shape, but first and foremost because we know previously only 3 genera (each with one species) of Copepods endoparasitic in Ophiurids, viz.,

Philichthys amphiuræ Hérouard 1906,

Chordeumium obesum (Jungersen 1912), and

Arthrochordeumium appendiculosum K. Stephensen 1918

(for literature etc. on these species, see K. Stephensen 1918, p. 268).

Genus *Cancerilla* Dalyell.

Cancerilla G. O. Sars 1918, p. 138.
— C. B. Wilson 1932, p. 597, no. 126.

Previously only two species were known, viz., *C. tubulata* Dalyell (see G. O. Sars 1918, p. 139, pl. 80), on *Amphipholis squamata* D. Ch., from W. Norway (the Trondheimfjord) to the Mediterranean, and

C. neozelanica K. Stephensen (1927, p. 377, figs.), on the same host, from the Auckland Islands and New Zealand.

Below will be described a third species, on the same host.

Cancerilla durbanensis n. sp.

(Fig. 1).

Parasitic on *Amphipholis squamata* D. Ch.

Specimen no. 1: Durban, abt. 100 m., on the dorsal side of the base of an arm of *Amphipholis*, 1 ♀ ovig., length 1 mm. Dr. Th. Mortensen leg. 27-VIII-1929. — Specimen no. 2: Durban, abt. 425 m., on the ventral side of the base of an arm of *Amphipholis*, near the mouth. 1 ♀, without eggs, length 0.9 mm. Dr. Th. Mortensen leg. 26-VIII-1929.

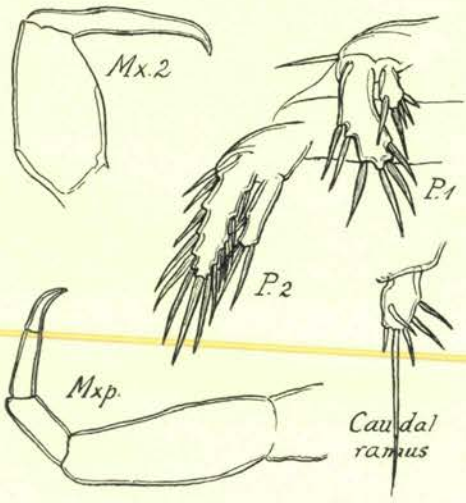


Fig. 1. *Cancerilla durbanensis* n. sp. *Mx. 2*: Maxilla 2. *Mxp.*: Maxilliped. *P. 1—P. 2*: Pereiopod 1—2.

No male was found.

Description. Specimen no. 1 agrees totally with *C. neozelanica*, as described l. c., except: the posterior part of the cephalic segment has its margins a trifle concave (in specimen no. 2 the outline is quite as in *C. neozelanica*). The apical joint of maxilla 2 is somewhat larger than in *C. neoz.* The maxilliped has the joint proximally of the claw distinctly 2-articulate as in *C. tubulata* (this articulation could not be found in *C. neozelanica*).

The most important difference is in pereiopods 1—2: pereiopod 1 has on the very short inner ramus 5 setæ (2 longer, 3 shorter), and on the outer ramus 6 setæ. Pereiopod 2 has a long narrow inner ramus ($^2/_3$ the length of outer ramus), with 4 setæ; the outer ramus is long, narrow, with 6 pairs of setæ. Especially the long inner ramus of per. 2 and the long outer ramus of the same leg, with 6 setæ on each margin (in the other species there is 1 seta or none on the median margin) characterises this species. Pereiopods 3—5 could not be found.

Genus *Cancerillopsis* n. gen.

The new genus *Cancerillopsis* (with the type-species described below) is very closely allied to *Cancerilla*; it differs in 1. and 2. leg having the outer rami and 2. leg also the inner ramus 2-articulate (not uni-articulate), and 3. leg has 2 joints and is rather well developed (not "extremely small and rudimentary, being only represented by a minute bisetose joint" (G. O. Sars on *Cancerilla tubulata*, 1918, p. 140)).

Cancerillopsis nanaimensis n. sp.

(Fig. 2).

Parasitic on *Amphiodia urtica* (Lütken).

Nanoose Bay, Nanaimo, abt. 20 m. Some ovigerous ♀ on *Amphiodia urtica*, on the disc or on the arms. Dr. Th. Mortensen leg. 11-VI-1915.

No male was found.

Description of ♀ ovig., abt. 0.5 mm. in length. The body is very short and stout, with the back somewhat vaulted, not very different from *Cancerilla*; the length only slightly exceeding the width.

The cephalic segment occupies abt. $^2/_3$ of the total length, broader than long, rectangular-oval; the front is not produced, and the lateral margins are bent downwards, with a notch off the hinder fourth. There are some hairs along the margins.

Of the succeeding segments the first is very short, only visible on the ventral side, and only half as broad as the cephalic segment. 2. segment is much longer and somewhat broader; the next 3 segments are decreasing in breadth and partly also in length.

The tail is rather short; the genital segment is much dilated, the breadth twice the length, with the hind corners rather projecting; the next segment is much shorter. The anal segment is apically somewhat contracted, as long as broad. The caudal rami are irregularly oval, distally broadened, with abt. 8 setæ (5 longer, 3 shorter).

Antenna 1 is rather short, 6-articulate, with short setæ. 1. joint is as long as the 3 next combined; 6. joint as long as the two preceding ones combined. Antenna 2 is very strong, (4- or) 5-articulate; the apical joint is much curved, the penultimate joint of abt. equal length. The siphon is apparently short and of the typical form, the mandibles acute. The maxilla 1 is oblong, with 3 terminal setæ and one proximal

seta on the lateral margin. Maxilla 2 consists of only 2 joints, of equal length, the proximal joint very thick. The maxilliped is feebler,

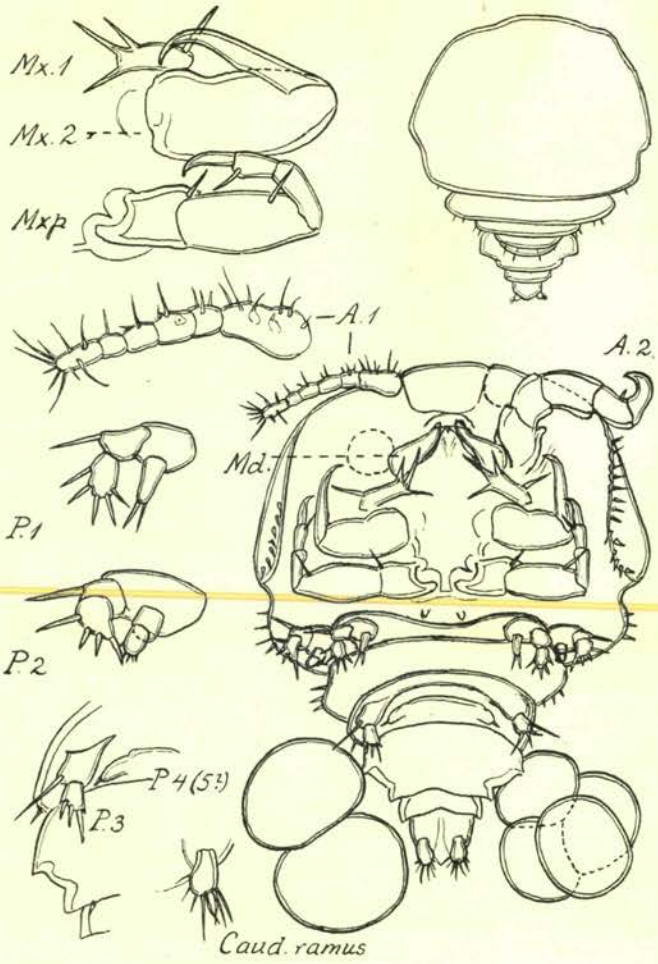


Fig. 2. *Cancerillopsis nanaimensis* n. gen. n. sp., in ventral view (the larger fig.) and in dorsal view (the smaller fig.). *A. 1—A. 2*: Antenna 1—2. *Caud. ramus*: Caudal ramus. *Md.*: Mandible. *Mx. 1—2*: Maxilla 1—2. *Mxp.*: Maxilliped. *P. 1—4 (5?)*: Pereiopods 1—4 (5?)

2. joint twice as long as 1. joint, 3.—5. joints combined in length equal to 2. joint; there is a spine on 1., 2. and 4. joint.

Pereiopod 1 has a short basal part; the inner ramus is conical,

There were some traces of egg-masses, consisting of numerous very small eggs, and wrapped up quite irregulary around the female.

Other details than those described above could not be ascertained with certainty.

The species differs from *A. appendiculosum* K. St. 1918 (— the species hitherto described —) in wanting segmentation in the posterior part of the body and in the more acutely pointed lateral processes. Also the length of the body is much smaller (length 1.10 mm.; A. appendiculosum 2.5 mm.).

Distribution of the host. Amboina, clinging on a Gorgonid, *Mopsea* (type-loc. for *Astroschema koehleri;* Döderlein, Jenaer Denschr., vol. 8, 1898, p. 487). — Amboina and the Kei Isl., 4 loc., on a pier and 90—125 m. (*Ophiogelas perplexum;* Koehler, l. c. 1930, p. 43). — 4°20′—5°36′5 S., 134°53′9 E., 57—94 m. (*Astroschema rousseaui;* Koehler, Siboga-Exp., Ophiur. litt. 1905, p. 123).

Systematical position. No doubt this species is congeneric with *Arthrochordeumium appendiculosum* K. Stephensen (1918, p. 268, with figs.). The similarity of the two species is very striking; even the triangular posterior dorsal process is present.

After the finding of this new species the genus *Arthrochordeumium* can be defined as follows:

Arthrochordeumium K. Stephensen (1918, p. 269).

(Type-species: *A. appendiculosum* K. St. 1918, p. 269).

Female: Body somewhat symmetrical and compressed, abt. as broad as long, with more or less distinct segmentation (most conspicuous in the fore-end), with some 3 pairs of short lateral processes. Only 2 pairs of limbs are present: 1st antennæ, 1-articulate, bipartite at tip; — and 2nd antennæ (or maxillæ), 3-articulate. The egg-masses consist of very small eggs and are irregularly wrapped round the body. Live in swellings with (or without?) pore in the basal part of the arms of Ophiurids belonging to the fam. Trichasteridæ.

Wilson (1932, p. 598) has referred the genus to the suborder *Cyclopoida.* —

The genus (the female) bears a certain — but probably only quite superficial — resemblance to the Copepod *Ichthyotaces pteroisicola* Shiino (1932, p. 417, with figs.), occurring in galls under the skin of

Cet elargissement des grands bras varie d'ailleurs suivant les individus, et par exemple il est beaucoup moins marqué dans l'un des exemplaires".

According to the above the parasite would seem to be rather common; but unfortunately only two specimens have been at hand for examination (preserved in alcohol; the remaining material of the host was dried).

Any pore in the gall (— as in the case of *A. appendiculosum* K. St., in *Astrocharis gracilis* Th. Mortensen —) has not been found.

Description. No male was found.

Young female, length 1.25 mm., breadth abt. 0.50 mm. (Fig. 3, ♀ jun.). The body is somewhat sausage-shaped and symmetrical, a little depressed, and anteriorly a little tapering. There is no trace of segmentation, and laterally there are 3 pairs of short, blunt processes and in the very hind end a single bud. Anteriorly there are 2 pairs of limbs: 1 pair of apically cleft 1. antennæ and 1 pair 3-articulate 2. antennæ or maxillæ. Between the 1. antennæ there is a pair of very small appendages.

Other details could not be traced; mouth etc. could not be found, and no internal organs were visible through the skin (the specimen was cleared in oil of cloves).

Ovigerous female, length 1.10 mm., breadth abt. 0.80 mm. (Fig. 3, ♀ ovig.). The specimen seems to be shrunken, and is much more depressed and comparatively much broader than the young ♀; the lateral margins somewhat parallel, the anterior part not markedly narrower than the posterior.

There is in this stage some segmentation: anteriorly on the ventral side 2 short segments and dorsally 1 longer segment, corresponding to the two anterior ventral segments and in addition comprising the head. In the posterior third of the dorsal side there is a low triangular process. The 3 pairs of lateral processes are present also in this stage, but are more irregular than in the younger specimen. The bud in the hind end seems to be perforated and is probably the genital opening (but no internal organs could be made out with certainty, though the specimen was cleared in oil of cloves).

The limbs are of the same shape as in the young ♀, but are stronger. The two small appendages between the antennæ have become still smaller and are now placed at a greater distance from each other.

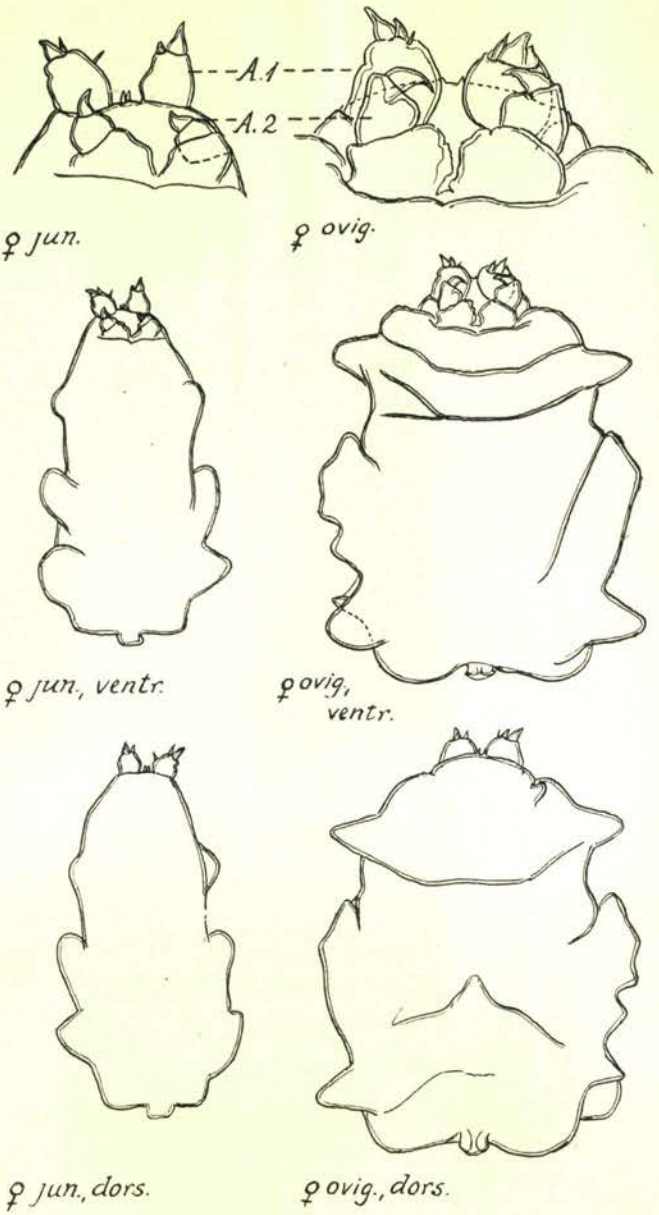


Fig. 3. *Arthrochordeumium asteromorphæ* n. sp. Young and ovigerous ♀ in ventral and dorsal view, and the antenna 1—2.

1-articulate, not very short, apically with 2 setæ; the outer ramus is 2-articulate, with 1 long seta on 1. joint and 5 setæ on 2. joint. Pereiopod 2 has a rather large basal part; the inner ramus has 2 very short joints, apically with a few very short setæ; the outer ramus is 2-articulate, 1. joint with 1 long seta, 2. joint with 1 longer and 3 shorter setæ. Pereiopod 3 has on the basal part 1 rather long seta and on the 1-jointed ramus 1 longer apical and 2 shorter proximal setæ on the lateral margin. The last (4. or 5.?) pereiopod is very short, bud-like, apically with a single or possibly with a few very short bristles.

The eggs are rather large, but there are only very few in each ovisac.

Genus ***Arthrochordeumium*** K. Stephensen.

For diagnosis see below, p. 204.

Arthrochordeumium asteromorphæ n. sp.

(Fig. 3).

Endoparasitic in *Asteromorpha koehleri* (Döderlein) (= *A. perplexum* (Koehler)).

Amboina, 100 m., Dr. Th. Mortensen, leg. II-1922. 1 jun., length abt. 1.25 mm., 1 ♀ ovig. length abt. 1.10 mm.

Place in the host. "One arm of each [of the hosts] was conspicuously swollen at the base; there were, however, no gonads in these swellings, but a parasitic Copepod" (Th. Mortensen, Vid. Meddel. Dansk Naturh. Foren., vol. 96 (Festskrift II), 1933, p. 61). Photos of the host with swollen arms are reproduced especially by Koehler, in Vid. Medd. Dansk Naturh. Foren., vol. 89, 1930, pl. 4 fig. 9—10 and pl. 5 fig. 1—3 ("*Ophiogelas perplexum*"). Döderlein and Koehler have described the host, but have not had a clear understanding of the real state of the case. Koehler who has the most elaborate description, mentions the phenomenon as follows (l. c. 1930, p. 43): "Généralement il y a trois bras plus grands et trois autres beaucoup plus petits; l'un des individus a deux bras plus grands et quatre plus petits", and (p. 45) "Les grands bras se continuent insensiblement avec le disque et leur région basilaire est élargie, tandis que les petits bras, non élargis à la base, en sont beaucoup plus distincts.

the fish *Pterois lunulata*, from Tanabe Bay, Japan. The males are, however, very different in the two genera.

Genus ***Ophioika*** n. gen.

On the genus, see below.

Ophioika ophiacanthæ n. sp.

(Fig. 4).

Endoparasite in *Ophiacantha severa* Koehler.

1 ♀ ovig. Dr. Th. Mortensen's Java-S. Africa Expedition stat. 16: 7° 35′ S, 118°42′ E. (Bali-Sea), abt. 200 m., 10-IV-1929.

Place in the host. The parasite lives in one of the bursæ; its presence is disclosed through a bulging of the dorsal skin of the host.

No male was found.

Description of ♀ ovig. The parasite is rather pellucid; and as its skin is very delicate and fragile and moreover adheres to the walls of the bursa, it is no wonder that the single specimen was rather damaged when loosened from the host.

Length and breadth of the body (excl. the long appendages) abt. 1.5 mm.

The body is somewhat compressed, but not symmetrical, and there is no distinct segmentation; the shape would seem to be impressed by the narrow room within the host. There is no distinct head and no limbs; therefore it was impossible to make out the place of the fore- and hind end. The $^2/_3$ of the parasite are broader than the rest and have laterally abt. 9 longer or shorter serpentine appendages. The narrower part of the body consists of 2 large lobes, one much broader than the other. There are, too, 3 sausage-shaped appendages, placed quite unsymmetrically. Each of them seems to have an apical opening, and a little proximally of the apex there are near the axis two short oblong organs. Possibly we have here the genital papillæ; then the oblong organs are probably a sort of mucous glands for the eggs. If this interpretation be right, there is a certain agreement between the number of genital papillæ (3) and that of the egg-masses (4), and as the animal is somewhat damaged, it cannot be considered excluded, that originally there have been 4 genital papillæ.

Each of the 4 egg-masses is abt. 0.50 mm. in length, 0.25 mm. in breadth, and consists of numerous small eggs, abt. 0.05 mm. in diameter.

Unfortunately the specimen was so damaged, that scarcely other details than those described above and drawn in the figure could be found; limbs, mouth and intestine seem to be absent, but the greater part of the body is filled up by the large genital organ.

Affinities of the species. No doubt this is one of the strangest Copepods ever known; and all forms previously described are more or less symmetrical. The long serpentine appendages are not unknown in endoparasites within the group. They are found especially in *Philichthys amphiuræ* Hérouard (l. c. 1906) in which species the ♀ has 3 pairs and the ♂ has 1 pair, and in other species of the apparently very heterogeneous genus *Philichthys* (see Richiardi l. c. 1874—76; for the type-species *Ph. xiphiæ* Steenstrup, see Wilson 1932, p. 532, with lit. and fig.). It would not seem to have close affinity to any known Copepod.

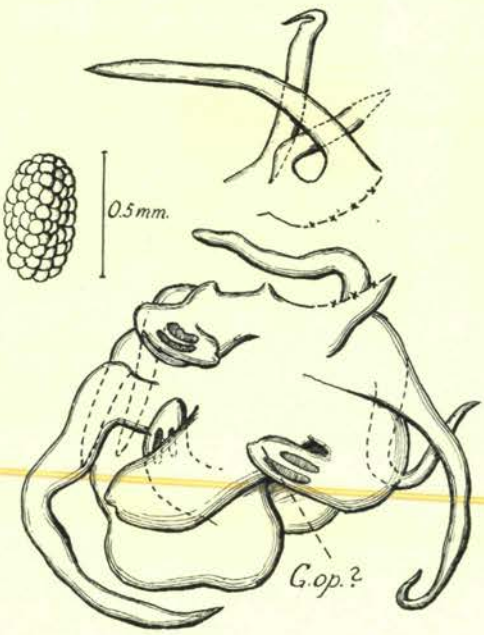


Fig. 4. *Ophioika ophiacanthæ* n. gen. n. sp., and one of its egg-masses. The crossed line in the two figures marks a line of fracture, where the smaller piece (the upper figure) probably has been torn off from the animal. *G. op.?*: Genital opening?

The genus Ophioika may possibly be characterised as follows. Endoparasitic Copepods (in Ophiurids). The body of the adult ♀ more or less unsymmetrical, with long serpertine appendages and several (4?) genital openings and more than 2 (viz. 4) eggmasses. Probably there are no inner organs other than the ovary.

The ♂ is unknown.

If the organisation of the single and very defective specimen is understood correctly, we have here a case of a very degenerate endo-

parasite, with the body reduced to a lobate sac only containing the genital organs, and absorbing its nutriment from the host through the serpentine appendages.

II. A new endoparasitic Copepod in Echinids (*Dichelina phormosomæ* n. gen. n. sp., in *Phormosoma* spp.).

Previously only two Copepods endoparasitic in Echinids are known, viz.,

Pionodesmotes phormosomæ Koehler (1898, p. 61, with 1 pl.), in galls on the inner side of the test of "*Phormosoma uranus* W.-Th.", — in reality *Hygrosoma Petersi* (A. Agassiz) — found in 3 places abt. 39°—40° N., 27°—31° W., 1384—1850 m. (the description with the plate is reproduced by Brian 1912, p. 42, 1 pl.), and

Calvocheres globosus (H. J. Hansen 1902). — *Echinocheres globosus* H. J. Hansen 1902, p. 437, pl. 15, in galls in the spines of *Calveria gracilis* (Ag.), from 6°47′ N., 124°28′ E., abt. 475 m. (near the Philippine Isl.; "Challenger" stat. 200). (The name *Echinocheres* was preoccupied by Claus 1889 for another Copepod genus, and therefore altered by Wilson (1932, foot-note p. 595) into *Calvocheres*).

Genus *Dichelina* n. gen.

For diagnosis of the genus, see below.

Dichelina phormosomæ n. sp.

(Figs. 5—7).

S. of Mindanao 7°25′ N., 123°14′ E., abt. 500 m., 9-3-1914, Dr. Th. Mortensen leg. 1 ♂ and 1 ♀ ovig., in the intestine of *Phormosoma bursarium* A. Ag. — "Albatross" st. 5654: 3°42′ S., 120°45′50″ E., abt. 1500 m. Further, several specimens (♂, ♀ ovig.) found in the deposits on the bottom of a jar with some rather badly preserved specimens of *Phormosoma verticillatum* Th. Mortensen.

Description of ♀ ovig., length abt. 3.8 mm. (Fig. 5, 1-2). The body is somewhat sausage-shaped, a little depressed, with the anterior third or fourth a little broader than the rest. The posterior, narrower part is divided into 5 segments by some narrowings which are some-

times rather indistinct; when the segmentation is most distinct, it is as shown in the fig. of a ♂ in dorsal view (fig. 7, the smaller fig.), but a true segmentation is probably not present. In the hind end is the anus, and on the lateral part of the ventral side a pair of (sometimes rather prominent) buds with the genital openings.

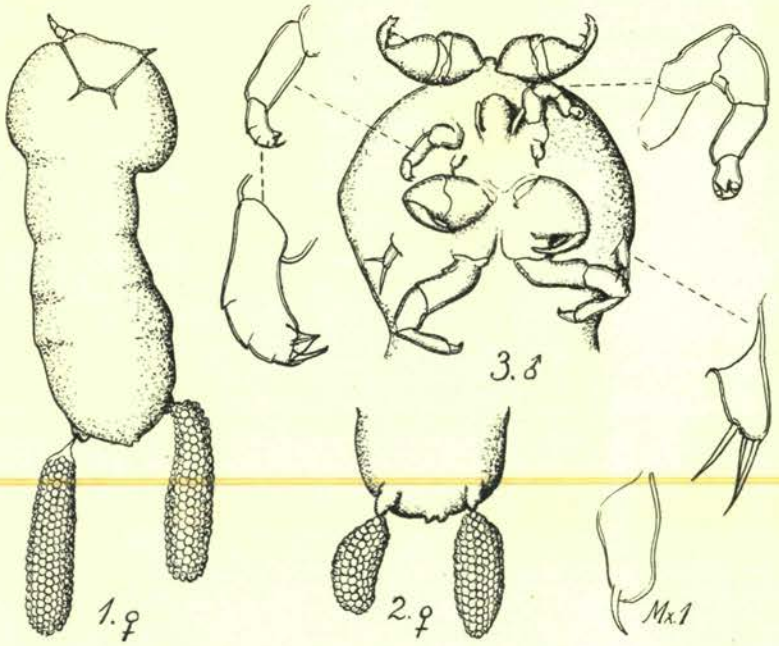


Fig. 5. *Dichelina phormosomæ* n. gen. n. sp. *1.* ♀: ovigerous ♀ from S. of Mindanao, in dorsal view. — *2.* ♀: the hind end of an ovigerous ♀ from the "Albatross", in ventral view. — *3.* ♂: the fore end of a ♂ from the "Albatross", in ventral view, showing the limbs (for explanation of the limbs, see fig. 6). — *Mx. 1*: Maxilla 1 of the ♂.

The genital openings are throughout the Copepods rather constantly placed on the 7. trunk segment. In the ♀ of the present species they have their position on the hindmost of the 5 segments of the narrow part of the body (— in the ♂, too, the segmentation in 5 somites is more distinct, but the genital openings could not be found in this sex —). Thus the broader, anterior part comprises the head + the two anterior segments, but only one pair of pereiopods could be found (see below).

On the dorsal side of the head there is a chitine list formed like a X or a very open H.

On the ventral side of the anterior part there are 6 (or 7?) pairs of limbs (fig. 6).

Antenna 1 (Fig. 6, *A. 1*) is rather strong and short, not prehensile, straight, tapering towards the apex, with 7 joints of varying length. The antenna is almost naked, with very few setæ. Antenna 2 (Fig. 6, *A. 2*) is somewhat shorter and probably 4-articulate, very slightly

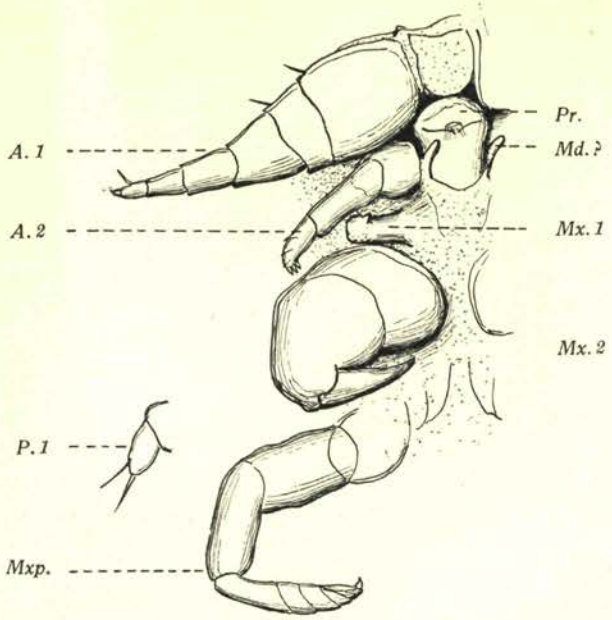


Fig. 6. *Dichelina phormosomæ*, ♀ ovig., from S. of Mindanao. Ventral side, with the appendages. *A. 1—A. 2*: Antenna 1—2. *Md. ?*: Mandible?. *Mx. 1—2*: Maxilla 1—2. *Mxp.*: Maxilliped. *P. 1*: Pereiopod 1. *Pr.*: Proboscis.

tapering towards the apex, somewhat curved, and probably prehensile. The 3 proximal joints are of abt. equal length, the distal joint is somewhat shorter, very indistinctly divided into 3—4 shorter joints and terminating in 2—4 small and rather acute claws. The mouth is sucking, formed as a more or less cylindrical proboscis (Fig. 6, *Pr.*) between the bases of the two antennæ 2. No details could be traced as to the form of the mouth; on each side of the base of the proboscis there is, however, a small narrow lappet (the mandibles?; fig. 6, *Md.* ?). These lappets are quite simple, without articulation or other details.

Behind the antenna 2 there is a pair of small cylindrical protuber-

ances, abt. as long as each of the joints of ant. 2 and not much more slender, without articulation, and each terminating in a single seta (?.) These protuberances are no doubt the 1. maxillæ (or maxillulæ; fig. 6, *Mx. 1;* see also fig. 5, *Mx. 1*). The next pair of limbs, the 2. maxillæ (Fig. 6, *Mx. 2*), are very strong, more stout than ant. 1, strongly prehensile, consisting of one very thick joint (— in some cases it seems to be divided into two joints —), and a much more slender apical joint. The last pair of appendages of the head, the maxillipeds (Fig. 6, *Mxp.*), consist proximally of two abt. equally-sized joints; then follows a "knee", and apically of this come several (abt. 7) shorter joints, decreasing in length towards the apex (see also fig. 7); the last joint is claw-shaped. The articulation between these joints is sometimes very difficult to be ascertained; in other cases small short, but broad muscles between the joints are very distinct.

Only one pair of thoracic limbs could be found (Fig. 6, *P. 1*); they are small, bud-like or somewhat cylindrical appendages placed near the margin of the body, off the place where the maxillipeds are fixed. Apically they have 2—3 setæ.

The ♀ from S. of Mindanao has 2 sausage-shaped egg-masses (Fig. 5, *1*), each consisting of numerous small eggs; the length is abt. 5 times the breadth. The egg-bearing ♀♀ from the "Albatross" have the egg-masses somewhat shorter (Fig. 5, *2*), the length only $2^1/_2$—3 times the breadth; moreover the anal end of these specimens is more abruptly cut off.

Description of ♂ (Fig. 7). The ♂♂ are not markedly different from the ♀, apart from the size and the shape of antenna 1.

The length is smaller, abt. 2.5—3 mm., and the anterior part of the body is usually somewhat broader compared with the posterior part. In most cases this is markedly divided into 5 segments, but only between the 3 anterior segments (and not always) there is a real articulation. The posterior end is sometimes more acute than in the ♀, but the genital openings could not be found.

Antenna 1 is very strong and prehensile, 4-articulate, of a shape that could be compared with the subchelate legs in Amphipods and other Crustacea. The 3 proximal joints form together a cone; the apical (4.) joint is much narrower and somewhat curved. All the other appendages are quite like those of the ♀.

Inner organisation. Some of the specimens were cleared in oil

of cloves, for the study of inner organs. But it was evident that the material was not very well preserved, and only the quite straight digestive tube (somewhat widened in the narrow part of the body) and the ovaria (or testes) could be traced.

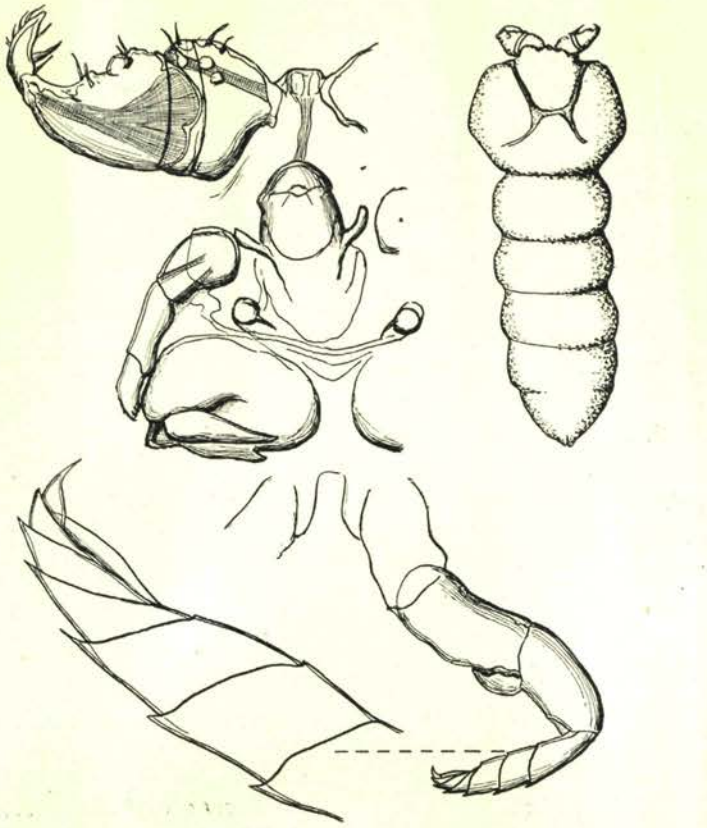


Fig. 7. *Dichelina phormosomæ*. Limbs of the ♂ from S. of Mindanao (for explanation, see fig. 6; *P. 1* is omitted). — The smaller fig. is a ♂ from the "Albatross", in dorsal view.

The specimens from the two different species of sea-urchins would seem to be quite identic. No real difference could be found; but the single ♂ from *Ph. bursarium* has on the 1. antenna some small warts (see fig. 7), not present in the specimens from *Ph. verticillatum*, and the egg-masses of the ♀ from *Ph. bursarium* are longer than those of the *Ph. verticillatum*-specimens.

Affinites of the genus. If we try to identify the present genus after the keys in Wilson 1932, it is clear that it is most closely allied to *Hatschekia* and *Dichelestium*, but that it is not identic with any of these two genera. It has the closest resemblance to *Dichelestium;* but the disagreements are several and not insignificant. The most important of these are: *Dichelestium* (with only one species, *D. oblongum* (Abildgaard 1794) (= *D. sturionis* Hermann 1804); see Scott 1913, p. 106, with figs., and Wilson 1932, p. 478, 611, with fig.) has 2. antenna (not 1. ant.) cheliform, and even in both sexes; there are 3 pairs of pereiopods (per. 1—2 biramose, but the rami 1-articulate; per. 3 uniramose, 1-articulate) (also several of the other limbs are rather differing); a short abdomen with small caudal rami present; the egg-strings are long, narrow, and each of them consists of only a single row of rather large, discoidal eggs (Scott l. c., pl. 45, fig. 4).

The genus Dichelina may be defined as follows. The body somewhat sausage-shaped, without very distinct segmentation, and with the head not much broader than the body; no abdomen and no caudal rami. Antenna 1 of ♂ 4-articulate, prehensile, in ♀ 7-articulate, not prehensile. Antenna 2 is 4(?)-articulate, probably prehensile. Only 1 pair of pereiopoda: bud-like, 1-articulate, with 2—3 setæ. The ovisacs are paired, not long, but containing numerous very small eggs. The ♂ is shaped as the ♀; but it is somewhat smaller, and ant. 1 is prehensile.

The generic name *Dichelina* was chosen in allusion partly to the resemblance to *Dichelestium*, and partly to the presence of the prehensile antenna 1 of the ♂.

Literature.

1912, Brian, Al.: Copépodes parasites des Poissons et des Échinides . . . — Rés. Camp. Sci., Monaco, fasc. 38, 1912.

1902, Hansen, H. J.: Echinocheres globosus n. gen. n. sp., a Copepod parasitic in spines of an Echinothurid. — Vid. Meddel. Naturh. Foren. Kjøbenhavn, 1902, pp. 437—449, pl. 15.

1898, Koehler, R.: Échinides et Ophiures provenant des Campagnes du yacht de l'Hirondelle. — Rés. Camp. Sci., Monaco, fasc. 12, 1898.

1922, Mercier, L.: Copépode parasite d'une Ophiure. — Bull. Soc. Linnéenne Normandie, vol. 4, 1922, p. XVII (On *Cancerilla tubulata* from France).

1918, Mortensen, Th., and Stephensen, K.: On a gall-producing Copepod infesting an Ophiurid. — Vid. Meddel. Dansk Naturh. Foren., vol. 69, 1918, pp. 263—275.

1874, Richiardi, S.: Sopra lo Sphærifer cornutus, Rich. (Sphærifer corvinæ, Leydig) ed una nuova specie del genere Philichthys Steenstr., Ph. sciænæ Rich. — Atti Soc. Toscana di Sci. Naturali, Pisa, vol. 2, fasc. 2, 1874, pp. 1—14, 1 pl.

1875, — Intorno al Peroderma cylindricum dell'Heller e sopra due specie nuove del genere Philichthys. — Ibid., vol. 2, fasc. 2, 1875, pp. 1—13, 1 pl.

1876, — Dei Filictidi osservazioni critiche e descrizione di sei specie nuove. — Ibid., vol. 3, fasc. 1, 1876, pp. 1—15, 1 pl.

1876, — Descrizione di cinque specie nuove del genere Philichthys ed una di Sphærifer. — Ibid., vol. 3, fasc. 1, 1876, pp. 1—14, 1 pl.

1918, Sars, G. O.: Crustacea of Norway, vol. 6, Copepoda Cyclopoida.

1913, Scott, Th. & A.: The British Parasitic Copepoda (Copepoda Parasitic on Fishes). — London (Ray Society) 1913.

1932, Shiino, Sueo M.: Ichthyotaces pteroisicola, n. gen. & n. sp. A Copepod parasitic on the fish Pterois lunulata Temm. & Schl. — Annotat. Zool. Japonenses, vol. 13, 1932, pp. 417—433.

1918, Stephensen, K., see Mortensen, Th., and Stephensen, K.

1927, — Crustacea from the Auckland and Campbell Islands. — Vid. Meddel. Dansk Naturh. Foren., vol. 83, 1927, pp. 289—390.

1932, Wilson, Chas. B.: The Copepods of the Woods Hole region Massachusetts. — Bull. U. S. Nat. Mus., no. 158.

Separate copies ready from the press 12.X.1933.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LXV.[1])

Echinoderms of South Africa.
(Asteroidea and Ophiuroidea).

By

Th. Mortensen.

(With Plates VIII—XIX.)

In H. L. Clark's most important paper "The Echinoderm Fauna of South Africa" (Annals of S. African Museum XIII. 1923) the first adequate report on the South African Echinoderm fauna is given, from which we get an idea of what a rich and peculiar fauna this is.

Since then two more papers on S. African Echinoderms, based on material collected by the Fisheries Survey of S. Africa have been published by H. L. Clark, viz. on the Echinoidea and the Asteroidea (Fisheries and Marine Biological Survey. Report No. 4. I and VII. 1925—26), in which a considerable number of additions to the South African Echinoderm Fauna are given. The rest of the Echinoderms collected by the Fisheries Survey of South Africa after those reported on in Clark's first paper have not been dealt with.

A few more additions to the S. African Echinoderm fauna are given in my paper "On some Echinoderms from S. Africa" (Ann. Mag. Nat. Hist. 9. Ser. XVI. 1925) based on material sent me from the Durban Museum, viz. *Dactylosaster cylindricus* Gray, *Anthosticte Pacei* Mrtsn.,

[1]) It is with the special permission of the Board of Directors of the Rask-Oersted Fund that this report on S. African Echinoderms, as also the following report on the Echinoderms of St. Helena, are included in the series of "Papers from Dr. Th. Mortensen's Pacific Expedition". I beg to express my sincere thanks for this favour — a favour the more important, as the publication of these rather voluminous reports might otherwise have met with some difficulties.

Th. Mortensen.

Anthenoides Marley Mrtsn., *Hacelia superba*, var. *capensis* Mrtsn., *Astroschema capense* Mrtsn., and *Ophiactis savignyi* (Müll. & Troschel).

In a paper by Koehler "Sur quelques Ophiures des côtes de l'Angola et du Cap." (Göteborgs K. Vet. & Vitterh. Samh. Handlingar. XXV. 1923) is recorded *Ophiacantha Barracoutæ* n. sp., which is, however, identical with Clark's *Ophiacantha nerthepsila.*

M. Hertz in her memoir "Die Ophiuriden d. deutschen Südpolar-Expedition 1901—1903" (1926) records from S. Africa *Ophiactis africana*, var. *capensis* n. subsp., which is, however, identical with the common S. African *Ophiactis plana*, and in her memoir "Die Ophiuriden d. Deutschen Tiefsee-Expedition. I." 1927 *Ophiachasma nitida* n. sp. *Gymnophiura novembris* n. sp., and *Ophiura carnea* Ltk.; the latter is, however, identical with *Dictenophiura anoidea* H. L. Clark, not with the North Atlantic *Ophiura carnea.*

In my Monograph of the Echinoidea I. 1929 I recorded the existence in S. African Seas of a *Goniocidaris* sp., and in my paper "New Contributions to the knowledge of the Cidarids" (Mem. Ac. R. Sci. Copenhague. 9 Ser. IV. 1932) I added to the S. African fauna: *Histocidaris elegans* (A. Ag.), *Sterocidaris squamosa* Mrtsn., *Sterocidaris excavata* n. sp.; *Acanthocidaris maculicollis* (de Meijere), *Kionocidaris striata* n. g. n. sp., with the variety *teretispina* n. var.

During a visit to S. Africa in 1929 I had some opportunities of making investigations in S. African Seas, particularly through the Government and the Director of the Fisheries Survey of S. Africa, Dr. C. v. Bonde, placing the survey steamer "Pickle" at my disposal for some time; first off Durban, in August. It was arranged that I should have the vessel at disposal for marine investigations for some three weeks, immediately after the ending of the meeting of the British Association, which took place in S. Africa (Cape Town, Johannesburg) that year. Through an unfortunate accident it happened, however, that the screw of the "Pickle" was damaged, when the ship on its way up from Cape Town was some miles from Durban. The necessary reparation of the screw took about two weeks. This, combined with unsettled weather conditions, had the result that I could actually dispose of the ship for trawlings and dredgings only 6 days. Nevertheless, the outcome was of very considerable importance, and quite a number of species new to science, or new to the S. African fauna were found (particularly of Ophiurans); but one cannot help deploring the said

unfortunate accident, in view of the incomparable richer outcome which would most certainly have been the result, if the ship had actually been at my disposal for two weeks more in the wonderfully rich sea off the Natal Coast.

Later on, on my return to S. Africa after a visit to Mauritius I could use the "Pickle" for 5 days for explorations off Cape Peninsula, with very fine results. I also got permission from the firm Irwin & Johnson to accompany their trawler "John C. Meikle" on a trip to the Agulhas Bank from 8th to 15th December, which gave a good deal of interesting Echinoderms. After my return to Denmark I had further the great pleasure of receiving an important sending of Echinoderms from off East London from Captain G. Pace of the trawler "Disa"; also Mr. Bell Marley, Director of the Natal Fisheries, Durban, sent me some fine Echinoderms.

A fact of the highest importance for me was that Dr. C. van Bonde placed at my disposal the whole of the Echinoderm material accumulated in the Laboratory of the Fisheries Survey, containing all the material collected by Dr. F. Gilchrist, which had not been sent to H. L. Clark for being reported on. This gave me an opportunity of studying quite a number of species not taken by myself during my own investigations in the S. African seas.

All this material thus being at my disposal has resulted in quite a material increase of our knowledge of the Echinoderm fauna of the South African seas. Already through Clark's researches we had got a good idea of the unusual interest that attaches to this fauna. The present researches contribute very materially to strengthening this interest, showing that the South African Echinoderm Fauna is one of the richest and most characteristic of the world.

It is my very agreable duty here to express my great indebtedness to the South African Government, and to the director of the Fisheries Survey of South Africa, Dr. C. van Bonde, for the most important assistance thus rendered me. Likewise my best thanks are due to the firm Irwin & Johnson and to the officers of the ships "Pickle" and "John C. Meikle", as also to Captain G. Pace of the "Disa". Further I beg to express my cordial thanks for all assistance rendered me, to the Danish Consuls, Mr. Jeppe in Cape Town and Mr. Andersson in Durban, to the authorities of the South African Museum, Cape Town, Dr. L. Gill, Dr. K. H. Barnard, and Dr. Law-

rence, to the director of the Durban Museum, Dr. E. C. Chubb and to Mr. Bell Marley, and, last not least, to my friends Mrs. and Mr. Lindstrøm, Rondebosch, and Mrs. and Mr. Eigil Christiansen, Durban, who all through their kindness and ever ready assistance have contributed very materially to increasing my scientific results and to make my visit to South Africa an unforgettable experience.

I beg to express also my cordial thanks to the authorities of various Museums for sending me specimens for comparison with my S. African Echinoderms, viz. Prof. W. Arndt of the Berlin Museum, Dr. K. H. Barnard of the South African Museum, Cape Town, Prof. Sixten Bock of the Stockholm Museum, Dr. H. Engel of the Amsterdam Museum, Prof. L. Jägerskjöld of the Gothenburg Museum, Prof. L. Joubin of the Paris Museum, Dr. C. C. A. Monro of the British Museum, London, and Dr. A. C. Stephen of the Edinburg Museum. Particularly it was of material importance that most of the species mentioned in Bell's Reports on S. African Echinoderms were sent me for reexamination so that the remarkable "identifications" of this author could be corrected.

In this report I intend to deal only with the Asteroids and Ophiurids of the S. African seas. The Holothurians will be dealt with by Mr. S. Heding and the Crinoids by Professor Torsten Gislén. The Echinoids, exclusive of the Cidarids, which were reported on in my paper "New Contributions to the knowledge of the Cidarids" will be included in my "Monograph of the Echinoidea".

I think it practical to give first a tabellaric view of all the Asteroidea and Ophiuroidea now known to occur in South African Seas, viz. from Natal to Lüderitz Bay. In the first column are given the species hitherto recorded, by Clark, and in the works quoted above which have been published after Clark's report. From this list are, of course, excluded those species included in Clark's report which are, or were by that time, not known from further South than Mozambique and thus do, or did by that time, not properly belong to the S. African fauna.

In second column is given a corrected list of all the species now actually known to occur in S. African Seas.

In the list of the previously recorded species are added letters indicating, who is responsible for the record, viz. B. — F. Jeffr Bell; D. — Döderlein; H. — Hertz; Lj. — Ljungman; Me. — Meissner; M. — Mortensen. For those species, where no letter is added, Clark

is responsible. The species not examined by Clark or by the present author are marked with an asterisc. Some few of the species not thus marked are not reported on in the special part of this paper; of such species I have had an opportunity of seeing specimens identified by Clark, but no new material has been available of them.

List of Asteroidea and Ophiuroidea of S. African Seas, from Natal to Lüderitzbay.

Previously recorded species.	Revised list of species.
Asteroidea.	Asteroidea.
Porcellanaster coeruleus W. Th.	*Porcellanaster coeruleus W. Th.
Pectinaster Filholi Perrier	*Pectinaster Filholi Perrier
Luidiaster hirsutus Studer	Luidiaster hirsutus Studer
Plutonaster intermedius (Perrier)	Plutonaster intermedius (Perrier)
— proteus H. L. Clark	— proteus H. L. Clark
Dipsacaster Sladeni Alcock	Dipsacaster Sladeni Alcock
Leptychaster kerguelensis E.A.Smith (B)	— —
	Persephonaster Roulei, var. euryplax n. var.
Bathybiaster robustus Verrill	Bathybiaster robustus Verrill
Psilaster acuminatus Sladen	Psilaster acuminatus Sladen
Astropecten polyacanthus M. & Tr.	Astropecten polyacanthus M. & Tr.
— granulatus M. & Tr.	— granulatus M. & Tr.
— anacanthus H. L. Clark	— anacanthus H. L. Clark
— leptus H. L. Clark	— leptus H. L. Clark
— irregularis pontoporæus Sladen	— irregularis pontoporæus Sladen
	— Hemprichii M. & Tr.
	— antares Döderlein
	— exilis n. sp.
Luidia africana Sladen	Luidia africana Sladen
— Savignyi Audouin	* — Savignyi Audouin
	? — maculata M. & Tr.
Pseudarchaster tesselatus Sladen	Pseudarchaster tesselatus Sladen
— brachyactis H.L.Clark	— brachyactis H.L.Clark
Mediaster capensis H. L. Clark	Mediaster capensis H. L. Clark
	— — durbanensis n. var.
Ceramaster chondriscus H. L. Clark	Ceramaster chondriscus H. L. Clark
— trispinosus H. L. Clark	* — trispinosus H. L. Clark
— patagonicus euryplax H.L. Clark	* — patagonicus euryplax H.L. Clark
Calliaster baccatus Sladen	Calliaster baccatus Sladen
— acanthodes H. L. Clark	— acanthodes H. L. Clark
Tosia tuberculata Gray	Tosia tuberculata Gray

Cladaster macrobrachius H. L. Clark
Sphæriodiscus Bourgeti Perrier
Hippasteria phrygiana (Parelius)
— strongylactis H. L. Clark
Anthosticte Pacei Mrtsn. (M)
Anthenoides Marleyi Mrtsn. (M)
Odontaster australis H. L. Clark
Oreaster mamillatus Audouin

Chondraster elattosis H. L. Clark
Austrofromia Schultzei Döderlein (D)
Dactylosaster cylindricus Gray (M)
Hacelia superba capensis Mrtsn. (M)
Cycethra sp.(?)
Asterina granifera (Gray)
— — sporacantha H. L. Clark
— exigua (Lamk.)
— dyscrita H. L. Clark
* — calcarata (Gray) (K)
— lüderitziana Döderlein (D)
— gracilispina H. L. Clark
* — coccinea (Gray)
*Parasterina bellula Sladen
*Asterina penicillaris (Lamk.) (Me)

Anseropoda novemradiata (Bell)
— habracantha H. L. Clark

Echinaster reticulatus H. L. Clark
Henricia ornata (Perrier)
— —
Poraniopsis capensis H. L. Clark
Cryaster brachyactis H. L. Clark
Culcita veneris Perrier (B)
Crossaster penicillatus Sladen
Lophaster quadrispinus H. L. Clark
Pteraster capensis Gray
— affinis E. A. Smith

Diplopteraster multipes (M. Sars)
Hymenaster lamprus H. L. Clark
— gennæus H. L. Clark
— latebrosus Sladen

Cladaster macrobrachius H. L. Clark
Sphæriodiscus Bourgeti Perrier
Hippasteria phrygiana capensis n. var.
— strongylactis H. L. Clark
Anthosticte Pacei Mrtsn.
Anthenoides Marleyi Mrtsn.
Odontaster australis H. L. Clark
*Oreaster mamillatus Audouin
Tylaster meridionalis n. sp.
*Chondraster elattosis H. L. Clark
Austrofromia Schultzei Döderlein
Dactylosaster cylindricus Gray
Hacelia superba capensis Mrtsn.
*Cycethra sp.(?)
Asterina granifera (Gray)
— — sporacantha H. L. Clark
— (Patiriella) exigua (Lamk.)
— — —
— — —
* — lüderitziana Döderlein
— gracilispina H. L. Clark
Not S. African
Parasterina bellula Sladen
— —
— formosa n. sp.
Disasterina leptalacantha africana n. var.
Anseropoda novemradiata (Bell)
— habracantha H. L. Clark
— grandis n. sp.
Echinaster reticulatus H. L. Clark
— ornatus Perrier
Henricia abyssalis Perrier
Poraniopsis capensis H. L. Clark
Cryaster brachyactis H. L. Clark
— —
Crossaster penicillatus Sladen
Lophaster quadrispinus H. L. Clark
Pteraster capensis Gray
* — affinis E. A. Smith
— fornicatus n. sp.
— flabellifer n. sp.
Diplopteraster multipes (M. Sars)
Hymenaster lamprus H. L. Clark
— gennæus H. L. Clark
* — latebrosus Sladen

Species	Depth in meters	Cape Province	Algoa Bay	Natal	Mosambique	Indian Ocean	Malay Archipelago	Australia	S.W. Africa	Atlantic	West Indian	Magellanic Region	Kerguelen	Other localities
Porcellanaster coeruleus W. Th.	1475—2700	×	..	..	..	..	..	..	..	×	..	..	..	..
Pectinaster Filholi Perrier	1180—2460	×	..	..	..	..	..	..	..	×	..	..	..	..
Luidiaster hirsutus Studer	235—440	×	..	..	..	..	..	..	..	..	..	..	×	..
Persephonaster Roulei, var. euryplax Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	..
Plutonaster intermedius Perrier	560—1720	×	..	..	..	..	..	..	×	..	×	..	..	..
— proteus H. L. Clark	1360—1800	×	..	..	..	..	..	..	..	..	..	..	..	..
Dipsacaster Sladeni Alcock	165—650	×	..	..	..	×	..	..	..	..	..	..	..	..
Bathybiaster robustus Verrill	1360—2630	×	..	..	..	..	..	..	..	×	..	..	..	(Off N. America)
Psilaster acuminatus Sladen	35—1710	×	..	..	..	..	..	×	..	..	..	..	..	N. Zealand
Astropecten polyacanthus M. Tr.	0—90	..	..	×	×	×	×	×	..	..	..	..	..	N. Zealand
— irregularis, pontoporæus Sladen	10—180	×	×	..	..	..	..	..	..	..	..	..	..	..
— granulatus M. Tr.	10—55 (?360)	×	..	×	..	..	×	×	..	..	..	..	..	..
— Hemprichii M. Tr.	Littoral (?)	..	..	×	×	..	..	..	..	..	..	..	..	Red Sea
— antares Döderlein	9—63	×	..	..	×	..	..	..	..	..	..	..	..	..
— leptus H. L. Clark	205—370	..	..	×	..	..	..	..	..	..	..	..	..	..
— exilis Mrtsn.	?	..	..	× (?)	..	..	..	..	..	..	..	..	..	..
— anacanthus H. L. Clark	122—277	..	..	×	..	..	..	..	..	..	..	..	..	..
Luidia africana Sladen	54—320	×	×	..	..	..	..	..	..	..	..	..	..	..
— maculata M. Tr.	0—640	..	..	×	×	×	×	×	..	..	..	..	..	Japan
— Savignyi Audouin	18—45	..	..	×	..	×	×	..	..	..	..	..	..	Red Sea
Pseudarchaster tesselatus Sladen	150—450	×	..	..	..	..	..	..	..	..	..	..	..	..

*Ophioderma Wahlbergi Müll. & Troschel	*Ophioderma wahlbergi Müll. & Troschel
	Ophiolepis cincta Müll. & Troschel.
Ophiura costata (Lyman)	Ophiura costata (Lyman)
— irrorata (Lyman)	— irrorata (Lyman)
— flagellata (Lyman)	— flagellata (Lyman)
— trimeni Bell	— trimeni Bell
	— (Ophiuroglypha) tumida n. sp.
Dictenophiura anoidea H. L. Clark	Dictenophiura anoidea H. L. Clark.
Ophiocten amitinum Lyman	Ophiocten amitinum Lyman
	— — var. microplax n. var.
— pacificum Ltk. & Mrtsn.	— latens Koehler.
Ophiomusium Lymani Wyv. Thomson	Ophiomusium Lymani Wyv. Thomson
Ophiomisidium flabellum (Lyman)	*Ophiomisidium flabellum (Lyman)
Astrophiura cavellæ Koehler	Astrophiura permira Sladen
Ophiernus vallincola Lyman	Ophiernus vallincola Lyman

The present report serves greatly to emphasize the zoogeographical relations of the South African Echinoderm fauna as set forth by Clark (Op. cit. 1923. p. 224—227). The percentage numbers of the components of that fauna are, of course, somewhat modified, but not so much as to alter the general results, and I do not therefore think it necessary, or even desirable to give any details here, where only the Asteroids and Ophiurids are dealt with. It may only be stated briefly that out of the total number of Asteroids now actually known from S. African Seas, viz. 85, no less than 58 are known from nowhere else in the world, and of the Ophiuroids 56 of a total number of 82.

I would point out the extraordinary number of new forms, particularly Ophiurids, found off Durban. This result of the few dredgings done there gives definite promise of a rich harvest, when once extensive trawlings and dredgings are undertaken in the deeper waters off the Natal coast. It is to be expected that most of the Deep-sea fauna of the Indian Ocean will be found there — and probably much farther South. This will be one of the most interesting problems to investigate: how far South the Indian Ocean species go, and how far North the Cape region species go. I would expect the region off Algoa Bay to be, if I may so say, the critical area, where most of these species have respectively their southern and northern limit.

Very noteworthy are the facts that there are scarcely any species common to the S. African and the Magellanic region (*Ophiomyxa vivipara*, *Ophiactis plana*, and *Diplopteraster multipes*, the two latter of

Continued on p. 230.

	Ophiothamnus remotus var. cordatus n. var.
Ophiothrix aristulata Lyman	Ophiothrix aristulata Lyman
— fragilis (Abildgård)	— fragilis (Abildgård)
— triglochis Müll. & Troschel	— triglochis Müll. & Troschel
— roseo-coerulans Grube (B)	— —
— longipeda (Lamarck)	* — longipeda (Lamk.)
— capensis Lütken	Ophiogymna capensis (Lütken)
	— fulgens (Koehler)
Ophiocnemis marmorata (Lamarck)	?Occurrence at S. Africa doubtful.
Ophiopsammium nudum H. L. Clark	*Ophiopsammium nudum H. L. Clark
Ophiothela dividua v. Martens	Ophiothela dividua v. Martens
Ophiactis carnea Ljungman	Ophiactis carnea Ljungman
— plana Lyman	— plana Lyman
— africana, var. capensis (H.)	— — —
— abyssicola (M. Sars)	— abyssicola (M. Sars)
	— nidarosiensis Mrtsn.
Amphiura dilatata Lyman	Amphiura dilatata Lyman
— capensis Ljungman	— capensis Ljungman
— angularis Lyman	— angularis Lyman
— incana Lyman	— incana Lyman
— candida Ljungman	Not recognizable; species delenda.
	Amphiura uncinata Koehler
	— grandisquama, var. natalensis n. var.
	— linearis n. sp.
	— adjecta n. sp.
	— compressa n. sp.
Amphipholis squamata Delle Chiaje	Amphipholis squamata (Delle Chiaje)
— minor (Döderlein)	— — —
	— strata n. sp.
	— similis n. sp.
Amphioplus gibbosus (Ljungman)	Amphioplus(?) gibbosus (Ljungm.)
— integer (Ljungman)	— integer (Ljungm.)
	— falcatus n. sp.
	— pectinatus n. sp.
	— furcatus n. sp.
	Amphilepis scutata n. sp.
Ophionereis dubia (Müll. & Troschel)	Ophionereis dubia (Müll. & Troschel)
— porrecta Lyman	— porrecta Lyman
Ophiochiton australis H. L. Clark	— australis (H. L. Clark)
	Ophiocoma valenciæ Müll. & Troschel
Cryptopelta aster (Lyman)	Cryptopelta aster (Lyman)
Ophiarachnella capensis (Bell)	Ophiarachnella capensis (Bell)
	Ophiopezella decorata n. sp.
Ophioderma leonis Döderlein	Ophioderma leonis Döderlein

Hymenaster membranaceus Sladen	*Hymenaster membranaceus Sladen
Stichaster felipes Sladen	Cosmasterias felipes (Sladen)
Marthasterias glacialis (Linn.)	Marthasterias glacialis rarispina (Perrier)
— rarispina (Perrier)	— — —
— africana (M. & Tr.)	— — africana (M. & Tr.)
*Asterias capensis Perrier (B)	Sclerasterias capensis (Perrier)
Eustolasterias stenactis H. L. Clark	— stenactis (H. L. Clark)
	— eustyla (Sladen)
Coscinasterias calamaria (Gray) (B)	*Coscinasterias calamaria (Gray)
Perissasterias polyacantha H. L. Clark	Perissasterias polyacantha H. L. Clark
— obtusispina H. L. Clark	* — obtusispina H. L. Clark
— heptactis H. L. Clark	* — heptactis H. L. Clark
	— sp.
Coronaster volsellatus (Sladen)	Coronaster volsellatus (Sladen)
Brisinga cricophora Sladen	Brisinga cricophora Sladen
Stegnobrisinga splendens H. L. Clark	*Stegnobrisinga splendens H. C. Clark
Ophiuroidea.	Ophiuroidea.
Asteronyx Loveni Müll. & Troschel	Asteronyx Loveni Müll. & Troschel
	Astroceras spinigera n. sp.
	Asterostegus tuberculatus n. g., n.sp.
Ophiuropsis Lymani Studer	not S. African.
Astroschema capensis Mrtsn. (M)	Astroschema capensis Mrtsn.
Astrothamnus papillatus H. L. Clark	Astrothorax papillata (H. L. Clark)
Gorgonocephalus chilensis (Philippi)	Gorgonocephalus pectinatus n. sp.
Astrocladus euryale (Retzius)	Astrocladus euryale (Retzius)
	— hirtus n. sp.
	— africanus n. sp.
	Astroconus capensis n. sp.
Ophiomyxa vivipara Studer	Ophiomyxa vivipara Studer
	— bengalensis Koehler
	— tenuispina n. sp.
Ophioscolex dentatus Lyman	Ophioscolex dentatus Lyman
	— — var. spiniger n. var.
	— inermis n. sp.
Ophiacantha nerthepsila H. L. Clark	Ophiacantha nerthepsila H. L. Clark
	— scutigera n. sp.
	— baccata n. sp.
	— striolata n. sp.
	— (Ophiotreta) durbanensis n. sp.
Ophiomitrella corynephora H. L. Clark	Ophiomitrella corynephora H. L. Clark
	— hamata n. sp.
	Ophioplinthaca sexradia n. sp.
Ophiothamnus remotus Lyman	Ophiothamnus remotus Lyman

— patagonicus, euryplax H. L. Clark	153—322	×	..	..	..	..	..	..	..	..	..	..	..	..
Calliaster baccatus Sladen	9—140	×	×	..	..	..	..	..	..	..	..	..	..	..
— acanthodes H. L. Clark	115—405	×	×	×	..	..	..	..	..	..	..	..	..	..
Tosia tuberculata Gray	80—540	×	×	×	..	..	..	..	..	..	..	..	..	..
Cladaster macrobrachius H. L. Clark	385—900	×	..	..	..	..	..	..	..	..	..	..	..	..
Hippasteria phrygiana, capensis Mrtsn.	306—966	×	..	..	..	..	..	..	..	..	..	..	..	..
— strongylactis H. L. Clark	315—966	×	..	..	..	..	..	..	..	..	..	..	..	..
Anthosticte Pacei Mrtsn.	? (ca. 250)	..	..	× (?)	..	..	..	..	..	..	..	..	..	..
Anthenoides Marleyi Mrtsn.	250—270	..	..	×	..	..	..	..	..	..	..	..	..	..
Sphæriodiscus Bourgeti Perrier	410—760	..	..	×	..	..	..	..	..	×	..	..	..	(Cape Verde)
Odontaster australis H. L. Clark	240—315	×	..	..	..	..	..	..	..	..	..	..	..	..
Oreaster mamillatus Audouin	Littoral	×	..	..	×	..	..	..	..	..	..	..	..	Red Sea
Tylaster meridionalis Mrtsn.	194	×	..	..	..	..	..	..	..	..	..	..	..	..
Chondraster elattosis H. L. Clark	966—1008	×	..	..	..	..	..	..	..	..	..	..	..	..
Poraniopsis capensis H. L. Clark	288—414	×	..	..	..	..	..	..	..	..	..	..	..	..
Austrofromia Schultzei Döderlein	14—16	×	×	..	..	..	..	..	..	..	..	..	..	..
Dactylosaster cylindricus Gray	Littoral	..	..	×	×	×	..	..	..	..	..	..	..	Hawaiian Isl.
Hacelia superba, capensis Mrtsn.	?	..	..	(?) ×	..	..	..	..	..	..	..	..	..	..
Cycethra sp.	77	..	×	..	..	..	..	..	..	..	..	..	..	..
Parasterina bellula (Sladen)	0—54	×	..	..	..	..	..	..	..	..	..	..	..	..
— formosa Mrtsn.	54	×	..	..	..	..	..	..	..	..	..	..	..	..
Asterina granifera (Gray)	0—40	×	..	..	..	..	..	..	..	..	..	..	..	..
— —, sporacantha H. L. Clark	0—80	×	..	..	..	..	..	..	..	..	..	..	..	..
— (Patiriella) exigua (Lamk.)	Littoral	×	×	×	×	×	×	×	×	..	..	..	..	St. Helena
— lüderitziana Döderlein	Littoral	..	..	..	..	..	..	..	×	..	..	..	..	..
— gracilispina H. L. Clark	25—40	×	..	..	..	..	..	..	..	..	..	..	..	..
— leptalacantha, africana Mrtsn.	Littoral	..	×	..	..	..	..	..	..	..	..	..	..	..

Species	Depth in meters	Cape Province	Algoa Bay	Natal	Mosambique	Indian Ocean	Malay Archipelago	Australia	S.W. Africa	Atlantic	West Indian	Magellanic Region	Kerguelen	Other localities
Anseropoda novemradiata (Bell)	60—300	×	..	×	..	..	..	..	..	..	..	..	..	..
— habracantha H. L. Clark	120—150	..	×	×	..	..	..	..	..	..	..	..	..	..
— grandis Mrtsn.	310	..	..	..	..	..	..	..	×	..	..	..	..	..
Henricia abyssalis (Perrier)	210—1635	×	..	..	..	..	..	..	..	×	..	..	..	..
Echinaster ornatus Perrier	0—35	×	..	..	..	..	..	..	..	..	..	..	..	..
— reticulatus H. L. Clark	30—288	×	..	..	..	..	..	..	..	..	..	..	..	..
Cryaster brachyactis H. L. Clark	40—100	×	×	..	..	..	..	..	..	..	..	..	..	..
Crossaster penicillatus Sladen	70—805	×	×	..	..	..	..	..	..	..	..	..	..	..
Lophaster quadrispinus H. L. Clark	350—520	×	×	×	..	..	..	..	..	..	..	..	..	..
Pteraster capensis Gray	35—365	×	×	..	..	..	..	..	..	..	..	..	..	..
— affinis E. A. Smith	50—415 (?)	× (?)	..	..	..	..	..	..	..	..	..	..	×	..
— fornicatus Mrtsn.	322	×	..	..	..	..	..	..	..	..	..	..	..	..
— flabellifer Mrtsn.	360	..	..	..	..	..	..	..	×	..	..	..	..	..
Diplopteraster multipes (M. Sars)	100—1170	×	..	..	..	..	..	..	..	..	..	×	..	N. Atlantic, N. Pacific
Hymenaster latebrosus Sladen	ca. 1450—3500	×	..	..	..	..	..	..	..	..	..	..	..	Antarctic, Deep-sea
— membranaceus Sladen	ca. 1450—2025	×	..	..	..	..	..	..	..	×	..	..	..	..
— lamprus H. L. Clark	ca. 1450	×	..	..	..	..	..	..	..	..	..	..	..	..
— gennæus H. L. Clark	ca. 1350—1450	×	..	..	..	..	..	..	..	..	..	..	..	..
Cosmasterias felipes (Sladen)	153—367	×	..	..	..	..	..	..	..	..	..	..	..	..
— capensis (Perrier)	Littoral (?)	× (?)	..	..	..	..	..	..	..	..	..	..	..	..
Marthasterias glacialis regressa (Perrier)	45—145													

Perissasterias polyacantha H. L. Clark														
— sp.	?	× (?)	..	..	..	..	..	..	..	..	..	..	..	
— obtusispina H. L. Clark	385	×	..	..	..	..	..	..	..	..	..	..	..	
— heptactis H. L. Clark	378	×	..	..	..	..	..	..	..	..	..	..	..	
Coscinasterias calamaria (Gray)	0—ca. 40	..	..	×	..	×	..	×	..	..	..	..	..	N. Zealand
Coronaster volsellatus (Sladen)	170—405	×	..	×	..	..	×	..	..	..	..	..	..	
Brisinga cricophora Sladen	410—700	×	..	..	..	..	..	..	..	..	×	..	..	
Stegnobrisinga splendens H. L. Clark	846	..	..	×	..	..	..	..	..	..	..	..	..	
Asteronyx Loveni M. Tr.	ca. 100—1800	×	..	..	..	×	×	×	..	×	×	..	..	Pacific
Astroceras spinigerum Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	
Asterostegus tuberculatus Mrtsn.	376	..	..	×	..	..	..	..	..	..	..	..	..	
Astroschema capensis Mrtsn.	?	..	..	×	..	..	..	..	..	..	..	..	..	
Astrothorax papillata (H. L. Clark)	43—558	×	×	×	..	..	..	..	..	..	..	..	..	
Gorgonocephalus pectinatus Mrtsn.	350—540	×	×	..	..	..	..	..	..	..	..	..	..	
Astrocladus euryale (Retzius)	15—90	×	×	..	..	..	..	..	..	..	..	..	..	
— hirtus Mrtsn.	?	..	..	× (?)	..	..	..	..	..	..	..	..	..	
— africanus Mrtsn.	?	?	..	..	..	..	..	..	..	..	..	..	..	
Astroconus capensis Mrtsn.	415	..	..	×	..	..	..	..	..	..	..	..	..	
Ophiomyxa vivipara Studer	0—360	×	..	..	..	..	..	..	..	..	..	×	..	
— bengalensis Koehler	250—550	..	..	×	..	×	×	..	..	..	..	..	..	
— tenuispina Mrtsn.	?	..	..	?	..	..	..	..	..	..	..	..	..	
Ophioscolex (Ophiolycus) dentatus Lyman	160—405	×	..	..	..	..	..	..	..	..	..	..	..	
Ophioscolex (Ophiolycus) dentatus, spiniger Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	
Ophioscolex inermis Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	
Ophiacantha nerthepsila H. L. Clark	30—90	×	..	..	..	..	..	..	..	..	..	..	..	
— scutigera Mrtsn.	160—215	..	..	×	..	..	..	..	..	..	..	..	..	
— baccata Mrtsn.	228—284	..	..	×	..	..	..	..	..	..	..	..	..	

Species	Depth in meters	Cape Province	Algoa Bay	Natal	Mosambique	Indian Ocean	Malay Archipelago	Australia	S.W. Africa	Atlantic	West Indian	Magellanic Region	Kerguelen	Other localities
Ophiacantha striolata Mrtsn.....	405	..	..	×	..	..	..	..	..	..	..	..	..	..
— (Ophiotreta) durbanensis Mrtsn.....	405	..	..	×	..	..	..	..	..	..	..	..	..	..
Ophiomitrella corynephora H. L. Clark	288—415	×	..	..	..	..	..	..	..	..	..	..	..	..
— hamata Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	..
Ophioplinthaca sexradia Mrtsn.....	43	×	..	..	..	..	..	..	..	..	..	..	..	..
Ophiothamnus remotus Lyman.....	90—415	×	..	×	..	..	..	..	..	..	..	..	..	..
— — cordatus Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	..
Ophiothrix aristulata Lyman	70—530	×	..	..	..	..	×	×	..	..	..	..	..	..
— fragilis (Abildgård)	0—475 (1245)	×	..	..	..	..	..	..	..	×	..	..	..	Mediterranean
— triglochis M. Tr.....	0—215	×	×	×	..	..	..	..	..	..	..	..	..	..
— longipeda (Lamk.).....	0—658	..	..	×	×	×	×	×	..	..	..	..	..	..
Ophiogymna capensis (Lütken).....	?	..	..	× (?)	..	..	..	..	..	..	..	..	..	..
— fulgens (Koehler)	25—925	..	..	×	..	..	×	..	..	..	..	..	..	..
Ophiopsammium nudum H. L. Clark..	65	..	..	×	..	..	..	..	..	..	..	..	..	..
Ophiothela dividua v. Martens	?	..	×	..	..	..	..	..	..	..	..	..	..	..
— Danæ Verrill.....	12—215	..	..	×	..	..	×	..	..	..	..	..	..	Fiji
Ophiactis carnea Ljungman.....	0—215	×	×	×	..	..	..	..	..	..	..	..	..	..
— plana Lyman.....	70—405	×	..	×	..	..	(×)	..	..	..	..	×	..	Cosmopolitan(?)
— abyssicola (M. Sars)	125—4000	×	..	..	..	..	..	..	..	×	..	..	..	..
— nidarosiensis Mrtsn.....	200—560	× (?)	..	..	..	..	..	..	..	×	..	..	..	..
Amphiura atlantica, dilatata Lyman..	150—265	×	..	..	..	..	..	..	..	..	..	..	..	..
— capensis Ljungman.....	Littoral	×							×					

— linearis Mrtsn.	90—160	..	..	×	..	..	..	..	..	..	..	..	..	..
— adjecta Mrtsn.	63	..	..	×	..	..	..	..	..	..	..	..	..	..
— compressa Mrtsn.	54	×	..	..	..	..	..	..	..	..	..	..	..	..
— albella Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	..
Amphipholis squamata (D. Ch.)	0—740	×	..	×	..	×	×	×	×	×	×	..	..	Cosmopolitan
— strata Mrtsn.	54	×	..	..	..	..	..	..	..	..	..	..	..	..
— similis Mrtsn.	63	..	..	×	..	..	..	..	..	..	..	..	..	..
Amphioplus gibbosus (Ljungm.)	?	..	..	×	..	..	..	..	..	..	..	..	..	..
— integer (Ljungm.)	15—63	×	..	×	..	..	..	..	..	..	..	..	..	..
— falcatus Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	..
— pectinatus Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	..
— furcatus Mrtsn.	45	..	..	×	..	..	..	..	..	..	..	..	..	..
Amphilepis scutata Mrtsn.	405	..	..	×	..	..	..	..	..	..	..	..	..	..
Ophionereis dubia (M. Tr.)	13—230	..	×	×	×	×	×	×	..	..	..	..	..	Japan
— porrecta Lyman	ca. 10—160	..	×	×	..	×	×	×	..	..	..	..	..	Hawaiian Isl. / Riu-Riu
— australis (H. L. Clark)	84—160	..	..	×	..	..	..	..	..	..	..	..	..	..
Ophiocoma Valenciæ M. Tr.	Littoral	..	..	×	×	×	..	..	..	..	..	..	..	Red Sea
Cryptopelta aster (Lyman)	77—415	×	..	..	..	..	..	..	..	..	..	..	..	..
Ophiarachnella capensis (Bell)	0—90	×	..	..	..	..	..	..	..	..	..	..	..	..
Ophiopezella decorata Mrtsn.	Littoral	..	..	×	..	..	..	..	..	..	..	..	..	..
Ophioderma leonis Döderlein	0—18	×	..	..	..	..	..	..	×	..	..	..	..	..
— wahlbergi M. Tr.	Littoral	..	..	(?) ×	..	..	..	..	..	..	..	..	..	? Red Sea
Ophiolepis cincta M. Tr.	0—35	..	..	×	..	×	×	×	..	..	..	..	..	Society Isl.
Ophiura costata (Lyman)	45—1620	×	..	..	..	..	..	..	..	..	..	..	..	..
— irrorata (Lyman)	600—4315	×	..	..	..	..	×	..	..	×	..	..	..	Cosmopolitan
— flagellata (Lyman)	96—2330	×	..	..	..	×	×	..	..	×	..	..	..	N. Pacific
— trimeni Bell	160—1620	×	..	..	..	..	..	..	..	..	..	..	..	..
— (Ophiuroglypha) tumida Mrtsn.	120—405	..	..	×	..	..	..	..	..	..	..	..	..	..

Species	Depth in meters	Cape Province	Algoa Bay	Natal	Mosambique	Indian Ocean	Malay Archipelago	Australia	S.W. Africa	Atlantic	West Indian	Magellanic Region	Kerguelen	Other localities
Dictenophiura anoidea H. L. Clark....	40—100	×	:	:	:	:	:	:	×	:	:	:	:	:
Ophiocten amitinum Lyman.....	50—3510	:	×	:	:	:	:	:	:	:	:	×	×	Antarctic Deep-sea
— — microplax Mrtsn.	Littoral	:	×	:	:	:	:	:	:	:	:	:	:	:
— — latens Koehler.....	2140—4700	×	:	:	:	:	:	:	:	×	:	:	:	:
Gymnophiura novembris Hertz.....	564	×	:	:	:	:	:	:	:	:	:	:	:	:
Ophiomusium Lymani W. Th.....	130—3435	×	:	:	:	:	×	:	:	×	×	:	:	Pacific
Ophiomisidium pulchellum (Lyman) ..	180—270	×	:	:	:	:	:	:	:	:	:	:	:	:
Astrophiura permira Sladen.....	180—318	×	:	:	:	:	:	:	:	:	:	:	:	Madagascar
Ophiernus vallincola Lyman	825—2475	×	:	:	:	×	:	:	:	× (?)	:	:	:	Antarctic Deep-sea

which are of almost cosmopolitan distribution), or to S. Africa and Kerguelen — *Luidiaster hirsutus*, *Pteraster affinis*, *Amphiura incana*, and *Ophiocten amitinum* being the only ones — and I cannot help wondering whether the only specimen of *Pteraster affinis* recorded from S. Africa is correctly identified [1]).

A fact of considerable zoogeographical interest is the find of a *Tylaster* species in S. African waters, very closely related to the only other species of that genus known, the rare *Tylaster Willei* Kor. & Dan. of the arctic Atlantic Deep-sea N. of Iceland.

As Clark gives only the rather meagre percentage numbers of the species endemic to S. Africa or common to S. Africa and other regions I think the above list, giving the actual distribution of each species, to be of some practical value.

[1]) Cf. Additional Note, p. 397.

As facts of more general interest resulting from these investigations I would mention the viviparity of *Pteraster capensis*, *Cryptopelta aster*, and *Ophiomitrella hamata*, the two latter, together with the likewise viviparous *Ophiomitrella corynephora* being also hermaphroditic. A very interesting anatomical fact is made known for the two said *Ophiomitrella* species: *O. corynephora* has the bursæ at each arm coalesced above the arm, there being thus in this species 5 large bursæ, each with two openings; this is carried to an extreme in *O. hamata*, all the bursæ being there coalesced into one single, circular space, lying below the stomach and, of course, with the 10 usual openings. On the other hand, in *Ophiothamnus remotus* there are no bursæ at all.

Asteroidea.

I. Family *Benthopectinidæ*.

Luidiaster hirsutus Studer.

Th. Studer. 1884. Asteriden u. Euryaliden d. "Gazelle". Abh. Ak. Berlin v. J. 1884. p. 47. Taf. IV. 7. a—d.
H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 241.
— 1926. Echinod. S. Africa. Fish. & Mar. Biol. Surv. II. Asteroidea, p. 2.

Off Cape Peninsula, 34°5′ S. 18°1′ E. 118 fathoms. 4 specimens. 17. XII. 1929.
Off Cape Peninsula, 34°21′ S. 17°57′ E. 178 fathoms, 1 specimen. 18. XII. 1929.
These specimens dredged onboard the "Pickle".
There are further some specimens from:
31°14′ S. 16°30′ E. 171 fms. 7 specimens
31°02′ S. 15°42′ E. 245 - 10 —
30°43′ S. 16°38′ E. 126 - 1 —

The colour of the live specimens was a faint reddish pink, which has kept fairly well in some of the dried specimens.

The difference between the present species and *Pectinaster Filholi* Perr. given by Clark (Op. cit. 1923) in the key, viz. that the latter has only one large spine on the ventral side of the adambulacrals, whereas *Luidiaster hirsutus* has three large spines there, does not at all hold good. I find now one, now two, now three such large spines in *Luidiaster* (viz. specimens with the papularium V-shaped) — these specimens being otherwise so perfectly alike that there can be no question but that they all are really one and the same species. — Not

having seen specimens of *Pectinaster Filholi*, I shall not try to indicate the characters, by which the two forms may be distinguished.

II. Family ***Astropectinidæ.***

Astropecten irregularis, var. *pontoporæus* Sladen.

Astropecten pontoporæus Sladen 1883. J. Linn. Soc. XVII. p. 259.
— *capensis* Studer 1884. "Gazelle" Ast. p. 44.
— *pontoporæus* Sladen 1889. Challenger Ast. p. 210 Pl. XXXV. 1—2; XXXVIII 10—12.
— *irregularis*, var. *pontoporæus* Döderlein 1917. "Siboga" Ast. I. Astropecten. p. 75. Taf. I. 5; VII. 9—10.
— *pontoporæus* H. L. Clark. 1923. Ech. Fauna S. Africa p. 249.
— *irregularis*, var. *pontoporæus* H. L. Clark 1926. Echinoderms S. Africa. Fish & Mar. Biol. Surv. II. Seastars (Asteroidea) p. 6.

A number of specimens I took onboard the trawler "John C. Meikle" on the Agulhas Bank, 35—42 fathoms, off Cape Barracouta, in December 1929. Also some specimens were taken in False Bay, at depths of 15—30 fathoms, onboard the "Pickle", December 1929. Further, I have in 1930 received a number of specimens from off East London from Captain Pace.

I quite agree with Döderlein and Clark that this South African *Astropecten* can only be regarded as a subspecies of the N. Atlantic *A. irregularis*, and I may add that also the colour is the same as in *irregularis*, a light reddish-violet, particularly in the distal part of the arms, which may sometimes keep fairly well also in dried specimens.

As in *irregularis* the spine on the superomarginals may be totally wanting, corresponding to the var. *pentacanthus*.

Astropecten Hemprichii Müll. & Troschel.

Astropecten Hemprichii Müller & Troschel. 1842. Syst. d. Asteriden p. 71.
— — Döderlein 1917. "Siboga"-Ast. I. Astropecten. p. 139. Taf. VI. 1—2; Taf. XIII. 1—1 b.
— — H. L. Clark 1923. Echinod. Fauna S. Afr. p. 250.

One specimen of this species was sent me in 1931 by Mr. Bell Marley, Durban. Unfortunately there was no information about the locality from where it came. But as other specimens sent at the same time were from Durban, it is rather sure that also this species came

which may be somewhat larger in the proximal plates — apparently not in the distal plates; but on account of the poor preservation, most of the infero-marginals having lost their covering of spinelets nearly completely, this cannot be ascertained definitely. There are 3 fairly well developed ventrolateral plates to each side, apparently without pedicellariæ. Adambulacrals with three furrow spines, the median one slightly compressed. Outside the furrow spines a longitudinal series of 3, the middle one distinctly enlarged; distally to them again usually 2 similar, enlarged spines. — It is, however, only few of the adambulacrals that have the spines intact; but it would seem that it is the typical arrangement here described and figured (Fig. 2). The jaws apparently have a double row of ca. 10 rather coarse spines on the outer surface.

Colour of the dried specimen white.

This species seems to be nearest related to *Astropectus eremicus* Fisher from the Philipine Seas, from which it seems to differ only in rather unimportant details e. g. in the paxillæ. But then *eremicus* is black ("sepia"), the present specimen white; this would seem to show definitely that they are two distinct species.

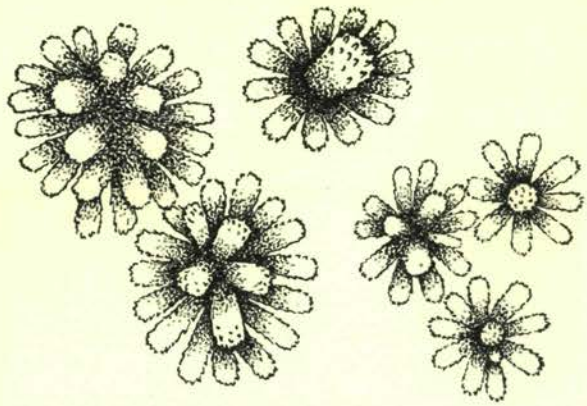
Psilaster acuminatus Sladen.

Psilaster acuminatus Sladen. 1889. "Challenger" Ast. p. 225, Pl. 40. 1—2; 42. 7—8.
— — H. L. Clark. 1916. "Endeavour" Ech. p. 32.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa p. 248.
— — Th. Mortensen. 1925. Ech. N. Zealand- & Auckland-Campbell Isl. III—V. p. 274. (Papers Dr. Th. M. Pacif. Exp. XXIX; Vid. Medd. Dansk Nat. Foren. Bd. 79).
— — H. L. Clark. 1926. Echinod. S. Africa. Fish. & Mar. Biol. Surv. II. Sea-stars (Asteroidea) p. 3.

Off Cape Peninsula (34°21′ S. 17°57′ E. 178 fathoms); 2 specimens, dredged onboard the "Pickle", 18. XII. 1929. There are further numerous specimens from the S. African Fisheries Survey, 30°30′ S. 15°55′ E. 143 fathoms, and one from 31°03′ S. 15°42′ E. 245 fathoms.

The latter specimen is interesting in having the marginal plates rather bare. That this is, however, not a character of specific value is quite evident, this specimen differing in no other respects from the other specimens with the marginal plates totally covered by papillæ.

side of the arm; they are here about equally long and broad, whereas in the basal part they are much broader than long. They are covered with a low granulation, slightly larger in the upper part, but there



a. b.

Fig. 1. Paxillæ of *Astropecten exilis* n. sp. a. From the disk, in the radii; b. from the distal part of arm. × 30.

are no spines on any of the supero-marginals. The granules are partly more in the shape of short somewhat pointed spinelets and directed distalwards. Infero-marginals do not extend laterally beyond the supero-marginals. There is one conspicuous flattened lateral spine, and below

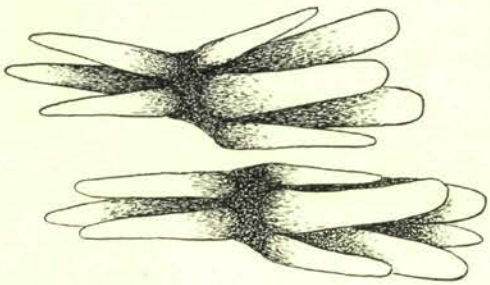


Fig. 2. Two adambulacrals of *Astropecten exilis* n. sp. × 30.

that, at the distal edge of the plate, there is usually a second such spine, scarcely half the length of the first one. The infero-marginals covered with short, flattened, lanceolate spinelets, a median series of

bique. Probably then it is a warm-water species having a southward extension, its southern limit being at the Agulhas Bank, as may be concluded from the fact that it has not been found in the Cape region in spite of much dredging and trawling there, and that only a single specimen was found on the Agulhas Bank, where *Astropecten pontoporœus* was found in great numbers.

I beg to thank my friend Professor Döderlein for kindly identifying this species for me.

Astropecten leptus H. L. Clark.

Pl. IX. Figs. 3—4.

H. L. Clark. 1926. Echinoderms S. Afr. Fish. and Mar. Biol. Surv. II. Sea-stars (Asteroidea), p. 6. Pl. I. 3—4.

A couple of specimens (cotypes) of this species having been left me by the Fisheries Survey, I take the opportunity of giving new figures of it; the figures given in Clark's paper are so very poor that hardly any details can be made out on them, and it is therefore necessary to have better figures of the species. I hope, the figures here given will prove more satisfactory.

I have nothing to add to the careful description of the species given by Clark.

Astropecten exilis n. sp.

Pl. VIII. Figs. 1—2.

1 specimen of unknown locality, but probably from off the Natal Coast or off Portuguese East Africa.

R = 70 mm, r = 8. — Arms very slender, tapering very gradually towards the point. Disk slightly elevated in the centre. Paxillæ of disk with ca. 16 slender, but rather coarsely serrate, peripheral spinelets and 4—6 more club-shaped central spinelets. In the interradii there is mostly one, very conspicuous, club-shaped central spinelet. The papillæ of the arms are only very indistinctly arranged in transverse series; in the distal half of the arms the paxillæ are distinctly smaller than in the basal half and on the disk, and have only ca. 8—10 peripheral, 1—3 central spinelets (Figs. 1. a, b.). No pedicellariæ.

Supero-marginals very high, particularly in the interradii, forming ca. $^3/_4$ of the vertical side of the arm. In the distal part of arms they become gradually lower, and also encroach somewhat on the dorsal

from there, so that this species would now actually belong to the fauna of S. Africa, viz. the Natal coast, where so many other tropical forms have their southern limit.

Astropecten anacanthus H. L. Clark.

Pl. VIII. Figs. 7—8.

Astropecten anacanthus H. L. Clark 1926. Ech. S. Afr. Fish & Mar. Biol. Surv. II. Sea-stars (Asteroidea) p. 4. Pl. I. 1—2.

Off Durban, 68 fathoms. 29. VIII. 1929. 6 specimens, dredged onboard the "Pickle".

Off Durban, 120 fathoms. 22. VIII. 1929. 1 specimen, dredged onboard the "Pickle".

The figures of this species given in Clark's paper being not very satisfactory, I give here new figures of the species.

The coloration is quite characteristic, brownish in the centre of the disk and the interradii, and a band of the same brownish colour across the arms about at the middle or nearer the distal end. — The largest specimen in hand has a size of R = 35 mm.

Astropecten antares Döderlein.

Pl. VIII. Figs. 3—6.

L. Döderlein. 1926. Über Asteriden a. d. Museum von Stockholm. Kgl. Svenska Vetensk. Akad. Handlingar. 3. Ser. II. p. 6. Taf. I. 4; IV. 3, 3. a.

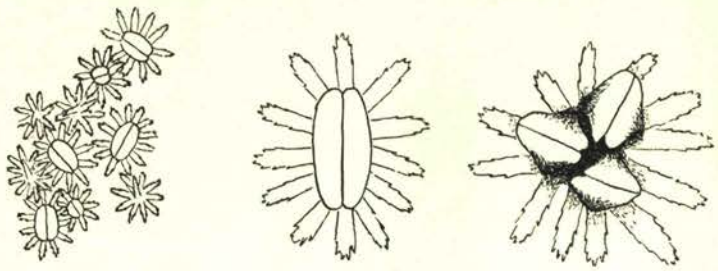
One large fine specimen (R = 51 mm) I took onboard the Trawler "John C. Meikle" on the Agulhas Bank (4 miles S. of Cape Barracouta) 35 fathoms. 13. XII. 1929. Further there are some smaller specimens (R ca. 25 mm) from 31°23′ S. 29°55′ E. 13 fathoms.

These specimens are quite conform with the description of the type given by Döderlein. I would only remark that the number of the ventro-lateral plates is not very constant; most of the specimens have two to each side, but they may be reduced to only one or, on the other hand, there may be three of them. The median series of paxillæ of the arms in some of the specimens have, as described by Döderlein, a small central spine, forming a distinct longitudinal series particularly in the distal part of the arm, but this is no constant feature. — The large specimen (dried) has preserved traces of a reddish colour on the superomarginals.

The only specimen hitherto known of this species came from Mozam-

specimen mentioned by Clark it has a distinct central spinelet on the paxillæ, and the pedicellariæ on the ventro-lateral plates are quite different from those of *L. africana*. I think therefore, it is another species, but which species, I must leave undecided.

The specimens from off Morocco which I referred (Echinodermes du Maroc et de Mauritanie. Bull. Soc. Sc. nat. Maroc. V. 1925.) to *L. africana* are not really that species, and most probably the same



a. b. c.

Fig. 3.

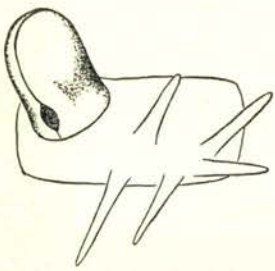


Fig. 4.

Fig. 3. Paxillæ, with pedicellariæ, of *Luidia africana* Sladen. a. Group of paxillæ from disk. × 12. b. Paxilla with pedicellaria. × 30. c. Paxilla with three pedicellariæ. × 30.

Fig. 4. Ventro-lateral plate, with pedicellaria, of *Luidia africana* Sladen. × 20.

is the case with those from various localities off N.W. Africa identified as *L. africana* by Sladen (Chall. Ast.) and Koehler (Echinod. Mission Gruvel. Ann. Inst. Océanogr. II. 5. p. 2.). I shall not enter here on the question to which species these N.W. African specimens really belong, but only state that there is no proof — and no probability either — that *Luidia africana* occurs off N.W. Africa.

IV. Family *Goniasteridæ*.

Pseudarchaster tesselatus Sladen.

Pseudarchaster tesselatus Sladen. 1889. "Challenger" Asteroidea, p. 112, Pl. XVII. 3—4; XVIII. 9—10.

Döderlein. 1920. Die Gattung Luidia. "Siboga" Exped. XLVI. b. p. 241, 262.
H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 252.

2 specimens, almost certainly from off the Tugela river, 18 fathoms, received from the Fisheries Survey of S. Africa. There is thus hardly any doubt that this species is really to be included in the S. African fauna.

Luida africana Sladen.

Sladen. 1889. "Challenger" Ast. p. 256. Pl. XLIV. 1—2.
Bell. 1905. Marine Invest. S. Africa. III Echinod. II. Ast. p. 245.
Döderlein. 1920. Die Gattung Luidia. "Siboga" Exped. XLVI. b. p. 245, 288.
Clark. 1923. Echinoderm Fauna S. Africa. p. 252.
— 1926. Echinod. S. Afr. Fish. & Mar. Biol. Survey. II. Sea-stars, p. 8. (*Luindia*! sic).

False Bay, 30 fathoms. 20. XII. 1929. 1 large, 2 small specimens.
Cape Point in N. 83° E. 18 miles. 20. XII. 29. 2 specimens.
34°17′ S. 17°58′ E. 160 fathoms. 18. XII. 29. 6 large specimens.
34°21′ S. 17°57′ E. 178 fathoms. 18. XII. 29. 1 large specimen.
These specimens all dredged onboard the "Pickle". Further, I took 2 specimens onboard the trawler "John C. Meikle" 4 miles S. of Cape Barracouta, 13. XII. 29. Finally I have a specimen from off East London, sent me by Captain Pace, VIII. 1930.

Clark (Op. cit. 1926) expresses doubt whether *L. africana* can be maintained as distinct from *L. Sarsi* of the North Atlantic. I do not think there can be any doubt but that the two are quite distinct, although in most regards they are so much alike that it is hard to find quite reliable differences. But the pedicellariæ offer a striking difference. While in *L. Sarsi* pedecellariæ are never found on the dorsal paxillæ, they are usually found in *L. africana*, in larger specimens at least, sometimes in very great numbers, so as to give a peculiar aspect to the dorsal side — as if it were full of something like *Globigerina*-shells. These pedicellariæ are usually broad, spoon-shaped, but may also be narrow, round bodies, very much like a *Globigerina* in shape (Fig. 3). The pedicellariæ on the ventro-lateral plates are also broad, spoon-shaped, very different from those of *L. Sarsi* (Fig. 4). Sometimes there may be two, or even three pedicellariæ on some of the paxillæ. — The dark longitudinal median stripe on the arms is no constant character — at least I do not observe it in some of my larger, dried specimens.

About the specimens from off Durban I shall not express any opinion, having only a single arm from there (39 fathoms); like the

Persephonaster Roulei, var. *euryplax* n. var.

Pl. IX. Figs. 1—2.

Off Durban, 29°56′ S. 31°19′30″ E. 225 fathoms. 26. VIII. 1929. 1 specimen dredged onboard the "Pickle". R. = 120 mm; r. = 25 mm.

This specimen in general corresponds very well with the description of *Persephonaster Roulei* given by Koehler, 1910, in his report on the "Investigator" Asteroidea I. p. 19. viz. with the second of Koehler's specimens, in which the spines of the supero-marginals were almost completely reduced.

In the absence of photographic figures of this latter specimen it is not quite easy to form a definite opinion of it, but for the present, until new and richer material comes to hand, we must accept Koehler's statement, that it is identical with the type of *P. Roulei*, differing only in the reduction of the spines of the supero-marginal plates, and it does, indeed, seem quite probable that Koehler is right in maintaining this reduction to be of no specific value, the species *Roulei* offering variations in regard to the armature of the supero-marginal plates corresponding to what obtains in *Astropecten irregularis*.

As for the specimen in hand it may perhaps rather represent a separate species. It appears to differ from *P. Roulei* in the supero-marginals being broader than in that species. Koehler describes these plates as being a little broader than long, in the present specimen they are twice as broad as long; also their number is a little smaller, ca. 40, than in *P. Roulei*, 47—48, by a corresponding arm length. Further, the paxillæ would seem to be more numerous in *P. Roulei*, ca. 20 to a half transverse series at the base of the arms, than in the present specimen, ca. 10—12 to each half transverse series. In the other characters, particularly the armature of the infero-marginals and adambulacrals there seems to be no difference.

I think then the best course, for the present, will be to designate the specimen from off Durban as a variety of *Persephonaster Roulei* Koehler. The exact locality of the latter is unknown, we know only that it is in the Indian Ocean.

III. Fam. *Luidiidæ*.

Luidia maculata Müller & Troschel.

Müller & Troschel. 1842. System d. Asteriden, p. 77.

Koehler. 1910. Astéries et Ophiures des îles Aru et Kei. Abhandl. Senckenb. Naturf. Ges. XXXIII. p. 267, Pl. XV. 1—2; XVI. 8—9; XVII. 8.

Moreover there is a good deal of variation in the density of the covering of the marginal plates, several specimens having some few of the supero-marginals partly naked, though not to such an extent as in the specimen mentioned.

The colour in life is a light pink as in *Psilaster andromeda*.

Dipsacaster Sladeni Alcock.

Dipsacaster Sladeni Alcock. 1893. Natural History Notes from H. M. "Investigator". Ser II. 7. An account of the collection of Deep-sea Asteroidea. Ann. Mag. Nat. Hist. 6 Ser. XI. p. 87. Pl. V. 3—4.

— — H. L. Clark. 1923. Echinoderm Fauna S. Africa p. 264.

— — H. L. Clark. 1926. Ech. S. Africa. Fish. & Mar. Biol. Survey. II. Sea-stars (Asteroidea) p. 3.

Leptoptychaster kerguelensis F. Jeffr. Bell. 1905. Marine Investigat. S. Africa. III. Echinod. II. p. 242. (non: *Leptoptychaster kerguelensis* E. A. Smith.)

This large, splendid species is one of the commonest of Sea-stars in deep-water off Cape Peninsula. It occurred in numbers in all the hauls I made there; I think it superfluous to give the exact localities, the depths were 93—178 fathoms, thus extending the known bathymetrical limits somewhat upwards.

A number of specimens were also received from Captain Pace from off East London.

The colour in life is a beautiful red.

The specimens recorded by Bell (Op. cit.) under the name of *Leptoptychaster kerguelensis* is a *Dipsacaster Sladeni*, as I can ascertain, a specimen having been sent me for examination from the British Museum. This specimen has a large Spatangoid (probably a *Brissopsis*) in its stomach.

I may call attention to the fact that Otto le Roi has found the interesting Cirripedian parasite *Dendrogaster* in this sea-star (*Dendrogaster arborescens* und *Dendrogaster Ludwigi*, zwei entoparasitische Ascothoraciden. Zeitschr. f. wiss. Zoologie, Bd. 86. 1907). Also in one of the specimens in hand this parasite is found, even two parasites in the same specimen; it is a very interesting fact that the gonads of the sea-star are very small and undeveloped, an indication of the parasite having at least some castrating effect on its host.

Pseudarchaster tesselatus H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 253.
— — H. L. Clark. 1926. Ech. S. Afr. Fish. & Mar. Biol. Surv. II. Sea-stars (Asteroidea), p. 9.

Several specimens dredged onboard the "Pickle" viz.:
Off Cape Point, 93 fathoms, 20. XII. 1929. 12 specimens.
Off Cape Peninsula, 34°6′ S. 18°2′ E. 118 fathoms, 23. XII. 1929. 6 specimens.
Off Cape Peninsula, 34°21′ S. 17°57′ E. 178 fathoms, 18. XII. 1929. 1 specimen.
Besides these specimens I got a considerable number of specimens from the Fisheries Survey of S. Africa:
30°43′ S. 16°46′ E. 118 fathoms. Several specimens.
30°30′ S. 16°25′ E. 115 fathoms. Several specimens.
10 miles W. of Hout Bay, 89 fathoms. 19. XII. 1917. 3 specimens.

It is evident from the records here given that this species is very common in deep water off Cape Peninsula. Several of them, particularly those from 30°30′ S. 16°25′ E., are rather large, R. up to nearly 100 mm; the largest of all is the specimen dredged in 178 fathoms, 18. XII. 1929, its R. = 105 mm.

The colour in life is a uniform red.

Two specimens have 6 arms, and one has one arm bifid at the point.

In some specimens the spines of the infero-marginals are erect, not appressed, as is usually the case. This gives these specimens a rather different appearance — but is decidedly only due to preservation, there being no other differences between such specimens and those with the spines appressed.

A character which has apparently not been noticed by the previous authors is this that the spinelets on the ventral interadial plates are usually conspicuously club-shaped, their basal part being slender, almost forming like a stalk. This may be particularly distinct on the larger of these spinelets.

Mediaster capensis H. L. Clark.

Pl. VIII. Fig. 10.

H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 256; pl. XVI. 1—2.

Cape Point in N. 83° E. 18 miles. 93 fathoms. 2 specimens dredged onboard the "Pickle", 20. XII. 1929.

These specimens are perfectly conform with the description and figures given by H. L. Clark.

Colour in life red.

Mediaster capensis var. *durbanensis* n. var.

Pl. VIII. Fig. 9.

Off Durban, 225 fathoms. 1 specimen, dredged onboard the "Pickle" 26. VIII. 1929.

This specimen (R. = 40 mm, r. = 18 mm) agrees in general very closely with the typical *M. capensis*, only in regard to the marginal plates there is a very noteworthy difference. These are, on the whole, not nearly so well marked off from the disc as in the typical form, and particularly the infero-marginals are much broader than in the latter and encroaching more on the ventral interradius. This difference is so conspicuous (Pl. IX. Fig. 9, to compare with Pl. IX. Fig. 10) that it does not seem justifiable simply to regard these two forms as identical. On the other hand, with only one specimen available of the deviating form, it is, of course, impossible to decide whether we have here a separate species, or a variety, or perhaps only an individual aberration of *M. capensis*. The fact that the typical form has till now been found only off Cape Peninsula rather indicates that the form from off the Natal Coast may be a distinct species. For the present I shall prefer to designate it only as a variety of *M. capensis*.

If a distinct species one may expect it to be distributed over the Indian Ocean. Koehler ("Investigator" Asteroidea I. p. 78. Pl. X. 4) has recorded *Mediaster ornatus* Fisher from the Arabian Sea, 492 fathoms. One would beforehand expect that the specimen from off Durban might be identical with this species from the Arabian Sea. If, however, Koehler's figure be correctly drawn, such identity is out of the question; the marginal plates are represented as narrow as in *M. ornatus* (and *M. capensis*), not broad like those of the Durban-specimen.

Ceramaster chondriscus H. L. Clark.

H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 258. Pl. XIV. 5—6.

Off Cape Peninsula, 34°17′S. 17°58′E. 160 fathoms, 18. XII. 1929. 3 specimens.
Off Cape Peninsula, 34°21′S. 17°57′E. 178 fathoms, 18. XII. 1929. 4 specimens.
Dredged onboard the "Pickle".

These specimens agree very well with the description and figures given by Clark, so that I cannot have any doubt about the identification.

Without entering on a more detailed discussion of the S. African *Ceramaster*-species I would merely point out that, judging from some

specimens in hand of *Ceramaster patagonicus* var. *euryplax* H. L. Clark, identified by Clark himself, it seems that the main characters given by Clark as distinguishing this latter from *C. chondriscus* are not very reliable. The length and breadth of the supero-marginals is subject to considerable variation, and the distal subambulacral spines are usually as conspicuously enlarged as in the var. *euryplax* — and in the latter they are not always enlarged (cf. H. L. Clark. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Sea-stars, p. 10). Also the pedicellariæ may be as numerous in the var. *euryplax* as in *C. chondriscus*. I think it, therefore, very doubtful, whether *Ceramaster patagonicus* var. *euryplax* can really be maintained as separate from *Ceramaster chondriscus*.

Tosia tuberculata (Gray).

Pl. X. Figs. 5—7.

Astrogonium tuberculatum Gray. 1866. Synopsis of the species of Starfish in the British Museum. p. 10. Pl. I. 2.

Pentagonaster granulatus Bell. 1905. Mar. Investig. S. Africa. III. Asteroidea, p. 246.

Tosia tuberculata H. L. Clark. 1923. Echinod. Fauna S. Africa p. 266. Pl. IX. 1—2.

— — H. L. Clark. 1926. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Sea-stars (Asteroidea), p. 11.

A considerable number of specimens were dredged onboard the "Pickle" in December 1929 off Cape Peninsula, at depths of 94—178 fathoms, this species being, together with *Dipsacaster Sladeni*, very common in this area. Several specimens were further sent me from East London by Capt. Pace (depth unknown).

The largest specimen in hand has a size of R. = 95 mm. In these larger specimens the tubercles of the dorsal side may be very closeset; they have the shape of low warts, most of them with one or more pedicellariæ sitting in deep pits (Pl. X. Fig. 7).

Whereas all the specimens from off the Cape Peninsula have slender, pointed arms, the distal marginals not increasing in size, some of the specimens from off East London have the distal 5—6 marginals very conspicuously enlarged, the end of the arm being correspondingly thicker (Pl. X. Fig. 6). The 3—4 distalmost supero-marginals are contiguous in the dorsal midline.

On comparing these thick-armed specimens with the slender-armed form from off Cape Peninsula, one would very naturally think

them to be two different species — however, also the slender armed form is represented among the specimens from off East London, and there are all transitions between the two forms so that it is impossible to draw a limit between them. We have thus here a case parallel to that of *Calliaster acanthodes* and of the New Zealand species *Pentagonaster pulchellus* Gray, in which latter particularly the size of the distal marginal plates varies to an extraordinary degree (cf. my paper "Echinoderms of New Zealand and the Auckland-Campbell Islands. III—V. Asteroidea, Holothurioidea and Crinoidea". Papers from Dr. Th. M. Pacif. Expedition XXIX. Vid. Medd. Dansk Nat. Foren. Bd. 79. 1925, p. 281—285. Pl. XII. 6—10).

In view of the fact that the type of *Tosia tuberculata* is stated to come from Port Natal it is of interest that by my dredgings and trawlings off Durban in August 1929 I did not secure any specimens of *Tosia*; that it does occur off the Natal coast is evident, however, from the fact that I have received from the Durban Museum 3 specimens taken 18 miles East off the Tugela River, by Capt. Pace. Two of these specimens are of the thick-armed form, the third more intermediate. — The colour of the live specimens is a beautiful red.

Calliaster baccatus Sladen.

Sladen. 1889 "Challenger" Asteroidea, p 280, Pl. 56. 1—4.
Bell. 1905. Mar. Invest. S. Africa. III. Echinoderma. II. Asteroidea. p. 247.
H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 264.

One small specimen of this species I dredged onboard the "Pickle" in False Bay, 27 fathoms, 19. XII. 1929. Some specimens were later on received from Capt. Pace from off East London.

Some of the specimens in hand show a rather conspicuous coloration of the disk, a mottling of brownish-olive and a light greenish-olive. It would seem then that this is the colour in life. The marginal plates are a uniform greenish-olive.

Calliaster acanthodes H. L. Clark.

Pl. X. Figs. 1—2.

H. L. Clark. 1923. Echinod. Fauna. S. Africa, p. 264. Pl. XII. 3—4.
— 1926. Echinod. S. Africa. Fish. & Mar. Biol. Surv. II. Sea-stars (Asteroidea). p. 11.

5 young specimens (R. = 21—25 mm) dredged onboard the "Pickle" off Durban, 225 fathoms (26. VIII. 1929).

Further, I have received some larger specimens from Capt. Pace, collected onboard the trawler "Disa" off East London.

In the young specimens the dorsal side is nearly naked, spines being developed as yet only on the plates in the middle of the disk, and mainly in the carinal series. The 3—4 distal supero-marginals are contiguous in the midline. The characters of the marginal plates and of the oral side are already those typical of the species.

These specimens have kept a light mauve colour — but I have made no notice of their colour in life, so it cannot be said definitely that this is their real colour.

As mentioned by Clark (Op. cit. 1926) the distal marginal plates may sometimes be considerably swollen. Such specimens look strikingly different from those with not swollen marginals. (Figs. 1—2. Pl. X). This is a parallel to what obtains in *Tosia tuberculata*.

Anthenoides Marleyi Mrtsn.

Th. Mortensen. 1925. On some Echinoderms from S. Africa. Ann. Mag. Nat. Hist. 9 Ser. XVI. p. 149. Pl. VIII. 1—2.

In the laboratory of the S. African Fisheries Survey I found 3 specimens of this species from 29°34′ S. 31°49′ E. 150 fathoms, and 1 specimen from 29°43′ S. 37°31′ E. 140 fathoms, thus from off the Natal coast.

The former specimens are of a uniform brownish red colour. The largest specimen has R. = 85 mm, thus very nearly the size of the type specimen, the others are slightly smaller, that from 140 fathoms only R. = 50 mm.

These specimens on the whole agree very closely with the type, only a few minor features call for some remarks. None of the tubercles on the distal supero-marginals are bilobed, as was the case in the type, and only rarely they are flattened and shield-shaped. The infero-marginals have usually 6—7 spines in the interradii (2—3 in the type) and the ventro-lateral plates mostly have 2—3 tubercles in the middle (1 in the type). These small differences, of course, are only individual variations.

Hippasteria phrygiana, var. *capensis* n. var.

Pl. XI. Fig. 1.

H. L. Clark (Echinoderm Fauna of S. Africa, p. 270) felt uncertain whether the S. African *Hippasteria* represents a separate species or is simply identical with the North Atlantic *Hippasteria phrygiana*

(Parelius), and it is only provisionally that he designates the South African form as *H. phrygiana*. In his report of 1926 (p. 13) he seems to have come to the definite result that the S. African form cannot be separated from the N. Atlantic species, stating his largest specimen to be "a very typical *phrygiana*", and that "compared with specimens from the North Atlantic, the resemblance is notable and the differences insignificant".

I cannot quite agree with Clark herein. On a comparison of my S. African specimens (2 fine, large specimens, taken by the trawler "John C. Meickle", Table Mountain in N.W. 46 miles, 195 fathoms, 4.II.1930, and a large specimen, identified by H. L. Clark, presented to me by the Fisheries Survey of S. Africa) with specimens from N. European seas, I find a very conspicuous difference in the size of the pedicellariæ on the oral side, these being much smaller in the S. African than in the N. European form, — as appears from the two figures, Pl. XI. Figs. 1—2. This is not a difference due to age; the specimen of the variety figured (Fig. 1) is much larger than that of the N. European form (Fig. 2). Other fully reliable differences may not exist, but the said difference in the size of the pedicellariæ of the ventral (not the dorsal) side is so conspicuous and apparently constant, that it seems to me not justifiable to regard the S. African form simply as identical with the N. European, typical form of *Hippasteria phrygiana*. The right course will be, in my opinion, to regard the S. African form as a variety of the North Atlantic *H. phrygiana*. Whether it is, perhaps, identical with the S. American *Hippasteria hyadesi* (Perrier) is impossible to say at present, our knowledge of this latter form being altogether too insufficient.

V. Family ***Odontasteridæ.***

Odontaster australis H. L. Clark.

Pl. X. Figs. 3—4.

H. L. Clark. 1926. Echinod. S. Africa. Fish. & Mar. Biol. Survey II. Sea-stars, p. 16. Pl. I. 5—6.

Off Cape Peninsula, 34°17′ S. 17°58′ E. 160 fathoms, 1 specimen.
Off Cape Peninsula, 34°24′ S. 18°16′ E. 133 fathoms, 1 specimen.
Both were dredged onboard the "Pickle", 18. XII. 1929.

These two specimens are a good deal larger than the type, viz. R. = 65 mm, r. = 24 mm; R. = 60 mm, r. = 21 mm. They are con-

siderably more long-armed than the type, which is much more pentagonal; however, one of the arms in the smaller specimen is only 47 mm — and it does not seem to have been broken and regenerated. Corresponding to the greater length of the arms the number of the marginal plates is larger than in the type (ca. 25 to each side of arm in the largest specimen). The madreporite is distinctly nearer to the centre of disk than to the supero-marginal (in the type apparently situated about midway). The spinelets of the paxillæ and of the ventro-lateral plates are more numerous than in the type.

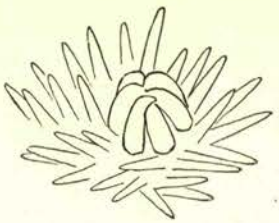


Fig. 5. Pedicellaria from inner ventro-lateral plate of *Odontaster australis* H. L. Clark. × 12.

These differences from the type are rather conspicuous so that it might well seem doubtful whether they could belong to the same species as the specimen described and figured by Clark. But then the two specimens in hand again differ conspicuously among themselves. One (the smaller) has numerous pedicellariæ (Fig. 5), particularly on the supero-marginals, on the inner ventro-lateral plates, and also here and there on the dorsal paxillæ, the other has none; in the former the unpaired median supero-marginal is about rectangular, in the other it has the same shape as in the type, narrowed at its lower end.

Most probably these differences are all nothing but individual variations — but much more material is necessary for settling the question definitely. For the present we have the choice between regarding the three specimens known as representing three different species or as belonging all to one and the same rather variable species. The latter course seems the only reasonable.

The smaller specimen has still (in dried condition) preserved a uniform yellowish-red colour.

VI. Family *Linckiidæ.*

Austrofromia Schultzei (Döderlein).

Pl. XIII. Figs. 8—10.

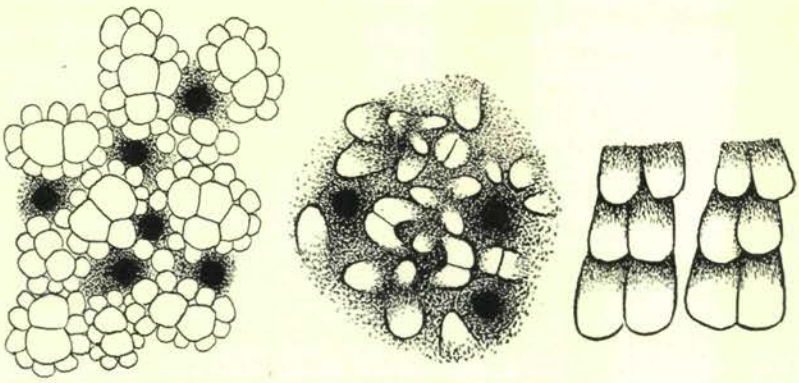
Fromia Schultzei Döderlein. 1910. Asteroidea, Ophiuroidea und Echinoidea, in Schultze. Ergebn. Forschungsreise Südafrika. IV. Jen. Denkschr. XVI. p. 249. Taf. IV. 3—3. b.

Austrofromia Schultzei H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 276.

One specimen dredged onboard the "Pickle", 19. XII. 1929, in Gordon Bay 8—9 fathoms.

Further I have received 2 specimens from off East London, from Capt. Pace, VIII. 1930.

These specimens correspond very well with the description and figures given by Döderlein. I would only mention the characteristic arrangement of the granules on the dorsal side, as shown in fig. 6. a. This is not seen clearly in Döderlein's figures and not mentioned



a. b. c.

Fig. 6. *Austrofromia Schultzei* (Döderlein). a. Granules of dorsal plates; b. spines from the oral side, partly forming pedicellariæ; c. spines of two adambulacral plates. All × 12.

either in his description. It appears that the plates (groups of granules) of the dorsal surface were somewhat larger in the type than in the present specimens; but this is, evidently, subject to some variation, since they are decidedly smaller in my specimens from off East London than in the one from Gordon Bay. On the oral side the granules, or spines, are sometimes placed two and two together so as to form a kind of pedicellaria (Fig. 6. b.).

The dried specimens are of a reddish-brown colour, which probably nearly corresponds with the colour in life, but I have omitted to notice particularly the colour in life of the specimen, I took in Gordon Bay.

VII. Family *Asteropidæ*.[1])

Cryaster brachyactis H. L. Clark.

Pl. XII. Fig. 14.

Culcita veneris Bell. 1905. Mar. Invest. S. Africa III. Echinoderma II p. 248. (non: *Culcita veneris* Perrier.)

Cryaster brachyactis H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 293. Pl. XI. 1—2.

The specimen recorded by Bell (Op. cit.) as *Culcita veneris* has been sent me for examination from the British Museum. I find it to be identical with Clark's *Cryaster brachyactis*. On the other hand, it must be agreed that it bears a rather considerable resemblance to Perrier's *Culcita veneris* from St. Paul, so that Bell's referring his specimen to that species is not so meaningless, as the name "*Culcita*" would seem to imply. The fact is that the "*Culcita veneris*" is no *Culcita* at all, as Perrier himself has also hinted at in his description of the species (Les Stellérides de l'île St. Paul. Arch. de Zool. expér. & génér. VIII. 1879. p. 48); it belongs probably to the family *Asteropidæ* or perhaps to the *Cryasteridæ*. That the South African species is not identical with the *C. veneris* is evident from the fact that its ventral interradii are quite smooth, whereas in the St. Paul species they are covered with fine spines.

Tylaster meridionalis n. sp.

Pl. XII. Figs. 11—13.

30°44′ S. 15°43′ E. 108 fathoms, 3 specimens.

The type specimen is almost pentagonal, R. = 28 mm, the other specimens have the arms fairly well set off, R. = 25 mm, r. = 20 mm. The type has the disk very high, cushion-like, in one of the other specimens the disk is more flattened, but it seems that this is due to preservation. The end of the arms somewhat upturned. The dorsal side is rather slimy, with the scattered small spinelets just visible. The madreporite is a flat, round, white disk, 2 mm in diameter, situated

[1]) Koehler has made the genus *Cryaster* the type of a separate family including also his genus *Magdalenaster*. I do not think this family sufficiently well founded. *Cryaster* is so closely related to the *Asteropidæ*, that there seems no good reason for separating it from the said family (— judging at least from the S. African *Cryaster brachyactis* —), and *Magdalenaster* is nothing but a very large *Henricia sanguinolenta*.

about midway between the margin and the centre of the disk. Its white colour makes it very conspicuous against the flesh-coloured dorsal skin. Anal opening rather distinct, surrounded by some whitish granules. — When cleared in xylol the dorsal skin is seen to contain only some few very minute irregular calcareous deposits, which do not form a real skeleton and are in no connection with the spinelets of the skin.

Along the edge of the disk there is a rather conspicuous fringe of short spines, 3—4 to each marginal plate; in the type there is a second series of 4—5 spines inside the marginal fringe; in one of the specimens this inner series is absent, and here also the marginal fringe is little developed. In this latter specimen, which has been dried, there is seen to be 3—4 irregular transverse series of plates in the oral interradii; in the not dried specimens, these plates cannot be distinguished, but an irregular radial striation is seen.

Adambulacral armature somewhat irregular, but as a rule there is one furrow spine and one outer spine to each adambulacral spine, forming two conspicuous longitudinal series; sometimes there are two furrow spines to a plate, sometimes one or other spine is bifid. Mouth plates flat, with 3—4 marginal spines to each side and one somewhat larger superoral spine to each half of jaw.

It is of very considerable interest thus to find the genus *Tylaster*, hitherto known only in one single, very rare species, *Tylaster Willei* Dan. Kor.[1]) from the deep Polar Sea to the North of Iceland, represented also in S. African Seas. The S. African species differs from the northern species in the adambulacral spines being arranged mainly in two series (in 3 series in *Tylaster Willei*). It would also seem that in *T. Willei* there are no superoral spines on the jaws. Otherwise the two species are obviously very much alike and, no doubt, very closely related.

[1]) A subgenus *Tylaster* was etablished by W. K. Spencer for some Jurassic Goniasterids related to *Calliderma*. (The evolution of the Cretaceous Asteroidea, Philos. Transact. Vol. 204. p. 99. 1913). This name being preoccupied for the recent Asteroid named (1884) *Tylaster Willei* by Danielssen & Koren, the name of the fossil form was altered into *Tylasteria* (through a printers error made into *Tylasterie*) by Dom Aurelien Vallette, in his "Note sur une nouvelle espéce d'Astropecten du Bathonien du Tremblay (Nièvre)" Bull. Soc. Géol. de France 4. Sér. XXIX. 1929. p. 418. Note.

VIII. Family *Asterinidæ*.

Anseropoda (*Palmipes*) *habracantha* H. L. Clark.

H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 287. Pl. XVII. 4—5.

Off Durban, 68 fathoms, 1 specimen, dredged onboard the "Pickle" 29. VIII. 1929.

This specimen which is a small one, R. = 15 mm, corresponds very closely with the description given by Clark, excepting only that the second of the spines on the ventral surface of the adambulacral plates is not much longer than the others, and not curved, as is stated to be the case — "as a rule" — in the type specimen. Also the marginal spines of the oral plates, or jaws, amount to 10, against 6—8 in the type.

In view of the otherwise complete agreement with the type these two differences most probably mean only individual variations. But as long as we know only two specimens of the species, it is of course impossible to say anything more about that.

The fact that both the specimens known are so small (the type R. = 16 mm) may perhaps indicate that this species does not reach any large size.

The specimen has preserved traces of a pinkish colour.

Anseropoda (*Palmipes*) *grandis* n. sp.

Pl. XII. Figs. 1—2.

31°14′ S. 16°27′ E. 173 fathoms, 1 specimen.

The specimen is very badly broken, and only the disk and one arm and a fragment of another are preserved. But these fragments show that the specimen must have been a very large one, R. = ca. 130 mm. Arms 5.

In the centre of the disk the plates are irregularly arranged, but along the radii they form regular series: a carinal series and 4 lateral series, the three outer of which carry papulæ, there being thus 3 series of papulæ to each side of the radial midline, continuing for about $^2/_3$ of the armlength; the inner of these series continues a little farther outwards. The papulæ are small, equal sized, surrounded by a circle of 6—7 erect, pointed spines, scarcely 1 mm long.

These groups of papular spines give the median part of the rays and the centre of the disk a rough appearance contrasting rather

strongly with the very smooth interradii. The carinal plates may have a similar group of spinelets placed on a small elevation; in the distal part of the one nearly complete arm they form a fairly conspicuous median line. Besides the papular spines the plates may carry one or some few isolated spinelets of the same size and shape. The interradial plates each carry one or 2—3 fine spinelets at their proximal edge, the plates otherwise remaining entirely smooth. The ventral interradial plates carry each a bundle of 3—4 somewhat longer spines, ca. 15 mm long, arranged in a transverse line, and webbed in their basal part; besides, there is a number of much smaller spinelets, scattered over the plates. The adambulacral plates carry a bundle of 8—9 equally long, slender, partly webbed furrow spines, and on their outer surface an oblique series of 3—4 webbed spines, outside which there may again be one or two similar spines (Fig. 7). The jaws carry 7—8 somewhat stronger marginal spines and on their outer surface a group of 3—4 spines.

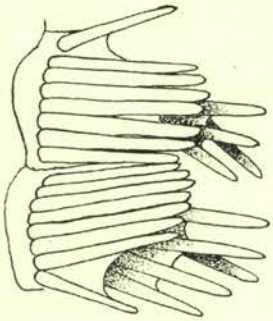


Fig. 7. Two adambulacral plates of *Anseropoda* (*Palmipes*) *grandis* n. sp. × 12.

The dried specimen has a slight, uniform pinkish tint on both dorsal and ventral side. It appears to be very fragile; the smaller arm-fragment has the distal half regenerated. — Complete adult specimens must form very striking and magnificent objects.

This species appears to be related to *Palmipes ludovici* Koehler from off the Maldive Islands ("Investigator" Asteroidea I. p. 100, Pl. X. 1) from which it differs, however, very markedly, particularly in the character of the papulæ and the armature of the dorsal plates. It does not seem to be nearly related to any other of the 5-armed *Palmipes*-species.

In the laboratory of the S. African Fisheries Survey I found a small fragment of an arm labelled by Clark: "*Anseropoda* sp., apparently not *novemradiata*"; it undoubtly belongs to the present species.

Asterina (*Patiriella*) *exigua* (Lamarck).

Pl. XII. Figs. 4—8.

Asterias exigua Lamarck. 1816. Animaux sans vertèbres III. p. 554.
Asterina — Perrier. 1875. Revision des Stellérides du Mus. d'hist. nat. Paris. (Sep. copy). p. 302.

but we may well assume, that, like e. g. *A. exigua*, it will prove to be subject to rather considerable variation, so that the present specimen will come within its limits. For the present I think it to be the only reasonable course to refer this specimen to *A. gracilispina*, with due reservation, because of the coarser character of the spinelets of its dorsal and ventral sides.

Asterina granifera (Gray).

Patiria granifera Gray 1847. Descr. New Gen. & Species of Asteriadæ. P. Z. S. p. 82.
Asterina — Perrier. 1876. Rev. Stellérides du Mus. Paris. p. 319. (Sep. copy).
— — H. L. Clark. 1923. Echinod. Fauna S. Afr. p. 281. Pl. XVII. 1—2.

Sea-Point, Cape Peninsula; rocky coast, at low tide, 29. XI. 1929. 2 specimens.

Gordon Bay, 8—9 fathoms. 19. XII. 1929. 1 young specimen.

The latter should perhaps rather be referred to *Parasterina bellula*, of which some larger specimens were taken at the same locality. The matter is of slight importance, since, as stated below, there is much probability that *Parasterina bellula* and *Asterina granifera* are in reality identical, in spite of the fact that one is referred to the genus *Parasterina*, the other to the genus *Asterina*. The value of these genera is, namely, also questionable — or perhaps rather the referring of *granifera* to the genus *Asterina* is questionable.

Asterina coccinea (Gray).

Pl. XIII. Fig. 4.

Patiria coccinea Gray. 1841. Synopsis of the genera and species of the class *Hypostoma* (*Asterias* Linnæus). Ann. Mag. Nat. Hist. VI. p. 290.
Asteriscus coccineus Müller & Troschel. 1842. System d'Asteriden, p. 43.
Patiria coccinea Gray. 1847. Proc. Zool. Soc. p. 82.
— — — 1866. Synopsis of the species of Starfish, p. 17.
Asterina — Perrier. 1875. Revision des Stellérides du Museum Paris, p. 314.
— — Clark. 1923. Echinod. Fauna S. Africa, p. 283.
Non: *Asterina coccinea* Bell. 1905. Mar. Invest. S. Africa, III. Asteroidea, p. 248. (= *Parasterina bellula* (Sladen) and *Asterina* (*Patiriella*) *exigua*).

Koehler in his report on the Echinoderms of the "Scotia" (p. 296) records *Asterina calcarata* (Val.) from False Bay and Saldanha Bay, stating to have compared the S. African specimens with specimens of *calcarata* from the Chilenian coast and found them completely identical. "L'*A. calcarata* peut donc remonter plus haut vers le Nord qu'on ne le croyait." Seeing that he does not mention the commonest S. African *Asterina*, *A. exigua*, and in view of the fact that nobody else has found *Ast. calcarata* in S. African waters, I could not help thinking, that these specimens identified by Koehler as *A. calcarata* might in reality be *A. exigua*.

On my application Dr. A. C. Stephen of the R. Scottish Museum, Edinburgh, kindly sent me some of Koehler's specimens of *A. calcarata* from False Bay. My suspicion proved fully justified — they are not *calcarata*, but, as was to be expected, the common *Ast. exigua*. That the other specimens thus identified by Koehler are likewise *A. exigua*, there is, of course, no reason to doubt. The occurrence of the S. American *Asterina calcarata* at S. Africa thus has been proved to rest on a misidentification.

It may be mentioned here, that *Asterina exigua*, so widely distributed all over the Indo-Pacific region, has been found by me also at St. Helena (cf. my forthcoming report on the Echinoderms of St. Helena).

Asterina gracilispina H. L. Clark.

H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 286. Pl. XVI. 3—4.

In the collection of the S. African Museum there is a specimen from False Bay, 14 fms. R. = 10 mm, which I refer, though with considerable doubt, to this species. In general shape it is exactly like the type, as figured by Clark, Op. cit. But there are some rather noteworthy differences. The spinelets of the dorsal plates are not sharp, might rather be designated as blunt, and they are disposed round the edge of the plates, leaving a median space bare. The madreporite is distinct. The spinelets on the ventro-lateral plates I would not designate as "delicate" either, they are rather stout, and I do not find more than 3 of them on the outer, mostly only two on the inner of these plates.

The species *gracilispina* was described from two specimens only, and accordingly nothing is known about the extent of its variations;

surface below them. When removed they rapidly retract the stomach.

When thus creeping around, their circumference is almost circular, the interradial edges being distinctly convex. On preservation they usually change their outline considerably, the interradii becoming more or less distinctly concave. By throwing them into formaline immediately on their being picked off the rock I succeeded in preserving some few of them in their natural shape (Pl. XII. Figs. 5, 7), but even so most of them contracted more or less and folded in their interradial edges.

I may recall here the observation mentioned in my "Studies of the Development and Larval forms of Echinoderms" (1921, p. 188), that *Asterina exigua* has direct development, like *Asterina gibbosa*, its eggs being deposited on the rock surface; also its genital pores are on the ventral surface, as in *Ast. gibbosa* (Pl. XII. Fig. 6).

Fisher (Op. cit.) and Clark (Op. cit. 1928) have called attention to the bare area in the interradii just outside the jaws as very characteristic of this species. It certainly is — but it is found likewise e. g. in *Asterina calcarata*, and, on the other hand, it is not constantly found in *Ast. exigua*. On the whole, there is much variation in the characters of this species, particularly in regard to the spinulation of the ventral side. More usually the interradial plates nearest the jaws are devoid of spines, as is also the series of plates nearest the adambulacral plates; in such specimens the proximal interradial plates are usually more or less reduced in size, and separated by broad interspaces of naked skin, which on dried specimens become very conspicuous through being darker than the plates (Pl. XII. Figs. 6—8). But in several specimens there is no such naked space, and spines are found on all the interradial plates, also those nearest the adambulacrals. All intermediates are found between these two extremes. Also in regard to the spines on the distal interradial plates there is much variation, there being sometimes only one spine to each plate, almost to the margin of the disk, sometimes two spines to each plate, now only on two—three plates near the margin, now on 5—6 plates in the median series. Likewise the size and shape of the outer adambulacral spine varies very much, being now simply blunt, now distinctly widened and flattened, truncate, sometimes even slightly bifid at the end. These variations show definitely that Clark's *Asterina dyscrita* cannot be distinguished from *Ast. exigua*, not even as a separate variety.

Asterina calcarata Koehler. 1908. "Scotia" Echinod. p. 296. (non: *Ast. calcarata* (Val.)).
— *exigua* Koehler 1910. "Investigator" Asteroidea II. p. 129. Pl. IX. 6—7.
Patiriella — Verrill. 1913. Rev. Gen. Starfishes Subfam. Asterininæ. Amer. J. Sc. 4 Ser. XXXV. p. 484.
— — W. K. Fisher. 1919. Starfishes Philippine Seas. Bull. U. S. Nat. Mus. 100. 3. p. 416. Pl. 109. 3—4.
Asterina — H. L. Clark. 1923. Echinoderm Fauna S. Africa. p. 285.
— *dyscrita* — Ibidem. p. 284. Pl. XVI. 5—6.
Patiriella exigua — 1928. Sea-Lilies, Sea-stars. S. Australian Museum. Rec. S. Australian Mus. III. p. 392.
— — Döderlein. 1928. Seesterne d. deutschen Südpolar-Exped., p. 296.

Numerous specimens collected on the rocky shores of Cape Peninsula (St. James, Sea Point, Cape of Good Hope) I. 1932. Further, I collected several specimens on the rocky shores at Humewood, near Port Elizabeth (12. VII. 1929), and off Durban (the "Bluff", VIII. 1929). Most of the specimens are small, R. = ca. 5—10 mm, but some few are considerably larger, one from St. James and one from Port Elizabeth as large as R. = 20 mm. A couple of 6-armed and 4-armed specimens are also found in the rich material at hand.

This species appears to be strictly littoral; it may be found under stones at the shore, but it is particularly common in rock pools between high and low tide, where the water remains still-standing, when the tide is low, the temperature of the water then often rising very considerably, which does not seem to be detrimental to this beautiful little seastar. Flat rock surfaces in such pools, covered with a vegetation of calcareous algæ (*Melobesia*, *Lithothamnion*) and other low algal growth, with few centimeters of water over, are its favorite resorts. Its colour marvellously resembles that of the bottom, a mottled reddish-greenish of various shades, so that it requires much attention to discover it. Over and over again I have had to admire, how perfect a concealment their colour affords them on such flats, though directly exposed to the strongest light.

Their food evidently consists of all the minor animal organisms found on the rocks or the algæ (not rarely one may find them on such larger algæ as may grow in these rock pools, particularly Florideans, clinging round the stems and branches of the algæ). Observing the specimens immediately on their being removed from the rock, one finds them to have the stomach expanded so as to cover almost their whole under surface; in this way then they directly suck off the rock

Through the kind help of Dr. Monro I have received two photos of one of Gray's types[1]), one of which is reproduced here in Pl. XIII. Fig. 4, so that we have now, at length, an illustration showing what this species really looks like. It is rather mysterious that such a large striking form has never been refound — the *Asterina coccinea* of Bell, the only author after Gray to record it from S. Africa, being something different, as I find on examining two of his specimens, sent me from the British Museum. One specimen labelled st. 176 (? the one numbered 10004 in Bell's report) is *Asterina exigua*, var. *dyscrita* H. L. Clark, another from Mossel Bay, is *Parasterina bellula* (Sladen). It is rather extraordinary, that Bell could think these two specimens to be one and the same species. (A third specimen listed by Bell as *Ast. coccinea* I have not seen — but judging from the two other specimens it is rather safe to say that it will not be a genuine *coccinea* either).

As it seems impossible that such a large, evidently littoral seastar could have passed unnoticed, I cannot help suggesting that the labelling of the old specimens on which Gray's description is based, is erroneous and that they did not really come from the Cape of Good Hope — and I would even venture to suggest that they came from the Pacific, i. e. that they are identical with *Asterina miniata* (Brandt). From the photos their identity cannot be seen definitely, but there is nothing decidedly against it and the red colour of *coccinea* might fit fairly well with *A. miniata*. Only the direct comparison of the type specimens of *coccinea* with specimens of *A. miniata* (or *pectinifera*) can solve the question. But that *Asterina coccinea* does not properly belong to the S. African fauna, I feel rather sure. (— See Additional Note, p. 397).

Asterina penicillaris (Lamk.).

Pl. XIII. Figs. 5—7.

According to a kind information from Professor Joubin the type of Lamarck's *Asterias penicillaris* does not exist any more (— and probably was lost long ago, since Perrier does not mention this species in his "Revision"). The specimen described by Müller & Troschel

[1]) Dr. Monro informs me that there are only 3 specimens of the *Patiria coccinea* in the British Museum, whereas *Perrier* (Op. cit.) says that there are "plusieurs individus". It may also be noticed that the description given by Perrier does not seem to fit well with the photos, which might perhaps indicate that different species were confounded by Gray under the name *coccinea*.

in their "System der Asteriden", p. 42, under the name of *Asteriscus penicillaris*, then alone can give us information of the species *penicillaris*.

Through the kindness of Professor W. Arndt I have had these specimens, collected in the Red Sea by Hemprich & Ehrenberg, sent for examination, together with three specimens from the Cape identified by Meissner as *Asterina penicillaris*.

First, as regards the Cape specimens of Meissner it is quite clear that they are identical with *Parasterina bellula* (Sladen). As for the specimens of Müller & Troschel (Pl. XIII, figs. 5—7) it is evident that they are likewise very closely related to *Parasterina bellula*, and were it not for the description of the colour given by Müller & Troschel I would really think them identical. But this description "oben mit blaülichen Grunde und rothbraunen Stacheln, unten blau" does not at all fit with the red colour of the Cape species. If this description be correct, the identity of the Red Sea specimens with those of the Cape is out of the question. But is that description correct? Müller & Troschel state the description of the colour to be taken from drawings (from life evidently) by Lesueur — but their specimens were collected by Hemprich & Ehrenberg, and there is no evidence at all that Lesueur was there together with them. There is then no proof at all that Lesueur's drawing was of the same species as those described by Müller & Troschel as *Asteriscus penicillaris*.

Only through renewed researches on living material of the Red Sea Asterinas can we get a solution of the question. If the specimens of the Red Sea are really coloured as described by Müller & Troschel, they will represent a distinct species, which may then well keep the name *penicillaris*, Müller & Troschel's specimen being then regarded as the neotype of *A. penicillaris*. If they turn out to be not thus coloured, but red as the Cape specimens, they will be identical with the latter and must then be named *Parasterina bellula* (Sladen), since there is no guarantee at all that Müller & Troschel were right in identifying this form with Lamarck's *A. penicillaris*, and this latter will then be a *species delenda*.

The great number of *Asterina* species, no less than eleven, enumerated in Clark's Echinoderm Fauna of S. Africa thus becomes considerably reduced through this critical examination.

First two species, *A. coronata* and *Burtonii* are to be eliminated as not S. African, being not known S. of Mozambique. One, *A. calcarata*, is an erroneous identification of *A. exigua;* the same holds good of *Asterina penicillaris*, which is *Parasterina bellula.* Another species, *A. coccinea*, is probably the Pacific *Ast. miniata*, and certainly not S. African. Finally, *A. dyscrita* is not valid, not to be distinguished from *A. exigua.*

There are thus left only *Ast. granifera*, with the var. *sporacantha*, *Ast. exigua*, *gracilispina* and *lüderitziana* as truly S. African species of *Asterina* — and moreover it is rather probable that *Ast. granifera*, with the variety *sporacantha*, are not distinguishable from *Parasterina bellula.* As a compensation for this reduction there are in the present report added two new characteristic Asterinids to the S. African fauna, viz. *Parasterina formosa* and *Disasterina leptalacantha*, var. *africana*, besides the new *Palmipes* (or *Anseropoda*) *grandis*, so that the S. African region is still very rich in Asterinids.

Disasterina leptalacantha, var. *africana* n. var.

Pl. XII. Fig. 3.

1 specimen found, together with *Asterina exigua*, in a rock pool off Humewood, Port Elizabeth, 12. VII. 1929. Further, there is a specimen in the S. African Museum from off Tugela river, Natal, 200 fathoms.

These specimens agree very closely with the *Asterina leptalacantha* from Queensland, described by H. L. Clark, 1916, in his "Report on the Sea-Lilies, Star-fishes, Brittle-Stars and Sea-Urchins obtained by the F. I. S. "Endeavour" on the coast of Queensland . . . and Western Australia" (Biol. Results Fishing Experiments F. I. S. "Endeavour" IV. 1. p. 57. Pl. XVIII. 3—4), so closely, indeed, that it is quite probable, they are not even distinguishable as a separate variety. If I do establish a new variety for the S. African specimens, it is mainly for zoogeographical reasons, the type species being known only from Queensland. If once discovered in intermediate localities, and when a more extensive material becomes available, it is quite probable, that the characters by which the variety is distinguished come within the individual variations of the species, corresponding to what obtains in *Asterina exigua.*

These characters are: the ventro-lateral plates are all of them provided with a spine, whereas in the type the three most adoral plates of the

first series are perfectly bare. There are 7 marginal spines to each side of the jaws, whereas there are only 5 in the type. In regard to the dorsal side the two S. African specimens show some difference: the specimen from 200 fathoms is completely naked on the dorsal side, except the plates round the anus and the merest indication of spinelets on one of the plates adjoining the madreporite; in the specimen from Port Elizabeth there are, besides the spinelets on the plates round the anus and the madreporite (— which latter are as well developed as in the type —) also some spinelets on a few of the interradial plates, though less so than in the type. This character thus shows a perfect gradation, and is, evidently, of no value as distinguishing feature, but the two other characters mentioned above may perhaps hold good.

The specimen from Port Elizabeth, preserved in alcohol, affords the important information that both the dorsal and the ventral surface is covered by a rather thick, gelatinous skin. On the dorsal side of the arms the skin lies in transverse folds, corresponding to the transverse series of plates; on the ventral side all the spines are enclosed in a rather thick skin; the spine-series, with their skin-sheaths, form elevated walls, separated by deep furrows, the whole underside being thus distinctly radially striated. — Of the colour of the live specimen I can give no information.

It is of very considerable interest to have found this Asterinid, so characteristic through its naked dorsal side and the thick gelatinous skin covering the whole surface, represented in S. African Seas. Also the large bathymetrical distribution, from 0 to 200 fathoms is very noteworthy.

Parasterina bellula (Sladen).

Patiria bellula Sladen. 1889. "Challenger" Ast. p. 385. Pl. LXIII. 1—2; LXIV. 5—6.

Asterina coccinea. Bell. 1905. Marine Invest. S. Africa. Asteroidea p. 248 (non: *Patiria coccinea* Gray).

Patiria bellula Koehler. 1908. "Scotia" Echinod. p. 296.

Callopatiria bellula Verrill. 1913. Revision of the genera of Starfishes of the Subfamily Asterininæ. Amer. J. Sc. 4. Ser. XXXV. p. 480.

Parasterina — Clark. 1923. Echinod Fauna. S. Africa, p. 280.

Of this very fine species I collected 4 specimens on the rocks at St. James, Cape Peninsula. Further, I dredged 5 specimens in Gordon Bay, at a depth of 8—9 fathoms, 19. XII. 1929, and two in Buffals Bay, 30 fathoms, 20. XII. 1929, onboard the "Pickle".

The largest specimen has a size of R. = 60 mm. The colour of the live specimens is a very beautiful red, which has kept fairly well in specimens preserved in formaline and then dried.

One of the specimens from Buffals Bay might perhaps rather be identical with Clark's variety *sporacantha* of *Asterina granifera*. I am, indeed, very much inclined to think that this variety should rather be referred to *Parasterina bellula;* — on the whole, the limit between *Asterina granifera* and *Parasterina bellula* is by no means clear, as already pointed out by Clark (Op. cit. p. 280). It is indeed, very probable that it is all only one, rather variable species, which would then have to keep the species name *granifera* Gray.

A specimen from old times in the collection of the Copenhagen Museum is remarkable in the small, secondary plates of the dorsal skeleton being developed to so extraordinary a degree as almost to conceal the primary plates. It is otherwise a typical *bellula*, and as it is labelled "Cap" there is no reason for regarding it as anything but an individual variation of the species.

The specimen from Mossel Bay recorded by Bell as *Asterina coccinea* (Gray) has been sent me for examination. It is *Parasterina bellula*. Another of Bell's specimens of *A. coccinea* (St. 176. Cape of Good Hope), likewise sent me for examination, is *Asterina exigua*. Also the specimen of "*A. coccinea*" from the third locality in Bell's report is something else, since Dr. Monro informs me that it looks quite different from Gray's types.

Parasterina formosa n. sp.

Pl. XII. Figs. 9—10.

False Bay (Cape Point S. $2^1/_4$ miles), 30 fathoms. Sand. 1 specimen, dredged onboard the "Pickle", 19. XII. 1929.

R. = 22 mm, r. = 10 mm. The arms rather slender, elevated, scarcely narrowing towards the end, which is rounded. Disk covered with small plates, there being a circle of slightly larger plates round a small central area, in the middle of which is seen the anus and at the edge of which is seen the madreporite. The plates along the dorsal midline of the arms are of the same size as those of the disk, but only for about $^1/_3$ of the arm-length, then the plates increase conspicuously in size, and in the distal half they are much larger than those of the disk, very distinctly limited against each other. The spinelets of these

distal plates are arranged in a circle along the margin of each plate, leaving a conspicuous central space bare, except for 2—4 isolated spinelets. The bare space shows in the distalmost plates some small granular elevations of hyaline substance. On the smaller plates in the basal part of the arms and on the disk the spinelets form irregular groups, leaving no bare central space on the plates (for which there would be no room either); between these plates are seen very small spinelets, isolated or in groups of 2—4; evidently they are born on small secondary plates, which can, however, not be distinguished without cleaning away the skin. These small spinelets are not found between the large plates in the distal part of the arms. The papulæ are rather conspicuous, they continue almost to the end of arms. In the dorsal interradii the plates are small, like those of the disk. Marginal plates distinct, both series covered with spinelets like those of the dorsal side. The two first series of ventro-lateral plates continue almost to the end of the arm, the third series to about the middle of the arm; the fourth series is quite short. The ventro-lateral plates with a transverse series of (2) 3—5 spines each, except the plate just outside the jaw, which has only one spine; these spines are about twice the length of those of the dorsal side. Furrow spinelets 3—4, the middle one the longest; on the outer surface of the adambulacrals there is an oblique series of three similar spines. Jaws with 7 marginal spines to each side, the 4 outer ones small, the three proximal ones larger, the one at the apex the largest. On the outer surface each jaw-plate carries an arch of 3—4 spines, similar to the adambulacral spines. — Colour of the preserved (dried) specimen a light purplish of the skin between the plates of the dorsal side, which makes the plates stand out very distinctly.

I do not see any near relation between this very beautiful species and any other known Asterinid.

IX. Family *Echinasteridæ.*

Echinaster ornatus Perrier.

Pl. XIII. Figs. 1—3.

Echinaster ornatus Perrier. 1869. Rech. s. les Pédicellaires et Ambulacres des Astéries et des Oursins. Ann. Sc. Nat. 5. Sér. XII. p. 251. (Separate copy p. 59).

Cribrella ornata Perrier. 1875. Revision des Stellérides du Museum d'Hist. nat. Paris. Arch. Zool. Expér. IV. p. 376. (Separate p. 112).
— — Sladen. 1889. "Challenger" Ast. p. 543.
— — Koehler. 1908. "Scotia" Echinod. p. 293. Pl. XII. 105—106.
Henricia — Döderlein. 1910. Ast. Oph. & Ech. in Schultze. Forschungsreise in W. und Zentral Süd Africa. IV. 1. (Jen. Denkschr. XVI.) p. 252. Taf. IV. 2—2. a.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 289.
Non: *Henricia ornata* H. L. Clark. 1926. Echinod. S. Afr. Fish & Mar. Biol. Surv. II. Sea-stars. p. 19. (= *Henricia abyssalis* (Perrier)).

Some specimens taken on the rocky shores at St. James, Cape Peninsula. Further some specimens dredged onboard the "Pickle" in False Bay, 8—15 fathoms. 19. XII. 1929.

It is perfectly evident that this species is not a *Henricia*, since it has no papulæ on the oral side. The question is only, whether it can remain in the genus *Echinaster*, in which it was originally placed by Perrier, or it should rather form a separate genus. It is the fact that there are numerous short, grain-like spinelets on the dorsal skeletal meshes, not isolated spines as in *Echinaster*, which makes the reference to that genus questionable. I find, however, that, whereas in all the specimens from the shore there are such numerous grain-like spinelets, in some of the specimens from False Bay the spinelets are arranged in single series along the skeletal meshes (Pl. XIII. fig. 3) — and also in *Echinaster sepositus*, the type of the genus, the spines may be arranged in rather dense series along the skeletal meshes. Thus there are all transitions from the typical *Echinaster*-arrangement to the closeset spinelets of the littoral specimens of *Ech. ornatus*, and since there are no other essential differences, there can be no doubt that the Cape species is a true *Echinaster*. It should be emphasized that the arrangement of the dorsal spinelets in single or multiple series is not dependant on age; my largest specimen has the spinelets in single series, and, on the other hand, I have quite young specimens in which they are already numerous and closeset.

The colour of the live specimens is a beautiful reddish-orange. The largest specimen in hand has R. = 60 mm.

The species has been most excellently figured from the oral side by Döderlein (Op. cit.), but it may not be superfluous to give some new figures here, particularly for showing the different aspect of those

with the closeset spinelets from those with the spinelets in single series (Pl. XIII. figs. 1 and 3) — and also for comparison with the real *Henricia* species.

One of the specimens from St. James has one of its arms quite short; it suggest autotomy, so commonly observed in another *Echinaster*-species, *Ech. luzonicus*. But whether it really is a case of autotomy can, of course, only be ascertained through direct observations.

That the specimens identified by Clark 1926 as *Henricia ornata* are not identical with the present species, I can say with certainty, having several of those specimens before me. They must be referred to *Henricia abyssalis* Perrier.

The specimens recorded by Bell (1905. Mar. Invest. S. Africa. III. p. 251) as *Henricia ornata* very probably are partly the true *ornata* (viz. the littoral specimens), partly *Henricia abyssalis* (Perrier) viz. the deep-water specimens. It is curious to see Clark (Op. cit.) praise the wisdom of Bell in referring all these specimens to *Henricia ornata*. It is very rare to have reason to praise Bell for wisdom in his identifications of Echinoderms — and the present case proves to be no exception to the rule. A bit of careful examination cannot leave the slightest doubt of two very distinct types being here confounded.

Döderlein (Op. cit.) regards *Cribrella simplex* Sladen (Chall. Ast. p. 547. Pl. 97. 5—6; 98. 9—10) as identical with *Ech. ornatus*. I do not think this correct; the statement that the spinelets of the dorsal side are at wide intervals apart, single isolated hemispherical or slightly conoid granules which are quite invisible without the aid of a magnifying glass (Op. cit.) does not fit with *Ech. ornata*. Otherwise I shall not enter more nearly on a discussion of this question.

Bell (Mar. Invest. S. Africa. III. Ast. p. 252) mentions two specimens of *Echinaster*, which he could not identify. These two specimens were sent me for examination from the British Museum; they are both of them quite typical *Echinaster ornatus*.

Echinaster reticulatus H. L. Clark:

H. L. Clark. 1923. Echinod. Fauna S. Africa. p. 290. Pl. XV. 1—2.

To this species I refer a specimen which I dredged onboard the "Pickle" off Cape Peninsula, 34°17′ S. 17°58′ E. 160 fathoms. 18. XII. 1929.

Further, a specimen from 31°29′ S. 16°54′ E. 153 fathoms, is, evidently, the same species. This latter specimen has an extraordinary large, elevated, madreporite; it makes the impression of being pathological.

The distinction between *Echinaster reticulatus* and such forms of *Ech. ornatus* which have the spinelets of the dorsal side arranged in single series is not very clear. The existence of numerous papulæ on the oral side in *reticulatus* and their complete absence in *ornatus* would seem to make a sharp distinction, — but, as a matter of fact, they vary very considerably in number, being sometimes very few. — But the question of the specific value of the two forms cannot be solved through examination of some few poorly preserved specimens. Also the relation of *Ech. reticulatus* to *Henricia abyssalis* is not very clear — it seems rather to stand as intermediate between the typical *Echinaster ornatus* and the typical *Henricia abyssalis*.

Henricia abyssalis (Perrier).

Pl. XIII. Figs. 11—12.

Cribrella abyssalis Perrier. 1894. Échinodermes du "Travailleur" et du "Talisman". p. 144. Pl. XI. 1.

Henricia ornata Bell. 1905. Mar. Invest. S. Africa. III. Asteroidea, p. 250. (Pro parte).

— — H. L. Clark. 1926. Echinod. S. Africa. Fish. & Mar. Biol. Survey. II. Sea-stars (Asteroidea) p. 19. (Non: (*Henricia*) *Echinaster ornatus* Perrier.)

Off Cape Peninsula (34°5′ S. 18°2′ E.), 118 fathoms. 23. XII. 1929. 5 specimens.

Off Cape Peninsula (34°17′ S. 17°58′ E.), 160 fathoms. 18. XII. 1929. Several specimens.

Off Cape Peninsula (34°2′ S. 18°7′ E.), 94 fathoms. 17. XII. 1929. 4 specimens.

Off Durban, 225 fathoms. 26. VIII. 1928. 7 specimens.

These specimens all dredged onboard the "Pickle". Further, 46 miles N.W. of Table Mountain, 130—195 fathoms, 1 specimen, taken by the trawler "John C. Meikle".

That these specimens have nothing with (*Henricia*) *Echinaster ornatus* to do is perfectly evident, as explained above. I think it rather certain that they are identical with Perrier's *Cribrella abyssalis*, at least I do not see, how they could be distinguished from that species, of which I have had sent a specimen from the Paris Museum for comparison.

As for the specimens from off Durban, I agree with Clark that they are probably identical with the specimens from off the Cape.

The largest specimens seen by me (R. = 70 mm) were taken by Dr. K. H. Barnard off Dassen Island, 140 fathoms.

This species, though rather variable as other *Henricia*-species, is well characterized by the regularity of the series of ventral interradial plates, two of which continue nearly to the end of the arm, parallel to the adambulacral plates. Also the armature of the adambulacral plates (Fig. 8. a.), particularly the small, delicate spines occupying the outer part of the plates, is conspicuously different from that of the true (*Henricia*) *Echinaster ornatus* (Fig. 8. b.) with which this species was hitherto confounded.

In the figure of the oral side of this species given by Perrier (Op. cit. Pl. XI. 1. a.) the jaws are represented as being uniformly

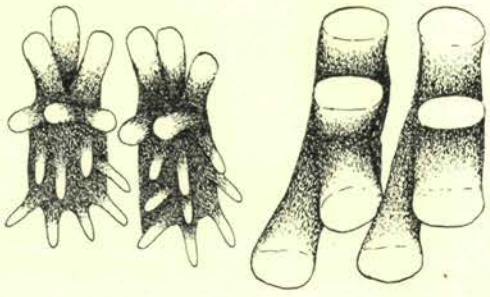


Fig. 8. Adambulacral spines of *Henricia abyssalis* (Perrier) (a), and of *Echinaster ornatus* Perrier (b). × 20.

covered by closeset short spines; in the Cape specimens it is evident that there is a double, irregular series of spines on the outer surface of the jaws — and exactly the same arrangement I find in the cotype of *abyssalis*. There is thus no difference herein between the Cape-specimens and the typical *abyssalis*, the said figure being not quite correct in this detail.

I fail to see, how the *Cribella caudani* Koehler (Echinodermes du "Caudan", p. 46. figs. 16—17) can be distinguished from *abyssalis;* most probably the two are identical.

It is scarcely to be doubted that *Henricia abyssalis* will prove to be distributed all over the Southern Atlantic Deep-sea, so that its occurrence off S. Africa does not mean its distribution to be discontinuous.

X. Family *Pterasteridæ.*

Hymenaster lamprus H. L. Clark.

Pl. XIV. Figs. 8—9.

H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 301. Pl. XI. 3—4.

Some specimens from the "Pieter Faure" collections, P. F. 17074. Cape Point N. 58° E. 49 miles, 900 fms, and P. F. 17114 B. Cape Point N. 70° E. 40 miles, 800 fms. Green mud.

The largest of these specimens has a size of R. = 110 mm.

I can have no doubt that these specimens must be referred to the species *H. lamprus* H. L. Clark, in spite of the fact that the oral spines are not two, as found by Clark in the type specimen, but 3, sometimes even 4, besides the strong spine at the apex. Also the ventro-lateral spines are somewhat longer than indicated by Clark. It should also be pointed out that here and there we may find 3 spines on an adambulacral plate.

Clark says that it may not be impossible that this is only the young *H. giganteus* Sladen, though he thinks this highly improbable. Undoubtedly it is nearly related to *H. giganteus*, but particularly the quite different arrangement of the spiracles seems to me to prove that the two species are quite distinct. The great size of the specimens in hand also tend to indicate the specific distinctness of *H. lamprus.*

I think it not superfluous to give here a couple of new figures of the species, after dried specimens, in which particularly the ventro-lateral spines come out very distinctly.

Two of the specimens have a large, deep scar in some of the interradii, near the centre of the disk. It lies at hand to suggest that this may be due to young ones of rather large size having left the dorsal cavity here, much as we know it from *Pteraster obscurus*, and as it is shown here to be the case also in *Pteraster capensis.* I have, however, been unable to find any young ones in any of the specimens, so it can merely be a suggestion that this species may be brood-protecting like the said *Pteraster* species.

Pteraster capensis Gray.

Pl. XIV. Figs. 1—3.

Pteraster capensis Gray. 1847. Proc. Zool. Soc. p. 83.
— — Perrier. 1875. Révis. des Stellérides du Mus. d'hist. nat. Paris. p. 382. (Separate).
Retaster — Bell. 1905. Echinod. S. Africa. II. Asteroidea. p. 250.

Pteraster capensis H. L. Clark. 1923. Echinod. Fauna S. Africa. p. 298.
— — — 1926. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Sea-stars. p. 21.

Off Cape Peninsula 34°17′ S. 17°58′ E. 160 fathoms. 18. XII. 1929. 9 specimens.

Off Cape Peninsula 34°5′ S. 17°59′ E. 146 fathoms. 23. XII. 1929. 1 specimen.

Off Cape Peninsula 34°21′ S. 17°57′ E. 178 fathoms. 18. XII. 1929. 1 specimen.

These specimens dredged onboard the "Pickle".

Further, some specimens from East London were sent me by Capt. Pace.

The specimen from 178 fathoms is very interesting in showing two large young ones about to leave the brood cavity of the mother specimen (Pl. XIV. Fig. 1), just as we know it from *Pteraster obscurus*. Some other specimens, which I opened, did not show either eggs or young ones in the marsupium.

One of the specimens from off East London has one of the arms bifurcating (Pl. XIV. Fig. 3).

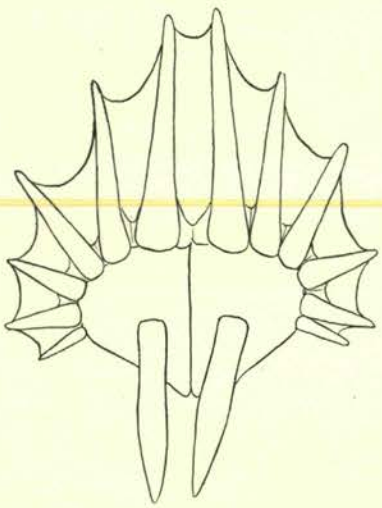


Fig. 9. Jaw of *Pteraster capensis* Gray. × 6.

The characters given by Clark as distinguishing this species from *Pteraster affinis* and *Retaster cribrosus*, viz.: the arm length, the number of the spiracles, and the number of the adambulacral and oral spines, do not hold good. There is so considerable variation in these characters, that it seems impossible to distinguish the species by means thereof. Thus, e. g. a specimen in hand, identified correctly by Clark as *Pteraster capensis*, has 5 oral spines but only 4 spines on most of the adambulacral plates. But there is another much better character, viz. the webbing of the oral spines. In *Pt. capensis* the oral marginal spines are all united by a common membrane (Fig. 9), (as already mentioned by Perrier, Op. cit.). In *Pt. affinis* the web does not continue across the point of the jaw, the spines to each side forming

a separate web; this is well shown by E. A. Smith in his Pl. XVI. Fig. 5, though not mentioned in the description of the species (Philos. Transact. 1879, p. 275). Finally, in *Retaster cribrosus* the web does not continue across the point of jaw, but passes on to the spine on the outer side of the jaw, as also mentioned and figured by v. Martens (Über ostasiatische Echinodermen. Arch. f. Naturgesch. 1867, p. 109. Taf. III. 2. c.).

Also the spine of the outer surface of the jaws appears to offer a good specific character; in *Pt. capensis* its distal, hyaline part is simply cylindrical, gradually tapering to a point[1]), whereas in *Pt. affinis* it is tricarinate. In *Retaster cribrosus* these spines are simply cylindrical, scarcely hyaline in the distal part; (there is a specimen of this species from Zanzibar in the collection of the Copenhagen Museum).

Another character distinguishing *Pt. capensis* from *affinis* is the fin-membrane along the ventral side of the arms. In *capensis* it is very narrow; as this it not seen in the figure of the oral side, given by Clark (Pl. IX., 4), I give here a new figure from a specimen in alcohol (Pl. XIV. Fig. 2); in the dried specimens it does not come out so distinctly.

Pteraster flabellifer n. sp.

Pl. XIV. Figs. 6—7.

31°03′ S. 15°51′ E. 200 fathoms, 1 specimen.

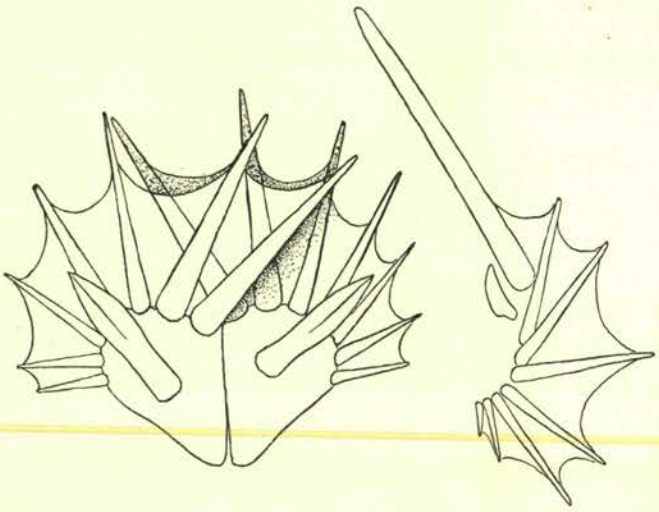
Arms 6; R. = ca. 30 mm, r. = ca. 16 mm; the arms are thus rather long and fairly slender.

The jaws are low, but with the distal end prominent. 7 slender oral spines to each side, increasing gradually in length and strength from the outer to the inner, united on each side by a web which leaves the distal part of the spines free. At the apex of the jaw the two webs cross over a little, but are not united (Fig. 10. a.). The superoral spines are sharply tricarinate. — Adambulacral spines 6—7, arranged in curved series, the concavity outwards; the spines nearest the furrow much the smallest (Fig. 10. b.). Ventro-lateral spines of moderate length, the fin-membrane partly distinct from above. Paxillæ of dorsal side with 5—6 rather long, slender spines; no strong central spine. Dorsal membrane without calcareous deposits. Spiracles apparently few, scattered, apparently of varying size.

[1]) Gray (Op. cit.) states this spine to be absent; perhaps it was lost in the type specimen — but it is well developed in the species.

Colour of the dried specimen white.

That this species is quite distinct from any other known species seems evident — but it is, of course, impossible from the single specimen to judge about the constancy of all the characters described. Indeed, I think they are not constant. I have namely two other, smaller specimens, with only 5 arms, one from 31°00′ S. 16°17′ E. 156 fathoms, the other from off Durban, 225 fathoms (dredged onboard the "Pickle",



a. b.

Fig. 10. *Pteraster flabellifer* n. sp. a. Jaw; b. Adambulacral and ventro-lateral spines. × 9.

26. VIII. 1929) which I am inclined to think identical with the 6-armed specimen; the oral and adambulacral armature is the same, only the oral webs do not cross over at the apex of the jaw.

Only a much larger material can give the definite solution to the problem, whether we have here two distinct species, one 6-armed, the other 5-armed, or only one species with a varying number of arms.

Pteraster fornicatus n. sp.

Pl. XIV. Figs. 4—5.

S.W. of Cape St. Martin, 179 fathoms. 1. IV. 1920. 2 specimens.

Type specimen R. = 8 mm, r. = 6 mm; the second, smaller specimen has R. = 6.5 mm, r. = 5 mm. Shape almost pentagonal, the

arms being very short and with the end turned upwards. Disk rather high, cushion-like.

Jaws low, but with the posterior end raised. Oral spines 6 (5) to each side, free, not united by a web, very slender, except the first; superoral spine rather short, but stout, strongly tricarinate (Fig. 11). Adambulacral spines 5, in a curved series (the concavity outwards), the innermost much the smallest. Ventro-lateral spines of moderate length, the fin-membrane not discernible from above.

Paxillæ of dorsal side with 5—6 slender spines. No reticulation of dorsal membrane, which is very delicate, without spicules. Spiracles scattered singly all over the dorsal side.

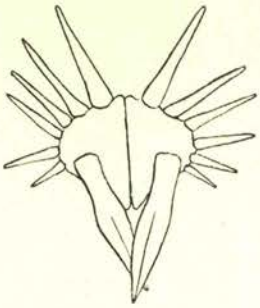


Fig. 11. Jaw of *Pteraster fornicatus* n. sp. × 12.

These are the two specimens from St. 34, which H. L. Clark, 1926 (p. 21—22) records under the name of *Pteraster capensis*, stating that they are "too small to make their identity certain". I cannot at all agree with Clark herein. Although they are very probably only young specimens, the character of the jaws — the not webbed oral spines and the strongly tricarinate superoral spines — shows very clearly that they have nothing with *Pt. capensis* to do. The species to which they are the nearest related is, evidently, the Japanese species *Pt. obesus* H. L. Clark, which differs from the S. African species mainly in the greater number of spines (8—10) in the dorsal paxillæ and in the two proximal oral spines being flat and square-cut at the end. I think then, there can be no doubt that we have here a distinct species, easily recognizable by the characters here described, even though it should ultimately prove to grow to a much larger size than the specimens in hand.

Diplopteraster multipes (M. Sars).

Pteraster multipes M. Sars. 1877. Fauna littoralis Norvegiæ. III. p. 65. Pl. VIII. 1—17.

Diplopteraster multipes W. K. Fisher. 1911. Ast. North Pacific. Bull. U. S. Nat. Mus. 76. p. 371. Pl. 107. 1—2.

— — H. L. Clark. 1923. Echinod. Fauna. S. Africa. p. 300.

— — — 1926. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Sea-stars. p. 22.

Off Cape Peninsula, 34°17′ S. 17°58′ E. 160 fathoms. 18. XII. 1929. 2 specimens.

Off Cape Peninsula, 34°21′ S. 17°57′ E. 178 fathoms. 18. XII. 1929. 7 specimens.

Dredged onboard the "Pickle".

The two large specimens from the latter locality were of a dark red colour when alive, the other, smaller, specimens were of a light red or pink colour.

In the paper of 1926 Clark suggests that the S. African form may ultimately prove to be different from the N. Atlantic-N. Pacific form. The comparison which I have undertaken between S. African and N. Atlantic specimens has led me to the result that they cannot be distinguished — as was also the result reached by Clark in 1923.

XI. Family *Solasteridæ.*

Lophaster quadrispinus H. L. Clark.

H. L. Clark. 1923. Echinod. Fauna S. Africa. p. 295. Pl. XVIII. 1—2.
— 1926. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Sea-stars. p. 21.

Off Durban, 225 fathoms, 12 young specimens, dredged onboard the "Pickle" 26. VIII. 1929.

I have further received a specimen from off East London, sent me by Captain Pace.

To Clark's description I would only add that there may be as many as 12 slender spines along the edge of the oral plates, and that the adambulacral plates often have 5—6 furrow spines instead of 4.

Crossaster penicillatus Sladen.

Crossaster penicillatus Sladen. 1889. "Challenger" Asteroidea, p. 446. Pl. LXX. 5; LXXII. 9—10.
Solaster — Bell. 1905. Marine Invest. S. Africa. III. Ast. p. 249.
Crossaster — Koehler. 1909. "Scotia" Echinoderms. p. 224.
— — Clark. 1923. Echinod. Fauna S. Africa. p. 295.
— — — 1926. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Ast. p. 21.

Off Cape Peninsula, 34°2′ S. 18°7′ E. 94 fathoms, 17. XII. 1929. 2 specimens.
Off Cape Peninsula, 34°5′ S. 18°2′ E. 118 fathoms, 23. XII. 1929. 1 specimen.
These specimens dredged onboard the "Pickle". Further, I found in the

collection in the laboratory of the Fisheries Survey some specimens from 33°43′ S. 16°38′ E. 126 fathoms.

Two specimens were sent me by Capt. Pace from off East London.

The colour in life appears to be a uniform red, judging from the preserved specimens. I have, however, not made any notes about their colour after the living specimens.

XII. Family *Asteriidæ*.

Marthasterias glacialis, var. *rarispina* Perrier.

Pl. XVI. Figs. 2—3.

Asterias rarispina Perrier. 1875. Revis. Stellérides Mus. Paris. p. 62.
Marthasterias rarispina Clark. 1923. Echinod. Fauna S. Africa. p. 305.
Asterias glacialis Bell. 1905. Mar. Invest. S. Afr. Ast. p. 252.

Agulhas Bank, 4 miles S. of Cape Barracouta, 35 fathoms, sandy mud. 6 specimens, taken onboard the trawler "John C. Meikle".

False Bay, 11—30 fathoms. 10 specimens; Gordon Bay, 8—9 fathoms. 1 specimen. 19. XII. 1929, dredged onboard the "Pickle".

Further, there are some specimens from off Sea Point, 45 fathoms, from the Fisheries Survey. Finally, 6 specimens from Capt. Pace from off East London.

The largest specimens in hand have R. = 110 mm; it would appear then, that this variety does not attain more than about half the size of the typical, N. Atlantic *Marthasterias glacialis*.

The difference between specimens with only the three main series of dorsal spines and the variety *africana*, with many irregularly arranged spines, is very striking (Pl. XVI. Figs. 1—2). But transitional forms are found (Pl. XVI. Fig. 3) so that neither of the two forms can rank higher than as — not very distinct — varieties.

The colour of the live specimens is a light reddish or pinkish, much as the typical *Marthast. glacialis*.

On some of the specimens I find a number of Caprellids attached on the dorsal side. This would appear to be a similar symbiosis as that known of *Asterias rubens* and the Caprellid *Podalirius typicus*.

Marthasterias glacialis, var. *africana* (Müll. & Troschel).

Pl. XVI. Fig. 1.

Asteracanthion africanus Müller & Troschel. 1842. System d. Asteriden, p. 15.
Marthasterias africana Clark. 1923. Echinod. Fauna. S. Afr. p. 306.

St. James, Cape Peninsula. 3 specimens, taken on the rocky shore, Jan. 1930.

These specimens agree very well with Müller & Troschel's description, and, as they come from the type locality, it may be regarded as beyond doubt that we have here the true *Ast. africana*. Though I have never met with similar specimens in deeper water, it is evident that there are all transitions between this form and the typical *rarispina*. It would seem that the variety *africana* is strictly littoral, whereas the var. *rarispina* does not occur directly on the coast.

Cosmasterias felipes (Sladen).

Pl. XV. Figs. 1—4.

Stichaster felipes Sladen. 1889. "Challenger" Asteroidea. p. 433. Pl. 101. 1—2; 103. 7—8.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 304.
— — — 1926. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Ast. p. 22.
Cosmasterias capensis W. K. Fisher. 1930. Ast. N. Pacific. III. (Bull. U. S. Nat. Mus. 76.) p. 228. (Non: *Asterias capensis* Perrier.)

Off Cape Peninsula, 34°24′ S. 18°16′ E. 133 fathoms, 18. XII. 1929. 12 specimens.

Off Cape Peninsula, 34°17′ S. 17°58′ E. 160 fathoms, 18. XII. 1929. 3 specimens.

Off Cape Peninsula, 34°21′ S. 17°57′ E. 178 fathoms, 18. XII. 1929. 2 specimens.

Off Cape Peninsula, 34°2′ S. 18°7′ E. 94 fathoms. 17. XII. 1929. 8 specimens.

Cape Point N. 83° E., 18 miles. 93 fathoms, 20. XII. 1929. 12 specimens.

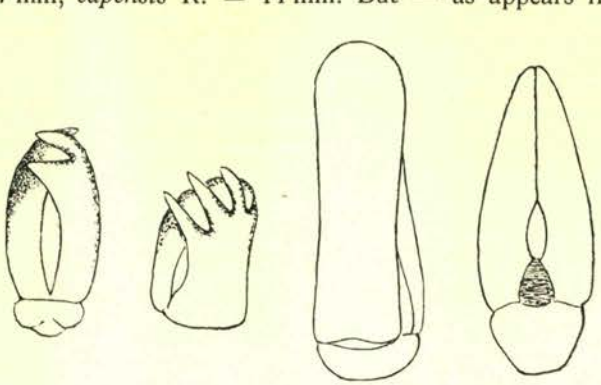
These specimens dredged onboard the "Pickle".

There are further some specimens from the Fisheries Survey, labelled only with some numbers, the meaning of which could not be traced.

The colour of the live specimens was a dull reddish.

Fisher (Notes on Asteroidea IV. Ann. Mag. Nat. Hist. 9 Ser. XVIII. 1926, p. 198) suggests that *Asterias capensis* Perrier is only the young stage of *Stichaster felipes*, which latter name should then be discarded for the name *capensis* Perrier — and in his work of 1930 (Op. cit.) he has definitely changed the name *felipes* into *capensis*. Having had one of the specimens of *Asterias capensis* from the British Museum (labelled 1847, Dr. A. Smith, and thus evidently one of the specimens examined by Perrier and accordingly a cotype) for examination and comparison with my specimens of *Cosmast. felipes*, I must decidedly protest against the idea that the two could be identical. It is true, I have no specimens

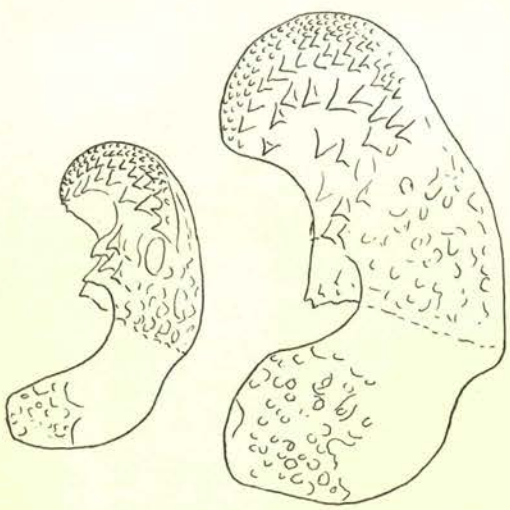
of *felipes* quite as small as *capensis*, the youngest *felipes* having R. = 27 mm, *capensis* R. = 14 mm. But — as appears from the



a. b.

Fig. 12. Straight pedicellariæ of *Cosmasterias felipes* (Sladen) (a), and of *Sclerasterias eustyla* (Sladen) (b.). × 30.

(slightly magnified) photos of these two specimens, Pl. XV. Figs. 3—4, they are so very unlike — *capensis* very much more robust than *felipes* — that alone from their general appearance it is evident, they could



a. b.

Fig. 13. Valves of crossed pedicellariæ of *Cosmasterias capensis* (Perrier) (a), and of *Cosmasterias felipes* (Sladen) (b.). × 235.

not be identical. Then the disk-plates are much more distinct in *felipes* than in *capensis*, and the spines are much more slender in *felipes*. Fisher thinks the *capensis* specimens too young for having as yet developed the large unguiculate pedicellariæ (Fig. 12. a.) so characteristic of *felipes*; but in the youngest specimen in hand of the latter they are already numerous. Also the crossed pedicellariæ are much larger, ca. twice the size, in *felipes* than in *capensis* (Figs. 13. a—b.).

Then *capensis* is evidently a selfdividing species — the specimen in hand has four madreporites — and is usually 6-armed. None of the specimens of *felipes* show any trace of being selfdividing, and not one of them has 6 arms. On the whole, I think the idea that species normally 6-armed and selfdividing as young transform into 5-armed, non-dividing adult, a mistake — for Asteroids as well as for Ophiuroids.

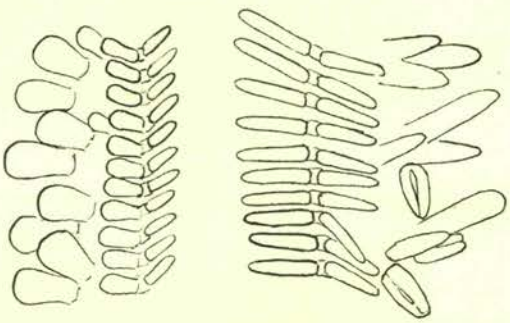
The information and figures now given show definitely that *capensis* and *felipes* are two quite distinct species.

Cosmasterias capensis (Perrier).

Pl. XV. Figs. 11—12.

Asterias capensis Perrier. 1875. Revis. Stellérides. Mus. Paris. p. 73.
— — Clark. 1923. Echinod. Fauna. S. Africa. p. 307.
Cosmasterias capensis Fisher. 1926. Notes on Asteroidea. IV. Ann. Mag. Nat. Hist. 9 Ser. XVIII. p. 198.

Referring to the remarks given above under *Cosmast. felipes* I shall here confine myself to giving figures of the specimen lent me from the British Museum. Attention should be called to the club-shape of the



a. b.

Fig. 14. Adambulacral spines of *Cosmasterias capensis* (Perrier) (a), and of *Cosmasterias felipes* (Sladen) (specimen R. = 35 mm) (b.). × 6.

spines outside the adambulacral spines, so very different from that of *Cosmast. felipes* (figs. 14. a—b.).

The specimen of *Ast. capensis* mentioned by Bell (1905) Mar. Invest. S. Afr. III. Ast. p. 252) could not be found, I am informed by Dr. Monro. There is then no certainty at all that it was a true *capensis*, and there is no possibility either of any reasonable guess as to what it was.

Sclerasterias stenactis (H. L. Clark).

Pl. XV. Figs. 5—6.

Eustolasterias stenactis H. L. Clark. 1926. Echinod. S. Afr. Fish. & Mar. Biol. Survey II. Ast. p. 23. Pl. 4.

Sclerasterias — W. K. Fisher. 1928. Asteroidea of the North Pacific. II. Bull. U. S. Nat. Mus. 76. p. 107.

Off Durban, 225 fathoms, 4 young specimens, dredged onboard the "Pickle", 26. VIII. 1929. The largest has R. = 35 mm.

The figures given here differ rather conspicuously from those given by Clark. Nevertheless, I can have no doubt that the identification as *E. stenactis* is correct, both because they agree fully with Clark's description, and also because they agree no less completely with a young specimen in hand identified by Clark himself. Also the locality is the same.

The specimens, dried from formaline, are of a reddish-brown colour, which, evidently, is much like the colour in life.

Fisher (Op. cit. p. 108) regards *stenactis* as a subspecies only of his *Sclerasterias euplecta* from the Hawaiian Islands. He has, however, not seen any specimen of *stenactis*, and as I have no specimen of the typical *Scl. euplecta* I think it preferable for the present to maintain *stenactis* as a separate species.

Sclerasterias sp.

From off Durban, 50 fathoms, there is a single small specimen (R. = 5 mm) of a 6-armed, self-dividing Asterid (dredged onboard the "Pickle" 27. VIII. 1929), which I cannot hesitate in referring to the genus *Sclerasterias*, but I do not think it advisable to try to identify the species on the base of a single young specimen. It should only be stated that it is certainly different from *Sclerasterias stenactis* (H. L. Clark) and likewise that it has nothing with *Cosmasterias capensis* to do.

Sclerasterias eustyla (Sladen).

Pl. XV. Figs. 7—8.

Asterias (*Stolasterias*) *eustyla* Sladen. 1889. "Challenger" Ast. p. 587. Pl. 106. 5—8.

Sclerasterias — Fisher. 1928. Asteroidea N. Pacific. II. p. 107.

30°44′ S. 15°43′ E. 108 fathoms, 1 specimen (from the Fisheries Survey).

This specimen, which has all the arms broken off the disk, agrees so well with the description and figures of the species *eustyla* given by Sladen that I cannot hesitate in identifying it with that species. The apparent differences seen on comparing the figures here given with those of Sladen are evidently due to the present specimen being dried, whereas the specimen figured by Sladen was in alcohol. This fact also easily explains, why Sladen does not mention the straight pedicellariæ, which, although quite conspicuous on the dried specimen, may easily be concealed by the richly developed papulæ. These pedicellariæ, ca. 1.2 mm long, are not unguiculate, but have the end of the valves simple, rounded, rather duck-bill shaped (Fig. 12. b; p. 275).

As Sladen states specially to have been unable to find any "forficiform" pedicellariæ on the oral side of the single specimen examined by him, it should be mentioned that in the present specimen they occur in fair numbers on the oral side.

It may be observed that the plates of the very small disk are almost completely naked.

The species was hitherto known only from off Tristan da Cunha, 100—150 fathoms. There is nothing surprising then in finding it to occur in S. African waters.

Perissasterias polyacantha H. L. Clark.

H. L. Clark. 1923. Echinod. Fauna S. Africa. p. 307. Pl. XVIII. 3.

— 1926. Echinod. S. Afr. Fish. & Mar. Biol. Surv. II. Ast. p. 29. Pl. 6.

Off Cape Peninsula, 34°17′ S. 17°58′ E. 160 fathoms, 18. XII. 1929. 1 specimen.

Cape Point N. 83° E. 18 miles. 93 fathoms. 20. XII. 1929. 1 specimen.

These specimens were dredged onboard the "Pickle".

The species is an exceedingly brittle one, the arms dropping off from the disk almost by merely touching it.

The colour in life is a dull reddish.

Perissasterias sp. (young).

Pl. XV. Figs. 9—10.

From an unknown S. African locality (the label has only the number 1480) there is a young 5-armed specimen which may not improbably represent a new species of the genus *Perissasterias;* as, however, young specimens of the species *polyacantha* H. L. Clark and *obtusispina* H. L. Clark are unknown, we have no means of deciding whether it be the young of one of these, or it represents a new species. The specimen is in very poor condition, and all the arms broken from the disk. R. = ca. 40 mm. There are only three spines on the adambulacral plates, only in the basal part some of them have 4 spines, without attached pedicellariæ. No ventro-lateral plates (as in the distal part of arms in larger specimens of *polyacantha*). Infero-marginals with two rather large, distinctly flattened spines. Supero-marginal and dorsal spines few, small, pointed; pedicellariæ scattered, not in wreaths.

As there are known already three species of this genus, so characteristic of S. African Seas, it would not be altogether too surprising to find still a fourth species there; but so long as we know only large specimens of the three other species, it is quite impossible to say whether the characters observable in this young specimen are of specific value or they are only characters of youth.

Ophiuroidea.

Family ***Gorgonocephalidæ.***

Astrothorax papillata (H. L. Clark).

Astrothamnus papillatus H. L. Clark. 1923. Echinoderm Fauna of S. Africa. p. 316. Pl. XX. Figs. 5—6.

There is no doubt that this species belongs, not to the genus *Astrothamnus* Matsumoto, to which it was referred by Clark, but to the genus *Astrothorax* of Döderlein, characterised by its hook-belts consisting of larger, isolated plates carrying numerous not regularly arranged hooks, and by its hooks having only one secondary tooth (in *Astrothamnus* there are 4—6 secondary teeth on the hooks).

To the careful description given by Clark a few remarks may be added, as also figures of the hooks and spines (Fig. 15. a—f.). The

hook-belts become very broad on account of the series of granules of the "interannuli" nearest the hook-bearing plates being rather large and as high as these latter, thus apparently forming part of the hook-belts, whereas the one or two middle series of the interannuli are much smaller and low, the result being that the broad hook-belts are separated by narrow, sunken rings, as partly well seen in Pl. XX. 5 of Clark's paper. On the sides of the arms the interannuli are reduced to only one series of plates, the lowermost one of them, between each two

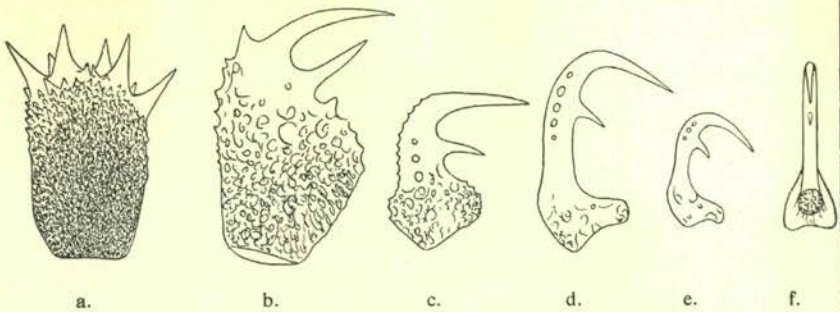


Fig. 15. Spines and hooks of *Astrothorax papillata* (H. L. Clark). Shows the gradual transformation from the normal armspine (a) to the hook-shaped spines from distal part of arm (b, c). Hooks from the belts of the dorsal side of arm (d, e); hook seen in front view (f.). a. × 50; b—f. × 120.

spine-bundles, being usually quite a conspicuous, rounded, smooth plate.

The arm-spines are stated by Clark to be, beyond the proximal-most segments, 4, or usually 5, very rarely 6. I find in a specimen of 20 mm diameter of disk even 7 arm spines. In preserved specimens the arm-spines are generally turned towards the base of the arms. They terminate in a varying number of hyaline thorns (Fig. 15. a.).

The said specimen of 20 mm diameter of disk has no less than 4 madreporites. Generally there is, however, only one madreporite.

I have specimens from the following localities:

Off Durban, 123 fathoms, 1 specimen.
Off Durban, 209 fathoms, 1 specimen.
30°3′ S. 31°3′ E., 112 fathoms, 2 specimens.
33°17′ S. 27°35′ E., 24 fathoms, 5 specimens.

Gorgonocephalus pectinatus n. sp.

Pl. XVIII. Figs. 1—2.

Gorgonocephalus Pourtalesi Bell. 1905. Marine Invest. S. Africa. III. Ophiuroidea, p. 259.

— *chilensis* H. L. Clark. 1923. Echinoderm Fauna of S. Africa. p. 318.

Non: *Gorgonocephalus chilensis* (Philippi).

Description of type specimen. Diameter of disk ca. 30 mm. Dorsal side of disk almost perfectly naked, only here and there a single, small granule. The radial ribs very prominent, narrow, widely apart at the arm-base, convergent towards the centre of the disk, which is distinctly sunken. The radial ribs are of nearly the same width throughout; they carry a number of small, but rather conspicuous tubercles, arranged without any regular order; where intact (in the centre of the disk) they terminate in some small thorns. The marginal belt of plates (which is very distinct) carries some tubercles of the same size as the radial ribs. The ventral interradii are closely covered with small, uniform granules. Such granules are found also along the abradial edge of the genital slits; these latter are short, reaching from about the 5th to the 9th—10th arm-segment.

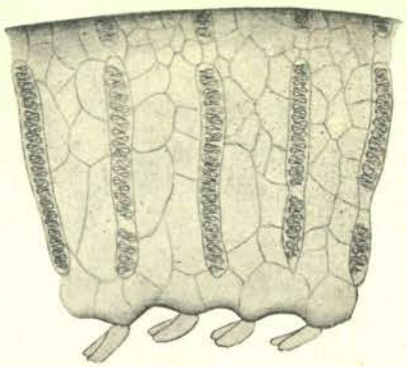


Fig. 16. Part of arm (segments 3—6 from disk) of *Gorgonocephalus pectinatus* n. sp. Side view. Showing the plating and the hook-belts. × 8. (The limitation of the plates in the lower part scarcely as distinct as here represented.)

The mouth-frame perfectly smooth, excepting a few granules at the edge of the interradii. Also the ventral side of the arms smooth, only with a few, scattered, small granules in the proximal part. Mouth papillæ rather slender, in a not very dense cluster at the apex of the jaws. Madreporite of moderate size, slightly protruding into the interradius. Arm-spines present from the second pore-pair, 2 at the first 4—5 pore-pairs, then three on some segments, then two or three, quite irregularly alternating, now three, now two being the predominant number. The spines terminate with some small thorns.

The first forking is just outside the disk. There are 8 segments unto the first forking, 10—11 between the 1st and 2nd; from the 2nd forking the branches become of unequal length; on the main arm the shorter branch has 10—11, the longer ca. 30—33 segments. Beyond the third forking there is somewhat less difference in the length of the branches.

The dorsal side of the arms smooth, covered with fairly large, irregular, smooth plates, interrupted by the rather conspicuous belts of hooks (Fig. 16). The hook-belts are interrupted in the dorsal midline

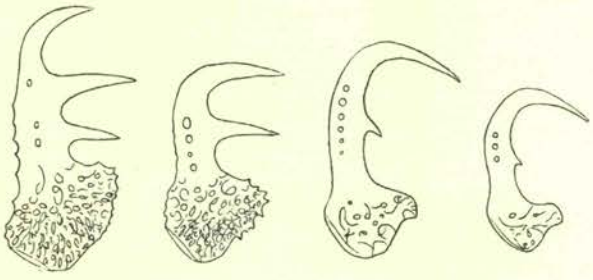


Fig. 17. Hooks of *Gorgonocephalus pectinatus* n. sp. a—b. Transformed armspines from distal part of arms; c—d. Hooks from dorsal side of arms. × 120.

on the proximal 4—6 segments, and also broken up into 2—3 pieces on the sides of the arm; but they are complete from about the 2nd forking. The hooks (Figs. 17. c, d.) are of the typical form, with one secondary tooth, which is, however, unusually small.

The colour of the dried specimen creamy-white; the naked parts of the disk a light brownish, with some small darker spots.

From the examination of a number of specimens received from the S. African Museum it appears that, as might be expected, there is a good deal of variation in this species, as in other *Gorgonocephalus*-species. It is mainly in the character of the disk that there is a conspicuous variation. In some specimens the interradial spaces carry more numerous tubercles, sometimes they are even almost as closely covered as are the radial shields. Also the character of the tubercles varies, they being sometimes thicker, more conical, sometimes longer and more slender, spine-like. A young specimen, 11 mm diameter of disk,

has relatively the strongest tubercles; still, I do not think it doubtful that it really belongs to this species. The tubercles of the interradial spaces are of the same character as those on the radial ribs. The number of arm-joints between the forkings is subject to much variation; but on the whole there is a conspicuous difference in the length of the two branches of each forking after the second or the third forking. In some specimens the hook-belts are not distinct in the proximal part of the arms — partly evidently because of bad preservation.

The largest specimen is ca. 55 mm diameter of disk.

The type specimen, which was taken off East London, S. Africa (Buffalo River N.N.E. 17 miles, 195 fms.), was received from the S. African Museum under the name of *Gorgonocephalus chilensis*. Finding it to be quite distinct from *G. chilensis*, I was naturally led to suggest that the specimens from S. African seas mentioned in literature might rather be *G. pectinatus*, not *G. chilensis*. I therefore applied to the British Museum and to the S. African Museum with the request to have their S. African specimens of *G. chilensis* sent for reexamination. From the British Museum I received the specimen mentioned by Bell (Op. cit. 1905) as *Gorgonocephalus Pourtalesi* Lyman (= *Gorg. chilensis* (Philippi)) — it is *Gorgonocephalus pectinatus*, not *G. chilensis*. From the S. African Museum I received a number of specimens among which 4 labelled in Clark's hand *Gorgonocephalus chilensis* (Cape Point N.E. by E. $^3/_4$ E., 28 miles, 300 fathoms). They are all of them *G. pectinatus*, not *G. chilensis*. Thus, — although I have not seen the 2 specimens mentioned by Clark (loc. cit.) from the locality Vasco da Gama Peak, N. 71° E., 15 miles, 230 fms. — it may safely be stated that *Gorgonocephalus chilensis* is not known from S. African Seas, what has been recorded as this species being the quite distinct species *Gorgonoc. pectinatus*. From a zoogeographical point of view this result is very satisfactory, serving to emphasize the fact that, at least as regards the Echinoderms, there is no nearer relation between the S. African and the S. American marine faunas.

Gorgonoc. pectinatus is very easily distinguished from *G. chilensis* by the character of the arms — distinctly plated and nearly or completely without granules, and with the arm combs very distinct already from the base or, more rarely, from the 2nd forking in *G. pectinatus*, closely granular from the base, and the hooks not beginning till about

the 4th forking and forming conspicuous belts only on the terminal branchlets in *G. chilensis*[1]).

The localities from which I have seen specimens are:

Cape Point N.E. by E. $^3/_4$ E. 28 miles, 300 fathoms.
Lions Head, Cape Peninsula, S.E. $^1/_4$ E. 50 miles, 230 fathoms.
Cape Point, N.E. $^3/_4$ E. 29 miles, 470 fathoms.
Buffalo River, East London, N.N.E. 17 miles, 195 fathoms.

The type specimen is from the last locality.

The nearest relations of *G. pectinatus* must be sought among those species which have distinct hook-belts already in the proximal part of the arms, viz. *G. dolichodactylus* Döderl., *G. sundanus* Döderl., and *G. moluccanus* Döderl. The first of these stands apart on account of its hooks having no secondary tooth. The S. African species may be the nearest related to *G. moluccanus*, but differs from it in various characters, e. g. the much larger size of the genital slits in the latter species. So long as we do not know the range of variation of *G. sundanus* and *moluccanus* (Döderlein had only 1 specimen of each, and he suggests that possibly the two are only variations of a single species. Op. cit. 1927, p. 26—27) it is not easy to state more definitely the differences between the S. African and the Moluccan species. But that they must be regarded as representing distinct species can hardly be questionable — particularly so long as they are known only from so widely distant localities, one from the S. African, the other(s) from the Moluccan Sea.

Clark (loc. cit.) suggests that *G. chilensis* (i. e. *G. pectinatus*) "is viviparous and the young remain with the mother until well grown", because he has found the larger individuals carrying on their backs much younger ones, which are "clinging very tightly, some of the

[1]) From the descriptions and figures of *G. chilensis* found in previous literature it does not appear clearly, how it is with the hook-belts in the proximal part of the arms. In Bell's description of *Astrophyton Lymani* (Account of the collections of the "Alert" in the Strait of Magellan and on the coast of Patagonia. P. Z. S. 1881. p. 99) which is generally recognised to be identical with *G. chilensis*, it is stated that the dorsal side of the arms is closely granulated; this character alone shows that the S. African form with the plated, non-granulated arms must be a different species. A specimen of the true *G. chilensis* in hand (from off the coast of Argentina, 38°15′ S. 54°20′ W.), agreeing perfectly with Bell's rather unusually careful description of "*Astrophyton Lymani*", shows the hooks to begin only at about the 4th forking.

ultimate arm divisions entering into the genital slits of the carrier". Alone the fact that there are innumerable small gonads, as in other *Gorgonocephalus*-species, proves sufficiently that it cannot be viviparous. That the young ones may be found on the back of the adult has nothing with viviparity or brood-protection to do, as will be evident from my observations on *Gorgonoc. caput-medusæ*, in which young ones are often found on the back of the adult in spite of the fact that the eggs are shed free in the sea (cf. my paper "Observations on some Echinoderms from the Trondhjem Fjord. K. Norske Vidensk. Selsk. Skr. 1923. 3, p. 13—16). It simply means that the young ones happen — which must be quite easy where many specimens live together — to attach themselves to an adult, in the same way as they may happen to find a Gorgonian or the like to attach themselves to. In this way it happens that also in Ophiurids like *Ophiothrix fragilis* or *Ophiopholis aculeata*, which are known with certainty to have pelagic larvæ, the young ones may be found on the back or the arms of the adult.

That the young *Gorgonocephalus* even assumes a kind of parasitic habit, eating of the skin of the adult to which it has attached itself, as is rather convincingly shown by Fedotov (Über eigenartigen Parasitismus bei Stachelhäutern. Z. f. Morph. u. Oekol. d. Tiere. 22. 1931), is an additional proof that this occurrence of the young specimens on the back of the adults has nothing with protection of the brood or with viviparity to do.

Astroconus capensis n. sp.

Pl. XVIII. Figs. 3—4.

One specimen from 29°51′ S. 31°28′ E. 230 fathoms (Fisheries Survey). Diameter of disk ca. 30 mm.

Disk rather flat. The radial ribs are narrow, conspicuously raised, widely apart distally, converging towards the centre, which is deeply sunken. Along the ribs are placed, without any order, several conical tubercles of moderate size, terminating (when intact) in a number of small thorns. Along the interradial edges of the disk are some smaller conical tubercles, likewise ending in some small thorns. The disk otherwise closely covered with minute, smooth plates, which produce a very finely granular appearance. The ventral interradii are rather closely tuberculate, the tubercles being small, but distinct. At the edges of the genital slits, particularly the adradial edge, they assume the

shape of small, slender spines. In the distal part of the interradii are found scattered some tubercles intermediate in size between those on the edge of the disk and those of the general covering of the ventral interradii.

The mouth frame and the ventral side of the arms covered with a dense mosaic of small irregularly polygonal, flat plates. On the jaws, which are somewhat elevated, these plates are smaller and have more the character of granules; along the interradial edges of the mouth frame, on the other hand, they partly assume the character of tubercles like those of the interradii. The mouth papillæ are rather long and stout, particularly those on the apex of the jaw; they form a continuous series all round the edge of the mouth slits. The madreporite is very inconspicuous, situated at the edge of the mouth frame, encroaching a little upon the interradius. The genital slits are ca. 5 mm long, equalling about four arm segments in length.

The underside of the arms is flat, without any grooves, but there may be an indication of a transverse furrow between the segments from the first forking onwards. The first forking is at the edge of the disk, at the 8th segment; from the 2nd forking the branches are very unequally developed, there being a main stem with alternating side branches; there are 8—9 segments between 1. and 2. forking, 12—13 between the following forkings on the main branches, ca. 7—8 on the side branches. In the distal branches there may be up to ca. 20 segments between the forkings, but this is quite inconstant. The arm-spines begin at the 2nd pair of pores. There are at first only 2 (sometimes only 1) of them; from about the first forking there are 3 (rarely 4) of them, and on the distal branches again only 2. On the proximal part of the arms the spines are simply pointed, farther out they terminate in 2—3 hyaline thorns, and in the distal part of the arms, of course, they gradually assume the shape of hooks (Fig. 18. a, b.). They are much shorter than an arm-joint, the inner one is the longest.

The dorsal side of the arms covered with a mosaic of very small plates which may along the upper surface partly assume the character of small tubercles; on the whole the dorsal surface of the arms is very smooth. There is a rather conspicuous median furrow, and also between the segments there are somewhat sunken transverse furrows, the arms having thus a slightly annulated appearance. The hooks begin at about the 3rd forking and form complete belts from about the 4th forking.

The hooks are of the typical form, with only 1 secondary tooth (Fig. 18. c—d.).

Ventral plates do not exist, as seen on removing the general covering by means of hypochlorite of sodium. No distinct belt of the hook-bearing plates is observable on removing the superficial covering, such as is found in *Astrocladus euryale*.

Colour of the preserved, dried specimen pure white.

After this report on the S. African Ophiurids had been completed I received from the Hamburg Museum a specimen of an Euryalid from

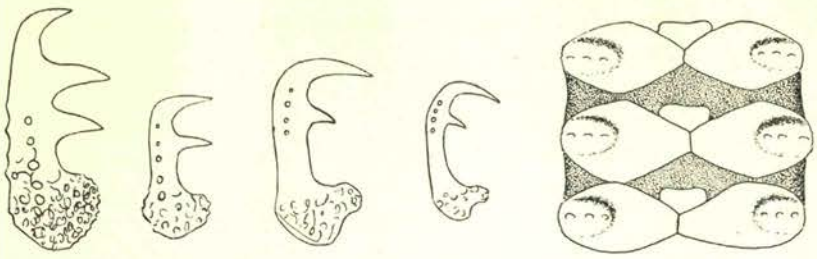


Fig. 18. Hooks of *Astroconus capensis* n. sp. a—b. Transformed armspines from distal part of arm; c—d. Hooks from dorsal side of arm. e. Ventral side of arm of *Astroconus australis* (Verrill); three armjoints, cleaned so as to show the small ventral plates and the large lateral plates, each with an evelated part to which the armspines are attached. a—d. × 135; e. × 9.

the Natal coast (between Natal and Mossel Bay, Bell Marley, 1927) which proves to belong to *Astroconus capensis*. It is about the same size as the type specimen, with which it agrees very well. It is only to be remarked that the distal edge of the mouthframe is more distincly spiny than that of the type, and that there is a small but fairly distinct pit or depression at the base of each arm in the midline, just outside the mouth slit. The colour of this specimen is a light brownish.

It may perhaps be open to discussion whether the present species rightly belongs in the genus *Astroconus*. At least it differs rather conspicuously from the two other species of this genus hitherto known, *A. australis* (Verrill), the genotype, and *A. annulatus* Koehler, in the much smaller size of the tubercles of the radial ribs. In *A.annulatus* the disk is very high, but in this regard *capensis* is more like *A. australis*.

According to Döderlein (Op. cit. 1911, p. 36) the genus *Astroconus* agrees with *Gorgonocephalus* in all essential points, thus also in the

very important character: the existence of a marginal series of larger interradial plates. On p. 69 Döderlein says about this marginal belt of plates that its existence is difficult to ascertain on account of the hard skin, "doch glaube ich ihn bei *Astroconus* annehmen zu dürfen" (cf. also p. 71, under *Astroconus australis*). This belt of marginal plates, however, does not exist in any of the three species, as I have been able to ascertain definitely by applying hypochlorite of sodium. Another character of *Astroconus* is, according to Döderlein (Op. cit. 1911, p. 36), the existence of simple ventral arm-plates, in contradistinction to *Gorgonocephalus* which has the ventral plates divided into smaller plates. In *A. capensis* there are absolutely no ventral arm-plates. But the ventral plates of *A. australis* are quite rudimentary (Fig. 18. e.) and may be entirely absent in the finer branches; in *A. annulatus* they are likewise quite small and rudimentary. The step from these rudimentary plates in the two said species to their total disappearance in *A. capensis* is so small that it would hardly necessitate creating a new genus for the latter for this reason, and there are no other characters which could be regarded as of generic value. Thus I think it the only reasonable course simply to refer this S. African species to the genus *Astroconus* (otherwise known only from the Australian Seas), though it must be acknowledged that it has no very close relation to the two other known species. It is out of the question to refer the S. African species to any other of the genera of Gorgonocephalids.

Astrocladus hirtus n. sp.

Pl. XIX. Figs. 1—3.

Three specimens from off the coast of Natal (or perhaps from off Portuguese E. Africa; locality uncertain).

Diameter of disk of the largest specimen ca. 20 mm, of the smallest ca. 14 mm.

The very conspicuous radial ribs are closely covered with slender, almost spine-like papillæ, ca. 0.1—0.2 mm long, terminating in a varying number of short thorns. The interradii and the space between the radial ribs more sparsely covered with similar, but somewhat coarser papillæ rising from a very finely granular general covering. Some of the papillæ between the radial ribs may be rather conspicuously larger than the rest of them. The whole dorsal surface has a somewhat shaggy appearance. The radial ribs are subject to some irregularity. Normally they are nearly parallel, slightly attenuating

towards the centre of the disk, which they nearly reach. In the largest specimen one pair of the radial ribs is reduced to merely the distal end, in the smallest specimen one of the ribs is shortened, as if the inner end had been cut off.

The mouth frame, the jaws, and the ventral side of the arms very smooth, only on a closer inspection seen to be covered with a very dense mosaic of very small plates, scarcely of granular character. The ventral interradii with a similar, only still finer, general covering, but towards the edge of the disk with some scattered, short, slender spines.

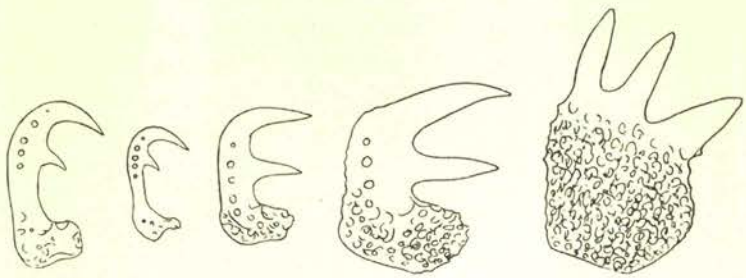


Fig. 19. Hooks of *Astrocladus hirtus* n. sp. a—b. From dorsal side of arm; c—d. transformed armspines from distal part of arm; e. normal armspine. × 135.

The mouth papillæ rather short and coarse, in a dense cluster at the apex of the jaw, continuing along the sides of the jaw, but not forming a continuous fringe across the outer end of the mouth slits, which are not coalesced to any noticeable degree. The madreporite projects to some degree into the soft interradius; there are two madreporites in the largest specimen, one in the others. The genital slits are rather unusually narrow, ca. 2—3 mm long, situated at the edge of the disk, off the first branching.

The first branching of the arms is entirely within the disk. The distances between the branchings very short; there are 5 segments until the first branching, as a rule only 4 segments between the following branchings, rarely as many as 6, or as few as 3. There are no distinct grooves on the underside of the arm in the basal part. The arm-spines begin at about the 3rd forking; at first there are only 2—3, farther out 4—5. They are very short, terminating in one or more hyaline thorns (Fig. 19. e.).

The dorsal surface of the arms closely covered by papillæ of the same general character as those of the radial ribs, only much smaller. No larger papillæ or tubercles are found on the arms, but a number of small, flat, naked plates produce a more or less uneven appearance of the covering of the arms. These plates evidently represent the hook-bearing plates, but there are no hooks on them; no larger plates are found at the ventral edge of the arms. Scattered hooks are found from about the 5th forking, entire belts from about the 6th forking. On the distal branchlets the hook-belts are rather prominent and, together with the arm-spines, make these branchlets look rather coarse. The hooks are of the form typical of *Astrocladus*, with one secondary tooth (Fig. 19. a—b.).

The colour of the preserved specimens a uniform creamy-white.

This species appears to be related to *Astrocladus tonganus* Döderlein which has a similar disk-covering (cf. Döderlein 1911, p. 77); but it differs very markedly from the latter species in various characters, the small number of segments between the branchings being particularly noteworthy.

To *Astrocladus hirtus* I refer a couple of young specimens, 8—4.5 mm diameter of disk from off Zululand (Durnford Point N.E. by E. 9 miles, 13 fms.) sent me from the S. African Museum. That the armspines begin before the first forking in the smallest, and before the 2nd forking in the larger of them is only what should be expected, and other differences of importance from the above description I do not find.

Astrocladus hirtus, var. *reticulatus* n. var.

Pl. XVIII. Figs. 5—6.

One specimen from off Tugela River, 14 fms. (British Museum). Diameter of disk 23 mm.

This specimen differs in various respects from the typical *A. hirtus*. The radial shields are not so close together as those of the type, and the spinous covering less conspicuous, as is also that of the arms. As in the type there are some coarser papillæ rising from a finely granular general covering, but these papillæ are arranged in irregular lines, forming a rather distinct reticulation. The mouth papillæ are more blunt and less distinct than those of the type; finally the arm-spines begin at the 2nd forking, in the type only at the 3rd.

Particularly the last mentioned character forbids simply to identify

this specimen as *A. hirtus*, the more so as this specimen is larger in diameter of disk than any of the specimens of *A. hirtus*. Possibly a richer material will show this specimen to belong within the limits of variation of *A. hirtus*, but with the scanty material now at hand I think it the safest course to regard it as a variety of *A. hirtus*.

Astrocladus africanus n. sp.

Pl. XVII. Figs. 1—2.

Diameter of disk 58 mm. Dorsal side of disk with a number of moderately sized conical tubercles, placed, without any regularity whatever, mainly on and between the radial ribs and at the centre of the disk, the interradii being almost entirely devoid of these tubercles. The general covering of the disk is very smooth, but is seen on the dried specimen to consist of a mosaic of very small, flat plates, not of granular character; they are slightly larger, and also a little conically raised on the radial ribs — which are very conspicuous. The ventral interradii are set with rather numerous short spines, much finer than the tubercles of the dorsal side.

The mouth frame and the underside of the arms are covered by a mosaic of small, flat, irregular plates, continuing also over the jaws which are rather thick and elevated. On the interradial part of the mouth frame are found a few scattered spines like those of the interradii; also on the jaws a few such spines may occur. The mouth papillæ form an irregular cluster on the apex of the jaw and continue as an uninterrupted fringe all round the mouth slits, which are to some degree coalesced, as those of *A. euryale*. The madreporite is close to the edge of the mouth frame, scarcely protruding into the interradius. The genital slits are ca. 10 mm long. A curious feature is the existence of a short, ca. 2 mm long, rather deep, radiating furrow in each interradius, except the one with the madreporite, beginning just outside the mouth frame. Whether this is a constant feature cannot, of course, be ascertained after the single specimen in hand.

Some very indistinct grooves are found on the ventral side of the arms in the basal part. The first branching lies wholly within the disk. The distances between the branchings are very short, the number of segments between the branchings is in the proximal part of the arms 7—8. The arm-spines begin at the first branching, but may exceptionally be found already at the 2—3 last pores before this branching.

There are in the proximal part of the arms generally only 2, farther out generally three spines; they are short, slightly curved, ending in a single thorn; farther out they gradually assume the shape of hooks, with 3—1 teeth, and serrate along the convex side (Figs. 20. e—f.). The dorsal surface of the arms is covered by a dense, uniform mosaic of very small, smooth, almost flat plates, without any larger tubercles among them. There is a fairly distinct, sunken, dorsal midline, and also the spaces between the segments are somewhat sunken, the arms thus getting a rather distinct annulated appearance. In places a couple

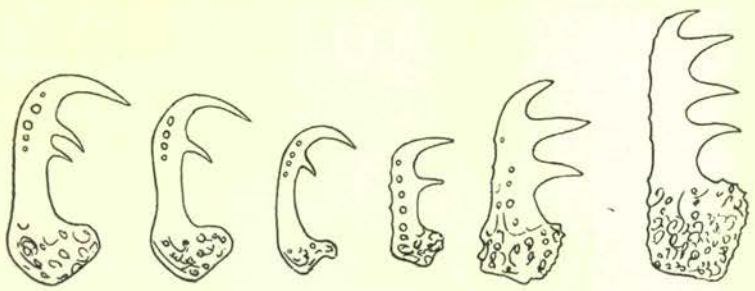


Fig. 20. Hooks and spines of *Astrocladus africanus* n. sp. a—c. Hooks from dorsal side of arm; d—f. transformed armspines. × 160.

of somewhat larger oval plates are found in the sunken rings near the dorsal midline, but this is subject to great irregularity. They represent the hook-bearing plates, but there are no hooks on them in the specimen at hand. Also at the ventral edge of the arms a round plate, smaller and less conspicuous than the oval plates on the dorsal side, may occur, but still more irregularly. The hooks begin at about the 4th branching, but very few and scattered. Complete belts are found only on the finer branches. The hooks are of the typical form, with one secondary tooth (Figs. 20. b, c.), exceptionally there may be two secondary teeth (Fig. 20. a.).

As in *Astrocladus euryale* there is, in the more distal part of the arms a more or less complete belt of hook-bearing plates partly concealed under the general covering of granules. There are no traces of ventral plates.

The single specimen in hand is, unfortunately, without locality. But there is no doubt that it has come from somewhere in the South

African Seas. It was found in the collections of the Fisheries Survey of S. Africa.

This species would seem to have its nearest relation in *Astrocladus coniferus* Döderlein from the East Asiatic Seas. It is, however, quite distinct from that species, and very easily distinguished from it by the general covering of the disk which consists in *A. coniferus* of small sharply pointed granules, in the present species of quite flat, smooth granules. To none of the other *Astrocladus* species hitherto known has it any nearer relation.

Astrocladus euryale (Retzius).

Pl. XVIII. Fig. 7.

Gorgonocephalus verrucosus Lyman. 1882. Chall. Oph. p. 262. Pl. XLVIII.
— — Bell. 1905. Marine Invest. S. Afr. III. Ophiuroidea, p. 260.
Astrocladus euryale Döderlein. 1910. Asteroidea, Oph., Echin. in Schultze: Zool. u. Anthropol. Ergebn. im Westl. u Zentral Süd-Afrika. IV. Jena'er Denkschr. XVI. p. 256.
— — Döderlein. 1911. Japan. u. a. Euryalæ, p. 106.
— — H. L. Clark. 1923. Echinod. Fauna S. Afr. p. 319.
Non: *Gorgonocephalus verrucosus* Bell. 1909. Report on the Echinoderms (other than Holothurians) coll. by Stanley Gardiner in the Western Parts of the Indian Ocean. Trans. Linn. Soc. 2. Ser. Zool. XIII. p. 19. (= *Astroglymma Robillardi*, var. *spinosum* Mrtsn.).

This species I found in great numbers in Walker's Bay at a depth of ca. 50 meters, sandy bottom, in a haul with the big trawl of the trawler "John C. Meikle". All the specimens were of about the same large size, ca. 50—60 mm diameter of disk. It was further taken at the following localities:

False Bay, 40 m; Agulhas Bank, Cape Infanta N.E. by N. 15 miles, 90 meters; sand.

Gordon Bay (False Bay), 15—17 m.

A couple of specimens were also sent me by Capt. Pace, from off East London.

Although a very common species, represented in most collections, a few descriptive remarks may not be out of place.

Ventral arm-plates are not at all developed. The lateral plates are, as seen when the outer covering of granules has been removed (on treating with hypochlorite of sodium), very short and small, scarcely

reaching the edge of the arm. On the distal branches a belt of small plates continues across the dorsal side of the arm, lying on the vertebræ (Fig. 21); these plates carry the hooks. On the thicker parts of the arms these plates are absent or rudimentary, in correspondance with the fact that hooks are also absent here. The hooks have the usual shape, with one secondary tooth. In the distal part of the arm-branches the arm-spines (or tentacle scales) gradually assume the shape of hooks, only somewhat larger and coarser than the hooks of the dorsal side of the arms (Fig. 22).

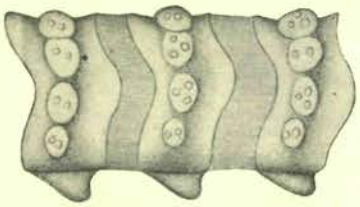


Fig. 21. Three armjoints from distal part of arm of *Astrocladus euryale* (Retzius), side view. The covering granules removed, in order to show the belt of small plates lying on each vertebra. × 12.

The tubefeet, which are sheathed as usual in the Gorgonocephalids, are very faintly developed; only the mouth tubefeet are well developed, with the sheath full of small calcareous plates. The mouth is remarkably small, due to the fact that the distal part of the mouth-angles is covered over through the skin of each two neighbouring jaws uniting for a distance of a couple of millimetres (Pl. XVIII. Fig. 7). The gonads are extremely numerous, small, apparently without any regular arrangement. The eggs are very small, ca. 0.1 mm, which fact may indicate that it has a pelagic larval stage.

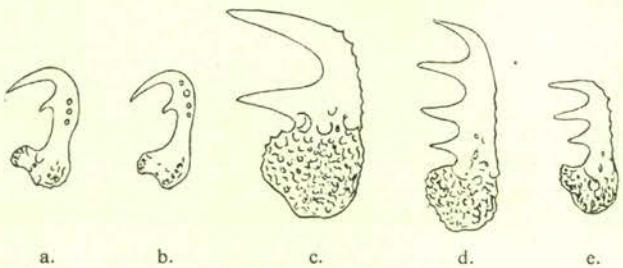


Fig. 22. Hooks and armspines of *Astrocladus euryale* (Retzius). a—b. Hooks of dorsal side of arm; c—e. transformation of armspines in distal part of arms. × 120.

A number of specimens were opened, in the hope of finding parasites (*Protomyzostomum*) in them, but nothing was found. The smallest specimens were ca. 20 mm diameter of disk. It is rather important to notice that these young specimens, about the identification of which

there cannot be the slightest doubt, have the arm spines (or tentacle papillæ) well developed also on the proximal part of the arm, before the first forking, even from the 2nd foot-pore.

In some material sent me from the S. African Museum there are two very young specimens, of 5.5 and 6 mm diameter of disk, which I think must be *A. euryale* (one from off Cape Peninsula, Vasco da Gama N. W. $^3/_4$ N. 41 fms., the other from S.E. of East London, 32 fms.). Here the large tubercles have scarcely begun to form on the disk; in the smaller of them there is still a trace of naked radial shields.

As pointed out by Clark, it appears that the distribution of *A. euryale* is very restricted, and that it is one of the eminently characteristic S. African forms. There are, however, two statements found in literature of its occurrence outside S. African waters. Bell (Op. cit.) records it from Providence Island (N. of Madagascar), and Stiasny & Groenewegen (Verzeichniss d. Ophiuriden Sammlung d. Naturhist. Reichsmuseum Leiden. Zool. Mededeelingen 's Rijks Mus. Nat. Hist. Leiden. XII. 1929, p. 178) record it from Jobi, New Guinea, and from the Moluccas.

The two specimens from Providence Isl. referred by Bell to *Gorg. verrucosus* = *Astrocladus euryale*, have been lent me for reexamination from the British Museum. As I expected beforehand, Bell's identification is erroneous. The two specimens very clearly belong to the genus *Astroglymma*, characterised by having 5 madreporites, and the hooks provided with a secondary tooth. Of course, Bell could not then know of the genera created later on by Döderlein for the various groups within the Gorgonocephalids; but to refer them to so easily recognisable and relatively well known a species as "*Gorg. verrucosus*" is certainly unpardonable; the merest glance at the specimens shows the large tubercles of "*G. verrucosus*" to be absent and that there is no likeness at all between the two forms, beyond the fact that they are both Gorgonocephalids. Of the two specimens the smaller, 10 mm diameter of disk, is indistinguishable from specimens of *Astroglymma Robillardi* (de Loriol) of a corresponding size; the larger, 20 mm diameter of disk, differs from *A. Robillardi* in having branched spines on the disk. It is described in my "Studies of Indo-Pacific Euryalids" (Vid. Medd. Dansk Naturh. Foren. Bd. 96, 1932, p. 38) as var. *spinosum* of *A. Robillardi*.

As for the specimens from New Guinea and the Moluccas recorded

by Stiasny & Groenewegen, I am informed by Dr. Stiasny that the labelling is unreliable, so there is in their records no proof at all for the occurrence of *A. euryale* outside the S. African Seas. *Astrocladus euryale* accordingly is known only from the S. African Seas, from off Cape Peninsula to off East London, and from depths of 15—90 meters.

Family *Trichasteridæ.*

Astroceras spinigerum n. sp.

Pl. XVIII. Figs. 8—9.

Diameter of disk 7 mm; arms rather short, scarcely more than ca. 5 times the diameter of disk, but none of them complete. Radial shields narrow, rib-like, each with a very conspicuous series of 3—4 thick, cylindrical, smooth spines, the outermost the largest, the innermost the smallest. The disk otherwise naked. As a continuation of the spines of the radial shields there is a double series of quite similar spines along the dorsal side of the arms, one pair to each joint. On the proximal 4—5 joints they are as large as the outermost ones on the radial shields, then gradually they become reduced in size, until on the last joints where they are found, the 15—17th, they are only quite small tubercles. The proximal 4—5 joints are widened for accommodating the gonads, and in this part there are distinct "bars", which carry the spines.

The mouth papillæ are represented by few, small, round warts, which become somewhat larger and more numerous deeper down on the sides of the jaws. The infradental papilla rather unusually slender for an *Astroceras*, but the teeth are broad and strong as usual in this genus. The adoral shields are short and square, the buccal shields so rudimentary as not to be distinctly observable. The lateral arm plates are broad, joining in the ventral midline till far out on the arms, at least in the proximal half length of the arms, the vertebræ having in accordance herewith the ventral furrow open. In the distal part of the arms the vertebræ have the ventral furrow closed over as typical of the Trichasterids (cf. Th. Mortensen. Studies of Indo-Pacific Euryalids. Vid. Medd. Dansk Naturhist. Foren. Bd. 96, 1932, p. 3). The ventral arm plates beyond the second are small, somewhat irregular in outline, but fairly distinct. The two first ones are rather large, the second may be divided into two (Fig. 23. a.). The two arm-spines,

beginning normally at the second pore-pair, are short, cylindrical, with the end thorny; the inner one not longer than the outer one, even in the middle of the arm. In the distal part of the arms they are transformed into hooks of the shape usual in Trichasterids (Fig. 23. b.). Colour a uniform greyish-brown.

The single specimen of this species I took on board the "Pickle" off Durban (29°48′ S. 31°18′ E.) at a depth of 225 fathoms, on a sandy bottom with sponges. 22. VIII. 1929.

Through the character of the lateral arm plates joining in the ventral midline this species is related to *Astroceras compar* Koehler, from which it differs, however, very conspicuously in the spines of the radial shields and along the dorsal side of the arms.

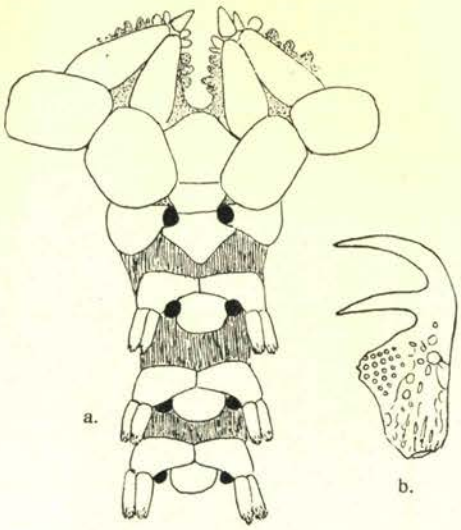


Fig. 23. *Astroceras spinigerum* n. sp. Part of oral side (a); armspine, transformed into a hook, from distal part of arm (b). a. × 12; b. × 120.

Asterostegus n. g.[1])

A Trichasterid with large disk; the arms robust, unbranched; disk and arms covered with thick, naked skin. Radial shields and dorsal side of arms with numerous prominent tubercles. A single column of rather strong teeth; mouth papillæ reduced to small grains. Outside the adoral shields there is a half-moon-shaped group of smaller plates forming a kind of roof projecting over the ventral interradii with the deep-lying, nearly vertical genital slits.

Genotype: *Astrostegus tuberculatus* n. sp.

This genus stands nearest to *Astroceras*, particularly *Astroceras compar*, but differs markedly from it in the unique character of interradial plates forming a projection like a roof over the proximal part

[1]) τὸ στέγος — the roof.

of the interradius. Also the numerous large tubercles on the dorsal side of the arms is a very unusual character probably of generic value.

Asterostegus tuberculatus n. sp.

Pl. XIX. Figs. 4—5.

One specimen in rather poor condition, taken off Durban, 209 fathoms (Fisheries Survey).

Diameter of disk 23 mm, arms probably ca. 15 times the length of the disk diameter; they are all incomplete and rather much coiled up so that their exact length cannot be ascertained.

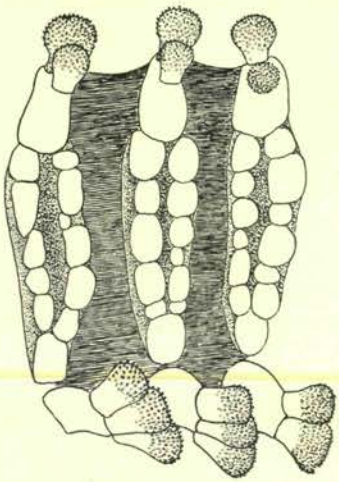


Fig. 24. Part of arm of *Asterostegus tuberculatus* n. sp., in side view, cleaned in order to show the series of small plates continuing from the lateral plates to the "bars". × 8.

The disk is not reenteringly curved at the interradial edges. The radial shields form (in the dried specimen) slightly raised ribs, well separated from each other; they carry each an irregular series of round tubercles, in the distal part forming an irregular group of 3—5. There is an irregular plate near the centre of the disk, indicating that there is likely to be a rosette of distinct primary plates in the young specimens. The skin between the radial shields and in the interradii entirely naked, but along the interradial edges of the disk are seen some few small tubercles.

The arms are very robust, ca. 6 mm broad at the base, distinctly higher than broad (ca. 8 mm high) and distinctly compressed, the sides being vertical. Along the dorsal side each segment normally carries, on each side, two conspicuous tubercles like those of the radial shields, attached to the upper end of short, but distinct "bars"; thus there are four series of tubercles along the dorsal side of the arms, more or less regularly, there being sometimes three tubercles to a bar instead of two, more rarely only one. The tubercles continue to about the middle of the arm, becoming gradually smaller, reduced to quite small granules; these latter also totally disappear in

the distal part of the arm, which is thus quite naked. In the proximal part of the arms the sides are apparently quite naked, but through the skin is seen a more or less distinct rugosity. On dissolving the skin it is seen that there is on each vertebra a double series of small, low plates continuing up till where the "bar" originates (Fig. 24). The gonads, as

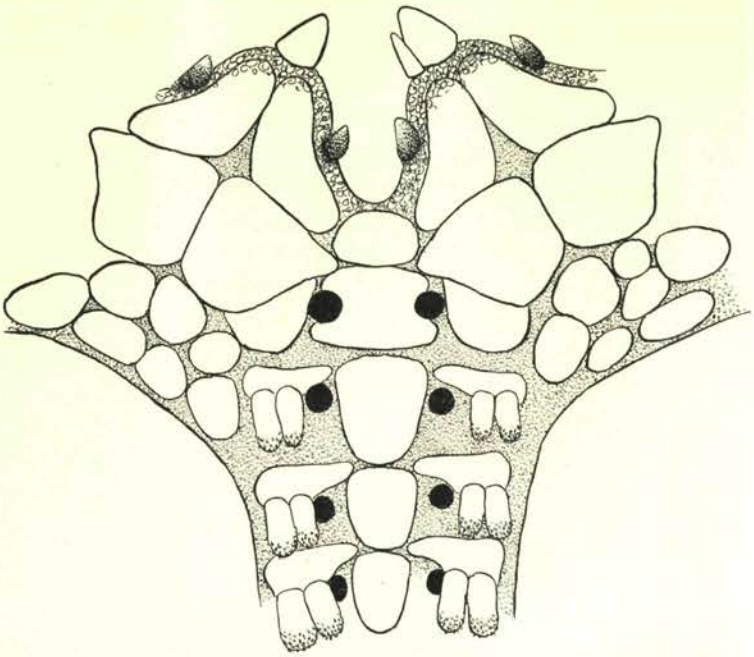


Fig. 25. Part of oral side of *Asterostegus tuberculatus* n. sp. Cleaned, in order to show the plates distinctly. × 6.5.

usual in the unbranched Trichasterids, are only one pair to each arm, passing out along the dorsal side of the arm in the cavity supported by the bars. But they are here passing much farther out on the arm than usual, even to about the 25th joint. The gonads are thus of an extraordinary length, but — in the present, male specimen, at least — rather thin, the dorsal cavity being not very wide.

On the mouth frame and along the oral side of the arms are found some few, scattered grains, just visible through the thick skin (when dried). The jaws are short, carrying a single vertical series of not very conspicuous, well spaced teeth, and a number of very fine granules on the sides, but no true mouth papillæ. The buccal tubefeet placed

on the middle of the jaw side, nearer the upper edge, not at the corners of the mouth slits as is otherwise the usual position. The adoral plates square, rather thick. Outside the adoral plates is found a number of 4—5 rounded plates, arranged in a semi-circle, joining the edge of the mouth frame, and outside these again 2—3 similar plates, all these plates together forming like a roof over the inner part of the ventral interradius, the genital slits also being for a great part covered thereby (Fig. 25).

The ventral arm plates are rather unusually large and well developed, elongate oval, contiguous in the proximal part of the arm. The lateral arm plates accordingly do not join in the midline of the arm, but they are rather broad, not reduced to narrow spine-bearing shafts (Fig. 25). In accordance herewith the vertebræ in about the proximal half of the arms have the ventral furrow open; in the distal part of the arms the ventral furrow of the vertebræ is closed as in other Trichasterids. The lateral plates carry usually two short, thick spines, which have almost the same shape as the tubercles on the dorsal side of the arm, the end being more or less widened, swollen or distinctly flattened, and finely spinous (Fig. 24). In places there are three or even four arm-spines. They remain short and of equal length till about the middle of the arm, also the lateral plates remaining low. Then rather suddenly the spines are transformed into hooks, of the typical Trichasterid shape (Fig. 26), and at the same time the lateral plates are transformed into the usual narrow shafts, at the end of which the two hooks are attached. The hooks are rather unusually large, but gradually become smaller in the distal part of the arm.

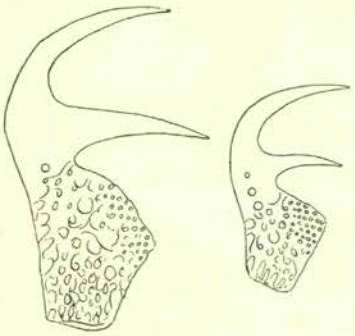


Fig. 26. Hooks (transformed armspines) from distal part of arms of *Asterostegus tuberculatus* n. sp. × 80.

The colour of the single, dried specimen is a uniform brownish.

Family *Asteronychidæ.*

Asteronyx Loveni Müller & Troschel.

Asteronyx Loveni Müller & Troschel. 1842. System d. Asteriden, p. 119. Taf. X. 3—5.

Asteronyx Loveni Koehler. 1904. "Siboga" Oph. I. p. 167.
— — H. L. Clark. 1911. North Pacif. Ophiurans, p. 285.
— — Döderlein. 1911. Japan. u. a. Euryalae, p. 115.
— — Th. Mortensen. 1912. Über Asteronyx Loveni. Z. wiss. Zool. 101.
— — H. L. Clark. 1916. "Endeavour" Echinoderms, p. 78.
— — Matsumoto. 1917. Monogr. Jap. Oph. p. 33.
— — Koehler. 1922. Oph. Philippine Seas ("Albatross"), p. 34.
— — H. L. Clark. 1923. Echinod. Fauna S. Afr. p. 314.
— — Döderlein. 1927. Indopacif. Euryalae. p. 59. Taf. 7. 7—8.
— — Koehler. 1930. Oph. des Mers d'Australie et de l'Arch. Malais, p. 23.

Some specimens got from the Fisheries Survey, viz.
33°37′ S. 16°55′ E. 1000 fathoms. 1 specimen.
31°21′ S. 16°17′ E. 246 — 4 —
31°17′ S. 16°11′ E. 254 — 3 —

The larger specimens are ca. 35—40 mm diameter of disk. None of the arms are complete, but the longest must have been at least ca. 350 mm, probably more. (Matsumoto gives the arm length of a specimen 42 mm in diameter of disk as 500—590 mm).

Some of the larger specimens were opened in order to see, whether they would contain the parasitic Copepod, *Chordeumium obesum* (Jungersen)[1]) rather commonly found in the specimens from the Danish Seas. I did, however, not succeed in finding any.

I quite agree with H. L. Clark that the S. African specimens cannot be distinguished from the typical *A. Loveni*, which is a truly cosmopolitan species.

Family ***Ophiomyxidæ.***

Ophiomyxa vivipara Studer.

Ophiomyxa vivipara Studer. 1876. Über Echinod. a. d. antarkt. Meere. Monatsber. Akad. Berlin. p. 462.
Ophioscolex Coppingeri Bell. 1881. Echinod. of the Strait of Magelhan and the Coast of Patagonia. P. Z. S. 1881. p. 98. Pl. VIII. 6.

[1]) H. F. E. Jungersen. Chordeuma obesum, a new parasitic Copepod endoparasitic in Asteronyx Loveni. Rep. Brit. Ass. 1912. Mindeskrift for Japetus Steenstrup. I. No. XVI. 1914. — The name *Chordeuma* being preoccupied it was altered into *Chordeumium* by K. Stephensen in his description of *Arthrochordeumium appendiculosum*, a new endoparasitic Copepod in the Ophiurid *Astrocharis gracilis* Mrtsn. (Th. Mortensen & K. Stephensen. On a gall-producing parasitic Copepod infesting an Ophiurid. Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16. II. Vid. Medd. Dansk Naturh. Foren. Bd. 69. 1918, p. 268).

Ophiomyxa vivipara Studer. 1883. Übersicht über die Ophiuriden d. "Gazelle". Abhandl. Akad. Berlin v. Jahr. 1882. p. 29. Taf. III. 15.
— — H. Ludwig. 1898. Ophiuren d. Sammlung Plate. Zool. Jahrb. Suppl. 4. p. 768.
— — Ludwig. 1899. Jugendformen v. Ophiuren. Sitz. ber. Akad. Berlin 1899. p. 26.
— — Koehler. 1908. Asteroidea, Ophiuroidea, and Echinoidea of the Scottish Nat. Antarctic Exped. "Scotia". Zool. Vol. V. p. 278.
— — H. L. Clark. 1915. Cat. Rec. Oph. p. 170. Pl. 2. 1—2.
— — — 1923. Echinod. Fauna S. Afr. p. 313.
— — Th. Mortensen. 1924. Echinod. New Zealand & Auckland-Campbell Islands. II. Ophiuroidea. p. 114.

Some specimens got from the Fisheries Survey, viz.
34°17′ S. 17°58′ E. 160 fathoms. 4 specimens.
34°21′ S. 17°57′ E. 178 — 3 —
33°02′ S. 16°53′ E. 200 — 2 —

The suggestion by Clark (Op. cit.) and by myself (Op. cit.) that the S. African specimens are not really the same species as the *Ophiomyxa vivipara* of the Patagonian seas still remains unproved for want of sufficient material of the latter form. As seen from the figures I gave in the work quoted, there is scarcely any appreciable difference between these two forms in the shape of the plates. It may also be stated that there is no reliable difference in the shape of the radial shields (as seen from the interior) in both forms; they may vary very considerably in shape even in the different radii of the same specimen. The only difference I can find, which would seem to hold good, is that in the S. African form there is only one spine at the proximal 5—6 pores, whereas in the Magellanic form there are two spines already at the third or fourth pore-pair. And even if this be a constant difference, it would seem a rather insufficient reason for regarding them as two separate species. At most, I think, we could then regard the S. African form as a variety of *Ophiomyxa vivipara*.

A very interesting observation was made on one of the S. African specimens in regard to the double anchors. These were found in fair numbers both in the dorsal skin, in the bursal wall and in the gonads; but in the stomach wall particularly they were exceedingly numerous and arranged vertically in the epithelium itself (Fig. 27), like a kind of pallisade work. In another specimen I found them arranged in the same way, but much less numerous, and in a third specimen there

were only very few double anchors in the stomach wall. The anchors differ from those of *Ophiomyxa australis* figured p. 112, fig. 5. 2, in my paper of 1924, in having a small thickening in the middle of the bar (Fig. 28. d.).

Quite young specimens with only 2—5 arm-joints, found in the bursæ, are interesting in showing a number of small, somewhat rudimentary spines on the dorsal side (fig. 28. a—c.). In larger young ones as well as in the adult there is no trace of spines. The young ones grow to a very considerable size before leaving the bursa of the mother, up to 5 mm diameter of disk, and an arm length of 15—20 mm, with up to ca. 30 segments. There is usually 1—3 young ones in each bursa. I have found them of two different sizes in the same specimen, the smaller ones ca. 2 mm diameter of disk, with 2—4 arm joints, the larger ones ca. 5 mm diameter of disk and ca. 25—30 arm joints. The larger ones may be exceedingly much folded up.



Fig. 27. Section of stomachal wall of *Ophiomyxa vivipara* Studer, containing numerous double anchors. × 110.

Ludwig (Op. cit. p. 274) states that in the young ones is seen "an der medianen Seite eines jeden Tentakelpores an den unteren Gliedern der jungen Arme die Anlage einer zarten, relativ langen Tentakelschuppe, die beim alten Thiere gänzlich in Wegfall kommt

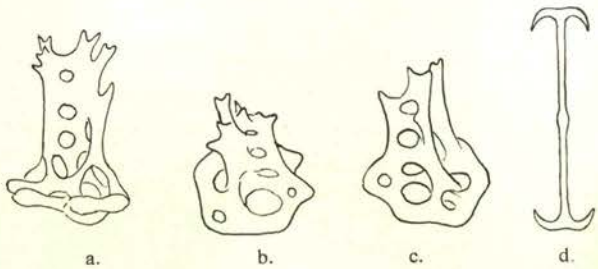
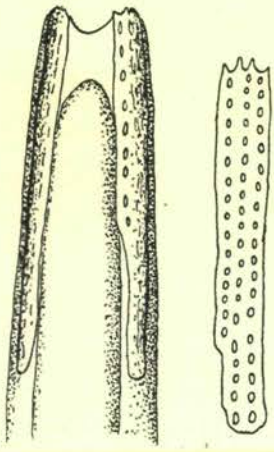


Fig. 28. *Ophiomyxa vivipara* Studer. a—c. Spines of young ones from the bursæ; d. double anchor. × 225.

oder nur noch als Rudiment vorhanden ist". Finding no traces of tentacle scales in the young ones of the S. African specimens, I thought that we might perhaps have herein an important difference between the two forms, the young ones of the S. American form having a tentacle scale, the S. African form having no such scale. On a closer examination of some young ones of the S. American form I found a

trace of a tentacle scale only at one pore in one specimen, but a rather broad one, evidently something different from what Ludwig observed. In fact, I have little doubt that what Ludwig saw was not the tentacle scale, but the slender, calcareous plates lying in the end of the sheath surrounding the tubefeet in *Ophiomyxa* (Fig. 29; description and figures of this structure in *Ophiomyxa serpentaria* are given in my report on the "Ingolf" Ophiuroidea, p. 13). Thus there is no difference herein between the S. African and the S. American form. It may further be pointed out that also in the S. American form spines are found on the disk, in the smaller of the young ones, only, it would appear, in a rather smaller number than those of the S. African form.



a. b.

Fig. 29. *Ophiomyxa vivipara* Studer. Point of tubefoot, showing sheath with the two calcareous plates (a); an isolated calcareous plate from sheath (b). × 220.

The double anchors are found in good numbers already in the youngest stage present, lying below the plates, probably in the stomach wall. The glassy plates are not yet found in the smallest specimens, only fenestrated plates as in other Ophiurids, but in those of ca. 5 mm diameter of disk they are present, together with the normal fenestrated plates. These latter are partly in evident transformation into glassy plates, the holes being more or less completely filled out; but it is likewise evident that glassy plates are forming also directly as small glassy disks, without holes. No doubt the main part of the exceedingly numerous glassy plates filling the skin of the disk of the adult have originated in this way, directly, not through the transformation of originally fenestrated plates.

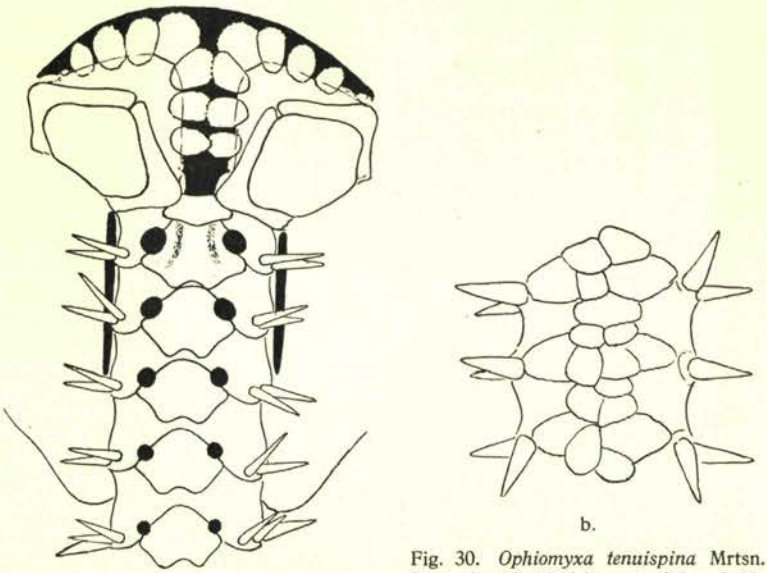
Ophiomyxa tenuispina n. sp.

Pl. XIX. Fig. 27.

One specimen from the "Pieter Faure" collection; P. F. 13476. Sandy Point N.$^1/_4$E. 10 miles, 95 fms., rock. (ca. 50 miles N. of East London). Ca. 12 mm diameter of disk, arms broken.

Mouth papillæ with indistinctly serrated margin, 3 to each side of jaw. Buccal shield rather broad, distinctly broader than long, with

rounded edges; adoral shields narrow, just meeting in the median line. First ventral arm plate small, rhomboidal; the following ones about as broad as long, with an outer notch and the outer corners produced (Fig. 30. a.). They are distinctly separated from each other. Dorsal plates distinct, a group of ca. 4 irregular plates in the midline and a larger plate to each side, reaching to the lateral plate (Fig. 30. b.). The spines are rather unusually slender, particularly on the proximal



a. b.

Fig. 30. *Ophiomyxa tenuispina* Mrtsn. Part of oral side (a); part of dorsal side of arm (b). × 9.

part of the arms, and the lowermost one is both the most slender and the longest, about the length of an arm joint. There are 2 spines on the joints within the disk; the free joints have almost regularly 4 spines, the uppermost of which is the strongest; some few joints here and there have only 3 spines; they are very erect. Marginal plates distinct. The genital slits reach to about the 3rd joint.

As usual in *Ophiomyxa* a rather thick skin covers the whole animal, so that the exact shape of the plates can only be seen after the skin has been dissolved.

The colour of the dried specimen is a uniform creamish-white.

The specimen is a male; there is then no possibility for ascertaining

whether the species is viviparous or not, the two known viviparous species of *Ophiomyxa*, *O. vivipara*, and *O. brevirima* having separate sexes.

This species is very clearly distinct from *Ophiomyxa vivipara*, particularly the shape of the ventral and dorsal armplates leaving not the slightest doubt of their being two separate species. It would seem that this new species is the most nearly related to the New Zealand species *Ophiomyxa brevirima* H. L. Clark, with which it agrees in the shape of the ventral and dorsal arm plates; as a matter of fact, the only noteworthy difference is in the armspines, which are longer and more slender in the S. African species. Possibly there may also be found to be some slight difference in the double anchors, which would seem to be somewhat more slender, and also more numerous in the S. African species. If it be ultimately found that also *O. tenuispina* is viviparous, then I should think it to represent only a variety of *O. brevirima*. But until its eventual viviparity has been ascertained it will be better to regard it as a distinct species.

Ophiomyxa bengalensis Koehler.

Ophiomyxa bengalensis Koehler. 1899. "Investigator" Oph. I. p. 69. Pl. XII. 91—92.
— — — 1922. Oph. Philipp. Seas. "Albatross" p. 17. Pl. 5. 5—6; 92. 1.
— — — 1930. Oph. Mers d'Australie et de l'Archipel Malais. p. 48.

Some specimens got from the Fisheries Survey, viz.
29°43′ S. 32°21 E. 140 fathoms. 3 large specimens.
Off Durban, 305 fathoms. 1 large specimen, in rather poor condition.

On comparing the figures given here (Fig. 31) of this species with the figures of *O. bengalensis* given by Koehler in his Report on the "Investigator" Ophiurids, Pl. XII. 91—92, one would not think it possible that they could represent the same species. These figures of Koehler's are, however, anything but good, a recognition of which fact is also implied in Koehler's statement in the "Albatross" report that the photographic figures there given "show better than my figures published in 1896 and 1899 the habitus of this species". They certainly do, and a comparison of the specimens at hand with these latter figures leaves hardly any doubt of their identity. Further, I have some specimens

from the Kei Islands, identified by Koehler himself as *Ophiomyxa bengalensis*[1]), and they also quite agree with the S. African specimen.

Also the description given by Koehler needs various corrections, so I think it better to supply a new description based mainly on the specimens from S. Africa.

The mouth papillæ are rather pointed, not such broad scales as otherwise usual in *Ophiomyxa*, and they are only very finely serrate along their edges. There is, however, much variation in the shape of these papillæ, even from jaw to jaw in the same specimen. The buccal shields are almost semicircular, with a small outer lobe; there is no inner angle, as is stated in Koehler's description — probably it has been so in the type specimen; the specimen figured in the "Albatross" report shows the inner edge rounded as in the present specimens. The adoral plates may or may not have an outer lobe, separating the buccal shield from the first ventral plate; this varies within the same specimen as is also seen on Pl. 5. 5 of the "Albatross" Ophiuroidea.

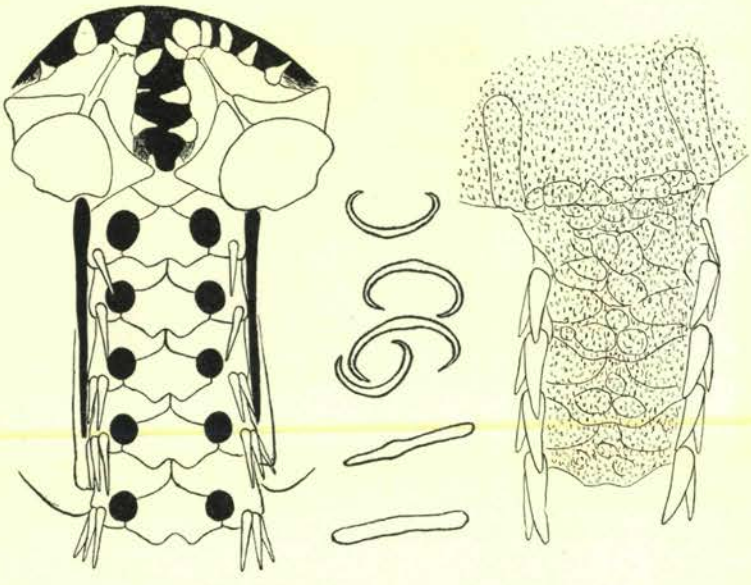
The ventral arm plates have got a most extraordinary shape in the figure of the "Investigator" report, looking rather like a pair of small dumb bells — due to the fact that Koehler did not clean his specimen sufficiently, so that he saw only the two somewhat raised outer lobes. As seen from fig. 31. a (and also from Pl. 5. 5 of the "Albatross" Ophiuroidea) they are of quite usual Ophiomyxid shape, with a deep notch in the distal edge. The two first are contiguous, the following ones distinctly separated by the ventral plates which join in the mid-line. Dorsal arm plates are quite rudimentary or absent, represented only by some small, irregular plates lying on the dorsal side of the vertebræ in the proximal part of the arm (Fig. 31. b.), otherwise it is only the vertebræ which are seen through the skin. Three slender, finely serrate arm-spines about the length of an arm joint, the uppermost one usually somewhat thickened. The two-three first joints have as a rule only one spine, then one or two joints with two spines; from the fourth or fifth there are three. No tentacle scale.

The radial shields are fairly well developed. According to Koehler marginal plates are completely absent. This does not quite hold good. They are quite distinct across the arm base, connecting the radial

[1]) Not all the specimens mentioned in Koehler's work of 1930 as *O. bengalensis* are really this species. This need, however, not concern us here, as it has no bearing on the geographical distribution of the species.

shields; in the interradii they are rather rudimentary, but still they are there, forming the usual belt along the interradial margin, only less conspicuous than usual in *Ophiomyxa*.

The skin of the disk does not contain the usual glassy disks; instead I find it to contain numerous small, delicate c-shaped spicules (Fig. 31. c.), a feature not known from any other Ophiomyxid. On



a. c. b.

Fig. 31. *Ophiomyxa bengalensis* Koehler. Part of oral (a) and of dorsal side of disk and arm (b). Spicules from skin of disk (c-shaped) and from the stomach wall (rod-shaped) (c). a—b. × 6; c. × 340.

the other hand the double-anchors, otherwise so characteristic of *Ophiomyxa*, appear to be completely absent. In the stomach wall small simple rods (Fig. 31. c.) occur together with the c-shaped spicules.

A very characteristic feature of *O. bengalensis* is the presence of a number of small, irregular, white spots on disk and arms, as seen very well on Pl. 5. 6 of the "Albatross" Ophiuroidea. In the "Investigator" report Pl. XII. 91 they are represented very exaggeratedly as distinct, round granules. On a microscopical examination I find them to be quite irregular heaps of exceedingly minute calcareous grains.

The "Investigator" took this species at the Andaman Islands, its

occurrence in the S. African seas is then not so unexpected. It is otherwise known from the Philippines and the Kei Islands, so it will be sure to be distributed over the whole Indo-Malayan region. As to its bathymetrical distribution a curious mistake has crept into the "Albatross" report, p. 17. It is stated there that it was found at the Andamans in depths between 250 and 1073 fathoms (457—1962 meters); in the "Investigator" report it is given as 250 and 173 fathoms, so the 1073 is a rather serious lapsus! In reality the known bathymetrical distribution is: 250—550 m.

Ophioscolex (*Ophiolycus*)[1]) *dentatus* Lyman.

Ophioscolex dentatus Lyman. 1878. Oph. & Astroph. of the "Challenger". Bull. Mus. C. Zool. V. p. 157. Pl. VII. 184—186.
— — — 1882. "Challenger" Oph. p. 233. Pl. XXIV. 4—6.
— — Bell. 1905. Echinoderma. Marine Invest. S. African III. p. 259.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa. p. 314.

Several specimens I dredged onboard the "Pickle", XII. 1929, viz.

34° 5′ S. 18° 1′ E.	118 fathoms.	10 specimens.
34°17′ S. 18° 5′ E.	160 —	8 —
34°21′ S. 17°57′ E.	178 —	Several specimens.
34°23′ S. 18° 8′ E.	157 —	2 specimens.

Further, some specimens were received from the Fisheries Survey, from:

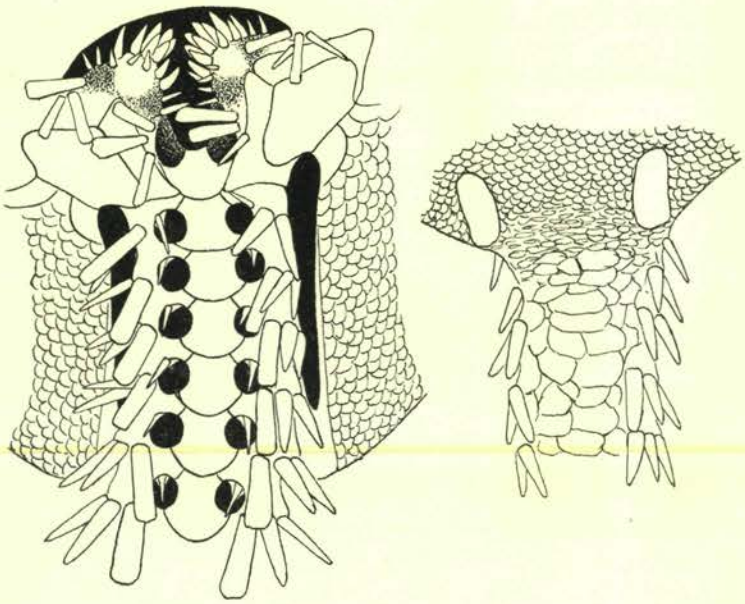
33° 6′ S. 16°52′ E.	225 fathoms.	1 specimen.
31°29′ S. 17° 1′ E.	153 —	2 —
32°37′ S. 17°15′ E.	90 —	1 —
32° 2′ S. 16°53′ E.	200 —	1 —

H. L. Clark (Op. cit.) with full right observes that the figures of this species given by Lyman are not very satisfactory, without, however, supplying any new figures. I have then thought it desirable to give such figures here, drawn from dried specimens, showing the outline of the plates etc. distinctly, which Lyman's figures do not. Particularly the indications of the ventral arm plates in Lyman's figures are very misleading. As for the three outer mouth papillæ I would say that in one alcoholic specimen I find them very much as shown in Pl. XXIV. 4 of the Challenger Oph., as also the tentacle scales are in alcoholic specimens, on the whole, as shown in Lyman's figures, the enclosing skin being much broader than the enclosed

[1]) As for the name *Ophiolycus*, see p. 315.

calcareous scale. When dried the real shape of the scales, as well as of the mouth papillæ comes out clearly (Fig. 32).

The mouth papillæ form a whole cluster on the apex of jaws in adult specimens; on the sides follow 2—3 very slender papillæ, and then the 3 (more rarely 4) outer papillæ, which are very much longer, usually flattened and widened towards the point. Sometimes there is



a. b.

Fig. 32. *Ophioscolex* (*Ophiolycus*) *dentatus* Lyman. Part of oral (a) and dorsal side (b). × 8.

another long and slender papilla placed abradially to these papillæ, on the edge of the adoral plate. The jaws are raised into a conspicuous knob at the apex. The mouth shields are distinctly broader than long, with an obtuse inner angle; the adoral plates, which are meeting within, may have a broad outer lobe separating the mouth shield from the first lateral plate — or there may be no outer lobe at all — both cases to be found in one and the same specimen (Fig. 32. a.).

The ventral plates are, on the whole, — particularly in young specimens — somewhat longer than broad, contiguous, with a rounded, more or less prominent, outer edge; a good deal of variation, however, obtains in the shape of these plates, particularly in regard to their

distal edge (Figs. 32. a., 33. b.). The tentacle scale is slender, setaceous, about as long as the diameter of the pores, or a little more. The dorsal arm plates are more or less irregularly split up into a number of smaller plates; often they are only divided into two plates, especially in young specimens (Figs. 32. b., 33. a.).

The arm-spines are usually characteristic in the lowermost one being flattened and much broader than the others; it may even be much more so than those of the specimen represented in fig. 32. a., sometimes widening towards the end so as to be quite spatulate. There is, however, much variation in this regard also. In the distal part of the arm the two uppermost spines are transformed into hooks (Figs. 33. c.).

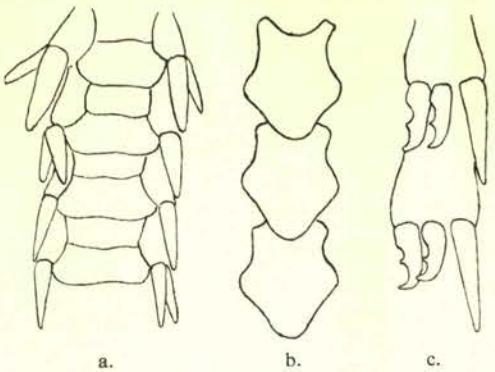


Fig. 33. *Ophioscolex* (*Ophiolycus*) *dentatus* Lyman. a. Part of arm of young specimen, dorsal side, showing division of dorsal plates; b. three ventral armplates; c. two armjoints from distal part of arm in side view, showing the two uppermost spines transformed into hooks. a—b. × 12. c. × 30.

When dried the disk is seen to be covered with minute, imbricating

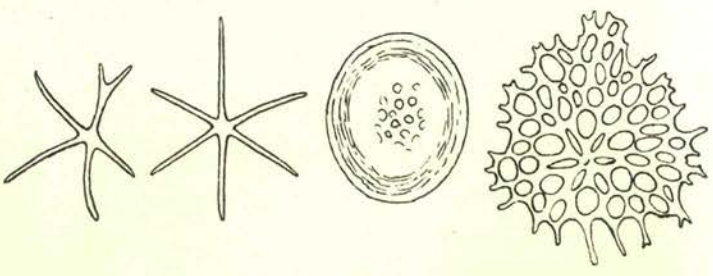


Fig. 34. *Ophioscolex* (*Ophiolycus*) *dentatus* Lyman. a. Star-shaped spicules from stomach wall; b. glassy plate from skin of disk; c. spicule from bursal wall. × 120.

scales of the usual *Ophioscolex*-type, clear, glassy plates with a few holes in the centre, and a more or less distinct concentric striation in the outer part (Fig. 34. b.). The radial shields are fairly distinct, narrow, elongate.

In the stomachal wall are found a number of beautifully star-shaped spicules (Fig. 34. a.) usually with 5—6 rays, but 3—4 rayed samples also occur; some of the rays may be a little branched. The spicules of the bursal wall have the more usual shape of fenestrated plates (Fig. 34. c.).

The colour of the live specimens is a beautiful dark red, on the dorsal side of both disk and arms. — The largest specimens have a diameter of disk of 15—16 mm.

This species is, evidently, closely related to *Ophioscolex purpureus* Düb. Kor. of the North Atlantic, of which it is the southern representative. It may even be questionable whether they are not in reality identical. Also in *O. dentatus* there are sometimes some few spines on the disk, though much less commonly so than in *purpureus*.

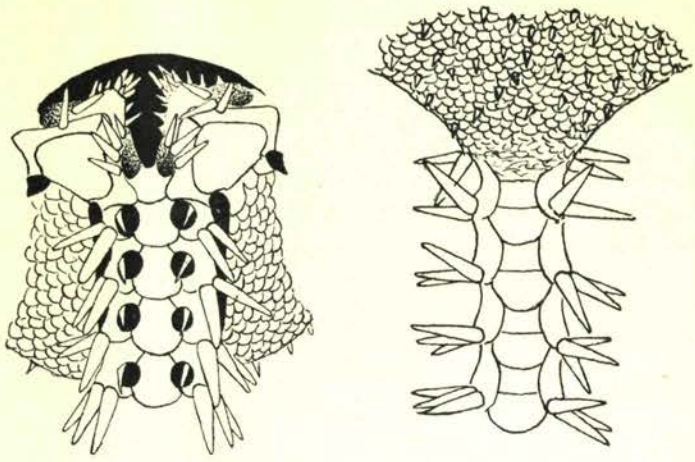
O. dentatus is known only from the S. African Seas. The known bathymetrical distribution is 90—225 fms.

Ophioscolex dentatus, var. *spiniger* n. var.

Off Durban, 29°56′ S. 31°19′30″ E. 225 fathoms. Sandy mud. 26. VIII. 1929. 3 specimens, dredged on board the "Pickle", the largest having a diameter of disk of 7 mm, an arm length of ca. 25 mm.

These specimens differ rather conspicuously from the typical *dentatus* in the disk being set with scattered small spines. As, however, a few spines may sometimes be found on the disk also of *O. dentatus*, this character is not so reliable for a specific distinction — and other good distinguishing characters I do not find. As seen on a comparison of figs. 35. a. and 32. a., the mouth papillæ, ventral plates, tentacle scales, arm spines are in the main alike; only the buccal shields are slightly different, but there is much variation in their shape in *dentatus*, so this is no very reliable character either. The dorsal arm plates would seem to offer a conspicuous difference (Fig. 35 b. to compare with figs. 32. b. and 33. a.); but in young specimens of *dentatus* they may be exactly as in the specimens from off Durban. The two upper arm spines in the distal part of the arms are transformed into hooks also in the specimens from off Durban. The absence of radial shields in fig. 35. b. is no reliable character either, as in another radius of the same specimen they are fairly distinct. On the whole, there is scarcely any other reliable character distinguishing the two forms than the spines of the disk.

The specimen of 7 mm diameter has the gonads strongly developed, which may mean that this form does not grow to nearly as large a size as the typical *dentatus;* if so, it should no doubt be regarded as a good species. But the scanty material at hand cannot give any certainty



a. b.

Fig. 35. *Ophioscolex dentatus*, var. *spiniger* n. var. Part of oral (a) and dorsal side (b). × 12.

as to the size which this form attains. It therefore seems to me the best course for the present to regard this form only as a variety of *Ophioscolex dentatus*.

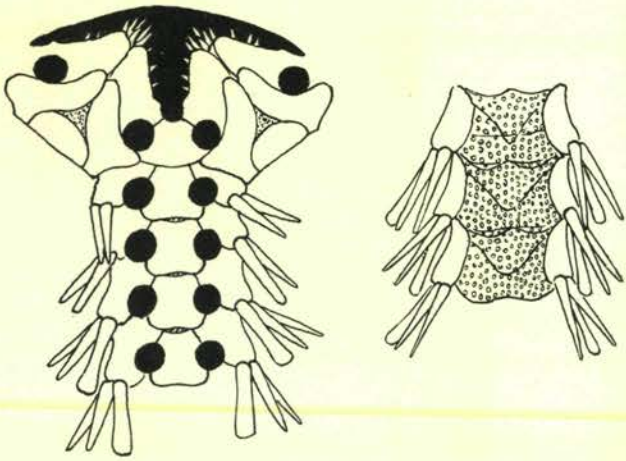
Ophioscolex inermis n. sp.

One specimen, dredged on board the "Pickle".
Off Durban, 29°56′ S. 31°19′30″ E. 225 fathoms. Sandy mud. 26. VIII. 1919.

The specimen is in poor condition, the disk lacking — dissolved as usually happens in *Ophioscolex*, when not preserved at once on coming out of the water. It is, however, seen by the traces of the skin left that the diameter of disk must have been ca. 8 mm. One arm is preserved almost complete; it is a little over 20 mm long and has probably been ca. 25 mm long when complete.

The mouth papillæ are few, small, and slender; on the apex there is a cluster of slightly longer papillæ, continuing a little downwards on the jaw, representing the "teeth", which must, however, be said

to be rather rudimentary. The second oral pores are distinctly outside the mouth edge. The buccal shields are very small, with rounded, semicircular inner edge and straight (or slightly concave) outer edge. The adoral plates are large, conspicuously prolonged adorally. The ventral arm plates are slightly longer than broad, with the distal edge a little concave (Fig. 36. a.). At a first glance one would rather say that dorsal plates are lacking; but as a matter of fact they are



a. b.

Fig. 36. *Ophioscolex inermis* n. sp. a. Part of oral side; b. dorsal side of three arm-joints, showing delicate dorsal plates, through which the vertebræ are seen. × 12.

there, only they are so delicate as to let the vertebræ shine through (Fig. 36. b.). They are very broad, contiguous, with a notch in the distal edge; in places it seems that they are divided by a transverse line into two parts. Three long and slender, somewhat glassy arm spines, the lowermost usually distinctly club-shaped. Upper arm spines not transformed into hooks in the distal part of the arms. No tentacle scales. — In the small rag of the dorsal skin preserved no glassy plates are found, only some scattered, small, delicate, fenestrated plates.

This species is evidently the most nearly related to *Ophioscolex glacialis*, from which it differs, however, markedly in the absence of the spine on the adoral plates, so characteristic of *O. glacialis*. According to Matsumoto (Monograph of Japanese Ophiuroidea. 1917.

Journ. Coll. Sci. Tokyo. XXXVIII. p. 8—9) *Ophioscolex* belongs to the group of the *Ophiomyxidæ* which have the second oral tentacle pore opening entirely within the oral slits, and the present species thus would seem not to be referable to the genus *Ophioscolex*. But in *O. glacialis*, the genotype of the genus *Ophioscolex* the second oral pore is in reality in the same position as in the present species, but on account of the sloping of the jaw, and of the presence of the spine on the adoral plate it has rather the appearance of the pore being inside the mouth slits, which it is in reality not, and the mouth papillæ do not pass outside this pore, as they do in *O. dentatus* (and *purpureus*). Thus there is herein no objection to referring the present species to the genus *Ophioscolex*. On the other hand, it also seems to fit perfectly with the genus *Ophiocynodus* of H. L. Clark (N. Pacif. Ophiurans, p. 274), with which it also agrees in the lowermost arm spine being club-shaped. But, as a matter of fact, I do not see how *Ophiocynodus* can be distinguished from *Ophioscolex* (also in *O. glacialis* the lowermost arm spine may be slightly club-shaped). I therefore think that *Ophiocynodus* should be regarded only as a synonym of *Ophioscolex*, which then falls in two distinct groups, one comprising the species *glacialis*, *corynetes*, and *inermis*, the other the species *purpureus* and *dentatus* (and probably also the other species having a tentacle scale), these latter having really the second oral pore inside the mouth slits, and also characterised by the two uppermost spines in the distal part of the arms being transformed into hooks. The latter group I think should rather be made a separate genus, or at least a subgenus, which I shall name ***Ophiolycus*** (*ὁ λύκος* — hook).

One more species of *Ophioscolex* without tentacle scale has been described, viz. *O. serratus* H. L. Clark (Echinoderms of Porto Rico, Bull. U. S. Fish Comm. 1901. II. p. 250, Pl. XIV. 14—17). This species differs very conspicuously from the other true *Ophioscolex* species through its strongly serrate, flattened spines, which resemble those of the genus *Ophiostyracium* H. L. Clark (N. Pacif. Ophiurans, p. 253). The character of the dorsal side of its arms, as well as the absence of spines on its disk, however, forbid simply referring it to that genus. So far as can be gathered from the description and figures given by Clark, it is a real *Ophioscolex*, but standing rather apart from the other true *Ophioscolex* species.

Family *Ophiacanthidæ.*

Ophiacantha nerthepsila H. L. Clark.

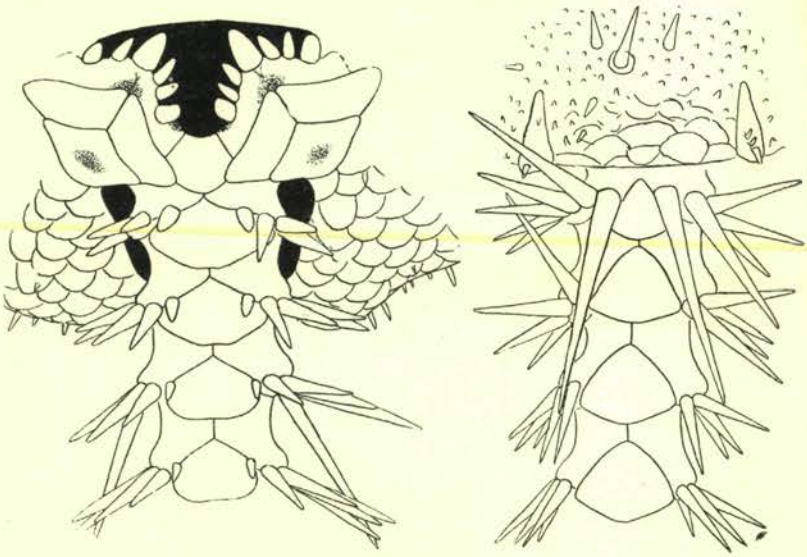
Ophiacantha nerthepsila H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 319. Pl. XIX. 3—4.

— *Barracoutæ* Koehler. 1923. Sur quelques Ophiures des côtes de l'Angola et du Cap. Göteborg K. Vet. Vitterh. Samh. Handl. XXV. 5. p. 3. Figs. 1—3.

15 miles S.W. by W. of Cape Infanta, 48 fathoms. 14. XII. 1929. 7 specimens.

None of these specimens exceed a size of 4 mm diameter of disk, but they are adult, full of ripe sexual products.

Clark has drawn only the dorsal side of this species, and the photographic figure he gives of the oral side (Pl. XIX. 4) does not show



a. b.

Fig. 37. *Ophiacantha nerthepsila* H. L. Clark. Part of oral (a) and of dorsal side (b). × 20.

the details clearly. I have therefore thought it desirable to give a drawing of the oral side, as also of the dorsal side of an arm for showing the variation in the shape of the dorsal arm plates (Fig. 37).

The arm spines on the first free joint I find usually to join almost completely in the dorsal midline (Fig. 37. b.). The spines — or "spini-

form granules" — usually scattered among the granules of the disk may sometimes be totally lacking. The granules may continue till about midway in the ventral interradii. This is the case also in a cotype, which I have received from the S. African Museum. The buccal shields are more or less sunken in the middle.

There may be a large white spot in the centre of the disk.

It is rather remarkable that I found this species only in the above mentioned locality, whereas Clark has it from a good many localities, so that it would seem to be fairly common in the S. African seas.

There can be no doubt but that Koehler's *Ophiacantha barracoutæ* (from off Cape Barracouta, 40 fms.) is the same as Clark's *O. nerthepsila*. The question is only which of the two names has the priority. Both papers were published in May 1923. Koehler's paper was published on May 2nd, as I am informed by my friend Professor L. A. Jägerskjöld, Gothenbourg; the exact date of publication of Clark's paper it has, however, not been possible to ascertain. In view of this uncertainty I think it preferable to keep the name given by Clark, as his paper is much the more important and also much more easily accessible than Koehler's paper.

Ophiacantha scutigera n. sp.

Pl. XIX. Figs. 6—7.

Off Durban. 29°48′30″ S. 31°18′ E. 120 fathoms. 22. VIII. 1929. 6 specimens.
Off Durban. 30°2′30″ S. 31°3′ E. 90 fathoms. 27. VIII. 1929. 5 specimens.
Dredged onboard the "Pickle".

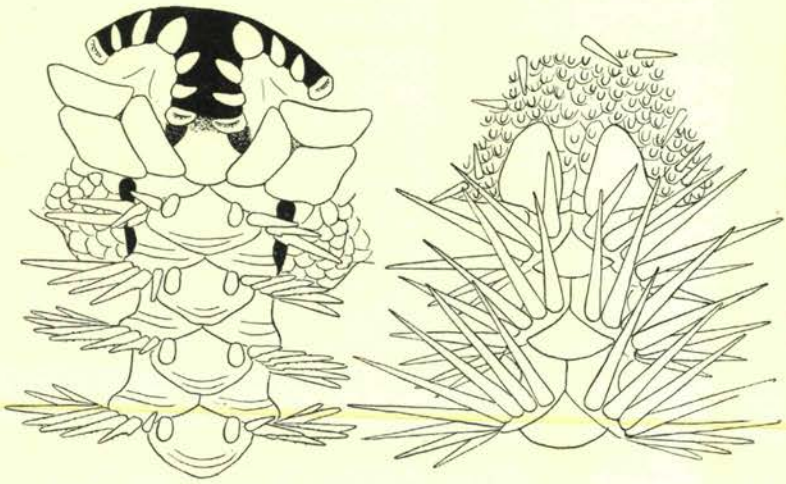
Diameter of disk 5 mm; length of arms ca. 30 mm.

Disk covered more or less densely with low, rounded, slightly rough stumps or grains, which may conceal the scales rather completely, except those between the radial shields; sometimes the scales are fairly distinctly discernible. Scattered among these stumps are found some slender, smooth, ca. 1 mm long spines in varying numbers; as a rule they occur more constantly in the centre of the disk and at the outer edge of the radial shields; these latter are about equally broad and long, and quite conspicuous, though rather small. They are separated by a varying number of scales. The scales of the ventral interradii are quite naked.

Mouth papillae three, exceptionally four to each side of jaw, the outer one slightly the largest, often rather distinctly concave on the

outer side. Buccal shields broader than long, with an obtuse inner angle and a not very pronounced outer lobe, or with the outer edge simply convex or even straight (Figs. 38. a.; 39. b.). There is thus rather much variation in the shape of the buccal shields. Adoral plates broad, meeting broadly within, but without any outer lobe, the buccal shield and first lateral plate thus in direct contact.

The first ventral plate rather large, hexagonal, the following ones



a. b.

Fig. 38. *Ophiacantha scutigera* n. sp. Part of oral (a) and dorsal side (b). × 15. The scales of the dorsal side somewhat too distinct in the figure.

with a very obtuse inner angle, the outer edge convex, with an indistinct median lobe. They are distinctly broader than long, slightly separated or just contiguous. The dorsal armplates are triangular, about twice as wide as long, with an acute inner angle and the outer edge more or less convex. They are widely separated (Figs. 38. b.; 39. c.). 10 arm-spines in the proximal part of arm, joining completely or nearly so in the dorsal midline (Fig. 39. a.). The upper ones are smooth, the lower ones somewhat serrate and particularly with a distinct prominence at the base, on the aboral side; they increase in length from below upwards, the uppermost being about the length of two arm joints. — One fairly large, rounded tentacle scale.

There is a quite marked concentric striation on the ventral and lateral armplates. The arms are not moniliform.

As a rule there are some conspicuous, small, dark spots round the radial shields and along the dorsal midline of the arms, standing out markedly against the grayish ground colour.

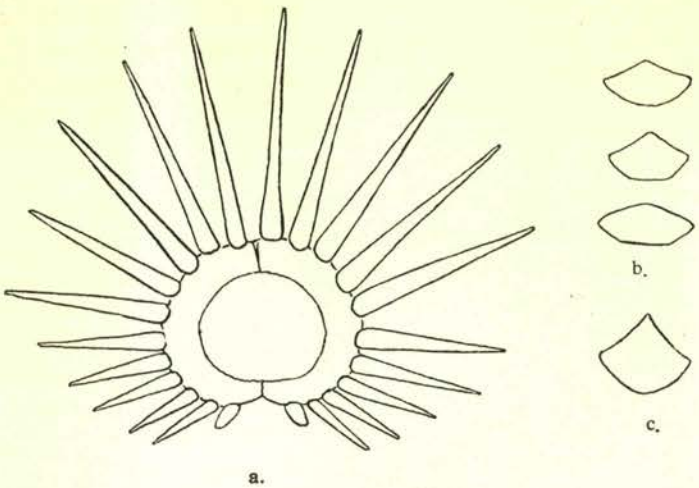


Fig. 39. *Ophiacantha scutigera* n. sp. a. End-view of armjoint, showing arrangement of spines; b. various forms of buccal shields; c. dorsal armplate. × 12.

I do not see any nearer relation between this characteristic species and any of the numerous species of *Ophiacantha* hitherto known.

Ophiacantha baccata n. sp.

Pl. XIX. Fig. 8.

Off Durban, 29°59′ S. 31°7′30″ E., 127 fathoms. 3 specimens, dredged on-board the "Pickle", 27. VIII. 1929. Further, I have received from the Fisheries Survey several specimens in a poor state of preservation from 29°51′S. 31°16′E. 158 fathoms.

Diameter of disk 5 mm; length of arms ca. 30 mm. Disk closely covered with a uniform coat of delicate stumps terminating in three diverging, often bifurcating thorns (Fig. 41. a.). At most the distal end of the radial shields may be naked; but there is usually an indication of radial ribs. Ventral interradii also completely covered by the stumps, no scales being visible.

Three mouth papillæ to each side of jaw, the outermost one usually somewhat larger than the others; the fact that they are often placed on edge makes them appear somewhat more slender than they are

really; the infradental papilla distinctly the largest, somewhat indistinctly serrate. Buccal shields about twice as broad as long, inner sides concave, outer side convex, with an indistinct lobe; they have a rather distinct depression in the middle. Adoral shields very broad, with a narrow distal lobe separating the buccal shield from the first ventral plate; it is, however, set off from the main part of the adoral plate so as to appear like a small separate plate, which it is not, the

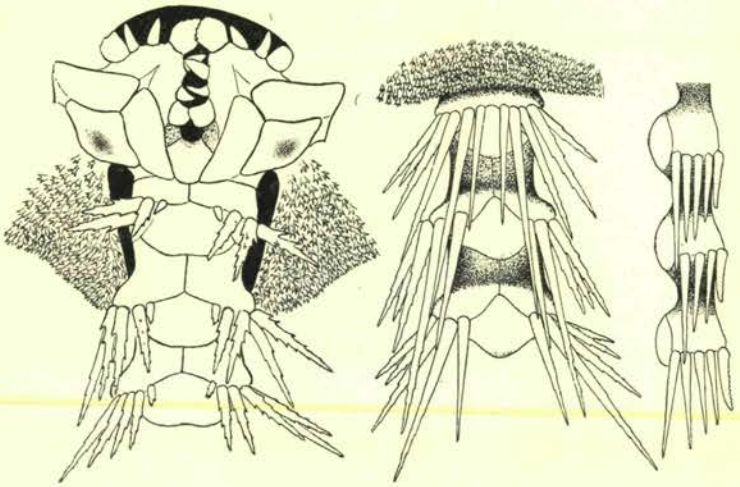


Fig. 40. *Ophiacantha baccata* n. sp. a. Part of oral side; b. part of disk and the dorsal side of the three proximal armjoints; c. three armjoints from distal part of arm, side view. × 15.

apparent dividing line being only the limit between the much thicker main part of the adoral plate and the somewhat sunken lobe (Fig. 40).

First ventral plate a little longer than broad, the following ones distinctly broader than long, particularly the second. They are widely separated; the inner angle is very obtuse, the outer edge slightly convex, with an indistinct notch in the middle. The dorsal arm plates are triangular, with the distal edge somewhat prominent. 6—7 spines at the base of arms, joining in the dorsal midline on the first free joint; they increase in length from the lowermost, which is scarcely as long as an arm joint, to the uppermost — or the second from above — which is about the length of two arm joints. The lower ones are strongly serrate, the serrations gradually diminishing upwards, the upper-

most spines being almost entirely smooth. A single small tentacle scale, which is somewhat serrate.

The arms are very strongly moniliform (Fig. 40. c.) (the species name *baccata* refers to this character); in the distal part of the arms this becomes still more pronounced through the fact that the constricted part of the joints consists of clear, transparent, calcareous substance almost without any reticulations, the long and slender,

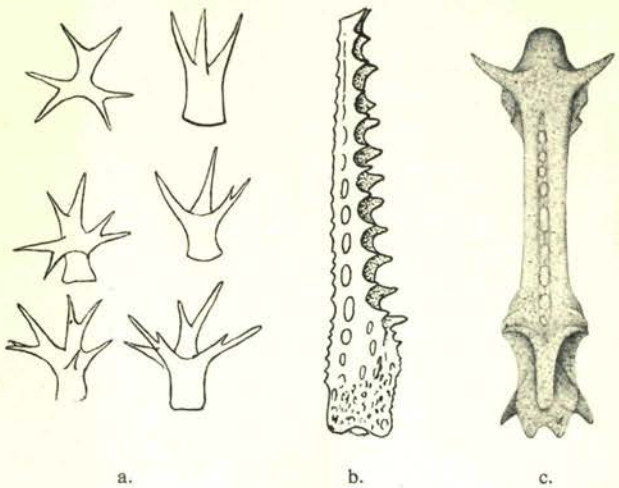


Fig. 41. *Ophiacantha baccata* n. sp. a. Stumps from the disk, seen from above and in side view; b. lowermost armspine from distal part of arm; c. vertebra from distal part of arm. a—b. × 125; c. × 95.

only partly coalesced vertebræ (Fig. 41. c.) being distinctly discernible through the transparent lateral plates. This structure makes the arms look very much like a string of beads. The arm spines in the distal part of the arms are only 5 or 4; they are almost smooth, except the lowermost one, which has a double series of serrations along its under side (Fig. 41. b.).

The colour is a light straw-colour, with numerous small dark spots scattered over the disk; sometimes it is only single stumps here and there which are thus darker coloured. There are often some indistinct brownish bands on the arms.

This species is related to *Ophiacantha pentagona* Koehler from which it is, however, easily distinguished particularly by its very strongly moniliform arms. Other species with similarly moniliform

arms are *O. pentacrinus* Lütken and *O. moniliformis* Ltk. & Mrtsn. Both of them differ markedly from *O. baccata* in the outer mouth papilla not being widened; also the shape of the mouth shields is quite different, as are the stumps of the disk, particularly in *moniliformis*. There is no question but that the S. African species *O. baccata* is quite distinct from these or any other *Ophiacantha*-species hitherto described.

It would appear that also *Ophiacantha angolensis* Koehler ("Sur quelques Ophiures des côtes de l'Angola et du Cap" 1933 p. 6. Figs. 4—5) is related to *O. baccata* and has strongly moniliform arms. But the fact that it has only 5 arm spines shows it to be different from the present species.

Ophiacantha striolata n. sp.

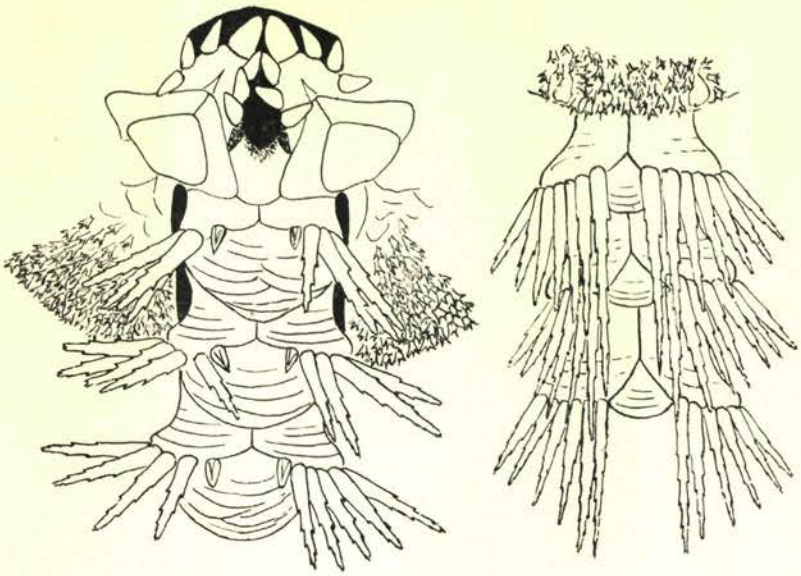
Off Durban, 29°56′ S. 31°19′30″ E. 225 fathoms. 26. VIII. 1929. 2 specimens, dredged onboard the "Pickle".

Diameter of disk 3 mm; length of arms ca. 12 mm.

Disk closely covered with stumps terminating in 3 divergent, rather coarsely serrated branches (Fig. 42; 43. a.). Only the distal end of the radial shields just discernible; no radial ribs. Also the ventral interradii covered by these stumps, except a small space just outside the buccal shields.

Mouth papillæ three to each side of jaw, of uniform size, conspicuously smaller than the infradental papilla. Buccal shield rounded triangular, with an indistinct lobe on the outer edge. Adoral plates rather narrow, joining within, and with a narrow outer lobe separating the first lateral plate from the buccal shield. First ventral plate rather narrow, longer than wide; following ventral plates distinctly broader than long, with a very obtuse inner angle and the outer edge conspicuously convex. They are all separated, but not very widely so (Fig. 42. a.). Dorsal armplates small, triangular, widely separated. Arm spines very slender, rather strongly thorny, in basal part of arms 8, joining in the dorsal midline or very nearly so; they increase in length upwards, the uppermost being about the length of two arm joints. The number of the spines gradually decreases, till in the distal part of the arms there are only 4; here they are nearly smooth, except the lowermost one, which is finely serrate along the lower edge (Fig. 43. b.). — One small tentacle scale, which is pointed and somewhat furrowed on its upper side.

Both ventral and lateral plates, and even the small dorsal arm plates, show a very conspicuous concentric striation, which makes these

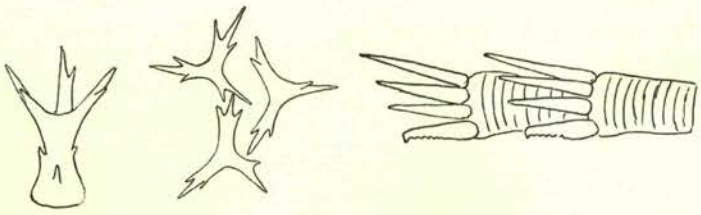


a. b.

Fig. 42. *Ophiacantha striolata* n. sp. Part of oral (a) and dorsal side (b). × 30.

plates look quite shining under the microscope. The arms are not moniliform.

The colour of the dried specimens is the usual light straw colour.



a. b.

Fig. 43. *Ophiacantha striolata* n. sp. a. Stumps from the disk, in side view and from above; b. two armjoints from distal part of arm, side view. a. × 125; b. × 30.

A similar concentric striation of the arm plates is found also in some other *Ophiacantha*-species, e. g. *O. Bairdi* Lyman, *O. graphica*

Koehler, *O. lineata* Koehler, *O. metallacta* H. L. Clark, and the here described species *O. scutigera* Mrtsn. Among these *O. Bairdi*, *metallacta*, and *scutigera* have no nearer relation to the present species. *O. lineata* would seem to have much general resemblance to the present species, but differs markedly from it in the shape of the buccal shields and the ventral arm plates; also the stumps of the disk have a crown of 5—6 thorns, not 3 as in the present species (cf. Camp. Sci. Monaco, 34. Pl. XXV. 6—8). Still greater would seem to be the resemblance of *O. graphica* to the present species. Unfortunately, the illustrations of this species given in Koehler's report on the Ophiurans of the "Albatross" Philippine Expedition (Pl. 18. 4—5) are very indistinct; but the fact that *O. graphica* has two tentacle scales on the first two pore pairs shows sufficiently that it is different from the S. African species. Also the species *O. longidens* Lyman and *O. legata* Koehler, with the same concentric striation of the arm plates, resemble the present species rather much, but the stumps covering the disk in these species are so different from those of the present species that there can be no question of their being identical.

Ophiacantha (*Ophiotreta*) *durbanensis* n. sp.

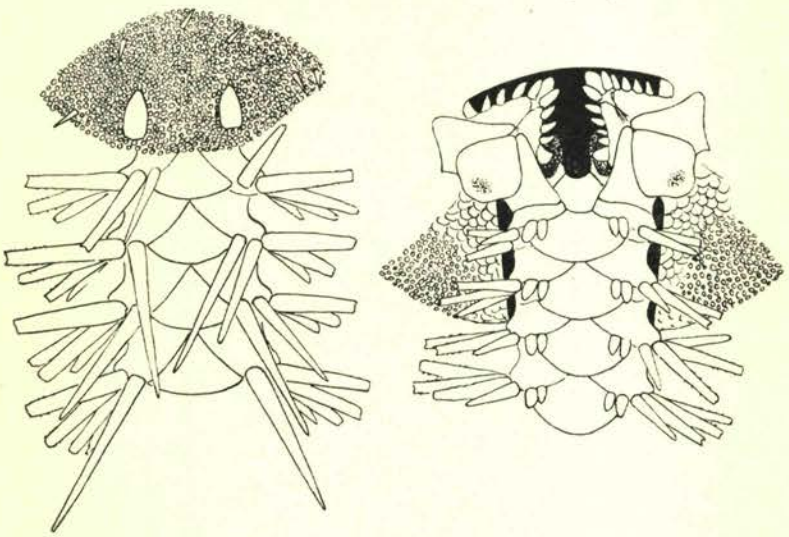
Pl. XIX. Figs. 13—15.

Off Durban, 29°56′ S. 31°19′30″ E., 225 fathoms, 2 specimens, dredged onboard the "Pickle", 26. VIII. 1929.

Diameter of disk 7 mm, length of arms ca. 45 mm (all broken). Disk very flat, covered by a uniform coat of small grains which conceal the scales completely. Scattered among these grains are a number of slender, erect spines, ca. 0.5 mm long. The radial shields are small but quite distinct, widely separated from each other; they are about twice as long as wide (Fig. 44. a.). The ventral interradii grain-covered (but without the spines) in the outer part, the — very small — scales being naked in the proximal part.

5—6 small mouth papillæ to each side of jaw, the outermost one somewhat enlarged. The infradental papilla is small, placed at a lower level than the mouth papillæ. Mouth shield spearhead-shaped, distinctly longer than broad, with a slight impression in the distal part. Adoral plates narrow, joining or not quite joining within, with a broad outer lobe, separating the buccal shield from the first lateral plate. First ventral arm plate broader than long; the following ones about twice

as broad as long, contiguous, with the outer edge convex (Fig. 44. b.). Dorsal arm plates triangular, with an acute inner angle and the outer side convex; they are merely contiguous. The grain covering of the disk continues a little over the basal part of the arm; there may be a couple of grains at the distal border of the first dorsal plate. 5 arm spines, the uppermost the longest, about as long as two arm joints; they are compressed, the lower ones distinctly truncate, slightly bifid and with



a. b.

Fig. 44. *Ophiacantha* (*Ophiotreta*) *durbanensis* n. sp. Part of dorsal (a) and oral side (b). × 10.

finely serrate edges. Tentacle scales two at each pore, the inner one slightly the smaller and gradually diminishing in size, to disappear completely in the distal part of the arm.

Colour of the disk a very faint mottling of white and light brownish (in the dried specimens); arms without special colour.

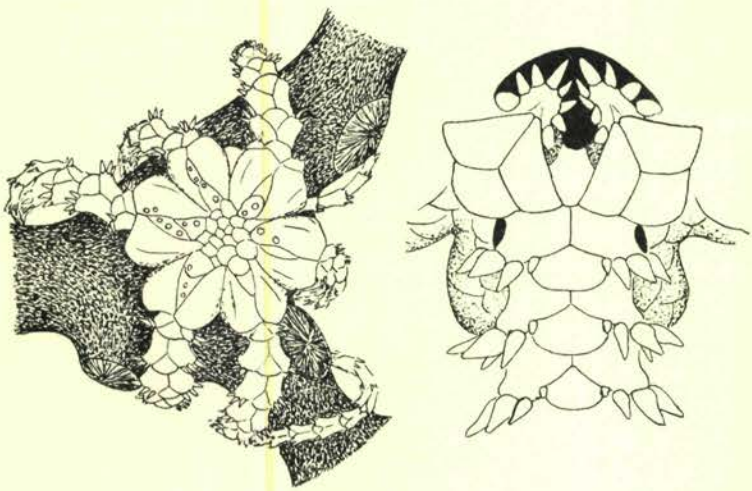
This species is related to *Ophiacantha* (*Ophiotreta*) *Valenciennesi* Lyman and *O. bisquamata* Matsumoto, both of which have likewise two tentacle scales in the main part of the arm, not only on one or two of the basal joints, and their arm spines likewise are truncate and slightly bifid at the point. The present species is, however, very distinctly characterized by its naked radial shields and the presence of spines among the granules on the disk.

Ophioplinthaca sexradia n. sp.

33°17′ S. 27°35′ E. 24 fathoms. 2 specimens, attached to a Gorgonian (Fisheries Survey).

Diameter of disk 2.5 mm. Arms wound round the coral, so that their length cannot be measured, but they are apparently ca. 4—5 times as long as the diameter of the disk. Arms six.

Disk occupied in the main by the radial shields, which are some-



a. b.

Fig. 45. *Ophioplinthaca sexradia* n. sp. a. Specimen attached to a Gorgonian; b. part of oral side of disk. a. × 10; b. × 25.

what elevated, contiguous in their distal part, diverging inwards, separated by an irregular wedge of scales, some of which carry 2—3 small granules. Also on the radial shields some granules may occur (Fig. 45. a.). There is a more or less distinct longitudinal furrow in each radial shield, nearer the abradial edge. The centre of the disk is somewhat sunken, occupied by a few irregular, polygonal plates. There is a deep interradial furrow; in one interradius of one of the specimens there is a distinct wedge of scales, the interradial edge here bulging out, whereas otherwise there is a deep marginal interradial incision as usual in *Ophioplinthaca*. The ventral interradii with fairly large, naked scales. Genital slits very short.

Mouth papillæ three or four to each side of jaw, the outer one a

little widened; the infradental papilla rather slender. Adoral plates very broad, without an outer lobe; buccal shield with an obtuse inner angle and a strongly convex outer edge. First ventral plate distinctly longer than broad; the second ventral plate widely separated from the first, broader than long, with an obtuse angle within and the outer edge convex; the following ones gradually assume a more triangular form, all distinctly separated from each other (Fig. 45. b.). Dorsal arm plates triangular, with convex outer edge, widely separated from each other. Arm spines 4, very short, thick and clumsy. One small tentacle scale. Colour of dried specimens straw colour.

This small form is the only 6-armed *Ophioplinthaca*-species made known till now, and is accordingly very easily distinguished. It has no distinct relation to any other known species.

Ophiothamnus remotus Lyman.

Pl. XIX. Figs. 9—11.

Ophiothamnus remotus Lyman. 1878. Oph. & Astroph. of the "Challenger". Bull. Mus. Comp. Zool. V. p. 149. Pl. VIII. 201—203.
— — — 1882. "Challenger" Oph. p. 212. Pl. XIV. 1—3.
— — Studer. 1883. Übersicht über die Ophiuriden, welche während der Reise S.M.S. Gazelle um die Erde 1874—76 gesammelt wurden. Abh. Ak. Berlin v. J. 1882. p. 24.
— — Bell. 1903. Echinoderma. III. Ophiuroidea. Marine Invest. S. Africa. III. p. 258.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 324.

Several specimens were dredged onboard the "Pickle":
34° 2′ S. 18° 7′ E. 94 fathoms. 17. XII. 1929. 8 specimens.
34° 5′ S. 18° 1′ E. 118 — — 15 —
34°17′ S. 18°58′ E. 160 — 18. XII. 1929. Several specimens.
34°21′ S. 17°57′ E. 178 — — — —
34°24′ S. 18°16′ E. 133 — — 6 specimens.
34° 5′ S. 17°52′ E. 146 — 23. XII. 1929. 12 —
Off Durban, 30°2′ S. 31°3′ E. 90 fathoms. 1 specimen.

This species evidently is one of the commonest of the S. African Ophiurids, particularly off the Cape Peninsula at depths of ca. 100—200 fathoms. But it ranges as far North along the East coast as off the Natal coast (Tugela River). The present records do not extend its bathymetrical range beyond that given by Clark, 51—230 fathoms.

Studer (Op. cit.) gives the locality 34°13′6″ S. 18°0′7″ W. 117 fathoms. — This locality is in the middle of the Atlantic, W. of Tristan da Cunha, in the true deep-sea area. Looking at his list of the species, Op. cit. p. 30, we find that in the 18°0′7″ *W* is a printer's error for *O* — viz. off the Cape of Good Hope, the type locality of the species. An exactly similar case occurs under *Ophiuropsis Lymani*, in the same author's report on the Asteroids and Euryalids of the "Gazelle" (Abh. Akad. Berlin v. J. 1884, p. 55), where the locality is given as 11° E., instead of 112° E., which has caused Clark to include this species in the S. African fauna, whereas in reality the locality is off West Australia (cf. my "Studies of Indo-Pacific Euryalids", Vid. Medd. Dansk Naturh. Foren. Bd. 96. 1932—33 p. 73).

As pointed out by Clark there is a good deal of variation in regard to the spines on the disk, both in regard to their number and size. Therefore, although I have not seen any specimen corresponding to that mentioned by Clark as having 7 stout, abruptly pointed spinelets, 5 of which form a symmetrical quintet at the centre of the disk, and having in addition a number of minute widely scattered granules, I do not doubt that he is right in referring this specimen also to *O. remotus*, when, as he says, there are no other differences from the typical form.

Also in other respects there is some variation. Thus the mouth shields may differ a good deal in size, but their shape remains essentially the same, apart from some irregularities which may occur now and then. A much more conspicuous variation, however, occurs in regard to the shape of the disk, in that it may be deeply incised in the interradii, so as to recall the genus *Ophioplinthaca*, or it may be simply round or even bulging out in the interradii (Pl. XIX. Figs. 9—10). The difference between the extremes is so great that at a first glance one would think it improbable that they could belong to one and the same species. There are, however, all possible transitions between the extremes, and as there are no other differences to be found, it is beyond doubt that they are really all the same species. — Also as regards the number and relative size of the scales on the disk there is a very considerable variation. This, however, is no doubt due to the fact that it is apt to lose (or actively throw off?) its disk and regenerate it again. It would appear that specimens with numerous small disk-scales are such as have regenerated their disk. In these specimens also

the spines of the disk are in general smaller and less numerous than normally; they may even be totally absent. Such specimens recall the Japanese species *Ophiothamnus venustus* Matsumoto.

Looking on such thrown off disks one sees that there are no openings along the sides of the arms. The calcareous plating continues without any interruption across the dorsal side of the arms — apart from a small hole in the radial midline. *Ophiothamnus remotus* accordingly

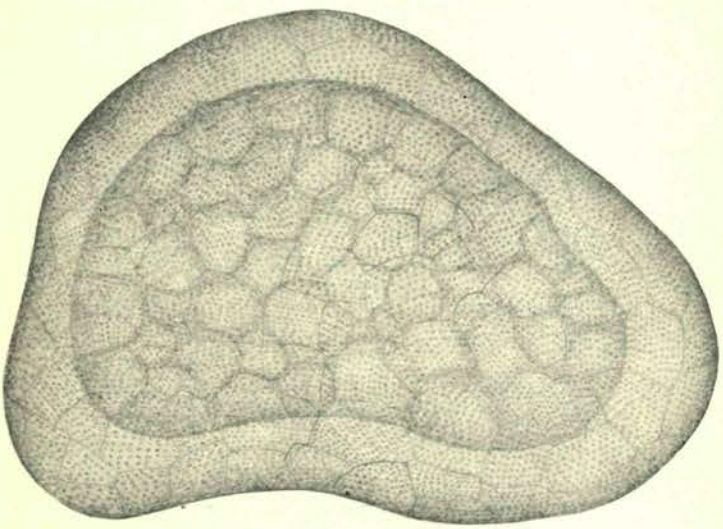


Fig. 46. Gonad of *Ophiothamnus remotus* Lyman. × 125.

has no bursæ. The genital plates also lack a genital scale. The complete specimens, with their disk preserved, show a narrow but distinct slit along the side of each arm, resembling a bursal slit; but it does not lead into any bursa, it is only the limitation of the disk against the arm, there being no coalescing between disk and arm except on top of the arm, which accounts for the fact that the disk is so easily lost.

There is only one rather large gonad to each side of the arm, lying within a spacious cavity, the wall of which is paved with angular calcareous plates (Fig. 46). This cavity resembles a bursa (Lyman's "ovarial bursæ"), but the fact that the gonad lies within it, and that there is no outer opening, proves that it cannot be a bursa. As the gonad lying within the cavity is surrounded by a fine membrane, it seems that

the outer membrane with the calcareous plates cannot be the homologue of the gonad membrane. What its true morphological value is, I do not know.

Exactly the same arrangement of the genital organs and the absence of bursæ was found by Lyman ("Challenger" Oph. p. 212, Pl. XLII. 1) in *Ophiothamnus vicarius* and by Matsumoto (Monogr. Japan. Ophiuridea, p. 129) in *O. venustus*. In my paper "Über Ophiopus arcticus (Ljungman), eine Ophiure mit rudimentären Bursae" (Zeitschr. f. wiss. Zool. LVI. 1893) I have tried to show that the "creases of the disk" along the arms represent true bursæ, against the opinion of Lyman. I shall have to modify that opinion in so far that the slits ("creases") can at most be regarded as rudimentary bursæ, being probably derived from the bursal structure typical of Ophiurids. (Also my statement Op. cit. p. 509, that the apparent polygonal plates seen over the gonads in Lyman's figure Pl. XLII. 1 must probably be the ripe eggs shining through the ovarian wall, not the calcareous plating of which Lyman speaks, must be corrected. Lyman's description is quite correct, only the figure is not very intelligible. On seeing the thing itself one can easily understand it. The figure here given may, I hope, be more clear).

How the sexual products are shed, in the absence of bursæ, is not clear. I suppose it will be in the same way as in *Ophiopus arcticus;* in this Ophiuran, likewise without bursæ, I have found that the eggs come out through pores formed in the ventral side of the disk, simply through resorption of the skin and the calcareous plates (cf. my paper "Über Ophiopus arcticus"). In the material at hand I have seen only one specimen with eggs protruding in one place in an interradius — but I am not sure that it is something normal, it might be due to some casual rupture.

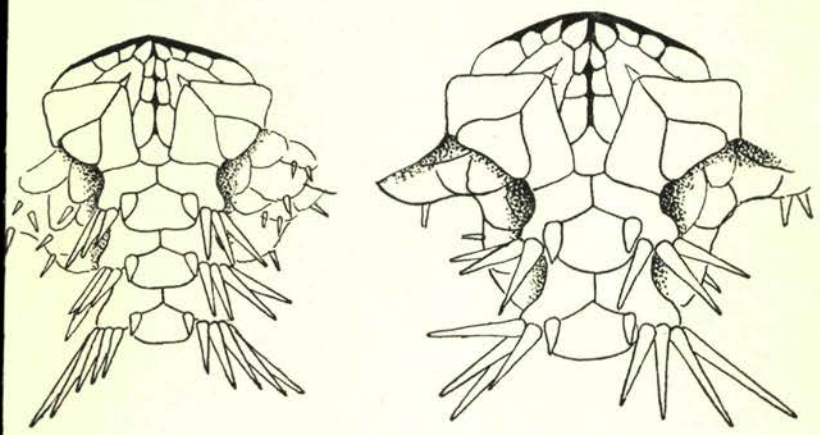
It would seem that in *Ophiocymbium cavernosum* Lyman the genital organs are arranged in a similar way as in *Ophiothamnus remotus*, judging from the description given by Lyman (Challenger Oph. p. 163).

Ophiothamnus remotus, var. *cordatus* n. var.

Off Durban, 29°56′ S. 31°19′30″ E. 225 fathoms. 4 specimens, dredged onboard the "Pickle", 26. VIII. 1929.

These specimens differ markedly from the typical *O. remotus* in the shape of the buccal shields, which are distinctly heart-shaped (Fig. 47. b,

to compare with Fig. 47. a. showing the typical *O. remotus*). This is the only appreciable difference I can find; the difference in the shape of the first (second) ventral plate seen in the two figures is not to be relied on; it may show a slight concavity in the outer edge also in the variety, and in the typical *O. remotus* the concavity is not always distinct, may vary from arm to arm even within the same specimen. It would appear that the arms are a little more slender and the joints



a. b.

Fig. 47. Part of oral side of *Ophiothamnus remotus* Lyman (a) and of the var. *cordatus* n. var. (b). a. × 12; b. × 30.

more constricted in the variety than in the typical form. But with the scanty material available, and the four specimens being of smaller size (ca. 2 mm diameter of disk, *O. remotus* up to 4—5 mm diameter of disk), it is not safe to ascertain that we have here a distinct species. The only reasonable course seems to me for the present to be this, to distinguish this form with the heart-shaped buccal shields as a — very distinct — variety of *O. remotus*. — It may be pointed out that also the typical *O. remotus* occurs off the Natal coast.

Ophiomitrella corynephora H. L. Clark.

Ophiomitrella corynephora H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 322. Pl. XIX. 5—6.

34°17′ S. 17°58′ E. 160 fathoms. 3 specimens, dredged onboard the "Pickle". Further, several specimens, partly attached to Gorgonians, were received

from the Fisheries Survey; for most of them the locality cannot be made out any more. 1 specimen is from 39°2′ S. 16°53′ E. 200 fathoms.

The specimens agree very well with the description given by Clark. As he has given a detail figure of only the dorsal side of disk and arm, and the photographic figure of the oral side, Pl. XIX. 6, shows none of the details of the plates, I have thought it desirable to give here a figure of part of the oral side, showing the outlines of the plates (Fig. 48). To Clark's excellent description I would only add that the jaws are rather distinctly sunken.

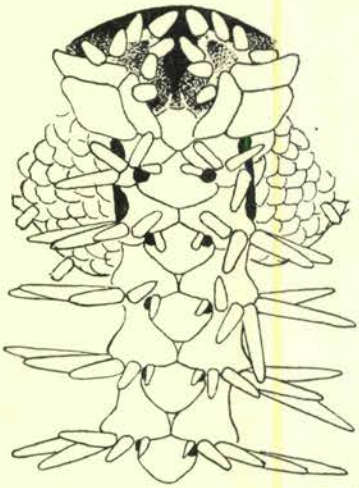


Fig. 48. Part of oral side of *Ophiomitrella corynephora* H. L. Clark. × 12.

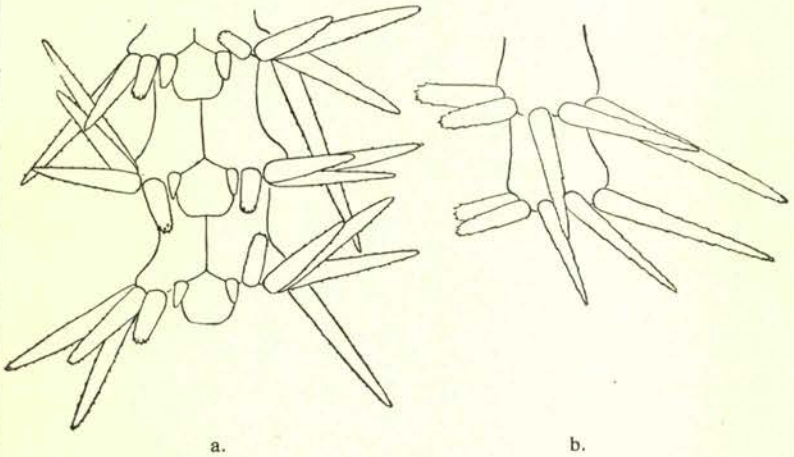
Clark states that "as usual in *Ophiomitrella* there is a distinct papilla or tentacle-scale on the inner side of the oral tentacle-pore, which seems to be borne on the first under arm-plate". I cannot agree at all with Clark in regarding this as a tentacle scale; it is nothing but an elevated ridge on the jaw forming the admedian edge of the pore (Fig. 48). For a comparison with *O. hamata* n. sp. are given figures to show the character of the spines (Figs. 49. a—b.).

The interesting observation was made by Clark that this species is viviparous. I can add that, like the other viviparous species of *Ophiomitrella*, *O. clavigera* (Ljungman), it is also hermaphroditic, and likewise a proterandric hermaphrodite. Further there is a very remarkable anatomical feature in *O. corynephora*, viz. that the two bursæ of each radius unite across the arm so as to form one large, common space. This is a feature otherwise quite unknown in Ophiurids outside the Euryalids.

As is the case with *Ophiomitrella clavigera* the present species may be infested with a peculiar parasitic Copepod — apparently the same as is found in *O. clavigera*, living in the gonads. The parasite does not completely castrate its host, as is neither the case in *O. clavigera;* it destroys only the gonad in which it is lodged. There is, however, also

another very peculiar parasitic Copepod which lives in galls in the dorsal side of the disk. The gall is lined — also in the interior — with skin containing calcareous plates like those of the dorsal skin; it remains open to the exterior through several small irregular pores. Both these parasites appear to be quite rare, contrary to what is the case with *Ophiomitrella clavigera*, of which generally the majority of the specimens are parasitized.

H. L. Clark points out the near relation between the S. African



a. b.

Fig. 49. Armjoints of *Ophiomitrella corynephora* H. L. Clark, from middle of arm. a. From the ventral side; b. in side view. × 20.

O. corynephora and the species from the Gough Island described by Koehler under the name of *Ophiomitrella ingrata*. To the differences between the two species mentioned by Clark I would add that, judging from a couple of paratypes of *O. ingrata*, which I received long ago from Dr. Bruce, *O. ingrata* is not viviparous and its bursæ are not united across the dorsal side of the arms.

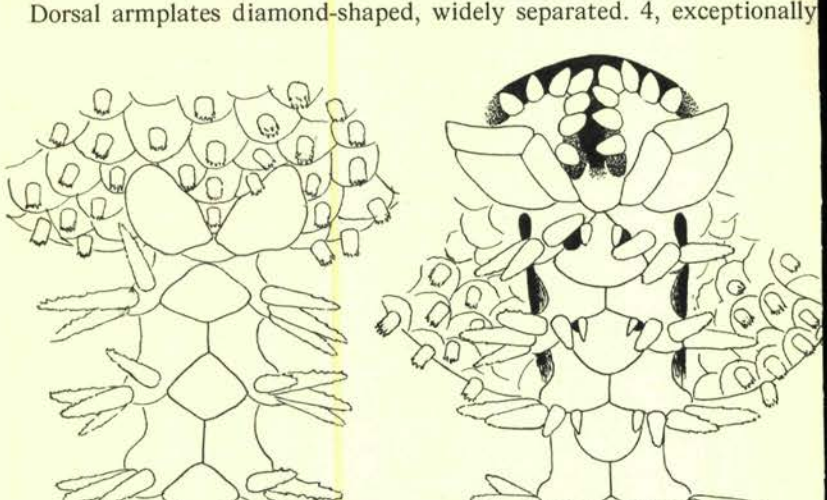
Ophiomitrella hamata n. sp.

Pl. XIX. Fig. 12.

Off Durban; 29°56′ S. 31°19′30″ E. 225 fathoms. 8 specimens on a Gorgonarian (*Thouarella* sp.).

Diameter of disk 4 mm, length of arms ca. 12 mm. Three thick mouth papillæ to each side of jaw. Buccal shields about twice as broad

as long, with inner edges slightly concave, outer edge convex. Adoral shields rather broad, joining within, not outwards prolonged between buccal shield and first lateral plate; jaws not sunken as in *O. corynephora*. The two first ventral plates narrowly contiguous, the following ones widely separated, about as long as broad, the outer edge strongly convex (Fig. 50. b.). One distinct, but rather small tentacle scale. Dorsal armplates diamond-shaped, widely separated. 4, exceptionally



a. b.

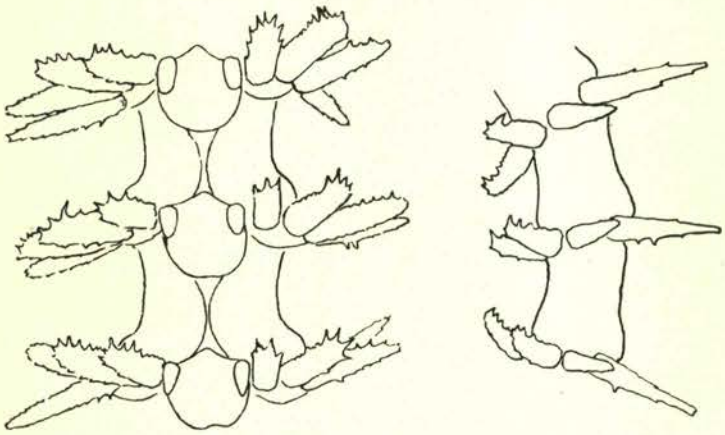
Fig. 50. *Ophiomitrella hamata* n. sp. Part of dorsal (a) and oral side (b). × 20.

on one or other of the basal joints 5, arm spines, scarcely as long as an arm joint, rather robust and coarsely and irregularly dentate, particularly along the adoral side (Figs. 51. a—b.). The arm joints are not much constricted. Radial shields distinct, rather broad, diverging, merely in touch at the distal end. Scales of disk rather coarse, each with a coarse stump, finely thorny in the end (Fig. 50. a.). — Colour in alcohol whitish.

In regard to the shape of the plates and the disk covering this species differs very little from *O. corynephora*, so little, indeed, that one might be inclined to think them identical; but the arm spines are so very conspicuously different from the smooth arm spines of

O. corynephora that they alone offer a sufficiently sharp distinction between the two species (Fig. 51 to compare with Fig. 49). Another difference is found in the jaws, which in the present species are flat, not sunken as those of *corynephora*.

Like *O. corynephora* this species is viviparous and a proterandric hermaphrodite. I found two rather large young ones of the same size in one of the specimens opened. As regards the bursæ it offers a very striking difference from *corynephora* in all the



a. b.

Fig. 51. Armjoints, from middle part of arm (joints 20—22) of *Ophiomitrella hamata* n. sp. a. From ventral side, b. in side view. × 30.

bursæ having coalesced so as to form one common circular space, a feature entirely unique in Ophiurids outside the Euryalids. It is a very remarkable fact that of the three viviparous species thus far known within the genus *Ophiomitrella*, one, *O. clavigera* (Ljungm.), has the bursæ separate as usual in Ophiurids, another, *O. corynephora*, has them united two and two, forming a common space across each arm, the third, *O. hamata*, has them all united into a common circular space, on the top of which lies the stomach, which is thus entirely devoid of interradial pouches.

The peculiar parasitic Copepod living in galls on the dorsal side of the disk, in connection with the outside through irregular pores, was found in this species, as in *O. corynephora*.

Family *Ophiothrichidæ.*

Ophiothrix aristulata Lyman.

Ophiothrix aristulata Lyman. 1882. "Challenger" Oph. p. 223. Pl. XXI. 9—12.
— — Bell. 1905. Ech. S. Africa. III. Ophiuroidea. p. 258.
— — Koehler. 1922. Oph. "Albatross" Philippine Exp. p. 205. Pl. 35. 1—3; 97. 1. a—f.
— — Clark. 1923. Ech. Fauna S. Africa, p. 336.
Non: *Ophiothrix aristulata* Döderlein. 1910. Asteroidea, Ophiuroidea, Echinoidea, in L. Schultze. Zool. u. Anthropol. Ergebn. Forschungsreise im Westl. u Zentr. Südafrica. Jena'er Denkschr. XVI. p. 254. Pl. V. 4—5. (= *Ophiothrix fragilis* Abgd.).
Non: — — Hertz. 1926. Oph. d. deutschen Südpolar Exp. p. 35. (= *Ophiothrix triglochis* M. & Tr.).

Several specimens were dredged onboard the "Pickle", XII. 1929, viz.

34° 5′ S.	17°52′ E.	146 fathoms.	4 specimens.
34° 5′ S.	18° 1′ E.	118 —	6 —
34°17′ S.	17°58′ E.	160 —	8 —
34°21′ S.	17°57′ E.	178 —	15 —

Further, some specimens were received from the Fisheries Survey, viz.

31° 3′ S.	15°51′ E.	200 fathoms.	4 specimens.
34°37′ S.	18°29′ E.	139 —	2 —

As pointed out by Koehler (Op. cit. 1922) it is evident that the specimens from Lüderitzbay mentioned by Döderlein (Asteroidea, Ophiuroidea, Echinoidea, in L. Schultze. Zool. u. anthropol. Ergebn. Forschungsreise im westl. u. zentr. Südafrica. Jena'er Denkschriften. XVI. 1910, p. 254. Pl. V. 4—5) as *Ophiothrix aristulata* are not that species. Koehler thinks it to be *Ophiothrix fragilis* var. *pentaphyllum*. Professor Döderlein having kindly sent me one of his specimens I must join Koehler in the opinion that it is only a variety of *O. fragilis*. Whether really the var. *pentaphyllum* I would not like to say definitely, the varieties of *O. fragilis* being not too clearly distinguishable.

The specimens from off Simonstown mentioned by Hertz (Op. cit.) under the name of *Ophiothrix aristulata* are — as might be expected — not that species, but *O. triglochis*. I can state this definitely, Prof. Döderlein having kindly sent me one of these specimens for re-examination.

In the work quoted Koehler throws doubt on the validity of the

variety *investigatoris* of *O. aristulata*, which he described in his report on the "Investigator" Ophiuroids (p. 67, Pl. XI. 86—87). I can only join him herein. Another thing is that perhaps not all that has been recorded as *Ophiothrix aristulata* from various parts of the Indo-Pacific is really that species. But this does not concern us here, as there can be no doubt of the S. African specimens being the true *O. aristulata*, the type locality of the species being off the Cape Peninsula.

Ophiothrix triglochis Müller & Troschel.

Ophiothrix triglochis Müller & Troschel. 1842. Syst. d. Asteriden. p. 114.
— — Lütken. 1869. Add. Hist. Oph. III. p. 59.
— — Koehler. 1904. Oph. nouv. ou peu connues. Mém. Soc. Zool. Fr. 1904. p. 81.
— — Bell. 1905. Echinod. S. Africa. III. Oph. p. 259.
— — Clark. 1923. Ech. Fauna S. Africa, p. 337.

Off Durban, 35—120 fathoms. Several specimens.
Agulhas Bank, 4 miles S. of Cape Barracouta, 35 fathoms. Several specimens.
Agulhas Bank, 10 miles W. of Cape Barracouta, 40 fathoms. Several specimens.
False Bay, 8—30 fathoms. Several specimens.
Cape of Good Hope, under stones, at low tide. 2 specimens.

Though very closely allied to *Ophiothrix fragilis*, I think it correct to maintain it as a separate form — species or variety —. It is evident that, on the whole, in spite of a good deal of variability it has quite a distinct stamp of its own, so that one is generally not in doubt about the identification.

Young specimens are sometimes found clinging to the arms of the adult; as in *O. fragilis* this is not a case of protection of the brood, it being quite per chance that the young ones after their metamorphosis from the pelagic larva happen to settle down on adult specimens in places where these latter occur in good numbers. There is thus exceedingly little probability that the adult specimens are the parents of the young ones clinging to them.

The specimens from off Durban are, on the whole, much smaller than those from Agulhas Bank and False Bay, only two-three specimens out of more than a hundred being of about the same size as the full-sized ones from the more southern localities. This would seem to indicate that the species up here in the warmer regions off Natal does not in general reach the same size as in the colder waters farther South. Also it appears that it becomes sexually mature at a smaller

size — ca. 3 mm diameter of disk — in the warmer regions than it does farther South. But my evidence for this is not sufficient, the specimens from off Durban being taken in August, those from Agulhas Bank and False Bay in December. But the facts available do point towards this conclusion.

That the specimens from off Simonstown and Simons Bay mentioned by Hertz (Oph. d. Deutsch. Südpolar-Exped., p. 35) as *Ophiothrix aristulata* are in reality *O. triglochis*, was pointed out above, under *O. aristulata*.

Clark (Op. cit. p. 338) suggests that the specimens from False Bay identified by Bell as *Ophiothrix roseo-coerulans* are "better referred to *triglochis*"; evidently he has, however, not seen Bell's specimens. Dr. C. C. A. Monro having sent me one of Bell's specimens for examination I can state that it corresponds exactly to the form of *triglochis* mentioned by Clark (loc. cit.) as having long spinelets on the disk, so numerous as to replace most of the stumps, the radial shields remaining bare. This form of *O. triglochis* appears to be relatively rare, but is connected with the typical form, the disk of which is covered by short stumps only, by transitional forms so that it would appear it cannot claim the rank of a separate species. Perhaps it might deserve ranking as a separate variety of *triglochis;* I have, however, not material enough of this form, so I prefer not to take any definite position as to this question. That this spinous form is not identical with *O. fragilis* I quite agree with Clark.

Ophiothrix fragilis (Abildg.).

H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 337.

I did not myself collect this species, but in the material from the S. African Fisheries Survey there are some specimens — in very poor state of preservation — from Dassen Island (on kelp), and some other localities which cannot now be made out with certainty.

Ophiogymna fulgens (Koehler).

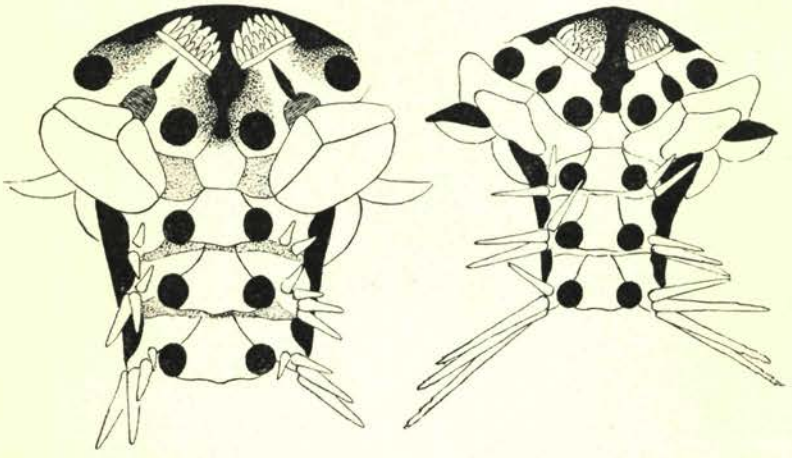
Pl. XIX. Fig. 25.

Ophiothrix fulgens Koehler. 1905. "Siboga" Oph. II. p. 107. Pl. X. 3—6.
Ophiogymna — — 1922. Ophiuroidea. "Albatross" Philippine Exped. Bull. U. S. Nat. Mus. 100. p. 288. Pl. 42. 1—8; 43. 9—10; 44. 8; 60. 6; 103. 8.

Ophiogymna fulgens Koehler. 1930. Oph. d'Australie & de l'Archipel Malais. p. 189.

Off Durban, 68 fathoms. 1 specimen, dredged onboard the "Pickle", 29. VIII. 1929.

This specimen, which is a rather large one, 12 mm diameter of disk, corresponds very well with the descriptions and figures of *O. fulgens* given by Koehler, the only noteworthy difference being that



a. b.

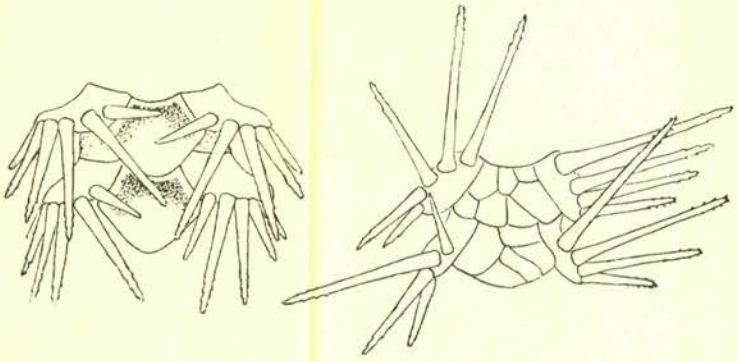
Fig. 52. Part of oral side of *Ophiogymna fulgens* (Koehler) (a) and of *Ophiogymna capensis* (Lütken) (b). × 10.

the opening in the jaw is much narrower than usual (Fig. 52. a.). It is wholly white, but also Koehler records such purely white specimens, the coloration being, on the whole, rather variable, as are also the other characters of the species. The dorsal armplates of the present specimen are undivided (Fig. 53. a.), only quite exceptionally one or other plate may be found which is slightly divided. They are somewhat excavated in the basal part.

It is, of course, possible that the species *fulgens* is taken in a too wide sense, and that the white specimens do not really belong to it, in which case the S. African form would also have to be removed from the species *fulgens*. This question, however, can only be decided through the study of a much richer material. It would particularly be important to see whether the S. African specimens are all white

or they show the same colour variations as the *O. fulgens* of the Malay Archipelago; likewise it would be important to see whether the opening in the jaw is always such a narrow slit as in the present specimen; if so, that would evidently be an important character speaking against the identity of the S. African and the Indo-Malayan form. For the present, however, with only a single specimen available, I must regard it as identical with the Indo-Malayan *O. fulgens*.

The specimen carried a *Myzostoma* at one of its genital slits —



a. b.

Fig. 53. Two armjoints, dorsal side, of *Ophiogymna fulgens* (Koehler) (a) and of *Ophiogymna capensis* (Lütken) (b). × 10.

a very interesting fact, since this is the first case recorded of an Ophiothrichid infested with *Myzostoma*.

Ophiogymna fulgens has hitherto been recorded only from the Indo-Malay region; its occurrence off Durban indicates it to be distributed also over the Indian Ocean.

Ophiogymna capensis (Ltk.).

Pl. XIX. Fig. 26.

Ophiothrix capensis Lütken. 1869. Add. hist. Oph. III. p. 59, 100.
— — H. L. Clark. 1923. Echinod. Fauna S. Afr. p. 340.

No new material of this species has come to hand. The following remarks are based on Lütken's two original specimens, which were bought from Salmin, labelled Cap, without more detailed information of locality and depth at which they were taken. — It is perfectly evident that this species is not an *Ophiothrix*, but an *Ophiogymna*, as

might already be concluded from the description given by Lütken, the covering of the dorsal and ventral arm plates by a thick skin, and the absence of a tentacle scale being features characteristic of the genus *Ophiogymna*, not of *Ophiothrix*.

Lütken's statement of the buccal shields being coalesced with the adoral plates and the genital scales is due to the skin covering making the outlines of these plates indistinct; on removing the skin by means of cautiously applying hypochlorite of sodium one sees the outlines of the plates distinctly, as well as those of the ventral plates, as shown in fig. 52. b. The dorsal arm plates are broken up into several small, irregular fragments (Fig. 53. b.). There are no stumps on them.

The coloration of these two specimens is very characteristic: a conspicuous, dark (apparently originally black, now brownish) line beginning in the midline between the radial shields and continuing along the midline of the 4—6 proximal arm joints, ending there abruptly. Then a dark transverse band on the dorsal side of every 3rd—6th arm joint continuing out on the spines. The band may be complete or limited to the sides. The skin of the dorsal side of the arms otherwise finely dotted; one of the specimens has also the skin of the ventral side of the arms dotted, only much more finely than the dorsal side.

I would think it quite possible that *Ophiogymna pulchella* (Koehler) is in reality identical with *O. capensis*. The dark, dorsal midline of that species may be confined to a few of the proximal joints as in *capensis* — or it may be continuous along the dorsal side of the arm, or again it may be confined to the disk, from the centre to midway between the radial shields; the latter case is found in one of the two specimens from the Amboina Bay mentioned by Koehler in his report on the Ophiuroids of Australia and the Malay Archipelago (1930, p. 190). In this specimen the skin of the arms is conspicuously dotted and banded, somewhat more strongly than in *capensis*. In the other specimen, the one with the continuous, dark, dorsal midline, the dots are only slightly developed, and there are no transverse bands. Any distinct, reliable characters by which the species *capensis* and *pulchella* may be distinguished I do not see. If ultimately found to be identical, the species — which must then keep the name *capensis* — will no doubt be found distributed also over the Indian Ocean.

Ophiothela Danæ Verrill.

Ophiothela Danæ Verrill. 1869. New and imperfectly known Echinoderms and Corals. Proc. Boston Soc. Nat. Hist. XII. p. 391.
— — Döderlein. 1896. Bericht über die von Prof. Semon bei Amboina u. Thursday Isl. ges. Ophiuroidea. Semon's Forschungsreisen, Bd. V. Jena Denkschr. VIII. p. 297. Taf. XVII. 25. a—b.
— — — 1898. Über einige epizoisch lebende Ophiuroidea. Ibid. p. 486. Taf. XXXVII. 3—3. c.
— — Matsumoto. 1917. Monogr. Japan. Oph. p. 230.
— — Koehler. 1922. Oph. Philippine Seas. Bull. U. S. Nat. Mus. 100. 5. p. 297. Pl. 59. 1—3; 103. 1.

Off Durban, 29°47′ S. 31°12′ E. 35 fathoms. 22. VIII. 1929. Several specimens.
Off Durban, 29°48′ S. 31°18′ E. 120 fathoms. 22. VIII. 1929. Several specimens.
Dredged onboard the „Pickle".

I do not see any possibility of distinguishing these specimens from the common, over the whole Indo-Pacific distributed *Ophiothela Danæ*. None of them show the dark-blue lines on disk and arms so characteristic of *Ophiothela dividua* v. Martens.

Thanks to the kindness of Professor W. Arndt of the Berlin Zoological Museum I have had the opportunity of seeing the type specimens of the latter species. In view of the very great variability of *O. Danæ* I think it very difficult to point out any character by which *O. dividua* can be distinguished from it with certainty, beyond the coloration. But that does seem to afford a good distinguishing character — at least I have never seen any similarly coloured specimen among the very numerous specimens of *Ophiothela* which I have collected in various parts of the Indo-Pacific.

Ophiothela Danæ was not hitherto known from off the African East Coast. Probably its southern limit is here off the Natal Coast.

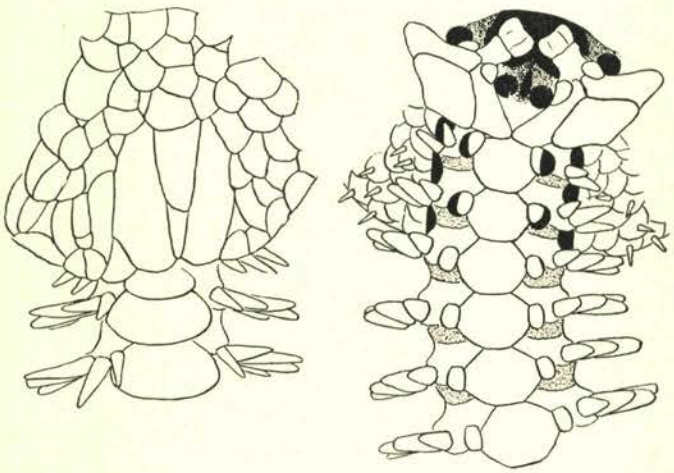
Family ***Ophiactidæ.***

Ophiactis carnea Ljungmann.

Ophiactis carnea Ljungman. 1867. Oph. viv. huc usque cogn. p. 324.
— — H. L. Clark. 1918. Brittle-Stars, new and old. Bull. Mus. C. Zool. LXII. p. 309.
— — — 1923. Echinod. Fauna S. Africa; p. 332. Pl. XX. 3—4.
— *africana, capensis* Hertz. 1926. Oph. Deutsch. Südpolar-Exp p. 29.

Off Durban; 35 fathoms. Several specimens. 22. VIII. 1929.
Off Durban; 120 fathoms. 1 specimen. 22. VIII. 1929.
4 miles S. of Cape Barracouta, 35 fathoms. 15 specimens. 13. XII. 1929.
Gordon Bay (False Bay), 8—9 fathoms. Several specimens. 19. XII. 1929.
False Bay, 15—17 fathoms. Several specimens. 19. XII. 1929.
Dredged onboard the „Pickle" (except those from off Cape Barracouta).

The species varies a good deal in colour. Whereas Clark states to have had only one specimen of olive-green colour, I find that most of the specimens from False Bay and Gordon Bay are of an olive-green



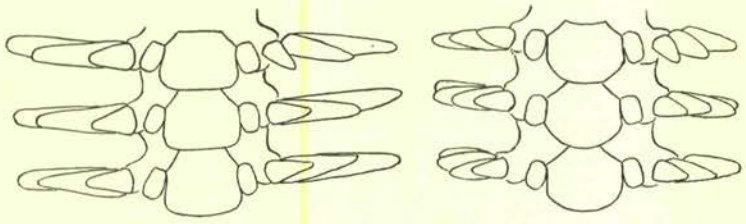
a. b.

Fig. 54. *Ophiactis carnea* Ljungman. Part of dorsal (a) and oral side (b). × 20.

ground colour, more or less variegated, the arms usually with darker bands. The specimens from off Durban are, on the whole, of a more reddish hue so that the name "carnea" fits quite well to them.

Such reddish specimens also occur among the specimens from False Bay and Gordon Bay, but they are much rarer than the olive-green specimens. The more light coloured specimens do not in any other way differ from the dark coloured ones, so that, although they look rather different, it is impossible to distinguish them by any other characters, and there can be no doubt that they are all one and the same species. The variations that may be found in the shape of the dorsal and ventral plates (Figs. 55—56) do not correspond with the colour-variations.

It is a marked feature of this species that, as a rule, the infradental papilla is not at all developed. Sometimes a small irregular papilla or scale is found in its place, but it is not easy to say whether it is a

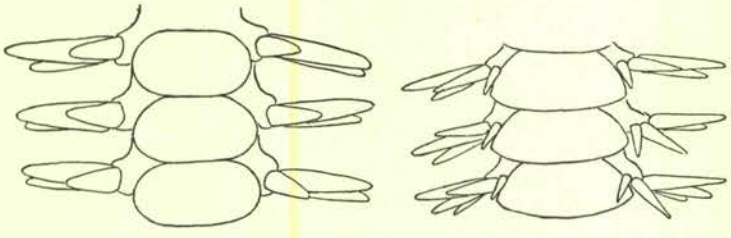


a. b.

Fig. 55. *Ophiactis carnea* Ljungman. Armjoints, ventral side, of specimens from False Bay (a) and from off Durban (b). × 20.

deform mouth papilla or a deform tooth. The upper tooth is generally large and well developed, often by radiating striæ divided into three parts (cf. fig. 54. b.).

In the report on the Ophiuroids of the German S. Polar Expedition Dr. Hertz (Op. cit. p. 29) records an *Ophiactis* from Simonstown, which she designates as a subspecies, *capensis*, of *Ophiactis africana* Koehler, a species hitherto known only from the West Coast of Africa, from Senegal to Angola. No figures are given of this subspecies *capensis*, and from the short descriptive note one can hardly gather anything



a. b.

Fig. 56. *Ophiactis carnea* Ljungman. Armjoints, dorsal side, of specimen from False Bay (a) and from off Durban (b). × 20.

else but that it is characteristic by one of the buccal plates being considerably larger than the others. Evidently Dr. Hertz has not understood that this larger buccal plate is the madreporite. Also in *Ophiactis*

carnea the madreporite is distinctly larger than the other buccal plates — and there can scarcely be any doubt that this "subspecies *capensis*" is nothing but *Ophiactis carnea*, the common species of False Bay, and the only *Ophiactis*-species known to occur there.

On the other hand, Dr. Hertz is quite right in finding these specimens to resemble closely Koehler's *Ophiactis africana*, the two speces *O. carnea* and *O. africana* being decidedly very nearly related. H. L. Clark in his revision of the genus *Ophiactis* (Op. cit. 1918) gives (in the key, p. 300) as difference between them that the disk-scaling is fine, 11—15 series in each interbrachial area, in *O. carnea*, coarser, 6—9 series in each interbrachial area, in *O. africana*. I rather think Clark has here accidentally interchanged the two names. At least I find *O. africana* to have, on the whole, much finer and more uniform, rounded scales than *O. carnea*. Also the radial shields are smaller in *O. africana*.

Ophiactis plana Lyman.

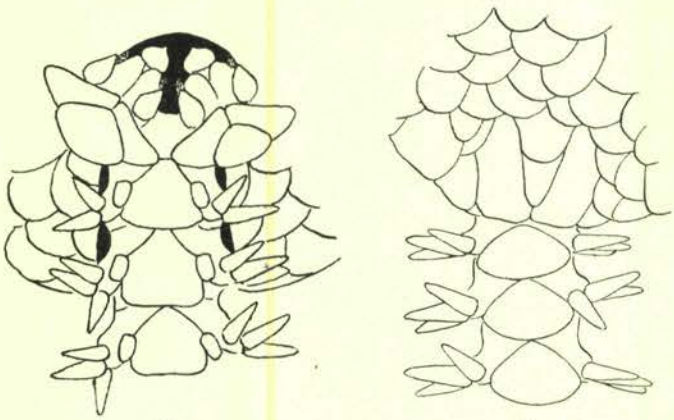
Ophiactis plana Lyman. 1869. Prelim. Rep. on the Oph. and Astroph. dredged in deep water between Cuba and the Florida Reef. Bull. Mus. C. Zool. I. 10. p. 330.
— — H. L. Clark. 1915. Cat. Rec. Oph. p. 264. Pl. 10. 1—2.
— — — 1918. Brittle-Stars, old and new. Bull. Mus. C. Zool. LXII. p. 301.
— — — 1923. Echinod. Fauna S. Africa, p. 333.

Several specimens dredged onboard the "Pickle", viz.

Off Durban,	29°56′ S.	31°19′ E.	225 fathoms.	26. VIII. 1929.	1	specimen.
—	29°54′ S.	31°22′ E.	39 —	—	1	—
—	30° 2′ S.	31° 2′ E.	90 —	27. VIII. 1929.	2	—
—	29°54′ S.	31°10′ E.	68 —	29. VIII. 1929.	1	—
—	34° 5′ S.	18° 2′ E.	118 —	23. XII. 1929.	6	—

The identification of these specimens with the West Indian *Ophiactis plana* Lyman rests on the authority of H. L. Clark, who has had the opportunity of comparing the S. African specimens with the type of Lyman's species. Of this latter Clark gave in his Catalogue of the Recent Ophiurans a couple of photographic figures, in which, unfortunately, not all the necessary details are to be made out. I do, however, not doubt that he was right in this identification, and I am also inclined to think he is right in regarding *Ophiactis profundi* Ltk. & Mrtsn. as identical with *O. plana*, whereas, on the other hand,

I must decidedly object to his regarding the 5-armed, not self-dividing *O. flexuosa* Lym. as identical with the 6-armed, self-dividing *O. plana*. Whether the *Ophiactis parva*, which I described in my report on the Suez-Canal Echinoderms (Trans. Zool. Soc. 1926. p. 123) is identical with *O. plana*, (a possibility already hinted at there) I do not venture to say; much more material is needed for deciding the question. I would only point out that the difference in the shape of the buccal shields seen on a comparison of the figure of *O. parva* (Op. cit.) with



a. b.

Fig. 57. *Ophiactis plana* Lyman. Part of oral (a) and dorsal side (b). × 22.

that given here of *O. plana* (Fig. 57) is not a reliable character, as particularly the shape of the buccal shields is subject to great variation in species which propagate by autotomy. On the whole, it does seem that *O. plana* is a cosmopolitan species, like *Ophiactis Savignyi*.

Ophiactis nidarosiensis Mrtsn.

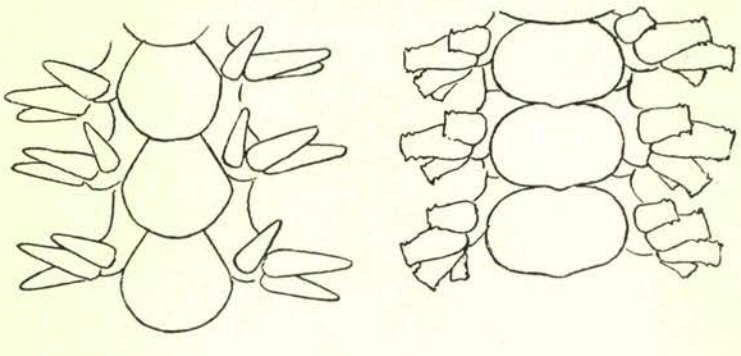
Ophiactis nidarosiensis Th. Mortensen. 1920. Notes on some Scandinavian Echinoderms, with descriptions of two new Ophiurids. Vid. Medd. Dansk Naturh. Forening. Bd. 72. p. 60.

— — — 1927. Handbook Ech. Brit. Isles, p. 200.

In the material received from Fisheries Survey there are two specimens of this species, unfortunately without locality. But it would then seem beyond doubt that this North Atlantic species occurs also

n S. African Seas; it would then also seem beyond doubt that it must ɔe distributed all over the Eastern Atlantic.

From the two other 6-armed, self-dividing *Ophiactis*-species found



a. b.

Fig. 58. Armjoints, dorsal side, of *Ophiactis nidarosiensis* Mrtsn. (a) and *Ophiactis Savignyi* (Müll. & Troschel) (b). × 30.

in S. African Seas, *O. plana* and *O. Savignyi*, it is distinguished at a glance by the quite different shape of the dorsal arm plates (cf. figs. 57—58).

Ophiactis abyssicola (M. Sars).

Amphiura abyssicola M. Sars. 1861. Norges Echinod. p. 18. Pl. II. 7—12.
Ophiactis — Ljungman. 1867. Oph. viv. huc usque cogn. p. 324.
— *poa* Lyman. 1882. Challenger Oph. p. 119. Pl. XX. 13—15.
— *corallicola* Koehler. 1896. Echinod. du "Caudan". p. 75. Pl. III. 30.
— *abyssicola* H. L. Clark. 1918. Brittle-Stars, old and new. Bull. Mus. C. Zool. LXII. p. 304.
— — — 1923. Echinod. Fauna S. Afr. p. 334.
— — Th. Mortensen. 1927. Handbook Ech. Brit. Isles, p. 202.

I did not collect this species myself, but there are some fine specimens in the material from the Fisheries Survey. Unfortunately the locality cannot be made out, but it is certain that they are from S. Africa.

Whereas I quite agree with Clark in regarding Lyman's *Ophiactis poa*, from off Tristan d'Acunha, as identical with *O. abyssicola*, I do not think it justifiable to regard also *O. cuspidata* Lyman, from off the Kermadec Islands as the same species. Till now *O. abyssicola* is otherwise unknown from the Indo-Pacific.

Ophiactis Savignyi (Müll. & Troschel).

Ophiolepis Savignyi Müller & Troschel. 1842. System d. Asteriden, p. 95.
Ophiactis — Ljungman. 1867. Oph. viventia huc usque cogn. p. 323
— *Reinhardtii* Lütken. 1859. Add. hist. Oph. II. p. 161. Tab. III. 7 a—b.
— *Savignyi* H. L. Clark. 1918. Brittle-Stars, new and old. Bull. Mus. C Zool. LXII. p. 305.

Specimens of this species, which was not hitherto known from S. Africa were sent me from the Durban Museum. They were collected by Mr. D. R. Boyc at Park Rennie, Natal. I also dredged one specimen off Durban (29°47′ S. 31°12′ E. 35 fathoms), onboard the "Pickle" (22. VIII. 1929).

It may be mentioned also that I found the species at Inhaca, Delagoa Bay, from where it had not been recorded either till now.

From the two other 6-armed, self-dividing *Ophiactis*-species occurring in S. African seas *O. Savignyi* is easily distinguished, from *O. planc* by having spines on the disk, from *O. nidarosiensis* by its broad dorsa arm plates, with a more or less conspicuous median lobe (Fig. 58. b.).

Family ***Amphiuridæ.***

Amphiura capensis Ljungman.

Amphiura capensis Ljungman. 1867. Oph. viv. huc usque cogn. p. 320.
— — Lyman. 1882. Challenger Oph. p. 129. Pl. XVIII. 14—16
— — Koehler. 1908. Ast., Oph., Ech. Scottish Nat. Antarct. Exp. p. 298.
— — Döderlein. 1910. Ast., Oph., Ech. L. Schultze. Forschungsreise Südafrika. p. 253. Taf. V. 2—2. b.
— — Koehler. 1914. Echinod. Meeresfauna W. Afrikas. p. 190. (pro parte; the specimens from Lüderitzbay only).
— — Diakonov. 1914. Über Viviparität u. Wachstumserscheinungen by *Amphiura capensis* Ljungman. Zool. Jahrb. Syst. Bd. 36. p. 291. Taf. 8.
— — Mortensen. 1920. On Hermaphroditism in viviparous Ophiurids. Acta Zool. I. p. 12.
— — Clark. 1923. Echinod. Fauna S. Africa. p. 327.

Several specimens were collected by the author on the shores of Cape Peninsula; particularly at Sea Point, (29. XI. 1929 and 20. XI. 1930) but also at the Cape of Good Hope (5. I. 1930).

They are found under stones, often so close together that one can take some 4—5 specimens at a time with the hand. They do not go

eep down in the ground, lying almost directly under the stones, much s is the case with *Amphipholis squamata*. When touched they coil p their arms so as to cover the disk entirely — one cannot help hinking of somebody covering his head with his arms. They vary ery much in colour; some are very dark, with nearly black arms, thers are lighter coloured, with the arms yellowish with dark spots rranged in indistinct bands, others again have the arms a uniform ght yellowish. Specimens preserved in alcohol usually have lost all olour, but some specimens still show traces of the original colour, s a faint violet tinge along the ventral side of the arms and in the istal part of the arms; sometimes there are traces of bands on the rms. Not rarely the spines have remained darker coloured.

One of the specimens had a whole Gastropod shell in its stomach. his does not mean to say that this Amphiurid feeds on Gastropods; robably it eats anything eatable that is not too big to be swallowed. ut this is for direct observations on living specimens.

The discovery that this species is viviparous is due to Diakonov (Op. cit.); that it is also a hermaphrodite I made known in my paper of 1920 "On Hermaphroditism in viviparous Ophiurids". Diakonov expresses the opinion that the young ones normally leave the mother through a rupture in the disk, not normally through the bursal slits. As stated in my paper quoted, I think that the ruptures observed by Diakonov are accidental, and that the young ones normally get out through the genital slits, as in other viviparous Ophiurids. Fedotov, in his paper "Über eigenartigen Parasitismus bei Stachelhäutern" (Zeitschr. f. Morph. u. Ökologie d. Tiere. Bd. 22. 1931, p. 414) referring to the observations of Diakonov, states as an established fact that the young ones of this species leave the mother specimen through a rupture of the disk, overlooking the reservation taken by Diakonov, as well as the view expressed by me, that the ruptures observed by Diakonov are accidental. The rather numerous specimens in hand serve to strengthen my view; there are some of them with ruptures of the skin, but it is perfectly evident that these ruptures are accidental, without any relation to the young ones, being found in various places, now at the adoral edge of the ventral interradius, now on the dorsal side, now at the edge or close to one of the bursal slits — and not at all on the interradii with the largest young ones, ready to be born. Likewise I have found no specimens with scars that could be due to

ruptures caused by the young ones having made a rupture in the skin for getting out that way. On the other hand, I find only one specimen with a young one with one of its arms protruding through the bursal slit. Also in some cases the young ones are so large and have widened the skin of the mother to such a degree that it seems rather difficult to understand, how they could get out through the bursal slit. — The whole question can only be settled through direct observations on living specimens; it may be hoped that some S. African biologist will take up the matter. With the very easy access to living material it should be easy enough to make the necessary investigations.

The species is known to occur along the S. African coasts from Port Natal to Lüderitzbay. It is also recorded by Koehler (Op. cit. 1908) from Ascension and (Op. cit. 1914) from Angola and Senegal. Through the kindness of Dr. A. Panning of the Hamburg Museum I have been able to reexamine the specimens from Angola and Senegal identified by Koehler as *Amphiura capensis*. Those from Senegal are *Ophiactis africana*, differing from the typical *O. africana* only in having no spines on the disk; possibly they may prove to be a separate variety of that species, but I rather think them to be individual variations. That Koehler could mistake them for *Amphiura capensis* is due to the fact that there is really a considerable, superficial resemblance between these two forms; but a glance at the mouth structure shows that they have nothing with one another to do. His specimens from Lüderitzbay are *Amph. capensis*, sure enough, but the one from Angola which I have seen is an *Amphipholis*.

The specimen from Ascension referred by Koehler to *Amph. capensis* I have likewise had the opportunity of reexamining, Dr. A. C. Stephen of the R. Scottish Museum, Edinburgh, having kindly lent it to me for reexamination. There is no doubt that the identification is correct — it is really *Amph. capensis* (the specimen also contains a young one in one of its interradii). This isolated occurrence (the species does not occur at St. Helena — at least I have not been able to find it there during my researches there in February-March 1930) of the species at Ascension is so remarkable that I cannot help suggesting, it must be due to some casual interchange of labels. Until the species is found anew at Ascension I must remain sceptical as to the occurrence of this eminently South African species in that isolated tropical locality.

Amphiura incana Lyman.

Amphiura incana Lyman. 1882. "Challenger" Oph. p. 128. Pl. XXXIII. 5—7.
— — Clark. 1923. Ech. Fauna S. Africa, p. 328.
— — Hertz. 1926. Oph. Deutsche Südpolar-Exp. p. 34. Taf. VII. 1.
Non: *Amphiura incana* Bell. 1905. Ophiuroidea. Marine Invest. S. Africa. III. p. 258. (= *Amphioplus furcatus* n. sp. cf. below p. 370).

False Bay, 8—30 fathoms. 15 specimens. XII. 1929.
Off Durban 30°4′ S. 31°00′ E. 50 fathoms. 27. VIII. 1929. 6 specimens.
Dredged onboard the "Pickle".

On comparing the figure given by Hertz (Op. cit.) with the corresponding figure in the "Challenger" Oph., one cannot but wonder that the same species could vary to such extent in regard to the shape of the mouth shields. Nevertheless it does so. The figures here given (Fig. 60. c.) show some various forms, giving the transition from the narrow, angular form in Lyman's figure to the nearly circular form in Hertz's figure. It would seem that the rounded shape, as in the lowermost of these figures, is the more common. Very often there is a central depression in the mouth shields, but this is no constant feature. That the specimens from off Durban are really *incana* cannot be doubted. Thus it might also be possible that Bell's specimens from off the Tugela river were correctly identified. This is, however, not the case; they are the species described below as *Amphioplus furcatus*, as I must state after having had Bell's specimens for examination.

Amphiura atlantica, var. *dilatata* Lyman.

Amphiura dilatata Lyman. 1882. "Challenger" Oph. p. 135. Pl. XXIX. 4—6.
— — Clark. 1923. Echinod. Fauna S. Africa. p. 326.

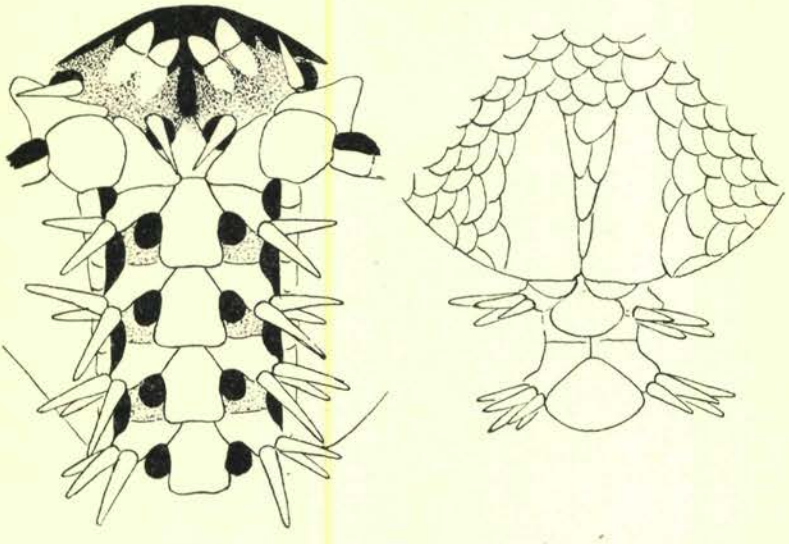
Several specimens dredged onboard the "Pickle", viz.

34°24′ S.	18°16′ E.	133 fathoms.	18. XII. 1929.	1 specimen.
34° 5′ S.	18° 2′ E.	118 —	23. XII. 1929.	5 —
34° 5′ S.	17°52′ E.	146 —	—	3 —

Some of the younger specimens have only 3 arm spines, the species having typically 5 arm spines. Also the radial shields are contiguous in the distal part, whereas they are wholly separated in the typical form. These differences, however, apparently are due only to age, and I do not think, there can be any doubt but that these specimens really belong to *A. dilatata*, the more so as they come from the type locality, off Cape Peninsula.

In a specimen at hand, identified by H. L. Clark, there are distinct traces of a single, small tentacle scale in the greater part of the arm.

Dr. Hertz (Oph. d. deutschen Südpolar Exp. p. 32) in describing an antarctic variety *gaussi* of *A. dilatata*, comments on the fact that Lyman's figure of the oral side of *A. dilatata* does not show the tentacle scale of the inner tentacle pore, and remarks that if that



a. b.

Fig. 59. *Amphiura atlantica*, var. *dilatata* Lyman. Part of oral (a) and dorsal side (b). × 25.

scale be really absent in *dilatata* the antarctic form must be regarded as a separate species. It is then of importance to state that this inner tentacle scale is even unusually well developed in *dilatata*, Lyman's figure being deficient in this respect. The corresponding figure in the preliminary report of the "Challenger" Oph. Pl. XI. 14 (Bull. Mus. Comp. Zool. VI. 1879) also shows this papilla.

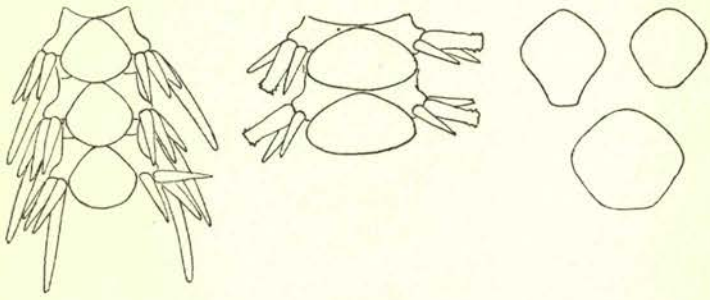
H. L. Clark (Op. cit.) suggests that *Amph. dilatata* may be identical with *Amph. atlantica* Ljungman, known from St. Helena. Koehler (Revision de quelques Ophiures de Ljungman. Arkiv. f. Zoologi. Bd. 19. a. 1926, p. 4) in redescribing the type-specimen of *A. atlantica*, thinks that the two species are not identical. Having now a fairly rich material of *Amph. atlantica* from St. Helena at disposal I must

join the opinion of Clark. It was pointed out by Koehler as an important character of *A. atlantica* that the second spine from below is somewhat axe-shaped widened, much as in *Amph. filiformis*. The same character I find, however, also in *dilatata* (Fig. 60. b.). On comparing the figures of *dilatata* given here (Fig. 59) with those of *A. atlantica* given in my report on the St. Helena Echinoderms it will be seen that the resemblance is almost complete. At most, I can regard *dilatata* as a variety of *atlantica*, mainly on account of its outer mouth papillæ being somewhat more slender than those of the typical *atlantica*.

Amphiura grandisquama, var. *natalensis* n. var.

Off Durban 29°56′ S. 31°19′ E., 225 fathoms. 4 specimens, dredged onboard the "Pickle", 26. VIII. 1929.

These specimens, which are all small and rather poorly preserved, are indistinguishable from the atlantic specimens of *Amphiura gran-*



a. b. c.

Fig. 60. a. Armjoints, dorsal side, of *Amphiura grandisquama*, var. *natalensis* n. var.; b. same of *Amphiura atlantica*, var. *dilatata* Lyman. c. Buccal shields of *Amphiura incana* Lyman; the differences in size due to the differences in size of the specimens from which these buccal shields were drawn. × 20.

disquama Lyman, except by the character of the dorsal arm plates, which are narrower and more rounded than those of the typical *A. grandisquama* (Fig. 60. a.; figures of the typical *A. grandisquama* are given in my report of the St. Helena Echinoderms). We may then for the present, at least, keep these specimens from off the Natal coast as a separate variety.

As Koehler (Oph. Albatross Philippine Exped. 1922. p. 159) has recorded *A. grandisquama* from the Philippine Seas, there is nothing

surprising in finding it also in the S. African Seas — it must rather be expected to occur all over the Indian Ocean. That it has not been found off the Cape and the Agulhas Bank, where now quite a good deal of investigations have been made, might indicate that the distribution of *A. grandisquama* from the West Indies to the Philippine Seas is not now continuous.

Amphiura angularis Lyman.

Amphiura angularis Lyman. 1882. "Challenger" Oph. p. 134. Pl. XXIX. 1—3.
— — Koehler. 1917. Echinodermes de Kerguelen. Ann. Inst. Océanogr. VII. Fasc. VIII. p. 67. Pl. VIII. 13—15.
— — Clark. 1923. Echinod. Fauna S. Africa. p. 327.

Cape Point in S. 22. W. 2 miles. 30 fathoms. 20. XII. 1929. 1 specimen.
Cape Point in S. 2 miles. 30 fathoms. 19. XII. 1929. 1 specimen.
These specimens dredged onboard the "Pickle".

These two small specimens are perfectly conform with the figures and the description given by Koehler (Op. cit.). The species was not hitherto known from so small a depth, only from 150—190 fathoms. But there is no record of the depth from which the specimens dredged by Rallier du Baty (Koehler. Op. cit.) came.

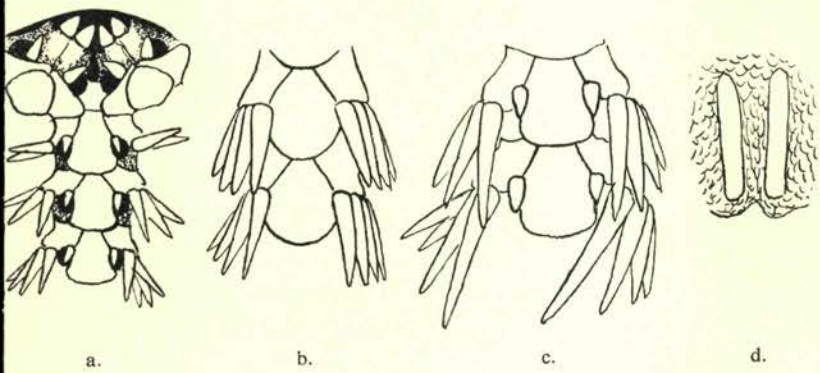
That the specimens from the West Indies ("Blake") and from the Atlantic, (the Josephine Bank, "Princesse Alice") recorded as *A. angularis* are not really that species, was pointed out by Koehler (Op. cit.). *A. angularis* is till now known with certainty only from Kerguelen and S. Africa. A variety or subspecies, *protecta*, from the Antarctic was described by M. Hertz in her report on the Ophiuroids of the German South Polar Expedition (p. 32).

Amphiura linearis n. sp.

Off Durban, 30°2′ S. 31°3′ E. 90 fathoms. 1 specimen.
Off Durban, 30°4′ S. 31°0′ E. 50 fathoms. 1 specimen.
These specimens dredged onboard the "Pickle".

Both these specimens, dredged onboard the "Pickle" 27. VIII. 1929, are in very poor condition; one is ca. 2 mm in diameter of disk, arms ca. 10 mm; the other ca. 3.5 mm diameter of disk, arms broken. The infradental papillæ are rather thick; on account of the jaws being very low, sunken, these papillæ form a conspicuous circle of small beads round the mouth-opening. Outer mouth papilla rather broad, but

pointed. Buccal plates rounded triangular, about equally broad and long; they are not very distinct in the larger specimen, but apparently of the same shape as in the small specimen (Fig. 61. a.). Ventral arm plates somewhat elongate, rather broadly contiguous; dorsal arm plates distinctly longer than broad, with outer edge convex; they are narrowly in contact. Arm spines 5 in the smaller, 6 in the larger specimen, flattened and appressed in the larger, not in the smaller specimen; the lowermost one is somewhat longer than the others. 1 leaf-shaped



a. b. c. d.

Fig. 61. *Amphiura linearis* n. sp. a. Part of oral side; b. armjoints, dorsal side; c. same, ventral side; d. radial shields. × 30.

tentacle scale of moderate size. Disk, both dorsally and ventrally, with a uniform covering of small scales. Radial shields very narrow, linear, parallel (Fig. 61. d.), a little more than $^1/_3$ the disk radius.

This species is particularly characterized by its narrow, linear radial shields, by which it is easily distinguished from all other species hitherto known.

Amphiura adjecta n. sp.

Off Durban, 29°47′ S. 31°12′ E. 35 fathoms. 5 specimens, dredged onboard the "Pickle", 22. VIII. 1929.

Diameter of disk up to 4 mm, length of arms ca. 5 times the diameter of disk. Infradental papillæ square, not particularly prominent; outer mouth papillæ short, spiniform, not pointed. Jaws low, short. Mouth shields rounded triangular, longer than wide. Ventral arm plates longer than wide, broadly contiguous, with convex outer edge. The fact that the first ventral plate is separated from the second (Fig. 62. b.),

rather unusual in *Amphiura*, does not afford any character of special value, as it is not constant, not even in all radii of the same specimen. Dorsal arm plates about as wide as long, apparently narrower because of the arm spines, which are flattened and appressed, leaving thus only a relatively narrow median belt free (Fig. 62. c.). The number of the arm spines is 6—5; the lowermost may be slightly the longest; no terminal widening, at most a very faint indication of lateral serrations

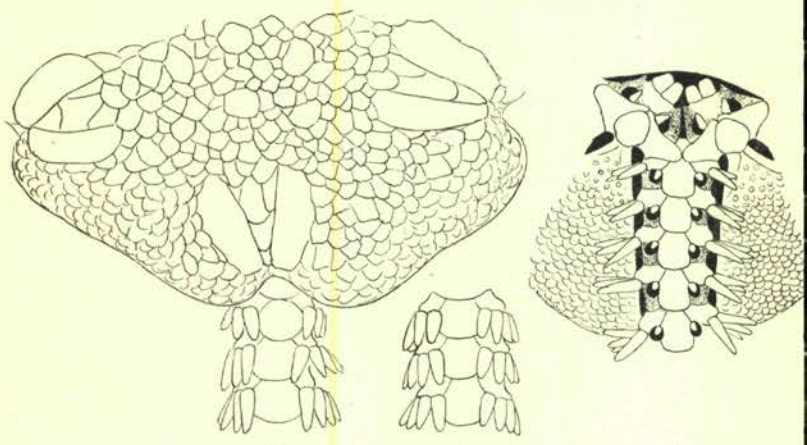


Fig. 62. *Amphiura adjecta* n. sp. Part of dorsal (a) and oral side (b). Armjoints, dorsal side, showing the appressed spines (c). × 20.

at the end. 1 rather small tentacle scale. Dorsal side of disk (Fig. 62. a.) with rather coarse scales, among which the primary plates may be quite distinct; radial shields diverging inwards, rather broad, about $^1/_3$ of the disk radius. Ventral interradii covered with smaller scales which become more or less scarce adorally. No particular colour.

Similarly appressed, flattened spines are found in *Amphiura rapida* Koehler (cf. Pl. XVI. 11 of Koehler's memoir "Ophiures recueillis par le Dr. Th. M. dans les mers d'Australie et dans l'Archipel Malais" 1930 — not mentioned in the text which states (Op. cit. p. 100) incorrectly that the spines are cylindrical). There is, however, no nearer relation between these two species, *A. rapida* having 2 tentacle-scales, an important character within the genus *Amphiura*. Also the species *Amphiura latispina* Koehler and *Amph. kinbergiensis* Koehler (Bull. U. S. Nat. Museum 84. 1914. Pl. 5. 1—2 and Pl. 4. 6) have similar

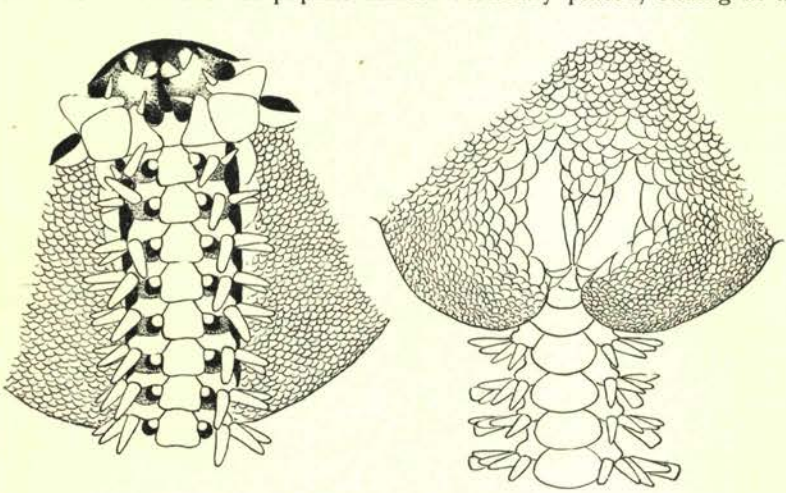
flattened, appressed spines, but they likewise differ conspicuously from the present species in having 2 tentacle scales. The relation of *A. adjecta* is rather with *Amph. angularis* Lyman and *A. algida* Koehler; but both of these differ from it in the arm spines being not flattened nor appressed; also the number of the spines is smaller, 4—3, against 6—5 in the present species. There can thus be no doubt that we have here a distinct new species of the great genus *Amphiura*.

Amphiura compressa n. sp.

Pl. XIX. Fig. 16—17.

False Bay (Cape Point in S., $2^1/_4$ miles), 30 fathoms; sandy bottom. 1 specimen, dredged onboard the "Pickle", 19. XII. 1929.

Diameter of disk 11 mm, length of arms ca. 7 times the diameter of disk. — Infradental papillæ almost vertically placed, ending in a

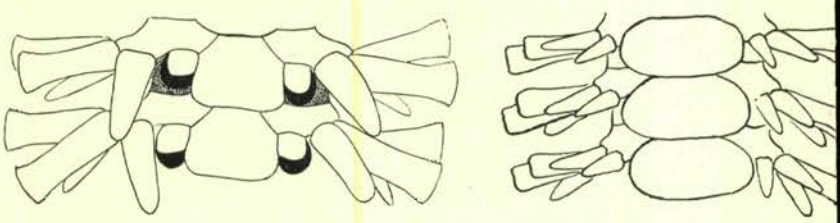


a. b.

Fig. 63. *Amphiura compressa* n. sp. Part of oral (a) and dorsal side (b). × 8.

point upwards; outer mouth papilla spiniform, rather coarse, not pointed. Buccal plates slightly longer than broad with a rounded apex and a small outer lobe. Ventral arm plates about as broad as long, broadly contiguous, with the outer edge somewhat concave (Fig. 63. a.). Dorsal arm plates transverse-elliptical, about twice as broad as long, broadly contiguous. Arm spines 6, erect, of about equal

length. From just outside the disk the second to fourth spine from below distinctly compressed and somewhat axe-shaped widened at the point, but with only very indistinct lateral serrations (Fig. 64). One tentacle-scale of moderate size. The arms on the whole rather robust. — Disk conspicuously lobed, with a deep notch above each arm and a somewhat less marked notch in each interradius. Radial shields about $^1/_3$ the disk radius, diverging broadly inwards. Disk covered, above and below, with very fine scales, among which the primary plates are scarcely distinguishable; around the radial shields the scales are somewhat coarser (Fig. 63. b.). No particular colour.



a. b.

Fig. 64. *Amphiura compressa* n. sp. Armjoints, ventral (a) and dorsal side (b); a. from proximal; b. from more distal part of arm. a. × 15, b. × 20.

The species does not bear distinct relations to any of the species of *Amphiura* hitherto known; it is particularly characterized by its compressed arm spines.

Amphiura uncinata Koehler.

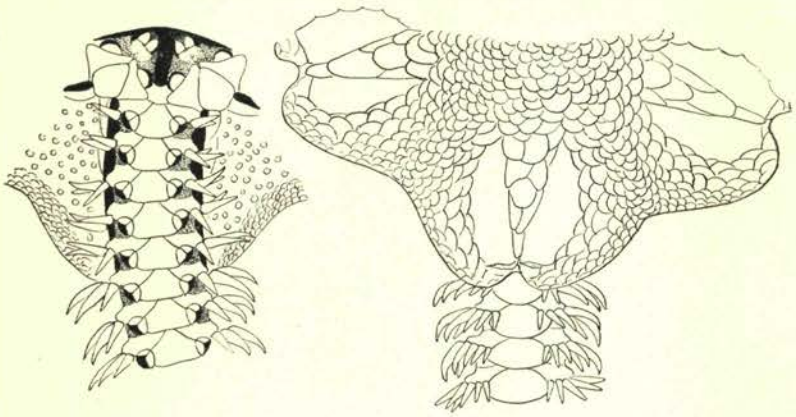
Amphiura uncinata Koehler. 1904. "Siboga" Oph. I. p. 76. Pl. XIV. 3—4.
— — — 1922. Oph. "Albatross" Philippine Exp. p. 160. Pl. 65. 6—8; 96. 4.

Off Durban, 29°56′ S. 31°19′ E. 225 fathoms. 10 specimens, dredged onboard the "Pickle", 26. VIII. 1929.

I do not see any character by which these specimens could be distinguished from the *A. uncinata* of the Malay Archipelago. This leads to the suggestion that the species will be found to occur in suitable localities all over the Indian Ocean, its southern limit being probably about here off the Natal coast.

The figures here given (Fig. 65—66) show some differences from those given by Koehler in the "Siboga" Oph., but it is evidently due

to these latter figures being somewhat diagrammatic. Thus the peculiar shape of the buccal shield shown there is hardly correct; in the photo-



a. b.

Fig. 65. *Amphiura uncinata* Koehler. Part of oral (a) and dorsal side (b). × 8.

graphic figure given in the "Albatross" Oph. the shape of the buccal shields is in accordance with that observed in the S. African specimens.

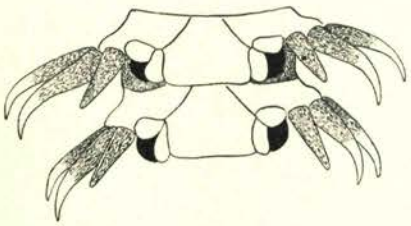


Fig. 66. Arm joints, ventral side, of *Amphiura uncinata* Koehler. × 15.

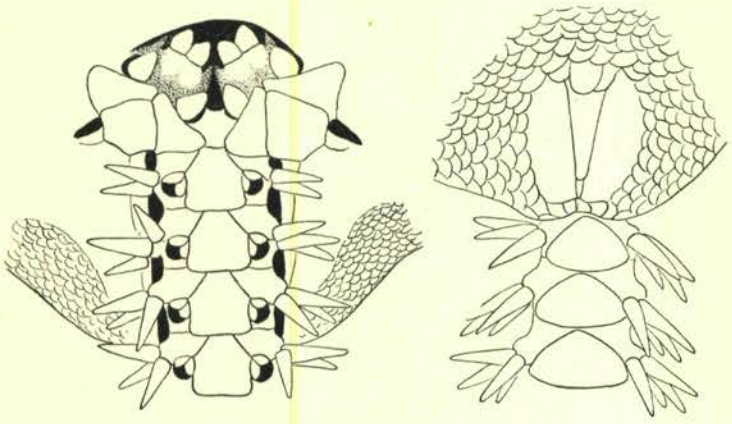
A couple of young specimens show the hyaline hook of the basal spines only just beginning to appear.

Amphiura albella n. sp.

Off Durban, 29°56′ S. 31°19′ E., 225 fathoms. 2 specimens, dredged onboard the "Pickle", 26. VIII. 1929.

Diameter of disk of the larger specimen (the type) 5 mm, length of arms ca. 6 times the diameter of the disk. — Infradental papillæ

flat, not prominent; outer mouth papilla rather broad, leaf-shaped, rounded. Buccal shields in the type specimen somewhat varying in shape, as appears from fig. 67. a.; the typical shape is like that to the right in the figure, or slightly less elongate. Adoral plates distinctly joining within. Ventral arm plates rather broadly contiguous, with outer edge straight. Dorsal arm plates broad, fan-shaped, scarcely contiguous. 4—3 conical, smooth arm spines. 2 tentacle scales. Dorsal side of disk covered with rather fine scales, the primary plates indistinct



a. b.

Fig. 67. *Amphiura albella* n. sp. Part of oral (a) and dorsal side (b). × 18.

in the larger specimen, but fairly distinct in the smaller specimen (of 3.5 mm diameter of disk). Radial shields ca. $^1/_3$ the disk radius, not contiguous, diverging inwards (Fig. 67. b.). Ventral interradii naked, except in the distal part. Colour whitish.

This species is evidently very nearly related to the Atlantic *Amphiura Richardi* Koehler. Judging by the figures given by Koehler (Camp. Sci. Monaco. XXXIV. Pl. XXVII. 1—2) there is a number of small differences — e. g. in the shape of the outer mouth papilla, the buccal and adoral plates; the radial shields are more widely separated in *Richardi*, the ventral arm plates much more narrowly contiguous. However, none of these characters are of great importance, and if it should ultimately be found that *A. Richardi* occurs also off S. Africa, I think the specimens from off Durban should be united with it; for

the present, with *A. Richardi* not known South of the Azores and Portugal, I think it necessary to regard the specimens from off Durban as representing a separate species.

(*Amphiura candida* Ljungman).

The description of this species given by Ljungman (Oph. viv. huc usque cogn. p. 318) is insufficient for recognizing the species — particularly as he does not say anything about the arm spines, their number and shape. The type specimen still exists, but is in so bad condition, all the calcareous substance having been completely dissolved, that nothing can be gathered from it as regards the specific characters of the species. It is therefore quite hopeless to try to identify the species among the S. African Ophiurids, and we must simply drop this "*Amphiura candida*" as a not recognizable species. The specimen described by Koehler (Ophiures nouvelles ou peu connues. Mém. Soc. Zool. Fr. 1904, p. 66) as *Amphiura candida* comes from Japan, and, in spite of the fact that it was identified by Marktanner-Turneretscher as *Amph. candida*, there is not the slightest proof that this identification was correct; on the contrary, there is every probability that this is quite a different species, as also suggested by Clark (Echinod. Fauna of S. Africa, p. 328). It is therefore not justifiable to make this specimen the neotype of *A. candida*, as does Koehler. *Amphiura candida* Ljungman is a *species delenda*.

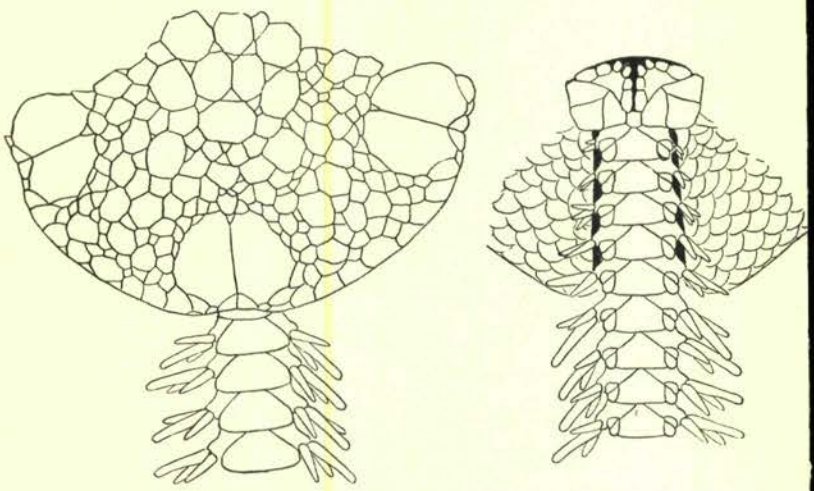
Amphipholis strata n. sp.

Pl. XIX. Fig. 20.

Cape Point in South, 2 miles; 30 fathoms; sand. 4 specimens. Dredged onboard the "Pickle", 19. XII. 1929.

Diameter of disk 8 mm, arms ca. 24 mm, thus only 3 times the diameter of the disk. — Mouth papillæ rather thick, of the typical *Amphipholis*-shape. Exceptionally (on one jaw-side in one specimen) the second papilla is double, there being thus on this side 4 mouth papillæ. Adoral plates rather broad, joining within, not continuing out between buccal plate and first lateral plate. Buccal plate with an acute angle within and a short, rounded distal lobe. It has a rather indistinct median impression. First ventral arm plate very small, forming like a continuation of the mouth papillæ. The ventral arm plates distinctly broader than long, with a straight outer edge and a

truncated angle within, the plates being narrowly contiguous. Dorsal arm plates broad, fan-shaped, truncated within, they being rather broadly contiguous. Lateral arm plates little prominent, carrying 3 arm spines, the middle one the longest, about as long as an arm segment, and slightly club-shaped. The spines on the arm joints enclosed in the disk are short, gradually increasing in size until just outside the disk, where they are the longest (Fig. 68. b.). After some 5—6



a. b.

Fig. 68. *Amphipholis strata* n. sp. Part of dorsal (a) and oral side (b). × 8.

joints the spines again decrease in size. This gives the arms a rather characteristic appearance. Two large tentacle scales, covering the foot-pore completely. Dorsal side of disk covered with a pavement of rather large, smooth, polygonal plates, among which the primary plates remain distinct, usually forming a regular rosette; the primary plates are separated by a varying number of small plates. (In the type specimen there is some irregularity in the rosette). Radial shields contiguous, broad, rounded (Fig. 68. a.). Ventral interradii covered by rather coarse, imbricated scales. Colour of the preserved specimens white.

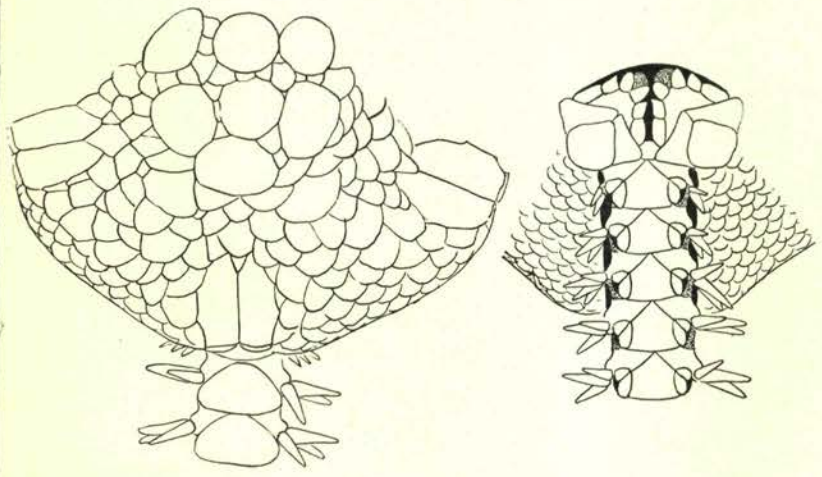
This notable species recalls to some degree, by its disk-covering, *Amphiodia grisea* Ljungman (cf. Koehler. Revision de quelques Ophiures de Ljungman, Ark. f. Zoologi. Bd. 19. A. 2. 1926. Pl. III. 7), but in its other characters it differs so markedly from this West Ameri-

can species that their identity is quite out of the question. Also *Amphioplus integer* (Ljungman) has some resemblance with the present species (cf. Koehler. Ophiures nouvelles ou peu connues. Mém. Soc. Zool. France. 1904. p. 65, figs. 16—17) but, apart from the fact that it has four mouth papillæ and thus belongs to another genus, there are so many differences that an identity is out of the question. The species to which the present species seems the nearest related is *Amphipholis* (or *Amphiodia*) *violacea* (Lütken) (cf. Eigil Nielsen. Ophiurans from the Gulf of Panama, California and the Strait of Georgia. Papers from Dr. Th. Mortensen's Pacific Exped. LIX. Vid. Medd. Dansk Naturh. Foren. Bd. 91. 1932; p. 269); but, in spite of the general resemblance, there are so many differences, e. g. in the shape of the dorsal arm plates, the mouth shields, the arm spines, that an identity is out of the question — as also the locality of *A. violacea* (Gulf of Panama) must beforehand make an identity with the S. African species very improbable.

Amphipholis similis n. sp.

Off Durban, 29°47′ S. 31°12′ E., 35 fathoms. Sand, shells. 1 specimen, dredged onboard the "Pickle", 22. VIII. 1929.

Diameter of disk 3 mm, arms ca. 5 times the diameter of disk, rather robust. Mouth papillæ as typical of *Amphipholis;* buccal shields



a. b.

Fig. 69. *Amphipholis similis* n. sp. Part of dorsal (a) and oral side (b). × 20.

about equally broad and long, rounded-rhomboidal. Adoral plates joining rather broadly within, not prolonged outwards between buccal shield and first lateral plate. Ventral arm plates about equally broad and long, with a scarcely truncated inner angle, the plates being only very narrowly contiguous, and the outer edge straight or slightly convex (Fig. 69. b.). Dorsal arm plates broad, fan-shaped, barely in contact. Three rather thick, simply pointed, arm spines. 2 rather large tentacle scales. Dorsal side of disk with rather coarse, imbricate scales, among which the primaries are very distinct, narrowly separated by some smaller scales. Radial shields contiguous, rather narrow, about $^1/_3$ the disk radius (Fig. 69. a.). Ventral interradii with scales about as coarse as those of the dorsal side. No special colour in the preserved specimens.

This species has much general resemblance with *Amph. strata*, but differs very distinctly from it in the character of the arm spines and the shape of the mouth shield. Also the radial shields are distinctly narrower than those of *A. strata*. Like this latter species it seems to be the most nearly related to *Amph. violacea* Lütken.

Amphipholis squamata (D. Ch.).

Amphipholis squamata H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 330.
— *minor* M. Hertz. 1926. Oph. Deutsch. Südpolar Exp. p. 35.

Sea Point, Cape Peninsula; the coast, under stones. 20. I. 1930. Several specimens.

Off Simonstown, 16 fathoms. 2 specimens, 19. XII. 1929.
Gordon Bay, 8—9 fathoms. 1 specimen, 19. XII. 1929.
Off Durban, 29°56′ S. 31°19′ E. 225 fathoms. 8 specimens, 26. VIII. 1929.
— 29°59′ S. 31° 7′ E. 127 — 1 — 27. VIII. 1929.
— 30° 4′ S. 31°00′ E. 50 — 1 — —
— 29°54′ S. 31°10′ E. 68 — 2 — 29. VIII. 1929.
All these specimens dredged onboard the "Pickle".

The specimens from off Durban, 225 fathoms, are partly somewhat larger than usual for this species, 5 mm diameter of disk, and with arms ca. 25 mm long. The dorsal arm plates are rather distinctly separated from each other, but this does not appear to be a constant difference. And I do not see any other tangible character by which they could be distinguished from *A. squamata*.

Two of the specimens from off Durban are infested with an ecto-parasitic Copepod of the genus *Cancerilla*. In one of them the parasite

is attached as usual on the oral side, in the other the parasite has attached itself on the dorsal side at the base of the arm, producing some anomaly in the disk in the corresponding radius.

This parasite has been described, under the name of *Cancerilla durbanensis*, by Mr. K. Stephensen in his paper "Some new Copepods, parasites of Ophiurids and Echinids" (Papers from Dr. Th. M. Pacific Expedition, 1914—16. LXIV. Vid. Medd. Dansk Naturh. Forening. Bd. 93. 1933. p. 198).

H. L. Clark has already suggested that the *Amphipholis minor* (Döderlein) may not be really distinguishable from *A. squamata*. I think it quite safe to assert that it is identical with *A. squamata*. The specimens mentioned by M. Hertz (Op. cit.) as *A. minor* I have had sent from the Berlin Museum. I do not see any possibility of distinguishing them from *A. squamata*. Hertz's suggestion that *A. minor* may have developed twice independently from *A. squamata* (since she has it also from St. Paul) is quite superfluous. *A. squamata* is found almost everywhere in the world, evidently having an excellent means of transportation in the roots of littoral algæ.

The littoral specimens from Sea-Point are partly very dark coloured, some of them almost black.

Amphioplus falcatus n. sp.

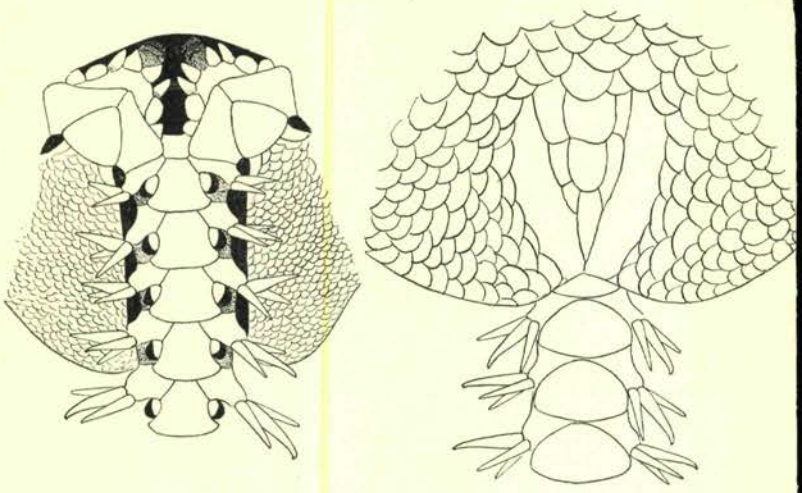
Pl. XIX. Figs. 18—19.

Off Durban, 29°56′ S. 31°19′ E. 225 fathoms. Several specimens, dredged onboard the "Pickle", 26. VIII. 1929.

Diameter of disk 7 mm, length of arms ca. 10 times the diameter of the disk. — Second mouth papilla placed at a somewhat lower level than the others, so that it may perhaps be questionable whether it should be reckoned as a true mouth papilla. The third papilla is the largest, broad, scale-like. Mouth shields triangular, with rounded angles; they vary rather considerably in shape, as appears from the figures 70. a. and 71. Adoral plates meeting broadly within, usually continuing in a broad lobe distally, separating the first ventral plate from the buccal shield.

Ventral plates somewhat longer than broad, rather broadly contiguous; outer edge slightly convex, outer corners somewhat produced. Dorsal arm plates distinctly broader than long, with outer edge slightly convex, the inner edges forming almost a half-circle. They are scarcely

in contact. Lateral plates not very prominent, carrying three spines, the middle one of which is the longest, ending in a small hook. One rather large, somewhat triangular, tentacle scale. Dorsal side of disk



a. b.

Fig. 70. *Amphioplus falcatus* n. sp. Part of oral (a) and dorsal side (b). × 15.

with moderately coarse, imbricated scales, among which the primary plates are scarcely distinguishable. Radial shields narrow, curved, broadly diverging inwards, separated by three rows of scales; (their curved, falcate shape comes out better in the photo, Pl. XIX. Fig. 19, than in the drawing Fig. 70. b.); they remain in contact distally.

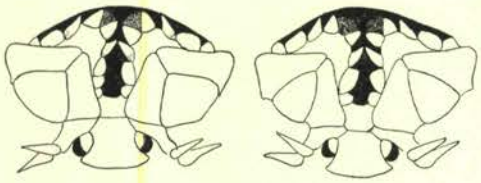


Fig. 71. *Amphioplus falcatus* n. sp. Part of oral frame of different specimens, to show variation in shape of buccal and adoral plates. × 15.

Ventral interradii covered with much finer scales than those of the dorsal side. The disk is rather conspicuously incised above the base of the arms. Most of the specimens have lost their disk. Colour of disk (in the preserved specimens) a light bluish-gray; the arms whitish,

somewhat shining on the dorsal side, sometimes with indication of a faint reddish-brown colour on the under side.

This species, so characteristic by its curved, falcate, radial shields and the hooked median spine, does not seem more nearly related to any other hitherto known species.

Amphioplus pectinatus n. sp.

Off Durban, 29°56′ S. 31°49′ E. 225 fathoms. 2 specimens dredged onboard the "Pickle", 26. VIII. 1929.

Diameter of disk 5 mm, arms slender, broken, but apparently rather long. Mouth papillæ 5 to each jaw side, the 4th distinctly the

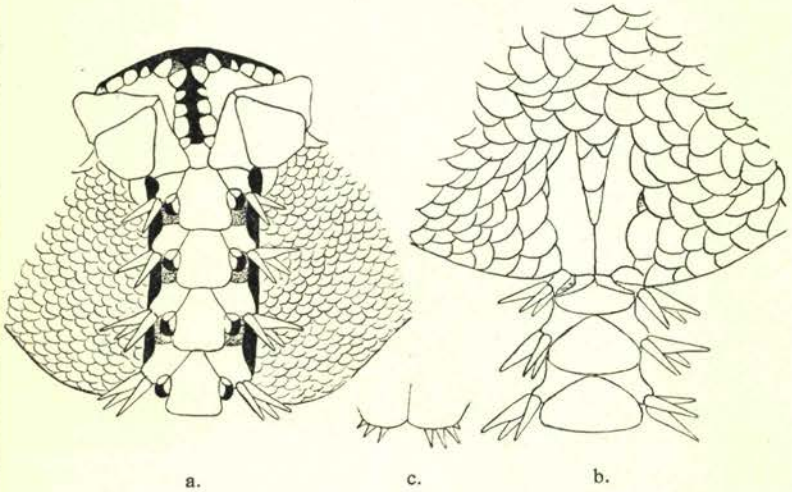


Fig. 72. *Amphioplus pectinatus* n. sp. Part of oral (a) and dorsal side (b). Distal end of radial shields, with the hyaline thorns (c). a—b. × 20; c. × 35.

broadest. Buccal shields slightly longer than broad, with a short outer lobe; inner angle rounded, the sides slightly concave. Adoral plates joining within; an outer process separates the first lateral plate from the buccal shield. Ventral plates somewhat longer than broad, with a truncate inner angle, the plates being rather broadly contiguous; the distal edge straight, outer corners rounded. Dorsal arm plates broad, fan-shaped, scarcely contiguous. 3 simply pointed arm spines, the middle one somewhat enlarged proximally. 2 small tentacle scales. Dorsal side of disk covered with rather coarse scales, among which the primary

plates are not distinguishable. Radial shields rather slender, $^1/_3$ the length of the disk radius, contiguous in the distal part, diverging in the proximal half, separated by a wedge of scales. At the distal end of each radial shield is a scale produced into one or more (3—5) hyaline thorns (Fig. 72. b. c.). Ventral interradii covered with scales very much finer than those of the dorsal side. Colour of the dried specimens whitish, but the scales of the dorsal side of disk present a peculiar aspect in their centre being dark, the edges white, due evidently to their central part being quite thin, the edge somewhat thickened.

The second specimen differs in the scales of the dorsal side of the disk being finer and in the radial shields being somewhat shorter. Also the comb at the distal end of the radial shields is less developed, though still distinct. There being no other differences, I cannot hesitate in referring this specimen to the same species as the type.

The only species hitherto known with a similar comb at the distal end of the radial shields is *Amphiodia digitula* H. L. Clark (North Pacific Oph. p. 162, Fig. 70), which differs otherwise markedly from the present species (in the mouth papillæ, buccal shield, radial shields, arm spines). It would appear that the present species is in reality more nearly related to the Japanese species *Amphioplus rhadinobrachius* H. L. Clark (North Pac. Oph. p. 167, Fig. 74), which differs, however, — besides in the absence of the combs — in the shape of the buccal shields and in the mouth papillæ; an identity with the present species is excluded.

Amphioplus integer (Ljungman).

Amphipholis integra Ljungman. 1867. Oph. viv. huc usque cogn. p. 313.
Amphiura — Koehler. 1904. Oph. nouv. ou peu connues. p. 65.
Amphioplus integer Clark. 1923. Echinod. Fauna S. Afr. p. 330.

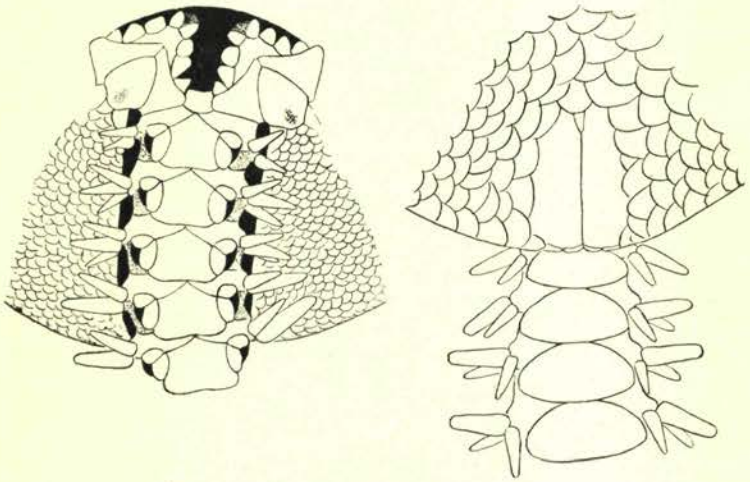
Off Durban, 29°47′ S. 31°12′ E. 35 fathoms. 1 specimen, dredged onboard the "Pickle", 22. VIII. 1929.

Gordon Bay (False Bay), 8—9 fathoms. 1 specimen, dredged onboard the "Pickle", 19. XII. 1929.

The specimen from Gordon Bay answers completely the description given by Koehler (Op. cit.), excepting one point: the dorsal arm spine is not club-shaped — which was also the fact with the specimens referred by Clark to this species. I quite agree with Clark that this sole character, not mentioned in the original description by Ljungman,

loes not justify distinguishing these specimens as a different species besides *A. integer*.

The specimen from off Durban differs rather more from Koehler's description (Figs. 73. a—b.). The radial shields are somewhat longer and narrower, and the arm spines are shorter and thicker; here the middle one may be slightly spatulate, recalling to some degree the upper spine in Koehler's figure 16.



a. b.

Fig. 73. *Amphioplus integer* (Ljungman). Specimen from off Durban. Part of oral (a) and dorsal side (b) × 20.

Here again, I think the differences too small for separating this specimen from *A. integer* — the more so as it comes from near the type locality. Probably it will be found, when a much richer material comes to hand, that the differences pointed out do come within the limits of variation of the species *Amphioplus integer*. On the other hand, it seems clear that the specimen from Durban has much resemblance with *Amphioplus gibbosus* (Ljungman), and it is quite possible that it should rather be referred to that species; particularly the arm spines recall that species (cf. the description given by Koehler. Revis. de quelques Ophiures de Ljungman, p. 21, Pl. IV. 5—6) — but then the type specimen has a distinct rosette of primary plates, which the

present specimen has not. — Much more material is needed for clearing up fully the species *Amphioplus integer* and *gibbosus*, their variation and interrelation — possibly their identity.

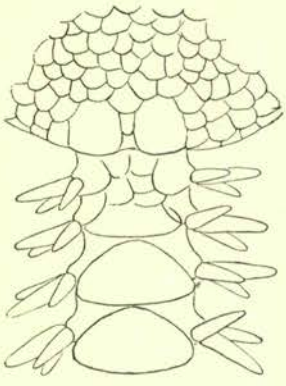


Fig. 74. Part of dorsal side of specimen of *Amphioplus integer* (Ljungman), probably abnormally regenerated. × 20.

From the same locality off Durban there is a specimen with a remarkably small disk and with quite small radial shields (Fig. 74); some irregular plates are found on the dorsal side of the arm at the base. Otherwise this specimen is in every respect similar to the above mentioned specimen of *A. integer*. I think it almost beyond doubt that this is a specimen of the same species which has lost its disk and regenerated it somewhat anomally. At least, we must have more specimens like it, before we can accept it as a normal form; if so, it will, of course, represent a distinct species.

Amphioplus furcatus n. sp.

Off the South Head, Tugela River, N. by W. $4^3/_4$ miles; 25 fathoms, black mud, 10 specimens.

This is the species recorded by Bell (Marine Investigations in S. Africa III. 1905. The Echinoderma. III. Ophiuroidea. p. 258) under the name of *Amphiura incana*, with the remark, though, that he was "not very confident of this determination". An extraordinary idea to identify this species as *Amph. incana*, a species with which it has no resemblance at all, beyond the fact that both are Amphiurids.

Diameter of disk 5 mm; arms very slender, ca. 8 times the length of the disk diameter. Mouth papillæ four to each jaw side, the third slightly the largest. Buccal shields nearly twice as long as broad with a rounded, outer lobe; inner angle rounded; sides nearly straight. Adoral plates may or may not continue out between the buccal shield and the first lateral plate; both conditions may be met with in the same specimen (Fig. 75. a.). Ventral arm plates slightly broader than long, scarcely in contract, the inner angle being barely truncated. Distal edge straight or slightly concave. Dorsal arm plates broad

fan-shaped, hardly in contact. Armspines 3, slender, simply pointed, the middle one the longest. Two large tentacle scales, particularly the one along the ventral plate very large. Disk with a uniform covering of small scales, among which the primary plates are not distinguishable. Radial shields about $^1/_3$ the disk radius, joining in their whole length. Edge of the disk sharp, with a bordering of small, branching, hyaline thorns (Fig. 75. c.); they are not easily observable except in side view.

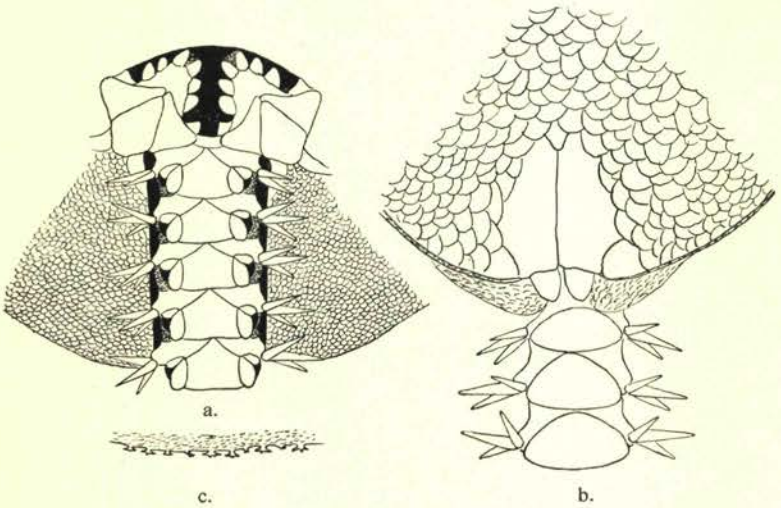


Fig. 75. *Amphioplus furcatus* n. sp. Part of oral (a) and dorsal side (b). Edge of disk with the small branching thorns (c). a—b. × 18; c. × 30.

Ventral interradii covered with exceedingly fine scales. The disk is very easily lost. No special colour.

It is interesting to find an Amphiurid with this sort of marginal fringe, known hitherto only in species from the West Coast of N. America and from Amboina, represented also in S. African waters. Eigil Nielsen (Oph. from the Gulf of Panama, California and the Strait of Georgia, p. 276) has proposed to unite these species with the branching thorns at the edge of the disk into a separate subgenus or genus *Amphispina*. This is certainly very natural — but the fact that the present species has 4 mouth papillæ, thus belonging to the *Amphioplus*-group, whereas the three other species have 3 mouth papillæ, and belong to the *Amphiodia*-group seems to indicate that this character has arisen separately within both these groups. It would therefore not be correct

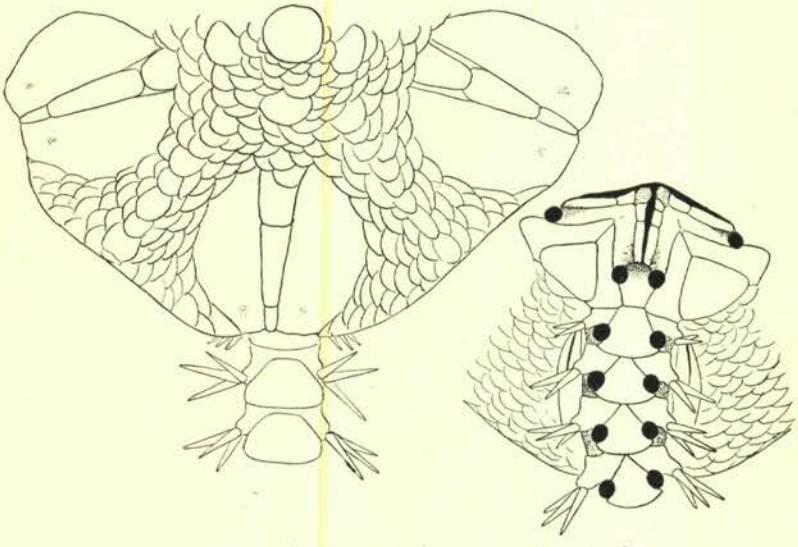
to unite the present species within the same subgenus as the three other species. I think it better to leave it for the present in the genus *Amphioplus*. That these branching spines are much smaller in the present species than in the others is also a noticeable fact.

Family ***Amphilepidæ.***

Amphilepis scutata n. sp.

Off Durban, 29°56′ S. 31°19′ E. 225 fathoms. 1 specimen, dredged onboard the "Pickle", 26. VIII. 1929.

Diameter of disk 5 mm, length of arms 45 mm. Mouth papillæ two to each side of jaw, the outer one by far the broadest; on one jaw



a. b.

Fig. 76. *Amphilepis scutata* n. sp. Part of dorsal (a) and oral side (b). × 15.

side the inner papilla is divided into two. Buccal shield rounded-triangular; adoral plates joining broadly wihtin. First ventral arm plate distinctly longer than broad, the proximal part of it sloping rather abruptly down towards the mouth slit. The proximal ventral plates contiguous, but already from the fifth they are separated; their outer edge is slightly convex (Fig. 76. b.). Dorsal arm plates not con-

tiguous, with a nearly straight distal edge and a much narrower, but similarly straight proximal edge. Arm spines three, slender, pointed, the median one slightly the longest. No tentacle scale. Dorsal side of disk with rather coarse, imbricated scales, among which the central plate is very conspicuous, the other primary plates rather indistinct. Radial shields large, of about semilunar shape, narrowly separated throughout by a single series of elongated scales. Each pair of radial shields form together an almost circular figure, resembling very much a shield, the more so as they are slightly elevated in the middle. An inconspicuous depression is found on each radial shield near the outer edge (Fig. 76. a.). The ventral interradii covered with imbricated scales of about the same size as those of the dorsal side. Genital scales narrow, the slit between them being found off first to second armjoint. Colour whitish.

This species, the first Amphilepid discovered in S. African Seas, is evidently the nearest related to *Amphilepis mobilis* Koehler from the Malay Archipelago, in which the radial shields are somewhat similar. It differs from that species in the complete absence of the characteristic, broad border of small scales (cf. Koehler. "Siboga" Oph. I. p. 94. Pl. XX. 6—7). Also the genital scales are different; they are broad and more distally placed in *A. mobilis*, much as in *A. norvegica*. (This feature is not mentioned by Koehler; but I have, through the kindness of Dr. H. Engel of the Amsterdam Museum, had the specimens of *A. mobilis* sent to me, so that I could compare them directly with the present species).

Family ***Ophiochitonidæ.***

Ophionereis porrecta Lyman.

Ophionereis porrecta Lyman. 1865. Oph. & Astroph. Ill. Cat. Mus. Comp. Zool. I. p. 147.
— — H. L. Clark. 1921. Echinod. of Torres Strait. p. 117. Pl. XII. 6; XXX. 2—3.
— — — 1923. Echinod. Fauna S. Africa, p. 344.

Off Durban, 30°2′ S. 31°3′ E. 90 fathoms. 2 young specimens, dredged on-board the "Pickle". 27. VIII. 1929.

The question was raised by H. L. Clark (Op. cit. 1923), whether the S. African specimens are really identical with the Indo-Malayan

Ophionereis porrecta, or they should rather be distinguished as a separate subspecies or species. The scanty material in hand (one specimen from off East London was sent me for identification from the Hamburg Museum) does not give sufficient opportunity for taking a definite position in regard to this question. My impression is, however, that they are not identical, so it is with all reservation that for the present I follow Clark in naming it *O. porrecta*.

Ophionereis dubia (Müller & Troschel).

Ophiolepis dubia Müller & Troschel. 1842. Syst. d. Asteriden, p. 94. Savigny. Description de l'Egypte. Echinodermes. Pl. I. 3.
Ophionereis — Lyman. 1865. Oph. & Astroph. Bull. Mus. C. Zool. I. p. 149.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa.

Off Durban, 30°2′ S. 31°3′ E. 90 fathoms. 1 small specimen, dredged onboard the "Pickle" 27. VIII. 1929.

Ophionereis australis (H. L. Clark).

Ophiochiton australis H. L. Clark. Echinod. Fauna S. Africa, p. 345. Pl. XX. 1—2.

Off Durban, 30°4′ S. 31°00′ E. 50 fathoms; gravelly bottom, with masses of agglutinated worm tubes. 9 specimens.

Off Durban, 30°2′ S. 31°3′ E. 90 fathoms; 2 specimens.

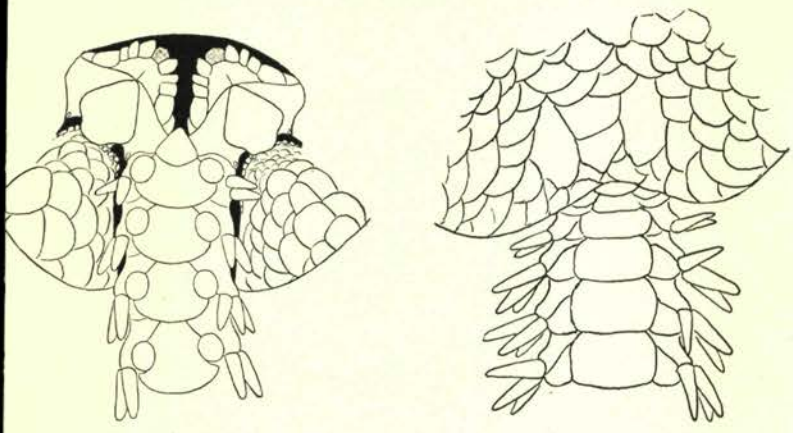
Off Durban, 29°54′ S. 31°10′ E. 68 fathoms; 2 specimens. All these specimens dredged onboard the "Pickle", 27—29. VIII. 1929. Further, 4 specimens from 30°3′ S. 31°3′ E. 112 fathoms, were received from the Fisheries Survey.

The largest specimen has a diameter of disk of 11 mm. A specimen of scarcely 9 mm diameter of disk has the arms 80 mm long.

I have nothing to add to the careful description given by Clark, only I think it desirable to give figures (Fig. 77. a—b.) to show the details, the photographic figure given by Clark being rather unclear, the outlines of the various plates not showing very distinctly.

Clark refers this species to the genus *Ophiochiton* because of the (supposed) complete absence of supplementary dorsal arm plates; in the figure he gives of the dorsal side of an arm, he shows, however, very distinctly these supplementary plates on the second and the third joints. It is rather funny that he could overlook them in spite of having drawn them himself. As a matter of fact, these supplementary plates are present on several of the proximal armjoints; in the largest

pecimen I find them present until about the middle of the arm, but rowing gradually smaller and more or less concealed by the arm pines. In young specimens, 5—6 mm diameter of disk they are dis-ernible only on the proximal 5—6 arm joints. On the whole, these upplementary plates are very inconspicuous; but they are there, ure enough, and accordingly this species is an *Ophionereis*, not an



a. b.

Fig. 77. *Ophionereis australis* (H. L. Clark). Part of oral (a) and dorsal side (b). × 12.

Ophiochiton. As well noticed by Clark it has a considerable resem-blance to *Ophionereis porrecta*, but it is easily distinguished from that species by its much smaller supplementary dorsal arm plates.

Family ***Ophiocomidæ***.

Ophiocoma valenciæ Müller & Troschel.

Ophiocoma valenciæ Müller & Troschel. 1842. Syst. d. Asteriden, p. 102.
— — H. L. Clark. 1915. Cat. Rec. Oph. Pl. 16. 7—8.
— — — 1921. Echinod. Torres Strait, p. 131.
— — — 1923. Echinod. Fauna S. Africa, p. 349.

One specimen of this species I collected in the rock pools at the Bluff, Durban, in August 1929. Another specimen from the same locality was sent me by Mr. Bell Marley in 1931.

The species was not hitherto known S. of Mozambique, and it is thus only now that it can be justly included in the S. African fauna.

Family *Ophiodermatidæ.*

Cryptopelta aster (Lyman).

Pl. XIX. Fig. 21.

Ophiopeza aster Lyman. 1882. Challenger Oph. p. 12. Pl. XXI. 16—18.
Cryptopelta — H. L. Clark. 1909. Notes on some Australian and Indo-Pacific Echinoderms. Bull. Mus. C. Zool. LII. p. 131.
— — — 1923. Echinoderm Fauna S. Africa, p. 350.

34°5′ S. 18° 1′ E. 118 fathoms, 17. XII. 1929. 4 specimens.
34°21′ S. 17°57′ E. 178 — 18. XII. 1929, 1 —
34° 5′ S. 17°52′ E. 146 — 23. XII. 1929, 1 —
All these specimens dredged onboard the "Pickle".

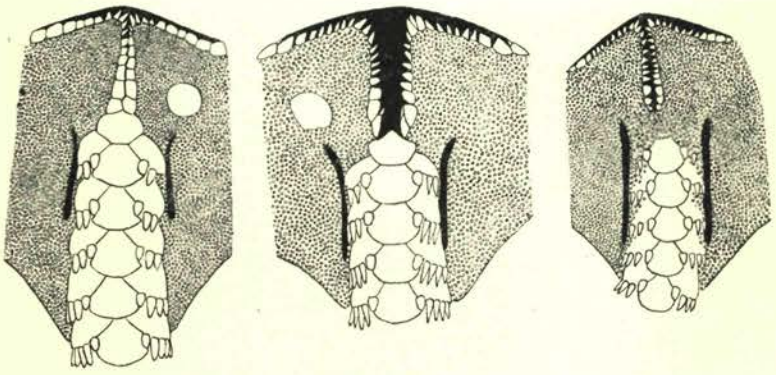
Clark (Op. cit. 1923) suggests that the specimens from the Malay Archipelago referred by Koehler ("Siboga" Oph. II. p. 13) to "*Ophiopeza*" *aster* may not be really the same species as the true *Cryptopelta aster* from off Cape Peninsula. In his "Ophiures rec. par le Dr. Th. M. dans les Mers d'Australie et dans l'Archipel Malais" (Papers from Dr. Th. M. Pacific Exped. 1914—16. LIV. Vid. Medd. Dansk Naturh. Foren. Bd. 89. 1930, p. 276) Koehler establishes a new variety, *longobrachialis* for the specimens from the Malay Archipelago. Having now had an opportunity of directly comparing both forms (which neither Clark nor Koehler has had), I can definitely state that they are distinct species.

The only difference thought by Koehler to exist between the South African *Cr. aster* and the Indo-Malayan var. *longobrachialis* is in the relative length of the arms. The specimens from the "Siboga", recorded under the name of *Ophiopeza aster* (Siboga Oph. II. p. 13), are 8—12 mm diameter of disk, with an arm length of 50 mm. In the S. African specimens the arms are ca. 38—40 mm long in specimens of 10—12 mm diameter of disk, 40—50 mm in specimens of 15 mm in diameter. Thus there is really some little difference in the arm length, but not so much that it can be said to be a very distinct character. But there are other characters which put the specific difference of the two forms beyond question.

The mouth papillæ are distinctly coarser and thicker in *aster* than in *longo-brachialis*; the first ventral plate is covered by grains in *longo-brachialis*, but not in *aster* (or any of the other species) (Fig. 78). The dorsal side of the arms is rounded and arched in *Cr. aster*, flat

in *longo-brachialis*, and also the shape and width are different in the two species (cf. Fig. 79—80).

The characters here pointed out leave no doubt of the Indo-Malayan form being a distinct species, which thus gets the name *longobrachialis* Koehler. Another question is this, whether all the specimens from the Indo-Malayan Archipelago reported by Koehler under the name of *aster* or var. *longo-brachialis* really belong to the same species. I do not think so. I have examined the specimens from



a. b. c.

Fig. 78. Part of oral side of *Cryptopelta aster* (Lyman) (a), *Cr. keiensis* n. sp. (b), and *Cr. longobrachialis* Koehler (c). × 7.

the "Siboga", which Dr. Engel has very kindly sent me. The specimens from Stat. 40 and 99 are typical *Cr. longobrachialis*. The specimen from St. 282 differs in not having the first ventral plate covered by grains, though otherwise agreeing well with *longobrachialis*. Whether this specimen represents perhaps another species I do not venture to say; much more material is needed for deciding whether we have here only an individual aberration or a separate species (or variety). Of the specimens mentioned by Koehler in his work of 1930 the two specimens from off Jolo are typical *Cr. longobrachialis* and must be regarded as the types of that species; but the specimen from the Kei Islands, Stat. 53, is decidedly another, distinct species, differing from *Cr. longobranchialis* not only in the first ventral plate being uncovered, but also in other characters. Thus the dorsal arm plates are separated in at least the distal $^1/_3$ of the arms, only in about the distal $^1/_5$ or even less in *longobrachialis* and *aster*. Also the colour is quite different:

numerous very small, pink spots on the disk along the ventral interradii and indistinct pink bands on the arms, whereas *longobrachialis*

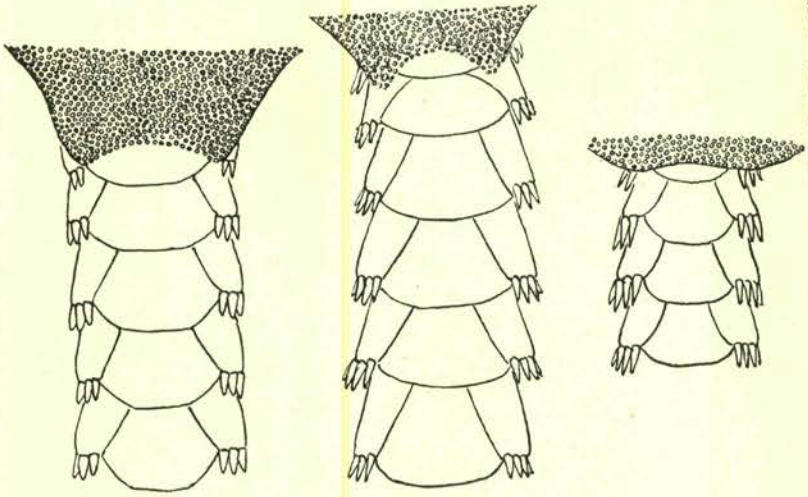


Fig. 79. Part of disk and dorsal side of arm of *Cryptopelta aster* (Lyman) (a), *Cr. keiensis* n. sp. (b), and *Cr. longobrachialis* Koehler (c). × 12.

is of a uniform brownish-yellow on the disk and with indistinct olive bands on the arms (*Cr. aster* is simply white on the disk and has, in

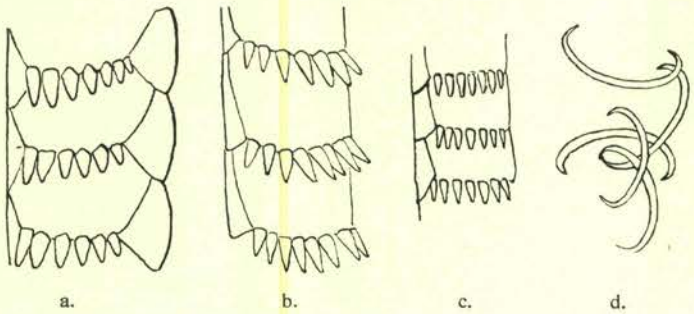


Fig. 80. Part of arm, side view, of *Cryptopelta aster* (Lyman) (a), *Cr. keiensis* n. sp. (b), and *Cr. longobrachialis* Koehler (c). Spicules from stomach wall of *Cryptopelta aster* (Lyman) (d). a—c. × 12; d. × 125.

live specimens, a tint of yellow in the distal part of the arms; in the preserved specimens also the arms are simply white).

The said specimen from the Kei Islands thus evidently represents third species, which I shall designate ***Cryptopelta keiensis*** n. sp. Figs. 78—80). One very important character of *Cryptopelta aster* I an add, viz. that it is viviparous and hermaphroditic. This also the case with another species, viz. *Cryptopelta granulifera* . L. Clark (from Mauritius), but not with *Cr. longobrachialis*. With gard to *Cr. keiensis* I must leave it undecided whether it is vivi-arous or not, the single specimen known having been dried.

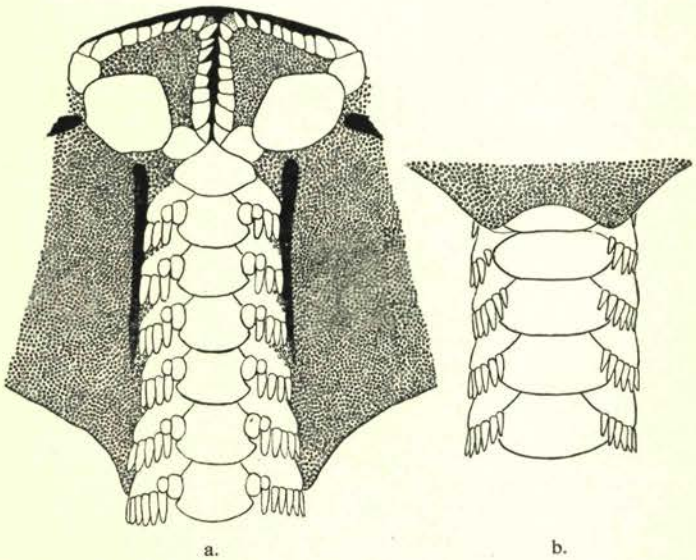
An interesting character of the genus *Cryptopelta* is the presence in he stomach wall of innumerable C-shaped (bihamate) spicules Fig. 80. d.). It should also be pointed out that generally the madre-orite remains naked.

Ophiopezella decorata n. sp.

Pl. XIX. Fig. 24.

Durban, under stones at the pier, 10. VII. 1929, 1 specimen.

Diameter of disk 14 mm, arms up to 40 mm long, rather stout. louth papillæ 8, exceptionally 9, to each side of jaw, the penultimate he largest. Buccal shields distinctly broader than long, rounded, with n obtuse, rounded point within; adoral shields covered, except a small



a. b.

Fig. 81. *Ophiopezella decorata* n. sp. Part of oral (a) and dorsal side (b). × 8.

part at the distal end, occupying the space between first ventral ar plate and the buccal shield. The first ventral plate with a peak withi broader than long. The following ventral plates about as broad as lon broadly contiguous, with a convex distal edge (Fig. 81. a.). Dors arm plates distinctly broader than long, broadly contiguous, the dist edge nearly straight (Fig. 81. b.). Dorsal side of arms flat. Two tentac scales, the outer one the smaller, covering the base of the first spin Number of arm spines at base of arm 11—12; they are not quite ha as long as the arm joint, the two lowermost ones slightly the longes Disk with a uniform covering, above and below, of very small granule Marginal plates not very conspicuous. Colour of disk (of dried spec men) a uniform grayish, the arms with 4—5 conspicuous brownish olive bands, not continuing on to the ventral side of the arms.

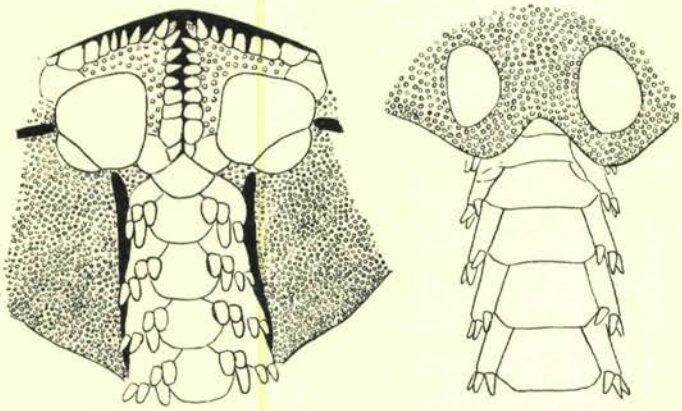
From the two other known species of the genus *Ophiopezell* *O. spinosa* and *dubiosa*, the present species is very easily distinguishe by several characters e. g. the shape of its buccal shields, dorsal ar plates, as well as by the striking coloration.

Ophiarachnella capensis (Bell).

Pectinura capensis F. Jeffr. Bell. 1888. Descriptions of four new species Ophiurids. Proc. Zool. Soc. London. p. 282. Pl. XV 3—4.

Ophiarachnella capensis H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 351.

Cape of Good Hope, under stones at low tide. 1 specimen, 5. I. 1930.



a. b.

Fig. 82. *Ophiarachnella capensis* (Bell). Part of oral (a) and dorsal side (b). × 10.

The figures given by Bell not being too exact in the details, I have nought it desirable to give some new figures of the species (Fig. 82. —b.). Particularly the different shape of the mouth shields is noticeble. The grains on the jaws are somewhat larger and more spaced han those on the disk. The spines are conical, excepting the first, hich is slightly the longest. The present specimen (9 mm diameter f disk) has 5 arm spines. One of the buccal shields, viz. the madreorite, is without supplementary plate, as Clark found it to be the ase in one of his specimens. The coloured bands of the arms are istinct, and there is an irregular dark spot in the centre of the disk.

Ophioderma leonis Döderlein.

phiura tongana Lyman. 1882. "Challenger" Oph. p. 9. (non: *Ophioderma tongana* Lütken).

phioderma leonis Döderlein. 1910. Ast. Oph. & Ech. in Schultze. Zool. u. Anthrop. Ergebn. Forschungsreise W. u. Zentr. Süd-Afrika. IV. 1. (Jen. Denkschr. XVI.) p. 252. Taf. V. 1, 1. a.

— — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 351.

Gordon Bay, 8—9 fathoms. 2 specimens, dredged onboard the "Pickle", 9. XII. 1929.

In one of the specimens (20 mm diameter of disk) the radial shields re totally covered by grains, in the other (24 mm diam. of disk) one adial shield remains naked, and a mere trace of its neighbour can e seen.

Both Döderlein and Clark (Op. cit.) suggest that the "*Ophiura ongana*" recorded by Lyman (Op. cit.) from Simons Bay, 10—20 fms., s in reality *Ophioderma leonis*, not Lütken's *Ophioderma tongana*. can now ascertain definitely that this suggestion is correct. Dr. Monro as very kindly examined the single specimen from the "Challenger", reserved in the British Museum, and has sent me a drawing of one f its jaws (Fig. 83). It has the adoral plates naked, as in *O. leonis*, whereas in *tonganum* the adoral plates are, according to Lütken's description, completely covered by granules. Further, the narrow, white, double lines occurring on every 4—5 joints in *tonganum* are not found in the "Challenger" specimen, but it has indistinct, whitish bands, as in typical *leonis*. Thus, there is not the slightest reason for doubt as to the identity of this "Challenger" specimen with *Ophio-*

derma leonis, the only *Ophioderma*-species known with certainty t occur in the S. African seas — the actual locality of *Ophioderm Wahlbergi* Müller & Troschel being still pr blematic (cf. Clark. Op. cit. p. 353).

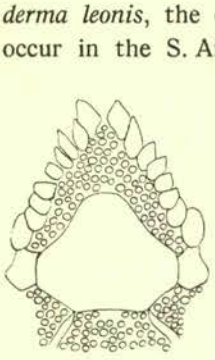


Fig. 83. Jaw of Lyman's "*Ophiura tongana*" from Simon's Bay. Drawing by Dr. Monro. (Enlargement not stated.)

As regards *Ophioderma tonganum* Lütken otherwise must give the rather sad informatio that the type specimen appears to have bee lost. It is, according to the kind information Dr. A. Panning, not found in the Hambur Museum, where the collections of the Museu Godeffroy are preserved, and it is not in th Copenhagen Museum either, where the oth types of the Ophiurids described by Lütke are preserved. But the two characters mentione above: the complete covering of the adoral shiel and the white, double lines on the arms, should be sufficient for r cognizing the species, when it is ever met with again.

Family ***Ophiolepidæ.***

Ophiolepis cincta Müll. & Troschel.

Ophiolepis cincta Müller & Troschel. 1842. System d. Asteriden, p. 90
— — Lütken. 1859. Add. hist. Oph. II. p. 101. Tab. II. 6. a—
— — De Loriol. 1894. Cat. Rais. Echinod. Île Maurice. III. Oph. Astroph. p. 9. (Here complete list of literature).
— — Koehler. 1905. Siboga Oph. II. p. 16.
— — H. L. Clark. 1921. Echinod. Torres Strait, p. 143.

One specimen was taken under stones, at low water, on the pier of Durba 10. VII. 1929. Another fine specimen I took under old coral blocks at Inhac Delagoa Bay.

The species was not hitherto known South of Zanzibar.

Ophiolepis Garretti Lyman 1865 (Oph. & Astroph. Ill. Cat. Mus. C Zool. I. p. 61, Pl. II. 4) is generally regarded as a synonym only *O. cincta*. H. L. Clark (Op. cit. 1921) states: "Lyman has given very good colored figure of the adult under the name *Ophiolepis gar retti*. The young are much less handsomely colored." The specimen o *O. Garretti* is 9 mm in diameter, thus hardly to be designated as th adult of *O. cincta*, which grows to a much larger size, at least 15 mm diameter of disk. Then Lyman states *O. Garretti* to be distinguishe

from *O. cincta* "by shorter mouth shields and much longer arms. The best distinguishing mark, however, is the microscopic appearance of granulation which the upper arm plates have, while in *O. cincta* they are smooth and glossy". — To these differences must be added that of the colour. *O. Garretti* is red, with yellow bands on the arms. *O. cincta* is grayish, mottled with whitish on the disk, and with bands of the same whitish colour on the arms. Both small and large specimens are similarly coloured, and I have seen no specimens with the slightest indication of a reddish colour.

I think it therefore very unlikely that *O. Garretti* could be identical with *O. cincta*. Whether all the specimens from the Malay Archipelago referred by Koehler to *O. cincta* are really identical with the typical form (Red Sea, East Africa) is another question which might well deserve a closer investigation; I have, however, no time to enter on such investigation now.

Ophiura flagellata (Lyman).

Ophioglypha flagellata Lyman. 1882. "Challenger" Oph. p. 42. Pl. IV. 16—18.
Gymnophiura coerulescens Lütken & Mortensen. 1899. "Albatross" Oph. p. 114. Pl. VII. 5—7.
Ophioglypha flagellata Koehler. 1899. "Investigator" Oph. I. p. 18.
— — — 1904. "Siboga" Oph. I. p. 56.
— — — 1906. Oph. "Travailleur" & "Talisman". p. 261.
Ophiura — H. L. Clark. 1911. North Pac. Oph. p. 60.
— — Matsumoto. 1917. Monogr. Jap. Oph. p. 273.
— — Koehler. 1922. Oph. "Albatross". Philippine Exp. p. 375. Pl. 85. 1, 6—7; 86. 1—4, 10.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 359.

This almost cosmopolitan species was not taken in any of my own trawlings or dredgings in S. African seas; but there are specimens in the material handed over to me by the Fisheries Survey, viz.

33°37′ S. 16°55′ E. 1000 fathoms. 2 specimens.
33°28′ S. 16°40′ E. 1000 — 15 —

These specimens are all in poor condition (dried), hardly anything of the arms being left. All of them have the disk scales very well developed, with a distinct central plate; there is nothing recalling the condition of "*Gymnophiura coerulescens*". The same was the case with the specimens examined by Clark (Op. cit. 1923). I therefore must say that I do not feel quite convinced of regarding these specimens as

identical with the Pacific *Oph. flagellata* (*Gymnoph. coerulescens*), the more so as also the arm spines are shorter, not exceeding the length of the arm joint, and there are also some other small differences (e.g. the genital papillæ). But for a final decision it would be necessary to have a much larger material and also specimens from the Atlantic and the Indian Ocean for comparison with the specimens from the Pacific, which are not available to me. I shall then for the present follow Clark in referring also the S. African specimens to *C. flagellata*, stating, however, expressly that I do not feel convinced of the correctness of this identification.

Ophiura trimeni Bell.

Ophiura trimeni F. Jeffr. Bell. 1905. Echinoderma. III. Ophiuroidea. Marine Invest. S. Africa. III. p. 257. Pl. I. 3—4.
— — H. L. Clark. 1923. Echinod. Fauna. S. Africa, p. 360.

Several specimens dredged onboard the "Pickle":
34°17′ S. 17°58′ E. 160 fathoms. 18. XII. 1929. Several specimens.
34°21′ S. 17°57′ E. 178 — — 9 specimens.
34° 5′ S. 17°52′ E. 146 — 23. XII. 1929. 12 —
Further, some specimens were received from the Fisheries Survey, viz. from.
32°37 S. 17°15′ E. 90 fathoms. Several specimens.
33° 2′ S. 16°53′ E. 200 — 10 specimens.

As said by Clark the description of this species by Bell is rather inadequate. I would particularly point out that his statement "no arm comb" is incorrect; the arm combs are there, only not very strongly developed and not passing high up on the dorsal side, so that they are more easily seen in side view. The species being very fragile, the papillæ are often lost, but when only tolerably well preserved the combs are distinct enough. As this is a character of rather considerable importance, it was necessary to have the statement of the absence of the arm combs corrected.

The figures given by Bell being in several respects incorrect — too many mouth papillæ, proximal ventral plates too short, passage from the larger proximal pore pairs to the smaller ones on the following joints much too abrupt, the shape of dorsal arm plates not correctly shown etc. — I have thought it desirable to give new figures of the species (Fig. 84). Further, an important character appears to have been overlooked by both Bell and Clark, viz. the existence of small spines on the disk. This character recalls *Ophiura Ljungmani* (Lyman) —

nd it is perfectly evident that these two species are closely related. That they are, however, perfectly distinct is equally evident; as distinguishing characters I may mention the shorter arm spines in *Ljungmani* scarcely as long as an arm joint in *Ljungmani*, about as long as two joints in *trimeni*), the better developed arm comb in *Ljungmani* and

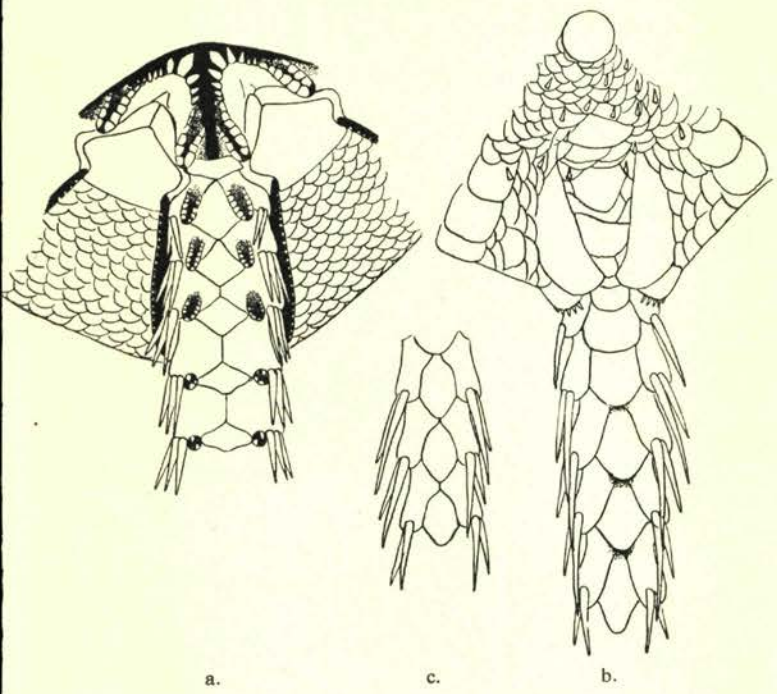


Fig. 84. *Ophiura trimeni* Bell. Part of oral (a) and dorsal side (b). Armjoints, dorsal side from distal part of arm (c). × 8.

he somewhat different shape of the dorsal arm plates. Also the spines on the disk are much shorter in *trimeni* than in *Ljungmani*.

A couple of specimens of *O. trimeni* have still preserved a reddish colour on the dorsal side of the arms and, somewhat fainter, on the disk. — It appears not to surpass a size of ca. 10 mm diameter of disk.

Ophiura (*Ophiuroglypha*) *costata* (Lyman).

Ophioglypha costata Lyman. 1882. "Challenger" Oph. p. 50. Pl. V 1—3.
Ophiozona capensis Bell. 1905. Echinoderma. III. Ophiuroidea. Marine Invest. S. Afr. III. p. 256. Pl. I. 1—2.

Ophiura costata. H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 357.
Ophiuroglypha capensis M. Hertz. 1927. Ophiuroidea d. deutschen Tiefsee-Exped p. 90. Taf. VII. (II) 10.

Off Cape Peninsula, 34°2′ S. 18°7′ E. 94 fathoms. 17. XII. 1929. Severa specimens.

Off Cape Peninsula, 34°5′ S. 18°1′ E. 118 fathoms. 17. XII. 1929. Severa specimens.

Off Cape Peninsula, 34°17′ S. 17°58′ E. 160 fathoms. 18. XII. 1929. 5 spec imens.

Off Cape Peninsula, 34°21′ S. 17°57′ E. 178 fathoms. 18. XII. 1929. 5 spec imens.

Off Cape Peninsula, 34°24′ S. 18°16′ E. 133 fathoms. 18. XII. 1929. Severa specimens.

Cape Point in N. 83° E. 18 miles. 93 fathoms. 20. XII. 1929. 7 specimens All these specimens dredged onboard the "Pickle".

A very characteristic feature of this species is, as pointed out by Hertz, the presence of a ring-shaped, deep furrow across the jaws the proximal end of the jaws being somewhat elevated; it looks like a small plate, raised a little in the centre. Bell's statement that the podia appear to be absent does, of course, not hold good; they are only as a rule strongly contracted in the preserved specimens so as to be not directly visible, without some preparation. Sometimes, however, they are found fully extended. — The colour of the live specimens is a light reddish, which generally disappears on preservation in alcohol as well as in formaline.

In view of the fact that Lyman's figure of the oral side of this species (Chall. Oph. Pl. V. 1) shows the 4 proximal pore pairs well developed, whereas normally only the three first pore pairs are developed, it is of interest to state that sometimes 4 pore pairs may be developed on one or other arm, though apparently never on all of the arms. — Among the very numerous specimens examined only one is 4-rayed. Not rarely a small supplementary plate is found at the inner angle of the mouth shield.

It would seem that the reduction of the pores, combined with the transformation of the middle spine into a small upturned hook, may justify the genus (or subgenus) *Ophiuroglypha* established by Hertz for the group of species showing this combination of characters.

The species is evidently very common in deep water off the Cape, and it is one of the species characteristic of S. African seas, being not known from elsewhere.

Ophiura (*Ophiuroglypha*) *tumida* n. sp.

Pl. XIX. Figs. 22—23.

Off Durban, 29°59′ S. 31° 7′ E. 127 fathoms. Several specimens.
— 29°54′ S. 31°10′ E. 68 — — —
— 29°56′ S. 31°19′ E. 225 — 1 specimens.

These specimens dredged onboard the "Pickle", 27. VIII. 1929.

Further, I got some specimens from the Fisheries Survey: 29°51′S. 31°16′E. 158 fathoms.

Most of the specimens are small, but a good deal of them, mainly from the depth of 127 fathoms, reach a size of up to 15 mm diameter and have all appearances of being full grown.

The species is very closely related to *O. costata*. On the oral side the only difference to be noted is that of the central plate-like depression being much less pronounced than in *costata*. The aspect of the dorsal side is rather conspicuously different from that of *costata* in the larger plates being distinctly swollen, particularly the radial shields and the interradial marginal plate, these plates being all quite flat in *costata*. Also the outline of the arms, in side view, is conspicuously different, the dorsal plates being distinctly tumid in *tumida*, quite

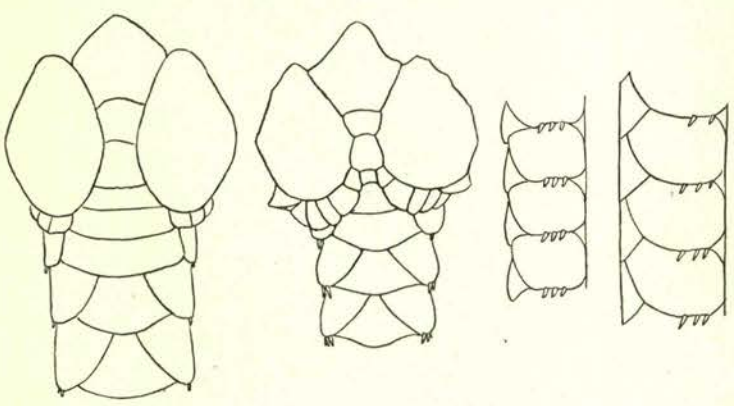


Fig. 85. Part of dorsal side of *Ophiura costata* (Lyman) (a) and *Oph. tumida* n. sp. (b); part of arm, side view, of *Oph. tumida* (c) and of *Oph. costata* (d). × 12.

flat in *costata* (Figs. 85. c—d.). Finally, there is a conspicuous difference in the combs at the base of arms, they being much farther apart in *costata* than in *tumida* (Figs. 85. a—b.). By means of this character also the younger specimens, in which the tumidity of the radial shields

and marginal plates is much less outspoken, may be distinguished fairly easily from the young *O. costata*. — The latter also grows to a considerably larger size than *O. tumida*, up to ca. 25 mm in diameter.

The specimens from the Fisheries Survey are all small, and their marginal plates scarcely so much swollen as those of the typical form. Still I cannot doubt that they do belong to this same species. Also, the combs at the arm bases are as those of the typical form.

Ophiura (*Ophiuroglypha*) *irrorata* (Lyman).

Ophioglypha irrorata Lyman. 1882. "Challenger" Oph. p. 47. Pl. V. 7—9.
Ophiura — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 358.
Ophiuroglypha irrotata (sic!). M. Hertz. 1927. Oph. Deutsch. Tiefsee-Exp. p. 86.
Ophiura (*Ophiuroglypha*) *irrorata*. Th. Mortensen. 1923. "Ingolf" Oph. p. 86.

This species did not occur in any of my own dredgings and trawlings in S. African seas, but there are some specimens in the material left me by the Fisheries Survey, from 33°37′ S. 16°55′ E. 1000 fathoms and 33°28′ S. 16°40′ E. 1000 fathoms (1 small specimen).

The fact that the well developed podia are not confined to the three or four proximal joints, but continue a good way out, till about the 10th joint, decreasing very gradually in size, contribute to the effacing of the otherwise rather clear limits of *Ophiuroglypha* and cause me to hesitate in accepting this group of species as more than a subgenus.

Dictenophiura anoidea H. L. Clark.

Dictenophiura anoidea H. L. Clark. 1923. Echinod. Fauna S. Africa. p. 361. Pl. XIX. 1—2.
Ophiura carnea. Hertz. 1927. Oph. d. deutsch. Tiefsee-Exp. p. 69.

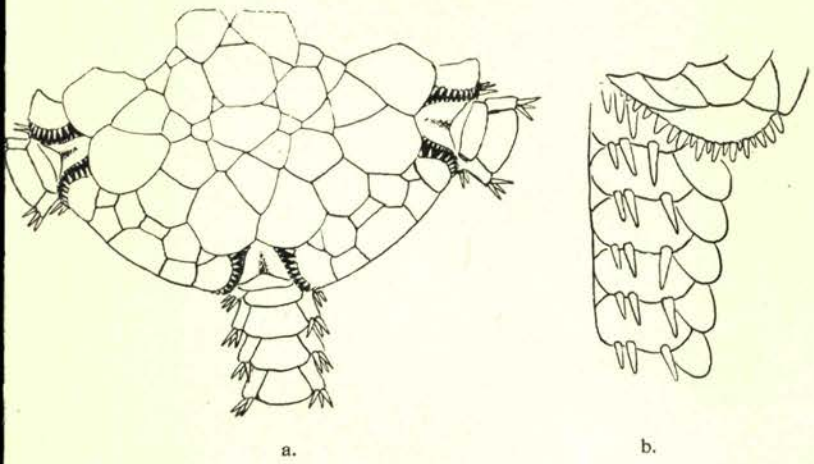
Cape Point in South $2^1/_4$ miles. 30 fathoms; sand. 19. XII. 1929. 12 specimens.
34°5′ S. 18°2′ E. 118 fathoms; black sand. 23. XII. 1929. 1 specimen.
Chapmans Bay, 28 fathoms; sand. 20. XII. 1929.

There are further in the material left me by the Fisheries Survey some specimens from Nieca River mouth N.W.×N$^1/_4$W. 7 miles, 43 fms.; s. sh. coral P. F. 13313 (near East London).

The specimen from Chapman's Bay is 10 mm in diameter of disk, thus considerably larger than the largest specimen seen by Clark (6.5 mm diam.).

As the photographic figures of this species given by Clark do not show any structural details distinguishably, I give here some drawings of it (Fig. 86, 87. a.).

H. L. Clark has well remarked that this species is very closely related to the European *Oph. carnea*, the genotype of the genus *Dictenophiura*, but he thinks it to be perfectly distinguishable from the latter particularly by the upper arm plates of *anoidea* being perfectly flat, in *carnea* swollen. The figure given here of the side view of an arm of the specimen of 10 mm diameter shows, however, the dorsal arm plates



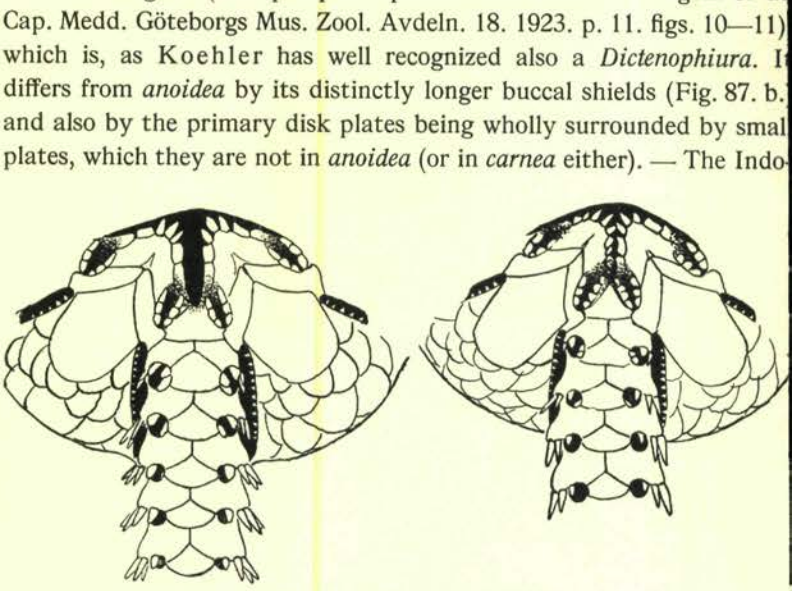
a. b.

Fig. 86. *Dictenophiura anoidea* H. L. Clark. Part of dorsal side (a); basal part of arm and armcomb, side view. (b). a. × 10; b. × 20.

of the adult *anoidea* to be very distinctly swollen, by no means less so than those of *carnea*. This character, accordingly, does not hold good. Further, Clark states the ventral arm plates to be smaller and less conspicuous in *anoidea* than those of *carnea*. I wonder how he came to this statement. The case is exactly the inverse; in *carnea* the ventral plates are distinctly smaller, and they are thick, elevated, whereas in *anoidea* they are flat. This is, I think, the most conspicuous difference between the two species. The disk plates of *carnea* are also a little smaller and more numerous (by no means "much more numerous" as says Clark) and the arm spines a little shorter (not "about twice" as short) than those of *anoidea*. That the two are good, distinct species can scarcely be doubted. That the specimen from the Agulhas Bank

recorded by Hertz (Op. cit.) as *Ophiura carnea* is not really this species but *Dictenophiura anoidea* can hardly be doubtful.

Another very closely related species is the *Ophiura Skoogi* of Koehler from Angola. (Sur quelques Ophiures des côtes de l'Angola et du Cap. Medd. Göteborgs Mus. Zool. Avdeln. 18. 1923. p. 11. figs. 10—11) which is, as Koehler has well recognized also a *Dictenophiura*. It differs from *anoidea* by its distinctly longer buccal shields (Fig. 87. b.) and also by the primary disk plates being wholly surrounded by small plates, which they are not in *anoidea* (or in *carnea* either). — The Indo-



a. b.

Fig. 87. Part of oral side of *Dictenophiura anoidea* H. L. Clark (a), and of *Dictenoph. Skoogi* Koehler (b). × 12.

Malayan species *stellata* is sharply distinguished from the three other species, particularly by its large marginal, interradial plate, and I cannot at all agree with Clark that *anoidea* should be intermediate between *carnea* and *stellata*.

Ophiocten amitinum Lyman.

Ophiocten amitinum Lyman. 1882. "Challenger" Oph. p. 79. Pl. IX. 7—9.
— — Studer. 1883. Oph. d. "Gazelle", p. 16. Taf. II. 8. a—f.
— — Ludwig. 1899. Oph. d. Hamburger Magalhaensische Sammelreise, p. 4.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 363.
— — Koehler. 1923. Ast. & Oph. Swedish Antarctic Exped. p. 122.

Some specimens dredged onboard the "Pickle":
False Bay, 30 fathoms. 20. XII. 1929. 4 specimens.
34°5′ S. 18°2′ E. 118 fathoms. 23. XII. 1929. 2 specimens.

It is on the authority of H. L. Clark that I refer these specimens to *Ophiocten amitinum*. They are identical with some specimens from S. African seas identified by Clark (left me by the S. African Museum). As Clark has directly compared these specimens with specimens from the "Challenger" there ought to be no doubt of the correctness of this identification. Still, I will not omit pointing out some small differences from the figures given by Lyman.

The buccal shields are represented by Lyman as broader than long, and also stated so in the description; in the S. African form they are rather longer than broad. That the papillæ on the basal arm joints are less developed than those of the typical form is mentioned by Clark, but he does not say that there is a rather distinct incision in the disk above the arm base, recalling rather much *Ophiura affinis*. On the whole, this species recalls rather much *Ophiura affinis* and, with the latter, tends to efface the limit between the genera *Ophiocten* and *Ophiura*.

The species *Ophiocten africanum* described by Koehler from Angola (Sur quelques Oph. des côtes de l'Angola et du Cap; p. 15, figs. 6—7) is another such intermediate form. Having had an opportunity of examining the type specimen, kindly lent me by my friend, Professor L. Jägerskjöld, Director of the Gothenburg Museum, I may state that it is very closely related to the Mediterranean *Ophiura Grubei* Heller, and should, in my opinion, rather be referred to the genus *Ophiura* than to *Ophiocten*.

The specimens in hand of *Oph. amitinum* have partly rather distinct, dark bands on their arms.

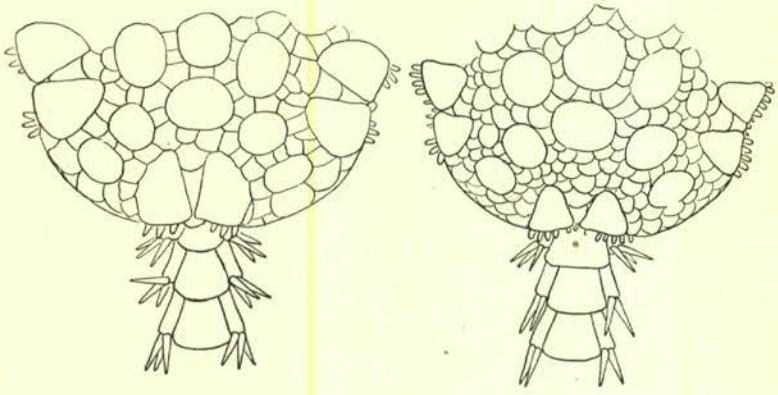
Ophiocten amitinum, var. *microplax* n. var.

Under stones in rock-pools at Humewood, near Port Elizabeth. 12. VII. 1929. 8 specimens.

The specimens are all small, the largest 2.5 mm diameter of disk.

In general they have great likeness to *Ophiocten amitinum*, the only distinct, and apparently constant, difference being in the size of the radial shields. These are in the present form very small, scarcely half the size of those of the typical *O. amitinum* of a corresponding size (Fig. 88. a—b.). It would seem that also the buccal shields are a little longer in the present form than in *amitinum* — but this is no very distinct or quite constant difference.

The rather unusual habitat for an *Ophiocten*, none of the other species having been found in the purely littoral region, makes one expect it to represent a separate species. In view of its great general resemblance with *O. amitinum* I shall, however, prefer to designate this littoral form only as a variety of that species, leaving it to future researches to settle the question of its specific validity. — None of the specimens were sexually mature, so it may be expected that it will



a. b.

Fig. 88. Part of dorsal side of *Ophiocten amitinum* Lyman (a) and of *Oph. amitinum*, var. *microplax* (b) n. var. × 18.

reach a larger size than that of the present specimens. The colour of the preserved (dried) specimens is a pure white.

Ophiocten latens Koehler.

Ophiocten latens Koehler. 1906. Oph. du "Travailleur" & du "Talisman", p. 267. Pl. XVIII. 11—12.
— — Th. Mortensen. 1927. Handbook Echinod. Brit. Isles, p. 246.
— — — 1933. "Ingolf" Oph. p. 98.
— *pacificum*. H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 364. (non: *Ophiocten pacificum* Ltk. & Mrtsn.).

This species was not taken in any of my own dredgings or trawlings in S. African seas, but there are 3 specimens from 33°50′ S. 17°59′ E. 1190 fathoms, in the material left me by the Fisheries Survey.

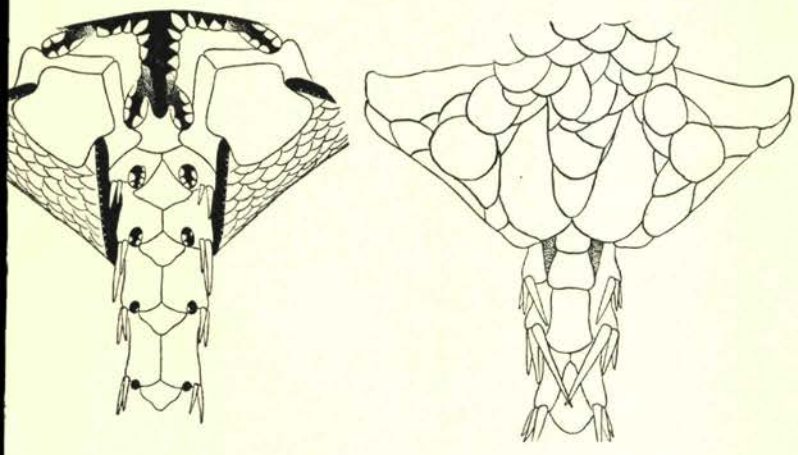
These specimens are quite conform with those recorded in my report of the Ophiuroidea of the Ingolf Expedition under the name of *Ophiocten latens* Koehler. As I have set forth there (p. 98, Figs. 51. a, b.)

do not think it safe to regard *O. latens* and *O. pacificum* as identical, he difference in the shape of the mouth shields, the arm combs, and he ventral arm plates being characters apparently important enough or regarding them as different species. In these regards my S. African pecimens agree completely with the Atlantic species *O. latens*, not vith the species of the Pacific. Although I have not examined the . African specimens identified by Clark as *O. pacificum*, it will scarcely e too rash to suppose that they also belong to the Atlantic type.

Gymnophiura novembris Hertz.

ymnophiura novembris M. Hertz. Oph. d. deutsch. Tiefsee-Exp. p. 72. Taf. VI (I). 9—10.

No specimens of this species were collected by myself or by the . African Fisheries Survey, the species having till now been found nly by the German Deepsea Expedition off the Agulhas Bank (35°9′ S.



a. b.

Fig. 89. *Gymnophiura novembris* Hertz. Part of oral (a) and dorsal side (b). × 15.

18°32′ E.) at a depth of 564 meters. Having a cotype at disposal (left me by the Berlin Museum) I think it desirable to give a couple of figures of it (Fig. 89), as the photographic figures given by Hertz do not show the details at all distinctly; particularly the figure of the oral side is very indistinct.

As for referring this species to the genus *Gymnophiura* I do not

feel quite convinced of the correctness of so doing — but I have no sufficient material for entering on a discussion of this question. I would only point out the great general resemblance between this species and *Ophiura trimeni* Bell, as will appear on a comparison of the figures 8 and 84.

Ophiomusium Lymani Wyv. Thomson.

Ophiomusium Lymani Wyv. Thomson. 1873. Depths of the Sea, p. 172.
— — Clark. 1923. Echinod. Fauna S. Africa, p. 364.
— — Mortensen. 1927. Handbook Ech. Brit. Isles, p. 253.
Ophiomusa — Hertz. 1927. Oph. Deutsche Tiefsee. Exp. p. 103.
Ophiomusium — Mortensen. 1933. "Ingolf" Oph. p. 100.

No specimens were taken in my own dredgings and trawlings in S. African seas, but there are specimens in the material of the S. African Fisheries left me by the Fisheries Survey, viz.

33°37′ S. 16°55′ E. 1000 fathoms. 2 specimens.
33°28′ S. 16°40′ E. 1000 — 4 —

In the report on the "Ingolf" Ophiuroidea (p. 102) I have given my reasons for not accepting, at least for the present, the genus *Ophiomusa* established by Dr. Hertz for the species of *Ophiomusium* with only two pairs of pores.

Astrophiura permira Sladen.

Astrophiura permira Sladen. 1879. On the structure of Astrophiura, a new and aberrant genus of Echinodermata. Ann. Mag. Nat. Hist. 5. Ser. IV. p. 401. Pl. XX.
— *Cavellæ* Koehler. 1915. Description d'une nouvelle espèce d'Astrophiura, l'Astrophiura Cavellæ. Bull. Inst. Océanogr. No. 311.
— — Clark. 1923. Echinod. Fauna S. Africa, p. 354.
— *permira* Hertz. 1927. Oph. d. deutsch. Tiefsee-Exp. p. 83. Taf. VII (II). 4—5.

There are 4 specimens in the material of the Fisheries Survey, left me by Dr. C. van Bonde. They are, unfortunately, labelled only by a number, the meaning of which cannot be made out.

Clark has expressed grave doubts as to the specific value of the *Astrophiura Cavellæ* described by Koehler, and Hertz simply calls the same specimens upon which Koehler's species was based *Astr. permira*, without even entering on a discussion of the question of the

validity of Koehler's species. I can only join Hertz in regarding *A. cavellæ* as identical with *A. permira*.

Koehler points out as differences between *permira* and *Cavellæ* the arrangement of the dorsal plates, the presence of buccal shields in *Cavellæ*, they being absent in *permira*, and the absence of arm spines beyond the first free joint in *Cavellæ*, their presence in *permira*. That the two first of these characters are invalid was shown by Clark; as regards the arm spines the material at hand proves that no difference exists here either, spines occurring at least until the 6th free arm joint in the South African form (Fig. 90); very probably they continue to the end of the arm. Thus there is not a single reliable difference between *permira* and the S. African form, and there can be no doubt any longer of Koehler's species *A. Cavellæ* being simply a synonym of *Astrophiura permira* Sladen.

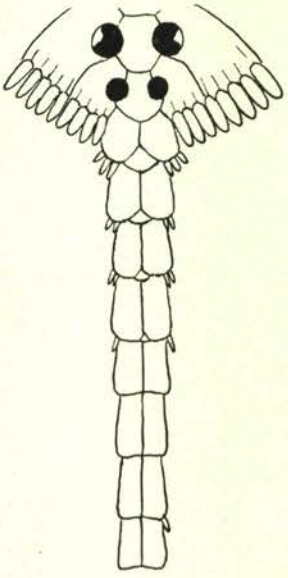


Fig. 90. Part of disk and arm, ventral side, of *Astrophiura permira* Sladen. × 12.

In one of the specimens an arm piece of 7 free joints is preserved (Fig. 90); it is evident that there must have been some 4—5 joints more in the intact arm. Thus there is no difference in the length of the arms between *A. permira* and the Japanese species *A. kawamurai* Matsumoto. As a matter of fact, I do not see any character by which the Japanese form can be distinguished from the S. African form, and I can hardly doubt that they really belong to one and the same species.

Koehler (Op. cit. p. 9) mentions having observed the genital organs as a pair of small, dark, slightly branching glands. I give here a figure to show these organs (Fig. 91). As eggs cannot be discerned it is probable that the species is a male. No genital openings are observable in any of the specimens in hand. That pores for the shedding of the genital products are formed by resorption of the plates of the skin, as it takes place in *Ophiopus arcticus*, cannot be doubted, since genital slits are absent. — I fully agree with Matsumoto in seeing in the

10 large plates round the mouth the jaw-plates and in the elongated narrow plate along the first arm joint the adoral plate, not the genital scale, as it was interpreted by Sladen.

The strong development of the tubefeet on the arm joints enclosed in the disk, together with the whole shape of the disk, makes it eminently

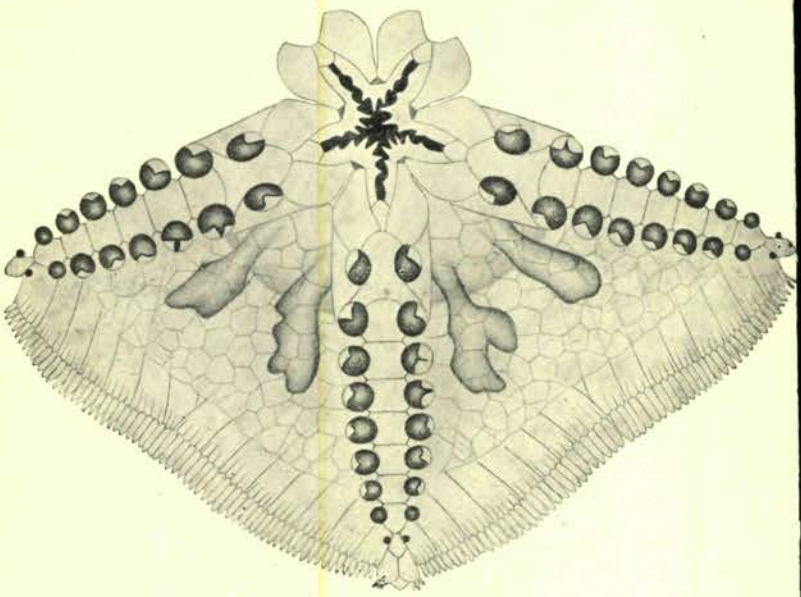


Fig. 91. *Astrophiura permira* Sladen. Part of oral side, showing genital organs. × 10

fit for acting as a large sucking disk, and there can hardly be any doubt that the species lives attached on stones or other hard objects much as a *Patella*, as Matsumoto also found it to be the case with the Japanese species, *A. kawamurai*, and as I found it to be the case with the closely related *Ophiophycis gracilis* Mrtsn. from St. Helena.

Additional Note.

Asterina coccinea (Gray) (ad. p. 256—57). During a recent visit to the British Museum I had the opportunity of seeing the type material of this species. All 3 specimens are in a very poor condition, nothing to be seen of the ambulacral or buccal armature. It is therefore impossible to identify them with full certainty; but judging from

he characters of the dorsal side it seems rather certain that they are dentical with the Californian species *Asterina miniata* (Brandt). As Brandt's name is the older (1835) the *Patiria coccinea* of Gray (1841) ecomes a synonym of *Asterina miniata*.

Pteraster affinis E. A. Smith (ad. p. 230). The specimen referred to this species by H. L. Clark, 1923 (Echinod. Fauna S. Africa, . 300), has been sent me for examination by Dr. K. H. Barnard. I ind it to differ remarkably from *Pt. affinis* in the character of the uperoral spine, which terminates in a cylindrical peg, whereas this pine is stated to be tricarinate in *Pt. affinis*. However, examining the riginal specimens of *affinis* in the British Museum I find a good deal f variation to obtain in the character of the superoral spine; it cannot really be said to be typically tricarinate — even in the type specimen it is not very distinctly tricarinate; more generally it is cylindrical, omewhat irregular. I think it not at all improbable that the specimen rom off Cape Peninsula is really identical with the Kerguelen form, as tated by Clark.

After this paper was nearly ready from the press, I received Dr. Arthur A. Livingstone's paper "Some genera and species of the Asterinidæ" (Rec. Australian Mus. XIX. 1. 1933). It being too late for including references to it, I must content myself with calling attention here to this important paper.

Explanation of the Plates.

Plate VIII.

Figs. 1—2. *Astropecten exilis* n. sp. Aboral (1) and oral side (2).
- 3—4. — *antares* Döderlein. Large specimen, aboral (3) and oral side (4).
- 5—6. — — Döderlein. Small specimen, aboral (5) and oral side (6).
- 7—8. — *anacanthus* H. L. Clark. Aboral (7) and oral side (8).
- 9—10. *Mediaster capensis* H. L. Clark. The typical form (10) and Var. *durbanensis* n. var. (9). Oral side.

All figures natural size.

Plate IX.

Figs. 1—2. *Persephonaster Roulei*, var. *euryplax* n. var. Oral (1) and aboral side (2).
- 3—4. *Astropecten leptus* H. L. Clark. Oral (3) and aboral side (4).

All figures natural size.

Plate X.

Figs. 1—2. *Calliaster acanthodes* H. L. Clark. Aboral side. Showing difference i the size of the distal superomarginals.
- 3—4. *Odontaster australis* H. L. Clark. Aboral side.
- 5—7. *Tosia tuberculata* Gray. Aboral side. 5—6. Two young specimens showing difference in the size of the dista supero-marginals. 7. Part of very larg specimen, with closeset tubercles, carryin pedicellariæ.

All figures natural size.

Plate XI.

Fig. 1. *Hippasteria phrygiana*, var. *capensis* n. var. Oral side.
- 2. — — (Parelius). Specimen from the Skagerrack. Ora side.

Natural size.

Plate XII.

Figs. 1—2. *Anseropoda* (*Palmipes*) *grandis* n. sp. Disk and one arm; oral (1 and aboral side (2).
- 3. *Disasterina leptalacantha*, var. *africana* n. var. Oral side.
- 4—8. *Asterina* (*Patiriella*) *exigua* (Lamarck). Very large specimen, ora side (4). Large specimen, abora side, showing rounded outline (5). Six-armed specimen, oral side showing genital pores (6). Smalle specimens, oral side, showing th naked space at the oral end o interradii (7—8). In specimen 7 the normal convex outline of the interradii partly preserved.
- 9—10. *Parasterina formosa* n. sp. Aboral (9) and oral side (10).
- 11—13. *Tylaster meridionalis* n. sp. Oral (11) and aboral side (12). Dried specimen in side view (13).
- 14. *Cryaster brachyactis* H. L. Clark. Oral side. (The "*Culcita veneris*" of Bell; cf. p. 249).

All figures natural size.

Plate XIII.

Figs. 1—2. *Echinaster ornatus* Perrier. Aboral (1) and oral side (2).
- 3. — — — Specimen with the spinelets arranged in simple series. Aboral side.
- 4. *Patiria coccinea* Gray. Type specimen; aboral side.

Plate XV.

Figs. 1—4. *Cosmasterias felipes* (Sladen). Aboral (1 and 3) and oral side (2 and 4).
- 5—6. *Sclerasterias stenactis* (H. L. Clark). Aboral (5) and oral side (6).
- 7—8. — *eustyla* (Sladen). Arms, from the oral side (7) and in side view (8).
- 9—10. *Perissasterias* sp. Arms, from the oral (9) and aboral side (10).
- 11—12. *Cosmasterias capensis* (Perrier). Type specimen. Aboral (11) and oral side (12).

Natural size, except figs. 3—4 which are slightly magnified.

Plate XVI.

Fig. 1. *Marthasterias glacialis*, var. *africana* (Müll. & Troschel). Aboral side.
- 2—3. — — — *rarispina* (Perrier). Aboral side.

All figures natural size.

Plate XVII.

Figs. 1—2. *Astrocladus africanus* n. sp. Type specimen. Aboral (1) and oral side (2).

Natural size.

Plate XVIII.

Figs. 1—2. *Gorgonocephalus pectinatus* n. sp. Type specimen. Aboral (1) and oral side (2).
- 3—4. *Astroconus capensis* n. sp. Type specimen. Oral (3) and aboral side (4).
- 5—6. *Astrocladus hirtus*, var. *reticulatus* n. var. Type specimen. Oral (5) and aboral side (6).
- 7. — *euryale* (Retzius). Oral side of disk; two of the mouth slits denuded in order to show (in the other three slits) that the distal part of the mouth slits is covered over by the skin (best seen in the right side of the figure).
- 8—9. *Astroceras spinigerum* n. sp. Type specimen. Aboral (8) and oral side (9).

All figures natural size.

Plate XIX.

Figs. 1—3. *Astrocladus hirtus* n. sp. Aboral (1—2) and oral side (3).
- 4—5. *Asterostegus tuberculatus* n. sp. Type specimen. Oral (4) and aboral side (5).
- 6—7. *Ophiacantha scutigera* n. sp. Oral (6) and aboral side (7).
- 8. — *baccata* n. sp. Aboral side.

Figs. 5—7. *Asterina penicillaris;* specimens from the Red Sea, thus identifie by Müller & Troschel.
- 8—10. *Austrofromia Schultzei* Döderlein. Specimens from East Londor Oral (8) and aboral side (9). Arm in sid view (10).
- 11—12. *Henricia abyssalis* (Perrier). Aboral (11) and oral side (12).

All figures natural size.

Plate XIV.

Figs. 1—3. *Pteraster capensis* Gray. Specimen with two young ones about t leave the brood chamber; indistinctly seen i upper right interradius (1). Specimen from th oral side, showing the narrow fin-membran (2). Specimen with bifurcating arm; oral side (3)
- 4—5. — *fornicatus* n. sp. Type-specimens; aboral (4) and ora side (5).
- 6—7. — *flabellifer* n. sp. Type specimen; aboral (6) and oral side (7)
- 8—9. *Hymenaster lamprus* H. L. Clark. Aboral (8) and oral side (9).

All figures natural size.

Figs. 9—11. *Ophiothamnus remotus* Lyman. Aboral (9—10) and oral side (11)
- 12. *Ophiomitrella hamata* n. sp. Aboral side.
- 13—15. *Ophiacantha* (*Ophiotreta*) *durbanensis* n. sp. Aboral (13, 15) an oral side (14).
- 16—17. *Amphiura compressa* n. sp. Type specimen. Oral (16) and abora side (17).
- 18—19. *Amphioplus falcatus* n. sp. Oral (18) and aboral side (19).
- 20. *Amphipholis strata* n. sp. Aboral side.
- 21. *Cryptopelta aster* (Lyman). Specimen opened so as to show the bursa filled out by young ones.
- 22—23. *Ophiura* (*Ophiuroglypha*) *tumida* n. sp. Oral (22) and aboral side (23)
- 24. *Ophiopezella decorata* n. sp. Type specimen. Aboral side.
- 25. *Ophiogymna fulgens* (Koehler). Aboral side.
- 26. — *capensis* (Lütken). Type specimen. Aboral side.
- 27. *Ophiomyxa tenuispina* n. sp. Type specimen. Oral side.

All figures natural size.

Separate copies ready from the press 23. X. 1933.

Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LXVI.

The Echinoderms of St. Helena.

(Other than Crinoids).[1]

By

Th. Mortensen.

With Plates XX—XXII.

For many years, almost ever since I began studying Natural History, I have been interested in the question of the origin of the marine fauna of St. Helena, my interest being particularly roused when, in the early nineties, I read Wallace's "Island Life". In this fascinating book the origin of the land fauna and flora of St. Helena is explained, the various ways and means of transport pointed out, through which the components of the land fauna and flora may have reached that little island, so isolated in mid-ocean, and there flourished — until it was for the greater part destroyed through "civilized" mans agency.

It is only the land fauna and flora that is dealt with by Wallace, the marine fauna and flora being left entirely out of consideration, and very naturally so, because altogether too little was known of the marine fauna and flora for being at all usable for a discussion of its origin. But it is clear that quite similar, and no less interesting, problems as those connected with the land fauna and flora must be connected with the origin of the marine fauna and flora of such an isolated island,

[1]) This report on the Echinoderm Fauna of St. Helena, is, together with the following paper, by Professor T. Gislén, dealing with the Crinoids of St. Helena, included in the series "Papers from Dr. Th. Mortensen's Pacific Expedition" with the special permission of the Board of Directors of the Rask-Oersted Fund.

which has evidently never been in much nearer connection with th continents than it is now.

For many years my interest in the marine fauna of St. Helena was however, mainly platonic, no thorough investigations of that faun having been undertaken, and the little that was known being altogethe too insufficient for speculation about the origin of this fauna. Bu then prospects of myself being able to make such investigations a St. Helena offered themselves when, through the liberal grants of th Rask-Oersted Fund and the Carlsberg Fund, I could undertake a expedition to Java—Mauritius—South Africa in 1929—1930. Bein in S. Africa it was natural enough to take the homeward trip by th normal monthly mail passing St. Helena and use the time from on mail to the next for making marine investigations there. It cam even so fortunate for me that the next mail was somewhat delayed s that I could spend a little more than 5 weeks at St. Helena, fron January 26th to March 6th, 1930. By another very fortunate circum stance it happened that the "Dana" on her famous circumnavigatio arrived at Cape Town early in February that year and took the home ward course via St. Helena. Through the kindness of the leader of th "Dana Expedition" the late, lamented Professor Johs. Schmidt the "Dana" was then placed at my disposal for dredgings and trawling round St. Helena for 3 days — and by the small distances, the islan being only 47 □ miles (123 km²), much work might be accomplishe in three days with a steamer well fitted out for that kind of work.

It did, however, not come out quite as easily as I had fancied. Fo work in the shallower water on the coastal plateau surrounding th island I could use a fair-sized motor-boat hired from Mr. Solomon the Danish Consul in Jamestown. Accordingly I wanted to use th "Dana" for work in deep water on the steep ledge of the coastal plateau and in the deep-sea just outside the ledge. But this proved to offe unexpected difficulties. The bottom of the edge of the plateau wa exceedingly irregular, must, indeed, have much the appearance o the coast of the island itself, with steep rocks and deep ravines i close succession. We might set the trawl at a depth of 1100 meters then after having moved about the ship's length there would be 50 meters, immediately after again 1800 meters, and so on. No wonde that the trawl would at once get hold in the bottom and come up completely torn; that it did come up at all is more to be wondered at.

thought then, it might be more profitable to work in much deeper water, where clean mud bottom was to be expected. The trawl was set in 2400 meters — and was immediately caught in the bottom. It

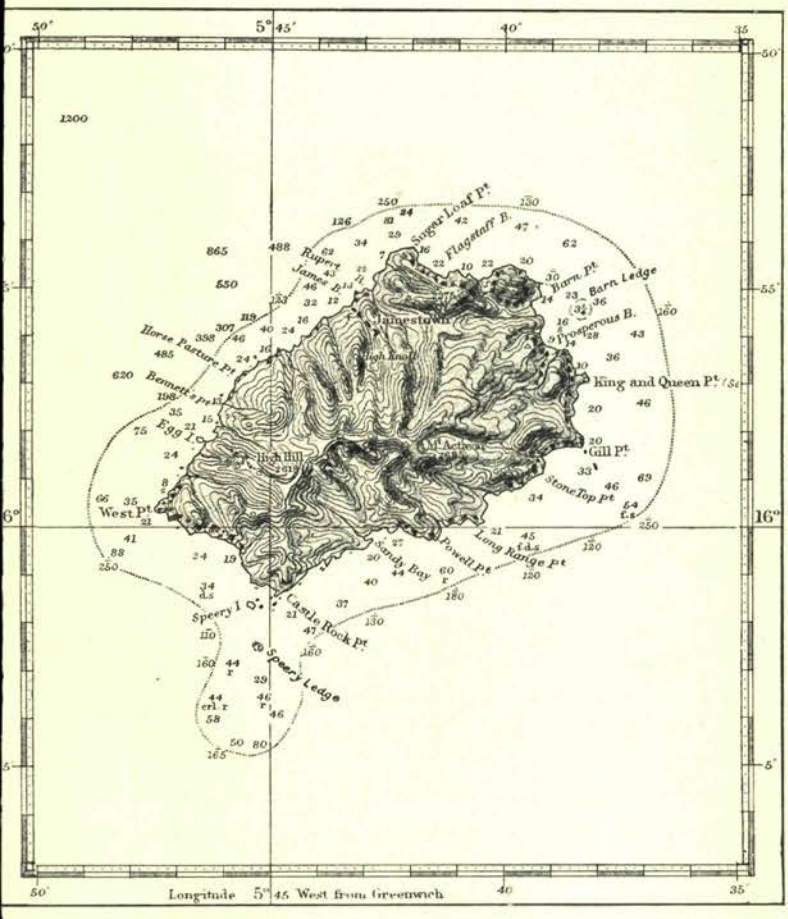


Fig. 1. Map of St. Helena.

gave great trouble to get it up, — the depth was now 2780 meters — but we got it at length, not too much torn and with some few very interesting specimens, not the least interesting being some pieces of volcanic rock, from the very foundation stone of the island. It was then deemed preferable, in spite of all, to work on the slope itself,

and we did succeed in getting some successful hauls, which gav very fine results, so that we have now an idea of the sort of faun that lives on the steep ledge round the island.

The main work was, however, that accomplished, by means of th said motor-boat, on the coastal plateau. Conditions are here in genera very good for dredging and trawling, the bottom being in the mai clean. The operations were in the main carried out on the lee-side, o the N.W. coast, but also in Flagstaff Bay and Prosperous Bay on th North side and in Manatee Bay[1]), at the S.W. end of the Island. O the S. E. coast I could not work with my small motor boat, distance from Jamestown being too great, and there being no safe anchor plac here on the windward side. But some dredgings undertaken here on board the "Dana" gave nothing but what had been found off the lee side of the island, so there is every reason to expect that the faun of the windward side does not differ essentially from that of the lee side.

Over great åreas, particularly in Flagstaff Bay and Prosperou Bay, the bottom is a fine black sand with only a very poor fauna an flora. On the lee side the bottom is more varied. Off Sugarloaf area with clay bottom are found; off Jamestown wide areas are covere with the big, irregular lumps of the sponge *Chondrosia plebei* O. Schmidt; other areas are covered with big mussels of the genu *Arca*[2]), on most of which grow some corkscrew-shaped *Cirripathe* Off Egg Island the bottom was covered with small stones overgrow with *Lithothamnion;* in Manatee Bay again the trawl got filled wit a fernlike branched Anthipathid, which must form a rather dens covering of the bottom. I was greatly disappointed in finding n Ophiurids on these Anthipathids, as on the whole, the fauna wa rather poor and uniform there, as everywhere. On the sponges o Jamestown *Ophiothrix roseo-coerulans* was fairly common, likewis *Eucidaris clavata*, the young ones generally more or less hidden in th cavities of the sponge. On the bottom with *Arca-Cirripathes* the oth

[1]) The name Manatee Bay is not found on the chart, fig. 1. It is the middl part of the S.W. end of the island.

[2]) According to the kind information from my friend Dr. N. Odhner of th Stockholm Museum this is *Arca Bouvieri* Fischer, known otherwise from W. Africa It was described by E. A. Smith as a separate species, *Arca St. Helenæ*, bu Dr. Odhner thinks it identical with the said W. African species.

Cidarid, *Tretocidaris spinosa*, was rather common. On the stony bottom off Egg Island *Pseudoboletia* occurs in patches in great numbers. Otherwise only scattered individuals of the various Echinoderm species were taken in the dredgings or trawlings.

Near the coast *Diadema* occurs in flocks, as is usual for Diademas. On the black rocks are found in great numbers the black *Echinometra lucunter*, together with the remarkable large, black Actinian, *Phymactis Sanctæ Helenæ* (Lesson). Whereas the Actinian is attached directly to the rock surface, exposed to the surf, the Echinometras sit in holes in the rocks and are thus protected against being washed away by the surf. Whether the holes are natural or bored by the sea-urchin I shall not try to decide — but I think rather they are natural holes in the rock. In the more protected rock pools *Asterina exigua* is common. On the rocks off the pier at Jamestown are found the black Comatulid *Tropiometra carinata* and the black *Holothuria farcimen*, none of them very numerous. Among all these black specimens the red *Ophidiaster ophidianus*, now and then seen near the low water line, makes a very striking show.

On the whole, the Echinoderm fauna, as the marine fauna in general, is poor, nothing like what would be found on a coral island in the Indo-Pacific or in the West Indies. Also corals are very poorly represented for a tropical island; there are no reef-building corals, only some dwarfed stone-corals are found here and there in the rock pools. In deeper water in the outer part of the coastal plateau the beautiful pink *Sclerohelia* occurs, but in isolated colonies, whereas on the steep slope a kind of Lophohelian coral forms submarine reefs much like the Lophohelias in the Trondheimfjord. On these corals I found the interesting new, small, brood-protecting Ophiurid *Ophiophycis gracilis*.

The first record of an Echinoderm from St. Helena is, so far as I have been able to find, that of G. C. Wallich, who, in his curious "Note on the discovery of an extremely minute Vertebrate lower jaw in mud dredged at St. Helena" (Ann. Mag. Nat. Hist. 3 Ser. X. 1862, p. (304) 440), states to have collected *Echinus lividus* there. That this in reality means *Echinometra lucunter*, the common black sea-urchin found everywhere on the rocks at low water mark, cannot be question-

able, the more so since *Paracentrotus lividus* does not occur at St. He lena. — That the object which Wallich thought to be the lower jav of a tiny vertebrate animal is a valve of a small globiferous pedicellaria of *Eucidaris clavata* Mrtsn. I have demonstrated in my note "Übe den angeblichen Kieselschwamm Microcordyla Asteriæ Zirpolo. Ein Beitrag zur Geschichte der Pedicellarien" (Zoolog. Anzeiger. 97 1932, p. 201). Thus, in this curious way, Wallich was the first to give evidence of the existence of this species at St. Helena. — It was on his way home from India, that he had an opportunity of making a single dredging off Jamestown, on the N. W. Coast of St. Helena, and thus was enabled to give this first little contribution to the knowledge of the Echinoderm fauna of St. Helena.

In April 1853 the Swedish fregate "Eugenia" called at St. Helena on returning from her circumnavigation (1851—53), and the medical officer and zoologist I. G. M. Kinberg made some marine collections there, including some Echinoderms. Unfortunately these Echinoderms were never dealt with, excepting alone a brittle-star which was described by Ljungman as *Amphiura atlantica* n. sp. in his paper "Ophiuroidea viventia huc usque cognita" (Öfvers. K. Svenska Vet Akad. Förhandl. 1866. p. 321). Through the kindness of my friend Professor Sixten Bock, director of the department of Invertebrates of the Stockholm Museum, the rest of the Echinoderms collected by Kinberg at St. Helena were sent me for examination. They proved to be:

Echinometra lucunter (Linn.)
Moiraster magnificus (Bell)
Linckia formosa Mrtsn.
Asterina exigua (Lamk.)
Coscinasterias tenuispina (Lamk.).

All of these species would have been new to the St. Helena fauna if a report on them had then been published. Now it can only be stated that all these species were actually first found there by the "Eugenia" Expedition, though first described or recorded from there much later, from the researches by Melliss, the "Scotia", Cunningham and the present author.

The next contribution is that of A. E. Grube, who in his note "Über einige seltnere oder neue Ophiuriden" (Jahresber. d. Schlesischen

Gesellsch. f. Vaterländ. Cultur. 45. 1868. p. 45) describes the new species *Ophiothrix roseo-coerulans* after some specimens from St. Helena, found in the Museum of Breslau; there is no history given of these specimens, which were bought from the naturalist dealer Salmin. But that they did really come from St. Helena is proven by my own researches there, which show this species to be quite common and, indeed, the only Ophiuran at all common at St. Helena.

The first general account of the Echinoderms of St. Helena is that given by J. C. Melliss in his fine book "St. Helena. A physical, historical, and topographical description of the island; including its Geology, Fauna, Flora, and Meteorology" 1875, p. 219—220. He there records the following Echinoderms as known to him to occur at the island:

Cidaris metularia Lamk. It is said that "there are two varieties of this species found at St. Helena". This, evidently means the two species of Cidarids common at St. Helena: *Eucidaris clavata* Mrtsn. and *Tretocidaris spinosa* Mrtsn.

Echinometra acufera Blainville, "the common thin-spined, black Sea-Egg, which abounds on the rocky coast all along the sea-shore just below high-water mark. This creature bores a hole in the solid basaltic rock sufficiently deep to protect itself". — He further mentions "a third, a very fine-spined Sea-urchin, the fragments of which I have picked up occasionally on the wind-ward sea-coast, but I never obtained a complete specimen". Whether this has been a *Diadema* or a *Pseudoboletia* is impossible to say.

Asterina minuta? "A small greenish Star-fish, found aboundantly sticking closely to the rocks around the sea-coast about high-water mark." This is the *Asterina exigua* (Lamk.).

Echinaster sp.? "A bright orange-coloured Sea-star. This brilliant creature may often be seen lying at the sea bottom near the shore, at the depth of a fathom or two". This is *Ophidiaster ophidianus* (Lamk.), which I found at the same depth off the pier of Jamestown.

Comatula sp.? "This very pretty, purple, feathery creature, not unlike the head of a miniature palm-tree, is occasionally taken from the pools of sea-water on the West rocks, and other parts of the coast." This is *Tropiometra carinata* (Lamk.).

Melliss further says: "There are several species of sand-stars, some of them very large and taken from deep water. I sent a collection

of them to the British Museum with the fishes, but as yet they have not been examined."

One of these sea-stars was the one described under the name of *Archaster magnificus* by F. Jeffr. Bell. 1881 (Description of a new species of the genus *Archaster* from St. Helena. Ann. Mag. Nat. Hist. 5 Ser. VIII. p. 440). It is now named *Moriaster magnificus* (Bell). The others of these sea-stars thus sent home by Melliss have apparently never been reported on. Thus in the "Challenger" Asteroidea the only sea-star recorded from St. Helena is *Moiraster magnificus*.

In 1903, in my "Ingolf" Echinoidea I, p. 17, I described the new Cidarid *Tretocidaris spinosa* after a specimen from St. Helena in the collection of the British Museum, probably one of the Echinoderms sent home by Melliss.

In 1908 R. Koehler in his report on the "Ophiures et Echinides de l'Expédition Antarctique nationale Ecossaise" (Trans. R. Soc. Edinburgh. XLVI) mentions the following Echinoderms dredged at St. Helena by the "Scotia" on its homeward voyage: *Linckia Bouvieri* Perrier and *Cidaris tribuloides* Lamarck. These are the *Linckia formosa* n. sp. described in the present paper and *Eucidaris clavata* Mrtsn. described in my Monograph of the Echinoidea, I, p. 408.

In 1909 Professor J. T. Cunningham spent five weeks at St. Helena making fisheries investigations. By his trawlings a small number of Echinoderms were obtained, a list of which he gives in a paper "On the marine Fishes and Invertebrates of St. Helena" in Proc. Zool. Soc. 1910, p. 124—125. It contains only the following species, identified by F. Jeffr. Bell: *Cidaris tribuloides*, *Tripneustes ventricosus*, *Echinometra subangularis*, *Linckia* sp. and *Antedon carinata*. The *Cidaris tribuloides* is, of course, *Eucidaris clavata*, the *Linckia*, if correctly identified to genus ("too young for specific determination" according to Bell) must, no doubt be *Linckia formosa*. The only species new to St. Helena in this list is *Tripneustes esculentus*. But I feel rather sure that this must be an erroneous identification or that the locality is wrong.

By my own researches off St. Helena I was very intent on finding this latter species there — but not a single specimen, or even a fragment of a dead test was found, whereas I often found fragments of dead tests besides numerous living specimens of *Pseudoboletia atlantica*. If *Tripneustes esculentus* did really occur at St. Helena, I do not think

could have missed it. Also, there is no mention of a specimen from t. Helena in H. L. Clark's Catalogue of the recent Echinids (p. 124). ne might suggest that it was a misidentification of *Pseudoboletia lantica*, but of this species Clark mentions (p. 131) only one speci- en from St. Helena and that is labelled as taken by Alexander, not y Cunningham. There is thus some mystery about this species; oreover Cunningham states to be not sure of the exact locality here he obtained it. Seeing that Clark records *Tripneustes esculentus* om Ascension, one might suggest that the said specimen came from ere, not from St. Helena. In any case we cannot accept this species ithout reservation as belonging to the St. Helena Echinoderms, till ew reliable proof of its occurrence there is given.

In H. L. Clark's Catalogue of the recent sea-urchins in the collec- on of the British Museum (1925) the following species are recorded om St. Helena: *Tretocidaris spinosa* Mrtsn., *Eucidaris tribuloides* Lamk.), *Diadema antillarum* (Phil.), *Parechinus angulosus* (Leske), *chinometra lucunter* (Linn.), and *Brissus brissus* (Leske). Of these *arechinus angulosus* is the most remarkable. The fact that I did not nd a single specimen of this species at St. Helena makes me doubt ery much the correctness of this statement. If it did really occur ere, it would be sure to occur in numbers in the rock pools, as is the ase at the S. African coasts, but not one was seen.

H. L. Clark is not sure of the identification, but of this there can carcely be any doubt. Dr. C. C. A. Monro has very kindly sent me me of these specimens, and I think the identification correct. r. Monro informs me that these specimens, as also the specimen f *Brissus brissus* were collected by Lieutenant Turton of the R. Bri- sh Navy and presented to the Museum in 1887. Now, one cannot elp wondering that here comes a young lieutenant and finds at a lance two notable Echinoids on the shores of St. Helena, which neither Melliss, Cunningham nor myself have been able to find — and or my own part I venture to say, that if *Parechinus angulosus* did eally occur there, I could hardly have missed it — coming, as I did, rom S. Africa, where I had collected any numbers of this species, nd thus knew its habitat perfectly well. As for the *Brissus*, I am nformed that it is a dried test with some spines on it. This would eem to indicate that it was found on the beach — but it would be ather impossible to find such tests lying on the little bits of sandy

beach that are found at St. Helena. I have never found anythin there, and feel convinced that any such specimen that happened t be washed ashore there would be sure to be crushed by the violer surf reigning there. I cannot help, therefore, thinking that these spec imens did not really come from St. Helena, and at least until new reliable records of the occurrence of these species at St. Helena ar at hand, I cannot without reservation accept them as belonging t the St. Helena fauna.

I shall now give a list of the St. Helena Echinoderms. In the lef column are given the species hitherto recorded, under various names in the right column the revised list, according to my own researches

In the list of the previously recorded species I have added letter indicating on whom the record rests, viz.: B. = Bell; C. = Cunning ham; Cl. = H. Lym. Clark; Gr. = Grube; K. = Koehler; Lj. = Ljungman; Me = Melliss; Mo. = Mortensen; W. = Wallich

List of Echinoderms of St. Helena.

Species hitherto recorded.	Revised list of species.
Asteroidea	Asteroidea
	Astropecten sanctæ Helenæ n. sp.
	— variegatus n. sp.
Archaster magnificus Bell (B)	Moiraster magnificus (Bell)
	Luidia aciculata n. sp.
	Hacelia superba H. L. Clark
Echinaster sp.? (Me)	Ophidiaster ophidianus (Lamk.)
	Narcissia trigonaria, var. Helenæ n. va
Linckia Bouvieri Perrier (K)	Linckia formosa n. sp.
	Chætaster longipes (Retzius)
Asterina minuta(?) (Me)	Asterina exigua (Lamk.)
	Coscinasterias tenuispina (Lamk.)
Ophiuroidea	Ophiuroidea
	Ophioscolex dentatus Lyman
	Ophiacantha prolata n. sp.
	— nitens n. sp.
	— trivialis n. sp.
	(— Helenæ n. sp.)
	Ophiotreta sp.
Ophiothrix roseo-coerulans Grube (Gr.)	Ophiothrix roseo-coerulans Grube
	Ophiactis abyssicola (M. Sars)
	— Savignyi (Müll. & Trochel)

	Ophiactis Lymani Ljungman
mphiura atlantica Ljungman (Lj.)	Amphiura atlantica Ljungman
	— grandisquama Lyman
	Amphipholis squamata (D. Ch.)
	Ophiopyren atlanticum n. sp.
	Ophiura Ljungmani (Lyman)
	Ophiophycis gracilis n. sp.
	(Ophiomusium spinigerum n. sp.)
Echinoidea	Echinoidea
idaris metularia Lamk. (Me)	Eucidaris clavata Mrtsn.
— tribuloides Lamk. (K, C)	— — —
retocidaris spinosa Mrtsn. (Mo)	Tretocidaris spinosa Mrtsn.
	Cidaris cidaris, var. meridionalis Mrtsn.
iadema antillarum Phil. (Cl)	Diadema antillarum, var. ascensionis Mrtsn.
seudoboletia atlantica H. L. Clark (Cl)	Pseudoboletia atlantica H. L. Clark.
ripneustes ventricosus (Lamk.) (C)	? Not St. Helena
	Echinus atlanticus Mrtsn.
arechinus angulosus (Leske) (Cl)	? Not St. Helena
chinus lividus Lamk. (W)	Echinometra lucunter (Linn.)
chinometra acufera Blv. (Me)	— — —
— subangularis (Leske) (C)	— — —
	Echinocardium connectens n. sp.
	Plagiobrissus costæ (Gasco)
rissus brissus (Leske) (Cl)	? Not St. Helena
Holothurioidea	Holothurioidea
	Euapta (?) lappa (Müller)
	Holothuria farcimen Selenka
Crinoidea	Crinoidea (identified by Gislén)
omatula sp. (Me)	Tropiometra carinata (Lamk.)
ntedon carinata (Lamk.) (C)	— — —
	Crinometra transversa Gislén
	(Monachocrinus incrassatus Gislén.)

Excluding the deep-sea species *Ophiacantha Helenæ*, *Ophiomusium spinigerum*, and *Monachocrinus incrassatus*, which do, of course, not strictly belong to the St. Helenan fauna, we know thus at present in all only 39 species of Echinoderms from St. Helena, 12 of which had formerly been recorded, under various names, from the island. Of these 39 species 13 are known only from deeper water on the steep edge of the

coastal plateau surrounding the island; from the coast and the coasta plateau are known in all only 26 species, a very poor fauna, indeed, fo a tropical island. And, whereas it is highly probable that still a fair num ber of species may be found in greater depths on the steep edge of th coastal plateau, it is not very likely that many more species — if any — will be found on the coastal plateau itself or on the coasts of the island

A very extraordinary fact, very striking for anybody who ha undertaken marine investigations in various part of the world, is th total absence of species of the genus *Ophiura*, or any other Ophiolepid On the whole, the Ophiurids form a very inconspicuous element of th St. Helena fauna, though three species: *Ophiothrix roseo-coerulans Amphiura atlantica* and *Ophiactis Lymani* are not uncommon; th *Ophiothrix* is the only one generally found in the dredgings — parti cularly on the big sponge *Chondrosia plebeia*, so very common in place off Jamestown.

The greatest interest that connects with the St. Helena fauna i its geographical relations. It must be regarded as an established fac that St. Helena originated as an isolated volcano, rising from th bottom of the deep-sea in the middle of the Atlantic Ocean, and tha it was never in much nearer connection with either Africa or S. Americ than it is now. It is true, H. v. Ihering, in his "Geschichte d. Atlan tischen Oceans" 1927 (p. 13) finds in the statement that the Manate occurred at St. Helena in pleistocene times proof that the island wa formerly much larger and in much nearer connection with Africa o S. America than now, since it would be impossible for a Manatee t cross the Ocean by the enormous distances now separating St. Helen from Africa (1140 miles) and S. America (1800 miles). However, as think to have shown definitely in my paper "On the Manatee of St. He lena" (Vid. Medd. Dansk Naturhist. Foren. Bd. 97. 1933), it is a mis take that the Manatee has been found pleistocene in St. Helena, an as for the records of the Manatee living at St. Helena in the 17th—19t century they rest on a misapplication of the name Manatee to — probably — a sea-lion. Thus the "Manatee" of St. Helena does no prove that the island was ever larger than it is now. A glance at the sea chart will at once convince us that the steep edge of the coastal platea represents the utmost limit to which the island can ever have extended

By the geographical isolation of the island ever from the time o its origin, it is clear that the fauna (and flora) now inhabiting its littora

egion (as well as its land fauna and flora) must have reached it by ransport across the ocean separating it from the nearest continents or from the nearest islands, e. g. Ascension). This means, for the Echinoderm fauna, that the species now occurring there must have been transported across the sea as pelagic larvæ, or on floating algæ or the like — unless they have so great a bathymetrical distribution, hat they occur also in the deep-sea and thus may have risen from here to the coastal plateau. This is probably the case with most of he species living in deep water on the edge of the coastal plateau. As for the species found on the coast or on the coastal plateau, not one of them is known to have such great bathymetrical distribution hat it could have come to St. Helena via the deep-sea. Only *Chætaster ongipes* is known to extend to a depth of 1140 m, but even this would not help it to cross the great depths of ca. 2500 meters separating St. Helena from Ascension (where this species likewise occurs), or Ascension from the nearest point on the African Coast, Cape Palmas ca. 4000—5000 meters).

It is evident that such transport across the ocean must be comparatively rare events, and this accounts for two striking features in the St. Helena fauna (and flora): its relative poverty and the comparatively large number of endemic forms. These latter must be supposed to have come to the island in the earliest time of its existence and thus have had time enough to transform into new species or even genera (e. g. *Moiraster*).

The species not endemic of St. Helena must be supposed to have arrived later on, so that there has not been time enough for them to transform into new types — or it may be that there has been a more constant influx of larvæ (or adults) from outside, so that they could maintain their typical form unaltered.

The exact age of the island is uncertain, because of the absence of fossiliferous deposits. Wallace ("Island Life"), from the general character of the land fauna and flora of St. Helena, concludes that it must date back at least to the Miocene, perhaps earlier[1]). The character of the Echinoderm fauna would seem to fit well with that estimation of the age of St. Helena.

We may now give an analysis of the Echinoderm fauna of the coast and the coastal plateau of St. Helena.

[1]) Cf. also Daly. Geology of St. Helena. Proc. Amer. Acad. Arts & Sc. LXII. 1927.

Astropecten Sanctæ Helenæ ...	Endemic.
— *variegatus*	Endemic.
Moiraster magnificus	Known also from Ascension; related t the Indo-Pacific genus *Anthosticte*
Luidia aciculata	Endemic.
Hacelia superba.....	West Indian.
Ophidiaster ophidianus.....	N. E. Atlantic, Mediterranean.
Narcissia trigonaria, var. *Helenæ*	Endemic, closely related to and evi dently originating from the Bra zilian *N. trigonaria*.
Linckia formosa	Endemic. Closely related to the N. E Atlantic-African *L. Bouvieri*.
Chætaster longipes.....	N. E. Atlantic—Mediterranean.
Asterina exigua.....	S. African, Indo-Pacific.
Coscinasterias tenuispina.....	N. E. Atlantic, Bermudas, Brazil.
Ophiothrix roseo-coerulans	Endemic. Closely related to th E. Atlantic-S. African *O. fragilis*.
Ophiactis Savignyi	Cosmopolitan, in the warmer areas.
Ophiactis Lymani.....	West Indian.
Amphiura atlantica.....	Endemic. Closely related to the S. Afri can *Amph. dilatata*.
Amphipholis squamata.....	Cosmopolitan.
Eucidaris clavata.....	Endemic. Closely related to, and evi dently originating from the Wes Indian-African *E. tribuloides*.
Tretocidaris spinosa	Known also from Ascension; related t the West-Indian *Tr. Bartletti*.
Diadema antillarum, var. *ascensionis*	Known also from Ascension. Closely related to and evidently originating from the West-Indian-African *D antillarum*.
Pseudoboletia atlantica.....	Known also from Ascension. Related to the Indo-Pacific *Pseudoboletia maculata*.
Echinometra lucunter	West-Indian—African.
Echinocardium connectens	Endemic.

lagiobrissus Costæ..... N. E. Atlantic—Mediterranean.
uapta lappa..... West-Indian.
olothuria farcimen ..... Azores.
ntedon carinata..... West-Indian—East African.

Of the 26 littoral-sublittoral Echinoderms of St. Helena no less an 9 are endemic and 4 known only from St. Helena and Ascension, us exactly 50 $^0/_0$, a fact bearing incontestable testimony of the very ng time these small islands in the mid-Atlantic must have existed, s also of their total isolation during the whole time they have xisted.

Four of these species viz. *Astropecten Sanctæ Helenæ*, *A. variegatus*, *uidia aciculata*, and *Echinocardium connectens* are of unknown origin. or the rest of the species, endemic or not, we can, trace their origin ith a fair degree of certainty. There are three distinct sources: The orth East Atlantic—Mediterranean, the West Indies—Brazil and outh Africa—the Indo-Pacific.

Fom the N.E. Atlantic—Mediterranean region have come: *Ophiaster ophidianus*, *Chætaster longipes*, *Plagiobrissus Costæ* and *Holothuria farcimen;* further, in all probability, also *Linckia formosa* and *oscinasterias tenuispina* must originate from this region, directly *Coscinast. tenuispina*) or indirectly, having developed from some ncestral form coming from this region, viz. *Linckia formosa* (from . *Bouvieri*).

From the West-Indian-Brazilian region have come: *Hacelia superba*, *Narcissia trigonaria Helenæ*, *Ophiactis Lymani*, *Euapta lappa*, — irectly (*Hacelia superba*, *Ophiactis Lymani* and *Euapta lappa*) or ndirectly, having developed from an ancestor coming from there, viz. *Narcissia trigonaria Helenæ* (from the Brazilian typical *N. trigonaria*). ossibly also *Tretocidaris spinosa* may have originated from the West ndian *Tr. Bartletti*. As for *Diadema antillarum ascensionis*, *Eucidaris avata*, and *Echinometra lucunter* it is impossible to decide whether ney came from the West Indian or from the East Atlantic—African egion, these species, or, for the two first named, the species from hich they have derived, being common in both these regions. That phiactis Savignyi also came from the West Indies is rather certain, hereas it is, of course, impossible to say definitely from where he cosmopolitan *Amphipholis squamata* came.

From South Africa and the Indo-Pacific region came *Moiras magnificus*, *Asterina exigua*, *Amphiura atlantica* and *Pseudobole atlantica*, possibly also *Tropiometra carinata*. As the latter occurs bo at East Africa and in the Brazilian-West Indian region it is impossib to state definitely from where it came; the fact that it does (apparentl not now occur in the Cape region, would tend to indicate that it ca to St. Helena from Brazil — but as the species must, no doubt, forme have occurred also in the Cape region, it is possible that it has co from there.

Moiraster magnificus is so closely related to the S. African *Anth sticte Pacei* Mrtsn., that it must, no doubt, have come from S. Afric developed from a common ancestor of these two species. That they a referred to two different genera does not mean so much, since — all probability — *Anthosticte* is not to be distinguished from *Moirast* but is simply a synonym of the latter. The N. E. Atlantic—Medite ranean *Tethyaster subinermis* is also related to *Moiraster*, but mo distantly, so probability is for *Moiraster magnificus* having come fro S. Africa.

From S. Africa has come also *Amphiura atlantica*, which is so close related to the S. African *Amph. dilatata* that it is even very likely t two are identical.

Pseudoboletia atlantica has no relations in the Atlantic or the We Indies, whereas the genus is widely distributed in the Indo-Pacif It must, evidently, have come from there — although the genus not now represented in S. African seas. (The genus is not known fossil.) In this case, as with *Tropiometra carinata*, it may be assum that in a former warmer period, it did occur in S. African seas and b that time was transported to St. Helena—Ascension.

The only species now actually common to S. Africa and St. Hele is *Asterina exigua*. As this species has not pelagic larvæ, but dire development, like *Asterina gibbosa* (cf. Th. Mortensen. Studies the development and larval forms of Echinoderms. 1921, p. 189) it certain that it must have been transported directly to St. Helena and there should be no difficulty for such transport. The huge Lam narian *Eclonia*, so very common at the S. African coasts is oft carried by the current as far as St. Helena. I have found it cast asho there, at Sandy Bay. That *Asterina exigua* must have been transport

St. Helena on the roots of this alga is rather indisputable. Also the viparous *Amphipholis squamata* may very well have come in this ay to St. Helena — and it is likewise quite probable, that *Ophiothrix seo-coerulans* came this way, derived from the S. African *Ophiothrix agilis* or *Oph. triglochis*, though it is also quite possible that it came om the N.E. Atlantic *Oph. fragilis*.

It is rather curious that no more Echinoderms appear to have come om S. Africa, by this constant means of transport. One might expect at e. g. *Marthasterias glacialis rarispina* and *africana* might have en thus transported to St. Helena, but this does not appear to have ppened. Likewise *Parechinus angulosus* would be liable to be trans-rted in this way. I may recall in this connection that Koehler Scotia" Echinoderms p. 634) records *Amphiura capensis* as occurring Ascension. I have had his (single) specimen for examination and ust testify the correctness of the identification. But the fact that does not occur at St. Helena (— I have collected great numbers of is species on the coast of Cape Peninsula and know its habits perfectly, ere is thus no probability at all that I could have overlooked it at . Helena, where I was specially on the look out for it —), and that is otherwise known only from S. Africa (Koehler's records of its currence at the Senegal coast are due to misidentifications; cf. my port on the S. African Echinoderms) make it almost certain that is record of *Amph. capensis* from Ascension must be due to some nfusion of the labels.

I venture to think that this discussion of the relations of the Echi-derm fauna of St. Helena has borne out my expectations, that it ould prove of considerable interest for the study of the historical volution of the fauna of the island. No doubt, there are other very olated small islands which will offer problems of similar interest nd importance in regard to the origin of their marine faunas (— I ight name as examples the Bonin Islands, Easter Island, not to peak of the much larger Galapagos and Hawaiian Islands —). But t. Helena is rather unique by the fact that we can trace so distinctly ow it received the components of its present littoral fauna of Echino-erms along three different ways. In this regard the Echinoderm fauna ather surpasses the land fauna, in so far as we cannot there so directly oint out the sources of the various components, as it is possible for

several of the Echinoderms. Most probably a detailed study of th other marine Invertebrates would also give equally interesting an important results.

On the Wegener theory St. Helena has no direct bearing. It ca only be said that, provided this theory be true, St. Helena must hav come into existence after the continents of Africa and S. America ha reached about their present distance from each other.

I. Asteroidea.

Astropecten Sanctæ Helenæ n. sp.

Pl. XX. Figs. 1—3.

Ruperts Bay, ca. 20 meters. 29. I. 1930. 1 specimen.
Off Sea-Cow Cove, ca. 30 meters. 13. II. 1930. 4 specimens.
Flagstaff Bay, ca. 60 meters. 24. II. 1930. 5 specimens.
Off Egg Island, ca. 40 meters. 5. III. 1930. Several specimens.

On the latter locality the bottom was covered with *Lithothamnio* it would seem then that the species prefers this kind of bottom to th black sand-bottom of the other localities.

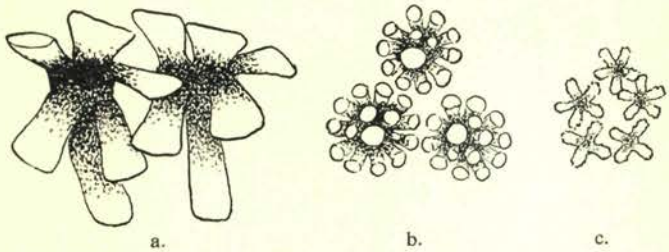
Largest specimen: R. = 53 mm, r. = 14 mm. Arms rather broa gently tapering, the end somewhat rounded. The paxillar area broa occupying ca. $^2/_3$ width of the arm in the basal part, but there ma be a very considerable variation herein, due mainly to preservation[1]

The paxillæ are arranged in more or less distinct transverse seri along the sides of the arms. The paxillar spinelets are short, smoot distinctly thickened at the end, assuming thus rather the aspect granules (Fig. 2. b.), the central ones being the largest. Often there only one spinelet, but the number varies from 1 to 5—6; peripher spinelets ca. 10. In the center of the disk, which usually forms a sma conical elevation, the paxillæ are, as usual, small, and very dense packed. The madreporite is small, naked, nearer the edge than the centr

Supero-marginals 25—26 to each side of arm in adult specimen in the distal part of the arm they are distinctly broader than lon but not much encroaching on the dorsal side of the arm. They a

[1]) By poor preservation a narrowing of the paxillar area will very easi occur; the paxillar area sinks and the marginals become more prominent, ben ing inwards, so that the paxillar area becomes much narrower than usual. C specimens lying a little while out of the water before being preserved such narrowing of the paxillar area will very easily occur.

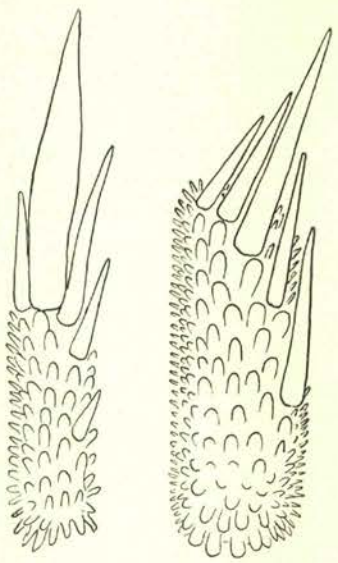
covered on the upper side with low, flattened granules; at the outer edge there is a low, obtuse spine; the vertical side is covered with



a. b. c.

Fig. 2. *Astropecten Sanctæ Helenæ* n. sp. Two adambulacral plates (a); paxillæ of adult (b) and young specimen (c). × 12.

small spinelets. Infero-marginals not extending outside the supero-marginals. There is one large terminal spine, flattened and pointed, and adorally to it a much smaller spine. Along the aboral edge there is a series of 3—5 pointed spines, gradually decreasing in size. The plates otherwise covered by low, flattened, somewhat scalelike spinelets (Fig. 3. a.). Ventro-lateral plates 3—4 to each side of arm, carrying simple spinelets. No pedicellariæ.



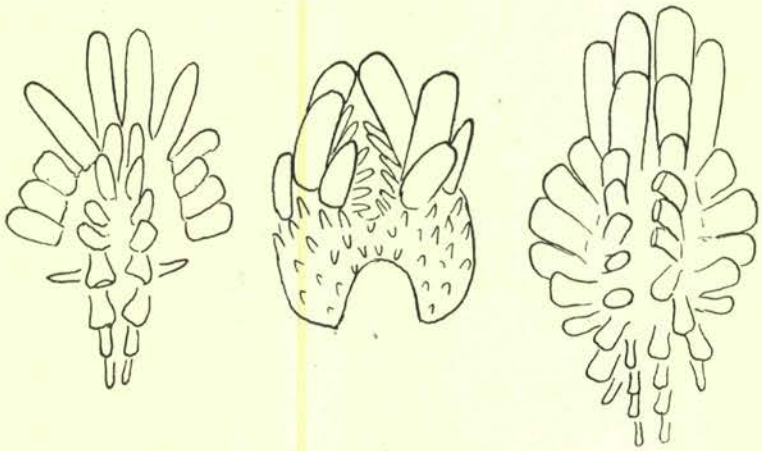
a. b.

Fig. 3. Infero-marginal plate of *Astropecten Sanctæ Helenæ* n. sp. (a) and of *A. variegatus* n. sp. (b). × 9.

Adambulacral plates with 3 furrow spines, the median one slightly the longer, cylindrical, the two lateral ones compressed at the point. Outside the furrow spines are three spines placed in somewhat oblique series; they are distinctly compressed, the median one distinctly the largest (Fig. 2. a.) some times they are excavated on the outer side. The jaws carry on the elevated median keel a double series of 8—10 short compressed spines, sometimes with one or two slender spinelets on the sides of the median keel. The jaws are somewhat truncate at the oral

end, carrying here four rather long, cylindrical spines; on the sides there are 3—4 much shorter, flattened spines (Fig. 4. a.).

The colour is a light pinkish-gray, usually with a more or less conspicuous dark band across the arms, and often with some small dark spots scattered on the disk. The end of the arms often with some pink colour. The oral side may be dark reddish-brown. — The specimens from black sand-bottom are as a rule darker than those from Lithothamnion-bottom, of a uniform red-brown, on both sides.



a. b. c.

Fig. 4. *Astropecten Sanctæ Helenæ* n. sp. Jaw (a); terminal plate of young specimen (b). *Astrop. variegatus* n. sp. Jaw (c). a. and c. × 12; b. × 30.

This species belongs to the *irregularis*-group, but is quite distinct from any of the species hitherto known.

In quite young specimens the paxillæ have only 4—5 peripheral spinelets and as yet no central one (Fig. 2. c.). In such specimens there are 3—4 large spines to each side of the terminal plate (Fig. 4. b.).

Astropecten variegatus n. sp.

Pl. XXI. Figs. 3—6.

Ruperts Bay, ca. 20 meters. 29. I. 1930. 1 large and 1 small specimen.
Off Sugarloaf, ca. 40 meters. 14. II. 1930. 1 specimen.
Off Jamestown, ca. 50 meters. 3. II. 1930. 3 young specimens.

Largest specimen R. = 35, r. = 11. Arms rather broad at base, tapering, point not rounded. Paxillar area at base of arm about $^2/_3$

the width of the arm, the paxillæ not arranged in transverse rows, or at most so in the distal part of the arms. Disk flat, without any central, conical elevation. Paxillar spinelets short, smooth, capitate; in the proximal part of arm and on the disk the paxillæ are rather large with ca. 10 central and ca. 12—15 peripheral spinelets; usually some of the central ones are larger than the rest (Fig. 5. b.). At the sides along the supero-marginals the paxillæ are smaller and their spinelets fewer and more slender. In the central part of the disk the paxillæ are small and crowded.

Supero-marginals 15—16 to each side of arm in the largest specimen; they are distinctly broader than long, encroaching rather much on the

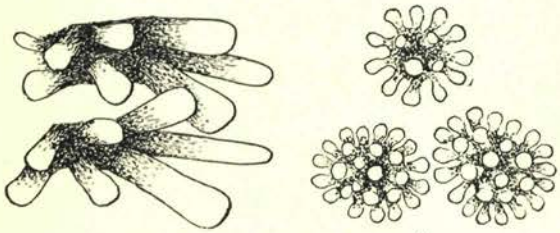


Fig. 5. *Astropecten variegatus* n. sp. Two adambulacral plates (a); paxillæ, the upper one from an arm, the two below from the disk (b). × 12.

dorsal side of the arm. They are covered uniformly by low, capitate spines, almost of the appearance of granules. No indication of larger spines on the supero-marginals.

Infero-marginals with a conspicuous oblique series of 5—7 long, pointed, not flattened spines along distal and aboral edge, the 3rd being the largest (Fig. 3. b.); the plates otherwise covered with low, flattened, scale-like, not pointed spinelets. 3 ventro-lateral plates to each side, carrying slender spinelets. No pedicellariæ found anywhere.

Adambulacrals with three furrow spines, the median of which is slightly the longest, slender, cylindrical, the two lateral ones coarser, compressed; outside the furrow spines follow two longitudinal series of two spines each, none of which is enlarged and all distinctly smaller than the furrow spines (Fig. 5. a.). Rarely there may be a single spine outside the second series. The jaws with a double series of ca. 10 spines along the median keel; the innermost pair is considerably enlarged, those at the distal end smaller, more slender; also on the

sides of the median keel there are some spines, forming a secondary series which may have the appearance of continuing directly into the marginal series. There are to each side 3—4 short, flattened marginal spines and 2 larger, thicker at the proximal end (Fig. 4. c.).

The colour is a variegated dark-brown and cream-yellowish; there is a dark band across the middle of the arm, and the end of the arm is likewise dark. Also the jaws may be of the same dark colour.

This very characteristic species may be referred to Döderlein's *pectinatus*-group; but it does not seem very nearly related to any species hitherto known.

Moiraster magnificus (Bell).

Pl. XXI. Figs. 1—2; XXII. Fig. 1.

Archaster magnificus F. Jeffr. Bell. 1881. Description of a new species of the genus Archaster from St. Helena. Ann. Mag. Nat. Hist. 5 Ser. VIII. p. 440.

Moiraster — Sladen. 1889. "Challenger" Ast. p. 193.

— — Koehler. 1908. "Scotia" Echinod. p. 294. Pl. XII. 107—110.

Off Egg Island, St. Helena, ca. 40 meters. 3. III. 1930. 3 large specimens.

R. = 160—170.

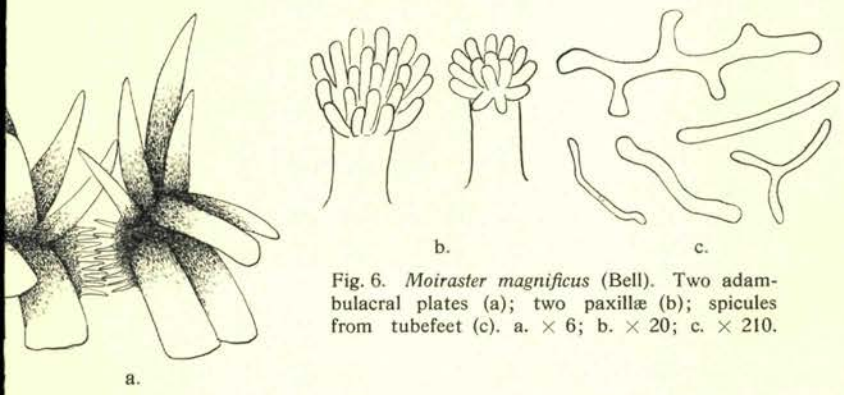
These specimens agree very well with the description given by Bell, so that there can be no doubt of the identification, the more so as they are from the type locality.

The photographic figures here given will show the general aspect of this large and fine sea-star better than Koehler's drawing (Op. cit.) of a medium sized specimen (from Ascension, 40 fathoms). Also some additions to the descriptions by Bell and Koehler are required; likewise some figures of details.

The paxillæ have a slender stalk; the spinelets are cylindrical, smooth, not distinctly capitate (Fig. 6. b.); that they are "closely appressed together, and not forming any kind of fringing crown" (Bell), is, partly at least, a consequence of poor preservation. Sometimes the central spinelets bend together so as to form a sort of pedicellaria.

The infero-marginal plates are separated by very deep furrows, the sides densely covered with fine spinelets; very deep fasciolar channels thus are formed, which continue between the radiating series of ventro-lateral plates (Pl. XXII. Fig. 1) and even between the adambulacral

ates, where, however, the furrows are shallower and the spinelets wer. A median, incomplete, unpaired, radiating series of ventro-teral plates is distinct, and even a shorter series to each side of it l. XXII. Fig. 1). The typical arrangement of the adambulacral mature would seem to be three somewhat curved, compressed, inted furrow spines, followed by a longitudinal series of 3, the middle e of which is the largest, flattened, and outside this another longi-dinal series of 2 or 3 enlarged, flattened spines (Fig. 6. a.); but as a le the arrangement is indistinct, and one might also say, there are furrow spines followed by one enlarged spine etc. Along the edges



a. b. c.

Fig. 6. *Moiraster magnificus* (Bell). Two adambulacral plates (a); two paxillæ (b); spicules from tubefeet (c). a. × 6; b. × 20; c. × 210.

f the adambulacrals there are some small spinelets forming a conti-uation of the ventro-lateral fascioles. The jaws are large and thick, ith numerous, not distinctly serially arranged spines on the outer rface. There are rather deep fasciolar channels between the jaws nd the first adambulacral plates. None of the specimens are well nough preserved for showing clearly the number and character of the arginal spines of the jaws.

The colour of the live specimens was a uniform red. The gonads re serially arranged in the arms, continuing almost to the end. The ubefeet contain spicules as in *Tethyaster* and *Anthosticte* (Fig. 6. c.). he papulæ are distributed (singly) all over disk and arms. Although ny specimens are dried it is clearly seen that the papulæ are some-hat branched or perhaps rather papillate.

The specimen represented in Pl. XXI. 2, the one collected by Kinberg (sent me from the Stockholm Museum, after this report

was ready), is interesting in showing the spines of the ventro-later plates much less developed than in the adult specimens, more lik what obtains in the specimen figured by Koehler in his "Scotia report (Op. cit. 1908).

A very young specimen (R. = 4 mm), taken together with th three large specimens, evidently is the young of this species, as appea from the fact that a second series of ventro-lateral plates has begu to develop; thus it cannot be referred to any other of the know Asteroids of St. Helena.

W. K. Fisher in his Report on the Asteroidea of the "Albatross Philippine Expedition (Bull. U. S. Nat. Mus. 100. 3, 1930, p. 14 emphasizes the near relation that exists between the genera *Moiraste Tethyaster*, *Sideriaster* and *Anthosticte*, the ascertaining of whic characters are of generic importance being made the more difficu since only one species is known of each of the four genera (— a secon species of *Anthosticte*, *A. Pacei* Mrtsn., was described in my paper "O some Echinoderms of S. Africa. Ann. Mag. Nat. Hist. 9 Ser. XV 1925, p. 147), and two of them, *Sideriaster* and *Moiraster* only incom pletely known.

The knowledge now acquired of the characters of *Moiraster* make it clear that the four genera are even much more closely related tha Fisher thought them to be, so closely, indeed, that it seems scarcel possible to maintain all the four genera. *Tethyaster* is well characterise by its midradial row of enlarged paxillæ, the shallow marginal fasciole and the low paxillæ, so it may justly be maintained as a separat genus. (Fisher's statement, loc. cit., that its gonads do not exten to the end of the rays is a curious mistake, in flat contradiction to th careful description given by Ludwig in his "Seesterne d. Mittel meeres"). As for *Anthosticte* it is seen now that the only character b which it differs from *Moiraster* is the absence of enlarged spines on th ventro-lateral plates. In regard to fascioles between the adambulacra plates there seems to be a very gradual passage from *Anthosticte* t *Moiraster* and *Sideriaster*. The latter, which is still imperfectly known would likewise seem to differ from *Moiraster* only in lacking enlarge spines on the ventro-lateral plates. It is, of course, a matter of taste whether this character, the presence or absence of enlarged spines o the ventro-lateral plates, affords sufficient reason for generic distinc tion. But it would appear that this is all the difference there is. Sinc

Moiraster is the oldest name of the three the question of the value of the three said genera does not concern the naming of the present species.

Luidia aciculata n. sp.

Pl. XX. Figs. 7—12.

Off Egg Isl., St. Helena, ca. 40 meters. 1 specimen.
Off Jamestown, ca. 50 meters. 1 specimen.
Off Lemon Valley, ca. 50 meters. Arm fragments.
Prosperous Bay, ca. 50 meters. 1 arm fragment.

5 Arms. Longest arm fragment ca. 130 mm. Arms slender, the largest piece 12 mm broad. Paxillæ all with a distinctly enlarged, pointed median spine (Fig. 7. b.), but it is still rather slender, nothing comparable to the thick spines found e. g. in *L. numidica* Koehler and in so many other *Luidia* species. Generally there is only one central spine, only on the supero-marginals there may be 2—4 such larger central spines.

The paxillæ of the lateral parts are arranged in distinct transverse series of 3 each, and very well spaced, the papular spaces (in dried specimens) being seen very distinctly between them. There are two transverse series corresponding to each supero-marginal. Along the midline paxillæ are much smaller and without any regular arrangement, but still so much spaced as to show clearly the papulæ, which are here much smaller than in the lateral parts of arm. On the disk the paxillæ stand quite close, the papulæ being indistinguishable. The madreporite is covered by a large paxilla. No pedicellariæ on the dorsal

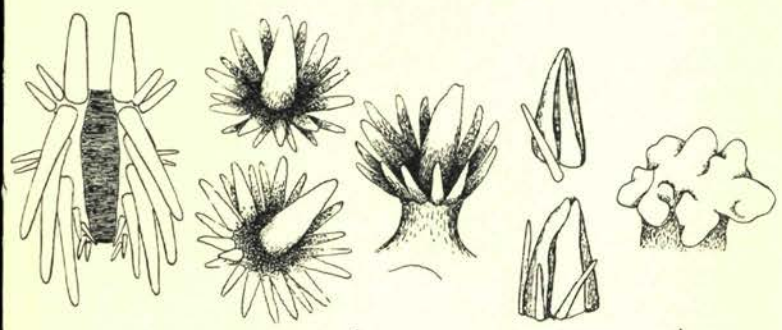


Fig. 7. *Luidia aciculata* n. sp. a. Jaw; b. paxillæ; c. pedicellariæ, from the 1. ventro-lateral plate (below), and from one of the ventro-lateral plates on the middle of the arm (above); d. papula. a. × 8; b—c. × 20; d. × 33.

paxillæ. The papulæ (Fig. 7. d.) are of the usual shape, low, lobed bushes.

Infero-marginals with 3, in the proximal part some of them with 4 large, erect, cylindrical, pointed spines, the uppermost the longest the sides are densely covered with slender spinelets, forming a distinct fairly deep fasciole; some few scattered similar, erect spinelets on the surface of the plates. No pedicellariæ are found on the infero-marginals. A single series of small ventro-lateral plates, continuing to the end of the arms, each carrying a bundle of 3—5 diverging, slender spinelets. The first unpaired ventro-lateral plate may carry a large, three-pronged pedicellaria (Fig. 7. c.); also on some of those farther out on the arm there may be a similar, but somewhat more slender pedicellaria. Adambulacrals with the usual three strong spines, the inner one sabre-shaped; also a single slender spinelet is found on some of the plates, but no pedicellariæ. The jaws (Fig. 7. a.) have four or five long, cylindrical spines to each side of the median suture (the first one at the apex of jaw) and 3—4 much smaller spines at the distal end. Near the proximal end are two moderately sized lateral spines, placed close together, sometimes joining like a pedicellaria, and at the distal end there are two slender spinelets close together, not forming a pedicellaria.

The colour is a uniform light brownish-gray. The large infero-marginal spines are brown at the base.

This species is quite distinct from any other Atlantic or West-Indian species, as also from the S. African *Luidia africana*. It must be referred to the *ciliaris*-group of Döderlein, but does not seem very closely related to any of the species of that group.

Hacelia superba H. L. Clark.

H. L. Clark. 1921. Echinoderm Fauna of Torres Strait, p. 87. Pl. 32.

Off Jamestown, St. Helena, ca. 40 meters. 6 specimens.
Off Lemon Valley, St. Helena, ca. 50 meters. 2 specimens.

These specimens so completely agree with the description and figures given by Clark (Op. cit.) that I can have no doubt but that they are really identical.

I have very little to add to Clark's description. The largest of the specimens in hand has R. = 100 mm, thus being somewhat larger

an the type. The colour of the live specimens was a light yellow, e papular areas dark orange.

An interesting feature is the existence of a dense ring of calcareous ates in the edge of the sucking disk of the tubefeet, seen as distinct itish rings in the dried specimens. is was also observed by Ludwig in *celia attenuata* (Ast. d. Mittelmeeres, 299) and may well be a character of neric value. Also in the tubefeet pro- r there are spicules, irregular rods, ranged mainly transversally (Fig. 8). Clark states the terminal plate to naked. In some of the specimens in nd it is provided with ca. 3—5 coarse arts, in others it is naked, but it has then much the appearance the warts having been worn off. May not this be the case with e type specimen?

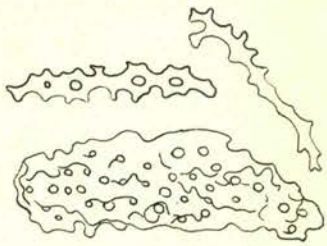
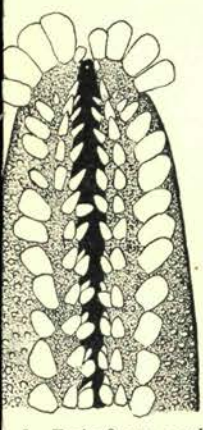


Fig. 8. Spicules from tubefoot of *Hacelia superba* H. L. Clark. × 235.

Here and there a single one of the dorsal plates at the end of arm may show a small naked spot. This is of interest in respect to the variety *africana* that I described in my paper "On some Echinoderms from S. Africa" (Ann. Mag. Nat. Hist. 9. Ser. XVI. 1925, p. 152), in which a number of the dorsal plates show such a naked space. Since in the present specimens there is only a single such naked plate, whereas in the S. African specimen up to 10 plates are thus naked, we have here a confirmation of my view that the S. African form is not identical with the West-Indian-St. Helena form.



g. 9. End of arm, oral e, of young specimen *Hacelia superba* H. L. Clark. × 23.

There is a single very small specimen (R. = 4 mm) from off Jamestown, which I cannot hesitate in identifying as the young of *Hacelia superba*. It offers some features of considerable terest (Fig. 9). At the point of the arm there are 4(3) large, broad, t spines, forming like a fan; they are attached to the lower edge of e terminal plate and, no doubt, correspond to the warts found here the adult. But then the specimen apparently differs very markedly

from the other Linckiids found off St. Helena in having a series of spi between the furrow spines and the usual outer series of spines; a this series is the first to appear, as seen clearly at the distal end of t ambulacral furrow in the figure. This series of spines is not found any of the Linckiids of St. Helena in the adult stage. However, if look at the distal end of the arms in *Hacelia superba*, we find th such a median series of spines between the furrow spines and the ou series — and this median series is even the most strongly develop of them. In *Ophidiaster* nothing of the kind is seen, and not in *Linc* or *Narcissia* either, which also for other reasons cannot come i consideration in the parentage of this young specimen. There can t be no doubt that we have here really a young stage of *Hacelia super* The plates are all completely covered with granules; the papulæ a single, one in each papular space.

Ophidiaster ophidianus (Lamk.).

Müller & Troschel. 1842. System d. Asteriden, p. 28.
Perrier. 1875. Revis. Stellérides Mus. Paris, p. 120.
Ludwig. 1897. Seesterne d. Mittelmeeres, p. 300. Taf. 3. 4—5; 8. 18—30.
H. L. Clark. 1921. Echinod. Fauna of Torres Strait, p. 79.
Koehler. 1921. Faune de France, Echinod., p. 38.
— 1924. Echinod. des Mers d'Europe. I. p. 163. Pl. VI. 7.

Off Jamestown, St. Helena, on rock-coast. II. 1930. 15 specimens.

This magnificent sea-star, mentioned already by Melliss, un the name of *Echinaster* sp. (cf. above p. 407), was not rarely seen on t rocks at Jamestown, sometimes just at the low water line, sometim on the rock bottom off the pier, where it was taken by divers. So specimens were uniformly red, others a mottled red and white or purp The largest specimens have R. = ca. 100 mm.

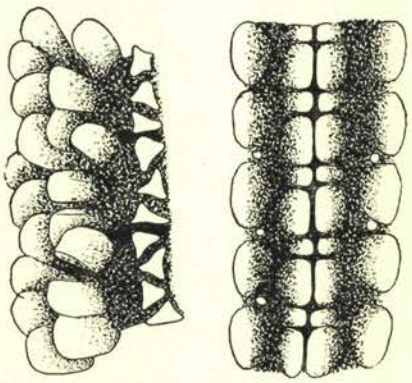
Without entering upon the question of the specific value of *Ophidi ter guildingii*, I would only emphasize that I have found, both he at St. Helena and at the Canaries, specimens of uniform red colo and such as were mottled with white or purple living together in t same locality, such specimens not being distinguishable by any oth characters, so that no doubt can obtain as to their being all the sa species, *Oph. ophidianus*. Thus, evidently, the mottled coloration not a valid character by which to distinguish *Oph. guildingii* fro *ophidianus*, as stated by Clark (Op. cit. 1921, p. 79).

Narcissia trigonaria, var. *Helenæ* n. var.

Pl. XX. Figs. 4—6.

Off Jamestown, ca. 40 meters. 26. I. 1930. 10 specimens.
Off Egg Island, ca. 40 meters. 6. III. 1930. 6 specimens.

These specimens bear so close a resemblance to *Narcissia trigonaria* den, as described in the "Challenger" Asteroidea, p. 414, Pl. LXV. -8, that it is tempting to regard them as identical therewith; as *trigonaria* was taken off Bahia (depth unknown) there would be zoogeographical objections to regarding the St. Helena specimens identical with the Brazilian pe. There are, however, some nor differences which make it eferable, at least for the pre- nt, to distinguish the St. He- na form as a separate variety, not a separate species.



a. b.

Fig. 10. Three adambulacral plates of *Narcissia trigonaria* var. *Helenæ* n. var. (a); ambulacral furrow and five pairs of adambulacral plates of *Linckia formosa* n. sp. (b). × 12.

The arms of the typical form e stated to be "distinctly trian- lar in section, with a strongly arked median keel, in which ere is a conspicuous break at e base of the ray, separating e keel of the ray from the evated part of the disk". In e St. Helena specimens the ms are more rounded above, t distinctly triangular in section, and the passage from the arms the disk is usually very gradual, without any distinct break. The edian series of plates in the basal part of the arms is usually less nspicuous than those of the type and without tendency to be- ming tubercular. The marginal plates can scarcely be said to be ghtly convex, as they are stated to be in the type, and finally ere would appear to be some difference in the adambulacral arma- re, there being only three spines in the median series on the ter surface of the adambulacral (Fig. 10. a.), whereas the type is ated to have 4 spines in this series (as also shown in Pl. LXV. Fig. 7); e furrow spines may be 3 or 4, and those of the outermost series 3 4, rarely 5, essentially as in the type.

If these differences prove constant, the St. Helena form rath represents a separate species; but as the type is known only from t single specimen taken by the "Challenger", we can have no id whether these differences are really constant, and it seems to n therefore, the safest course for the present to regard the St. Hele form as a variety only of *N. trigonaria*, to which it is at any ra much more closely related than to *Narcissia canariensis*.

The ground-colour of the live specimens was orange or a reddis orange, the plates on the dorsal side standing out whitish (or crea yellow) against the ground-colour, producing a mottled aspect. T oral side is more whitish. Colour in life of the type species unknow

The largest specimens have R. = 60 mm.

Linckia formosa n. sp.

Pl. XXII. Figs. 2—4.

Off Jamestown, St. Helena; ca. 50 meters. 15 specimens.
Off Egg Island, St. Helena; ca. 40 meters. 6 specimens.

Largest specimens R. = ca. 60 mm, r. = ca. 8 mm. Arms ve slender, very slightly attenuating. Disk with a circle of 5—6 lar primary plates surrounding one or more central plates. The origin condition would seem to be one central and 5 radial plates, but the is much irregularity prevailing in the development of the disk plate there may be several smaller plates in the central part, and the radi plates may be broken up into a number of smaller plates, hardly o of the original radials remaining intact. Along the median line of t arms there are several large plates, usually irregularly arranged, b sometimes arranged in fairly regular series, mainly in the proxim part of the arms; they are slightly elevated, but not tuberculate. Ma ginal plates small, but distinct, ca. 45 to each side of arm in the larg specimens. The dorsal side of arm rounded, the ventral side somewh flattened. Papulæ few, usually 3—5 in each papular area. Ventr lateral plates only very indistinctly observable, on account of the den granulation, but apparently there is only one series, continuing about the middle of the arm. Adambulacral armature consisting two furrow spines, the proximal one small, the distal one much large flattened. On the outer surface there is one slightly larger spine of t same shape as the distal furrow spine, and sometimes a very sma spinelet, or granule alternating with the large spines (Fig. 10. b.). T

arrow space between the series of the furrow spines and the outer pines is entirely naked. The jaws are very small, their armature simply continuation of the adambulacral armature. No pedicellariæ. The ranules have the shape of low, somewhat pointed cones. In the distal art of arms sometimes one of the central granules of the marginal — ainly the inframarginal — plates may be enlarged so as to form a mall, inconspicuous spine. Colour in life: the plates of the dorsal side cream-yellow, the spaces between them reddish-orange.

It is clear that this species is nearly related to *Linckia Bouvieri* errier, but it differs strikingly from that species particularly in its olour, *L. Bouvieri* being a uniform bluish-violet. Also the arms are ore slender and attenuate in the St. Helena species, the dorsal lates of the arms larger, more convex, and the number of papulæ istinctly smaller (3—5 in *L. formosa*, ca. 10 in *L. Bouvieri*). Not aving any specimen of *L. Bouvieri* I sent a specimen of my St. Helena pecies to my friend, Prof. H. L. Clark, asking him to compare it ith *L. Bouvieri*. He kindly informed me that the comparison fully ustified my view of the St. Helena form representing a distinct pecies evidently related to *L. Bouvieri*, but differing from it in charac-ers pointed out above.

No doubt it is this species which Koehler has recorded from t. Helena under the name of *Linckia Bouvieri* ("Scotia" Echinoderms, . 296); as it was no doubt preserved in alcohol and thus had lost its haracteristic coloration it would very naturally be regarded as a *inckia Bouvieri*, the other distinguishing characters being little onspicuous.

Chætaster longipes (Retzius).

sterias longipes Retzius. 1805. Diss. sistens spec. cogn. Asteriarum, p. 20.
hætaster subulatus Müller & Troschel. 1842. Syst. d. Ast. p. 27.
— *longipes* Müller & Troschel. 1842. Syst. d. Ast. p. 127.
— — Perrier. 1875. Revis. Stellérides du Muséum, Paris. p. 329.
— — Ludwig. 1897. Seesterne d. Mittelmeeres, p. 134. Taf. I. 3—4; IX. 15—31.
— — Koehler. 1908. "Scotia" Echinod., p. 296.
— — Koehler. 1909. Res. Camp. Sci. Monaco. XXXIV. p. 88.

Off Jamestown, St. Helena, ca. 50 meters. II. 1930. 10 specimens.

The finding of this N. African-Mediterranean species as far outh as St. Helena is of very considerable zoogeographical interest

— though not so very surprising, as it was taken by the "Scotia" a Ascension (Koehler, Op. cit. 1908.)

It is important that the statement of its occurrence also at Ber mudas is erroneous, as shown by H. L. Clark in his paper on "Th Echinoderms of the Challenger Bank, Bermuda". (Proc. Amer. Acad Arts & Sci. LVII. 1922, p. 254), the specimen from there being *Chæt aster nodosus* Perrier.

I may recall here that it has recently been found as far North a the S. Coast of Brittany (cf. R. Legendre. Deux Echinodermes nou veaux pour la Faune du Sud de la Bretagne. C. R. Sommaire d. Scien ces. Soc. de Biogéographie. IX. No. 77. 1932.) This latter locality give the northern, St. Helena the southern limit of this species, so eminentl characteristic of the Eastern Atlantic.

The live specimens were of a uniform lemon-colour.

Asterina (*Patiriella*) *exigua* (Lamk.).

Th. Mortensen. 1933. Echinoderms of S. Africa. Asteroidea and Ophiuroidea p. 252. Pl. XII. figs. 4—8.
For literary references see that paper.

This species was first recorded from St. Helena by Melliss (Op. cit p. 219) under the name of *Asterina minuta*?

Numerous specimens collected in rock pools off Jamestown I. 1930 also 1 specimen taken in a rock pool at Prosperous Bay (17. II.1930 and a few specimens in Lot's Wife's Pond (2. III. 30).

These specimens are perfectly conform with those from S. Africa and the species evidently must have been transported from there t St. Helena, most probably on the roots of the large algæ (*Eclonia*) which are also nowadays found driven ashore on St. Helena, wherea they do not grow there. Evidently the water is too warm for the alga but, on the other hand, the *Asterina*, which occurs all over the tropica Indo-Pacific, will find the temperature very suitable. — It is a fac of great zoogeographical interest that we find thus this Indo-Pacific South-African *Asterina* at St. Helena, but none of the Atlantic or Wes Indian species of the genus.

In the rock pools, where they were found, I noticed some bare star-shaped spots on the rock surface, suggesting that they were spot that had been sucked clean by the sea-star. I was, however, unabl to find anything like it directly under the sea-stars themselves, so i remains questionable whether the said suggestion be right.

Coscinasterias tenuispina (Lamk.).

teracanthion tenuispinus Müller & Troschel. 1842. Syst. d. Ast. p. 16.
— — Lütken. 1859. Bidrag til Kundskab om de ved Kysterne af Mellem- og Syd-Amerika levende Arter af Søstjerner. Vid. Medd. 1859. p. 71.
terias tenuispina Perrier. 1875. Revis. Stellérides Mus. Paris. p. 42.
— — Ludwig. 1897. Seesterne d. Mittelmeeres, p. 344. Taf. III. 8; XI. 18—19.
scinasterias tenuispina Koehler. 1921. Faune de France, Echinodermes, p. 26.
— — Koehler. 1924. Echinod. des Mers d'Europe. I. p. 103. Pl. I. 13.
lasterias — H. L. Clark. 1933. Handbook Littoral Ech. Porto Rico. p. 30.

Several specimens found on the rocks off Jamestown, St. Helena; also ne specimens on the rocks at Prosperous Bay. One small specimen was ken by dredge in ca. 40 meters off Sugarloaf, 27. II. 1930.

The largest specimen, with 8 fully developed arms, has R. = ca. mm. The St. Helena specimens are quite typical *tenuispina*, in ery respect completely resembling specimens, which I collected in arch 1930 at Las Palmas, Canary Islands.

The splitting up of the genus *Coscinasterias* into two subgenera — genera — *Coscinasterias* s. str. and *Stolasterias* — seems to me ther unnecessary, at least I think it preferable here to keep the ore familiar name *Coscinasterias* for this characteristic, mainly East-lantic species. Its occurrence in the West Indies needs confirmation; occurrence at Bermudas (already recorded by Lütken in 1859 . cit.) may be due to accidental introduction from Europe, as sug-sted by Clark (Op. cit. 1933). After the species has now been found St. Helena, its occurrence at the Cape Verdes and Brazil becomes ly quite natural.

II. Ophiuroidea.

Ophioscolex dentatus Lyman.

hioscolex dentatus Lyman. 1882. "Challenger" Oph. p. 233. Pl. XXIV. 4—6.
— — H. L. Clark. 1923. Echinod. Fauna S. Africa, p. 314.

2 miles S. 49 E. of Long Range Point, St. Helena. 280—450 m. 24. II. 1930. specimens, dredged onboard the "Dana".

The only reason for referring these specimens to *O. dentatus* rather an to *O. purpureus* Düb. Kor. lies in the fact that the latter till

now has not been recorded from farther South than the Bay of Bisc
("Talisman"). On the other hand, *O. dentatus* is otherwise kno
only from the S. African seas.

As I have explained in my report on the S. African Echinoderm
I do not think it really possible to keep *O. dentatus* distinct fr
O. purpureus, so it does not matter much whether we call these sp
imens from St. Helena *dentatus* or *purpureus*. The fact that they ha
all of them a few spines on the disk might rather point to the northe
form, *purpureus*, in which spines are usually found on the disk, where
in the S. African form, *dentatus*, such spines are only rarely found.
If by future researches it is found that *O. purpureus* occurs also
the region between the Bay of Biscay and St. Helena — as I exp
it will, in accordance with the fact that so many other Echinoderm
from the Mediterranean—East-Atlantic region do extend as far Sou
as St. Helena, I should not hesitate in identifying the St. Hele
Ophioscolex with the northern *O. purpureus* instead of with the S. Af
can *dentatus*.

One of the specimens has only 4 arms.

Ophiacantha prolata n. sp.

2 miles E. of Bay Point, St. Helena; 480 m, bottom with old Lophoheli
24. II. 1930. 10 specimens, dredged onboard the "Dana".

Diameter of disk of largest specimens 7 mm; arms ca. 4 times t
diameter of the disk. Mouth papillæ 3 to each side of jaw, the out
one not widened. Mouth shields distinctly broader than long, with
rounded distal lobe, the lateral corners very sharp, usually slight
upwards curved. Usually they are somewhat depressed in the midd
Adoral plates joining broadly within; they have no outer lobe, t
first lateral plate and the buccal shield being directly contiguou
First ventral arm-plate small, polygonal; the following ventral plat
twice as broad as long, widely separated; the distal edge straight
very slightly concave. One small tentacle scale. Dorsal arm-plat
triangular, with distal edge convex; inner angle somewhat rounde
lateral corners rather sharp. They are separated, but not widel
Arm-spines 8—9 on the basal joints, increasing in length upward
the uppermost being as long as two joints; they may almost join
the dorsal midline on the first joint. They are very slender, rath

distinctly thorny, seen with some magnification. In the distal part of the arm the lowermost spine becomes rather strongly serrate along the adoral side (Fig. 11. c.). The arms are distinctly moniliform in the distal part. The disk is flat, without distinct radial ribs; it is wholly covered — also on the ventral side — by a very uniform coat of small low stumps, which are seen under a high magnification to terminate in usually three short thorns (Fig. 11. d.). — Colour (dry) a uniform light brownish.

At a first sight this species recalls *Ophiacantha abyssicola*, with which it agrees also in the shape of the ventral arm-plates; but it

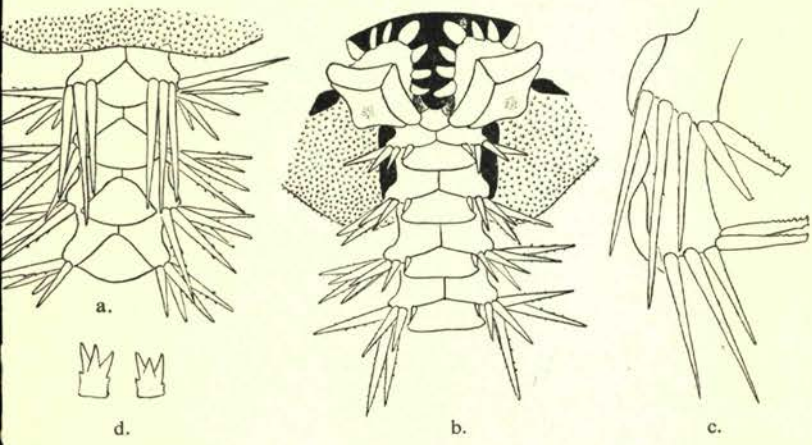


Fig. 11. *Ophiacantha prolata* n. sp. Part of dorsal (a) and oral side (b); two armjoints from distal part of arm, side view (c); stumps from the disk (d). a—b. × 9; c. × 22; d. × 90.

differs markedly from that species in the shape of the dorsal arm-plates, the buccal shields etc., so that an identity is absolutely excluded. Other species to which it bears some resemblance are: *Ophiacantha aculeata* Verr. and *Ophiacantha* (*Ophiomitrella*) *levis* Koehler; but, again, it differs from these species in several particulars, especially the characters of the stumps and the arm-spines, so that an identity is out of the question. It therefore seems beyond doubt that these St. Helena specimens represent a distinct, hitherto unknown species.

Ophiacantha nitens n. sp.

2 miles E. of Bay Point, St. Helena; 480 meters. Bottom with old Lophohelias. 24. II. 1930. 1 specimen, dredged onboard the "Dana".

Diameter of disk 2 mm; arms broken, probably ca. 4—5 times the diameter of the disk. Mouth papillæ small, 6 to each side of jaw. Buccal shields somewhat broader than long, with a small, rounded outer lobe and an obtuse angle within; lateral corners much rounded. Adoral plates narrow, joining proximally, with an outer lobe separating first lateral plate from buccal shield. First ventral arm plate rather large, oblong; the following all widely separated, the second broader than long, with outer edge convex, then gradually longer than broad. A

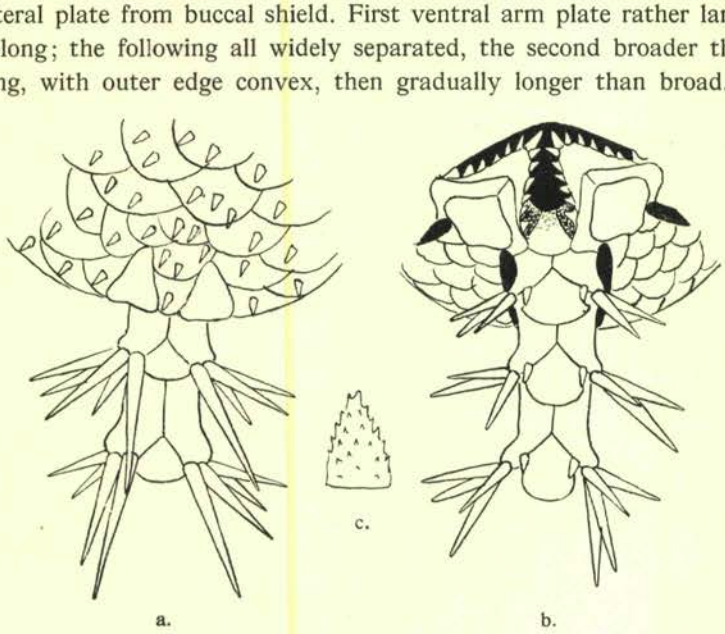


Fig. 12. *Ophiacantha nitens* n. sp. Dorsal (a) and oral side (b). Stump from the disk (c). a—b. × 30; c. × 125.

single, small tentacle scale. Dorsal arm plates small, triangular, with convex distal edge, widely separated. Arm spines four, simple, smooth, pointed, increasing in length from the lowermost to the uppermost, which latter is, in the proximal part of the arm, somewhat longer than an arm joint. The joints are not much swollen at their distal end, the arms not being distinctly moniliform. The disk is covered by large, somewhat shining scales with a metallic lustre. Each plate carries one or 2—3 short, but rather robust stumps, which — as seen by high magnification (Fig. 12. c.) — are finely rough. Radial shields small, but distinct, triangular, not joining distally. Scales of ventral interradii naked.

This species is related to *Oph. spinosella* Mrtsn., described in my

report on the "Ingolf" Oph. (p. 29). These two species, together with *Ophiacantha macrarthra* H. L. Clark (North Pacific Oph. p. 236, Fig. 12), would seem to form a special group within the vast genus *Ophiacantha*. Among themselves they differ very strikingly (which need not be specified here), so there can be no doubt of their specific validity. Each of these species is known from only a single specimen, of the same small size, 2 mm diameter of disk. This may perhaps indicate that, in spite of their small size, they are really adult.

Ophiacantha trivialis n. sp.

2 miles E. of Bay Point, St. Helena, 480 m. Bottom with old Lophohelias. 24. II. 1930. 1 specimen, dredged onboard the "Dana".

Diameter of disk 4 mm; arms broken, but apparently ca. 4 times the diameter of the disk.

Mouth papillæ three to each side of jaw, the outermost one not enlarged. Buccal shield distinctly broader than long, with a rather inconspicuous outer lobe. Adoral shields very broad, with an outer

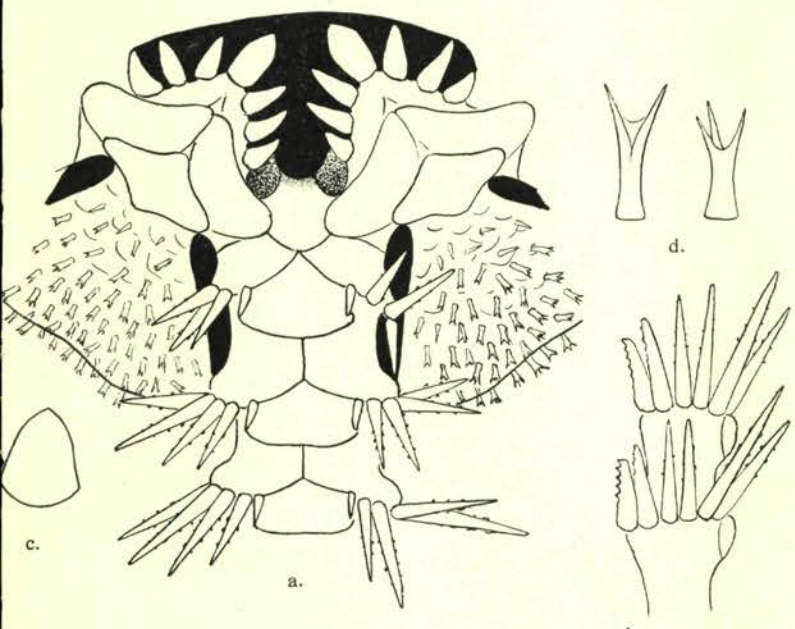


Fig. 13. *Ophiacantha trivialis* n. sp. Part of oral side (a); two joints from distal part of arm, side view (b); a dorsal plate (c); stumps from the disk (d). a—c. × 25; d. × 100.

lobe separating the first lateral arm plate from the buccal shield, this lobe being, however, apparently separated from the main part of the plate, because it lies at a somewhat lower level. First ventral plate large, longer than broad; the second barely in contact with the first, the following ones widely separated from each other, distinctly broader than long, with the distal border slightly concave. Dorsal arm plates somewhat cup-shaped (Fig. 13. c.), widely separated from each other. Arm spines 6—7 on the proximal joints, nearly joining in the dorsal midline. They increase in length upwards, the uppermost ones being about the length of two joints; they are slender, finely serrate. Farther out on the arm the lowermost spine, partly also the second from below, become conspicuously serrate on the under side (Fig. 13. b.). The arms are rather distinctly moniliform. The disk is covered by a close coat of stumps terminating in three, more rarely two, diverging thorns (Fig. 13. d.). Radial ribs not distinct. On the ventral interradii the stumps are less close set, and in the main terminating in two thorns, or even simply pointed. Colour (of dried specimen) white.

This species belongs to a group of species: *pentacrinus* Ltk. *pentagona* Koehler, *composita* Koehler, *angolensis* Koehler, *adiaphora* H. L. Clark, *baccata* Mrtsn., *vilis* Mrtsn., etc. — all of very uniform appearance, distinguished by characters of small general interest, and the varied combinations of these characters. That the present form cannot be identical with any previously described species seems evident, so I must, although reluctantly, describe it as a new species.

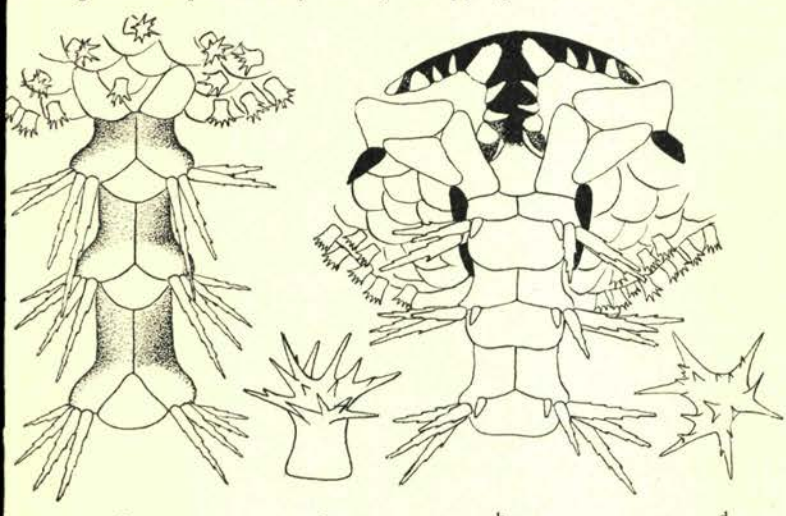
Ophiacantha Helenæ n. sp.

8 miles W. t. N. of the Sugarloaf, St. Helena, 2400—2780 m. 1 specimen, dredged onboard the "Dana", 23. II. 1930.

Diameter of disk 4 mm; length of arms ca. 3 times the diameter of disk, not to be measured exactly, the arms being too much convoluted. Disk covered, not very closely, by rather coarse stumps, terminating in a crown of some 6 thorns which may again have some smaller branches (Fig. 14. c., d.). The disk scales are rather large and seen fairly distinctly through the covering of stumps. The radial shields are small, but fairly distinct, separated by a broad wedge of scales. No radial ribs, the disk being, it would appear, uniformly convex (the specimen is slightly distorted). The stumps continue a little on to the ventral side, the main part of the ventral interradii being naked.

Mouth papillæ three to each side of jaw, slender and pointed, the ıter one slightly enlarged. The infradental papilla conspicuously rger, elongate. Adoral shields very broad, with a broad outer lobe parating the buccal shield from the first lateral plate. Buccal shields ore than twice as broad as long, with a very obtuse inner angle and ıe outer edge straight or with a very indistinct median lobe.

First ventral plate about equally long and broad, hexagonal; the llowing ventral plates very broad, occupying the whole width of the



g. 14. *Ophiacantha Helenæ* n. sp. Part of dorsal (a) and ventral side (b). Stumps from the disk in side view (c) and seen from above (d). a—b. × 18; c—d. × 75.

rm; the inner angle is very obtuse, the two inner sides forming almost straight line; the outer edge has a slight median concavity. The entral plates all widely separated. Dorsal arm plates of the two basal ints triangular, with a well marked inner angle and the outer edge onvex; from the third joint the inner angle becomes more obtuse. spines on the basal joints, conspicuously serrate, the upper one the ngest, about the length of an arm joint. One small, slender tentacle cale. Arms distinctly moniliform. Colour a simple light straw colour.

This species is related to *Ophiacantha aristata* Koehler, and perhaps till more so to *O.* (*Ophiomitrella*) *levis* (Koehler), which latter has the ame characteristic shape of the ventral and dorsal arm plates cf. Koehler. A contribution to the study of the Ophiurans of the

U. S. National Museum. Bull. U. S. Nat. Mus. 84. 1914. Pl. 10. 1—2
It differs, however, in the shape of the buccal and adoral plates,
also in having 9 arm spines. *O. aristata* differs from the present speci
in the shape of both the buccal and adoral plates as well as of t
ventral and dorsal arm plates, besides in having 8 arm spines. T
identity of the present species with any of the said species is th
out of the question. Another related species would seem to be *Ophi*
cantha cornuta Lyman, from off the Kermadec Islands (Chall. Op
Pl. XV. 3—5), which differs, however, both in the shape of the bucc
and adoral plates and in having 8 arm spines, the lowermost one
which is curved and thickened, (this character is not shown in t
figures!).

Evidently this species does not, strictly speaking, belong to t
fauna of St. Helena. It will most probably be found to be wide
distributed over the S. Atlantic deep-sea.

Ophiotreta sp.

2 miles E. of Bay Point, St. Helena, 480 m. Bottom with old Lophohelia
24. II. 1930. 1 specimen, diameter of disk 4 mm.

As the *Ophiotreta* species are generally of fairly large size, it ca
scarcely be doubted that the present specimen is only a young on
and I deem it, therefore, better not to describe it (it cannot be referre
with certainty to any of the known species).

Ophiothrix roseo-coerulans Grube.

Pl. XXII. Figs. 5—7.

Ophiothrix roseo-coerulans Grube. 1868. Über einige seltenere oder neue Ophiu
den. Jahresber. d. Schles. Ges. f. Vaterländ. Cu
tur. 45. p. 45[1]).

— — Koehler. 1904. Ophiures nouv. ou peu connues. Mém
Soc. Zool. France. 1904. p. 97.

Numerous specimens of this species — besides *Ophiactis Lymar*
and *Amphiura atlantica* the only Ophiuroid at all common at St. Helen
— were taken at various places on the coastal plateau off Jamestow
from off the Sugarloaf to off Egg Island, at depths of 20—30 fathom

[1]) The reference to Grube's paper given by Koehler (Op. cit.) is erroneou
in every respect, excepting alone the name of the author and the title of th
periodical.

particularly on the large sponges, *Chondrosia plebeia* O. Schmidt, so very common there in some places. Also in Prosperous Bay a specimen was taken at a corresponding depth, but here, on a bottom of black sand, it was evidently much less common.

Specimens were also taken on the shore, under stones in rock pools, off Jamestown and, particularly, off Prosperous Bay. Also in "Lot's wife's pond" some specimens were taken.

The largest specimens found — from the rock pools off Prosperous Bay — have a diameter of disk of 9 mm; thus it is evident that this species does not reach any large size.

The colour varies to a great extent — as seen already from the careful description given by Koehler — from a dark purple or almost black to a light pinkish, but the darker colours are the more predominant. The specimens are of a rather uniform character, particularly as regards the covering of the disk: long, slender spines, scattered among much shorter stumps; the radial shields small, naked, or with some scattered stumps, often arranged in a longitudinal line.

The suggestion by H. L. Clark (The Echinoderm Fauna of S. Africa, p. 338) that *O. roseo-coerulans* cannot be separated from the S. African *Ophiothrix triglochis* M. & Tr. is, in my opinion, entirely unacceptable. The rich material which I have collected of both these forms show them to be quite distinct — even though some few specimens of *O. triglochis* may have longer spines on the disk among the normal uniform covering of small stumps. On the other hand, I quite agree with Clark (Op. cit.) that the specimens from S. Africa recorded by Bell (1805. Marine Investigations in S. Africa. The Echinoderma III. Ophiuroidea, p. 258) as *O. roseo-coerulans* are not that species, but *O. triglochis*.

The species *Ophiothrix roseo-coerulans* is till now known only from St. Helena.

Ophiactis abyssicola (M. Sars).

Amphiura	*abyssicola*	M. Sars. 1861. Norges Echinod. p. 18. Pl. II. 7—12.
Ophiactis	—	Ljungman. 1867. Oph. viv. huc usque cogn. p. 324.
—	*poa*	Lyman. 1882. Challenger Oph. p. 119. Pl. XX. 13—15.
—	*corallicola*	Koehler. 1896. Echinod. du "Caudan", p. 75. Pl. III. 30.
—	*abyssicola*	H. L. Clark. 1918. Brittle-Stars, new and old. Bull. Mus. C. Zool. LXII. p. 304.
—	—	H. L. Clark. 1923. Echinod. Fauna S. Africa. p. 334.
—	—	Th. Mortensen. 1927. Handbook Ech. Brit. Isles. p. 202.

3 miles N.E. by E. of the Sugarloaf. 6 specimens, dredged onboard the "Dana" 22. II. 1930. From what depth they came it is impossible to say, the groun being exceedingly uneven, the depth varying within very short distances fro 1200 to 425 meters.

The finding of this common North-Atlantic species at St. Helen is only what should be expected, since it has been found off Trista d'Acunha (the *Ophiactis poa* of the "Challenger") and off S. Afric (H. L. Clark, op. cit. 1923).

Ophiactis Savignyi (Müll. & Troschel).

Ophiolepis Savignyi Müller & Troschel. 1842. System d. Asteriden. p. 95.
Ophiactis Reinhardtii Lütken. 1859. Add. hist. Oph. II. p. 161. Tab. III. 7. a—b
— *Savignyi* Ljungman. 1867. Oph. viv. huc usque cogn. p. 323.
— — H. L. Clark. 1918. Brittle-Stars, new and old. Bull. Mus Comp. Zool. LXII. p. 305.
— — H. L. Clark. 1933. Handbook littoral Echinod. Port Rico, p. 59.

James Bay, ca. 20 fathoms; 29. I. 1930. 2 specimens.
Prosperous Bay, 25 fathoms; 22. II. 1930. 1 specimen.

The occurrence of this cosmopolitan species at St. Helena is, o course, not at all surprising. It is only surprising that only 3 specimen were found in all, the species being otherwise usually found in grea numbers, where it does occur. Perhaps this means that life condition are not very favourable for it in the St. Helena waters. It is wort noticing that, whereas the species is otherwise often found in grea numbers in sponges, I did not find it in the sponge so very common o St. Helena, *Chondrosia plebeia* O. Schmidt; perhaps this sponge has no the right flavour.

Ophiactis Lymani Ljungman.

Ophiactis Lymani Ljungman. 1871. Förteckning öfver uti Vestindien af D A. Goës, samt under Korvetten Josefinas Expedition Atlantiska Oceanen samlade Ophiurider. Öfvers. K. Ve Akad. Förhandl. 1871. No. 6. p. 629.
(?) — — Koehler. 1909. Echinodermes. "Princesse Alice". Camp. Sci Monaco. Fasc. XXXIV. p. 172. Pl. XXVIII. 9—10.
— — Koehler. 1926. Revision de quelques Ophiures de Ljungman appartenant au Musée d'hist. nat. Stockholm. Arkiv f Zoologi. Bd. 19. A. p. 24. Pl. V. 1—2.

n: *Ophiactis lymani* H. L. Clark. 1918. Brittle-Stars, old and new. Bull. Mus. C. Zool. LXII. p. 303. Pl. IV. 5—6. (= *Ophiactis algicola* H. L. Clark. 1933).

Several specimens were taken at the following localities:
James Bay, ca. 20 fathoms. 29. I. 1930. 10 specimens.
Off Lemon Valley, ca. 20 fathoms. 4. II. 1930. 1 specimen.
Off Lemon Valley, ca. 60 fathoms, on a colony of *Sclerohelia*. 17. II. 1930. specimens.
Off Sugarloaf, 25 fathoms. 22. II. 1930. 1 specimen.
Prosperous Bay, 5 fathoms. 17. II. 1930. 1 specimen.
Prosperous Bay, 25 fathoms. 22. II. 1930. 16 specimens.
Flagstaff Bay, 60 fathoms. 24. II. 1930. 1 specimen.

They were generally found on a bottom with shells and sponges; ose from Prosperous Bay on a bottom of black sand.

There can be no doubt but that these specimens should be referred the West Indian *Ophiactis Lymani*. Already from the detailed deription given by Ljungman and the photographic figures given by oehler (Op. cit. 1926) this seemed fairly evident. But in order to tain full certainty I asked my friend, Professor Sixten Bock of the ksmuseum, Stockholm, to lend me the type specimen, which he very ndly did. The direct comparison of the St. Helena specimens with the pe confirmed the view of their identity. Only in one respect I notice small difference, viz. in the shape of the ventral plates; these have the type the distal edge rather distinctly concave, whereas in the . Helena specimens the distal edge is slightly convex; (cf. Figs. 15 b. d 16 d—e.). Perhaps the St. Helena specimens therefore ought ther to be regarded as a separate variety, var. *Helenæ* — but for ating so definitely we must first know, whether the said character the ventral plates is constant in the West Indian specimens. In the . Helena specimens the shape of the ventral plates is always as in gs. 15. b. and 16. e.

Although the figures of the type specimen given by Koehler p. cit. 1926) are fairly good, they do not give all the details distinctly; have therefore thought it desirable to give some drawings for showing e shape of the plates more clearly (Fig. 15). Attention should be called the spines of the disk, which are characteristic in terminating in distinct hyaline point (Fig. 15. d.); as a rule they are not present young specimens. In the type these spines are very few and poorly reserved, but they seem to be of the same character as those of the

St. Helena specimens. Towards the end of the arms the lowerm arm spine assumes the shape of a hook (Fig. 15. c.). In the type specim this character cannot be made out distinctly, the preservation n being sufficiently good for showing these delicate structures. T characteristic shape of the mouth shields is to be observed only in t fully developed part, not in the regenerating part. The colour is usua brownish-red, spotted with whitish; sometimes, however, it is mo greenish; in these latter specimens the dusky spot on the arm spi

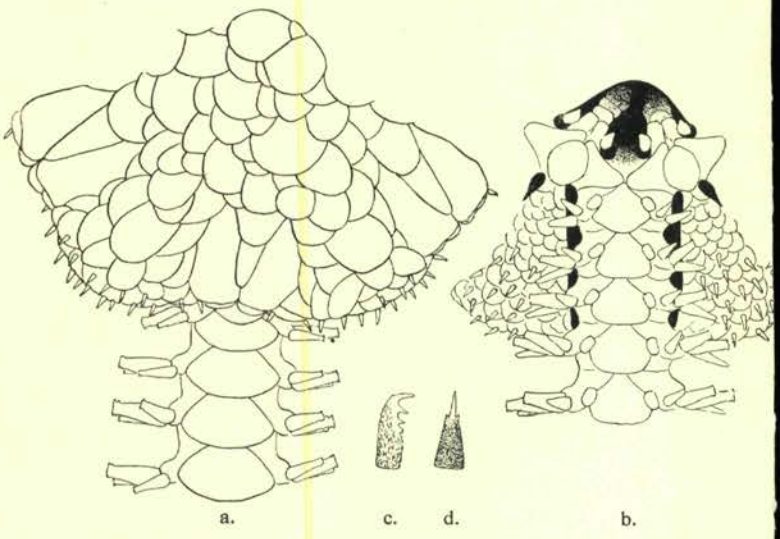


Fig. 15. *Ophiactis Lymani* Ljungman; specimen from St. Helena. Part of dorsal and oral side (b). Hookshaped spine from distal part of arm (c); spine from the disk (a—b. × 18; c—d. × 75.

is particularly distinct. The largest specimens have a diameter of di of 5 mm; one specimen has 7 arms.

Koehler, in his paper of 1926, refers to the description and figures *O. Lymani*, which he gave in 1909 (Op. cit.) after a couple of specime taken by the "Princesse Alice" off the Cape Verde Islands. He add "Je n'ai rien à ajouter à ma description à laquelle le lecteur pourra reporter." On comparing the figures of the type specimen with tho of the specimens from Cape Verde, one can only wonder that Koehl did not find anything to say about it. These latter figures are different from those of the type that — if the drawings of the Ca Verde specimens be only tolerably correct — they certainly cann

identical — as already suggested by Clark (Op. cit. 1918). Not
at I think it of much importance that Koehler represents these
cimens as having two oral papillæ, since it seems rather certain
at the innermost one of these papillæ does not represent a true
uth papilla, but the one belonging to the innermost foot pore. But
ventral and dorsal arm plates, and particularly the buccal plates,
so different from those of the type that it seems hardly possible
at it could be due to poor drawing alone.

Otherwise the occurrence of *O. Lymani* at the Cape Verde Islands
uld fit very nicely with its occurrence at St. Helena.

The specimens recorded by Clark, Op. cit. 1918, as *Ophiactis*
mani are distinguished as a new species, *Ophiactis algicola*, in his
andbook of the littoral Echinoderms of Porto Rico . . ." 1933, p. 56.

The species *Ophiactis Lymani* is very closely related to *Ophiactis*
illeri Lütken. This statement may seem rather strange, since H. L.
ark in his revision of the genus *Ophiactis* (Op. cit. 1918) places
Mülleri among the species with two mouth papillæ, whereas *O. Ly-*
ni has only one mouth papilla, a difference which is of primary im-
tance within the genus *Ophiactis*. But the fact is that Clark is
olly mistaken about the species *Ophiactis Mülleri* of Lütken, it
uld seem, because he did not think it worth the while to ascertain
ich is the real *Ophiactis Mülleri* — as he says (Op. cit. p. 306): "It
quite possible that the names in use for the West Indian species of
hiactis, *O. mülleri*, and *O. savignyi*, are not only not the first names
plied to the respective forms, but are not now used as Lütken
ginally used them. Nothing whatever would be gained, however,
an attempted readjustment."

It is rather extraordinary to have such a declaration from H. L.
ark, who otherwise does not refrain from changing old, familiar,
iversally used names into names of totally unrecognizable species
m old works, regardless of any damage and confusion thereby
used, as exemplified by his changing *Ophiura texturata* Lamarck
o *Ophiura ophiura* (Linn.), or *Ophiocomina nigra* (Abildgård) into
hiacantha sphærulata (Pennant) (that he also transfers the latter
cies to the genus *Ophiacantha* is another highly questionable matter,
ich does, however, not concern us in this connection).

I quite agree with Clark that nothing at all would be gained by
gging up some old, totally forgotten name which might perhaps refer

to *O. Savignyi;* if such be found I would strongly advocate that t
name *Savignyi* be made a nomen conservandum. But with regard
Lütken's *Ophiactis Mülleri* it is quite a different matter. Lütken
the founder of the modern study of Ophiuroids, and there is no excu
for disregarding his species, particularly of the West Indian Ophiuroi
of which Lütken made so profound and excellent a study. It is regr
table, of course, that Lütken did not give any illustrations of
Ophiactis Mülleri, but his description of it is so detailed and care
that there is no trouble in recognizing the species therefrom. A
even if the Danish language may offer some difficulty, there is
excuse for giving *Ophiactis Mülleri* 2 mouth papillæ, when Lütk
expressly says, both in the tabular view (Add. hist. Oph. II. p. 12
and in the description (p. 127) that it has only 1 mouth papilla, or
make it a 5-armed species when Lütken expressly says that it h
as a rule, 6 arms (the 6 being even a fat type). Also the number of t
arm spines is different, Lütken stating that there are 4, at most
at the base of the arm, whereas there are 6—8 in the species th
Clark calls *O. Mülleri.*

It appears that the confusion in regard to *Ophiactis Mülleri* arc
from Ljungman taking the extraordinary step of regarding
species *quinqueradia* only as a variety of *O. Mülleri*[1]). Whereas Lym
in his "Ophiuridæ and Astrophytidæ (Ill. Catalogue Mus. Comp. Zo
I. 1865, p. 109) has a perfectly correct description of *O. Mülleri*,
places it in the "Challenger" Ophiuroidea (p. 113) in his "first type
viz. among the species whose mouth papillæ (are supposed to) increa
in number with age — because, in accordance with Ljungma
he regards *quinqueradia* as the adult of *Mülleri.* Thus he comes
the statement that *O. Mülleri* has, as adult, 3—4 mouth papillæ
each side of jaw. Koehler (Revision de la collection des Ophiures
Mus. d'hist. nat. Paris. Bull. Sci. France & Belgique. XLI. 1907, p. 31
points out that Lyman was in error here, as Lütken in his origin
description states that there is only one mouth papilla. "C'est
chiffre qui est exact." — (Whether the specimens, represented
Koehler in his report on the Echinoderms in Michaelsen's Meere

[1]) It is a curious fact that also Lütken himself has felt uncertain wheth
this 5-armed species might perhaps be the adult of *O. Mülleri;* three specimens
O. quinqueradii (in very poor condition, but still with all the characters perfec
distinguishable) are labelled by Lütken "n. sp.? an *O. Mülleri* ad(ult)."

auna Westafrikas, 1914. Pl. VII. 9—10 as *Ophiactis Mülleri* are really hat species, I do not feel sure; the very small, wholly separated adial shields make a rather conspicuous difference from typical *. Mülleri*). Another reason for Clark's error in regard to *Ophiactis Mülleri* is very probably the fact that in general he appears to think pecies which are self-dividing and 6-armed to have only 5 arms in he adult stage (e. g. *Astroceras pergamenum* Lyman), an opinion for vhich there is no real support. It is true that we find among the adults f *Ophiactis Savignyi*, a typical self-dividing species, both 6-armed nd 5-armed specimens. But it is highly probable that these 5-armed pecimens are such as have never practised self-division. 5-armed pecimens, with all arms equally developed, are likewise found among he young specimens. For proving that the adult 5-armed specimens ave developed from young 6-armed, self-dividing specimens, it must e required that 5-armed specimens are found sometimes with half he disk and 2 or 3 arms in regeneration. I have never seen such pecimens and, until such specimens are found, I do not believe that -armed specimens ever developed from originally 6-armed ones.

The 5-armed species figured by Clark in his Catalogue of Recent phiurans, Pl. XI. 5—6 as *Ophiactis Mülleri* has accordingly nothing t all with the latter species to do; it is the one described by Ljungman as *Ophiactis Mülleri*, var. *quinqueradia*, and thus must be designated *Ophiactis quinqueradia* Ljungman, to which come as synonyms he names *O. dispar* Verrill and *O. longibrachia* H. L. Clark. Whether he *Ophiactis Ljungmani* of Marktanner-Turneretscher also is dentical with *quinqueradia*, as appears to be the opinion of Clark, r with *O. Savignyi*, as thinks Koehler (Op. cit. 1914. p. 185) I shall ot try to decide. On the other hand, the species described by H. L. lark (Op. cit. 1918, p. 307. Pl. 4. 3—4) under the name *Ophiactis yanosticta* is identical with the true *Ophiactis Mülleri* of Lütken, nd Clark's name thus becomes a synonym of the latter. I would articularly point out that the colour of the type specimens of *O. Müleri* is — as correctly described by Lütken — exactly like that of *. cyanosticta*, a variegated dull bluish-green and whitish, with dark narkings on the arms, as seen in Clark's figures. (There is often a ark dorsal midline, which widens into a band on some of the plates).

There is one character which must be mentioned specially, viz. the cale-covering of the disk. Clark emphasizes that there are about

five series of scales in the interradial areas at the narrowest point I find in the type-specimens usually only three series of scales here one larger scale in the middle and a smaller one to each side. Bu there is a good deal of variation, even within the various interradi in the same individual, so I do not think any stress can be laid on thi single character, the more so as it seems that in the specimen figure

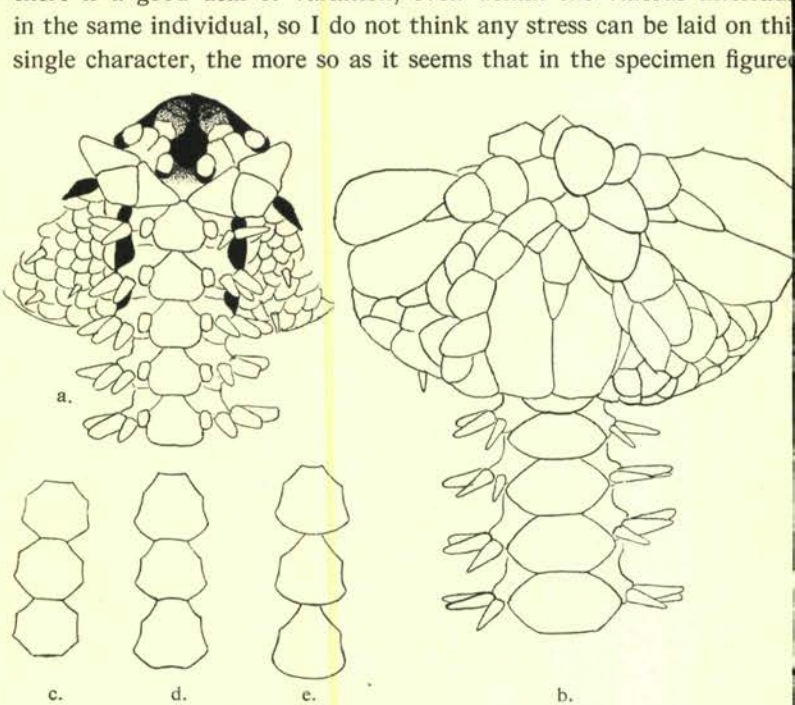


Fig. 16. *Ophiactis Mülleri* Lütken. Part of oral (a) and dorsal side (b) of type specimen Three arm plates from about the middle of arm of *O. Mülleri*, type specimen, (c), o *O. Lymani*, type specimen (d), and of the St. Helena form of *O. Lymani* (e). All × 25

by Clark, the holotype of *O. cyanosticta*, there are likewise only three series of scales at the narrowest point of the interradii.

It should be added that the arm spines are, as in *O. Lymani*, flattened and with small thorns at the distal end, recalling to some degree the axe-shaped spines of *Amphiura filiformis* etc.; in the distal end of the arms the lowermost spine becomes hook-shaped as in *O. Lymani*. Also the spines of the disk terminate in a hyaline point as those of that species. On the whole, as already stated, the two species *O. Lyman* and *Mülleri* are closely related, but easily distinguished by their very different coloration, *O. Lymani* never having those dark blue spot

characteristic of *O. Mülleri*. Also the mouth shields are different shape (cf. Figs. 15. b. and 16. a.), and likewise the ventral arm plates are somewhat different, particularly when — as is often the case in *O. Mülleri* — they become almost regularly hexagonal, as in Fig. 16. c. In *O. Mülleri* they are generally somewhat sunken in the middle, the distal border thus looking somewhat swollen (as also seen to some degree in Clark's figure of *O. cyanosticta*). In *O. Lymani* they are quite flat.

I take the opportunity here of giving some figures (Fig. 16) to show the structural details of *Ophiactis Mülleri*, drawn from the type-specimen. I think it superfluous to enter on a detailed comparison of this species with *O. quinqueradia*, the distinctness of the two species being quite evident from the foregoing remarks; but it may be just as well to mention that, besides in the above mentioned characters, they differ in the shape of the buccal shields, the dorsal and ventral arm plates, the radial shields, the disk covering, the colour, the size, the arm length — in short they are as different as species within the same genus could well be imagined to be. Of course, Clark did not regard them as identical either, he only misplaces the name *Mülleri* to apply to the species *quinqueradia*, giving the true *Mülleri* the new name *cyanosticta*. This he does likewise in his recently published "Handbook of the littoral Echinoderms of Porto Rico and the Virgin Islands" p. 57—58 — but it does not become more correct thereby.

Amphiura atlantica Ljungman.

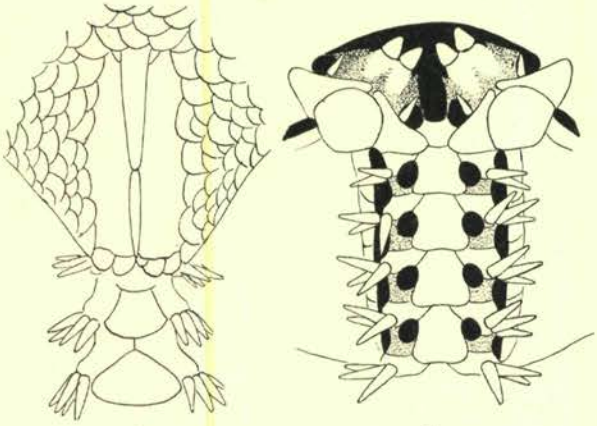
Amphiura atlantica Ljungman. 1867. Oph. viv. huc usque cogn. p. 321.
— — Koehler. 1926. Revision de quelques Ophiures de Ljungman. Arkiv f. Zool. Bd. 19. A. 2. p. 4.

Off Sugarloaf, 20—30 fathoms. 17 specimens. 27. II. 1930.
Flagstaff Bay, 35 fathoms. 2 specimens. 24. II. 1930.
Off King & Queen's Point, 40 fathoms. 1 specimen. 24. II. 1930.
Off Sea Cow Cove, ca. 15 fathoms, 1 specimen. 11. II. 1930.
7 miles E. of Bay Point, 480 m. (Old Lophohelias), 3 specimens. 24. II. 1930.

The species was hitherto known only from the specimen described by Ljungman, redescribed and figured by Koehler. It is therefore very satisfactory that new material has now come to hand, and I have thought it desirable to give some figures of it, the figures given

by Koehler not being all that could be desired — particularly th figure of the oral side.

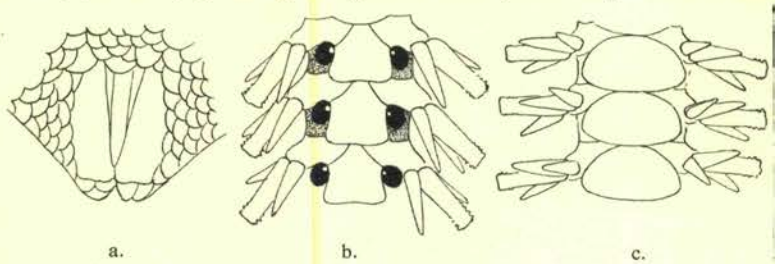
There is some variation in regard to the shape of the radial shields as appears from Figs. 17 a. and 18. a.; also as regards the scale-coverin



a. b.

Fig. 17. *Amphiura atlantica* Ljungman. Dorsal (a) and oral side (b). × 18.

of the disk there is some variation, the primary plates being sometime quite distinct, sometimes scarcely distinguishable. The number of th arm-spines varies from 4—6. A very small, rudimentary tentacle scale i usually present (Fig. 18. b.), though not in the proximal part of the arm



a. b. c.

Fig. 18. *Amphiura atlantica* Ljungman. Part of dorsal side of disk (a); three armjoint from middle of arm, showing the rudimentary tentacle scales (b); same, dorsal side (c) × 18.

There can be no doubt but that the South African *Amphiur dilatata* Lyman is so very closely related to *A. atlantica* as to be hardl distinguishable from it, even as a variety only. The characters pointe out by Koehler as justifying to keep the two forms as separate species

iz. the scales of the disk, the radial shields, and the number of arm pines, vary so much that they cannot be used as distinguishing characters; the same holds good of the shape of the disk (more or less excavated in the interradii). Rudimentary tentacle scales are present so in *A. dilatata*, and the second spine from below is widened in the me way as in *atlantica*.

The only noticeable difference that I can find is that the outer outh papilla is generally longer and more slender in *dilatata*.

Amphiura grandisquama Lyman.

mphiura	*grandisquama*	Lyman. 1869. Prelim. Report Oph. & Astroph. dredged in deep water between Cuba and the Florida Reef. Bull. Mus. C. Zool. I. 10. p. 334.
—	—	Lyman. 1875. Oph. & Astroph. Zool. Res. of the Hassler Exped. Ill. Cat. Mus. C. Zool. VIII. Pl. V. 65.
—	*longispina*	Koehler. 1898. Ech. & Oph. de l'Hirondelle. Camp. Sci. Monaco. Fasc. XII. p. 52, Pl. IX. 45—46.
—	*grandisquama*	Verrill. 1899. Oph. of the Bahama Exped. Bull. Lab. Nat. Hist. Mus. Iowa. V. 1. p. 26.
—	—	Koehler. 1907. Rev. de la Coll. des Oph. du Mus d'hist. nat. Paris. Bull. Sci. France & Belgique XLI. p. 301.
—	—	Koehler. 1909. Echinod. "Princesse Alice". Camp. Sci. Monaco. Fasc. XXXIV. p. 177.
—	—	Koehler. 1914. Echinod. Meeresfauna W. Afrikas. p. 190.
—	—	Koehler. 1922. Oph. Albatross Philippine Exped. p. 159. Pl. 66. 6—8.
—	—	Mortensen. 1927. Handbook Ech. Brit. Isles. p. 209, 211.

3 miles N. by E. of Sugarloaf, 1200—425 m. 22. II. 1930. 1 specimen.
2 miles S. 49 E. of Long Range Point, 280—450 m. 24. II. 1930. 2 specimens.
2 miles E. of Bay Point; 480 m. (Old Lophohelias). 24. II. 1930. 5 specimens.
Dredged onboard the "Dana".

These specimens agree very well with the descriptions of *A. grandisquama;* only the tentacle scales are larger than those of two West ndian specimens at hand, and than shown in Koehler's Pl. XI. 46 898); but as there is a considerable difference in the size of the tenacle scale even in the specimens from St. Helena (Figs. 19. b. and d.), his is no sufficient reason for separating them from *grandisquama*. lso the shape of the mouth shields varies rather considerably. One of

the specimens has in two places two outer mouth papillæ, evidentl
a splitting up of the normally single, large outer papilla. The papil
of the first mouth-tubefoot is unusually strongly developed.

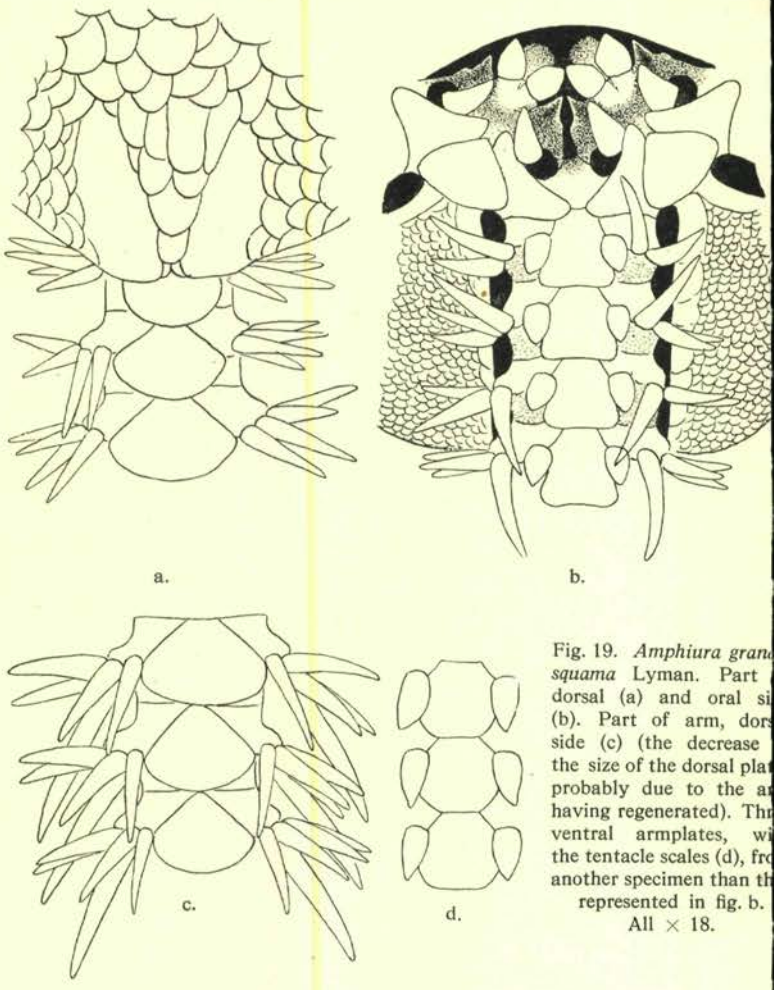


Fig. 19. *Amphiura gran squama* Lyman. Part dorsal (a) and oral si (b). Part of arm, dor side (c) (the decrease the size of the dorsal pla probably due to the a having regenerated). Thr ventral armplates, wi the tentacle scales (d), fr another specimen than th represented in fig. b. All × 18.

The species being known already from the Bay of Biscay and t Gulf of Guinea, besides from the West Indian Seas, and from t Moluccan Sea, and off Durban, it is not so very surprising to find now to occur also at St. Helena.

The figures given by Koehler (— Lyman never gave figures

, except the very unsatisfactory one of the mouth parts, op. cit. 875. —) being not quite satisfactory as regards the outlines of the lates, I deem it desirable to give here some new figures of this species Fig. 19).

The exact depth at which these specimens were taken being unnown, because of the irregularity of the bottom just outside the oastal plateau of St. Helena, the bathymetrical distribution of the oecies is not increased by the findings of it at St. Helena.

Amphipholis squamata (D. Ch.).

(For literary references, see my Report on the Ophiuroidea of the Danish Ingolf" Expedition. 1933. p. 63.)

Prosperous Bay, 25 fathoms; black sand. 22. II. 1930. 1 specimen.

There is nothing surprising in the finding of this cosmopolitan mphiurid at St. Helena. Although being viviparous and thus incapable f dispersal as pelagic larva, it has an excellent means of transportaon in the large littoral algae, in the "roots" of which it is often found. n this way its occurrence in another very isolated place, viz. St. Paul cf. M. Hertz. 1926. Ophiuroidea d. Deutschen Südpolar Exp. p. 35 – under the name of *Amphipholis minor* (Döderlein)) is evidently lso to be explained.

The facts that it was not found on the shores under stones at low ater[1]) and that only the said single specimen was taken in all the umerous dredge-hauls made, indicates that it does not thrive very ell in the waters of St. Helena.

H. L. Clark, in his "Handbook of the littoral Echinoderms of orto Rico and the other W. Indian Islands" 1933, p. 50, states that ery young specimens may have 6 arms and show evidence of autoomy". This sounds rather extraordinary to me; I have examined undreds and hundreds of this species from very many localities all ver the world, but I do not remember ever having seen a six-armed oung or adult specimen, and certainly I never found the slightest gn of autotomy. Are those 6-armed specimens of Clark really *Amhipholis squamata*?

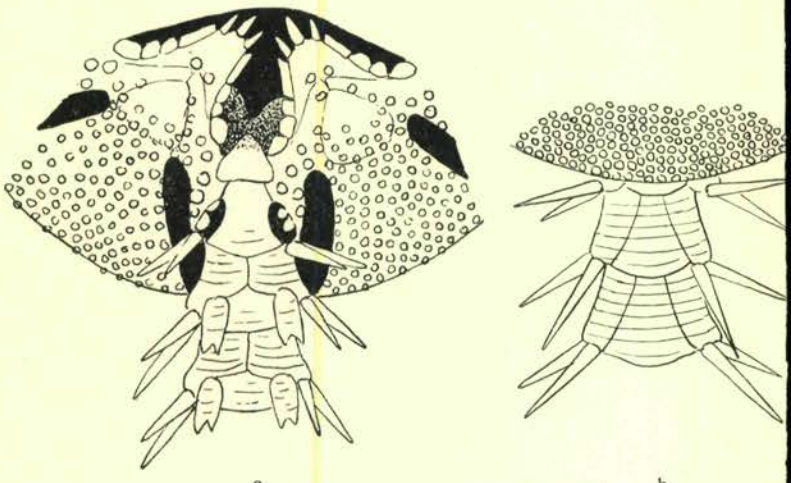
[1]) I find in my notebook special mention of the fact that no specimens of *mph. squamata* could be found under the stones in places, where it would be kely to occur; the possibility of its having been overlooked is therefore exuded.

Ophiopyren atlanticum n. sp.

2 miles E. of Bay Point, 480 m. Bottom with dead Lophohelias. 24. II. 193
2 specimens.

Dredged onboard the "Dana".

Diameter of disk of the largest specimen 2.5 mm, length of arm
ca. 12 mm. Disk wholly covered with granules, even the jaws partl
covered, the buccal shields and adoral plates just discernible. Mout
papillæ 5 to each side of jaw; the innermost one elongate, slender, lik
the infradental one, the second broad and low, the three followin



a. b.

Fig. 20. *Ophiopyren atlanticum* n. sp. Part of oral (a) and dorsal side (b). × 30.

ones narrower, more rounded. Buccal shields rounded-triangula
First ventral arm plate broad, triangular; the second broadly cont
guous with the first, much longer than broad; the following ones ar
widely separated, broader than long, with straight outer edge and
very obtuse angle within. Tentacle scales at the first pore pair tw
small ones on the abradial edge of the pore. From the second por
pair onwards there is one large, leaf-shaped tentacle scale, almos
twice as long as the ventral plate, and distinctly bifid at the point
Dorsal arm plates narrow, longer than broad, contiguous, rathe
distinctly keeled. The lateral plates with very conspicuous concentri
lines, continuing also across the dorsal plates, the whole dorsal surfac
of the arms thus getting a peculiar lustrous appearance. On the ventra

ide of the arms it is only the lateral plates that are thus distinctly riped, the ventral plates and the tentacle scales showing a less distinct ransverse striation. Arm spines two, about the length of an arm oint; the uppermost is slightly the longer. Genital slits wide. The ranules are finely spiny, of a honey-combed appearance as seen under igh power in the microscope. — Colour white.

This species recalls to some degree *Ophiopyren bispinosum* Koehler om the Indian Ocean, and also *Ophiopyren striatum* Mrtsn. from the rctic Sea, described in my Report on the "Ingolf" Ophiuroidea; ut it differs very markedly from both, and indeed from all the species f *Ophiopyren* hitherto made known, in the character of the ventral lates.

Ophiura Ljungmani (Lyman).

phioglypha Ljungmani Lyman. 1882. "Challenger" Oph. p. 44. Pl. IV. 8—10.
— *lepida* Lyman. Ibidem. p. 43, Pl. IV. 1—3.
— *Thouleti* Koehler. 1896. Ech. du "Caudan", p. 69. Pl. IV. 39—40.
phiura Ljungmani Mortensen. 1927. Handbook Ech. Brit. Isles, p. 240.
— — Mortensen. 1933. "Ingolf" Oph. p. 83.

3 miles N.E. by E. of the Sugarloaf, St. Helena, 1200—425 m. 3 specimens, redged onboard the "Dana".

The occurrence of this species off St. Helena is only what might be xpected, it being already known from off the coast of Brazil ("Chal- nger") and off S. Africa.

Ophiophycis gracilis n. sp.[1])

2 miles S. 49. E. of Long Range Point, 360—280 m. 24. II. 1930. 2 specimens.
2 miles E. of Bay Point. 480 m. 24. II. 1933. 10 specimens.
Dredged onboard the "Dana".

Diameter of disk in adult specimens scarcely exceeding 2 mm; rms about 3 mm long, very slender and delicate. Dorsal side of disk ightly elevated, oral side flat or slightly concave. There is a con- picuous rosette of primary plates, viz. a pentagonal central plate with ightly concave sides, and 5 rounded-polygonal radial plates. Distally o the radial plates, and in touch with these latter, follow the radial hields, which are contiguous in their whole length. In the interradii

[1]) The figure 21 was reproduced, much reduced, in the popular account of he "Dana" Expedition, 1932, p. 295, where also the name was first published.

there is a single elongate plate with straight sides and an angle at th inner end; its outer edge is slightly concave and joins a broader, almos elliptical marginal plate. At the base of each arm, outside the radia

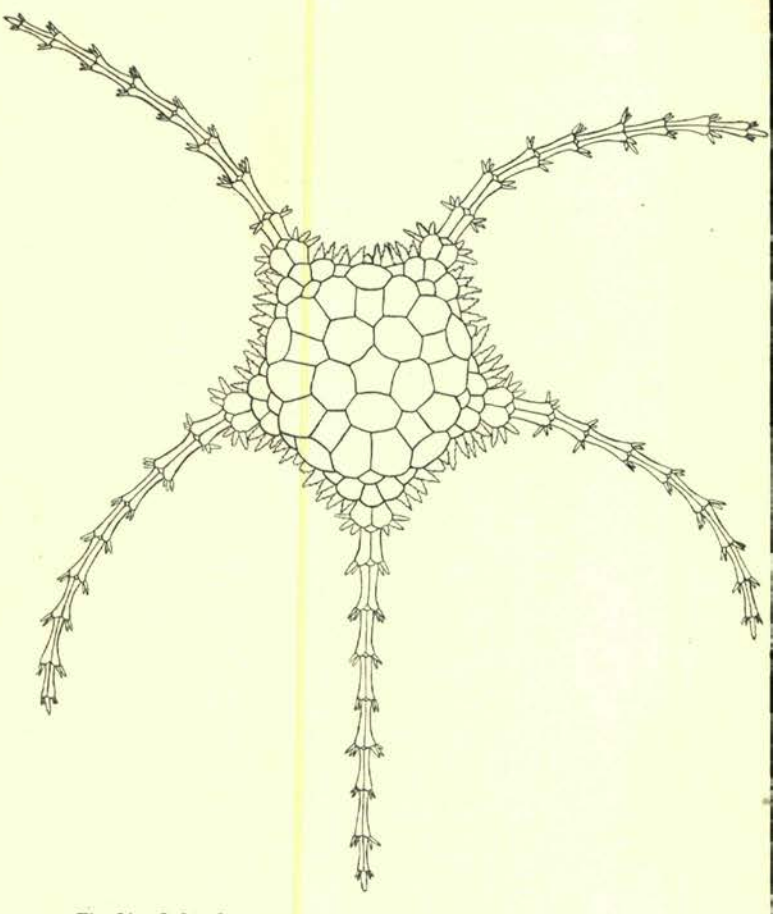
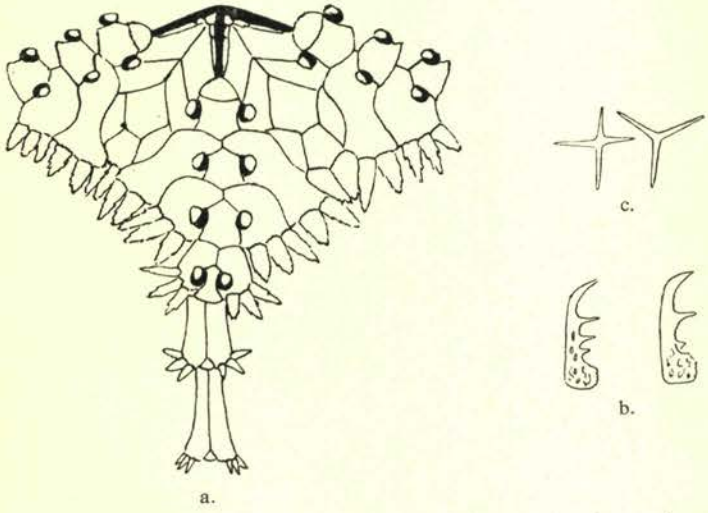


Fig. 21. *Ophiophycis gracilis* n. sp. Type specimen. Dorsal side. × 15.

shields, there are some smaller plates which partake in forming th border of the disk, but they are no true disk plates; they are the end of the widened lateral plates of segments 1 and 2, in conformity wit the fact that they carry spines. The two small plates in the radia line are, of course, the dorsal plates of the two first segments (Fig. 21)

he plates of the dorsal side all smooth, but the radial plates are ightly thickened in the middle.

The jaws carry a single broad papilla at the apex, and two or three arrow papillæ at the sides, the middle one much the largest; the outh papillæ, on the whole, are very inconspicuous and to be made ut distinctly only on specimens cleared in Canada balsam (Fig. 25). he adoral plates join broadly within; they are somewhat broader their distal part that joins the first lateral plates. The mouth shield



ig. 22. *Ophiophycis gracilis* n. sp. Part of oral side (a); hook-shaped armspines from distal part of arm (b); spicules from stomachal wall (c). a. × 30; b—c. × 160.

s pentagonal or more rounded; distally to the mouth shield there is a ingle rather large plate reaching to the margin of the disk, and at each ide, in the corner between the mouth shield and the marginal plate, a smaller, somewhat elongate plate. The shape of all these plates s subject to some variation. There is no trace of bursal slits, unless he small space between the mouth shield and the first lateral plate Fig. 25) should be regarded as the equivalent of the bursal slits; but s it is covered by skin, this would not seem likely. The ventral rm plates are all separated, except the two first; they are restricted n the middle because of the pores. From the fifth the ventral plates re reduced to very small, triangular plates, beyond the 6th they are o minute as to be observable only by rather strong magnification on

specimens cleared in Canada balsam. The lateral plates of the tw
first segments are much widened so as to reach the edge of the disk
the third pair is much less widened, and from the fourth joint the
are long and slender, joining below and above so as to form a slende
tube, slightly widened at the distal end, where the spines are carried
(As it was found very difficult to trace the exact limits of the plate
on the oral side on the alcoholic or dried specimens, the figure of th
oral side (Fig. 22) was drawn after a specimen cleared in Canada balsam

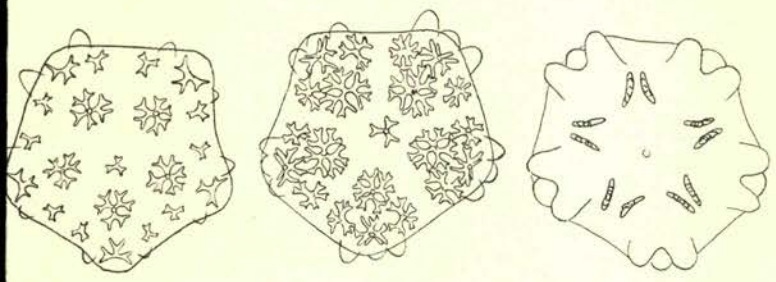
The arm spines are two on the first, three on the following latera
plates, only on the distalmost joints there may be only two. Thos
of the two first segments are broad and flat, serrate along the edges
they form a conspicuous fringe all round the disk, which is made pos
sible through the fact that the lateral plates are so elongate as t
reach the edge of the disk, thus forming the greater part of the margi
of the disk. In the middle of the interradius there are two spine
apparently issuing from the median interradial marginal plate, no
from the lateral plates. On the third joint the spines are also rathe
broad and flat, so as to form part of the marginal fringe. From th
fourth joint they are much smaller, slender, and on the distal joint
they gradually assume the character of small hooks (Figs. 22. b.). Th
dorsal arm plates are very small, triangular, disappearing on the las
joints. Only four pairs of pores are distinct, each with a single, sma
tentacle scale. On the first free arm joint a pair of small pores may b
observed in microscopical preparations; beyond this there is no trac
of pores on the arms. The number of free arm joints in adult specimen
is 7 to 9, the number varying in the arms of one and the same specimen

The colour of the live specimens was a faint pinkish; the pre
served specimens are whitish.

This very fine little Ophiurid I took (2 specimens) in a dredgin
with the "Dana" at St. Helena, 2 miles S. 49° E. of Long Rang
Point, at a depth of 360—280 meters; it was found attached to a stone
A few more specimens — one of them with four arms only — wer
found in another dredging the same day, 2 miles E. of Bay Point
480 meters; these latter specimens were found in the washings of som
old, dead "*Lophohelia*" branches, to which they had evidently bee
attached.

On removing the first specimen from the stone to which it wa
attached I was very surprised in discovering under its disk 8 young

mbryos. This species thus protects its brood, covering it with s body, much as do several seastars. I have opened a couple of specnens and found only one gonad to each side of the arms, each gonad ontaining, in the female, one egg, ca. 0.15—0.2 mm in diameter, rich yolk. The male gonads are slightly larger than the female gonads. s there are no bursal slits, the eggs must pass out through openings rmed specially for that purpose, through resorption of the body all with its calcareous plates, much as I have found it to occur in *phiopus arcticus* (cf. my paper "Über Ophiopus arcticus Ljungman, ne Ophiure mit rudimentären Bursen". Z. f. wiss. Zool. Bd. LVI



a. b. c.

ig. 23. Embryos of *Ophiophycis gracilis* n. sp. a—b. Dorsal side, showing two consecutive stages of development of the skeletal plates; c. oral side. × 105.

893. p. 510). As no such openings are to be observed in the specimen ound covering its young ones, this must mean that the openings hrough which the eggs pass out are already healed up again. Alhough thus protecting its young ones the species is not viviparous nd not hermaphroditic.

In the anatomical preparations it was found that the stomachal all contains a number of three- or four-radiate spicules (Fig. 22. c.).

The embryos were found to be in two slightly different stages of evelopment, one showing the young skeletal plates a little further eveloped than the others (Fig. 23. a—c.). It appears that the first rmed skeletal elements are the five radial plates and the terminal lates; next follow the radial shields and the central plate. In the more dvanced stage the central plate is still the smallest. On the oral side nly one pair of plates have made their appearance in the later stages, ndoubtedly representing the jaws. The first pair of tentacles have

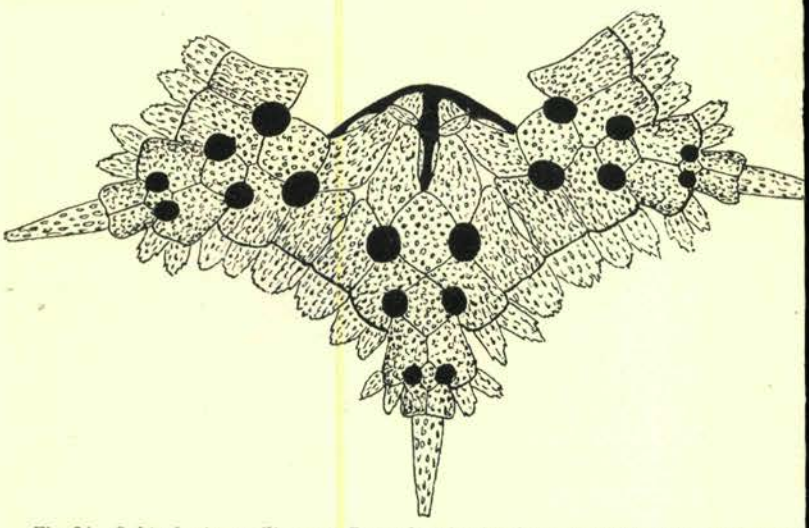


Fig. 24. *Ophiophycis gracilis* n. sp. Part of oral side of youngest free-living stage. × 6

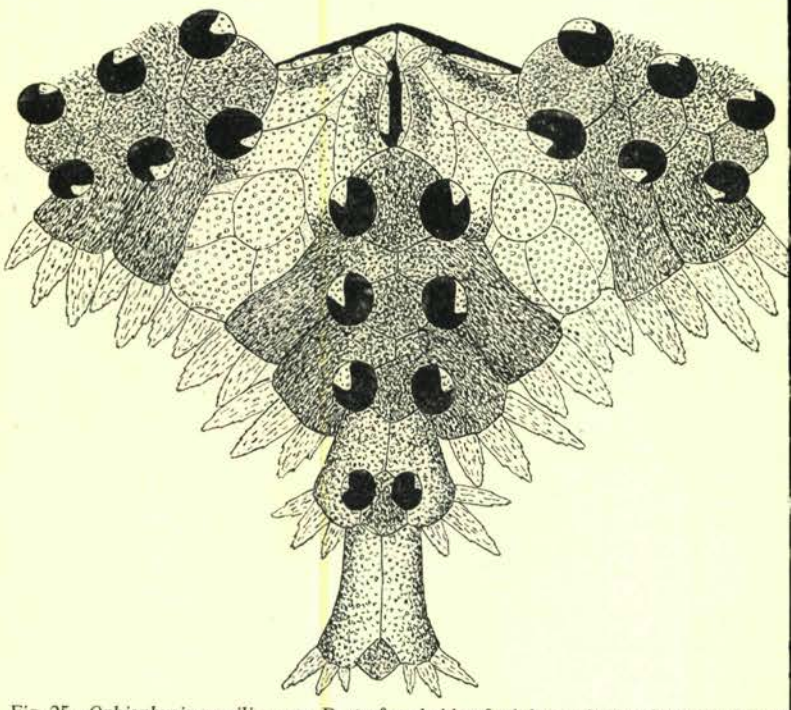


Fig. 25. *Ophiophysis gracilis* n. sp. Part of oral side of adult specimen, cleared in Canad balsam. × 55.

een formed; the terminal "feeler" is still quite short. The mouth pening has not yet been formed in the later of the two stages.

The youngest specimen found free-living (Fig. 24) has only three rm joints. It has as yet no mouth shields and no tentacle scales. ut the main interest attaches to the fact that the adoral shields re widened like the lateral plates and reach the margin f the disk, carrying here one broad spine. In the course f growth the distal part of these plates is resorbed, so that they are idely removed from the margin (Fig. 25 to compare with Fig. 24). ut the spines remain, now apparently issuing from the marginal late; the development thus gives proof that these two spines in the iddle of the interradial margin in reality belong to the adoral plates vhich morphologically represent the lateral plates of the first segnent).

This species has a fairly close resemblance to the *Ophiophycis mirailis* Koehler, the genotype of *Ophiophycis* and the only species hitherto nown. This latter species, which was taken (2 specimens) by the Princesse Alice" off the Azores (38°26′ N. 26°30′45″ W., 1165 m), iffers from the St. Helena species in various characters; it has 6 pairs f pores, against 4 in *O. gracilis*, and the 5 first lateral plates are idened, against only the 3 first in *O. gracilis*. The spines of the marinal fringe differ in shape from those of *O. gracilis* (cf. Pl. XXVI. 3—4 f Koehler's Report, Monaco, Fasc. XXXIV)[1]). The tentacle scales eem to be larger in *O. mirabilis*, and there are two of them at the first ore pair, only one in the St. Helena species; also, *O. mirabilis* appears o have more mouth papillæ, and its arms are not nearly as slender s are those of *O. gracilis*. Finally the species from the Azores is a good eal larger, ca. 5 mm diameter of disk, than the St. Helena species, vhich appears not to exceed 2 mm. While there are thus characters nough to prove the distinctness of the two species, there can be no oubt that both of them belong to the same genus, characterised articularly by the widening of the proximal lateral plates, their pines forming a fringe all round the disk.

[1]) Koehler figures these spines as an immediate prolongation of, not limited rom, the lateral plates. This must be an error in the drawing; there can be o doubt that the spines will be limited against the lateral plates, as in *). gracilis*.

Ophiomusium spinigerum n. sp.

8 miles W. by N. of Sugarloaf, St. Helena. 2400—2780 m. 1 specimen; dredge onboard the "Dana", 25. II. 1930.

Diameter of disk 15 mm; arms probably ca. 4—5 times the dia meter of disk; the longest preserved is 48 mm long.

Mouth papillæ 6—7 (8) to each side of jaw, the outermost but on large and broad, the outermost one very small. Buccal shield longe

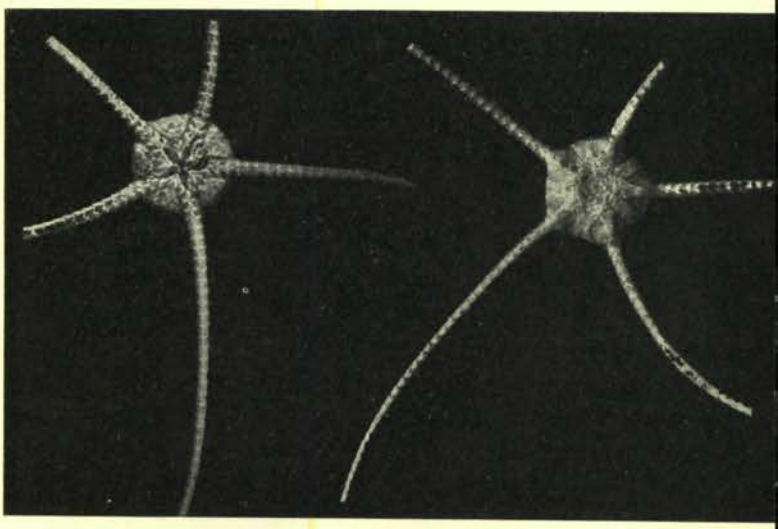
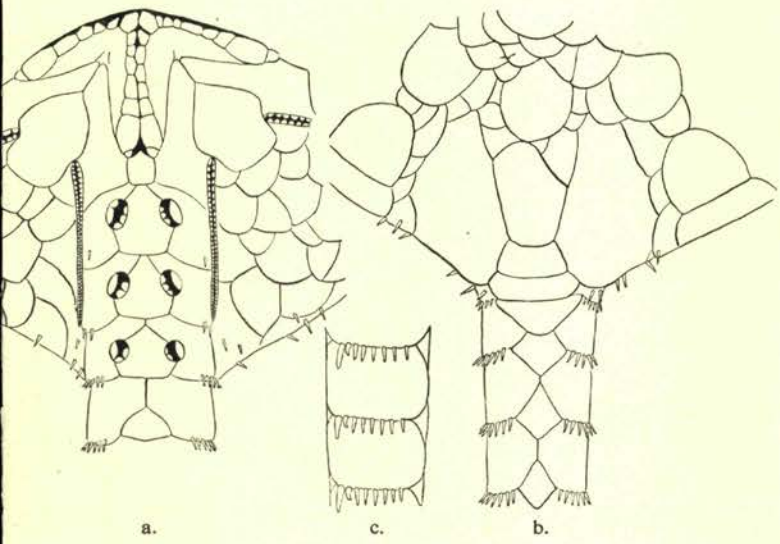


Fig. 26. *Ophiomusium spinigerum* n. sp. Type specimen, oral and aboral side. Natur size.

than broad; it has an acute angle within, the sides being more or les distinctly convex, till, about halfway, they get a distinct notch for th adoral end of the genital slit. The outer half of the buccal shield ha straight sides and a slightly convex distal edge; this outer half of th shield is somewhat narrower than the inner half. Adoral shields ver well developed, joining broadly within and having a broad outer lob separating the first lateral plate widely from the buccal shield. Firs ventral plate very small, almost rectangular, but with a small angl within. The two following ventral plates narrowly contiguous, th fourth slightly separated from the third; the sides of the three firs ventral plates are conspicuously notched by the pores. From the fift

e ventral plates are widely separated, reduced to small triangular ates at the end of the joint; they continue to the end of the pre- rved part of the arms. Tentacle pores on the first 3 segments; they ve 3—2 scales on the adradial side and 1 very broad scale on the radial side, more exceptionally two, a small proximal and a large stal one. Genital slits do not reach the border of the disk, only the end of the second arm joint; both margins are set with small pillæ (Fig. 27. a.). Dorsal arm plates rhombic, widely separated,



. 27. *Ophiomusium spinigerum* n. sp. Part of oral (a) and dorsal side (b); three arm-joints, side view (c). × 6.

cept the proximal ones, viz. two or three transformed ones in the tch between the radial shields, and the one of the first free arm nt, which has the inner angle truncate. Arm spines 8 on the proximal nts, somewhat outstanding, well developed; the lowermost one is ghtly the longest, and the second from below is transformed into a all hook (Fig. 27. c.). Radial shields well separated; disk scales her large, but not very distinctly limited. Primary plates not very tinct; two larger plates in the interradii, and one fairly large mar- al plate, not distinctly seen from the ventral side; plates of ventral erradii well sized but irregularly arranged. The most striking char- ter is the existence of some slender spines placed, without any order,

at the base of the arms and along the margin of the disk. — Colo (of dried specimen) white.

This species appears to be the nearest related to *Ophiomusiu armatum* Koehler from the Philippine Seas (Oph. "Albatross" Phili pine Exped. p. 389, Pl. 89. 8—10), which, according to the descriptio would seem to have also some scattered spines on the edge of the dis Judging from the, unfortunately, very poorly reproduced photos, seems to have also the second spine from below transformed into spine. That they are not identical is certain; thus the genital slits a longer in *O. armatum*, and it has only 6 arm spines, and also the sha of the buccal shields appears to be somewhat different.

III. Echinoidea.

Eucidaris clavata Mrtsn.

Cidaris metularia Melliss. 1875. St. Helena, p. 219.

— *tribuloides* Koehler. 1908. Ast. Oph. & Ech. de l'Exped. Antarct. Ec saise. ("Scotia"). Trans. R. Soc. Edinburgh. XLVI. p. 6

— — Cunningham. 1910. On the Marine Fishes and Invertebr. St. Helena. P. Z. S. p. 124.

Eucidaris clavata Mortensen. 1928. Monogr. of the Echinoidea. I. p. 4 Pl. XLII. 1—4; LXVII. 10—11; LXXIII. 2; LXXX 15.

— — Mortensen. 1932. New Contrib. to the Knowl. of the Cidar I—II. Mem. Ac. R. Copenhague. 9 Ser. IV. p. 169. Pl. 3—5.

As mentioned in my paper of 1932 this species is quite comm at depths of ca. 20—60 meters on the coastal plateau off Jamestow particularly where the bottom is covered by the sponge *Chondro plebeia*. Also on the rocks about low water mark it is sometimes four

This species, which is known only from St. Helena, is quite distir from the West Indian *Eucidaris tribuloides*, but has evidently originat from the latter, the larvæ of which must have been transported acr the ocean to St. Helena and there have developed into this ne characteristic form.

Tretocidaris spinosa Mrtsn.

Tretocidaris spinosa Th. Mortensen. 1903. "Ingolf" Echinoidea. I. p. 17, Pl. X. 10, 11, 16.

retocidaris spinosa Koehler. 1908. Ast. Oph. & Ech. Exped. Antarct. Ecossaise ("Scotia"), p. 300. Pl. XVI. 163, 164.
— — H. L. Clark. 1925. Cat. Rec. Ech. Brit. Mus. p. 20.
— — Mortensen. 1928. Monogr. Echinoidea. I. p. 317, Pl. XXXIII. 1—3; XXXIV. 1—2; LXVII. 9; LXXI. 15; LXXXII. 32—36.
— — Mortensen. 1932. New Contrib. Knowl. Cidarids. p. 154. Pl. IV. 6—12; 15; XIII. 3.

Like *Eucidaris clavata* this species is quite common on the coastal ateau off Jamestown, but mainly at depths of 50—60 meters, and pecially where the bottom is covered with *Arca Bouvieri*, overgrown y *Cirripathes*.

This species, which occurs also at Ascension, is nearly related to ıe West Indian *Tretocid. Bartletti* (A. Agassiz), from which it may ot improbably have originated.

Cidaris cidaris, var. *meridionalis* Mrtsn.

h. Mortensen. 1928. Monogr. Echinoidea. I. p. 298. Pl. XXXI. 8—10; LXVII. 5; LXXII. 20—21.
— 1932. New Contrib. Knowl. Cidarids, p. 154.

6 specimens dredged omboard the "Dana" 2 miles E. of Bay Point, 480 eters (24. II. 1930).

The colour of the live specimens was in general a light yellowish, e primary spines a faint pinkish; the small spines on the apical stem with a small dark spot at the base. The point of the tubefeet ark brownish; also the genital openings dark.

These specimens thus are somewhat lighter coloured than in the pes of the variety (from the Bay of Biscay). On the whole this variety not very well marked.

Diadema antillarum, var. *ascensionis* Mrtsn.

adema ascensionis Th. Mortensen. 1909. Echinoidea d. deutschen Südpolar Exped.; p. 55. Taf. VII. 10; XVI. 1, 4, 8, 16—17, 21—23.
— *antillarum* Koehler. 1914. Beiträge z. Kenntnis d. Meeresfauna W. Afrikas. Echinoderma. I. p. 218. Pl. XI. 12, 13, 15; XV. 64—72.
— — H. L. Clark. 1925. Catalogue Recent Sea-Urchins. Brit. Mus. p. 42.

Diadema antillarum Mortensen. 1927. Echinides du "Travailleur" et d "Talisman". p. 25.

Several specimens were taken off the pier of Jamestown at a depth of 4—5 m further, off Old Woman's Valley at the same depth. Off Egg Island, ca. 30 meter 1 specimen. Also at Ascension I found some specimens in rock pools, during th half hour I was allowed to spend ashore there.

Evidently the species is quite common at St. Helena at least o the lee side of the island. It was found in various sizes, up to ca. 70 m h. d.; the smallest ones were ca. 35 mm h. d. Quite young ones wer not observed. The specimens found at Ascension were much smalle the smallest 17 mm h. d.

The study of the rich material now at hand has convinced me tha I was quite justified in regarding (Op. cit. 1909) the specimens fro Ascension as distinct from the West Indian *Diadema antillarum*. Th very characteristic shape of the tridentate pedicellariæ, as figured i my work quoted (1909, Taf. XVI. fig. 16), I find to be quite constan in the specimens from St. Helena (and Ascension); they occur in grea numbers, scarcely surpassing a size of 0.8 mm length of head.

Whereas this character of the tridentate pedicellariæ at onc distinguishes the St. Helena-Ascension form from the West India *Diadema antillarum*, I must agree that in the characters of the tes the two forms are alike. Also the colour is essentially the same. In th St. Helena form I noticed the colour of the live specimens to be: a blu ring on the apical system, and a blue stripe downwards in the inte ambulacrum, bifurcating, one branch continuing downwards alon each side of the interambulacrum; there is also a blue ring round th base of the primary spines. No distinct white spot in the naked upp part of the interambulacrum. The anal tubus (which is, of course, we developed) entirely black. In some specimens the blue stripes are s weak as almost totally to disappear. — This colour corresponds ver well to that of *Diadema antillarum*, according to own observations o live specimens of the latter (in 1906).

Also the colour of the spines is as in *D. antillarum*, generally black but sometimes a number of the spines are white. In the young specimen from Ascension the spines are conspicuously banded, black and white

Whereas thus of the characters hitherto noted only that of th tridentate pedicellariæ holds good, there is one more character distin guishing the St. Helena form from *D. antillarum*, viz. that the spine

re in general decidedly thicker and more robust in the former than n the West Indian species.

In view of the fact that the tridentate pedicellariæ afford one of the nain distinguishing characters within the genus *Diadema*, the very istinct difference in the shape of these pedicellariæ existing between nose of the West Indian and the St. Helena-Ascension form forbids mply uniting this latter form with the West Indian *Diad. antillarum*. Whether we then regard it as a variety only of *D. antillarum* or as a istinct species does not matter, the main thing is that they are kept part.

I will take the opportunity of stating here that I think the *Diadema* f the Canaries, Madeira, Cape Verde should likewise be distinguished s a separate variety of *D. antillarum*. It is not identical with the ar. *ascensionis*, but rather nearer *D. antillarum*. However, I shall not t present enter on a discussion of this matter.

Echinus atlanticus Mrtsn.

chinus atlanticus Th. Mortensen. 1903. Ingolf Echinoidea. I. p. 101. Pl. XVIII. 17; XIX. 37.
— — H. L. Clark. 1925. Cat. Rec. Ech. Br. Mus. p. 110.

2 miles 49 E. of Long Range Point, St. Helena. 520—375 meters. 1 large ecimen, dredged onboard the "Dana", 24. II. 1930.

The species was hitherto known only from off Ascension; its occur- nce at St. Helena is only what was to be expected, but, all the same, is a matter of satisfaction to have thus actually found it there.

The specimen, which measures 64 mm h. d., is nearly white.

A full description of this species with figures, I expect to give in art III of my Monograph of the Echinoidea.

Pseudoboletia atlantica H. L. Clark.

seudoboletia maculata Koehler. 1908. "Scotia" Echinoderms, p. 305. Pl. XV. 139—142; XVI. 165.
— *atlantica* H. L. Clark. 1925. Cat. Rec. Ech. Brit. Mus. p. 131.

Several specimens were dredged off Sea-Cow Cove, St. Helena, ca. 20 meters, a bottom with small stones covered with *Lithothamnion*, in places also with ose *Furcellaria*-like algæ. On this locality they evidently occurred in great mbers, whereas the species was otherwise found only very rarely and mostly ly fragments of dead tests.

It is a very peculiar fact that only large specimens were found all ca. 80 mm h. d.

The colour varies rather much, from pure white, with the spine only very indistinctly banded, to greenish, with the spines very con spicuously banded. The naked test of a faintly greenish or pinkis tint, with more or less distinct darker spots arranged in concentri bands on the upper side.

The pedicellariæ are very numerous, particularly in the ambu lacral and interambulacral median space on the upper side, and the are in the live specimens in a constantly waving movement, recallin a corn-field waving for a gentle breeze.

It covers itself with stones and algæ, quite as does *Tripneust* and several other littoral Echinoids.

As I expect to deal more in details with this species, together wit the other *Pseudoboletia*-species, in Part III of my Monograph of th Echinoidea, I shall here content myself with the above remark putting off also the photographic figures of the species till that work

The species is known only from Ascension and St. Helena.

Echinometra lucunter (Linn.).

Echinometra subangularis A. Agassiz. 1872. Revis. of Ech. p. 283, Pl. X. a. 2—
— *acufera* Mellis. 1875. St. Helena, p. 219.
— *lucunter* Th. Mortensen. 1903. "Ingolf" Echinoidea I. p. 128.
— *subangularis* Koehler. 1908. "Scotia" Echinod. p. 304.
— — Cunningham. 1910. Mar. Fishes & Invertebr. St. Helena. P. Z. S. p. 125.
— *lucunter* Koehler. 1914. Beitr. z. Kenntn. d. Meeresfauna W. Afr kas. Echinod. I. p. 249; Pl. XV. 83—84.
— — H. L. Clark. 1925. Cat. Rec. Ech. Br. Mus. p. 143.

Common on the rocks all along the lee side of St. Helena, an probably also on the windward side, wherever the rocks afford irregu larities among which they can maintain themselves. At least I hav observed it at Prosperous Bay and Lots Wife's Pond. Also at Ascensio I took some specimens.

Though I am naming it here, in accordance with Koehler an H. L. Clark, *Ech. lucunter*, I do not feel quite convinced that it really simply identical with the West Indian species. It is, on th whole, less elongate than the typical *Ech. lucunter*, and there are als other minor differences — e. g. the peculiar fact that the colour

onstantly black, not now black, now brown, as in the West Indian orm. But, as a thorough revision of the *Echinometra*-species is very nuch needed, I shall not at present take up a definite position towards he question, whether these mid-atlantic specimens perhaps rather epresent a separate species or variety, like the mid-atlantic *Diadema*.

No doubt it is the present species which was mentioned by Wallich (Ann. Mag. Nat. Hist. 3. Ser. X. 1862. p. 441) under the ame *Echinus lividus* as found at St. Helena. By a superficial examination it has, indeed, much resemblance with *Paracentrotus lividus*, vhich species does, however, not occur at St. Helena.

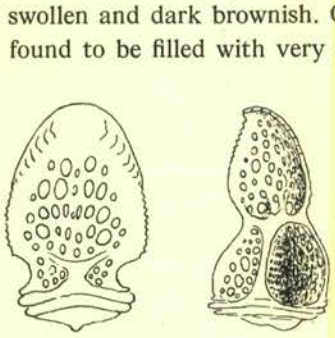
Echinocardium connectens n. sp.

Some fragments of a specimen of an *Echinocardium* were dredged (5. III. 1930) ff Egg Island, St. Helena, at ca. 40 meters, on a bottom of small stones with *ithothamnion*. Also off Lemon Valley, ca. 50 meters, some fragments of a dead est were taken.

Although the fragments are much too incomplete for allowing a ull description of the species, they suffice for proving that we have ere a very distinct new species of the genus *Echinocardium*, and a very interesting species too, forming a connecting link between two o rather distantly related species as *Ech. cordatum* (Pennant) and *Ech. pennatifidum* Norman.

The shape of the test must be rather like that of *pennatifidum*, the rontal ambulacrum being not sunken or, at most, very slightly so. Length of the specimen ca. 40 mm). The pores within the fasciole are arge, close set, very different from the tiny, distant pores of *pennatifidum;* they more recall those of *Ech. cordatum*, but they are placed n a single, regular series, not in an irregular double series as in the atter species. There appear to be no large spines above the ambitus. Characters of the labrum and the subanal fasciole cannot be made ut. Of pedicellariæ only the triphyllous and a small tridentate form re found. The triphyllous pedicellariæ (Fig. 28. a.) are of the type ound in *Ech. cordatum*, with a series of inner teeth on the blade, a tructure hitherto known only in *Ech. cordatum*. The tridentate pedicellariæ (Fig. 28. b.) are not characteristic; that the large tridentate, s well as the globiferous pedicellariæ will offer good specific characters ve may well infer — but, unfortunately, none of them are found on he fragments preserved. A peculiar feature is to be observed on

several of the triphyllous pedicellariæ, the neck and head being muc swollen and dark brownish. On a microscopical examination they ar found to be filled with very small yellowish or dark brown bodies – in all probability a parasitic plant-or ganism. The valves of these pedicella riæ are not dissolved or in any wa abnormal in shape.



a. b.

Fig. 28. *Echinocardium connectens* n. sp. Valve of triphyllous (a) and tridentate pedicellaria (b). a. × 360; b. × 120.

It is very unfortunate that onl such poor fragments have been foun that none of the other characters o the species can be made out. Bu those characters which could be as certained are sufficient to show tha this is a quite distinct species, and have no doubt that it will be quit possible to recognize the species fro these characters, so I think it fully justifiable to establish this ne species in spite of the insufficient material available.

Plagiobrissus Costæ (Gasco).

Metalia Costæ F. Gasco. 1876. Descrizione di alcuni "Echinodermi" nuove per la prima volta trovati nel Mediterraneo. Rendi Acc. Sci. Napoli. XV. 2. p. 4. fig. 1—2.

— — Th. Mortensen. 1913. Die Echiniden d. Mittelmeeres. Mitt. a. d Zool. Stat. Neapel. XXI. p. 32. Taf. III. 1—6; V 1—4, 6—10, 12—17, 19, 21, 24—27.

Plagiobrissus Costæ H. L. Clark. 1917. Hawaiian a. o. Pacific Echini. Echin neidæ ... Spatangidæ. Mem. Mus. Comp. Zoo XLVI. p. 208.

— — Th. Mortensen. 1927. Echinides du "Travailleur" et d Talisman". Arch. Mus. Paris. 6. Sér. II. p. 32.

Some fragments of some dead and of one or two living specimens were dredge off Egg Island, St. Helena, at a depth of ca. 40 meters, on a bottom of coars gravel and small stones with *Lithothamnion*.

I have succeeded in putting together some of the fragments so as t get almost the complete dorsal side of one large test, ca. 100 mm long The resemblance with specimens from the type locality off Napo is so complete that there can be no doubt of their identity. On th fragments of the live specimen(s) I have found only small tridentate

phicephalous and triphyllous pedicellariæ. The tridentate pedicellariæ re rather intermediate between the two forms figured in Fig. 25 and 7, Taf. V. of my paper of 1913.

The species being now known from the Mediterranean, from off he N.W. Coast af Africa, and from St. Helena, it is evident that it nust be distributed all over the N. E. Atlantic, at least from Gibraltar o St. Helena, being one of the species characteristic of the area.

IV. Holothurioidea.

Euapta lappa (Müller)(?).

A fragment of a large Synaptid was dredged off Egg Island, St. Helena, on *Lithothamnion*-bottom, ca. 40 meters, (5. III. 1930). Unfortunately it is only a piece of the middle part of the body and thus it s impossible to identify the species with certainty, but according to Mr. S. Heding, who has kindly examined the fragment for me, it s an *Euapta*, and quite probably the common West Indian *E. lappa* (Müller), not *Euapta tobagoensis* Heding.

At any rate, it is an interesting fact that the existence at St. Helena of a large Synaptid has herewith been proved.

Holothuria farcimen Selenka.

Selenka. 1867. Beitr. z. Anatomie u. Syst. d. Holothurien. Z. wiss. Zool. Bd. XVII. p. 330, Taf. XVIII. 65.
Lampert. 1885. Die Seewalzen, p. 68.
Théel. 1885. "Challenger" Holoth. II. p. 220.
R. Perrier. 1902. Holothuries du "Travailleur" et du "Talisman", p. 417, Pl. XV. 15—27.

Some specimens taken on the rocks off the pier at Jamestown, II. 1930. Also in rock pools at Prosperous Bay and Lots Wife's Pond some few specimens were found. Finally, two specimens were dredged off Egg Island, St. Helena, on *Lithothamnion* bottom, ca. 40 meters, 5. III. 1930.

To the very careful description of this species given by R. Perrier (Op. cit.) I have only little to add.

The dorsal papillæ are stated to be placed on top of large, slightly prominent tubercles, which are almost contiguous. I find considerable variation to obtain in this respect in the St. Helena specimens. On

the dorsal side the papillæ mostly issue directly from the skin, toward the sides the tubercles may become gradually more distinct, and at th edge they may be quite conspicuous and almost contiguous; but i some specimens there is hardly a trace of such tubercles. Probabl these differences are in the main due to preservation.

Perrier states the base of the tubercles to be whitish and the inter spaces between the tubercles to be a lighter brown. This is not seen i the St. Helena specimens, which are all of a uniform brown colour as described by Selenka, but some are of a distinctly lighter shad than others. There is thus some variation in regard to the colour.

As to the anatomy it should be remarked that I find, in the on

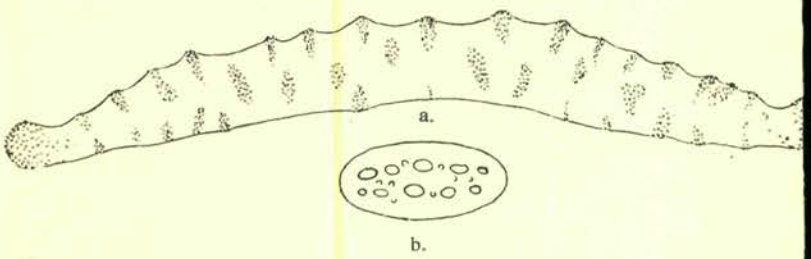


Fig. 29. *Holothuria farcimen* Selenka. Large, bow-shaped spicule from tentacles (a) button (b). × 165.

specimen opened, only one Polian vesicle, not two as found Per rier. The Cuvierian organs are small and thin, very numerous. I ob served them to be discharged as short, ca. 1 cm long pieces, connecte by very thin threads, so as to form a close net, like a spider's web evidently a very active means of defence.

The calcareous deposits are, on the whole, very well figured by Perrier; I would only add that the buttons have not rarely some few irregularly scattered small knobs (Fig. 29. b.) and that the larg bow-shaped spicules of the tentacles do not have quite the appearanc seen in Pl. XV. Fig. 26 of Perrier's report; I find them as shown i Fig. 29. a.

The species was till now known only from the Azores.

Explanation of the Plates.

Plate XX.

gs. 1—3. *Astropecten Sanctæ Helenæ* n. sp. Adult specimen, aboral (1) and oral side (2). Younger specimen, aboral side (3).

4—6. *Narcissia trigonaria*, var. *Helenæ* n. var. Adult specimen, oral (4) and aboral side (5). Young specimen, aboral side (6).

7—12. *Luidia aciculata* n. sp. Specimen with regenerating arms, aboral side (7); aboral (8) and oral side (9) of disk, arms broken. Parts of arms, aboral (10, 12) and oral side (11).

All figures natural size.

Plate XXI.

gs. 1—2. *Moiraster magnificus* (Bell). Adult specimen, aboral side (1); young specimen, from the Stockholm Museum, oral side (2).

3—6. *Astropecten variegatus* n. sp. Adult specimen, oral (3) and aboral side (4); younger specimen, aboral (5) and oral side (6).

All figures natural size.

Plate XXII.

g. 1. *Moiraster magnificus* (Bell). Adult specimen, oral side.

2—4. *Linckia formosa* n. sp. Aboral side (2—3), oral side (4).

5—7. *Ophiothrix roseo-coerulans* Grube. Aboral side.

All figures natural size.

Separate copies ready from the press 24. X. 1933.

apers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LXVII.

A small Collection of Crinoids from St. Helena.

By

Torsten Gislén.

With Plate XXIII.

Through the courtesy of my friend Dr. Th. Mortensen of penhagen I have been offered the opportunity of studying a small, t very interesting, series of Crinoids from St. Helena. My thanks e due to Dr. Mortensen, who did not only place the material at y disposal, but also in every way has facilitated my work by pro-ding me with forms from different parts of the globe necessary for mparison.

It has been evidenced here that two forms of *Tropiometra* from America and Africa, earlier generally treated under two different mes, must be regarded as belonging to the same species.

Moreover, the collection contains two new species. One has to be ferred to *Crinometra*, a genus earlier regarded as endemic of the est Indies, but now, thanks to an inevitable redefinition of the nus, extending via St. Helena to Kermadec and Fiji. The second w species is a stalked crinoid of the genus *Monachocrinus* presenting aracters of the BB which are unique among the *Bathycrinidæ*. In me respects it is the most primitive type of a Bathycrinid so far ported.

A stalked young, possibly of *Crinometra*, is also figured.

Tropiometra carinata (Lam.)
syn. *Tr. picta* (Gay).

Text-figs. 1—3.

From 1) James bay, St. Helena, 36 m., stone and shell. 29. I. 1930. 1 sp. (Sp.
2) Jamestown, St. Helena, rocky coast. 1. II. 1930. 4 spp. (Spp. 2—5).
3) Jamestown, St. Helena, 36 m., sponges. 4. II. 1930. 3 spp. (Spp. 6—
4) Sea-cow cove, St. Helena, 27 m., stone, gravel. 11. II. 1930, 1 sp. (Sp.
5) Prosperous Bay, St. Helena, rocky coast. 17. II. 1930. 9 spp. (Sp
10—18).

Sp. 1. Dorsal cirrus-free area of Cd. 4.5 mm. C. ± XX 20—2
15—17 mm. Stout arm-bases. Arm-tips broken. Colour purp

Sp. 2. Dorsal cirrus-free area 3 mm. C. XXXVIII 24—27; 20—22 m
Arms 80—90 mm, weakly carinated. P_2 25; 11 mm. Colo
dark purple.

Sp. 3. Dorsal cirrus free area 6 mm. C. XXII 21—25; 20—22 m
Arms ± 100 mm. Brr in the outer part of the arm with
small eminence distally. P_1 13; P_2 15; P_3 14; 8 mm. Colo
purple blotched with yellowish.

Sp. 4. Dorsal cirrus-free area 7 mm. C. XXIX 25—27; ± 20 m
Arms ± 80 mm. Stout arm-bases. Weak carination of arm
P_1 21; P_3 21; ± 10 mm.

Sp. 5. Dorsal cirrus-free area 3 mm. C. XIII 20—21; 14 mm. Arr
40 mm. Young specimen. Colour blotched purple and yello

Sp. 6. Dorsal cirrus-free area 6 mm. C. XLIII 21—26; 22—26 m
Arms 170—180 mm. P_1 23; 13 mm; P_2 27; 13 mm; P_3 2
13 mm; P_8 24; 11 mm. All proximal pinnules smooth a
angular. Colour blotched as before, especially on the outer pa
of the arms.

Sp. 7. Dorsal cirrus-free area 5 mm. C. XXXVII 25—26; 20—21 m
Arms 75 mm, purple.

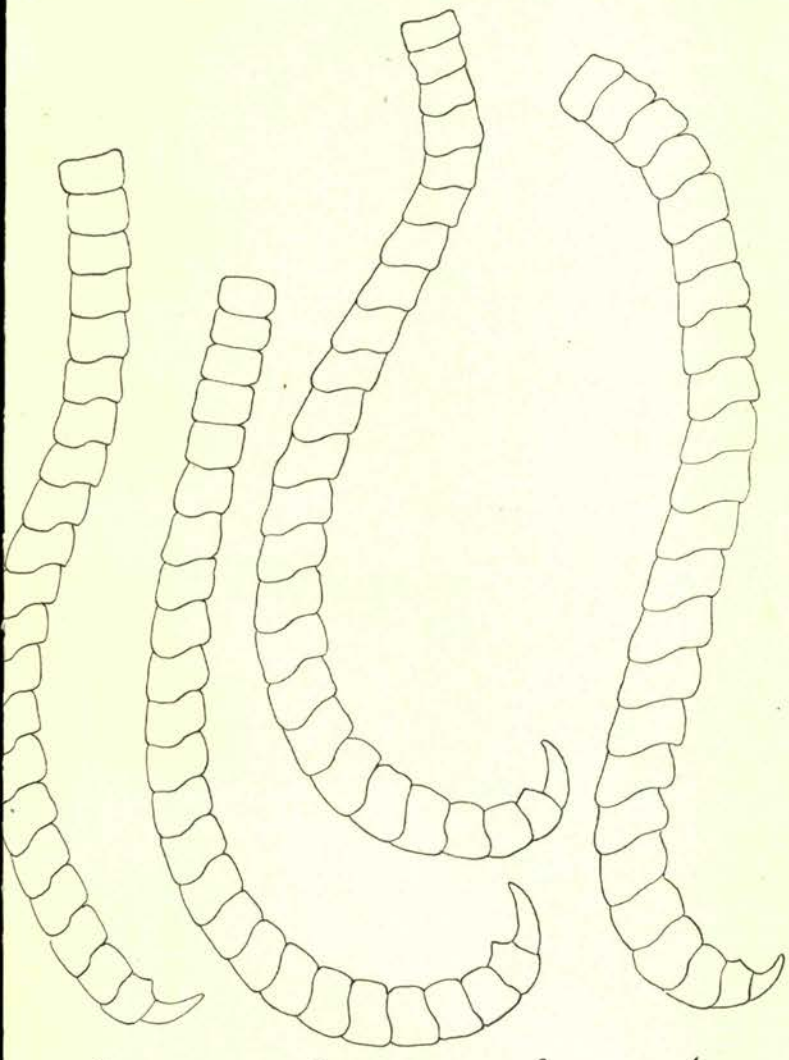
Sp. 8. Dorsal cirrus-free area 3 mm. C. XXXIII 26—28; 18—25 m
Arms ± 80 mm purple.

Sp. 9. Dorsal cirrus free area 6 mm. C. XXIV 22—27; 18—22 m
Arms rather much broken. Colour blotched in the out
part.

Spp. 10—18. Largest specimen: C. XXXI 28—29; ± 27 mm. Arr
140 mm. Smallest specimen: C. XXIV; 21. Arms about 70 m
Brachials with a weak median carination and a small, oft

yellow-coloured eminence on the distal part of each Br. This eminence in smaller specimens is often lacking.

Through the courtesy of Dr. Mortensen I have been able to mpare these specimens with specimens from Tobago, West India,



1. 2. 3. 4.

gs. 1—3. *Tropiometra carinata*, cirri. 1) From Tobago, 22 cirrals; 2) From St. Helena, 25 cirrals, 3) From Portuguese East Africa, 25 cirrals; 4) Cirrus of *Tr. encrinus*, 8/1.

Portuguese East Africa, and Zanzibar and examples of *T. encrin* (determined by A. H. Clark).

A. H. Clark in 1911 (Proc. U. S. Nat. Mus. Vol. 40, p. 36) sta "*Tropiometra encrinus*, while having the same number of cirrus-se ments as *T. carinata* and *T. picta* has proportionally longer and stou cirri". This difference in specimens which I have seen seems to valid (Fig. 4). In 1918 Clark (Siboga Exped. 42 B, p. 131) gives t difference between *T. carinata* and *picta* to be, for the former speci cirrus-segments more than twice as broad as long, for the latt cirrus-segments in the outer half or $^2/_3$ of the cirri much less than twi as broad as long. I refer the reader to drawings of cirri taken fro specimens from West India, from St. Helena, and from Portugue East Africa (Figs. 1—3).

I must confess that I have failed to get out any difference as the proportion of the cirrals. As the carination of the arms in specime from West India and East Africa seems to me to be identical I (H. L. Clark) must regard *T. picta* as a synonym of *T. carinata*.

The specimens from St. Helena usually have a little higher numb of cirri than examples from other localities, but I cannot regard th difference even as a varietal character. The cirrals are also usually little more numerous in the St. Helena specimens (24—27 or even 2 A. H. Clark, however, mentions a specimen of *T. carinata* from Africa with 28 cirrals (Smiths. Misc. Coll. 61, No. 15, p. 39).

Crinometra transversa n. sp.

Text-fig. 5(?). Pl. XXIII. Figs. 1—4.

From 2 miles south, 49 east for Long Range Point, St. Helena, 280—360 Hard bottom. 24. II. 1930. 2 spp. Dredged onboard the "Dana".

Sp. 1. Cd a thick disk, rather much deepened in the dorsal middl The free dorsal surface 3 mm, granulated and pitted. Interradial par of Cd covered by stout and pointed tubercles. C. XXXVI 17—1 $\pm$ 23 mm, in XV—XX crowded rows. 1st—3rd segment sho 4th L = br, 5th L = $1^1/_2$ br, 6th L = $1^1/_3$ br, 8th L = br. A dors eminence from about the 8th segment which from the 9th up to th 12th cirral is transformed into a transverse, indistinctly biloba crista. Opposing spine similarly transverse and sometimes with a wea notch in the crista. Terminal claw slightly shorter than the precedi segment which is L = $1^1/_3$ br.

Arms XXIV, 150 mm; partly broken. II Brr 2 (9 cases), 4 (3 + 4) case). III Brr 2 (4 cases). Example of arm-division:

$$\text{I } 1\text{—}2 \begin{cases} \text{II } 1\text{—}2 \begin{cases} \text{Br } 1 \pm 2 \ldots \\ \text{III } 1\text{—}2 \begin{cases} \text{Br } 1 + 2 \ldots \\ \text{Br } 1 + 2 \ldots \end{cases} \end{cases} \\ \text{II } 1\text{—}2\ 3 + 4 \begin{cases} \text{III } 1\text{—}2 \begin{cases} \text{Br } 1 + 2 \ldots \\ \text{Br } 1 + 2 \ldots 16 + 17 \end{cases} \\ \text{Br } 1 \pm 2 \ldots 16 + 17 \end{cases} \end{cases}$$

In other ramifications there is often Br 1—2 3 + 4.

RR scarcely visible except in the interradial corners where there e some projecting tubercles. I Br 1 very short, covered by long bercles which proximally and distally fuse to serrate flanges along e borders of the ossicle. I Ax with a high medio-dorsal tubercle and e flanged proximal and distal borders provided with 3 to 4 stout inences on each side of the median line both proximally and distally. this way the margin of the ossicle is bordered by a more or less stinct and everted denticulation. Moreover, there is a median dorsal bercle or crest. Otherwise, however, the ossicle is smooth. A crest, ll set off, also appears on II Brr 1—2 which have generally everted rgins and sometimes also marginal tubercles. On Br 1 and 2 there a medio-dorsal knob and in some rays also slightly everted margins. Br 3 and 4 there may, moreover, appear some extra submedian obs. The median tubercle is later transformed into a dorsal spine carination which is developed in the distal part of the ossicle. This bercle is traceable only on a short way of the arm. The distal margin the Brr soon becomes a little overlapping and more or less denticulate. ough in rather close contact latero-basally the arm-bases are only ghtly or not at all wall-sided. Second syzygy at about Br 16 to 20. stal syzygies with an interval of 2—17, usually $\pm$ 10 oblique arti-lations.

P_1 27—28; $\pm$ 13 mm; P_2 24; 14 mm; P_4 19; 12 mm; P_5 13; $\pm$ 9 mm; 15; 9 mm; P_{13} 15; 9 mm. Distal pinnules a little longer again. oximal segments short, the distal ones L = $1^1/_3$ br (also in proximal nnules). From P_5 or so the 3rd—5th segments are somewhat ex-nded.

Disk thrown off; closely granulated by small calcareous granules.

Colour yellowish except in some of the basal arm-parts where is blackish (to Br 1 usually).

Sp. 2. Cd flattened dorsally, with free dorsal surface closely pitte Rather high crests inter-radially. C. thrown off, ± XX cirrus-socke arranged in X groups.

Arms XXI, 60 mm. II Br 4 (7 cases), 2 (3 cases), III Br 2 (1 cas Carination of arm-bases much less than in sp. 1, especially so I Br 1 which is well visible. Its margins are a little everted, but t tubercles are rather insignificant.

I Ax with a well marked median crest and one or two submedi tubercles, the borders are a little everted. There is a high carina al on II Br 1—2. Following ossicles provided with rounded high medi knobs. Proximal syzygies usually Br 1 + 2 after a II Br 4 axilla and Br 1 ± 2 3 + 4 after a II Br 2 axillary. P_{II} ± 20; ± 9 m P_{Dist} ± 10; 5 mm.

The arm-bases are dark-coloured. Yellowish regenerates fro Br 1 or 3.

This new species as to the arm-sculpture resembles some of Har laub's *brevipinna* varieties: *decora*, *gracilis*, *tuberosa*, and A. H. Clark *insculpta*. Still, the middle pinnules of the arms are proportional longer than in most of the other Crinometras, the wall-sidedness the basal arm-parts and the carination of proximal pinnules is n at all or only slightly developed. The medio-dorsal carina of the bas arm-parts is more sharply set off than in any of the forms describe earlier. But above all, the transverse crest of the cirrals distingui this species at once from all the other species of *Crinometra* so f described.

When in 1909 A. H. Clark established his genus *Crinometra* (Pro Biol. Soc. Washington, Vol. 22, p. 22) he distinguished it from t related genus *Pachylometra* by the very long proximal pinnul which should be very strongly carinate, and by the proportionate short middle and distal pinnules, "not quite half as long as P_1". T genital pinnules should be more abruptly expanded than in *Pachyl metra*. Besides, there should appear in *Crinometra* overlapping brachia and usually tuberculation of the basal arm-parts. In 1918 (Siboga Ex 42 B, p. 171) he considers the difference of length between proxim and middle pinnules (together with proximal carination of the forme to be the chief distinguishing characteristic between *Crinometra* a

ıe rest of the *Charitometridæ*. In fact, both the overlapping of the rachials, the expansion of the pinnules and the tuberculation of the asal arm-parts are so variable or vague characters within *Crinometra* ıat they certainly cannot be used for generic characterization. Now, is the question if the characteristic: middle pinnules not quite alf as long as P_1, could be used as distinguishing mark for *Crinometra*.

When studying Hartlaub's treatise upon the "varieties" of *rinometra brevipinna* (1912 Mem. Mus. Comp. Zool. Vol. 27) we find ıe following statements. Var. *elegans* has P_1 10—12 mm, pinnules of ıe middle arm-parts 7 mm (p. 332), and concerning the var. *diadema* $_1$ 8 mm; pinnules of middle arm-parts (in spite of broken tips) 5 mm . 339). I have found the same proportion in a specimen of *Crinometra sculpta* borrowed from Copenhagen (determined by A. H. Clark): $_1$ 11.5 mm, shortest middle pinnules 7 mm (cf. also the specimens escribed above). On the other hand short middle pinnules, being alf as long as the proximal ones, may occur in *Charitometridæ* which o not fall within *Crinometra* (cf. *Perissometra aranea*, *carinata*, *Monaıometra mortenseni*, Gislén 1927, Vid. Medd. Dansk Naturh. Foren. ol. 83, p. 33 ff.). It is clear that this characteristic cannot be used one for distinguishing *Crinometra*. It might be asked whether it ould be used together with other distinguishing marks. The carination f the proximal pinnules may be a rather good characteristic, but in me forms referred to this genus it is weakly developed and very ingnificant (e. g. *granulifera* and specimens described above). The tuberılation in some forms is very characteristic and apparent, but in ther forms lacking. Either, therefore, some forms with smooth armases should be excluded from the genus (e. g. Clark's "*pulchra*" . Fig. 682, Monograph 2, 1921) or this characteristic should not be sed as a generic distinguishing mark. As pointed out earlier the uberculation of the arm-bases seems to me to have a low systematic nportance only.

The high number of pinnulars in proximal pinnules (20—40) as ompared with those of the middle ones (10—15) may be generically nportant, but similar conditions seem to occur also in some *Pachylo-ıetra* and *Perissometra*. However, the length of the middle pinnules oes not seem to decrease in the last mentioned case. It is to be reretted in this connection, that our knowledge of proportion of proximal

pinnules is very scanty especially as regards the more recently describ species.

As the comatulid described above, as well as some of the forms *Crinometra* which are known earlier, cannot be separated as a gro of species which can possibly be distinguished from other *Chari metridæ*, either the genus mentioned has to be given up or to be giv an emended diagnosis. Facts seem to speak in favour of the latt solution. It may thus be possible to distinguish t genus in the following manner.



Fig. 5. Pentacrinoid. possibly of *Crinometra transversa*. 16/1.

Crinometra is a genus of the *Charitometridæ* whe the Cd is a thick disk; C. are > XX 15—25, cirrus-socke (in mature individuals) arranged in about 15 crowd columns. I Br 1 is very short, II Brr are 2 or 4, III Brr, wh occurring, are 2, developed internally. Br 1 and 2 unit by a syzygy at least after a II Br 4 or III Ax. P_1 or P_2 a the longest pinnules of the arm, with more than 20 se ments. Pinnules then rapidly decreasing in length, t pinnules of the middle arm-part being about $^3/_4$ or of the proximal ones. Genital pinnules moderately e panded over a number of segments.

With this limitation also *Pachylometra inæqualis* mu be included in the genus (cf. P. H. Carpenter 1888, tex fig. 5, p. 246 and Pl. 51) and perhaps *P. lævigata* too. *distincta*, in 1909 by A. H. Clark made the type *Pachylometra*, in reality is a *Crossometra* (a genus creat in 1916) as pointed out by me in 1928. (Ark. f. zoologi, Stockhol Bd. 19 A, No. 32, p. 8). *Crossometra*, therefore, becomes a synony of *Pachylometra*.

There is a small Pentacrinoid from 2 miles off Bay Point, St. Helen 480 M. 24. II. 1930 (Dredged onboard the "Dana"); Fig. 5.

The calyx is chiefly composed of orals and basals. Small radia appear in the corners between the OO and BB. The orals have everte lateral borders. There are two short proximal stem-joints, the 2r being wider than the stem. 3rd and 4th joints are apparently doubl L = $1^1/_2$—2 br. 5th and 6th joints very long, L = 4—3 br. 7th joi much shorter, 8th L = $1^1/_3$ br; 9th joint a short disk attached to t substratum (dead "*Lophohelia*").

As no comatulid in the vicinity of St. Helena is known from th

epth except *Crinometra transversa* the young may be a larva of is form. The possibility of a species of the *Thalassometridæ* occurring ere cannot, however, be denied.

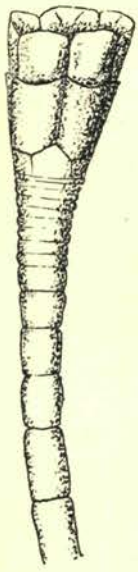
Monachocrinus incrassatus n. sp.

Text-figs. 6—9. Pl. XXIII, Figs. 5—7.

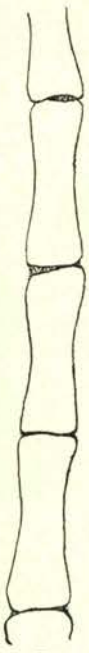
From 8 miles W to N of Sugarloaf, St. Helena. Hard bottom. 2400—2780 M. redged onboard the "Dana" 23. II. 1930, 1 sp.

BB pentagonal, separated by distinct sutures, median L about br (br 0.6 mm). RR twice as long, L = $1^1/_2$ br (h 1 mm). I Br 1 horter again, L = $^2/_3$ br. Arms broken from here. Calyx evenly conical, at proximal part of BB 0.8 mm, at distal part of RR 1.1 mm.

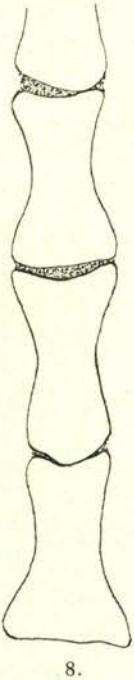
Stem 75 mm, broken at distal tip. There are 49 stem-joints in all. o radiculi on any segments. 8 proximal stem-joints very short, th L = $^1/_3$ br, 10th L = $^1/_2$ br, 11th L = br, 14th L = $1^1/_2$ br, 20th L



6.



7.



8.



9.

gs. 6—9. *Monachocrinus incrassatus*. 6) Calyx and upper part of stem, 7) middle part, distalmost segments of preserved part of stem, 11/1. 9) Distal articular facet of I Br 1, 17/1.

= 2 br. Longest stem-joints L = 3 br. The distalmost segments wit knobby ends, L = $1^1/_2$—2 br of the swollen ends. The diameter of th stem under the BB is 0.8 mm. At the 10th segment 0.6 mm. Midd stem part 0.5 mm. Distally at the knobs 1 mm.

Colour: Calyx brownish, stem whitish.

As the new species lacks radiculi and is stated to have been take on hard bottom the question may be raised if it might be a memb of the *Phrynocrinidæ* which is anchored to hard bottom by a calcareou plate. In this family the genera *Phrynocrinus* and *Naumachocrinu* have very reduced BB, therefore the new species cannot be range among them. Still, the relative shortness of the BB and length of th RR distantly point towards the conditions found in *Naumachocrinus Porphyrocrinus* shows much the same conditions as in those Monach crini which have separate BB, but in *Porphyrocrinus* the upper pa of the stem is not thickened and the distal stem-joints only ver gradually reach the type of long slender knobby stem-joints which so well developed in most *Bathycrinidæ* and all Monachocrini. Besid this, all the *Phrynocrinidæ* are large and stout forms, while the ne species just as the *Bathycrinidæ* is a small and slender form. Therefor *Monachocrinus incrassatus*, in spite of the distal stem-part not bein known, seems properly to be ranged in the *Bathycrinidæ*.

This species is easily distinguished from all other Monachocri (and even Bathycrinids) by its short free BB. Besides, the few sho proximal stem-joints and the proximal thickening of the stem are ver characteristic. As to the character last mentioned the new speci bears some resemblance to *M. recuperatus* from which it is, howeve distinguished at once by the low BB and the few short proxim stem-joints.

As to the proportion between BB and RR it recalls very strongl the Mesozoic genus *Mesocrinus* which had, however, a proximale an therefore belongs to the *Bourgueticrinidæ* (cf. P. H. Carpenter 188 Quarterly Journ. Geol. Soc. Vol. 37, Pl. 6).

The thickening of the proximal part of the stem is remarkable a we have the same condition in the Triassic *Recoarocrinus recubariens* (cf. Gislén, 1924 Zool. Bidr. Bd. 9, p. 201, and F. A. Bather 1897, Geo Mag. Dec.4, Vol. 4, p. 118). This form differed from the recent Bathycr nids in a complete pinnulation of the proximal arm-parts, in thoroughl short stem-joints and, as far as we know, absence of radiculi and radice

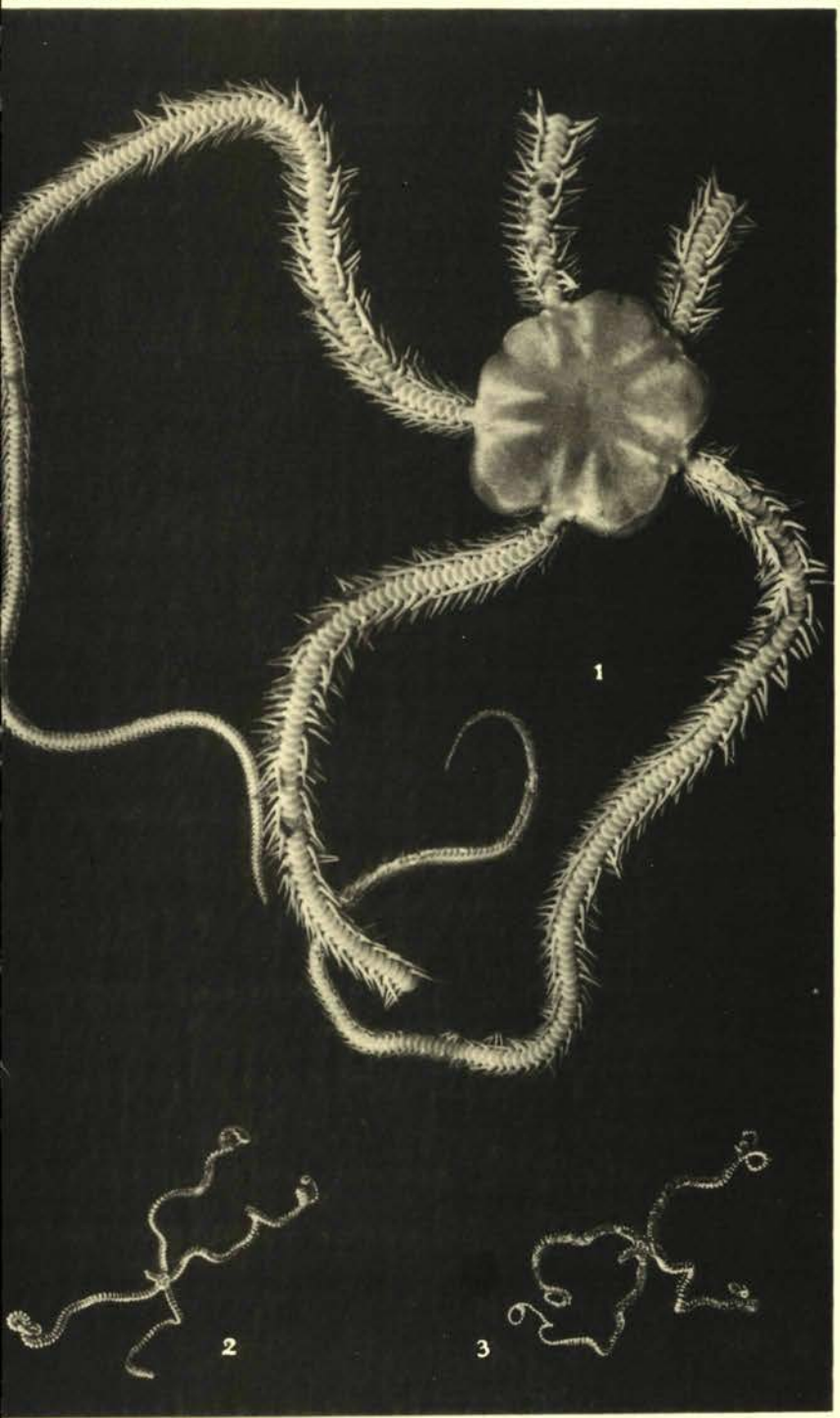
may have been a starting point for the Apiocrinids which got the pper part of the stem excessively thickened. The little differentiated R and BB in the new form described above, together with the swelng of the upper part of the stem shows it to be one of the most primive of the recent Bathycrinids hitherto reported.

Explanation of Plate.

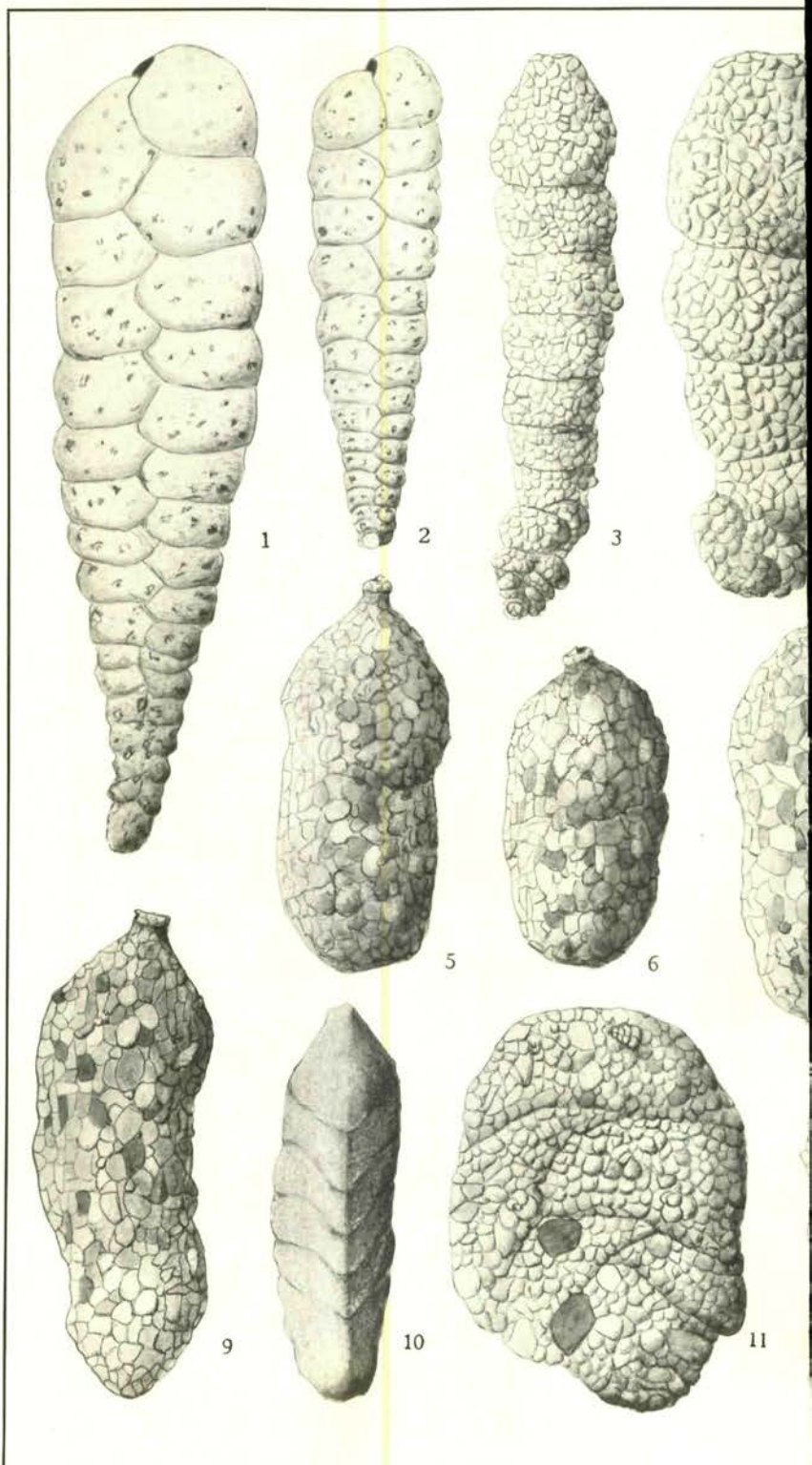
Plate XXIII.

g. 1. *Crinometra transversa* n. sp. Type-specimen, $^3/_4$ natural size.
2. — — Cirrus. × 4.
3. — — P_1 × 4.
4. — — P_9 × 4.
5—7. *Monachocrinus incrassatus* n. sp. Type. Figs. 5, 6 × 4; 7 × 6.

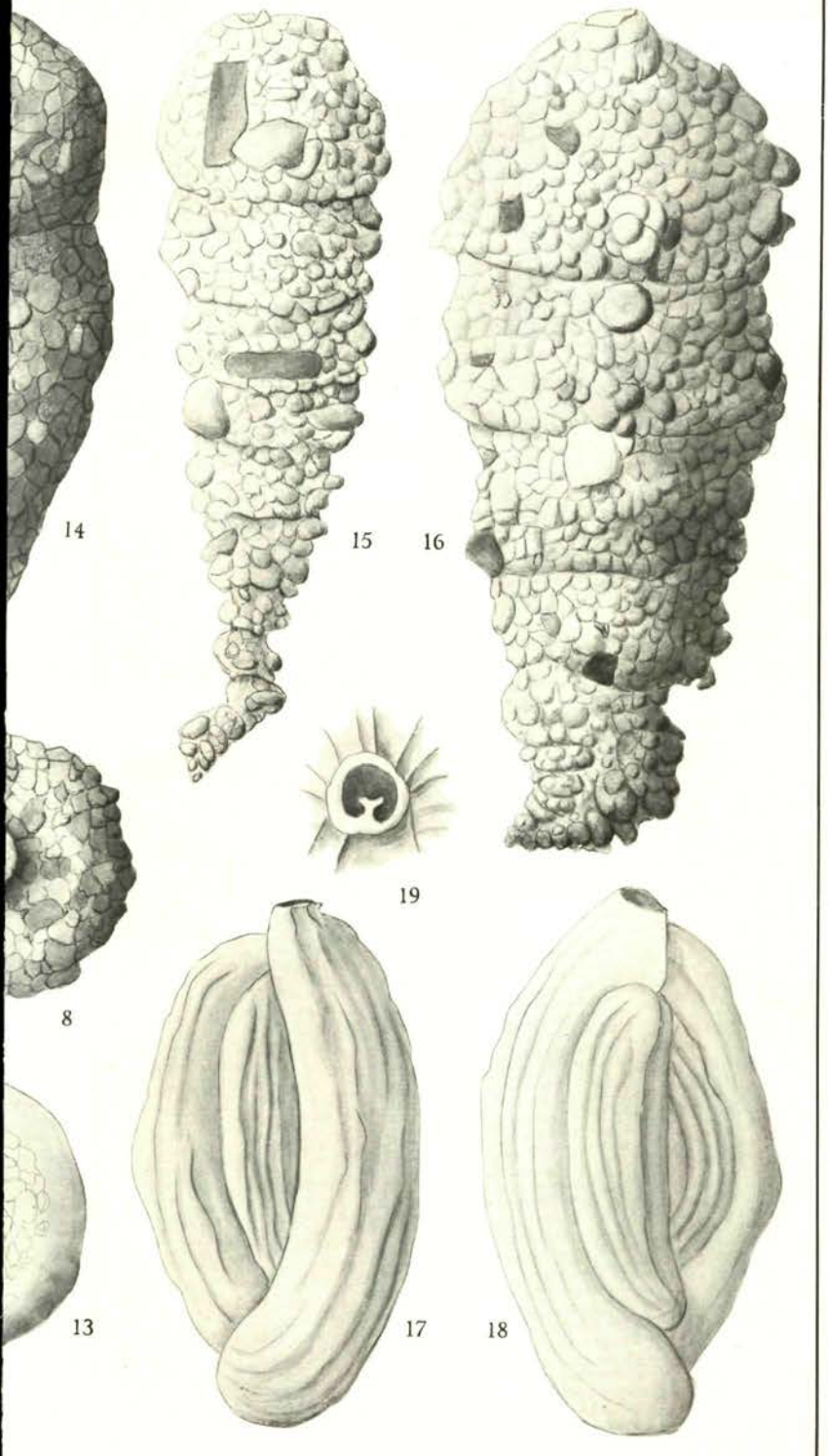
Separate copies ready from the press 26. X. 1933.

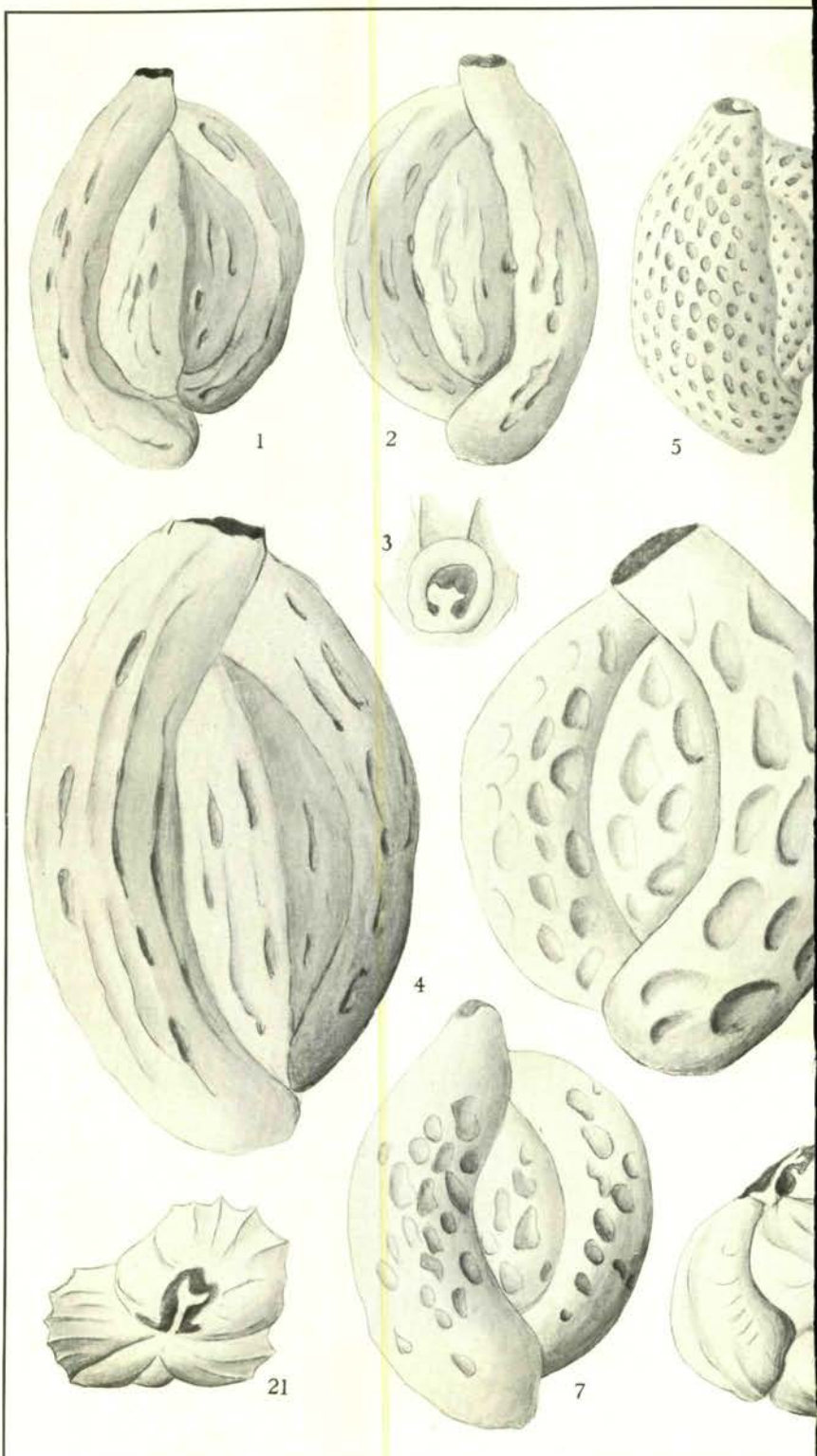


Huth fot. Pacht & Crones Eftf. Fototypi.

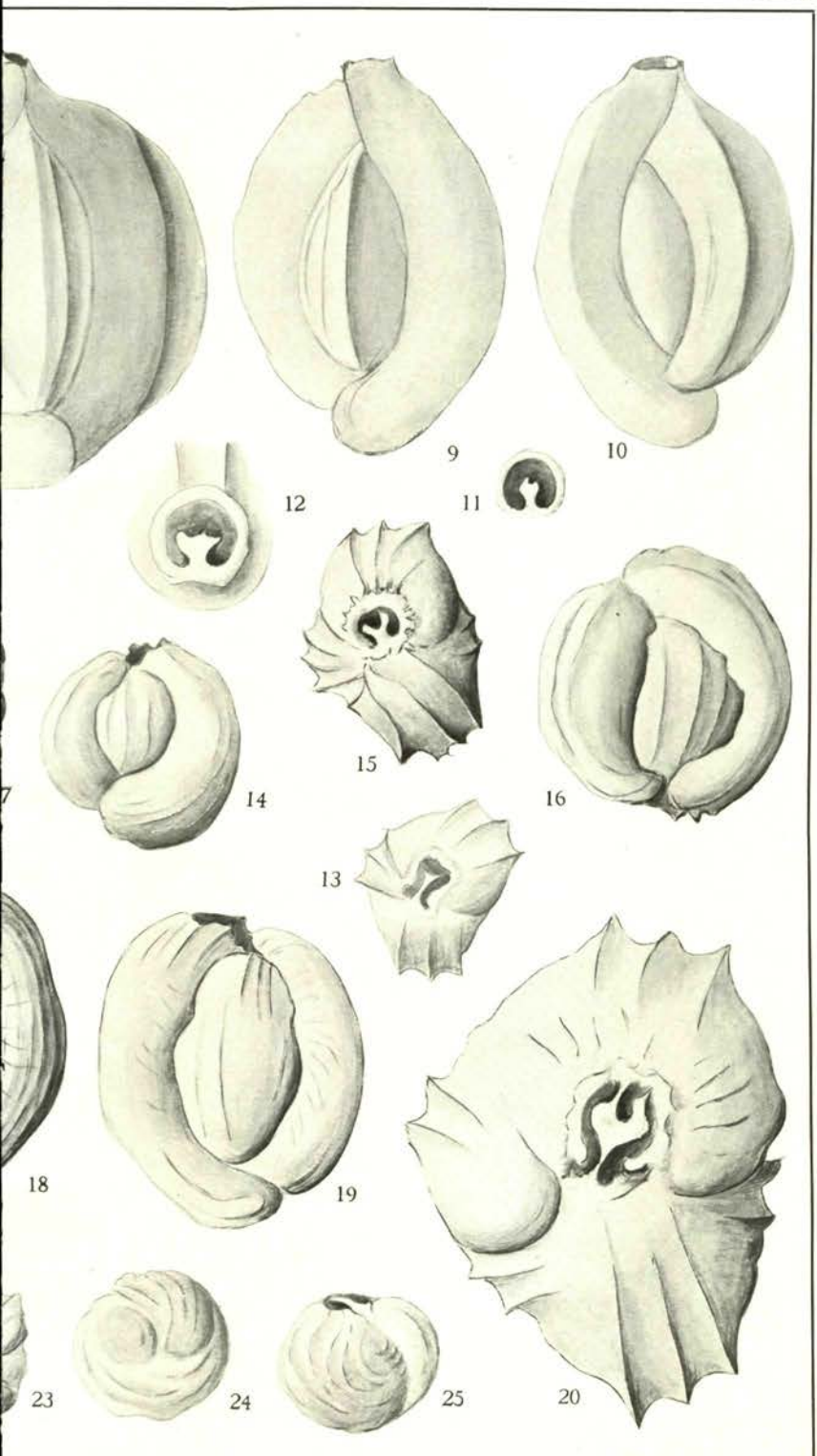


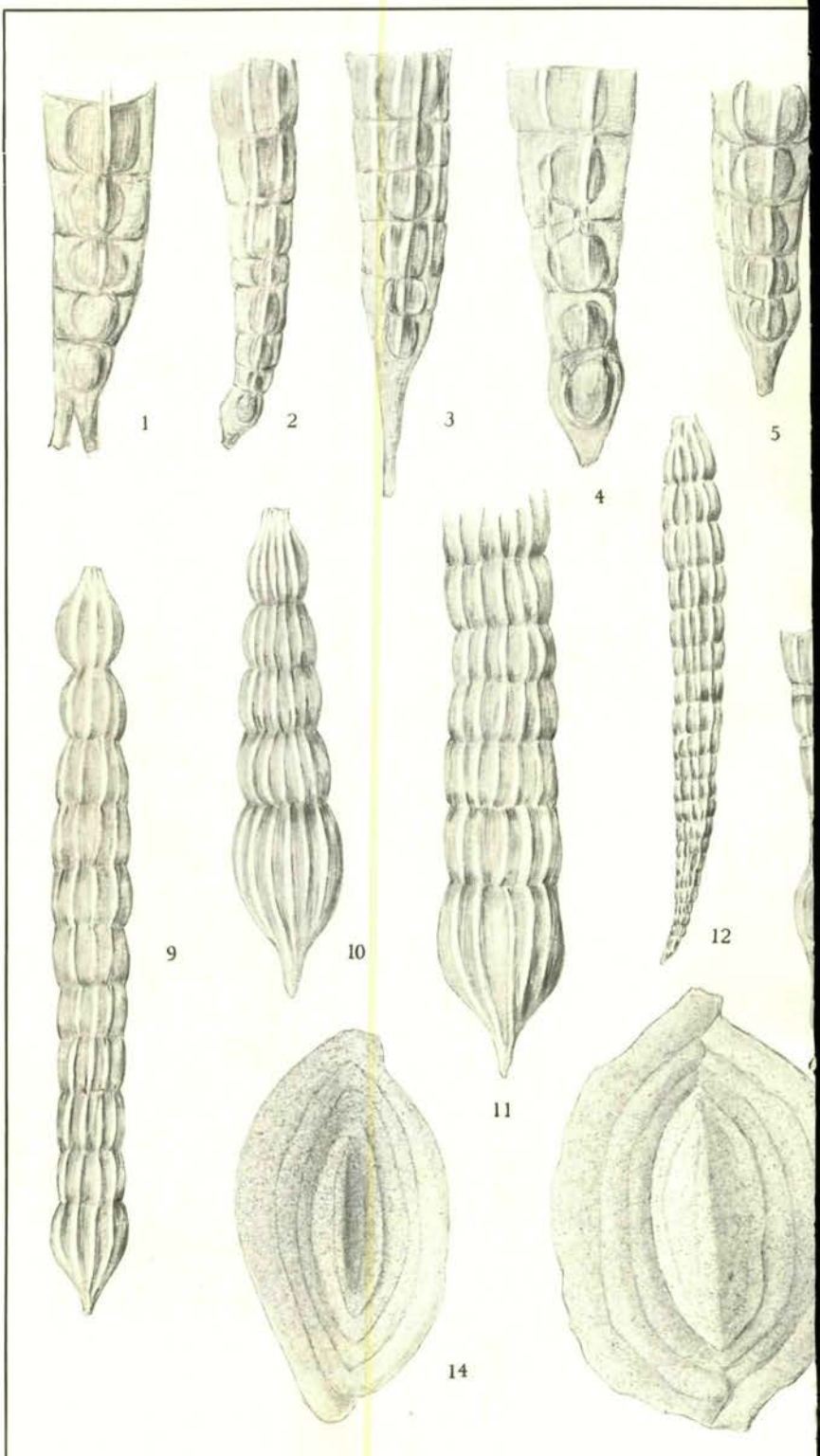
A. C. Hofker del.


14
15
16
19
8
13
17
18



A. C. Hofker del.

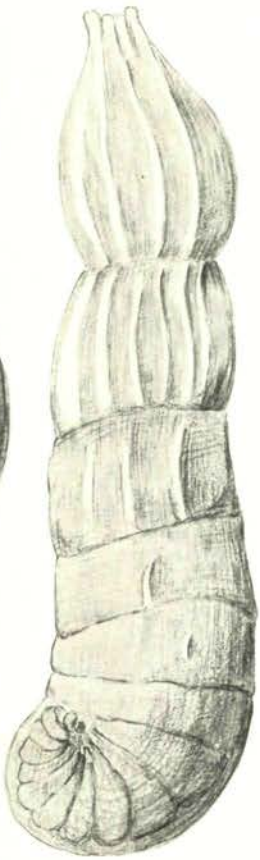

9
10
12
11
15
14
16
13
18
19
20
23
24
25



A. C. Hofker del.



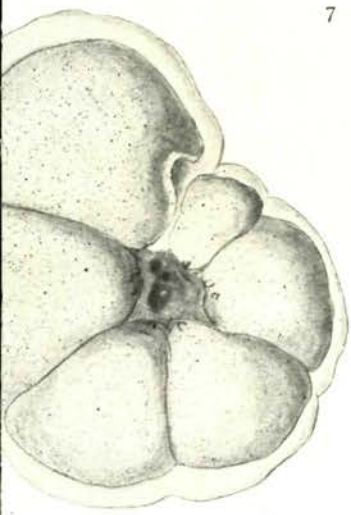
6

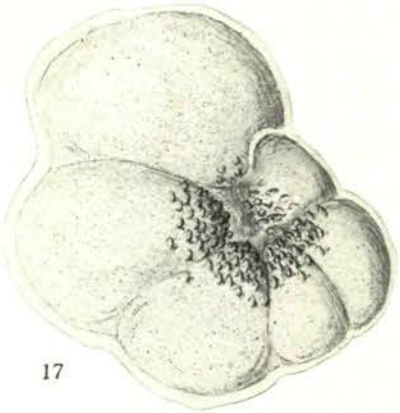


7

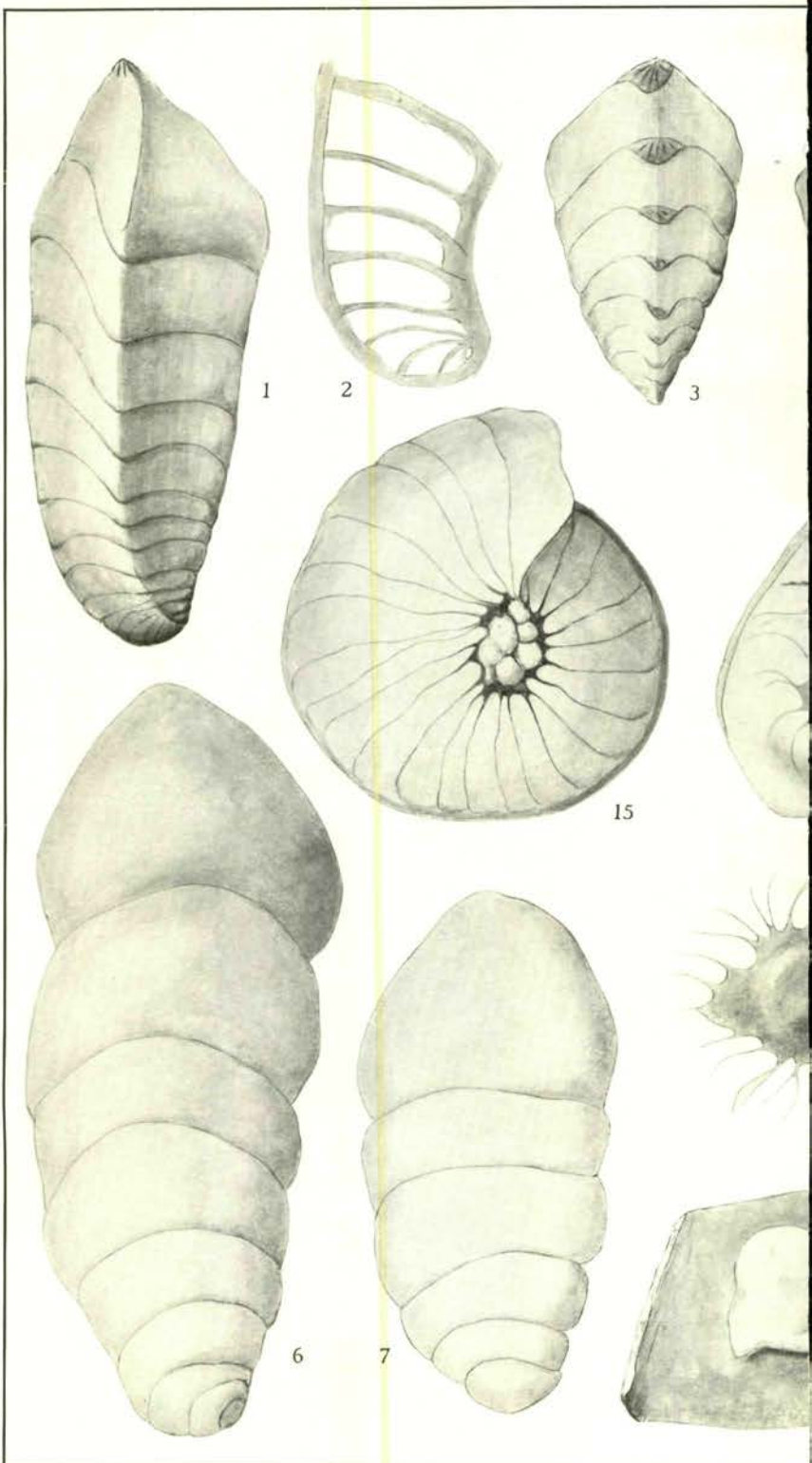


8



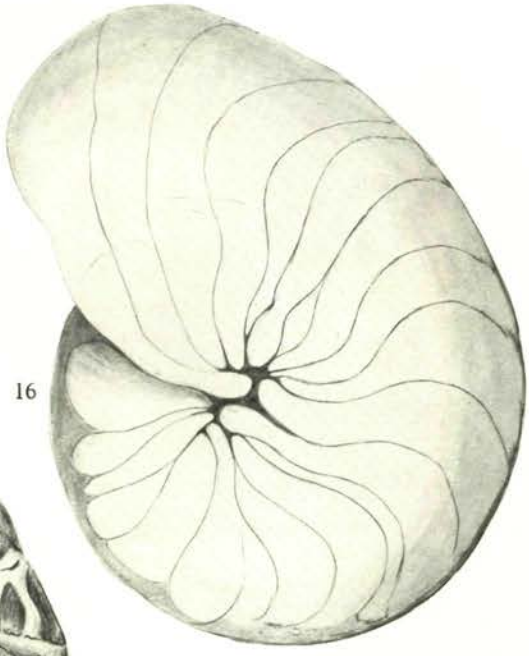


17



A. C. Hofker del.

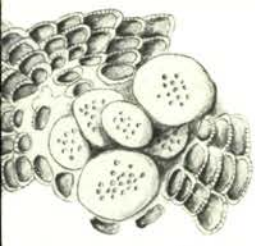




16



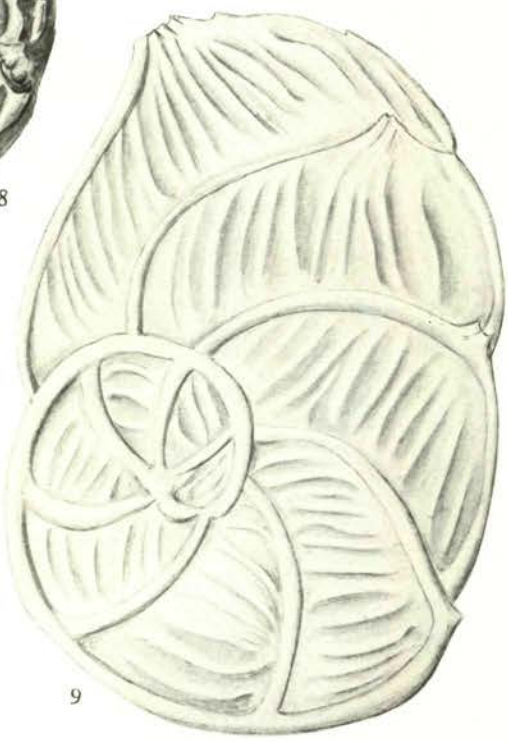
8



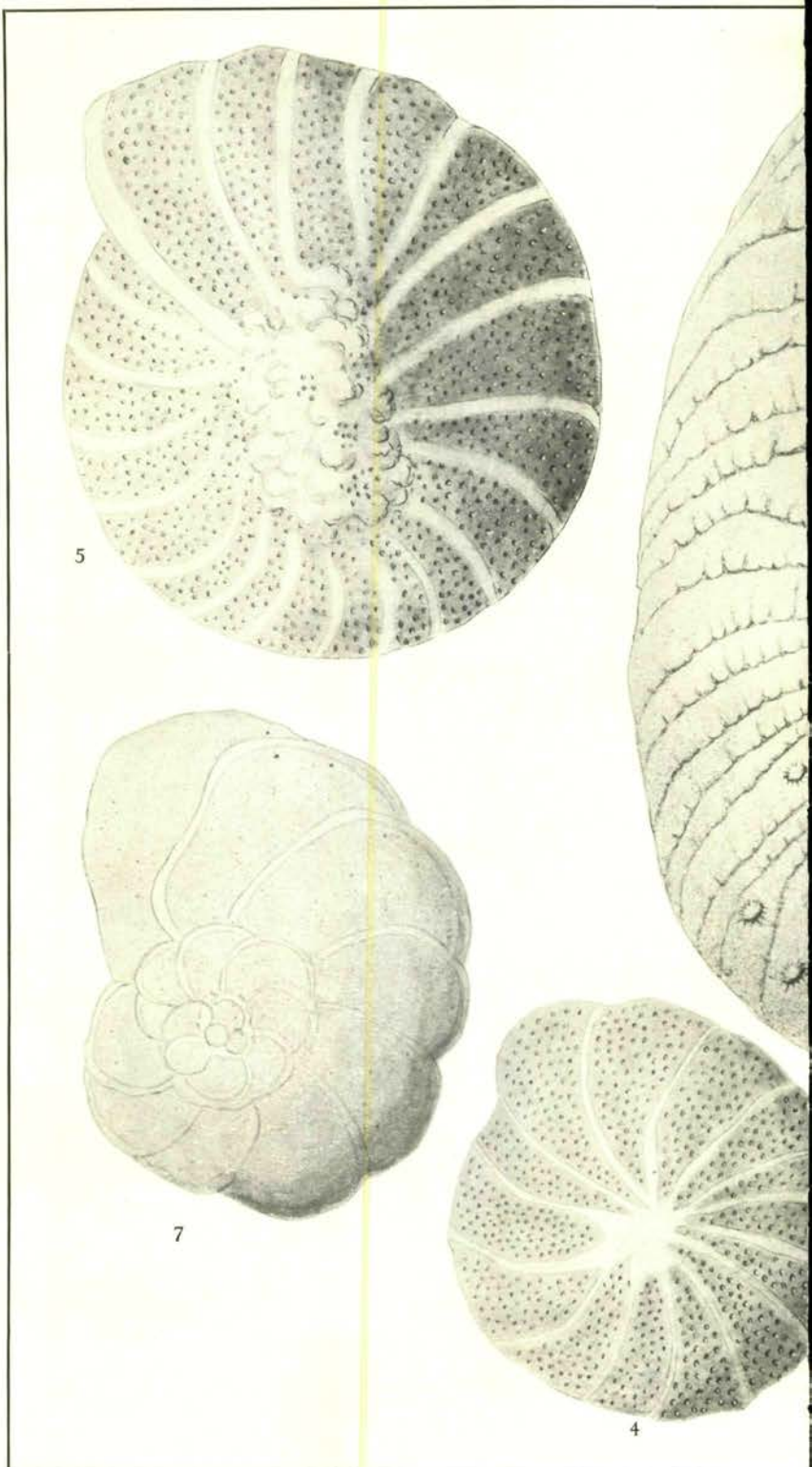
10



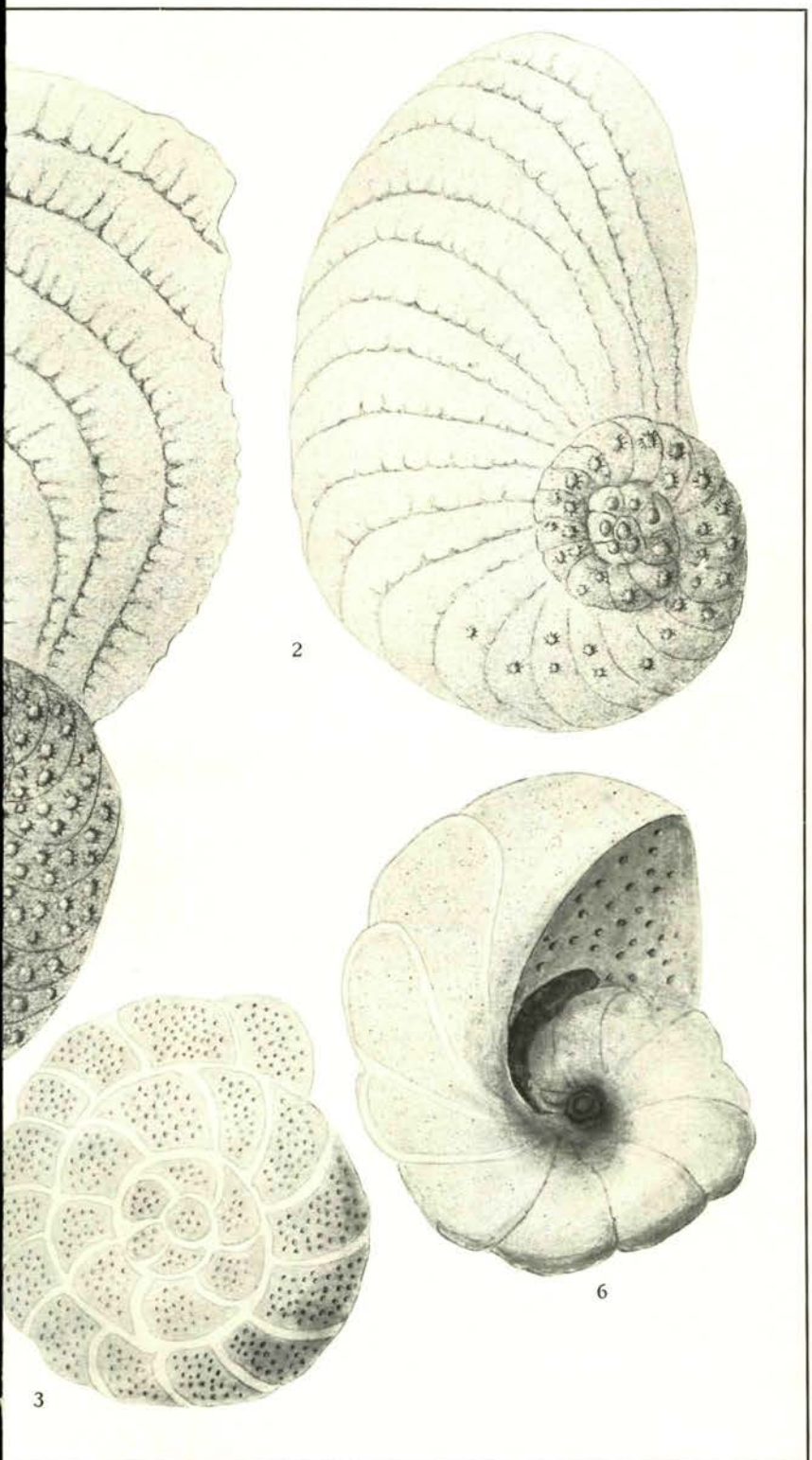
11

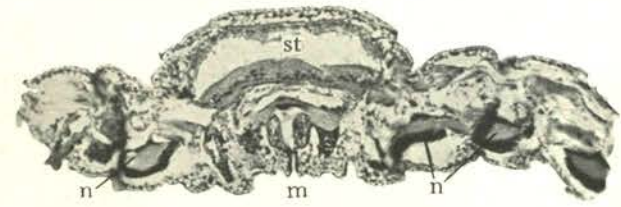


9



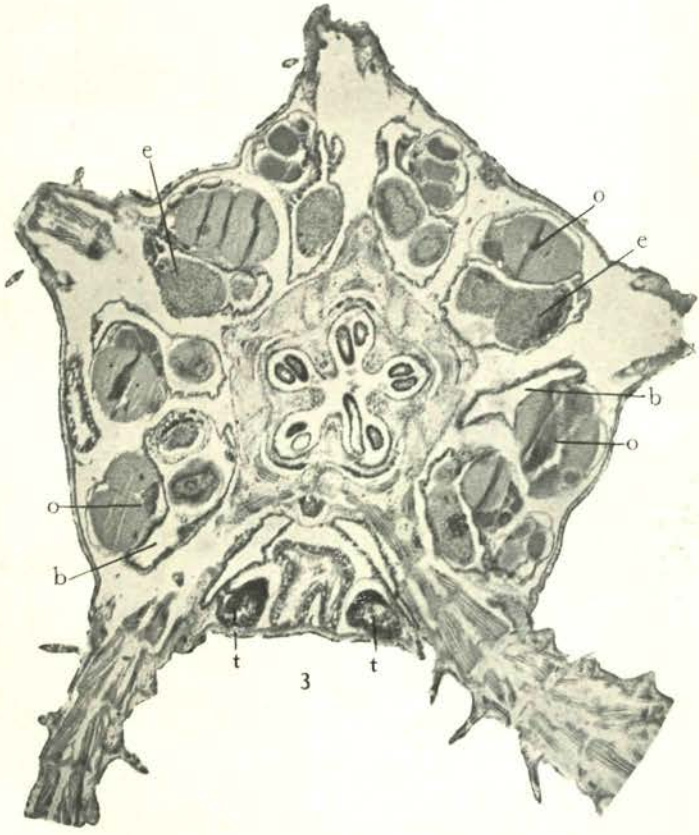
A. C. Hofker del.


2
6
3



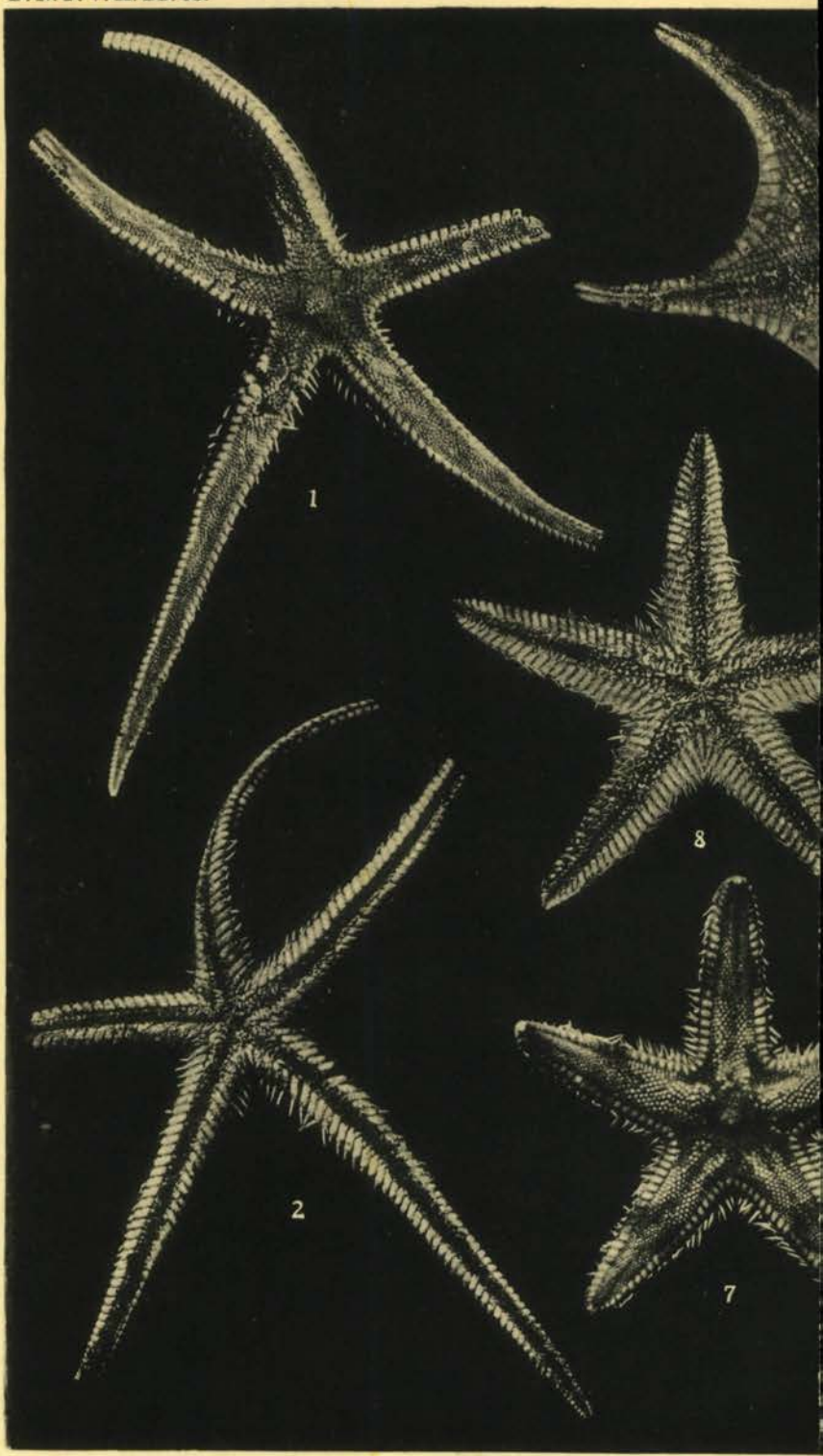


2

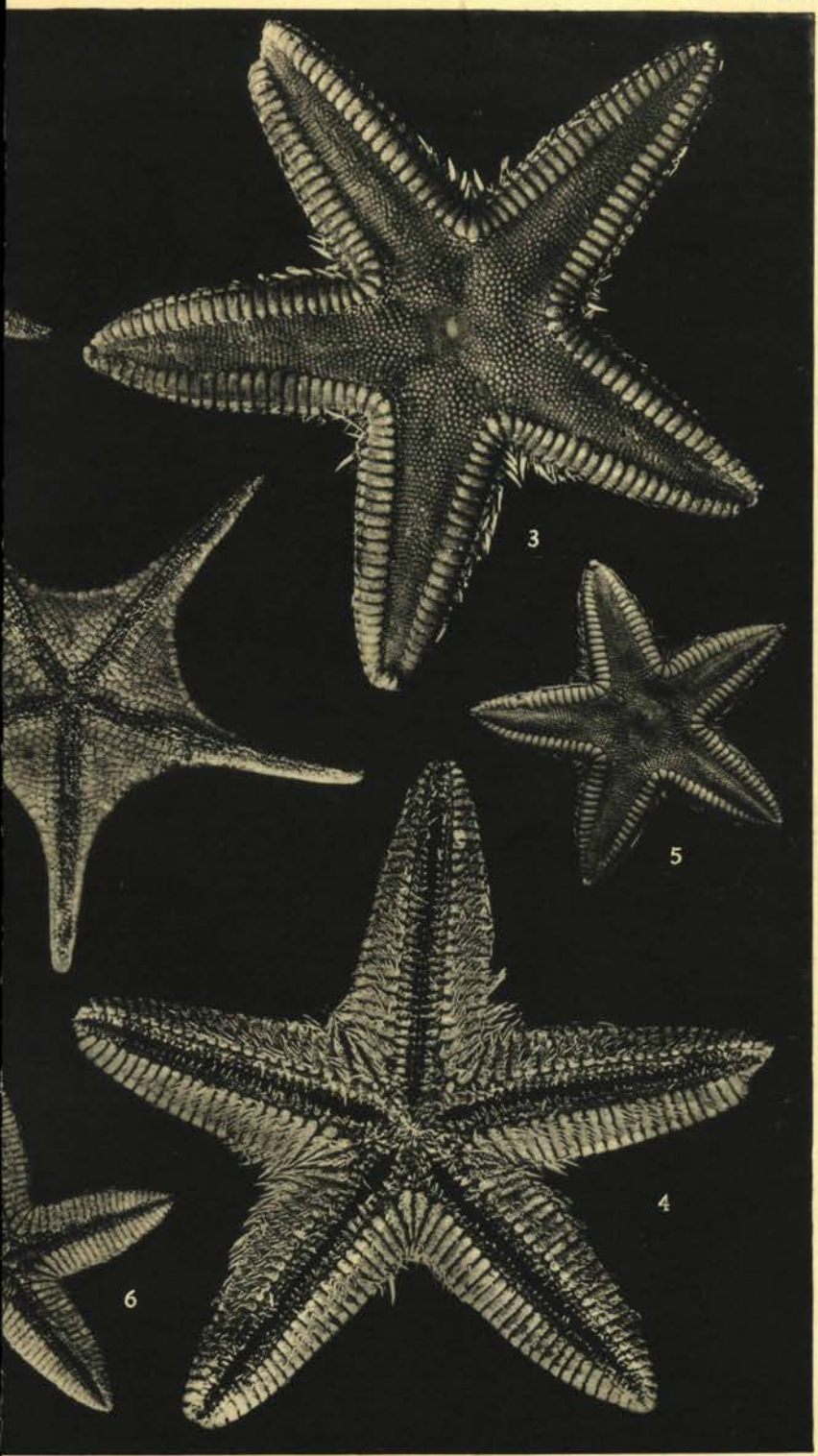


3

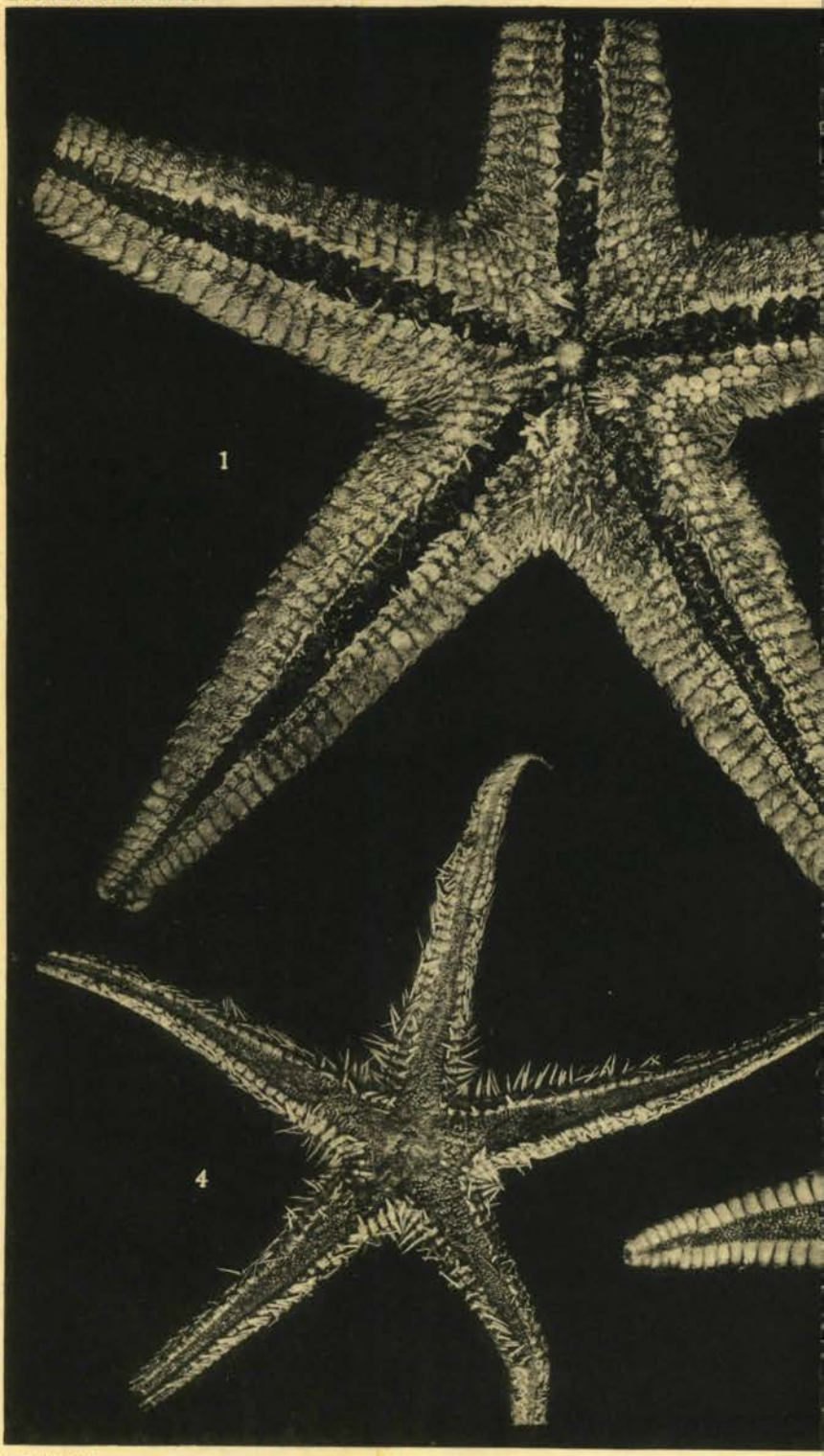
EBERKIND PHOT.



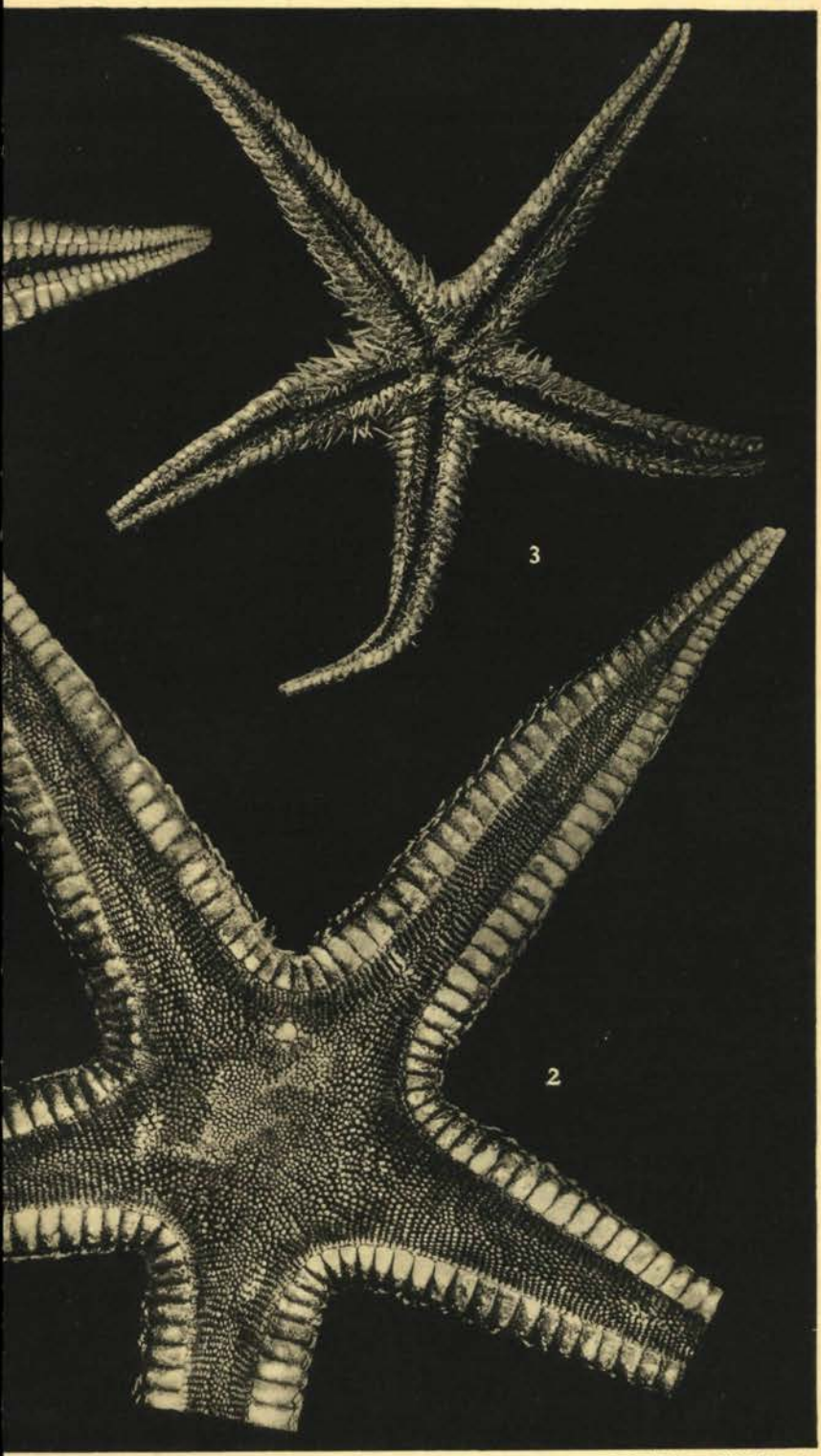
J. v. Huth fot.



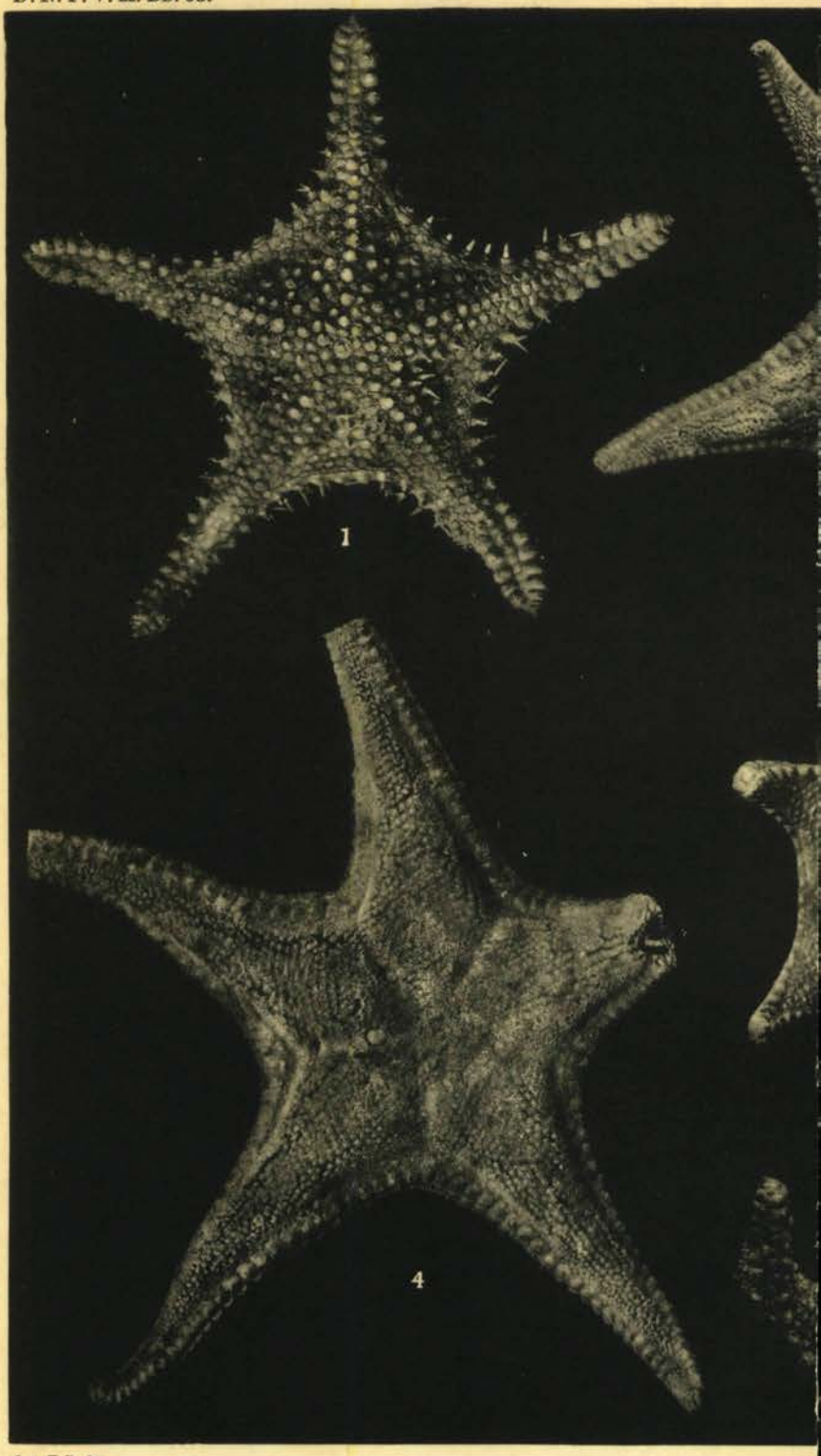
Pacht & Cronos Eftf. Fototypi.



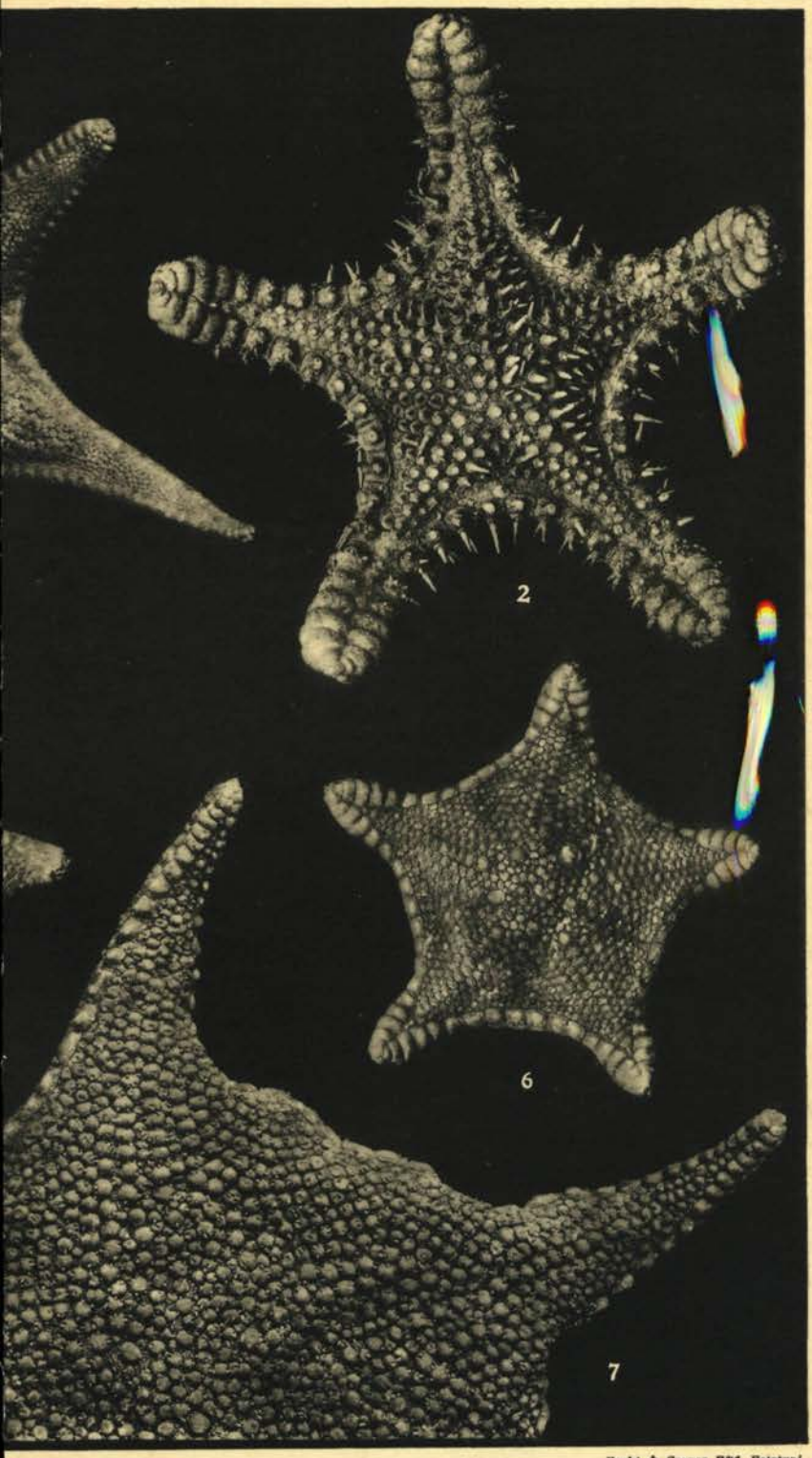
J. v. Huth fot.



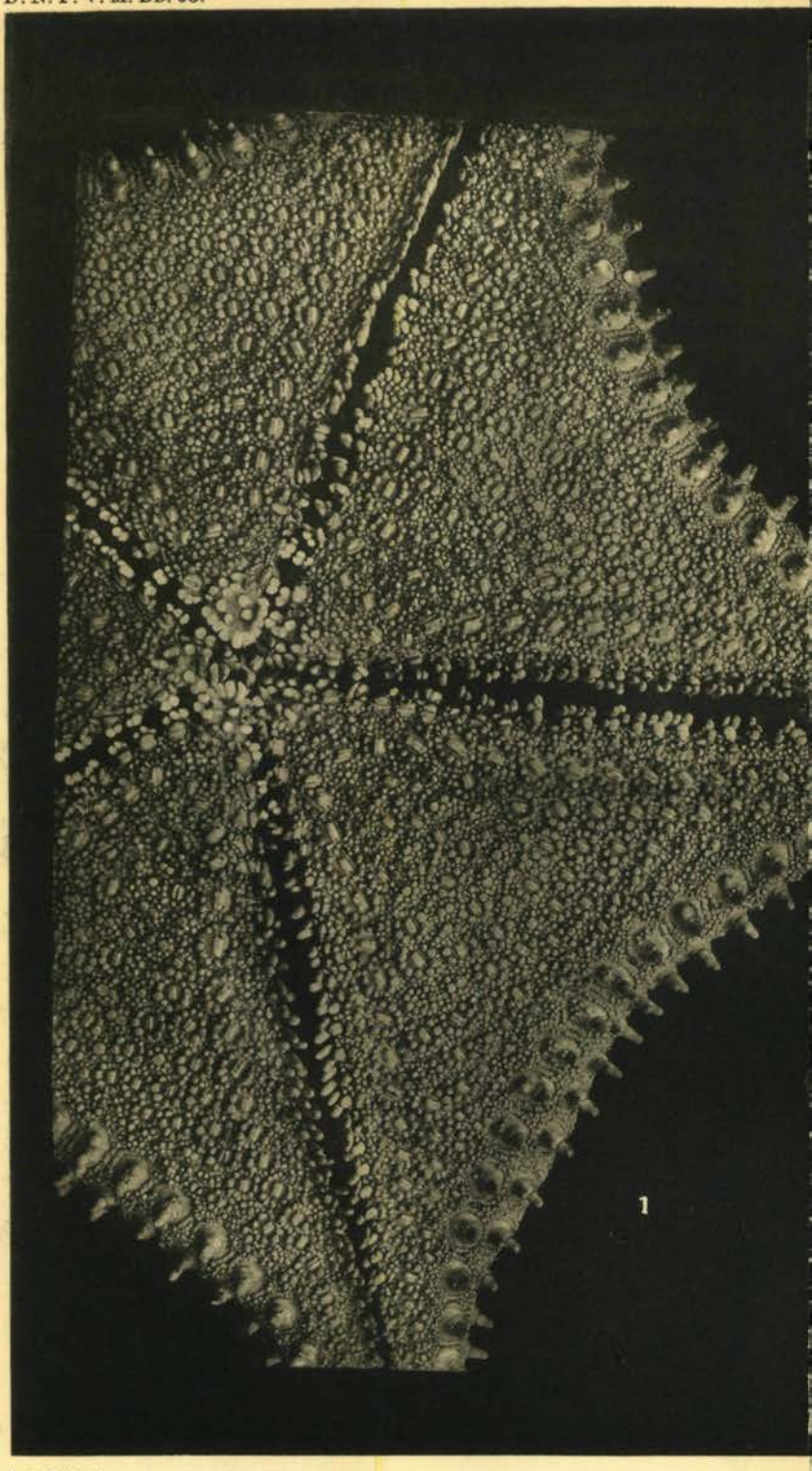
Pacht & Crones Kflf. Fototypi.



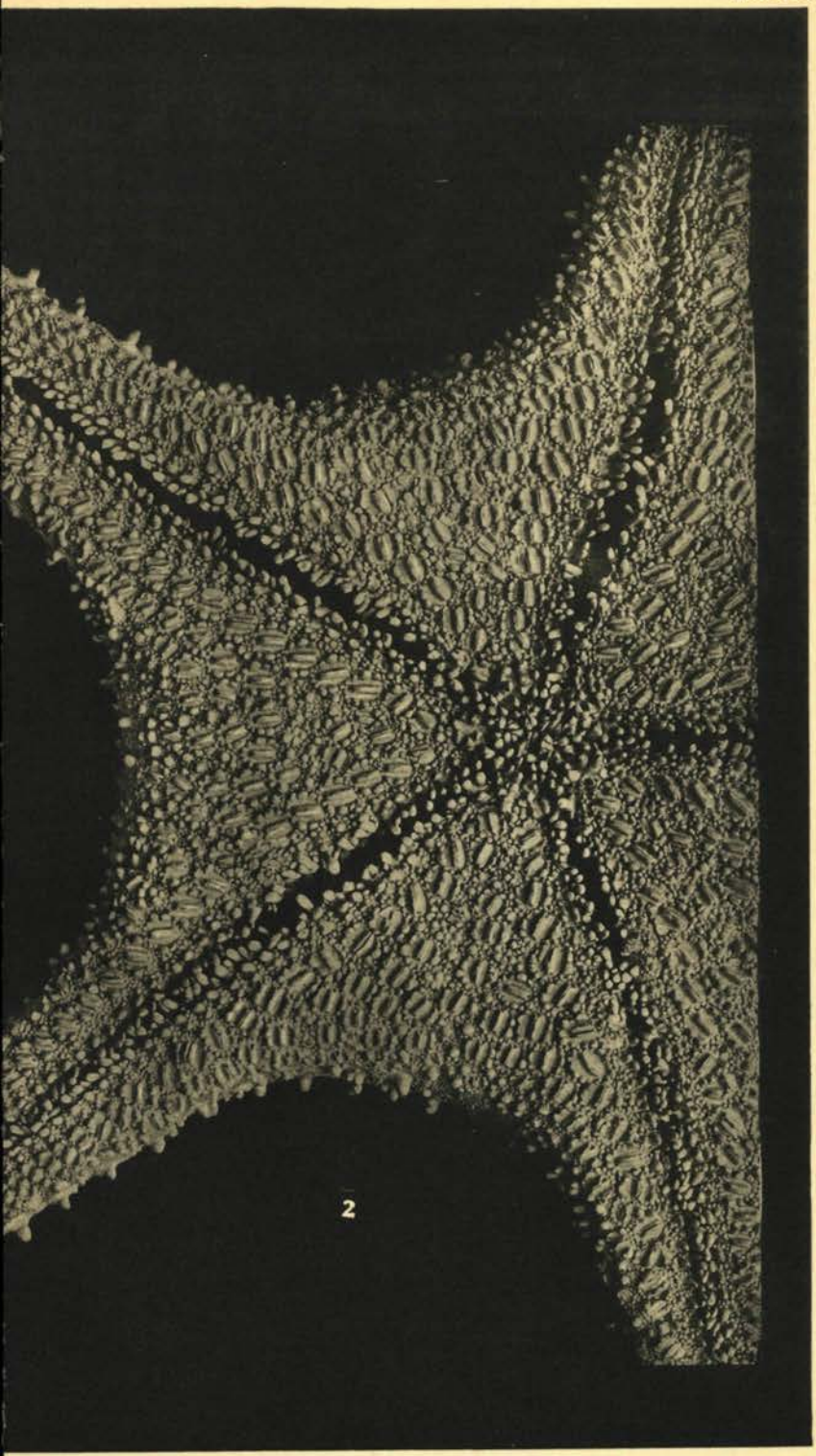
J. v. Huth fot.



Pacht & Crones Kflf. Fototypi.



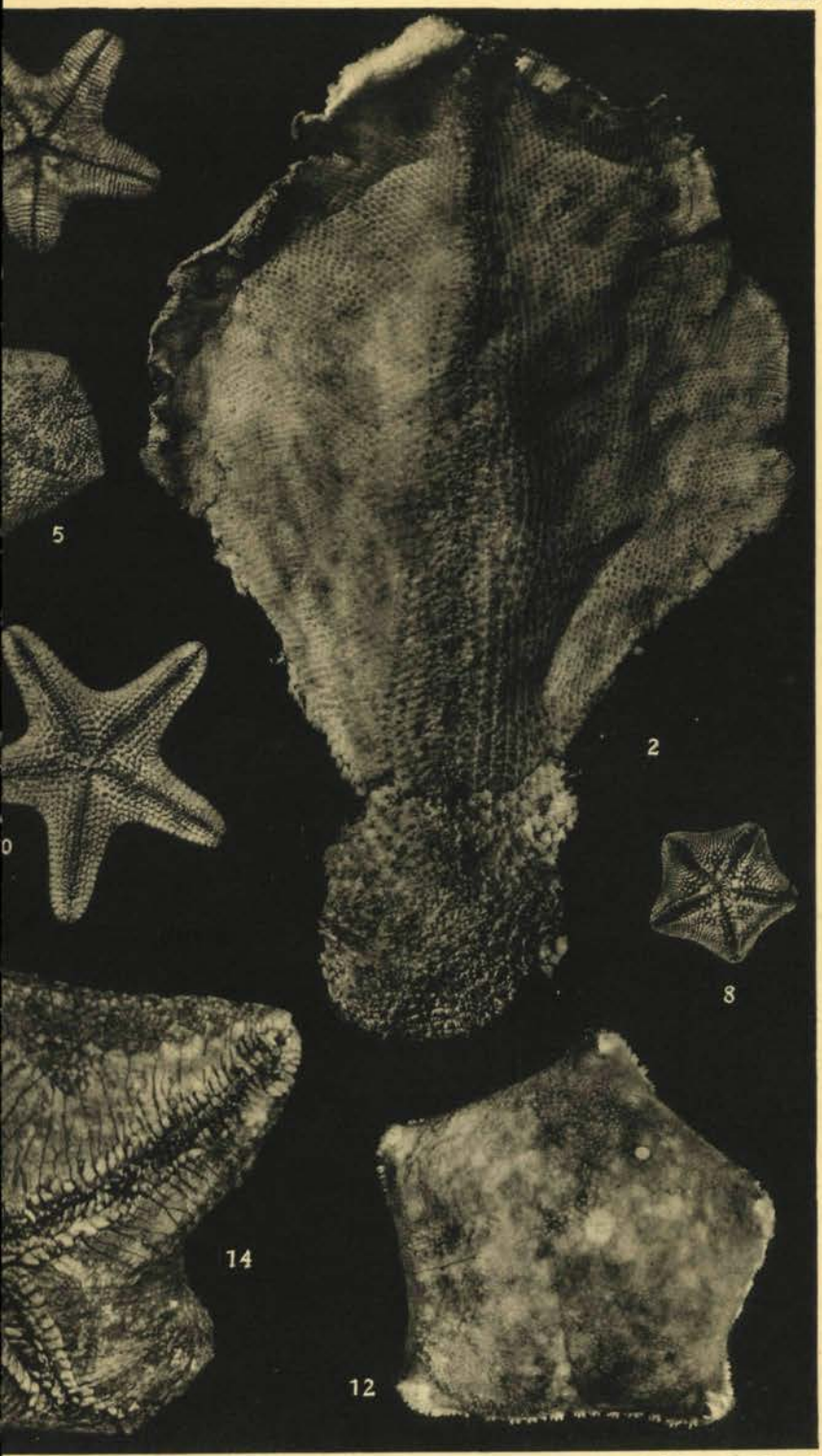
J. v. Huth fot.



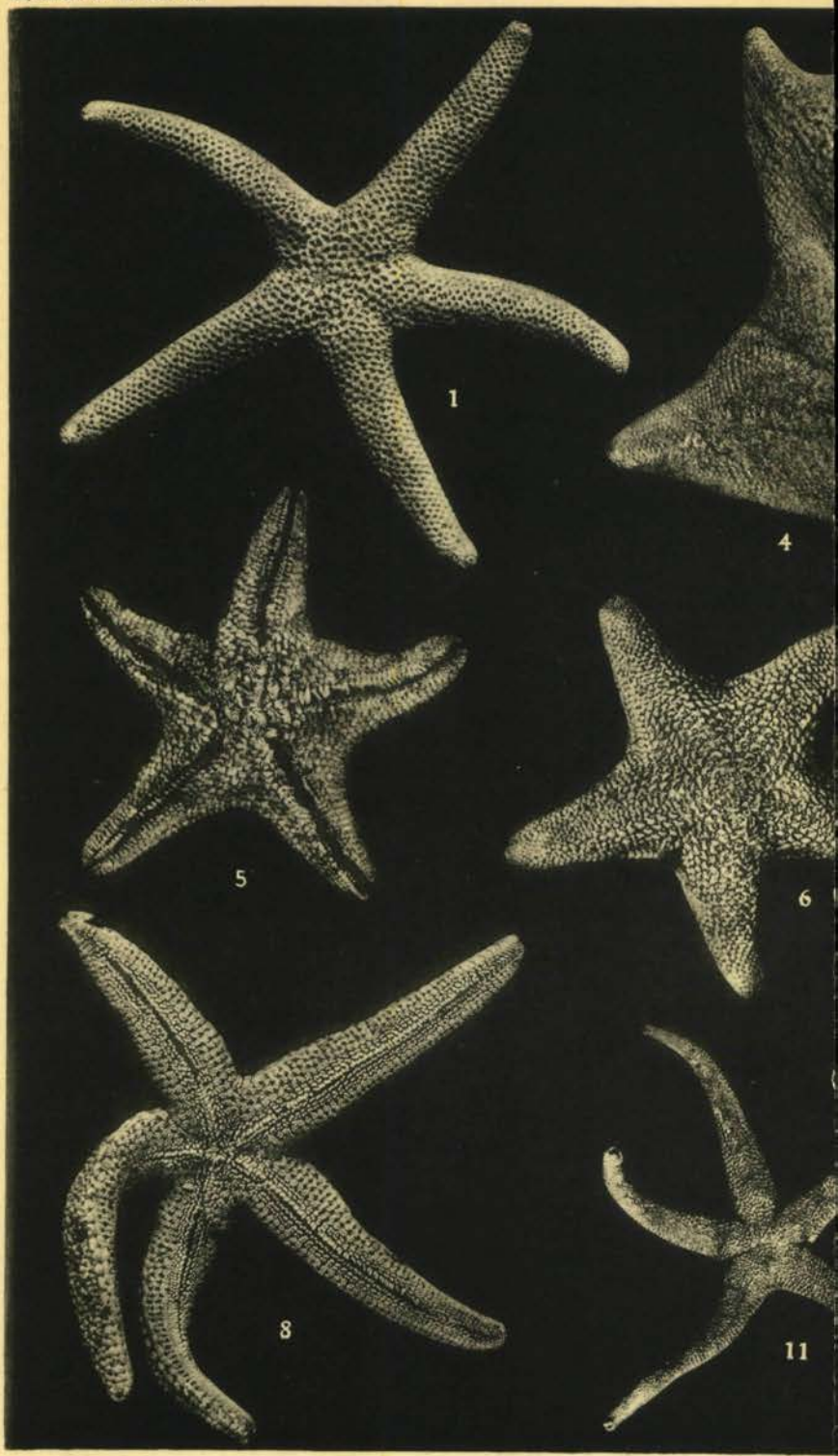
Pacht & Cronos Kfir. Fototypi.



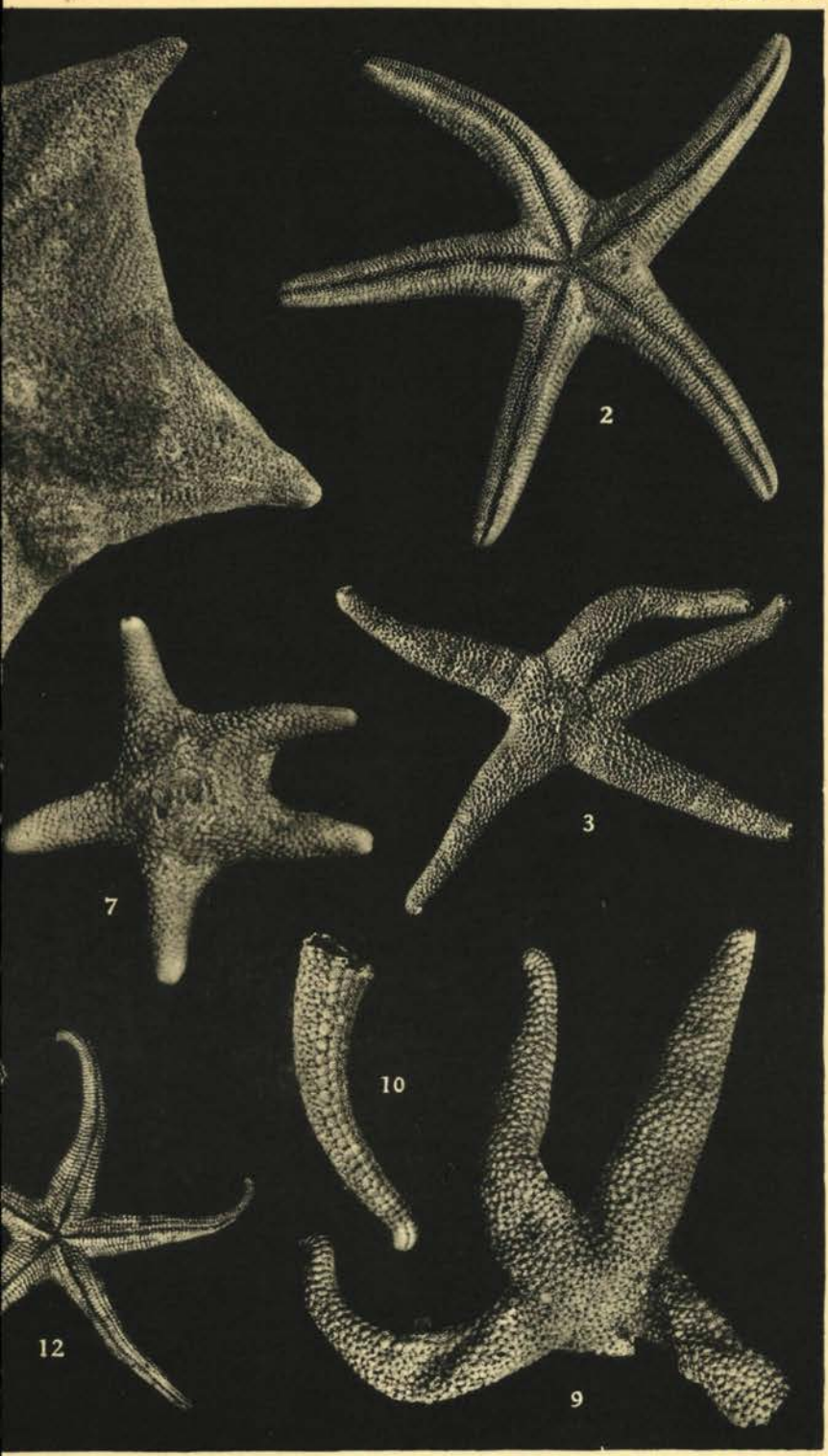
J. v. Huth fot.



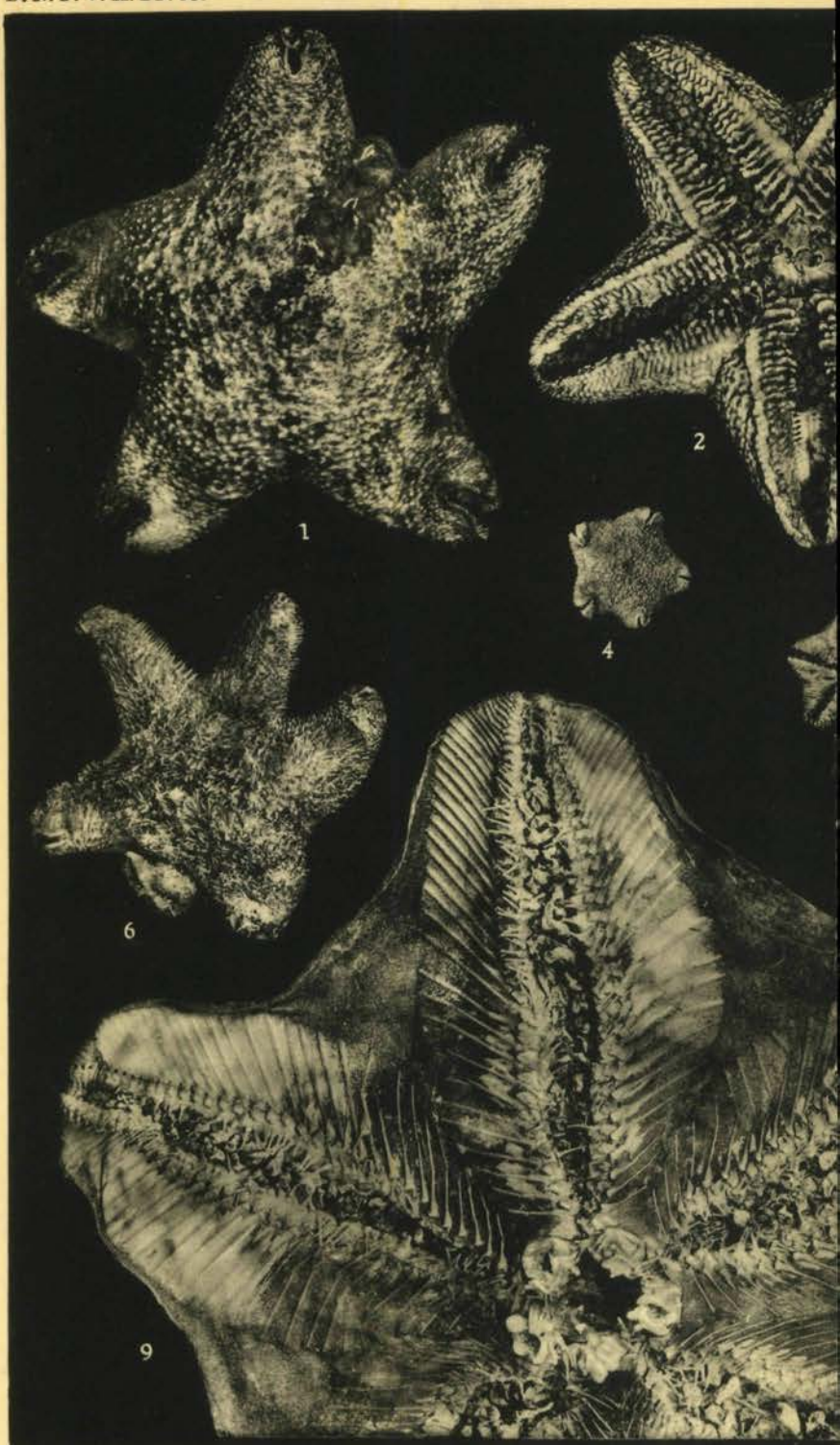
Pacht & Crones Eftf. Fototypl.



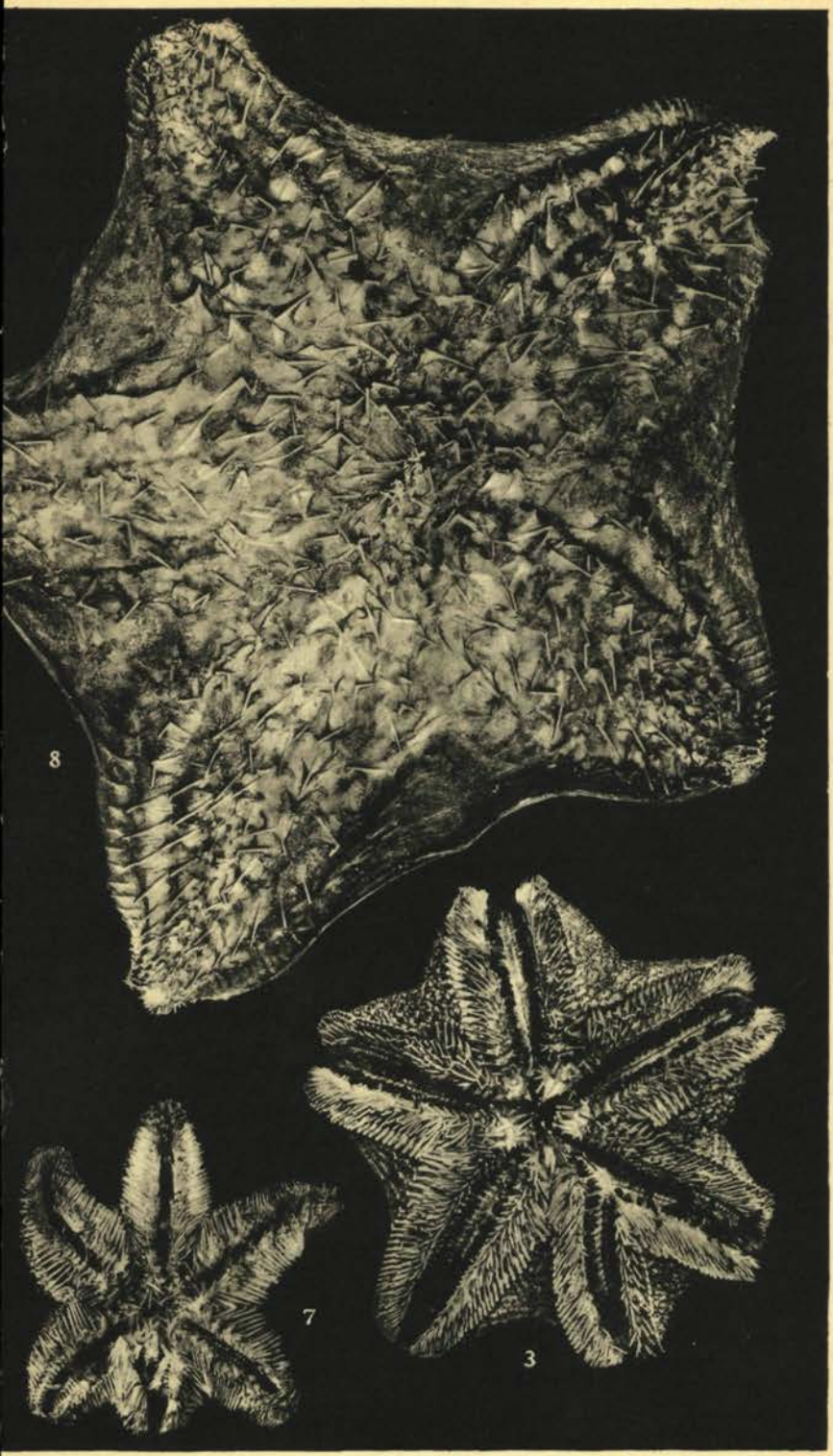
J. v. Huth fot.



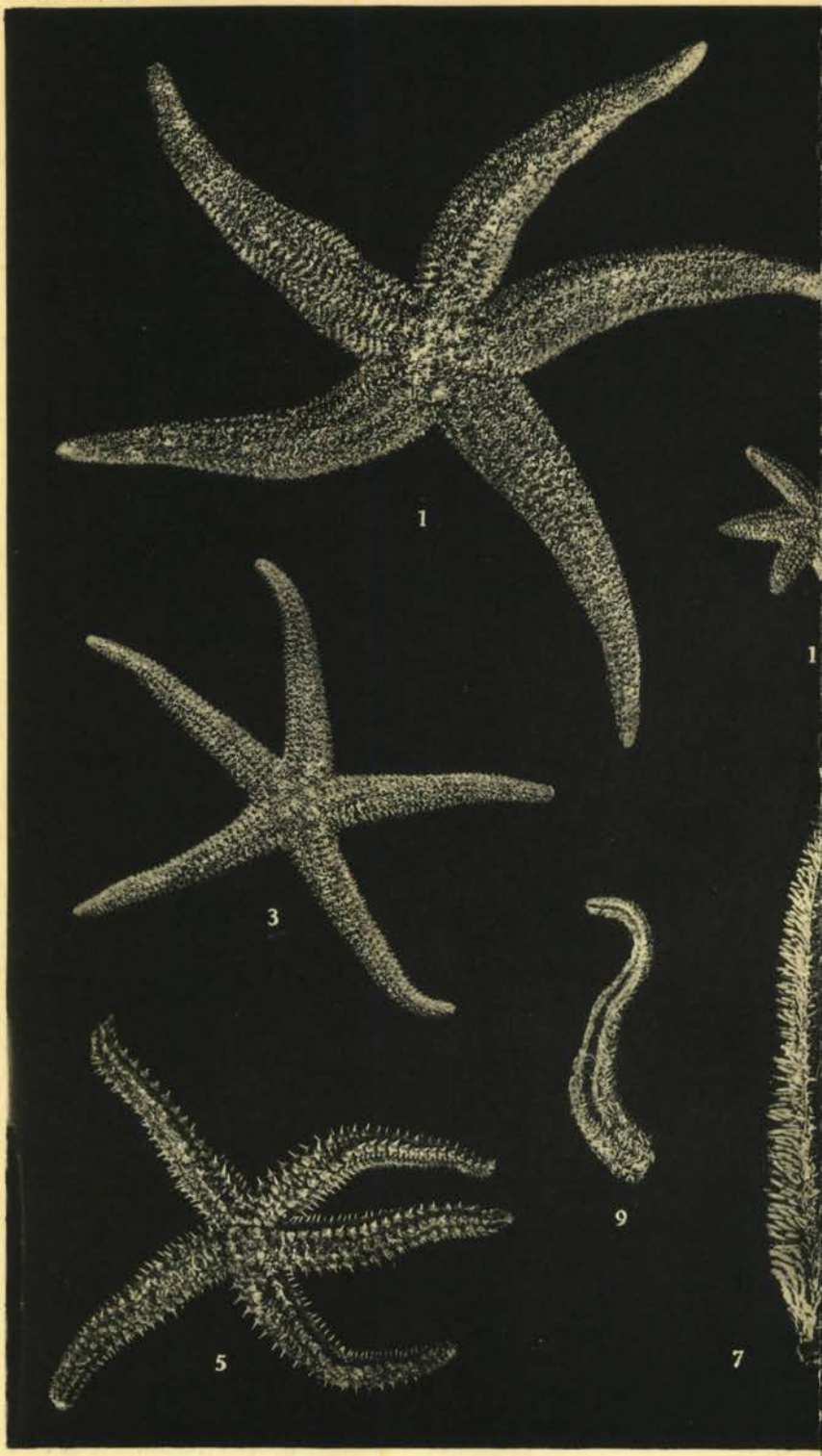
Pacht & Crones Kftf. Fototypl.



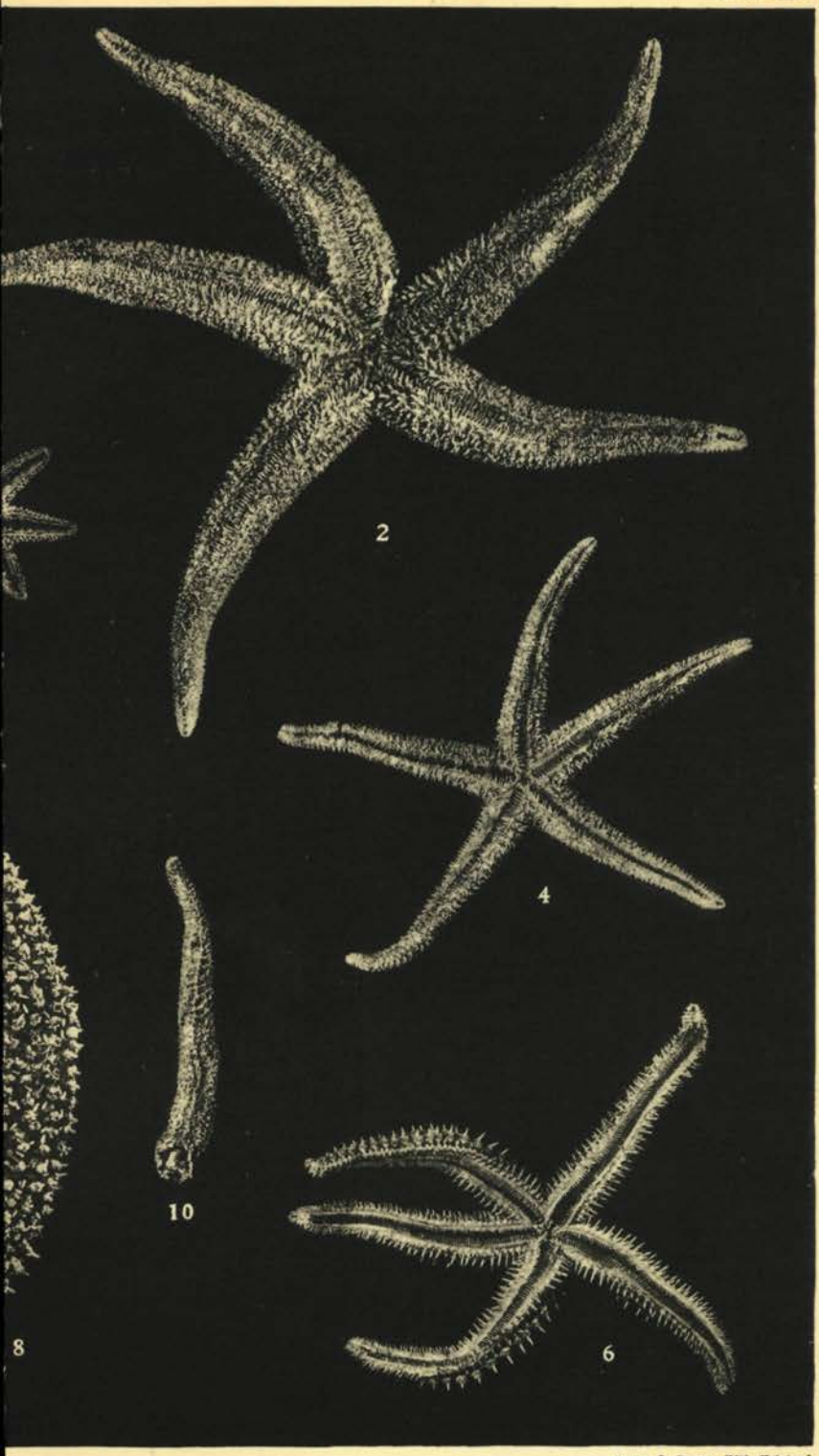
J. v. Huth fot.



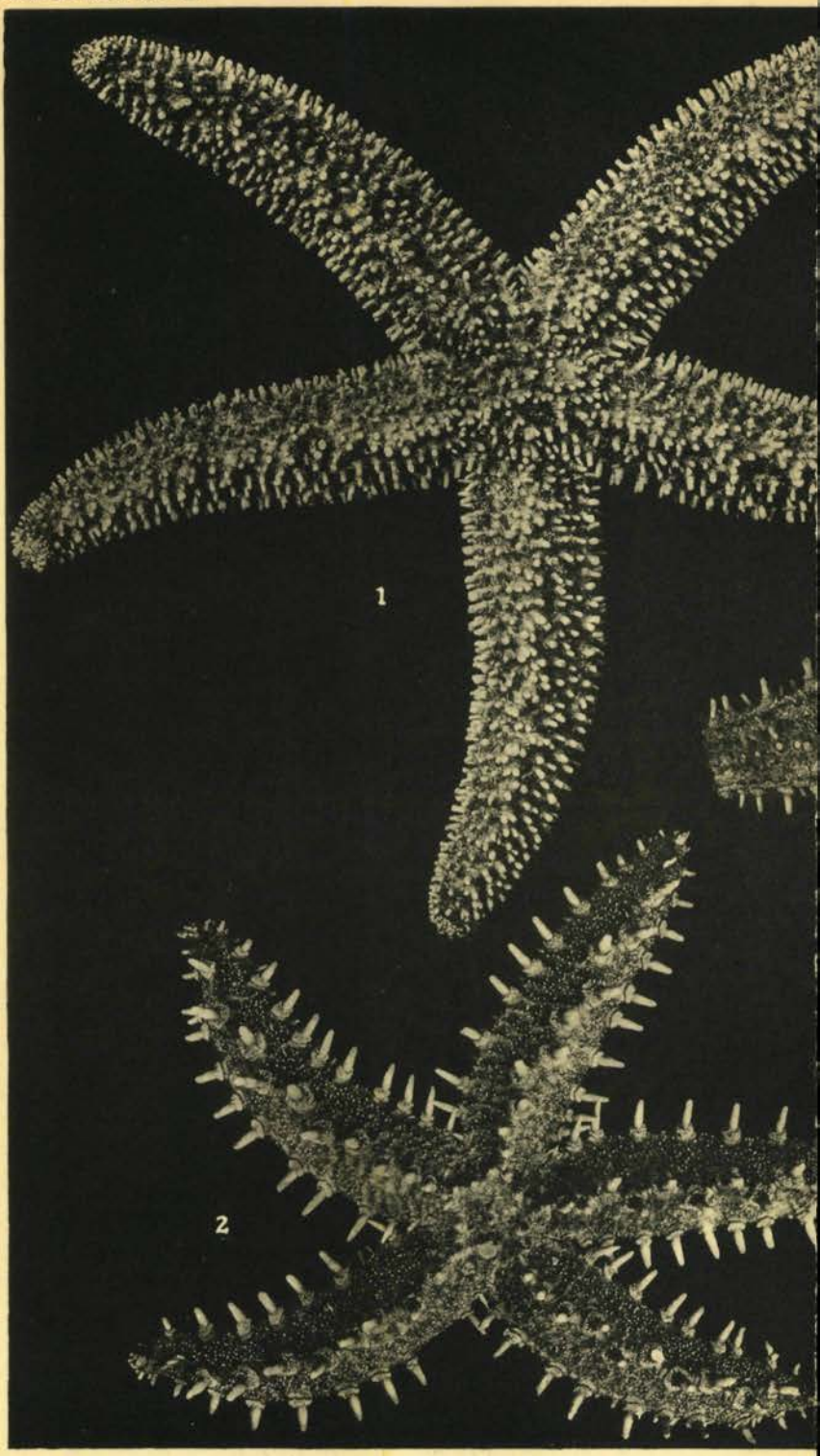
Pacht & Cronas Kftf. Fototypl.



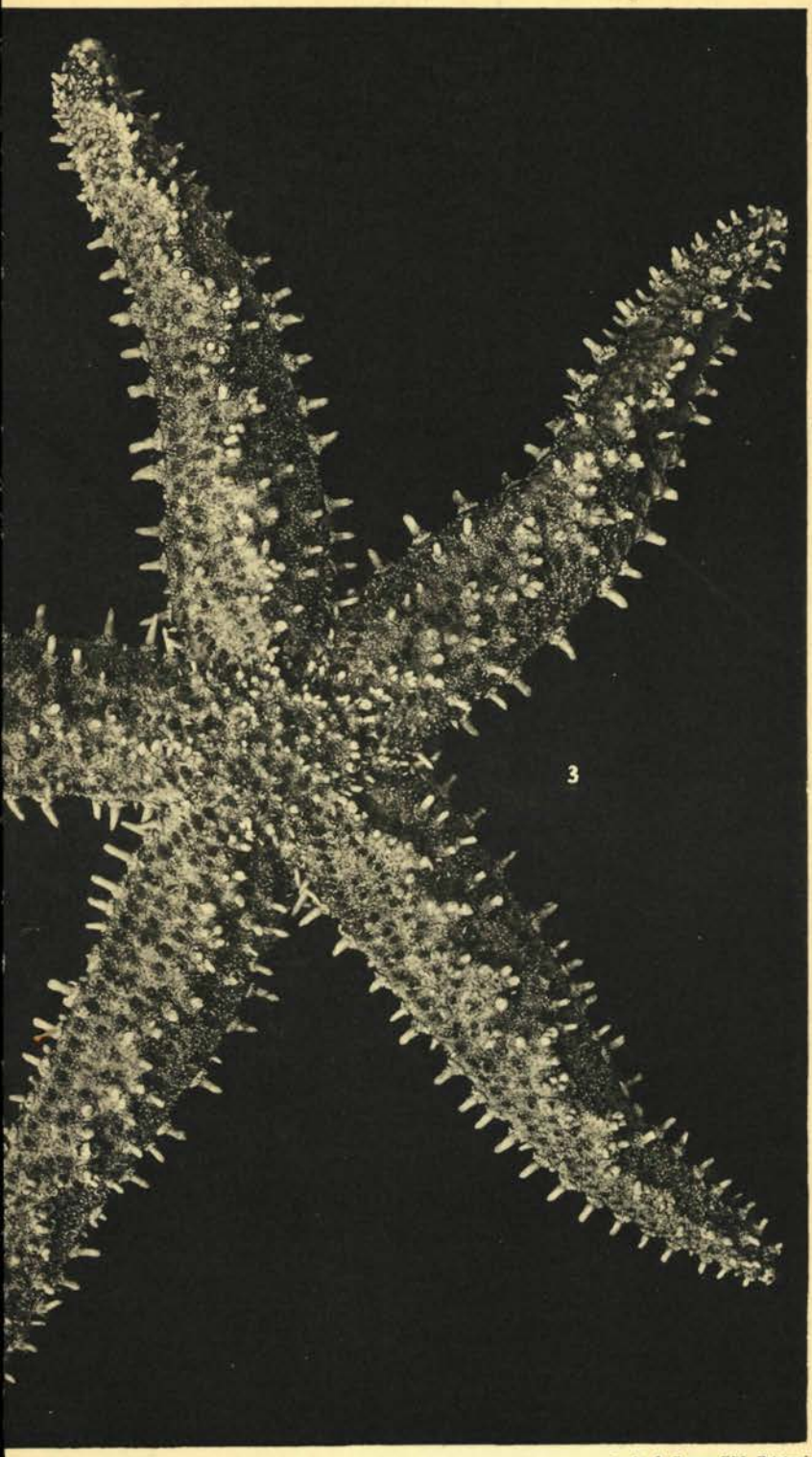
J. v. Huth fot.



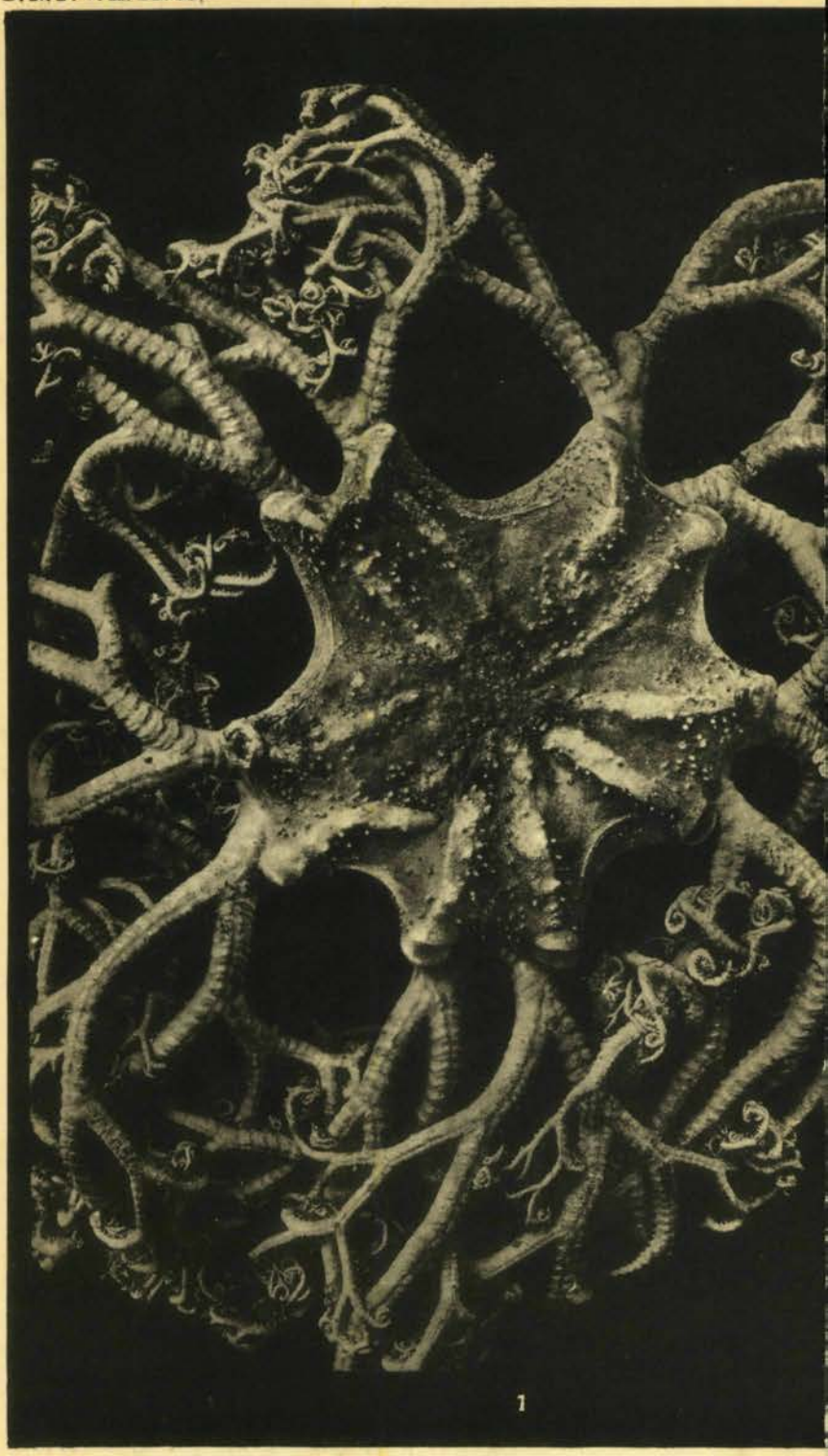
Pacht & Crones Kfif. Fototypi.



J. v. Huth fot.

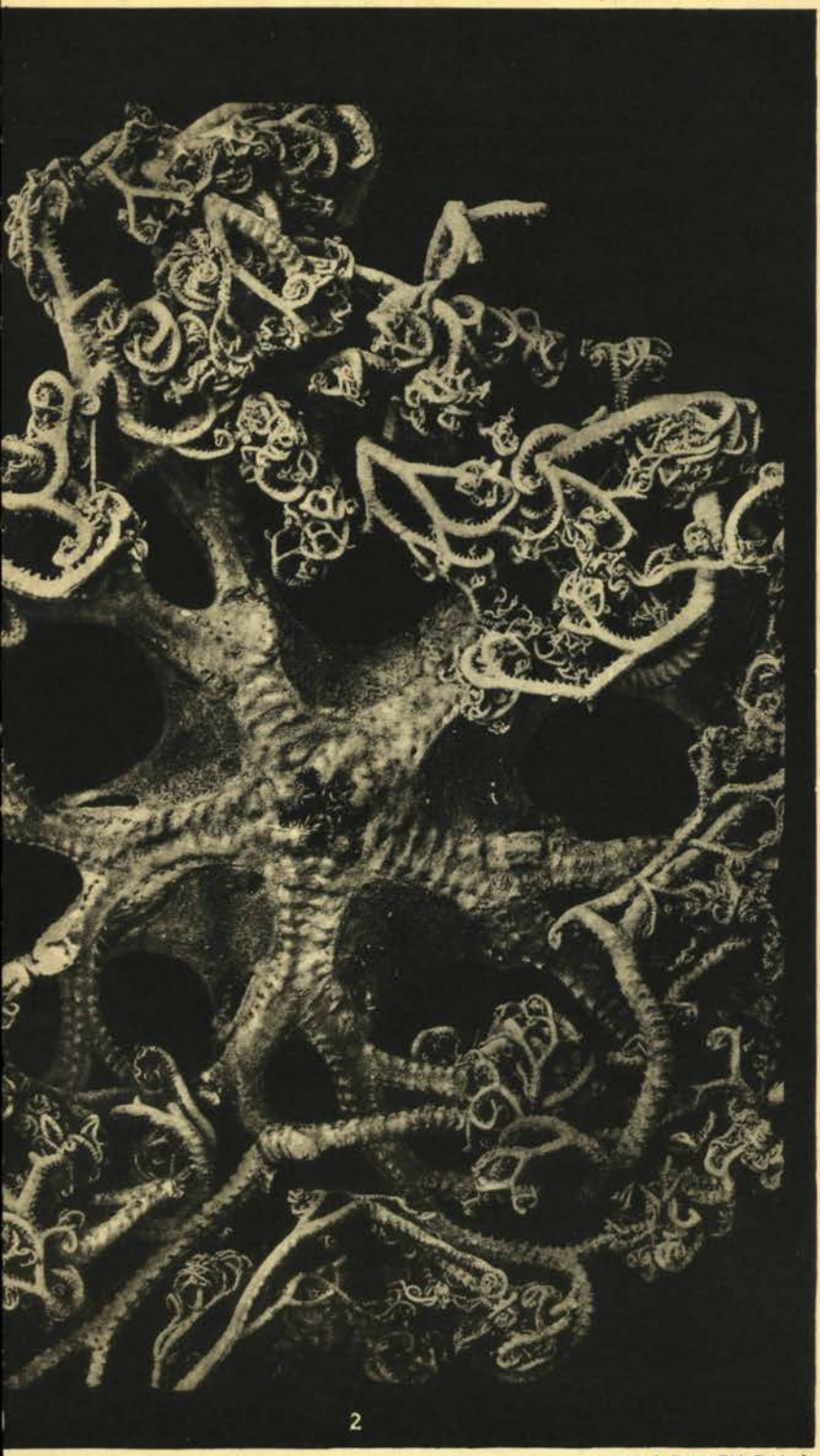


Pacht & Cronos Eftf. Fototypi.



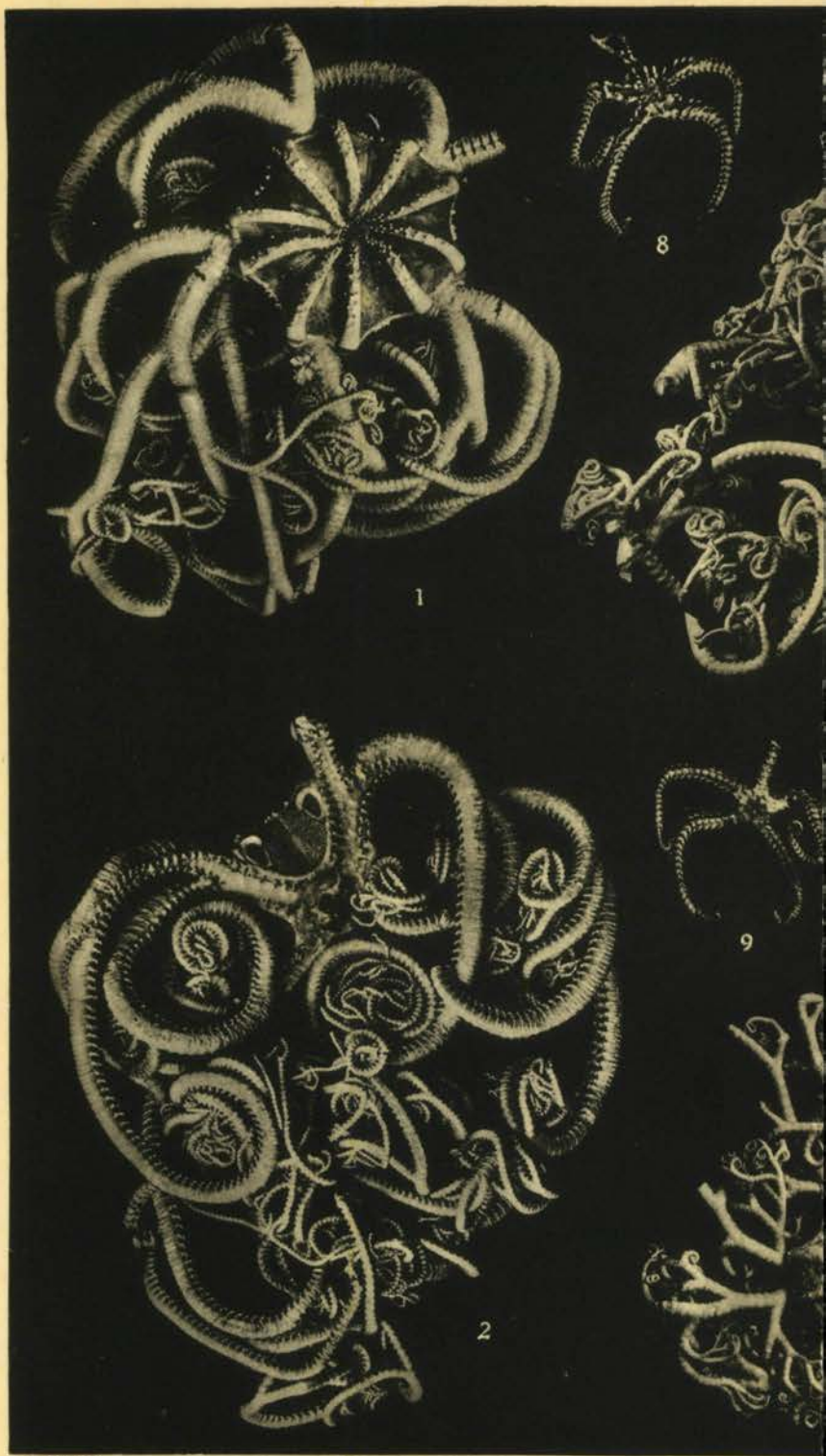
1

J. v. Huth fot.

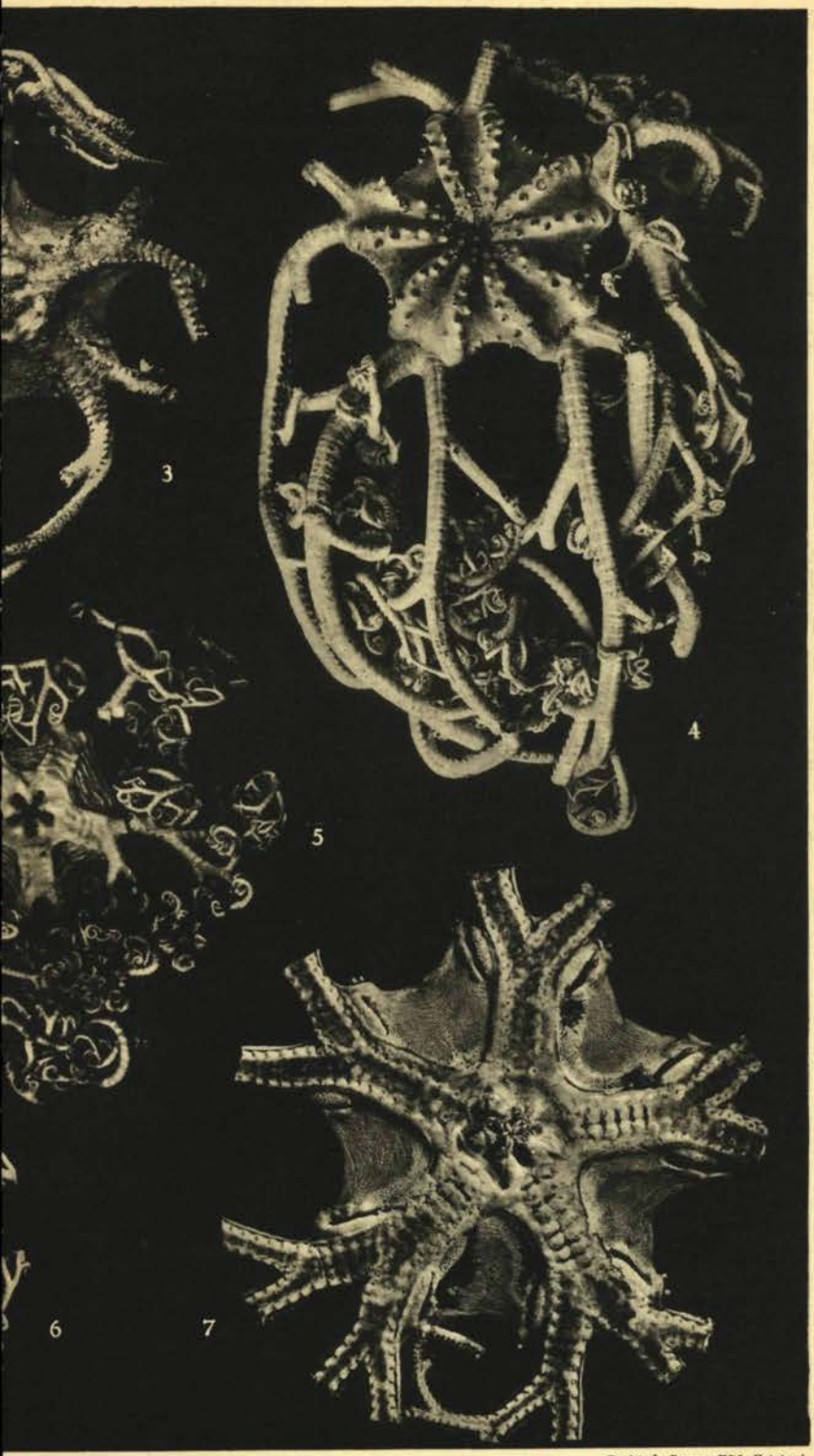


2

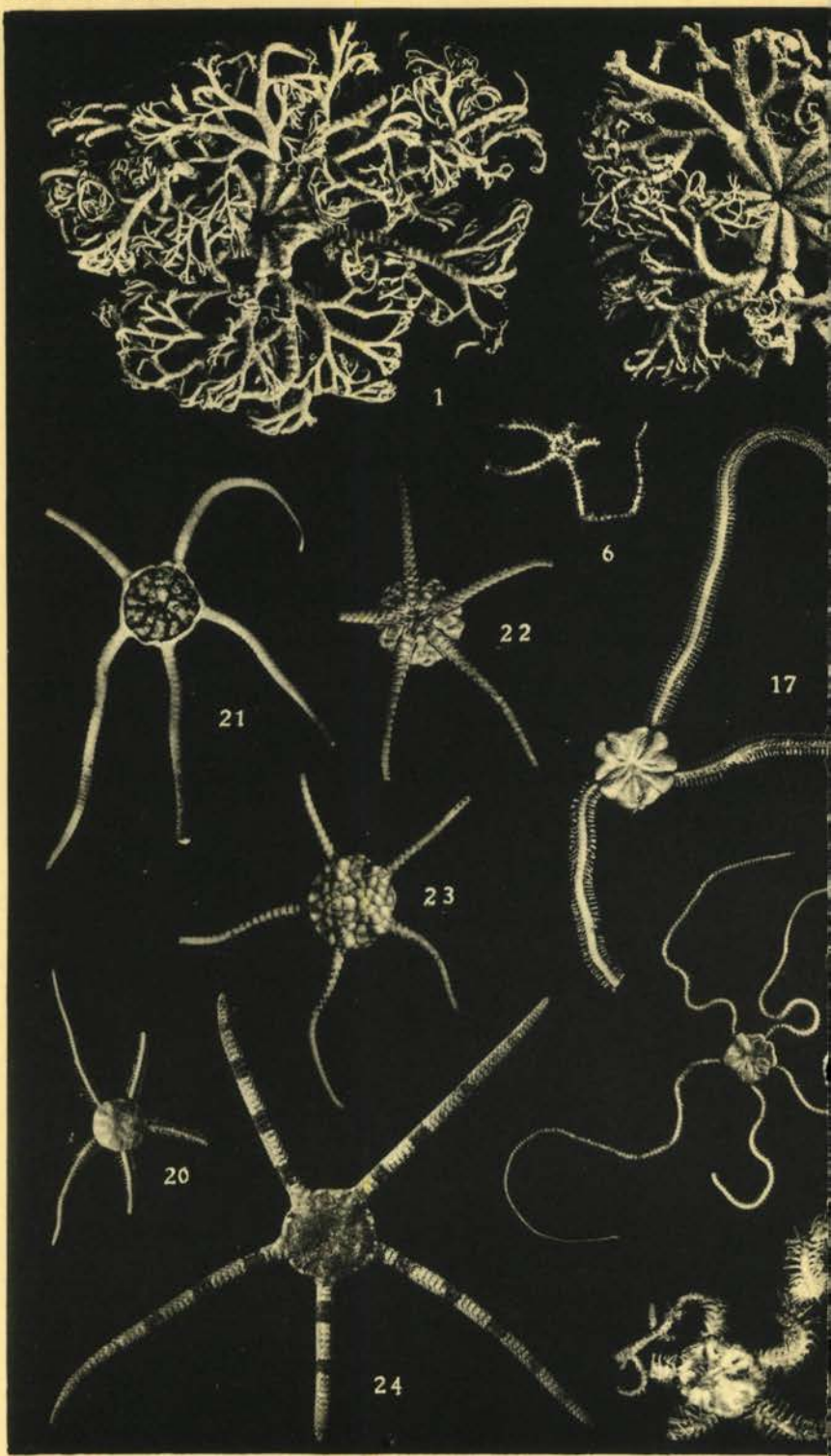
Pacht & Crones Kftf. Fototypi.



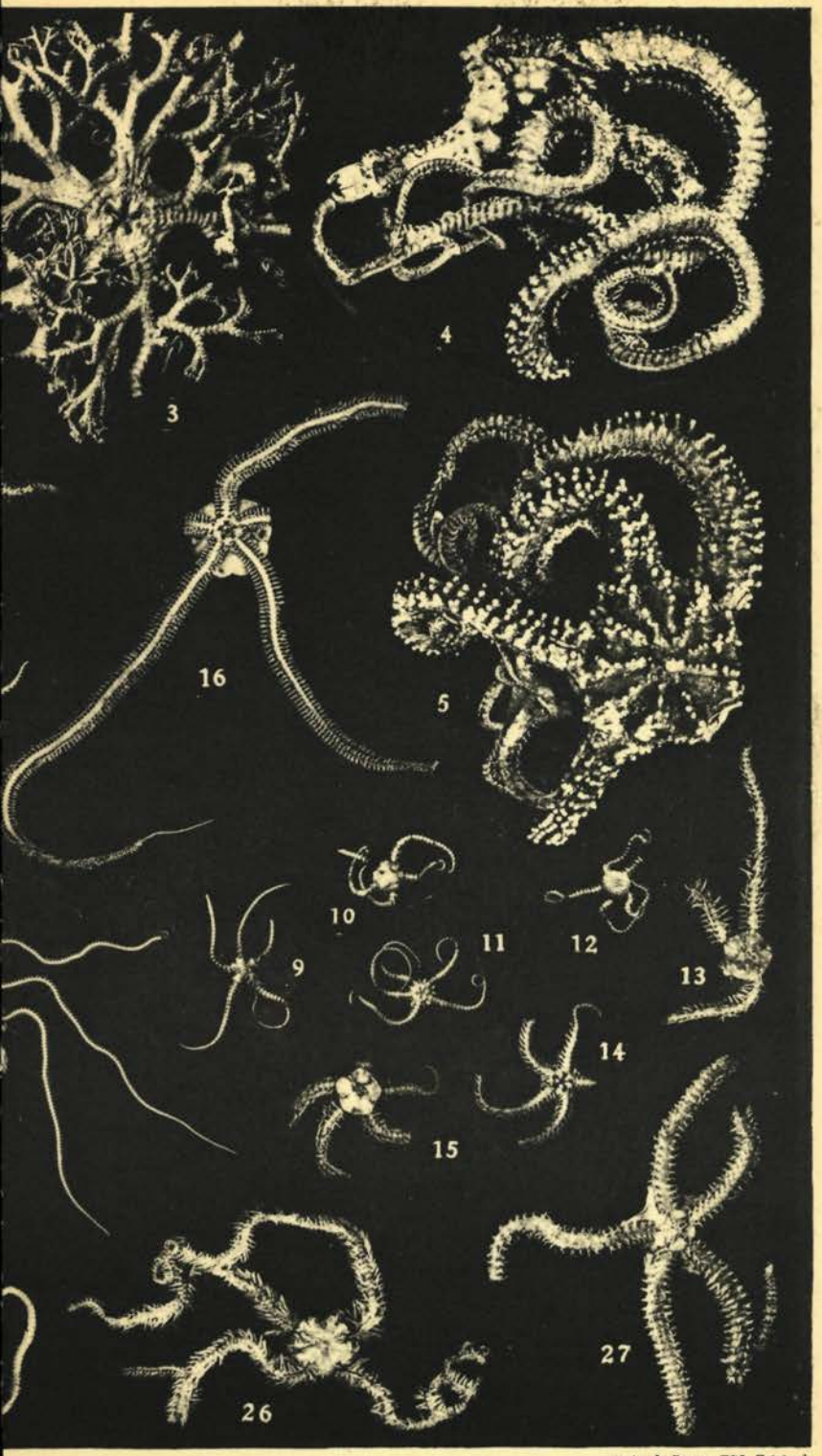
J. v. Huth fot.



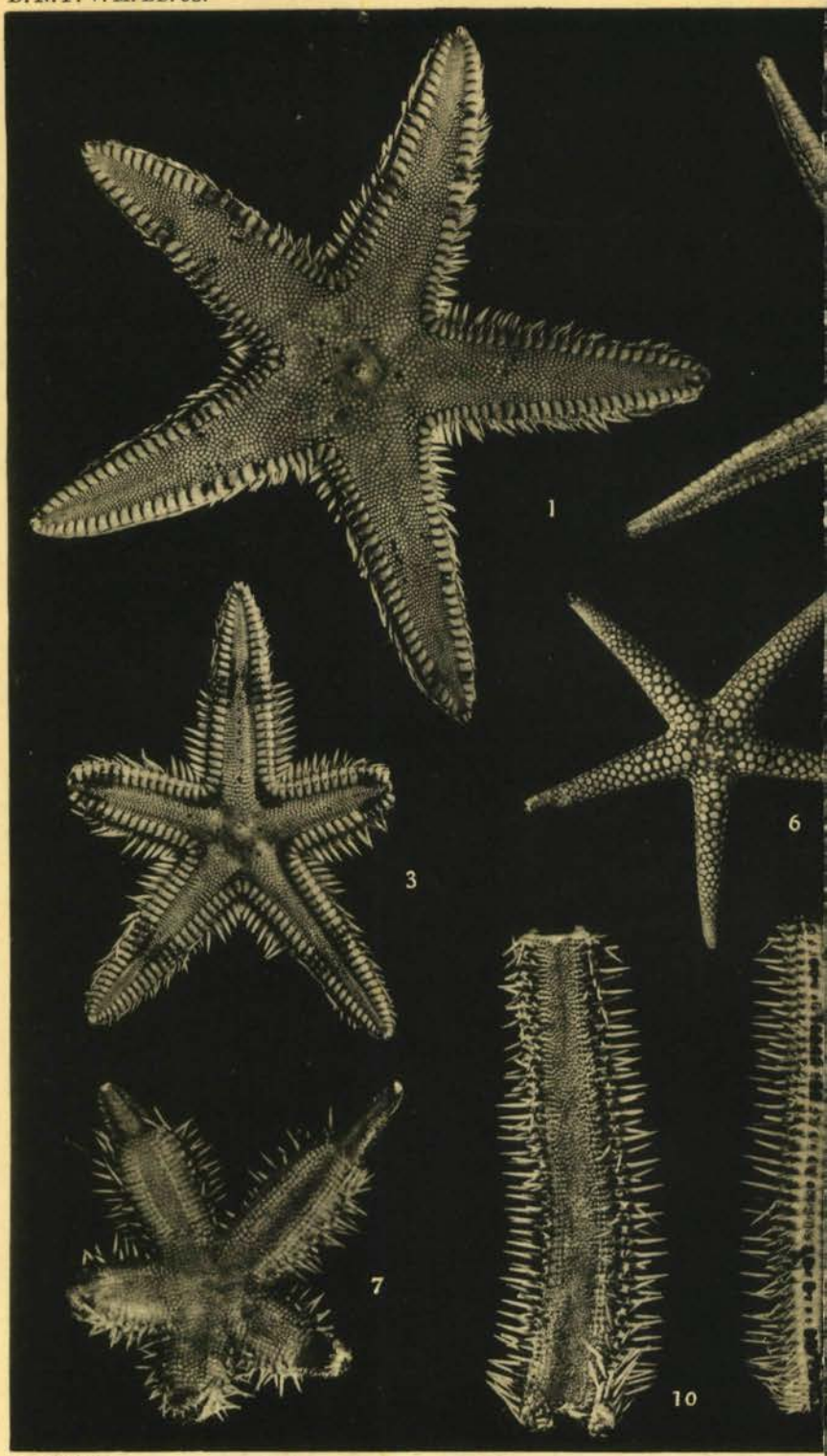
Pacht & Crones Kflf. Fototypi.



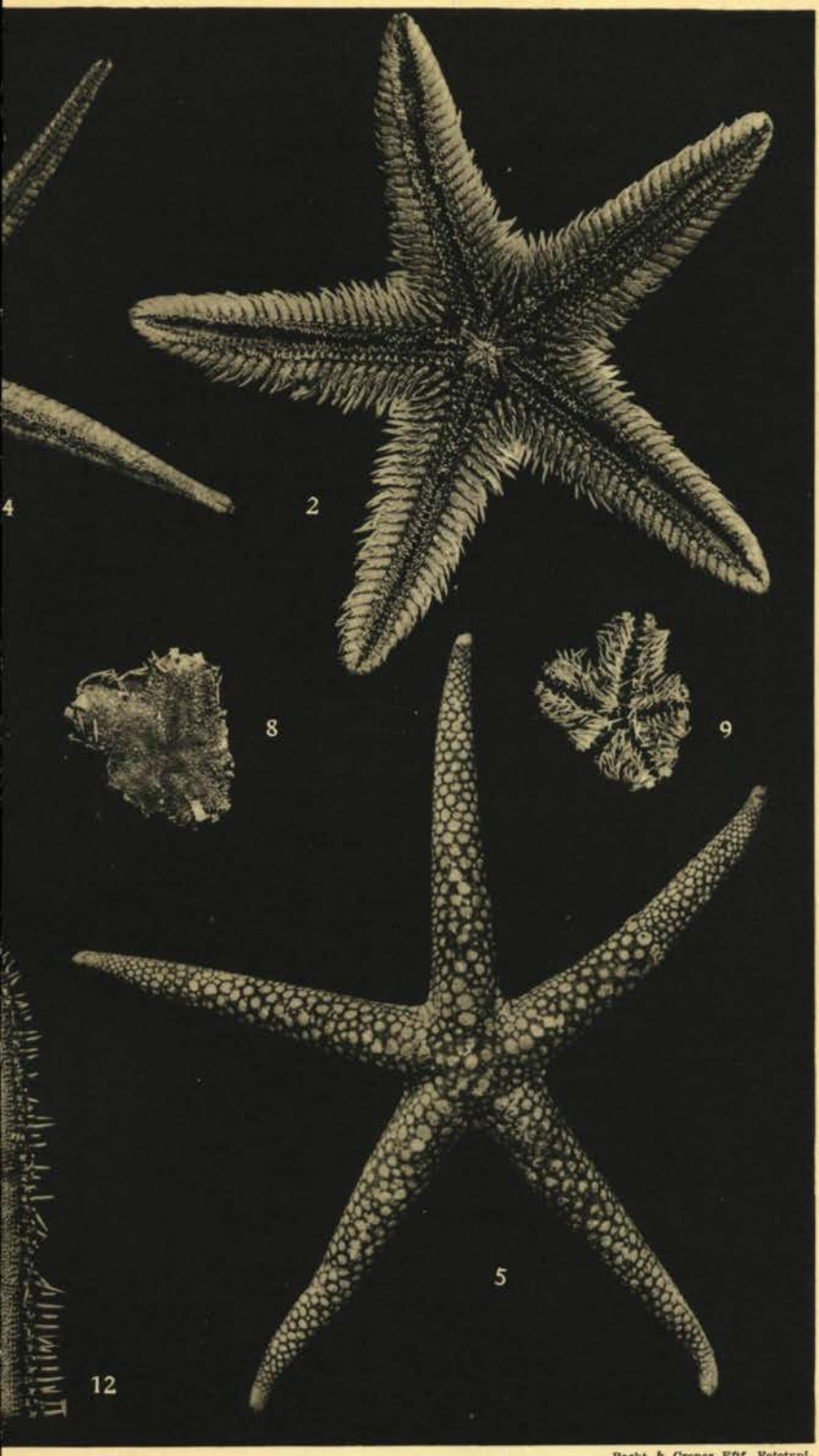
J. v. Huth fot.



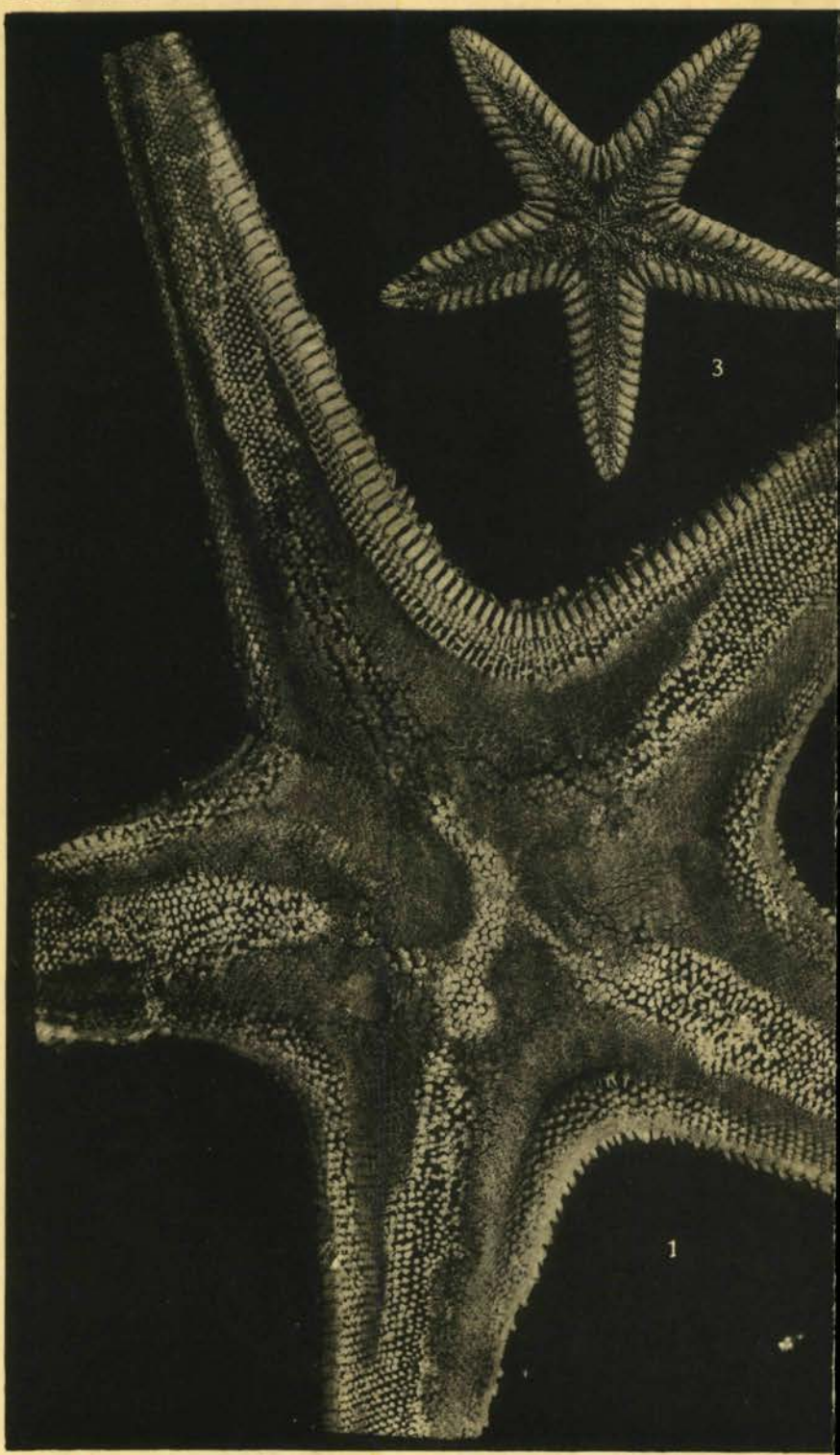
Pacht & Crones Eftf. Fototypi.



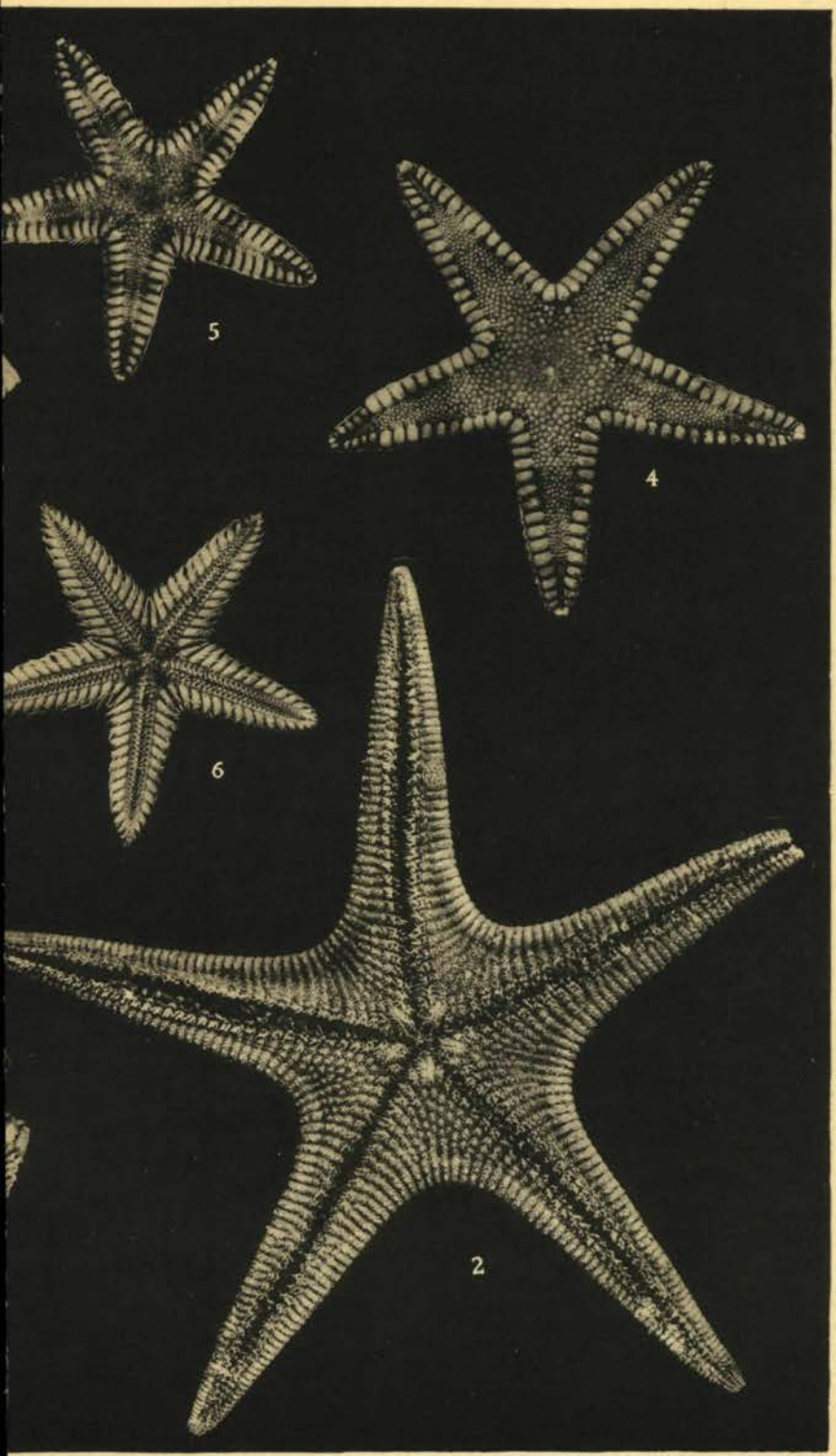
J. v. Huth fot.



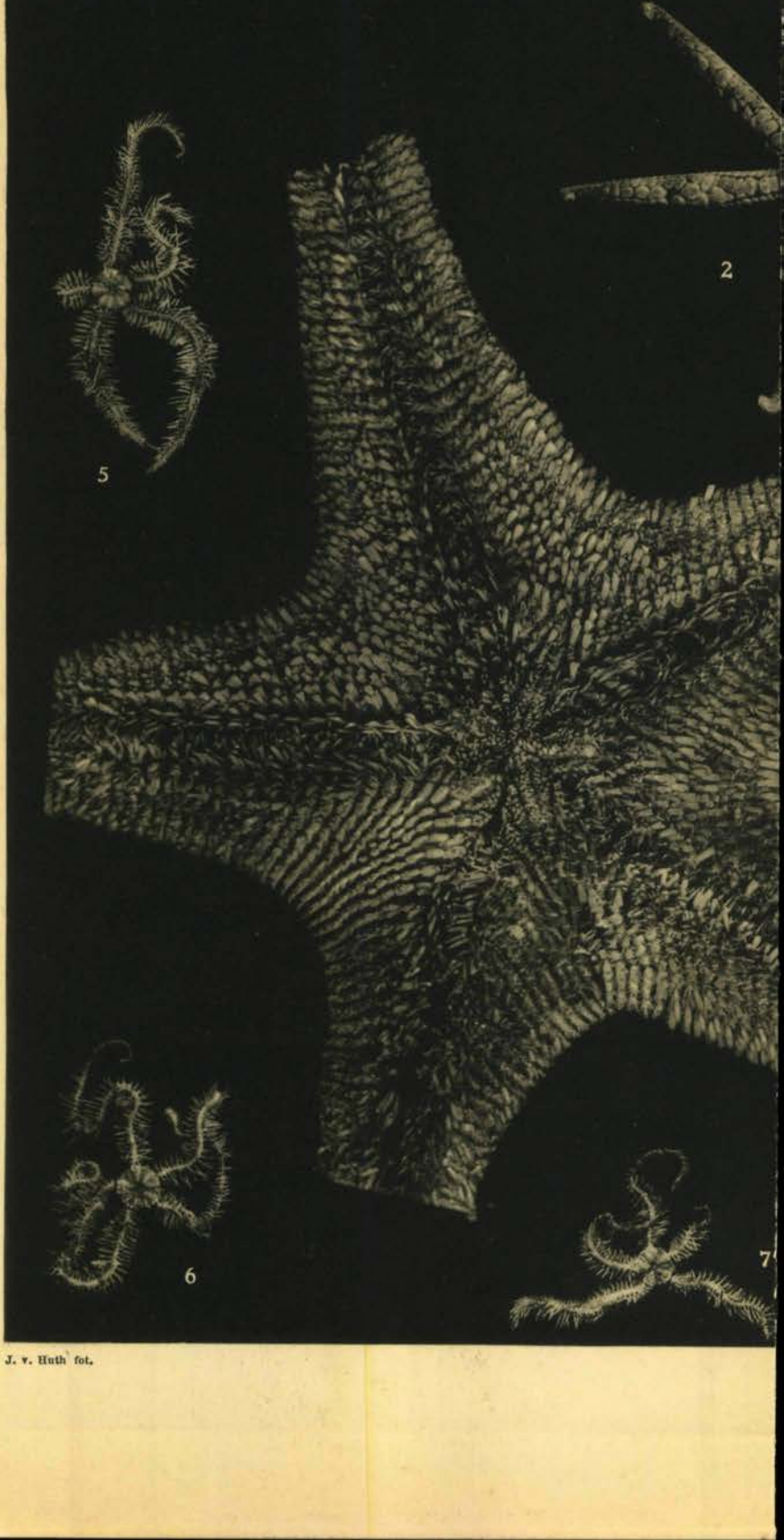
Pacht & Crones Eftf. Fototypl.



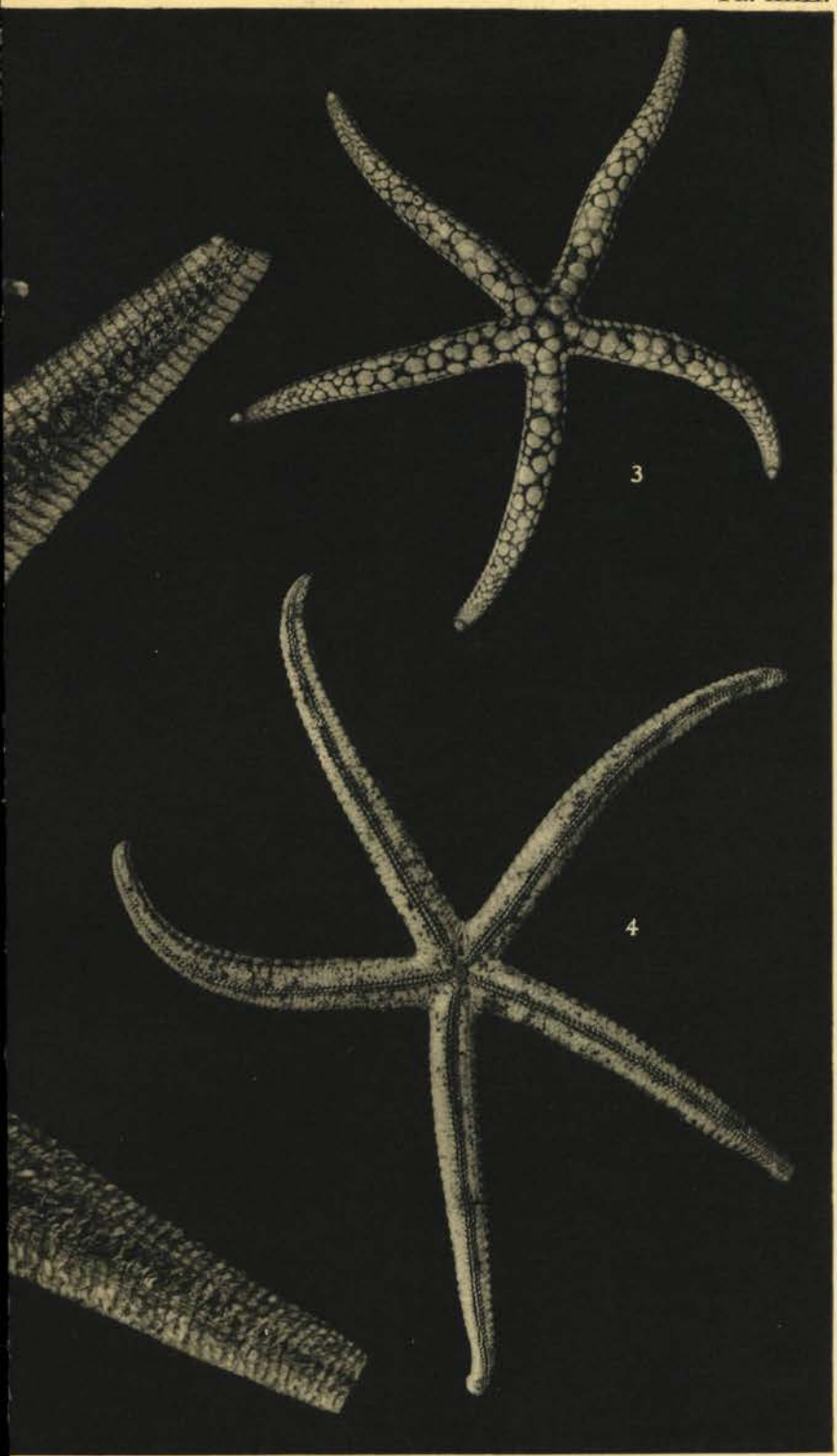
J. v. Huth fot.



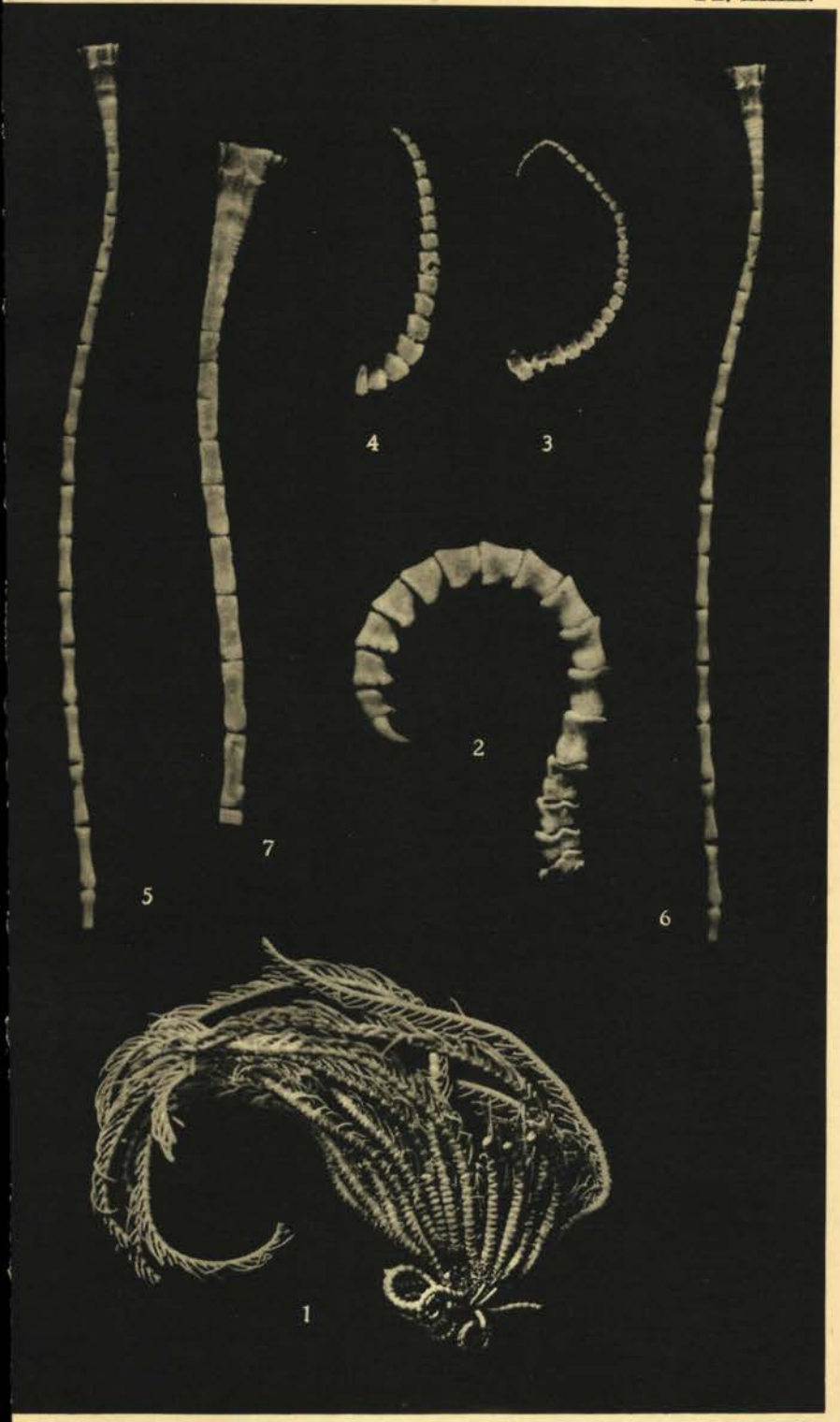
Pacht & Crones Eftf. Fototypi.



J. v. Huth fot.



Pacht & Cronea Eftf. Fototypi.



Pacht & Crones Eftf. Fototypl.

DANMARKS FAUNA

Illustrerede Haandbøger over den danske Dyreverden,
med Statsunderstøttelse udgivne af Dansk naturhistorisk Forening.

Hidtil er udkommet:

1. H. F. E. JUNGERSEN: **Krybdyr og Padder.**
   Med 70 Afbildninger. — 1 Kr. 60 Øre, indb. 3 Kr. 10 Øre
2. J. C. NIELSEN: **Gravehvepse og Gedehamse.**
   Med 52 Afbildninger. — 1 Kr. 60 Øre, indb. 3 Kr. 10 Øre.
3. BERTRAM G. RYE: **Biller. I. Løbebiller.**
   Med 155 Afbildninger. — 2 Kr. 50 Øre, indb. 4 Kr.
4. A. KLÖCKER: **Sommerfugle. I. Dagsommerfugle.**
   Med 134 Afbildninger. — 2 Kr., indb. 3 Kr. 50 Øre.
5. HERLUF WINGE: **Pattedyr.**
   Med 117 Afbildninger. — 2 Kr. 50 Øre, indb. 4 Kr.
6. P. ESBEN-PETERSEN: **Ørentviste, Kakerlaker, Græshopper.**
   Med 40 Afbildninger. — 75 Øre, indb. 2 Kr. 25 Øre.
7. A. KLÖCKER: **Sommerfugle. II. Natsommerfugle.** I. Del.
   Med 113 Afbildninger. — 2 Kr. 25 Øre, indb. 3 Kr. 75 Øre.
8. P. ESBEN-PETERSEN: **Guldsmede, Døgnfluer, Slørvinger.**
   Med 133 Afbildninger. — 2 Kr. 60 Øre, indb. 4 Kr. 10 Øre.
9. K. STEPHENSEN: **Storkrebs. I. Skjoldkrebs.**
   Med 108 Afbildninger. — 2 Kr. 75 Øre, indb. 4 Kr. 25 Øre.
10. C. M. STEENBERG: **Bløddyr. I. Landsnegle.**
    Med 181 Afbildninger. — 3 Kr. 50 Øre, indb. 5 Kr.
11. C. V. OTTERSTRØM: **Fisk. I. Pigfinnefisk.**
    Med 93 Afbildninger og 1 Kort. — 3 Kr. 25 Øre, indb. 4 Kr. 75 Øre.
12. A. C. JENSEN-HAARUP: **Tæger.**
    Med 171 Afbildninger. — 4 Kr. 50 Øre, indb. 6 Kr.
13. A. KLÖCKER: **Sommerfugle. III. Natsommerfugle.** II. Del.
    Med 360 Afbildninger. — 4 Kr., indb. 5 Kr. 50 Øre.
14. K. HENRIKSEN: **Biller. II. Pragtbiller og Smeldere.**
    Med 130 Afbildninger. — 1 Kr. 80 Øre, indb. 3 Kr. 30 Øre.
15. C. V. OTTERSTRØM: **Fisk. II. Blødfinnefisk.**
    Med 150 Afbildninger og 1 Kort. — 5 Kr. 50 Øre, indb. 7 Kr.
16. A. C. JENSEN-HAARUP og K. HENRIKSEN: **Biller. III. Træbukke.**
    Med 93 Afbildninger. — 1 Kr. 75 Øre, indb. 3 Kr. 25 Øre.
17. A. KLÖCKER: **Sommerfugle. IV. Natsommerfugle.** III. Del.
    Med 284 Afbildninger. — 3 Kr. 25 Øre, indb. 4 Kr. 75 Øre.
18. J. C. NIELSEN og K. HENRIKSEN: **Træ- og Bladhvepse.**
    Med 135 Afbildninger. — 3 Kr 75 Øre, indb. 5 Kr. 25 Øre.
19. P. ESBEN-PETERSEN: **Vaarfluer.**
    Med 189 Afbildninger. — 3 Kr. 50 Øre, indb. 5 Kr.

20. C. V. Otterstrøm: **Fisk. III. Tværmunde m. m.**
Med 73 Afbildninger og 1 Kort. — 2 Kr. 75 Øre, indb. 4 Kr. 25 Øre.

21. A. Klöcker: **Sommerfugle. V. Natsommerfugle. IV. Del.**
Med 116 Afbildninger. — 1 Kr. 50 Øre, indb. 3 Kr.

22. Victor Hansen: **Biller. IV. Snudebiller.**
Med 151 Afbildninger. — 6 Kr. 50 Øre, indb. 8 Kr.

23. R. Hørring: **Fugle. I. Andefugle og Hønsefugle.**
Med 82 Afbildninger. — 4 Kr. 50 Øre, indb. 6 Kr.

24. A. C. Jensen-Haarup: **Cikader.**
Med 79 Afbildninger. — 5 Kr., indb. 6 Kr. 50 Øre.

25. Lavrids Jørgensen: **Bier.**
Med 32 Afbildninger. — 6 Kr. 50 Øre, indb. 8 Kr.

26. Victor Hansen: **Biller. V. Aadselbiller, Stumpbiller m. m.**
Med 119 Afbildninger. — 6 Kr. 50 Øre, indb. 8 Kr.

27. Th. Mortensen: **Pighude (Echinodermer).**
Med 129 Afbildninger. — 7 Kr. 50 Øre, indb. 9 Kr.

28. P. Nielsen: **Stankelben.**
Med 168 Afbildninger. — 4 Kr. 50 Øre, indb. 6 Kr.

29. Victor Hansen: **Biller. VI. Torbister.**
Med 76 Afbildninger. — 4 Kr. 50 Øre, indb. 6 Kr.

30. R. Hørring: **Fugle. II. Lomfugle, Stormfugle, Vandhøns, Tranefugl og Vadefugle.** Med 70 Afbildninger. — 5 Kr., indb. 6 Kr. 50 Øre.

31. Victor Hansen: **Biller. VII. Bladbiller og Bønnebiller.**
Med 108 Afbildninger. — 7 Kr. 50 Øre, indb. 9 Kr.

32. K. Stephensen: **Storkrebs. II. Ringkrebs. 1. Tanglopper (Amfipode**
Med 93 Afbildninger. — 7 Kr. 50 Øre, indb. 9 Kr.

33. P. Esben-Petersen: **Netvinger og Skorpionfluer.**
Med 90 Afbildninger. — 3 Kr. 50 Øre, indb. 5 Kr.

34. Victor Hansen: **Biller. VIII. Vandkalve og Hvirvlere.**
Med 119 Afbildninger. — 5 Kr. 50 Øre, indb. 7 Kr.

35. Povl Hammer: **Tusindben.**
Med 101 Afbildninger. — 4 Kr. 50 Øre, indb. 6 Kr.

36. Victor Hansen: **Biller. IX. Vandkærer.**
Med 68 Afbildninger. — 3 Kr. 75 Øre, indb. 5 Kr. 25 Øre.

37. J. Maltbæk: **Frynsevinger.**
Med 49 Afbildninger. — 3 Kr. 75 Øre, indb. 5 Kr. 25 Øre.

38. K. Stephensen: **Havedderkopper og Rankefødder.**
Med 51 Afbildninger. — 4 Kr., indb. 5 Kr. 50 Øre.

G. E. C. Gads Forlag - København.

BIANCO LUNO A/S, KØBVN