12. — *The Echinoderm Fauna of South Africa* — By Hubert Lyman Clark. (With Plates VIII—XXIII.)

INTRODUCTION.

Knowledge of the Echinoderm fauna of South Africa has not kept pace either with our zoological knowledge of the region or with our knowledge of echinoderms in general. The literature dealing with it is scanty and scattered and there are vast stretches of coast line where no collector has yet been. During the years preceding the voyage of the *Challenger*, a few echinoderms taken at the Cape of Good Hope came into the hands of zoologists in Europe but prior to 1875, there were scarcely thirty species recorded from the region; with the exception of one comatulid and three or four holothurians, these were about equally divided among the sea-stars, brittle-stars and sea-urchins. The visit of the *Challenger* marks the real beginning of our knowledge of the echinoderm fauna of South Africa. During her stay of seven weeks at Cape Town, her naturalists collected 23 species of echinoderms of which about half were new to science. At stations 141 and 142, just off the Cape, 18 additional species were taken of which half were new. The reports on the echinoderms taken by the *Challenger* are in every case monographic and it is possible to determine from them the species known from the Cape region during the "eighties" including the *Gazelle* collection. We find there were all told some 80 species listed but not all of these were reliable records, so that it is safe to say the number of echinoderms actually known from South Africa at the close of the nineteenth century was not in excess of 75 species. There were about thirty additional species recorded from Mozambique, but many of these were improperly identified and for this, and similar reasons, it is hard to say how many valid species really were known from that Portugese settlement.

The early years of the present century saw a great advance in the collecting and study of the echinoderms of the South African region. The *Valdivia* made a short stay at Cape Town and several of the Antarctic exploring vessels have stopped there. A German expediton collected at Angra Pequena Bay in 1903–05 and also secured material at the Cape. The holothurians of this collection were reported on

by Britten (1910, Schultze's Zool. Anthrop. Erg. Forsch. Südafrika, vol. IV, pt. I, pp. 239–243) but the other echinoderms served for a very important paper by Döderlein, in the same series of reports (1910, pp. 245–258, pls. IV, V). He gives lists of the sea-stars, brittle-stars and sea-urchins recorded from South Africa up to 1910 and including his own new species of which there were three. More detailed reference to these lists will be found beyond (pp. 237, 310 and 366).

In 1897, the Cape Department of Agriculture began an investigation into the marine resources of the colony and accumulated a large amount of very valuable material, a portion of which was finally sent to the British Museum for identification. Bell's reports on the echinoderms appeared during 1904 and 1905 and were a great disappointment to students of the group, they are so brief and summary. Many species whose occurrence at the Cape warranted an interesting discussion are listed with scarcely any comments and even the new species are described very briefly and inadequately. A. H. Clark (1911, Proc. U.S. Nat. Mus., vol. 40, p. 5) has already commented on this unfortunate state of affairs so far as the crinoids are concerned, but the reports on the sea-stars, brittle-stars and sea-urchins are on the same plane. No report on the holothurians was published.

Early in 1916, Dr. Péringuey sent to me the collection of Echinoderms which had accumulated at the South African Museum, subsequent to Bell's reports. With this collection as a basis I have been able to prepare the present report on the Echinoderms of South Africa. I have included not only all the species examined by me but all species recorded by previous writers, unless the validity of the record was so dubious as to warrant its rejection. The collections sent me have been largely made by the Cape Government vessel, the *Pieter Faure*, and include a considerable number of deep-water species, some hauls of the dredge or trawl having been made at depths of 900—1000 fms. These deep-water hauls are of very great interest. Excepting the holothurians the material is in excellent condition. Much of that taken along shore, particularly Mr. K. H. Barnard's collections, has very interesting and valuable data on the labels, with reference to habitat and colour in life.

The area included in this report extends from Mozambique on the east coast around to Mossamedes on the west, and outward to the thousand-fathom line. Of course, the collections hitherto made only represent isolated and widely separated spots in this vast area. Something like four thousand miles of coastline is included but excepting between Cape Town and Durban, there are not half a dozen

places on all this reach of shore where collections of echinoderms have been made. As a matter of fact we know nothing of the western coast of South Africa from Cape Town to Mossamedes, yes even to the mouth of the Congo, excepting only Saldanha Bay and Angra Pequena Bay. It was only at the earnest request of Dr. Péringuey that I consented to include Mozambique, for so far as the echinoderms are concerned that region is distinctly Indo-Pacific and has a very different fauna from that of Natal and Cape Colony. I think this will be clearly shown in the following discussion of the South African fauna.

For the privilege of preparing this report and for the honour done me in entrusting these valuable collections to my care, it gives me pleasure to express my sincere thanks to Dr. Péringuey, who has spared no pains to assist my work in every possible way.

Museum of Comparative Zoölogy,
Cambridge, Mass., U.S.A.
August 1, 1922.

THE ECHINODERM FAUNA OF SOUTH AFRICA.

The collections of the South African Museum entrusted to my charge contained 1854 specimens of echinoderms, representing 157 species. Of these 32 seem to have been hitherto undescribed and one of these represents a new genus (*Spatagobrissus*). It has also seemed desirable to establish a new genus (*Tropholampas*) for the remarkable little sea-urchin called by Studer *Catopygus loveni*, and another genus (*Dictenophiura*) is instituted for a small group of brittle-stars of which *Ophiura carnea* Ltk. is the type.

In addition to the 157 species of the present collection, there are valid records for 59 other species, so that the present report includes 216 species, or more than double the number known from this region twenty years ago. The importance of the work done by the Pieter Faure and the South African Museum during the past twenty years could scarcely be better emphasized than by that simple statement of fact. Of the 216 species treated herein, 118 are strictly littoral, occurring in less than 20 fms. of water, while 23 are abyssal, occurring only beyond the 600 fms., line. The remaining 75 species may be called continental.

Of the 118 littoral species, 45 are endemic and 2 are, if not actually cosmopolitan, of such wide distribution that they may be ignored in considering the origin of the echinoderm fauna. Of the remaining 71 species no fewer than 66, or 93%, are species of the Indo-Pacific region or at least of the western Indian Ocean. Only three seem to have an Atlantic origin and only two are distinctly austral.

Of the 75 continental species, on the other hand, 50 are endemic and 4 are of too wide a distribution for consideration, while of the 21 remaining only 4, or 19%, are of Indo-Pacific affinities, while 10 are austral and 7 are Atlantic Ocean forms. The abyssal fauna is like the continental except that of the 23 species only 5 are endemic. There are 6 of very wide distribution and of the remaining 12, only two, or 17%, are Indo-Pacific, while 2 are austral and 8 are Atlantic.

These figures show at a glance what a highly characteristic fauna

South Africa possesses, but this will be more evident if we first see what the relation is between the Mozambique fauna and that of the Cape. Of the 216 species here listed, 59 occur at Mozambique; of these, 32 or 54% are not known from south of that district and 5 others are not known south of Delagoa Bay, and 12 others either are not known west of Durban or the records for them on the Cape Colony coast are dubious. There are then only 10 species common to the South African coast and to that of the Mozambique region. On the other hand, of the 59 species occurring at Mozambique, 50 occur at Zanzibar or further northward and 5 others are known from some other part of the Indo-Pasific region. Examination of the list of ten species common to Cape Colony and Mozambique shows that one (*Tropiometra carinata*) ranges from Zanzibar, around the Cape of Good Hope to Brazil and the West Indies, and another (*Parechinus angulosus*) is one of the endemic species of the Cape, which apparently has extended its range northward along the coast far enough just to reach the Mozambique region. Still another (*Asterina exigua*) is very common in southeastern Australia and may possibly have reached Mozambique via Cape Colony. The records of the remaining seven species, like *Oreaster mammillatus* and *Ophiocnemis marmorata* are based on single specimens or single instances or on old unreliable Museum specimens, so that there are not more than two or three species of echinoderms which can really be called common to both Cape Colony and Mozambique. As already pointed out 55 of the 59 species listed from Mozambique are characteristic Indo-Pacific species so that there can be no question in what zoögeographical region the Portugese colony belongs.

If we subtract from the 216 species included in this report, the 32 species not known from south of Mozambique, we shall be able to emphazize better the peculiarities of the South African fauna. Of the 184 species of echinoderms known from south of Mozambique, no fewer than 100 or 54% are endemic, certainly a very large number. Not quite half (86) of the species are littoral and 45 of these are endemic, while only 7 seem to belong to some other than the Indo-Pacific fauna. Even the 45 endemic forms as a rule show their affinity to some Indo-Pacific species. The littoral echinoderms of South Africa then seem to have come from the east but with the passage of time have become very largely specifically differentiated. The additions from the west have been so exceptional (*Ophiothrix fragilis* for example) as to be conspicuous.

When we examine the continental and abyssal faunas however we find a striking difference. There are 98 species in this combined

group and of these 55 are endemic, about the same percentage as among the littoral species. But the remaining 43 species show very little Indo-Pacific connection. Only half a dozen are really species of that region, while at least 15 are from the Atlantic and a dozen more are distinctly austral. The remainder are more or less cosmopolitan. When we examine the 55 endemic species we find that their nearest relatives are very largely Atlantic Ocean or West Indian forms or at least they belong in genera occurring in the Atlantic. It seems clear then that the deeper water fauna of the Cape region has not come in from the east but has largely come from the west and north, with the addition of a considerable austral element, the significance of which is not clear.

Examination of a chart showing the ocean currents on the coasts of South Africa suggests that they have been a determining factor in the development of the echinoderm fauna of the region. The warm Agulhas current has brought the shoal water Indo-Pacific fauna clear to the Cape itself but the further south and west this fauna has been carried the more it has become modified until no truly Indo-Pacific species occurs at the Cape itself. The Benguela current flowing northward along the western coast has effectually prevented any influx of northern littoral species from the Atlantic. The few notable exceptions such as *Ophiothrix fragilis* and *Ophioderma leonis* (an endemic species of a West Indian genus) may perhaps be accounted for as the result of artificial introduction, for example on the foul bottom of a sailing vessel. It is worthy of note that the cold winter water at the Cape, westward of the bend in the Agulhas current, has acted as a very effective barrier in preventing any considerable extension of the echinoderm fauna of Natal and southeastern Cape Colony up the west coast. The west coast fauna as revealed by collections at Saldanha Bay and Angra Pequena is a small one made up of about sixteen species, of which only one (*Parechinus angulosus*) is known from east of Algoa Bay.

On the other hand the great surface currents seem to have had little to do with the development of the deeper water fauna, which seems rather to suggest changed continental boundaries. The very evident relation of this fauna to that of the North Atlantic and the West Indies is difficult to account for with the present ocean depths and their boundaries as they are to day. Moreover the distinct and considerable austral element suggests the possibility of former continental lines to the south very different from those of to day. And finally the considerable percentage of widely distributed, if not cosmopolitan, species, such as those occurring in the North Pacific,

indicates the lapse of a long time since this deep water fauna entered the South African region.

Perhaps the conclusion is more sweeping than the facts warrant but the impression left by the study of the South African fauna is that the region south of Delagoa Bay now forms a very distinct zoögeographical region, only superficially connected with the Indo-Pacific region to the north and east, and quite isolated from any other region; that its original echinoderm fauna was common to a large continental area to the northwest in the Atlantic and to the southward; and that its present day littoral fauna has moved in from the northeast under the influence of the Agulhas current, but restricted by the cold winter water from the southeast.

SEA-LILIES. CRINOIDEA.

The crinoids form a very insignificant part of the Echinoderm fauna of South Africa. They were listed in 1915 by Mr. Austin Hobart Clark (Deutsche Süd-Polar Exp.: Zoologie, vol. 8, p. 163) who gives three species as occuring along shore in 0–30 fms. and two species as occuring in deep water, 250–450 fms. The collection of the South African Museum (45 specimens) contains four of these five species and also four species not known hitherto from the South African region. Of these, one is from comparatively shallow water (90 fms.) but the other three were taken by the Pieter Faure only in depths of 900–1000 fms. It is interesting to see therefore that the South African crinoids fall into three groups of three species each, an "abyssal" group of two stalked forms and a five-armed comatulid, a "continental" group of comatulids and a "littoral" group of comatulids.

Of the abyssal group, one (*Monachocrinus coelus*) appears to be a new species of a genus previously known from both the Atlantic and Indian Oceans. A second species (*Bythocrinus chuni*) was hitherto known only from the western part of the Indian Ocean near the Somaliland coast in something over 900 fms. The third species (*Pentametrocrinus varians*) was hitherto known only from the northeastern Indian Ocean, the vicinity of the Philippine Islands and southern Japan, in 361–1050 fms. It is interesting to note that the Valdivia took an as-yet-undescribed species of *Pentametrocrinus* in the same region where *Bythocrinus chuni* was taken, but in slightly shallower water. The Pieter Faure found the two genera at the same station.

Of the three continental comatulids, one (*Liparometra multicirra*) appears to be an undescribed species of a wide-spread East Indian

group, while the other two are also apparently endemic species of East Indian genera.

The three littoral species are of particular interest in connection with questions of geographical distribution. One (*Cominia occidentalis*) is a peculiar, endemic species of a genus known otherwise only from Korea Strait in 170 fms. while a second (*Comanthus wahlbergii*), also endemic, finds its nearest relative in a South Australian species. The third South African littoral comatulid is the wide-ranging *Tropiometra carinata*, which occurs from Zanzibar, the Seychelles and Mauritius, southward around the Cape of Good Hope and thence northwestward to St. Helena, the coast of Brazil and the extreme southeastern West Indies. The genus is otherwise distinctly East Indian.

It is evident therefore that the South African crinoid fauna is essentially East Indian in its relationships and no doubt in its origin also. The only exception is the *Comanthus* which is closely allied to a species known only from southern Australia in shallow water. This clearly hints at a common origin for the two and suggests interesting speculations.

In the following key to South African crinoids, I have used only the simplest and most obvious characters. There are two reasons for this: first, Mr. Austin Hobart Clark, in his most useful work on the Crinoids of the Indian Ocean (1912, Echinoderma of the Indian Museum, pt. 7) has given admirable keys to the families and genera and it is therefore quite superfluous for me to repeat his work; second, the South African species of *Cominia* is so unlike the *Comanthus* that it is not feasible to fit them into the same section of a brief, artificial key and I have therefore ignored their family relationship. Consequently the following key is absolutely artificial and does not give the natural sequence of the species, a sequence which is followed in the subsequent pages. The number of species involved is, however, so small that little inconvenience will result from the inconsistency.

Key to the South African Species of Crinoids.

Stalk present.

Only one or two short discoidal segments at top of stalk, immediately below calyx . . . . . *Bythocrinus chuni.*

More than a dozen short discoidal segments at top of stalk *Monachocrinus coelus.*

Stalk wanting (Comatulids).

Arms 10 or more.

Cirri numerous, 35—40.

Cirrus segments few, 14—18 . . . *Cominia occidentalis.*

Cirrus segments many, 30—36 . . *Liparometra multicirra.*

Cirri not so numerous, 12—30.
Cirrus segments few, 12—20.
Mouth excentric; basal pinnules of arms with terminal comb *Comanthus wahlbergii.*
Mouth central; no terminal combs on pinnules.
Arms 10, more or less compressed; arm-segments beyond middle of arm, short, the distal portion more or less rough and projecting . . . *Tropiometra carinata.*
Arms 10, or more in adults, not compressed; arm-segments beyond middle of arm not short with the distal portion more or less rough and projecting *Pachylometra sclateri.*
Cirrus segments numerous, 60—63 . *Crotalometra magnicirra.*
Arms only five. . . . . *Pentametrocrinus varians.*

BOURGUETICRINIDAE.

Bythocrinus chuni.

Rhizocrinus chuni Döderlein, 1907. Siboga Stalked Crinoids, p. 14, fig. 6; pl. 1, fig. 5.
Rhizocrinus (*Bythocrinus*) *chuni* Döderlein, 1912. Valdivia Stalked Crinoids, p. 14, pl. 3.

The specimens of *Bythocrinus* in the collection all lack the arms, and only two have the calyx still intact. The best has the stalk 47 mm. long and half a millimeter thick at the top: the calyx is 3 mm. high and rather more than 1·5 mm. in diameter at the top. All the specimens are white. They answer so well to Döderlein's description and figures of his specimens from off the Somaliland coast, that, in spite of their imperfect condition, their identity seems sure.

Pieter Faure. 17350. Cape Point. N. 86° E., 43 miles. 900—1000 fms. Gray mud. 4 specimens.

Monachocrinus coelus,* sp. nov.

Plate VIII. Fig. 1.

Fragment of upper part of stem present, not quite 7 mm. long, about ·30 mm. in diameter at broken end, a very little thicker where it joins calyx; it is made up of 29 segments of which the topmost 12 are very low and discoidal, the height about one-fifth or one-sixth the diameter; the next six are discoidal but successively higher; the nineteenth is nearly, and the twentieth quite, as high as thick, and

* κοῖλος = hollowed, in reference to the slightly concave lines of basals and radials.

the remainder are much higher than broad (the 29th is three times as high as thick), smooth and cylindrical.

Basals completely fused into a truncated cone, about half a millimeter high, nearly half a millimeter in diameter, where it joins the radials, and about one-third of a millimeter where it joins the stem. Seen from the side, the lateral margins of this cone are distinctly though very slightly concave.

Radials 5, about ·75 mm. high: the upper (distal) diameter of the cup they form is one millimeter. Seen from the side, the lateral margins of this cup are distinctly though slightly concave.

I Br_1 about 1·10 mm. long and ·85 mm. wide, very little wider distally than proximally. The lateral margins are very slightly thinned and flaring. The median line is not at all carinate but is barely elevated on the distal two-thirds of the plate.

I Br_2, the axillary, is remarkably low and wide: it measures about ·85 mm. in width, but is only about ·60 mm. high, even in the median line where it is slightly higher than at the sides. The lateral portions are flat, in contrast to the middle, but are hardly flaring.

The brachials are about twenty in number; the lowest is about ·40 mm. wide where it joins the axillary but is only about ·35 mm. at the distal end, and that is the approximate width of the following segments. The brachials are arranged in pairs, ·75–·80 mm. long, the total length of the arms, from axillary to tip being about 8 mm. The latero-distal margin of the distal brachial of each pair is slightly projecting and overlapping, first on the outer side of the arm (second brachial), then on the inner (fourth), and thus in regular alternation, but the projection is much too slight to give the arm a serrate or even a rough appearance.

Colour, nearly white.

P.F. 17350. Cape Point N. 86° E., 43 miles. 900–1000 fms. Gray mud. 1 specimen only. Holotype South African Museum, no. A 6434.

This is a most interesting little crinoid, clearly a *Monachocrinus*, but differing from all the previously known members of the genus in the very wide, low axillaries, and in the slightly concave radials and basals. These two characters taken in connection with the large number of discoidal columnars and the structure of the arms, make the species easily recognizable. As the genus is known from both the Atlantic and Indian Oceans, its occurrence off South Africa is quite natural.

COMASTERIDAE.

Cominia occidentalis.

A. H. Clark, 1915. Deutsche Süd-Polar Exp.: Zool., vol. 8, p. 164; pl. 10.

This little comatulid is a most perplexing form, for while the general appearance is quite like a comasterid, the central mouth and excentric anal tube combined with the absence of terminal combs on the basal pinnules completely conceal the family relationship. Mr. Clark in his original description says: "Die Zähne des Endkammes sind so wenig entwickelt dass sie bei gewöhnlicher Untersuchung nicht auffallen." I have failed to detect the combs even with the aid of a magnification of 70 diameters, in either alcoholic or dry material. It is true that with high magnification, on dry pinnules an uneven margin can be found at the tip, but it is not enough to consider even as a rudimentary comb. In view of this absence of combs and the central position of the mouth, it is hard to see why this species should be considered one of the *Comasteridae* but in deference to Mr. A.H. Clark's much wider experience and greater knowledge of the group, I leave it where he has placed it.

Some of the Pieter Faure specimens are a little larger than those of the Gauss and there are some trivial differences. The cirri are about XL, 16–18, and the longer ones measure 12–15 mm. The dorsal interradial perisome has calcareous plates more or less abundant but it is not "heavily plated". The three lower pairs of pinnules are approximately equal. Genital glands occur out as far as the twentieth pinnule. The color is yellow-brown with no trace of olive.

The Gauss specimens were taken in False Bay (west side, Simon's Bay) while those of the Pieter Faure, it is interesting to note, were collected well up on the Atlantic coast of Cape Colony,

P.F. 14905. Saldanha Bay, Cape Colony, 10–14 fms. Sand and mussel-beds. 16 specimens.

Comanthus wahlbergii.

Plate VIII. Fig. 3.

Alecto wahlbergii J. Müller, 1843. Arch. f. Naturg., Jahrg. 9, vol. 1, p. 131.
Comanthus wahlbergii A. H. Clark, 1911. Proc. U.S. Nat. Mus., vol. 40, p. 17.
Actinometra parvicirra Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 141.

It is interesting to note, although the fact may not be of any significance, that the distribution of this characteristically South

African species is from Simon's Bay, eastward to the Tugela River, Natal, while the preceding species seems to range rather from Simon's Bay westward and northward. This apparent difference of distribution may however be quite unreal and due only to our present ignorance.

P.F. 18282. Simon's Bay, False Bay, Cape Colony, 8–10 fms Rocks. 3 specimens.

MARIAMETRIDAE.

Liparometra multicirra,* sp. nov.

Plate VIII. Fig. 2.

Disk about 23 mm. across, very deeply incised: arms about 85 mm. long but they are not quite equal and some scarcely exceed 75 mm. Disk membrane full of crowded, small, calcareous plates. Centro-dorsal large, thick, dorsally flat or a little concave, 6 mm. in diameter; bare dorsal area, nearly 4 mm. across. Cirri XLIII, 30–36, cylindrical at base, but compressed distally; the segments 7–10 have the length about equal to or even a little exceeding the diameter, but elsewhere the greatest diameter exceeds the length; beginning usually with the tenth or eleventh segment, but on some cirri further out, there is a median, dorsal elevation, at first rather blunt but soon with a short compressed tip or even a sharp point; on the last segment this becomes an opposing claw as long as half the diameter of the segment; terminal claw longer than last segment, very sharp.

Arms about 50, all but two broken and detached from disk at or near base; arm-segments numerous, exceeding 150, the distal ones being quite short. Division series all 2, well-separated, rounded and smooth. First syzygy between brachials 3 and 4 of the free arm; second syzygy far out, usually after an interval of more than 20 segments and often 30–40, rarely before segment 20; subsequent syzygies few and at very wide intervals. Low and relatively inconspicuous synarthrial tubercles occur on all the division series.

Lower pinnules not noticeably larger on outer side of arm than on inner. P_1 (P_a similar) about 9–10 mm. long, consisting of 17–21 segments, all but the basal three longer than wide and all but the basal five or six, cylindrical. P_2 and P_b very similar but noticeably larger, 12–13 mm. long, with 24–26 segments. P_3 and P_c similar to P_2 and approximately equal, or a little smaller and with 1–3 fewer segments. P_1 and P_d distinctly smaller, about equal to P_1.

* *Multicirrus* = having many cirri.

Succeeding pinnules somewhat smaller, about 7 mm. long. All the basal pinnules are moderately stout at base but taper to a slightly flagellate tip, which is not however very slender.

Colour, pale fawn with the oral surface of disk and arms very dark brown, almost black; margins of food grooves on disk, black.

P.F. 12157. Durnford Point, Zululand, N.W. ¾ W., 12 miles. 90 fms. Broken shells. 1 specimen. Holotype, South African Museum, No. A 6435.

It is with no little hesitation that I put this fine new comatulid in the genus *Liparometra*, but as P_2 and P_3 are of approximately equal size, it seems to me clear that it cannot be placed in either *Dichrometra* or *Lamprometra*, as those genera are diagnosed by their founder, Mr. Austin H. Clark. I am somewhat inclined to question the desirability of recognizing these three very closely allied genera, but here again I must defer to the much wider experience of my friend. The present species is, I think, quite distinct from any previously known form, as the large number of arms and cirri, with their numerous segments, are quite characteristic. The few and widely spaced syzygies is also a noticeable feature.

TROPIOMETRIDAE.

Tropiometra carinata.

Comatula carinata, Lamarck, 1816, Anim. s. Vert., vol. 2, p. 534.
Tropiometra carinata, A. H. Clark, 1907. Smithson. Misc. Coll., vol. 50, p. 349.
Antedon capensis, Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 139; pl. 2.

The distribution of this species is of considerable interest. It ranges from the Seychelles, Réunion, Mauritius and Zanzibar southward to the Cape of Good Hope and thence northwestward to St. Helena, Brazil and the southernmost West Indies. It is true that Mr. A. H. Clark considers the specimens from the latter regions specifically distinct from those taken on the east coast of Africa, but a prolonged comparison of specimens from Tobago, B. W. I., with individuals of the same size from Zanzibar has satisfied me that the supposed differences do not exist.

The specimens from the South African Museum are not notable, except that the smallest (12405–c) has the arms only 20 mm. long, and, like specimens from Tobago of a similar age, the colors are pale yellow and pink-purple.

Mozambique: low tide. Nov. 1912. K. H. Barnard coll. 2 specimens.

Delagoa Bay. Portugese East Africa. Oct. 1912. K. H. Barnard coll. 1 specimen.

P.F. 12405–c. Itongazi River, Natal, N.W. ¾ W., 3 miles. 25 fms. Sand and stones. 1 young specimen.

THALASSOMETRIDAE.

* Crotalometra magnicirra.

Antedon magnicirra, Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 141; pl. 4.
Crotalometra magnicirra, A. H. Clark, 1909. Proc. Biol. Soc. Washington, vol. 22, p. 80.

This species is not now in the South African Museum, the original specimens having apparently all been retained at the British Museum. It was taken in 300–450 fms., 15–20 miles off the coast of Cape Colony, near East London.

Pachylometra sclateri.

Antedon sclateri, Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 140; pl. 3.
Pachylometra sclateri, A. H. Clark, 1909. Proc. Biol. Soc. Washington, vol. 22, p. 21.

This characteristic species is represented in the present collection by an armless adult specimen and a number of quite young individuals. The latter were rather puzzling owing to the small centrodorsal and the relatively long I Br series, and the presence in every case of just ten arms. On the other hand, the cirri are essentially like those of the adult (XV–XVI, 15–17) and the I Br series and lower brachials are distinctly wall-sided and in close apposition. The radials are conspicuous, the height being equal to half the breadth, while in the adult specimen they are not only completely concealed but even I Br_1 is barely visible. The adult specimen has the calyx about 12 mm. in diameter and the cirri 18–20 mm. long, while the young ones are only 2 mm. in diameter through calyx and the cirri are but 4–6 mm. long. It is to be regretted that the condition of the adult does not permit of a full description for Bell's account is utterly inadequate. In the young specimens, P_1 is stiff, erect with 7 segments and P_a is similar. P_2 is a little longer, with 9 segments; P_b, the same. P_3 (and P_c) is a little longer, with 11 segments and is more flagellate at the tip. Subsequent pinnules are shorter.

P.F. 12872. East London, Cape Colony, N. 15 miles. 310 fms. Mud. 1 adult specimen, with arms all broken off.

* Those species marked with an asterisk are not represented in the South African Museum collections.

P.F. 12884. East London, Cape Colony, N. 15 miles. 310 fms. Mud. 1 young specimen.

P.F. 13227. Cove Rock, near East London, N.W. $^3/_4$ W., 13 miles. 80–130 fms. Coral rock. 13 young specimens.

PENTAMETROCRINIDAE.

Pentametrocrinus varians.

Endiocrinus varians, P. H. Carpenter, 1882. Jour. Linn. Soc., Zool., vol. 16, p. 496. 1888, Challenger Comatulae, pl. VIII, figs. 3–7.
Pentametrocrinus varians, A. H. Clark, 1908. Proc. Biol. Soc. Washington, vol. 21, p. 135.

Although this specimen lacks cirri and has all the arms broken, it is so similar to specimens of *varians* from southern Japan, with which I have compared it, that I do not doubt it belongs to that species. The nearest point to South Africa at which the species has previously been taken is near the Andaman Islands in the north-eastern Indian Ocean.

P.F. 17351. Cape Point, N. 86° E., 43 miles. 900–1000 fms. Grey mud. 1 specimen.

SEA-STARS. ASTEROIDEA.*

The sea-stars form a very large and important part of the South African Echinoderm fauna. They were listed in 1910 by Döderlein (Schultze's Zool. Anthrop. Ergeb. Forschungsr. Südafrica, vol. 1, pt. 1, p. 246) but he did not include species occurring only at depths over 278 fms. (500 m.) nor did he extend the South African region to include Mozambique. His list includes 30 species, but two are synonymous (*Astropecten capensis* and *pontoporaeus*) and one (i. e. Sladen's record of *Asterina gunnii*) is probably due to a mistaken identification or a misplaced label. The collection sent me from the South African Museum contains 51 species but of these only 14 are in Döderlein's list. There are however 9 additional species previously recorded from Mozambique or from deep water off South Africa and hence not listed by Döderlein which fall within the scope of the present report, which thus includes 74 species; 18 seem to be new to science and are here described for the first time.

* After this section was ready for the press I had the pleasure of a visit from Dr. W. K. Fisher, the well-known authority on sea-stars, who very kindly examined many of the specimens and permitted me to profit by his wide knowledge and sound judgement. For this help I beg to offer him herewith my best thanks.

Of these 74, 35 are truly littoral occurring in water less than twenty fathoms deep, while 9 are strictly abyssal, occurring only in depths beyond 600 fms. The remaining 30 species may be classed as continental.

Of the 35 littoral species, 13 are endemic so far as our present knowledge goes; as 10 of these have been known for a considerable time and have not yet been reported from elsewhere, it is probable that they are truly characteristic forms. Of the remaining 22, 18 are East Indian or Indian Ocean species, of which 15 were previosuly known from the east coast of Africa, north of Mozambique. There are two littoral species (*Asterina calcarata*, *Henricia ornata*) which occur on the shores of the southern end of South America, but both these cases require further investigation; each belongs in a genus in which specific limits are ill-defined. There are also two littoral species known from the coasts of southern Australasia; one of these (*Coscinasterias calamaria*) is a well-defined species and its occurrence at Mauritius has long been known; it is unquestionably a valid link between the littoral faunas of Australasia and Africa; the other species however is the dubious *Henricia ornata*, a name under which several species are perhaps involved. Of the two remaining South African littoral species, one is the rare and little known *Culcita veneris*, originally from St. Pauls Island, southern Indian Ocean, and since recorded by Bell only, from Cape Colony; the other is the northern starfish, *Marthasterias glacialis*, whose occurrence at the Cape no longer admits of doubt. It is of importance to note that 12 of the littoral seastars here listed as South African, are not known from south of Mozambique and there are two or three others whose occurrence south of that point is known from only a single record.

Of the 30 Continental species, 20 appear to be endemic, but 12 of these are here described as new and may later be found elsewhere. Nevertheless the Continental fauna is very characteristic for in addition to the endemic forms, three are known only from the Kerguelen region. There are three species hitherto known from the Atlantic, two from the East Indian region and one from Australia. The thirtieth, one of the most remarkable members of the Continental fauna is *Ceramaster patagonicus*, which occurs not only in South American waters but along the Pacific coast of North America to the region of the Commander Islands in Bering Sea. One of the Atlantic members of this fauna (*Diplopteraster multipes*) has an equally remarkable range, as it occurs in the North Atlantic from about 35° North to Barents Sea and Norway and in the North Pacific

from San Diego, California, and Suruga Gulf, Japan, to Bering Sea.

Of the 9 abyssal species occurring in the present list, only 3 are endemic, while 5 are already known from the deep waters of the Atlantic and one is Antarctic. The endemic species are all new to science. It is of interest to note that none of the abyssal species seems to have come from the east, whereas the littoral fauna has nearly all come from the Indian Ocean.

In conclusion then, we may say that so far as our present knowledge goes the sea-star fauna of South Africa is highly characteristic. Nearly half (36) of the species are endemic and several others occur only in the region of Kerguelen or St. Pauls Island. Of the non-endemic forms, 20 are from the Indo-Pacific region and 10 from the Atlantic, while the remainder are Australian or South American. The affinities of the littoral fauna are distinctly Indo-Pacific, but if the tropical species, not known from south of Mozambique, are left out of account, it is evident that most of the littoral starfishes of South Africa have become specifically differentiated. On the other hand the continental and abyssal faunas, while perhaps equally well differentiated and as characteristic, have slight East Indian but rather strong Atlantic affinities. The impression made by the study of the South African sea-stars is that the shallow-water forms are of Indian origin and the deeper-water forms are from the Atlantic.

There is very little evidence of an Australian or South American influence in the composition of the fauna. It is true that *Coscinasterias calamaria* is a characteristic Australian species, but it seems to be very rare in South African waters. As already stated no reliance can be placed on evidence offered by such forms as *Henricia ornata* and *Asterina calcarata*. The occurrence of the characteristically Antarctic genus *Cryaster* in Algoa Bay is worthy of more than passing notice, since the entire family is otherwise unknown outside of the Antarctic region.

The 74 species included in this report belong to no fewer than 16 families. They can be most easily recognized if these families are first differentiated from each other. Under each family will be found the necessary key to the species included in it, which occur in South African waters.

Key to the South African Families of Asteroidea.

Marginal plates large, defining the contour of the body; abactinal skeleton never reticulate or imbricated but made up of plates, which often bear paxillae or granule-bearing tabulae.

Cribriform organs * present in each interradius . . *Porcellanasteridae.*
No cribriform organs.
Marginal plates very spiny, more or less alternate; papulae restricted to special areas at base of rays . . . . *Benthopectinidae.*
Marginal plates opposite; papulae not restricted to special areas at base of rays.
Abactinal surface covered with paxillae.
Superomarginal plates well developed . *Astropectinidae.*
Superomarginal plates aborted . . . *Luidiidae.*
Abactinal surface not covered with paxillae.
Disk large with big actinal interradial areas, but no actinal papulae.
Marginal plates large and conspicuous; disk more or less flat; papulae single or a few together *Goniasteridae.*
Marginale plates not conspicuous; disk elevated or at least very thick; papulae numerous in large groups.
Marginal plates large; abactinal skeleton more or less conspicuous. . . . . *Oreasteridae.*
Marginal plates small and with abactinal skeleton covered and concealed by a thick skin . . *Poraniidae.*
Disk small with very small actinal interradial areas, or if the latter are well developed there are actinal papulae; marginal plates small; tegumentary developments, granulate (rarely wanting) *Ophidiasteridae.*

Marginal plates small or wanting; abactinal skeleton more or less imbricated or reticulate.
Disk not circular and sharply set off from long, more or less terete, and readily detachable arms; marginal plates small but regularly present (except Cryasteridae).
Pedicellariae rare or wanting, never pedunculate forcipiform; ambulacral ossicles rarely crowded; pedicels usually in two series.
Oral plates rather small, not shovel- or plowshare-shaped; ambulacral furrows narrow.
Marginal plates conspicuous; actinal plates regularly radiatingly arranged . . . . . *Ganeriidae.*
Marginal plates quite inconspicuous.
Abactinal skeleton formed of closely imbricated plates, bearing very small spinelets . . . . *Asterinidae.*
Abactinal skeleton not imbricate.
Abactinal skeleton more or less reticulate *Echinasteridae.*
Abactinal skeleton entirely aborted *Cryasteridae.*
Oral plates big and shovel- or plowshare-shaped; ambulacral furrows wide.
Abactinal skeleton with paxillae or pseudopaxillae, not concealed by a supradorsal membrane . . . *Solasteridae.*

* Technical terms used in this or subsequent keys are fully explained and illustrated in Sladen's CHALLENGER report (1889) or in Fisher's North Pacific Asteroids (Bull. 76 U. S. Nat. Mus, 1911).

Abactinal skeleton with paxillae concealed, more or less, under a remarkable supradorsal membrane . . . *Pterasteridae.*
Pedicellariae abundant, especially forcipiform; ambulacral ossicles crowded; pedicels in four series . . . . . *Asteriidae.*
Disk circular sharply set off from the long, more or less terete and readily detachable arms; marginal plates microscopic or wanting . *Brisingidae.*

PORCELLANASTERIDAE.

This deep water family is represented in the South African region by only a single species.

Porcellanaster caeruleus.

Wyville Thomson, 1877. Voy. Challenger: Atlantic, vol 1, p. 378; figs. 97, 98.

The specimens are all small, with R = 7–9 mm. They are too young to make their specific identity certain but comparison with somewhat larger specimens of *caeruleus*, taken by the Challenger and the Blake, indicates that they are immature examples of that species. The only noteworthy differences are the absence of spines on the superomarginal plates and the incomplete calcification of the interbrachial areas below. Both these however are easily accounted for as evidence of immaturity. On account of the locality, it would be natural to refer these specimens to *P. eremicus* Sladen but I am myself satisfied that the specimen on which that species is based, is a young *caeruleus*.

P.F. 16905. Cape Point, N.E. by E. ¼ E., 40 miles. 800–900 fms. Green mud. 1 specimen; young.

P.F. 17351. Cape Point, N. 83° E., 43 miles. 900–1000 fms. Gray mud. 3 specimens; young.

BENTHOPECTINIDAE.

This family of deep-water starfishes was not known from the South African region hitherto, but the Pieter Faure has found two species, each representing an interesting genus. One of these forms was known only from near Kerguelen while the other is a widely distributed Atlantic species. They may be separated from each other by the characters given in the following key, but it is evident that each is somewhat variable and does not conform exactly to a strict specific description.

Key to the South African Species of Benthopectinidae.

Papularium a small, circular elevated area; one large spine on actinal surface of adambulacrals. . . . . *Pectinaster filholi.*

Papularium V-shaped; three large spines on actinal surface of each adambulacral . . . . . *Luidiaster hirsutus.*

PECTINASTER FILHOLI.

Perrier, 1885. Ann. Sci. Nat. (6), vol. 19, no. 8, p. 71.
Sladen, 1889, CHALLENGER Ast., pl. 8, figs. 3, 4 (as *forcipatus*).

The South African specimens show slight, but obvious differences from a *cotype* of *filholi* with which I have compared them, but agree very closely with a cotype and other specimens, from the northwestern Atlantic, of Sladen's *Pontaster forcipatus*. From the geographical point of view they would naturally, and I think correctly be referred to Sladen's variety *echinata* (*sic*) but Ludwig considers *forcipatus* a synonym of *filholi* and after a comparative study of the material in the M. C. Z., I believe he is right. The species has a wide range from near Nova Scotia in the northwest to the vicinity of Marion Island in the southeast, but it is always an abyssal form, ranging from 699 fms. down to 1700. The specimens taken by the PIETER FAURE are of varied size, the smallest having R = 8 mm. and $r = 2$ (R = 4r), while the largest has R = 59 mm. and $r = 11$ (R = 5·4r); the body form is thus assumed very early in life. In spinulation, the smallest specimen is surprisingly like the largest, the only difference of importance being the presence, in the adult, of *two* spines on many inferomarginal plates. The youngster has only a very minute madreporite, scarcely distinguishable, and the papularia are each represented by a single pore, or two, but in the largest specimen there are only 10–12 pores in each papularium. The number and distribution of the pedicellariae shows great diversity in this species; in the PIETER FAURE specimens they are rather numerous but are confined to the actinal surface.

P.F. 16902. Cape Point, N.E. by E. 1/4 E., 40 miles. 800–900 fms. Gr. m. 3 specimens; young.

P.F. 16905. Same station. 1 specimen; very young.

P.F. 17332. Cape Point, N. 86° E., 43 miles. 900–1000 fms. Gray m. 6 specimens; adult and young.

P.F. 17351. Same station. 1 specimen; young.

LUIDIASTER HIRSUTUS.

Studer, 1884. GAZELLE Ast., p. 47; pl. 4, figs. 7*a–d*.

This species was originally found northwest of Kerguelen, on sandy bottom, in 130 fms. of water. Its occurrence in South African waters is thus of much interest, though not surprising. The individuals before me show a range in size from R = 20 mm. to R = 65 mm. but the growth changes are trivial between these two extremes. In the largest specimen, there are not infrequently 3 large spines on the actinal surface of the adambulacral plates and there are 2 large inframarginal spines. It is remarkable that Ludwig in his otherwise useful key to the species of *Luidiaster* (1910. Sitz. K. Preus. Acad. Wiss. Berlin, p. 453) says of *hirsutus* "untere Randplatten mit einem Stachel", when Studer distinctly says they bear two long spines. Even in the smallest specimen at hand, there are two such spines on the basal inferomarginals.

P.F. 18904. 36° 40′ S × 21° 26′ E, 200 fms. Gr. s. 3 young specimens.

P.F. 18913. Same station. 2 adult specimens.

ASTROPECTINIDAE.

This family is represented in South African waters by 10 species, most of which are however continental rather than truly littoral forms. One, apparently new species, is distinctly abyssal. They may be distinguished from each other as follows:

Key to the South African Species of Astropectinidae.

No specialized spines or spinelets on either series of marginal plates
Leptychaster kerguelenensis.

More or less conspicuous spines or spinelets on inferomarginals and often on superomarginals as well.

Actinal interradial areas more or less extensive; madreporic body hidden by paxillae on its surface.

Inferomarginals, and often superomarginals also, with single large spinelets.

No large spine on actinal surface of adambulacral plates
Plutonaster intermedius.

A large erect spine on actinal surface of each adambulacral plate, at least distally . . . . . *Plutonaster proteus.*

Inferomarginals with a few insignificant spinelets on each, none on superomarginals . . . . . *Dipsacaster sladeni.*

Actinal interradial areas small; madreporic body small not hidden by paxillae on its surface.

Marginal plates, especially inferior, more or less vertical, at least at base of ray, the vertical height of ray at base being approximately equal to combined height of both series of marginals.

Papillae of marginal plates squamiform, and spinelets short and very flat . . . . . *Bathybiaster robustus.*
Papillae of marginal plates not at all squamiform; spinelets of inferomarginals slender and rather long . . . *Psilaster acuminatus.*
Marginal plates, at least inferior, oblique or nearly horizonal; vertical height of ray at base not remarkable.
Large sharp spines present on superomarginals *Astropecten polyacanthus.*
Spines on superomarginals small or wanting.
Small spinelets on at least some superomarginals.
R = 2·5—3·5 *r*; radial paxillar areas much wider than combined marginal plate series . *Astropecten pontoporaeus.*
R = 4—5 *r*; radial paxillar areas narrower than combined marginal series . . . *Astropecten hemprichii.*
No superomarginal spinelets . *Astropecten granulatus.*

* Leptychaster kerguelenensis.

E.A. Smith, 1876. Ann. Mag. Nat. Hist. (4), vol. 17, p. 110. Sladen, 1889. Challenger Ast., pl. 31, figs. 1, 2.

Although Bell (1905, Mar. Inv. South Africa, vol. 3, p. 242) records this starfish from three stations, there are now no specimens in the South African Museum, and I include it here solely on the strength of Bell's identification.

Plutonaster intermedius.

Goniopecten intermedius Perrier, 1881. Bull. M. C. Z., vol. 9, p. 25. 1884, Blake Ast. pl. 7, figs. 1, 2.
Plutonaster intermedius Perrier, 1894. Trav. et Tal. Ast., p. 316.

Comparison of the South African specimens with others from off the east coast of the United States fails to reveal any differences worthy of note. The African specimens are adult, the greater radius being 53–75 mm.

P.F. 17394. Cape Point E. ½ N., 34 miles. 500–550 fms. Green mud. 1 specimen; adult

P.F. 18110. Cape Point N. E. ¼ N., 46 miles. 760 fms. Green mud. 1 specimen; adult.

Plutonaster proteus * sp. nov.
Plate XIII. Figs. 3–7.

R = 58 mm.; *r* = 14·5 mm.; R = 4 *r*. Br = 14·5 mm. R = 4 *br*. Disk moderately large, rather flat; rays narrow, flat, tapering, at

* *Πρωτεύς* = Proteus, in reference to the remarkable change in appearance during growth.

first very slightly, but distally more abruptly, to a somewhat blunt tip. Disk and rays, within area bounded by superomarginal plates, covered by numerous low, rounded pseudopaxillae, each ·10–·25 mm. in diameter, the height, little, if any, greater; each carries about ten (6–16) short slender spinelets, some of which form a slightly radiating marginal circle; these are rather longer than those within it and the latter may be scarcely more than rounded granules; the pseudopaxillae show no regular arrangement. Papulae small, single, numerous. Madreporic body large, nearly 4 mm. across, concealed under some 14 pseudopaxillae of varied size; the outer margin of the madreporite is less than 3 mm. from the inner margin of the superomarginal plates. The latter are 29 in number on each side of the ray; interradially they are nearly square but conspicuously swollen or elevated at center; distally they soon become longer than wide and less swollen and on the distal half of the arm they are scarcely swollen at all but are evidently wider than long; each plate bears a single large spinelet, which is, in the interradial regions, 1 mm. high and basally ·5 mm. in diameter and occupies the center of the plate but becomes smaller and smaller distally and is placed more and more near the outer (lower) edge of the plate; on most of the proximal plates a second, but much smaller spinelet occurs on the inner (upper) margin of the plate; the rest of the surface of each superomarginal is covered by a fairly uniform but well-spaced coat of low spinelets or spiniform granules, longest and most numerous along the lateral margins of the plates. Terminal plate moderately large; it has all its spinelets rubbed off in the only instance where the plate itself is not missing.

Inferomarginals almost exactly like the superomarginals in all particulars, except that the large spinelets are rather longer, and the second spinelet on the inner edge of the interradial plates is larger and so is quite conspicuous. The two series of marginal plates form a vertical wall for each side of the ray, about equally in evidence above and below; the fasciolar channels between the plates are moderately developed more particularly in the interradii. Actinal intermediate plates wanting at tip of ray and indeed on the entire distal half; the first one adjoins the sixth inferomarginal (counting from interradial line) and there are rather more than a dozen, lying next to the adambulacrals, between that point and the oral plate: a second series begins at the fourth marginal and contains nine or ten plates; some 25–30 smaller plates fill up, more or less irregularly, the remainder of the notably small actinal interradial area; all the intermediate plates are covered, but not very thickly, with

short, well-spaced, rough spinules; a few of these are enlarged here and there into short, thick spinelets and rarely a little group make up a pedicellaria of a rudimentary sort.

Adambulacrals about 37 on each side of the furrow; except the first two or three and the distalmost half dozen, they are longer than wide; furrow-margin of each plate with about 8 conspicuous spinelets, the middle ones 1·5 mm. long, the adoral one shortest; outside this series, on the actinal surface of the plate, near its distal margin, is a single large spinelet, nearly equal to those on the marginal plates; the rest of the surface of each adambulacral plate is sparsely covered by spinelets like those on the actinal intermediate plates. Oral plates rather large, swollen; each bears a marginal series of a dozen spinelets, of which the first (inner) two are the largest (about 2 mm. long), the others being gradually smaller; surface of plate rather thickly covered with spinelets, of which those near the interradial margin are largest, particularly those at inner end of plate. Color, dull brownish-yellow, in the present condition, dried from alcohol.

Cutting through and laying back the skin of one ray reveals large double ampullae, the complete absence of dorsal muscle bands, and the genital glands confined to the interradial regions. Seen from within the plates of the dorsal skeleton are circular and isolated, but seemingly more crowded along the sides of the ray.

P.F. 16743. Cape Point, N.E. by E. $^1/_4$ E., 38 miles. 755 fms. Gr. m. 1 specimen; adult.

P.F. 16902. Cape Point, N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gr. m. 5 specimens; young.

P.F. 16931. Same station. 1 specimen; adult.

P.F. 16944. Same station. 4 specimens; young.

P.F. 17351. Cape Point, N. 86° E., 43 miles. 900–1000 fms. Grey m. 2 specimens; young.

Holotype, South African Museum no. A 6427, P.F. 16931.

This species is undoubtedly near to *P. bifrons* (Wyv. Th.) but it is at once distinguished from that species by the absence of large spinelets on the actinal interradial areas and the presence of a second series of spines on both sets of marginal plates in the interradii. Another very marked difference is that in very young *bifrons*, the infero marginal spines are well developed while in much larger specimens of *proteus*, they are lacking or just beginning to appear.

The series before me affords opportunity for a very interesting study of growth changes which are of more than ordinary interest

in this species. The smallest specimen (R = 6 mm.) has R = 1·5 *r* and is thus somewhat pentagonal with deeply concave sides: the pseudopaxillae are similar to those of the adult and the madreporite is completely concealed; there are 8 marginal plates in each series, on each side of a ray and they are quite uniformly covered with minute rough spinules; the actinal interradial plates are few and covered like the marginals. In two particulars this youngster is quite different from the adult; the large spines and spinelets of the adambulacral and marginal plates are wanting and there are distinct, though simple, pedicellariae on the abactinal surface and between the marginal plates, as well as actinally. On the most interradial of the inferomarginals, one spinule is distinctly larger than the others and may be considered the first indication of the spine, later so prominent. The terminal plate of each ray is relatively very large; on each side of the tip, near the oral surface is a large spinelet and back of this (orally) are two smaller spinelets.

The next larger specimens have R = 7·5 mm., *r* = 3·5; hence R = 2·1 *r*. The spinulation of these individuals is exactly like that of the smallest, except that on some of the distal adambulacral plates, one of the actinal spinelets is noticeably bigger than the others; pedicellariae are very noticeable, especially among the marginal plates. A specimen with R = 10 mm. is not essentially different in any way. A specimen with R = 12·5 mm. and *r* = 4·5 mm. (R = 2·75 *r*) has the large spinelet indicated on most of the inferomarginal plates, quite distinct on nearly all the adambulacrals, and evident on the interradial superomarginals; there are no pedicellariae except on the actinal interradial areas. A specimen from the same station as this one, with R = 13 mm. and *r* = 5·5 mm. (R = 2·37 *r*) has distinctly wider rays and there are many pedicellariae, chiefly of two spinelets, all over the abactinal surface; large spinelets are indicated only on the interradial inferomarginals and doubtfully on a few distal adambulacrals. The largest of the young individuals, from the same station as the holotype, has R = 19 mm. and *r* = 7; R = 2·7 *r*; there are no pedicellariae, the large spinelets of the inferomarginals are conspicuous while those of the superomarginals are evident; the proximal adambulacrals show no large actinal spinelet but on all of those on the distal half of the arm it is perfectly distinct. The adult specimen from 16743 has R = 48 mm., *r* = 14 and hence R = 3·5 *r* but in only one other particular does it show any notable difference from the holotype; there is no second large spinelet on any marginal plate.

To sum up the growth changes of this species then we may say

that it changes from a nearly pentagonal form, uniformly covered with pseudopaxillae and minute rough spinules, with no large spinelets whatever, into a stellate form with moderately long rays, having conspicuous spinelets on all adambulacral and marginal plates. During this change pedicellariae are wholly lost, at least abactinally. It is worthy of special note that the large spinelet of the adambulacral plates appears first on the *distal* part of the ray and occurs proximally only after the individual is half grown. The second set of spinelets on the marginal plates appears only in what is apparently the fully grown individual.

Dipsacaster sladeni.

Alcock, 1893. Ann. Mag. Nat. Hist. (6), vol. 11, p. 87; pl. 5, figs. 3, 4.

These specimens answer so well to Alcock's description that I feel satisfied they should be referred to *sladeni*, but in two particulars they are different: the pedicels of the paxillae are certainly not "long, slender", as I understand those terms, and the adambulacral spines are not what I should call "needle-like". Such terms ought not however to be construed too rigidly. The adambulacral armature of the South African specimens is almost exactly like that of *laetmophilus* Fisher, and the only point in Fisher's description to which the present specimens do not answer is the covering of the inferomarginal plates, in describing which Fisher uses the word "squamiform". There is nothing "squamiform" in the spinelets covering the inferomarginals of the African specimens. Comparison of Fisher's description and figures of *laetmophilus* with Alcock's of *sladeni* certainly suggests the identity of the two, but oddly enough Fisher makes no reference whatever to *sladeni*.*

The present series reveals some very interesting growth changes in this starfish. The smallest specimens have R = 15 mm, and $r = 7$, while the rays are nearly 10 mm. across at their very base; thus R = $2r$ and about $1{\cdot}5\,br$. A somewhat larger specimen has R = 26 mm., $r = 11$ and $br = 13$: thus R = $2{\cdot}36\,r$ and $2\,br$. The next larger specimen has R = 45 mm., $r = 17$ and $br = 18$; thus

* After critical examination of the South African specimens of *sladeni*, Fisher finds at least half a dozen differences between them and *laetmophilus*. Of these the most obvious, if not the most important, is in the spinelets of the inferomarginals, which are distinctly *squamiform* in the Alaskan species and *spiculiform* in the African. Other important differences are to be found in the form of the inferomarginals, in the plates and fasciolar channels of the actinal intermediate areas, and in the mouth plates. The two species, although nearly allied, seem to be perfectly distinct.

R = 2·65 *r* and 2·5 *br*. In the largest specimen, R = 78 mm., *r* = 26 and *br* = 28; thus R = 3 *r* and 2·78 *br*. It is thus obvious that the larger the specimen of this species, the longer and proportionately narrower are the rays. The number of superomarginal plates on each side of a ray in these four specimens is 16, 22, 28 and 39 respectively. The number of marginals is relatively greater therefore in proportion to the length of the ray in young specimens than in adults; thus, while the length of ray increases five times the number of marginals is increased only two and a half times. It will be noticed that the largest African specimen has several more superomarginal plates than much larger specimens of *sladeni* and *laetmophilus*, but I think this is merely a matter of individual, or possibly, geographical variation.

In the smallest specimen, the enlarged spinules on the outer ends of the inferomarginal plates are barely recognizable and then only in the interbrachial arcs. They are more pronounced but are not at all conspicuous in the specimen with R = 26 mm. The adambulacral armature shows very little change with growth; in the smallest specimen there are 5 and often 6 adambulacral spines and they are somewhat compressed, especially near base; in the largest specimen, there are 7, occasionally 8, adambulacral spines and they are markedly compressed at base.

Colour in life: upper surface reddish orange, lower surface pale.

P.F. 2285. Lion's Head, Cape Town, N. 67° E., 25 miles. 131–136 fms. Black specks. 2 specimens; adult.

P.F. 2330. Same station. 2 specimens; young.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles. 230 fms. St. 1 specimen; adult.

P.F. 17604. Cape Point, E. by N., 30 miles. 345 fms. Green sand and mud. 4 specimens; very young.

Bathybiaster robustus.

Archaster robustus Verrill, 1884. Amer. Journ. Sci. (3), vol. 28, p. 383.
Bathybiaster robustus Verrill, 1894. Proc. U. S. Nat. Mus., vol. 17, p. 256.

These specimens range in size from R = 7 mm. to R = 80 mm. The largest has been critically compared with similar specimens of *robustus* from off the Eastern coast of the United States and there is no doubt of their identity. The growth changes of this species are very interesting. Small individuals were described by Sladen (1889, Challenger Ast., p. 236, pl. 40, figs. 3–6) as *Phoxaster pumilus*, supposedly representing a new genus, distinguished from *Bathybiaster*

by the presence of an epiproctal cone and the absence of pedicellariae, but Verrill has shown that both these features are youthful and quite unreliable. In the present series, there is no epiproctal cone in the large specimen, but it is obvious in all the small ones; it is however *smallest* in the smallest specimen (1 mm. high) and largest (3 mm.) in a specimen with R = 17 mm. Apparently therefore it reaches its fullest development in late youth and then disappears, but is still evident in specimens one-third grown. The terminal plate is but very little larger in the big specimen than in the smallest and has entirely lost the three conspicuous spines which it bears in youth. The adambulacral plates are relatively considerably longer in the adult but the adambulacral armature changes but little, as there are 3 spines in the smallest specimen and only 5 in the big one. There is no indication of a superomarginal spinelet in the smaller specimens but in the largest it is evident on a dozen plates or more in each series; it is however remarkably low and squamiform.

P.F. 16742. Cape Point N. E. × E. 1/4 E., 38 miles. 755 fms. Green mud. 1 specimen; adult.

P.F. 16902. Cape Point N. E. × E. 1/4 E., 40 miles. 800–900 fms. Green mud. 2 specimens: young.

P.F. 17351. Cape Point N. 83° E., 43 miles. 900–1000 fms. Green mud. 2 specimens; young.

Psilaster acuminatus.

Sladen, 1889. Challenger Ast., p. 225; pl. 40, figs 1, 2.

It is not without some hesitation that I refer these specimens to Sladen's species, for in one particular they are very different from his description. He says the marginal plates are more or less bare (lower part of superomarginals, upper part of inferomarginals) and covered by a membrane, while in the African specimens, papillae cover the plates; along the margins the papillae are slender but on the surface of the plates they are quite squamiform. In one specimen, the lower portion of the largest superomarginals is only sparsely covered with papillae so perhaps if the specimens were larger these plates would be bare. But in these specimens, R = 60 mm. ± and Sladen's type had R only 65 mm.

Another difficulty is that these specimens are so unlike a much larger *Psilaster* from Australia which in my Endeavour report I have called *acuminatus*, that it is hard to believe they are the same species. Sladen however called attention to differences between the African, Australian and New Zealand specimens of the Challenger

collection, but he felt that more material was necessary before it could be conclusively determined whether all were the same species or not. I certainly have not sufficient available material to enable me to satisfy myself in the matter, so I follow Sladen's example and let all remain under the name which he gave.

P.F. 2330. Lions Head, Cape Town, N. 67° E., 25 miles. 131–136 fms. Black specks. 1 specimen; adult?

P.F. 14976. Lions Head, Cape Town, S.E. $^1/_2$ E., 47 miles. 175 fms. Green sand. 4 specimens; adult?

Astropecten polyacanthus.

Müller and Troschel, 1842. Syst. Ast., p. 69.

The occurrence of this species south of Zanzibar is noteworthy and its presence on the coast of Natal is really remarkable. The present specimen (R = 70 mm.) though the rays are somewhat broken, is in admirable condition for study. The superomarginal spines are unusually small and slender, the largest (those on the interradial pair of plates) being less than 3 mm. high and about two-thirds of a millimeter in diameter at base. The paxillae bear many spinelets; those on the convex surface are very low and papilliform while those on the margin are relatively long and slender. The oral surface is much less spiny than in typical examples of *polyacanthus*, this appearance being due to the somewhat squamiform spinelets and the absence of large spines on the adambulacral end of the inferomarginal plates. The species is so widespread and so diversified that local races will probably be recognized ultimately, and when that is done the South African form will probably be given a subspecific name. The more typical form is well figured by Savigny, 1803. Pl. d'Ech. Égypte, pl. 4, fig. 1.

P.F. 12516. Off Umhlanga River, Natal, $2^1/_2$ miles. 22–26 fms. Fine sand. 1 specimen; adult.

Delagoa Bay. K. H. Barnard.

Astropecten pontoporæus.

Sladen, 1883. Jour. Linn. Soc. Zool., vol. 17, p. 259. 1889, Challenger, Ast., pl. 35, figs. 1, 2.

Astropecten capensis Studer, 1884. Gazelle Ast., p. 44.

The present specimens (R = about 35 mm.) are a trifle smaller than Studer's but they leave no doubt in my mind as to the identity of *capensis* and *pontoporæus*. The differences mentioned by Studer are trivial. The relatively longer arms in Sladen's specimens are

due to their larger size, while the degree of projection of the inferomarginal plates and the exact form of their spines is a matter of individual diversity. Bell (1905, Mar. Inv. South Africa, vol. 3, p. 243) records *pontoporæus* from 21 stations and *capensis* from one, but he does not hint at the means by which he distinguished them.

P.F. 15835. Cape Point, N.W. 5 miles. 47 fuss. Sand and rocks. 4 specimens; adult?

* Astropecten hemprichii.

Müller and Troschel, 1842. Syst. Ast., p. 71. De Loriol, 1885. Cat. Rais. Ech. Mauritius: Stellérides, pl. 21, figs. 7–8.

This species is reported by Peters (1852) from Inhambane, P.E.A. and by Bell (1884) from Mozambique. I have not myself seen specimens from the African coast, south of Zanzibar.

Astropecten granulatus.

Müller and Troschel, 1842. Sys. Ast., p. 75. Döderlein, 1896. Jena Denksch., vol. 8, lief. 3, pl. 18, figs. 30, 30*a*.

These South African specimens were at first identified with *monacanthus* Sladen but in the larger specimens the paxillae always show several to many central granules, and Sladen emphasizes the single central granule as an important species character. Koehler however has stated that the number of central granules on the paxillae is a matter of age and examination of these specimens satisfies me that he is correct. Careful study of his text and figures, and those of Döderlein, with Sladen's, convinces me that *monacanthus* is identical with *granulatus*. The only point on which I am doubtful is the coloration, some specimens (none from South Africa however) showing a conspicuous mottling of the upper surface. This mottled form is figured by Sladen as *granulatus* and Koehler says his specimen from the Aru Islands is exactly like it in color. On the other hand he says his specimen is identical with that figured by Döderlein from Torres Strait and Döderlein's specimen is unicolorous. Probably the coloration is more or less subject to individual diversity. The length of the superomarginal plates and the extent to which they occupy the dorsal surface of the arms is a matter of age; they are longest and dorsally most conspicuous in the smallest individuals before me (R = 7·5 mm); they are relatively shortest and least visible from above in the largest specimens (R = 38 mm). These large specimens are just the size of Koehler's from the Aru Islands, and considerably larger than those seen by Sladen and Döderlein, but they are smaller

than some which Koehler has had from India. One of the smaller African specimens shows six superomarginal spines and similar spines occur in one of the larger specimens of the Indian Museum. It is interesting to note that the proportion of R to *r* is practically the same in the smallest and largest specimens, namely R = 4 *r*, but the arms are broadest in the smallest specimens, R = 2·7 *br*; in the large individuals, R = 3·5 *br*.

In spite of a deficiency of material which is much to be regretted, I think we may say then that *granulatus* is a small species of *Astropecten* with unarmed superomarginal plates, which ranges from India to South Africa on the west and to Torres strait on the east.

One of the specimens here referred to *granulatus* (1890*4*) may perhaps represent a different species. The colour is a noticeably deeper brown, there are usually two and often three infero-marginal spines, and the spinules everywhere, but especially on the oral surface, appear to be more or less sacculate. This individual is obviously immature (R = 19 mm.) and comes from deeper water than the others, so that the probability of its not being *granulatus* is rather strong.

P.F. 10975. Tongaat River, Natal, N. W. by N. ¼ N., 5 miles. 36 fms. Sand and rocks. 2 specimens, very young.

P.F. 12516. Off Umhlanga River, Natal, 2½ miles. 22–26 fms. Fine sand. 9 specimens; adult? and young.

P.F. 1890*4*. Cape Agulhas, Cape Colony, N. W. 175 miles (36° 40′ S., 21° 26′ E.). 200 fms. Green sand. 1 specimen, Young and dubious.

LUIDIIDAE.

It is not certain whether two or three species of this family are found on the coast of South Africa, but it is likely that at least three occur and not improbable that others will be found when the marine fauna is better known. The species recorded from the region may be distinguished from each other as follows;

Key to the South African Species of Luidiidae.

Rays 5; no enlarged central spinelet on paxillae . . *Luidia africana.*

Rays 7 or more.

No enlarged central spinelet on any paxillae; latter with quadrate tabulum *Luidia maculata.*

An enlarged central spinelet on many paxillae; latter with a stellate crown *Luidia savignyi.*

Luidia africana.

Sladen, 1889. Challenger Ast., p. 256: pl. 44, figs. 1 and 2.

I have not seen this species but Sladen records it from Simon's Bay, Cape of Good Hope and Bell lists it from four stations in 85–90 fms.

* Luidia maculata.

Müller and Troschel, 1842. Sys. Ast., p. 77. H. L. Clark, 1916. Endeavour Ech., pl. 5.

This species is recorded by Peters from Mozambique (1852, Monatsb. Berlin Akad., p. 178) but de Loriol thinks he probably had *L. savignyi*. While this is quite possible, it does not seem to me unlikely that *maculata* occurs as far south as Mozambique and I therefore let Peter's record stand.

Luidia savignyi.

Asterias savignyi Audouin, 1826. Expl. som. des pls. Echinod. de l'Egypte pub. par Savigny, p. 208; Rayonnés, pl. 3.
Luidia savignyi Gray, 1840. Ann. Mag. Nat. Hist. (1), vol. 6, p. 183.

This fine *Luidia*, originally noted from the Red Sea, was known only as far south as Mauritius and Zanzibar. In the Pieter Faure collection however, I find a badly broken specimen with R = 170 mm., which is undoubtedly this species, thus greatly extending the known range to the southward. It would be interesting to know by what characters Sladen distinguished his Challenger species *aspera* from *savignyi*, for they seem to me identical, but he makes no reference to the old species.

P.F. 10833. Natal: Umhloti River, N. W. by W. $^3/_4$ W., $2^3/_4$ miles, 25 fms. 1 specimen; adult.

GONIASTERIDAE.

Up to the present time only three species of this large family had been taken in South African waters. All of these are in the collection at hand and in addition the Pieter Faure captured eight species, six of which seem to be new to science. Nearly all of the eleven species are deep water (85–500 fms.) forms and none seems to be common. Indeed not a species of *Goniasteridae* is represented in the collection by more than *four* specimens, and of four species there is but a single example of each. Unfortunately two at least

of these four appear to be new. The following key shows how easily the South African goniasterids can be distinguished from each other.

Key to the South African Species of Goniasteridae.

Abactinal surface of disk covered with pseudopaxillae or granule-bearing tabula.
- Rays more or less elongated; R more than $2r$.
  - Each inferomarginal with 1—3 small, more or less appressed spinelets; no true (alveolar) pedicellariae present.
    - R = 3—4 r; superomarginals occupy less than $^1/_4$ r; paxillar area at base of arm about ·60 of arm-width . *Pseudarchaster tessellatus.*
    - R = 2—2·5 r; superomarginals occupy $^1/_3$ r; paxillar area at base of arm about ·40 of arm-width . . *Pseudarchaster brachyactis*
  - No spinelets on inferomarginals; at least a few true pedicellariae present *Mediaster capensis.*
- Rays short, form more or less pentagonal; R less than $2r$.
  - Interradial superomarginals squarish, often longer than wide, but occasionally wider than long; distal subambulacral spines not conspicuously enlarged.
    - Inner ends of interradial superomarginals distinctly squarish; their length equals or exceeds width; paxillae granules very close set, the marginal series with vertical outer sides *Ceramaster chondriscus.*
    - Inner ends of interradial superomarginals markedly rounded; their width exceeds length; paxillae granules rounded and not close-set *Ceramaster trispinosus.*
  - Interradial superomarginals nearly twice as wide as long; distal subambulacral spines conspicuously enlarged *Ceramaster patagonicus*, var. *euryplax.*

Abactinal surface of disk with no pseudopaxillae or distinct tabula.
- Actinal intermediate plates, each with a heavy spine, more or less elongated.
  - Pedicellariae wanting; adambulacral furrow series of 3 or 4 stout spines *Calliaster baccatus.*
  - Pedicellariae present; adambulacral furrow series with 6—9 slender compressed spines . . . . . *Calliaster acanthodes.*
- Actinal intermediate plates with granules, tubercles and pedicellariae, but no spines.
  - No marginal plates with spines or conspicuous tubercles *Tosia tuberculata.*
  - Many marginal plates with tubercles or stout spines.
    - No disk plates with stout capitate spines or big central tubercles *Cladaster macrobrachius.*
    - Many disk plates with stout capitate spines or big central tubercles *Hippasteria phrygiana.*

Pseudarchaster tessellatus.

Sladen, 1889. Challenger Ast., p. 112; pl. 17, figs. 3, 4.

The specimens at hand (R = 32–50 mm.) are about the same size as Sladen's (R = 48 mm.) and answer very closely to his description. There is however a median unpaired spine at the tip of the jaw

which is not mentioned by Sladen. Bell (1905, Mar. Inv. South Africa, vol. 3, p. 242) lists the species from five stations but gives no data about the specimens. It way be mentioned here that he, consistently and erroneously, throughout his report gives the date of Sladen's Challenger report as 1887.

P.F. 15436. Cape Point, N.E. by N. $7^3/_4$ miles, 85 fms. F. gn. s. 4 specimens; adult.

Pseudarchaster brachyactis *, sp. nov.

Plate XII. Figs. 1, 2.

R = 33 mm.; r = 15 mm.; R = 2·2r. Br = 18 mm., with paxillar area 6 mm. wide at same point. Disk large, flat, about 6 mm. thick. Arms also flat and nearly as thick as disk, except distally; they taper rapidly from the wide base to the bluntly pointed tips. Interbrachial arcs broadly curved. Abactinal area of disk and rays, within the boundary of superomarginals, covered by low pseudopaxillae which typically bear one central granule and a marginal series of 6–8; the granules are large, somewhat angular, rather close-set and more or less nearly subequal; near the superomarginals the granule-bearing plates lose their tabulate form and the granules are arranged more or less evidently in rows parallel to the margin. Madreporite small but distinct, about half way between the inner end of the superomarginals and the center of the disk. Superomarginal plates very oblique, approaching the horizontal, in position, about 22 on each side of each ray but the distalmost three are very small, with their inner ends abutting on the somewhat swollen but not large terminal plate; the two plates on either side of the interradial line are about 5 mm. wide, but only 1 mm. long at the outer end and less than 1·5 mm. at the inner; the succeeding plates gradually become longer and narrower but even near the tip of the ray they are twice as wide as long; each plate is closely covered by granules like those on the pseudopaxillae but more rounded; the largest granules (·25–·30 mm. across) are at the outer (lower) end of the plate while the smallest are along the inner margin; there are no spinelets or tubercles on any of the plates. Inferomarginals exactly like those of upper series, with granulation and end-width reversed; on all however, one or more (sometimes as many as four) of the median granules is, or are, enlarged, lengthened and flattened to form a small and appressed but distinct spinelet; the largest of these however rarely exceeds half a millimeter in length and they

* βραχύς = short + ακτίς = ray, in reference to the relatively short arms.

are only bluntly pointed. Actinolateral plates about 40 in each area; the series next to the adambulacrals extends out only as far as the fifth inferomarginal; beyond that the inferomarginals abut directly on the adambulacrals; actinal areas covered so closely with coarse granules like those on the inferomarginals that it is almost impossible to make out the plates; near the oral plates are two or three very simple and slightly differentiated pectinate pedicellariae, formed by the marginal granules of adjoining plates.

Adambulacral plates 28–30 in each series, about as long as wide or longer, markedly convex on inner margin and slightly swollen on the oral surface. Each plate, on proximal half of ray at least, carries a marginal series of 6, rarely 7, spines, subequal as to length (about 1 mm.) or the first and last shortest, the middle pair most slender and distal pair evidently the stoutest; on the oral surface of each plate are two or three slightly oblique series of 2–4 blunt well-spaced spinelets or granules; those nearest the furrow margin are most spine-like, while those of the opposite margin are only granules; one spinelet of the series nearest the furrow or of the next series, is somewhat enlarged and distally becomes conspicuous as a thick, blunt but not very long subambulacral spine; not rarely two such spines occur on a plate, especially near tip of arm. Oral plates not much swollen; each plate carries two series of 8–10 spinelets, one along the sutural margin, the other following the outer margin; in each series, the longest spines are proximal and they become shorter and stouter distally quite rapidly; sometimes there is an isolated spine between the two series. Whether an unpaired median spine is present at the tip of the jaw is not easy to determine in the holotype as the jaws are turned upward into the mouth. But on at least one jaw it seemed to be present while on another it was almost certainly wanting. Colour, uniformly brownish-yellow.

P.F. 17965. Cape Point, N. 41° E., 38 miles. 315–400 fms. S., blk. sp. 3 specimens; very young.

P.F. 18904. 36° 40′ S., 21° 26′ E., 200 fms. Gr. s. 1 specimen, adult.

Holotype, South African Museum, no. A 6430, P.F. 18904.

The specimens from 17965 are not only young but are in very poor condition and it is not impossible that they are the young of *tessellatus* or even that they represent some other species. The tips of the arms are missing and the granules are largely rubbed off from both surfaces. The holotype however is in good condition and I have little doubt that it is quite a different species from any as yet described. The short wide rays with the almost horizontal marginals give it a very characteristic appearance. In the young

specimens, the median, unpaired spine at the tip of the jaw is very conspicuous in every case, so there is reason to believe it is normally present in the adult. The smallest specimen has R = 7·5 mm., $r = 4{\cdot}5$ mm., $R = 1{\cdot}66\,r$; the unpaired spine on the jaw is perhaps ·35 mm. long by ·25 mm. thick. In the largest of the young specimens, $r = 5{\cdot}5$ mm. while R was certainly more than twice as much: the unpaired jaw-spine is about ·70 mm. long by ·30 mm. wide. There is no indication of spinelets on any of the inferomarginal plates.

Mediaster capensis *, sp. nov.

Plate XVI. Figs. 1, 2.

R = 53 mm.; $r = 19$ mm.; $R = 2{\cdot}8\,r$. Br = 20 mm.; at middle of ray, 8 mm.; at tip, 2·5 mm. Disk large, somewhat swollen in the radial regions; arms wide at base, narrowing rapidly at first and then, on distal half of arm, very gradually to the blunt tip. Abactinal plates of disk and base of rays, tabulate, more or less paxilliform, crowned with a marginal series of 12—15, slightly angular, blunt spinelets or coarse granules and within this circle 3—8 similar and scarcely smaller granules; in the interradial regions, near the superomarginals and on the distal part of the rays, the plates are less paxilliform and carry 5–10 small granules, variously arranged; occasionally one of the granules, on the larger plates, is replaced by a small 2-jawed pedicellaria, but these are neither numerous nor conspicuous. Papulae numerous, large, arranged quite regularly, so that around each plate, there are six, but around any two plates there are ten and around any four plates only sixteen. Madreporite small, rounded triangular, about as large as one of the larger abactinal plates, only half as far from centre of disk as from disk-margin.

Superomarginal plates about 29 on each side of each ray, all wider than long, the interradial ones almost twice as wide as long; they are closely covered with granules, almost exactly like those on the adjoining abactinal plates; there are 50–60 granules on one of the interradial superomarginals; occasionally a pedicellaria replaces a granule. Terminal plates small, slightly swollen, almost circular or rounded hexagonal. Inferomarginals apparently one fewer than superomarginals on each side of each ray; the series alternate more or less clearly at least at the middle part of the arm; the covering

* In reference to the geographical occurrence, the region being a new one for the genus.

of the inferomarginals is like that of the upper series. Actinolateral plates in about eight series; the first (next the adambulacrals) extends from the oral plates to about the fourteenth inferomarginal (counting from interradius); the second series extends to the eighth inferomarginal and the third reaches the sixth: remaining series irregular and made up of somewhat smaller plates than the first three; each actinolateral plate carries a marginal series of 7–9 angular granules, more widely spaced than on the abactinal plates, and a *single* central granule, or rarely two: there seem to be no pedicellariae on these plates.

Adambulacral plates about 56 on each side of the furrow; they are distinctly wider than long and their armature is in three very sharply defined parallel series; the furrow series consists of 4, rarely 5, subequal, almost cylindrical, blunt spines, over a millimeter long; the second series consists of 3, rarely 4, very similar but somewhat more prismatic spines of about the same size; the third and outermost series is made up of 3 angular spinelets not much larger than the granules on the adjoining plates. Oral plates not at all conspicuous and little swollen: their outlines are quite indistinct; proximally there are 5 spines on each side, the ones at tip of jaw longest (about 2 mm.); these spines are very strongly compressed, with widened and rounded tips; on the surface of each plate are a dozen or more smaller and more prismatic spines. the distalmost much like the actinolateral granules. Colour, brownish-yellow.

P.F. 18183. Cape Point, N. by E., 9 miles. 81–87 fms. Gr. m. and s. 2 specimens; adult.

P.F. 18230. False Bay, 21 fms. Fne. s. 2 specimens; adult.

Holotype, South African Museum, No. A 6422, P.F. 18230.

Examination of the internal anatomy confirms the evidence of the external characters, and proves this to be a true *Mediaster*: The internal radiating ossicles of the abactinal skeleton are well developed and rudimentary superambulacral plates are present. As regards the latter feature, however, I do not place very much confidence in its value, for unless these plates can be shown to have a real morphological value in some group of sea-stars, I must doubt their phylogenetic significance, and their presence in a rudimentary condition, or their absence, would not seem a matter of any real importance. Their position is such with reference to the ambulacrals and adambulacrals that their independent origin in totally unrelated groups would appear to be highly probable.

There is no doubt that *Mediaster capensis* is very nearly related to *M. australiensis* H. L. C. but I think the differences in the paxilliform

plates of both surfaces justifies regarding them as different species. Abactinally these plates in *capensis* are noticeably larger, especially in the midradial line, and they carry more granules within the marginal circle, than in *australiensis*, while actinally the reverse is true, the actinolateral plates of *capensis* rarely having more than one central granule while in *australiensis* there are almost always 2–5. The papulae in *capensis* are noticeably larger and more regularly arranged than in *australiensis*. In this particular, *capensis* is more like *ornatus* Fisher of Hawaii, but the differences in the actinolateral plates and adambulacral armature prevent any confusion with that species.

The specimens from 18183 are smaller than those from 18230 but they are like them in all essentials and call for no special comment.

Ceramaster chondriscus*, sp. nov.

Plate XIV. Figs. 5, 6.

R = 52 mm.; *r* = 30 mm.; R. = 1·7 *r*. Interbrachial arcs very broadly round; the interradial margins of the body are almost perfectly straight; rays well marked and rather abruptly projecting. Abactinal plates tabulate, completely granulated; the six primary plates are easily seen as the largest tabulae; otherwise the largest tabulae are at the center of the disk and on the median line of the basal half of each ray; these larger tabulae are more or less perfectly hexagonal, but the plates of the proximal part of each interradial area are more rhomboidal (in the holotype, they are perfectly rhomboidal) or pentagonal or irregular; distally in the interradii the plates become very small, and are roughly oblong or hexagonal; the sides of the tabulae are very straight, their marginal granules being sharply cut vertically on the outer side; on the larger tabulae there are about 20 marginal and about 25 central granules, all closely crowded. In the holotype and the smallest specimen, one or several of these granules are, on a few tabulae, replaced by large, bivalved, often excavate pedicellariae; on the third specimen, these are remarkably abundant.

Superomarginal plates 16–18 (17 in the holotype) on each side of each ray. Those in the interradii are nearly or quite square and there are only 6 or 7 on the basal half of the ray, as against 10 or 11 on the outer half; the distalmost three or four are however very short and this increase in number is no doubt correlated with the relatively long rays. The bare area, which in some species of *Ceramaster* may occupy the whole abactinal surface of the plate, is

* χονδρίσκος = a granule, in reference to the numerous abactinal granules.

greatly reduced, and is entirely wanting on the large plates of the interradial region of the larger specimens; it is evident on *all* the plates of a specimen with R = 42 mm. On the inferomarginals, the bare space is present though small on 5 or 6 plates on each side of the interradius in this small specimen but is wholly wanting in the larger specimens. It looks therefore as though with increasing age and size, the marginal plates tend to become wholly covered with granules. The number and distribution of the pedicellariae is very variable; in the small specimen they are very few but in the larger ones they are more abundant; in one of the latter, they are present on a large proportion of the dorsal tabulae, and on all the superomarginals, except those near tip of ray, there is at least one, often there are two and not infrequently, three; on most of the inferomarginals too they are present, and even on the actinolateral plates a few are to be found; in the region just back of the oral plates are 3 or 4 pedicellariae notable for their large size, fully twice that of those on the abactinal surface; on the adambulacrals, there seem to be no pedicellariae.

Actinolateral plates rather numerous and crowded but their outlines are very distinct at the center of each area, less so near mouth and least so on the outer part of each ray; except near the mouth and distally, the two series adjoining the adambulacrals are wider than long and oblong; those at center of area are rhomboidal; elsewhere they are irregularly polygonal or rounded; the granulation is much coarser than abactinally and there is no obvious distinction between the marginal and central granules; even the largest plates have only 20–25 altogether. The series adjoining the adambulacrals extends out to about the sixth or seventh inferomarginal from the tip; the next series reaches only to the ninth. At the middle of each interradial margin there are about $3^1/_2$ actinolateral plates abutting on each inferomarginal.

Adambulacral plates 40–45 on each side (in the holotype) wider than long at first but becoming squarish distally. The armature consists of a furrow series of 4, blunt, thick, somewhat prismatic or slightly flattened, subequal spines about 1·5 mm. long; back of these is a nearly parallel series of 3 similar but shorter spines and the outer end of the plate is occupied by 2–4 still smaller, but yet somewhat similar spinelets; these last are distinctly larger than the biggest granules of the adjoining actinolateral plates. Oral plates large but flat and not at all swollen; the armature is almost exactly similar to that of the adjoining adambulacrals; there are about 8 large spines on each free margin and a series of about 8 prismatic

granules along each of the opposed margins. — Colour in alcohol, pale brown, becoming brownish-white on drying.

P.F. 15147. Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gr. s. and bl. sp. 3 specimens. Adult.

Holotype, South African Museum, no. A 6414.

I had determined to call these three specimens *patagonicus* but Fisher thinks they are nearer to his recently described *C. smithi* from the Philippines, in 554 fms. He says that the South African specimens differ from *smithi* in the clean cut hexagonal tabulae of the mid-radial areas, the more numerous abactinal granules (only 10–15 central granules on largest tabulae in *smithi*), in the smooth tips of the subambulacral and furrow spines, in the lower abactinal pedicellariae, and in the larger oral plates. From *patagonicus* (of which I have seen no specimens) Fisher tells me the South African species differs "in having narrow, sunken, wholly granulated marginal plates, broader abactinal radial plates with more crowded, numerous granules, large instead of small plates in center of disk, a different sort of actinal pedicellaria, etc." It seems to me very clear that *patagonicus*, *smithi* and *chondriscus* are very closely related forms and that we shall not know the true interrelationship until we have far more material.

Ceramaster trispinosus*, sp. nov.

Plate XIV. Figs. 3, 4.

R = 41 mm.; r = 21 mm.; R = 1·95r. Interbrachial arcs broadly rounded; rays bluntly pointed. Abactinal plates tabulate, polygonal, of diverse sizes and closely crowded; most of the plates are rather large with a marginal series of 10–20 coarse, rounded granules and 10–20 similar, not crowded, granules within the marginal series; smaller plates have 6–12 marginal granules and 4–10 more on the top; the five basal plates are easily distinguishable, as one is somewhat crescent-shaped and encloses the madreporite on its outer side, while the other four have more numerous and smaller granules than the other tabulae, about 30 in the marginal series and about 35 within. Superomarginal plates 13 or 14 on each side of each ray or 26 or 28 on each side of the pentagon; the interradial pair are, each 4 mm. wide and 3 mm. long, with the inner end so curved as to be almost a semicircle; they are fully covered by about 150 granules, of which the largest are on the lower margin, next

* *trispinosus* = having three spines, in reference to the armature of the adambulacral plates.

the inferomarginals; there are 8–10 on that margin, 8 or 9 in the marginal series up each side and 18–20 on the semicircular inner (upper) margin; the second, third and fourth superomarginals are similar but progressively slightly smaller and with more square cut inner ends; on the fifth plate is a small bare area and this increases in size on the succeeding plates, until on the distal plates only a marginal series of granules remains; the last three superomarginals of the two sides meet in the midradial line, so the abactinal plates do not reach the terminal plate: the latter is of moderate size, rounded triangular or pentagonal and decidedly swollen. Madreporite small, only 1·5 mm. in diameter, its outer margin 12 mm. from edge of disk. Inferomarginals 14 or 15 on each side, always one more and sometimes two more than the superomarginals of the same side; in the neighborhood of the sixth superomarginal there are two inferomarginals and at the tip of the ray another extra inferomarginal is often to be found; the inferomarginals are very similar in form and granulation to the adjoining superomarginals. Actinolateral plates numerous, but so crowded and so closely granulated that the series can be made out only with difficulty; that adjoining the adambulacral plates extends to the eighth inferomarginal while the next series reaches only to the sixth; the granulation is much coarser than that on the marginals or abactinal plates and is well-spaced: there are rarely as many as 20 granules on a plate.

Adambulacral plates about 50 in each series, short and crowded, much wider than long except distally where the length nearly equals the width. Each plate carries a series of 3 (or rarely 2) stout spines on the furrow margin; these spines are a millimeter long, subequal, blunt, cylindrical or more or less compressed: back of this series, there are on the oral surface of each plate, three pairs of spines; the first (innermost) of these is much stouter and a little shorter than the furrow-spines, and the distal spine is larger than the proximal: on the terminal part of the arm, this larger spine becomes quite conspicuous as relatively the biggest adambulacral spine; the other two pairs of spines are much smaller, and the outer one is scarcely larger that the granules of the actinolateral plates; on some adambulacrals, one (or even two) of these six surface spines is wanting. Oral plates not at all swollen; on each free margin is a series of 5 or 6 stout, more or less prismatic, subequal spines; just back of these is a series of 5 similar but shorter spines, and on the distal part of each plate are about 5 still shorter spines or coarse prismatic granules. There seem to be no pedicellariae anywhere. Color of dried specimen, uniformly dingy, brownish-yellow.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Stones. 1 specimen, adult.

Holotype, South African Museum, no. A 6415.

This species has a very characteristic appearance due to the form of the marginals, the absence of pedicellariae and the crowded adambulacral plates with their furrow-series of three spines. The form is distinctly less pentagonal than in most members of the family, the tips of the rays being markedly prolonged. The granulation both above and below is noticeably coarse, but it is especially so on the actinolateral plates.

Ceramaster patagonicus var. euryplax * var. nov.

Plate XIV. Figs. 1, 2.

R = 32 mm.; *r* = 20 mm.; R = 1·6 *r*. Form nearly pentagonal but the sides are slightly concave. Abactinal plates tabulate, polygonal, of diverse sizes and closely crowded, so that the sides are very straight and clear cut, as in *C. patagonicus*; radially the plates are perfectly hexagonal and interradially they are rhombic; they are smallest at center of disk and near the marginal plates; the larger plates have a marginal series of 12–14 coarse granules and 10–18 similar but slightly smaller granules are within the marginal series; the latter have their outer sides quite vertical and the adjoining angles sharp; a central plate and the five basals are distinguishable by their smaller granules. Superomarginal plates 10 or 11 on each side of each ray or 20–22 on each side of the pentagon; the interradial pair are each 4 mm. wide and 2·5 mm. long, approximately rectangular, with nearly straight edges; succeeding plates similar but progressively shorter; there is little change in width until very near the tip of the ray; the central abactinal part of each plate is slightly tumid, bare and smooth; this bare area is largest distally and smallest on the interradial pair; elsewhere the plates are closely covered with a coat of granules of very uniform size, of which there may be more than 200 on a plate. Terminal plate of moderate size, very tumid, pentagonal, smooth. Madreporite small, wider than long, 1·75 mm. across, its outer margin 13 mm. from edge of disk. Inferomarginals of the same number as the superomarginals; the interradial pair underlie the interradial superomarginals but each succeeding plate lies progressively more distal so that near the tip of the ray the two series alternate; in granulation the inferomarginals resemble

* ἐυρύς = wide + πλάξ = plate, in reference to the very wide interradial superomarginals.

the upper series exactly except that the bare area is smaller, while in form they are perfect complements of the adjoining superomarginals. Actinolateral plates numerous and crowded, arranged in about eight series parallel to the adambulacrals; first series extends from oral plates to sixth inferomarginal and is made up of about 21 plates, which, excepting 2 or 3 at each end, are distinctly wider than long; succeeding series very crowded and hard to distinguish, the component plates about square; all the plates are covered by a close granulation like that on the inferomarginals but becoming coarser on the series near the adambulacrals.

Adambulacral plates about 33 in each series, not much wider than long (if any) and not specially crowded. Each plate carries a series of 4 or 5 stout spines on the furrow margin; these spines are about a millimeter long, blunt and thickened at tip, more or less compressed; when 4 are present, the middle pair are a trifle longer than the others; if a fifth spine occurs it is proximal in position and much smaller than the others; back of this marginal series, there are, on the oral surface of each plate, parallel with the furrow, three series of spinelets, of which two have three spinelets each and the outermost usually has four; the outermost series is no larger than the adjoining granules of the actinolateral plates, while the other series are slightly more spine-like; near the mouth, the outer series merges with the third or disappears altogether; distally the number of spinelets in each series is reduced. Just beyond the middle of the ray the distal spinelet of the second series is somewhat larger than its fellows: this disproportion increases as the tip of the ray is approached and the number of spinelets decreases, until, on the last ten or a dozen adambulacral plates, this spinelet is a conspicuous subambulacral spine, about a millimeter long and half a millimeter thick. Oral plates not at all swollen; on the free margin is a series of 9 stout, prismatic spines, the innermost stoutest; parallel to the sutural line between the two plates is a series of 8 crowded spinelets, of which the distal ones are scarcely larger than the granules of the adjoining actinolateral plates; a secondary series of 6 smaller spinelets runs irregularly parallel to this sutural series and there are 2 additional spinelets between it and the marginal series. There seem to be no pedicellariae. Colour of dried specimen, dingy brownish-yellow.

P.F. 15366. Cape Point N. 16° E., 10 miles, 85 fms. Gm. m. 1 specimen; adult.

Holotype, South African Museum, no. A 6413.

This handsome goniasterid is very near *patagonicus* of the same size from Alaska. Dr. Fisher has kindly compared them and finds

so little difference that he advises considering this specimen, for the present, as only a variety of *patagonicus*. He says the abactinal plates are larger than in *patagonicus*, being more as in *granularis*. It is possible that in larger specimens, the bare area on the marginal plates would disappear, at least interradially.

Calliaster baccatus.

Sladen, 1889. Challenger Ast., p. 280; pl. 56, figs. 1–4.

The Pieter Faure specimens agree well with Sladen's description and figures. The larger has R = 44 mm. and the smaller, 40 mm.; the former is thus just the size of the original specimen. The Mossel Bay specimen is somewhat larger as R = 52 mm. On a single actinal plate of this specimen is an indubitable pedicellaria and there are several of the pits where pedicellariae have been. The pedicellariae are thus not invariably wanting in this species. Their usual absence is however one of the many good species characters which *baccatus* possesses. The single pedicellaria seen has unequal, asymmetrical, non-denticulate valves; the larger valve is scarcely higher than wide and is a little bent sideways; the smaller is more decidedly bent and is distinctly narrower.

P.F. 1173. 34° 18′ S., 22° 13′ E., 38 fms. 1 specimen; adult?

P.F. 1710. Cape St. Blaize, N. by E. ¾ E., 6¼ miles, 35 fms. M., s. 1 specimen, adult?

Mossel Bay. C. W. Black, 1913. 1 specimen, adult.

Calliaster acanthodes * sp. nov.

Plate XII. Figs. 3, 4.

R = 79 mm.; *r* = 27 mm.; R = nearly 3*r*. Br = 30 mm.; at fifth superomarginal, *br* = 14 mm. and at 12th, *br* = 9 mm. Disk large, slightly tumid but with depressions near interradial margins. Rays tapering at first abruptly but beyond fifth superomarginal, very gradually. Abactinal surface of disk covered with irregularly circular plates, which are more or less tumid and bare, though there is a marginal series of coarse, flat, irregular granules around each one: the median radial series comprises the largest plates and runs almost to the tip of the ray but the distalmost plates are separated from the terminal plate and from each other also, by the meeting in the midradial line of the distal superomarginal plates; the series of plates on either side of the radial runs as far as the 12th superomarginal;

* ἀκανθώδης = full of thorns, in reference to the numerous abactinal spines.

all the larger abactinal plates and many small ones too, bear a single, central blunt spine, 1–3 mm. long and about $^1/_2$ mm. in diameter; not rarely the spine, on the smaller plates, is replaced by a large non-denticulate spatulate-jawed pedicellaria; on the larger plates, spine and pedicellaria may both occur. Madreporite large, tumid, about 3 mm. in diameter and 12 mm. from the disk margin.

Superomarginal plates 16 on a side, bare and tumid; the proximal are squarish and about as long as wide but distally the plates become much wider than long; each plate (except near tip of ray) carries 2, and sometimes 3, stout spines like those on the abactinal plates; these are placed one above the other; besides these spines one or more coarse granules or small tubercles may be present or, occasionally, one or even two pedicellariae occur instead of the tubercles: the usual series of marginal granules surrounds each of the plates. Terminal plate quite small, swollen and with no spines or tubercles whatever; it is possible that these may have been present in life and have since been knocked off but if so they have left no scars. Inferomarginal plates 17 on each side, the basal ones longer than wide and longer than the corresponding superomarginals, but distally they decrease in length rapidly and an extra one is intercalated below the twelfth of the upper series, or thereabouts; these plates carry 2–5 spines in a central group, or in a vertical or horizontal series; the spines are similar to those of the upper plates, and like them may be accompanied by pedicellariae. Actinolateral plates in six or seven series, the first parallel to the adambulacrals and reaching as far as the seventh inferomarginal; the second series does not quite reach the fifth inferomarginal; the remaining series are confined to the disk; each plate is surrounded by the usual marginal granules and these also occur more or less abundantly on the surface of the larger plates, especially near the mouth; each plate, excepting only the small ones, carries a large, central spine, similar to those of the abactinal surface but perhaps a little bigger; on some of the plates, the large characteristic pedicellariae occur.

Adambulacral plates 57 in each series but 21 of these are on the last 18 mm. of the arm; there are 6–9 (usually 8 or 7) slender compressed spines on the furrow margin, which are subequal or the end ones may be much the smallest; on the surface of the plate are 2 large spines, placed one behind the other, and on the adoral, inner corner there is usually a big pedicellaria; the plates are surrounded by the usual marginal granules and a number of these occur on the face of the plate, particularly around the base of the outer spine. Oral plates long and narrow, but not swollen; on the free margin

is a series of 8 or 9 long, blunt, compressed or prismatic spines, the innermost largest; on the face of each plate is a single big spine, between which and the tip of the jaw are three or four sharp, angular spinelets; distally a series of 10 or 11 granule-like spines runs along the outer margin, and 5 or 6 much coarser granules lie along the sutural margin. Colour of holotype, in alcohol, yellow-brown; of paratype, dull brownish-red above, more or less irregularly bleached; lower surface, nearly white.

P.F. 12831. Buffalo River, N.N.E. 17 miles, 195 fms. St., r. 1 specimen; small adult.

P.F. 14232. Cape St. Francis, N.E. 29 miles, 75 fms. S., sh., r. 2 specimes; adult; one very poor.

Holotype, South African Museum, no. A 6424. P.F. 14232.

This fine species is quite different from *baccatus* but is very near *corynetes* Fisher and *spinosus* H. L. C. It is readily distinguished from the former by the spiny upper surface and the pedicellariae on the adambulacral plates, and from *spinosus* by the bare abactinal plates and the presence of only one large spine on each oral plate. I was at first inclined to consider these specimens as adult *baccatus* but careful comparison shows that this idea is absurd. The differences in the adambulacral armature are fundamental and cannot possibly be construed as growth stages, and the same must be said of the condition of the marginal plates. One of the specimens from 14232 was evidently dried directly from salt water, perhaps with the laudable purpose of preserving the colour, but unfortunately, with the passage of time, it has disintegrated sadly and is now of little value. It was somewhat larger than the holotype, as $r = 30$ mm. The present colour is deep red brown, the marginals being darker than the abactinal plates.

Tosia tuberculata.

Plate IX. Figs. 1, 2.

Astrogonium tuberculatum Gray, 1847. Proc. Zool. Soc. London, p. 79.
1866. Syn. Starfish, p. 10; pl. 1, fig. 2.
Tosia tuberculata Verrill, 1899. Trans. Conn. Acad., vol. 10, p. 161.

Although Bell (1905, Mar. Inv. South Africa, vol. 3, p. 246) recognized the fact that this species is very little known, he does not give one word of information about the numerous specimens he had before him, except that the species is now "found to grow to a good size". What "a good size" may be each reader must decide for himself! However, two of Bell's specimens are now in the collection

of the Museum of Comparative Zoölogy and have been examined by Fisher, who has published some notes on them (1911, Bull. 76 U. S. Nat. Mus., p. 166). In the Pieter Faure collection, I find a single starfish (P.F. 18154. Cape Point, N.E. by E. $^3/_4$ E., 28 miles. 300 fms. Fne. s.) which is undoubtedly identical with these M. C. Z. specimens (as comparison side by side shows) but it is considerably larger and differs in certain details. Its most striking feature is the abundance of large bivalved, and often excavate, pedicellariae all over the abactinal and marginal plates; they are rather infrequent on the actinal surface and seem to be wholly lacking on the adambulacral plates, the only plates on which they are to be found in the M. C. Z. specimens, one would infer from Fisher's notes (*op. cit.* p. 167). However Fisher probably does not mean to imply that, for there are numerous pedicellariae on the abactinal surface of both these specimens, while the adambulacral pedicellariae occur only in the larger. Judging from the three individuals at hand, in which R = 42, 48 and 54 mm. respectively, one would say of this species: large, bivalved, often excavate, pedicellariae occur commonly and even abundantly on the abactinal and superomarginal plates, but are less frequent and may be wanting on the inferomarginal and actinal plates; their occurrence on the adambulacrals is unusual and when present there, they are strictly bivalve and have high, rather narrow jaws.

Both Verrill and Fisher put this species in *Tosia* but it would seem to be nearer to *Plinthaster*. Verrill apparently had not seen any specimens but, except for the large size of the pedicellariae, the individuals at hand, answer well to his diagnosis of *Plinthaster*. They also run down to *Plinthaster* most naturally and without question in Fisher's admirable key to the genera of *Goniasteridae* (*op. cit.*, pp. 169—174); here again the only difference is in pedicellariae. On the other hand the obvious presence of secondary plates in the radial areas seems an obstacle to putting this species in *Tosia*, and the general facies is quite as unlike that genus as it is that of *Plinthaster*. Dr. Fisher thinks that the species these South African specimens represent might well be made the type of a new genus but I think it will be well to wait until more material is available and further study has been made of Gray's type material in the British Museum.

The Pieter Faure specimen has much longer rays relatively than either of the M. C. Z. specimens, so that the body form is quite different. This can best be shown by the following comparison. In the larger M. C. Z. specimen, R = 48 mm.: *r* = 28 mm.; *br* halfway to tip of ray, 22 mm.; *br* three-quarters of the way to tip, 8 mm.:

thus R = 1·7 *r*: or 2·2 *br* at half-way point; or 6 *br* at three-quarters point. In the PIETER FAURE specimen, R = 54 mm.; *r* = 26 mm.: *br* at half-way point, 13 mm.: *br* at three-quarters point, 7 mm.: thus R = 2·1 *r*; or 4·1 *br* at half way point: or 7·7 *br* at three-quarters point. Probably a large series of specimens would show that there is considerable individual diversity in these proportions, and very likely, an increasing ray-length, with age.

Colour in life: upper surface reddish orange, lower surface pale.

Perhaps it ought to be added that it is not certain that the specimens identified by Bell are really *tuberculata*; he does not say whether he compared them with the type or not. Certainly Gray's figure does not resemble at all closely any one of the three specimens at hand.

CLADASTER MACROBRACHIUS * sp. nov.

Plate XIII. Figs. 1, 2.

R = 40 mm.: *r* = 16 mm.: R. = 2·5 *r*: *br* = 18 mm. but at half-way to tip it is only 9 mm. Disk large, somewhat convex but only about 8 mm. thick, even at center. Rays flat, tapering, at first rapidly, then gradually to the blunt tip. Abactinal plates moderate in both size and number, irregularly polygonal, with rounded corners, thick and close together; papulae few, single, typically six about any one plate on center of disk or base of rays but usually one or more of the six, lacking. Each plate, in life, was evidently surrounded by a marginal series of small, well spaced granules and bore on top, several larger, more widely spaced granules, one of which was here and there replaced by a large bivalved, more or less excavate pedicellaria; in the preserved specimen (dry) all the top granules, some pedicellariae and many marginal granules have been rubbed off but each has left a shallow pit to indicate its location. Median radial series of plates shut off from terminal plate by the meeting of the five distal pairs of superomarginals; series of plates adjoining radials only extends as far as the fourth or barely to the fifth superomarginal. Madreporite small (less than 2 mm. in diameter), pentagonal, situated about 10 mm. from the disk margin. Superomarginals 13 or 14 on each side of each ray, wider than long, more or less markedly tumid; like the abactinal plates, each is surrounded by a marginal series of small granules, and in life was very sparsely covered by much coarser and more widely spaced granules; on the upper end of each plate, where it is most markedly tumid, there are two or three (distally one or none) large, shallow scars, which indicate that in life rather

* μακρός = long + βραχίων = arm, in reference to the relatively long rays.

coarse granules or big tubercles were present. Terminal plate small and swollen; there are indications that in life it may bear 1–3 tubercles. Inferomarginals agreeing with superomarginals in number, form, size, position and granulation, except that the large, shallow scars are as a rule less well-marked and often seem to be wanting. Actinal plates few, irregularly arranged (except for series adjoining adambulacrals), of diverse sizes; the smaller ones are pretty well covered by the very large marginal granules, but all the larger plates show a bare central area on which is a big, wide-valved pedicellaria, and rarely a single big granule also; the series adjoining adambulacrals extends out only as far as the fourth inferomarginal.

Adambulacral armature conspicuously heavy; the plates themselves are numerous, about 45 in each series, crowded, much wider than long proximally, but squarish distally; each plate carries a series of 3 (rarely 2) furrow spines, about a millimeter long near middle of arm (longer proximally, shorter distally) subequal, or middle one longest, markedly compressed at right angles to furrow and more or less conspicuously widened at tip; back of these is a second series of which the adoral is very small, the middle one is much larger and the aboral is a stout, somewhat capitate subambulacral spine, the largest spine on the plate: on the outer margin of the plate is a third series of three spines of which the middle one is much the largest; the two small ones are hardly bigger than the marginal granules of the adjoining actinal plates: proximally all the adambulacral spines are longer, heavier and more conspicuous, while distally they decrease in number as well as in size. Oral plates not swollen, their outlines hard to determine; each has a marginal series of strongly compressed spines, about 2 mm. long, with much widened tips; there is also a series along the sutural margin consisting of 5 or 6 spines of which the first is small and pointed, the second is a long heavy spine like those of the free margin, the third is like it but a little smaller and the remainder are successively shorter and smaller in every way. Color of dried specimen, light yellowish-brown.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles. 230 fms. Stones 1 specimen; adult?

P.F. 17998. Cape Point, N.E. $^3/_4$ N., 39 miles, 310–500 fms. Gn. m. 1 specimen; adult?

Holotype, South African Museum, no. A 6429, P.F. 17998.

Aside from these interesting individuals, which differ little from each other, only two specimens of *Cladaster* are known; one, the holotype of *C. validus* Fisher with R = 17 mm. was taken near the Aleutian Islands; the other, the type of *C. rudis* Verrill with

R = 25 mm., was taken in the West Indies. The present individuals are thus much larger and it is noticeable that they have clearly the longest arms; *validus* is most nearly pentagonal. Probably the relative length of the rays increases with age. Perhaps the number of spines in the furrow series also increases with age, for the South African form has three as against two in the other species. Whether these South African specimens are adult seems doubtful and it is probable that a fully grown specimen would throw much light on the relationships of the genus. If it is true that the superomarginal plates in *macrobrachius* bear coarse tubercles, the definition of the genus will need some modification.

Hippasteria phrygiana.

Asterias phrygiana Parelius, 1768. K. Norske Vid. Sels. Skrift., vol. 4, p. 423; pl. 14, figs. 1, 2.

Hippasteria phrygiana Verrill, 1885. Rep. U. S. Fish Comm. for 1883, p. 542.

Up to the present time only a single specimen of *Hippasteria* has been recorded from the southern hemisphere. This was from the Strait of Magellan and was first described by Perrier as *H. hyadesi*, later as *H. magellanica*, and subsequently he used either name, apparently interchangeably. Verrill adopted *magellanica* but *hyadesi* seems to have priority, if the species has any validity. Perrier himself says it is very difficult to distinguish from *phrygiana*, and the differences which he points out are no greater than are to be found between two specimens of *phrygiana* from the New England coast. He gives no measurements and no figures so that there is no way of determining whether his specimen was adult or young.

The two specimens in the Pieter Faure collection only add to the difficulty; they are quite unlike each other and neither is like Perrier's specimen. But I am quite unable to estimate the value of the characters they show, for while they seem like representatives of two different species, they are not so unlike each other as are two specimens of *phrygiana* from the north-eastern coast of America, which lie before me. All four specimens are young, not half grown, but their peculiarities are not to any great degree due to their youth, I feel quite sure. I am forced to conclude that either all four represent one species, or each one represents a separate species. The former seems to me the more probable alternative and I am therefore referring the Pieter Faure specimens to *phrygiana*. It is quite likely however that a good series of adult *Hippasteria* from

either South Africa or the southern part of South America will show some constant specific characters. Meanwhile it may be well to record briefly the chief peculiarities of each of the Pieter Faure specimens.

Specimen A. R = about 52 mm.; r = 21 mm.; R = 2·5 r; br = 21 mm. but at half-way point is only 11 mm. Disk large, rather flat; rays tapering rapidly to an almost pointed tip. There are no large spines on the abactinal surface but each of the larger plates carries a big pedicellaria or a short spine or a high tubercle. Superomarginal plates, each with one or interradially two rather stout spines; on the interradial plates there are some large granules in addition. Inferomarginals with a shorter and thicker spine and 2–10 coarse granules in addition; the interradial plates have the most granules. Actinal plates usually with a big central pedicellaria and a marginal series of few very coarse granules; often a big granule or two replaces the pedicellaria. Adambulacral armature usually of a single large spine on the furrow margin, a similar but shorter subambulacral spine and 3 or 4 granules on outer end of plate; proximally there are 2 and rarely 3 spines on the margin, but they are more slender, and compressed, and there is no conspicuous subambulacral spine. Oral plates with only 4 or 5 marginal spines, but they are big, somewhat compressed and blunt; there are no big spines on the oral surface of plates.

P.F. 2798. Vasco de Gama peak, N. 71° E., 18 miles. 230 fms. Stones 1 specimen; young?

Specimen B. R = 50 mm.; r = 25 mm.; R = 2 r; br = 30 mm. but at half-way point is 17 mm. Disk large, slightly tumid; rays broad, rather flat, tapering uniformly to a blunt point. There are no spines at all on the abactinal surface; many plates carry a pedicellaria or a single large granule at center but some are quite bare; the result is an unusually smooth surface for a *Hippasteria*. Superomarginal plates, each with a single, short thick spine; on the interradial pair, a second shorter spine is below the first; on a few plates a large granule accompanies the spine. Inferomarginals with a single large tubercle or thick spinelet; interradially, several granules accompany this tubercle. Actinal plates as usual with a big central pedicellaria or occasionally a large tubercle. Adambulacral armature made up of a furrow series of two stout, bluntly pointed spines, the aboral the larger, a very stout sugar-loaf shaped subambulacral spine with one or two granules adoral to it, and about 4 coarse, angular granules on the outer end of the plate. Oral plates forming a rhomb, on each side of which are 3 stout spines;

those of the inner sides are quite markedly compressed; on the surface of each plate is a single, stout spine.

P.F. 17997. Cape Point, N. E. ¾ N., 39 miles, 310–500 fms. Gn. m. 1 specimen; young?

A specimen of *phrygiana* taken by the CHALLENGER on La Have Bank, south of Nova Scotia, in which R = about 57 mm. is much like A in form and proportions but in its adambulacral armature it is much like B. On the other hand, a specimen with R = 48 mm., collected near Grand Manan, has so many big nearly spherical tubercles on the abactinal, marginal and actinal plates that its general appearance is quite different from any of the others; the adambulacral armature approaches that of A but the big furrow spine usually has a very small spine adoral to it and sometimes an aboral one is present also.

There is little question that *Hippasteria phrygiana* is very variable. Possibly more than one species is now included under that name or it may be that varieties or subspecies should be recognized. But until the growth changes are known and a large series of specimens from many localities has been gotten together and studied, it seems to me best to let a single name cover all the Atlantic forms of Hippasteria.

OREASTERIDAE.

There is only a single specimen in the South African collection to represent this well-known tropical family of big sea-stars. Four other species have been reported from South Africa however, so the family is better represented there than the present collection indicates. Nevertheless it must be granted that South Africa is a little too far outside the tropics for even such a ubiquitous warm-water genus as *Oreaster* to flourish, and probably south of Mozambique, the *Oreasteridae* are represented chiefly by stragglers. It is an easy matter to distinguish the few species that have been recorded hitherto.

Key to the South African Species of Oreasteridae.

Rays well developed.

One or two distal superomarginals on each side of each ray bear a very big spine, while the remaining marginal plates are merely a little tumid and carry no spines . . . . . *Oreaster linckii.*

Superomarginals without spines or with small or moderate ones on many plates, especially in interradii . . . *Oreaster mammillatus.*

Rays very short or apparently wanting, as the body is thick and cushion like, and pentangular or roughly circular.

Furrow-series of adambulacral armature with 5—7 spinelets; papulae confined to special areas above the margin.

Papular areas with little spinelets; tubercles of dorsal side rather small and more or less pointed . . . . *Culcita novaeguineae.*

Papular areas without spinelets; tubercles of dorsal side, big, scattered and blunt . . . . . *Culcita schmideliana.*

Furrow-series of adambulacral armature with only 2 or 3 spinelets; papulae all over back, clear to the margin . . . *Culcita veneris.*

* Oreaster linckii.

Asterias linkii de Blainville, 1830. Dict. Sci. Nat., vol. 60, p. 219. See also Linck, 1733, De Stell. Mar., pl. 7, no. 8.

Oreaster linckii Lütken, 1864. Vid. med., p. 156.

Linck's figure gives a very good idea of a typical specimen of this species, which is common at Zanzibar and has been reported from Mozambique by both Peters and Bell.

Oreaster mammillatus.

Asterias mammillatus Audouin, 1826. Expl. som. des pls. Echinod. de l'Egypte pub. par Savigny, p. 209: Rayonnés, pl. 5.

Oreaster mammillatus Müller and Troschel, 1842. Syst. Ast., p. 48.

This is a very variable species and the growth changes and limits of variation need very much to be worked out. In some specimens, spines and even the big tubercles are nearly or quite lacking while at the other extreme, every big dorsal or superomarginal plate carries a small or moderate spine. Peters reported the species from Mozambique and it is not recorded from south of there, but in the present collection is a specimen from Mossel Bay, Cape Colony, which thus extends the known range of the species many hundreds of miles to the south. The specimen is a small one (R = 60 mm.) and lacks one ray, which is however beginning to regenerate. There are no spines anywhere but many of the marginals, especially of the lower series, and a number of abactinal plates bear more or less elevated tubercles. The dry specimen is light yellowish-brown. Mossel Bay. C. W. Black. 1914.

* Culcita novaeguineae.

Müller and Troschel, 1842. Syst. Ast., p. 38. Döderlein, 1896. Jena Denkschr., vol. 8, pls. 19 and 20, figs. 1—9.

This widely distributed Indo-Pacific species is very variable and has been described under a number of names. It has been reported from Mozambique and there is a young individual from that place

in the Museum of Comparative Zoölogy, identified and labelled by Perrier as "*Randasia granulata* Gray. jeune *Culcita areolata* E. Per."

Culcita schmideliana.

Asterias schmideliana Retzius, 1805. Diss. Ast., p. ?*
Culcita schmideliana Gray, 1840 Ann. Mag. Nat. Hist., vol. 6, p. 276.
Döderlein, 1896. Jena Denkschr., vol. 8, pl. 20, figs. 10–15.

This species seems to be common at Zanzibar and has been reported from Mozambique by Bell. A specimen is in the S. A. Museum from Mozambique collected by K. H. Barnard, 1912.

*Culcita veneris.

Perrier, 1879. Arch. Zool. Exp., vol. 8, p. 48; pl. 4.

This species then known only from the holotype, taken at St. Paul Island in the southern Indian Ocean, was recorded by Bell (1905, Rep. Mar. Inv. South Africa, vol. 3, pag. 248) from near the Cape of Good Hope, in 23—37 fms. In spite of the extraordinary interest attaching to the rediscovery of so remarkable an animal, Bell does not give a single bit of information in regard to his specimen and we can only surmise that it was so much like the holotype in size and appearance that he felt no doubt of their identity.

PORANIIDAE.

This family was not hitherto known from the vicinity of South Africa, and it is represented in the Pieter Faure collection by only a single specimen. This however is of very great interest as it proves to be an undescribed species of a little-known, and hitherto monotypic genus of the North Atlantic.

Chondraster elattosis**, sp. nov.

Plate VIII. Fig. 4.

R = 115 mm.; r = 75 mm.: R = 1·53r. Disk elevated, v. d. at center, 40 mm. Whole animal covered with a thick, smooth, fleshy skin. Abactinal skeleton wanting or greatly reduced; marginal plates present but very spongy and without spines or tubercles. Papulae numerous, arranged in two parallel series, 20 mm. wide and 5 mm apart, along the median radial area: a few small groups of papulae, occur irregularly near the center of the disk. Anal opening

* Few writers have been able to consult this paper and no one has given the page reference. The paper is not accessible to me.

** ἐλαττόω = to lessen, in reference to the reduction of the skeleton.

evident. Madreporite distinct but small, 3 mm. across; rather spongy.

Actino-lateral areas with numerous parallel furrows running to margin and even over the margin onto the upper side; no spines or tubercles anywhere. Adambulacral plates with an inner series of 3 or often 4 sharp spines, 1–3 mm. long, sacculate, the saccules extending far beyond the spine-tip; and an outer series of 3, rarely 4, similar but stouter spines, enclosed in a thick, fleshy sack and forming a low, racquet-shaped appendage, 3–4 mm. high and 2·5 mm. wide. Oral plates very thick but flat with no superoral spines or tubercles: at the inner tip of each plate is a rather stout, sacculate, nearly horizontal spine; along the free margin of each plate is a series of similar but longer and stouter, vertically placed spines, united with each other and with the plate itself by skin. Feet large in two series. Colour uniformly dull, deep pink: feet brown.

P.F. 19003. South from Cape Infanta, Cape Colony, 36° 49′ S., 21° 14′ E., 560 fms. Gn. s. 1 specimen; adult.

Holotype, South African Museum No. A 6448.

This remarkable sea-star was unfortunately preserved in formalin and it is evident that some decalcification has taken place. It is however impossible to determine now how much of the sacculate appearance of the adambulacral and oral spines is due to decalcification and how much is natural. It is also uncertain how much of the absence of a dorsal skeleton, and to what degree the sponginess of the marginal plates, is artificial. There is however little doubt as to the generic position of this notable specimen, as it agrees so well in its main features with *Chondraster grandis* Verrill, which occurs in the northern Atlantic, southeast of New England, in 220–538 fms. The South African species differs from the genotype however in the wider papular bands, the greater reduction of the skeleton, the absence of marginal tubercles, and particularly in the armature of the adambulacral plates. In *grandis* there are only two spines in the inner series. The two species apparently differ also in colour, as the northern form is red above and yellow beneath, while the southern species seems to be unicolorous. This may of course be only an individual matter.

OPHIDIASTERIDAE.

This is another tropical family and its inclusion in the present report is due chiefly to the fact that four species are listed by Bell in the Alert Report (1884) as having been taken at Mozambique. One of these is represented in the South African collection before

me by two small specimens but these also are from Mozambique. The only truly South African species is the interesting *Austrofromia* from False Bay.

Key to the South African Species of Ophidiasteridae.

Papulae on actinal surface; adambulacral armature spiniform.
Papulae single; rays 3 or 4 times as long as wide at base
Austrofromia schultzei.
Papulae in areas; rays 5 or 6 times as long as wide at base *Nardoa variolata.*
No papulae on actinal surface; adambulacral armature granuliform.
Inner (furrow) series of adambulacral spines with spines separated from each other by vertical series of little granules.
Colour blue; arms relatively short and wide, R = 5 or 6 *br*
Linckia laevigata.
Colours orange and green; arms relatively long and slender, R = 7—12 *br*
Linckia multifora.
Inner (furrow) series of adambulacral spines with small spines alternating with larger and no vertical series of little granules between *Linckia diplax.*

* Austrofromia schultzei.

Fromia schultzei Döderlein, 1910. Jena. Denkschr., vol. 16, p. 249; pl. 4, figs. 3–3*b*.

Austrofromia schultzei H. L. Clark, 1921. Echin. Torres Strait, p. 49.

This interesting species is based on a single specimen from False Bay, Cape of Good Hope. Its nearest ally, *A. polypora* H. L. C., occurs on the southern and western coasts of Australia. No nearly related forms are known from the African coast.

* Nardoa variolata.

Asterias variolata Retzius, 1805. Diss. Ast., p. 19. See Linck, 1733, De Stell. Mar., pl. 8, no. 10.

Nardoa variolata Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 286.

This well-known Indo-Pacific species is recorded by Bell from Mozambique, whence Peters also reported it half a century ago. Curiously enough, it has never been well figured, for Linck's figures while recognizable are far from good.

* Linckia laevigata.

Asterias laevigata Linné, 1758. Syst. Nat. ed. 10, p. 662. See H. L. Clark, 1921. Echin. Torres Strait, pls. 9 and 26.

Linckia laevigata Nardo, 1834. Oken's Isis, p. 717.

This handsome sea-star, notable for its colour, so unusual among echinoderms, has been reported from Mozambique by both Peters and Bell.

Linckia multifora.

Asterias multifora Lamarck, 1816. Anim. s. Vert., vol. 2, p. 565. *Linckia multiforis* von Martens, 1866. Arch. f. Naturg., Jhrg. 32, Bd. 1, p. 65. See de Loriol, 1885. Mém. Soc. Phys. Hist. Nat. Genève, vol. 29, pl. 9.

This species is reported by Bell from Mozambique, and two young individuals from the same place, taken by K. H. Barnard in November, 1912, lie before me. Some years ago (1908, Bull. M. C. Z. vol. 51, p. 283) I expressed the opinion that *multifora* could only be considered a variety of *laevigata*. Since then I have collected and examined hundreds of *laevigata* near the Great Barrier Reef of Australia and I find its specific characters are very constant. I am inclined to think therefore that *multifora* is probably entitled to rank as a valid species, but its characters still need elucidation.

* Linckia diplax.

Ophidiaster diplax Müller and Troschel, 1842. Syst. Ast., p. 30. *Linckia diplax* Lütken, 1871. Vid. Med., p. 269.

This species is reported by Bell from Mozambique. Its status is dubious. It is very near the species so beautifully figured by de Loriol (1885, Mem. Soc. Phys. Hist. Nat. Genève, vol. 29, pl. 10) as *L. ehrenbergii* M. & T., while Ludwig ranks it only as a variety of *L. pacifica* Gray. In my opinion, *pacifica* is identical with the West Indian species, *guildingii* Gray; at any rate, I have not been able as yet to find any tangible difference between them. The Indo-Pacific *Linckias* are badly in need of a careful revision based upon fieldwork, as the study of museum material alone proves very unsatisfactory.

GANERIIDAE.

The presence of this family in this report is due to a very young sea-star which I am unable to refer to any known genus but which seems to belong in the *Ganeriidae*. The specimen was sent to Dr. W. K. Fisher for his examination and he writes: "My guess would be *Cycethra* or a close relative. ..... If the tube-feet have true disks, I think the *Ganeriidae* will be a safe assumption." The tube-feet appear to have true sucking-disks, so I am listing the family *Ganeriidae* in the present report. Most of the members of the family occur in the vicinity of the Straits of Magellan and the Falkland Islands.

The important features of the youngster before me may be listed

as follows: Disk and rays flattened, the general form being distinctly star-shaped but with very obtuse rays. R = 5·5 mm.; *r* = 3 mm.: R = 1·8 *r*; *br* = 3 mm. Abactinal plates relatively few, tabulate, with well-spaced, short rough spines; under a magnification of 40 diameters, they thus appear paxilliform. No madreporite is visible but in each interradius is a small, bare, depressed area, covered only by thin skin. Marginal plates 5 on each side of each ray, in each series; all very much alike; they bear short, rough spinelets, well-spaced as on the abactinal plates. Terminal plate short but wide, roughly kidney-shaped, covered with little spinules, like the abactinal plates. Actinal plates small and rather numerous, each with 2–5 (usually 3) rough spinelets similar to those of the abactinal plates but rather longer; the series next to the adambulacrals runs nearly to the tip of the ray and the second runs to the fourth inferomarginal; the remaining two are very short and carry only 4 (or 3) and 2 (or 1) plates respectively. Adambulacral plates very wide and short and very characteristic: the adoral marginal corner extends inward half-way across the furrow, and at the tip curves abrubtly aborally, thus half-way encircling a large tube-foot with a fairly well-developed sucker; on this furrow-projection of the plate are three relatively long, rough spines, of which the middle one is slightly largest and stands at the bend in the plate, another is at the tip of the plate and the third is between the largest and the furrow-margin; on the actinal surface of each plate is an oblique series of 3 or 4 spines the largest being nearest the furrow and farthest from the mouth; the largest is equal to, or a trifle larger than, the one on the bend of the plate, while the smallest is about equal to the spines on the actinal plates. Oral plates of moderate size, flat but distally rather abruptly raised; on each free margin are four spines, the one at the tip of the jaw, much the largest, flat, wide and truncate, the others progressively smaller, more cylindrical and more slender; on the distal angle of each plate are two spines like those on the actinal plates and proximal to them is a single slightly larger spine.

P.F. 13240. Cove Rock, near East London, N. ¾ E., 5 miles. 43 fms. St., brk. sh. 1 specimen; very young.

I know of no sea-star with the ambulacral furrow guarded as in this specimen and I have little doubt it represents an undescribed genus. But it is conceivable that with growth the adambulacral armature would become more like that of *Cycethra*, and in any case it seems unwise to base a new genus on so obviously immature a specimen. And in this opinion, I am glad to say, Dr. Fisher fully concurs.

ASTERINIDAE.

This is the best represented in South African waters of any of families of sea-stars, although the present collection contains but seven forms. Eleven of those here listed are *Asterinas* in the wide sense of that term and several of them are very imperfectly known. The group was revised by Verrill in 1913 (Amer. Jour. Sci., vol. 35, p. 477) but owing to an unfortunate mistake one or more paragraphs of his "key" failed to be printed and as a consequence, it is quite useless. Some of his statements also are very summary and many species are not even mentioned. I have not found it practicable therefore to adopt his proposed new genera, though I have no doubt they are destined to come into use when the numerous species of *Asterinidae* are carefully revised. Meanwhile I use *Asterina* in its old broad sense. I regret to have to add two new species and a new variety to this mass of undigested material but there seems to be no other course open. Another new species is a small but interesting *Anseropoda*. Sladen (1889. CHALLENGER Ast., p. 390) records *Asterina gunnii* Gray from the Cape of Good Hope but I feel sure this is a mistake and I therefore omit that species from the present list. The fourteen forms included are separable as follows:

Key to the South African Species of Asterinidae.

Body not very flat and thin; $r = 1{\cdot}25$—2 v. d. at center of disk.
R = 1·8 *r* or more, usually more than 2 *r*.
Actinal intermediate plates, at least near mouth, each with 5 or more spines.
Abactinal plates not imbricated, covered with spines *Parasterina bellula.*
Abactinal plates more or less imbricated.
Actinal intermediate plates, each with a cluster of 8—15 spines *Asterina penicillaris.*
Actinal intermediate plates, each with 5—11 spines in a single, or rarely double, transverse series.
Abactinal plates closely covered with minute, crowded spinelets . . . . . *Asterina granifera.*
Abactinal plates relatively bare, the spinelets scattered, frequently marginal or in a single transverse series *Asterina granifera* var. *sporacantha.*
Actinal intermediate plates, each with 1—4 spines.
Abactinal plates with 5 or more spines and often in addition a tuft of 2—4 stouter spines having a common base *Asterina coronata.*
Abactinal plates not as above . . . *Asterina burtonii.*
R = 1·25—1·8 *r*, only very rarely 2 *r*.

Adambulacral spines 2 (or sometimes 3).

No big subambulacral spine; actinal intermediate plates with 3—6 spinelets . . . . . *Asterina coccinea.*

A big subambulacral spine on the surface of each adambulacral plate; actinal intermediate plates with only 1 or 2 spinelets.

Abactinal spinulation, granuliform.

Abactinal granules coarse; many actinal intermediate plates with 2 spines each; subambulacral spine very large, blunt or truncate . . . . *Asterina dyscrita.*

Abactinal granules rather fine; actinal intermediate plates nearly always with 1 spine each; subambulacral spine not disproportionately big, pointed. . *Asterina exigua.*

Abactinal spinulation spiniform, the spinelets rather long but stout and blunt; actinal intermediate plates usually with 1 spine each; subambulacral spine very large, blunt or truncate *Asterina calcarata.*

Adambulacral spines 3 or 4, with 2 or more spines on the surface of each plate.

Abactinal spinelets thick, blunt, crowded; actinal spines relatively long, blunt . . . . *Asterina lüderitziana.*

Abactinal spinelets short, delicate, sharp, well-spaced; actinal spinelets very similar . . . . *Asterina gracilispina.*

Body very flat and thin; $r = 2{\cdot}5$—5 v. d. at center of disk.

Rays 9 . . . . . *Anseropoda novemradiata.*

Rays 5 . . . . . *Anseropoda habracantha.*

* Parasterina bellula.

Patiria bellula Sladen, 1889. Challenger Ast., p. 385; pl. 63, figs. 1, 2.

The original specimens of this species were taken by the Challenger in shallow water, Simons Bay, Cape of Good Hope. So far as I know it has not been met with since except by the Scotia which took one specimen in Saldanha Bay. Fisher (1908. Smiths. Misc. Coll., vol. 52, p. 90) called attention to the error in using the generic term *Patiria* and suggested *Parasterina*, but he did not publish the combination of the latter name with *bellula*. Sladen emphasizes the non-imbrication of the abactinal plates, using that as the one distinctive character in his key. Fisher does the same in his key to the genera of *Asterinidae* (1911, Bull. 76 U. S. Nat. Mus., p. 253) and as I have never seen an authentic specimen of *Parasterina*, I can only follow in the steps of these eminent predecessors. I may add however that I am not convinced of the great importance of imbrication as a generic character; for the *degree* of imbrication is subject to individual diversity, especially in the long-rayed *Asterinas*. I think the relationship between *Parasterina* and such *Asterinas* as *granifera* and *penicillaris* needs a careful re-investigation.

* Asterina penicillaris

Asterias penicillaris Lamarck, 1816. Anim. s. Vert., vol. 2. p. 555.
Asterina penicillaris von Martens, 1866. Arch. f. Naturg., Jhrg. 32, Bd. 1. p. 74.

This species is very imperfectly known and has never been figured, so far as I can learn. Goto (1914, Mon. Jap. Ast., pt. 1, p. 651) denies its occurrence in Japan and says that the specimens, which Sladen, in the Challenger Report, recorded from Kobé represent a new species which he describes under the name *batheri*. Meissner (1892, Arch. f. Naturg., Jhrg. 58, Bd. 1, p. 187) records five specimens of *penicillaris* from Cape Town. One of these, and a similar one from the Red Sea, are now in the M. C. Z. collection, received in exchange from the Berlin Museum. They seem to me to belong to the following species (*granifera*), which has been rather fully described by Perrier from specimens from Table Bay, Cape of Good Hope. But Perrier makes no reference whatever to *penicillaris* and I am not at all sure that *granifera* and *penicillaris* are not synonymous. At any rate, if distinct, they must be very nearly related.

Asterina granifera.

Plate XVII. Figs. 1, 2.

Patiria granifera Gray, 1847. Proc. Zool. Soc. London, p. 82.
Asterina granifera Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 239.

This is another little known and unfigured species of *Asterina*, recorded as yet only from the Cape of Good Hope. There are a number of *Asterinas* in the Pieter Faure collection which seem to me better referred to this species than to any other. Perrier's description is adequate and I hope the two figures given herewith may serve to make the species easily recognizable henceforth. The specimens before me range in size from R = 20 to R = 45 mm. The smallest specimen has the rays flatter and less tapering that in the larger ones, the abactinal secondary plates and the papulae are fewer in number and the abactinal spinelets are smaller and more pointed; orally there is little difference. The specimens from P.F. 3010 are so similar to the figures and description of *Parasterina bellula* given by Sladen (*l. c.*) that if they were the only ones before me, I should refer them to that species. But I fail to find any character by which they can be certainly distinguished from the others and I must therefore refer them to the older species.

One of the specimens from P.F. 15908 is remarkable for apparently

having *six* rays, but seen from below, it is obviously a 5-rayed specimen in which one ray split very early in life and has since developed as two rather widely diverging rays.

P.F. 3010. False Bay, Cape Colony; littoral. 3 specimens; adult.

P.F. 5008. Rockland Point, False Bay, N.W. ¼ N., 2 miles. 23 fms. R. 1 specimen; adult.

P.F. 14711. Saldanha Bay, Cape Colony; low tide. 1 specimen; adult.

P.F. 15908. False Bay, Cape Colony. 11 fms. R. 2 specimens; adult.

P.F. 16151. False Bay, Cape Colony. 9 fms. Brk. sh. 2 specimens; young.

Mossel Bay, Cape Colony. 1 specimen; adult, poor.

Asterina granifera *var.* sporacantha *, var. nov.

Plate XVII. Fig. 3.

Three specimens of Asterina, which I am satisfied are but a variety of *granifera*, look so different that I at first believed them a distinct species. The alcoholic specimens are distinctly pinkish and this color is evident when dry, whereas the specimens of *granifera* are yellowish, though sometimes with a pinkish cast. The colour in life of both the type form and the variety is said to be bright orange-red, with the madreporite more or less violet. The chief character however is the spinulation of the abactinal plates; in the typical form these plates are well covered and often densely packed with minute spinelets; in the present variety these plates are more or less bare, the spinelets occurring in marginal or single, transverse series, or irregularly scattered; they are rather larger than in the typical form and are generally acute; the surface of the larger plates where the spines are lacking is more or less evidently shagreened or minutely tuberculated.

I am led to regard this form as only a variety of *granifera* because it occurs at the same stations with the typical from, and in the latter there is more or less individual diversity in the density of the spinulation of the abactinal plates.

The largest of the specimens of *sporacantha* has R = 53 mm., *br* = 23 mm. and *v.d.* = 19 mm.; the form is thus very thick and heavy. The other specimens are less stout in every way but they

* σποράς = scattered + ἄκανθα = spine, in reference to the widely scattered abactinal spinelets.

are nevertheless somewhat stouter than specimens of typical *granifera* of a corresponding size.

P.F. 1268. Cape St. Blaize, N.E. by E., 27 miles. 45 fms. Fne. s. 1 specimen; adult.

P.F. 5008. Rockland Point, False Bay, N.W. $^1/_4$ N., 2 miles. 23 fms. R. 1 specimen; adult.

P.F. 14711. Saldanha Bay, Cape Colony; low tide. 1 specimen; adult.

Holotype, South African Museum, no. A 6419, P.F. 1268.

*Asterina coronata.

Von Martens, 1866. Arch. f. Naturg. Jhrg. 32, Bd. 1, p. 73.

This species, originally recorded from the East Indies, is given by Sladen as occurring at Mozambique. But I have not been able to find his authority for the statement. The species and three varietal forms have been fully discussed by Fisher (1919, Bull. 100 U. S. Nat. Mus., pp. 411–416).

Asterina burtonii.

Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 289.

This widely distributed species, well-figured by Savigny (1809, Desc. l'Egypte. Rayonnés, pl. 4, figs. 2·1–2·8) but without a name, has very generally been called *cepheus*, the name given by Müller and Troschel in 1842. I can find no reason however for rejecting Gray's name. It is true no type specimen is extant but Gray's description is unusually good (*for him*) and I have no doubt as to the *Asterina* he had in hand. Perrier gives *burtonii* as a synonym of *cepheus* without question but calmly ignores its two year's priority! Verrill has recently revived the older name and I follow him therein. It may be mentioned in passing that Perrier (and others) spelled the specific name *cepheus* as *cephea* on transferring it from *Asteriscus* to *Asterina*, overlooking the fact that it is (as Bell pointed out in 1884) a proper noun (Cepheus, the father of Andromeda) and not an adjective.

This species has been known from Mozambique for a long time, and there is a very fine specimen from there in the South African Museum's collection. It was taken by Mr. K. H. Barnard in November, 1912.

Asterina coccinea.

Patiria coccinea Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 290.
Asterina coccinea Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 234.

This is another of the unfigured and little known species of *Asterina*. Perrier's description, based on material in the British Museum, where

there are said to be many specimens, supplies some of the deficiencies of Gray's inadequate diagnosis, but is not wholly satisfactory. He says the species is pentagonal, and then that R = *r*; of course if R = *r*, the outline is approximately circular; probably R = 1·25 *r*. Of the ambulacral spines, he says they are arranged in a single series; if this were true, the species would be unique; if it means the furrow series only it is true of all *Asterinas*; if it refers only to the actinal surface of the plate it would be distinctive; but there is no way of determining just what is meant. Bell records this species in his South African Report, 1905, as occurring at three stations, but he gives no information about the material and there is reason for doubting whether he examined the specimens carefully. Some at least seem to have been the following species, *dyscrita.*

Asterina dyscrita *, sp. nov.

Plate XVI. Figs. 5, 6.

R = 14 mm.; *r* = 11 mm.; R = 1·3 *r*; *r. d.* = 5·5 mm. General form pentagonal with slightly concave or notched sides, rather thick. Abactinal plates scarcely distinguishable under the covering of coarse, spherical granules; these are ·20–·35 mm. in diameter and occur 4–10 on each plate; the plates or at least the groups of granules, are arranged very regularly in longitudinal series, radially, and hence in diagonal series, interradially. Papulae fairly numerous but small, not so large as most of the granules.

Actinal intermediate plates numerous, in regular series parallel to ambulacral furrows, and hence forming oblique series running to the margins; each plate of the series adjoining adambulacrals carries a single, stout, bluntly pointed spinelet; in the next series, a few plates carry two spinelets but most have only one; in the following series, nearly all the plates carry two; the size of the spinelets decreases from the adambulacrals outward.

Adambulacral armature consists of two (or very rarely three) furrow spinelets, and a single large subambulacral spine, on the actinal surface of each plate; furrow spinelets slender, ·75–·80 mm. long, subequal; subambulacral spine, nearly a millimeter long, stout, slightly flattened, blunt or almost truncate.

Oral plates each with 6 or 7 marginal spines and with one large, blunt spine on the actinal surface near the middle; the innermost spine (one of the pair at tip of jaw) is a millimeter long, stout, flat

* δύσκριτος = hard to determine, in reference to its doubtful status.

and truncate; the next is rather smaller in every way; the remainder are very markedly smaller and are pointed.

Colour in life, various shades of green, mottled with specks of red, blue, yellow etc.

P.F. 10004. Between River and Sebastian Bluff, nearer the former; low tide. 2 specimens; adult?

Holotype, South African Museum, no. A 6420.

These two specimens were sent to me with the label: "*Asterias coccinea*. Bell's no. 10004. (Not seen by Bell)." There is also a note saying: "These have not been actually seen by Bell, but are taken from a bottle with the same number as given by Bell in his Reports". Of course, it is obvious from the appearance of the actinal surface that these specimens are not *coccinea*. They are closely related to both *exigua* and *calcarata* but are readily distinguished from either of those species by the armature of the oral plates, and the very coarse, nearly spherical granules of the abactinal surface. I find no species as yet described to which they are any nearer and I have therefore described them as new, but it is possible that they will prove to be only a variety of *exigua*.

* Asterina exigua.

Asterias exigua Lamarck, 1816. Anim. s. Vert., vol. 2, p. 554.
Asterina exigua Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 222.

This widely distributed Indo-Pacific species was collected at the Cape of Good Hope nearly a century ago and has also been reported from Natal. There are no specimens in the South African Museum but the Museum of Comparative Zoölogy has a specimen labelled Cape of Good Hope, received many years ago from the "Huguenot Seminary, South Africa". It is reported in numbers by Döderlein from Angra Pequena Bay.

* Asterina calcarata.

Asteriscus calcaratus Gay, 1854. Hist. fis. pol. Chile. Zool., vol. 8, p. 427.
Asterina calcarata Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 222.

Koehler (1908, Trans. Roy. Soc. Edinburgh, vol. 46, p. 632) records this species from two stations on the Cape Colony coast. He says he has compared the South African specimens with others from Chile and is sure they are identical. He also states that one specimen had 6 rays. Such a 6-rayed specimen is probably the basis of the record of *A. gunnii* from South Africa.

It is obvious that *exigua*, *dyscrita*, *calcarata* and *gunnii* are closely related forms which need much more careful comparative study than has been possible as yet. It is by no means clear how a 6-rayed individual of *calcarata* is to be distinguished from *gunnii*.

Asterina luderitziana.

Döderlein, 1908. Jahrb. Nass. Ver. Naturk. Wiesbaden, Jhrg. 61, p. 296; pl. 2.

This well-characterized species is represented in the present collection by two specimens from Walfish Bay, some distance north of the type-locality at Angra Pequena.

Asterina gracilispina*, sp. nov.

Plate XVI. Figs. 3, 4.

R = 6 mm.; *r* = 4 mm.; R = 1·5 *r*.; *v. d.* = 2·75 mm. Rays 5. Abactinal plates arranged in half a dozen distinctly imbricating series on each ray and a few additional plates at the interradial margin; secondary plates few and confined to center of disk. Each abactinal plate has the free surface covered with well-spaced minute, short, sharp spinelets. Papulae rather large, in about eight series on each ray but many series are very incomplete. Seen from above there is no evident marginal fringe of spinelets. No madreporite can be seen.

Actinal intermediate plates not very numerous, 50–60 in each interradial area, but most of these are small plates near the margin; each plate carries a single transverse series of 3–5 delicate spinelets, of which the middle ones are longest; those near mouth are ·40 mm. long but they become smaller and smaller as the disk margin is approached. In many series the spinelets appear united by a web.

Adambulacral armature in two series, as usual; the furrow series is made up of 3 or 4 slender, pointed spinelets, the middle ones half a millimeter long, united by a web; the series on the actinal surface of the plate is similar but is placed obliquely or almost directly at right angles to the furrow margin; there are rarely, if ever, more than three spinelets in this series and they are smaller than the furrow series.

Oral plates, each with five spines on the free margin and two spines on the actinal surface; of the marginal spines, the proximal two are large and flat, somewhat truncate while the other three

* *gracilis* = delicate + *spina* = spines, in reference to the delicate spinulation.

are noticeably smaller, more terete and pointed; the pair on the surface of the plate is placed transversely across the plate; each is about the size and shape of one of the larger spines of the furrow series of an adambulacral plate.

Colour (dried) dull pinkish.

P.F. 13280. Coke Rock, N. E. by E. $^1/_2$ E., 4 miles. 22 fms. R. and brk. sh. 1 specimen; young.

Holotype, South African Museum, no. A 6421.

I have been at a loss to know what to do with this little *Asterina*. I could not find a species to which it might be assigned properly, yet I hesitated to base a new species in so undigested a genus on a single small specimen. I am driven however to the latter course, as the only one which is justifiable. Moreover I do not know to what section of the genus it is most nearly related, for its spinulation is very characteristic and quite unlike any other South African species of similar form. It is however not impossible (though highly improbable) that the present specimen is a very young stage of *A. granifera*. Abundant material, of early stages of that species, alone will tell. The apparent absence of a madreporite may be an indication of very early youth.

* Anseropoda novemradiata.

Palmipes novemradiatus Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 248.

Although Bell was one of the first writers to point out the priority of *Anseropoda* over *Palmipes*, when he came to name his new species from South Africa, he lacked the courage of his convictions. Moreover he gives such a very inadequate description that were it not for the unusual number of rays, his species would be quite unidentifiable. His statement that "no *Palmipes* is known with more than five rays" ignores *Anseropoda rosacea* Lamk. which has 15 or 16 rays and has been known for a hundred years!

Anseropoda habracantha *, sp. nov.

Plate XVII. Figs. 4, 5.

R = 16 mm.; r = 11 mm.; R = 1·45 r; $v.d.$ = 3·5; $r = 3\,v.d.$ Rays 5. Form as usual in the genus, the central portion of the disk and median area of each ray rather abruptly elevated above the thin, flat interradial regions. Abactinal plates very numerous,

* ἁβρός = delicate + ἄκανθα = spine, in reference to the delicate spinulation.

crowded, arranged in very regular longitudinal and diagonal series, their outlines hidden under the spinelets: each plate carries a tuft of 10–20, slender radiating spines about half a millimeter long; the plates of the median radial series are largest. No madreporite is visible. Of papulae, a single series can be detected on each side of the median radial series of plates.

Actinal intermediate plates in regular series: each carries a transverse series of long, very slender spinelets; on the larger plates, this series consists of 8–10 spinelets, the middle ones a trifle the longest and nearly a millimeter long; on the smaller plates, as the margin is approached the spines become fewer and shorter.

Adambulacral armature consists of a furrow series of 4 (or 3) spines and an actinal series of about 5 spines; the middle spines of the furrow series are longest, exceeding a millimeter; all are webbed on the basal half; the second spine of the actinal series, which is oblique or distinctly curved, is much the longest, as a rule, and considerably exceeds a millimeter; these actinal spines are also webbed basally. All the adambulacral spines are exceedingly delicate and most of them are more or less broken and crushed.

Oral plates, each with a marginal series of 6–8 long slender spines, the innermost longest, and a surface series of 6–8 slightly smaller spines placed longitudinally on the plate.

Colour (dried) very pale woodbrown.

P.F. 909. Off East London, Cape Colony, 33° 6′ S. × 28° 11′ E., 85 fms. 1 specimen; young.

Holotype, South African Museum, no. A 6425.

It is a pity there is only a single young specimen of this interesting species. It seems to be nearest to *A. placenta* (Penn.) of Europe but comparison with small specimens of that species shows it to be quite distinct. The abactinal spinelets are much longer, giving a very different appearance to that surface. Orally too the spinulation is finer and more crowded.

ECHINASTERIDAE.

This family is poorly represented in South African waters, only three species being present in the collection before me, and no others have been recorded hitherto. Bell (1905) lists *Henricia ornata* and a species of *Echinaster*, concerning which he says only that the two specimens do not "link on" to any known species. He considers that they "closely resemble" a specimen from Port Natal, long in the British Museum, which he is "unable to determine". In spite then of having three available specimens, he not only does not describe

the new species, but neglects to give a single character by which it may be recognized. It is quite possible that it is the species described beyond as *E. reticulatus* but, at present, there is no means of knowing. The three members of the family represented in the collection of the South African Museum may be distinguished from each other as follows:

Key to the South African Species of Echinasteridae.

Abactinal plates with numerous very small spinelets	*Henricia ornata.*
Abactinal plates with isolated spines or tubercles.	
Rays short, inflated, with very large papular areas	*Poraniopsis capensis.*
Rays long, terete, with small papular areas	*Echinaster reticulatus.*

HENRICIA ORNATA.

Echinaster (Cribella) ornatus Perrier, 1869. Ann. Sci. Nat., vol. 12, p. 251. *Henricia ornata* Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 250. Döderlein, 1910, Jena. Denksch., vol. 16, p. 252; pl. 4, figs. 2–2*a*.

In view of the extraordinary diversity which *Henricia sanguinolenta* shows in nearly every character upon which species may be based, it would be most unwise to attempt to differentiate the natural forms of *Henricia* occurring in the southern temperate zone, without far more material than is at present available. Bell was wise in referring all his specimens to *ornata* and it would be foolish for me to do otherwise with the few in the present collection. They agree with each other well and there is no doubt they represent a single species. It is not so sure whether they are really *ornata* or not, but there is really little reason to doubt that, since the Cape of Good Hope is the type-locality for that species.

The individuals at hand are all well-grown, R = 34–44 mm. One individual has six subequal rays which are relatively stouter and less tapering than in the others.

S.A.M. No. 3011. Cape Colony: False Bay. Littoral. Dr. Purcell. 5 specimens.

PORANIOPSIS CAPENSIS *, sp. nov.

Plate XV. Figs. 3, 4.

R = 27 mm.; r = 13·5; R = 2r. Disk large and inflated, Rays short, wide and inflated, about 16 mm. long and 13 mm. wide at base, triangular in outline. Abactinal skeleton rather weak, with very large papular areas; on many of these areas are minute, scat-

* *Capensis* = of the Cape, in reference to the general locality whence the type specimen came.

tered, calcareous plates, a few of which carry very small spinelets. Abactinal plates with scattered spines, 1–2 mm. long, thick and pointed; these spines do not show any serial arrangement either longitudinal or transverse. Along the sides of the ray, limiting the ventral surface is an indistinct series of inferomarginal plates, each of which carries a single spine about 2 mm. long. Actinal interradial areas rather large, traversed by about five series of more or less imbricated plates, between which is thin, naked skin. Madreporite conspicuous, 2 mm. across.

Adamulacral plates, each with two spines, of which one, usually much the smaller, is on the somewhat projecting inner margin of the plate, while the other, which may be 2·5 mm. long, is on the actinal surface of the plate; these spines are either blunt or pointed, are often flattened and are more or less irregular in both size and position. Actinal intermediate plates do not extend half the length of the arm and are usually quite bare; in no interradial area are there more than half a dozen scatterd spines. Oral plates rather large, very little swollen; each carries a large, pointed flat spine at its inner end, a larger, blunt spine on the surface posteriorly and about three much smaller, sharp spines, or spinelets, on the free margin. Colour (dried) light yellow-brown, the bare skin darker than the plates.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles. 230 fms. Stones. 1 specimen.

Holotype, South African Museum, no. A 6416.

This interesting little starfish is very near the type-species of the genus, *P. echinaster*, from 53 fms. in Nassau Bay, Tierra del Fuego. It differs in the presence of only one spine on each inferomarginal plate, the lack of any serial arrangement of the abactinal spines, and the seemingly thinner skin. These differences are not important and a good series of specimens may show that the two forms are identical. But it is not desirable to list the South American species from South Africa until the identity is fully demonstrated and I have therefore given the African form a distinguishing name, for the present.

Echinaster reticulatus *, sp. nov.

Plate XV. Figs. 1, 2.

R = 75 mm.; r = 15 mm.; R = 5r; br = 17 mm.; R = 4·5br. Disk rather small; arms terete, but slightly flattened. Abactinal skeleton markedly reticulate, the papular areas quite small, and in

* *reticulatus* = netted, in reference to the network formed by the abactinal plates.

the holotype, quite depressed. The whole animal is covered with a rather thick skin, but this does not greatly obscure the abactinal skeleton. Abactinal plates carry numerous isolated spines, about a millimeter high, sharp-pointed, but with the basal half imbedded in a collar of the thick skin; when the tip is broken off or is undeveloped the spine has the appearance of a flat-topped tubercle. Madreporite small, sunken, near center of disk.

Actinal interradial areas small, with few plates, each of which carries a single spinelet, more or less imbedded in the skin. Adambulacral plates, short and numerous, as usual in the genus. Each plate bears a small furrow spine and a transverse series of three (often two) spines, which appear thick and blunt from their skin-covering; the spine on the furrow margin is longest and least blunt, the second is stoutest and bluntest, the third is distinctly the smallest. Outside the adambulacral plates, the spinulation is irregular and resembles that of the abactinal surface, but in some places there are two indistinct longitudinal series of spinelets next to the adambulacral plates; here and there a third spine accompanies these in such a way that there is a transverse comb of three spines adjoining the adambulacral series. Papulae are numerous on the actinal surface, even adjoining the adambulacral plates. Oral plates ill-defined; each bears three spines on the margin, similar to and scarcely larger than the adambulacral spines; on the surface of each plate, there is one, and frequently there are two, thick blunt spines. Colour, in alcohol, bright yellow-brown, the spinelets yellow, at least at tip.

P.F. 13509. Cape Morgan, Cape Colony, W. $^1/_2$ N., 3 miles. 17–20 fms. Rocks. 1 specimen; adult.

P.F. 15602. False Bay, Cape Colony, 18–25 fms. Sand. 1 specimen; adult.

Table Bay, Cape Colony. 1 specimen; adult.

Holotype, South African Museum no. A 6423. P.F. 15602.

The three *Echinasters* which I here list under the new name ***reticulatus*** are so unlike each other at first glance that I supposed each represented a different species, but after careful comparison I have decided it is probable the superficial differences are largely due to differences in preservation. The holotype is in fine condition and was undoubtedly living when put in alcohol but in one particular, it is imperfect, for most of the abactinal spinelets have the tips missing, so that they appear like low tubercles, and as they are quite numerous, they make the reticulations of the skeleton very conspicuous. In some cases, it is clear that the tip of the

spinelet was broken off but as a rule the tubercles seem never to have had a pointed tip.

The specimen from Table Bay looks very different. It was apparently not preserved until it had been dead for some time, so that the spines and spinelets are seldom erect but are appressed to the body wall; as they are whitish while the skin is deep brown, the coloration is quite different from that of the holotype. The abactinal spinelets are fewer than in that specimen while the adambulacral spines are more numerous (often 4 on a plate) and more slender. The double series of actinal spinelets just outside the adambulacrals is quite distinct. The reticulation of the skeleton is not at all distinct except on the distal halves of the rays, abactinally.

The specimen from off Cape Morgan is slightly smaller than the others and much lighter coloured. It is uniformly light wood-brown, the spines not much lighter and hence not in contrast. The reticulation is not so marked as in the type, partly because the skeletal plates are wider and the papular areas smaller, and partly because the abactinal spinelets are fewer and are well-spaced. The madreporite is very small and hard to find. Actinally the specimen is much like the holotype except that the spines are smaller and more slender; many adambulacral plates have only two spines, in addition to the furrow spine; the oral plates on the contrary, may have four marginal spines instead of three.

On the whole, *reticulatus* is no more variable than some of the other species of the genus and I think there is little doubt that these three specimens are really a single species. It is evident that if the genus *Othilia* is to be recognized because of the actinal papulae, *reticulatus* is an *Othilia*. On the other hand, it is superficially very near the Mediterranean *sepositus*, which is a typical *Echinaster*. It differs from *sepositus*, not only in the matter of the papulae but in the adambulacral armature. This latter feature also distinguishes *reticulatus* from several other *Echinasters* to which it is nearly allied.

CRYASTERIDAE.

This small family was instituted in 1906 by Koehler for some remarkable starfishes taken by the first French Antarctic Expedition. Additional specimens were secured by the second expedition in 1908–09, one of which represented a second species. The genus *Cryaster* is distinguished especially by the almost complete absence of a skeleton; only along the ambulacral furrows are connected calcareous ossicles present. This character is so unusual that Koehler

considered it necessary to institute a new family for the reception of the genus. The French expeditions took *Cryaster* far to the south of Tierra del Fuego, and the Shackleton expedition took it near South Victorialand, even further south from Australia. The occurrence of two specimens, which are certainly of the same family, in the PIETER FAURE collection, from shallow water in Algoa Bay, is thus of unusual interest. These individuals are obviously different from the Antarctic species but there seems to be no reason why they should not be placed in the same genus.

CRYASTER BRACHYACTIS*, sp. nov.

Plate XI. Figs. 1, 2.

R = 40 mm.; *r* = 25 mm.; R = 1·6 *r*; *br* = 27 mm. Disk very large, thick (*v. d.* = 18 mm.), dorsally flat, orally convex. Rays 5, short, wide, thick and bluntly pointed. Abactinal surface covered by a leathery body wall, a millimeter thick, in which are imbedded innumerable minute plates, each of which carries one (seldom two, very rarely more) sharp, rough spinelet, half a millimeter long; the entire upper surface is thus quite uniformly, minutely prickly. Papulae minute, very numerous, but not uniformly distributed. Seen from the inner side the abactinal body wall has the appearance of a decalcified wall in which there had been a well-developed reticulate skeleton, and the papulae are confined to the meshes of this leathery reticulation. There is however no evidence whatever of decalcification having occurred anywhere. Madreporite not conspicuous, 3 mm. across, situated about half way between the margin and center of disk.

Actinal intermediate areas large, without calcareous plates, spinules or papulae; the surface is somewhat wrinkled or folded in radial series but very superficially. The boundary between the actinal and abactinal surfaces is well-marked by a series of rather large plates buried in the skin, most of which carry several small sharp spinelets but some are armed with spines 1·5 mm. long and nearly ·5 mm. thick at base. Adambulacral plates numerous, short, wide and well developed; each plate bears on the furrow margin a stout, sharp, somewhat flattened spine, 1–2 mm. long; on a few plates here and there, this spine has distal to it, a smaller and more slender spine; on the surface of each plate is a second spine, equal to or larger than the first and very rarely a third spine, somewhat smaller, occurs at the outer end of the plate; none of these adambulacral spines

* βραχύς = short + ἀκτίς = ray, in reference to the very short rays.

are sufficiently clothed with skin to be called saccate. Oral plates flat, very small, each with four subequal spines (about 1·5–2 mm. long) on the free margin; occasionally a similar spine occurs on the surface of the plate. Pedicels in two series in each furrow. Ampullae large but single. Color (in alcohol) light brown, with a reddish-tinge orally; in life brilliant scarlet.

P.F. 18771. St. Croix Island, Algoa Bay, N.W. 3/4 W., 8 miles. 26 fms. M. 1 specimen; adult?

P.F. 19055. Nanquas Peak, Algoa Bay, N. by E., 11 miles. 57 fms. M. 1 specimen; adult.

Holotype, South African Museum no. A 6412; P.F. 19055.

One ray of the holotype shows a curious malformation, due to the forking of the ambulacrum about 12 mm. from the tip. This is obvious in the figure.

The specimen from 18771 is remarkable for the extreme contraction of the dorsal body wall, which is evidently very muscular. The rays are drawn up into an almost vertical position, so that, although each ambulacral furrow is 38 mm. long, the disk is only 23 mm. across, and from the tip of one ray to that of the next-but-one is at most only 32 mm. In all essentials of structure however this specimen agrees very closely with the holotype.

This remarkable starfish is readily distinguished from the other two members of the genus by the very short rays and the adambulacral armature. All three species are mud dwellers in shallow water but the occurrence of what was supposed to be a distinctly Antarctic genus in Algoa Bay is certainly of unusual interest. The two Antarctic species are much larger than the African and their longer rays give them quite a different appearance.

SOLASTERIDAE.

This family is best represented in the colder waters of the northern hemisphere. Only one species is recorded from the South African region. That and an undescribed species of *Lophaster* are in the Pieter Faure collection. They may be distinguished from each other easily by the number of rays. There is also in the collection a dried, 9-rayed specimen of *Solaster endeca* with the label: "? *Palmipes novemradiatus* J. Bell. Loc.? No number. (P.F. coll.)". It is highly improbable that this particular specimen was ever taken by the Pieter Faure. The species *might* occur in South African waters but it is not known south of the equator.*

* This specimen is undoubtedly South African, it being labelled as a duplicate of specimens sent to Prof. Bell [Ed.].

Key to the South African Species of Solasteridae.

Rays 8—10	*Crossaster penicillatus.*
Rays 5	*Lophaster quadrispinus.*

Crossaster penicillatus.

Sladen, 1889. Challenger Ast., p. 446; pls. 70, fig. 5 and 72, figs. 9, 10.

Although the largest of these individuals is much larger than Sladen's types, and has the rays relatively much more slender than in his figure, there is no reason to doubt their identity. Bell (1905) lists this species from half a dozen stations but gives no data whatever about the specimens. In the present collection, only two extremes of age are represented, young ones with R = 10–15 mm. and big adults with R = 55–60 mm. It is very interesting to find that of the ten young, two have only 8 rays and eight have 9, while of the five adults, only one has 9 rays and four have 10. This suggests that 10 is the normal number of rays in the species and that smaller numbers are growth-stages.

P.F. 17965. Cape Point, N. 41° E., 38 miles. 315–400 fms. S., bl. sp. 10 specimens: young.

P.F. 18206. Cape Point, N.N.E. ½ E., 14 miles. 100 fms. Gn. m. 5 specimens; adult.

Lophaster quadrispinus *, sp. nov.

Plate XVIII. Figs. 1, 2.

R = 70 mm.; $r = 20$ mm.; R = 3·5 r; $br = 20$ mm. Disk rather large, flat but quite high ($r.\ d.$ = 10 mm.) Rays 5, rather flat, tapering steadily to the pointed tip. Abactinal skeleton with rather small meshes, the papular areas usually with only 3–5 papulae. Paxillae relatively few and widely spaced, the distance between two about equal to height of column; each paxilla bears a tuft of 10–12, or more, long, slender spines, about equal to the column. Madreporite large, about 3 mm. across, nearer to center of disk than to margin. Marginal plates about 23 in each series, the superomarginals above and not alternating with, the lower series. Marginal paxillae similar to the abactinal but abruptly much larger and correspondingly conspicuous.

Actinal interradial areas fairly well developed; a series of actinolateral plates adjoining the adambulacrals, 25—30 in number, extends

* *Quadrispinus* = having four spines; in reference to the furrow series of the adambulacral armature.

nearly to the tip of the ray; proximally they are close together and there is one for each adambulacral plate but distally they are more and more widely spaced and there is only one for every other adambulacral; these plates carry a central tuft of slender spinelets; remainder of the interradial area covered by 8–12 similar but smaller plates, each with a central tuft of long slender spinelets. Adambulacral plates two to each inferomarginal, as a rule, short, moderately wide, well-spaced, the spaces often wider that the length of the plates; each plate carries on its furrow-margin 4 long slender spines, the relative lengths of which it is very hard to determine as they are all more or less broken; from the middle of the ray on, there are usually only 3 spines and near the arm-tip there are only 2; on the actinal surface of each adambulacral plate is a series of 4 (or 3 or 2) similar but slightly stouter spines, arranged in an oblique series corresponding to the width of the plates; these spines are also generally broken. Oral plates large rounded, much swollen along the suture distally; the margin of each carries 8 or 9 slender spines of which the one at tip is longest and stoutest; on the sutural swelling is a series of about 4 similar but stouter spines, the *innermost* largest. Membranes cover the actinal plates and spines, but they are thin and unite the spines with each other very slightly. Tube feet large, with well developed suckers. Colour yellowish-brown (dry) with a more or less pinkish cast in alcoholic specimens.

P.F. 2798. Vasco de Gama Peak, Cape Peninsula, N. 71° E., 18 miles. 230 fms. St. 1 specimen; young.

P.F. 15060. Lion's Head, Cape Town, S.E. ¼ S., 50 miles. 230 fms. Gr. s. 2 specimens; adult.

Holotype, South African Museum no. A 6426; P.F. 15060.

The discovery of a typical *Lophaster* in South African waters is very interesting, and the interest is increased by the fact that it is much nearer to *L. furcilliger* Fisher of the eastern North Pacific ocean than it is to *L. stellans* Sladen from the western coast of Patagonia. It differs from *stellans* in the body-form, the length of the paxillar and adambulacral spinelets and the much more numerous actino-lateral plates. From *furcilliger* it is more difficult to separate it, but the actinal intermediate areas are distinctly larger, four furrow spines are more generally present and the abactinal skeleton appears to be much stouter. From *antarcticus* Koehler, it differs in the much more numerous adambulacral plates, in having only one actino-lateral plate to each inferomarginal and in the armature of the oral plates.

The young specimen from 2798 has R only a little more than 20 mm. long; the rays are flatter, blunter and less tapering; the

actinal intermediate areas are relatively smaller; but the adambulacral armature is essentially the same, and the paxillae spinelets are characteristically long. The specific characters are thus well shown even in very small specimens.

PTERASTERIDAE.

This remarkable family of starfishes is well represented in South African waters, since two species occur in shallow water and half a dozen others are found further off shore. The family is a puzzling one and the limits of the typical genus are ill-defined. So far as the South African species are concerned, *Retaster* and *Diplopteraster* are excellent genera, sharply set off from each other as well as from *Pteraster*. But when all the known species are considered the line between *Retaster* and *Pteraster* becomes exceedingly hard to draw and that between *Pteraster* and *Diplopteraster* tends to become very hazy. So far as I can see, *Retaster* and *Diplopteraster* are quite distinct from each other and easy to separate, and it is strange Sladen should have united them.

Key to the South African Species of Pterasteridae.

Armature of adambulacral plates forming transverse combs, the spinelets united by a membrane.

Adambulacral plates alike, equally prominent and equally armed; pedicels in 2 series.

Paxillar spinelets united by conspicuous, ligamentous bands, forming a heavy reticulum, each mesh of which forms a sharply defined area, containing numerous small spiracles; R much exceeds $2r$ *Retaster cribrosus.*

Paxillar spinelets united by slender fibres, often very indistinct, not forming a regular reticulum; spiracles more or less scattered; R = $2r$ or less.

R = $1{\cdot}5r$; oral spines, 5—7; adambulacral spines, 5—7 *Pteraster capensis.*

R = $2r$; oral spines, 4; adambulacral spines, 4 *Pteraster affinis.*

Adambulacral plates unlike, a more prominent regularly alternating with a less prominent; latter with fewer adambulacral spines; pedicels in 4 series *Diplopteraster multipes.*

Armature of adambulacral plates not forming webbed combs; spinelets free.

Adambulacral armature of 3 spinelets.

Supradorsal membrane not very thin; fibres connecting paxillae indistinct; 3 oral spines on free margin of each plate . *Hymenaster latebrosus.*

Supradorsal membrane very thin; fibres connecting paxillae conspicuous; 4 or 5 oral spines on sides of each plate . *Hymenaster membranaceous.*

Adambulacral armature of fewer than 3 spinelets.

Adambulacral armature of 2 spinelets . *Hymenaster lamprus.*

Adambulacral armature of a single spinelet. *Hymenaster gennaeus.*

* Retaster cribrosus.

Pteraster cribrosus von Martens, 1867. Arch. f. Naturg., Jhrg. 33, Bd. 1, p. 109; pl. 3, figs. 2–2*c*.

Retaster cribrosus Sladen, 1889. Challenger Ast., p. 477.

When Perrier instituted his genus *Retaster* in 1878, he gave a very indefinite diagnosis, mentioned no species by name and speedily forgot his own creation, ignoring it entirely in his faunal lists. Sladen revived it and added a number of species but so far as I know no type has ever been designated and all workers have found it difficult to draw a satisfactory line between *Retaster* and *Pteraster*. If however we take *cribrosus* as the type (and I herewith so designate it), the difficulty greatly diminishes, if it does not wholly disappear. For *R. cribrosus* is a well-marked form, easily distinguished from typical *Pteraster* by the nature of the supradorsal reticulum, which is made up of ligamentous bands, becoming quite hard when dry, though apparently not calcified. Each mesh of the reticulum is a sharply defined spiracular area, with numerous small spiracles. The adambulacral plates are like those of *Pteraster* and similarly armed with a transverse webbed comb but the actinolateral spines are notably short. If we accept the character of the dorsal reticulum as the real basis for generic separation from *Pteraster*, we find that *Retaster* is a small genus with few species. Sladen lists seven species but of these only *insignis* seems to me congeneric with *cribrosus*, although *gibber* may perhaps also belong with them. Aside from these, I find no representatives of the same type of structure among all the species of *Pterasteridae* known. The other so called *Retasters* should, I think, be relegated to *Pteraster*. Von Martens records *cribrosus* from Mozambique but it is not known from south of that point. It seems to be one of the characteristic sea-stars of Zanzibar.

Pteraster capensis.

Plate IX. Figs. 3, 4.

Gray, 1847. Proc. Zool. Soc. London, p. 83.

Bell (1905) records this species under the name *Retaster capensis* from seven stations on the South African coast chiefly in shallow water. But he gives no data whatever in regard to the specimens. In the collection sent me are two large *Pterasters* from False Bay (one of the stations noted by Bell) labelled "*Retaster capensis*"? With these is the note: "We have no specimens of *Retaster capensis* bearing numbers similar to those given by Bell, but two supposed specimens

of this species are sent from False Bay, 20–30 fms". Besides these two, there are nine other *Pterasters* from half a dozen stations which seem to be identical with them. As this is evidently the common pterasterid of South Africa, I should have no question about considering it Gray's species (it answers his brief description satisfactorily) were it not that Perrier, who had seen Gray's specimen, says that *capensis* and *cribrosus* agree in having "un réseau à large mailles formées de ligaments unissant les épines," etc. The specimens at hand differ from *cribrosus* strikingly in the absence of such a reticulum, except in the outer part of the actinal interradial areas. Either Perrier was mistaken, or *capensis* is very variable in the extent to which the meshwork is developed, or the specimens before me are not *capensis*.

It is an interesting and surprising fact that these South African *Pterasters* which I am here calling *capensis*, can be distinguished only with great difficulty from specimens of the same size, of *Pteraster tessellatus* Ives from Puget Sound! In fact after careful comparison, the only constant difference seems to be in the structure of the paxillae: in *capensis* each paxilla has a single central spinelet of a size about equal to the surrounding series of 6 or 7 similar spinelets, while in *tessellatus* instead of this central spinelet is a cluster of smaller and more slender spinelets. This difference is not conspicuous but it seems to be constant and is certainly important.

Some specimens of *capensis*, and of *tessellatus* also, have a well marked reticulum along the lower sides of the rays. It is possible, though I have no evidence to support the view, that there is much variation in the extent of this reticulum and the British Museum type may possibly have it developed dorsally. But if this proves to be so, it will be useless to try and maintain *Retaster* as a separate genus.

The specimens before me range from R = 53 and r = 40 mm. (R = 1·325r), to R = 19 and r = 12 (R = 1·6r). One specimen has R = 36 and r = 20 (R = 1·8r) which is the extreme arm-length for the group in which *capensis* and *tessellatus* belong.

P.F. 2336. Lions Head, Cape Town, N. 67° E., 25 miles. 131–136 fms. Blk. spks. 1 specimen; small adult.

P.F. 2429. Lions Head N. 84° E., 38 miles. 195–204 fms. Blk. spks. 2 specimens; small adults.

P.F. 14532. Cape Point N. 50° E., 18 miles. 180 fms. Gn. s., blk. spks. 2 specimens; young.

P.F. 18154. Cape Point N.E. by E. ¾ E., 18 miles. 200 fms. Fne. s. 1 specimen; young.

P.F. 19054. Nanquas Peak, Algoa Bay, N. by E., 14 miles. 57 fms. M. 2 specimens; adult.

False Bay, Cape Colony, 20–30 fms. 2 specimens; adult.

Mossel Bay, Cape Colony. 1 specimen; adult.

Bathymetrical range, 20–204 fms.

Colour in life: dark or pale violet, either uniform or with a dark angular ring on the upper surface on a paler ground colour.

Pteraster affinis.

E. A. Smith, 1876. Ann. Mag. N. H. (4), vol. 17, p. 108.
1879, Phil. Trans., vol. 168, pl. 16, fig. 5.

The specimen before me has R = 28–30 mm., r = 15 mm., so that R = 1·8–2 r. It is thus considerably larger than Smith's type but it agrees with his description so well that I have no doubt it is the same species. The colour in alcohol is light dingy yellow.

P.F. 2798. Vasco de Gama Peak, Cape Peninsula, N. 71° E., 18 miles. 230 fms. St. 1 specimen; adult, probably.

Diplopteraster multipes.

Pteraster multipes M. Sars, 1865. Forh. Vid. Selsk. Christiana, p. 200.
Fisher, 1911. Bull. 76 U.S. Nat. Mus., pl. 107.

The occurrence of this northern species off the Cape of Good Hope is indeed remarkable. One of the specimens has R = 25 mm. and the other has R = 55 mm. I have compared them with a specimen, taken in 207 fms. off the northeastern coast of the United States, and there is no doubt, in my mind, of their identity. Fisher (*op. cit.* p. 371) has given a key to the three known species of *Diplopteraster* and these specimens run down at once to *multipes*. One would naturally expect one of the two southern species to be the South African form. Sladen can hardly have compared this species with *Retaster cribrosus* when he placed *Diplopteraster* in the synonymy of *Retaster*.

P.F. 14532. Cape Point N. 50° E., 18 miles. 180 fms. Gn. s., blk. spks. 2 specimens; 1 adult and 1 young.

Hymenaster latebrosus.

Sladen, 1882. Jour. Linn. Soc. London (Zoöl.), vol. 16, p. 230.
1889, Challenger Ast., pl. 92, figs. 4, 5.

The single specimen, which I refer to this species, has R = 27 mm. and r = 15 mm., but two of the arms seem to have been bitten or

broken off at some time and are partly regenerated; they are only 15 mm. in total length. This individual is thus somewhat larger than Sladen's type which was taken in the Antarctic Ocean, far to the south of West Australia, in 1950 fms. The South African specimen agrees well with Sladen's description and figure, except that the dorsal paxillae are fewer and they project more strikingly, and there are only two, instead of three, oral spines on the free lateral margins of the plates. These differences seem to me well within the probable range of individual diversity.

P.F. 16906. Cape Point N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gn. m. 1 specimen; adult.

Hymenaster membranaceus.

Sladen, 1882. Jour. Linn. Soc. (Zoöl.), vol. 16, p. 237.
1889, Challenger Ast., pl. 92, figs. 6, 7.

It is with much hesitation that I refer a number of small *Hymenasters*, in very poor condition, to this species. They are all small, R = 20–30 mm., and are so badly rubbed, orally, that it is impossible to determine what the armature of the oral plates was. The adambulacral plates certainly carried three short, slender spines. The supradorsal membrane is very thin and full of interlacing fibres. The type of *membranaceus* was from 1125 fms. in the northeastern Atlantic, and was larger (R = 35 mm.) than any of these South African specimens. The oral plates and armature were a very characteristic feature and it is to be regretted that all of the specimens before me have the oral plates badly rubbed. It is evident however that there were 5 small spines on lateral margins of each oral plate. In view of this fact and the character of the dorsal membrane, it has seemed to me best to refer these specimens to *membranaceus* though their identity is of course doubtful.

P.F. 16906. Cape Point N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gn. m. 7 specimens; young?

P.F. 1726. Cape Pont E. $^3/_4$ N., 42 miles. 930 fms. Gn. m. 6 specimens: young?

Hymenaster lamprus*, sp. nov.

Plate XI. Figs. 3, 4.

R = 42 mm.; r = 32 mm.; R = 1·3 r. Form almost pentagonal, as the rays are blunt and little produced and the sides are very lightly concave. Disk not very high or thick; radial paxillar areas

* λαμπρός = bright-colored, in reference to the fine colour of the actinal surface.

elevated and sharply defined, with paxillae in about half a dozen series: each paxilla has 3 or 4 rather stout spinelets, about 2 mm. long, which radiate widely and push the membrane up above themselves to such a degree that the paxilla areas look very spiny. Spiracles in small groups of 3–5, lying in widely scattered little patches of slightly thickened membrane; there are also a few straight, narrow patches of spiracles extending out onto the interradial membrane, much as in *H. nobilis*. Interradial membrane, smooth and thick, but numerous fine, interlacing fibres can be made out on its surface.

Actinally the interradial areas are smooth, but fibrous as above; the free area, not touched by actinolateral spines, is 20–25 mm. wide and 10 mm. deep. Adambulacral plates each with two subequal, sharp, slender, slightly diverging, sacculate spines; the saccules extend far beyond the spine-tips. Aperture papillae sacculate, and not peculiar, fully occupying the areas between the bases of the actinolateral spines. The latter are remarkably short, only a little over 6 mm. long, at the best; there are 25–30 on each side of each ray, but only 4 or 5 are in contact with those of the adjoining ray; from the fifth to the thirteenth or fourteenth, they are subequal, but they then become rapidly shorter and shorter. Pedicels in two series.

Oral plates short and wide, projecting greatly at the distal end; each plate carries on the free lateral margin, which is somewhat flaring, 2 subequal, sharp, slender spines; a much longer and stouter spine stands at the middle of the anterior margin and back of it, near the middle of the plate is a second, similar spine.

Colour, in alcohol; dorsally, dull pink, abruptly darker even dull claret on the interradial membrane; whole actinal surface, except the dull brown feet, deep, dull red, nearly claret.

P.F. 16932. Cape Point N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gr. m. 1 specimen; adult.

Holotype, South African Museum no. A 6446.

This handsome *Hymenaster* belongs in the same group with *glaucus* and *giganteus*, but it differs from them both in the very short actinolateral spines, and the armature of the mouth plates. While it is not impossible that it is the young of *giganteus*, it seems to me highly improbable. The arrangement of the spiracles is peculiar, reminding one a little of *nobilis* or perhaps better of *koehleri*.

Hymenaster gennaeus *, sp. nov.

Plate X.

R = 75 mm.; r = 60 mm.; R = 1·25 r. Form almost perfectly

* γενναῖος = of noble brith, in reference to the close relationship to *H. nobilis*.

pentagonal, the sides being only very slightly concave. Dorsally very similar to *H. nobilis*, but the radial paxillar areas are relatively narrower, only about 23 mm. wide or less than one-third R.; in *nobilis*, they are about ·40 R. The narrow bands of spiracles running out onto the interradial membrane are numerous and well-defined and run clear to the margin. Actinally, the ambulacra are not at all petaloid but the pedicels and ambulacral plates and armature, including the aperture papillae are very much like those of *nobilis*. The actinolateral spines are very short, only about 11 mm. long, and from the sixth to the twenty-fifth are subequal; this gives a characteristic appearance to the ambulacra. Oral plates short and wide, conspicuously projecting distally and with lateral portions a little concave, so the margin projects downward (in normal position of animal) a trifle; on the free margin of each plate are 4 (rarely 3) spines of which the innermost is quite small, the others moderate and subequal; at the inner corner of each plate is a spine, conspicuously larger than the marginal spines; back of this is a similar spine, but a little larger; and back of this again is a third spine, apparently the largest of all; these three superoral spines are close together but they do not form a straight series, as the middle one of the three is nearer the median suture than are either of the others. Colour, in alcohol, very light brown with a pink tinge.

P.F. 16825. Cape Point N.E. by E. $^3/_4$ E., 38 miles. 750–800 fms. Gn. m. 1 specimen; adult.

Holotype, South African Museum no. 6447.

This fine starfish is in excellent condition except that most of the oral and adambulacral spines are broken. Apparently however they were all sharp, though sacculate as usual. The relationship to *nobilis* is evident but the armature of the oral plates is so different from that described and figured by Sladen for the CHALLENGER's fine Antarctic species that the two forms cannot be conspecific. The shorter actinolateral spines and the longer series of interradial spiracles are also characters of *gennaeus* which cannot be ignored.

ASTERIIDAE.

This large family of starfishes, so common on the coasts of the northern hemisphere, and especially on the Pacific coast of North America, is represented by but few species in South African waters. I fully concur in Verrill's decision that the group called "Stichasteridae" is not of family rank and its members really belong in the *Asteriidae*. Perhaps *Coronaster* belongs in the *Pedicellasteridae* rather

than here but as a matter of convenience, and for lack of material, I have left it in this family.

Of the 7 species hitherto known from South Africa, only 3 are in the PIETER FAURE collection; on the other hand, that vessel secured a fourth species, which seems to be new to science. Of the four species recorded from South Africa but not in the PIETER FAURE collection, two are well defined and there is no reason to doubt their occurrence as recorded, but Bell has thrown some doubt on the validity of *Asterias capensis* and there is a possibility that *A. africana* is identical with *A. rarispina*. The following key distinguishes the eight species included in this report.

Key to the South African Species of Asteriidae.

Abactinal plates small and rather uniform, arranged in very regular longitudinal (and also transverse) series, the intervals occupied by small but distinct groups of papulae; plates well covered by small blunt spinelets and numerous pedicellariae
Stichaster felipes.

Abactinal plates not as above.
Adambulacral armature of 1 spine (monacanthid).
Rays 5.
Large pedicellariae of ambulacral furrows, slender (length 3—4 × thickness) . . . . . *Marthasterias glacialis.*
Large pedicellariae of furrows, stout (length about twice thickness).
Abactinal spines on rays few, all of one kind, stout
Marthasterias rarispina.
Abactinal spines numerous, large and small
Marthasterias africana.
Rays 6—12.
Disk moderate, its diameter ·25—·30 R; rays not very long, R = 6 or 7 *br* . . . . . *Coscinasterias calamaria.*
Disk small, its diameter only ·20 R; rays long and slender, R = 10 *br*
Coronaster volsellatus.
Adambulacral armature of more than 1 spine.
Diplacanthid (with 2 adambulacral spines); rays 5 or 6 *Asterias capensis.*
Polyacanthid (with more than 2 adambulacral spines)
Perissasterias polyacantha.

STICHASTER FELIPES.

Sladen, 1889. CHALLENGER Ast., p. 433; pl. 101, figs. 1, 2.

The specimens at hand, one with R = 88 mm. and the other with R = 44 mm., are quite typical. Verrill says this species is not a member of *Stichaster* in a strict sense, indeed he intimates that *Stichaster* is monotypic, but he does not suggest in what genus he would place *felipes*, and its final disposition may be left until the so-called *Stichasteridae* are properly revised.

P.F. 2435. Lion's Head, Cape Town, N. 84° E., 38 miles. 194–204 fms. 1 specimen; adult.

P.F. 15434. Cape Point Lighthouse, N.E. by N., 7¾ miles. 85 fms. Fne. gn. s. 1 specimen; young.

Marthasterias glacialis.

Asterias glacialis Linné, 1758. Sys. Nat. ed. 10, p. 661.
Marthasterias glacialis W. K. Fisher, 1906. Ann. Mag. Nat. Hist. (7), vol. 17, p. 575.

There are three starfishes in the Pieter Faure collection which I think must be referred to this northern species. Bell has already recorded it (1905) from three South African stations. I have compared the present specimens with others from further north and find they agree very closely with those from the Azores. The species has an extraordinary range, as it is found throughout the eastern Atlantic from Iceland to the Cape of Good Hope; it occurs also on the coasts of northern Norway and yet in the Mediterranean too! The specimens in the Pieter Faure collection are not large, R equalling 33, 50 and 90 mm. The smallest has very few spines abactinally except the median series, only 3–5 spines occurring between that series and the superomarginals. The larger specimens have a complete but not very regular lateral series on each side and some additional spines. I agree with Bell that the number of series of abactinal spines is not a valid specific character in *glacialis*. The species is beautifully figured in Ludwig's great monograph "Seesterne des Mittelmeeres", 1897, pl. 3, figs. 1–3. Much more South African material must be secured before the real relation of *glacialis* to *africana*, *capensis* and *rarispina* can be determined and the validity of the three South African species be established.

P.F. 3009. Cape Colony; False Bay. 2 specimens; adult.

Locality unknown. 1 specimen; young.

Marthasterias rarispina.

Asterias rarispina Perrier, 1875. Arch. Zool. Exp., vol. 4, p. 246.
Marthasterias rarispina Verrill, 1914. Shallow Water Starfishes of the North Pacific Coast, p. 47.

There is a well-preserved sea-star in the present collection which seems to me undoubtedly a representative of this species. It is apparently adult, R = 85 mm., (but as Perrier gives no measurements whatever, it is impossible to show how its size compares with that of the type). The abactinal surface of the rays is extraordinarily bare; there are only 10–12 spines and these are all in the median radial

series; they are less stout and much sharper than the corresponding spines in *glacialis*; many of the superomarginal plates, more particularly on the basal half of the ray bear no spines. The colour of this specimen is deep, dull purplish-pink, in alcohol.

P.F. 13743. Great Fish Point, Cape Colony, N. by W., 7 miles. 49 fms. S., sh. 1 specimen; adult.

* Marthasterias africana.

Asteracanthion africanus Müller and Troschel, 1842, Syst. Ast., p. 15.

This species has never been figured or even fully described. The type locality is the Cape of Good Hope. A specimen of *Marthasterias* before me from Port Natal is regarded by Dr. W. K. Fisher as probably *africanus*, and it is from this specimen, and not from published descriptions, that the character emphasized in the key on p. 304 is taken.

* Coscinasterias calamaria.

Asterias calamaria Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 179. De Loriol, 1885. Cat. Rais. Ech. Mauritius: Stellérides, pl. 7, figs. 1, 2. *Coscinasterias calamaria* Perrier, 1894. Trav. et Talisman Stell., p. 106.

This sea-star, characteristic of the Australian and New Zealand coasts, has long been known from Mauritius and de Loriol says it is common there. Bell (1905) reports a specimen from rock pools at low tide, in Three Anchor Bay, Cape Colony, but evidently it is rare in South African waters. There are none in the present collection.

* Coronaster volsellatus.

Asterias (*Stolasterias*) *volsellata* Sladen, 1889. Challenger Ast., p. 584; pl. 107, figs. 1–4.

Coronaster volsellatus Fisher, 1917. Proc. Biol. Soc. Washington, vol. 30, p. 25.

The type-locality for this species is in the Philippine Islands but Bell (1905) ascribes "some remarkable fragments", "dredged off Great Fish Point Light House, N. by W. $^3/_4$ W., 17 miles", in 100 fms., to this species.

* Asterias capensis.

Perrier, 1875. Arch. Zool. Exp., vol. 4, p. 258.

Little is known of this species, which was based on a specimen from South Africa, in the British Museum. Bell (1905) lists a spe-

cimen; "Dredged off Cape St. Blaize, N. by E. 1/4 E., 65 miles. Depth 89–90 fms." As I have never seen a specimen, and no adequate description or figure has been published, I do not know in what genus it really belongs. But it is probably not a true *Asterias*. At one time (1882) Bell thought it identical with *glacialis*, which would indicate it is a *Marthasterias*.

Perissasterias *, gen. nov.

Abactinal skeleton made up of more or less cruciform plates, arranged in numerous (15–17) longitudinal series, united internally by strong, transversely placed supplementary ossicles; the exact position of these ossicles is more or less oblique and occasionally longitudinal. Abactinal spines small and numerous, more or less wreathed with pedicellariae or with a cluster of pedicellariae near the tip. Median radial series of spines somewhat larger than the others and united together in longitudinal or oblique pairs and trios. Papulae numerous but none below the inferomarginals. Actinolateral plates wanting. Adambulacral plates very wide and short, *each with a close-set transverse series of six, or usually seven spines*; each of these spines bears one or more pedicellariae at or near the tip. Major and minor pedicellariae numerous, but small; no very large pedicellariae anywhere. Pedicels in four very regular parallel series, extending nearly to extreme tip of ray.

This remarkable genus is sharply distinguished from the rest of the family by the adambulacral armature. The absence of actinolateral plates makes the actinal skeleton very simple but the excessive width of the adambulacral plates provides the necessary area for the attachment of the numerous crowded spines.

Perissasterias polyacantha **, sp. nov.

Plate XVIII. Fig. 3.

R = not less than 310 mm.; *r* unknown; *br* = 40 mm.; R = nearly 8 *br*. Disk unknown. Ray wide at base, somewhat flattened, tapering steadily to the blunt tip; the ray is widest, not where it joins the disk but somewhat distal to that point. Abactinal skeleton made up of numerous series of plates arranged in longitudinal series of more or less regularity; the median series is largest and is more elevated

* *περισσός* = above measure, excessive + *Asterias*, in reference to the exceptional development of adambulacral spines.

** *πολυάκανθα* = having many thorns, in reference to the numerous adambulacral spines.

than the others; at the base of the arm there are *eight* series on each side between the median plates and the superomarginals. Median series with spines about 5 mm. long, and over a millimeter thick, bluntly pointed and with a wreath of minor pedicellariae; these spines are arranged in longitudinal or oblique pairs or trios which are apparently more or less fused together at base and are there enclosed in a common sheath of thick skin. The remaining abactinal spines are somewhat smaller (about 4 mm. long) and more slender and pointed; near the median series they are usually single and have a distinct wreath of minor pedicellariae but near the marginals there are often two and sometimes three spines on a plate and the wreaths of pedicellariae are reduced to irregular clusters. Superomarginal plates relatively rather large, each with a group of four or five irregularly placed spines about 4 mm. long, blunt and slightly widened and even flattened at the tip; there are several minor pedicellariae, as a rule, on each of the spines. Inferomarginals somewhat smaller than the upper series, each with three, or rarely four, spines, similar to those above them but a little smaller; as a rule these inferomarginal spines form an oblique series but they are occasionally irregularly placed; they are in close proximity to the adambulacral spines. No actinolateral plates whatever. Adambulacrals about 6 mm. wide and not quite a millimeter long; each carries a series of six or more commonly seven spines, of which the innermost are about 5 mm. long and the outer about 3·5 mm.; these spines are much more slender than those of the abactinal plates and each carries one or more pedicellariae near the tip. Papulae very numerous, in groups in every interspace above the inferomarginals. Pedicellariae, both major and minor, abundant; the latter are about ·40–·50 mm. long and not only compose the wreaths and clusters on the spines but are widely scattered on the skeletal plates and papular areas; the major pedicellariae are about ·60–·75 mm. long and occur all over the animal, even in the ambulacral furrow and attached to the adambulacral spines. Colour dull yellowish-brown.

P.F. 2105. Lion's Head, Cape Town, S.E. ½ E., 42 miles. 156 fms. Dk. gn. s. 1 arm of a large adult.

Holotype, South African Museum no. A 6445.

It is of course to be regretted that there was no complete specimen secured of this remarkable starfish, but it is a cause for gratification that the arm taken is so well preserved that both generic and specific characters are unmistakable. It is a little hard to decide with what genus *Perissasterias* is most nearly allied but probably the group which Perrier has named *Distolasterias* may be considered

its nearest relative, although the type of that genus is from Japanese waters, and no species are known from the southern oceans. Some species of *Asteriidae* are already known which occasionally have three adambulacral spines on a plate, but there are no connecting links between such forms and this remarkable South African starfish.

BRISINGIDAE.

This remarkable family, not hitherto known from South African waters, is represented in the PIETER FAURE collection by the following species.

BRISINGA CRICOPHORA.

Sladen, 1889. CHALLENGER Ast., p. 606; pl. 109, figs. 6–8.

There are two specimens of *Brisinga* in the collection from South Africa, and they seem to be representatives of this species which Sladen described from a single fragmentary individual taken in the West Indies. The specimens before me answer well to Sladen's description and figures except in two or three points. The type of *cricophora* had but 11 rays while each of the PIETER FAURE specimens had 13, though all are now detached. As the number of arms in other species of *Brisinga* shows no little diversity, it is not strange that this discrepancy occurs. On many adambulacral plates there may be on the aboral margin, well up in the furrow, one or even two very delicate spines. These would have been very easily overlooked by Sladen if he did not dry his specimen. The oral plates have three pairs of superoral spines, instead of two as in Sladen's description, and two on each margin instead of one. These differences are too trivial it seems to me, in the light of such scanty material, to warrant describing the South African Brisinga as a distinct species. The type of *cricophora* was 20 mm. across the disk; the present specimens are about 24 mm. The curious actinal spines at the base of the ray are quite well marked but rather similar spines occur in a specimen of *B. endecacnemos* in the M. C. Z. collection. This specimen was collected by the TALISMAN and identified by Perrier, by whom it was sent to the M. C. Z. If Sladen is right in stating that the basal actinal spines in *endecacnemos* are needle-like, this TALISMAN specimen ought to be referred to *cricophora*, but I have no authentic material of *endecacnemos* for comparison.

P.F. 18960. 36° 44′ S., 21° 44′ E., 250 fms. Gn. s., st. 2 specimens: adult.

Fisher (1917, Ann. Mag. Nat. Hist. (8), vol. 20, p. 426) places *cricophora* in his genus *Craterobrisinga*, a group separated from *Bri-*

singa by differences in the adambulacral armature which seem to me hardly of generic significance. For the present at least I think *cricophora* may remain in *Brisinga.*

BRITTLE-STARS. OPHIUROIDEA.

Brittle-stars form a relatively small part of the South African echinoderm fauna, there being fewer species represented than there are sea-stars and scarcely a dozen seem to be common along shore. Döderlein, in his list referred to previously (see p. 222), names 29 species as occurring in water of less than 278 fms. but one of these (*Ophiozona capensis*) is synonymous with another (*Ophiura costata*) and two others (*Ophioderma tonganum* and *Ophiothrix roseocoerulans*) are due to mistaken identifications. The collection from the South African Museum contains over 1200 specimens representing 44 species, of which 22 are in Döderlein's list. There are however 5 species hitherto known from Mozambique and one from Algoa Bay, as well as two from deep water off South Africa, and hence not listed by Döderlein, which fall within the scope of this report. There is also a species (*Ophiocnemis marmorata*) in the collection of the M. C. Z. from the Cape of Good Hope, collected by Wahlberg, of which Döderlein was necessarily ignorant. There are thus 57 species of brittle-star included in the present report, of which however only 6 are new to science: these are here described for the first time.

Of the 57 species, 30 are truly littoral occurring in water less than twenty fathoms deep, while 5 are strictly abyssal occurring only (or, at least, generally) in water beyond 600 fms. The remaining 22 species may be classed as continental.

Of the 30 littoral species, 16 seem to be endemic and as all but one have been known for some years, it is fair to say that half the littoral brittle-stars are characteristic forms. Of the remaining 14 species, 12 are East Indian or Indian Ocean forms while one (*Amphipholis squamata*) is cosmopolitan and one (*Ophiothrix fragilis*) is European. None of the littoral species are known from either South America or the southern coasts of Australia. It is noteworthy that of the 30 littoral brittle-stars here treated as South African, 8 are not known from south of Mozambique and one or two others are of very doubtful occurrence south of that point.

Of the 22 continental brittle-stars, no fewer than 14 are endemic, five of these being here described for the first time. The continental fauna is thus a very characteristic one. Of the eight species not

endemic, two are antarctic, two are known from southern South America and one is known from Australia and the East Indian region. There are therefore no fewer than 19 distinctly austral species in the 22 making up the continental fauna. The remaining three species are more or less cosmopolitan in deep water and their occurrence in South African waters is thus of uncertain significance. Two of the three are species of *Ophiactis*, a difficult genus, the distribution of whose deep water species is still a puzzle. The other cosmopolitan ophiuran is *Asteronyx loveni*, which was originally discovered in Norwegian seas, but has since been taken in the North Atlantic, North Pacific and Indian oceans, as well as among the West Indian Islands, off the Western coast of Mexico and off the southeastern coast of Australia.

Of the 5 abyssal ophiurans included in the present report, none are endemic but all are well-known and wide-spread species. Two are known from both the North Atlantic and North Pacific and two from the North Pacific and East Indian regions. One, *Ophiernus vallincola*, being previously known only from the North Atlantic and the Antarctic abysses, would naturally be expected in the deeps off South Africa.

In conclusion then, we may say, in the light of our present knowledge, that the brittle-star fauna of South Africa is quite characteristic, more than half (30) the known species being endemic and five others being distinctly austral forms. Nearly half the remaining species are not really part of the South African fauna at all, as they are not known from south of Mozambique. The affinities of the littoral species are distinctly Indo-Pacific and yet there are two notable cases of Atlantic relationship, in *Ophiothrix fragilis*, an European species, and *Ophioderma leonis*, a member of a very characteristic West Indian genus. The continental fauna is more emplatically endemic than is the littoral, and its affinities are clearly not Indo-Pacific, as only four or five of its members are certainly derived from that side of Africa, while twice as many have a more or less clearly marked relationship to the Atlantic fauna and three are distinctly austral, two being Antarctic. The impression made by the study of the sea-stars that the shallow water fauna is of Indian origin while that of the deeper water is from the west, is thus strengthened by study of the brittle-stars.

There is surprisingly little similarity between the brittle-stars of Australia, or those of southern South America, and those of South Africa. The small and specialized genera *Ophiomisidium* and *Dictenophiura* have Australian species but they are also known from the

Atlantic, while the fine *Ophiothrix aristulata*, which seems to unite the Cape deep waters with those of the southern coasts of Australia, is also known from the East Indies and Indian Ocean. As for the South American connections, the *Ophiomyxa* of Agulhas Bank may not be the South American species, so that *Gorgonocephalus chilensis* is the only species actually common to the two regions.

The 57 species included in the present report belong to 11 families. They can be most easily distinguished from one another if these families are first differentiated, which the following key attempts to do. Thanks to the brilliant work of Matsumoto, the families of brittle-stars are now beginning to take on tangible form. Under each family will be found a key to its South African representatives.

Key to the South African Families of Ophiuroidea.

Disk and arms covered with a smooth skin; upper arm plates rudimentary or wanting; side arm plates ventral or subventral in position.

Arms simple, not very long, 3—5 times disk-diameter, not capable of vertical coiling . . . . . *Ophiomyxidae*, p. 313.

Arms branching, or if simple, very long, capable of being vertically coiled.

Teeth present in a vertical series on each jaw tip; arms not annulated with bands of microscopic hook-bearing granules *Trichasteridae*, p. 314.

No true teeth; arms annulated with double series of hook-bearing granules *Gorgonocephalidae*, p. 315.

Disk and arms not covered by a smooth skin; upper arm-plates usually well-developed; side arm-plates not ventral or subventral in position (except when upper arm-plates are unusually wide).

Arm-spines moderately or quite long, more or less at right angles to long axis of arm, never minute or closely appressed.

Upper arm-plates small, more or less triangular, in contact (if at all) only at base of arm; teeth triangular or sharply pointed; oral papillae well-developed, 3 or more on each side . *Ophiacanthidae*, p. 319.

Upper arm plates well-developed, forming a more or less continuous series, or if triangular and discontinuous, then teeth broad, squarish and oral papillae only 1, 2 or 0 on each side.

Dental papillae none; two proximal oral papillae may occupy tip of jaw.

Not more than 4, often only 2 or 3, oral papillae on each side of jaw . . . . . *Amphiuridae*, p. 325.

5 oral papillae on each side of jaw *Ophiochitonidae*, p. 343.

Dental papillae present in a cluster at tip of jaw.

No oral papillae . . . *Ophiotrichidae*, p. 335.

Oral papillae several on each side of each jaw *Ophiocomidae*, p. 347.

Arm-spines small or at least slender, often minute, closely appressed to side arm-plates.

Disk closely granulated (rarely some plates are visible); arm-spines 5—10, short, subequal. . . . . *Ophiodermatidae*, p. 349.

Disk without, or with a fugaceous coat of granules; arm-spines rarely more than 3, uppermost often decidedly longest (numerous and subequal in *Ophiomusium lymani*).

Arms inserted laterally to disk; arm-spines 3 or rarely more
Ophiolepididae, p. 353.

Arms inserted ventrally to disk; ventral arm-plates small, covering only a narrow median area on lower surface of arm; arm-spines 2
Ophioleucidae, p. 365.

N.B. Statements made in the above key are not intended to apply to each family as a whole but only to its South African representatives.

OPHIOMYXIDAE.

This family seems to have but two representatives in South Africa, each representing a wide-spread genus. Each occurs in the PIETER FAURE collection but each has been recorded before at least once. They may be distinguished from each other as follows:

Key to the South African Species of Ophiomyxidae.

Second (outer) oral tentacle-pore small, opening within the mouth slit; oral papillae flat with wide somewhat serrate tips, the distalmost smallest *Ophiomyxa vivipara*.
Second oral tentacle-pore large, opening on oral surface of mouth plate; oral papillae spiniform, the 3 distal ones conspicuously longest and largest
Ophioscolex dentatus.

OPHIOMYXA VIVIPARA.

Studer, 1876. Monatsb. K.-Preus. Akad. wiss. Berlin, p. 462.
H. L. Clark, 1915, Mem. M. C. Z., vol. 25, pl. 2, figs. 1, 2.

The specimens at hand agree very well with those taken by the CHALLENGER on the Agulhas Bank, but they are not so closely similar to specimens from the Strait of Magellan. The available material is neither of sufficient quantity nor of suitable quality to determine whether the South American and South African are actually identical. The few specimens before me suggest that they are distinguishably different. The largest of the PIETER FAURE specimens is about 20 mm. across the disk (dry) and has arms 80–90 mm. long. It is of a nearly uniform pale reddish-brown, the disk somewhat darker.

Station 2528. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. spc. 5 specimens; adult.

Station 13225. Cove Rock, N.W. $^3/_4$ W., 13 miles, 80–130 fms. Crl. and r. 1 specimen; adult.

OPHIOSCOLEX DENTATUS.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 157; pl. VII, figs. 184–186.
1882, CHALLENGER Ophs., pl. XXIV, figs. 4–6.

Mr. Lyman's figures are better in his preliminary, than in his final report. In neither case do they correspond closely to his excellent description. The picture of the remarkably long outer oral papillae is particularly bad in the CHALLENGER report and even in the preliminary paper, they are not represented nearly long or slender enough. The four, long, flat, blunt arm-spines are better represented as to form, in the preliminary paper, but number, position and relative size are much better shown in the final plate. Apparently Mr. Lyman did not examine a dry specimen or he would not have called the tentacle-scale rounded, when it is conspicuously spiniform, nor would he have said "the upper arm-plates are only indicated by thin films of slightly calcified skin". The upper surface of the arms, at least the basal half, is covered by numerous small but distinct plates, similar to but rather larger than those which cover the disk.

This species was taken by the CHALLENGER only on the Agulhas Bank, but Bell (*op. cit.* p. 259) records it from "off Buffalo" in 195 fms. The specimens before me in the PIETER FAURE collection have a disk diameter, ranging from 9–18 mm.; the largest is thus somewhat larger than Lyman's type.

Station 2386. Lion's Head, N. 76° E., 28 miles, 140 fms. Blk. spc. 1 specimen; half grown.

Station 2528. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. spc. 3 specimens; adult.

TRICHASTERIDAE.

This family is poorly represented in South African waters, only the two following species having been found and these very sparingly. They are easily separated from each other as follows:

Key to the South African Species of Trichasteridae.

Arms long, 8—10 times disk-diameter or more, with 4 or 5 minute arm-spines on each side arm plate. . . . . *Asteronyx loveni.*

Arms short, scarcely twice disk-diameter, with only 2 minute arm-spines *Ophiuropsis lymani.*

ASTERONYX LOVENI.

Müller and Troschel, 1842. Sys. Ast. p. 119; pl. 10, figs. 3–5.

The discovery of this species off South Africa is interesting but not surprising. It has been known previously from almost all parts

of the world in deep, cold water. The largest of the PIETER FAURE specimens is still young, with the disk only 12 mm. across, while others are only half as large. I have compared the specimen with those of similar size from other regions and find no differences to which weight may be given. The oral papillae are shorter, flatter and more regularly arranged than in most northern specimens and in this particular, the South African specimens approach most nearly to one from off Victoria, but some northern specimens show a similar tendency and I do not think even a varietal name can be given to the southern form.

Station 17268. Cape Point, E. $^3/_4$ N., 42 miles, 930 fms. Gn. m. 2 specimens; very young.

Station 17303. Cape Point, E. $^3/_4$ N., 41 miles, 890 fms. Gn. m. 2 specimens; young.

* OPHIUROPSIS LYMANI.

Studer, 1884. Abh. K.-Preus. Akad. wiss. Berlin, p. 55; pl. V, figs. 12*a–d*.

This remarkable little ophiuran is known only from the holotype (disk-diameter, 6 mm.; arm-length, 10 mm.) which was taken by the GAZELLE off Spencer Bay, Southwest Africa, in 60 fms. The colour in life was rosy red. It is quite possible that this will prove to be the young of some other genus but we have no clue yet as to its relationships. The first spelling of the specific name was with two n's but as a subsequent spelling (in the Explanation of Pl. V) is correct, we must treat the first as a slip of the pen or a typographical error.

GORGONOCEPHALIDAE.

This interesting family is represented in the region about the Cape by only three species, of which two have the much-branched arms which have led to the fisherman's name of "basket-fish".* Both of these have long been known from South Africa but the third species, having unbranched or simple arms, is a discovery of the PIETER FAURE. The three forms are very easily distinguished from each other by obvious characters. The simple-armed species and one of the basket-fish seem to be endemic but the other basket-fish has an extraordinarily wide distribution, ranging as it does from Chili, Argentina and the Falkland Islands to Kerguelen and Heard Island.

* This is the colloquial name of an allied species, on the New England coast.

Key to the South African Species of Gorgonocephalidae.

Arms simple . . . . . *Astrothamnus papillatus.*
Arms much-branched.
Nearly all tentacle-pores before first fork of arms guarded by minute arm-spines . . . . . *Gorgonocephalus chilensis.*
No arm-spines on basal tentacle-pores* . . . *Astrocladus euryale.*

ASTROTHAMNUS PAPILLATUS **, sp. nov.

Plate XX. Figs. 5, 6.

Disk 18 mm. across; arms rather more than 100 mm. long. Disk slightly tumid, the ridges formed by the radial shields wide (3 mm. distally) and not conspicuous, though the interradial depressed groove is fairly well marked, thus defining clearly the radial wedges. Whole upper surface of disk covered by coarse granules, the largest nearly a millimeter in diameter; they are well-spaced but there are scattered among them smaller granules with which they intergrade; the larger granules usually are rough or even prickly on the top. Arms 4 mm. in diameter at base but tapering rather rapidly to the attenuate tip. From their very base the arms are encircled by alternating bands of fine and coarse granules; the former bear numerous minute hooks and hooklets while the latter are more or less nearly smooth. There are two or three (rarely more) series of granules in each band; when more than two, the marginal series are the coarsest.

Interbrachial areas below rather small and covered with a coat of very fine granules, abruptly and conspicuously smaller than those at the margin of the disk. Genital slits fully 3 mm. long. Surface of jaws and mouth frame and lower surface of arms as well, covered by a rather uniform coat of fine granules, coarsest on the interradial portions of the mouth-frame. Teeth, tooth-papillae and oral papillae present, spiniform and similar except that the teeth are much the largest and the distal oral papillae are smallest. First pair of tentacle-pores of arm naked and small, nearer together than the following; second pair with 2 short, slightly thorny arm-spines; third pair with 3 or 4; following pairs with 4 or usually 5 and very rarely 6. Colour, drled from alcohol, light yellow-brown.

P.F. 12872. East London, N. 15 miles, 310 fms. M. 9 specimens; adult and young.

* In specimens more than 15 mm. across disk. Young specimens may have minute arm-spines on all but the first pair of pores. Such specimens may be distinguished from young *G. chilensis* by the absence of granules on the disk and the generally smooth appearance of both surfaces of the body.

** *papillatus* = having papillae, in reference to the numerous oral papillae.

P.F. 14380. Cape Hangklip, N.N.E. 31 miles, 95 fms. Gn. s. 1 specimen; very young.

P.F. 18229. Cape Hangklip, N.E. $^1/_2$ E. 5 miles, 60 fms. Gn. m. 1 specimen; adult.

Holotype, South African Museum, no. A 6443. P.F. 18229.

The growth-stages as revealed by this interesting series are most interesting. The smallest individual has the disk only 3·5 mm. across, and the arms about 18 mm. long; the proportion is thus about the same as in the adult. Conspicuous radial shields about ·75 mm. long and ·40 mm. wide are present in two adjoining radii but are lacking in the other three; in one of these three the arm is noticeably smaller than in the other four radii. There is thus some indication of an earlier reproduction by fission, but none of the other specimens hint at such a possibility. The disk granules are few but relatively large. Most of the arm-segments have only 2 arm-spines and none has more than 3. The genital slits are well developed.

The next specimen in size is 7 mm. across the disk. Radial shields, 1 mm. long by ·50 mm. wide, are distinguishable; they are more or less surrounded by a series of minute granules, but as many disk granules are nearly a millimeter in diameter, they are not very distinct. Some of the basal arm-segments have 4 arm-spines, but those near middle of arm have only 3 and distally only 2. In specimens 9 mm. across the disk, there are no radial shields visible; their position is indicated by a group of minute granules; the appearance is as tho the little granules which surrounded the radical shields had closed in over the shield and buried it. The specimens from off East London are dry and are clasping coral fragments, cidarid spines, etc.; they are light brownish-white, and the arms are tightly coiled, so their general appearance is quite unlike that of the holotype, at first glance.

This species is as isolated structurally as it is geographically. The four species of *Astrothamnus* previously known are all Asiatic; one from the coast of Oman, two from the East Indies and one from Japan. The South African form is nearest to the Japanese species, *echinaceus*, so far as can be judged from descriptions and figures but it differs in the presence of numerous oral papillae, in the possession of arm-spines guarding the second tentacle-pore, in having 4–6 arm-spines on the basal arm-segments (instead of only 3) and in the finer and more even granulation of the oral surface. In the possession of oral papillae, *papillatus* resembles *bellator* from the Sulu archipelago, but the differences in the granulation of the

disk, on both surfaces, and in the tentacle-pores and arm-spines are quite evident. Matsumoto gives the absence of oral papillae as a characteristic of the genus *Astrothamnus* but Koehler's figure of *bellator* (1904, Siboga-exp. Oph. Mer Prof., pl. XXVIII, fig. 8) shows them distinctly and they are certainly well marked in the present species. All the papillae of the jaws are so similar that their extension distally along the sides of the mouth slits is hardly of sufficient importance to affect the position in the genus *Astrothamnus*, of the species so characterized.

Gorgonocephalus chilensis.

Astrophyton chilense Philippi, 1858. Arch. f. Naturg., vol. 24, p. 268.
Gorgonocephalus chilensis Lyman, 1882. Challenger Oph., p. 261. Döderlein, 1911. Japan. Euryalae, pl. 5, fig. 5; pl. 8, figs. 1 and 1*a*.

This widespread and variable species is represented in the present collection only by small specimens. Those from 2798 resemble the Patagonian form in that the disk granules are widely scattered, low and rounded, only a few at center of disk and on the radial ribs rising into conical tubercles. The other specimens have the center of the disk and especially the ribs crowded with relatively big conical tubercles, more as in Kerguelen specimens. I have sought in vain for some character or group of characters by which the South American and Falkland Island *Gorgonocephalus* might be constantly distinguished from the South African and Kerguelen specimens. Perhaps in the future, more abundant material will make such a separation possible and desirable, which is not the case at present.

The larger individuals in the Pieter Faure collection are carrying on their backs much younger ones. This at least suggests that the species is viviparous and the young remain with the mother until well grown. In one case before me, an individual with a disk 25 mm. across carries, well-fitted into the very middle of its abactinal surface, a young one only 10 mm. in disk-diameter. In another case, the larger specimen carries two small ones, one near the center, the other near the margin of the disk. The young ones are clinging very tightly, some of the ultimate arm divisions entering into the genital slits of the carrier.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 15 miles, 230 fms. Stns. 2 specimens; rather young.

P.F. 18154. Cape Point, N. E. by E. ¾ E., 28 miles, 300 fms. Fn. s. 7 specimens; small adults and young.

ASTROCLADUS EURYALE.

Asterias euryale Retzius, 1783. K. Vet. Akad. Hand., vol. 4, p. 243.
Astrocladus euryale Döderlein, 1911. Japan. Euryalae, p. 28.
Gorgonocephalus verrucosus Lyman, 1882. CHALLENGER Oph., p. 262.
L. Agassiz, 1839. Mem. Soc. Nat. Hist. Neuchatel, vol. 2, no. 8, pls. 1–3.

This very fine species, with only one exception known the longest of any member of the family, seems to have a very limited range as it has not yet been found anywhere except in the vicinity of southernmost Africa. The PIETER FAURE collection contains five specimens, of which two are fine adults, 60 and 65 mm. across the disk, and the remainder are about half as large.

P.F. 18381. Flesh Point, N. 6 miles. Depth and bottom unknown. 3 specimens; small adults.

False Bay. 2 specimens; fine adults.

OPHIACANTHIDAE.

This large and cosmopolitan family is very poorly represented in the seas about South Africa. Only three of thirty-three genera occur and each of these has but one representative. The genus *Ophiacantha* with more than 125 valid species was not hitherto known from the region but the PIETER FAURE has found a very characteristic species at a considerable number of stations. The three South African ophiacanthids are readily distinguished from each other as follows.

Key to the South African Species of Ophiacanthidae.

Radial shields small and nearly or quite separated; outermost oral papilla not wide and operculiform.

Disk closely covered with granules and a few, more spiniform grains; upper arm-plates large and in contact at base of arm *Ophiacantha nerthepsila.*

Disk scales evident, each with one rough-pointed, thick, short cylindrical spinelet; upper arm-plates small and widely separated *Ophiomitrella corynephora.*

Radial shields relatively large and broadly in contact; outermost oral papilla wide and operculiform . . . . . *Ophiothamnus remotus.*

OPHIACANTHA NERTHEPSILA *, sp. nov.
Plate XIX. Figs 3, 4.

Disk 7 mm. in diameter; arms 25 mm. long. Disk covered with scales which, except around margin, are completely concealed by a

* νέρθε = below + ψιλός = stript bare, in reference to the bare interbrachial areas below.

close coat of granules, among which are scattered irregularly a number of spiniform grains; there are 75–100 of the nearly spherical granules to each square millimeter of surface: the spiniform grains are 3–4 times as high as thick, pointed and well-spaced. Radial shields narrow, widely separated, only the distal tip visible. Upper arm-plates large, in contact basally but soon becoming slightly separated; they are broadly triangular, with slightly convex sides but the shape is variable owing to the degree of convexity of the proximal sides; some or all of the basal plates have these sides so strongly convex that they are almost bell-shaped and are nearly as long as wide. In the holotype however most of the upper arm-plates are distinctly triangular with a convex distal margin. Inter-

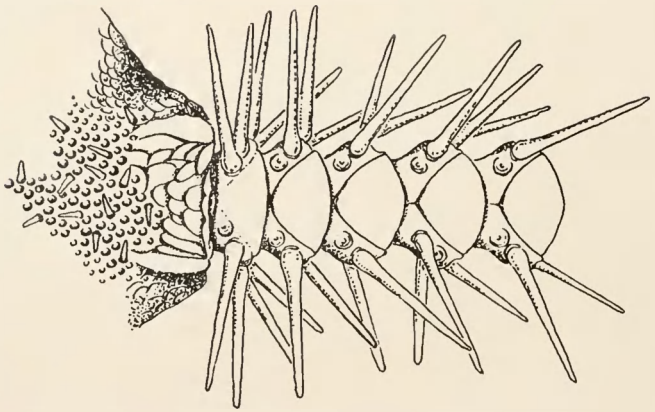

Fig. 1. Upper side of part of disk and arm of *Ophiacantha nerthepsila* sp. nov. Some of the arm-spines removed. × 10.

brachial areas below, and margin of disk both radially and interradially covered by overlapping scales, which are quite bare and entirely free from granules. Genital slits wide but short, reaching from the oral shields not quite to the second series of arm-spines. Oral shields diamond-shaped, twice as wide as long; madreporite much bigger than the others, its length and breadth more nearly equal. Adoral plates large, quadrilateral, in full contact interradially, about equally wide at the two ends, but the proximal margin longer than the distal. Oral plates small and ill-defined but each bears 4 (or 3) small, flat oral papillae; these are twice as wide as long, the outermost is distinctly the widest and bluntest; one or more of the others may be pointed. There are 6 teeth in each column, the lowest one or two pointed and somewhat triangular but

the upper ones blunt and squarish. First under arm-plate moderate, hexagonal, a trifle wider proximally than distally; second plate large rather axe-head-shaped but much wider than long; succeeding plates somewhat oblong, wider than long, but soon becoming squarish, distal corners rounded; all the under arm-plates are separated from each other more or less widely. Side arm plates not large or with prominent spine ridges, meeting both above (except at base of arm) and below; the basal plates bear 7 or 6 smooth, pointed spines, the uppermost longest and equal to at least two arm segments; on the first segment outside the disk, the rows of spines are closely approximated dorsally and on the second segment they are fairly close but the number of spines then drops to 5 and they do not approach each other dorsally; the lowest spine is smallest and bluntest and scarcely equals one arm-segment. Tentacle-scale single, blunt and spine-like. — Colour (dry): — pale brown, lightest below: disk with faint indications of white variegation and arms very faintly banded on the upper side distally.

P.F. 12983. Gonubie River, N. W. by W. $^3/_4$ W., 3 miles, 20 fms. Brk. sh. 1 specimen: small adult.

P.F. 13193. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh. and r. 1 specimen; small adult.

P.F. 13240. Cove Rock, N.E. $^3/_4$ E., 5 miles, 43 fms. St. and brk. sh. 4 specimens; small adults.

P.F. 13280. Cove Rock, N.E. by E., $^1/_2$ E., 4 miles, 22 fms. R. and brk. sh. 1 specimen; small adult.

P.F. 13455. Sandy Point, N.E. by N., 6 miles, 51 fms. Brk. sh. and st. 1 specimen; adult.

P.F. 13619. Great Fish Point, W. by N., 5 miles, 22 fms., R., crl., st. 1 specimen; adult.

P.F. 13801. Riet Point, N.E. by E., 2 miles, 23 fms. S. and st. 12 specimens; adult.

P.F. 15502. False Bay, 22 fms. S. and sh. 1 specimen; small adult.

P.F. 15627. False Bay, 17–27 fms. R. 2 specimens; adult and young.

P.F. 16231. False Bay, 22 fms. Brk. sh. 1 specimen; small adult.

Bathymetrical range, 17–51 fms.

Holotype, South African Museum no. A 6437. P.F. 13801.

This is a well marked species in a genus of perplexing specific lines and is not near enough to any species yet known to cause any difficulty. The long approximated spines at the base of the

arms, the bareness of the sides and lower surface of disk, the big upper arm-plates and the covering of the disk itself make a combination of characters which are quite distinctive. The species is evidently not a rare one on the southeastern coast of Cape Colony but does not seem to reach a large size. The smallest specimen is only 2 mm. across the disk while the arms are more than 8; it does not differ essentially from the adults but the side arm-plates are relatively more conspicuous and hence the arms are more „knotty", while the granulation of the disk covers the marginal plates and there are a few granules on the oral side.

There is some diversity of colour among the specimens at hand, though the adults agree well with the holotype. The arms however are sometimes quite distinctly banded. In one specimen most of the disk is occupied by a symmetrical flower-like blotch of whitish and in each interradius there is a conspicuous marginal spot of pure white. The smaller specimens are as a rule paler and the smallest are nearly white. Considerable diversity is shown in the number of "spiniform grains" on the disk. In some specimens they are few (10–15) and far between, while in other cases, they are quite numerous (75–100). There is some diversity too in their height for while they are usually only 2–4 times as high as thick they are occasionally elongated into little spinelets 5–6 times as long as their diameter.

Ophiomitrella corynephora*, sp. nov.

Plate XIX. Figs. 5, 6.

Disk 8 mm. in diameter; arms about 30 mm. long. Disk covered by a coat of thin overlapping scales, most of which bear a single, cylindrical (2–3 times as high as thick) granule with a rounded tip; there are many plates with no granules but there are very few that bear more than one. Radial shields moderate, rounded triangular, as wide as long, separated from each other by a series of scales, at least one of which is granule-bearing; the radial shields themselves bear no granules but the inner distal corner of each shield tends to project as a low tubercle. Upper arm-plates small, diamond-shaped, about as long as wide, widely separated and becoming very small distally. Interbrachial areas below like disk but there are only three or four granules in each area. Genital slits long and narrow, extending from oral shield nearly to disk-margin. Oral shields (except madreporite) diamond-shaped, wider than long, the two proximal sides lightly concave, the two distal lightly convex; madreporite more

* κορυνηφόρος = club-bearing, in reference to the lowest arm-spines.

nearly pentagonal as long as wide; the oral shields seem to be in contact with the first pair of side arm-plates. Adoral plates rather large, slightly curved, tetragonal with rounded angles, wider within, where they meet, than without. Oral plates very small, but each bears three big, club-shaped, subequal oral papillae, 2–3 times as long as thick. 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. Teeth about 4, the upper squarish but the lowest thick and narrow, pointed, not unlike one of the oral papillae. No tooth-papillae. First under arm-plate small, somewhat pentagonal, longer than wide; succeeding plates pentagonal a little wider than long, with distal angles rounded, all

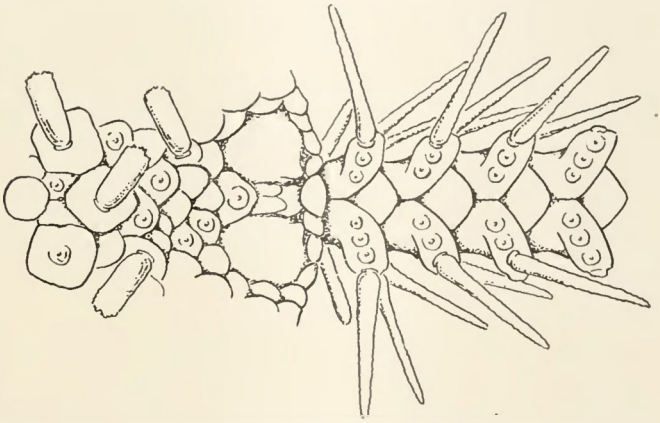

Fig. 2. Upper side of part of disk and arm of *Ophiomitrella corynephora* sp. nov. Some of the spines removed. × 10.

except first two well separated; they rapidly increase in relative length, and distally, are very small and rather narrow, scarcely three-fourths as wide as long. Side arm plates large, meeting above and below, the spine ridges becoming more and more prominent distally, where the arms are quite "knotted"; each plate carries 6 (or basally 7) spines, of which the first (uppermost) is longest and may equal two arm-segments while the sixth or seventh is shortest, little exceeding one segment; the upper spines are pointed but the lowest two or three are blunt and thickened at tip, becoming more or less club-shaped; all the spines are smooth except the lowest which may be more or less prickly at tip. Tentacle-scale large, but narrow, blunt and flattened, about half as long as under arm-plate. Colour (dry): — nearly white; specimens in alcohol have a faint pinkish tinge

and it is probable the colour in life is red or orange of some shade.

P.F. 2563. Vasco de Gama Point, S. 75° E., 13 miles, 166 fms. Blk. spc. 17 specimens; adult and young.

P.F. 2798. Vasco de Gama Peak. N. 71° E., 18 miles, 230 fms. St. 1 specimen; adult.

Holotype, South African Museum no. A 6441. P.F. 2798.

This species is near *O. ingrata* Koehler in its general features but differs in the arm-spines and in the higher and more cylindrical disk-granules. The lower arm-spines are very distinctive, no other member of the genus approaching it in this particular. The smallest specimen in the present series is only a little over 1 mm. across the disk and the arms are scarcely 3 mm. long; it is obviously very immature and shows none of the specific characters clearly. The next larger is about 2·5 mm. across the disk and shows all the specific characters more or less distinctly. These two specimens were associated with an adult in such a way as to indicate that they were its young and led me to the conviction that this species, like so many other austral echinoderms, is viviparous. On opening one of the alcoholic specimens, I found this to be the case, as there was a single young one, like the smallest described above, in each one of six bursae. The young evidently leave the bursae at this stage of development but apparently may remain on or with the mother until twice as large.

Ophiothamnus remotus.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 149; pl. VIII, figs. 201–203.

In neither the preliminary report (*op. cit.*) nor in his final Challenger Report, do Lyman's figures give an accurate idea of the close-set, operculiform oral papillae of this little brittle-star, but the earlier figures are the better in this particular. I have compared the Pieter Faure specimens with a Challenger cotype and there is no doubt of their identity. Bell (1905, Mar. Inv. South Africa, vol. 3, p. 258) reports that, of this species, "a good set was obtained from Cape Natal" and "a few from off Algoa Bay".

One of the specimens in the present collection, (13455), about 3 mm. across the disk is remarkable for the spinulation of the disk; instead of slender acicular spinelets which characterize most specimens there are just 7 stout abruptly pointed spinelets, 5 of which form a symmetrical quintet at the center of the disk; in addition there are a number of minute widely scattered granules. At first I thought this specimen might represent a second species but in view of the

facts that it is otherwise quite a typical *remotus* and that there is some individual diversity in *remotus* as to the thickness of the disk spinelets, it is better to consider this one an individual variant.

P.F. 2218. Lion's Head, E. 18 miles, 104 fms. Blk. spc. and r. 5 specimens; adult.

P.F. 2289. Lion's Head, N. 67° E., 25 miles, 131–136 fms. Blk. spc. 1 specimen; young.

P.F. 2766. Vasco de Gama Point, N. 40° E., 13 miles, 120 fms. R. 19 specimens: adult and young.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Sts. 1 specimen: small adult.

P.F. 11359. Tugela River, N.W. by N. $^1/_4$ N., 24 miles, 65–80 fms. R. 10 specimens: small adult and young; 1 hexamerous.

P.F. 13227. Cove Rock, N.W. $^3/_4$ W., 13 miles, 80–130 fms. Chr.? 1 specimen; adult.

P.F. 13455. Sandy Point, N.E. by N. 6 miles, 51 fms. Brk. sh. and st. 1 specimen: young.

P.F. 13576. Stalwart Point, N.N.W., 9 miles, 53 fms. S. and sh. 1 specimen: small adult.

Bathymetrical range, 51–230 fms.

AMPHIURIDAE.

Although thirteen species of this family are now known from the South African region, they represent only four of the twenty genera, and in view of the large number and wide distribution of the species of *Amphiuridae* it must be admitted the group is not adequately represented around the Cape. A striking feature of the family's occurrence is the apparent absence of the cosmopolitan species, *Ophiactis savignyi*, although three other species of *Ophiactis* do occur. It is highly probable that a considerable number of the smaller amphiurids will be found by more intensive collecting but it is evident from the PIETER FAURE collection that local conditions are not particularly favorable to the *Amphiuridae*. The thirteen species, here recorded, may be distinguished from each other as follows.

Key to the South African Species of Amphiuridae.

Tip of each jaw occupied by a pair of block-like oral papillae.

Two oral papillae on each side of each jaw, the second being at its distal angle.

Tentacle-scales none . . . . . *Amphiura dilatata.*

Tentacle-scales present.

Tentacle-scale single.

Arm-spines 6—8, short . . . *Amphiura capensis.*
Arm-spines 4 or 5, longer than arm-segment *Amphiura angularis.*
Tentacle-scales 2.
Radial shields several times as long as wide, their length exceeding one-half disk-radius; upper arm-plates not wider than long . . . . . *Amphiura candida.*
Radial shields 2—2·5 times as long as wide, not nearly one-half disk-radius; upper arm-plates much wider than long *Amphiura incana.*
More than two oral papillae on each side of each jaw.
Three oral papillae on each side, outermost wide and operculiform, equalling or exceeding the other two together in width.
Disk scales relatively coarse, especially at center of disk where some are ·25—·30 mm. across; 5—7 series of scales in each interradial area where narrowest; radial shields large . *Amphipholis minor.*
Disk scales much smaller, more numerous; radial shields smaller, less conspicuous . . . . *Amphipholis squamata.*
Four oral papillae on each side, outermost not greatly enlarged; tentacle-scales 2; arm-spines 3.
Margin of disk ornamented with round tubercles or papillae *Amphioplus gibbosus.*
No papillae or tubercles on disk margin.
Radial shields short, broadly in contact, equal to about one-third disk-radius; arms, 4—5 times disk-diameter *Amphioplus integer.*
Radial shields long, in contact, equal to half disk-radius; arms more than 7 times disk diameter . . *Amphioplus hastatus.*
Tip of each jaw without oral papillae, but occupied by the lowest tooth.
Upper arm-plates broadly oval, twice as wide as long, fully in contact *Ophiactis carnea.*
Upper arm-plates more or less triangular little or not at all in contact.
One oral papilla on each side of jaw, large scale-like *Ophiactis plana.*
Two oral papillae on each side of each jaw . *Ophiactis abyssicola.*

Amphiura dilatata.

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 26; pl. XI, figs. 314–316.

There is good reason for believing that this species is identical with Ljungman's *atlantica* from St. Helena. The only difference is that *dilatata* is known to have the lower surface of the disk bare, while one *infers* from Ljungman's description that such is not the case in *atlantica*, although nothing is said one way or the other about the matter. If the St. Helena species does have the interbrachial areas below, naked, the identity of the two species would be clear and the name *atlantica* would have priority. The Challenger took *dilatata* only at her station 141, in 98 fms. but the Pieter Faure

has found it at the following places. The specimens range in size from 2 to 7 mm. across the disk, but the growth changes are relatively slight and the agreement with Lyman's description and figures is close.

P.F. 458 A. Outside False Bay, 34° 34′ S. × 18° 32′ E., 100 fms. Gn. s. 7 specimens; young.

P.F. 461 A. Outside False Bay, 34° 38′ S. × 18° 33′ E., 110 fms. Bott.? 3 specimens; young.

P.F. 2732. Vasco de Gama Point, N. 10° E., 13 miles, 85 fms. D. gn. s. 77 specimens; adult and young.

P.F. 14833. Cape Castle, W.coast, E. ½ N., 9 miles, 89 fms. D. m. and s. 7 specimens; adult.

Amphiura capensis.

Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 320.
Lyman, 1882, Challenger Oph., pl. XVIII, figs. 14–16.

These specimens range from 3·5 to 6·5 mm. across the disk; in the smallest there are as a rule but 5 arm-spines, but one or two of the basal segments have 6; in the largest, there are 7 spines on all the basal joints. Ljungman's type, 5 mm. across the disk, had 6 or 7 arm-spines but Lyman's specimen, figured in the Challenger Report, must have been about 10 mm. across and had 8 arm-spines. Döderlein reports numerous specimens of this species from Lüderitz Bay, Southwest Africa, 3·3–8 mm. across (1910, Schultze's Zool. Anth. Ergeb., vol. 4, lfg. 1, p. 253). He suggests Lyman's large specimen with 8 spines was not *capensis*, but I have examined several of the Challenger specimens and can vouch for their identity. Lyman's figures are, as Döderlein suggests, rather "schematic". The species seems to be distinctly a littoral one, in spite of the fact that the Challenger specimens were taken at 98 fms.

S.A.M. No. 3015. False Bay. Littoral. Dr. Purcell coll. 5 specimens; adult.

Rocks at Sea Point, Feb. 2, 1904. 1 specimen; young.

Amphiura angularis

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 25; pl. XI, figs. 311–313.

It is very interesting to find a fine adult individual of this Antarctic species in the collection. It is one of four specimens labelled "*Ophiothrix triglochis* Bell no. 15110 (not seen by Bell)". The others are *Ophiactis abyssicola* and are listed below. The *Amphiura* is

about 7 mm. across the disk and has arms 50–60 mm. long. It agrees well with CHALLENGER cotypes.

P.F. 15140. South Head, Table Mountain, E. by S. ½ S., 25 miles, 190 fms. Gn. s. and blk. spc. 1 specimen; adult.

* AMPHIURA CANDIDA.

Ljungman, 1867. Öft. Kongl. Vet.-Akad. Förh., vol. 23, p. 318.
Koehler, 1904, Mem. Soc. Zool. France, vol. 17, p. 67, figs. 18, 19.

Koehler has examined the holotype of this species and reports it in such poor condition that he wrote his description and made his figures from a specimen from Japan, now in the Vienna Museum and identified by Marktanner-Turneretscher. It does not seem to have occured to Koehler that the Japanese specimen was not identical with Ljungman's lone specimen from Mozambique, but it seems to me more material must be collected and studied before we can feel sure of it. No specimen has been taken south of Mozambique, and referred to *candida*, since Ljungman's type was collected.

AMPHIURA INCANA.

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 20; pl. XI, figs. 285–287.

This species is very near the preceding and I am inclined to think that Ljungman's type of *candida* was a specimen of *incana*, while Marktanner-Turneretscher's specimen of *candida* from which Koehler's figures were made represents another species. But since Ljungman's holotype is no longer identifiable (according to Koehler), it might be just as well to let the name *candida* stand for the present for the Japanese species. Matsumoto (1917, Mon. Japan. Oph., p. 201) however asserts, without comment, that *candida* Mark. Turn. is not *candida* Ljungman, and treats it as a synonym of *euopla* H. L. C. Until more material is available from the vicinity of Mozambique, it will be impossible to definitely settle the matter. Meanwhile the name *incana* may be used for the South African species.

Lyman's types of *incana* came from Simon's Bay, 10–20 fms. Bell lists the species from "off the South Head, Tugela River, N. by W.", 4·75 miles, 25 fms., blk. m. but says he is not very confident of the accuracy of his determination. This is odd, for the species is unusually well characterized and Lyman's type is in the British Museum! I have compared the PIETER FAURE material with

some of the CHALLENGER specimens and have no doubt of their identity. They come from eight stations and as there are 77 of them, the species is evidently common in suitable localities. The disk-diameter ranges from 2 to 7·5 mm. The growth changes are very trivial: in the smallest specimen there are only 5 arm-spines, even at base of arm, and they are pointed, the radial shields are relatively larger, the disk scales are fewer and the arm-plates are relatively longer than in the adult.

P.F. 545. Near Port Elizabeth, 33° 54′ S. × 25° 53′ E., 31 fms. Fne. s. 10 specimens; adult and young.

P.F. 3068. False Bay, 18 fms. S. and sh. 2 specimens; adult, very fine.

P.F. 3099. False Bay, 22 fms. R. and sh. 34 specimens; adult and young.

P.F. 13280. Cove Rock, N. E. by E. ½ E., 4 miles, 22 fms. R. and brk. sh. 1 specimen; young.

P.F. 15502. False Bay, 22 fms. S. and sh. 15 specimens; adult and young.

P.F. 16231. False Bay, 22 fms. Brk. sh. 9 specimens; adult and young.

P.F. 17451. False Bay, 12 fms. S. and sh. 4 specimens; adult.

P.F. 18282. False Bay, 8–10 fms. R. 2 specimens; adult.

Bathymetrical range, 8–31 fms.

AMPHIPHOLIS MINOR.

Ophiactis minor Döderlein, 1910. Schultze's Zool. Anth. Ergeb. vol. 4, lfg. 1, p. 253; pl. V, figs. 3, 3*a*.

Amphipholis minor H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 243.

It is very curious that Döderlein did not recognize this species as an *Amphipholis* when it is so similar to the cosmopolitan *A. squamata*, with which he is unquestionably familiar. There is a single specimen (3·5 mm. across disk), of this species, in the PIETER FAURE collection. It agrees well with Döderlein's description but differs from the figures in having an elevated disk and sharper arm-spines. The species was previously known only from Angra Pequena Bay where it occurs with *Amphiura capensis*.

P.F. 13732. Great Fish Point, N. by W., 7 miles, 49 fms. S. and sh. 1 specimen; adult.

AMPHIPHOLIS SQUAMATA.

Asterias squamata Delle Chiaje, 1828. Mem. Anim. sans Vert. Napoli, vol. 3, p. 74.

Amphipholis squamata Verrill, 1899. Trans. Conn. Acad., vol. 10, p. 312. H. L. Clark, 1904, Bull. U. S. F. C. for 1902, pl. 6, figs. 33, 34; pl. 7, figs. 43, 44.

This remarkably cosmopolitan species was first recorded from South Africa by Ljungman in 1871 under the name *A. kinbergi*. One of Ljungman's types is now in the M. C. Z. collection and is figured in the Mem. M. C. Z., vol. 25, pl. 6, figs. 9, 10. In 1882, Mr. Lyman decided that *kinbergi* was not distinguishable from *squamata* and hence the CHALLENGER specimens from South Africa are listed under the latter name. A specimen in the PIETER FAURE collection is apparently identical with the cotype of *kinbergi* now before me, but it is clear that to separate it from specimens of *squamata* from the east coast of the United States requires a most unscientific use of the imagination, and I must therefore agree with Mr. Lyman and call the South African specimens *squamata*. The PIETER FAURE specimen is quite different from the specimen of *A. minor* but large series of *squamata* from other regions show intermediate forms and I am not fully satisfied that the two species are distinct.

S.A.M. no. 3015. False Bay. Littoral. Dr. Purcell coll. 1 specimen; adult.

* AMPHIOPLUS GIBBOSUS.

Ophiophragmus gibbosus Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 316.

Amphioplus gibbosus H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 257.

This species has not been recorded since its original description from a specimen taken near Port Natal. Even its generic position is by no means certain.

AMPHIOPLUS INTEGER.

Amphipholis integra Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh. vol. 23, p. 313.

Amphiura integra Koehler, 1904. Mem. Soc. Zool. France, vol. 17, p. 65, figs. 16, 17.

Amphioplus integer H. L. Clark, 1915. Mem. M. C. Z., vol. 23, p. 258.

This species, like the preceding, was originally described from a specimen taken near Port Natal. Koehler has given a more detailed

description and figures, based on one of Ljungman's types. There are in the PIETER FAURE collection two amphiurids which agree so nearly with Koehler's figures and description that it seems to me best to refer them to this species. The larger and better preserved is 5 mm. across the disk and has arms about 20 mm. long. The one particular in which these specimens do not agree with the type is in the shape of the upper arm-spines. Koehler naturally lays great stress on this feature for such flattened biscuit-shaped arm-spines, as are shown in his figure, would certainly be a diagnostic character of great value, if it were constant. But Ljungman does not refer to it; which indicates that it was either wanting in some of his specimens (if he had more than one) or was not conspicuous enough to attract his attention. In the two specimens before me there is only a hint of this character; in the larger specimen a few of the uppermost spines near the base of the arm are flattened and widened and one or two even show the biscuit-shape of Koehler's figure 16 to a trifling degree. The radial shields in the specimens before me are not quite so wide in proportion to their length as in Koehler's figure, and the six primary plates of the disk are more distinct. Under the circumstances however, in spite of these differences, it seems to me better to refer these specimens to Ljungman's species than to give them a new name.

P.F. 13598. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl., and st. 1 specimen; adult.

Rocks at Sea Point, Feb. 2, 1904. 1 specimen; adult.

* AMPHIOPLUS HASTATUS.

Amphipholis hastata Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 313.

Amphioplus hastatus H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 257.

This is another of Ljungman's species which has not been met with since its original description from a specimen, 4 mm. in disk-diameter, from Mozambique. Verrill (1899) puts this species in *Amphipholis* (although he says frankly that it has four oral papillae) while *gibbosus* and *integer* he puts in *Amphiodia*. Ljungman however distinctly says in each description, "Papillae orales quaternae", so that until further material proves them to be otherwise unlike *Amphioplus*, the three species must rest in that genus.

Ophiactis carnea.

Plate XX. Figs. 3, 4.

Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 324.

There is an excellent series of this characteristic species, which has previously been something of a rarity. The smallest is barely 2 mm. across the disk and the arms are scarcely 10 mm. long; the disk is covered by a central rosette of 16 primary plates with about ten additional plates in each interradial area, and two small plates between the proximal ends of each pair of radial shields; there are small sharp spinelets scattered over the disk more especially near the margin; the upper arm-plates are broadly in contact and might be called transversely oval, but the proximal half is distinctly narrower than the distal and the plates are not much wider than long; the under arm-plates are squarish with rounded corners, nearly or quite in contact; there are only 4 arm-spines, even at base of arm, and they are relatively short and thick; there is a single, relatively large oral papilla at the distal angle of each jaw, on each side. In a specimen 2·5 mm. across the disk and with arms about 13 mm. long, the disk scales are much more numerous and the primary plates (except the central) are no longer distinct; the upper arm plates are broadly oval, much wider than long and there are 5 arm-spines. The largest specimen, 6 mm. across the disk and with arms nearly 35 mm. long, differs from this very little indeed; the under arm-plates are wider than long and have the distal margin convex and the arm-spines seem to be relatively a trifle longer. Most of the specimens are very light, nearly white, or more or less pinkish, but the larger ones are light brown, with the arms more or less distinctly banded with darker. One specimen, from Sea Point, is variegated gray-green, olive-green, and greenish-white, but it is not otherwise peculiar. It will be interesting to learn the colour in life.

P.F. 106 A. Between Cape St. Blaize and Mossel Bay, 4 fms. S. 14 specimens; adult and young.

P.F. 215 A. Cape St. Blaize. S.W. by W. ¼ W., 6 miles, 15–18 fms. Stns. 46 specimens; adult and young.

P.F. 769. Off East London, 32° 52′ S. × 28° 12′ E. Depth and bottom? 1 specimen; young.

P.F. 859. Off East London, 32° 45′ S. × 28° 26′ E. 36 fms. Stns. 2 specimens; young.

S.A.M. No. 3015. False Bay, Cape Colony. Littoral. Dr. Purcell coll. 1 specimen; small adult.

P.F. 10975. Tongaat River, N.W. by N. $^1/_4$ N., 5 miles, 36 fms. S. and sh. 1 specimen; very young.

P.F. 12459. Umtwalumi River, N. by W., 2 miles, 25 fms. Brk. sh. 1 specimen; young.

P.F. 13280. Cove Rock, N.E. by E. $^1/_2$ E., 4 miles, 22 fms. S. and brk. sh. 2 specimens; young.

P.F. 13520. East London, N.W. by W. $^1/_2$ W., 2 miles. Depth? R. and brk. sh. 2 specimens; adult, fine.

P.F. 13598. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl., and st. 3 specimens; young.

P.F. 13619. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl., and st. 8 specimens; adult and young; fine.

P.F. 15627. False Bay, Cape Colony, 17–27 fms. R. 1 specimen; young.

P.F. 18282. False Bay, Cape Colony, 8–10 fms. R. 2 specimens; adult, fine.

Rocks at Sea Point, Feb. 2, 1904. 1 specimen; young.

Bathymetrical range from shore to 36 fms.

Ophiactis plana.

Lyman, 1869. Bull. M. C. Z., vol. 1, p. 330.
H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 10, figs. 1, 2.

In the Challenger Report, Lyman, after describing *Ophiactis flexuosa* (p. 116), records ten, small, six-armed specimens of *Ophiactis* from St. 142 (Agulhas Bank) as possibly young *flexuosa* but says they can scarcely be distinguished from *plana*. A recent critical study of the species of *Ophiactis* has led to the conclusion that *plana* and *flexuosa* are identical, the former name being the earlier though based as Lyman suggests, on young specimens. There are two very young six-armed specimens of *Ophiactis*, 2–3 mm. across the disk, in the Pieter Faure collection which are certainly not either *carnea* or *abyssicola*. They agree fairly well with *plana*, except that the radial shields are not so large and the disk scales not so few and large as in that species. But in both specimens, the disk is being regenerated at least in part, and hence I think there is little reason to doubt that these youngsters are identical with those taken by the Challenger on Agulhas Bank, and all may properly be referred to *plana*.

P.F. 13227. Cove Rock, N.W. $^3/_4$ W., 13 miles, 80–130 fms. Crl. 1 specimen; young.

P.F. 13859. Glendower Beacon, N. $^1/_4$ W., 21 miles, 100 fms. Sh. and r. 1 specimen; very young.

Ophiactis abyssicola.

Amphiura abyssicola Sars. 1861. Ov. Norges Ech., p. 18; pl. 2, figs. 7–12.
Ophiactis abyssicola Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 324.

A recent critical study of the genus *Ophiactis* has shown that *O. poa*, described by Lyman (1882, Challenger Rep., p. 119; pl. XX, figs. 13–15) from near Tristan d'Acunha in 500–1000 fms. is not to be distinguished from Sars' species *abyssicola* of the North Atlantic. The Pieter Faure has extended the range of the species far to the southeastward by collecting a good series of specimens, as listed below. They range in disk-diameter from 3 to 8·5 mm. While they agree well in most details and are with little doubt all to be referred to one species, they show an extraordinary and most interesting diversity in the disk covering: the radial shields, while always large, vary from broadly triangular to a curved pear-seed shape with concave sides towards each other; the disk scales may be few, large and thick, or more numerous and thinner, and in two specimens (from very deep water) they are very numerous with many secondary plates intercalated around and among the larger ones; the disk spines may be numerous, all over the disk or confined to the margin, or there may be only two or three widely scattered ones; these spines are usually long and fairly stout, but they may be very slender and pointed, and in one or two specimens (from very deep water) they are very small. All the specimens are pale gray, pale brown or whitish; some have a pinkish tinge.

P.F. 2134. Lion's Head, S.E. ½ E., 42 miles, 156 fms. D. gn. s. 1 specimen; adult.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Stns. 19 specimens; adult.

P.F. 14984. Lion's Head, 55½° E., 47 miles, 175 fms. Bottom? 1 specimen; adult.

P.F. 15110. South Head, Table Mountain, E. by S. ½ S., 25 miles, 190 fms. Gn. s. and blk. spc. 3 specimens; adult.

P.F. 16758. Cape Point, N.E. by E. ¼ E., 38 miles, 755 fms. Gn. m. 1 specimen; adult.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 1 specimen; adult.

P.F. 17541. Cape Point, N.E. by E. ¾ E., 8 miles, 91 fms. S. and spc. 1 specimen; adult.

P.F. 18154. Cape Point, N.E. by E. ¾ E., 28 miles, 300 fms. Fne. s. 1 specimen; young.

P.F. 18933. Southeast from Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 15 specimens; adult.

Bathymetrical range, 91–1000 fms.

OPHIOTRICHIDAE.

This large, tropical family is fairly well represented around the Cape, in view of the extratropical character of the region. There are ten species now known, representing four genera. The six species of *Ophiothrix* are more or less perplexing owing to the variability of several of the species, and to the fact that specific limits in the genus are not well worked out as yet. In some species, the colour pattern seems to be the most reliable character while in other cases it seems to be perfectly worthless. So too with the character of the spinelets or thorny stumps on the disk; these may give reliable specific characters but as a rule they are not to be trusted. The arm-spines are usually dependable but their characters are not easily expressed in words and they are not often distinctive. The following key shows how the South African species of *Ophiotrichidae* may be distinguished from each other, but in this family in particular such keys must be used with caution.

Key to the South African Species of Ophiotrichidae.

Under arm-plates well developed.

Disk plates with thorny stumps or spinelets or both; these are often very numerous, concealing the plates, but they may be few and scattered.

Disk plates with numerous thorny stumps or rough spinelets or both.

Arm-spines, glassy, slender and sharp, though thorny
Ophiothrix aristulata.

Arm-spines more or less opaque, the longest ones at least, flattened dorso-ventrally more or less, and truncate or blunt.

Radial shields big and bare; rest of disk covered chiefly with rough spinelets; arm-spines little flattened *Ophiothrix fragilis.*

Radial shields smaller and usually more or less covered by the small thorny stumps which occupy all the rest of the disk surface; larger arm-spines much flattened.

Arms moderately long, 4–6 times disk-diameter; upper arm-plates fan-shaped, rhombic or pentagonal, not much wider than long, if any . . *Ophiothrix triglochis.*

Arms very long, 9–18 times disk-diameter; upper arm-plates very much wider than long *Ophiothrix longipeda.*

Disk plates with scattered acicular spinelets.

Upper and under arm-plates obscured by skin; five distinct radiating black lines on disk, one extending onto base of each arm
Ophiothrix capensis.

Upper and under arm-plates distinct; no radiating black lines on disk.
Upper surface of arms marked with narrow transverse lines of deep red . . . . *Ophiothrix poecilodisca.*
Upper surface of arms, at least near tip, with a narrow median stripe made up of three white lines separated from each other by distinct black ones . . . *Ophiothrix trilineata.*
Disk plates flat, smoothly covered by a uniform coat of granules; radial shields bare and very large . . . *Ophiocnemis marmorata.*
Under arm-plates wanting or apparently so.
Side arm-plates projecting as spine-bearing ridges occupying the whole height of the arm or nearly so; upper surface of arms in adults (except distally) covered by a coat of granules and not showing any upper arm-plates . . . . . *Ophiopsammium nudum.*
Side arm-plates low, squarish, projecting as wing-like plates on lower half of arm; upper surface of arms with irregular granules among which the upper arm-plates can often be distinguished *Ophiothela dividua.*

Ophiothrix aristulata.

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 50; pl. XV, figs. 421—424.

In Mr. Lyman's description, he says the arm-spines are "scarcely tapering" and "slightly flattened". If this were so, it would be exceedingly difficult to distinguish this species from *triglochis* and *fragilis* (see below, under *fragilis*) but the many specimens I have seen from South Africa, the East Indies and Australia, including two of Lyman's cotypes from the Agulhas Bank, have tapering, acuminate spines which are seldom appreciably flattened. They show some diversity in length, relative thickness and thorniness but they are seldom stout and often very thorny. Bell (1905, Mar. Inv. S. Afr., vol. 3, p. 258) records this species from two stations, one in 35 fms. and one in 22 fms. Specimens of *Ophiothrix* from the latter station are before me and are here listed as *triglochis*, the common South African species, which Bell records from only one station. As *aristulata* is normally a deep water species, I suspect all of Bell's specimens were *triglochis*.

The Pieter Faure collection contains only seven specimens of this fine species. They range in disk diameter from 6 to 14 mm. and all are nearly white, with more or less of a pinkish tinge still left on the arms: on the upper arm plates, there are faint indications of a more or less broken median longitudinal, white stripe.

P.F. 2529. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. spcs. 3 specimens; adult.

P.F. 2798. Vasco de Gama Peak N. 71° E, 18 miles, 230 fms. Stn. 2 specimens; adult.

P.F. 13225. Cove Rock, N. W. $^3/_4$ W., 13 miles, 80—130 fms. Crl. and r. 2 specimens; adult.

Ophiothrix fragilis.

Asterias fragilis Abildgaard, 1789. In Müller's Zool. Dan., vol. 3, p. 28; pl. XCVIII.
Ophiothrix fragilis Düben and Koren, 1846. Kongl. Vet.-Akad. Handl. f. 1844, p. 238.

Some specimens of a coarse *Ophiothrix* from Saldanha Bay perplexed me greatly until I found that Koehler had recorded this European species from that very place. Comparison of these specimens with some of equal size of *fragilis* from Heligoland shows that they may without impropriety be referred to that species, although they do not agree in all details. They approach so nearly to some specimens of *triglochis*, indeed, that one wonders whether *fragilis* and *triglochis* are really distinct. The only difference between the two species is that in typical *triglochis* there are no disk-spinelets among the stumps and the radial shields are more or less well covered by the latter. But as will be pointed out below, the present collection shows that *triglochis* is a very variable species and it may be that it will be best to treat it merely as a southern variety of *fragilis*.

As pointed out in the key above, the *Ophiothrix* from Saldanha Bay has very large, bare radial shields and the rest of the disk is rather densely covered with long, stout, thorny spinelets. The general colour is dingy white on the disk, with both disk-spinelets and arm-spines pale brown; the radial shields have narrow dull red margins and the upper arm-plates are a mixture of dull reddish and dingy white.

P.F. 14905. Saldanha Bay, Cape Colony, 10 fms. S. and mussel-beds. 6 specimens; adult.

Ophiothrix triglochis.

Müller and Troschel, 1842. Sys. Ast., p. 114. Koehler, 1904. Mem. Soc. Zool. France, vol. 17, p. 81, figs. 41—45.

The Pieter Faure collection shows clearly that this is the common *Ophiothrix* of South Africa. There are 170 specimens from 23 stations, and while they show great diversity I feel no hesitation in referring them all to *triglochis*. The smallest is only 2·5 mm. across the disk and shows the primordial central plate very plainly.

The largest specimen is 13 mm. across the disk. In colour, the diversity is very great, ranging from almost pure white (dry specimens) to deep, dull indigo, on the disk. The arms range from white to pink, dull red or various shades of brown: often there are indications of alternating red and blue bands; sometimes there is a distinct median white stripe and usually the distal tip of the upper arm-plates is white: not uncommonly the whole distal margin of each plate is whitish. The variation in the disk covering is nearly as great as in the coloration. Typically, the whole upper surface of the disk including the radial shields is covered by low, thorny stumps as shown in Koehler's fig. 41, but the stumps themselves show no little diversity, for they may be low and crowned with short thorns (see Koehler's fig. 43) or slender and more cylindrical (Koehler's fig. 44) or they may, whether low or high, be crowned with three long, slender spinelets; all sorts of intergradations between the extremes occur. Moreover in some specimens from False Bay, we find among the stumps, disk spinelets over a millimeter long and more or less thorny; in the largest specimen, these are so numerous as to replace most of the stumps and the radial shields are bare. This individual, if by itself and labelled "Saldanha Bay", would probably be considered *fragilis*. Compared directly with Saldanha Bay specimens however, several differences are obvious: the radial shields are much smaller in *triglochis*, the disk spines, much less thorny, the upper arm-plates wider and smoother and the under arm-plates shorter and wider and more widely separated. These differences hold so well in all the material at hand that I feel justified in not uniting the two species as one.

I am inclined to think *O. roseocoerulans* Grube of St. Helena is not to be separated from *triglochis* but until more is known of the colour varieties of the Cape species, they may be kept apart. I have no doubt however that the specimens from False Bay, identified by Bell as *roseocoerulans* (*op. cit.* p. 258) are better referred to *triglochis*.

The Pieter Faure collected *triglochis* at the following points:

P.F. 106 A. Between Cape St. Blaize and Mossel Bay, 4 fms. S. 2 specimens; young.

P.F. 507. Algoa Bay, 33° 58′ S. × 25° 51′ E., 25 fms. R., blk. spcs. 1 specimen; adult.

P.F. 590. Algoa Bay, 33° 50′ S. × 25° 54′ E., depth and bottom not recorded. 1 specimen; young.

P.F. 769. Near East London, 32° 52′ S. × 28° 12′ E., depth and bottom not recorded. 30 specimens; adult.

P.F. 859. Off Great Kei River, 32° 45′ S. × 28° 26′ E., 36 fms. Stns. 7 specimens; adult and young.

S.A.M. 3014. False Bay, Cape Colony. Littoral. Dr. Purcell coll. 12 specimens; adult.

P.F. 3028. Cape Point, N.W. by W. 1/4 W., 11 3/4 miles, 45 fms. M. and r. 1 specimen; adult.

P.F. 10354. Gericke Point, N. 3/4 E., Knysna E. 3/4 N., 46 fms. S., sh., and r. 6 specimens; adult.

P.F. 10975. Tongaat River, N.W. by N. 1/4 N., 5 miles, 36 fms. S. and sh. 13 specimens; young.

P.F. 11556. Tugela River, N.W. by N., 22 miles, 47 fms. Brk. sh. 1 specimen; very young.

P.F. 12360. Umhlangakulu River, N.W. by N., 7 miles, 50 fms. S. and sh. 1 specimen; young.

P.F. 12983. Gonubie River, N.W. by W. 3/4 W., 3 miles, 20 fms. Brk. shs. 8 specimens; adult.

P.F. 13068. Hood Point, N. by W. 1/2 W., 11 miles, 49 fms. Brk. sh. 1 specimen; adult.

P.F. 13193. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh. and r. 4 specimens; young.

P.F. 13240. Cove Rock, N. 3/4 E., 5 miles, 43 fms. St. and brk. sh. 14 specimens; adult and young.

P.F. 13280. Cove Rock, N.E. by E. 1/2 E., 4 miles, 22 fms. R. and brk. sh. 11 specimens; adult.

P.F. 13455. Sandy Point, N.E. by N., 6 miles, 51 fms. Brk. sh. and st. 4 specimens: small adults.

P.F. 13519. East London, N.W. by W. 1/2 W., 2 miles. Depth? R. and brk. sh. 5 specimens; adult.

P.F. 13619. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl. and stns. 20 specimens; adult and young.

P.F. 15502. False Bay, Cape Colony, 22 fms. S. and sh. 2 specimens; young.

P.F. 16231. False Bay, Cape Colony, 22 fms. Brk. sh. 1 specimen; very young.

P.F. 17468. False Bay, Cape Colony, 9 fms. S. and sh. 11 specimens; adult and young.

P.F. 18282. False Bay, Cape Colony, 8—10 fms. R. 15 specimens; adult and young.

Bathymetrical range, shore to 51 fms.

Ophiothrix longipeda.

Ophiura longipeda Lamarck, 1816. Anim. s. Vert., vol. 2, p. 544.
Ophiothrix longipeda Müller and Troschel, 1842. Syst. Ast., p. 113.

It is rather odd that this big, common and long known species has never been properly figured. The colored figure by Herklots (1869, Ech. p. d'apres Nature, pl. 7) is unlike any specimen I have ever seen, and I have examined scores of living individuals as well as large numbers of museum specimens.

The collection from the South African Museum extends the known range of this tropical species far to the southward. This collection contains six fragmentary specimens, of which the two larger (20–22 mm.) are unquestionably *longipeda*, while the four smaller (6–13 mm.) seem to be identical and are, with little doubt, the young. Their only peculiarities are the lack of blue in the coloration and the relatively short arms, which were apparently less than ten times the disk diameter. They are poorly preserved however and all the arms are more or less broken. There is reason to believe they were much more brightly coloured in life. It is probable too that in this species the relative length of the arms increases with age until maturity. The largest specimen I have measured, alive, was 37 mm. across the disk and had arms 625 mm. long, or 17 times the disk diameter.

P.F. 12359. Umklangakulu River, N.W. by W., 7 miles, 50 fms. S. and sh. 1 specimen; small adult.

P.F. 12405. Itongazi River, N.W., $^3/_4$ W., 3 miles, 25 fms. R. and st. 4 specimens; adult and young.

Delagoa Bay, P.E.A. K. H. Barnard, Oct. 1912. 1 specimen.

* Ophiothrix capensis.

Lütken, 1869. Add. ad Hist. Oph., pt. 3, pp. 59 and 100.

This species does not seem to have been met with since its original description, based on a specimen from the Cape of Good Hope. It has never been figured but is apparently nearly related to *O. suensonii* of the West Indies. The concealment of the arm-plates in skin is a very remarkable character in this species and the radiating black lines on the disk would also seem to be distinctive.

Ophiothrix poecilodisca.

H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 276; pl. 13, fig. 5.

This well-marked species, known hitherto only from Zanzibar, is represented in the present collection by a small and badly damaged specimen from Delagoa Bay. It is about 5 mm. across the disk and was collected by K. H. Barnard in October, 1912. The transverse, deep red lines across the arms are very distinctive. The lower arm plates however lack the red markings altogether. The disk carries only 7 or 8 spines.

* Ophiothrix trilineata.

Lütken, 1869. Add. ad Hist. Oph., pt. 3, pp. 58 and 100.

This wide-spread and handsome Indo-Pacific species has long been known from Mozambique, whence specimens came to the M. C. Z. many years ago, but it has not yet been found south of that point, and it is not represented in the collections of the South African Museum.

* Ophiocnemis marmorata.

Ophiura marmorata Lamarck, 1816. Anim. s. Vert., vol. 2, p. 543.
Opiocnemis marmorata Müller and Troschel, 1842. Sys. Ast., p. 87.
Döderlein, 1888. Zool. Jahrb., vol. 3, pl. XXXII, figs. 6*a–c*.

The inclusion of this species in the South African fauna seems to rest wholly on a specimen in the M. C. Z. collection, collected by Wahlberg and said to have come from the Cape of Good Hope. It occurs commonly at Zanzibar but has not been recorded from Mozambique and its occurrence on the coasts of Natal and Cape Colony seems to me very unlikely.

Ophiopsammium nudum *, sp. nov.

Disk 6 mm. in diameter; arms five, 25–30 mm. long. Disk covered by a thin naked skin, through which the five pairs of large radial shields are plainly visible: scattered sparsely over this skin are plates and granules; at the center of the disk are about a dozen, flat, nearly circular plates irregularly scattered, and others form a single discontinuous series in each of the narrow interradial areas; these plates are from ·10 to ·25 mm. across and some of them bear spherical or

* *nudum* = naked, in reference to the absence of plates at center of disk and on interbrachial areas below.

conical granules; all over the radial shields, which are about 2·5 mm. long and distally 1·5 mm. wide, and also on the interradial margin between the distal ends of the pairs of radial shields, are numerous granules about ·10 mm. in diameter; these are well spaced, and even irregularly scattered except at distal ends of the radial shields where they become somewhat crowded to form the uniform granular coat which covers the upper surface of the arms; in each interbrachial area are scattered a dozen or more granules, of which about half are conical and pointed, ·25–·50 mm. high. No upper arm-plates; distally the granular covering of the arms becomes less and less continuous, until there is only bare skin with a few scattered granules on each segment. Interbrachial areas below, perfectly naked except for a very few conical granules. Oral shields, adoral plates and under arm-plates wanting or apparently so, for if present they are completely obscured by the thin skin. Oral plates large and dental papillae numerous. No oral papillae, of course. Base of each jaw perforated as in Ophiothrix. Side arm plates short, about as high as arm, compressed into a spine-bearing ridge, which carries 6 or 7 short, blunt, not very thorny spines; uppermost and three lowest spines smallest, third longest and equal to an arm-segment; the lowest does not become hook-like until near tip of arm. No tentacle scales but the tentacles are protected by the basal part of each side arm-plate. Colour of dry specimen, pale salmon, the bare skin browner and the granules whiter.

P.F. 10975. Tongaat River, N.W. by N. $^1/_4$ N., 5 miles, 36 fms. S. and sh. 1 specimen; very young.

P.F. 10976. Same locality as 10975. 1 specimen; adult.

Holotype, South African Museum no. A 6440, P.F. 10976.

This species differs very noticeably from *O. semperi* in the much coarser granulation of the dorsal surface, the large areas of naked skin and the conspicuous radial shields. The last two characters serve to distinguish it also from *O. rugosum*, the only other member of the genus.

The specimen from P.F. 10975 has obviously undergone fission as it has six arms, three of which, with their associated radial shields, are much smaller than the others. At first glance it resembles an *Ophiothela* but more careful examination shows that the side arm-plates are not like those of that genus. In colouration it is very similar to the adult. The upper surface of the arms, however, even at the base, is not uniformly granular but has few, irregular, unequal scattered granules on each segment, much as in *Ophiothela*, and just as on the terminal segments of the arms of the adult.

* Ophiothela dividua.

Von Martens, 1879. Sitzb. Berlin Ges. Nat. Fr., p. 127, figs. 1–4.

Three of von Marten's cotypes are in the M. C. Z. collection. They were taken at Algoa Bay on alcyonarian coral. There is nothing for me to add to the original description, but it may be worth while to note that these dry specimens have retained their pretty colouration very well. The general effect is dull blue, of an indigo tint, variegated with whitish; the deep blue lines across the outer ends of the radial shields, and at intervals across the arm, are conspicuous.

OPHIOCHITONIDAE.

This small family was not previously known from South Africa but the Pieter Faure has detected three species, representing the two most characteristic genera. They may be distinguished from each other as follows:

Key to the South African Species of Ophiochitonidae.

Supplementary plates present on each side of each upper arm-plate.
  Disk scales exceedingly numerous and minute, 150—200 or more per sq. mm. near center of disk where they are scarcely distinguishable with a magnifying glass. . . . . *Ophionereis dubia.*
  Disk scales fine or rather coarse, 25—100 per sq. mm. at center of disk *Ophionereis porrecta.*
No supplementary plates present on the upper surface of arms *Ophiochiton australis.*

Ophionereis dubia.

Ophiolepis dubia Müller and Troschel, 1842. Sys. Ast., p. 94. Savigny, 1809. Descr. de l'Egypte (Audouin): Rayonnes, pl. 1, figs. 3^{1}–3^{10}.
Ophionereis dubia Lyman, 1865. Illus. Cat. M. C. Z., no. 1, p. 149.

This species was not previously known from south of Zanzibar but the Pieter Faure collection shows it is a regular inhabitant of the coast of Natal and eastern Cape Colony. None of the specimens are full grown, the disk-diameters ranging from 2·5 to 6·5 mm. No two are coloured alike; the disk is usually light, white or whitish, with or without a dark spot or line, between or across the radial shields; the arms are usually some light shade of brown or olive, with or without indefinite whitish variegation, but in all cases with transverse rings of brown at intervals of 3–10 (usually 4–6) segments; these rings are usually very distinct on the dorsal surface but they may be faint even there and wanting orally. Savigny's beautiful

figures show the general colour pattern well but very wisely do not attempt to indicate the disk-scales.

P.F. 859. Off Great Kei River, 32° 45′ S. × 28° 26′ E., 36 fms. St. 2 specimens; young.

P.F. 11556. Tugela River, N.W. by N., 22 miles, 47 fms. Brk. sh. 1 specimen; young.

P.F. 12360. Umhlangakulu River, N.W. by N., 7 miles, 50 fms. S. and sh. 1 specimen; small adult.

P.F. 13455. Sandy Point, N.E. by N., 61 miles, 51 fms. Brk. sh., and st. 1 specimen; small adult, diskless.

P.F. 13520. East London, N.W. by W. ½ W., 2 miles. Depth? S. and brk. sh. 1 specimen; small adult.

Ophionereis porrecta.

Lyman, 1860. Proc. Boston Soc. Nat. Hist., vol. 7, p. 260.
1865, Illus. Cat. M. C. Z., no. 1, p. 147, figs. 14 and 15.

The Pieter Faure found this species even more common than the preceding and in the same localities, although it has not been previously reported from the coast of Africa. I have compared these South African specimens with Lyman's types and find that they agree in all essentials. But whereas, in Lyman's original material from an unknown locality and in the other material at hand from various Indo-Pacific localities, the scaling of the disk becomes increasingly finer with growth, so that in large specimens it is, at center of disk at least, very fine, in these South African specimens the disk is always covered with relatively coarse scales: in the largest specimen (15 mm. disk-diameter) even at center of disk, there are not more than 20–25 scales to each sq. mm. and there may not be so many. This retention of a youthful character is of no little interest and it may be desirable ultimately to recognize this form as a subspecies or variety. But the decision on that point must await further investigations along the East African coast and accumulation of more material.

The Pieter Faure specimens range from 5·5 to 15 mm. in disk-diameter, but show little diversity in coloration. No two are exactly alike but all are more or less variegated with dull shades of brown, purplish and whitish: the arms are more or less distinctly annulated with a darker shade than the ground colour. The specimen from 13280 is peculair in the very smooth, tessellated plating of the disk; the primary plates are quite distinct and with other large plates are surrounded by circles of smaller ones in an indistinct but rather

ornate pattern; the dorsal side of the arms is very prettily marbled with dull purplish and whitish: the under surface is white but on each arm is a broad, dull purple, longitudinal stripe which does not decrease in width distally and hence comes to occupy the entire under surface of the arm. Such a stripe is faintly indicated on some other specimens.

P.F. 507 A. Algoa Bay, 33° 58′ S. × 25° 51′ E., 25 fms. R., blk. sp. 2 specimens; adult.

P.F. 859. Off Great Kei River, 32° 45′ S. × 28° 26′ E., 36 fms. St. 3 specimens; young.

P.F. 12361. Umhlangakulu River, N.W. by W., 7 miles, 50 fms. S. and sh. 3 specimens; adult and young.

P.F. 12405. Itongazi River, N.W. ¾ W., 3 miles, 25 fms. S. and st. 5 specimens; adult and young.

P.F. 13068. Hood Point, N.W. by W. ½ W., 11 miles, 49 fms. Brk. sh. 1 specimen; young.

P.F. 13280. Cove Rock, N.E. by E. ½ E., 4 miles, 22 fms. R. and brk. sh. 1 specimen; small adult.

P.F. 13520. East London, N.W. by W. ½ W., 2 miles. Depth? S. and brk. sh. 1 specimen; small adult.

Bathymetrical range, 22–50 fms.

Ophiochiton australis*, sp. nov.

Plate XX. Figs. 1, 2.

Disk 8 mm. in diameter; arms 55–60 mm. long. Disk covered by a coat of thick, irregular, overlapping scales, many of which are ·50–·75 mm. across and among which the six primary plates can hardly be distinguished. (They are evident in the smaller specimen, which is 6 mm. across the disk.) Radial shields small and widely separated: not much larger than the largest disk scales, in the smaller specimen; in the holotype they are about 1·5 mm. long, ·80–1 mm. wide just distal to the middle and about ·75 mm. apart. Upper arm-plates broadly hexagonal, 1·5–1·8 times as wide as long, the distal side slightly convex and occupying the full width of plate, the proximal margin only a little more than half as much; the disto-lateral angles are often a little rounded: the plates are in contact for the full width of the proximal margin. Interbrachial areas below covered by coarse, overlapping scales, no one of which is large or conspicuous. Oral shields, rhomboidal or spear-head-shaped, decidedly longer than wide, with all angles, except possibly the

* *australis* = southern, in reference to the locality where found.

proximal, rounded: proximal sides longer than distal; madreporite of holotype, larger and much longer than the other shields, its *distal* sides nearly twice as long as *proximal*. (On the other specimen, the madreporite is a trifle larger than the other shields but is not otherwise peculiar). Adoral plates curved pentagonal, pointed within where they barely meet, if at all, widest near middle and extending down between oral shields and side arm-plates. Oral plates small. Oral papillae, 5 on a side, of which the penultimate is much the largest; it is tetragonal and much wider than long, its width equalling the second and third together or even exceeding them; the distalmost papilla is partly concealed, as it passes inward

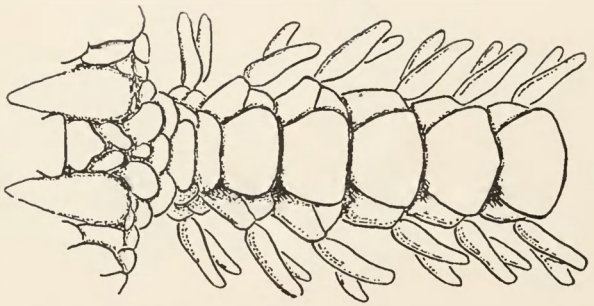

Fig. 3. Upper side of part of disk and arm of *Ophiochiton australis* sp. nov. × 10.

above the big one; the distal papilla and a part of each of the big papillae are borne on the adoral plates, while the oral plates bear the rest. No dental papillae. Teeth 5 or 6 in a column, tetragonal, except the lowest which may be somewhat triangular. First under arm-plates rather small, distally rounded and proximally prolonged, decidedly longer than wide; following plates axe-head-shaped, at first wider than long but soon becoming longer than wide, broadly in contact; the distal margin is slightly convex and the lateral margins markedly concave. Side arm-plates rather small, projecting but little and not meeting either above or below; each carries three short, thick, blunt spines, of which the uppermost equals one arm-segment, the middle one is a trifle longer, and the lowest nearly equals the middle one. Tentacle-scale, single, large, oval, nearly equal to the under arm-plate in length. Colour (dry) above light dull brown, with a purplish-shade, more or less variegated, especially on the upper arm-plates, with yellowish-white; each radial shield is whitish with a brown margin; beneath, yellowish-white.

P.F. 11556. Tugela River, N.W. by N., 22 miles, 47 fms. Brk. sh. 2 specimens; small adults.

Holotype, South African Museum no. A 6439.

This species so closely resembles *Ophionereis porrecta* in form, colour and all details, except the complete absence of supplementary upper arm-plates, that it might easily be mistaken for that species in life. It is interesting to note that it occured at the same station with *Ophionereis dubia*, while *O. dubia* and *O. porrecta* occurred together at least three times. The known species of *Ophiochiton* fall readily into two groups, of which the larger has 2 or more tentacle-scales, at least on the basal arm-pores, while the smaller has only a single, large scale. The present species belongs in the smaller group but is easily distinguished from its other members by the short, thick arm-spines, the form of the oral papillae, the oral shields, and the upper arm-plates. It seems to be nearer to the Atlantic species, *ternispinus* and *grandis*, than to any of the Pacific species. Excepting *O. lentus*, from deep water near the Kermadec Islands, this is the only *Ophiochiton* known from south of the equator.

OPHIOCOMIDAE.

No representative of this tropical family has been taken at any time by the Pieter Faure and I frankly question its right to a place in this report. It is true that several species are known from Mozambique and more probably occur there, but south of that point, there is not a single record except that of *Ophiocoma scolopendrina* which Lyman reports was taken at Simon's Bay, Cape of Good Hope, in 10–20 fms. He does not say how many specimens there were, but evidently there were very few and probably only one, as the M. C. Z. collection contains but half of the disk of a large individual from this station. While this specimen is unquestionably correctly identified, I suspect there was some mistake about the locality label, and I shall not believe that *Ophiocoma* occurs on the coasts of Cape Colony until further specimens are secured. Koehler has described an *Ophiopsila* (*O. puncispina*) from Fernão Veloso Bay, but the genus has not yet been found at Mozambique.

The species of this family now known from Mozambique are distinguished from each other as follows.

Key to the South African Species of Ophiocomidae.

Disk covered with a uniform coat of granules, except on the interbrachial areas below, where the scales are more or less bare.

Tentacle-scales 2, often 1 distally.
Colour variegated; more or less whitish on under side of arms; arms 5 – 8 times disk-diameter . . . *Ophiocoma scolopendrina.*
Colour very dark, nearly or quite black; no light colour anywhere; arms short, 4—5 times disk-diameter . . . *Ophiocoma erinaceus.*
Tentacle-scales 1, sometimes 2 on the first few basal joints.
Colour very dark as in *erinaceus* . . *Ophiocoma schoenleinii.*
Colour more or less light and variegated . . *Ophiocoma valenciae.*
Disk free from granules, but usually with a few scattered, blunt spines *Ophiomastix venosa.*

Ophiocoma scolopendrina.

Ophiura scolopendrina Lamarck, 1816. Anim. s. Vert., vol. 2, p. 544. *Ophiocoma scolopendrina* Müller and Troschel, 1842. Syst. Ast., p. 101. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 14, figs. 10, 11.

This common and wide-ranging brittle-star is known from Mozambique to Tahiti and from Torres Strait to southern Japan. As stated above, I do not accept the record of its occurrence at the Cape of Good Hope. Matsumoto, in his recent admirable monograph on Japanese ophiurans (1917, Jour. Coll. Sci. Imp. Univ. Tokyo, vol. 38, art. 2) considers the two following species as merely varieties of this one. While he may be right in this, I prefer not to discuss the matter here, as a revision of the family *Ophiocomidae* has appeared in my recently published (1921) account of the Echinoderms of Torres Strait. There is no difficulty in distinguishing the three forms from each other. A specimen in the South African Museum collection, taken at Mozambique, in November, 1912, by K. H. Barnard, is undoubtedly *scolopendrina.*

* Ophiocoma erinaceus.

Müller and Troschel, 1842. Syst. Ast., p. 98. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 15, figs. 5, 6.

This species has been the source of much dispute for there are many museum specimens which are intermediate between typical *erinaceus* and *scolopendrina.* After studying the two forms alive in Torres Strait, I became convinced that, at least in that region, they do not interbreed, or even mingle. I therefore consider them distinct species. The occurrence of *erinaceus* at Mozambique seems to be established.

* Ophiocoma schoenleinii.

Müller and Troschel, 1842. Syst. Ast., p. 99. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 15, figs. 1, 2.

Bell (1884, Alert Rep. p. 510) records this species, without comment, from Mozambique. As it is not otherwise known from west of the East Indies, the record must be regarded as dubious, to say the least.

* Ophiocoma valenciae.

Müller and Troschel, 1842. Syst. Ast., p. 102. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 16, figs. 7, 8.

This species is well known from Mozambique and northward.

Ophiomastix venosa.

Peters, 1851. Monatsb. K. Preus. Akad. Wiss. Berlin, p. 464. Koehler, 1904, Mem. Soc. Zool. France, vol. 17, p. 73, figs. 28, 29.

This handsome species is well known from Zanzibar but has not hitherto been recorded from Mozambique. A specimen from the latter place, collected by K. H. Barnard, in November, 1912, is in the present collection. It is of more than usual interest because, although it is about 20 mm. across the disk, and shows the specific characters clearly, there are no spines or granules whatever on the disk, and hence the specimen would properly be assigned to the genus *Ophiarthrum*. Koehler's figure shows no disk spines, but I have not previously noted a specimen, in which they were wholly wanting.

OPHIODERMATIDAE.

This is another family, like the preceding, characteristic of tropical shores and represented by few species outside of the tropics. In South African waters, four species have been found and three of these are in the present collection. It is very interesting to note that three and perhaps all of these species are peculiar to South Africa. They are distinguished from each other as follows:

Key to the South African Species of Ophiodermatidae.

Two long genital slits in each interbrachial area.

Granulation of lower surface of disk completely covers oral shields and face of jaws . . . . . *Cryptopelta aster.*

Oral shields large and bare, generally with an accessory shield on distal side *Ophiarachnella capensis.*

Four short genital slits in each interbrachial area.

No conspicuous bare plates on disk, except that the radial shields may be either bare or concealed . . . . . *Ophioderma leonis.*

Many conspicuously bare plates on disk; upper arm-plates often fragmented *Ophioderma wahlbergii.*

Cryptopelta aster.

Ophiopeza aster Lyman, 1879. Bull. M. C. Z., vol. 6, p. 50; pl. XIV, figs. 395–397.

Cryptopelta aster H. L. Clark, 1909. Bull. M. C. Z., vol. 52, p. 131.

The rediscovery of this interesting species, and the collecting of a good series of specimens, is one of the noteworthy results of the Pieter Faure's work. In disk-diameter, the specimens range from 2·5 to 13 mm.; the largest is thus somewhat larger than Lyman's type. The growth changes are very trivial and consist of an increase in the relative length of arm, in the number of arm-spines and in the widening and coming into broad contact of the upper and under arm-plates. The smallest specimen has arms less than 5 mm. long; one with disk 4·5 mm. has arms 9 mm.; one with disk 6·5, has arms 17; one with disk about 9 mm. has arms 27 mm. long; and the largest has arms nearly 45 mm. The proportion therefore increases from "arms 2 × disk" to "arms 3·5 × disk". The number of arm-spines is 4 on the basal arm-segments of the smallest specimen, 5 in one somewhat larger, 6 in the specimen 6·5 mm. across the disk, 7 in the one 9 mm. across, and even in the largest specimen it is very rarely 8.

Koehler has reported this species from two shallow water stations in the East Indies (7–13 fms.). But his specimens have decidedly longer arms and more arm-spines and I am inclined to think a comparison of specimens would show that the South African and East Indian species of *Cryptopelta* are not identical. The Pieter Faure specimens are all unicolorous, nearly white. They were taken at the following places.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. St. 2 specimens; adult.

P.F. 11359. Tugela River, N.W. by N. ¼ N., 24 miles, 65–80 fms. R. 1 specimen; very young.

P.F. 13194. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh. and r. 4 specimens; young.

P.F. 13240. Cove Rock, N. ¾ E., 5 miles, 43 fms. St. and brk. sh. 7 specimens; adult and young.

P.F. 14365. Cape St. Blaize, N.E. by N. $^1/_4$ N., 94 miles, 116 fms. S., sh., and r. 1 specimen; adult.

Bathymetrical range, 43–230 fms.

Ophiarachnella capensis.

Pectinura capensis Bell, 1888. Proc. Zool. Soc. London, p. 282; pl. XVI, figs. 3, 4.

Ophiarachnella capensis H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 306.

It is a matter of no little interest that this little-known species has been found by the Pieter Faure. It was originally described from specimens in the British Museum labelled "Cape of Good Hope", and has not since been met with. The three specimens at hand agree well with Bell's description, but there are often 6, and rarely 7, arm-spines. In the largest specimen (15 mm.) the colored bands on the arms are so faintly indicated as to be practically wanting, while in the smallest (9·5 mm.), they are very marked: dull olive-brown, conspicuously darker on both the proximal and distal margins: in this specimen, the ground colour of which is pinkish-white, there is a large blotch of pale brown on the disk. In the largest specimen, one of the oral shields entirely lacks the supplementary plate, and in one interradius of the smallest specimen, it is very small.

P.F. 507. Algoa Bay, 33° 58′ S. × 25° 51′ E., 25 fms. R., blk. spks. 1 specimen; small adult.

S.A.M. No. 3013. False Bay, Cape Colony. Littoral. Dr. Purcell coll. 1 specimen; large adult.

P.F. 12359. Umhlangakulu River, N.W. by N., 7 miles, 50 fms. S. and sh. 1 specimen; adult.

Ophioderma leonis.

Döderlein, 1910. Schultze's Zool. Anthr. Ergeb., vol. 4, lfg. 1, p. 252; pl. V, figs. 1, 1*a*.

The species of *Ophioderma* described by Lütken in 1872 as *tonganum* under the supposition that it was from the Tonga Islands has been recorded but once since, when in 1882, Lyman reported that the Challenger had taken it at the Cape of Good Hope, in Simon's Bay, in 10–20 fms. As Lütken had but a single small specimen, and its specific characters, were far from clear, it seems strange that Mr. Lyman gives no information whatever about his specimen or specimens. It is to be inferred however from his "Table of Species of *Ophiura*" that he had several specimens and that they

differed among themselves as to the nakedness of the radial shields. I think there can be little doubt that Döderlein is right in suspecting that Lyman's specimens were not *tonganum* but were identical with the species, *leonis*, from Lüderitzbucht, S.W. Africa. Döderlein's description and figures are quite sufficient but as there are several specimens before me in the Pieter Faure collection, I shall add a few notes. As for *tonganum*, I do not believe that Lütken's specimen came from Tonga, and I think it is probably to be referred to one of the West Indian species. Only one other *Ophioderma* has been described or even recorded from the Indo-Pacific region; this is the holotype of Koehler's species *propinquum*. Here again however I am sceptical that the specimen ever came from the East Indies; but the species itself seems to be valid.

The specimens from South Africa, now at hand, range from 17 to 25 mm. in disk-diameter: the arms are about three times as much. In the smallest specimen, the radial shields are all visible and similar; in another, 9 are visible but unequal and irregular; in the other specimens they are completely concealed as in Döderlein's specimens. This accounts for Mr. Lyman's statement (apropos *tonganum*) "occasionally radial shields naked". I am inclined to think that in the young the radial shields are naked but become covered at full maturity (Döderlein's specimens were all 17 mm. or more in disk-diameter) but it may be purely a matter of individual diversity. A large specimen, with gaping mouth slits reveals the interesting fact that the tentacle-scale of the first oral pore is a long, thick and very conspicuous papilla. The adoral plates are very small and naked, as is well-shown in Döderlein's figure; his description, saying they are for the most part granulated, does not seem to me accurate. Curiously enough, one of the Pieter Faure specimens, shows exactly the same fusion of an oral shield (apparently the madreporite) with an adoral plate which is so well shown in Döderlein's figure. The colouration of the present specimens is somewhat diversified: only two are gray, like Döderlein's, while three are very dark olive-brown, nearly black, above, and yellow or whitish beneath: in one of these, the transition from dark to light is very abrupt but in the others it is gradual; one specimen is uniformly rather bright yellow-brown.

S.A.M. No. 3013. False Bay, Cape Colony; littoral. Dr. Purcell coll. 3 specimens; adult.

P.F. 14714. Saldanha Bay, Cape Colony: littoral. 2 specimens: adult.

P.F. 18282. False Bay, Cape Colony; 8–10 fms. R. 1 specimen; adult.

* Ophioderma wahlbergii.

Müller and Troschel, 1842. Sys. Ast., p. 87.

This species, described originally from Port Natal, has not been met with since, nor has it ever been figured. Bell (1905, Mar. Inv. South Afr., vol. 3, p. 255) says it "appears to be widely distributed as there are examples in the Museum from the Red Sea and from Puerto Cabello." The occurrence of an *Ophioderma* in the Red Sea, whether identical with one from Natal or not, would seem to be worthy of more than this scant, passing notice, and surely we might have been informed a little more particularly as to the grounds on which specimens from Venezuela, the Red Sea and Natal are regarded as identical. It is certainly a unique distribution. According to Müller and Troschel, the Natal species is very well characterized, and it is much to my regret that I find no specimens in the Pieter Faure collection.

OPHIOLEPIDIDAE.

This large, cosmopolitan family is well represented in South African waters, by a small but diversified group of species, belonging to seven genera, three of which are of worldwide distribution, one is a distinctly Indo-Pacific littoral group, and the others are deep water genera of whose actual range our knowledge is still incomplete. Only one of the species here included is new to science, but the occurrence of two specimens of the extraordinary genus *Astrophiura* is of no less interest, though the genus had already been reported from the Agulhas Bank. The following key shows the diagnostic characters of the eleven species here listed.

Key to the South African Species of Ophiolepididae.

Side arm-plates of one or more basal arm-segments greatly extended laterally so as to meet corresponding plates of adjoining arms, or prevented from that only by the genital plates.

Basal arm-segments with their side-plates in contact all around the true disk area . . . . . *Astrophiura cavellae.*

Basal segments of adjoining arms separated by genital plates *Ophiomisidium pulchellum.*

Side arm-plates of basal arm-segmeuts not extraordinarily widened.

Tentacle-scales on second oral and first arm-pores numerous (5—15).

Radial shields at margin of disk, in contact with basal upper arm-plates; upper ends of genital plates not extending above dorsal surface of arms.

Arm-spines minute, peg-like.

Arm-spines 2 or 3, close together near middle or on lower half of side arm-plate; upper arm-plates pentagonal, in contact, becoming rhombic and finally triangular and distally well separated *Ophiura costata.*

Arm spines 3, the uppermost near top of side arm-plate, widely separated from the other two; upper arm-plates tetragonal, broadly in contact, distally elongated and finally somewhat separated . . . . . *Ophiura irrorata.*

Arm-spines 3, moderately long, the uppermost longest and equalling or exceeding an arm-segment.

Arm-spines wide and flat; radial shields small; upper arm-plates, tetragonal, broadly in contact . *Ophiura flagellata.*

Arm-spines acicular; radial shields large; upper arm-plates (except basal) oval. becoming elongated, little or not at all in contact . . . . . *Ophiura trimeni.*

Radial shields pushed back from margin of disk and separated from basal upper arm-plates by two closely united, small, swollen plates, which lie between the considerably elevated upper ends of the genital plates; a secondary arm-comb of minute papillae lies on the outer side of each of these swollen plates . . . *Dictenophiura anoidea.*

Tentacle-scales on second oral and basal arm-pores few, usually 1 or 2 but in Ophioplocus sometimes 4 or 5.

Upper arm-plates single and unbroken.

Upper arm-plates large and broadly in contact.

Oral shields distinctly longer than wide; primary plates of disk and two similarly large plates in each interradius conspicuous, each surrounded by a distinct belt of smaller scales *Ophiocten amitinum.*

Oral shields distinctly wider than long; disk plates thin, and rather indistinct, tho the primary plates are often quite evident *Ophiocten pacificum.*

Upper arm-plates very small and widely separated *Ophiomusium lymani.*

Upper arm-plates broken into half a dozen or more pieces, more or less symmetrically arranged . . . *Ophioplocus imbricatus.*

Astrophiura cavellae.

Koehler, 1915. Bull. Inst. Ocean., no. 311, p. 1, figs. 1–6.

It was with great pleasure that I found in the Pieter Faure collection, two specimens of *Astrophiura* in very fine condition. The first example of this remarkable genus was collected on the shores of Madagascar and was described by Sladen in 1879, as *A. permira.* (This date has been published by Koehler as 1870 and by Matsumoto as 1878; the former is probably a typographical error while the latter is due to a preliminary notice of Sladen's not sufficient to establish the species). In 1898, the Valdivia collected a species

of *Astrophiura* on the Agulhas Bank, off the coast of Cape Colony in 175 fms.: 5 specimens were taken, one of which was figured, but not named or described, by Chun (1900, Aus den Tiefen des Weltmeeres, p. 488). In 1913, Matsumoto was so fortunate as to be able to describe as a new species, a fine specimen of *Astrophiura* from Okinose, a submarine bank in the Sagami Sea, Japan. Finally Koehler in 1915 (*l. c.*) gave full descriptions of the five specimens taken by the VALDIVIA, which he considered different from both the Madagascar species and the Japanese. Matsumoto (1917, Mon. Jap. Oph., pp. 245–246) fails to realize that it is Chun's specimens upon which Koehler's species is based and hence he writes as though there were four species of *Astrophiura* known.

There is no doubt that the Japanese species (*A. kawamurai*) is a well-marked form; it needs no further discussion here. But when one begins to compare the South African and Madagascar species, difficulties arise. In the first place, there is but one specimen known of the latter (*permira*) and it is obvious from Sladen's figures that it is either an aberrant individual or the dorsal surface has been injured and more or less regenerated. In the second place, no two of the five specimens of *cavellae* are exactly alike in the arrangement of their dorsal plates. It is true that no one of them agrees with *permira* but it is hard to see that they differ more from that species than they do from each other. In the third place, the two specimens in the PIETER FAURE collection, measuring 9 and 10 mm. in diameter of entire body, agree closely with each other but differ from both *permira* and *cavellae* in certain particulars, although they were taken very near the type-locality of *cavellae*. Both specimens have large tubercles on the five largest radial plates, and a central cluster of five erect, peg-like spinelets or tubercles crowded at the center of the centrodorsal plate; the height of these is about one-half the radius of the centrodorsal. No such cluster is recorded for any specimen of *Astrophiura* as yet described. Again the first circle of plates surrounding the centrodorsal is made up, not of *five* plates as in typical *cavellae*, but of *ten* nearly equal plates, arranged in five radial pairs: there is a minute tubercle, at the center of more than half these plates. One of Koehler's specimens had ten plates in this first series but these were very unequal and so arranged as to give three large plates in each interradial series, besides the extramarginal triangle. In one of the PIETER FAURE specimens, there are three such plates in one interradius but this is due to the horizontal division of what is typically the uppermost interradial. There is no trace of a tubercle on the

extramarginal triangle, but the other interradials may have a tubercle more or less well developed or may entirely lack it. The same is true of the upper arm-plates.

In view of this diversity in the arrangement, form and appearance of the dorsal plates, I am very sceptical as to there being any true specific distinction between *cavellae* and *permira*. It would be perfectly possible to consider the Pieter Faure specimens representatives of an undescribed species, marked by the central cluster of spinelets and the circle of ten equal plates around the centrodorsal, but in view of the locality where they were taken and the diversity shown by the Valdivia specimens, I think they must be considered *cavellae*. I have compared them carefully with Sladen's description and figures and should have called them *permira* without hesitation had *cavellae* never been described. Koehler lays stress on the absence of oral shields in *permira* but, after examination of these specimens before me, I think this is only a matter of interpretation of the plate present in each adoral angle of each oral interbrachial area. One of these is fairly well marked and we are all agreed in calling it the madreporite, while the other four, as shown by Koehler's own figures, are more or less ill-defined. In the type of *permira*, they were so ill-defined that Sladen (1879, Ann. Mag. Nat. Hist. (5), vol. 4, p. 405) did not recognize their homology; if the lowest one in his fig. 5 were treated by the artist as the madreporite is, the homology would be obvious! I therefore believe *cavellae* and *permira* will prove to be synonyms, but until more material is available, I prefer to let the South African *Astrophiura* continue to bear the honoured name, *cavellae*.

As regards the position of *Astrophiura* in the system, I agree with Matsumoto in considering it only a highly specialized member of the *Ophiolepididae*, and not in any sense a primitive or annectent form. Sladen was carried away by the novelty of that original specimen!

P.F. 1909. Cape St. Blaize, N. by E. $^1/_4$ E., 67 miles, 90–100 fms. Rough bottom. 2 specimens; adult.

Ophiomisidium pulchellum.

Ophiomusium pulchellum Wyville Thomson; 1877, The Atlantic, vol. 2, p. 67. Lyman, 1882. Challenger Oph., pl. III, figs. 1–3.
Ophiomisidium pulchellum Koehler, 1914. Bull. 84 U. S. N. M., p. 32.

It is quite natural to find this interesting little brittle-star in the collection, but it is particularly noteworthy that it was taken with

Astrophiura and at no other station. The specimens are 3 to 4·5 mm. in disk diameter and show no trace of genital slits.

P.F. 1909. Cape St. Blaize, N. by E. $^1/_4$ E., 67 miles, 90–100 fms. Rough bottom. 4 specimens; adult and young.

Ophiura costata.

Ophioglypha costata Lyman, 1878. Bull. M. C. Z., vol. 5, p. 76; pl. IV, figs. 92–94.

Ophiura costata Meissner, 1901. Bronn's Thierreichs, vol. 2, pt. 3, p. 925.

Ophiozona capensis Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 256; pl. I, figs. 1, 2.

Matsumoto (1915, Proc. Philadelphia Acad. Nat. Sci., p. 81) first called attention to the fact that Bell's *Ophiozona capensis* was an *Ophiura*. The M. C. Z. contains two cotypes of Bell's species received from the British Museum in exchange. On examining them in connection with the Pieter Faure collection, I was struck by their resemblance to *Ophiura costata* and comparison with a cotype of that species proves them to be identical. Bell's figure does not show the arm-comb well and Matsumoto was misled into supposing it was made up of spiniform papillae, whereas the comb-papillae are really blunt, flat and very closely crowded together. It is curious that Bell should have considered the species an *Ophiozona*, for it is a very typical example of the *irrorata*-group of *Ophiura*. It seems to be fairly common in the vicinity of the Cape of Good Hope but is not as yet known from anywhere else. The Pieter Faure specimens range from 5 to 22 mm. in disk-diameter and show some interesting growth changes. The smallest has the disk covered by 51 plates, of which the radial shields, which are in contact at their middle, are largest, and the centrodorsal and 5 primary radials are conspicuous; a second radial and two interradials, one of which is marginal, are the only other large plates. The first two upper arm-plates lie between the distal ends of the radial shields; the third is the largest and widest of all, more than twice as wide as long; the fourth is pentagonal, as wide as long, in contact with the third; the fifth is triangular and barely touches the fourth while the remaining plates, all small and triangular, are widely separated. The comb-papillae are not essentially different from those of the adult but they are relatively thicker and rather less truncate. The oral surface shows only very slight differences from what is to be seen in adults; the under arm-plates are all well separated and the greater part of each interbrachial area outside of the oral shield is occupied by a single

large plate: the proximal end of the jaws is not at all elevated or swollen as it is so noticeably in adults. There are only 2 arm-spines on each side of three or four basal arm segments. A specimen 7 mm. across the disk differs from this one chiefly in the complete separation of the radial shields, between which the distal radial plate and the first upper arm-plate are in broad contact. One may now count more than 75 disk plates but the additional ones are small triangular scales, intercalated between the angles of the larger plates. Later growth changes consist chiefly in the multiplication of these secondary disk plates and in the increased size, especially width, of the basal upper arm-plates, of which as many as 25 are in contact in large adults.

P.F. 461 A. Off Cape of Good Hope, 34° 38′ S. × 18° 33′ E., 110 fms. Bottom? 1 specimen; young.

P.F. 2216. Lion's Head, E. 18 miles, 104 fms. Blk. spcs. and r. 5 specimens; adult and young.

P.F. 2714. Vasco de Gama Peak, N. 10° E., 13 miles, 85 fms. Dk. gn. s. 9 specimens; adult and young.

P.F. 2766. Vasco de Gama Peak, N. 40° E., 13 miles, 120 fms. R. 1 specimen; young.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Stns. 1 specimen; adult.

Bathymetrical range, 85–230 fms.

Ophiura irrorata.

Ophioglypha irrorata Lyman, 1878. Bull. M. C. Z., vol. 5, p. 73; pl. IV, figs. 106–108.

Ophiura irrorata Meissner, 1901. Bronn's Thierreichs, vol. 2, pt. 3, p. 925.

This characteristic species from the abyssal fauna is represented in the Pieter Faure collection by a good series of 21 specimens, ranging from 6 to 27 mm. in disk-diameter; the arms are broken in every case, usually proximal to the middle. The only growth-changes of importance shown are in the upper and under arm-plates, for in the smallest, as in the largest specimen, the primary disk-plates are obvious but separated by numerous, less well-defined, more or less overlapping plates, and the upper arm-spine is near the top of the side arm-plate widely spaced from the other two. This arrangement of the little peg-like arm-spines is one of the best and most invariable specific characters at any age. In the smallest specimen, only a few basal upper arm-plates are in contact, and only the first two are tetragonal and wider than long. In older specimens, more of the basal upper arm-plates are wider than long

and are broadly in contact, until we reach the condition of the largest adult at hand where all the arm-plates present (every arm is broken) are broadly tetragonal and very fully in contact, tho the more distal are markedly wider distally than proximally. The first under arm-plate of the smallest specimen is relatively large, much wider than long, somewhat heptagonal, in contact with the adoral plate on either side and with the second under arm-plate distally; the latter is considerably larger still, tetragonal with the convex distal side longest and the straight proximal side much the shortest: it is about as wide as long and is separated from the third under arm-plate by the side arm-plates; the third plate is similar to the first in size and shape: the fourth is similar but smaller; the fifth and subsequent plates are small, much wider than long, with a straight proximal side, strongly convex distally and with the lateral angles more or less truncated; the under arm-plates, except the first two or three, are broadly separated from each other. With increasing size, the basal under arm-plates become bigger and tend to be more and more in contact with each other, until the condition shown by the largest adult is reached where the first eight plates are in contact, and plates 2 and 3 are particularly large and conspicuous.

P.F. 16905. Cape Point, N.E. by E. $^1/_4$ E., 40 miles, 800–900 fms. Gn. m. 4 specimens; young.

P.F. 16991. Cape Point, N.E. by E. $^1/_2$ E., 43 miles, 900 fms. Gn. m. 4 specimens; adult and young.

P.F. 17268. Cape Point, E. $^3/_4$ N., 42 miles, 930 fms. Gn. m. 1 specimen; young.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 11 specimens; young.

P.F. 17351. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 1 specimen: young.

Ophiura flagellata.

Ophioglypha flagellata Lyman, 1878. Bull. M. C. Z., vol. 5, p. 69: pl. 11, figs. 49–51.

Ophiura flagellata Meissner, 1901. Bronn's Thierreichs, vol. 2, pt. 3, p. 925.

The specimens in the Pieter Faure collection are all young (7·5–14 mm. in disk-diameter) and all have the disk fully covered with scales. As most of the arm-spines are broken, the correct identification of the specimens was not at first suspected. They agree well however with specimens of similar size from Japan. The species has been reported from both the southern Atlantic and the Indian

Ocean as well as the Pacific and has a very wide bathymetrical, as well as geographical, range.

P.F. 17182. Cape Point, E. 3/4 N., 38 miles, 630 fms. Gn. m. 1 specimen; young.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 7 specimens; young.

P.F. 17631. Cape Point, N. 81° E., 32 miles, 460 fms. Gn. m. 1 specimen: young.

Ophiura trimeni.

Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 257; pl. I, figs. 3, 4.

Bell's description is obviously quite inadequate but his figures show the specific characters very well. The elongated oval, widely separated upper arm-plates is the best specific character, taken in connection with the large radial shields and long, slender arm-spines. The series in the present collection is a very fine one, consisting of 265 specimens, ranging from 2·75 mm. to 10 mm. in disk diameter, and taken at eleven different places. They have been compared with two of Bell's cotypes so there is no doubt of the identification.

P.F. 2146. Lion's Head, S. 72° E., 47 miles, 190 fms. Gn. s., blk. sps. 9 specimens; adult.

P.F. 2289. Lion's Head, N. 67° E., 25 miles, 131–136 fms. Blk. sps. 39 specimens; adult.

P.F. 2302 A. Lion's Head, N. 67° E., 25 miles, 131–136 fms. Blk. sps. 4 specimens: adult.

P.F. 2386. Lion's Head, N. 76° E., 28 miles, 140 fms. Blk. sps. 3 specimens; adult.

P.F. 2530. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. sps. 6 specimens; adult.

P.F. 6015. Cape Point, S. 83° E., 35 miles, 360 fms. Blk. sps. 5 specimens; adult and young.

P.F. 14559. Cape Point, N. 50° E., 18 miles, 180 fms. Gn. s., blk. sps. 2 specimens: adult.

P.F. 14566. Cape Point, N. 50° E., 18 miles, 180 fms. Gn. s., blk. sps. 2 specimens; adult.

P.F. 15038. Lion's Head, S.E. 1/4 E., 50 miles, 230 fms. Gn. s. 175 specimens: adult and young.

P.F. 16905. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 1 specimen; adult.

P.F. 18933. Southeast from Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 19 specimens; adult and young.

Bathymetrical range, 131–900 fms.

Dictenophiura * anoidea **, gen. et sp. nov.

Plate XIX. Figs. 1, 2.

Disk 6·25 mm. in diameter; arms, 15 mm. long; arms about two and a half times disk-diameter. Disk flat, but thick and elevated above arm-bases, its thickness one-fourth to one third of its diameter; there is an indistinct line between the scaling of its top and that of the interbrachial sides: the latter are each covered by about eight scales while the former is occupied by the six primary plates, a radial plate between the proximal ends of each pair of radial shields a proximal and a distal plate in each interradius, rather numerous small triangular plates intercalated among the larger ones, and the five pairs of large radial shields, the distal halves of which are in full contact; these plates are all, thick, smooth, and often shining. Genital plates large and conspicuous, the curved rounded upper end abutting on the outer corner of each radial shield, its breadth about one-third that of the shield. Between the upper ends of the genital plates of any one radius are a pair of closely united, almost soldered, thick, high plates, which effectively separate the radial shields from the armplates, as well as the genital plates from each other. On the outer side of each of these thickened plates is a secondary arm-comb of very fine papillae, lying just underneath and within the true armcomb. Papillae of latter, 15–20, spiniform and well-spaced, but short and blunt.

Arms more than a millimeter broad at base, where they are a little flattened, but only half as wide at the twelfth segment where they are nearly cylindrical. Upper arm-plates not at all swollen, the distal ones quite flat: first plate very short and wide: second much larger, 3 or 4 times as wide as long, extending across the full width of the arm; third, narrower and longer; each succeeding plate becomes narrower, especially proximally so that the sixth and subsequent plates are quite triangular; basal plates in contact but beyond the sixth or seventh plate, they are well separated.

* Δίς = *double* + κτείς (root, κτεν-) = *comb* + *ophiura*, in reference to the double arm-comb between the elevated ends of the genital plates. The type of the genus is *Ophiura carnea* Lütken. The only other species are *Ophioglypha stellata* Studer and the new South African one about to be described.

** Ἀ privative + οἰδέος = *swollen*, in reference to the upper arm plates, which are flat and not swollen as in *D. carnea*.

Interbrachial areas below covered by the very large, elongated oral shields and about ten small plates like those on the sides of the areas; each oral shield is about 1·5–1·75 mm. long by 1 mm. wide; the distal margin is well rounded, the lateral margins are more or less indented by the genital slits and the inner angle is quite acute. Adoral plates narrow, meeting within, distinctly longer than inner margins of oral shield. Oral plates distinct, proximally elevated or swollen. Oral papillae, 3 on a side and one at apex of jaw, the distalmost very wide but low. Second oral tentacle pores opening entirely outside mouth slit, guarded by about 5 scales on one side and 4 on the other. First under arm-plate very large, tetragonal but much wider without than within, in contact with distal end of adoral plate on each side; second plate widely separated from it, small, triangular; succeeding plates small and widely separated, much wider than long, somewhat pentagonal with a proximal angle and a convex distal margin. Side arm-plates very large, broadly in contact below, and, beyond the basal seven or eight segments, above; each carries 3 well-spaced, blunt cylindrical arm-spines; these are subequal or the uppermost is longest and at base of arm are nearly equal to a segment but distally they barely equal half a segment. Basal tentacle-pores large but rapidly decreasing in size; the first has 3 (or 2) scales on one side and 2 on the other; the second and third have one on each side, but after that there is only a single tentacle-scale to each pore. — Colour, nearly or quite white; colour in life unknown.

P.F. 545. Algoa Bay, 33° 54′ S. × 25° 53′ E., 31 fms. Fne. s. 12 specimens; young.

P.F. 599. Algoa Bay, 33° 49′ S. × 25° 56′ E., depth and bottom? 4 specimens; young.

P.F. 3076. False Bay, Cape Colony, 22 fms. S., sh. 7 specimens; adult.

P.F. 7099. Cape Infanta, N.E. by N. ½ N., 13 miles, 43 fms. Cal. s., few blk. sps. 7 specimens; adult and young.

P.F. 13194. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh., r. 1 specimen; young.

P.F. 13240. Cove Rock, N. ¾ E., 5 miles, 43 fms. St., brk. sh. 20 specimens; adult.

P.F. 13576. Stalwart Point, N.N.W., 9 miles, 53 fms. S., sh. 10 specimens; adult and young.

P.F. 13732. Great Fish Point, N. by W., 7 miles, 49 fms. S., sh. 40 specimens; adult and young.

P.F. 16231. False Bay, Cape Colony, 22 fms. Brk. sh. 2 specimens; adult.

Bathymetrical range, 22–43 fms.

Holotype, South African Museum no. A 6438. P.F. 16231.

This pretty little brittle-star is nearer to *carnea* of Northern European seas than it is to *stellata* of the East Indian region. All three species agree, as Koehler many years ago pointed out in respect to *carnea* and *stellata* (1898, Bull. Sci., vol. 31, p. 62), in the possession of the pair of peculiar swollen plates between the upper ends of the genital plates, and this is so characteristic and so obvious a feature, that it seems to be worthy of generic recognition, especially associated as it is, with a flat, elevated disk and short, stout flattened arms with small upper and under arm-plates. The differences between *carnea* and *anoidea* are not very important but are perfectly obvious. In the first place, the upper arm-plates of *carnea* are distinctly swollen, while those of *anoidea* are flat; the disk-plates of the European species are much more numerous (comparing specimens of the same size) than in the South African form; in the latter the arm-spines of the basal arm-segments are about twice as long as those of *carnea*; and finally the under arm-plates of *anoidea* are smaller and less conspicuous than those of the northern species. In a certain sense these differences show that *anoidea* is intermediate between *carnea* and *stellata* in structure, as it is geographically.

Ophiocten amitinum.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 100; pl. V, figs. 129, 130.

The specimens in the Pieter Faure collection resemble closely those taken by the Challenger, with which I have compared them, except that there is little or no indication of papillae on the distal margins of the basal upper arm-plates. These papillae however are not so well marked in all the Challenger specimens as Lyman's figure suggests and I do not think their absence in the specimens before me is due to anything more than individual diversity. The disk-diameter of these specimens ranges from 3 to 7 mm.

Several of the specimens from off the Glendower Beacon were parasitized by a nematode worm several centimeters in length, lying coiled within the disk. These worms have been sent to Professor H. B. Ward of the University of Illinois for study.

P.F. 13721. Great Fish Point, N. by W. ¾ W., 17 miles, 100 fms. S., sh., st. 11 specimens; adult and young.

P.F. 13859. Glendower Beacon, N. 1/4 W., 21 miles, 100 fms. Sh., st. 37 specimens; adult and young.

P.F. 13884. Nanquas Peak, N.W. 1/4 N., 15 miles, 49 fms. S., blk. sps. 1 specimen; adult.

Ophiocten pacificum.

Lütken and Mortensen, 1899. Mem. M.C.Z., vol. 23, p. 131; pl. III, figs. 5–7.

These specimens agree well not only with the description and figures of Lütken and Mortensen, but with numerous specimens of *pacificum* from the eastern Pacific and from Japan. They are peculiar in the complete absence of spinelets on the basal upper arm-plates and in the great reduction of the arm-comb. But as none are really in good condition, too much stress must not be laid on such negative characters. The specimens measure 6–12 mm. across the disk, and the arms are all broken, usually quite near the disk. The species seems to be abyssal only, in this region, as elsewhere.

P.F. 16905. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 9 specimens; adult.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 7 specimens; adult.

P.F. 17351. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 4 specimens; adult and young.

Ophiomusium lymani.

Wyville Thomson, 1873. Depths of the Sea, p. 172; figs. 32, 33.

This is another deep water species, of very wide distribution. The specimens at hand range from 5 to 24 mm. in disk-diameter. The large specimens are very closely tuberculated, even on the radial shields, while the young specimens are much smoother.

P.F. 16758. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 1 specimen; young.

P.F. 16905. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 2 specimens; young.

P.F. 16928 B. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 3 specimens; adult and young.

P.F. 17268. Cape Point, E. 3/4 N., 42 miles, 930 fms. Gn. m. 2 specimens; young.

* Ophioplocus imbricatus.

Ophiolepis imbricata Müller and Troschel, 1842. Syst. Ast., p. 93.
Ophioplocus imbricatus Lyman, 1861. Proc. Boston Soc. Nat. Hist., vol. 8, p. 76, footnote. Herklots, 1869. Echinod. peintes d'apres Nature, pl. V, fig. 1.

This tropical littoral brittle-star is recorded from Mozambique by Bell, but is not in the present collection.

OPHIOLEUCIDAE.

So far as we as yet know, this small family is represented in South African waters only by a single species, and that an abyssal form.

Ophiernus vallincola.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 122; pl. VI, figs. 170–172.

There is a fine series of this species in the present collection, ranging from 5·5 to 16 mm. across the disk, with arms 6–7 times as much. They show little diversity, among themselves, all having the small nearly circular radial shields and the naked disk skin characteristic of the species.

P.F. 16730. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 1 specimen; adult.

P.F. 16781. Cape Point, N.E. by E., 36 miles, 650–700 fms. Gn. m. 4 specimens; adult and young.

P.F. 17183. Cape Point, E. 3/4 N., 38 miles, 630 fms. Gn. m. 17 specimens; adult and young.

P.F. 17303. Cape Point, E. 3/4 N., 41 miles, 890 fms. Gn. m. 1 specimen; adult.

P.F. 17411. Cape Point, E. 1/2 N., 34 miles, 500–550 fms. Gn. m. 3 specimens; adult.

P.F. 17433. Cape Point, N. 89° E., 36 miles, 700 fms. Bottom? 4 specimens; adult and young.

P.F. 17440. Cape Point, N. 89° E., 36 miles, 700 fms. Bottom? 2 specimens; adult.

P.F. 17631. Cape Point, N. 81° E., 32 miles, 460 fms. Gn. m. 9 specimens; adult.

Bathymetrical range, 460–890 fms.

SEA-URCHINS. ECHINOIDEA.

Sea-urchins form a proportionately large part of the South African echinoderm fauna, for while the brittle-stars of the region are only about four per cent of the known species, the echini are nearly ten per cent of the known forms. This is in keeping with the results from the THETIS and ENDEAVOUR collections, about southern Australia, which show that Echini form a relatively large proportion of the echinoderms of that region. The fact as regards South Africa may be expressed in this way: that, whereas echini make up only about eleven per cent of the echinoderm fauna of the world, in South African waters, they make up more than twenty per cent of the echinoderm fauna as now known. And yet, curiously enough, south of Mozambique, not more than two or three sea-urchins are known to occur along shore, and only *Parechinus angulosus* is at all common on the Cape Colony coast.

Döderlein, in his list mentioned previously (see p. 222), gives 25 species of Echini as occuring in water under 278 fms., but one of these (*Protocentrotus annulatus*) is synonymous with another (*Parechinus angulatus*) and one (*Temnopleurus reevesi*) is not accepted for this report (see p.). The collection from the South African Museum contains 240 specimens of 30 species, (3 apparently new to science) of which only 13 are in Döderlein's list. There are however 2 species hitherto known from Mozambique and 1 from Natal, and a deep water species from 46 miles off Cape Point, which were not included by Döderlein in his list and are not in the collection before me, so that 44 species are included in the present report.

Of these 44 species, 23 are truly littoral, occurring in water less than 20 fms. deep, while only 4 are strictly abyssal, living normally beyond the 600 fms. mark. Of the remaining species 16 are continental and one (*Spatagobrissus*) is either littoral or continental but its exact habitat is unknown.

Of the 23 species known to be littoral, only 2 are endemic, a surprisingly small proportion. Of the remaining 21 species, 6 are characteristic of the western Indian Ocean, while 13 are widely distributed Indo-Pacific forms; one of the remaining two has been known hitherto only from Liberia, while the other is cosmopolitan. None of the littoral species is known from either South America or the southern coasts of Australia. It is noteworthy that 8 of the 23 littoral echini are not known from south of Mozambique and there

are three or four others, which are possibly only stragglers south of that point.

Of the 17 continental echini, we find that there are 11 which are endemic. This includes *Spatagobrissus* and one other species hitherto undescribed. Of the 6 species not endemic, only two are Indo-Pacific, one is distinctly southern, occurring off the coasts of both southern South America and southeastern Australia, one is West Indian and two are well-known North Atlantic forms. It ought to be added further that of the 11 endemic species, no fewer than 7 are nearly allied to north Atlantic or West Indian species. It is quite clear then that a very large proportion of the continental Echini of South Africa came from the west rather than from the east.

Of the 4 abyssal echini, one is endemic, one is distinctly antarctic (in deep water), one is North Atlantic and one is cosmopolitan.

We may conclude then that the South African echinoid fauna contains three distinct elements at least. First, an important Indian and Indo-Pacific element which makes up most of the littoral group. Many of these species do not occur south of Durban and a considerable number are only stragglers south of the vicinity of Mozambique. Only two are endemic and one of these is a persistent relict of a group, geologically very old. A second element in the South African fauna is from the North Atlantic and the West Indian region. This makes up nearly the whole of the continental fauna, and has one representative in the littoral and one in the abyssal group. Many of the continental forms have become sufficiently differentiated to be specifically distinguishable from their nearest allies but there is little doubt of their original stock. The third element in the fauna is austral and is relatively insignificant, being represented by only one abyssal and one continental species. The echini therefore add to the weight of evidence that the South African echinoderm fauna has received its littoral element from the east and its continental element from the west.

The 44 species of sea-urchins here listed belong to no fewer than 21 families. The *Palaeopneustidae* is the only one of the other eight families of Echini large enough to make its absence worthy of comment. The 21 families are distinguishable from each other as indicated in the following key. Under each family will be found a key to its South African species, when more than one occurs in the area covered by this report.

Key to the South African Families of Echini.

Mouth and periproct central and opposite.
- Primary tubercles perforate.
  - Ambulacral plates simple.
    - Peristome covered with numerous small plates. . *Cidaridae.*
    - Peristome with only ten large, buccal plates . *Aspidodiadematidae.*
  - Ambulacral plates compound, at least orally.
    - Test more or less flexible, or at least not very rigid; periproct more or less leathery; spines slender, hollow.
      - Peristome not covered by ambulacral plates *Centrechinidae.*
      - Peristome covered by five double columns of perforated ambulacral plates . . . . . *Echinothuridae.*
    - Test rigid; periproct well plated; spines stout, solid . *Pedinidae.*
- Primary tubercles imperforate.
  - Large, permanent, suranal plate, similar to those of oculo-genital ring, present . . . . . *Saleniidae.*
  - Suranal plate, if present, small, or if large, not at all like those of oculo-genital ring.
    - In midzone, every four or five ambulacral plates fused together and grown over by one large primary tubercle . *Stomopneustidae.*
    - Ambulacral plates in midzone, not thus fused together.
      - Ambitus circular.
        - Periproct covered by 4 (rarely 3,5 or more) similar, triangular plates . . . . . *Arbaciidae.*
        - Periproct covered by several or many dissimilar, and usually, irregularly arranged plates.
          - Ambulacral plates made up of 3 elements; ambitus at or below equator.
            - Test, at least abactinally or in midzone, more or less sculptured or ornamented with deep pits or furrows . . . *Temnopleuridae.*
            - Test not sculptured, pitted or furrowed *Echinidae.*
          - Ambulacral plates made up of 4 or more elements; or if only 3 are present, ambitus *above* equator *Strongylocentrotidae.*
      - Ambitus elliptical . . . . *Echinometridae.*

Mouth central or anterior; periproct posterior, often on oral surface.
- Mouth central, with jaws.
  - Auricles (of perignathic girdle) separate; test not discoidal; genital pores 5. . . . . *Clypeastridae.*
  - Auricles fused into a single piece.
    - Test not discoidal and with no lunules or marginal slits.
      - Petals more or less perfect; madreporic pores numerous; test flattened, moderate or large. . . . *Laganidae.*
      - Petals reduced, often rudimentary; only one madreporic pore; test small, 5—8 mm. long, rarely up to 15 mm., but often relatively high . . . . . *Fibulariidae.*

Test discoidal, with lunules or marginal slits, at least in posterior half (South African species). . . . *Scutellidae.*

Mouth anterior without jaws.

Interambulacrum 5 not essentially different orally from the other interambulacra . . . . . *Nucleolitidae.*

Interambulacrum 5 modified orally to form a sternum.

Labrum (i. e. primordial plate, adjoining mouth, in interambulacrum 5) followed by a single plate.

Mouth horizontally placed on oral surface of test *Urechinidae.*

Mouth vertical at the end of an oral invagination or furrow *Pourtalesiidae.*

Labrum followed by a pair of nearly, or quite, equal large plates.

Subanal fasciole wanting . . . . *Hemiasteridae.*

Subanal fasciole present . . . . *Spatangidae.*

CIDARIDAE.

This interesting family is poorly represented in South African waters, only one species, and that not a littoral one, being known certainly from south of Mozambique. Two widespread Indo-Pacific species occur at that point and perhaps somewhat further down the coast. The three forms may be distinguished from each other as follows. *

Key to the South African Species of Cidaridae.

Primary spines short, cylindrical and stout, barely equal to, or shorter than, test-diameter, truncate or at least very blunt, with no purple spots or lines at base *Eucidaris metularia.*

* It is difficult to determine whether any other species of *Cidaridae* occurs at Mozambique. Peters (1855, Seeigel von Mossambique, p. 118) lists *Cidaris verticillata* without comment and it is impossible to say whether he met with the species at Mozambique or at the Kerimba Islands. That the latter is the locality to which he referred is indicated by the fact that Mr. J. J. Simpson collected a small specimen of *verticillata* there some ten years ago. In his report on Simpson's collection, Rudmose Brown (1910, Proc. Roy. Phys. Soc. Edinburgh, vol. XVIII, p. 36) misspells the specific name, so that it reads *verticulata.* In this same report Brown records ten specimens of *Goniocidaris canaliculata* from the Kerimba Islands; he also lists Natal and Zanzibar as localities for this South American species. Obviously his locality records are taken from the "Revision". Mortensen's most important review of the cidarids in 1903 and my paper on the group in 1907 were evidently unknown to Mr. Brown. It is practically certain that *canaliculata* does not occur in South African waters. In view of the fact that Brown does not list *Eucidaris metularia*, which is common at Mozambique, there is good reason to believe his ten specimens called *canaliculata* are that species. This idea is confirmed by his remarks about the spines.

Primary spines decidedly longer than test-diameter, or if shorter, with purple spots or lines at base.

Primary spines with purple spots or longitudinal lines, conspicuous on the base or "neck" . . . . . *Prionocidaris baculosa.*

Primary spines with light-colored, unspotted neck *Stereocidaris capensis.*

Eucidaris metularia.

Cidarites metularia Lamarck, 1816. Anim. s. Vert., vol. 3, p. 56.
Eucidaris metularia Döderlein, 1887. Japan. Seeigel, p. 42.
Cidaris metularia A. Agassiz, 1873. Rev. Ech., pl. I*g*. fig. 1.

Although Mr. Agassiz lists this species from the Cape of Good Hope, on the strength of specimens in the British Museum, there is little doubt that the locality label for these old specimens is not to be trusted. Neither the Challenger nor any of the other expeditions which have collected at the Cape have met with this species there, nor has it been taken by the Pieter Faure. There are five specimens in the collection of the South African Museum but they were taken at Mozambique, by K. H. Barnard, along shore. There is no evidence to warrant the belief that this sea-urchin occurs very much to the south of that point.

Prionocidaris baculosa.

Cidarites baculosa Lamarck, 1816. Anim. s. Vert., vol. 3, p. 55.
Prionocidaris baculosa Mortensen, 1909. Gauss Ech., p. 50.
Phyllacanthus baculosa A. Agassiz, 1873. Rev. Ech., pl. I*f*, figs. 4, 5.

There is in the collection a small specimen of this well known Indo-Pacific species, which was taken by Mr. Barnard at Mozambique, the most southerly point on the African coast, whence *baculosa* is known. This specimen is only 23 mm. in diameter, with the longest primaries a trifle more. The "necks" of the primaries show clearly the longitudinal purple lines.

It is of great interest to find in the Pieter Faure collection two large primary spines (50–55 mm. long and 4–6·5 mm. in diameter) which show the characteristic purple lines of this species. They are undoubtedly from an individual identical with the small specimen from Mozambique. They are more or less water-worn or at least have that appearance and have undoubtedly been transported a long distance by some agency; for they were dredged in 25 fms. on a bottom of broken shells, two miles off the Umtwalumi River, Natal, hundreds of miles south of the known range of *baculosa*. They bear the reference no. 12466. It is possible they were carried by a fish.

Stereocidaris capensis.

Stereocidaris indica var. *capensis* Döderlein, 1901. Zool. Anz., vol. 23, p. 19.
Stereocidaris capensis Döderlein, 1906. Valdivia Ech., p. 110; pl. X, figs. 3–6.

This specimen, 62 mm. in diameter and 50 mm. high, with primary spines 75 mm. long, and only 4 mm. in diameter, does not answer to the description of any known species, but I have no doubt that both it, and the two specimens of *Cidaris* reported by Bell (1904, Mar. Inv. South Africa, vol. 3, p. 168) are to be referred to the same species as the specimens taken by the Valdivia on Agulhas Bank. None of the Valdivia specimens was nearly so large as the present individual, which is also peculiar in the relatively large peristome, 28 mm. across. I am more and more inclined to think that *capensis* and *indica* are identical and possibly one or more of the Japanese species of this perplexing genus, is also to be referred to *indica*. But more abundant material must be available before the matter can be decided. The present specimen has the abactinal system 31 mm. across and the ambulacra are, in width, ·23 of the interambulacra. There are, in each column, 7 or 8 coronal plates, 6 or 7 of which bore primary spines.

P.F. 14259. Cape St. Francis, N.E. by E., 32 miles. 74 fms. R. 1 specimen; adult.

ASPIDODIADEMATIDAE.

This small family of cosmopolitan, but abyssal, distribution was not previously known from South Africa or from any of the neighboring deeps. It is a matter of great interest therefore to find it in the Pieter Faure collection, where it is represented by the following species.

Aspidodiadema nicobaricum.

Döderlein, 1906. Valdivia Ech., p. 163; pl. XX, figs. 1–1*b*.

The specimens at hand are 11–17 mm. in horizontal diameter, and are therefore scarcely half as large as the original Valdivia specimens. They resemble closely specimens in the M. C. Z. collection from the Hawaiian Islands. The primary spines are only faintly purplish but the test, especially actinally, is quite purple. The slender tridentate pedicellariae of the abactinal region are very conspicuous with straight, narrow valves about 2 mm. long. The species was formerly known

from near the Nicobar Islands, near the Kei Islands and from the Hawaiian Islands.

P.F. 12793. East London, N.W. $^1/_2$ N., 20 miles. 400–450 fms. S., st. 4 specimens: small adults and young.

CENTRECHINIDAE.

This distinctly tropical, shallow-water family, is scarcely entitled to a place in this report for it occurs only at Mozambique or as a straggler southward to Natal. The three species, long known from Mozambique, and two of which have been reported from as far south as the Cape of Good Hope, are easily distinguished from each other as follows.

Key to the South African Species of Centrechinidae.

Test and spines black or blackish; primary spines sometimes banded, black and white.

Ambulacral primary spines not essentially different from those of interambulacra; ambulacra with few or no secondary spines abactinally and narrower there than at ambitus; a conspicuous abactinal white spot in life, in each interambulacrum . . . . . *Centrechinus setosus.*

Ambulacral spines filiform, smooth, except near tip; ambulacra with numerous secondary tubercles abactinally, and distinctly wider there than at ambitus; interambulacral primary spines fragile, diameter of their central cavity more than half diameter of spine; minute teeth on spine in distinctly separated whorls . . . . . *Echinothrix calamaris.*

Test and and spines with no black; greenish and red or red-brown, the prevailing tints; test very flat . . . . . *Astropyga radiata.*

Centrechinus setosus.

Echinometra setosa Leske, 1778. Add. ad Klein, p. 36; pl. XXXVII, figs. 1, 2.

Diadema setosa Gray, 1825. Ann. Phil., vol. 26, p. 426. (*Auct. omnes*).

Centrechinus setosus Jackson. 1912. Phyl. Ech., p. 28.

This well-known Indo-Pacific sea-urchin is represented in the collection at hand, by a single specimen collected along shore at Mozambique by K. H. Barnard. The test is about 35 mm. in diameter and the primary spines are 65-70 mms. long. The characteristic white spots in the interambulacra, abactinally, can still be detected, which is unusual in dry specimens. The species has long been known from Mozambique and Mr. Agassiz list's it in the "Revision" from Simon's Bay, Cape of Good Hope. Bell (1904, Mar. Inv. S. Africa, vol. 3, p. 168) lists a young specimen from off Cape Morgan, in

77 fms. These records from the coast of Cape Colony do not seem to me trustworthy though it cannot be denied that stragglers from the Mozambique region may occur far down the coast.

Echinothrix calamaris.

Echinus calamaris Pallas, 1774. Spic. Zool., vol. 1, fasc. 10, p. 31.
Echinothrix calamaris Peters, 1853. Monatsb. Berlin Akad., p. 484.

A fine, though small, specimen of this beautiful sea-urchin lies before me, taken at Mozambique by Mr. Barnard. No satisfactory figure has as yet been published of this remarkable echinoid. Leske, (1778, Add. ad Klein, pl. XLV, figs. 1, 2) gives two recognizable views and also (fig. 1 B) shows well one of the extraordinary primary spines, much enlarged. But a colored figure, taken from a living specimen, is really necessary to give any fair idea of this, perhaps the most lovely of sea-urchins. It has never been reported from south of Mozambique but it is well-known throughout the Indo-Pacific region.

Dr. Rudmose Brown (1910, Proc. Roy. Phys. Soc. Edinburgh, vol. XVIII, p. 38) records a small specimen of this species from the Kerimba Islands as *E. turcarum*. The differences between the two species of *Echinothrix* are by no means great and are evidently not clear in Dr. Brown's mind.

Astropyga radiata.

Cidaris radiata Leske, 1778. Add. ad Klein, p. 52.
Astropyga radiata Gray, 1825. Ann. Phil., vol. 26, p. 426. Peters, 1855. Seeigel von Mossambique, fig. 1 (as *A. mossambica*).

Although Bell says (1904, Mar. Inv. S. Afr., vol. 3, p. 169) that Krauss long since collected this species at the Cape, I have no doubt that the record is unreliable. Bell records young specimens from four stations on the coast of Natal, north of 30° S. lat. and two of these, about 15 mm. in diameter, from the South African Museum are before me. There is no reason to question the identification, but the fact that they were taken six and a half miles off shore at a depth of 48 fms. seems to warrant the opinion that they are only stragglers from the north. The species is not in the Pieter Faure collection. It is well known however from Mozambique and Zanzibar.

ECHINOTHURIDAE.

This remarkable family is sparingly represented in South African seas. Two species are in the PIETER FAURE collection and there is little doubt that the same two species are mentioned by Bell [1904, Mar. Inv. S. Afr., vol. 3, p. 169) as being in the collection he examined. He did not trouble to identify his specimens but simply says they are "allied respectively to *P. tenue* A. Ag. and *P. bursarium* A. Ag." The specimens before me are indeed allied to these Pacific species but they are nevertheless North Atlantic forms. They are easily distinguished from each other as follows.

Key to the South African Species of Echinothuridae.

Many actinal primary spines enclosed in skin bags, none with "hoofs"; abactinal and actinal surfaces abruptly and strikingly unlike . *Phormosoma placenta.*

Actinal primary spines not enclosed in skin bags, some at least ending in "hoofs"; abactinal and actinal surfaces not abruptly and strikingly unlike *Echinosoma petersii.*

PHORMOSOMA PLACENTA.

Wyville Thomson, 1872. Proc. Roy. Soc. Edinburgh, vol. VII, no. 84, p. 617. 1874, PORCUPINE Ech., pls. LXII and LXIII, figs. 1–8.

This well-known North Atlantic species is represented in the PIETER FAURE collection by a good series of specimens ranging from 7 to 120 mm. in diameter. The last is the largest specimen yet recorded for this species. Bell (*l. c.*) says that the *Phormosoma* from the Cape received by him was allied to *P. bursarium* but I am satisfied that the PIETER FAURE specimens are all *placenta*. I have compared them with specimens of *placenta*, *sigsbei*, *bursarium* and *indicum* and feel quite sure of the identification. They were taken at the following stations:

P.F. 16702. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 2 specimens; adult.

P.F. 16741. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 2 specimens; adult.

P.F. 16790. Cape Point, N.E. by E., 36 miles, 650–700 fms. Gn. m. 3 specimens; adult.

P.F. 16902. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 5 specimens; very young and young.

P.F. 16944. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 1 specimen; young.

P.F. 17351. Cape Point. N. 83° E., 43 miles, 900–1000 fms. Grey m. 6 specimens; young.

P.F. 17376. Cape Point, N. 81° E., 32 miles, 460 fms. Bottom? 1 specimen; very large adult.

P.F. 17440. Cape Point, N. 89° E., 36 miles, 700 fms. Bottom? 1 specimen; young.

Bathymetrical range, 460–1000 fms.

ECHINOSOMA PETERSII.

Phormosoma petersii A. Agassiz. 1880. Bull. M. C. Z., vol. 8, p. 76. 1883. BLAKE Ech., pls. X and XI.

Echinosoma petersii A. Agassiz and Clark, 1909. Mem. M. C. Z., vol. 34, p. 169.

I see no reason to doubt that the echinothurid to which Bell refers (*l. c.*) as allied to *Phormosoma tenue* is identical with one in the PIETER FAURE collection, which I believe to be the Caribbean species *E. petersii*. The only difference noticeable is that the primary tubercles appear to be somewhat larger on the abactinal surface, than they are in a Caribbean specimen of slightly larger size. The PIETER FAURE specimen is only about 125 mm. in diameter and is in poor condition. The surface is so badly rubbed I could find no tridentate pedicellariae and there are very few unbroken spines. There is a small vial with hoofed spines in it accompanying the specimen but there is no direct evidence to show that they actually came from this specimen. They probably did however.

P.F. 12580. Cape Natal, N. by E., 24 miles, 440 fms. M. 1 specimen; small adult.

PEDINIDAE.

This family, containing but one Recent genus, has not hitherto been found in southern seas. One species is known from near the Kei Islands but all the others are from north of the equator. The occurrence therefore of a *Coenopedina* from deep water off the Cape is a matter of very great interest. It appears to be an undescribed form and may be named for the locality where it occurs, as two of the other species have been.

COENOPEDINA CAPENSIS, sp. nov.

Plate XXI. Figs. 1, 2.

Test 16 mm. in diameter and only 7 mm. high; height therefore is about ·44 h. d. Coronal plates 9 or 10 in a column, all, or all but the uppermost, with primary tubercles and spines; interambu-

lacral areas in midzone, about 5·5 mm. wide. Ambulacral plates only 9, the uppermost and sometimes the two uppermost without primary tubercles; ambulacra about 4·5 mm. wide in midzone; poriferous areas very narrow, the pore-pairs in almost vertical arcs of three near the outer margin of plate. Primary tubercles relatively large, without crenulation, but conspicuously perforate. Abactinal system 8·5 mm. across; oculars moderately large, pentagonal, with pore distal to center, and several small tubercles; all decidedly exsert; genitals large, wider than high, heptagonal, well covered, except along lateral and distal margins, with secondary and miliary tubercles; genital pore small, situated about half way between center of plate and the distal tip; with the latter it is connected by a shallow furrow; anal system 4·25 mm. across, covered by numerous, small, thin,

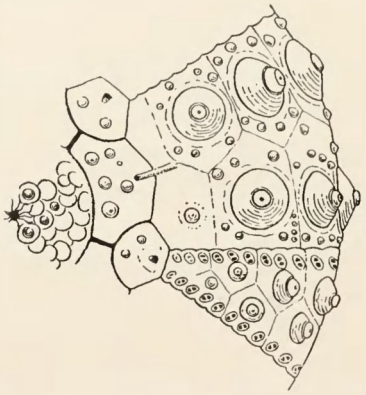

Fig. 4. Abactinal view of portion of test of *Coenopedina capensis* sp. nov. × 5.

somewhat overlapping plates, a dozen or more of which carry secondary tubercles and spines. Peristome 7·5 mm. across, covered by the five pairs of large buccal plates and numerous thin peristomal plates; a few of the largest of the latter carry pedicellariae while the buccal plates in addition to numerous small tridentate and ophicephalous pedicellariae, carry a very few secondary spines; gill cuts so shallow as to be barely perceptible.

Primary spines all broken, so it is impossible to state their length definitely, but the largest were ·75–·80 mm. in diameter at base and were thus probably 15–20 mm. long; they are not at all hollow and the surface is covered with 25–30 very delicate, parallel, longitudinal ridges, which are microscopically serrate; secondary spines similar but conspicuously smaller.

Pedicellariae fairly abundant, but only two kinds were noted, *ophicephalous* and *tridentate*. The former are characteristic having the markedly constricted valves found in *cubensis*, *mirabilis* and *pulchella*, but different from those of any of these species in the wider blades and the more abrupt contraction between blade and base; a typical valve is about ·27 mm. long, with the loop ·10 mm. more; the expanded part of blade is about ·17 mm. wide and ·11 long, while the base of the valve is ·19–·20 mm. wide. The tridentate pedicellariae are not abundant nor do they seem to reach a large size; the valves are always straight and narrow and are more or less expanded, as well as in contact, at the tip; the largest ones noted were ·80 mm. long. The ophicephalous pedicellariae are most common abactinally while the tridentate occur chiefly on the coronal and buccal plates. The calcareous plates of the tube-feet are very numerous, coarsely reticulated, often narrow with drawn-out, rod-like ends.

Colour of test, dried from alcohol; dingy whitish, but whole genito-ocular ring and the coronal plates immediately adjoining rich bright purple in abrupt contrast; periproct very pale violet or at center, whitish. Secondary spines whitish but the primaries above the ambitus are more or less markedly purple, though the basal portion may be dull flesh-color or reddish.

P.F. 16902. Cape Point, N.E. by E. $^1/_4$ E., 40 miles, 800–900 fms. Gn. m. 1 specimen; young.

P.F. 17215. Cape Point, N. 77° E., distant? miles, 660–700 fms. Gn. m. 2 specimens; small adult and young.

Holotype, South African Museum no. A 6432. P.F. 17215.

This very interesting sea-urchin is closely allied to *C. hawaiiensis* from the Hawaiian Islands, but careful comparison shows a number of differences of more or less value. Perhaps the most important of these are in the ambulacra, which are composed of fewer and wider plates; thus, in a specimen of *hawaiiensis* of the same size as the holotype of *capensis*, there are 10 or 11 ambulacral plates and 8 interambulacral, as against 9 of each in the African species; moreover the ambulacra are only about half as wide as the interambulacra, while in *capensis* they may be four-fifths as wide. Another difference is in the position of the genital pores, which are much further from the distal angle of the plate in *capensis* than in *hawaiiensis*. The periproctal plates in *capensis* are very thin and overlapping, while in *hawaiiensis* they are much more like granules. The ophicephalous pedicellariae in the two species are quite unlike. Although both species are conspicuously purple abactinally, the contrast between the purple and the dingy white of the greater part of the test is quite

marked in *capensis* whereas in the Hawaiian species, the purple fades out more gradually in the midzone. In view of all these differences, even though each is trivial in itself, it seems to me the two forms must be regarded as distinct species. Both are abyssal forms, while the other Recent species of the genus are inhabitants of the continental slope. The African species cannot be confused with the Atlantic species, *cubensis*, the conspicuous purple of the abactinal surface distinguishing it at a glance. But it agrees with that species in having the peristome distinctly smaller than the abactinal system, and in the general character of the ophicephalous pedicellariae.

SALENIIDAE.

This small, but old and interesting, family of little, deepwater sea-urchins is represented on the Agulhas Bank by the following species. No other saleniid is known nearer than Tristan d'Acunha.

*Salenia phoinissa.

A. Agassiz and Clark, 1908. Mem. M. C. Z., vol. 34, p. 54. See Döderlein, 1906, Valdivia Ech., pl. XXI, figs. 2, 2*a* (as *S. pattersoni*).

This is one of the characteristic species of the Agulhas Bank, where it was taken by the Valdivia in 56 fms.; but it must be rare, as it has not been met with by the Pieter Faure. The only other living members of the genus are found in the West Indies and near Japan.

STOMOPNEUSTIDAE.

This family contains but a single genus and probably the following widely distributed Indo-Pacific form is the only species.

Stomopneustes variolaris.

Echinus variolaris Lamarck. 1816. Anim. s. Vert., vol. 3, p. 47.
Stomopneustes variolaris Agassiz. 1841. Mon. d'Ech.: Obs. Prog. Rec. Hist. Nat. Ech., p. 7. A. Agassiz, 1873. Rev. Ech. pl. IV*b*, figs. 1–3.

There are two specimens in the collection before me, taken at Mozambique by Mr. K. H. Barnard in November, 1912. The species has long been known from this place but its occurrence south of there is doubtful. Mr. Agassiz, in the "Revision", lists a specimen from Natal, as occurring in the Stuttgart Museum, but there is a strong probability of a mistake in the label.

ARBACIIDAE.

The discovery of a representative of this family in South African seas was one of the interesting results of the VALDIVIA's collecting on the Agulhas Banks. Döderlein, at first, considered it identical with the West Indian representative of the same genus but later decided it was a distinguishable variety. In the PIETER FAURE collection is a magnificient specimen of what is apparently the same species, which convinces me that the form may well be recognized as a valid species, under the following name.

COELOPLEURUS INTERRUPTUS.

Plate XXI. Fig. 3.

Coelopleurus floridanus Döderlein, 1906. VALDIVIA Ech., p. 181 (*non* A. Agassiz, 1872).

Coelopleurus floridanus var. *interrupta* Döderlein, 1910. Jena. Denkschr., vol. 16, p. 257.

Döderlein had but a single small example (18 mm. in diameter) of this interesting species and as he had no specimen of *floridanus* at hand for comparison, it is not strange that he referred it to the West Indian species, and gave no detailed description. The PIETER FAURE specimen is 43 mm. in diameter, somewhat larger than the largest specimen of *floridanus* in the M. C. Z. collection. On comparing the two specimens one finds the following differences of taxonomic importance.

In the first place the colouration of the Cape specimen is totally different from that of *floridanus*. In the latter the bare interambulacral area is prevailingly blue-violet, clearest on the distal half of the genital plate and fading out rapidly towards the ambitus; there are small blotches of pale brown proximally which increase rapidly in size so that the brown occupies a much larger area than the blue-violet; the sides of the interambulacra are bright scarlet-red, the prevailing tint of the ambulacra. This general pattern of coloration is shown in all (16) of the specimens of *floridanus* in the M. C. Z. collection, the only diversity being in the brightness of the shades and their relative extent; in some young individuals, the brown is wanting and there remains the blue-violet and scarlet in vivid contrast; more commonly the shades are paler or duller and the brown is replaced by greenish-white or dirty whitish; some dry specimens are quite dingy but this is usually due to superficial foreign matter. Now in the fine specimen of *interruptus* before me,

the bare interambulacral area, including the distal half of the genital plate is brown, with 9 or 10 transverse, irregular bars of violet (with little indication of blue), of which the lowest are brightest and those near the genital plate are faintest; along each margin of the area is a rather broad vertical white stripe, not at all sharply defined but quite evident; the ambulacra are red, as in *floridanus*. The abactinal, and even some of the actinal, secondaries of *interruptus* are bright scarlet, but in *floridanus* they are commonly dirty white, though a few may be more or less red.

The primary spines of *floridanus*, when full grown and uninjured are pale greenish at base, particularly the collar; on the actinal side beyond the collar they are shining, pure white; abactinally the greenish passes more or less rapidly but not abruptly into brilliant scarlet-red: if the spines are very long, the red becomes discontinuous distally so that the extreme terminal part of the spine abactinally is pale greenish with well-separated scarlet cross-bands or spots. In some specimens, there is little red and it is nearly all confined to the abactinal surface of the middle third of the spine. More commonly however the red extends even to the collar and sometimes the collar itself is more or less red. But in any case the red is a more or less vivid scarlet. In *interruptus* on the other hand, the collar of the full-grown spines is usually greenish proximally and underneath but distally, at least on the abactinal ridge, it becomes dull purplish-red and this colour occupies the upper surface of most of the spine; distally it becomes redder and less purple and at the tip of certain spines, especially those that are regenerating, we find red spots on a greenish-ground, very similar to those found in *floridanus*. The under surface of the primaries is always more or less shining white. The amount of red on the spines shows considerably diversity but in any case, it is (except for occasional distal spots as noted) a very purplish red quite unlike the fine scarlet of *floridanus*. As a result of the colour differences *interruptus*, viewed as a whole, looks quite unlike any specimen of *floridanus* I have ever seen, and is even more different from the other Recent species of the genus.

Aside from the colour differences, *interruptus* differs from *floridanus* in the greater stoutness of the primary spines and in the ophicephalous pedicellariae. While the thickness of the basal part of the largest primaries in the West Indian species is about 2 mm. or, say, about 2 percent of the whole length, in the African form it is 3·5 mm. or about 4·5 per cent of the length. The ophicephalous pedicellariae in both species have stalks about 4 mm. long and

valves ·40–·50 mm., not including the loops, but in *floridanus*, the stalks are at base about ·20 mm. thick and the blades of the valves are in width ·60 of the valve-length, while in *interruptus*, the stalks are ·30 mm. or more in thickness at base and the width of the blades is only about ·45 of the valve-length.

The PIETER FAURE specimen of *interruptus* agrees well with the VALDIVIA specimen in all the proportions of the test; the primary spines seem however to have been relatively much shorter, for, though all are now broken, it is practically certain none of them were ever 100 mm. long.

Koehler (1908, Trans. Roy. Soc. Edinburgh, vol. 46, p. 641) records a specimen of *Coelopleurus* from Ascension, which he says had ophicephalous pedicellariae like those of the VALDIVIA specimen. As the pedicellariae of *floridanus* had not then been figured, Koehler could not have told whether the Ascension specimen is really nearer to *interruptus* than to *floridanus*, and he very naturally noted the resemblance to the form, of which the pedicellariae had been figured. It is very desirable to secure more material from near Ascension and see whether the *Coelopleurus* living there is the West Indian, the South African or an undescribed species.

P.F. 18707. Algoa Bay, Cape Colony. 30 fms. 1 specimen; fine adult.

TEMNOPLEURIDAE.

The occurence of this family along the southern shore of Africa is only that of a straggling interloper. It is not represented in the PIETER FAURE collections and there are but three specimens in the series sent me from the S. A. Museum. One of these represents a well-known species of *Salmacis*, which has hitherto been recorded from China and the Philippines in the east to the Red Sea and Mozambique on the west, while the other two belong to an equally well-known *Temnopleurus* with a similar range. Three other species of Temnopleurids are recorded from South Africa, all by Döderlein (1906) in his VALDIVIA Report; one is a second species of Temnopleurus (*reevesii*) but the other two represent a deep-water section of the family. As regards the *Temnopleurus*, I am inclined to think there is some mistake, for there was only a single small specimen, and it was labelled as taken in 57 fms. about 70 miles southeast of Cape Agulhas. As Döderlein certainly knows the species of *Temnopleurus*, it seems unlikely that this can be a case of mistaken identification. And yet, since *reevesii* is not otherwise known from east of Ceylon, I am loth to include it among South African

echini. Until further evidence is forthcoming therefore I must consider the young echinoid taken by the VALDIVIA and recorded as *reevesii*, as a young *toreumaticus*, a species whose occurrence at Delagoa Bay no longer admits of doubt.

The four temnopleurids, whose occurrence, in the region covered by this report, is indisputable, may be distinguished from each other as follows:

Key to the South African Species of Temnopleuridae.

Size large, diameter 20 mm. or more; color not white; test more or less deeply sculptured.

Spines more or less bright red . . . . *Salmacis bicolor.*

Spines not at all red or reddish . . . *Temnopleurus toreumaticus.*

Size small, diameter usually much less than 20 mm.; color more or less white; test only superficially sculptured.

Peristome with few plates proximal to buccal circle . *Orechinus monolini.*

Peristome with membrane proximal to buccal circle, well-plated *Lamprechinus nitidus.*

SALMACIS BICOLOR.

L. Agassiz, 1841. Pref. Val. Anat. Ech., p. VIII. A. Agassiz, 1873, Rev. Ech., pl. VIII*a*, figs. 11, 12.

This is a well-known sea-urchin of the western Indian Ocean and has long been known from Mozambique. A very good specimen in the South African Museum collection is labelled: "Durban. Jan. 1913. Low tide. K. H. Barnard." This is a notable extension of the known range of the species, which is one of the most beautifully coloured of sea-urchins. The bright red secondary spines form a good back-ground for the primaries banded with purple and green. The Durban specimen is somewhat subdued in colour as the secondaries are brown-red and the test a dull light green, while most of the primaries are broken.

In the Revision (Pt. 1, p. 156), *Salmacis sulcata* (= *S. sphaeroides* L.) is listed from Mozambique but it is probable that there is a mistake somewhere for the species is not otherwise known from the western part of the Indian Ocean.

TEMNOPLEURUS TOREUMATICUS.

Cidaris toreumatica Leske, 1778. Add. ad Klein, p. 155.
Temnopleurus toreumaticus L. Agassiz, 1841. Int. Mon. Scut., p. 7.

The occurrence of this characteristically Asiastic species at Delagoa Bay seemed to me so highly improbable that I have never credited

the published record from that place (See Junod, 1899. Bull. Soc. Vaudoise, vol. 35, p. 281, footnote to an appendix to a list of insects!). But there are two specimens before me from Delagoa Bay which were sent to the South African Museum for identification. There is no room for doubt that they are *toreumaticus*; hence Junod's identification and record are vindicated. The larger is 38 mm. in diameter and is notable for the long, slender primary spines, those at the ambitus being 24–26 mm. in length; they are distinctly banded on the distal half. The other specimen is only 26 mm. in diameter and the longest primary spines are only 10–12 mm. long; moreover very few of the spines show any indication of banding, and those only very faintly; one might well say the spines were unbanded. In this particular the specimen is very near *reevesii* but the abactinal system proves beyond question that it is *toreumaticus*. On the whole these two specimens are very similar to specimens of the same size from Japan. They are much less like those from the Persian Gulf.

Whether this species is confined to Delagoa Bay remains to be seen. If such is the case, it may have been accidentally introduced in some way, possibly on a foul ship-bottom.

* Orechinus monolini.

Trigonocidaris monolini A. Agassiz, 1879. Proc. Amer. Acad., vol. 14, p. 203.

Orechinus monolini Döderlein, 1905. Zool. Anz., vol. 28, p. 622. 1906, Valdivia Ech., p. 196; pls. XXV, fig, 1; XXXV, fig. 6.

The Valdivia took a single specimen of this East Indian species, with the following, southeast of Mossel Bay, in 276 fms.

* Lamprechinus nitidus.

Döderlein, 1905. Zool. Anz., vol. 28, p. 622. 1906, Valdivia Ech., p. 190; pls. XXXIII, figs. 1, 2, XXXV, fig. 11.

This little sea-urchin is known only from a single station, about a hundred miles southeast of Mossel Bay, Cape Colony in 276 fms. Two specimens were taken. I have little doubt it is identical with the preceeding species, the differences given by Döderlein seeming to be trivial and unreliable.

ECHINIDAE.

This large and widely distributed family is not extensively represented in South Africa, for of the five species here listed two occur

only in deep water and two of the others are tropical stragglers. The five species may be distinguished from each other as follows.

Key to the South African Species of Echinidae.

Ambulacral pores in regular arcs of 3 which may however be nearly horizontal.
Height of test two-thirds of diameter or more, and may even greatly exceed it; peristome very small, only ·15—·25 h.d.; color reddish, with slender red primaries . . . . . *Echinus horridus.*
Height of test rarely three-fourths of diameter and usually little, if any, more than half; peristome moderate or large, ·29—·50 of test diameter.
Gill cuts shallow and not very sharply defined; size moderate or small.
Oculars all exsert; primary spines relatively few and conspicuously longer than the small, rather crowded secondaries; coronal plates of specimens over 32 mm. h.d., only 15—17; color (of preserved specimens) whitish for both test and spines; deep water species *Echinus gilchristi.*
Ocular I often insert; primary spines numerous, not much longer than the larger secondaries, which are not small and crowded; coronal plates of specimens over 32 mm. h.d., 18—25; color very diversified but test at least never whitish; littoral species *Parechinus angulosus.*
Gill cuts deep and sharply defined; size large *Toxopneustes pileolus.*
Ambulacral pores in 3 vertical series, forming very broad poriferous areas *Tripneustes gratilla.*

* Echinus horridus.

A. Agassiz, 1879. Proc. Amer. Acad., vol. 14, p. 203. Döderlein, 1906, Valdivia Ech., p. 220; pl. XXVIII, figs. 1–1*c*. H. L. Clark, 1916, Endeavour Ech., p. 109; pls. XXXIX and XL.

The Valdivia took what seems to be a half-grown specimen of this remarkable urchin in 276 fms. about one hundred miles southeast of Mossel Bay. The species is particularly notable for occurring on the continental slopes of South Africa, southern South America and southeastern Australia. The extra-ordinary vertical height which the adult may attain makes the species doubly remarkable.

* Echinus gilchristi.

Bell, 1904. Mar. Inv. S. Afr., vol. 3, p. 170. Döderlein, 1906, Valdivia Ech., p. 213; pl. XXVI.

It seems a little strange that the Pieter Faure met with no further specimens of this species, as there is no specimen in the collection sent me. The full account and numerous figures given by Döderlein make the recognition of the species easy. It was listed

by Bell from half a dozen stations of which five were in 85 fms. or less while one was at 660–700 fms. The Valdivia specimens came from three stations at 40–276 fms. The numerous and rather crowded secondary spines seem to be the main distinguishing feature of this *Echinus*, when compared with the northern *acutus*, which seems to be its nearest relative. As in the northern species, the proportional height of the test varies greatly.

Parechinus angulosus.

Cidaris angulosa Leske, 1778. Add. ad Klein, p. XVII, 28.
Parechinus angulosus Mortensen, 1903. Ingolf Ech., pt. 1, p. 108. 1909, Gauss Ech., pls. VIII, figs. 7, 8; IX, figs. 8 and 10.
Protocentrotus annulatus Mortensen, 1909. Gauss Ech., p. 61; pl. VIII, figs. 9–13.

The series sent me from the South African Museum is of the greatest interest and value, for it shows that this characteristic South African urchin does occur as far north as Mozambique, that Mortensen's proposed species *annulatus* is only a phase of this variable species, and that another phase seems to be isolated as a recognizable variety in Saldanha Bay.

Ludwig (1899, Ech. Sansibar., p. 555) suggested that the specimens of *angulosus* recorded by Agassiz, in the Revision, from Mozambique were probably *Lytechinus verruculatus* and he accordingly lists them under that specific name. But the three specimens in the present collection, taken at Mozambique, although small, are almost certainly *angulosus* and it is therefore likely Mr. Agassiz's record should stand, and the name *verruculatus* must then be stricken from the Zanzibar list.

I am fortunate in having at hand three of Mortensen's original specimens (cotypes) of *annulatus* and have therefore been able to compare them directly with the young *angulosus* in the Pieter Faure collection. The lot from 17486 is particularly instructive, as they range from 10 to 18 mm. in diameter and show great diversity of colour (see J. S. Thomson, A. M. N. H. (8), 12, p. 190, 1913); one has all the spines orange-red except those around the peristome where the red fades to white; another has all the spines light violet; but in most, the spines are more or less annulated usually with dusky but sometimes with white. Examination of the ambulacra of these, and other young specimens shows that the characters supposed to distinguish *annulatus* are not regularly correlated with banded spines, but many specimens with unicolorous spines have numerous ambulacral plates and small tubercles. The only conclusion I can

reach is that *annulatus* is simply based on young specimens of *angulatus* which have banded spines, and unless adult specimens are found retaining this feature I do not see how we can use the name even in a varietal sense.

All of the specimens in the present collection from Saldanha Bay, on the west coast of Cape Colony are conspicuous for having *white* spines: the white is often tinged with green or rarely with purple, but the pale, unicolourous spines are in striking contrast to the greenish or reddish test. In view of the constancy of the character and the geographical isolation of the locality, I think this form may well be designated as variety PALLIDUS. The test is noticeably flattened and the buccal membrane has very few calcareous plates outside the circle of buccal plates. None of the specimens (the largest is 25 mm. h. d. and 11·5 mm. high) has an insert ocular. In some particulars this variety reminds one of the Marion Island form of *magellanicus* but when placed side by side, the differences between the two forms are obvious.

Among the specimens sent me from Capetown are half a dozen young ones, two each from the lots 180, 182 and 183 of Bell's report (1904, Mar. Inv. S. Afr., vol. 3, p. 171) and which he listed as "*Echinus* juv." Although Bell has not seen these particular specimens there is no doubt they are identical with his. I see no reason for considering them anything but young *angulosus*. Aside from these half dozen specimens, the localities for which are given in Bell's report, the material of *angulosus* in the collection sent me is from only the three following stations. There are however in the M. C. Z. collection more than a hundred additional specimens, all of which I have examined.

P.F. 14642. Off Saldanha Bay, west coast of Cape Colony, 20 fms. S., sh., r. 51 specimens; adult and young.

P.F. 17486. False Bay, Cape Colony, 9 fms. S., sh. 14 specimens; young.

Mozambique, Nov. 1912, K. H. Barnard. 3 specimens; young.

* TOXOPNEUSTES PILEOLUS.

Echinus pileolus Lamarck, 1816. Anim. s. Vert., vol. 3, p. 45.
Valenciennes, 1846. Voy. Venus: Zoophytes, pls. 8 and 9.
Toxopneustes pileolus Agassiz, 1841. Int. Mon. Scut., p. 7.

This well known Indo-Pacific species is recorded from Mozambique by Bell (1884, ALERT Rep., p. 510).

TRIPNEUSTES GRATILLA.

Echinus gratilla Linné, 1758. Sys. Nat. ed. 10, p. 664.
Tripneustes gratilla Lovén, 1887. Ech. Linn., p. 77.

This widely distributed Indo-Pacific species has long been known from Zanzibar and Mozambique. In the present collection are two specimens, each somewhat more than half grown, and each with light coloured test and white spines. One was taken at Delagoa Bay, October 1912, by K. H. Barnard while the other bears the number

P.F. 11862–C, showing it was taken in the harbour channel at Durban, 1–3·5 fms., on a bottom of sand and shells.

STRONGYLOCENTROTIDAE.

This is a northern family with few representatives south of the equator. One of these was discovered by the VALDIVIA on the continental slope of South Africa and has been met with three times by the PIETER FAURE but in very much deeper water than where the VALDIVIA specimens were taken. A second species, hitherto unknown to science, of notable size and appearance, has also been taken by the PIETER FAURE. It belongs to the same genus as the VALDIVIA's species, the least specialized group of the family and the one nearest to Echinus. A third species, quite different from these two, has long since been recorded from South Africa, but its occurrence there is doubtful. The three species are superficially quite unlike and are easily distinguished as follows.

Key to the South African Species of Strongylocentrotidae.

Ambitus well above equator; rock-boring species . *Echinostrephus molare.*
Ambitus at or below equator; not rock-boring.
Size small, up to 40 mm. horizontal diameter; height half diameter or less; peristome one-third to one-half diameter; no tridentate pedicellariae with long, straight, narrow jaws . . . . *Paracentrotus agulhensis.*
Size large, up to 80 mm. h. d.; height from more than half to nearly two-thirds h. d.; peristome less than one-fourth h. d.; tridentate pedicellariae with straight narrow jaws, 1—2 mm. long, abundant *Paracentrotus grandis.*

* ECHINOSTREPHUS MOLARE.

Echinus molaris Blainville, 1825. Dict. Sci. Nat.: Oursin, p. 88.
Echinostrephus molare A. Agassiz, 1872. Rev. Ech., pt. 1, p. 119.
1873, Rev. Ech., pt. 3, p. 457; pl. V*a*, figs. 10–12.

Mr. Agassiz lists this species from both Natal and the Cape of Good Hope, as well as from Mozambique. Its occurrence at Mozam-

bique is not unlikely but needs confirmation. The occurrence south of there seems unlikely. Mr. Agassiz's figures are of an Hawaiian Island specimen, which is now regarded as specifically distinct from the one found in the East Indies and Indian Ocean.

Paracentrotus agulhensis.

Döderlein, 1905. Zool. Anz., vol. 28. p. 623. 1906, Valdivia Ech., p. 207; pls. XXVII, figs. 1–4: XXXV, fig. 17; XLVII, fig. 1.

The Pieter Faure specimens are all small but agree very well with a cotype in the M. C. Z. collection. They measure 6–22 mm. in horizontal diameter and only 2·75–9 mm. in height. They are uniformly whitish or light yellowish in colour. In the smallest specimen the ambulacral plates, actinally and at midzone contain only three elements, while abactinally they are perfectly simple: the specimen is thus an *Echinus*, a most interesting growth-stage! The Pieter Faure specimens are all from the abyssal region, while the Valdivia specimens were taken in much shallower water.

P.F. 17215. Cape Point, Cape Colony, N. 77° E., distant?, 660–700 fms. Gn. m. 3 specimens; adult and young.

P.F. 17269. Cape Point. E. 3/4 N., 42 miles, 930 fms. Gn. m. 4 specimens; young.

P.F. 17351. Cape Point, N. 83° E., 43 miles, 900–1000 fms. Grey m. 2 specimens; young.

Paracentrotus grandis, sp. nov.

Plate XXII.

Test 78 mm. in diameter and 48 mm. high; height therefore about ·62 h. d. Coronal plates 18 or 19 in each column, all (or rarely, all but the uppermost) with primary tubercles and spines; interambulacral areas in midzone about 31 mm. wide; primary tubercles large, with shallow but sharply defined areolae, the diameter of which about equals height of plate. Ambulacral plates 21 or 22, the uppermost very rarely without a primary tubercle; ambulacra about 18 mm. wide in midzone, the interporiferous area about 10 mm.; poriferous areas not very narrow, the arcs of 4 large pore-pairs distinctly curved and not very near the outer margin of the plate: primary tubercles of ambulacra relatively large and conspicuous without crenulation or perforation, of course; their areolae ill-defined, shallow and small, the diameter about ·60–·80 of height of plate. Abactinal system 16·5 mm. across; oculars rather small,

pentagonal with distal side usually somewhat concave; ocular pore rather large, close to distal margin of plate; at center of each plate is a well-marked secondary tubercle and spine, proximal to which are several much smaller tubercles bearing miliary spines or pedicellariae; all oculars much exsert; genitals large, wider than high, broadly in contact, pentagonal with proximal side concave; madreporite large somewhat swollen and very fully occupied by the pores; each genital plate bears 3–5 conspicuous secondary tubercles and spines on the proximal side, with a number of miliary tubercles about them; genital pores large, close to distal angle of plate; both ocular and genital plates, aside from the pores and the sparse tubercles have a smooth and shining surface; anal system 9 mm. across, not very thickly covered with minute plates; there is no conspicuous suranal but a plate, somewhat larger than the others, adjoins genital 3, near its juncture with 2, and may be interpreted as such; there are no spinelets or pedicellariae on the periproct. Peristome only 17 mm. across and hence only ·22 h. d.; it is covered by a rather thick membrane in which are a considerable number of scattered small plates, some of which bear pedicellariae; buccal plates not very large scarcely in contact with each other, crowded with ophicephalous pedicellariae; gill cuts broad and shallow, hardly recognizable.

Primary spines all broken at tip, but it is evident that they were more than 20, but less than 30 mm. long; they are nearly 2 mm. in diameter at base; the surface is very delicately striated with 30 or more parallel longitudinal furrows. Secondary spines 5–6 mm. long, about half a millimeter thick at base, relatively few and well scattered; on an interambulacral plate in the midzone there are 10–14, well-spaced; on adjoining ambulacral plate, there are not more than 3 or 4. Miliary spines about 4 mm. long, about ·20 mm. thick at base, tapering steadily towards tip but suddenly expanded there into a thick flat-topped head, some ·20 mm. in diameter.

Pedicellariae abundant everywhere, on long stalks. The *globiferous* resemble closely those of *P. agulhensis* but are considerably larger, as the valves are often nearly a millimeter long. The *ophicephalous* too are like those of *agulhensis* but are somewhat larger. The *tridentate* are very numerous and very varied; some are like those of *agulhensis* with broad slightly curved valves, about ·50 mm. long, meeting only at tip; but most have straight, narrow valves ·60–2·20 mm. long, somewhat expanded near tip and more or less in contact there.

Colour of test white with a distinctly roseate tinge; all spines

and pedicellariae, white; muscles at base of spines and glands on globiferous pedicellariae, brown of lighter or darker shades, in more or less abrupt contrast: tubefeet pale brown.

P.F. 19020. About 160 miles south of Cape Infanta, Cape Colony, 36° 49′ S. × 21° 14′ E., 560 fms. Gn. s. 2 specimens; adult.

Holotype, South African Museum no. A 6452.

The second specimen is similar to the holotype in nearly every particular, although it is somewhat smaller, measuring about 62 mm. in horizontal diameter; the peristome is less than 15 mm. across. It is however somewhat flatter as the vertical diameter is less than 34 mm., instead of 39 as it should be to show the same proportions as the holotype.

This notable sea-urchin looks like an *Echinus* and it was a surprise to find the pairs of pores uniformly in arcs of four. The pores are large and conspicuous and well-removed from the margin of the plate. It is not inconceivable that these two specimens are the full grown adults of *agulhensis*, with which species they have much in common. But it is hard to see how a species which after it is 30 mm. in diameter is less than 15 mm. high and has a peristome whose diameter is one-third that of the test or more, can become transformed into such a high species, with so small a peristome, as *grandis*. The general appearance of the two species is quite unlike but it is possible that abundant material will show that the differences are due to age and individual diversity and are not specific.

ECHINOMETRIDAE.

Only one species of this tropical family has straggled southward along the South African coast. It is the following very variable and widely distributed Indo-Pacific species.

Echinometra mathaei.

Echinus mathaei Blainville, 1825. Dict. Sci. Nat.: Oursin, p. 94.
Echinometra mathaei Blainville, 1830. Dist. Sci. Nat.: Zoöphytes, p. 206.

It is a rather remarkable fact that this very common and widespread sea-urchin has never been adequately figured. Under the name *E. lucunter*, Mr. Agassiz has given a single figure of a nearly bare test (1873, Rev. Ech., pl. IV*b*, fig. 4) but the long axis of this specimen is less than 10 % longer than the short axis, whereas in many specimens the difference between the two axes is much greater than this and it is not often much less. The species is listed in the

"Revision" as occurring at Mozambique, Natal and Cape of Good Hope. In the collection before me, there is a specimen from Mozambique and one from Delagoa Bay. The former was taken in November, 1912 by Mr. K. H. Barnard and is chiefly of interest because its ambitus is so nearly a circle; the long axis is 45 mm. and the short one is only about 5 mm. shorter. The Delagoa Bay specimen, also taken by Mr. Barnard (October, 1912), is nearly the same length (44 mm.) but its breadth is much less (35 mm.).

The Pieter Faure has not taken an *Echinometra* and I doubt whether the species occurs regularly south of Delagoa Bay. The records in the "Revision" are based on Museum material of considerable age and the locality labels are not to be trusted implicitly.

CLYPEASTERIDAE.

The only published record of the occurrence of this family in South Africa is my own statement (1914, Mem. M. C. Z., vol. 46, p. 29) that there are specimens of *Clypeaster audouini* in the M. C. Z. collection from Natal. Since that time, I have found a small *Clypeaster*, also from Natal, in our collection, labelled *Laganum decagonale*, which while clearly a *Clypeaster* is certainly not *audouini*. In the Pieter Faure collection are two tantalizing specimens of *Clypeaster*, which can hardly be determined with certainty. One is a very young individual, which I am satisfied is identical with the small specimen from Natal in the M. C. Z.; I believe these young *Clypeasters* may best be referred to the wide-spread Indo-Pacific species, *C. humilis*, although they are really too young for certain identification. The other Pieter Faure specimen is a fragment of the lateral margin of a large Clypeaster, which the coarse tuberculation shows is certainly neither *audouini* nor *humilis*. The fragment (P.F. 12557) is nearly 80 mm. long and shows that the whole animal was about 140 mm. long. It is a somewhat waterworn fragment of a dead test and was taken 11 miles off Cape Natal in 180–200 fms. This locality and depth, as well as the condition of the specimen, show that it had undoubtedly come from farther north. The tuberculation of the fragment is quite similar to that shown by large specimens of *reticulatus*, but the individual from which it came was nearly twice as large as any known specimen of *reticulatus*, fully adult specimens of which are in the M. C. Z. collection from Mauritius. It seems probable that the Pieter Faure fragment comes from a species as yet unknown to science.

Key to the South African Species of Clypeasteridae.

Test about as wide as long, pentagonal with more or less concave sides; petals narrow with only slightly convex poriferous areas . . . *Clypeaster audouini.*
Test longer than wide, ambitus more or less elliptical; petals rather wide, with more or less obovate interporiferous area and strongly convex sides
Clypeaster humilis.

* Clypeaster audouini.

Fourtau, 1904. Bull. Inst. Egypt, ser. 4, no. 4, p. 418; pl. 1, figs. 1–3.

There are in the M. C. Z. collection three very good specimens of this well-marked species, which were presented by Dr. Robert T. Jackson, who purchased them in London. They were labelled as having come from Durban, Natal. Fourtau's specimens were from the Red Sea, so the species would seem to be characteristic of the whole Eastern coast of Africa.

Clypeaster humilis.

Echinanthus humilis Leske, 1778. Add. ad Klein, pp. XIX, 121.
Clypeaster humilis A. Agassiz, 1872. Rev. Ech., pt. 1, p, 100.
H. L. Clark, 1914. Mem. M. C. Z., vol. 46, p. 36; pls. 137; 138, fig. 4.

Although this species has long been known from Mauritius it has not been recorderd hitherto from the African coast. A small clypeastroid in the M. C. Z. collection, supposed to be from Durban, Natal, seems however to represent this species, altho it may not be denied that it is possible it is a young *audouini*. The test is 36 mm. long and 34 mm. wide, so that a very slight change in the rate of growth of either axis might make a perfectly pentagonal test. The petals however are relatively wide with strongly convex poriferous areas. In spite of the petals, I should call this specimen a young *audouini*, were it not for the Pieter Faure specimen. This is a much younger individual, 18 mm. long and 16 mm. wide, with relatively wide petals having strongly convex sides. It seems to me unlikely that the young of *audouini* would be less pentagonal than the adult, or that its petals would be so wide. As *humilis* probably occurs on the African coast, it seems to me better to list these two young clypeastroids under that name, especially as they agree with a young *humilis* from Ceylon, in practically every particular.

P.F. 12084. O'Neil Peak, N.W. 1/4 W., 9 miles, 90 fms. Brk. sh. 1 specimen; very young.

LAGANIDAE.

This family has not hitherto been found on the South African coasts but there is an unmistakable laganid, probably of the following species in the PIETER FAURE collection.

LAGANUM DECAGONALE.

Scutella decagonalis Blainville, 1827. Dict. Sci. Nat.: Scutelle, p. 229.
Laganum decagonale Bell, 1884. ALERT Ech., p. 122.

This species is still imperfectly known and indubitable specimens are rare. Usually specimens labelled *decagonale* turn out to be something else and it is so with the specimen in the M. C. Z. collection supposed to be from Durban, Natal. This proves on close examination to be a young *Clypeaster*. However there is a dead *Laganum* test, in poor condition, in the PIETER FAURE collection which seems to be this species; owing to its poor condition, it is however impossible to assert whether it is a *Laganum* or a *Peronella*. It is 30 mm. long, by some 28 mm. wide and only about 4 mm. high; the abactinal system and a large part of the oral surface are missing but enough of the petals remain to warrant referring it to this species.

P.F. 11740. Off Tugela River, Natal, N.W. by N. $^3/_4$ N., 15 miles, 36–42 fms. M. 1 specimen; adult, poor.

FIBULARIIDAE.

This family also was unknown from South Africa until now. But the PIETER FAURE has taken two specimens of an *Echinocyamus*, which I refer to the following species.

ECHINOCYAMUS ELEGANS.

Mazetti, 1895. Mem. Reg. Accad. Sci. Modena, ser. 2, vol. 10, p. 216.

Of the two specimens taken by the PIETER FAURE, one is a dead test but the other seems to have been living when taken and is densely covered with spines. The dead test is 8·5 mm. long, 6 mm. wide and 2·5 mm. high; the petals are well-developed with nearly straight and approximately parallel sides; there are 6 or 7 pore-pairs in each area; the genital pores are much larger than the ocular and are equal to or perhaps exceed the primary tubercles; the mouth is large, somewhat pentogonal, a trifle longer than wide,

and not much sunken; the periproct is not more than one-third as large as the mouth, is longer than wide, and lies half way between the posterior margin of mouth and the end of the test.

The other specimen is 9·5 mm. long, 7 mm. wide and about 3·5 mm. high. The crowded, very pale brown spinelets conceal the petals entirely but when they are rubbed off, it is possible to count 8 pore-pairs on one side of one of the paired petals, but they are so small and deeply sunken, it is hard to see them: the mouth is large, nearly circular, apparently about three times as large as the periproct; the latter is longer than wide.

In general these specimens answer well to Mazzetti's description, but in one or two particulars they differ; in his type, which was smaller than either of these, he counted *nine* pore-pairs, while eight is the maximum number for these larger specimens: again in these specimens the lower surface of the test is scarcely concave below while according to Mazzetti his specimen was markedly so. In spite of these differences however I think it better to refer the South African specimens to the Red Sea species *elegans*, than to establish a new species in a genus already overburdened with insufficiently known forms.

P.F. 10722. Cape Natal, W. by N., $6^1/_2$ miles, 54 fms. Fne. s. 1 specimen; adult; bare.

P.F. 13228. Cove Rock, N.W. $^3/_4$ N., 13 miles, 80–130 fms. Crl. and r. 1 specimen; adult.

SCUTELLIDAE.

This family is represented in South Africa by only the following species, both of which are well-known Indian Ocean forms.

Key to the South African Species of Scutellidae.

Each posterior ambulacrum with a long, narrow lunule distal to petal
Echinodiscus bisperforatus.

Each posterior ambulacrum with a deep, narrow slit, extending in from margin
Echinodiscus auritus.

Echinodiscus bisperforatus.

Leske, 1778. Add. ad Klein, p. 132. Agassiz, 1841. Mon. Scut., pl. XII (as *Lobophora bifora*).

There are specimens of this fine scuttellid in the M. C. Z. collection from Mozambique, Durban and Mossel Bay. It is well-known

from Madagascar, Zanzibar and Mauritius, and occurs also in the Red Sea and eastward to the Dutch East Indies.

* Echinodiscus auritus.

Leske, 1778. Add. ad Klein, p. 138. A. Agassiz, 1873. Rev. Ech., pt. 3, pl. XIIIc, figs. 1, 2.

This species is recorded from Mozambique by Sluiter and since its distribution is like that of *bisperforatus*, it may be expected along the coast at least as far south as Natal.

NUCLEOLITIDAE.

This old yet small family is but poorly represented in South Africa as two of the three species here listed occur only in deep water and the third is included here only on the basis of an old record, the reliability of which is open to question. The three species may be distinguished by means of the following key.

Key to the South African Species of Nucleolitidae.

Ambulacral pores wanting, and ambulacra hard to distinguish, on abactinal surface . . . . . *Tropholampas loveni.*

Ambulacral pores very evident abactinally.

Abactinal poriferous areas long, reaching nearly or quite to the almost circular ambitus . . . . . *Echinolampas crassa.*

Abactinal poriferous areas not long, not nearly reaching the oval or elliptical ambitus . . . . . *Echinolampas ovata.*

Tropholampas* loveni.

Catopygus loveni Studer, 1880. Monatsb. Berlin Akad. Wiss., p. 878; pl. II, figs. 1–1*d*.

Neolampas loveni H. L. Clark, 1917. Mem. M. C. Z., vol. 46, p. 110.

One of the most interesting of the captures made by the Pieter Faure is revealed by two small bottles of little echini from two stations in moderately deep water. These prove on critical examination to be identical with the two dead tests taken by the Gazelle in 117 fms. south of the Cape of Good Hope, which Studer reported as a Recent species of *Catopygus*. Without seeing any specimens, I concluded that Studer's species would go better in

* *Τροφός* = nurse + *λαμπάς* = lantern, in reference to the care of the young and in conformity with the terminal syllables of allied genera.

Neolampas, but now that I have examined specimens, it seems to me this interesting form had best be placed in a genus of its own, although its relationship to *Neolampas* is evident. It differs from *Neolampas* in the complete absence of any anal furrow or pit, the periproct being flush with the surface of the test, in having 4 distinct genital pores and in the complete shutting out of the oculars from the abactinal system, the five pairs of interambulacral plates forming a closed ring surrounding the fused plate formed from the genitals. The oculars are greatly reduced and I failed to detect any ocular pores.

The most striking character however, though it may prove to be specific rather than generic, is the development of a sunken brood-pouch in the female. This appears to be formed by the invagination of the fused genitals with their surrounding ring of interambulacral plates, so that the genital pores lie on the floor of the pouch, whose wall is thin and carries very few spines. The pouch itself is about 1·5 mm. deep and 2–3 mm. in diameter; the entrance is about half the diameter. Relatively large spines and pedicellariae guard the entrance but are outside of it. In one female, whose pouch I opened, there was a single young one, nearly circular in outline, slightly flattened, about 1·5 mm. in diameter, covered with many primary, but few miliary, spines and with a central circular mouth. In the males, there is no pouch but there may be a slight depression of the proximal end of interambulacrum 5. Studer speaks of it as a shallow groove concealed by overcrossing spines but it is not at all noticeable in his figure nor in any of the Pieter Faure specimens.

There are four well marked genital pores. Studer says the left anterior pore is noticeably smaller than the others but it does not seem to be so in any of the present specimens. Again, Studer says the peristome is covered by naked skin, but probably he did not dry a specimen, for when the membrane is dry it is found to be filled with thin calcareous plates. In his description of the basicoronal plates around the peristome, Studer does not refer to the large, glassy sphaeridia, one of which lies in a big, shallow pit at the middle of each ambulacral margin.

The miliary spines of *Tropholampas* are (like those of the other *Nucleolitidae*) similar to those of the *Laganidae*, in being made up of parallel rods, connected by cross-bars, and more or less expanded, flattened and toothed at the free end. Each spine is made up of six such rods in *Tropholampas* and each rod is so much expanded at the tip that the whole spine is abruptly three times as thick at the tip as elsewhere. While the miliary spines are thus noticeably

more capitate in *Tropholampas* than in *Neolampas*, it is interesting to find that the primary spines are much more acuminate, and are quite sharp.

The pedicellariae of *Tropholampas* are of only one kind so far as I can find, and they occur only about the abactinal system. They are large tridentate, with valves about ·20 mm. long; the basal part is about ·15 mm. wide and ·10 high; the blade is only about ·01 mm. wide at base but is twice that near tip; the valves are rather strongly curved near tip, where they meet only by their terminal edges.

The colour of these specimens in alcohol is pale grayish, with a slight yellowish tinge, but they are nearly white when dry. The largest is a male, measuring 8 mm. long, by 6 mm. wide and 5 mm. high. The largest female is about 7 mm. long but is nearly as wide and as high as the male.

There can be little doubt that this interesting little nucleolitid is nearly related to *Neolampas rostellata* of the Caribbean Sea. In this *Neolampas* there is a well-marked sexual dimorphism, as the genital pores of the female are very large so that a considerable part of the abactinal system is membranous. It is not hard to see how such a condition might lead to invagination of the area affected and thus a brood pouch would easily be formed. In *Neolampas rostellata* there are however only three genital pores, the left anterior (i. e. the one in genital 3) being wanting. In other particulars, the whole abactinal region of *rostellata* is less specialized than in the African species, for there are five distinct ocular pores and the ocular plates are in contact with the fused genitals.

The specimens of *Tropholampas* were taken at the following places.

P.F. 14252. Cape St. Francis, N. E. 29 miles, 75 fms. S., sh., r. 1 specimen; adult.

P.F. 15129. Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gn. s., bl. spks. 12 specimens; adult.

Echinolampas crassa.

Palaeolampas crassa Bell, 1880. Proc. Zool. Soc. London, p. 43; pl. IV.
Echinolampas crassa H. L. Clark, 1917. Mem. M. C. Z., vol. 46, p. 113.

It is a little strange that the Pieter Faure has not met with this species. It is apparently very local, for the only known station for living specimens is two miles north-northeast of Kromhout in 14 fms. of water. The Valdivia met with a fragment of a dead test off the Cape Colony coast in 276 fms. but this had no doubt been washed out from much shallower water.

* Echinolampas ovata.

Echinanthus ovatus Leske, 1778. Add. ad Klein, p. 127.
Echinolampas orata Döderlein, 1906. Valdivia Ech., p. 240. H. L. Clark, 1917, Mem. M. C. Z., vol. 46, pl. 153, figs. 1, 2.

This species is recorded in the "Revision" from the Cape of Good Hope but it has not been met with in recent years anywhere on the African coast south of the Red Sea. Evidently the South African record needs confirmation.

URECHINIDAE.

There is only a single species of this little family known from the region covered by this report.

Urechinus naresianus.

A. Agassiz, 1879. Proc. Amer. Acad., vol. 14, p. 207.
1881, Challenger Ech., pl. XXX.

Bell (1905, Mar. Inv. South Africa, vol. III, p. 173) lists this species as occuring in the South African material he studied, but he forgets entirely to give either place or depth. In the Pieter Faure collection is a lot of small urechinids in poor condition which I refer to this species with little hesitation. They are all rubbed more or less completely bare of spines and pedicellariae, and nearly all are broken or crushed to a greater or less extent. They range in length from 9.5 mm. to 21, but they show very little diversity in form, the height being half the length or a little less.

P.F. 17351. Cape Point, N. 83° E., 43 miles, 900–1000 fms. Gr. m. 40 specimens; young, bare.

POURTALESIIDAE.

The occurrence of this extraordinary family in the vicinity of South Africa was known only from a single small specimen identified by Bell as *Pourtalesia carinata* A. Ag. one of the Challenger echini, a large pourtalesiid, 90–100 mm. long, taken in 1600 fathoms near te Crozet Islands and at still greater depths further eastward. Fortunately the South African Museum collection contains ten Pourtalesias labelled as "duplicates of those sent to Bell". From these it is clear that the species is not *carinata* but a much smaller pourtalesiid, not very closely allied to that big, deep water form.

Pourtalesia alcocki.

Koehler, 1914. Ech. Indian Mus. Spat. p. 8, pl. 1, figs. 1–14.

The ten specimens before me accord well with Koehler's description and figures and confirm the validity of the species which was originally taken in the Golf of Oman. There is nothing but a most superficial resemblance to *carinata*, which is as Mortensen (1907, Ingolf Ech. pt. 2, p. 82), has shewn, really the representative of a distinct genus. Bell's reference of his specimen (1905, Mar. Invst. S. Afr. III, p. 172) to that species was probably based on geographical grounds as no other pourtalesiid has been recorded from any spot so near to Cape Town, as are the Croset Islands, far away as they are. The series of *alcocki* at hand range from 27–37 mm. in length; the largest is 18 mm. wide and the height is the same. The colour is light purple, darkest in the large specimens, and very pale in the small ones. All the specimens are from the station recorded by Bell, 46 miles west southwest of Cape Point, 900 fathoms.

HEMIASTERIDAE.

This widely distributed family is very poorly represented in South African waters although four genera and eleven species are characteristic echini of Antarctic and subantarctic waters on both sides of the region. One species has long been known from the Cape and a second has now been found by the Pieter Faure. They are easily distinguished from each other as follows.

Key to the South African Species of Hemiasteridae.

Vertical diameter of test about half the length; genital pores 3 *Brisaster fragilis.*
Vertical diameter of test ·60 of length or more; genital pores 2
Schizaster edwardsi.

Brisaster fragilis.

Brissus fragilis Düben and Koren, 1846. Skan. Ech., p. 280.
Schizaster (*Brisaster*) *fragilis* Gray, 1855. Cat. Ech. Rec. Brit. Mus., p. 61.
Mortensen, 1907. Ingolf Ech., pt. 2, pl. I, figs. 6, 7.

The single specimen in the Pieter Faure collection is badly crushed and throws no new light on the disputed question whether the Cape *Brisaster* is identical with the European species or not.

I cannot see that anything is gained by giving it even a varietal name for it is certainly so close to the northern form that from the zoogeographical point of view it is practically identical. The Pieter Faure specimen was apparently about 44 mm. long, 40 mm. wide and 20 mm. high.

P.F. 15143. Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gn. s. and spks. 1 specimen; adult, crushed.

Schizaster edwardsi.

Cotteau, 1889. Bull. Soc. Zool. France, vol. 14, p. 341. 1889, Compte-Rendu Cong. Int. Zool., p. 286; pls. III, figs. 7–12; IV, figs. 1–12.

Although the single *Schizaster* taken by the Pieter Faure was found on the Natal coast, and hence ought to belong to the Indo-Pacific species, it seems to be unquestionably identical with Cotteau's specimens from Cape Palmas, Liberia. Placed side by side with a specimen of *lacunosus* of the same size (28 mm. long, 24 mm. wide, 20 mm. high) from Japan, the differences are obvious, particularly in the width of petal III and the shortness and great divergence of the posterior petals. In my key to the species of *Schizaster* (1917, Mem. M. C. Z., vol. 46, p. 193), I have used the term "petal-length" without definition and hence in an ambiguous way; it refers to the length of the antero-lateral petals, not to the posterioir pair. It may also be mentioned in passing that *lacunosus* is somewhat variable in the character under consideration and specimens with petals I and V as divergent as in *edwardsi* will perhaps be found. — A careful search failed to reveal any pedicellariae on the Pieter Faure specimen of *edwardsi* but the specimen is badly damaged and most of the oral surface back of the labium is missing.

P.F. 11430. Off Tugela River, Natal, 12–14 fms. M. 1 specimen; small adult; damaged.

SPATANGIDAE.

This large and cosmopolitan family is well-represented in South Africa, although it is evident that none of its representatives are very common. Several species are identical with or at least very nearly allied to European forms. Two of these are recognizable as distinct and are here treated as endemic species. But the only really distinctive spatangoid is the one here made the type of a new genus, to which I have given the name *Spatagobrissus*. The seven species

occurring in the region covered by this report are easily distinguished from each other as follows.

Key to the South African Species of Spatangidae.

No internal fasciole present.
  Peripetalous fasciole well developed.
    Ambulacrum III dorsally sunken and more or less petaloid
      Brissopsis lyrifera.
    Ambulacrum III not at all sunken or petaloid.
      A distinct anal fasciole rises from subanal on each side of periproct
        Metalia spatagus.
      No anal fasciole . . . . *Spatagobrissus mirabilis.*
  Peripetalous fasciole wanting . . . . *Spatangus capensis.*
Internal fasciole present.
  Large, deeply sunken primary tubercles present in interambulacra; labrum very long and narrow; sternum with tubercles confined to posterior part
    Lovenia elongata.
  No large, deeply sunken, primary tubercles; labrum short and wide; sternum well covered with tubercles.
    Ambulacrum III not at all sunken, even at ambitus
      Echinocardium capense.
    Ambulacrum III distinctly sunken, especially at ambitus
      Echinocardium cordatum.

Brissopsis lyrifera.

Brissus lyrifer Forbes, 1841. British Starfishes, p. 187.
Brissopsis lyrifera Agassiz and Desor, 1847. Ann. Sci. Nat. Zool., (3) vol. 8, p. 14. Mortensen, 1907. Ingolf Ech., pt. 2, pl. III, figs. 2, 3, 7, 11, 12, 18, 20, 21, 22, 23.

The occurrence of this European species at the Cape of Good Hope has long been known. Mortensen thinks the Cape specimens are recognizable as a distinct variety and that more material may prove them to be entitled to specific recognition. I am unable to agree with him in this, and the small amount of material in the present collection provides no further reason for adopting his view. The specimens range from 6 mm. to 54 mm. in length. It is worthy of note that they were all taken on the west coast of Cape Colony and no *Brissopsis* was met with on the southern or eastern coasts.

P.F. Dassen Island, E. ½ S., 9 miles, 76 fms. Gn. s. 3 specimens; adult.

P.F. Table Mountain, E. by S. ½ S., 25 miles, 190 fms. Gn. s., blk. spks. 13 specimens; young.

* Metalia spatagus.

Echinus spatagus Linné, 1758. Syst. Nat. ed. 10, p. 665.
Metalia spatagus Lovén, 1887. Ech. Linn., p. 162.
Metalia maculosa A. Agassiz, 1873. Rev. Ech., pt. 3, pl. XXI*b*, figs. 8, 9.

This species is included here with great trepidation and solely on the strength of the reports that Peters took it at Mozambique in 1854. It is known from Mauritius but not from Zanzibar.

Spatagobrissus * mirabilis gen. et sp. nov.

Plate XXIII.

Test wide, low, well rounded in front, the ambitus rounded behind, but below ambitus interambulacrum 5 slopes abruptly forwards making an oblique surface on which opens the longitudinally elongated periproct. Peristome anterior, not deeply sunken. Ambulacrum III narrow, flush, not very distinct, ambulacra I and V moderately wide, conspicuously petaloid, the petals rather long, bluntly pointed, distinctly depressed; ambulacra II and IV similar, the petals as long or longer, and more divergent than I and V. Peripetalous fasciole a single very distinct band, enclosing a nearly circular area, containing numerous large primary tubercles. Subanal plastron small, subanal fasciole very distinct. Genital pores 4.

The above paragraph may serve for the generic diagnosis while the following additional data apply more particularly to the species. Test 112 mm. long, 95 mm. wide across anterior end of posterior petals but only 90 across their tips, and 53 mm. high posteriorly (about the same point as where widest) but only 43 high at peristome. Anterior petals 36 mm. long and posterior pair about the same. Anterior half of test above and below, inside and outside of peripetalous fasciole, crowded with primary tubercles, among which are secondaries and numerous miliaries also; the tuberculation is particularly thick in the midzone, outside the fasciole; on the posterior half of the test there are no primaries outside the peripetalous fasciole but within it they are nearly as numerous as anteriorly: even

* The characters of this genus combine so strikingly those of *Spatangus* and *Brissus*, it seemed to me fitting to combine those two generic names in one, dropping the n of *Spatangus* for euphony's sake and to accord with the names *Spatagocystis* and *Spatagodesma*. The significance of the specific name, *mirabilis*, is obvious.

in the interporiferous areas there are small primaries, though not in great number. In ambulacrum III the plates are high and have a well developed vertical pore-pair just distal to the centre; as the apical disc (which is anterior to the center) is approached the pore-pairs lie more and more towards the outer side of the increasingly lower plates. The apical system is small, compact and elongated; there are four large genital pores and a greatly elongated madreporite; from ocular III to a line joining the posterior margins of genital pores 1 and 4 is not quite 3 mm. but from that line to the distal tip of the madreporite in interambulacrum 5 is nearly 4 mm. The peripetalous fasciole is very distinct, obviously depressed below the test level and about a millimeter wide; it does not bend in at any interradius and posteriorly has an evident narrow squarish outward bend. Peristome not very much sunken, about 21 mm. wide and its length not quite half as much; its anterior margin is 29 mm. from anterior end of test. Sternum and subanal plastron considerably projecting but the surface of the subanal plastron is nearly flat and almost horizontal. There are, on each side of the plastron, two large tube-feet and apparently only 3 plates enter the fasciole. Periproct 12 mm. high and 7 mm. wide, pointed at both ends; its upper end is just below the ambitus, so no part of it is visible from above; its lower end is 6 or 7 mm. nearer the mouth than its upper, so oblique is the surface on which it is placed.

The holotype, S.A.M. No. A 6451, of this new species is a dead but not waterworn test from Onrust River, near Hermanus, Cape Province. There is also a second specimen in the collection but it is from an unknown locality and has no label. It is somewhat damaged and is also a little deformed, the ventral surface on the left side being somewhat pushed in, forming a hollow, where, on the opposite side of the test there is a slight outward arching of the surface.

This remarkable spatangoid combines to a very striking degree the characters of *Spatangus* and of *Brissus*. The petals, the mouth and the form of the posterior part of the test are quite like *Spatangus*, while the presence of the peripetalous fasciole (but not its course), the form of the anterior half of the test and the form and position of the periproct are much like *Brissus*. The proximal part of the anterior poriferous areas of petals II and IV are very nearly complete and normal, not more or less reduced as in *Spatangus*. In the tuberculation of the test the new genus is unlike either of the others for the primary tubercles are much more numerous, than in *Spatangus* while they are much larger than in *Brissus*. In some particulars,

Spatagobrissus approaches *Eupatagus* but the shape of the test, the form and depression of the petals and the distribution of the primary tubercles preclude their close association. It is rather remarkable that so large and well characterized a spatangoid has not hitherto been described and the discovery of living specimens will be a matter of very great interest.

Spatangus capensis.

Döderlein, 1905. Zool. Anz., vol. 28, p. 624. 1906, Valdivia Ech., pl. XXXIII, figs. 1, 1*a*.

This seems to be one of the common and characteristic echinoderms of the Cape region. The Pieter Faure specimens show some diversity in relative height and width. They range in length from 68 to 115 mm.: the width is ·84–·94 of the length and the height is ·48–·56 of the length. The colour varies from deep purple to purplish-gray, one specimen showing only a faint purple tinge. They were taken at the following places.

P.F. 1935. Cape St. Blaize, N.W. ½ N., 30 miles, 32 fms. R. 1 specimen: small adult.

P.F. 10325. Cape Hangklip, N. ¾ E., 29 miles, 48 fms. St. 1 specimen; adult.

P.F. 14841. Cape Castle, E. ½ N., 9 miles, 89 fms. Dk. grey m. and s. 1 specimen; adult.

Agulhas Bank. 2 specimens; large adult.

Lovenia elongata.

Spatangus elongatus Gray, 1845. Eyre Voy., vol. 1, p. 436.
Lovenia elongata Gray, 1851. Ann. Mag. Nat. Hist. (2), vol. 7, p. 131. A. Agassiz, 1873. Rev. Ech., pt. 3, pl. XIX*c*, figs. 1–4.

This fine spatangoid has long been known from South Africa, whence its range extends to northern Australia and Japan. It is rather remarkable that the Pieter Faure collection contains only a dorsal fragment of one specimen.

P.F. 11028. Umhloti River, Natal, N.N.W. 1½ miles, 27 fms. S., sh., r. 1 specimen; a fragment, with its spines.

* Echinocardium capense.

Mortensen, 1907. Ingolf Ech., pt. 2, p. 137; pl. II, figs. 5, 6, 11.

Although related to the North Atlantic species, *flavescens*, this form seems to be perfectly distinct. It is known only from the coasts of South Africa in 31–150 fms. Unfortunately it has not been taken by the Pieter Faure.

Echinocardium cordatum.

Echinus cordatus Pennaent, 1777. Brit. Zool., vol. 4, p. 69.
Echinocardium cordatus Gray, 1848. Brit. Rad., p. 6. A. Agassiz, 1873. Rev. Ech., pt. 3, pl. XX, figs. 5–7.

This cosmopolitan species is represented in the present collection collection by 28 specimens, ranging from 11 to 27 mm. in length, but a number are badly crushed.

P.F. 483. Algoa Bay, Cape Colony, 20 fms. M. 2 specimens: adult.

P.F. 608. Algoa Bay, 33° 49′ S. × 25° 56′ E.. Depth and bottom? 2 specimens; small adult.

P.F. 735. Between Roman Rock and Cape Recife, 22 fms. M. 2 specimens; adult and young.

P.F. 2911 and 2912. False Bay, Cape Colony, 30 fms. S. and sh. 19 specimens; adult and young.

P.F. 2959. Cape Point, S. W. by W. ¾ W., 3½ miles, 32 fms. S. and sh. 2 specimens; adult.

P.F. 4046. False Bay, 20 fms. Brk. sh. 1 specimen; large adult; crushed.

SEA-CUCUMBERS. HOLOTHURIOIDEA.

The collection of holothurians received from the South African Museum was an unpromising lot of material. It had previously been sent to a zoölogist whose work was interrupted by the war, and having been returned by him to Cape Town, was forwarded at once to me. Owing to transportation difficulties and custom's-house delays, it reached me only after some months of travel. Several jars and bottles were broken and from others the alcohol had vanished, so that many specimens were completely dried and appeared to be hopelessly unidentifiable. As a matter of fact however the collection proved to be a very interesting one and

only one specimen is beyond recognition. That is apparently a *Thyone* which was evidently preserved in formalin, and from which the anterior end is missing. As there are no calcareous structures left, there is no clue to its identity. The dried specimens yielded surprisingly well to prolonged soaking in water, followed by weak alcohol. The most serious difficulty with the collection however is the fact that in some way, at sometime, labels have been mixed, so that one jar containing five species bears both Natal and Mozambique labels and there are other jars in which there were more labels than specimens. On the other hand a few bottles contained no labels at all.

In spite of these drawbacks, the collection throws a great deal of light on the hitherto little known holothurian fauna of South Africa and its origin. There are also three species which seem to be new to science, each representing a large, cosmopolitan genus. One of the most striking features of the collection is the entire absence of apodous forms, neither a synaptid nor a molpadiid being present. This remarkable fact emphasizes anew the entire absence of apodous holothurians in the South African region. Possibly they may yet be found there but they must be at least relatively rare. The *Elpidiidae* are also conspicuous by their absence, a single specimen in the Pieter Faure collection being the only representative of the family as yet noted from that portion of the Southern Ocean.

The collection sent me contains 174 specimens of 24 species. It is a little hard to determine how many of these were previously known from South Africa for no list of the holothurians of the region has ever been published. In Theél's great monograph on the Challenger holothurians, the most useful, reliable and altogether satisfactory work dealing with this somewhat difficult class of echinoderms, there are some twenty species given which seem to occur in the region covered by this report. I have found a few other species recorded in subsequent papers, so that there are about 25 species now listed from South Africa but at least five of these are synonymous with others of the list, so that 20 seems to be the number of valid species now known. Of these 12 are in the collection sent to me from the South African Museum which also contains 12 species new to the fauna of the region. There are thus 32 species included in the present report, but it is perfectly clear from the available data that not more than three or four holothurians are at all common on the coasts of South Africa, at least south of Delagoa Bay.

Of the 32 species, 27 are truly littoral occurring in water less

than 20 fms. deep, and any one of them may be found at or just below low tide mark. Of the other five species, 2 are abyssal and 3 belong in the continental group. Of the 27 littoral species, 12 are endemic so far as our present knowledge goes but it is very probable that some of these have a wider range than is at present suspected. Of the other 15 species, one is known from the Red Sea, one is tropicopolitan and the others are well-known Indo-Pacific species. There is not a single Atlantic or West Indian species nor one known from the southern coasts of either Australia * or South America.

On the other hand, of the three continental species two are endemic while the third is a North Atlantic form, and of the two abyssal species, one is cosmopolitan and one is of the North Atlantic. It seems clear then that the very scanty deep water holothurian fauna of South Africa has come from the western side of the continent and apparently is closed allied to that of the North Atlantic, while the shallow water fauna is distinctly Indo-Pacific. It is noteworthy that there are included in this report no fewer than 9 holothurians not certainly known from south of Mozambique and there are 2 others not known from south of Delagoa Bay. As there are 5 others not known from south of Natal, it is evident that only 11 species of Holothurians occur on the coasts of Cape Colony.

In 1884, Bell (Alert Ech., p. 509) listed half a dozen holothurians from Mozambique, with the preliminary remark that they were "forms that are so thoroughly well known to students of this group of animals that it has not been thought necessary to burden the text with the ordinary bibliographical references". He even fails to give the authority for the names but these are easily guessed. In 1884, two years prior to Théel's great work, the identification of Holothurians was a tedious undertaking and there were few species of which it could be said that they were "thoroughly well known". Of Bell's six, one (*Actinopyga mauritiana*) is well-characterized and is fairly well-known but *Holothuria impatiens* is a very puzzling form. *H. maxima* is absolutely unknown in every detail, *H. amboinensis* is little known but is probably synonymous with *H. atra*. *H. pulla* is practically unknown and *H. lagoena* is now known to be synonymous with *H. leucospilota*. It might be added that we do not know whether the *H. maxima* of Bell's list is the species of Delle Chiaje or of Forskaal, and that *H. pulla* is listed with a question mark. Obviously

* Ludwig considers his *Colochirus australis* from Australia synonymous with *Pentacta doliolum* (Pallas) of Cape of Good Hope and Angra Pequena. Both forms are very imperfectly known and their identity seems to me highly improbable.

then the ALERT Report's list does not throw much light on the Holothurians of South Africa! Owing to our lack of knowledge as to their essential characters, I cannot include either *Holothuria maxima* or *H. pulla* in the present report.

The 32 species of South African holothurians represent only 3 families. These are easily distinguished from each other by the following characters.

Key to the South African Families of Holothurians.

Tentacles dendritic; retractor muscles well developed . . *Cucumariidae.*
Tentacles more or less peltate; no retractor muscles.
No tentacle-ampullae; no respiratory trees . . . *Elpidiidae.*
Tentacle-ampullae and respiratory trees present . . *Holothuriidae.*

CUCUMARIIDAE.

This large and widespread family is represented in South African waters by 17 species of which 13 are in the collection before me. Three of the species belong in the continental fauna and one is abyssal. Two seem to be new to science. Generic differences in the family are not easily maintained for the genera have been largely based upon the number and arrangement of the tentacles, characters which show more or less considerable changes during growth. The South African species fit into their respective genera well however, except that several of the species of *Cucumaria* approach so close to *Pentacta* that the line of difference between the two genera is hard to maintain. It is worthy of special note that with a single exception, all the *Cucumariidae* of this report occur on (or off) the coast of Cape Colony, or the adjoining coast of Southwest Africa and of Natal. The family is thus the characteristic one for the South African region. Two of the species here reported are new to science, and nine others are endemic, a very unusual proportion. The 17 species may be distinguished from each other as follows.

Key to the South African Species of Cucumariidae.

Body wall soft or leathery, more or less filled with microscopic calcareous particles.
Tentacles 10.
Ventral side of body not markedly distinct from dorsal nor are dorsal ambulacral appendages larger than those of ventral side.
Pedicels either confined to radii, or if present on the interradial areas they are much smaller there.
Inner layer of skin with numerous, often densely crowded, thick, knobbed perforated plates or buttons.

Outermost layer of skin with numerous minute branched rods, reticulated cups or "baskets" or very small plates with few large perforations regularly arranged.

Deposits of outermost layer of skin in form of reticulated cups or baskets.

Baskets with numerous little spines or knobs scattered over them . . . *Cucumaria discolor.*

Baskets smaller, perfectly smooth with few marginal projections . . *Cucumaria spyridophora.*

Deposits of outermost layer of skin not in form of baskets.

Deposits of outermost layer of skin short thick rods forked at each end, and often more or less further branched dichotomously . *Cucumaria insolens.*

Deposits of outermost layer of skin minute perforated plates, which appear to have been formed by fusions of the tips of branches of rods which have more or less frequently dichotomously branched *Cucumaria capensis.*

Outermost layer of skin apparently without deposits; no terminal plates in pedicels.

Small pedicels scattered over dorsal interambulacra *Cucumaria sykion.*

No pedicels on interambulacra . *Cucumaria jaegeri.*

Inner layer of skin with no knobbed plates or buttons.

Calcareous deposits in the form of more or less curved rods of two kinds . . . *Cucumaria frauenfeldi.*

Calcareous deposits in the form of reticulated baskets and large, smooth, perforated plates . *Cucumaria improvisa.*

Pedicels more or less generally distributed over body.

Calcareous deposits, in part at least, tables with irregular disk and spire of two rods . . . *Thyone serrata.*

No tables present.

Deposits, knobbed plates with a vertical arch at right angles to each surface . . . *Thyone sacellus.*

Deposits, perforated rods and smooth plates *Thyone aurea.*

Ventral side of body modified to form a creeping sole; dorsal ambulacral appendages, large papillae . . . . *Pentacta doliolum.*

Tentacles more than 15.

Calcareous particles of skin, short thick rods with sharp spines at each end and around middle . . . *Phyllophorus frauenfeldi.*

Calcareous particles, large lenticular perforated plates *Pseudocucumis africana.*

Body wall wholly, or at least on dorsal side, covered with macroscopic calcareous plates, either overlapping or closely joined along margins.

Whole body encased equally . . . . *Echinocucumis typica.*

Only back, or back and ends with overlapping plates.

Body not very flat; ventral sole not sharply defined *Psolus imperfectus.*

Body very flat with sharp margins and ventral sole correspondingly well-defined . . . . . *Psolus squamatus.*

Cucumaria discolor.

Theél, 1886. Challenger Holoth., p. 64: pl. IV, fig. 8.

The type locality of this species is Simon's Bay, 10—20 fms. and although Theél had but one specimen his account is, as usual for him, accurate and satisfactory, while his figures are equally good. The specimens before me range from 24 to 55 mm. in length; all are more or less strongly contracted but are relatively slender, the diameter being about one-fifth of the length. The closed and contracted oral end is as markedly stellate as in Pentacta and the body in cross section is distinctly pentagonal rather than circular. The color is light brown or fawn-color. Theél says the anus is without teeth but so far as I can judge these specimens have very small anal teeth, which might however be easily overlooked, and perhaps are not present in all individuals.

P.F. 16336. False Bay, 14 fms. Brk. sh. 1 specimen: young.

P.F. 16365. False Bay, Fishhook Bay, 5 fms. Fne. s. 3 specimens; adult.

False Bay; 3 specimens; 2 young.

Locality? 1 specimen.

Cucumaria spyridophora* sp. nov.

Body somewhat pentagonal in cross section, about 45 mm. long by 12 mm. in diameter; in the present specimens, which are much contracted the body is noticeably thicker at the anterior than at the posterior end. Color light brown, more or less finely mottled with darker; on one specimen the dark color predominates. Pedicels rather large, not at all crowded, confined to the ambulacra: in the midventral and two dorsal ambulacra there are only two well separated series of pedicels, but in the latero-ventral, the pedicels are more numerous and there are more or less evident indications of a third series; the dorsal pedicels seem to be a little smaller than the ventral. Tentacles 10, the two midventral very much smaller than the other eight. Anal teeth well developed but in these contracted specimens, they are rather difficult to demonstrate. Calcareous ring moderately stout, with no posterior prolongations: the radial pieces are more deeply notched than the interradial and have slightly shorter but wider anterior projections; the interradial pieces are about 3 mm. high.

Calcareous particles of skin in two very distinct layers; the inner

* σπυρίς = a round, plaited basket + φορέω = to bear, in reference to the characteristic calcareous particles.

is a densely crowded layer of very numerous knobbed buttons while the outer is a single layer of rather crowded reticulate "baskets" or cups. The buttons are quite uniform in size and shape, ·07—·08 mm. long and about two-thirds as wide; each button is perforated by four holes and carries, on each surface, two central and ten marginal knobs; on some buttons there are a few more knobs, or the knobs may be swollen and more or less fused but there is no marked tendency to form larger knobbed plates or spheres. The "baskets" are very characteristic for while they show some diversity in size and considerable diversity of form, scarcely two being exactly alike, they are mostly about ·03 mm. long, not quite so wide and about one-half to two-thirds as deep; the rims are slender and with either no knobs or a few low, small ones, while the dichotomous rod forming the floor of the basket is somewhat flattened, perfectly smooth and rather stout. They are thus much like those of *Cucumaria punctata* (see Ludwig, 1875, Arb. Zool. Inst. Würzburg, vol. 2, pl. VI, fig. 8) but the rims are much more slender and lack the prominent spinelets. Pedicels well supplied with broad curved supporting rods, having perforations at each end. Terminal plates seem to be wholly wanting.

Mossel Bay, Cape Colony. 3 specimens; adult. "Colour red".

Holotype, South African Museum No. A 6453.

This species belongs very evidently, to judge from its form and general appearance, in the same group with *C. discolor*, *insolens* and *capensis* but it is easily distinguished from any of these by the calcareous baskets of the outer layer of skin. Although in these baskets, there is some resemblance to *C. punctata*, in no other respect does *spyridophora* resemble that West Indian species.

Cucumaria insolens.

Théel, 1886. Challenger Holoth., p. 70; pl. IV, fig. 5.
Cucumaria leonina var. *africana* Britten, 1910. Schultze's Zool. Anthrop. Erg. Forsch. Südafrika, vol. 4, pt. 1, p. 240.

It is rather curious that Britten does not refer to *insolens* in his discussion of his supposed new *Cucumaria* from Angra Pequena Bay. However there are in the M. C. Z. collection several cotypes of his variety and they are unquestionably identical with the material before me from Cape Colony. The specimens at hand show much diversity in size, colour and form but agree well in the distribution of the pedicels and in the calcareous parts. Those from Saldanha Bay are 12—23 mm. long, very dark brown above, much lighter

below; these colours in the living animals, according to Mr. Barnard's notes, are dark maroon red above, bright scarlet below. Those from the unknown station are a trifle larger and are more or less uniformly light dirty gray-brown; they are in rather poor condition. Those from 1938 range up to 45 mm. in length and are dirty cream-colour; the body wall in these specimens is softer than, and the colouration utterly unlike, that of the Saldanha Bay specimens, but the calcareous particles seem to be identical. Comparing this material with Théel's description and figures has satisfied me that all must be called *insolens*. Evidently in shallow water, pigmentation occurs much more heavily than at greater depths, especially on the dorsal surface.

P.F. 1938. Cape St. Blaize N.W. $^1/_2$ N., 30 miles, 52 fms. R. 11 specimens; adult.

Saldanha Bay; low tide lying exposed in pools with sea-weed. 5, IX, 1912, K. H. Barnard. 20 specimens; young.

Saldanha Bay; low tide, under stones. 5. IX. 1912. K. H. Barnard. 7 specimens; young.

Locality unknown, but Pieter Faure collection and probably from off Cape Point. 23 specimens; young.

Cucumaria capensis.

Théel, 1886. Challenger Holoth., p. 62; pl. V, fig. 2.

In the form of the body, the distribution of the pedicels, and the firmness of the body-wall, this species approaches Ocnus and I was inclined to refer the specimens before me to that genus, but on comparing them with Théel's description and figures of *C. capensis*, I realized that they belong in that species. The Pieter Faure specimens are 16 and 38 mm. long, with a diameter about equal to one-fourth or one-fifth of their length. The smaller one is light gray but the larger one is nearly white.

P.F. 2836. Vasco de Gama Peak, N. 71° E., 18$^1/_2$ miles, 230 fms. St. 1 specimen: young.

P.F. 14987. Lion's Head, S.E. $^1/_2$ E., 47 miles, 175 fms. Gr. s. 1 specimen; adult.

Cucumaria sykion.

Semperia sykion Lampert, 1885. Die Seewalzen, p. 250.
Cucumaria sykion Théel, 1886. Challenger Holoth., p. 266.

The type locality for this species is Algoa Bay, but it seems to be rather common along the eastern coast of Cape Colony and

southern Natal. The specimens at hand range from 22 to 57 mm. in length; the larger individuals are quite stout, the diameter equalling half the length or more; all are strongly contracted. While most of the specimens still retain more or less of the characteristic black colouration, some are not at all black: the lot from East London is a uniformly light brown. The absence of deposits in the outer layer of skin and the lack of terminal plates in the pedicels are noticeable features of this species.

P.F. 918. 1 mile east of Cove Rock, East London, low tide. 9 specimens; adult.

Natal: Port Shepstone and Scottsburgh. K. H. Barnard coll. 6 specimens; adult and young.

Natal: Umhlali. K. H. Barnard coll. 2 specimens; adult.

Cape Colony: Port Elizabeth. 2 specimens; adult.

Locality unknown. 10 specimens; adult and young.

* Cucumaria jägeri.

Lampert, 1885. Die Seewalzen, p. 249.

This species seems to me to be very near the preceding but as there are no specimens at hand which I can refer to it, it is best to let the species stand as Lampert left it. The differences between *jägeri* and *sykion* in their calcareous particles is hard to understand (and Lampert gives no figures) while the differences in the distribution of the pedicels are of doubtful importance.

Cucumaria frauenfeldi.

Ludwig, 1882. Notes from Leyden Mus., vol. IV, p. 130.

This species has hitherto been inadequately described or at least, the descriptions are quite unsatisfactory. Ludwig gives no description, simply referring to Semper's notes on, and figures of, an unnamed species. Lampert, three years later, ignorant apparently of Ludwig's work, gave the same species another name (*posthuma*) and added some useful notes on the morphology, but neither he nor Britten (1910, Schultze's Zool. Anthrop. Erg. Forsch Südafrika, vol. 4, pt. 1, p. 239) have given a clear statement as to the calcareous particles. I have had one of Britten's specimens for comparison with those in the collection of the South African Museum.

The calcareous particles in this species are remarkably characteristic. They consist altogether of rods but there are two very distinct sorts of these rods. In the outer layer of the skin the

rods are very slender, more or less curved, but often nearly straight, with the ends more or less forked or branched; sometimes these branches unite and thus give rise to apparent perforations in the ends of the plates. Lampert evidently thought these slender rods were the supporting rods of the pedicels. While it is true that they occur abundantly in the walls of the pedicels, they also form a close, but not dense, layer all over the body surface. Beneath them, in the deeper layers of the skin are the other sort of rods, the so-called "spectacles" or "eye-glasses." They are very much stouter rods which usually have a single large perforation at each end: the rod is often nearly straight but when short and sufficiently curved the remenblance to eye-glasses is obvious. Many of these rods however are simply notched more or less deeply at the end and not perforated; probably such rods are but growth stages of the "eye-glasses".

The specimens of *frauenfeldi* in the present collection are of moderate or small size, the largest about 65 mm. long. The largest specimens are uniformly black but some of the smaller ones are light brown or brown. The body wall is relatively thin, not nearly so thick and firm as in the specimen from Angra Pequena. It seems to me quite probable that the *Cucumaria* from Java, which is in the Vienna Museum and which must be considered the type of *frauenfeldi*, is not identical with the South African form but until a critical comparison can be made, the two must remain under the same name.

P.F. 918. 1 mile east of Cove Rock, East London. Low tide. 2 specimens; adult.

Cape Colony: False Bay. 5 specimens; adult.

Cape Colony: Knysna, low tide. 11, III, '97, R. M. Lightfoot. 1 specimen; young.

* Cucumaria improvisa.

Ludwig, 1875. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 85; pl. VI, fig. 10.

The type locality for this species is Algoa Bay. So far, as I know it has not been met with since its description. Théel thinks it probable that it is identical with the European *C. elongata* but whether that is so or not, it is evidently quite distinct from any of the other South African *Cucumarias*.

*Thyone serrata.

Britten, 1910. Schultze's Zool. Anthrop. Erg. Forsch. Südafrika. vol. 4, pt. 1, p. 242.

This species is closely related to the European *T. fusus* but seems to be recognizably different. It is known only from Angra Pequena Bay where it seems to be fairly common.

Thyone sacellus.

Stolus sacellus Selenka, 1867. Zeit. f. wiss. Zool., vol. XVII, p. 355; pl. XX, figs. 115, 116.
Thyone sacella Théel, 1886. Challenger Holos., p. 138.

This species, well characterized by its calcareous ring and particles, has long been known from Zanzibar and Mozambique. The presence in the South African collection of specimens from Delagoa Bay, marks a note-worthy extension of the range southward. These specimens are 42—70 mm. long and are white or very pale reddish in color. They are accompanied by the following notes:

Delagoa Bay: Inyack Island. Oct. 1912. K. H. Barnard. Dull claret. In rock crevices. 1 specimen; adult.

Delagoa Bay: Inyack Island. Oct. 1912. K. H. Barnard. Claret colour. Beneath corals. 2 specimens; adult and young (half grown).

Thyone aurea.

Holothuria aurea Quoy and Gaimard, 1834. Astrolabe Zool., vol. IV, p. 120; pl. 7, figs. 15—17.
Thyone aurea Semper, 1868. Holothurien, II heft, p. 66.

The presence of some twenty *Thyones*, in more or less poor condition, from Table Bay, indicates that the species is common at the Cape. Most of the specimens were found washed up on the beach, some at least among the "holdfasts" of Laminaria. The colour of these specimens is said to have been "pink". While one cannot determine positively from Quoy and Gaimard's account, whether this *Thyone* is their *Holothuria aurea* or not, I feel so sure that it is, I am unwilling to give it a new name. The calcareous ring is like that of *T. sacellus* but the calcareous particles in the skin are entirely different and are very distinctive. They are small flat rods perforated at one or both ends, and irregular plates, of which these rods are the apparent starting point; thus there may be a hole on either or

on both sides of what was the primary rod; these holes differ greatly in size and shape and are not infrequently divided transversely in two; scarcely two of the plates are exactly alike. These deposits are unlike those of any species of *Thyone*, of which I know, and taken in connection with the wide calcareous ring, made up of many pieces and having long radial, posterior prolongations, and with the presence of well-marked anal teeth, they make the species easy to recognize. Since Quoy and Gaimard say their *Holothuria aurea* was found "parmi les racines de fucus de la rade du Cap de Bonne-Espérance", the habits and habitat of the *Thyone* at hand point strongly to *aurea*. The difference in colour, I think, may be due to the fact that all of the specimens at hand, of which the colour is given, were washed up on the beach and were very probably dead specimens from which most of the orange-red colour of the living animal had been washed out.

P.F. 15967. Zwartklip N.E. ¼ N., 1 mile, 10 fms. Brk. sh. 17, XI, '02. 1 specimen; adult.

P.F. 16365. False Bay: Fish Hook Bay, 5 fms. Fne. s. 24, XII, '02. 5 specimens; adult and young.

Table Bay: Mouille Point, amongst roots of laminaria, washed up on beach. Colour pink. June, 1912. Dr. L. Péringuey. 2 specimens; adult.

Table Bay: Woodstock Beach. July, 1915. K. H. Barnard. Pale pink. 15 specimens; small adults and young in very poor condition.

* Pentacta doliolum.

Actinia doliolum Pallas, 1766. Misc. Zool., p. 152; pl. XI, figs. 10—12.
Pentacta doliolum Goldfuss, 1820. Handbuch der Zoologie, pt. 1, p. 177.
Colochirus doliolum von Marenzeller, 1874. Verh. zool.-bot. Gesell. Wien, vol. XXIV, p. 303.

It is a matter of great regret to me that the collection from the South African Museum contains no specimen which I can refer to this species, originally described from the Cape of Good Hope and in 1887 recorded by Ludwig from Angra Pequena Bay. It is a curious fact that the species was not taken by the Challenger at the Cape nor by Schultze at Angra Pequena, while species of *Cucumaria* taken by those parties at those places, and also represented in the present collection, have calcareous particles of the same general type as those which Ludwig describes for his specimens from Angra Pequena. The line of separation between *Cucumaria* and *Pentacta* needs further elucidation.

If Ludwig and von Marenzeller are correct in assigning Pallas' *Actinia doliolum* to the genus *Colochirus*, instituted by Troschel in 1846, there is no doubt that the genus must be called *Pentacta*, for Goldfuss established *Pentacta* for Pallas' species alone: at least it is the only species named. *Pentacta* has usually been considered a synonym of *Cucumaria*, but there seems to be no good reason for such an opinion unless *doliolum* is a *Cucumaria*. And, as already stated, von Marenzeller long since (1874) showed it was a *Colochirus* and this view has been strongly confirmed by Ludwig (1887). *Pentacta* therefore simply replaces *Colochirus*.

Phyllophorus frauenfeldi.

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. II, p. 95; pl. VI, fig. 22.

Among the specimens before me which suffered much from dessication is what must have been a very fine example of this Red Sea species. The tentacles are well expanded and show distinctly the following asymmetrical arrangement: 3 large, 1 small, 4 large, 1 small, 3 large, 1 small, 2 large, 1 small, 3 large, 1 small. It has long been known that individuals of this genus show so much diversity in the relative size and arrangement of the tentacles that neither generic nor specific distinctions can be based thereon. The calcareous rods of this species are very distinctive, except that they are so suspiciously like those of *Urodemas ehrenbergii* Selenka, which is also a Red Sea species, that the identity of the two forms seems highly probable. But Selenka speaks of a peculiar arrangement of the rods in trios, which is not evident in the specimen at hand. This specimen has the label: Natal Coast. Dr. J. D. F. Gilchrist.

Pseudocucumis africana.

Cucumaria africana Semper, 1868. Holothurien, II heft, p. 53, pl. XV, fig. 16.

Pseudocucumis africana Ludwig, 1888. Zool. Jahrb. Abt. Syst., vol. III, p. 815.

There are two specimens in the present collection of this wide spread Indo-Pacific species. They are in a bottle with labels indicating both Natal and Mozambique (coll. K. H. Barnard) as the locality. Probably the latter is the correct one.

Echinocucumis typica.

M. Sars, 1859. Forh. Vid. Selsk. Christiana f. 1858. p. 174.

There are two small dried specimens of an *Echinocucumis* in the collection which are not unnaturally listed as *typica*, although the form of the body is somewhat different from that of any examples of *typica* in the M. C. Z. collection. The most noticeable difference is the very short "neck" and caudal regious, but this apparent elimination of the terminal prolongatious may be due to the drying. At any rate, I find no satisfactory characters by which these specimens may be separated from the northern species. The specimens are about 8—9 mm. long by 5—6 mm. thick.

P.F. 17350. Cape Point N. 86° E., 43 miles. 900—1000 fms. Grey mud. 2 specimens; young.

Psolus imperfectus * sp. nov.

Body nearly cylindrical and truncate at each end in these much contracted specimens, of which the larger is about 9·5 mm. long by 5 mm. in diameter, while the smaller is about 8 mm. long by 3·5 mm. in diameter. Color light yellow-brown. The middle of the ventral surface is slightly flattened to form a very imperfect sole, to which the pedicels are completely confined. On each lateral margin of the sole, which is rounded and not at all sharply defined there is a single series of pedicels, 8 in the smaller and 10 in the larger specimen: the median part of the sole is occupied by a few pedicels, anteriorly and posteriorly but is quite bare centrally; in the larger specimen, there are about 6 pedicels at the anterior end and 4 behind but in the smaller specimen the numbers are only 4 and 2. The skin of the sole is moderately thick and contains calcareous plates which are rather thick, with rounded margins, and perforated by 20—24 holes. The remainder of the body is covered by large overlapping plates, about half a millimeter across; these plates are covered by a thin epidermis but it is evident that if the animal was dried the plate margins would be conspicuous. The mouth is not dorsal but distinctly anterior and not protected by any special valves; the tentacles are completely retracted in the larger specimen and very much so in the smaller. The anus is distinctly dorsal and around it the plates are smaller than elsewhere.

* *Imperfectus* = incomplete, in reference to its incomplete approach to the typical *Psolus* form.

P.F. 18929. Southeast from Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 2 specimens; young?

Holotype, South African Museum, No. A 6454.

These little holothurians are quite unlike any I have ever seen but they approach several of the previously known species of *Psolus*. They are perhaps nearest to the Antarctic *P. charcoti* Koehler and Vaney, but the sole is more distinct and the calcareous plates it contains are perfectly distinctive. In life this species must look very much like the figure of *P. boholensis* given by Semper (1868, Holothurien, Heft II, pl. XII, fig. 3), although the sole is not quite so distinct and the color is brighter. Why Semper should say (p. 6) that *boholensis* is "von ausgesprochensten ascidienartigen Habitus" is impossible to see from his figure, which is not in the slightest degree ascidian-like!

Psolus squamatus.

Holothuria squamata O. F. Müller, 1776. Prod. Zool. Dan., p. 232.
Psolus squamatus M'Andrew and Barrett, 1857. Ann. Mag. Nat. Hist. (2) vol. 20, p. 45.

There are five small specimens of a *Psolus* at hand which I am unable to distinguish from *squamatus* and I therefore refer them to that northern species. But the specimens are too young for satisfactory determination. It is important however to emphasize what has been well said by both Ludwig and Théel that the proper descrimination between the northern and southern species of *Psolus* must await the accumulation of far more abundant material from a considerable number of localities. Owing to a suggestion of Lütken's that O. F. Müller's *Holothuria squamata* is the young of *Psolus phantapus*, the specific name of this holothurian is usually dated from Düben and Koren. Those authors however refer to Müller's name and I do not see how any one could question that the Danish author's name refers to either the present species or the form subsequently separated from it as *P. fabricii*. It seems highly improbable to me that Müller's figures represent the young of *P. phantapus*.

P.F. 14310. Cape Seal, N. by E. ¾ E., 37 miles, 80 fms. (Agulhas Bank). S., sh., r. 20/2/02. 4 specimens; young.

P.F. 18929. Southeast of Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 1 specimen; young; dry.

ELPIDIIDAE.

The right of this family to a place in this report is based on the extraordinary Planktothuria, whose position in the family is dubious, and on a single specimen in the Pieter Faure collection, which seems to be referable to the following nearly cosmopolitan species.

Benthodytes sanguinolenta.

Théel, 1881. Challenger Holoth., pt. 1, p. 104; pl. XXIII.

The single specimen referred to this species is in two unusually solid fragments 50–60 mm. long and 25–30 mm. in diameter. Owing to their condition my identification is based on the colour and general body-form.

P.F. 16822. Cape Point, N.E. by E. $^1/_4$ E., 38$^1/_2$ miles, 750 fms. 8/VII/03. Green mud. 1 specimen; adult.

Planktothuria diaphana.

Gilchrist, 1920. Quar. Jour. Mic. Sci., vol. 64, p. 373.

Although a careful and complete description is given of this remarkable pelagic holothurian, the locality and depth are recorded only as "deep water off the Cape of Good Hope".

HOLOTHURIIDAE.

This large tropicopolitan family is not well represented in South Africa proper, for of the following 14 species, only two occur south of Natal and only half a dozen are from south of Mozambique. All are littoral species, none being reported from a depth of more than 20 fms. Only three of the species are endemic and of these one is new to science. It will be noticed that within the genus *Holothuria*, the calcareous particles of the skin furnish almost the only reliable guide to the species. The various forms of these particles (tables, plates, buttons, rosettes, rods, etc.) are fully illustrated in Théel's invaluable Challenger Report.

Key to the South African Species of Holothuriidae.

Anus not protected by conspicuous calcareous teeth.
No large, pointed tubercles on back and sides.
Tables, more or less well formed, present in the outer layer of skin.
Rosettes or perforated plates present with the tables, but no rods or buttons.
Rosettes and small, irregular perforated plates present, but no large circular plates.

Color more or less uniformly black . *Holothuria atra.*
Color dark brown or blackish above, rose-color (in life) or gray (in alcohol) beneath . . *Holothuria edulis.*
No rosettes but rather large circular perforated plates present *Holothuria africana.*
No rosettes or plates present.
Curved, roughish rods present but no buttons *Holothuria cinerascens.*
No rods but buttons present.
Buttons smooth, without knobs.
Pedicels on ventral surface; pedicels or small papillae on back.
Buttons symmetrical usually with 3 pairs of holes.
Tops of table-spires squarish with 20 or more teeth . . . *Holothuria difficilis.*
Tops of table-spires circular with about 8 teeth *Holothuria leucospilota.*
Buttons more or less asymmetrical, usually with fewer than 6 holes, collected in heaps or circles *Holothuria pardalis.*
Large papillae all over the body *Holothuria impatiens.*
Buttons knobbed . . . *Holothuria scabra.*
No tables present.
Spinous, thick rods in skin . . . *Holothuria parva.*
Small irregular smooth rods and very diversified, asymmetrical plates in skin . . . . . *Holothuria grammata.*
Large pointed tubercles on back and along sides of quadrangular body; color deep green in life (dull yellow-brown in alcohol, usually) *Stichopus chloronotus.*
Anus guarded by 5 large, calcareous teeth.
Tentacles 25 or more . . . . *Actinopyga mauritiana.*
Tentacles about 20 (18—23) . . . . *Actinopyga miliaris.*

Holothuria atra.

Jaeger, 1833. De Holot., p. 22. See also Edwards, 1908, Biometrika, vol. VI, pp. 236—301, pls. I—V.

This common Indo-Pacific species has long been known from Mozambique and Zanzibar. A specimen in the present collection is labelled: Conducia Bay, Mozambique. Rock pools. Nov. 1912. K. H. Barnard.

* Holothuria edulis.

Lesson, 1830. Cent. Zool., p. 125; pl. 46, fig. 2.

This species has been recorded from Mozambique by Semper but it is not represented in the present collection. Although the cal-

careous particles are similar to those of *atra* the general appearance of the two species, especially in life, is quite unlike. The bright rose-red ventral surface of *edulis* makes it much the handsomer of the two, but unfortunately the colour is soon lost in alcohol.

* Holothuria africana.

Théel, 1886. Challenger Holoth., p. 174: pl. VIII. fig. 7.

Although the type locality for this species is Simon's Bay, 10—20 fms., it is not in the present collection and I therefore can add nothing to Théel's satisfactory description and figures.

Holothuria cinerascens.

Stichopus (*Gymnochirota*) *cinerascens* Brandt, 1835. Prod. Descr. Anim., p. 251.
Holothuria cinerascens Lampert, 1885. Die Seewalzen, p. 82.
Holothuria pulchella Selenka, 1867. Zeits. f. W. Zool., vol. XVII, p. 329; pl. XVIII, figs. 61, 62.

It is a pity to have to abandon Selenka's familiar name for the older and less euphonious one of Brandt but Ludwig's demonstration of the identity to the two leaves us no choice. Ludwig's Revision of Brand's holothurian names (1881, Zeits. f. w. Zool., vol. XXXV, p. 575) was one of the most valuable contributions to the study of holothurian taxonomy ever made, and it is unfortunate that neither he nor Théel adopted the resulting changes in nomenclature.

This species, previously known from Mozambique and widely distributed in the Indo-Pacific region, is represented in the present collection by two specimens. The larger is either from Mozambique or Natal, while the smaller, which is in poor condition, is said to be from Durban, Natal. The species therefore evidently ranges as far south as Durban, but is apparently not common as Mr. Barnard did not meet with it at the intermediate locality of Delagoa Bay.

Holothuria difficilis.

Semper, 1868. Holothurien, Heft III, p. 92; pl. XXX, fig. 21.

A single specimen of this Indo-Pacific species is in the collection of the South African Museum. It bears the label: Mozambique. In rock pools, freely exposed. Light brown. Nov. 1912. K. H. Barnard. Although known from Mauritius, this species was not

recorded hitherto from the African coast. The calcareous tables form a very uniform layer, making the surface of the body slightly rough to the touch and the epidermis quite brittle.

Holothuria leucospilota.

Stichopus (*Gymnochirota*) *leucospilota* Brandt, 1835. Prod. Descr. Anim., p. 251.

Holothuria leucospilota Lampert, 1885. Die Seewalzen, p. 71.

Holothuria vagabunda Selenka, 1867. Zeits. f. w. Zool., vol. XVII. p. 334; pl. XIX, figs. 75, 76.

Although Lampert cannot bring himself to abandon the universally used name, given by Selenka, for the earlier and often inappropriate name of Brandt, nevertheless he publishes the combination *Holothuria leucospilota* and seems to have been the first writer to do so. It is of course regrettable to have to abandon the name *vagabunda* but after all, very few zoologists indeed are acquainted with the specific names of holothurians and the abandonment of one in favour of another causes exceedingly little inconvenience. There is no valid reason therefore for not using the correct name.

Of this well-known and wide-spread Indo-Pacific species, long known from Mozambique, there are five specimens in the present collection, one of which is from either Mozambique or Natal (coll. K. H. Barnard), while the other four are said to be from Durban. They are very greatly contracted and in poor condition but there is little reason to doubt their identity. The range of the species is thus extended far to the southward along the coast. But Mr. Barnard did not find the species at Delagoa Bay.

Holothuria pardalis.

Selenka, 1867. Zeits. f. w. Zool., vol. XVII. p. 336; pl. XIX, fig. 85.

There is a single specimen of this common Indo-Pacific species in the present collection. There is no means of determining whether it is from Mozambique, as seems probable, or from Natal. (Coll. K. H. Barnard).

Holothuria impatiens.

Fistularia impatiens Forskål, 1775. Desc. Anim., p. 121; pl. 39. 1776, Icon. Rev. Nat., pl. XXXIX, fig. B.

Holothuria impatiens Gmelin, 1790. Syst. Nat. Linn. ed. XIII, p. 3142.

This very common tropicopolitan species has long been known from Mozambique. The single poor specimen in the present collection

is probably from Mozambique but may be from Natal. (Coll. K. H. Barnard).

Holothuria scabra.

Jaeger, 1833. De Holothuriis, p. 23.

This large Indo-Pacific species was not hitherto recorded from south of Querimba but in the present collection are five very badly contracted specimens, which are apparently from Delagoa Bay. They are recognizable by the large size, gray and white coloration and the characteristic calcareous particles. There are two labels with these specimens: one reads: "Inyack Island, Delagoa Bay, on sandy shore, light gray with black speckles. Oct. 1912 K. H. Barnard. 2 large specimens". I think there can be no doubt that this label belongs with the two largest and best preserved of the quintet. The other label reads: "Ilha da Inhaca, Delagoa Bay, low tide, burrowing in the sand. Oct. 1912. K. H. Barnard. 3 specimens. Ref. no. 305." I doubt if this label belongs with the remaining trio of *scabra* as I can hardly think this big species lives "burrowing in the sand". *

*Holothuria parva.

Lampert, 1885. Die Seewalzen, p. 246; fig. 38.

Although Lampert's description and figures show quite clearly that this is a valid species, collected by Krauss on the coast of Natal, Ludwig always considered it identical with *lubrica* Selenka and hence has listed the latter species from Natal. Lampert's species is not in the collection of the South African Museum nor have I ever seen a specimen, but I believe he is right in insisting on its distinctness from *lubrica*.

Holothuria grammata ** sp. nov.

Body very much contracted and distorted, about 50 mm. long by 20 mm. thick in the largest specimen. It is impossible to determine the number, arrangement or nature of the ambulacral appendages, but they seem to be few, scattered and like large pedicels arising from distinct papillae. Body wall thick and soft. Number of tentacles cannot be determined. Calcareous ring low, the anterior prolongations small and the posterior margin of each piece with a wide

* This statement as to the habitat is quite true. [Ed.].

** γράμματα = the alphabet, in reference to the diversity of form of the calcareous particles, many of which are fanciful representations of letters.

deep concavity. Polian vessels 1 or 2. Stone canal small, lying in the dorsal mesentery. Color, in life, red: in alcohol the specimens are cream-color or very light brown.

Calcareous particles very numerous but all of one kind, though no two are exactly alike. The fundament is a slender rod of variable length, which is forked at one end, and usually at both ends. All the extraordinary diversities shown by the particles result from the more or less extensive development of the forks and the curve that they take in growing; often the forks at each end of the rod curve inward, fusing when they meet, thus forming a straight rod, flattened and perforated at each end; a totally different result comes from the forks curving rapidly outwards until the original rod is met in the midline or forks from opposite ends of the rods meet; a curious triperforate plate arises when only one end of the rod has a fork and these forks are as large as the main rod; each of the three then forks and curves sharply outwards until adjoining forks meet and thus a very symmetrical ring with three radial bars is formed. By unequal growth of the forks, most asymmetrical and even bizarre figures arise and by the use of the imagination many, if not all, of the letters of the alphabet, either in script or print form, can be made out.

P.F. 918. One mile east of Cove Rock, East London. Low tide. 1 specimen; adult.

P.F. 10008. Sebastian Bluff. Low tide. Colour red. 1 specimen; adult; eviscerated.

P.F. coll. Sebastian Bay. 15, VII, '00. Low tide. Colour red. 3 specimens; young.

Holotype, South African Museum No. A 6455. P.F. 918.

I have been unable to satisfy myself whether this interesting and well marked species is a *Stichopus* or a *Holothuria*. There seem to be, in one specimen at least, two genital bundles and the ambulacral appendages are also *Stichopus*-like dorsally. On the other hand the small size, red color, slender calcareous ring and absence of numerous pedicels ventrally, all are features more like *Holothuria*. The calcareous particles are rather more like some species of *Holothuria* than they are like those of any known *Stichopus*. For the present, therefore the species may be placed in *Holothuria* with the understanding that more and better material may put it distinctly in *Stichopus*.

Stichopus chloronotus.

Brandt, 1835. Prod. Descr. Anim., p. 250.

This widespread Indo-Pacific species is easily recognized in life

by the characteristic form and colour, in which there is little diversity. It has long been known from Mozambique and there are two small specimens in the present collection collected at that place in Nov. 1912 by Mr. K. H. Barnard. It is a pity the colour quite disappears in alcohol.

* Actinopyga mauritiana.

Holothuria mauritiana Quoy and Gaimard, 1833. Astrolabe Zool., vol. IV, p. 138.

Actinopyga mauritiana W. K. Fisher. 1907. Holot. Hawaiian Is., p. 648: pl. LXVII, figs. 1—1*d*.

This species is recorded from Mozambique by Bell but it is not represented in the present collection.

Actinopyga miliaris.

Holothuria miliaris Quoy and Gaimard, 1833. Astrolabe Zool., vol. IV, p. 138.

Actinopyga miliaris Bell, 1887. Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p, 653.

Although Bell pointed out many years ago (1887, Ann. Mag. Nat. Hist. (5), vol. 19, p. 392 and vol. 20, p. 148) that the genus Mülleria as used for holothurians was preoccupied, few zoologists have troubled to correct the error. Fisher has done so however and used *Actinopyga*, as noted under the preceding species. It is by no means clear to me that *mauritiana* and *miliaris* are really different species. The former is supposed to have 25 tentacles or more but Fisher says his Hawaiian specimens had 22–26. On the other hand, *miliaris* is supposed to have only 20 tentacles but of the two adults in the present collection, one has 22 and one has 23. The difference in tentacle-number therefore is of doubtful value. Whether the calcareous particles show reliable differences, and whether there are any constant differences in color, habits or habitat, still remain to be demonstrated.

Mozambique (Island). Lying free in rock-pools. Skin usually with adherent sand-grains. Nov. 1912. K. H. Barnard.

Locality unknown. 1 specimen: very young.

INDEX.

Specific names are listed in this index only in connection with the accepted genus. Synonyms are in italics. Page references of first importance are in black-face type.

EXPLANATION OF PLATES.

All figures are natural size except where otherwise stated:

Plate VIII.

Fig. 1.	*Monachocrinus coelus* n. sp.	Holotype enlarged 8 times, the distal parts of the arms not shown.
Fig. 2.	*Liparometra multicirra* n. sp.	Holotype.
Fig. 3.	*Comanthus wahlbergii* (J. Müll).	
Fig. 4.	*Chondraster elattosis* n. sp.	Upper surface of holotype a little more than one half nat. size.

Plate IX.

Figs. 1, 2.	*Tosia tuberculata* (Gray).	Upper and lower surfaces.
Figs. 3, 4.	*Pteraster capensis* Gray.	Upper and lower surfaces.

Plate X.

Figs. 1, 2.	*Hymenaster gennaeus* n. sp.	Upper and lower surfaces of holotype.

Plate XI.

Figs. 1, 2.	*Cryaster brachyactis* n. sp.	Upper surface and a side view of holotype.
Figs. 3, 4.	*Hymenaster lamprus* n. sp.	Upper and lower surfaces of holotype.

Plate XII.

Figs. 1, 2.	*Pseudarchaster brachyactis* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Calliaster acanthodes* n. sp.	Upper and lower surfaces of holotype.

Plate XIII.

Figs. 1, 2.	*Cladaster macrobrachius* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Plutonaster proteus* n. sp.	Upper and lower surfaces of holotype.
Figs. 5, 6, 7.	*Plutonaster proteus* n. sp.	Juveniles to show growth changes.

Plate XIV.

Figs. 1, 2.	*Ceramaster patagonicus* var. *euryplax* n.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Ceramaster trispinosus* n. sp.	Upper and lower surfaces of holotype.
Figs. 5, 6.	*Ceramaster chondriscus* n. sp.	Upper and lower surfaces of holotype.

Plate XV.

Figs. 1, 2.	*Echinaster reticulatus* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Poraniopsis capensis* n. sp.	Upper and lower surfaces of holotype.

Plate XVI.

Figs. 1, 2.	*Mediaster capensis* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Asterina gracilispina* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.
Figs. 5, 6.	*Asterina dyscrita* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.

Plate XVII.

Figs. 1, 2.	*Asterina granifera* (Gray).	Upper and lower surfaces.
Fig. 3.	*Asterina granifera* var. *sporacantha* n.	Upper surface of paratype.
Figs. 4, 5.	*Anseropoda habracantha* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.

Plate XVIII.

Figs. 1, 2.	*Lophaster quadrispinus* n. sp.	Upper and lower surfaces of holotype.
Fig. 3.	*Perissasterias polyacantha* n.g. and sp.	Holotype, a little more than one half nat. size.

Plate XIX.

Figs. 1, 2.	*Dictenophiura anoidea* n. g. and sp.	Upper and lower surfaces of holotype, enlarged 4 and 3 times respectively.
Figs. 3, 4.	*Ophiacantha nerthepsila* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.
Figs. 5, 6.	*Ophiomitrella corynephora* n. sp.	Upper and lower surfaces of paratype, enlarged 3 times.

Plate XX.

Figs. 1, 2.	*Ophiochiton australis* n. sp.	Upper and lower surfaces of holotype, enlarged 4 and 3 times respectively.
Figs. 3, 4.	*Ophiactis carnea* Ljung.	Upper and lower surfaces, enlarged 3 times.

Figs. 5, 6. *Astrothamnus papillatus* n. sp. Upper and lower surfaces of holotype, the latter enlarged 3 times.

Plate XXI.

Figs. 1, 2. *Coenopedina capensis* n. sp. Upper and lower surfaces of holotype, enlarged 3 times.

Fig. 3. *Coelopleurus interruptus* Döderl. Upper surface.

Plate XXII.

Figs. 1, 2, 3. *Paracentrotus grandis* n. sp. Upper, lower and lateral surfaces of holotype.

Plate XXIII.

Figs. 1, 2, 3. *Spatagobrissus mirabilis* n.g. and sp. Upper and lower surfaces of holotype. $\frac{7}{8}$ natural size.

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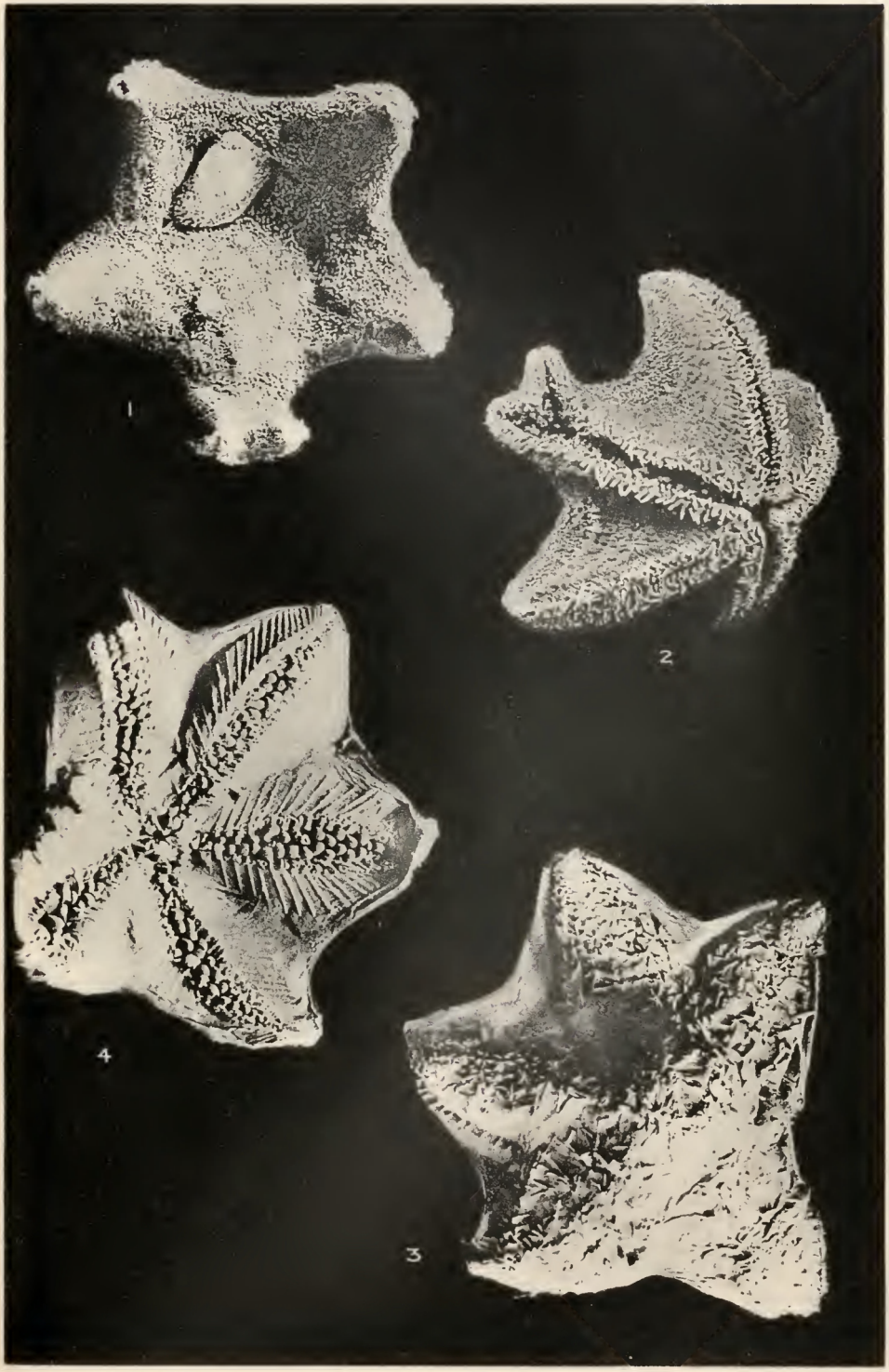

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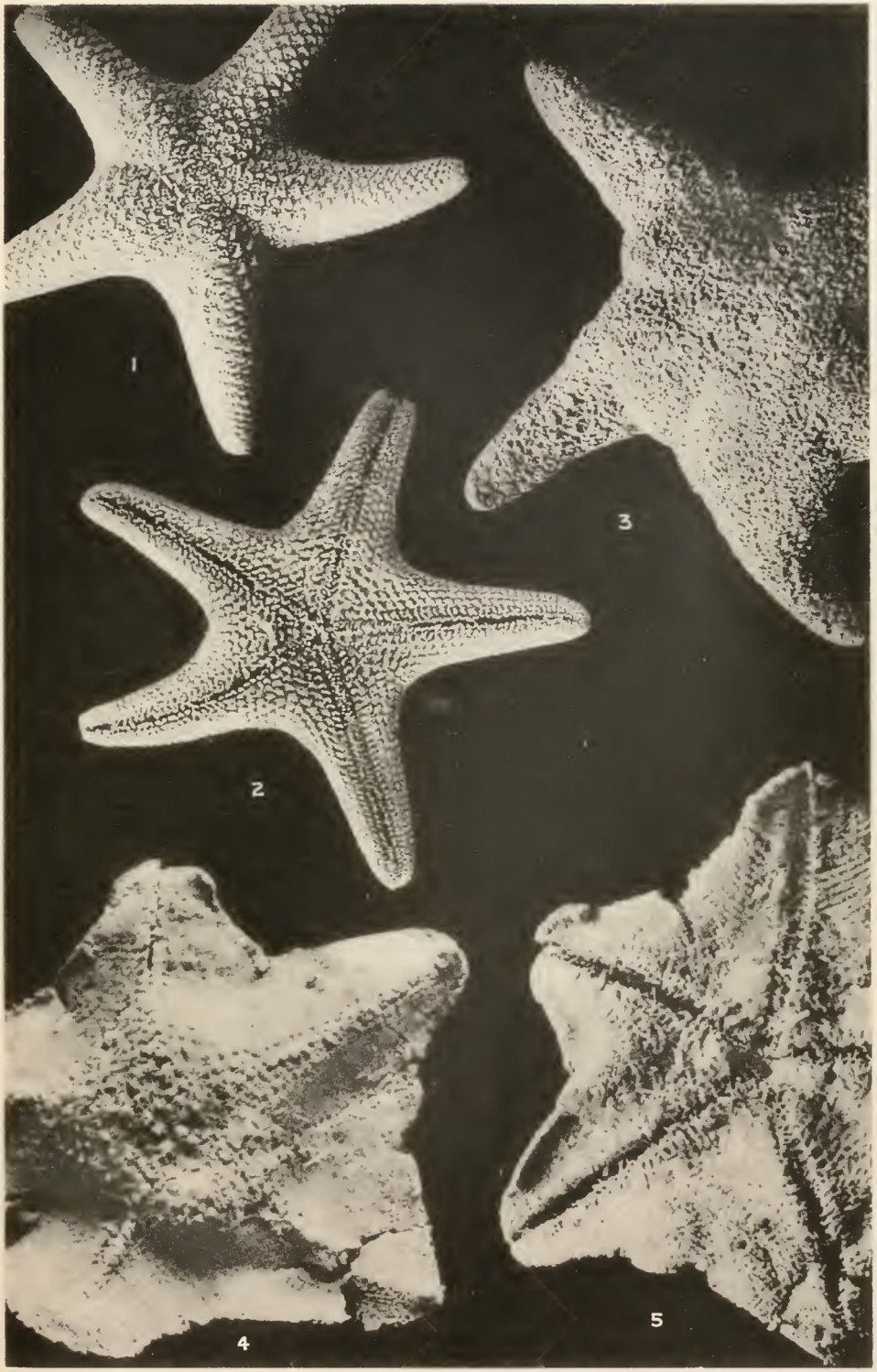

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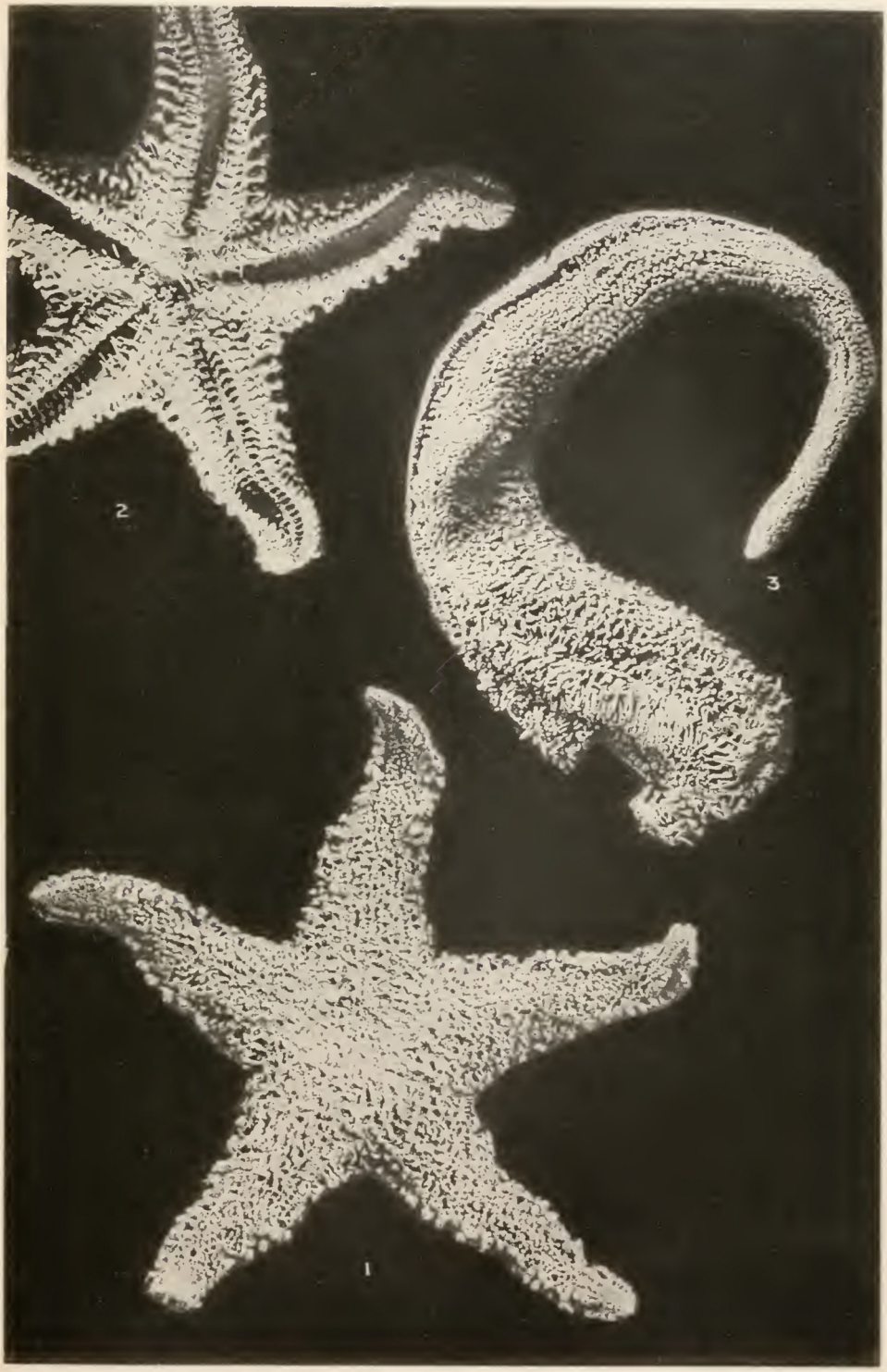

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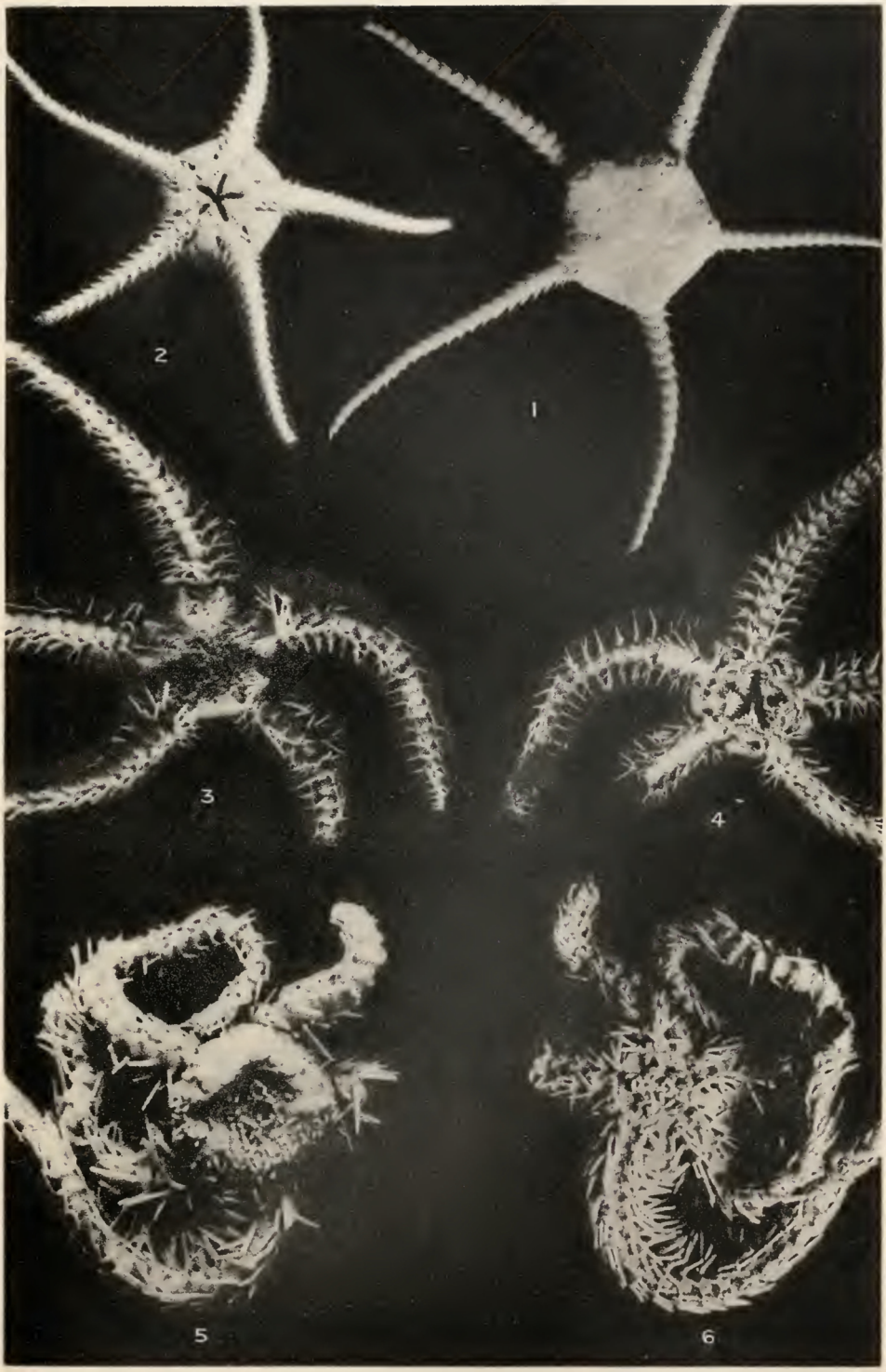

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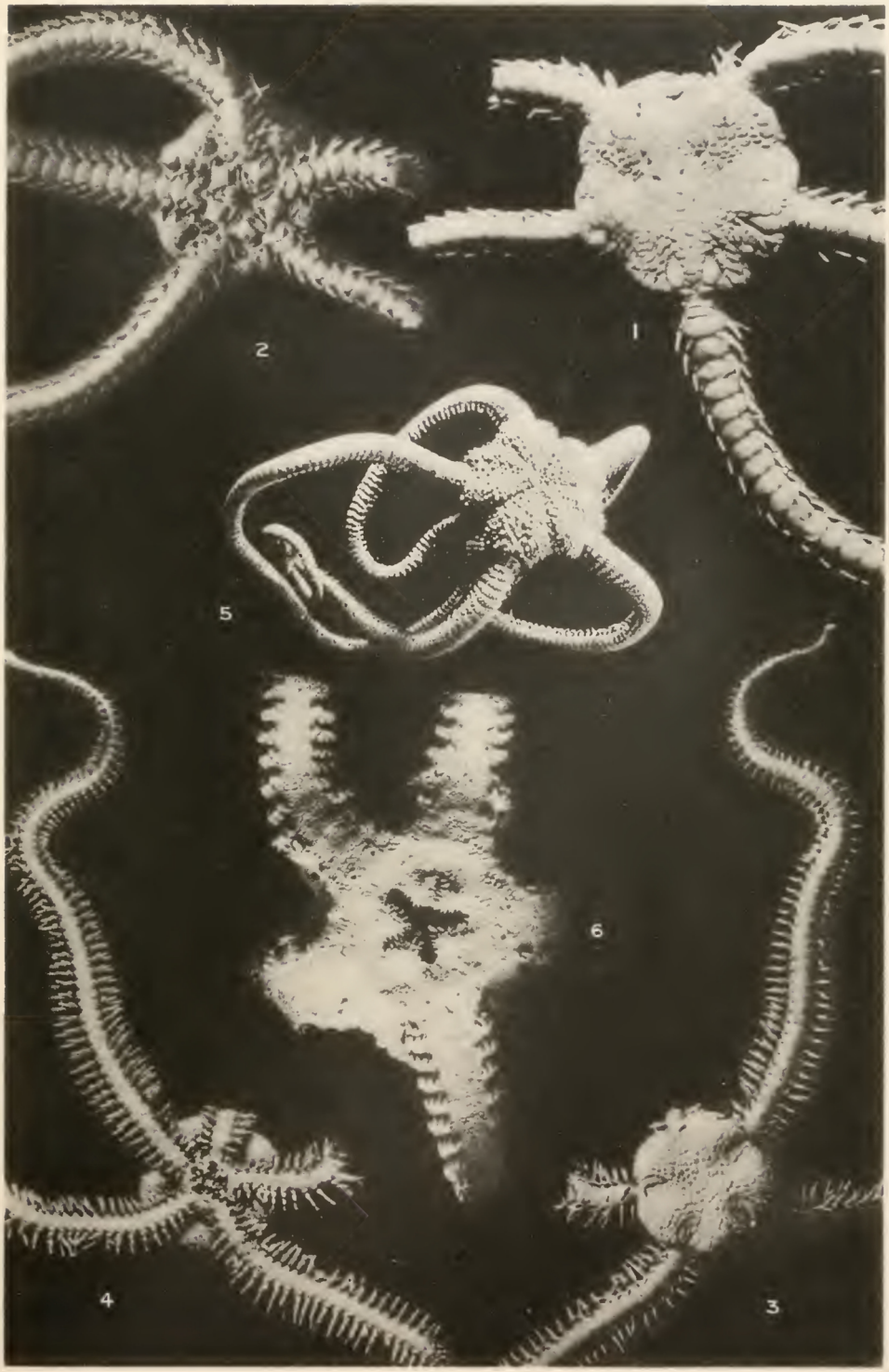

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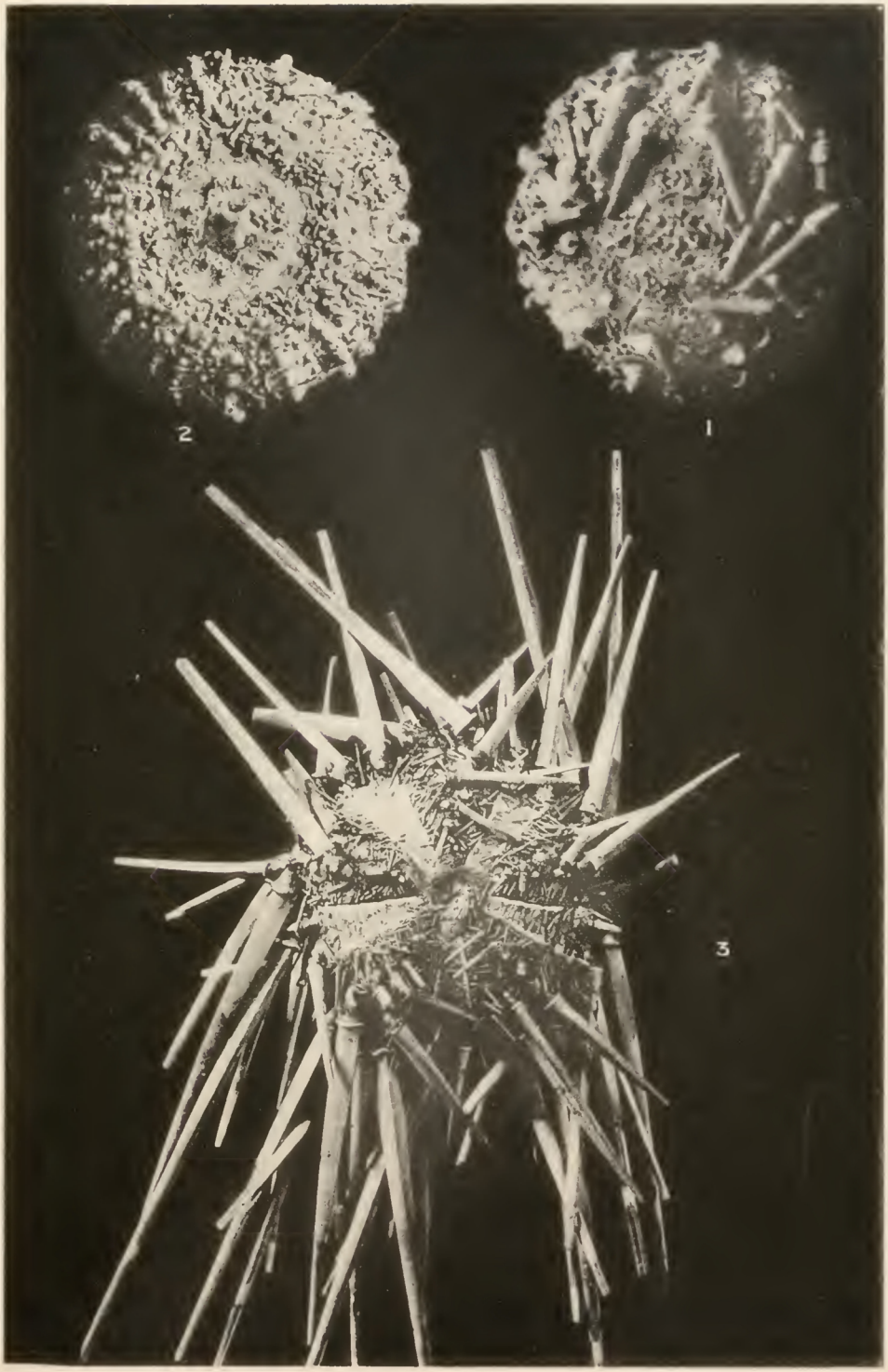

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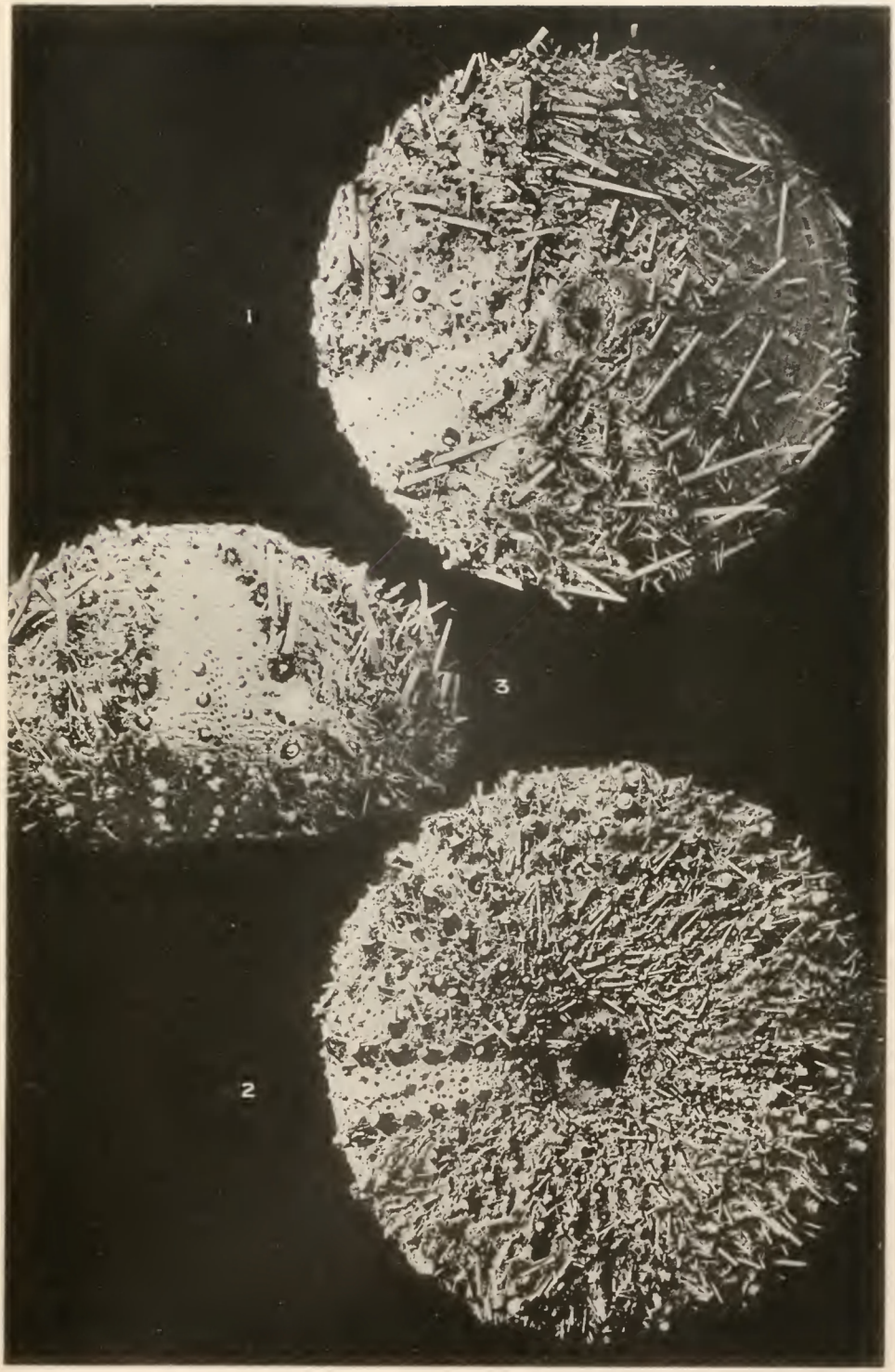

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