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Biological Results of the Fishing Experiments
carried on by the F.I.S. "Endeavour," 1909-14.

H. C. Dannevig,
Commonwealth Director of Fisheries

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I. Report on the Sea-Lilies, Starfishes, Brittle-Stars and
Sea-Urchins obtained by the F.I.S. "Endeavour" on
the coasts of Queensland, New South Wales, Tasmania,
Victoria, South Australia, and Western Australia.

BY

HUBERT LYMAN CLARK.

CURATOR OF ECHINODERMS, MUSEUM OF COMPARATIVE ZOOLOGY,
CAMBRIDGE, MASS., U.S.A.

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REPORT ON THE SEA-LILIES, STARFISHES,
BRITTLE-STARS AND SEA-URCHINS.

I.—INTRODUCTION.

THE collections dealt with in this report consist of the Echinoderms, excepting the Holothurians or Sea-cucumbers (*beche-de-mer*), or in technical terms the "Actinogonidiate Echinoderms," obtained by the Federal Fisheries Investigation Ship "Endeavour" along the Australian coast south of Lat. 24°S. at depths of less than three hundred fathoms, during the years 1909-1914 inclusive. The Holothurians were by mutual agreement sent elsewhere for study.

The collections were sent to me in five instalments and have included altogether one thousand and sixty-one specimens representing one hundred and fifteen species, of which thirty-nine seem to be new to science and fifteen others are now recorded from Australia for the first time. Others, previously known from northern Australia are now listed from stations south of the tropics, and the extension of ranges in this way is oftentimes very great. Up to the present time (1 July, 1915), the list of Actinogonidiate Echinoderms known from Australia was about three hundred and twenty, but owing to numerous cases of incorrect identifications and of inaccurate locality labels, it is impossible to give exact figures. There is no doubt, however, that including the large additions made by the "Endeavour," the known Echinoderm fauna of Australia includes more than three hundred and fifty valid species, aside from the Holothurians.

The geographical distribution of these species is very interesting. At least two hundred are endemic, or at least have not yet been reported from elsewhere, while most of the remainder are East Indian species, ranging southward along the eastern coast of the continent to southern Queensland or even to Port Jackson, New South Wales. In his very interesting and useful paper on the "Recent Crinoids of Australia,"¹ Mr. Austin H. Clark has recognised the existence of a *North Australian* and a *South Australian* subregion, Port Jackson on the east coast and Shark Bay on the west serving as the approximate boundary between the two. Study of the Echinoderms as a whole (including the Holothurians), however,

1. A. H. Clark—Mem. Austr. Mus., iv., 15, 1911.

indicates that such a division of the Australian marine fauna fails to bring out the interesting contrasts between the east and west coasts, and I would suggest the recognition of three Australian subregions as follows :—

1. East Australian subregion, extending from about 35°S. Lat. to 15°, merging northward in the East Indian or, more properly, Indo-Pacific fauna of the Torres Strait district. Of the more than four hundred Australian Echinoderms now known, about sixty-five, or some 16% belong exclusively to this fauna. Some of the characteristic species are the following :—

CRINOIDS.

Comatula cratera.
Ptilometra mülleri.
Compsometra loveni.

ASTEROIDS.

Mediaster monacanthus.
Anthenea acuta.
Astrogonium dübeni.

OPHIURANS.

Conocladus amblyconus.
Ophiarachnella ramsayi.
Ophiura multispina.

ECHINI.

Prionocidaris australis.
Centrostephanus rogersii.
Clypeaster australasiæ.

HOLOTHURIANS.

Teniogyrus australianus.
Molpadia dissimilis.
Cucumaria mirabilis.

Some of the species characteristic of this fauna no doubt range south of Lat. 35° and even reach Port Phillip, Victoria, but such cases are exceptional and do not invalidate the recognition of the subregion. The remainder of the more than two hundred Echinoderms known from the eastern coast of Australia, north of Shoalhaven Bight, New South Wales, are Indo-Pacific forms, many of which find a centre of abundance in Torres Strait. The distance southward to which they range differs greatly in different species, but it is evident from the "Endeavour" collection that most of

them may range as far south as Wide Bay, Queensland, and some are known to reach Port Jackson, New South Wales.

2. South Australian subregion, including Tasmania and the mainland coast south of 35°S. Lat. It merges on the east coast with the East Australian subregion, and some of its characteristic species reach Port Jackson. This is the typical Australian marine fauna and includes about one hundred and twenty species or approximately 30% of the known Echinoderms. More remarkable, however, is the fact that the great bulk of this fauna is endemic or at least is not at present known from elsewhere. Apparently not more than a dozen of the Echinoderms known from the southern coasts of Australia range north of Lat. 28° or east or west of the Australian region. A very few (of which *Ophionereis schayeri* is a conspicuous example) occur in New Zealand. One (*Echinus horridus*) is known from South America and South Africa and perhaps more will ultimately be found with that range. One starfish (*Luidia maculata*) has the very unusual range of encircling the Australian continent and reaching China and Southern Japan on the north. The following are some of the most characteristic species of this remarkable fauna :—

CRINOIDS.

Comanthus trichoptera.

Ptilometra macronema.

Compsometra incommoda.

ASTEROIDS.

Nectria ocellata.

Tosia aurata.

Pseudolinckia rhysa.

Plectaster decanus.

Coscinasterias dubia.

OPHIURANS.

Astroconus australis.

Ophiactis resiliens.

Ophiothrix spongicola.

ECHINI.

Goniocidaris tubaria.

Microcyphus annulatus.

Amblypneustes grandis.

Holopneustes porosissimus.

Helicoidaris erythrogramma.

HOLOTHURIANS.

*Leptosynapta dolabrifera.**Pentacta spinosa.*

The western limit of this subregion is not easy to determine. The little work the " Endeavour " did in the Great Australian Bight revealed a very interesting fauna and suggests that many of the Echinoderms of the South Australian subregion do not extend their range west of 125°E. Long. At any rate, there is no doubt that once Cape Naturaliste is passed, the Echinoderm fauna undergoes an appreciable change, although a few species from the south (as *Ptilometra macronema*) range northward to Geraldton, Western Australia.

3. West Australian subregion, extending northward from Lat. 35°S. ; the northern limit cannot be given as we know almost nothing of the echinoderm fauna between Lat. 20° on the north-west coast to Port Darwin, a distance of more than a thousand miles. Some eighty-five species of Echinoderms are now known from West Australia ; of these ten or a dozen are species of the South Australian subregion and rather more than thirty are species from the north, relatively few of which are, however, truly East Indian. More than forty species, or half the fauna, are peculiar to the subregion, so far as we know, and many of these are very remarkable forms, often representing peculiar genera. The following are some of the characteristic species :—

CRINOIDS.

*Comatula etheridgei.**Petasometra helianthoides.**Neometra gorgonia.*

ASTEROIDS.

*Nectria ocellifera.**Oreaster nodulosus.**Culcitaster anamesus.**Linckia tyloplax.*

OPHIURANS.

*Conocladus microconus.**Astrogymnotes catasticta.**Ophiocreas adhærens.**Ophiothrix smaragdina.*

ECHINI.

- Phyllacanthus magnificus.*
Centrostephanus tenuispinus.
Peronella aphnostina.

HOLOTHURIANS.

- Caudina tetrapora.*
Colochirus axiologus.

It is useless to speculate on the origin or significance of this West Australian fauna until we know the fauna of the north-western coast. The region between Shark Bay and Torres Strait should be thoroughly explored, and, as soon as possible, that between Melville Island and Timor. When this vast area is as well known as South-eastern Australia we shall be able to form an intelligent opinion concerning the West Australian subregion. We shall know then, too, whether we ought to recognise a North Australian subregion, and if so, whence its fauna came. There are some very characteristic species from that district, but they do not come within the scope of this report.

So far as the present evidence goes, it seems that the Western Australian fauna is a derivative of that of the South Australian subregion with a considerable element from the tropical Indian Ocean. The characteristic South Australian fauna is clearly derived from that of the east coast with at least a small addition from a southern fauna common to South Africa and southern South America. The exact extent and significance of this southern element is one of the most interesting and least known features of the South Australian fauna. There is little question that the East Australian fauna is derived directly from the Indo-Pacific and is still closely associated with the fauna of the East Indies and the Pacific Islands. Whether any of the east coast fauna has been received through Torres Strait or whether it has all come around the eastern end of New Guinea, or whether it is largely of southern origin and has spread northward and eastward, are still questions to be answered, but I see very little evidence indeed in favour of the latter view.

In the above discussion, I have obviously omitted all reference to other groups of animals, believing I could best do my part in the solution of the problem by presenting simply the evidence offered by the group I am studying. I believe the Echinoderms are a very satisfactory group by which to test possible lines of migration, the great antiquity of the phylum, the relatively small number of genera and species

and the general distinctness of lines between the classes and orders, all tending to make a correct interpretation of the distribution at least hopefully feasible. Of course, we are just beginning to approach the problem and do not as yet know all of its factors, but the possibility of a solution cannot be fairly denied. The collections made by the "Endeavour" have certainly thrown a flood of light on the composition of the Australian Echinoderm fauna, and hence bring us that much nearer to a knowledge of its origin.

For the honour done me in entrusting these valuable collections to me, and for the privilege of studying them, I desire to express my thanks to the Minister of Trade and Customs of the Commonwealth of Australia, Honourable Frank Gwynne Tudor, and to the former Comptroller-General for Trade and Customs, Nicholas Lockyer, Esq., I.S.O., and, of course, to Mr. Robert Etheridge, Curator of the Australian Museum. Since my correspondence has been entirely with Mr. Etheridge, I cannot forbear the expression of my great appreciation of his uniform courtesy, consideration and patience. To collaborate with him in scientific work is indeed a great pleasure.

II.—DESCRIPTION OF THE GENERA AND SPECIES.

CRINOIDEA.

The Crinoids collected by the "Endeavour" are of the greatest interest. There are two hundred and sixteen specimens, representing sixteen species, eight of which seem to be new to science, and ten genera, of which three have not previously been recorded from Australia. More than half the specimens (one hundred and forty-four) represent a single well-known species, while five species are represented by only a single specimen each, and five others by only two each. Of the eight species previously known to science, all have been recorded from Australia before, indeed seven of them are characteristic of the Australian fauna and only two have been reported outside this region. The "Endeavour" collection extends, often very considerably, the known range of four of these eight species. Undoubtedly the magnificent new stalked crinoid from off the south-eastern corner of the continent is the most notable form taken, but the new species of *Oreometra* and *Cosmiometra* are very fine. The number of species of Crinoids now recorded from Australia is sixty-six, not including those taken in depths exceeding three hundred

fathoms nor those known from Sahul Bank (south of Timor) ; of the sixty-six, thirty-seven, or more than half, are known only from Australia.

Family PENTACRINITIDÆ.

Genus METACRINUS, *P. H. Carpenter.*

METACRINUS CYANEUS,¹ *sp. nov.*

(Plate I.)

Stem rather stout, apparently not exceeding 400-500 mm. in length, and ranging from 5 to 8 mm. in diameter in the different specimens ; pentagonal in cross section, with slightly rounded angles ; immediately beneath the calyx, the sides are grooved and the angles sharp, but after five or six nodes, the grooves and angles have virtually disappeared. Cirrus sockets confined to the nodals, transversely oblong, the shorter diameter markedly less than the height of the nodal, one-fourth of which lies below the sockets. Nodals not at all produced at angles, nor otherwise conspicuous, but occasionally a low swelling is indicated on the rounded angle. Internodals 7-15, but rarely fewer than 9 ; the uppermost becomes fused with the nodal on the lower half of the stem ; the upper and lower margins are prettily crenulated along the suture, except on the lowest internodes ; their radial faces are plane (except on uppermost internodes) while the internodal angles may bear low, rounded swellings (scarcely large enough to be called tubercles), though these are often entirely wanting ; the internodals in some specimens are of nearly uniform height, but generally alternate internodals are higher than those between ; this difference may be very marked, especially on the uppermost internodes ; along the midradial line of the upper internodes, there is a conspicuous pit between each pair of stem-segments (nodals and internodals alike), but this vertical series of pits becomes indistinct at about the ninth or tenth internode and lower down completely disappears ; the lower internodes have a smooth, shining, porcelain-like surface, but the upper ones lack this entirely.

Cirri 50-65 mm. in length (eight to ten times the stem-diameter), the longest with 60-64 segments ; basal segments low (not half as high as wide), gradually becoming higher, but never becoming even approximately as high as wide ; terminal claw scarcely longer than the preceding joint, slightly curved :

1. *Kύανεος*=dark blue, dusky, in reference to the colour of the stem.

there are more or less evident median tubercles on a dozen or fifteen of the terminal segments ; there tend to be two on each segment but they are very low and small as a rule. Cirri transversely oval in cross-section at base, but soon become cylindrical and distally more or less laterally compressed. Fully developed cirri have a smooth, polished surface, as usual.

Basals rather prominent, somewhat produced downward over the angles of the stem, broadly in contact laterally. Radials two or three times as wide as high, with a marked proximal angle (between the basals) and a distinctly concave distal margin. IBr normally 6 (1+2, 4+5),¹ but often 7 (1+2, 4+5), occasionally 5 (1+2) and rarely 4 with no syzygy. Axillary triangular, almost as high as wide, lateral angles truncate, distal angle somewhat rounded. Pinnules on second, third and fifth segments and on sixth when seven are present. IIBr 6-11, usually 9 or 11, not rarely 7, but 6 only in one instance ; a syzygy between 3 and 4 ; in one instance the syzygy is between 2 and 3 instead. IIIBr almost always present, 9-21, usually 13 or 15 ; a syzygy between 3 and 4. IVBr often present, 16-27, usually 19 or 21 ; more generally present on the outer, than on the inner IIIBr series. Arms 45-60 (57 in holotype), with about 140 brachials after the IVBr series ; articular tubercles slightly indicated ; dorsal surface smooth ; beyond the IIIBr axillary the brachials have somewhat flaring distal margins, more or less spinulose at first, but becoming smooth near arm tip ; distally the arms are somewhat compressed ; the arms of the holotype are more than 200 mm. from the radial to the tip. Oral surface of arms with numerous granules and little plates, which are particularly crowded along the margins of the food-groove.

Pinnules rather stout, four-sided, somewhat flattened ; each segment is more or less concave or hollowed out on both the proximal and distal sides ; this is very marked on distal side of first pinnule but on the second is nearly wanting, the distal margin of the latter being compressed and keel-like ; subsequently the concavity of the distal and proximal sides of the pinnules becomes a constant feature ; the oral surface of each pinnule is provided with granules which guard the food-groove ; the terminal half of each pinnule is thus covered orally by a double, interlocking series of pointed granules. First pinnule (that on IBr 2) about 20 mm. long with 17-18 segments ; second somewhat longer ; third a little longer than

1. Not counting the radials themselves, of course.

second ; fourth (that on IIBr 4) about 25 mm. long, with 22-23 segments ; fifth about as long ; sixth a little shorter ; succeeding pinnules decrease in length very gradually, becoming about 10 mm. long, with 15 or 16 joints ; this size continues to the terminal part of the arm, where, about fifty segments from the tip, it drops quickly to 2 mm. and less, with only three segments or even fewer ; there are half a dozen or more intermediate pinnules with 12, 10, 8 and 6 joints, but the transition is quite abrupt as is usual in the genus.

Colour (in alcohol or dried from alcohol) either uniformly light bluish-grey, or crown pale yellow or whitish, and stalk deep greenish-blue in marked contrast. The holotype (in alcohol) is uniformly whitish with a distinct orange tinge, but only a small part of the stalk is attached to the magnificent crown. The stalk of this specimen, preserved dry, is deep greenish-blue. Unfortunately there are no notes on the colour in life, of any of the specimens, but it is not likely that the bluish shade in the stalk is the result of preservation. It is possible that the yellowish crowns are the result of preservation in alcohol. There are seven specimens.

This superb crinoid is well distinguished from all the previously described members of the genus by the large number of segments in all the various numerical series ; thus the number of internodals (usually more than 9 and often 14) is the maximum for the genus, the number of cirrus-joints is nearly the maximum, the number of radials is often the maximum, and the segments of both the IIBr and the IIIBr series approach the maximum number. In certain particulars, *M. rotundus*, Carpenter, seems to be the nearest relative of *M. cyaneus*, but it has decidedly fewer cirrus-joints, and the distal brachials are not at all flaring, the arms being quite smooth ; moreover the radials and the members of the IBr series are stouter, smoother and of quite a different shape in *M. rotundus*. As the only stalked crinoid as yet known from the coasts of Australia¹, *Metacrinus cyaneus* is of unusual interest and will certainly rank as one of the "Endeavour's" most noteworthy discoveries. The geographical isolation of *M. cyaneus* is remarkable, the Kermadec Islands, nearly 2500 miles to the north-east being the nearest locality where *Metacrinus* has been taken.

Locs.—Eastern Slope, Bass Strait, about 200 fathoms. This specimen has been selected as the holotype.

South-east of Wilson's Promontory, Victoria.

1. Sahul Bank, south of Timor, is scarcely Australian.

Twenty and a half miles S., 19° E. of Cape Everard, Victoria, 90 fathoms.

One good specimen from an unknown locality, but the appearance leaves little room for doubt that it is from the station south-east of Cape Everard, Victoria.

Family COMASTERIDÆ.

Genus COMATULA, *Lamarck*.

COMATULA CRATERA,¹ *sp. nov.*

(Plate II., fig. 1.)

Disk of holotype, 13 mm. across ; arms 175 mm. or more in length, 4 mm. in transverse diameter at base, 5 mm. at 20 mm. distance from base, and 3½ mm. at 50 mm. from base. Centrodorsal pentagonal, 4 mm. in diameter ; its sides are straight or more or less concave ; it is flush with the radials, all of which are fully exposed. Cirri none in the holotype and eight other specimens ; in three specimens, a single small cirrus is present in each ; one specimen has two and one has three such cirri, each with 16-19 joints. The second radial is more than twice as high as the first and half again as wide ; the third (axillary) is triangular, nearly twice as wide as high. Brachials (beyond the tenth) broadly triangular, the pinnule-bearing end three times as wide as the other ; the distal margin is slightly concave and projects as a faint articular tubercle where the brachial is widest ; the lowest brachials are nearly equally wide on the two sides and have the articular tubercle more marked on their proximal margins, but these tubercles are never conspicuous. Along the median line of the arm is a slight keel ; it is better marked on some brachials than on others and the degree of development differs in different specimens. Syzygies between br. 1 and 2, and 3 and 4 and then at intervals of 5-7 joints to about br. 30, after which the usual interval is 5, though 4 or 6 occur frequently. Pinnules rather stout but becoming long and slender distally ; P₁ about 20-25 mm. long, with some 45 segments, of which not more than 12-15 make up the small terminal comb ; succeeding pinnules successively shorter to P₈ which is about 16 mm. long and has some 25 segments ; terminal combs confined to first three pairs of pinnules ; basal segments on

1. *Κρατερά*=strong, stout, in reference to the unusually thick arms.

all pinnules, much wider than high, and somewhat compressed, especially at distal margin; on P_2 , P_3 , P_a , and P_b , this compressed distal margin becomes a conspicuous projecting keel on segments 2 and 3; beyond P_8 , the pinnules gradually lengthen and become more slender until they may exceed 20 mm. in length and have 35 segments.

Mouth radial in position, not very close to margin of disk, with equally developed food-grooves running to all the arms. There is no plating of disk or of the oral surface of arms and pinnules, but the membrane covering the disk is, when fully dried, seen to be filled with calcareous granules of very small size. Colour (in alcohol or dried), light fawn-colour with or without purple markings; perhaps in life all would show these purple markings more or less clearly; when well-developed they appear as longitudinal stripes one on each side of each arm, with a branch running up each pinnule; distally the stripes fade away altogether; proximally the stripes on the inner side of a pair of arms unite at the tip of the axillary from which they arise, while those on the outer side broaden out and cover the radials except for a narrow median area; even the centrodorsal may be purplish; the disk and oral surface of the arms are yellowish, quite yellow when dry.

Whether this fine comatulid should be considered distinct from *C. solaris* is, of course, a matter of opinion. The locality is some four hundred miles further south than *C. solaris* has been recorded and the depth is considerably greater than any published for that species. In view of these facts, it seems to me that the absence of cirri and reduction of the centrodorsal plate, combined with the very different terminal combs of the oral pinnules and the absence of plating on disk and oral surface of the arm bases, warrant the recognition of the form by a different name. In *C. solaris* the terminal comb of P_1 consists of 35-40 segments and occupies nearly half the pinnule; the shape of the individual teeth is, moreover, very different from what is seen in *C. cratera*. The comatulid taken by the "Alert" at Port Mollen, Queensland, referred by Carpenter to *C. solaris*, but specially discussed because of the absence of cirri and the unplated disk, is very possibly a specimen of *C. cratera*.

Loc.—Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms. Fourteen specimens.

Genus COMANTHUS, A. H. Clark.

COMANTHUS PERPLEXUM,¹ *sp. nov.*

(Plate III., fig. 2.)

Centrodorsal well developed, nearly 5 mm. in diameter, slightly concave; around its margin is a series of about 15 cirrus-sockets, 7 or 8 of which bear more or less developed cirri; the largest of these are about 13 mm. long and consist of 16-19 segments, of which the terminal 3 or 4, aside from the claw, carry very insignificant elevations or ridges on the proximal dorsal margin. IBr series, 3, all visible, the axillaries broadly triangular, not in contact interradially. IIBr 4 (3+4), low, broad, smooth and practically without articular tubercles; distal margins distinct, slightly flaring, especially on IIBr₂; the whole series is only 5 mm. long and is nearly 4 mm. wide. IIIBr series 2, except on one IIBr series, where one arm has a IIIBr series 4 (3+4) and the other arm is undivided. There are 4 IVBr series present, all 4 (3+4) and there are thus 44 arms; these are about 100 mm. long and have approximately 100 segments beyond the last division; there is a syzygy between 3 and 4, and a second ten to fifteen segments beyond; after that the syzygial interval is 5, with remarkable uniformity. Brachials quadrilateral but except near tip of arm, the pinnular side is much wider than the one opposite; distal margins flaring, thickened and minutely rough but not spinulose. Pinnules rather slender; P₁ about 17 mm. long, with 45 segments, of which only the terminal 10 form the comb; P₂ shorter with about 35 segments, 10 in the comb; P₃ remarkably short and weak, scarcely 5 mm. long and consisting of only 18-20 segments, the terminal comb of 7 segments is well-marked; none of the subsequent pinnules have a comb, but they gradually increase in length to 10 mm. or more, still consisting, however, of about 20 segments; none of the segments are conspicuously spinulose, though the terminal ones are more or less so, but the basal segments are notably triangular. Disk wanting. Colour (dry), uniformly pale fawn; oral surface of arms and pinnules brownish-black.

There is no doubt that this species is very near *C. briareus* (Bell), but after comparison with numerous specimens, I am unwilling to refer it to that species. The colour is naturally the most striking difference, but, of course, is the least

1. *Perplexus*=puzzling, in reference to the doubt whether it is really a distinct species.

significant; nevertheless it is noteworthy that all recorded specimens of *C. briareus* and all of the thirty specimens at hand are blackish-brown, brownish-black, or purplish-black; one recorded from Western Australia by A. H. Clark has lighter lines on the arm. Aside from colour, the flaring distal margins of the low radials and of the brachials in *C. perplexum* are quite different from those of *C. briareus*, while the smoothness of the brachials and pinnules is noticeable, as contrasted with the rough arms of *C. briareus*. I have carefully compared the single specimen with the descriptions of *C. weberi* and *C. rotula* of A. H. Clark, at the kind suggestion of that well-known authority on the group, but the cirri show at once that it is not *C. weberi*, and the characters of the centrodorsal, the cirri and the brachials seem sufficient to distinguish it from *C. rotula*. The geographical isolation of this interesting comatulid is remarkable for no near relative has been taken south of Port Molle and *C. briareus* is not known from south of Port Denison, some six hundred miles to the north.

Loc.—Eleven miles south by east of Ballina, New South Wales, 27-28 fathoms.

COMANTHUS PLECTROPHORUM,¹ *sp. nov.*

(Plate IV., fig. 1.)

Disk about 30 mm. in diameter; arms rather more than 100 mm. long. Centrodorsal about 10 mm. in diameter and more than 2 mm. thick; its bare central area is very rough, slightly concave and about 6 mm. across. Cirrus-sockets in three crowded and irregular horizontal series. Cirri LV.-LX., 29-37, usually about 32; some proximal segments, say 4-9, are cylindrical and longer than thick, 5 is particularly long; beyond 10 the distal dorsal margin projects slightly, the segments become compressed and a marked dorsal keel is formed, which is most fully developed on the four or five segments preceding the penultimate; seen from the dorsal side this is more of a tubercle than a keel, but the lateral aspect is very keel-like.

Radials entirely concealed; IBr 1 wide and low, in contact for about three-fourths of their height; radial axillaries, very low and wide, at least three times as wide as high, not at all in contact with each other. IIBr series 4 (3+4), in one instance only, 2, well separated from each other externally; internally IIBr₁ are more or less in contact. IIIBr series

1. $\pi\lambda\eta\kappa\tau\rho\nu$ = a spur + $\phi\omicron\rho\rho\acute{\epsilon}\omega$ = to bear, in reference to the notable spurs on the pinnules.

4 (3+4), in two instances only, 2; in the dry specimen the distal margins of this series and the preceding are thickened and slightly flaring and there is little indication of synarthrial tubercles, but in the alcoholic specimen while very slight synarthrial tubercles are indicated the joints are all smooth and indistinct. IVBr series, when present, 4 (3+4); not present at all in the dry specimen, but four such series are present in the alcoholic. Arms 40-44, terete; brachials soon become very markedly triangular, with thickened, flaring, roughened distal margins, but distally they again resume a quadrilateral form and the distal margins are not peculiar. A syzygy occurs between 3 and 4 and then at a variable distance of 8-16 segments; after the second syzygy there may be a second interval of 8-10 segments, but as a rule syzygies become frequent and very regularly spaced, in one specimen at intervals of 5 segments and in the other at 6; that is, in one specimen each syzygial pair is followed by 3 normal segments and then another syzygial pair, while in the other specimen, 4 normal segments intervene.

Pinnules long and slender, especially the oral pinnules, of which the first exceeds 30 mm. in length and consists of more than 70 segments; succeeding pinnules decreasing in length to P₄ which is only about 15 mm. long and contains only 20-25 segments. Comb of lowest pinnules consists of about 12-15 segments; the combs persist as far as P₄ on which the comb consists of 7 or 8 segments. Basal segments of all pinnules, except at very tip of arm, much wider than long; on the basal and middle portions of the arm, 3-12 of these widened segments are conspicuous for their flaring, spinulose margins, which are prolonged on the aboral side into remarkable spinulose spurs; these spurs are, of course, largest and most fully formed on the basal segments (excepting the lowest two) of the lowest pinnules; passing distally along the arm, as well as along each pinnule, these spurs become less and less evident and finally disappear. Disk quite fully plated, especially along the food-grooves; the position of the mouth cannot be determined in these specimens. Colour (of alcoholic specimen) light brown; cirri somewhat lighter than arms; on drying, the colour becomes uniformly light fawn or very pale buff.

This is a very well characterised and remarkable *Comanthus*, related to *C. bennetti* and *C. pinguis*, but easily distinguished from either, by the curious pinnule segments. The small number of arms and the colour will further distinguish it from *C. bennetti*, while the shape of the arms, especially at

base, separate it from *C. pinguis*. From the South Australian species *C. trichoptera*, the size, the cirri and the pinnules all distinguish it without difficulty.

Loc.—East of Flinders Island, Bass Strait, 100-300 fathoms. Two specimens.

COMANTHUS SPANOSCHISTUM,¹ *sp. nov.*

(Plate IV., fig. 3.)

Disk 5-12 mm. in diameter; arms 30-80 mm. long. Centro-dorsal large and flat, 5 mm. in diameter in adults, and about 1 mm. thick. Cirri, in one or in two imperfect series, about XXIV., 15-20; the longest are 10-15 mm. long; segments 4-7 or 3-8 are cylindrical and longer than wide, segment 4 (or 5) may be nearly twice as long as thick; distally the segments are a trifle compressed and the distal margin dorsally is elevated to form a low tubercle, which, at least on the penultimate segment, is spiniform. Radials hidden; IBr 1 low and wide, more or less in contact; radial axillary triangular, high and pointed, the height about two-thirds of the width. IIBr series, not often developed; when present, invariably 4 (3+4); arms usually 10, in one specimen 13, in another 14, and in a third 19; No IIIBr series is developed. Brachials at first quadrilateral, but soon becoming triangular; distal margins becoming more and more flaring and overlapping until near tip of arm where the brachials become quadrilateral again and the margins hardly flare. Syzygies between 3 and 4 and then at an interval of 7-11 segments; after that the syzygial interval is usually 5, but may be only 3. Pinnules long and slender; P₁ is over 10 mm. long and consists of about 30 segments, of which about 15 make up the comb; P₂ is somewhat smaller and P₃ is only 8 mm. long and consists of 20 segments, 9 in the comb; P₄ is 8 mm. long, but has no comb; succeeding pinnules become more slender and increase in length to about 10 mm.; basal segments of lower pinnules, more or less triangular with greatly flaring, spinulose margins which tend to project like rough spurs on the aboral side of the largest segments, much as in the preceding species (*C. plectrophorum*). Disk, except around tip of anal tube, smooth and naked; there are calcareous nodules in the anal tube. Mouth interradial. Colour, in alcohol and dry, more or less yellowish, with either a green or a brown cast; one

1. *σπανός*=rare+*σχιστός*=divided, in reference to the scarcity of arm divisions.

specimen is very dull purplish with yellow cirri; others are yellowish more or less clouded with purplish; in the 19-armed individual the dull purplish predominates. Twenty-three specimens.

The specimen from off Noosa Head, Queensland, is noticeably more slender than the others and the cirri are somewhat more compressed but these differences are very slight and no more than one might expect in view of the wide separation of Noosa Head from the Tasmanian waters where this species seems to be so common. It is no doubt nearly related to *C. trichoptera*, but the scarcity of division series and the absence of the peculiar axillaries characteristic of that species, would seem to preclude regarding the two as identical. Many of the specimens, even small ones, have the genital pinnules immensely swollen with the reproductive cells; in some cases only the pinnules near the tip of the arm are unaltered. The specimens which have dates on the labels were taken in March and April, 1914, and thus it is evident that the species breeds in late summer and early fall. It is possible, of course, that it has a prolonged breeding period.

Locs.—East of Babel Island, Bass Strait, 60-70 fathoms and 50-80 fathoms.

North-east of Babel Island, Bass Strait, 100-170 fathoms.

Twenty miles east of Babel Island, Bass Strait, 65 fathoms.

East of Maria Island, Tasmania, 78 fathoms.

East of Flinders Island, Bass Strait, 70-100 fathoms.

Eastern Slope, Bass Strait, 70-120 fathoms.

Off Noosa Head, southern Queensland, 16 fathoms.

Family ZYGOMETRIDÆ.

Genus ZYGOMETRA, *A. H. Clark*.

ZYGOMETRA ELEGANS (*Bell*).

Antedon elegans, Bell, Rep. Zool. Coll. H.M.S. "Alert," 1884, p. 162.

Zygometra elegans, A. H. Clark, Smiths. Misc. Coll., 1., 1907, p. 348.

The occurrence of this comatulid as far south as Sandon Bluffs, New South Wales, is an interesting extension of its range, since it is not recorded from a lower latitude than that of Port Curtis, Queensland. The three specimens are all of

large size (arms nearly 100 mm. long), but show considerable diversity of colour. One has 38 arms, the greater part of which are light brown, but basally all are heavily shaded with purple, the joints in particular being very dark; there are 35 cirri with about 54 segments; they are, at base, dorsally pale brown, orally deep purple, but distally the purple becomes very gradually dominant until it includes all of both surfaces. The second has at least 36 arms (several are missing) which are light brown with more or less of a purplish cast; basally three of the rays are very deep purple, the other two being decidedly lighter; there are more than 30 cirri with 47-53 segments, light brown at base, but becoming purple distally. The third specimen, from off Noosa Head, Queensland, has only 29 fawn-coloured arms (dry), with a faint purplish cast, the joints distinctly darker than the segments; there are, in marked contrast, 27 dull purple cirri, pale brownish at base dorsally (as in the centrodorsal), with 45-47 segments. In this dry specimen the IIIBr series is 2 except in one instance of 4 (3+4) but in the other specimens it is common to have the IIIBr series 4 (3+4), although 2 seems the usual number. The IIBr series, and the IVBr series, when present, are invariably 4 (3+4). The only VBr series noted is 2.

Locs.—Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

Off Noosa Head, southern Queensland, 16 fathoms.

ZYGOMETRA MICRODISCUS (*Bell*).

Antedon microdiscus, Bell, Rep. Zool. Coll. H.M.S. "Alert," 1884, p. 163.

Zygometa microdiscus, A. H. Clark, Smiths. Misc. Coll., 1, 1907, p. 348.

This is a small, dry specimen of uniformly pale brown colour, with only 22 arms. There are 8 IIBr series, one of which is 2, the rest 4 (3+4); there are 4 IIIBr series, all of which are 4 (3+4). The centrodorsal is low, conical, with 25-30 cirri, the longest having more than 40 segments. P₂ has 27 segments and is relatively large, but is less than 20 mm. long. The occurrence of this species near the Capricorn Islands is quite to be expected, but nevertheless extends the known range of the species far to the south. The present specimen is naturally referred to Carpenter's *Antedon multi-radiata*, but I think A. H. Clark is quite right in regarding that species as a synonym of *Z. microdiscus*.

Loc.—Thirteen miles north-east of North Reef, Capricorn Group, off Port Curtis, Queensland, 70-74 fathoms.

Family CALOMETRIDÆ.

Genus OREOMETRA, *A. H. Clark.*OREOMETRA PERICALLES,¹ *sp. nov.*

(Plate III., fig. 1.)

Disk wanting; centrodorsal 6 mm. in diameter. Cirri all missing, but cirrus-sockets 17, their ventral portion well on to the radials; centrodorsal slightly convex, smooth. IBr 1 and 2 (the axillary) united by syzygy; radials in contact laterally, but IBr 1 and 2 clearly separated from the adjoining series; each of these segments is about three times as wide as high and 2 has a low, obtuse distal angle; there is a cylindrical, blunt, spine-like tubercle (sometimes a pair) on the proximal margin of 1 and another on the distal margin, in the median line; there are 1-3 somewhat similar but flattened projections on each anterior margin of the axillary. IIBr series 4 (3+4), or once, 3 (2+3); segments 1-3 have the spine-like tubercle at the median, distal margin prominent, while the axillary may have one somewhat smaller, on each side; an additional similar tubercle may be developed in connection with the well-marked distolateral angles. Lower brachials quadrilateral with conspicuous distolateral angles on the pinnular side; the median spine-like tubercle is also often developed; after the seventh or eighth, the brachials tend to become triangular and the distal margins tend to flare, but there is no overlapping. Syzygy between 2 and 3 on every arm, with a IIBr series, but between 3 and 4 on arms arising direct from the radial axillary; second syzygy is somewhere between the eighth and fourteenth segments; after that the syzygial interval is five or six segments.

P₁ somewhat prismatic, about 7 mm. long, of about 15 segments, curved inward, flexible, but not at all flagellate, rather stout throughout; the first segment is notably enlarged, but not the second; P₂ erect, and spine-like, not at all prismatic, about 13 mm. long, of 15 nearly cylindrical segments, with spiny distal margins, all but the terminal and 2 lowest, longer than thick; P₃ very similar, perhaps a little longer; P₄ similar, perhaps a little shorter than P₃; P₅-P₁₀ similar, but successively shorter and with fewer segments, which have less and less spiny distal margins; P₁₁ of 11 segments and about 8 mm. long; succeeding pinnules distinctly prismatic and gradually increasing to about 10 mm. in length. Side and covering plates well developed. Arms about 75 mm. long.

1. *περικαλλής*=very pretty, in reference to both form and colouration.

Colour, of the single dry specimen, purple and white; centro-dorsal, dorsal surface of brachials and of pinnules, and scattered spots elsewhere, white or whitish; IBr series dirty whitish with a purple tinge; IIBr series, a few of the lowest brachials, a conspicuous line along each side of each arm, and oral surface of pinnules, at least on basal portion, more or less deep purple.

This very handsome species was at first referred to *Zygometra* on account of the syzygy in the radial axillary. Mr. A. H. Clark kindly suggested comparing it with *Calometra* and the examination of the pinnules indicated relationship to that genus. I think there can be no doubt, however, that this specimen is a representative of the recently described genus *Oreometra* and it is quite near the type-species, *O. maria*, A. H. Clark. The differences in the IBr series and in the pinnules, however, forbid referring it to that species. The occurrence of a syzygy between brachials 2 and 3 is noteworthy; Mr. Clark says nothing about syzygies in either one of his two published descriptions of *O. maria*. He does say, however, that the connection between IBr 1 and 2 is "an exceedingly close synarthry," while I have been convinced after a careful examination of the distal face of IBr 1 that the joint is certainly not a synarthry in the present species and I do not see why it is not a syzygy. If it is a syzygy or a pseudosyzygy, it seems to me the genus is a connecting form with the *Zygometridae*, if not actually a member of that family. The pinnules obviously count against any such view. The cirri I have not seen.

Loc.—Thirteen miles north by west of Double Island Point, Queensland, 25-26 fathoms.

Family HIMEROMETRIDÆ.

Genus AMPHIMETRA, A. H. Clark.

AMPHIMETRA CRENULATA (*Carpenter*).

Antedon crenulata, Carpenter, Journ. Linn. Soc., Zool., xvi., 1882, p. 507.

Amphimetra crenulata, A. H. Clark, Smiths. Misc. Coll., lx., 10, 1912, p. 16.

This is a fine adult individual with 28 arms; it had about 25 cirri, the longest with 45 segments. The colour (dry) is uniformly brownish-white. The species was not previously known from south of Port Curtis, Queensland.

Loc.—Thirteen miles north by west of Double Island Point, Queensland, 25-26 fathoms.

Family COLOBOMETRIDÆ.

Genus OLIGOMETRA, *A. H. Clark.*OLIGOMETRA THETIDIS, *H. L. Clark.**Oligometra thetidis*, H. L. Clark, Mem. Austr. Mus., iv., 11, 1909, p. 522.

These two specimens are uniformly yellowish in alcohol and show no noteworthy peculiarities.

Loc.—Eastern Slope, Bass Strait.

OLIGOMETRA ZEBRA,¹ *sp. nov.*

(Plate II., fig. 2.)

Disk wanting; arms about 70 mm. long. Centrodorsal, 3 mm. in diameter, markedly concave. Cirri in a single, crowded, fairly regular marginal series of about 20, 12-13 mm. long, each with 27 or 28 segments; all segments wider than long; basal ones nearly square but distally each successive segment becomes more compressed, ventrally rounded, and dorsally transversely ridged; transverse ridges never conspicuous, but more evident on the last four segments (not counting the claw), especially on the penultimate, where it forms a well-marked opposing spine. IBr series not peculiar, the synarthrial tubercle, however, being quite distinct; the axillary is nearly twice as wide as high; the adjoining rays are well separated from each other. Arms 10; brachials at first quadrilateral, becoming triangular, and then near tip of arm again quadrilateral; synarthrial tubercle of 2 and 3 well-marked; neither distal margins nor distolateral angles peculiar, though the latter are evident enough, especially on terminal half of arm; general contour of arm quite smooth.

P₁ about 7 mm. long, of 18 segments, not at all rigid or otherwise peculiar; the basal 6 or 7 segments are wider than long while the succeeding are squarish, or a little longer than wide; the oral margins of the lower segments are barely produced into one or two minute spines, while the aboral margins are inconspicuous, flattened and a trifle roughened; segments 8-12 are somewhat prismatic and the remaining segments are distinctly flattened. P₂ is 9 mm. long, with 18-20 segments; it is very similar to P₁ but is evidently stouter and is clearly the largest pinnule on the arm; the oral margins of

1. *Zebra*, a Latinised form of the native name of the well-known African quadruped; in reference to the colouration of the arms.

the basal segments are smooth, while the aboral margins are more or less produced as flattened, spinulose projections; the distal margins of all the segments, except the first five or six are finely spinulose, but none of these characteristics are at all conspicuous. P_3 is much like P_2 , but a little smaller, while P_4 , which is probably the shortest pinnule on the arm, is only a trifle shorter than P_3 ; succeeding pinnules become very slender, 8-9 mm. long and with 22 or more segments. On the basal half of the arm, the pinnule-segments, except the basal two or three, have distinctly, but finely spinulose aboral edges and distal margins, but on the outer half of the arm they seem to be quite smooth.

Colour (dry) of centrodorsal, basal portion of the cirri, all arm-segments and pinnules, uniformly pale buff or brownish-white; cirri gradually become dull purple at tip, the lighter shade being confined more and more completely to the ventral side of the segments and finally is crowded out altogether; arm joints rich reddish-purple, in sharp and handsome contrast to the light segments; oral surface of pinnules very dark, almost black. One specimen.

This seems to be a well-marked species, the long cirri, the flexible first pinnule, and the absence of conspicuous processes on the basal pinnule-segments combining to distinguish it at once from the other species of the genus.

Loc.—Eleven miles east-south-east of Clarence River mouth, New South Wales, 35-36 fathoms.

Family THALASSOMETRIDÆ.

Genus PTILOMETRA, A. H. Clark.

PTILOMETRA MACRONEMA (*Müller*).

Comatula macronema, Müller, Monatsb. K. Preuss. Akad., 1846, p. 179.

Ptilometra macronema, A. H. Clark, Smiths. Misc. Coll., 1., 1907, p. 358.

These ten specimens are all typical examples of this characteristic South Australian species.

Locs.—Great Australian Bight, about 131° E., 62 fathoms.

South-east of Flinders Island, South Australia, 37 fathoms.

Sanders Bank, off Kangaroo Island, South Australia, 28 fathoms.

Forty miles west of Kingston, South Australia, 30 fathoms.

PTILOMETRA MÜLLERI, A. H. Clark.

Ptilometra mülleri, A. H. Clark, Proc. Biol. Soc. Washington, xxii., 1909, p. 41.

This large series of *Ptilometras* (one hundred and forty-five specimens) shows no tendency to intergrade with the preceding species and fully justifies Mr. Clark's separation of the two forms. The occurrence of this species off the mouth of the Clarence River, New South Wales, extends its known range northward about 150 miles. It is interesting to note that no *Ptilometras* were taken by the " Endeavour " in Tasmanian or Victorian waters, though the genus has been reported from Port Phillip. None of the material in the present collection throws any light on the disagreement between Mr. A. H. Clark and myself with reference to the young of *Ptilometra*. We are each equally sure of being right, and no doubt will continue to feel so until the life history of one of the members of the genus is fully known. It seems to me possible that Bell's *Antedon wilsoni*, which I have never seen, and my *Himerometra pædophora* are the same species, but I am perfectly sure the latter is not a *Ptilometra* and has no near relationship to that genus. It is to be hoped that some Australian zoologist will before long investigate carefully the life history of the comatulids, so accessible from Sydney or Melbourne.

Locs.—Eleven miles east-south-east of Clarence River mouth, New South Wales, 35-36 fathoms.

Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

Six miles east of Cape Hawke, New South Wales, 47-50 fathoms.

Between Port Stephens and Newcastle, New South Wales, 22-60 fathoms.

Shoalhaven Bight, New South Wales, 15-45 fathoms.
South-eastern coast of Australia.

Genus COSMIOMETRA, A. H. Clark.

COSMIOMETRA DASYBRACHIA,¹ *sp. nov.*

(Plate IV., fig. 2.)

Arms 20, about 90 mm. long. Centrodorsal about 4 mm. high and scarcely 5 mm. in diameter at base, markedly

1. *ῥασύς*=rough, downy+*βραχίων*=the arm, in reference to the fine roughness of the arms, distally.

conical; cirrus-sockets in ten vertical series of 3 or 4 each (about 35 altogether), the series separated radially by a rather broad area, with finely roughened surface. Cirri 45 to 50 mm. long, with 68-74 segments, of which the fifth or sixth is longest (much longer than thick) and all but the basal fifteen have the distal dorsal margin produced into what looks like a sharp spine, when seen from the side; distal segments, including this dorsal spine twice as wide as high.

Radials completely concealed except for the small distolateral corner which appears in the interradial angles of the calyx. IBr1 crescentic, the proximal margin strongly convex, the distal correspondingly concave; excepting only the distal median portion, the whole surface is rough and spinulose, especially the lateral margins. IBr2 (axillary), rhomboidal with anterior margins, slightly concave; all margins finely serrulate and lateral surfaces rough and spinulose; synarthrial tubercle of 1 and 2, smooth and rounded, low but distinct. IIBr series, 2, very similar to the IBr series, but the lateral spinulose surfaces are much less marked, especially on the axillary and are nearly wanting on the inner side. First two brachials are similar but are relatively much longer and narrower and have no spinulose lateral areas, though the lateral margins are very serrulate and rough. The division series and these two brachials have strongly flattened sides; the division series are in closely appressed contact, but the lower brachials are much less so, and probably in life hardly touch. Brachials 3-10 quadrilateral, but subsequent segments become triangular, the distolateral angle being more and more prominent; beyond the middle of the arm the segments become quadrilateral again and nearly as long as wide; proximally both proximal and distal margins are everted and rough, but beyond the 12-14 joint only the distal margin is conspicuous; even near the tip of the arm, however, the distal margin is not very flaring and it never overlaps the following segment. Beginning at the 35th, or thereabouts, the distal dorsal surface of each segment is rough with minute spines and these soon cover the whole median area of the arm; near the tip, this area is a very narrow band.

P₁ about 11 mm. long, of 25 smooth segments, the six basal ones much wider than long, somewhat axe-head shaped, much flattened dorsally; remaining segments longer than wide, or at least as long, the eighth segment being the longest. P₂ similar, but only 10 mm. long and with only 22 segments. P₃ similar, but a little shorter. P₄-P₁₀ more prismatic, only

5-6 mm. long, with 12-14 segments, which have the distal margins, and a sharp dorsal keel, finely serrulate; remaining pinnules similar, but becoming much more slender, longer (8-10 mm.), and with more segments (17-18); the sharp, serrate dorsal keel is well-marked. Side and covering plates, highly developed. First syzygy between 3 and 4; in eleven arms of one specimen, but in only one arm of the holotype, a second occurs between 5 and 6, and the third is somewhere in the region between segments 18 and 27; in the other arms, the second syzygy is generally not until after the twentieth segment; distally the syzygial interval is at first 6-8, but near the tip of the arm it decreases to 4 or 5. Colour (in alcohol) yellowish-brown; when dry, the shade is much lighter.

While this species resembles both *C. komachi* and *C. helene* in the general character of the arms, the much more numerous cirrus joints, the longer pinnules and the markedly conical centrodorsal seem to prove it is quite distinct. The genus was not previously known from Australian waters.

Loc.—East of Flinders Island, Bass Strait, 70-100 fathoms. Two specimens.

Family ANTEDONIDÆ.

Genus COMPSOMETRA, A. H. Clark.

COMPSOMETRA INCOMMODA (*Bell*).

Antedon incommoda, Bell, Ann. Mag. Nat. Hist., (6), ii., 1888, p. 404.

Compsometra incommoda, A. H. Clark, Mem. Austr. Mus., iv., 15, 1911, p. 792.

Loc.—South-east of Flinders Island, South Australia, 37 fathoms. Two specimens.

COMPSOMETRA LOVENI (*Bell*).

Antedon loveni, Bell, Proc. Zool. Soc., 1882, p. 534.

Compsometra loveni, A. H. Clark, Proc. Biol. Soc. Washington, xxi., 1908, p. 131.

None of the specimens of *Compsometra* are especially noteworthy, but they give added weight to the correctness of Mr. A. H. Clark's opinion that there are two distinct species in the seas of south-eastern Australia. To judge from the present collection, as well as from previous records, *C. incommoda* would seem to be the more southern form, occurring from Port Jackson, New South Wales, southward and westward

to Flinders Island, South Australia, while *C. loveni* occurs from Port Jackson northward to Clarendon Island, Queensland. It is true that *C. loveni* is recorded from Port Phillip, Victoria, but further proof of its occurrence there is desirable. Perhaps the specimen in the British Museum is the victim of a misplaced label or a slip of the pen.

Locs.—Twenty miles north-north-east of Double Island Point, southern Queensland, 30 fathoms. One specimen.

Thirteen miles north by west of Double Island Point, Queensland, 25-26 fathoms. One specimen.

ASTEROIDEA.

The Starfishes, which the "Endeavour" collected, may fairly be counted as one of the most interesting lots which has been brought together by any one vessel since the "Challenger's" famous voyage. It is not so large as some that have been gathered by the "Albatross," but its value is disproportionate to its size, since it adds so much to our knowledge of the Australian marine fauna, three-fourths of the species taken being remarkable for one reason or another. The collection consists of two hundred and sixty-five specimens representing forty-four species, but fifteen of the species are represented by a single individual each; only four species are represented by more than twenty specimens each and of none are there twenty-five. As a natural consequence there is little opportunity to discuss growth changes or even individual diversity. Of the forty-four species, twenty-one are new to science, four are new to Australia and nineteen were previously known from that continent. But even among these nineteen species, there are a number whose occurrence in the "Endeavour" collection adds important data to our knowledge of their distribution. There is one new genus and several of the new species compel modifications of the diagnoses of the genera in which they are placed. The occurrence of the genera *Lonchotaster*, *Mimaster*, *Mediaster*, *Calliaster*, *Ogmaster*, *Pteraster*, *Zoroaster*, *Pedicellaster* and *Odinia* in Australian waters is of great interest; several of them have not previously been known in that quarter of the globe, and at least three of them are characteristic of the North Atlantic, where all, save *Calliaster* and *Ogmaster* occur.

The geographical distribution of the species is of much interest, as it reveals a very marked difference between the eastern, southern and western coasts of the continent. Of

the forty-four species, one from Lord Howe Island and one from Masthead Island, were not collected by the " Endeavour " but are from shore collections made by naturalists not connected with that vessel. Of the remaining forty-two, twenty-three were taken only in southern Australian waters, that is, south of Lat. 37° and east of Long. 128° , or in other words, on the coasts of South Australia, Victoria and Tasmania; of these twenty-three, nine were taken in the Great Australian Bight and three, all new to science, only there. There are eleven species from the eastern coast, of which ten were not found south of Port Jackson, while one was found at Shoalhaven Bight; only two of the eleven are new forms, the other nine being well-known species of tropical Australia. Only three species, all previously known, were found on both the eastern and southern coasts. There are four species from the western coast only, north of Cape Naturaliste, all of which are very distinct and highly characteristic forms. Of one species, specimens are present from Western Australia and from Tasmania, but the identity of the two is not perfectly established. There are no species in the " Endeavour " collections represented by specimens from all three coasts, but a few are known with that extensive range, such as *Luidia maculata*, *Coscinasterias calamaria* and *Allostichaster polyplax*; the two latter are distinctly southern species but the *Luidia* is a tropical form and its occurrence on all sides of the continent is most interesting. Two species, *Oreaster gracilis* and *Anseropoda rosacea* occur on both the east and west coasts, but not on the south; like the *Luidia* they are tropical species. It is probable that *Plectaster decanus* is a southern species occurring on all three coasts, but the evidence is as yet incomplete.

About one hundred species of Starfish had been recorded from Australia, including Lord Howe Island and Tasmania, prior to 1915, but of these some twenty are of very doubtful authenticity and ten others, while valid species, are of very unlikely occurrence in Australia. The " Endeavour " collections include twenty-five additions to the list, thus making up for most of those which must be stricken from the full list. It may not be out of place to add that the Museum of Comparative Zoology collection contains sixteen additional species from Torres Strait, and we are therefore safe in affirming that more than a hundred valid species of starfish are known from Australian waters, in less than three hundred fathoms. Of these at least seventy, or more than two-thirds, are peculiar to Australia.

Family LUIDIIDÆ.

Genus LUIDIA, *Forbes*.LUIDIA FORFICIFER, *Sladen*.*Luidia forficifer*, Sladen, Chall. Rep., Zool., xxx., 1889, p. 258.

This individual seems to be undoubtedly conspecific with the one taken by the "Thetis" in Newcastle Bight, New South Wales, at about the same depth. Both specimens differ from Sladen's types, which were taken north of Australia, in the absence of the pedicellariæ along the ambulacral furrows; in the New South Wales material, the pedicellariæ occur only close to the mouth. It is possible that more and better material will show this difference to be quite inconstant, but on the other hand, direct comparison of specimens from the northern coast of Australia with specimens from the south-east coast may demonstrate that they represent two distinct species.

Loc.—Six miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

LUIDIA MACULATA, *Müller and Troschel*.

(Plate V.)

Luidia maculata, Müller and Troschel, Sys. d. Ast., 1842, p. 77.

The occurrence of this East Indian species in the Great Australian Bight is particularly noteworthy. All of the six specimens have seven rays.

Locs.—East of Fraser Island, Queensland, 25-30 fathoms.

Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

South-east of Flinders Island, South Australia, 37 fathoms.

Family ASTROPECTINIDÆ.

Genus ASTROPECTEN, *Gray*.ASTROPECTEN PECTINATUS, *Sladen*.*Astropecten pectinatus*, Sladen, Journ. Linn. Soc., Zool., xvii., 1883, p. 251.

Most of these twenty-one specimens are large adults (largest with R=125 mm.) but half a dozen are still immature, with R only 35-40 mm. There are no specimens of intermediate size. In colour there is considerable diversity; the specimens from

Oyster Bay, Tasmania, are uniformly gray, those from the south coast of Australia are pale yellow, about half the adults are pale fawn-colour, and the remaining specimens are red-brown. Both the "Thetis" and the "Endeavour" collections show that this is a common and widely distributed species, apparently characteristic of south-eastern Australia. The careful working out of its growth changes would be of the greatest value to students of starfishes, as it would throw much light on the validity of specific characters in the large, cosmopolitan genus to which it belongs. It is to be hoped that some Australian zoologist will soon undertake the work.

Locs.—Eighteen miles south-west of Lady Elliott Island, Queensland, 18 fathoms.

Eleven miles south by east of Ballina, New South Wales, 27-28 fathoms.

Six miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

Shoalhaven Bight, New South Wales, 15-45 fathoms.

Oyster Bay, Tasmania.

Southern coast of Australia.

Great Australian Bight, 80-120 fathoms.

ASTROPECTEN PREISSII, Müller and Troschel.

Astropecten preissii, Müller and Troschel, Arch. f. Naturg., ix. i., 1843, p. 119.

Four of the rays in this individual are regenerating, while the fifth is broken in two; the latter, however, has no part lacking, and measures 150 mm. in length. Since r = only 20 mm., $R = 7\frac{1}{2} r$, whereas in Müller and Troschel's type $R = 5\frac{1}{2} r$. In other particulars, however, this specimen agrees well with Müller and Troschel's description, and since their type is said to have come from south-western Australia, it seems best to refer this individual to their species.

Loc.—South-east of Flinders Island, South Australia, 37 fathoms.

Genus LONCHOTASTER, Sladen.

LONCHOTASTER MAGNIFICUS,¹ *sp. nov.*

(Plate VI., fig. 1-2.)

$R = 155$ mm.; $r = 50$ mm.; $R = 3r$. $Br = 45-50$ mm.; $R = 3-3.5$ br. Disk very large, flattened but elevated in the central area and along the radii; rays broad, flat, tapering

1. *Magnificus* = superb; in reference to its notable size and appearance.

uniformly to a blunt point. Disk and rays, within area bounded by superomarginal plates, covered by small (little exceeding 1 mm. in diameter of the slightly capitate top), crowded paxillæ, each of which bears numerous (50-100) short, slender, delicate, somewhat glassy spinelets; paxillæ without definite arrangement, except along sides of rays, where series parallel to the width-diameter of the superomarginal plates may be distinguished; there are usually 2, but may be 3 such series adjoining each superomarginal plate. Madreporic body very large, 14 mm. across, carrying about 50 paxillæ which tend to conceal it very completely; these paxillæ are lower and less perfectly formed than those on the disk itself; the outer margin of the madreporite is 9 mm. from the inner margin of the superomarginal plates. The latter are 46 or 47 in number on each side of each ray; those near the interradian angle are about 2 mm. long by 6 mm. wide, but as one passes distally length increases and breadth decreases and near the middle of the arm they are 3 mm. long and 4 mm. wide; the length never quite equals the width; all of the superomarginals are densely covered by minute spinelets like those of the paxillæ; there are no spines or enlarged spinelets anywhere on the abactinal surface. Terminal plate small, slightly swollen, smooth, pentagonal-cordate, with rounded angles.

Inferomarginals correspond in number and position with the superomarginals but are much larger and project conspicuously beyond them, except near tip of ray; the interradian ones are 2 mm. long by 9 mm. wide, while those near the middle of the arm are 3 mm. by 6 mm.; their covering consists of a close coat of short, flattened, blunt spinelets, much coarser than those on the superomarginals. Fasciolar channels between marginal plates neither peculiar nor conspicuous. Actinal intermediate plates wanting at tip of ray; the series adjoining the adambulacrals begins at about the tenth inferomarginal from tip; a second series begins at about the 17th-20th inferomarginal from tip; a third at about the 30th; the last becomes irregular and difficult to follow before reaching the mouth. The remainder of the large, actinal interradian areas are covered by similar but smaller plates forming parallel, radial series between adambulacral and inferomarginal plates; these radial series are fairly regular; usually a distinct unpaired series of about 5 plates occupies the midradial lines, but reaches little more than half-way to the inferomarginals. All the actinal plates are covered, like the inferomarginals, with short, flattened, rough spinelets, wider and blunter on central area of each plate than along its margins. There are no spines or enlarged spinelets anywhere.

Adambulacrals about 57 on each side of each furrow, distinctly longer than wide, except near arm-tips; furrow margin with 8 conspicuous spines, the adoral and aboral ones being distinctly smallest, the others about 3 mm. long; outside of this series is a well-spaced line of 3-5 shorter and more slender spines and external to them is an irregular line of 4-6 small, slender spinelets; a few extra spinelets may occur on the outer corners of the plates, but there is no tendency to form pedicellariæ groups. No pedicellariæ are to be seen. Oral plates large, swollen, covered by flattened spinelets similar to those on the actinal plates, but distinctly larger; oral spines coarse and heavy, but neither number nor arrangement is peculiar. Colour, light dirty grayish, more or less yellow on various irregular areas.

This individual is much larger than either of the species, collected by the "Challenger," and for which the genus was established, is known to be, and it is not impossible that it will prove to be an adult specimen of *L. forcipifer*, which was taken south of Australia in 1950 fathoms. This seems to me highly improbable, however, for the difference in the form, in the paxillæ and in the matter of pedicellariæ are very marked. Nevertheless I think there can be little doubt that the two forms are congeneric.

Loc.—Great Australian Bight, 80-120 fathoms.

Genus PSILASTER, *Sladen*.

PSILASTER ACUMINATUS, *Sladen*.

Psilaster acuminatus, Sladen, Chall. Rep., Zool., xxx., 1889, p. 225.

Except in size, these four specimens show little diversity; in the smallest R=42 mm.; in the largest R=100 mm. The actinal interbranchial areas differ considerably in size in the different specimens; in the one from the Eastern Slope, Bass Strait, they are relatively much larger than in Sladen's figure, which answers well for the other specimens. All four individuals are somewhat rubbed, and the two largest are in rather poor condition; in none do I find any trace of spines on the superomarginal plates.

Locs.—Eastern Slope, Bass Strait, 80-200 fathoms.

South of Gabo Island, Victoria, 200 fathoms.

Great Australian Bight, 80-120 fathoms.

Family GONIASTERIDÆ.

Genus MIMASTER, *Sladen*.MIMASTER GRACILIS,¹ *sp. nov.*

(Plate VII., fig. 1-2.)

R=60 mm.; r=18 mm.; R=3.3 r. Br=18 mm.; R=3.3 br. Br at middle of ray, 8 mm.; at tip, 3 mm. Disk large, very flat in holotype, but much thicker and more elevated in other specimens; rays narrowing rapidly from the rather broad base, at first flattened but more or less cylindrical near tip. Abactinal surface of disk and rays covered by rounded or substellate plates, which, near centre of disk and along the radial lines are quite closely crowded; each plate bears a paxilla crowned with 10-12 (or more) slender spinelets exceeding the length of the paxilla stalk; the appearance of preserved specimens abactinally depends primarily on whether these spinelets were drawn together into a cylindrical bundle on each paxilla, when the starfish died, or whether they remained more or less flaring; the spinelets are so delicate, they are frequently more or less broken. Madreporic body large, about 5 mm. in diameter, fully exposed: its distal margin is about 2 mm. from the superomarginal plates. The latter are 50 or more in number, very small, scarcely larger than some of the abactinal plates; each carries an ordinary paxilla. As a rule, they are above and opposite corresponding inferomarginals but here and there they alternate with them; often the series is not easy to distinguish. In a small specimen, R=27 mm., the superomarginals are relatively much larger; particularly in the interbrachial arc they are well-marked oblong plates, longer than wide, and forming a very regular series. Terminal plate moderate, roughly dumb-bell shaped, being deeply notched both distally and proximally; apparently, in life, it is covered by minute spinelets, but in the preserved specimens, except the youngest, these are all rubbed off.

Inferomarginals of about the same number as superomarginals or somewhat fewer, larger and forming a more perfect series; their paxillæ are larger and carry longer spinelets, but they are by no means conspicuous. Actinal intermediate plates wanting at tip of ray; the series adjoining the adambulacrals begins at about the tenth inferomarginal plate from tip; a second series begins at about the seventeenth plate and a third at about the twenty-second; at the

1. *Gracilis*=slender; in reference to the very narrow rays.

base of the ray there are 8 such series. Actinal interradial areas large, covered by the transverse series of squarish, scarcely overlapping plates; these plates have the paxilla stalk reduced to an oval knob, but the spinelets are long, numerous and flaring. Adambulacral plates more than 70, wider than long; those nearest the mouth are about 2 mm. wide by a millimeter long; furrow margin with 3, or usually 4, slender, blunt, somewhat flattened spines of which the middle one or two are longest and may be 2 mm. long; outside of this series are three or four parallel series of similar but smaller spines; the whole plate is thus fairly well covered by 15-20 spines, the marginal ones largest, the outermost like those on the actinal plates. There are no pedicellariæ. Oral plates conspicuous, swollen; each bears a curved ridge 5 mm. long, carrying a double series of spines; these ridges lie with concave surfaces together, so that although in contact distally and proximally, they are well separated at the middle; the spines at the distal end are like the spines on the actinal plates but become longer and stouter proximally and at the tip of the jaw are larger than any of the adambulacral spines. Colour, light yellowish-brown or dirty yellowish. Five specimens.

The previously known species of this genus are from the North Atlantic, from the Pacific, west of the southern point of America, and from the Moluccas. The discovery of this fourth species south-east of Australia is therefore of great interest. There is little reason to doubt that it is a *Mimaster*, but it is easily distinguished from the previously known species by the shape of the rays, and by the adambulacral armature. In the appearance and position of the madreporic body, the Australian species resembles *M. cognatus*, the South American species; in the North Atlantic species *M. tizardi*, the madreporic body is concealed by paxillæ. The genus is a perplexing one and its real relationships are still obscure.

Locs.—South of Gabo Island, Victoria, 200 fathoms. This specimen has been selected as the holotype.

Between Gabo Island, Victoria, and Disaster Bay, New South Wales, 50-100 fathoms.

Genus NECTRIA, *Gray*.

NECTRIA OCELLATA, *Perrier*.

Nectria ocellata, Perrier, Arch. de Zool. exp. et gén., v., 1876, p. 4.

This is a nice series of twenty-two specimens, the smallest having R=17 mm. and the largest, R=130 mm. In the latter

$r=35$ mm. and $br=40$ mm. Comparison of these two specimens brings out the interesting fact that there is almost no increase, during growth, in the *number* of the big paxilliform ossicles; in the small specimen there are 7 in the midradial line of each arm, and about 8 in each interradial area; the whole dorsal surface is almost completely covered by them. In the big specimen, there are only 7 or 8 well formed ones on each radial line, while in the interradial areas the number is not more than 8 or 10; along the sides of the basal part of each ray new ones have formed, but they are smaller than the others and merge into the ordinary abactinal plates. But in the large specimen, the ossicles are widely separated from each other, the abactinal skeleton and papular areas being fully exposed. In the small specimen, there are only 12 marginal plates in each series on each ray; they are closely joined with no trace of intermarginal papulae. Even in the large specimen, however, I fail to find any intermarginal papulae.

Locs.—North-east of Cape Pillar, Tasmania, 55-80 fathoms.

Oyster Bay, Tasmania, 60 fathoms.

Off Babel Island, Bass Strait, 50-60 fathoms.

Between Davenport and Launceston, Tasmania.

Forty miles west of Kingston, South Australia, 30 fathoms.

Great Australian Bight, 80-120 fathoms.

NECTRIA OCELLIFERA (*Lamarck*).

Asterias ocellifera, Lamarck, Anim. sans Vert., ii., 1816, p. 553.

Nectria ocellifera, Gray, Ann. Mag. Nat. Hist., vi., 1840, p. 287 (*oculifera*, *lap. cal.*).

These five specimens are probably from the same lot as those in the Western Australian Museum at Perth, by means of which it was possible to clear up the difference between *N. ocellata* and *N. ocellifera*.¹ There can be no doubt, I think, that the two species are perfectly distinct, and the "Endeavour" collections seem to confirm the view that their areas of distribution do not overlap. The specimens of *N. ocellifera* at hand are all small, having R only about 40 mm.

Loc.—Between Geraldton and Cape Naturaliste, Western Australia.

1. H. L. Clark—Rec. West Austr. Mus., i., 1914, p. 139.

Genus NYMPHASTER, *Sladen*.

As regards the generic name, it is to be regretted that Koehler still persists in using *Dorigona* in place of *Nymphaster*. Sladen, in 1889, Verrill, in 1899, and Fisher more recently, have pointed out that *Dorigona* is not one of Perrier's genera, but dates back to Gray. Its type is either *D. reevesii*, Gray or *D. longimana* (Möbius); no other species can be the type since these are the only species mentioned by Gray, who, however, designated no type. It has been shown, and, so far as I know, never questioned, that *D. reevesii*, Gray is synonymous with *Goniodyscus capella*, Müller and Troschel, 1842. Now von Martens constituted a subgenus, *Ogmaster*, for *G. capella* in 1865, a year before Gray proposed *Dorigona*. All later writers have agreed that *G. capella* is entitled to generic rank and, including Koehler himself, use *Ogmaster capella* as the correct combination. Hence *Dorigona longimana* (Möbius) must be the type of *Dorigona*, and I am quite unable to see why Sladen should have deliberately replaced Gray's name with one of his own coining, *Iconaster*. So far as I can see *Iconaster* is a pure synonym of *Dorigona*, which is a monotypic genus with *Astrogonium longimanum*, Möbius, as its type.

It is evident then that *Nymphaster* and *Dorigona* are not in any way equivalent terms. Koehler proposes to restrict *Nymphaster* to the forms in which the superomarginal plates are separated by a single median row of abactinal plates and use *Dorigona* for the forms in which the superomarginal plates are in contact dorsally. It is, of course, obvious that *Dorigona* cannot be used in any such way. Moreover Verrill, in 1899, proposed *Nereidaster* for the species with separated superomarginals, and restricted *Nymphaster* to the species which Koehler would call *Dorigona*. This he was perfectly justified in doing, for Sladen designated no type for the genus in which he included five species. Clearly *Dorigona*, Koehler, is a perfect synonym of Sladen's *Nymphaster* as restricted by Verrill, and has no close relationship to *Dorigona*, Gray. It is to be hoped, therefore, that our able and honoured French colleague will no longer reject *Nymphaster* and will confine *Dorigona* to Möbius' remarkable species.

NYMPHASTER PENTAGONUS,¹ *sp. nov.*

(Plate VIII., fig. 1-2.)

R=60 mm. or thereabouts; r=18 mm.; R=3.3 r. Br=10 mm.: R=6 br. Br at middle of ray, 6 mm.: at tin.

1. *Pentagonus*=with five angles, or, as usually understood, five-sided; in reference to the nearly straight-sided area of abactinal plates.

apparently about 2 mm. Breadth at proximal margin of first superomarginals which meet=length of first three superomarginals (counting from interradius). Disk flat, rather large; rays moderately long and quite narrow, all broken at tip, but one seems to be nearly complete, quadrangular in cross-section with very slightly rounded angles, the width slightly exceeding the thickness, at all points. Abactinal plates entirely confined to disk, forming an almost perfectly pentagonal area, the sides of which are so slightly concave as to appear almost straight; there are 650-700 plates in this area but most of these are very small and lie along the boundaries formed by the superomarginal plates; the largest abactinal plates are near the centre of the disk in the interradial and along the midradial lines. At the centre of the disk and in the radial areas where the papulae occur, the plates are more or less stellate or substellate basally, the upper surface being rounded pentagonal or subcircular; each plate carries 15-25 coarse granules, nearly spherical and not at all rough, those of the marginal circle not being appreciably different from the rest; near the superomarginal plates, the abactinal plates are so small and crowded, the granules tend to form a continuous coat with those on the superomarginals. The latter are apparently rather more than 20 on each side of each ray, and excepting the basal 4 pairs are in complete contact in the midradial line: they are very flat, not at all tumid, and in the interbranchial arcs overhang the inferomarginals; eight superomarginals make up each side of the disk-pentagon: they are wider than long, the middle pair being each 5 mm. wide by 2.5 mm. long; at the middle of the arm the superomarginals are each about 2 mm. long, 2 mm. wide, and 1.5 mm. thick; all the superomarginals are covered by a uniform coating of granules similar to those on the abactinal plates; these are largely rubbed off in the present specimen; on the entire surface of each of the middle pair of superomarginals, there are about 200 granules.

Inferomarginals coincide in number and position with the superomarginals (except when regeneration has occurred), but owing to the presence of the ambulacral groove they are much narrower; at the middle of the arm they are about 2 mm. long, 1 mm. wide and 1 mm. thick; like the superomarginals, they are clothed with a close coat of granules, each one of the middle pair carrying about 150. Actinal intermediate plates wanting on rays; the series adjoining the adambulacral plates, extends only to the fourth inferomarginal and contains 10-12 plates; outside of it is a series of 6-8 plates, then a series of 5-6, then

a series of 2 or 3, and then a single plate, against the inferomarginals, completes the covering of the area ; all these plates tend to overlap inwardly and proximally ; all are bearers of granules like those on the inferomarginal plates. Adambulacral plates about 40, at first wider than long, but rapidly decreasing in breadth and becoming twice as long as wide ; distal to middle of arm there are about 7 adambulacrals to about 5 inferomarginals ; the furrow margin is at first nearly straight, but soon becomes convex and then the convexity becomes more and definitely restricted to the adoral end ; distal to the middle of the arm, these convexities on plates of opposite sides tend to meet across the furrow, the bridges thus formed alternating with conspicuous pores where the plates are not in contact ; proximally there are 6 or 7 blunt, somewhat angular, more or less flattened spines, about half a millimeter long on the furrow margin of each plate ; the middle spines are longest, the proximal and distal shortest ; on the plates distal to arm-middle there may be 8 or 9 spines in the series, but they are decidedly shorter ; outside the marginal series is a parallel set of 3-5 much smaller, thicker spines or high granules, and external to it a parallel series of 5-6 granules like those on the actinal plates ; additional similar granules may occur between the two external series or outside the outer one ; the adambulacrals may thus be about as well covered with granules as any of the actinal plates. Oral plates neither conspicuous nor peculiar, only the proximal spines enlarged and they not very greatly. Pedicellariæ none. Colour gray, more yellow beneath : nearly white where the granules are rubbed off.

The markedly pentagonal abactinal area, the flat and overhanging interradiial superomarginals, the adambulacral armature and the general proportions remind one very strongly of *N. albidus*, from the tropical Atlantic, but the adambulacral spines are angular and flattened in the Australian species and eight superomarginal plates, instead of six, make up the disk boundary on each side. None of the species from the Indian Ocean and Philippine Islands seem to be any nearer than *N. albidus* to this South Australian species.

Loc.—Great Australian Bight, 129° 28' E., 250-450 fathoms. One specimen.

Genus *MEDIASTER*, *Stimpson*.*MEDIASTER AUSTRALIENSIS*,¹ *sp. nov.*

(Plate ix., fig. 1-2; Fig. 1-3.)

$R=82$ mm.; $r=30$ mm.; $R=2.67r$. $Br=30$ mm.; $R=2.67br$. Br at middle of ray= 11 mm.; at tip, 2.3 mm. In the largest specimen, $R=100$ and $r=40$ mm. Disk large and flat; arms wide at base but tapering rapidly to a nearly cylindrical tip. Abactinal plates tabulate, more or less paxilliform (Fig. 1) especially at centre of disk and along midradial

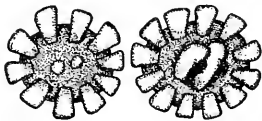


Fig. 1.x10. Fig. 2.x10.

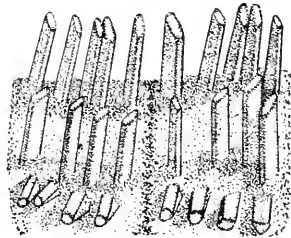


Fig. 3.x10.

lines; small and numerous; the largest and most paxilliform are crowned with a marginal series of 12-15 angular, blunt spinelets or coarse granules and within this circle 3-8 similar but smaller granules; the smallest and least paxilliform plates adjoin the superomarginals in the interradial areas and are crowned with a little group of 3-5 angular granules; the coarseness or fineness of the paxillar granules shows great diversity in different individuals and even in different parts of the same disk; thus in one specimen, plates proximal to the madreporite carry 10-20 coarse, well-spaced granules, while plates of the same size, distal to the madreporite, carry 25-40 smaller, more rounded and more crowded granules. Occasionally one or more of the granules is replaced by a 2-jawed pedicellaria; in the holotype, these pedicellariæ are very numerous and are so much higher than the granules (about twice as high), that they are quite conspicuous; they are also quite symmetrical and frequently entirely replace the granules on the top of the plate (Fig. 2); in other specimens, pedicellariæ are exceedingly rare, while in still others, though common, they are small and

1. *Australia+ensis*, expressing locality.

asymmetrical; they occasionally replace one or more of the marginal granules. Papulae numerous, small, single, occurring scattered more or less irregularly among the plates; occasionally a regular series of 6 surrounds a large plate. Madreporite small, about equal to 2 or 3 ordinary abactinal plates, rounded triangular, only half as far from centre of disk as from disk margin.

Superomarginal plates about 40 on each side of each ray (48 in the largest specimen), those in interradial region nearly twice as wide as long, more nearly square at middle of arm and then becoming much wider than long again near tip; all are closely covered with granules, similar to but more rounded, and the marginal ones at least, distinctly coarser, than those on the largest abactinal plates; there are about 100 on each of the superomarginals near the interradius; occasionally pedicellariae replace granules. Terminal plates small, distinctly longer than wide, not deeply notched distally. Inferomarginals apparently one less on each side of each ray than superomarginals, at least in the larger specimens; the number may be the same in the two series, but in many cases the series do not correspond exactly along the middle of the arm; the granular covering of the inferomarginals is like that of the other series. Actinolateral plates in 8-9 series; the first (adjoining the adambulacrals) extends from the oral plates to the tenth inferomarginal from the tip of the arm; the next series extends to the twentieth inferomarginal from arm-tip; the next series only reaches the eighth or ninth inferomarginal, counting from interradial mid-line; remaining series irregular and of few small plates; all the plates carry coarse, angular granules like those on the abactinal plates, but no pedicellariae occur; at least I have seen none. Adambulacral plates squarish or rather wider than long, about 60 (in the holotype), the inner margin at first straight but becoming decidedly convex distally; furrow margin with a series of 5 or 6 flat, blunt spines, rather crowded, nearly equal or the most adoral shortest (in the figure [Fig. 3] the spines are too abruptly truncate and are too widely spaced); externally is a second series of 4 shorter, thicker, more angular spines; a third series of 3 or 4 still shorter and thicker spines are borne on the outer margin of the plate; between this series and the second is a rather conspicuous bare space; the spines of the third series are scarcely to be distinguished from the angular granules on the actinolateral plates. Oral plates neither conspicuous nor peculiar; the oral spines, especially at tip of jaw, are, however, very heavy, more or less prismatic and 2-3 mm. long. Colour,

in alcohol, brownish-yellow; dry, pale brown. Seven specimens.

This fine species is obviously near to *Mediaster ornatus*, Fisher, from the Hawaiian Islands, but differs in the wider, shorter marginal plates and in the adambulacral armature. No other member of the genus is very closely allied. As regards the internal anatomy, the Australian species is a typical *Mediaster*, the internal abactinal ossicles being very evident and rudimentary superambulacral plates also being present.

Locs.—East coast of Flinders Island, Bass Strait, 40 fathoms. This specimen has been selected as the holotype.

East of Babel Island, Bass Strait, 65-70 fathoms.

Oyster Bay, Tasmania.

MEDIASTER MONACANTHUS,¹ *sp. nov.*

(Plate x., fig. 1-2; Fig. 4.)

R=110 mm.; r=37 mm.; R=3 r. Br=37 mm.; R=3 br. Br at middle of ray=19 mm.; at tip=5 mm. Disk large, flattened or slightly elevated; arms wide at base, tapering rather evenly to the blunt tip. Abactinal plates on disc and base of rays large, low, hemispherical, widely spaced, becoming smaller and more and more crowded near the superomarginals; they are connected with each other by heavy radiating ossicles, in the spaces between which the papule arise in groups of 3-15. Each plate is covered by a coat of low, spherical granules; there are about 50-75 on a plate 4-5 mm. in diameter; there are no granules on the membrane or on the ossicles between the plates. In the holotype, and some other specimens, most of the disk plates bear at the centre a pointed tubercle or low, blunt spine, about a millimeter in diameter and nearly or quite as high; in some specimens few or no plates have this spine, so it may be an indication of complete maturity. Distally on the rays and near the margins of the disk, the plates become smaller and crowded, so the granular covering is nearly or quite continuous. Madreporite very small, only about 2 mm. across, situated twice as far from the margin as from centre of disk. Anus conspicuous near centre of disk because surrounded by 10-20 large, smooth, elongated granules of diverse size and shape.

1. *μόνος*=single+*ἄκανθα*=a thorn or spine; in reference to the single prominent spine on some abactinal plates.

Superomarginal plates nearly or quite vertical in position, and hence scarcely to be seen from above, 30-32 in number, the interradial ones much higher than long, covered with granules similar to those on the abactinal plates; there are about 200 granules on one of the big interradial superomarginals. Terminal plate small, nearly circular, considerably swollen. Inferomarginals very similar to superomarginals in number, position, size and form; they have the same granular covering. In the holotype and in some other specimens intermarginal plates of irregular size, shape and position occur in considerable numbers, but this is not a constant feature, since in some individuals such plates appear to be rare if not altogether wanting. Actinolateral plates in about 7 series; the first, adjoining the adambulacrals, extends nearly or quite to the arm-tip, the second goes about the three-fourths of the way, and the third more than half; all the actinolateral plates are covered by granules distinctly coarser than those on the abactinal surface.

Adambulacral plates about 60, longer than wide, with a fairly straight margin; on this margin is a series of 4 subequal, squarish, blunt spines, about 2 mm. long (occasionally a fifth, adoral, much smaller spine occurs); outside this series is a second, consisting of 3 or 4 shorter, but thicker spines, and external to these is a series of 4 much smaller

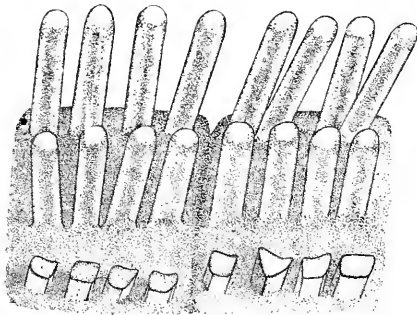


Fig. 4.x10.

spines or angular granules, which do not much exceed the granules on the actinal plates. Oral plates not conspicuous or peculiar; even the oral spines are not strikingly larger than those on the adjoining adambulacrals. No pedicellariæ were detected anywhere.

Colour (dry or in alcohol), brown, darkest on the bare membrane of the disk, lightest near the tips of the rays.

This is a very remarkable Starfish, one of the most interesting of the "Endeavour's" captures. It stands midway between *Nectria* and *Mediaster* having the heavy, widely separated abactinal plates of the former, but with these plates not at all paxilliform. It is very different from typical *Mediaster* in its general appearance abactinally, but actinally is very similar to *M. australiensis*, save that the spines and granules are much coarser. Supplementary internal abactinal plates and rudimentary superambulacra are present. The ampullæ are double. It might be made the type of a new genus between *Mediaster* and *Nectria* but there are already so many monotypic genera, one may well be avoided here, since the diagnosis of *Mediaster*, as at present used, does not require any essential modification to admit *M. monacanthus*. This specific name is not altogether a happy choice, since many specimens fail to show the single spinelet on the abactinal plates, so conspicuous in the holotype; but as the name has been in vogue as a manuscript name for several years, and specimens so labelled have been sent out from Sydney, it seems best to retain it. It is a little remarkable that this conspicuous Starfish was taken at only one station. Ten specimens.

Loc.—Six miles east of Cape Hawke, New South Wales, 47-50 fathoms.

Genus *TOSIA*, Gray.

TOSIA AURATA, Gray.

Tosia aurata, Gray, Proc. Zool. Soc., 1847, p. 80.

This is a fine series of this handsome pentagonasterid; the longest has $R=73$; in the smallest $R=40$; in the least pentagonal $r=.60R$, and in the most pentagonal, $r=.68R$. One of the specimens from Oyster Bay, Tasmania, with $R=63$ mm. is perfectly tetramerous. Eighteen specimens.

Locs.—Oyster Bay, Tasmania, 20-40 fathoms.

Isle de Phoque, Oyster Bay, Tasmania, 27 fathoms.

Mainwaring Cove, west coast of Tasmania, 50 fathoms.

South-east coast of South Australia.

South coast of South Australia.

Genus PENTAGONASTER, *Gray.*PENTAGONASTER STIBARUS, *H. L. Clark.*

Pentagonaster stibarus, H. L. Clark, Rec. West Austr. Mus., i., 1914, p. 136.

No doubt this specimen was taken with the types ; it adds nothing to our knowledge of the species ; there are, however, no abactinal tubercles, but R only=33 mm. By an unfortunate slip of the pen in the original account of this species, in discussing the relative size of the marginal plates in the genus, I wrote *superomarginal* for *inferomarginal*, and it is so printed (p. 138, l. 22), confusing the sentence.

Loc.—Between Geraldton and Cape Naturaliste, Western Australia.

Genus CALLIASTER, *Gray.*CALLIASTER SPINOSUS,¹ *sp. nov.*

(Plate xi., fig. 1-2.)

R=140 mm. ; r=45 mm. ; R=3 r. Br=40 mm. R=3.5 br. Br at middle of ray, 18 mm. ; at tip, 5 mm. Disk large, somewhat elevated at centre and along radii ; arms abruptly narrowed and tapering gradually to the blunt tip. Abactinal surface covered by moderately large stellate plates, the central portion of which is swollen into a flattened hemisphere ; each of these rounded centres is surrounded by a circle of coarse granules, which more or less conceal the papulae arising singly between the plates, and is crowned by a group of coarser granules, the central one of which is distinctly the biggest ; occasionally, though not commonly, one of these crowning granules is replaced by a large 2-jawed pedicellaria fitting into a special depression in the surface of the plate ; each jaw of the pedicellaria is broadly spatulate, rounded at the tip and, when open, lies back in the depression, so as to seem flush with the surface of the plate. The " crowning " granules differ from the " marginal " granules, not merely in being, as a rule, larger, but in that they are more or less spherical, while the marginal ones are very flat.

Along the midradial line of each ray, there is a series of plates which extend from the terminal plate, which is large and somewhat swollen (4 mm. long, 3 mm. wide proximally

1. *Spinusus*=provided with spines ; in reference to the spiny actinal surface.

and 3 mm. thick), to within 15-20 mm. of the centre of the disk ; distally these plates are much like the other abactinal plates and are about 2 mm. in diameter ; near the middle of the arm and proximal to it they become compressed and are much wider than long (3-4 mm. wide by 1.5-2 mm. long), but the 4-6 most proximal are again more or less nearly circular ; these circular proximal plates are the largest of the disk and are very much swollen ; the most proximal, which is largest, is 5-6 mm. in diameter and 3 mm. or more high ; on these big proximal plates, the central granule becomes developed into a huge spine, 2 mm. in diameter ; only one of these persists in the specimen at hand ; that is on the fourth plate of one of the radial series and measures 3 mm. in height. The median radial plates are accompanied nearly, and sometimes quite, to the terminal plate, by a series of similar, but smaller and less conspicuous plates, without spines. At the centre of the disk, and in each interradius, in line with the most proximal of the big radial plates, are enlarged plates, which apparently bore spines. The circular madreporite, 4 mm. across, lies just distal to one of these large interradial plates.

Superomarginal plates 25-26 on each side of each ray, more or less bare and smooth, and distinctly swollen ; each plate is surrounded by a series of flattened granules ; the plates in the interbrachial arc bear a vertically elongated cluster of spherical granules, among the lower ones a stout spine ; on the first superomarginal (adjoining the interradial line), this spine is about 6 mm. long and a millimeter thick at base ; each succeeding plate has fewer granules, and the spine becomes stouter and stands nearer to the centre of the plate ; at the middle of the arm, the spine may be 2 mm. in diameter and there are virtually no granules on the plate ; distally the spines become steadily smaller ; in the present specimen none are left distal to middle of arm ; occasionally one, or even two, of the granules on the plate are replaced by the big, characteristic pedicellariæ. Inferomarginal plates one more in number than the superomarginals and hence not corresponding exactly in position, except at each end of the series ; very similar in appearance but with more granules (especially at oral end, in interradial arc) and (to judge from the single one remaining) with more slender spines.

Actinolateral plates wanting on distal half of ray ; the first series (adjoining adambulacrals) begins at about the ninth, or eighth, inferomarginal (counting from interradial line) ; the second series begins at the third inferomarginal and a third series at the second ; the rest of the large actinal area is

occupied by about ten similar plates; these plates are more quadrilateral than the abactinal plates and differ in being less swollen, much more completely covered with granules and in having the central granule replaced by a more or less conspicuous spine, 1.5 mm. long, 1.2 mm. in diameter, and bluntly pointed, clavate or chisel-shaped at tip; these spines are smallest near the inferomarginals and largest near the adoral adambulacrals; the granules are coarser than on the abactinal surface and there is less distinction between "crowning" and "marginal" granules; many granules are replaced by the large, characteristic pedicellariæ. Adambulacrals about 55, wider than long or squarish, quite similar to the actinolaterals in having marginal granules on the adoral, outer and aboral sides, a group or series of somewhat coarser granules on the outer end and a large spine at or near the centre; these spines may exceed 5 mm. in length; on the first two plates (near mouth) and occasionally elsewhere, a second spine, similar but much smaller, stands just behind the large one; on the furrow margin of the plate is a series of 7-8 crowded, compressed, blunt spines of which the four or five middle ones are sub-equal, about 2 mm. long, while the aboral, and the adoral (1 or 2) are markedly shorter and more pointed; on the adoral, marginal corner of the plate is a very large pedicellaria, of the same type as those elsewhere, but with jaws of very different shape, 1.5-2 mm. long, slenderly spatulate and slightly asymmetrical, bluntly pointed. Oral plates not particularly large or prominent; each has 7 or 8 large, furrow spines, the proximal ones very large and prismatic; each plate bears on its surface two large spines like those on the adjoining adambulacrals plates. Colour (dry), pale yellowish-brown.

This is the most notable and the best characterised of all the "Endeavour's" Starfishes, not previously known to science. The adambulacrals armature with big pedicellariæ and the spiny actinal interradial areas distinguish it at once from any other member of the genus, although it seems to be nearest the Philippine species *C. corynetes*, since it has pedicellariæ like those of that species, spines on the actinal plates and an adambulacrals armature of the same type. It is readily distinguished from *C. corynetes*, however, by the absence of spines on the terminal plate and by the granulose abactinal plates. The diagnosis of *Calliaster* as given by Fisher¹ will require considerable modification to admit this fine new species from Australia (and the Philippine form, too), for

1. Fisher—Bull. U.S. Nat. Mus., lxxvi., 1911, p. 171.

there are abactinal pedicellariæ, the plates are not bare centrally and the actinal intermediate plates have very conspicuous spines. The validity and the sharp definition of the genus are not, however, in any way affected.

Loc.—Eastern Slope, Bass Strait, 80-200 fathoms.

Genus OGMAS^TER, *von Martens*.

OGMAS^TER CAPELLA (*Müller and Troschel*).

Goniodiscus capella, Müller and Troschel, *Sys. d. Ast.*, 1842, p. 61.

Goniaster (Ogmaster) capella, von Martens, *Arch. f. Naturg.*, xxxi. i., 1865, p. 359.

Ogmaster capella, Sladen, *Chall. Rep.*, *Zool.*, xxx., 1889, p. 261.

It is exceedingly interesting to find this little-known East Indian species so far south as North Reef, Queensland.

Loc.—Thirteen miles north-east of North Reef, 70-74 fathoms; thirty-eight miles north-east of North Reef, Capricorn Group, off Port Curtis, Queensland, 50-75 fathoms. Five specimens.

Genus STELLAS^TER, *Gray*.

STELLAS^TER INCEI, *Gray*.

(Plate xii., fig. 1-2.)

Stellaster incei, Gray, *Proc. Zool. Soc.*, 1847, p. 76.

About half these specimens are dark brick red, of varying degrees of intensity, while the others are pale brown or dull yellowish; the difference is not associated with locality. Regardless of the ground colour, certain individuals have, in marked contrast, a number of the actinolateral plates, adjoining the adambulacral plates near the mouth, deeply stained with reddish-purple. All the specimens are dry. There is more or less diversity also in the number of tubercles on the abactinal surface, the extremes being 10 and 100, and their size and arrangement is equally diverse. The largest specimen has R nearly 90 mm. Twenty-three specimens.

Locs.—Thirteen miles north-east of North Reef, Capricorn Group, off Port Curtis, Queensland, 70-74 fathoms.

Wide Bay, Queensland, 18-23 fathoms.

Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

Eleven miles south by east of Ballina, New South Wales, 27-29 fathoms.

East-south-east of Clarence River mouth, New South Wales, 35-36 fathoms.

STELLASTER INSPINOSUS,¹ *sp. nov.*

(Plate xiii., fig. 1-2.)

R=60 or 75 mm.; r=23 or 27 mm.; R=2.6 r. Br at middle of ray, 11 or 14 mm. Very similar to *S. incei*, but differing sharply in several features. The marginal plates, though of essentially the same number, encroach more on both surfaces than in *S. incei*; as a result, the median radial series of abactinal plates is accompanied by lateral series only to about the fourth (from interradius) superomarginal and there are practically no papulæ on the distal half of the arm, while in *S. incei* the lateral series extend to about the eighth plate and the papulæ occur far out on the arm; on the lower surface, there are only about 10 actinolateral plates in each area, aside from the series adjoining the adambulacrals, while in *S. incei* there are 12-20. The pedicellariæ on the adambulacrals are strikingly taller and more slender in *S. inspinosus* than in *S. incei*, while the big actinal spine is much smaller. More important is the fact that there are no spines on the inferomarginal plates, save that on some arms, the fifth (rarely the sixth) inferomarginal has a very small, flat spinelet, about .75 mm. long, on its outer distal corner. Finally, the granulation is finer in *S. inspinosus* than in *S. incei* and the abactinal tubercles are fewer, 10 in the smaller specimen, but only 2 in the larger. Colour (dry), very pale brown.

This Starfish is of particular interest not merely because it seems to replace *S. incei* on the west coast of Australia, but because it is apparently a connecting link between the genera *Stellaster* and *Ogmaster*. Fisher² thinks "there is no particular similarity between *Stellaster* and *Ogmaster*," but I am unable to agree with him. Indeed, I should be inclined to say there is no important difference between the two. *Ogmaster* is only a *Stellaster* which has lost its spines and granulation, and this new West Australian species, *S. inspinosus*, is quite intermediate in that

1. *Inspinosus*=without spines; in reference to the absence of spines of the inferomarginal plates.

2. Fisher—Bull. U.S. Nat. Mus., lxxvi., 1911, p. 169.

the granulation is finer than in other *Stellasters* and the marginal spines are gone; the abactinal spines too are much reduced in number and even the actinal, adambulacral spine is somewhat smaller than in other species. If *Ogmaster* is not a close relative of *Stellaster*, it is hard to see what its correct position is.

Loc.—Between Geraldton and Cape Naturaliste, Western Australia. Two specimens.

Genus *ANTHENEA*, Gray.

ANTHENEA ACUTA, Perrier.

Goniodiscus acutus, Perrier, Ann. Sci. Nat., Zool., (5), xii., 1869, p. 280.

Anthenea acuta, Perrier, Arch. de Zool. exp. et gén., v., 1876, p. 91.

This is an excellent series, with R ranging from 40 to 120 mm., and the vertical diameter of the disk from 12 to 50 mm. The growth changes are well shown, as well as considerable individual diversity. Twenty-four specimens.

Locs.—Off Fraser Island, Queensland, 32-33 fathoms.

Off the Queensland coast.

Twenty miles north-north-east of Double Island Point, Queensland, 30 fathoms.

Thirteen miles north by west of Double Island Point, Queensland, 25-26 fathoms.

Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

Eleven miles south by east of Ballina, New South Wales, 27-29 fathoms.

Eleven miles east-south-east of Clarence River mouth, New South Wales, 35-40 fathoms.

Eight miles east of Sandon Bluffs, New South Wales, 40 fathoms.

Family *OREASTERIDÆ*.

Genus *OREASTER*, Müller and Troschel.

OREASTER AUSTRALIS, Lütken.

Oreaster australis, Lütken, Vid. Med., 1871, pp. 252, 263.

These are all dry adults, illustrating not only the great individual diversity in abactinal spines, but also the diversity caused by differences in collapse and contraction when drying.

The proportion of R to r shows little diversity, ranging only from 2.3 to 2.5. The largest specimen has R=155 mm.; r=60 mm.; br at middle of ray, 30 mm. In colour, these specimens are either tawny brown or deep brick red; one of the red ones has the central abactinal area light yellowish-gray in sharp contrast. Sixteen specimens.

Locs.—Eighteen miles south-west by south of Lady Elliott Island, Queensland, 18 fathoms.

Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

OREASTER GRACILIS, *Lütken.*

Oreaster gracilis, Lütken, Vid. Med., 1871, pp. 260, 264.

The fact that this specimen comes from the same station as all but one of the specimens of *O. australis* makes me hesitate to designate it by a different name, yet it is obviously different. R=155 mm.; r=48 mm.; br at middle of ray=22 mm. R=3 r. Not only are the rays thus much longer and more slender proportionally than in *O. australis*, but the meshes of the abactinal skeleton are noticeably finer, and hence the papular areas are much smaller. The colour is light yellowish-gray. I think there is no doubt that the specimen is *O. gracilis* but I believe it may ultimately be shown that *O. gracilis* is only a form of *O. australis*, the peculiarities of which are emphasised in drying.

Loc.—Eighteen miles south-west by south of Lady Elliott Island, Queensland, 18 fathoms.

Genus ASTERODISCUS, *Gray.*

ASTERODISCUS TRUNCATUS, *Coleman.*

Asterodiscus truncatus, Coleman, Mem. Austr. Mus., iv., 14, 1911, p. 699.

This is a fine series of this notable species, but there is nothing to add to Coleman's careful description, save that the species grows to a size much larger than his types. His holotype has R=103 mm., while his figured specimen has R=138 mm. The smallest of the "Endeavour" specimens has R=83, while the large specimens have R=150-165 mm.

It is virtually impossible to distinguish the marginal plates, except partially in the small specimens. In the large specimens papulæ extend over onto the actinal surface. Nine specimens.

Locs.—Six miles east of Cape Hawke, New South Wales, 47-50 fathoms.

Eastern slope, Bass Strait, 80-200 fathoms.

Coast of Victoria.

Great Australian Bight, 80-120 fathoms.

Family LINCKIIDÆ.

Genus FROMIA, *Gray*.

FROMIA POLYORA,¹ *sp. nov.*

(Plate xiv., fig. 1-2.)

R=86 mm. ; r=18 mm. ; R=4.7 r. Br=19 mm. ; R=4.5 br. Br at middle of ray, 14 mm. ; at tip, 4 mm. Disk moderately large, not specially flattened ; arms more or less flattened, but cylindrical near tip. Whole abactinal surface covered by more or less circular plates about one millimeter in diameter, some larger, some smaller, with no definite arrangement whatever ; scattered everywhere are the numerous rather large, single papulæ ; the plates are covered by polygonal, more or less flattened granules, 10-30 to each plate, the marginal ones smallest, the central ones noticeably, but not conspicuously larger. Superomarginal plates about 37, not at all conspicuous, but the proximal ones are much larger than the abactinal plates. Inferomarginals of about the same number as the superomarginals and distally of about the same size and alternating with them ; proximally they are directly beneath them and are considerably smaller. All the marginal plates are covered by granules like those of the abactinal surface ; there are papulæ scattered among them. Terminal plate rather large, wider than long, covered by granules. Madreporite small (2 mm. across), rounded triangular, half way between centre of disk and margin.

Actinolateral plates in three series ; that adjoining the adambulacrals extends to the fourth inferomarginal from tip of arm ; the next extends to the ninth ; the third extends to the eleventh or thereabouts, but is distally irregular and

1. *πολυπόρος*=having many ways through ; in reference to the numerous papular pores.

broken up; all the plates resemble those of the abactinal surface. Papulae occur everywhere except between the adambulacrals, and on distal half of ray, between the adambulacrals and the adjoining actinolateral series. The granulation on the actinolateral plates near the mouth is coarser, more angular and more widely spaced than elsewhere. Adambulacrals more than 70, wider than long; furrow margin with 3 (distally 2) stout, prismatic, blunt spines, rather more than a millimeter long; back of this series is a second of 2 or rarely 3, short, stout, angular spinelets or granules; external to them are 5-8 smaller, angular granules similar to those on the actinolateral plates; except near the mouth, these are usually in two series with 1-3 granules in the inner and 4 or 5 in the outer. Oral plates not conspicuous or peculiar, the marginal and surface spines being essentially like those on the adambulacrals, though longer, more pointed and more sharply prismatic. No pedicellariae anywhere, unless pairs, trios and quartettes of low, angular spinelets, more or less appressed to each other, on some of the plates near the mouth, are to be so interpreted. Colour (dry), dirty brownish-white. Three specimens.

The form and size of this *Fromia*, in connection with its comparatively uniform granulation and its adambulacrals armature, easily distinguish it from the other members of the genus. I do not feel certain that the Western Australian specimen is conspecific with those from Tasmania; it has $R=65$ mm.; $r=16$ mm.; $br=16$ mm.; br at middle of ray 11 mm., and at tip 3 mm.; hence R is only 4 r , and only 4 br ; moreover, the arms are little flattened and taper uniformly to the slender tip, while there are, as a rule, 3 spines in the second adambulacrals series. These differences are so slight, it is sufficient to mention them here and await more abundant material. I am further constrained to do this because there is a *Fromia* in the Museum of Comparative Zoölogy collection, from Westernport, Victoria, the gift of Mr. J. Gabriel, which is certainly very near to the present species. In it $R=65$ mm., and r and br are 16 mm., but br at middle of ray is 13 mm., and at tip is nearly 4 mm.; hence the individual is much stouter in appearance than either the Western Australian or Tasmanian specimens; the granulation and adambulacrals armature also are noticeably coarser and the papulae, especially on the actinal surface, seem larger; the terminal plate and adjoining marginal and abactinal plates are perfectly smooth, but it is possible that the granulation has been accidentally rubbed off. A good series of *Fromias* from the western and southern coasts of Australia, and from Tasmania,

will be necessary before we can be sure that we are dealing with only a single species.

Locs.—East of Maria Island, Tasmania, 78 fathoms.

Between Geraldton and Cape Naturaliste, Western Australia.

Genus OPHIDIASTER, *L. Agassiz.*

OPHIDIASTER CONFERTUS,¹ *sp. nov.*

(Plate xv., fig. 1-2.)

R=81 mm. ; r=9 mm. ; R=9r. Br=10 mm. ; R=8 br. Br at middle of ray=10 mm. ; at tip=6 mm. Disk small ; rays 5, long and cylindrical. Abactinal plates in 3 regular series, about equal in size to marginals. Papular areas in 8 regular series, one on each side of ray, on actinal surface ; each area contains 15-20 papulæ. All abactinal and marginal plates more or less conspicuously tumid. Entire animal clothed in a densely granular skin ; on papular areas, there are 30-40 granules, or even more, to each square millimeter, but on convexities of abactinal plates, there may be only 10-15, though there are often more. Madreporite single, 2-3 mm. in diameter. Terminal plate scarcely more than a millimeter in diameter, bare. Adambulacral plates short and numerous ; on the furrow-margin are 2 blunt, rounded, but flattened spines, about 1 mm. long ; the aboral is a trifle the smaller as a rule ; the tips of these adambulacral spines are separated from each other by granules such as cover the surface of plates ; near the mouth each plate carries an oval, blunt, flattened spine about a millimeter long and rather more than its own length from the furrow-series ; distally, these subambulacral spines often occur only on every other plate and the transition from being on every plate to being on every other plate may be abrupt ; in such cases the spines near the mouth seem crowded. Oral plates not peculiar, small and completely buried in granules. Pedicellariæ more or less abundant everywhere, but particularly near the mouth and on the papular areas ; they are of the well-known type occurring in *O. germani*, *O. lorioli*, etc. ; the whole organ is about .75 mm. long by .25 mm. wide and each jaw has 3-5 teeth. Colour (dry), yellow-brown.

1. *Confertus*=crowded ; in reference to the tendency of the subambulacral spines to be very near together proximally.

Although not taken by the "Endeavour," this specimen was included in the collection, that a description and figures might be published. I have also had for comparison, and have used in drawing up the above description, two specimens also from Lord Howe Island, in the Museum of Comparative Zoölogy collection, received from the Australian Museum several years ago. As these bore the manuscript name *O. confertus*, it has seemed well to retain it. The species is near *O. germani*, but has only a single madreporite and the arms are much longer. In my report on the "Thetis" Echinodermata¹ I, with some hesitation, referred an *Ophidiaster* from Lord Howe Island to Perrier's species, but in view of these additional specimens, I am now inclined to think there is little doubt that *O. germani* is quite distinct. The character, to the presence of which my hesitation was due, is not, however, a constant one, no two of the specimens being alike in the arrangement of the subambulacral spines, although they are, in all cases, numerous and regularly arranged near the mouth.

Loc.—Lord Howe Island, South Pacific Ocean.

Genus PSEUDOPHIDIASTER,² *gen. nov.*

Linckiidae with three conspicuous series of abactinal plates and eight series of papular areas, at base of arms, the actinal series tending to disappear distally, near the tip of the pointed arm. Body-wall thick and leathery with little or no rigidity. Adambulacral armature in a single series. Actinolateral plates in several series at base of arms; no papular areas between them. Pedicellariæ present. Madreporite very large. Ampullæ single, large, with numerous calcareous plates in their walls. No superambulacral plates.

Type-species.—*Pseudophidiaster rhysus*, sp. nov.

This remarkable genus does not differ structurally from *Ophidiaster* in any very fundamental points, but in general appearance the difference is very great. Owing to the lack of rigid abactinal skeleton, dry specimens are very much wrinkled and the longitudinal series of plates are made unnaturally conspicuous; in alcoholic specimens, longitudinal furrows are not conspicuous, but numerous transverse grooves

1. H. L. Clark—Mem. Austr. Mus., iv., 11, 1909, p. 529.

2. $\Psi\epsilon\upsilon\delta\eta\varsigma$ =false+*ophidiaster*; in reference to its resemblance to that genus not being apparent.

are evident, especially on the sides of the arms. The superficial appearance of alcoholic specimens of *Pseudophidiaster* is more like that of *Phataria* than like that of *Ophidiaster*, but the latter genus seems to be structurally more nearly allied.

PSEUDOPHIDIASTER RHYSUS,¹ *sp. nov.*

(Plate xvi., fig. 1-2.)

R=150 mm.; r=25 mm.; R=6 r. Br=27 mm.; R=not quite 6 br. Br at middle of ray, about 15 mm.; at tip, 3-4 mm. Disk large, considerably elevated, the median radial series of plates extending outward from it in equally elevated ridges; rays therefore more or less distinctly trigonal at base, but tapering quite uniformly to a cylindrical, bluntly pointed tip. Whole animal clothed in a thick skin, bearing a dense coat of crowded granules, and concealing almost completely the skeletal plates; on papular areas, there are 60 or more granules per square millimeter, but on convexities and elevations of disk and base of rays, the granulation is much coarser, sometimes only 4-10 per square millimeter. Median radial series of abactinal plates very conspicuous proximally, but becoming less and less distinct distally; on each side is a much smaller series which, beyond the middle of the arm, becomes irregular and difficult to distinguish; then comes the series of superomarginals which are quite well marked except near tip of ray: inferomarginals as large or larger, and generally easily followed to very tip of ray, since they form the ventrolateral margin of the arm. Papular areas rather small, each with 20-25 papulae, forming eight regular series, one on each side of arm being actinal in position, below the inferomarginal plates; distally the series are less regular and the actinal do not reach the tip of the arm. Madreporite very large and conspicuous, 10 mm. long by 8 mm. wide. Terminal plate very small and inconspicuous.

Actinolateral plates in three regular series proximally, with a few plates indicative of a fourth series; the third series disappears about one-third of the distance from mouth to arm tip; the second extends beyond the middle of the arm; the series adjoining the adambulacrals apparently extends nearly to the arm tip. Adambulacral armature of 2 flattened, smooth spines nearly 2 mm. long, with blunt, rounded tips, placed close together, the aboral the slightly smaller of

1. $\rho\upsilon\sigma\acute{o}\varsigma$ =wrinkled, shrivelled; in reference to the appearance of dry specimens.

the two; the adambulacral plates being short and overlapping, the spines are crowded close together in a very regular and unbroken marginal series; the actinal surface of the plates is covered by the same coarse granulation, as the actinolaterals bear; at the very tip of the arm, there occur scattered subambulacral spines, like those of *Ophidiaster*, while close to the mouth, 3 or 4 plates in each series, carry short heavy spines of the same nature, 1-2 mm. long, and 1-1.5 mm. thick at tip; occasionally there are two such spines on a plate. Oral spines similar to the adambulacrals but somewhat heavier and more prismatic. Pedicellariæ present in very diverse numbers, of the usual Ophidiastrine type, each about .75 mm. long, the valves nearly or quite .50 mm. wide and with smooth valves, which are often low and wide; in one specimen they are fairly abundant on the abactinal surface, but in the others only a very few occur, careful search revealing one here and there on the papular areas; I have found none on the actinal surface. Colour (in alcohol), purplish-brown, each arm with three broad, indistinct cross-bands of a lighter shade; lower surface pale grayish; dried, the specimens become pale, dingy fawn-colour.

This remarkable linckiid is not a handsome Starfish but this is, in part certainly, the effect of preservation. The leathery nature of the body-wall, the form of the rays, the huge madreporite, the absence of superambulacral plates, the presence of pedicellariæ and the calcareous plates of the ampullæ combine to make it a very unusual member of the family. The tendency to develop subambulacral spines on the oldest (near mouth) and youngest (near arm-tip) adambulacral plates like those of *Ophidiaster* are suggestive of a phylogenetic connection with that genus and perhaps we shall not be far from the truth if we called *Pseudophidiaster* a deep-water ophidiasterid. The smallest specimen before me has $R=58$ mm. : $r=8$ mm. ; $R=7r$; in other particulars, it is not noteworthy.

Locs.—Great Australian Bight, 80-120 fathoms.

Thirty-six miles N. 58° E. of Cape Wickham, King Island, Bass Strait.

South of Gabo Island, Victoria, 200 fathoms.

Oyster Bay, Tasmania, 60 fathoms.

Family ASTERINIDÆ.

Genus ASTERINA, *Nardo*.ASTERINA ATYPHOIDA,¹ *sp. nov.*

(Plate xvii., fig. 1-2.)

Remarkably similar to *A. modesta*, Verrill, from Panama. On the upper surface the only difference is in the coarser granulation of the plates in the Australian specimens. Actinally the difference is somewhat more marked; the adambulacral plates almost never have more than one subambulacral spine, while in *A. modesta* two such spines are often, if not usually, present; the actinal intermediate plates near the margin have only a single spine while in *A. modesta* there are two and occasionally three. The largest specimen of *A. atypoida* is 19 mm. across; R=10 mm., and r=8.5 mm. Colour (dry), light brown or whitish. Four specimens.

The resemblance between these South Australian Asterinas and specimens of *A. modesta* from Panama is very extraordinary, whether one regards it as indication of genetic relationship or as a case of parallelism. In either case, the degree of difference is very slight in view of the fact that several other species of *Asterina* occur in the vast intervening distance between the homes of the two species. It is obviously impossible, without far more data and specimens than are now available, to determine what the relationship between them really is.

Locs.—Fifteen miles north-west of Cape Jervis, South Australia, 17 fathoms. This specimen has been selected as the holotype.

Off Cape Marsden, Kangaroo Island, South Australia, 17 fathoms.

ASTERINA LEPTALACANTHA,² *sp. nov.*

(Plate xviii., fig. 3-4.)

R=18 mm.; r=8 mm.; R=2.25 r. Br=9 mm.; R=2 br. Br at middle of ray=7 mm.; at tip, 3 mm. Disk and rays moderately arched, but general appearance flattened; margin formed by the conspicuous inferomarginals. Abactinal plates as usual in *Asterina*, more or less markedly

1. ἀτυφός=the Latin *modestus*+ἔιδος=form; in reference to the resemblance to *A. modesta*, Verrill.

2. λεπταλέος=fine, slender+ἄκανθα=thorn, spine; in reference to the very fine spines on the inferomarginal plates.

imbricating and with a proximal notch or concavity for the subtending papula ; there are no small supplementary plates ; across the base of the ray one may count 10-12 series of plates but only 8 or 6 distally above the superomarginals ; at base of ray there are 5-7 series of papulae but only three (or two) extend beyond the middle of ray. Except for a few minute spinelets around the anus and around the madreporite, all the abactinal plates, but 10 or so in each interradial angle, are perfectly bare and smooth ; the interradial plates referred to each carry 6-10 exceedingly slender spines, .75 mm. long. Superomarginal plates small and perfectly bare. Inferomarginals about 24 on each side of ray, very conspicuous, each one bearing a tuft of 12-15 (or more) exceedingly slender spines 1-1.5 mm. long. Actinolateral plates in two complete series, while a third runs as far as the twentieth (from interradius) inferomarginal ; there are 5 or 6 plates in a fourth series, and a few additional plates in the interbrachial arc : except the three most adoral plates of the first series, which are perfectly bare, each of these plates carries a single, sharp, relatively stout spine nearly a millimeter long ; in each interradial area except one, back of the oral plates, is a small bit of naked, uncalcified skin. Adambulacrals about 26, all but the two most adoral, corresponding to an inferomarginal with the intervening actinolaterals ; armature consists of a furrow series of 5 (4-6) spines, the middle one longest, adoral and aboral ones shortest, and a single prominent subambulacral spine on the surface of the plate. Oral plates rather large, with only 5 marginal spines, the terminal much the largest, and a single big spine on the surface. Madreporite small, triangular, nearer centre of disk than margin. Colour (dry), pale yellow-brown.

This very interesting *Asterina*, while not collected by the " Endeavour," is included in the collection sent me, and certainly deserves description. It belongs in the section of the genus to which Verrill has recently given the name *Patiriella*, the type of which is *A. regularis* from New Zealand. But there is little superficial resemblance between *A. leptalacantha* and *A. regularis* and if *Asterina* is to be broken up, one would hardly expect them to fall into the same section. The new Australian species cannot be mistaken for any hitherto described, the relatively long arms, the bare abactinal plates, the remarkable inferomarginals and the spinulation of the actinal surface forming a very distinctive group of characters.

Loc.—Masthead Island, Queensland, collected by Mr. A. R. McCulloch, December, 1913.

Genus ANSEROPODA, *Nardo*.ANSEROPODA ROSACEA (*Lamarck*).

(Fig. 5-6.)

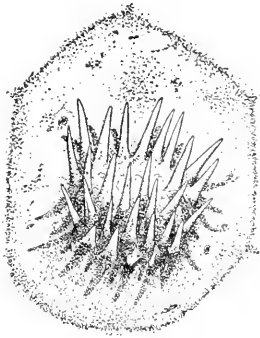
Asterias rosaceus, Lamarck, Anim. sans Vert., ii., 1816,
p. 558, par. 3.*Anseropoda rosacea*, Fisher. Bull. U.S. Fish Comm., 1906,
p. 1089.Evidently this is a more widely distributed species than
was supposed, since it is now known from Japan, the Indian

Fig. 5.x40.

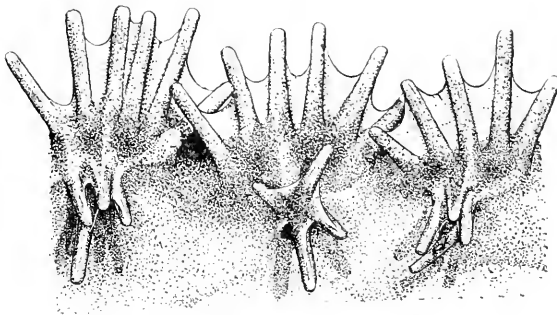


Fig. 6.x15.

Ocean, the western coast of Australia, and the eastern coast of Queensland. No doubt it will soon be reported from the East Indies. The specimens in the "Endeavour" collection have $R=85-115$ mm.; two have 15 and two have 16 rays. They

are pale, dirty grayish, or brown, and show no trace of any of the original colours. Four specimens.

Locs.—Off Fraser Island, Queensland, 32 fathoms.

Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

Family ECHINASTERIDÆ.

Genus HENRICIA, *Gray*.

HENRICIA HYADESI (*Perrier*).

Cribrella hyadesi, Perrier, Miss. Sci. Cap-Horn, vi., Zoologie, Echinod., 1891, p. K100.

Henricia hyadesi, Fisher, Bull. U.S. Nat. Mus., lxxvi., 1911, p. 293.

Although these specimens show considerable diversity in proportions and in spinulation, in view of the well-known inconstancy of characters in the genus, I do not feel justified in recognising more than one species, and that one I, for the present, identify with Perrier's species from southern South America. I cannot go as far as Ludwig and consider all the Antarctic and sub-Antarctic *Henricias* as a single species, for I doubt if Studer's *H. pagenstecheri* is identical with Perrier's *H. hyadesi*, and I am quite prepared to learn that the Australian and South American *Henricias* are distinct. But until more material is available, it is futile to discuss the matter. It is worthy of note that all the Australian specimens are from water relatively deep for the genus. The largest specimen has $R=80$ mm. ; in another $R=75$ mm. ; $br=18$ mm. ; in a third, $R=67$ mm. ; $br=9$ mm. Usually the arms taper to a slender tip, but in one specimen they are rather uniformly stout. One specimen from the Great Australian Bight has 6 arms but does not seem to differ otherwise from the rest. All the specimens have lost their original colours, and are now some shade of yellowish-brown. Eleven specimens.

Locs.—East of Maria Island, Tasmania, 78 fathoms.

Off Babel Island, Bass Strait, 50-60 fathoms.

South of Gabo Island, Victoria, 200 fathoms.

Great Australian Bight, 80-150 fathoms.

Genus ECHINASTER, *Müller and Troschel.*ECHINASTER ACANTHODES,¹ *sp. nov.*

(Plate xix., fig. 1-2; Fig. 7.)

R=70 mm.; r=12 mm.; R=6 r. Br=14 mm.; R=5 br. Br at middle of ray=9 mm.; at tip, 3.5 mm. Disk moderate, slightly arched; arms terete, tapering very uniformly to the narrow but blunt tip. Abactinal skeleton coarse and rather heavy; each plate bears a large sharp spine, .5-1 mm. high. Papulae confined to abactinal surface; the areas in six irregular longitudinal series, each area with few (2-6) papulae. Adambulacral armature consisting of 3 spines in a vertical series, the smallest high up in ambulacral furrow, the second, little larger, just below, and the third, much larger, on the furrow-margin; except on the 12-16 plates nearest the mouth, there occurs on the actinal surface of every other plate, a conspicuous subambulacral spine, equal to, or larger than, that on the furrow-margin; back of this

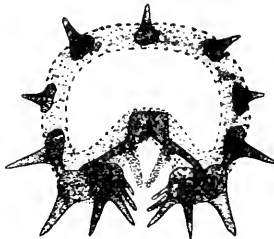


Fig. 7.x3.

spine, on the actinolateral or more likely the inferomarginal plate, is another still larger spine, about 2 mm. high. Oral plates with no surface spines and marginal spines united by membrane, which reaches more or less nearly to their tips, and extends outwards along the rays uniting more or less evidently the furrow-margin spines of the first few adambulacral plates. Beyond the disk, each spine is more or less clothed in membrane. Madreporite very small, about half-way between disk-centre and margin. Colour (dry), light brown. Three specimens.

The general appearance of this species is more like that of the West Indian Echinasters than like that of its East Indian congeners. The conspicuous spines and the total lack of

1. ἀκανθώδες=full of thorns; in reference to the spiny surface.

actinal papulae make it an easy species to recognise. The smallest of the three specimens has $R=30$ mm., and the more or less isolated papulae are in about 4 irregular series. There is only 1 prominent actinal spine for each 3 adambulacral plates, until near tip of arm. The membrane between the adambulacral plates has distinct non-calcified actinal areas about .35 mm. wide by .25 mm. long.

Locs.—Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

Thirteen miles north-east of North Reef, Capricorn Group, off Point Curtis, Queensland, 70-74 fathoms.

ECHINASTER ERIDANELLA, Müller and Troschel.

(Plate xx., fig. 1-2 ; Plate xxi., fig. 1-2.)

Echinaster eridanella, Müller and Troschel, Sys. der Ast., 1842, p. 24.

There is a bare possibility that the little specimen with 5 arms from twenty-five miles south-east of Double Island Point, Queensland, $R=25$ mm., is not this species, but except for the number of arms, I see no occasion for questioning it. The species is abundant on the reefs of northern Queensland, and it is quite possible that it reaches southward to twenty-five miles south-east of Double Island Point. Of the specimens figured, those from Bowen, Queensland, and from Murray Island, Torres Strait, are typical of the species ; the 4-rayed specimen from Mauritius is exceptional and is, moreover, poorly preserved. Three specimens.

Locs.—Bowen, Queensland. A specimen with seven rays.

Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms. A small specimen with five rays.

ECHINASTER GLOMERATUS,¹ *sp. nov.*

(Plates xxii.-xxiii. ; Fig. 8.)

$R=135$ mm. ; $r=25$ mm. ; $R=5.5$ r. Br=25 mm. ; $R=5.5$ br. Br at middle of ray=18 mm. ; at tip, 5 mm. Disk large, moderately elevated as are the bases of the broad, steadily tapering arms. Madreporite very small ; in holotype, only about 7 mm. from centre of disk but nearer the margin in other specimens. Abactinal skeleton very coarse

1. *Glomeratus*=grouped ; in reference to the arrangement of the abactinal spines.

and heavy, forming a wide-meshed network with rather large papular areas; wherever two or more plates meet is an elevation bearing a cluster of 2-12 stout, sharp spines, .5-1 mm. high; the papular areas contain 12-15 or more papulae; neither spine-clusters nor papulae show any serial arrangement. Actinal surface somewhat flattened; adambulacral plates very numerous; their armature shows some diversity; well up in the furrow is a sharp, slightly curved spine, below which is a second larger and somewhat blunter and straighter one; below the latter is, generally, a similar but slightly larger spine, about 3 mm. long, which stands on the furrow

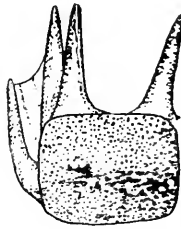


Fig. 8.x5.

margin and just outside of it, on the actinal surface of the plate is a similar but much shorter spine; diversity comes from the fact that there may be two or even three spines, instead of one on the furrow margin and they may stand side by side or in an oblique row, extending aborally from the margin; the marginal and furrow-spines are more or less encased in membrane. The actinolateral plates, outside the adambulacrals, seem to correspond to them in number, and each one bears a series (transverse to long axis of ray) of 2-3 sharp spines. Papulae are abundant on the actinal surface, but do not occur between the actinolaterals and adambulacrals, nor on the actinal interradial areas. Oral plates not peculiar, but the lateral spines are not concealed by the thin membrane which unites them. Colour (in alcohol), bright yellow-brown; (dry) similar, but duller.

Strictly speaking this species belongs in *Henricia* rather than in *Echinaster* since the spinelets are in groups and not isolated, but the general appearance is so unlike *Henricia* that it seems absurd to put it in that genus. It is quite unlike any previously described Echinasterid and will be easily recognised at once. The smallest of the six specimens at hand has R=75 mm.; it is not, however, notably different

from the larger specimens, save that the actinal skin is thicker and unites and conceals the spines along the furrow more fully.

Loc.—Off Cape Marsden, Kangaroo Island, South Australia, 17 fathoms.

ECHINASTER SUPERBUS,¹ *sp. nov.*

(Plates xxiv.-xxv.; Fig. 9-10.)

R=110 mm.; r=15 mm.; R=7 r. Br=20 mm.; R=5.5 br. Br at middle of ray=14 mm.; at tip, 4 mm. Disk small, not elevated; rays nearly terete, tapering uniformly to tip, somewhat flattened actinally. Abactinal skeleton pretty well concealed in the thick skin, but forming a rather fine mesh-work, with relatively small papular areas, which show no serial arrangement. Papulae large and numerous. Abactinal spines numerous, isolated, diverse in form, 1-2 mm. high, .5-1.75 mm. thick; few have a simple, pointed or blunt, tip; usually it is clavate to a greater or less degree, chisel-shaped with one or more notches, or with 5-6 low, rounded summits. Madreporite moderately large, very distinct and quite near centre of disk. Adambulacral plates numerous,

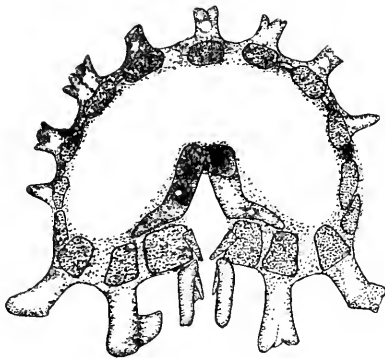


Fig. 9.x4.

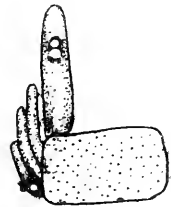


Fig. 10.x8.

about twice as wide as long, very well defined, separated from each other by distinct membranous spaces half as long as the plates; each plate carries, high up in the furrow, a small, curved pointed spine, immediately below which is a

1. *Superbus*=very fine; in reference to its notable form and size.

longer, straighter, stouter one; close to this, but on the furrow-margin is a large flattened spine, 2-2.5 mm. long and about as wide as the length of the plate; its outer side is more or less deeply furrowed (at least near tip) and its summit is a chisel-shaped or clavate edge; approximately every other spine is narrower, smoother and more nearly pointed, but there is considerable diversity. On the actinal surface of a very few plates, on the basal part of the ray, occurs a single, low pointed tubercle or spine. Outside the series of adambulacral plates occurs a very conspicuous series of spines, the largest on the Starfish; there are 2 of these to every 5 adambulacral plates; they are 2 mm. high or more, and their conspicuous chisel-shaped or clavate tips are frequently more than 2 mm. wide; outside this series, and virtually forming the boundary of the actinal surface, is a series of similar but smaller and more numerous spines, large ones often alternating with small ones as in the adambulacral series. Papulae occur between these two actinal series of spines. Oral plates and spines not peculiar or notable. Colour (dry), deep purplish-brown, tips of the spines lighter but apparently only by abrasion.

This is another remarkable *Echinaster*, unlike any previously known, and making the fourth notable species known only from Australia, besides the long-known East Indian species, *E. eridanella* and African *E. vestitus*. It is interesting that with one exception, each of these six species occurs on a different part of the coast; the present species *E. superbus* comes from the far north-west of the continent; two hundred miles further south, at Port Hedland, *E. vestitus* and the very different *E. arcystatus* have been taken; over two thousand miles of coast separate these three species from *E. glomeratus* of South Australia; another gap of some one thousand five hundred miles separates that sharply distinct species from *E. acanthodes* of southern Queensland; and just overlapping the latter's area is the southern limit of *E. eridanella*, the common species of northern Queensland. Of course further collections and studies may show that these geographical lines of division do not really exist in nature but their apparent occurrence seems worth noting. Unlike the various forms of *Echinaster* in the West Indian region to which different names have been given, these Australian species are very obviously different from each other and it is difficult to conceive of their intergrading.

Loc.—Broome, Western Australia.

Genus PLECTASTER, *Sladen*.PLECTASTER DECANUS (*Müller and Troschel*).

(Plate xxvi., fig. 1-2.)

Echinaster decanus, Müller and Troschel, Arch. f. Naturg., ix. i., 1843, p. 114.

Plectaster decanus, Sladen, Chall. Rep., Zool., xxx., 1889, p. 535.

This remarkable species never having been figured, it seems desirable to figure it here, and the Port Jackson specimen is shown on Pl. xxvi., fig. 1-2. In it, $R=115$ mm., and $r=27$ mm.; $R=4$ r. The specimens from Shoalhaven Bight, New South Wales, are smaller and not so well preserved, but they appear to have been placed in formalin and then dried, and hence are more nearly the natural colour. In them the papula areas are bright reddish-purple, while the skeleton and spinelets are light yellowish in sharp contrast; on the actinal surface, there is a considerable suffusion of reddish-purple, especially interradially, near the mouth. The Port Jackson specimen is yellowish-brown, the papular areas darker than the skeleton. Three specimens.

Locs.—Shoalhaven Bight, New South Wales, 15-45 fathoms. Off George Head, Port Jackson, New South Wales.

Family SOLASTERIDÆ.

Genus CROSSASTER, *Müller and Troschel*.CROSSASTER MULTISPINUS,¹ *sp. nov.*

(Plate xviii., fig. 5-6.)

Rays 11. $R=40$ mm.; $r=20$ mm.; $R=2$ r. $Br=10$ mm.; $R=4$ Br. Abactinal skeleton an open mesh-work of narrow, rather delicate ossicles, leaving large papular areas, in which, however, the papulae are few, large, isolated. Pseudopaxillae rather crowded on disk, but more widely spaced on arms; each bears a tuft of 8-15 long, slender, acicular spines, exceeding the stalk in length. Superomarginals insignificant. Inferomarginals few, widely spaced, conspicuous, about 16 on each side of an arm; they are greatly compressed at summit into a narrow vertical ridge, carry 25 (more or fewer) sharp, spinelets, most of which are shorter than those on the abactinal pseudopaxillae. Actinal

1. *Multispinus* = with many spines; in reference to the armature of the adambulacral and oral plates.

intermediate plates, few and scattered, with 6-12 spinelets; actinolateral plates very few, small and scattered, with very few spinelets. Adambulacral plates as wide as long, or wider; the furrow margin bears 8 or 7 (proximally), 6 or 5 (distally), slender, not sharp, membrane-united spines, the middle ones longest, 1.5-2 mm. long; actinal surface of plate with a transverse, slightly curved series of 7-9 similar spines, 2-3 mm. long. Oral plates with a marginal series of 14 similar spines, the proximal longest and largest, 3-3.5 mm. long; actinal surface of each plate with a longitudinal series of 8-10 similar spines, near inner margin. Madreporite small and inconspicuous, half way between centre of disk and margin. Colour (dry), dull brown; other specimens are light yellowish-brown.

Although all four specimens have 11 rays each, the three from Tasmania are obviously different from the holotype, in their lighter colour, more conspicuous skeleton, more slender rays, and thinner and less noticeable membrane covering and uniting the spines, both abactinally and actinally. In view of the well-known diversity in all such particulars shown by the common, northern species of *Crossaster* (*C. papposus*), I think there is little reason to consider these differences of any special significance, especially since the Tasmanian specimens are poorly preserved. The large number, and the slenderness of the adambulacral and oral spines readily distinguish the present species from any of those previously known.

Locs.—Between Gabo Island, Victoria, and Disaster Bay, New South Wales, 50-100 fathoms. This specimen has been selected as the holotype.

South-east of Bruni Island, Tasmania, 150-230 fathoms.

GENUS PTERASTER, *Müller and Troschel.*

PTERASTER TETRACANTHUS,¹ *sp. nov.*

(Plate xviii., fig. 1-2.)

R=30 mm.; r=24 mm.; R=1.25 r. General form almost perfectly pentagonal, moderately thick. Abactinal surface in such poor condition it is not possible to determine exactly the number of paxillar spines; paxillæ somewhat numerous and paxillar spines long, apparently about 6. Spiracles

1. τετρακάνθος=having four spines; in reference to the armature of the adambulacral plates.

small and seemingly widely scattered. Actinolateral spines only 5 mm. long, hence actinolateral membranes cover a relatively small part of actinal surface, and actinal intermediate areas are large and densely covered with groups of slender, membrane-united spinelets. Adambulacral spines 4, the innermost very small, the outermost about 4 mm. long, united by a thin membrane, which retreats little (say 25%) between the spines, and which connects with the actinolateral spine. Actinolateral membrane reaches practically to tips of spines, with little retreat between. Oral plates with prominent central keel and very stout suboral spines (one on each plate), 4 mm. long, sharply triangular near tip, but truncate and more or less succulate; oral spines 4, of which the first (proximal) is much larger than the next, about 3 mm. long, truncate and flat; no membrane connects these spines. Colour (dry), dull grayish-brown.

This specimen is the first representative of the genus to be taken anywhere near Australia. Judging by the keys to *Pteraster* which have been published one would expect either *P. danæ*, Verrill, or *P. stellifer*, Sladen, to be near allies, but in reality the present species is quite unlike either of these. The large actinal interradial areas, the narrow actinolateral membrane and the characters of the oral armature combine to give *P. tetracanthus* a very distinctive facies.

Loc.—South-east of Cape Everard to south of Gabo Island, Victoria, 90-150 fathoms.

Family ZOROASTERIDÆ.

Genus ZOROASTER, *Wyllie-Thomson*.

ZOROASTER MACRACANTHA,¹ *sp. nov.*

(Plate xxviii., fig. 1-2.)

Very similar to *Z. spinulosus*, Fisher, from the Hawaiian Islands, but differing in a few details. The plates of the mediocardial series are the largest on the arm and each succeeding series is made up of smaller plates; the superomarginals are thus larger than the inferomarginals. Two series of actinolateral plates are confined to the actinal surface at the base of the arm. The plates of the mediocardial series are provided with large central tubercles (bosses) on which are articulated stout sharp spines 5 mm. or more in length; on the basal part of the arm such a spine occurs on nearly every

1. μακρός=long + ἄκανθα=a thorn, or spine; in reference to the long abactinal spines.

medioradial plate, but distally only on every other plate ; there is never more than one to a plate ; nearly all these spines are missing in the specimens at hand, but the tubercles are conspicuous and enough spines are left to show their size. The superomarginals bear similar but smaller and more slender spines. Pedicellariæ both large and small are present everywhere, very large ones, 1.5-2 mm. long, occurring on the medioradial plates. Adambulacral armature essentially as in *Z. spinulosus* but pedicellariæ appear to be much more abundant. Colour (in alcohol), yellowish-brown. Three specimens.

It is not without some hesitation that I separate this *Zoroaster* from the Hawaiian species, but until something is known of the fauna of the vast area between southern Australia and the Hawaiian Islands, it seems best not to assume the identity of species in the two regions. Apparently the Australian *Zoroaster* is conspicuously more spiny than its Hawaiian congener, and since the medioradial plates and spines seem to furnish a tangible character, I have determined to give it a different name. The largest specimen has $R=160$ mm. ; $r=14$ mm. ; $R=11.5$ r. The primary disk-plates have prominent bosses like those on the medioradial plates and apparently, in life, bore similar conspicuous spines.

Loc.—Great Australian Bight, $129^{\circ} 28' E.$, 250-450 fathoms.

Family PEDICELLASTERIDÆ.

Genus PEDICELLASTER, *Sars.*

PEDICELLASTER RETICULATUS,¹ *sp. nov.*

(Plate xxvii., fig. 3-4.)

Rays 6, unequal, three larger and three smaller ; the middle one of the smaller trio much smaller than the others, being about 22 mm. long, while they are over 30 mm. $R=37$ mm. ; $r=5$ or 6 mm. ; $R=6$ or 7 r. $Br=5$ mm. ; $R=7$ br. Br at middle of ray, 3.5 mm. ; at tip, 1.5 mm. Disk small ; arms relatively broad for a *Pedicellaster*. Abactinal skeleton made up of slender rods and plates forming a large-meshed network ; on each arm there are about 4 longitudinal series of these meshes, with 20-25 meshes in each series ; at many

1. *Reticulatus*=with meshes like a net ; in reference to the wide-spaced skeleton.

points, there are only 3 series, a median, and one lateral on each side. Each mesh contains one or more papulæ, but in the dry specimen, it is difficult to determine their presence. Each plate of the skeleton bears a single, slender, pointed spine, 1-1.5 mm. long; also numerous small pedicellariæ, which may be either on the plate itself or on the spine or on both; often the spines, particularly along the actinal margin, have large wreaths or half-wreaths of pedicellariæ. Adambulacral plates, 15 to 5 marginals, at base of arm; armature of 2 spines, in a transverse series; they are about 1.5 mm. long and subequal or the outer a trifle the longer; the outer is also a trifle more adoral. There are a very few, scattered, small pedicellariæ just within the margin of the ambulacral furrow, which is notably broad and has the tube-feet in two distinct and well-separated series. Oral plates not large, but projecting distally so as to slope sharply into the mouth; each one bears 3 smooth spines; one on the actinal surface, which is similar to, about as long as, but stouter than the adambulacral spines; a second is still stouter and blunter and stands at the proximal end of the plate; while the third is much shorter than either of the others, is situated at the proximo-lateral corner of the plate and extends straight out across the ambulacral furrow; it carries a few small pedicellariæ. Madreporite large (2 mm. across), conspicuous, near margin of disk. Colour (dry); skeleton and spines, white; membranes and feet, brown.

This species is quite unlike the Atlantic members of the genus but bears considerable resemblance to *P. improvisus*, Ludwig, from the Galapagos Islands. It differs noticeably in the armature of the oral plates, however, as well as in some other details (number of papulæ, length of spines, etc.). The inequality of the arms suggests that schizogony occurs, but it is possible that the condition of the present specimen is accidental.

Loc.—East of Maria Island, Tasmania, 78 fathoms.

Family ASTERIIDÆ.

Genus ALLOSTICASTER, *Verrill*.

ALLOSTICASTER POLYPLAX (*Müller and Troschel*).

Asteracanthion polyplax, Müller and Troschel, Arch. f. Naturg., x. i., 1844, p. 178.

Allostichaster polyplax, Verrill, Harriman Alaska Exped., Starfishes, 1914, p. 363.

It is a little odd that this well-known Australian Starfish should have been taken only at Oyster Bay, Tasmania; not

all are labelled thirty fathoms and it is possible they were not all taken at that depth, nor at the one spot. One has only 4 arms, having divided very recently; a second has 6 arms, with indication of a seventh; a third has 9 arms; the remainder have eight. None are notably large or small. Seven specimens.

Loc.—Oyster Bay, Tasmania, 30 fathoms.

Genus COSMASTERIAS, *Staden.*

COSMASTERIAS DYSCRITA,¹ *sp. nov.*

(Plate xxix., fig. 1-2.)

Rays 5. R=67 mm.; r=11 mm.; R=6 r. Br=15 mm. R=4.5 br. Br at middle of ray=12 mm.; at 20 mm. from disk-centre, 17 mm.; at tip, 2.5 mm. Disk small, somewhat arched; rays slightly contracted at base, then increasing quickly to maximum breadth, and then tapering steadily to the narrow tip. Abactinal skeleton thick, moderately heavy, with small and distinct papular areas; those on disk contain 3-7 papulae, while the larger ones along sides of ray have 6-8. Disk plates without definite arrangement, bearing 2-10 low capitate spinelets, about .5 mm. high and .25 mm. thick at tip; there are also a very few big *feli-pedal* (as Verrill calls them) pedicellariae, nearly a millimeter long scattered here and there, besides numerous minute pedicellariae of the ordinary type; neither spines nor pedicellariae are in the least crowded at any point. Madreporite not very large but quite conspicuous, being situated at the centre of a large, elevated plate, half way between disk-centre and margin, surrounded by a circle of 12-15 spinelets. Abactinal plates of rays similar to those of disk but arranged in 13 series at base of arms, a mediocradial series with a dorsolateral series on each side, then the superomarginals, the inferomarginals, and 3 series of actinolaterals; of the latter, the series next the adambulacrals extends less than one-third of the ray, the second reaches to about the middle of ray or a little beyond, and the third goes to within 15-20 mm. of the tip. All the plates above the actinolaterals carry capitate spinelets and pedicellariae like the disk-plates, usually only 2-3 spinelets on a plate; the actinolaterals each carry one, or often two spines, the largest on the Starfish; near the mouth they are 2 mm. long, blunt, somewhat flattened and nearly a millimeter wide; on the

1. *ἔνδοκρῖτος*=hard to determine; in reference to the uncertain relationships of the species.

outer series of actinolaterals these spines are somewhat smaller and intergrade with similar spinelets on the inferomarginals. Papulæ and small pedicellariæ occur between the second and third series of actinolaterals.

Adambulacral plates numerous, about 13 to 5 adjoining actinolaterals at base of arm; armature diplacanthid, the spines 1.5-2 mm. long, the inner ones pointed, the outer blunt and slightly flattened; between the two series occur numerous very large pedicellariæ, those near the mouth being distinctly *felipedal*; pedicellariæ both large and small occur also within the ambulacral furrow. Oral plates, each with 4 spines, an inner proximal at the tip of the jaw, 2 mm. long, moderately stout and pointed; an outer proximal at the corner of the jaw, much smaller and extending outwards across the furrow; and two actinal spines behind the inner proximal, similar to it, but longer and stouter and forming with it a longitudinal series of 3; there are also numerous small pedicellariæ and one or more of the big felipedal ones. Tube-feet in 4 distinct, not greatly crowded series. Colour (dry), brownish-yellow.

This Starfish is undoubtedly a *Stichaster* in the old broad sense, but Verrill has well shown, what others have suspected, that *Stichaster* was a heterogeneous and unnatural assemblage. The present species shows some affinity to *Asteracanthion luridum*, Philippi (= *Asterias sulcifera*, Perrier) of southern South America, for which Sladen made the subgenus *Cosmasterias*. Verrill has raised the group to generic rank, including certain species which Sladen considered *Stichasters* and I think his action is correct and wise. The genus is characteristic of southern South America and that vicinity, so that the discovery of a species which seems to belong to it, in deep water south-east of Australia is of considerable interest. The Australian species is easily recognised by its general facies, short, capitate, scattered spines and adambulacral and oral armature.

Loc.—South of Gabo Island, Victoria, 200 fathoms

Genus COSCINASTERIAS, Verrill.

COSCINASTERIAS CALAMARIA (Gray).

Asterias calamaria, Gray, Ann. Mag. Nat. Hist., vi., 1840, p. 179.

Coscinasterias calamaria, Perrier, Exped. Sci. du "Travailleur" et du "Talisman," Echinod., 1894, p. 106.

This individual has 11 arms, of which 3 are very small; for the others, R=60 mm. There are no large pedicellariæ any-

where so far as I can discover, in which particular this specimen agrees with individuals from Westernport, Victoria.

Loc.—Sanders Bank, Kangaroo Island, South Australia, 28 fathoms.

COSCINASTERIAS DUBIA, H. L. Clark.

(Plate xxx., fig. 1-2 ; Fig. 11.)

Coscinasterias dubia, H. L. Clark, Mem. Austr. Mus., iv., 11, 1909, p. 532.

This is a much better series of specimens than those collected by the "Thetis" on which the species was based. They are as a rule very well preserved and range in size from R=22 mm. to R=138 mm. The pedicellariæ are much more numerous, particularly along the ambulacral furrow, than in the "Thetis" specimens, and the membrane connecting the marginal spines is not distinguishable ; it is probable that its conspicuousness in the "Thetis" specimens was due to their poor preservation. The second series of actinolateral spines is often provided with wreaths of pedicellariæ. As growth changes, one notes that in the smallest specimen while there are 5 fairly well-marked series of plates on the abactinal surface, above the inferomarginals, half or more of the superomarginals carry no spines ; there is only one series of actinolateral spines and this is confined to the basal half of the arm ; the inferomarginal spines are relatively long and narrow, not at all widened at the tip ; large pedicellariæ are relatively few and are virtually wanting along the ambulacral furrow.

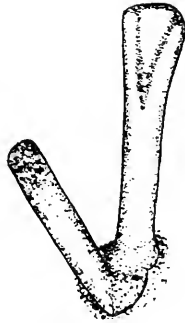


Fig. 11.x15.

In the largest specimen, on the other hand, one notes that while all the superomarginals carry conspicuous spines, there

are still only 5 series of abactinal spines, but the adradial series is very irregular, so that the broad space between the medioradial series and the superomarginals, bears relatively few and considerably scattered spines; there are two series of actinolateral plates and spines which extend more than three-fourths of the arm-length, and the plates of the inner series often bear 2 spines; the inferomarginal spines are very conspicuous, 5-7 mm. long and 2 mm. wide at tip, thick, heavy and deeply grooved on the actinal side at tip; the characteristic large, slender pedicellariæ are exceedingly abundant, especially along the ambulacral furrows and about the mouth. The small specimens (dry) are brownish-yellow, but the largest (dry) is dull purplish-gray abactinally with a decided red tinge, that suggests the possible natural colour. **Thirteen specimens.**

Locs.—Oyster Bay, Tasmania, 20-40 fathoms.
 East of Babel Island, Bass Strait, 65-70 fathoms.
 Shoalhaven Bight, New South Wales, 15-45 fathoms.
 South of Gabo Island, Victoria, 200 fathoms.
 Southern coast of South Australia.

COSCINASTERIAS GEMMIFERA (*Perrier*).

(Plates xxxi.-xxxii.)

Asteracanthion gemmifer, Perrier, Ann. Sci. Nat., Zool., (5), xii., 1869, p. 237.

Coscinasterias gemmifera, Fisher, Ann. Mag. Nat. Hist., (7), xvii., 1906, p. 574.

This species was described from a specimen in Paris, reported to have come from Chili. Sladen, in the "Challenger" Report, listed a specimen, without comment, from the reefs at Kandavu, Fiji! Now comes this third specimen from Tasmania! So far as I can judge from Perrier's description and Sladen's "key," the fine, large 11-rayed individual, figured herewith, represents *C. gemmifera* but I do not believe the differences between Perrier's species and Gray's *C. calamaria* are worth much. If *C. gemmifera* really occurs in Chili and Fiji and *C. Calamaria* really is found at Mauritius (as reported), we have a very notable case of distribution, which deserves critical study.

Loc.—Oyster Bay, Tasmania, 20-40 fathoms.

Family BRISINGIDÆ.

Genus ODINIA, *Perrier*.ODINIA AUSTRALIS,¹ *sp. nov.*

(Plate xxvii., fig. 1-2.)

Rays 14. $R=100$ mm.; $r=8$ mm.; $R=12.5$ r. $Br=2.5$ mm. Br where arm is widest (about 13 mm. from centre of disk) 5 mm.; at middle of arm, about 2 mm. Disk distinctly elevated above arm-bases, thickly plated, the plates without any definite arrangement but bearing minute pointed spinelets and countless pedicellariæ; papulæ very numerous, but usually, if not always single. Bases of arms, connected by marginal plates for only 2-3 mm. beyond the disk. Arms narrow at base, then suddenly swollen and often about 10 mm., gradually but quickly returning to the same width as at base; as far as they are swollen, they are covered by plates, spinelets, papulæ and pedicellariæ like the disk, but beyond the swelling a thin skin crowded with minute pedicellariæ is their only covering. Along each side of arm is a series of vertical plate-groups (apparently not more than 3 plates to a group distally), occurring at intervals of 2-3 mm. or about 3 adambulacral plates; on the swollen basal portion of arm these series extend to mediocradial line and the two of opposite sides may unite to form a very narrow band across the arm, but these bands are often incomplete, much bent or otherwise irregular; they are faintly indicated distal to the swollen region but only for a short distance. The first 2 or 3 of these bands carry no spines, only acute, conical spinelets dorsally like those on the neighbouring abactinal plates, but on the third or fourth band, the lowest plate (adjoining the adambulacral) carries a spine about a millimeter long; on succeeding bands this spine increases in length and at the middle of the arm and beyond is 4 mm. long; on the fifth or sixth band a second spine, just above the first appears and it too increases in length but never quite equals the first; on the seventh or eighth vertical group (corresponding to the "bands") a third spine appears but this remains distinctly shorter than the other two; in life, these spines are apparently covered with a loose membrane, which is densely clothed with minute pedicellariæ, but after capture, probably owing to the rough journey in the trawl, much of this membrane is commonly wanting. Adambulacral plates rather longer than broad; at base of arm, their armature consists of two spines, a very slender, acicular spine on the aboral end of the plate, with 2-3 minute pedicellariæ

1. *Australis*=southern; in reference to its being the first species of the genus to be taken in the Southern Hemisphere.

near the tip, extending inwards horizontally directly across the ambulacral furrow, but not quite as long as the width of the furrow, and a stout, flattened spine, 2-3 mm. long, with widened chisel-like tip, situated on the margin or actinal surface of the plate; this spine is more or less clothed on its outer side with a membrane densely covered with minute pedicellariæ. Beyond the middle of the arm the acicular furrow spine disappears, and the big marginal spine becomes smaller and smaller and steadily more acicular until at tip of arm, it is very minute or perhaps wanting. Oral plates each with 3 short (scarcely a millimeter long), blunt spines, one on the inner corner, one (the largest) on the outer corner, and the smallest at the aboral, radial corner; all carry a few minute pedicellariæ. Madreporites apparently 4, very small and with few, short, wide furrows; they are more or less elevated and near margin of disk, but are difficult to make out in an undried specimen. Colour (alcoholic or dry), dingy yellowish-white. Two specimens.

This is a notable species, one of the "Endeavour's" most interesting captures, since it is the first member of the genus to be taken in the Southern Hemisphere and except the recently discovered Hawaiian species, the only species not from the Atlantic. The genus must henceforth be recognised as cosmopolitan, for the present form can hardly be considered generically different from the others although its specific characters are well-marked. The occurrence of several madreporites is an unusual feature and the adambulacral furrow spine is also characteristic. Finally it is worthy of remark that no other species of *Odinia* has been taken in water as shallow as 200 fathoms.

Loc.—South-east of Cape Everard, Victoria, 200 fathoms.

OPHIUROIDEA.

The Ophiurans collected by the "Endeavour" are not an extraordinary lot in any particular, but they give added weight to the view that the Australian Ophiuran fauna is relatively poor. Up to the present about one hundred and fifteen species of Ophiurans have been recorded from Australia in three hundred fathoms or less, but fully half of these are known only from the far northern and north-western coasts of the continent, and are East Indian rather than Australian. Whitelegge lists only thirty-four Ophiurans from Port Jackson and neighbourhood, and six of these are from

water four hundred fathoms or more in depth, while half a dozen others are of doubtful authenticity. The "Endeavour" collection contains three hundred specimens of twenty-six species, of which five are new to science and three have not previously been recorded from Australia. There are several other species, previously known from the Torres Strait region which are now recorded for the first time from southern Queensland or New South Wales. Undoubtedly the best feature of the collection is the notable series of *Astroconus australis*, but all the Trichasterids and Gorgonocephalids are of great interest. The complete absence of ten or a dozen well-known Port Jackson brittle-stars is rather remarkable. Of the one hundred and twenty-three Ophiurans now known from Australia, at least sixty are not known from elsewhere.

Family OPHIOMYXIDÆ.

Genus OPHIOMYXA, Müller and Troschel.

OPHIOMYXA AUSTRALIS, Lütken.

Ophiomyxa australis, Lütken, Add. ad. Hist. Oph., pt. iii., 1869, p. 45.

These specimens range in disk-diameter from 15 to 25 mm. Several have the arms more or less distinctly banded, indicating a diversity of colour in life similar to that shown by the West Indian species, *O. flacirda*. Fourteen specimens.

Locs.—Twenty miles east-south-east of Tasman Head, Tasmania, 80-85 fathoms.

East of Maria Island, Tasmania, 78 fathoms.

North-east of Cape Pillar, Tasmania, 80 fathoms.

Forty miles west of Kingston, South Australia, 30 fathoms.

Genus OPHIOBYRSA, Lyman.

OPHIOBYRSA RUDIS, Lyman.

Ophiobyrsa rudis, Lyman, Bull. Mus. Comp. Zool. Harvard, v., 1878, p. 131.

This is a good series of this relatively little-known species, but they exhibit little diversity. The disk-diameter ranges from 9 to 27 mm. The colour is yellow-brown of diverse shades, the arms often with narrow darker bands. Seven specimens.

Locs.—East of Maria Island, Tasmania, 78 fathoms.

East of Babel Island, Bass Strait, 65-70 fathoms.

Off Gabo Island Victoria, 200 fathoms.

Between Gabo Island, Victoria, and Disaster Bay, New South Wales, 50-100 fathoms.

Off Twofold Bay, New South Wales, 30 fathoms.

Genus ASTERONYX, *Müller and Troschel.*

ASTERONYX LOVENI, *Müller and Troschel.*

Asteronyx loveni, Müller and Troschel, Sys. d. Ast., 1842, p. 119.

The occurrence of this cosmopolitan species south-east of Australia is notable since its known range southward is thus extended over two thousand miles. The specimens are all small, 10-20 mm. disk-diameter, and, so far as I can see, do not differ from North Pacific specimens of the same size. Six specimens.

Locs.—East of Babel Island, Bass Strait, 65-70 fathoms.

Off Gabo Island, Victoria, 200 fathoms.

South-east of Cape Everard, Victoria, 200 fathoms.

Genus EURYALE, *Lamarck.*

EURYALE ASPERA, *Lamarck.*

Euryale aspera, Lamarck, Anim. sans Vert., ii., 1816, p. 538.

This species was taken by the "Challenger" in Torres Strait, but the present collection extends the known range southward over a thousand miles. All the specimens are dried adults, the disk-diameter only ranging from 25 to 40 mm. There is considerable diversity in colour, however, for the specimen from Wide Bay is orange above, paling to yellow beneath; one from off Double Island Point is deep orange-brown; another is brown and another pale brown; the specimen from Port Curtis is very pale brown; all the other specimens are dull purple. Fourteen specimens.

Locs.—Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

Wide Bay, Queensland, 18-23 fathoms.

Port Curtis, Queensland, 14-16 fathoms.

Genus OPHIOCREAS, *Lyman*.OPHIOCREAS PHANERUM,¹ *sp. nov.*

(Plate xxxiii., fig. 1-2.)

Disk 18 mm. in diameter ; arms 380 mm. long ; arms about 20 times the disk-diameter. Disk and arms encased in a smooth, thick skin, which even when dry, shows no sign of calcareous plates or granules and more or less conceals the radial shields and arm-joints. In young specimens the skin is, of course, much thinner and when dry conceals very little. Radial shields narrow and convex, not closely approximate in pairs ; in young specimens, they are flat and are in rather closely joined pairs. Genital slits small (about 3 mm. long), deeply sunken. Tentacle-pores quite small ; first 2 pairs on arm, naked ; succeeding pores, all guarded by a pair of short, flattened, rough spines ; where largest (at about middle of arm) the inner spine is 2 mm. long, .80 mm. wide, pointed and prickly for more than half its length ; the outer is 1.5 mm. long by .45 mm. wide and neither as flat, nor as pointed, nor as rough as the inner. The skin of the side of the arm encases the basal half of the spines and so forms a thin but conspicuous wall along each side of the lower surface of the arm ; this occurs in many if not all species of *Ophiocreas*. Basal arm-tentacles not encased in cuticular tubes. Teeth only 6, triangular and very thick ; no tooth papillæ or oral papillæ in the adult ; in young specimens, a very few tooth papillæ are present. Colour (in alcohol or dry), deep red-purple ; young specimens somewhat lighter. Fourteen specimens.

This species can be distinguished at a glance from any *Ophiocreas*, of which I know, by the remarkably short and flattened tentacle-scales or arm-spines and the small number of teeth. Although the young specimens (disk=7 mm.; arms about 90-100 mm.) were taken much further north than any of the adults, I see no reason to feel any doubts as to their identity, the short arm-spines are so characteristic. The chief growth-changes appear to be the thickening of the skin, the entire loss of tooth-papillæ and the separation and convex thickening of the radial shields. In a specimen with disk-diameter 13 mm., these changes are complete.

Locs.—Twenty miles off Cape Barren, Cape Barren Island, Tasmania, 70 fathoms.

East of Flinders Island, Bass Strait, 80-300 fathoms.

Eastern Slope, Bass Strait, 70-100 fathoms.

Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

1. *φανέρως*=manifest, evident ; in reference to the species being so well characterised.

OPHIOCREAS SIBOGÆ, *Koehler.*

Ophiocreas Sibogæ, Koehler, *Ophiures de l'Exped. du Siboga*, i., *Ophiures de Mer Profonde*, 1904, p. 165.

It is not without some hesitation that I refer these seven specimens to this East Indian species, after comparing them with a cotype of *O. sibogæ*. The most obvious difference is in colour, the cotype being uniformly yellow and the Australian specimens reddish flesh-colour with a more or less heavy purple cast. This difference, however, must be disregarded since Koehler gives the colour of *O. sibogæ* as "reddish-purple violet," not altogether unlike the Australian material, apparently. Other differences, somewhat intangible, though noticeable when the specimens are side by side, I believe may properly be referred to individual diversity. The "Endeavour" specimens are all adult and are in fine condition; the largest has the disk 25 mm. across and the arms 610 mm. long. This is, I believe, much the largest specimen of *Ophiocreas* yet recorded. Although this species and the preceding (*O. phanerum*) were both taken east of Flinders Island, 80-300 fathoms, I do not infer from this record that they occurred in the same haul of the trawl, but of course it is possible they did. They are so obviously unlike in their arm-spines (tentacle-scales) and teeth, that they cannot be confused, even if taken together.

In regard to the use of the generic name *Ophiocreas*, I regret to see that Döderlein and Matsumoto treat it as a synonym of *Asteroschema*. While it is probable that the old line of division between the two genera is not by itself valid, I think it is practically certain that we are dealing with two natural groups which ought to be kept separate. I therefore propose to continue the use of *Ophiocreas* for species like *O. phanerum* and *O. sibogæ*, and of *Asteroschema* for species like *oligactes* (Pallas), even though I am not yet prepared to define either genus accurately.

Locs.—East of Flinders Island, Bass Strait, 80-300 fathoms.
Great Australian Bight, 129° 6' 30" E., 200-300 fathoms.

Family GORGONOCEPHALIDÆ.

Genus ASTEROPORPA, *Lütken.*ASTEROPORPA AUSTRALIENSIS, *H. L. Clark.*

Asteroporpa australiensis, H. L. Clark, *Mem. Austr. Mus.*, iv., 11, 1909, p. 547.

This is a nice series of this interesting species, the disk-diameters ranging from about 7 to nearly 18 mm.; in the

largest specimen the arms apparently exceed 75 mm. There is little diversity shown in colour or in any other feature. Ten specimens.

Locs.—South of Babel Island, Bass Strait, 92-160 fathoms.

East of Babel Island, Bass Strait, 65-70 fathoms.

Off Gabo Island, Victoria, 200 fathoms.

South of Gabo to south-east of Cape Everard, Victoria, 70-80 fathoms.

Genus CONOCLADUS, *H. L. Clark.*

CONOCLADUS AMBLYCONUS, *H. L. Clark.*

Conocladus amblyconus, H. L. Clark, Mem. Austr. Mus., iv., 11, 1909, p. 549.

This interesting series, with disk-diameter ranging from 12-40 mm. is not quite so diversified in size as that taken by the "Thetis," but in the number and distribution of the rounded tubercles on disk and arm-bases, it shows more diversity. The colour is also notable, some specimens being almost white, and others purplish-brown, while the remainder are fawn-colour. There is no indication of any intergradation with any other species, the distinctive characters being perfectly plain in all the twenty-one specimens.

Locs.—Between Port Stephens and Newcastle, New South Wales, 22-60 fathoms.

Shoalhaven Bight, New South Wales, 15-45 fathoms.

Off Twofold Bay, New South Wales, 30 fathoms.

CONOCLADUS OXYCONUS, *H. L. Clark.*

Conocladus oxyconus, H. L. Clark, Bull. Mus. Comp. Zool. Harvard, lii., 1909, p. 132.

The individuals from Shoalhaven Bight, New South Wales, are very similar to the originals from off Port Jackson, and call for no special comment. The specimen from South Australia was taken with a specimen of the next species (*Astroconus australis*) and owing to the locality was at first identified as *Astroconus*. Critical study has, however, convinced me that if *Conocladus oxyconus* and *Astroconus australis* are to be maintained as distinct species, this South Australian individual must be called *Conocladus*. But *C.*

oxyconus is not otherwise known from south or west of Shoalhaven Bight, and I must confess that the occurrence of this specimen taken off Cape Wiles, South Australia, with an undoubted *Astroconus* has shaken my faith in the distinctness of the two forms. I should like to believe that the specimen under discussion was wrongly labelled, but I cannot see the slightest reason for such a belief. The question of the relationship of *Astroconus* and *Conocladus* is thus reopened and will be discussed further under the next species, but it is worth noting here that up to the present time only eight specimens of *C. oxyconus* are known and two of these are from unknown localities, though there is reason to think they are from near Port Jackson; of the other six, two are known to be from off Port Jackson, one is from Coogee, two from Shoalhaven Bight and one from south of Cape Wiles, South Australia. Of forty specimens of *C. amblyconus* now known, all are from New South Wales, while all known specimens of *Astroconus* are from Bass Strait southward and westward. Evidently *Conocladus* is the more northern genus and *C. oxyconus* is much the rarest of the three species.

Locs.—Shoalhaven Bight, New South Wales, 15-45 fathoms. Two specimens.

Fifteen miles south of Cape Wiles, South Australia.

GENUS *ASTROCONUS*, Döderlein.

ASTROCONUS AUSTRALIS (Verrill).

Astrophyton australe, Verrill, Bull. U.S. Nat. Mus., iii., 1876, p. 74.

Astroconus australis, Döderlein, Abh. math-phys. Klasse K. Bayer Akad. Wissensch., ii. Suppl.-Bd., 5, 1911, p. 37.

This is a remarkable and highly interesting series of this little known species. The fifty-five specimens range in size from young ones, with disks 11-12 mm. in diameter to large adults, whose disks are 45-50 mm. across. Two are perfectly tetramerous. The colour is notably diversified, ranging from nearly uniform pale gray or almost white, through pale gray prettily marked with dull red-purple, to dark gray heavily marked with purplish; or the ground colour may be yellowish-brown, light or dark, either without markings of red-purple, or prettily marked with that shade; many individuals have the arms very regularly banded with the red-purple, but in others there are only

a few dots or no markings at all. Diversity is equally marked in other features. The distance of the first arm-fork from the distal end of the radial shields ranges from .25 of the radial shield length to 1.10; or the same fact may be expressed in another way by saying there are from 9 to 15 arm-joints in the undivided arm-base. The number of arm-divisions ranges from 6 to 10 or more. Most of the specimens show the radial shields well separated, and the disk has distinct interradiial areas, but there is a tendency on the part of some individuals to have the radial shields united in pairs by thick, concealing skin and in such cases the interradiial areas are much reduced; thus the condition, characteristic of *Conocladus*, is approached. Further resemblance to *Conocladus* is brought about in certain specimens by the large size of the disk spines. In typical *A. australis*, these spines are about a millimeter high, conical, and the thickness at base about equals the height; they are present chiefly on the radial shields and are often confined to them; in many specimens they are smaller and more numerous, and rarely they are reduced to low, inconspicuous tubercles. But in some cases, notably in some South Australian specimens, the spines are 1.5 mm. high and correspondingly stout. In these cases, too, the spines on the basal parts of the arms are larger than usual and the resemblance to *Conocladus* may be quite marked. Nevertheless none of the specimens have the radial shields completely united into five disk-wedges, with very much reduced interradiial areas as in *Conocladus*, nor do any have spines on disk and arm-bases really as big as in that genus. For these reasons one can, without difficulty, separate specimens of the two genera, but I am not sure that the separation is not an arbitrary rather than a natural one. I have previously expressed the belief that *Conocladus* is derived from *Astroconus*, while Döderlein thinks the reverse to be the case. Which of us is correct can only be determined by a study of growth-changes in much younger specimens than any at present available. But the youngest specimens in the present series are not at all *Conocladus*-like, the radial shields being narrow and widely separated, the interradiial areas large and the disk spines few and small. It is quite possible that further study and more abundant material will show that *Conocladus oxyconus* is only an extreme form of *Astroconus australis*, and not a separate species. In that case the genus *Conocladus* will need a new name, *i.e.*, the species *amblyconus* and *microconus*, for the name *Conocladus* will have to replace *Astroconus* as the generic name of Verrill's *Astrophyton australe*, since it has the same type and antedates *Astroconus* by two years. In any case, whether *C. oxyconus* is specifically different from

Astroconus australis or not, it does not seem to me possible to draw a subfamily distinction between them, as Döderlein does, and place one in the *Astrochelinae* and the other in the *Gorgonocephalinae*. If these two groups are worth distinguishing as subfamilies, I think *Conocladus* must certainly be put in the *Gorgonocephalinae*.

Locs.—Thirty-five miles south-east of Bruni Island, Tasmania, 150-230 fathoms.

North-east of Cape Pillar, Tasmania, 50-80 fathoms.

Bay of Fires, Tasmania, 40 fathoms.

Twenty miles east of Babel Island, Bass Strait, 35 fathoms.

Between Devonport and Launceston, Tasmania.

Eastern Slope, Bass Strait, 70-100 fathoms.

Off Gabo Island, Victoria, about 200 fathoms.

Thirty-six miles N. 58° E., of Cape Wickham, King Island, Bass Strait.

South-east coast of Australia.

Coast of Victoria.

Forty miles west of Kingston, South Australia, 30 fathoms.

Off Murray River mouth, South Australia, 17 fathoms.

Sanders Bank, Kangaroo Island, South Australia, 28 fathoms.

Fifteen miles south of Cape Wiles, South Australia.

Fifty miles south of Cape Wiles, South Australia, 75 fathoms.

South-east of Flinders Island, South Australia, 37 fathoms.

Fifteen miles south of St. Francis Island, South Australia, 30 fathoms.

Genus *ASTRODENDRUM*, *Döderlein*.

ASTRODENDRUM PUSTULATUM,¹ *sp. nov.*

(Plate xxxiv., fig. 1-2.)

Disk diameter, 40 mm.; arms, divided about 8 times, approximately 225 mm. long, measured from mouth; one arm measured as follows, by divisions, the figures, however, being only approximate: from mouth to first fork, 20 mm.; second division, 12 mm.; third, 13 mm.; fourth, 30 mm.;

1. *Pustulatus*=having blisters or pustules; in reference to the pimple like elevations on the disk.

fifth, 30 mm. ; sixth, 27 mm. ; seventh, 37 mm. ; eighth, 30 mm. ; and ninth, 25 mm. Radial shields distinct, well separated, but in pairs ; distance between distal ends of a pair, 6 mm. ; width of shield at distal end, 3 mm. ; distance between distal ends, across an interradius, 12 mm. Disk covered by a smooth, thick skin without calcareous plates, even at margin ; all over the surface, but chiefly along the radial shields, are scattered minute, pimple-like elevations, not at all crowded, but where thickest there may be 7 or 8 in a space 3 mm. square ; large parts of the surface, especially near margin have none. Oral surface covered by the same smooth, thick, non-calcified skin, but with no pustules. Madreporite single, small, but distinct. Genital slits only 5 mm. long, but very distinct. Teeth and teeth-papillæ indistinguishable, rather flat, about three times as long as wide. Mouth-papillæ none. First tentacle pore of arm without any protecting scale ; succeeding pores of basal portion of arm with two small peg-like scales ; on first division of arm, there are three scales to each pore, the inner one nearly a millimeter long and .50-.66 mm. thick, the second about as long, but more slender, the outer distinctly smaller in every way ; all three have rough, prickly tips when dry. Distally the outer spine disappears and then the second, while the inner one becomes transformed into the characteristic hook. The half-circles of hooklets are very narrow, consisting of only 2 series of granules ; they are incomplete on the second arm-division and on the first are represented only by little patches ; on the third and distal thereto they are complete. Colour (in alcohol) nearly uniform reddish flesh-colour ; the pustules and tentacle-scales are somewhat darker.

This species is easily distinguished from either of the other species in this restricted genus by the characteristic disk-covering and the tentacle-scales. It is so utterly unlike any other known Australian euryalid that there is no possibility of confusion with any of them.

Loc.—East of Flinders Island, Bass Strait, 100-300 fathoms.

Genus *ASTROTHAMNUS*, *Matsumoto*.

ASTROTHAMNUS RUGOSUS,¹ *sp. nov.*

(Plate xxxv., fig. 1-2.)

Disk 20 mm. in diameter ; arms 5, approximately 140 mm. long, but the tips are so closely spirally coiled, it is not possible to measure them exactly. Disk covered by coarse, rounded

1. *Rugosus*=rough ; in reference to the rough character of the disk-covering.

granules .30-.90 mm. in diameter, among which are a few insignificant, minute plates; the granules are low, hemispherical, with rough, or prickly surface. Radial shields approximate in pairs, 10-12 mm. long by 2-2.5 mm. wide distally, more or less concealed. Arms sharply distinct from disk, the dorsal surface and sides covering by alternating half-circles of glassy hook-bearing, and opaque, smooth granules; the half-circles are not at all sharply defined under a lens but nevertheless give an appearance of fairly uniform annulations. Genital slits only about 2 mm. long, but quite wide. Madreporite small but very distinct, just outside the mouth frame; in the holotype, there are two, not in adjoining interradii, but one is evidently smaller and out of place. Oral surface and lower surface of arms, uniformly and finely granulated. Teeth, teeth-papillæ and mouth-papillæ numerous, similar, spiniform; teeth somewhat larger in every way than the others. First tentacle-pore of arm with 3 or 4 short, stout, spinulose tentacle-scales; second with 6 or 7, third with 8, succeeding pores with 8, 9 or 10, nearly to middle of arm, when the number begins to drop rapidly and the scales become more and more like the hooks on the lower ends of the half-circles of hooks, until at the tip of the arm the tentacle-scales are no longer distinguishable. Colour (in alcohol), brownish-yellow; when dry, considerably lighter. Four specimens.

This is a very distinct species, remarkable for the large number of tentacle-scales. The disk covering too is characteristic, obviously different from that of any of the previously known species. The genus is an East Indian one, reaching Sagami Bay, Japan, on the north and now shown to reach Tasmania on the south. The specimens from off Cape Everard, Victoria, are only 9 mm. across the disk and the maximum number of tentacle-scales seems to be 7.

Locs.—East of Flinders Island, Bass Strait, 80-300 fathoms. South-east of Cape Everard, Victoria, 200 fathoms.

Family OPHIACANTHIDÆ.

Genus OPHIACANTHA, *Müller and Troschel.*

OPHIACANTHA HETEROTYLA, *H. L. Clark.*

Ophiacantha heterotyla, H. L. Clark, Mem. Austr. Mus., iv., 11, 1909, p. 542.

This is a little individual, not 3 mm. across the disk, but there seems no doubt of its identity.

Loc.—Between Devonport and Launceston, Tasmania.

Family AMPHIURIDÆ.

Genus OPHIACTIS, *Lütken*.OPHIACTIS LUTEOMACULATA, *H. L. Clark*.

Ophiactis luteomaculata, H. L. Clark, Mem. Mus. Comp. Zool. Harvard, xxv., 1915.

These specimens were all taken from the large spines of a Sea-urchin (*Prionocidaris australis*) and as a rule, they were more or less hidden in Barnacles (Acorn-shells) growing thereon. The species was hitherto known only from the holotype taken at the Murray Islands, Torres Strait, in a large sponge. None of the present series is quite so large as the original but they show little structural divergence. The smallest specimens have 6 arms and are clearly reproducing by fission, but the adults are symmetrically 5-rayed. All the specimens are dry and their colours are dull but the adults have the arms pinkish and more or less distinctly banded. The radial shields are not of a different colour from the rest of the disk. An excellent specific character is a dark band or spot at the middle of the larger arm-spines; all these specimens show it.

Loc.—Eleven miles south-east of Ballina, New South Wales, 27-29 fathoms. Eleven specimens.

OPHIACTIS RESILIENS, *Lyman*.

Ophiactis resiliens, Lyman, Bull. Mus. Comp. Zool. Harvard, vi., 1879, p. 36.

One of the individuals from off Kingston, South Australia, (disk-diameter, 6 mm.) has all the upper arm-plates broken into 2 or 3 pieces. The other specimens, with disk-diameters of 3.5 and 5.5 mm. respectively, are not peculiar. It may be noted, however, that the species has not previously been known from west of Bass Strait. Three specimens.

Locs.—Forty miles west of Kingston, South Australia, 30 fathoms.

Off Cape Martin, South Australia, 21 fathoms.

OPHIACTIS SYMBIOTA,¹ *sp. nov.*

(Plate xxxvi., fig. 1-2.)

Disk 6.5 mm. in diameter ; arms about 26 mm. long. Disk covered by a coat of 150-200 rather coarse, flat, rounded scales, the largest of which are near centre and the smallest near interradial margins ; between these plates or on their corners or edges are low, conical tubercles which increase in length near the interradial margins, becoming short sharp spinelets ; these tubercles and spinelets are not very numerous, some plates having none, while the largest plates have only 5-6 around them. Radial shields small, about 1 mm. long by .5 mm. wide, well separated within but sometimes in contact distally. Upper arm plates, fan-shaped, truncate proximally, strongly convex distally, with lateral corners more or less rounded or truncate. Interbrachial areas below covered like the interradial margins of disk, with rather small scales and numerous sharp spinelets. Oral shields pentagonal, widest proximally, disto-lateral sides concave, distal side shortest ; madreporite very much larger than other four and more iso-pentagonal. Adoral plates large, twice as long as broad, curved, meeting broadly within. Teeth about 6, squarish ; below the lowest is a very small, triangular dental papilla. Oral papillæ apparently 2 on a side but the proximal may be the scale of the inner oral tentacle-pore ; distal papillæ nearly circular, about .20 mm. in diameter ; proximal, a trifle smaller and more angular. First under arm-plate relatively large, longer than wide, in contact with second, thus broadly separating the adoral plates ; succeeding plates tetragonal, wider than long, with distal margin slightly convex and lateral margins concave, becoming, beyond the middle of arm, pentagonal with a proximal angle and longer than wide ; first 5 or 6 barely in contact. Side arm plates rather large meeting above and below at middle of arm and beyond ; each carries 4, or usually 3, opaque, stout, blunt spines ; uppermost longest, about 1 mm. long ; lowest, shortest, about .60 mm. long. Tentacle-scale single, moderately large, at side of lower arm-plate. Colour (dry), brownish-white.

This interesting Ophiuran, I found on a specimen of *Comanthus plectrophorum*, clinging closely to the oral surface of the disk. Its position leaves little doubt in my mind that it was commensal with the Crinoid in life, as a number of species of Brittle-stars are known to be. It is utterly unlike *O.*

1. *συμβιώτος*=living with ; in reference to the apparently symbiotic habits.

resiliens in its general appearance and I at first thought it to be an *Ophiolebes*, but the mouth parts seem to be undoubtedly those of an *Ophiactis* and I therefore have referred it to this genus without dissection. The oral surface is rather markedly like *Ophiactis abyssicola* but the disk-covering is utterly unlike that species, and is indeed the distinguishing specific character. The short arms, few stout arm-spines and pair of oral papillæ are additional features worthy of emphasis.

Loc.—East of Flinders Island, Bass Strait, 100-300 fathoms.

Genus AMPHIURA, *Forbes*.

AMPHIURA CONSTRICTA, *Lyman*.

Amphiura constricta, Lyman, Bull. Mus. Comp. Zool. Harvard, vi., 1879, p. 22.

These specimens are all smaller than Lyman's type and as a rule have only 4 or 5 arm spines, but on a few basal arm joints of the largest specimen (disk diameter, 4 mm.) there are 6 spines. The type locality was Port Jackson, New South Wales, and there is a specimen in the Museum of Comparative Zoology from Westernport, Victoria. The "Endeavour" specimens thus extend the known range considerably to the westward. Three specimens.

Locs.—Forty miles west of Kingston, South Australia, 30 fathoms.

Off Cape Martin, South Australia, 21 fathoms.

Family OPHIOTRICHIDÆ.

Genus OPHIOTRICH, *Müller and Troschel*.

OPHIOTRICH ARISTULATA, *Lyman*.

Ophiotrich aristulata, Lyman, Bull. Mus. Comp. Zool. Harvard, vi., 1879, p. 50.

These specimens range from 5 to 18 mm. in disk-diameter and make a fine series of this handsome Brittle-star. The colour ranges from nearly white to rosy pink; the spines are always white or colourless. Two of the large individuals are beautifully though sparsely spotted with bright brown. There is a broad longitudinal stripe on the upper side of the arms, in one large specimen deep pink, but usually pure white. It seems to be lacking in the specimen from Oyster Bay,

Tasmania, and this individual is also peculiar in the large number of disc scales and the short, thorny disk spines; the disk-diameter, however, is only 6.5 mm., and I believe the peculiarities are associated with youth. The smallest specimen is from east of Maria Island, Tasmania, and still retains the large, transparent central plate of the disk, known to be characteristic of the very young of some other species of *Ophiothrix*; its disk spines are quite thorny and relatively rather short. Nineteen specimens.

Locs.—Twenty miles south-east by east of Tasman Head, Tasmania, 80-85 fathoms.

East of Maria Island, Tasmania, 78 fathoms.

Entrance to Oyster Bay, Tasmania.

East of Babel Island, Bass Strait, 65-70 fathoms.

Off Gabo Island, Victoria, 200 fathoms.

OPHIOTHRIX CÆSPITOSA, *Lyman*.

Ophiothrix cæspitosa, Lyman, Bull. Mus. Comp. Zool. Harvard, vi., 1879, p. 53.

These specimens range in disk-diameter from 1.5 to 6 mm., and in colour from bright reddish-pink to purplish-gray, brownish-yellow and nearly white. The disk covering shows much diversity also, ranging from a uniform covering of minute thorny, somewhat stellate stumps, which even conceal the radial shields, to one where the thorny stumps are very largely replaced by rough spinelets and the radial shields are more or less bare; there are many intermediate stages. The upper arm plates and the arm spines are more uniform, but not perfectly so. I cannot see that there is any correlation between the characters mentioned and the locality whence the specimen came. The seven specimens from off Ballina, New South Wales, were all found on the abactinal surface of a Sea-urchin (*Prionocidaris australis*); they are all young and are bright reddish-pink, except two which have pale pink arms and a light coloured disk hardly tinged with pink. In view of the well-known instability of characters in the genus, and the present multiplicity of species, I think it best to regard all the specimens as *O. cæspitosa* and leave it for some future worker in Australia to determine whether I am right. Forty-one specimens.

Locs.—Twenty-three miles east-south-east of Round Hill Head, Queensland.

Nine miles east of Fraser Island, Queensland.

Eleven miles south-east of Ballina, New South Wales, 27-29 fathoms.

Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

Forty miles west of Kingston, South Australia, 30 fathoms.

Sanders Bank, Kangaroo Island, South Australia, 28 fathoms.

Fifteen miles north-west of Cape Jervis, South Australia, 17 fathoms.

OPHIOTHRIX FUMARIA, *Müller and Troschel*.

Ophiothrix fumaria, Müller and Troschel, Sys. d. Ast., 1842, p. 113.

This is a well-preserved individual with disk 9 mm. across, agreeing in all essentials with a specimen of *O. fumaria* identified by Mr. Lyman many years ago, which was purchased in Hamburg and was reported to have come from the East Indies. The type locality of the species is stated by Müller and Troschel to be unknown.

Loc.—Seven miles south-south-east of Double Island Point, Queensland.

OPHIOTHRIX NEREIDINA (*Lamarck*).

Ophiura nereidina, Lamarck, Anim. sans Vert., ii., 1816, p. 544.

Ophiothrix nereidina, Müller and Troschel, Sys. d. Ast., 1842, p. 115.

Although small, only 4 mm. across the disk, these are typical examples of this beautiful species. They are chiefly of interest in that they extend the known range of the species many hundreds of miles to the south. Two specimens.

Loc.—Nine miles east of Fraser Island, Queensland.

OPHIOTHRIX SPONGICOLA, *Stimpson*.

Ophiothrix spongicola, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, vii., 1855, p. 385.

These are typical specimens of this handsome and characteristically Australian species. It seems to me quite possible, however, that *O. fumaria* is really the proper name for this species, Müller and Troschel's type having very probably been brought to Paris from Port Jackson, but never having had a locality label. Koehler's careful description of it and his figures apply very closely to this species, more closely than to the specimen Mr. Lyman has called *O. fumaria*. In the ultimate revision of the genus, this matter should be given critical attention. Three specimens.

Locs.—Shoalhaven Bight, New South Wales, 15-45 fathoms.

Fifteen miles north-west of Cape Jervis, South Australia, 17 fathoms.

Genus OPHIOTHELA, *Verrill*.OPHIOTHELA HADRA, *H. L. Clark*.

Ophiothela hadra, H. L. Clark, Mem. Mus. Comp. Zool. Harvard, xxv., 1915, p. 284.

This is another species, previously known only from the holotype taken at the Murray Islands, Torres Strait. The present series shows that the original was immature, and the arms are not unusually short and stout in adults, though the general form is rather robust. The largest specimen at hand is 3 mm. across the disk and the arms are 10-11 mm. long. Only the smallest specimens are as light as the holotype, all the larger specimens being prettily variegated with dull deep bluish, pink and pale cream-colour; the centre of the disk, the sides of the arms and the arm spines are pink; but there is some diversity. There is also some diversity in the armature of the disk, the larger interradial spine-like granules being often wanting. The oral shields are very small, nearly circular, white; adoral plates *larger than oral shield*, but quite similar in form and colour, perfectly smooth, in close contact with each other. There are 5 arm spines at base of arm. The knobs on the upper arm plates are conspicuous. All of these specimens were taken from the primary spines of Sea-urchins (*Prionocidaris australis*); most of the smaller ones are reproducing by fission and have only 2, 3 or 4 rays, but the adults are symmetrically 6-rayed.

Loc.—Eleven miles south-east of Ballina, New South Wales, 27-29 fathoms.

Family OPHIOLEPIDIDÆ.

Genus AMPHIOPHIURA, *Matsumoto*.AMPHIOPHIURA COLLETA¹, *sp. nov.*

(Plate xxxvii., fig. 1-2.)

Disk 17 mm. in diameter; arms all broken, but one is nearly 50 mm. long and indicates a probable length of 55 mm. or more. Disk covered by a coat of 21 large, flat, smooth scales and the 10 radial shields, between which, in the angles, are much smaller, more or less triangular scales; many of these little scales and some of the larger show a narrow, marginal border as though cemented down to the neighbouring plates; primary plates very distinct, about 2.5 mm. across, but not conspicuous. Radial shields, 3-4 mm. long and nearly or quite as broad, irregularly rounded triangular, smooth, the inner ends separated by a large scale, but the distal inner corner of one distinctly overlapping the corresponding corner of the other for more than a millimeter. Basal upper arm plate about twice as broad as long; second and third at least three times as broad as long; the succeeding 7 or 8 plates are tetragonal, wider than long, broadly in contact, with distal margin convex and much wider than proximal; beyond the tenth joint the upper arm plates tend to become triangular, as long as broad, and separated from each other, the condition they show on distal half of arm. Interbrachial areas below covered by the oral shield, a large marginal plate, wider than long and 5 smaller, somewhat swollen plates, between them. Genital plates large, more than a millimeter wide at the upper end, bearing an arm-comb of about 25 low, triangular papillæ, placed closely side by side; there are no papillæ on the arm plates.

Oral shields oval, sharply pointed proximally, 4 mm. long by 3 mm. wide; adoral plates, short, three times as long as broad, meeting fully and closely within; oral plates larger than adorals, only slightly swollen. Teeth only 4, triangular. Oral papillæ only 3 on a side, borne wholly on the oral plates; the innermost is like the teeth, but narrower, while the other two are very wide and notched like the molar teeth of a dog. Oral tentacle-pore (the second or distal one, of course) opens entirely outside mouth slit, at distal end of oral plate; its inner side is guarded by 4 papillæ, its outer by 6. First under arm plate large, octagonal, much wider than long; second longer and narrower, hexagonal, about as long as wide;

1. $\kappa\omicron\lambda\lambda\eta\tau\acute{o}\varsigma$ =glued together; in reference to the appearance of the disk plates.

succeeding plates wider than long, more or less tetragonal, broadly in contact. Beyond the eighth or ninth joints the under arm plates are nearly or quite separated from each other, pentagonal with proximal angle, much wider than long: they keep this form to the end of the arm. Side arm plates rather large, but not conspicuous, well separated at base of arm, but broadly in contact distally; each carries 3 small arm spines, a minute, bluntly pointed, peg-like one on upper distal corner of plate (often wanting distally) and a pair of somewhat larger, more flattened spines, close to the lower distal corner of plate; except on one or two basal joints, none of the arm spines are as long as one-third the length of the side arm plates. Tentacle-pores rather larger; the basal ones have 3 or 4 scales on each side, but the number soon dwindles to one on the under arm plate and one on the side arm plate and near the middle of the arm, the former disappears. Colour (dry), yellowish-white.

This rather handsome species is well characterised by the peculiar oral papillæ, the arrangement of the arm spines, the shape of the papillæ in the arm-comb and the arrangement of the disk plates. In all these particulars, as well as in the shape of the under arm-plates it differs from *A. ornata*, which is one of its near allies, but except in the arrangement of the disk scales it is no nearer to *A. undata*, which is one of its nearest allies geographically. Its longer arms and very different arm-comb will distinguish it at once from *A. ctenophora* (H. L. Clark) taken by the "Thetis" off the coast of New South Wales.

Loc.—East of Babel Island, Bass Strait, 60-80 fathoms.

Family OPHIODERMATIDÆ.

Genus PECTINURA, Forbes.

PECTINURA DYSCRITA, H. L. Clark.

Pectinura dyscrita, H. L. Clark, Mem. Austr. Mus., iv., 11, 1909, p. 534.

This series of specimens has led me to question very much whether *P. dyscrita* can properly be distinguished from *P. anchista*, the Japanese species. But after comparing specimens of the same size, I have decided not to unite them at present. The arm spines in *P. anchista* are thinner, flatter and more pointed than in *P. dyscrita*. If similar specimens of *Pectinura* should hereafter be found in the Philippines or in the East Indies, it would probably result in including the

Japanese and Tasmanian forms under the same name. The New Zealand species, *P. cylindrica*, is undoubtedly a very near relation but seems to be a smaller form, with arm spines and arm plates somewhat different. Lyman's *P. arenosa* from Bass Strait and Bell's *P. assimilis* from Port Jackson seem to be quite distinct, but it must be granted that the five species form a very homogeneous group.

The "Endeavour" specimens show plainly that in *P. dyscrita* at least the relative as well as the actual arm-length increases markedly with age; in the smallest specimen the disk-diameter (D) is 10 mm., the arm length (A) 40 mm., and hence $A=4D$, while in another $D=12$, $A=60$, $D=5A$, and in the largest specimen, $D=20$, $A=140$, $D=7A$. There is some diversity in colour indicated; the arms are often banded with brownish, or dirty whitish, and in one case there are 5 or 6 transverse bands, dorsally, of rose-purple. The colour in life is probably white, dull yellow, or pale brown, with rose-purple markings, spots or bands. Fourteen specimens.

Locs.—North-east of Cape Pillar, Tasmania, 80 fathoms.

East of Maria Island, Tasmania, 78-128 fathoms.

East of Babel Island, Bass Strait, 65-70 fathoms.

East of Flinders Island, Bass Strait, 80-300 fathoms.

Off Gabo Island, Victoria, 200 fathoms.

Family OPHIOCHITONIDÆ.

Genus OPHIONEREIS, Lütken.

OPHIONEREIS SCHAYERI (*Müller and Troschel*).

Ophiolepis schayeri, Müller and Troschel, Arch. f. Naturg., x. i., 1844, p. 182.

Ophionereis schayeri, Lütken, Add. ad Hist. Oph., pt. 2, 1859, p. 110.

This is a very small specimen, only 4.5 mm. across the disk, but it is not otherwise notable.

Loc.—Between Devonport and Launceston, Tasmania.

ECHINOIDEA.

The collection of Sea-urchins made by the "Endeavour" strengthens the evidence in support of the opinion formed by study of the "Thetis" collection, that Echini are relatively unusually common in the waters of Southern Australia. Considering the fact that there are rather more than one

thousand four hundred species of Ophiurans known and that only twenty-six occur in the " Endeavour " collection, it is remarkable that twenty-nine species of Echini occur, with fewer than five hundred species known. Of these twenty-nine species, five are here described for the first time and five others are recorded for the first time from Australia. The most remarkable specimen is undoubtedly the adult individual of *Echinus horridus*, a species previously known from off the coast of Chili, but the fine series of *Prionocidaris australis*, the handsome new *Coelopleurus* and the new *Maretia* are worthy of particular mention. Up to the present time about sixty species of Echini have been listed from Australia, but wrong identifications have been so numerous and misleading, the real number of species is very uncertain. Probably, including the ten here added to the list, there are at least sixty Australian Echini occurring in less than three hundred fathoms, thirty-five of which are peculiar to Australia.

Family CIDARIDÆ.

GENUS PHYLLACANTHUS, Brandt.

As regards the generic name *Phyllacanthus*, I have given fresh and careful attention to Brandt's paper, and I see no ground for rejecting his subgenera. Lambert and Thiéry¹ have argued very strongly that these groups are invalid, but there seems to me a fundamental error in the argument which quite vitiates it. They assume that Brandt is revising and classifying all Echini, and hence when he gives three subgenera under the genus *Echinus* they assume that all the species of *Echinus* are to be placed in these three subgenera, and, of course, one would then *have* to be a synonym of *Echinus*. But such is not Brandt's intention. He is simply giving a classification of the forms noted by Mertens in his voyage; occasionally other species are mentioned for illustrative purposes, but there is no attempt to group all the known Echini. Under the circumstances, then, I do not see why Brandt's subgenera are not perfectly valid, certainly as much so as any genera of Echini that were proposed prior to 1846. Particularly in the case of *Phyllacanthus*, Brandt's course is clear; he had a large cidarid from the Bonin Islands to deal with; its peculiarities were obvious and are fairly well stated; for it he proposed a subgenus of *Cidarites* which he called *Phyllacanthus*, at the same time designating the species as *P. dubia*. The fact that he was planning for a full

1. Lambert and Thiéry—Bull. Soc. Sci. Nat. Haute Marne, vi., 23, 1909.

classification of Echini (as he states in a footnote) and so suggests two sections for the subgenus and mentions certain of Lamarck's species of *Cidarites* in connection with them, does not so far as I can see affect the status of *Phyllacanthus* at all. It seems to me clear that the only generic name, except *Cidaris* (= *Cidarites*), which may be used correctly for *dubia* and *imperialis*, whether they are identical, as is generally believed, or not, is *Phyllacanthus*.

PHYLLACANTHUS IMPERIALIS (*Lamarck*).

Cidarites imperialis, Lamarck, Anim. sans Vert., iii., 1816, p. 54.

Phyllacanthus imperialis, Brandt, Prodrôme, 1835, p. 268.

The test of this individual is about 45 mm. in diameter and the longest spines are 60 mm. long and 5 mm. thick. It is undoubtedly an example of Tenison-Woods' *P. parvispina*, but I am not prepared to recognise the form by name yet. A good series of specimens from the Murray Islands in Torres Strait are all typical *P. imperialis*, so far as I can see, but all the New South Wales material I have examined has the slender spines of *P. parvispina*. The amount of available material from other regions is not sufficient to enable me to decide as yet on the worth of this character.

Loc.—Shoalhaven Bight, New South Wales, 15-45 fathoms.

Genus PRIONOCIDARIS, A. Agassiz.

PRIONOCIDARIS AUSTRALIS (*Ramsay*).

Phyllacanthus australis, Ramsay, Cat. Echinod. Austr. Mus., 1885, p. 44.

Stephanocidaris bispinosa, A. Agassiz, Rev. Ech., pt. 1, 1872, p. 160 (*nomen nudum*); pt. 3, Sept., 1873, p. 393 (NON *Cidarites bispinosa*, Lamarck, as described and figured by de Loriol, Mém. Soc. Sci. Nat. Neuchâtel, v., May, 1873, p. 33).

Prionocidaris agassizii Döderlein, Abh. Senck. Naturf. Ges., xxxiv., 1911, p. 242.

This is a remarkable series of a very notable species. Döderlein (*loc. cit.*) has shown very clearly that the genus *Stephanocidaris* A. Ag. is a pure synonym of *Goniocidaris* and hence cannot be used for this species. He shows further that

Mr. Agassiz's application of the name *bispinosa* to this species cannot be maintained since de Loriol's restriction of Lamarck's name to the species Mr. Agassiz called *annulifera* has several months' priority over Mr. Agassiz's selection. The latter being left thus without a name, Döderlein courteously proposed to call it *agassizii*. When at the Australian Museum in November, 1913, I was surprised to find that Ramsay's type of *Phyllacanthus australis* is a fine example of the Sea-urchin Mr. Agassiz and I have called *Stephanocidaris bispinosa*. It is not strange that no one has suspected it hitherto, for Ramsay gives virtually no description but relies on three photographs to make clear the specific characters. The whole nomenclatural tangle is now fairly well cleared up, and apparently all living students of the recent Echini are agreed as to the proper use of Lamarck's names for cidarids, even though we still disagree as to generic divisions.

The present series of *P. australis* ranges from 27 to 73 mm. in test-diameter, horizontally (h.d.) ; the specimen with h.d. = 27 mm., has primary spines 67 mm. long or 2.5 h.d., while in the big individual they are only 60-65 mm. long or less than h.d. Evidently 65-70 mm. is the full length of the spine for this species, and growth ceases when that length is attained, though the test may continue to grow indefinitely. The primary spines when young are purple and smooth ; they soon develop sharp teeth along the sides, and with this development the spine becomes somewhat flattened ; at least the oral side is more or less flattened, the aboral side tending to become carinate ; the spine is thus almost or quite triangular in cross-section, where widest ; as the lateral teeth increase in size numerous similar but smaller teeth arise, particularly along the aboral side ; with this change in form of the spine there goes an equally great change in colour ; the teeth are greenish and as they increase in number the spines appear to be less and less purple ; as the spine matures it becomes coated with a loose, colourless or whitish calcareous coat which completely masks the remaining purple colour ; then Sponges, Bryozoa, Brachiopods, Lamellibranchs, Worm-tubes and Barnacles (but particularly Barnacles) proceed to encrust the adult spines, making them the habitations of small Brittle-stars and Crustaceans. Many of the old, short actinal primaries (but not the small ones around the mouth) become very flaring at the tip in old individuals ; thus a spine 3.3 mm. in diameter near the middle may be almost 5 mm. across the obliquely truncate and almost flat tip. The white spots on the collar of the primaries appear as soon as the collar is formed ; they are always visible, but the distinctness

differs much in different individuals and on different spines ; occasionally they merge into more or less complete longitudinal lines, but this is unusual ; they are often well developed on the neck of the spine above the collar. The actinal primaries have the collar very wide, and a thick, somewhat serrate "cap" formed from the outer layer of the spine.

The abactinal system is larger than the actinostome, but the difference shows some diversity ; in the smallest specimen the actinostome is little more than 8 mm., while the abactinal system is nearly 12 ; in the largest specimen the measurements are approximately 25 and 32 ; but in a specimen of average size the measurements are only 18 and 20.

The secondary spines show remarkable diversity of colour ; in several specimens they are bright red, with those of the ambulacra more or less greenish at both base and tip, and those of the interambulacra with very slightly greenish tips. In other cases they are reddish with purple tips and a longitudinal purplish stripe, or they are dull flesh-colour with red longitudinal stripe. In the largest specimens, all the secondaries are more or less greenish, those of the interambulacra with darker longitudinal stripe and pink or purplish tip, while those of ambulacra are more nearly uniformly dark greenish. Evidently no specific character can be drawn from the colouration of the secondary spines !

The occurrence of globiferous pedicellariæ shows an equal diversity ; in many specimens they are rare or wholly wanting, but in the larger specimens they are generally present, at least in the interambulacra, and in several of the biggest specimens they are excessively abundant and very conspicuous, as they are white or pale greenish in colour. The stalk is 3 mm. long (more or less) and has a very conspicuous limb. The head is about a millimeter long and the valves seem to be like those of *P. baculosa*. I have hitherto laid much stress on the absence of globiferous pedicellariæ in "*Stephanocidaris bispinosa*, A. Agassiz," but evidently the two specimens previously seen by me were misleading. I can no longer doubt that this species and *baculosa* are congeneric and that I have been wrong in counting the latter a *Phyllacanthus*. Since as already shown the name *Stephanocidaris* must be abandoned, I follow Döderlein in using *Prionocidaris*, of which *P. pistillaris* (= *baculosa*) is the type, for the group I have hitherto called *Stephanocidaris*, the diagnosis being modified to permit the inclusion of *baculosa*. Thirty-four specimens.

Locs.—Off Fraser Island, Queensland.

Twenty-five miles south-east of Double Island Point, Queensland.

Eleven miles south-east of Ballina, New South Wales, 27-29 fathoms.

Genus *CIDARIS*, *Leske*.

CIDARIS CONFERTA,¹ *sp. nov.*

(Plate xxxviii., fig. 1-4.)

Test little flattened; vertical diameter about .60-.70 of horizontal; coronal plates 7 or 8; areolæ large, nearly circular, only the lowest 2 or 3 confluent; median interambulacral area with vertical suture quite distinct and 3-4 series of tubercles on each side of it; ambulacra about one-fourth of interambulacra in width; poriferous zones not sunken, very narrow, the pores close together; median ambulacral area with a double series of tubercles on each side, inner much smaller; vertical suture not very distinct; pores large, nearly circular, only slightly oblique. Abactinal system about .46 of horizontal diameter of test, nearly circular and clearly defined, flat or slightly elevated, well covered with small secondary spines; genital plates large and nearly square, outer margin a little convex and inner equally or more concave, with pores near distal margin; ocular plates triangular or with inner angle truncated when plate is fully insert, as wide as high or wider, with pores very close to distal margin; in four specimens oculars I, V and IV are insert, while in the largest specimen all are insert, though IV is very narrowly so; anal system about one-half diameter of abactinal system, covered by a marginal series of 8-10 rather large plates and 12-15 (or more) smaller ones within; all abactinal and anal plates are fairly covered by rather coarse tubercles; there are 2-10 on the anal plates, 30 or more on the oculars, and 50 or more on the genitals. Actinostome small, only about .37 of horizontal diameter of test, not at all sunken, closely covered by stout plates, 12-15 in each interambulacrum and about a dozen pairs in each ambulacrum. Primary spines when fully grown 60-70 mm. long, and 2.5-3.5 mm. thick, cylindrical and tapering rather abruptly to a bluntly pointed tip; in the largest specimen they are distinctly compressed near tip; except when still immature, they are very closely covered by low, rounded granules, which are so closely crowded they do not form longitudinal series as is usual; the collar is very low, about 1-1.5 mm. high, very finely striate

1. *Confertus*=crowded; in reference to the densely crowded granules on the primary spines.

longitudinally; neck smooth, shining, porcelain-like; as the spine gets older, the smooth, shining neck comes to occupy more and more of the spine, so that in old spines only the distal half or two-thirds shows the crowded granules clearly; actinal primaries, smooth, flattened, not at all serrulate, with very broad collars; secondaries, narrow, flat and blunt. Pedicellariæ much as in *Cidaris affinis*, Phil.; large globiferous pedicellariæ very infrequent, wanting in some specimens; tridentate pedicellariæ rather numerous; small globiferous somewhat less so. General colour of test yellowish-brown or dull reddish; secondary spines whitish or yellowish, the larger ones about the primaries with a longitudinal stripe on the outer side, of brownish, greenish or yellowish tint; this stripe may be very faint and is often wanting, but is probably characteristic of the living animal; secondaries often tipped with yellowish or reddish; primary spines pure white (more or less soiled and encrusted distally) with yellow-brown collar; in the smallest specimen many of the primaries are encircled by two narrow, widely separated, rather faint rings of dull rose-red. The smallest specimen is 25 mm. in diameter, the largest 45 mm.; the latter is 33 mm. high. Five specimens.

At first glance these specimens look very much like *Cidaris cidaris* of Europe or *C. abyssicola* of Florida, but on more careful examination the relationship to *C. affinis* becomes more evident. I am no longer willing to separate *affinis* from *cidaris* generically, for in large series of specimens it is difficult to separate them even specifically. I have therefore abandoned the genus *Tretocidaris* in the sense in which I formerly used it, and I am the more ready to do this because I think the "splitting" of genera has been already carried too far in the Cidaridæ, and we need now to do a little consolidating and redefining.

The occurrence of the present species off South-eastern Australia is very interesting, for no nearly related species has been taken by the "Challenger," "Siboga," "Valdivia" or "Albatross" in their various collections in the Indian and Pacific Oceans. The "Challenger" species, *C. bracteata*, recently found off Western Australia, is as near an ally as any, but the difference in the primary spines is very marked. Indeed, the crowded condition of the granules on the primaries of *C. conferta*, and the lack or faint indication of longitudinal series in their arrangement, readily distinguish the present species from any cidarid with which I have compared it.

Locs.—Eastern Slope, Bass Strait, 80-200 fathoms.

South of Gabo Island, Victoria, about 200 fathoms.

Genus GONIOCIDARIS, *L. Agassiz and Desor.*GONIOCIDARIS CLYPEATA, *Döderlein.*

Goniocidaris clypeata, Döderlein, Arch. f. Naturg., li. i., 1885, p. 82.

It is only after much hesitation that I refer these little Echini to this Japanese species, but were they from Sagami Bay, Japan, I should do so without question. All are small, and only eight show the characteristic clypeate spines, but there is at least one of these from each of the stations listed below. All the specimens agree in a greenish colouration, or at least in having a greenish tinge, particularly on the actinal primaries and in lacking the big globiferous pedicellariæ characteristic of the two following species. The largest specimen is 20 mm. in horizontal diameter and comes from off Cape Pillar, Tasmania. I have compared it with a specimen of the same size from Japan, and while there are obvious differences, they are so trivial that I cannot find a single good character, nor any tangible combination of characters, which would justify calling the two specimens by different specific names. The "Siboga" took, in the East Indies, south of the equator, a cidarid which de Meijere called *G. hirsutispinus* but which I believe to be *G. clypeata*, so that the occurrence of this species in both Japanese and Tasmanian waters is not so improbable as at first appears. Fourteen specimens.

Locs.—Off Port Davey, Tasmania, 88 fathoms.

Near Storm Bay, Tasmania.

North-east of Cape Pillar, Tasmania, 80 fathoms.

Twenty miles east of Maria Island, Tasmania, 128 fathoms.

Oyster Bay, Tasmania, 20-40 fathoms.

East of Babel Island, Bass Strait, 65-70 fathoms.

GONIOCIDARIS GERANIOIDES (*Lamarck*).

Cidarites geranioides, Lamarck, Anim. sans Vert., iii., 1816, p. 56.

Goniocidaris geranioides, Agassiz and Desor, Ann. Sci. Nat., Zool., (3), vi., 1846, p. 337.

These specimens are nearly all small, only four exceeding 25 mm. in diameter. The largest, 37 mm. in diameter, is a good example of the species and shows the distinguishing characters well. The two other adults (30 and 32 mm.) are less typical, but are undoubtedly *G. geranioides*. Many of the

smaller specimens approach *G. tubaria* and the very young are distinguishable only with some difficulty. The differences between the preceding species, *G. clypeata*, and young *G. geranioides* are also very slight, but they seem to be constant; in the Tasmanian specimens of *G. clypeata* there are no large globiferous pedicellariæ, while these are generally very common in *G. geranioides*, and the actinal primaries are more or less greenish, which is not the case in *G. geranioides*. The growth changes in *G. geranioides*, as revealed by the present series are very interesting. Young specimens have either long, slender and often perfectly smooth primaries (*i.e.*, without thorns and prickles) or they are short, moderately stout and with a few coarse thorns. As the individual matures, the spines become more and more stout and the abactinal ones become expanded at the tip; they are rough, but not spiny, the coarse thorns which may have been present in youth, wearing down more or less markedly. Meanwhile the miliary tubercles and spines encroach more and more on the median ambulacral area, until the adult ladder-like arrangement of transverse ridges is perfected. As a result of these changes the mature specimens (30 mm. and over) look very unlike the young. Thirty-one specimens.

Locs.—Oyster Bay, Tasmania, 20-40 fathoms.

North-east of Cape Pillar, Tasmania, 80 fathoms.

Seven miles north-east of Cape Pillar, Tasmania, 50-60 fathoms.

Near Storm Bay, Tasmania.

Off Port Davey, Tasmania, 88 fathoms.

South-west of Rocky Point, Tasmania.

Near Mainwaring Cove, Tasmania, 50 fathoms.

Forty miles west of Kingston, South Australia, 30 fathoms.

Off Cape Marsden, Kangaroo Island, South Australia, 17 fathoms.

South of St. Francis Island, 35 fathoms.

GONIOCIDARIS TUBARIA (*Lamarck*).

Cidarites tubaria, Lamarck, Anim. sans Vert., iii., 1816, p. 57.

Goniocidaritis tubaria, Lütken, Vid. Med., 1863 (1864), p. 137.

This is a very good series of this well-known and characteristic species. The eighty-eight specimens range in size from 10 to 50 mm. (horizontal diameter). The primary spines seem to reach their maximum length, 40-50 mm.,

when the individual is about half grown (test diameter, 25 mm.), after which they may increase greatly in thickness, spininess and general bizarre appearance; they may decrease in length, probably from attrition, for the largest specimen in the present series has no primary 25 mm. long. This specimen, by the way, comes from the same station (and bears the same registered number), as the largest and most typical example of *G. geranioides*; in colour it is somewhat like the latter, as well as in the character of the primary spines, but the test is that of a perfectly typical *G. geranioides*. I confess to being uncertain as to the true interrelationships of the Australasian species of *Goniocidaris*. It will be noticed that all the specimens of *G. clypeata* taken by the " Endeavour " are from southern and eastern Tasmania; those of *G. geranioides* are from southern and western Tasmania and South Australia; while the range of *G. tubaria* is from northern New South Wales southward and westward to western South Australia, barely touching Tasmania. The specimen listed from Oyster Bay, Tasmania, is, however, a perfectly typical *G. tubaria*. Unfortunately we know very little of *G. umbraculum* from New Zealand, and only three old, bare tests are available for my study. After examination of the evidence I can secure, I am inclined to think that we shall ultimately consider *G. tubaria* and *G. geranioides* as one species (for which the latter name will be used) but separate subspecies, while the form here listed as *G. clypeata* will prove to be identical with *G. umbraculum*, which will in turn be considered a sub-species of *G. geranioides*. The Australasian forms of *Goniocidaris* would then list as follows:—

G. geranioides (Lamarck).—Southern Tasmania and westward to the Great Australian Bight.

G. g. tubaria (Lamarck).—Southern coasts of continental Australia, from northern New South Wales to central Western Australia.

G. g. umbraculum (Hutton).—Eastern Tasmania and New Zealand. I think *G. umbraculum* is undoubtedly distinct from the Japanese *G. clypeata*, but am unable to give any satisfactory differences at present.

Locs.—Eleven miles south-east of Ballina, New South Wales, 27-29 fathoms.

Six miles east of Cape Hawke, New South Wales, 47-50 fathoms.

Shoalhaven Bight, New South Wales, 15-45 fathoms.

Eastern Slope, Bass Strait, 80-200 fathoms.

Twenty miles east of Babel Island, Bass Strait, 65 fathoms.

Off Babel Island, Bass Strait, 50-60 fathoms.

Oyster Bay, Tasmania, 30 fathoms.

Twenty-four miles south-south-east of Eagles Nest Rock, Victoria, 15 fathoms.

Forty miles west of Kingston, South Australia, 30 fathoms.

Off Cape Marsden, Kangaroo Island, South Australia, 17 fathoms.

South of St. Francis Island, South Australia, 35 fathoms.

Genus HISTOCIDARIS, *Mortensen*.

HISTOCIDARIS ELEGANS (*A. Agassiz*).

Porocidaris elegans, A. Agassiz, Proc. Amer. Acad., xiv., 1879, p. 198.

Histocidaris elegans, Mortensen, "Ingolf" Ech., pt. 1, 1903, p. 22.

This is an interesting quartette, each one having some point of special interest. The smallest is 20 mm. in horizontal diameter (h.d.) and 12 in vertical (v.d.); there are only 6 coronal plates in each series; the primary spines are 50-58 mm. long, and while finely spiny have no coarse thorns; the test, secondaries and collar of the white primaries are dull, deep gray-purple. The next specimen is 38 mm. h.d. and 25 v.d.; there are 7 or 8 coronal plates; the primary spines are wonderfully fine, 100-130 mm. long, 3 mm. thick, and very thorny near base, becoming finely spiny near tip; the colour is like that of the small specimen. The third specimen is remarkable for the size and shape of the test and the number of coronal plates: h.d.=71 mm., and v.d.=61, so that the height is .85 of h.d.; there are 12 coronal plates and excessive number for a recent cidarid; the primary spines are all broken or missing (except actually), but it is evident that none were thorny; the test is deep yellow-brown, the secondaries, pedicellariæ, etc., dirty whitish; the general condition of the specimen is poor though the test is perfectly whole. The fourth specimen is remarkable only because of its large size, h.d.=78 mm., and v.d.=58; v.d.=.75 h.d.; there are 10 or 11 coronal plates; the primary spines are as a rule broken, but a number are whole, all are coarsely thorny and the longest probably exceeded 100 mm. It would seem that in this species, as in the preceding species of *Goniocidaris*, the primary spines reach their full length, 100-130 mm. when the test is about half grown, and that subsequent changes are

relatively slight, except as accident or attrition may decrease the length.

With reference to the generic name of this species, I think Lambert and Thiéry are right in objecting to any recent species being assigned to the genus *Porocidaris*; it is very unlikely that any now known really belong there; certainly none show the distinctive generic feature. On the other hand I think it still worse to put these characteristic recent forms into Pomel's ill-defined and heterogenous group *Plegiocidaris*, as my esteemed French colleagues do, and I believe the best plan is to follow Mortensen in creating a special genus *Histocidaris*. I differ from him, however, in considering *purpuratus* as much a member of *Histocidaris* as is *elegans*, and hence I am obliged to reject his proposed genus *Poriocidaris*. Including *purpuratus*, *Histocidaris* is one of the most natural genera yet recognised in the family.

Locs.—Eastern Slope, Bass Strait, 80-200 fathoms.

East of Flinders Island, Bass Strait, 100-300 fathoms.

Family CENTRECHINIDÆ.

Genus ASTROPYGA, Gray.

ASTROPYGA RADIATA (*Leske*).

Cidaris radiata, Leske, Add. ad Klein, 1778, p. 52.

Astropyga radiata, Gray, Ann. Phil., xxvi., 1825, p. 426.

The finding of this conspicuous Sea-urchin so far to the south of its previously known range is one of the " Endeavour's " many interesting discoveries. The " Siboga " took specimens near Ceram, north-west from New Guinea, but the genus has not hitherto been found in Torres Strait or anywhere on the Australian coast. The present specimens are 110 and 145 mm. in diameter; the larger is dull dark red, the primaries, especially the actinal ones, with a greenish cast; the smaller is reddish-white with actinostome, genito-ocular ring and outer half (or more proximally) of each abactinal interambulacral plate, rose-red; the abactinal blue spots show up plainly on the smaller specimen, but are much less distinct on the larger and darker one. The actinal primaries of the smaller specimens are prettily, transversely banded. Two specimens.

Loc.—Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

Genus CHÆTODIADEMA, *Mortensen*.CHÆTODIADEMA GRANULATUM, *Mortensen*.

Chætodiadema granulatum, *Mortensen*, *Vid. Med.*, 1903, p. 1.

This is another East Indian species, not previously known from south or east of Torres Strait, whose range the "Endeavour" has found to extend to southern Queensland. The "Challenger" took some small specimens west of Torres Strait, which were recorded as *Astropyga pulvinata*. The present specimen is larger than any hitherto recorded, measuring 115 mm. h.d. Its colour is also different, the abactinal surface being brownish-olive and the primary spines pink; orally, test and spines are whitish, the primaries with a green tinge; the abactinal blue spots are conspicuous and are distributed as described by *Mortensen*.

Loc.—Twenty miles north-east of Double Island Point, Queensland, 29-30 fathoms.

Family ECHINOTHURIDÆ.

Genus ARÆOSOMA, *Mortensen*.ARÆOSOMA THETIDIS (*H. L. Clark*).

Athenosoma thetidis, *H. L. Clark*, *Bull. Mus. Comp. Zool. Harvard*, lii., 1909, p. 134.

Aræosoma thetidis, *A. Agassiz* and *H. L. Clark*, *Mem. Mus. Comp. Zool. Harvard*, xxxiv., 1909, p. 176.

These specimens are 115-180 mm. h.d. and have the general appearance of those collected by the "Thetis." It is too bad that there is no knowledge of where most of these specimens were taken, for the range seems to be quite restricted. Apparently it is the only echinothurid in the shallower coastal waters of Australia.

Loc.—South of Gabo Island, Victoria, about 200 fathoms. Nine specimens.

Also eight specimens from an unknown locality.

Family ARBACIIDÆ.

Genus COELOPLEURUS, *L. Agassiz*.COELOPLEURUS AUSTRALIS,¹ *sp. nov.*

(Plate xliii., fig. 1.)

Test 40 mm. h.d. and 24 mm. v.d.; height therefore is .60 h.d. Coronal plates 11 or 12 in a column, but only the

1. *Australis*=southern, in reference to its being the most southern representative of the genus.

lowest 7 or 8 carry primary tubercles and spines ; interambulacral areas abactinally only about 8 mm. broad. Ambulacral plates 12, each with a large primary tubercle ; ambulacra 13 mm. wide at ambitus, where interambulacra are about 11, but only 8 mm. abactinally where interambulacra are 8. Primary tubercles large and smooth, without crenulation or perforation, of course. Abactinal system about 11 mm. across ; oculars all exsert ; anal system, 5.5 mm. across, covered by 4 similar, triangular plates. Actinostome some 16 mm. across, bare, except for the ring of buccal plates, close around the mouth which bear numerous, ophicephalus pedicellariæ. Primary spines, when fully developed, 85 mm. long, distinctly curved, tapering to a blunt point, which is nearly always broken off ; collar about 11 mm. long or about .13 of spine-length ; it is very slightly further advanced on the dorsal keel of the spine than on the lower surface ; on each side of the keel on the collar are two slight but distinct longitudinal ridges, and there are six such parallel ridges on the lower side of the collar ; on most of the primaries above the ambitus the collar is much longer, .30-.45 of spine-length, or the uppermost spine or two is all " collar," *i.e.*, has no smooth, polished surface. Actinal primaries very flat, thin, slightly curved, abruptly truncate, about half collar. Secondary spines, cylindrical or terete, stout and blunt, 4-5 mm. long. Pedicellariæ abundant ; the valves of the ophicephalous are not at all constricted as in *C. floridanus*, but on the other hand are not so wide and blunt at tip as in *C. longicollis*. Colour of test much as in *C. floridanus* and *C. longicollis*, light brownish, or dirty cream-colour, with ocular plates, outer borders of genital plates, outer portion of abactinal interambulacral plates, and a narrow, zigzag, median ambulacral line, vermilion red ; inner portion of abactinal interambulacral plates more or less lavender or rose-purple (according to dryness and conditions of lighting) ; secondary spines abactinally reddish-brown ; uppermost primaries and collars of the others very light gray-brown with, often, a greenish tinge ; in mature primaries the polished portion is light apple-green adjoining the collar, on upper surface, but very quickly passes into bright red (not abruptly, however) ; at the very tip of the spine may be one or two rather broad transverse bands of light green ; lower surface of primaries, pure white ; actinal primaries white, with collar pale grayish or gray-brown.

This is a very typical *Coelopleurus* and closely related to *C. floridanus* and *C. longicollis*, but it differs from both in the character of the dorsal interambulacra. The difference is marked when specimens are compared, but it is less easy to

describe. Perhaps it may be most easily stated thus: in *C. floridanus* and *C. longicollis*, the genital plates are about the same width as the bare interambulacral space, while in *C. australis* they are about the same width as the entire interambulacrum. In *C. australis*, the outer half of the upper interambulacral plates, which lack a primary tubercle, is well covered by a couple of secondary and 10-20 miliary tubercles; in *C. longicollis* there are very few such tubercles on those plates; in *C. floridanus*, the tubercles are numerous, but are very small, so the surface of the outer end of the plate is granular, rather than tuberculous. The Australian species resembles *C. longicollis* in the large size of the dorsal ambulacral tubercles; they are even larger than in that species. It is also like *C. longicollis* in the characters of fully developed primary spines, but the collar is lower and the colouration is totally different. *Coclopleurus* has been taken at the Kei Islands and at New Britain, but its occurrence in Bass Strait extends the range of the genus over two thousand miles at least.

Loc.—Eastern Slope, Bass Strait, 60-112 fathoms.

Family ECHINIDÆ.

Genus ECHINUS, Linné.

ECHINUS HORRIDUS, A. Agassiz.

(Plate xxxix.; Plate xl., fig. 1-2.)

Echinus horridus, A. Agassiz, Proc. Amer. Acad., xiv., 1879, p. 203.

The specimen from south of Gabo Island, Victoria, is not only the most remarkable Echinoid in the collection, but is one of the most extraordinary Sea-urchins which has ever been taken. It has a horizontal diameter at ambitus of 80 mm. and a vertical height of 115 mm.; there are 33 or 34 coronal plates and 61-62 ambulacrals, in each column; the abactinal system is 12 mm. across (.15 h.d.) and all the ocular plates are exsert; the anal system is nearly 5 mm. across, and is covered by about 160 small plates, many quite granule-like, among which the flat, circular suranal is very prominent; the spines are nearly all missing; those which remain are small secondaries or the bases of broken, bright red primaries; the actinostome is very small, only 11 mm. across, or less than .15 h.d. I have compared this specimen with the fragments of a slightly larger specimen of *E. horridus* from off southern

Chili, a cotype of Mr. Agassiz's species. The only difference of importance is in the covering of the anal system, which in the Chilian specimen consists of fewer and larger plates. This may prove to be a good specific character, but only more abundant material can determine the point, and meanwhile the Australian specimen may best be considered as *E. horridus*, the resemblance in colour, shape and character of the test and spines being so very marked.

The specimen from east of Flinders Island, Bass Strait, is very much smaller, and is of great interest as indicating that the extraordinary increase in length of the vertical axis occurs only after the individual is half grown. The horizontal diameter of this specimen is 41 mm. while the vertical is 32; v.d. is thus a little more than three-fourths h.d.; the abactinal system (8 mm.) and actinostome (7.5 mm.) are relatively a little larger than in the adult, but are notably small. There are 23 coronal plates, indicating that while the height of the test is increasing over 250 per cent., the number of coronal plates increases less than 50 per cent.; obviously the increase in height is due to marked increase in size of the coronal plates rather than to great increase in number. The colour of this smaller specimen is like that of the adult, reddish with bright red primary spines.

The specimen from off Maria Island, Tasmania, is obviously young. It is partly broken, and lacks the abactinal system entirely. It is 17 mm. in diameter, with an actinostome 7 mm. across and has 15-16 coronal plates in each column. There are no spines left. The tuberculation of the distinctly reddish test is much coarser relatively, if not actually than in the older specimens; in particular there are several secondary tubercles on each interambulacral plate which are very nearly equal to the primary tubercle in size. It is possible that this specimen is not a young *E. horridus*, but when locality and depth are considered it seems highly probable that it is. The developmental stages of this species would certainly be of extraordinary interest, and it is to be hoped that at some future day an oceanographic survey of the region between Tasmania and New Zealand and between the latter country and Chili may bring to light the necessary material. Three specimens.

Locs.—South of Gabo Island, Victoria, 100-250 fathoms.

East of Flinders Island, Bass Strait, 100-300 fathoms.

East-north-east of Maria Island, Tasmania, 125-180 fathoms.

Genus PARECHINUS, *Mortensen*.PARECHINUS NOTIUS,¹ *sp. nov.*

(Plate xli., fig. 1-3.)

Test 28 mm. h.d. and 18 v.d. ; height, therefore, is .64 h.d. Coronal plates thick, rough, though not actually sculptured, 20 in a column, each with a primary tubercle whose areola is about half the height of the plate (in midzone) and on each side of which are two secondary tubercles, not much smaller than primary ; the 5 tubercles form a horizontal series ; above midzone on a few plates the secondary tubercles are somewhat more numerous and less regularly arranged, but the uppermost 4 or 5 plates have only 3, 2, 1 or 0 ; interambulacra about 12 mm. broad at ambitus. Ambulacral plates 22, but little lower than the interambulacral, each (in midzone) with a primary and 1 large secondary tubercle ; the latter is near the inner end of the plate and disappears abactinally ; ambulacra 7 mm. wide at ambitus ; poriferous zones narrow (1 mm. wide), the arcs of pores vertical. Abactinal system small and compact, 7.5 mm. across ; all oculars exert but I nearly in ; anal system large (4 mm. across) nearly circular, covered by numerous (about 30) plates, among which the nearly circular suranal is very distinct and much the largest ; each genital plate carries 3 or 4 secondary tubercles, each ocular, 1. Actinostome rather large, 11 mm. across ; gill slits very slightly indicated ; buccal membrane thin and perfectly bare, except for the 5 pairs of primordial ambulacral plates, which are very near the mouth, but do not form a closed ring ; they are densely covered with ophicephalous pedicellariæ. Primary spines 7-8 mm. long, abruptly and not sharply pointed, each with about 10 longitudinal ridges, low, rounded and close together ; secondary spines similar but not so long and often somewhat swollen at tip ; miliary spines very few, most of the relatively few miliary tubercles bearing pedicellariæ. Globiferous pedicellariæ fairly common, very similar to those found on the New Zealand form (*albocinctus*) of *P. magellanicus* ; the blade is narrow, slightly widened near tip, with a long and conspicuous end-tooth and a smaller and more slender tooth on the left side, below tip ; base of valve wider than in Mortensen's figure of *P. albocinctus* ; tridentate pedicellariæ very rare or wanting, for I failed to find one ; ophicephalous pedicellariæ very abundant ; the valves are broadly rounded at tip and not at all constricted. Colour of test, very pale brown ; spines white.

1. νότιος=southern ; in reference to its geographical position.

I have been much puzzled by this Sea-urchin. It does not look like any of the many specimens of *P. magellanicus* which I have examined, but I am sure it is very nearly related to that species. Indeed it is difficult to point out any important distinguishing features. Perhaps the two most tangible differences are the narrow poriferous areas, with vertical arcs of pores, in *P. notius* and the noticeable scarcity of miliary tubercles; in *P. magellanicus* miliary tubercles are abundant and the poriferous areas are moderately wide with the arcs of pores more or less oblique. The anal system of *P. notius* looks quite different from that of *P. magellanicus*, as it is nearly circular and is covered by much more numerous plates. The presence of only one lateral tooth on the globiferous pedicellariæ, instead of one on each side as in *P. magellanicus*, and the white primary spines of *P. notius* are also worthy of mention, though perhaps not reliable specific characters. It may also be mentioned, though I do not lay any weight on the fact, that in *P. magellanicus* the buccal plates bear numerous tridentate pedicellariæ, while in *P. notius* these plates are covered with ophicephalous. The fact that all oculars are exsert in *P. notius* is interesting and may ultimately prove to be a good specific character. The general appearance of abactinal system, spines, pedicellariæ and buccal membrane is very much that of an *Amblypneustes*, but the test is very different, as are the buccal plates. It is a pity the "Endeavour" did not secure an abundance of specimens of *Parechinus*, for the Australasian species of the genus sorely need elucidation and this single specimen only adds to the difficulties!

Loc.—South of Gabo Island to south-east of Cape Everard, Victoria, 70-80 fathoms.

Genus GYMNECHINUS, *Mortensen*.

GYMNECHINUS EPISTICHUS, *H. L. Clark*.

Gymnechinus epistichus, H. L. Clark, Mem. Mus. Comp. Zool. Harvard, xxxiv., 1912, p. 289.

This specimen resembles the holotype closely, but differs in two points; genital 3 (as not infrequently happens in this genus) is completely shut out from the periproct, and the primary spines, especially the actinal ones, are a decidedly more distinct red. The horizontal diameter of the test is 22 mm.

Loc.—Twenty-five miles south-east of Double Island Point, Queensland.

Family TEMNOPLEURIDÆ.

Genus SALMACIS, *L. Agassiz*.SALMACIS OLIGOPORA, ¹ *sp. nov.*

(Plate xlii., fig. 1-2; Plate xliii., fig. 2.)

Test 60-81 mm. h.d.; 29-39 mm. v.d.; height therefore just less than half the horizontal diameter. Very similar to *S. dussumieri* and *S. erythracis*, but differing in at least three particulars; relative number of ambulacral and interambulacral plates in each column, form of base of valves of globiferous pedicellariæ, and colouration. The number of coronal plates in the specimens at hand runs from 28 to 34, while the number of ambulacral plates in a column is from 43 to 55; thus the number of ambulacral plates is only .52-.62 more than the number of coronal plates; in *S. dussumieri* and *S. erythracis* it is .70-.87 more. The base of the valves of the globiferous pedicellariæ is rather higher than wide and the upper lateral corners are elongated to a much greater degree than in any other species of *Salmacis*, and flare outwards slightly. Finally the colouration is utterly unlike that of *S. dussumieri* and quite different from that of *S. erythracis*. The test is pale brownish; the miliary spines and pedicellariæ are white, the secondary spines are white or pale greenish or tipped with greenish, and the primaries are greenish-white with 1-3 broad, indefinite bands of olive-green; the actinal primaries may be white without any green or they may be broadly tipped with olive-green; sometimes there is also a band of olive green near middle of spine. There is no hint of red or violet anywhere.

There are too few specimens of *S. dussumieri* and *S. erythracis* at hand to enable me to determine satisfactorily the relationship of the three species to each other. They agree in the peculiar characters of the ambulacra and abactinal system and so form a well marked section of the genus, but it is possible that the characters by which I have separated the three forms from each other are of less significance than I suppose.

One of the specimens of *S. oligopora* from off Sandon Bluffs, New South Wales, has a remarkably deformed abactinal area; the anal and genital plates are sunk much below the abactinal part of the ambulacra, and the latter are bent abruptly downwards and inwards to them; thus the vertical diameter of the test at the distal portion of genital I is 39 mm.,

1. ὀλίγος=few+πόρος=a way through, a pore; in reference to the relatively small number of ambulacral pores.

while at the third plate of ambulacrum IV it is 46 mm.; the sixth or seventh ambulacral plate is about on a level with the genital pores. Another specimen is remarkable in that four genitals are developed as madreporites; to judge from the position of the anus they are genitals 1, 2, 4 and 5; each genital plate except 2 has two genital pores, so there are nine such pores altogether. In neither of these exceptional specimens is there any ocular insert. The same is true of the largest normal specimen, but there are 6 specimens in which ocular I is more or less broadly insert. Eight specimens.

Locs.—Oyster Bay, Tasmania, 20-40 fathoms. This specimen has been selected as the holotype.

Six miles east of Cape Hawke, New South Wales, 47-50 fathoms.

Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

SALMACIS SPHÆROIDES (*Linné*).

Echinus sphaeroides, Linné, *Sys. Nat.*, 10th ed., 1758, p. 664.

Salmacis sphaeroides, Lovén, *Ech. Linn.*, 1887, p. 69.

These specimens range in diameter from 40 to 80 mm.; the height ranges from .65 to .75 h.d. The colouration is exceptionally red, the actinal primaries in particular being bright, almost vermilion, red with several bands of white; abactinally, however, the primaries, even in the reddest specimen, are green or greenish at base. Seven specimens.

Loc.—Twenty miles north-north-east of Double Island Point, Queensland, 29-30 fathoms.

SALMACIS VIRGULATA (*L. Agassiz and Desor*).

Salmacis virgulata, L. Agassiz and Desor, *Ann. Sci. Nat., Zool.*, vi., 1846, p. 359.

The specimens without definite locality are large, typical examples of this species, showing little or no trace of the horizontal sutural furrows of *S. alexandri*: they measure 75 and 90 mm. h.d. respectively. The specimen from off Double Island Point, Queensland, is much smaller (only 48 mm. h.d.) and has the sutural furrows well marked; its most striking feature, however, is the colouration of the primary spines, which at first glance seem to be whitish with

a broad indistinct band of purple around the middle; the specimen is in poor condition, however, and I think the colour of the spines has been altered; I believe they were, as usual, greenish at base, violet or purple distally and with an indistinct light tip; in the process of preservation the green tint has been nearly completely obliterated.

The occurrence of typical *S. virgulata* on the coast of southern Queensland necessitates the acceptance of Döderlein's view that *S. alexandri* is at best only a subspecies of *S. virgulata*, and I am the more ready to do this because the Museum of Comparative Zoölogy has now a typical specimen of *S. alexandri* from Badu Island, Torres Strait. Obviously the geographical ranges of the two forms are by no means distinct. Three specimens.

Locs.—Off the coast of Queensland.

Twenty-five miles south-east of Double Island Point, Queensland.

Genus MICROCYPHUS, *L. Agassiz and Desor.*

MICROCYPHUS ANNULATUS, *Mortensen.*

Microcyphus annulatus, Mortensen, Siam Ech., 1904, p. 101.

This is a typical example of this species, 11 mm. in diameter.

Loc.—Seven miles north-east of Cape Pillar, Tasmania, 50-60 fathoms.

Genus AMBLYPNEUSTES, *L. Agassiz.*

AMBLYPNEUSTES GRANDIS, *H. L. Clark.*

Amblypneustes grandis, H. L. Clark, Mem. Mus. Comp. Zool. Harvard, xxxiv., 1912, p. 329.

These are all large specimens, 50-63 mm. in diameter, with the height ranging from .60 to .76 h.d. In colouration there is considerable diversity. The specimens from an unknown locality are light brown, with the small spines whitish and the primaries greenish-brown, tipped with whitish; in one specimen the greenish-brown is confined to the basal part of the spine, especially on the actinal surface. The specimens from Flinders Island, Bass Strait, are similar but more green; the test is olive-greenish and the basal part of the primaries is more green than brown; in one specimen the primaries are nearly all white. The specimen from between Gabo Island, Victoria, and Disaster Bay, New South Wales,

is similar to the latter specimen, the primaries being almost wholly white, though the test is distinctly greenish. The South Australian specimen is the most peculiar, for while the test is greenish and not very unusual, the primary spines are all pale reddish with light tips; actually the light shade occupies more of the spine than the reddish tint. All the specimens show a zigzag band (similar to that of *A. formosus*) in the abactinal interambulacra, indistinct when the test is dry but very evident when the surface is moistened; the markings differ obviously from those of *A. formosus*, however, by being darker than the intervening angles.

Döderlein¹ has recently reviewed anew the species of *Amblypneustes*, adding another species and a variety to the already perplexing list. He is inclined to doubt the validity of both the present species and the next, considering them forms of *A. grisens*, but I am unable to agree with him. I confess, however, that I do not believe we have yet reached the truth in regard to the species of this interesting genus. We really have not as yet any clear idea as to the limits of variation in either form, tuberculation or colour, in even a single species, and we zoologists who are thousands of miles from the restricted home of the genus, are thus working largely in the dark in our efforts to identify specimens. Some day a zoologist on the ground, or with a careful and enthusiastic collector on the ground, will secure sufficient material to enable him to work out the actual natural limits of each species. Seven specimens.

Locs.—East coast of Flinders Island, Bass Strait.

Between Gabo Island, Victoria, and Disaster Bay, New South Wales, 50-100 fathoms.

Off Cape Marsden, Kangaroo Island, South Australia, 17 fathoms.

Also two specimens from an unknown locality.

AMBLYPNEUSTES PACHISTUS, *H. L. Clark.*

Amblypneustes pachistus, H. L. Clark, Mem. Mus. Comp. Zool. Harvard, xxxiv., 1912, p. 327.

These individuals range in size from 31 to 45 mm. h. d.; the height ranges from a little over .80 h. d. in the smallest to a little less than .90 h. d. in the largest. The colour is the same in all: test, pale brown when dry, more nearly olive

1. Döderlein—Fauna Südwest-Australiens, iv., 1914, pp. 460-475.

when moist: small spines, pale cream-colour or whitish; large spines, deep olive-green or greenish-brown, more or less extensively tipped with whitish. This is essentially the colouration of the holotype and is apparently the characteristic colouration of the species, which seems to me a perfectly valid one. Four specimens.

Locs.—Oyster Bay, Tasmania.

East coast of Flinders Island, Bass Strait.

Forty miles west of Kingston, South Australia, 30 fathoms.

Genus HOLOPNEUSTES, *L. Agassiz and Desor.*

HOLOPNEUSTES INFLATUS, *A. Agassiz.*

Holopneustes inflatus, *A. Agassiz*, Bull. Mus. Comp. Zool. Harvard, iii., 1872, p. 56.

The smallest individual is 30 mm. h.d. and 23 mm. high, while the largest is 72 mm. h.d. and 65 mm. high. All three specimens are light coloured, the spines both large and small being pale gray or nearly cream-colour. The test is decidedly darker, at least when wet. It is interesting to note that in this species, as in the preceding and in *Echinus horridus*, the relative height increases with age; in the present case the increase is from .77 h.d. to a trifle over .90. Four specimens.

Locs.—North-east of Cape Pillar, Tasmania, 80 fathoms.

Oyster Bay, Tasmania.

East coast of Flinders Island, Bass Strait.

HOLOPNEUSTES POROSISSIMUS, *L. Agassiz and Desor.*

Holopneustes porosissimus, *Agassiz and Desor*, Ann. Sci. Nat., Zool., vi., 1846, p. 364.

This individual is 40 mm. in diameter and 38 mm. high; the height is thus .95 h.d. The ambulacra are 13 mm. wide and the interambulacra 11.5 mm. The test is dull purple and the spines are dull purplish-red, without any green (as is usual) near the base.

Loc.—Off Cape Marsden, Kangaroo Island, South Australia.

Family STRONGYLOCENTROTIDÆ.

Genus HELIOCIDARIS, *L. Agassiz and Desor.*HELIOCIDARIS ERYTHROGRAMMA (*Valenciennes*).*Echinus erythrogrammus*, Valenciennes, Voy. Venus, Zooph., 1846, pl. vii., fig. 1.*Heliocidaris eurythrogramma*, Agassiz and Desor, Ann. Sci. Nat., Zool., vi., 1846, p. 371.

The specimens from Oyster Bay, Tasmania, are typical examples of the species, about 50 mm. in diameter, dark purplish in colour, becoming dull green with a purplish cast when dry. The specimen from Flinders Island, Bass Strait, is 68 mm. in diameter, with the test very pale brownish and the spines light olive green, as in *H. tuberculata*. The shortness of the primaries and the absence of any arcs of pores with more than 7 pairs show it must be referred to *H. erythrogramma*. I do not feel satisfied, however, that there are really four species of *Heliocidaris* on the southern and western coasts of Australia, as Döderlein affirms in his recent revision of the genus,¹ but I think it quite possible that these four forms will prove to be either a single species or perhaps two. I may here protest against Döderlein's action in putting the Peruvian Echinoid, *Cænocentrotus gibbosus*, into *Heliocidaris*. The differences in ambulacra, abactinal system, coronal plates and spines far outweigh the single resemblance in globiferous pedicellariæ. If the latter is such a weighty character, the species ought to be put in the family Temnopleuridæ, for the globiferous pedicellariæ are surprisingly similar to those of *Salmacis* and *Temnopleurus*! On the other hand, I think Döderlein is right in refusing to include the Japanese species *crassispina* in *Heliocidaris*. It is better left in *Strongylocentrotus*, if one is unwilling to recognise the genus *Anthocidaris* for its reception. Four specimens.

Locs.—Oyster Bay, Tasmania, 30 fathoms.

East coast of Flinders Island, Bass Strait.

Family CLYPEASTRIDÆ.

Genus CLYPEASTER, *Lamarck.*CLYPEASTER AUSTRALASIÆ (*Gray*).*Echinanthus australasiæ*, Gray, Proc. Zool. Soc., 1851, p. 34.*Clypeaster australasiæ*, H. L. Clark, Mem. Mus. Comp. Zool. Harvard, xlv., 1914, p. 32.

The smallest of these individuals is 46 mm. long, 42 mm. wide and 14 mm. high; the largest is 90 x 80 x 30 mm. The

1. Döderlein—Fauna Südwest-Australiens, iv., 1914, pp. 475-487.

widest specimen is .91 as wide as long ; the narrowest is .82. In the highest specimen the vertical diameter is .41 of the length ; in the flattest it is .29. The colour is some shade of brown, usually with a greenish tinge. Several of the specimens are slightly asymmetrical in one way or another. Ten specimens.

Locs.—Six miles east of Cape Hawke, New South Wales, 47-50 fathoms.

Shoalhaven Bight, New South Wales, 15-45 fathoms.

East of Babel Island, Bass Strait, 65-70 fathoms.

CLYPEASTER TELURUS, *H. L. Clark.*

Clypeaster telurus, H. L. Clark, Rec. West Austr. Mus., i., 1914, p. 166.

The unique holotype of this species was taken on the coast of Western Australia almost directly across the Australian continent from Fraser Island, Queensland, but a prolonged critical study of these Clypeasters fails to show any character or combination which will distinguish them from it, except that they do not have the posterior inter-radial margin depressed appreciably. They are all larger than the holotype, the largest measuring 145 x 135 x 20 mm. ; as a species character, it seems to be true that the breadth exceeds .90 of the length, while the height is less than .15. There are about 400 primary tubercles to a square centimeter of the aboral surface. The unpaired anterior petal is 39 mm. long and has 52 pore-pairs. The periproct is 8-12 mm. from the posterior margin, and this considerable distance, taken in connection with the thin, almost fragile, test, and the form of the petals, makes it easy to distinguish this species from *C. humilis*, which is its nearest relative. Tridentate pedicellariæ, with valves .25-.75 mm. long, are common on the oral surface. The colour of these specimens is more or less purplish-brown.

Loc.—Off Fraser Island, Queensland. Four specimens.

CLYPEASTER VIRESCENS, *Döderlein.*

Clypeaster virescens, Döderlein, Arch. f. Naturg., li.i., 1885, p. 102.

This individual is 105 mm. long, 95 mm. wide and 19 mm. high. The colour is yellow-brown with a distinct greenish tinge orally. Although none of the Japanese specimens at

hand are quite so large, comparison with them fails to reveal a single character by which this specimen can be distinguished from them. It is hard to believe that a Japanese species, not yet known from the East Indies or northern Australia, should occur in Shoalhaven Bight, New South Wales, but this specimen seems to prove it. There is no chance for a misplaced label, for in this case the metal number is not only wired on to the test, but the wire is firmly rusted in! I have tried to convince myself that the specimen is an aberrant example of *C. australasiæ*, but if that is the case the characters by which species in the genus are at present separated, are simply worthless, and we might as well call all Australian and all Japanese Clypeasters by a single name! I have also tried to find at least one character which would serve to distinguish this Australian specimen from the Japanese species, but I have not succeeded, and I am therefore obliged to record it as *C. virescens*.

Loc.—Shoalhaven Bight, New South Wales, 15-45 fathoms.

Family LAGANIDÆ.

Genus PERONELLA, *Gray*.

PERONELLA LESUEURI (*Agassiz*).

Laganum lesueuri, Agassiz, Mon. Scut., 1841, p. 116.

Peronella lesueuri, A. Agassiz, Rev. Ech., pt. 1, 1872, p. 148.

These are notably large individuals, and it is a pity that there is no record of either the locality or the depth. The largest one is 137 mm. long, 124 mm. wide, and only 12 mm. high; the petaloid area is nearly .60 of test length, but the marginal thickness of the test is less than .03 of the length! The smallest specimen is 100 mm. long. There is little diversity in shape; the narrowest specimen has the width .86 of the length, while in the widest it is .96.

Loc.—Off the coast of Queensland. Nineteen specimens.

Family FIBULARIIDÆ.

Genus ECHINOCYAMUS, *Leske*.

ECHINOCYAMUS PLATYTATUS, *H. L. Clark*.

Echinocyamus platytatus, H. L. Clark, Mem. Mus. Comp. Zool. Harvard, xlv., 1914, p. 63.

There is no doubt of the genus of these small pieces, but the reference to *E. platytatus* involves more uncertainty. I think it safe, however, to consider them that Victorian species.

Loc.—Between Devonport and Launceston, Tasmania.

Family SPATANGIDÆ.

Genus MARETIA, Gray.

MARETIA PELORIA,¹ *sp. nov.*

(Plate xliv., fig. 1-3.)

Length of test, 76 mm. ; breadth, 65 mm. ; height, 18 mm. ; abactinal system 33 mm. from anterior margin ; mouth, 12 mm. wide by 4 mm. long, with a very prominent lip, its anterior margin 20 mm. from test margin ; periproct, 9 mm. in diameter, on the vertical posterior end of test ; subanal fasciole, distinct but narrow, its area 24 mm. wide by 4 mm. high at middle ; bare sternal area nearly 30 mm. wide posteriorly. Unpaired petal indistinct, virtually wanting. Anterior petals very imperfect, but the posterior series of pore-pairs can be distinguished for about 25 mm. from apex. Posterior petals fairly well developed, about 35 mm. long and 7 mm. wide just proximal to the very slightly narrowed tip ; there are rather more than 20 pore-pairs on each side of the petal. Anterior ambulacrum, although not petaloid, is plainly indicated as a gradually widening area, covered only by miliary spines (or tubercles) ; proximally it is very narrow ; on each side is a series of 12-15 simple tube-feet (or pores), at first close together but near margin 3-4 mm. apart. Genital pores 4, large, but close together and concealed by the dense growth of miliary spines which covers the whole abactinal system and adjoining plates. Remainder of abactinal surface covered closely by more or less curved, slender miliary and secondary spines, pedicellariæ and scattered primaries ; the latter are nearly all broken, but when complete are 15-20 mm. long and taper to a very slender tip ; proximally they are hollow ; they are more or less distinctly curved near the base. In each antero-lateral interambulacrum there are about 35 primaries above the ambitus ; each is attached to a large, perforated tubercle placed in a deeply sunken areola ; in each postero-lateral interambulacrum there are some 50 similar primaries, and in the posterior interambulacrum there are about 25, but these latter are as a rule smaller than the primaries of the lateral areas.

Actinal surface largely free from spines and tubercles of any considerable size, except laterally and near anterior

1. *πελώριος*=huge, immense ; in reference to the size, remarkably large for a *Maretia*.

margin. In the antero-lateral interambulacra the margin is densely clothed with secondary spines and 15-20 rather small primaries; there are also a few secondaries close to the mouth. In the lateral (or postero-lateral) areas the margin is densely coated with secondary and miliary spines and inwardly with 7 or 8 oblique series of large primaries, 4-5 in each series. Within the subanal fasciole there is on each side a group of 10-12 primary spines, and below it is a triangular area (with apex towards mouth) well covered with secondary and miliary spines. All the rest of the oral surface seems bare, but is in reality sparsely covered with minute miliary spines and pedicellariæ. The lip, however, bears a dense cluster of secondary spines, and there are smaller and less dense clusters on each side of the mouth, while similar spines are borne on the peristomal plates themselves. Phylloides conspicuous, though in each one of the posterior pair there are only 7 of the ambulacral "brushes." Peristome covered by about 50 plates. Periproct covered by about 60 plates, each with 1-4 miliary spines.

Pedicellariæ abundant, of 4 kinds, each of which has 3 valves to make up the head; the valves of the globiferous pedicellariæ are about 1 mm. long, the terminal third or more encased in the glandular tissue; these valves resemble those of *Lovenia elongata* as figured by Koehler¹, but the blade narrows steadily to the truncate tip which terminates in 4 rather short but distinct teeth, lying practically in the same plane; the valves of the tridentate pedicellariæ are about .80 mm. long and resemble those of *Spatangus*; they are strongly curved, meeting only at tip; the base is higher than wide, the blade is less than half the length, and its own width (which is greatest distal to its middle) is less than half its own length; its margin is smooth, becoming finely serrate near tip; the valves of the ophicephalous pedicellariæ are only about .40 mm. long; they resemble very closely those of *Maretia elevata* as figured by Döderlein²; the valves of the triphyllous pedicellariæ are very small, about .20 mm. long, and are borne on the end of a very long neck; they resemble very closely those of *Metalia maculosa* as figured by Koehler³. The triphyllous pedicellariæ seem to occur everywhere on the test, the ophicephalous are mainly if not altogether abactinal, the tridentate occur on both the upper and lower surfaces, but seem more abundant actinally, and the globiferous are actinal, occurring chiefly near the mouth.

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1. Koehler—Indian Mus. Spat., 1914, pl. xix., fig. 27.
 2. Döderlein—Valdivia Ech., 1906, pl. xlvi., fig. 6a-d.
 3. Koehler—Indian Mus. Spat., 1914, pl. xix., fig. 70.

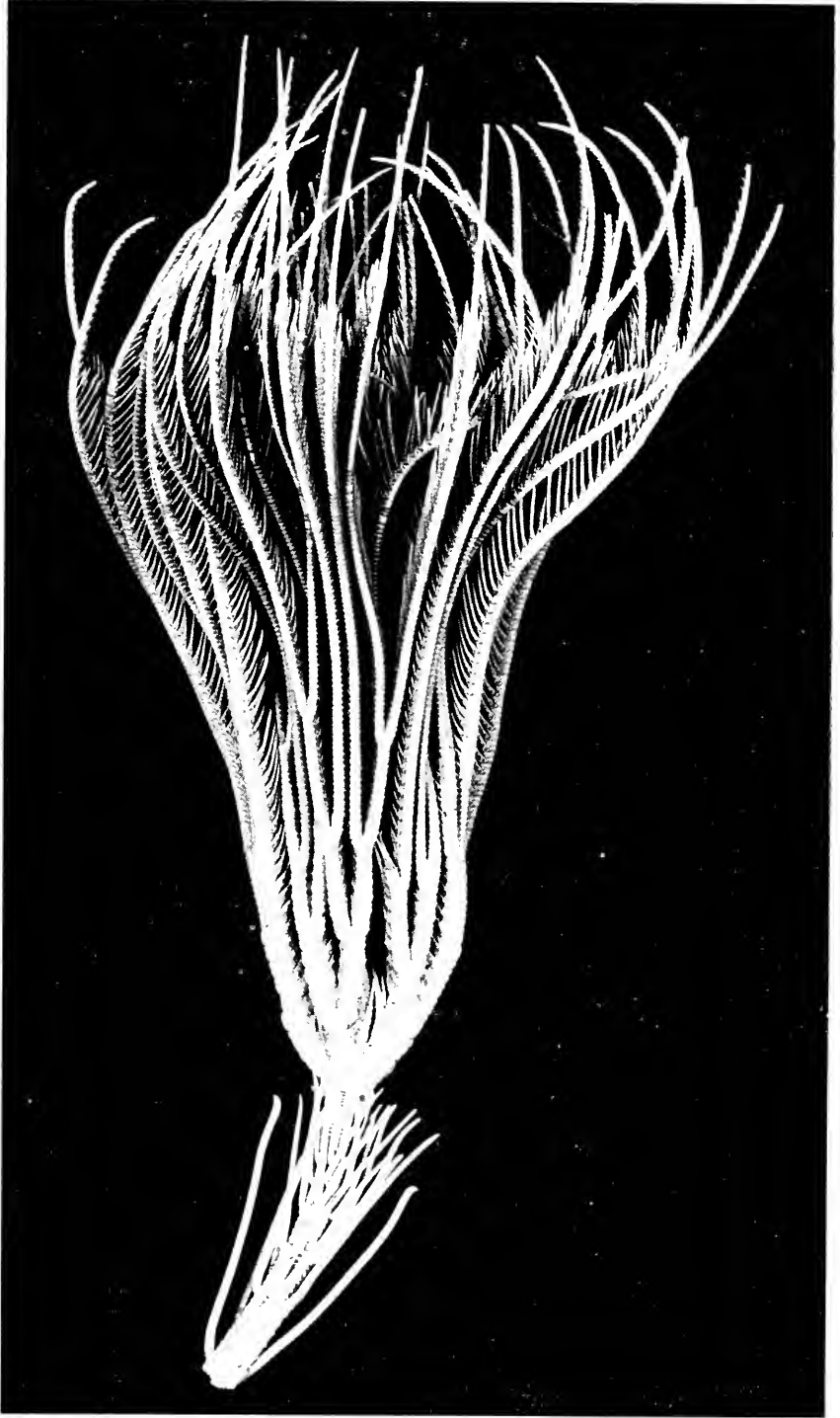
Colour, in alcohol or dry, pale purplish gray, the muscles around the bases of the primary spines, deep brown; small spines nearly white when dry; primary spines more or less pale purple or light gray; ambulacral "brushes" around mouth, nearly black.

Although resembling *Maretia ovata* (Leske) (= *planulata*, auct.) in form of test and in its generic characters, this species is easily distinguished by the longer and narrower posterior petals, the less complete anterior petals and the greater number of abactinal primary tubercles, particularly on posterior half of test. The primary spines are somewhat shorter, and those of the actinal surface are scarcely half as numerous as in *M. ovata*. The pedicellariæ also offer some striking differences between the two species. The occurrence of the genus in Bass Strait is very interesting, for it is essentially a shallow water, tropical group, and has been reported previously from only as far south as Port Jackson, New South Wales. While no depth is recorded for the station where *M. peloria* was taken, there is good reason for believing it was in the neighbourhood of 100 fathoms, for there is a station recorded "twenty-five miles south-west of Cape Everard, Victoria, 83-98 fathoms." In the Dutch East Indies, *M. ovata* was taken by the "Siboga" at one station in 83 fathoms, but as a rule *M. ovata* occurs from low water mark to about 20 fathoms. The largest specimen of *M. ovata* I have found recorded is 65 mm. long, but this is unusual, and most specimens are from 30 to 50 mm.

Loc.—Twenty-six miles south-west of Cape Everard, Victoria. Three specimens.

EXPLANATION OF PLATE I.

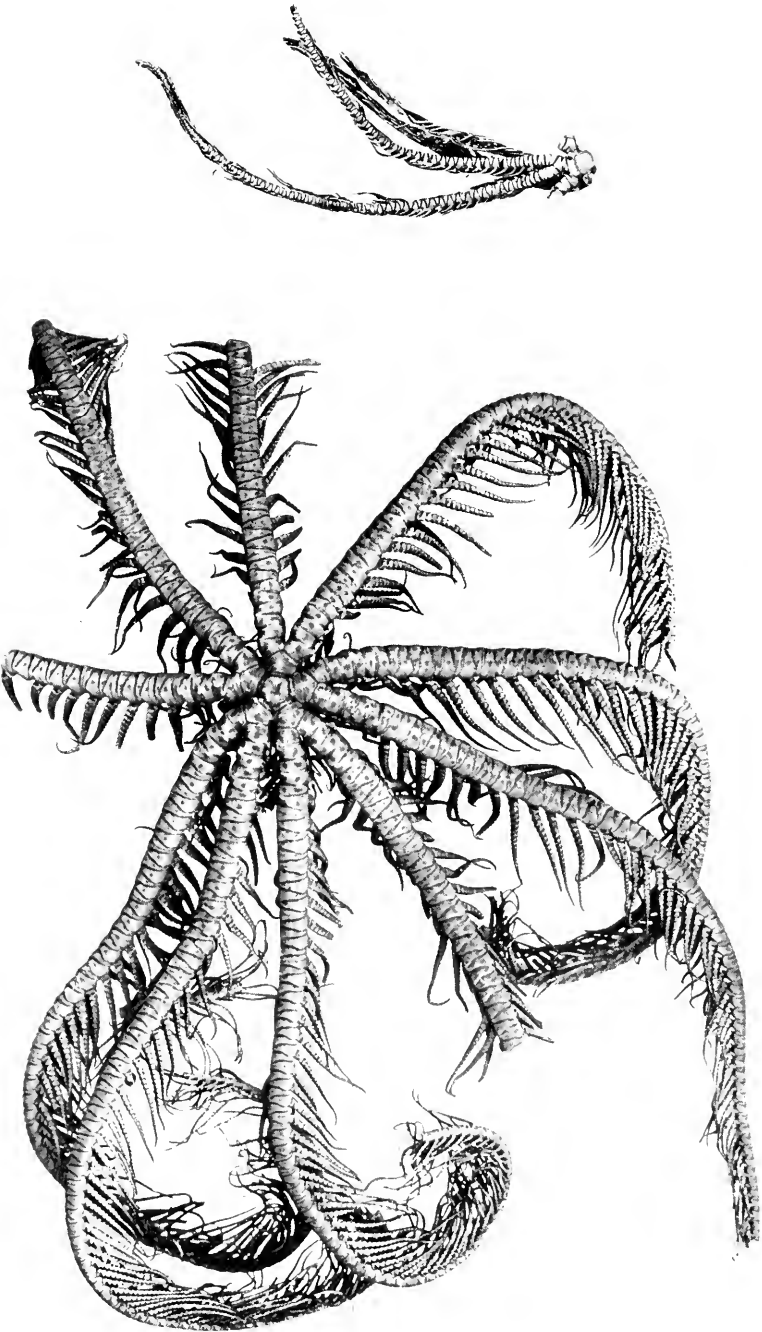
Metacrinus cyaneus, sp. nov. Photograph of the holotype from the Eastern Slope, Bass Strait, about 200 fathoms. Three-fourths natural size.



G. NELSON, Cambridge, U.S.A., photo.

EXPLANATION OF PLATE II.

- Fig. 1.—*Comatula cratera*, sp. nov. Photograph of the holotype from eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms. Six-sevenths natural size.
- Fig. 2.—*Oligometra zebra*, sp. nov. Photograph of the holotype from eleven miles east-south-east of Clarence River mouth, New South Wales, 35-36 fathoms. Natural size.

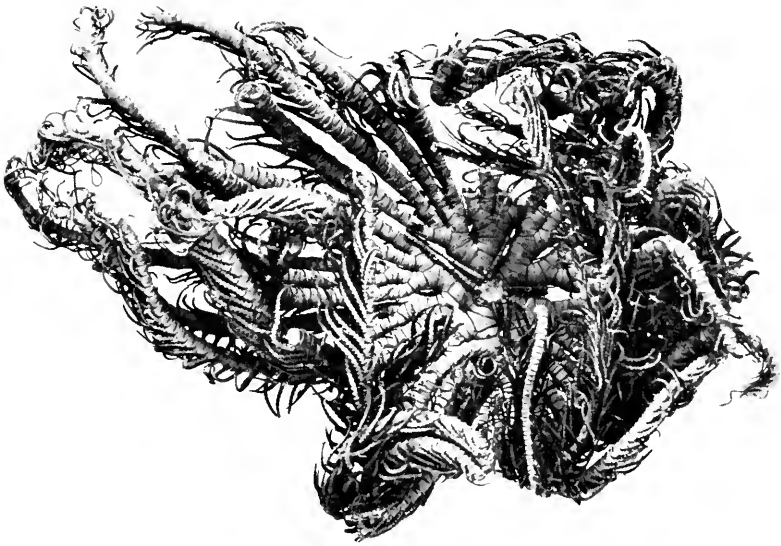


E. A. BRIGGS, Austr. Mus., photo.

EXPLANATION OF PLATE III.

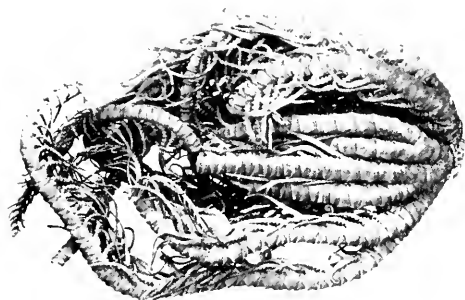
- Fig. 1.—*Oreometra pericalles*, sp. nov. Photograph of the holotype from thirteen miles north by west of Double Island Point, Queensland, 25-26 fathoms. Natural size.
- Fig. 2.—*Comanthus perplexum*, sp. nov. Photograph of the holotype from eleven miles south by east of Ballina, New South Wales, 27-28 fathoms. Natural size.

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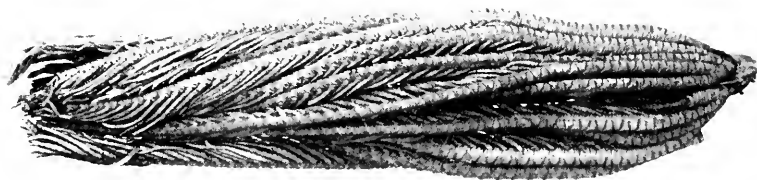


EXPLANATION OF PLATE IV.

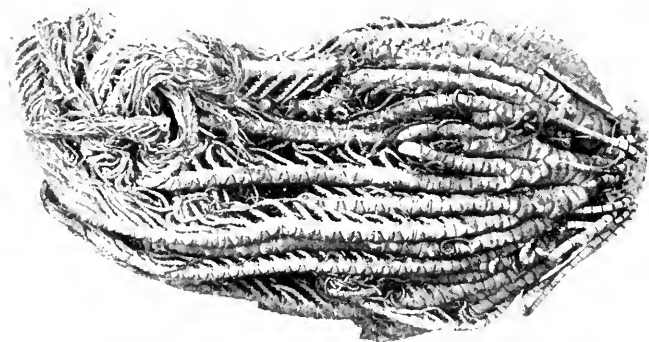
- Fig. 1.—*Comanthus plectrophorum*, sp. nov. Photograph of the holotype from east of Flinders Island, Bass Strait, 100-300 fathoms. Natural size.
- Fig. 2.—*Cosmiometra dasybrachia*, sp. nov. Photograph of the holotype from east of Flinders Island, Bass Strait, 70-100 fathoms. Natural size.
- Fig. 3.—*Comanthus spanoschistum*, sp. nov. Photograph of the holotype from east of Babel Island, Bass Strait, 60-70 fathoms. Natural size.



3



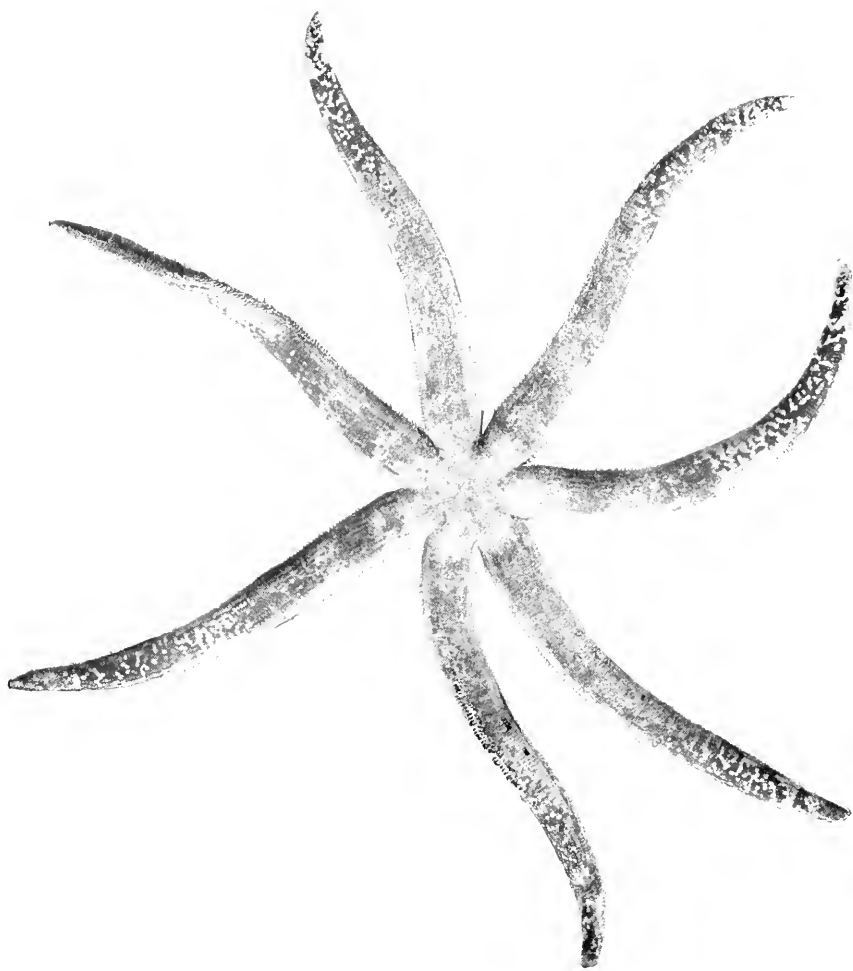
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EXPLANATION OF PLATE V.

Luidia maculata, Müller and Troschel. Photograph of a specimen from the coast of New South Wales. Abactinal view. One-fourth natural size.

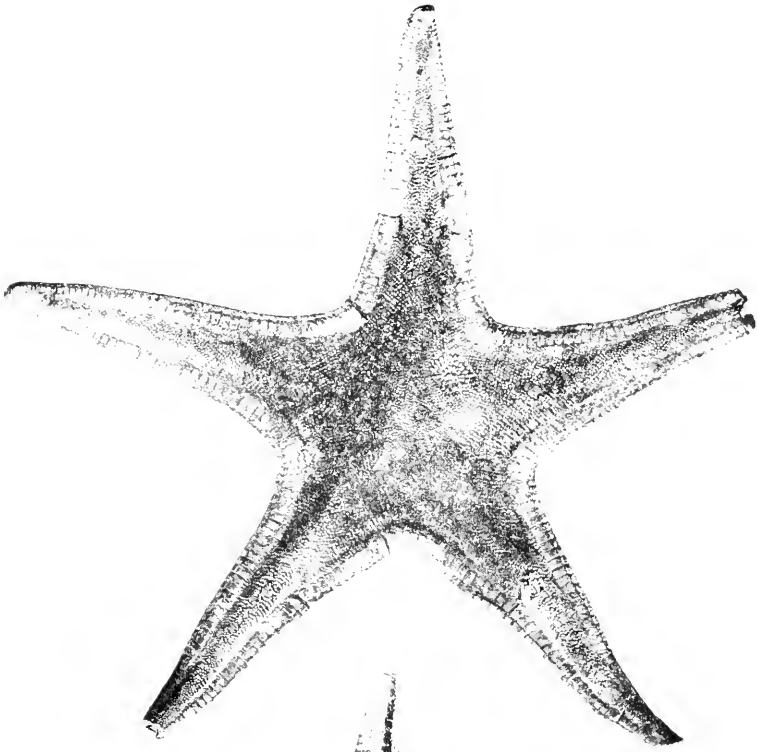


EXPLANATION OF PLATE VI.

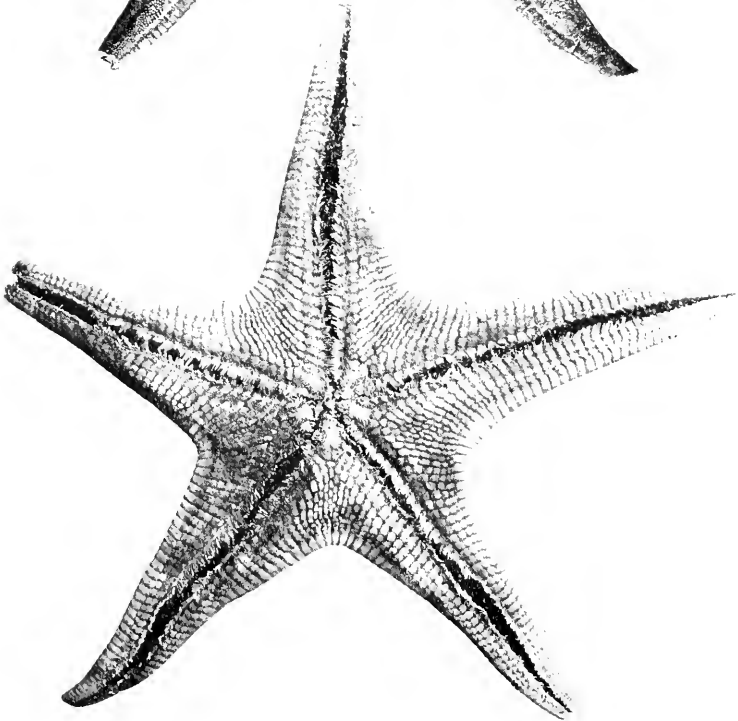
Fig. 1.—*Lonchotaster magnificus*, sp. nov. Photograph of the holotype from the Great Australian Bight, 80-120 fathoms. Abactinal view. Two-fifths natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.





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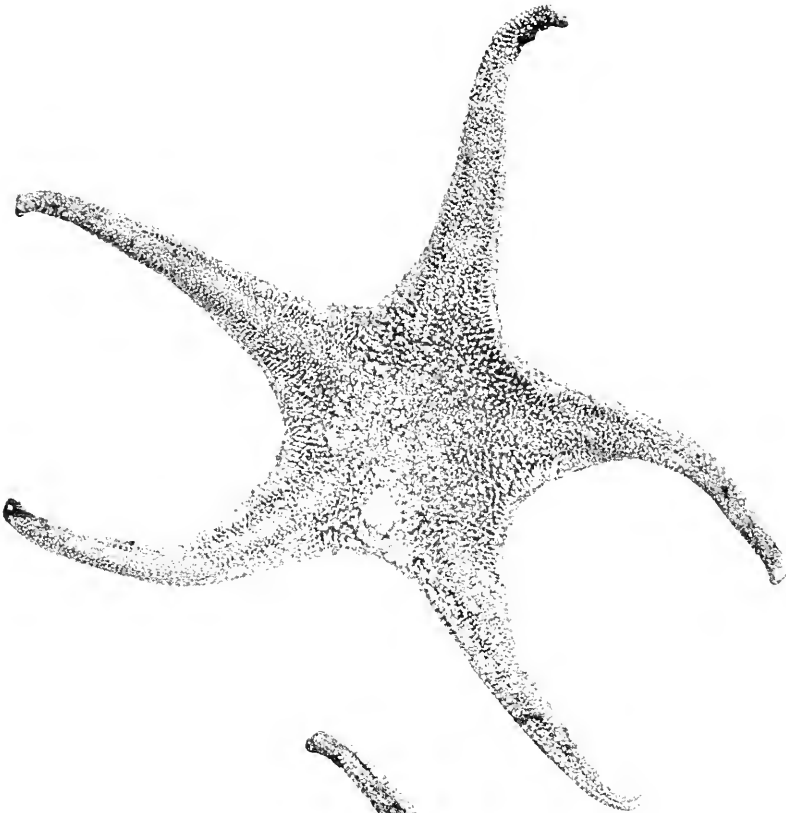
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EXPLANATION OF PLATE VII.

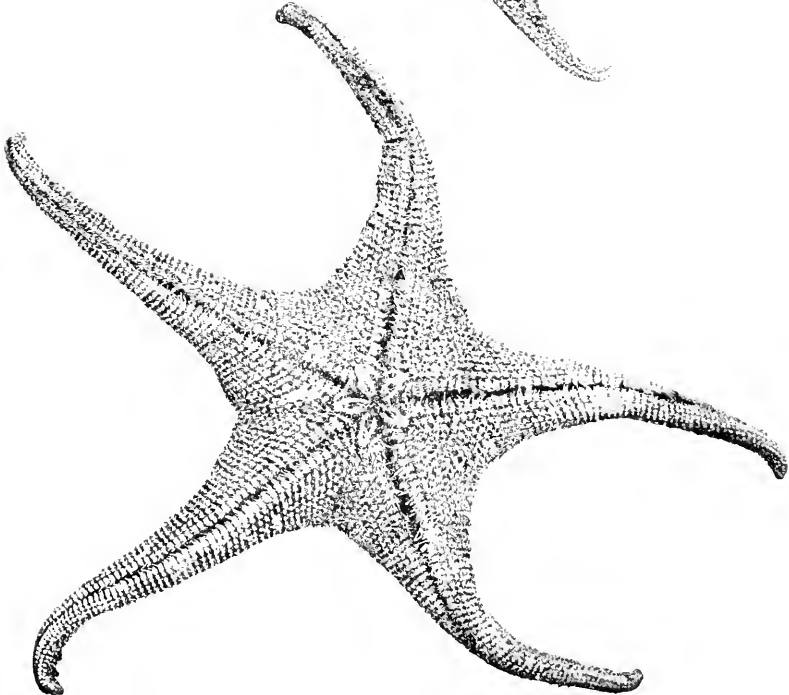
Fig. 1.—*Mimaster gracilis*, sp. nov. Photograph of the holotype from south of Gabo Island, Victoria, 200 fathoms. Abactinal view. Natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.





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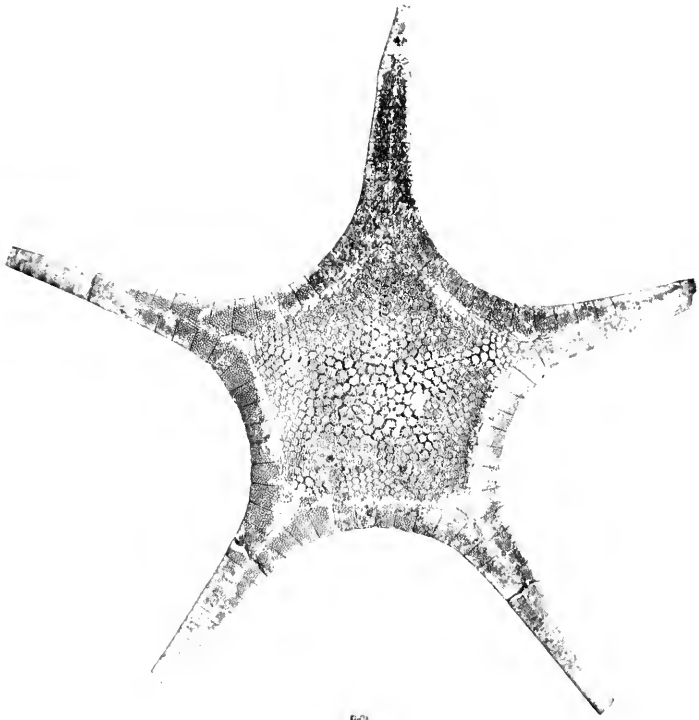
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E. A. BRIGGS, Austr. Mus., photo.

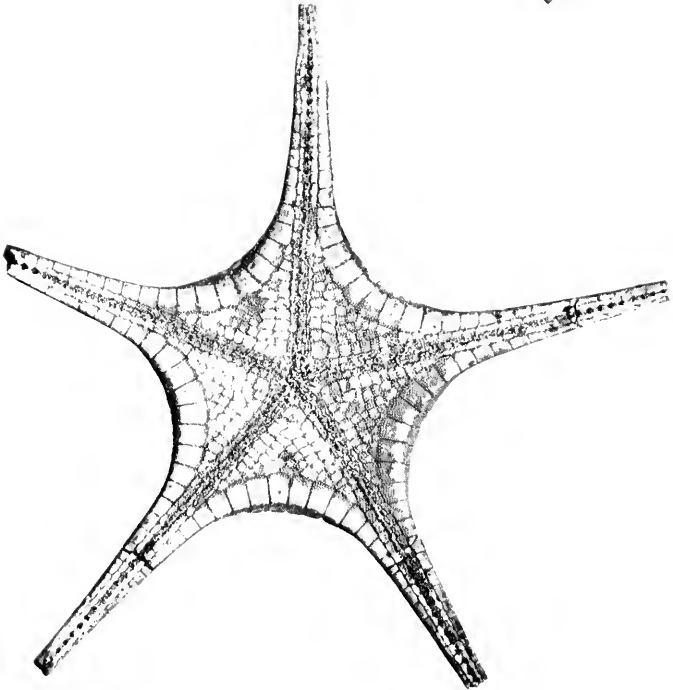
EXPLANATION OF PLATE VIII.

Fig. 1.—*Nymphaster pentagonus*, sp. nov. Photograph of the holotype from the Great Australian Bight, 129° 28' E., 250-450 fathoms. Abactinal view. Natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



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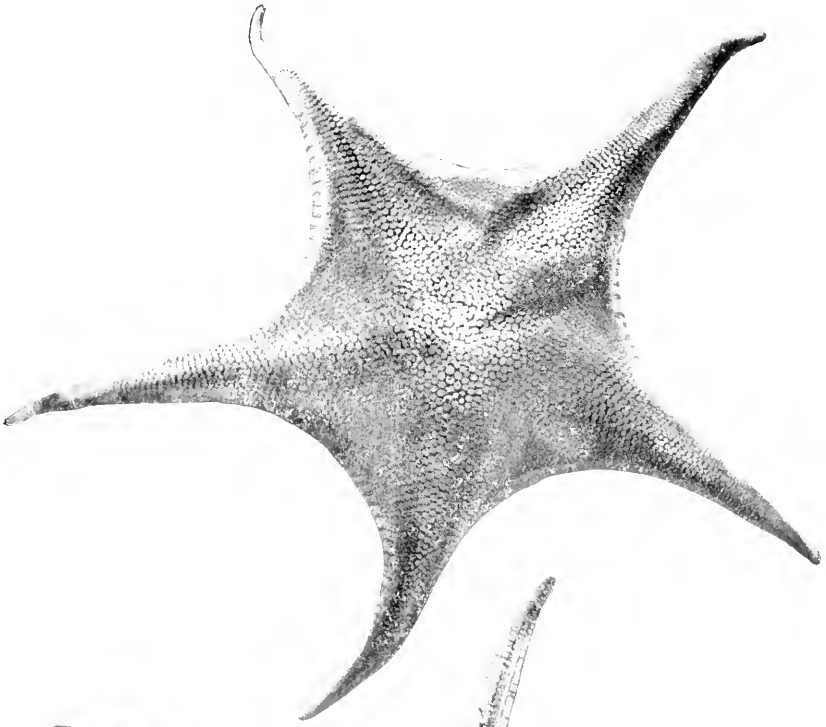


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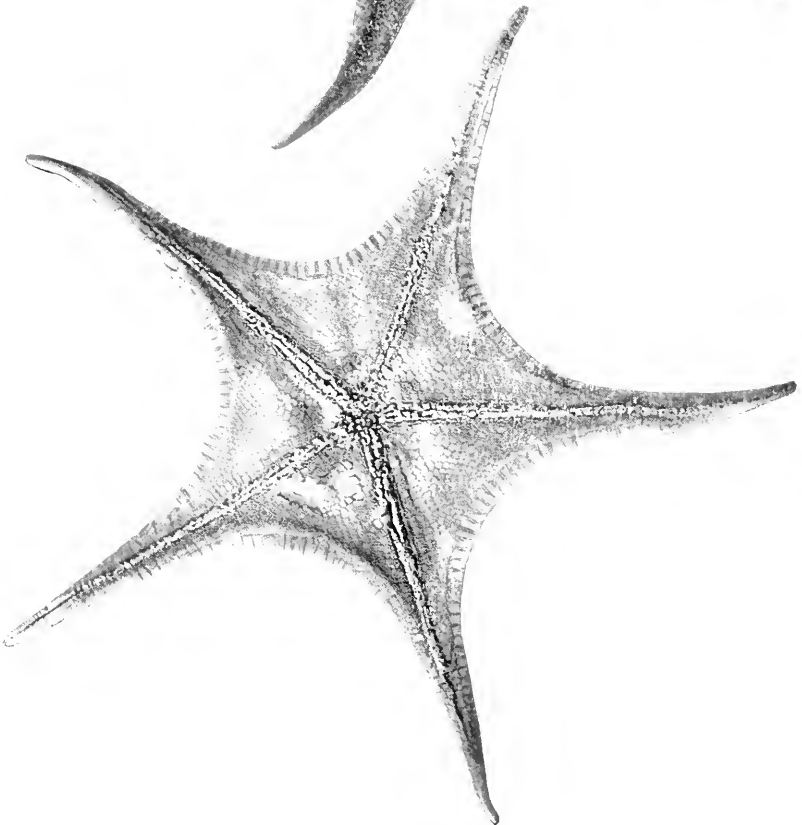
EXPLANATION OF PLATE IX.

Fig. 1.—*Mediaster australiensis*, sp. nov. Photograph of the holotype from the east coast of Flinders Island, Bass Strait, 40 fathoms. Abactinal view. Five-eighths natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



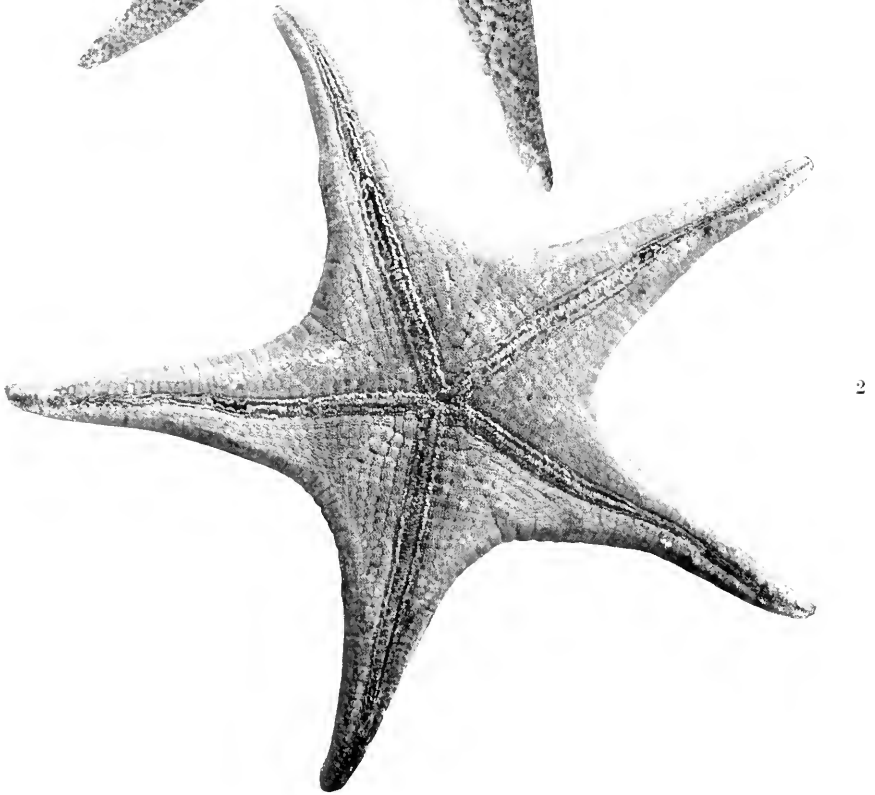
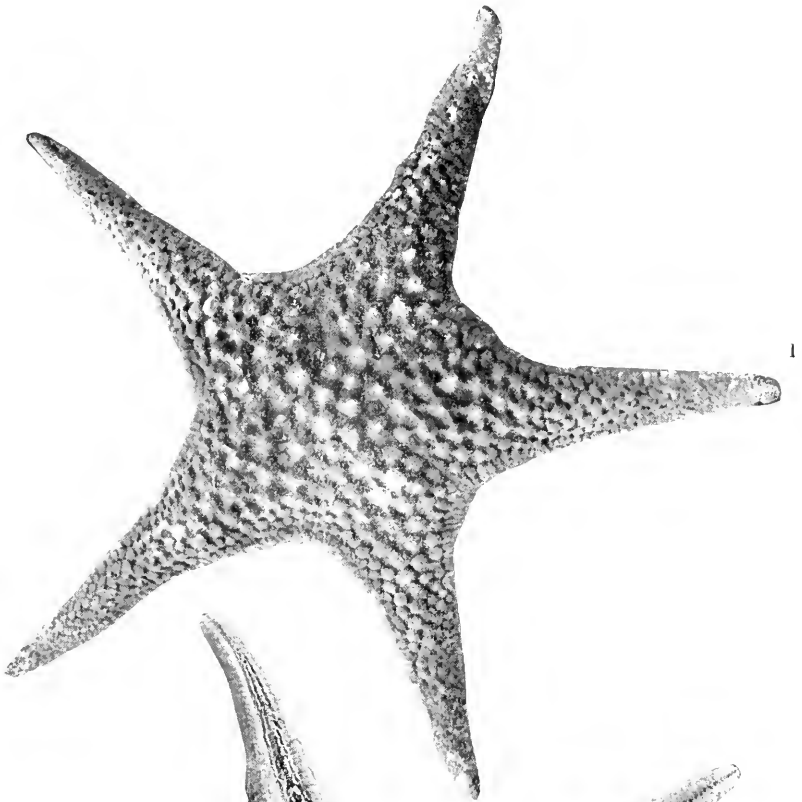
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EXPLANATION OF PLATE X.

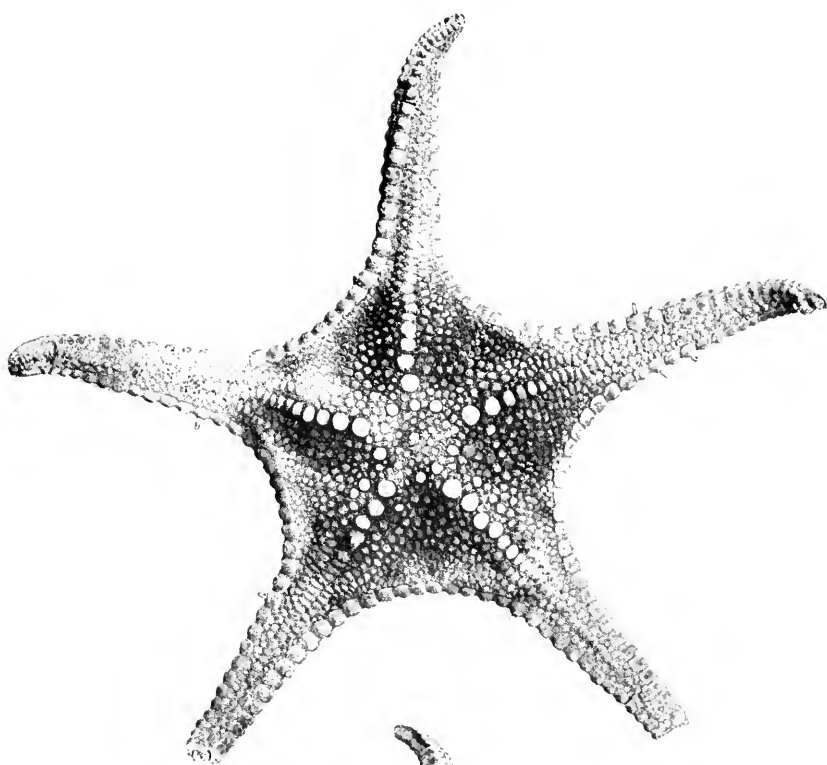
- Fig. 1.—*Mediaster monacanthus*, sp. nov. Photograph of the holotype from six miles east of Cape Hawke, New South Wales, 47-50 fathoms. Abactinal view. One-half natural size.
- Fig. 2.—*Mediaster monacanthus*, sp. nov. Photograph of the paratype from six miles east of Cape Hawke, New South Wales, 47-50 fathoms. Actinal view. One-half natural size.



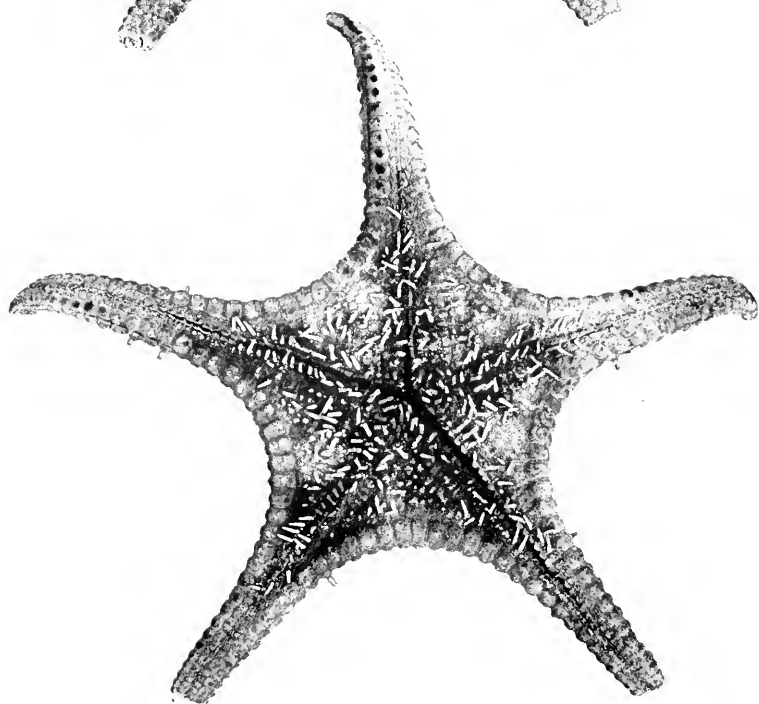
EXPLANATION OF PLATE XI.

Fig. 1.—*Calliaster spinosus*, sp. nov. Photograph of the holotype from the Eastern Slope, Bass Strait, 80-200 fathoms. Abactinal view. One-half natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



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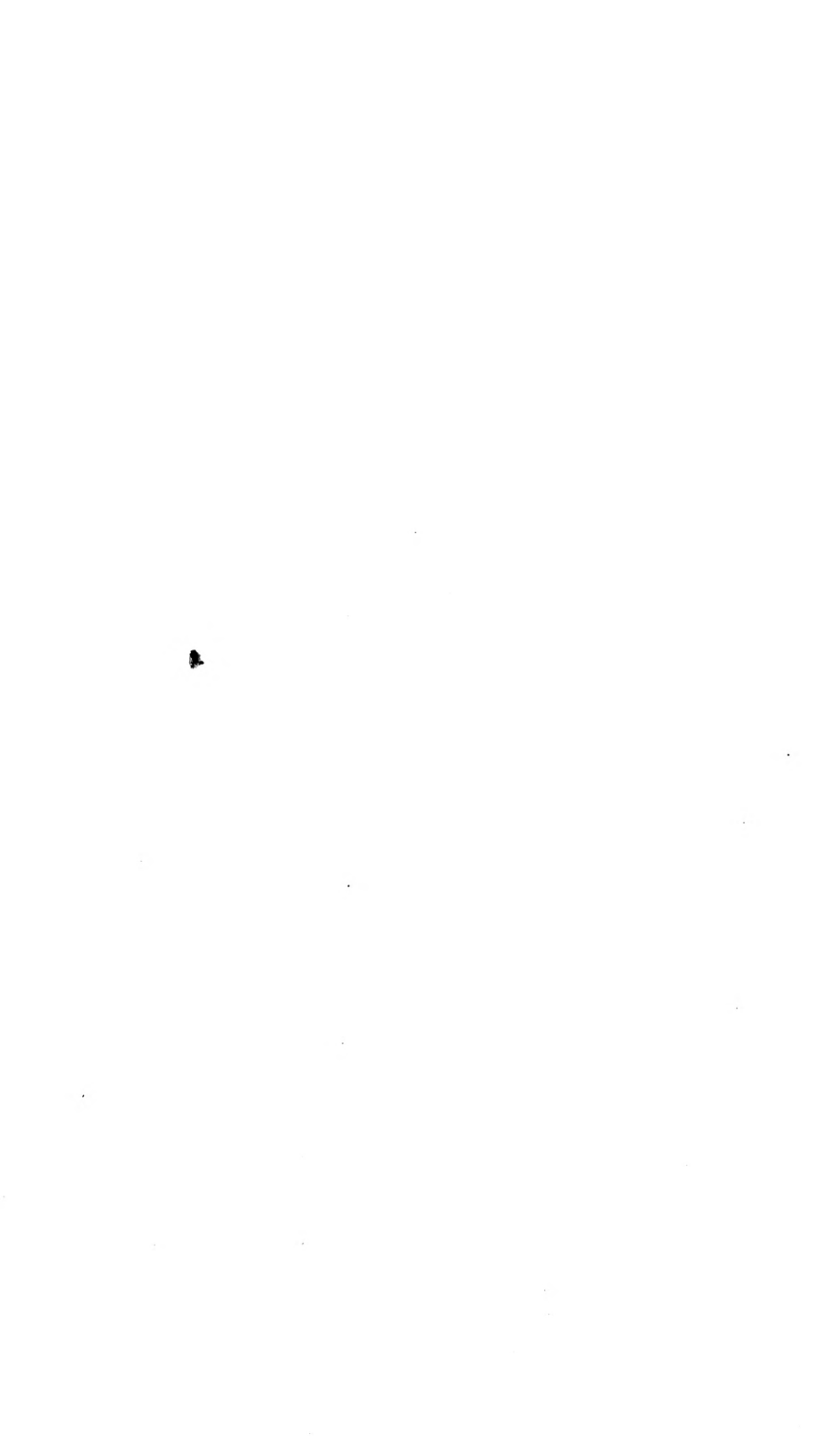


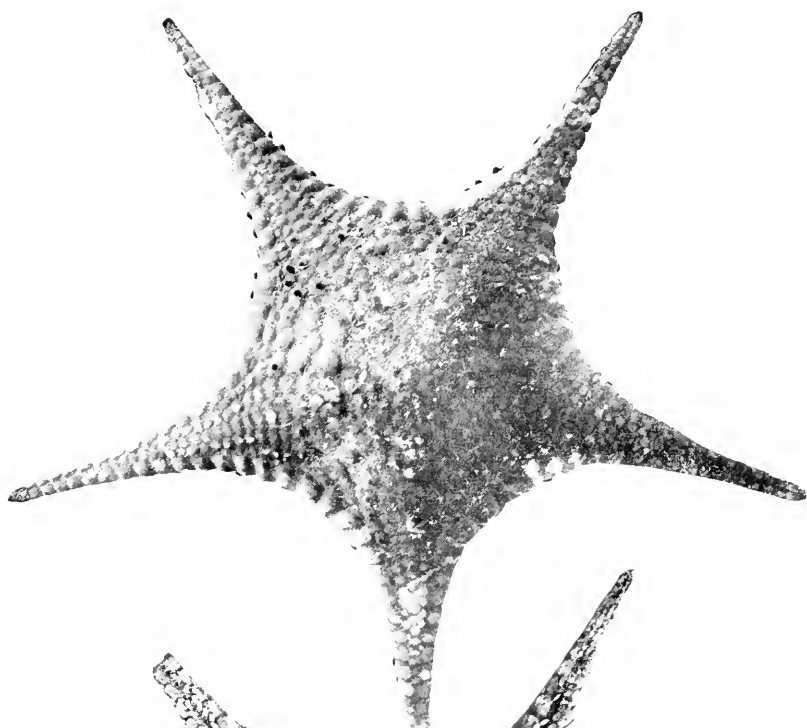
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EXPLANATION OF PLATE XII.

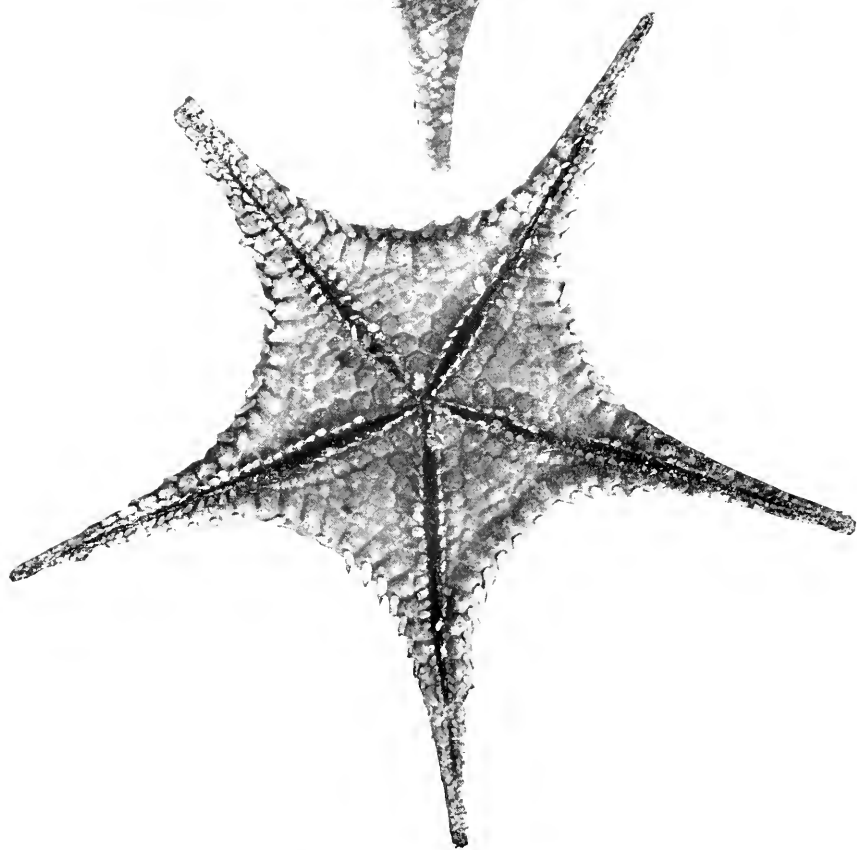
Fig. 1.—*Stellaster incei*, Gray. Photograph of a specimen from eleven miles south by east of Ballina, New South Wales, 27-29 fathoms. Abactinal view. Ninetenths natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.





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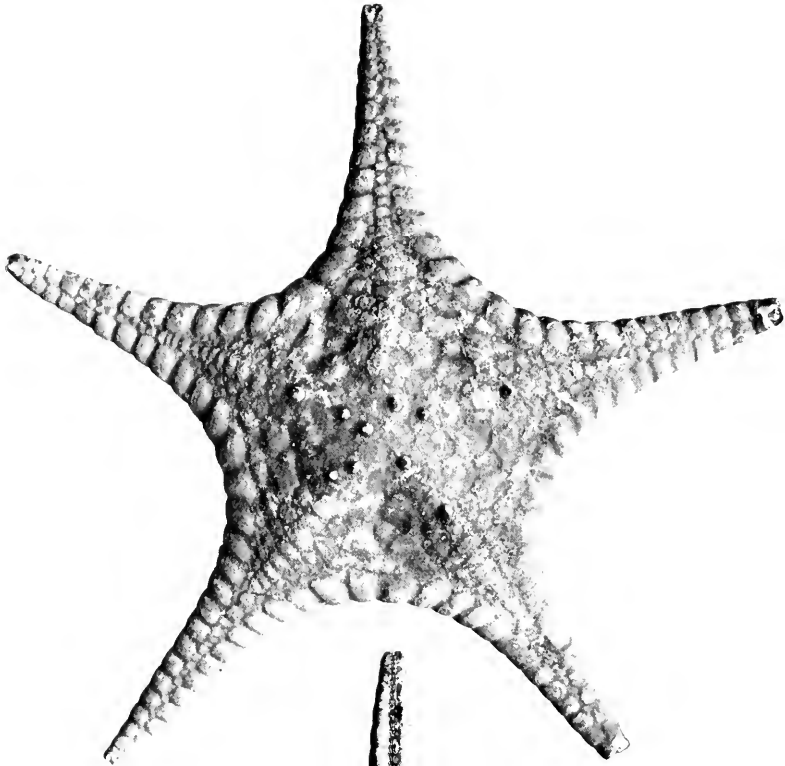
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EXPLANATION OF PLATE XIII.

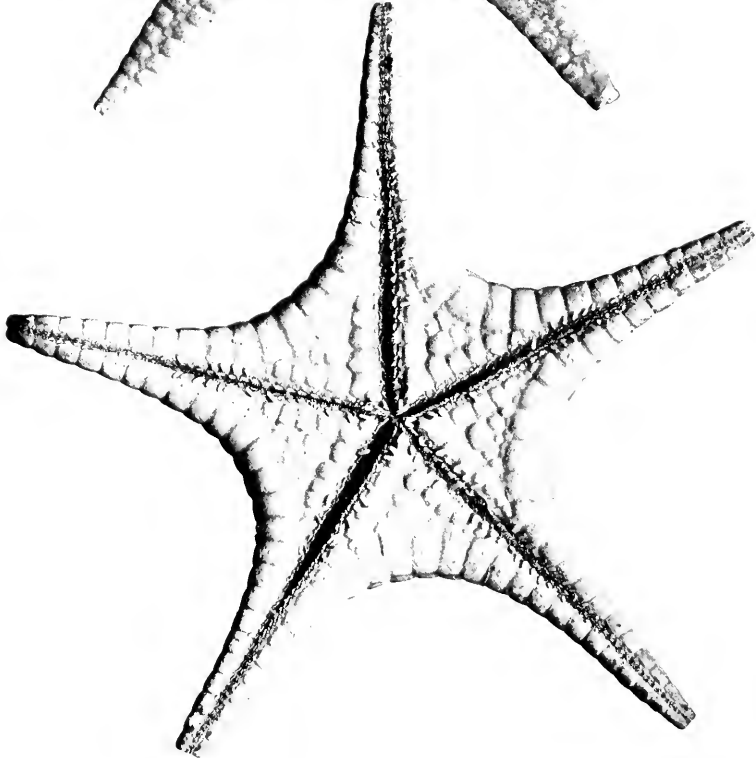
Fig. 1.—*Stellaster inspinosus*. sp. nov. Photograph of the holotype from between Geraldton and Cape Naturaliste, Western Australia. Abactinal view. Natural size.

Fig. 2 —Actinal view of same specimen as Fig. 1.





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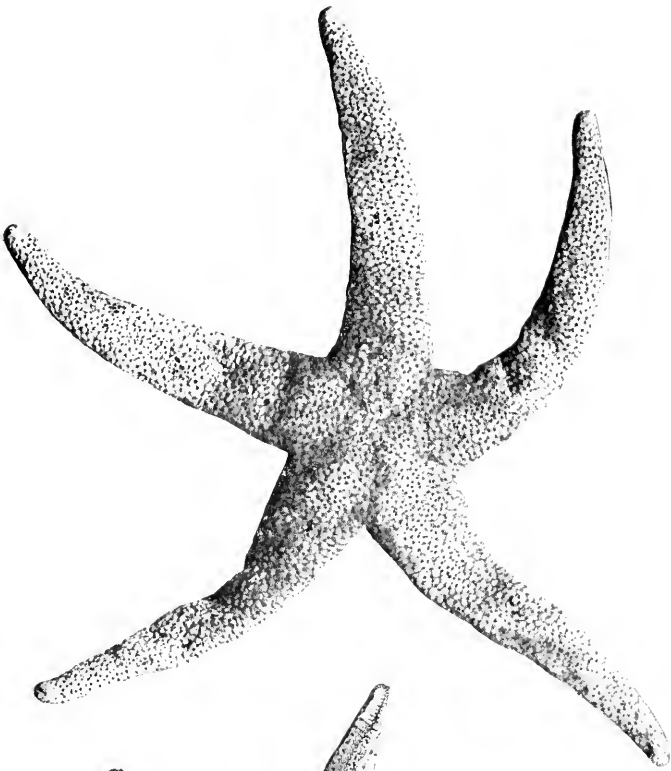


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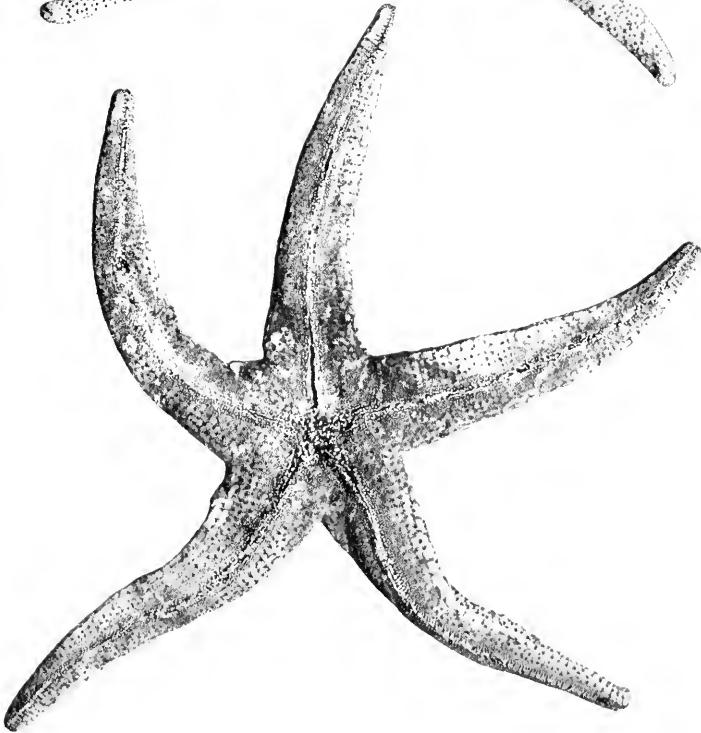
EXPLANATION OF PLATE XIV.

Fig. 1.—*Fromia polypora*, sp. nov. Photograph of the holotype from east of Maria Island, Tasmania, 78 fathoms. Abactinal view. Two-thirds natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



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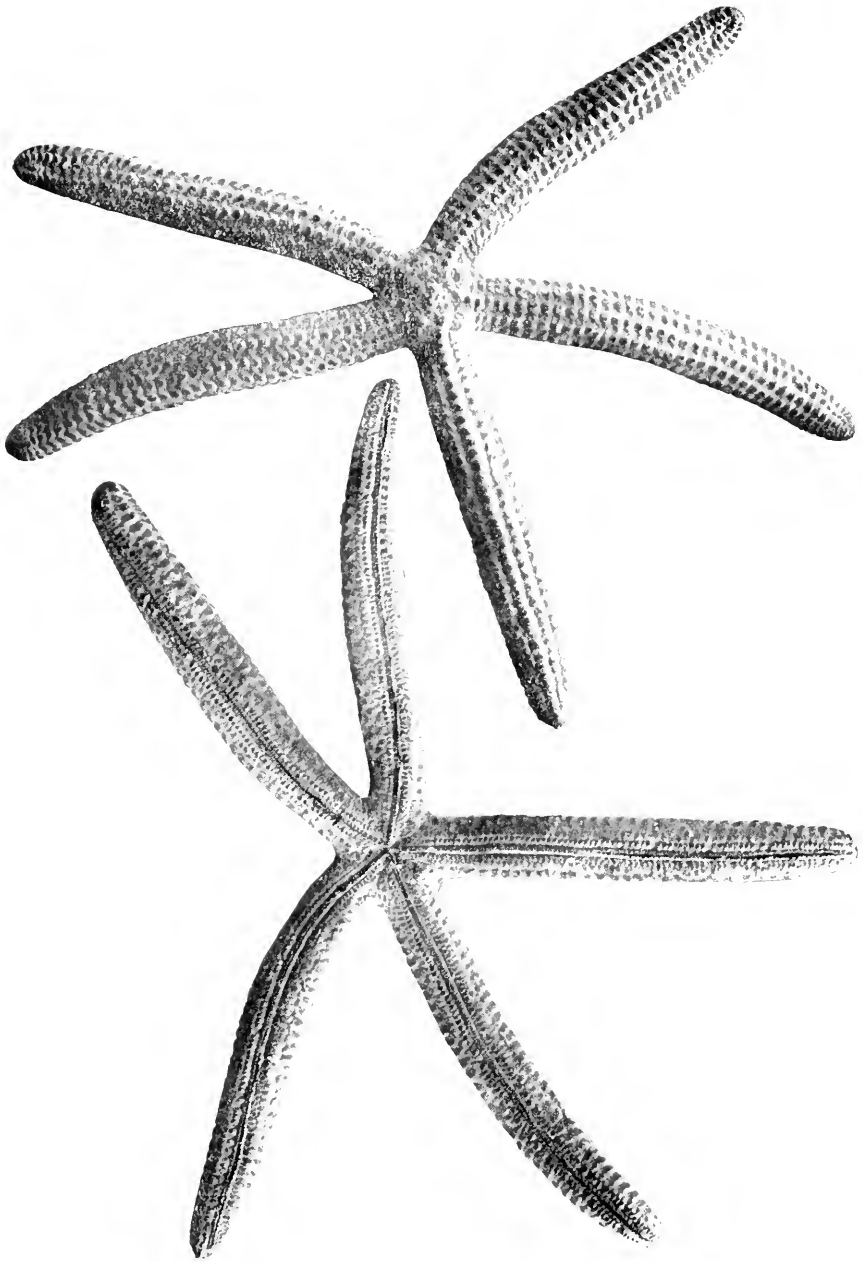


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EXPLANATION OF PLATE XV.

Fig. 1.—*Ophidiaster confertus*, sp. nov. Photograph of the holotype from Lord Howe Island, South Pacific Ocean. Abactinal view. Three-fourths natural size.

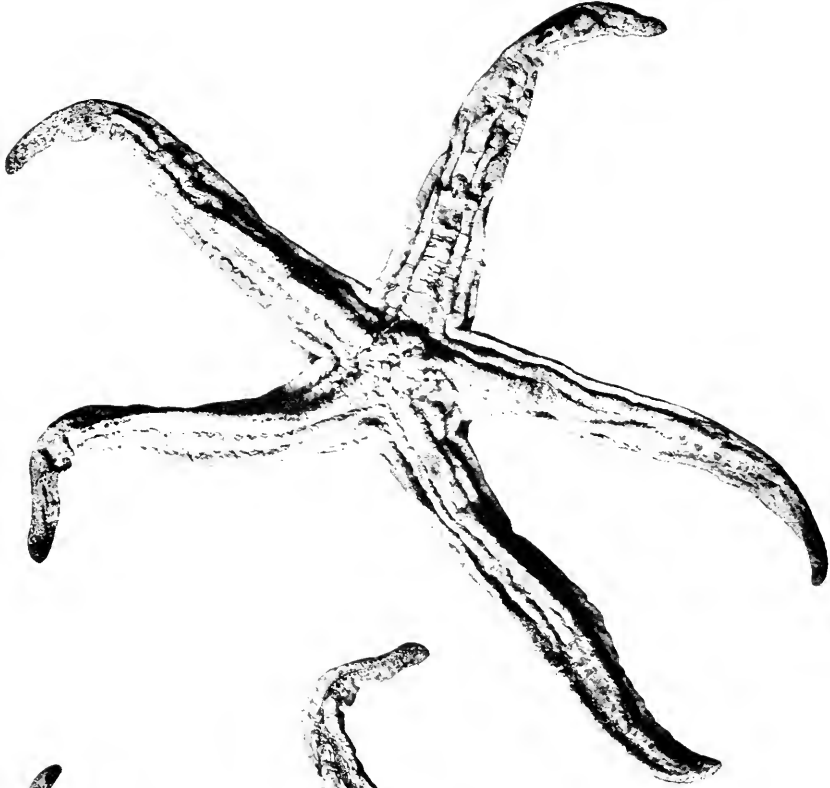
Fig. 2.—Actinal view of same specimen as Fig. 1.



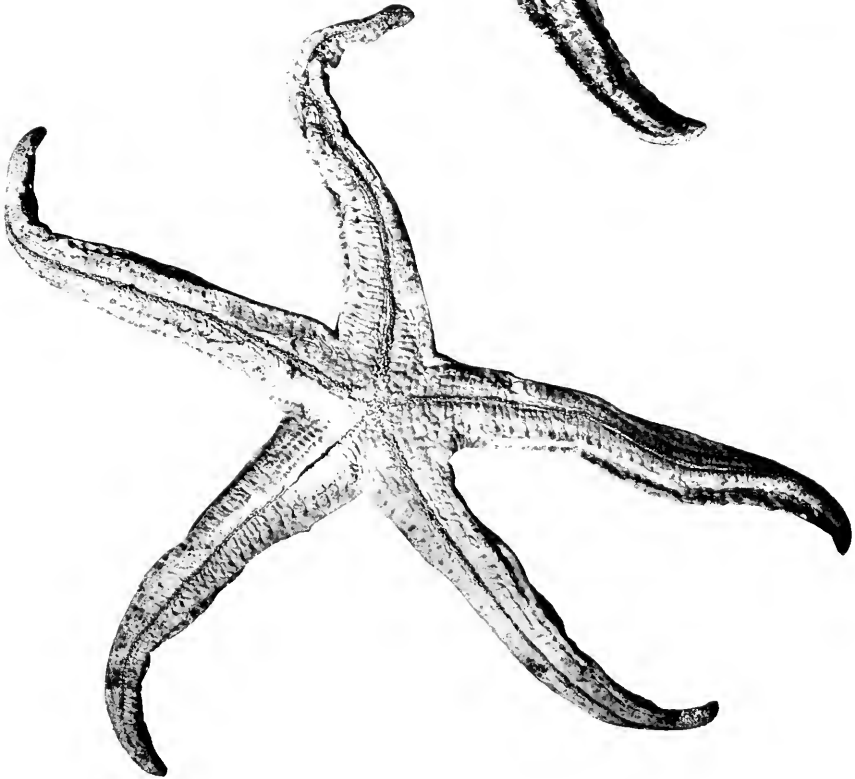
EXPLANATION OF PLATE XVI.

Fig. 1.—*Pseudophidiaster rhysus*, sp. nov. Photograph of the holotype from the Great Australian Bight, 80-120 fathoms. Abactinal view. One-half natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



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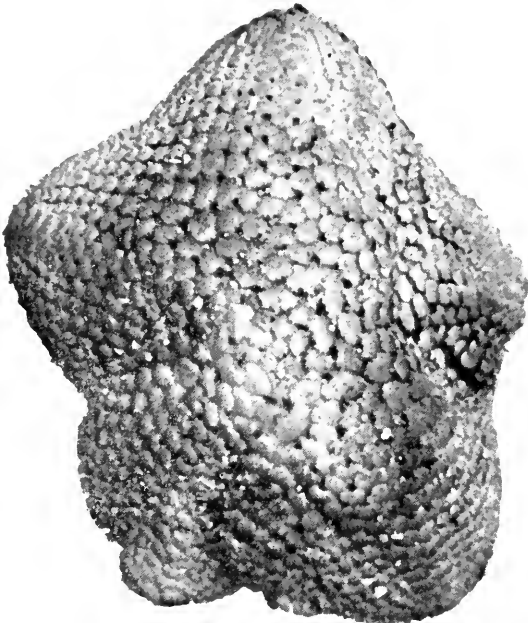
E. A. BRIGGS. Austr. Mus., photo.

EXPLANATION OF PLATE XVII.

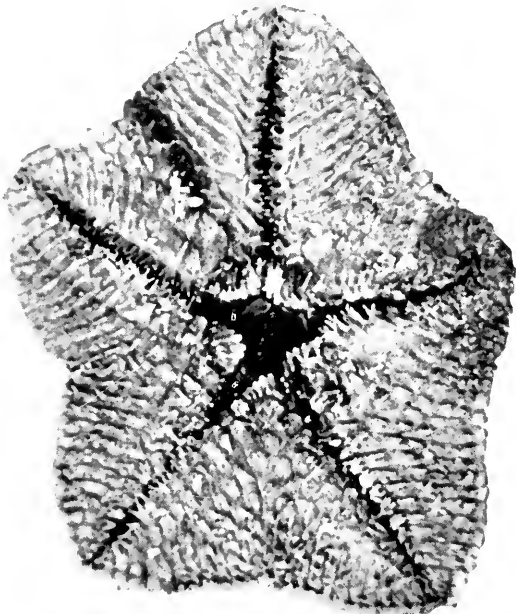
Fig. 1.—*Asterina atyphoida*, sp. nov. Photograph of the holotype from fifteen miles north-west of Cape Jervis, South Australia, 17 fathoms. Abactinal view. Four times natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.





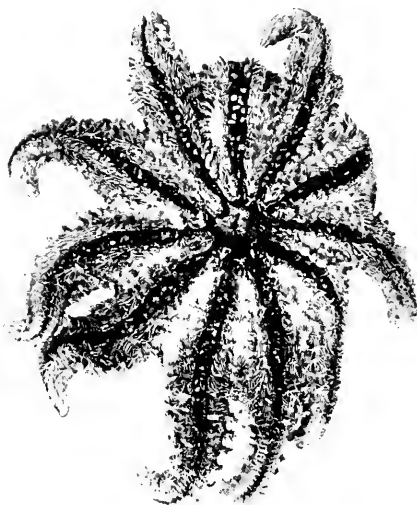
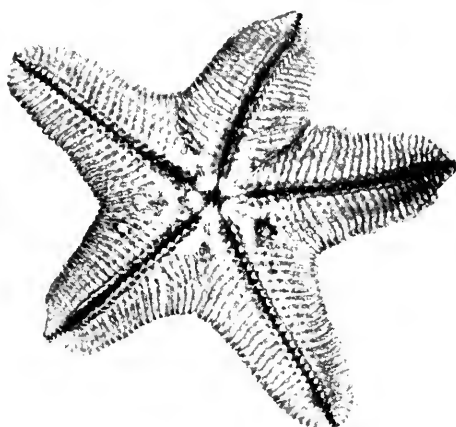
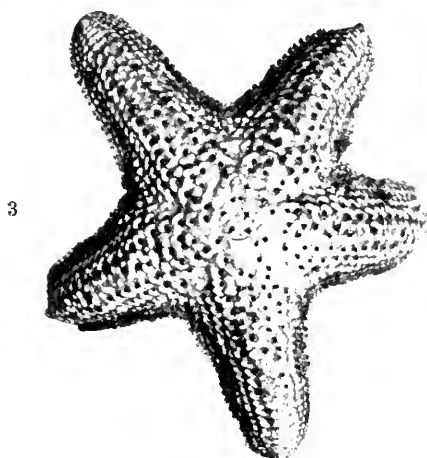
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EXPLANATION OF PLATE XVIII.

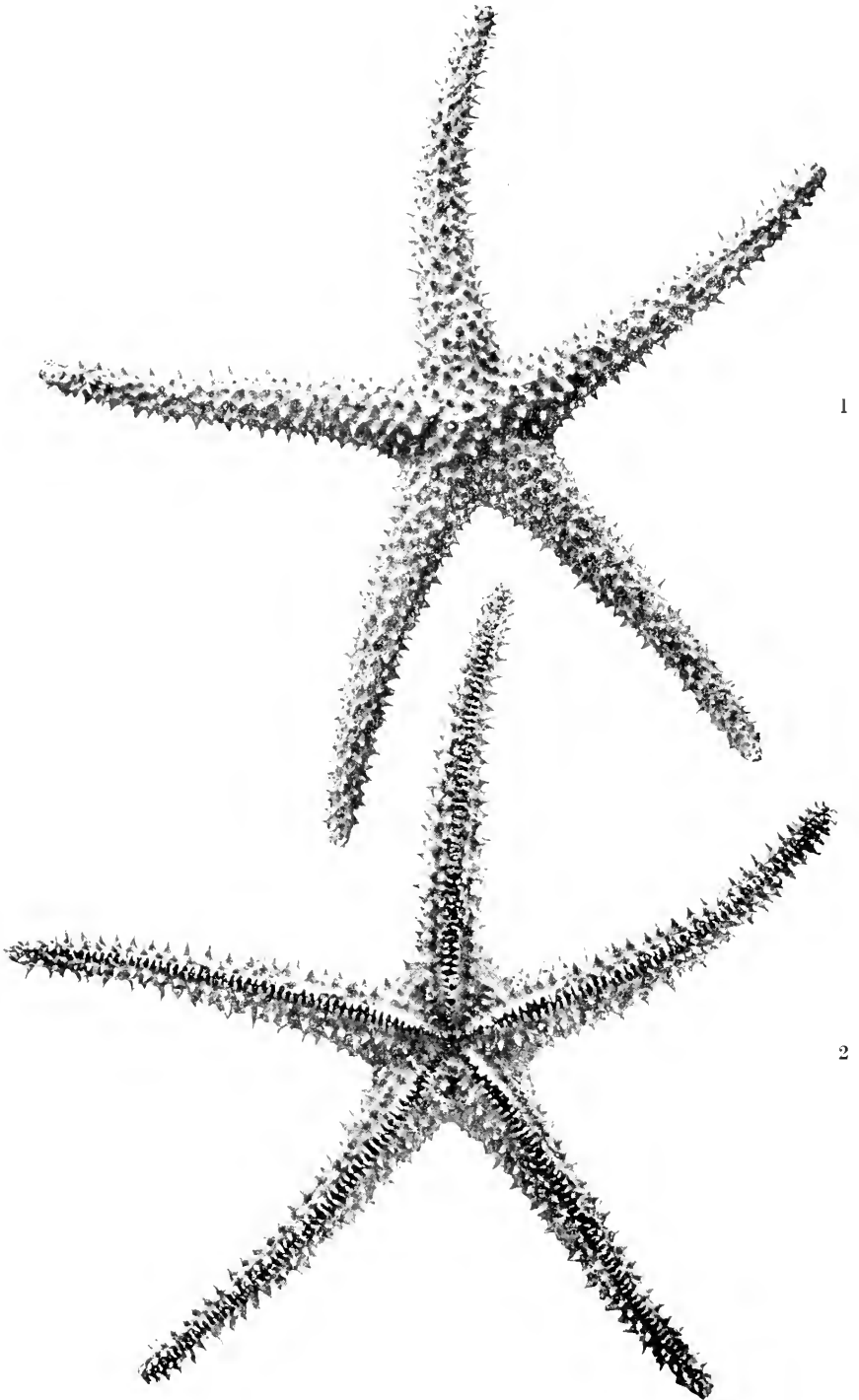
- Fig. 1.—*Pteraster tetracanthus*, sp. nov. Photograph of the holotype from south-east of Cape Everard to south of Gabo Island, Victoria, 90-150 fathoms. Abactinal view. Natural size.
- Fig. 2.—Actinal view of same specimen as Fig. 1.
- Fig. 3.—*Asterina leptalacantha*, sp. nov. Photograph of the holotype from Masthead Island, Queensland. Abactinal view. Twice natural size.
- Fig. 4.—Actinal view of same specimen as Fig. 3.
- Fig. 5.—*Crossaster multispinus*, sp. nov. Photograph of the holotype from between Gabo Island, Victoria, and Disaster Bay, New South Wales, 50-100 fathoms. Abactinal view. Natural size.
- Fig. 6.—Actinal view of same specimen as Fig. 5.



EXPLANATION OF PLATE XIX.

Fig. 1.—*Echinaster acanthodes*, sp. nov. Photograph of the holotype from twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms. Abactinal view. Six-sevenths natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



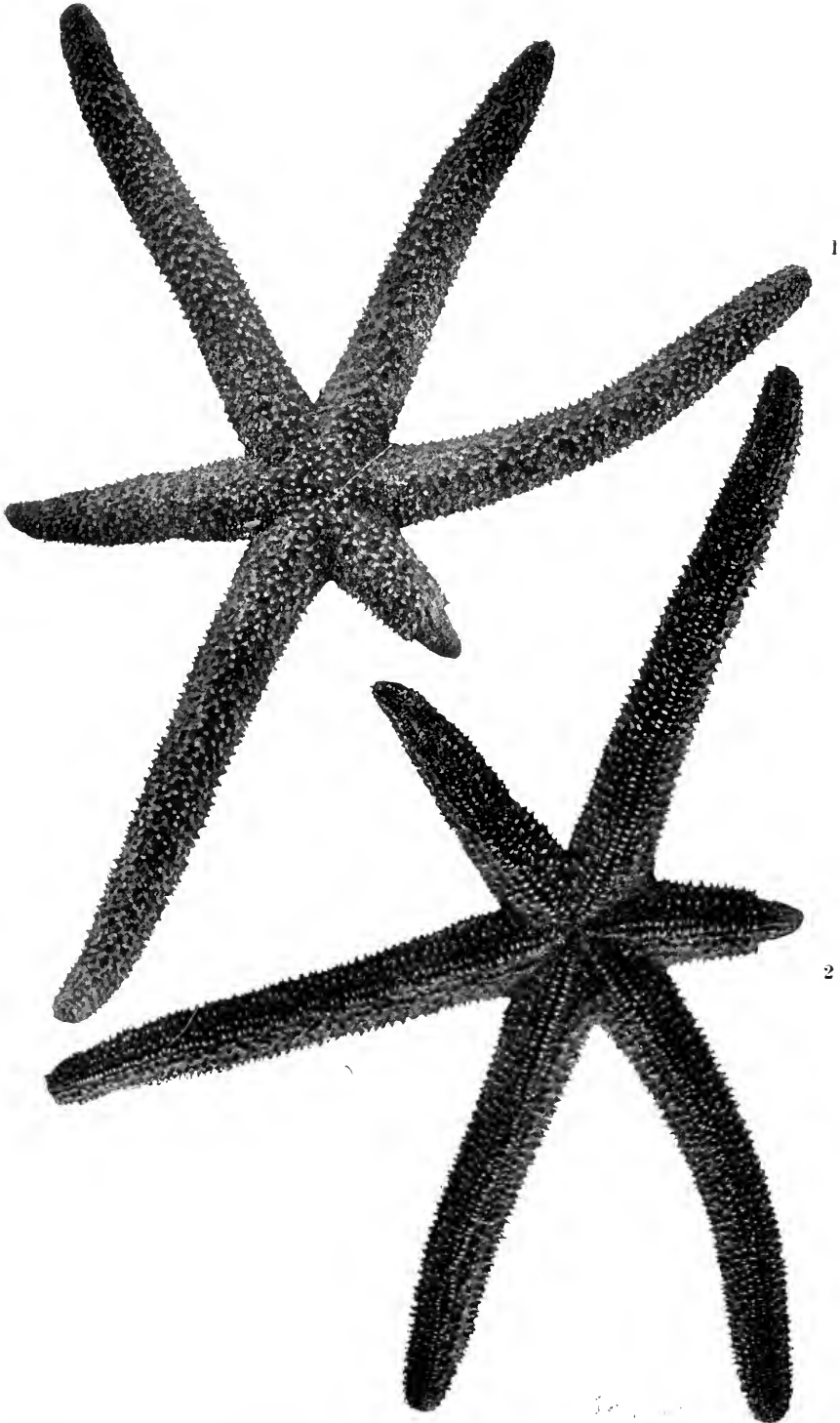
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EXPLANATION OF PLATE XX.

Fig. 1.—*Echinaster eridauella*, Müller and Troschel. Photograph of a specimen from Murray Island, Torres Strait. Abactinal view. Natural size.

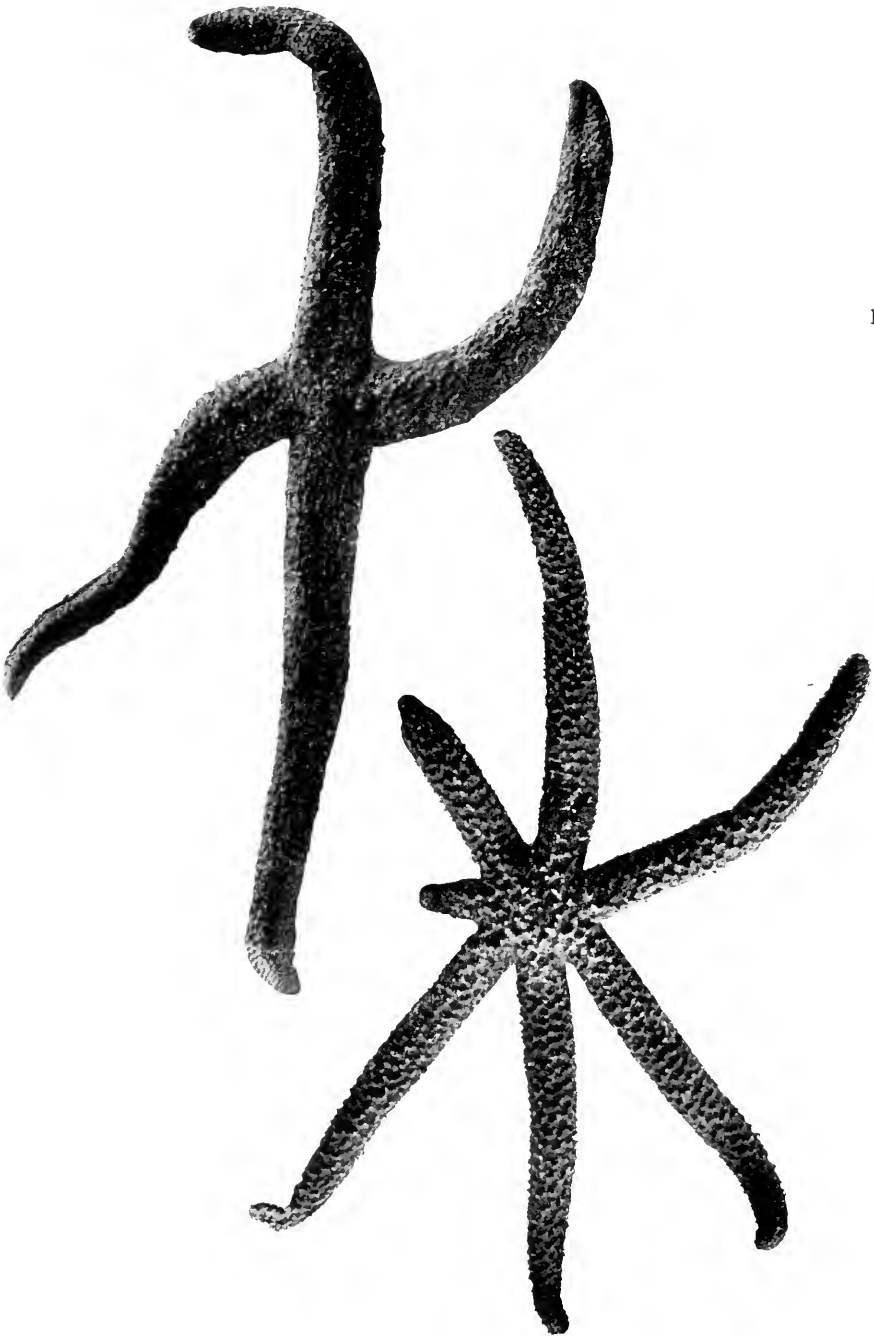
Fig. 2.—Actinal view of same specimen as Fig. 1.



H. BARNES, Junr., Austr. Mus., photo.

EXPLANATION OF PLATE XXI.

- Fig. 1.— *Echinaster eridanella*, Müller and Troschel. Photograph of a specimen with four rays from Mauritius. Abactinal view. Natural size.
- Fig. 2.— *Echinaster eridanella*, Müller and Troschel. Photograph of a specimen with seven rays from Bowen, Queensland. Abactinal view. Natural size.

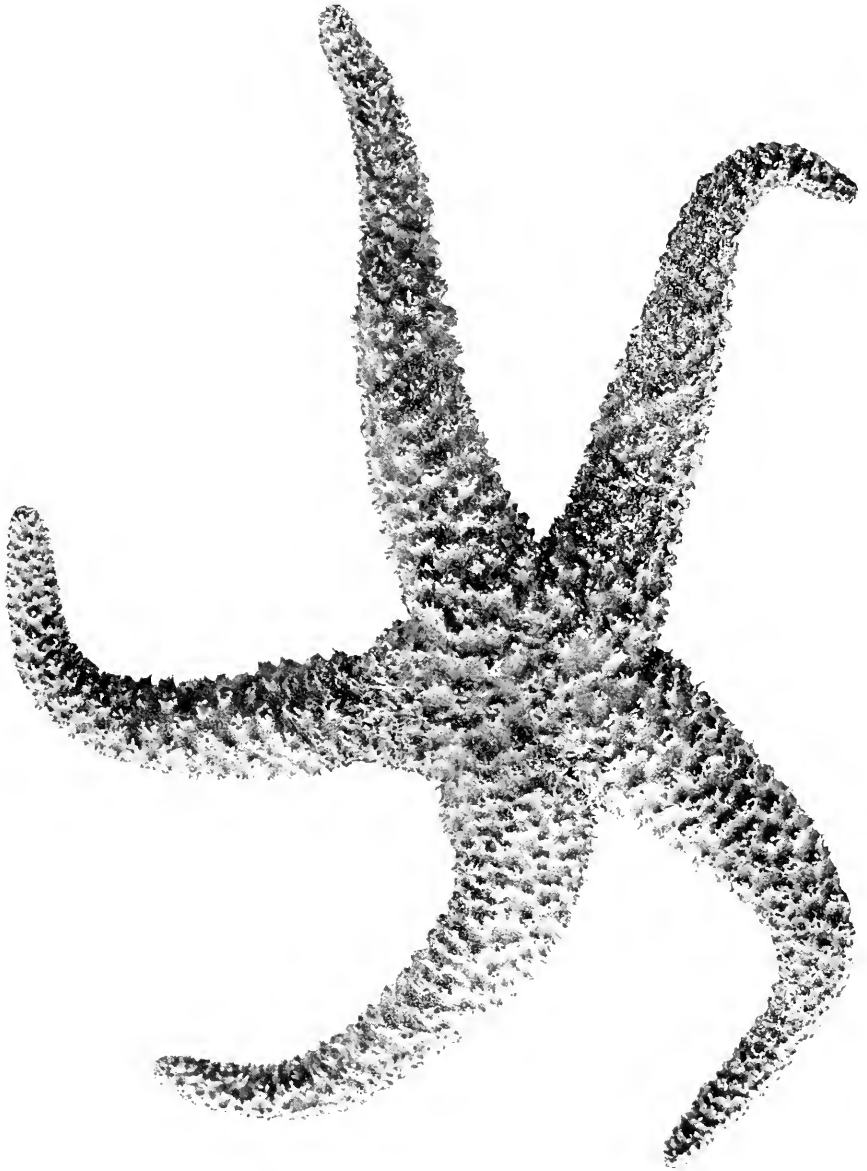


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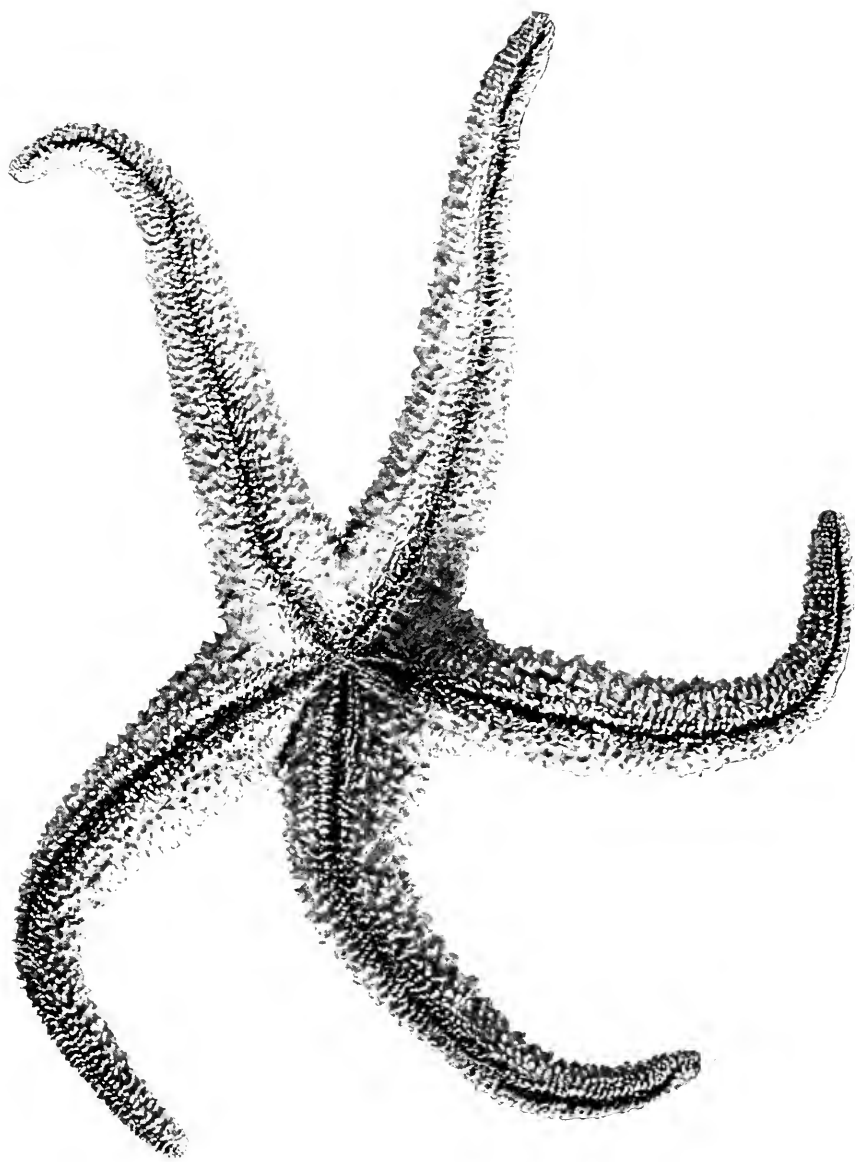
EXPLANATION OF PLATE XXII.

Echinaster glomeratus, sp. nov. Photograph of the holotype from off Cape Marsden, Kangaroo Island, South Australia, 17 fathoms. Abactinal view. Two-thirds natural size.



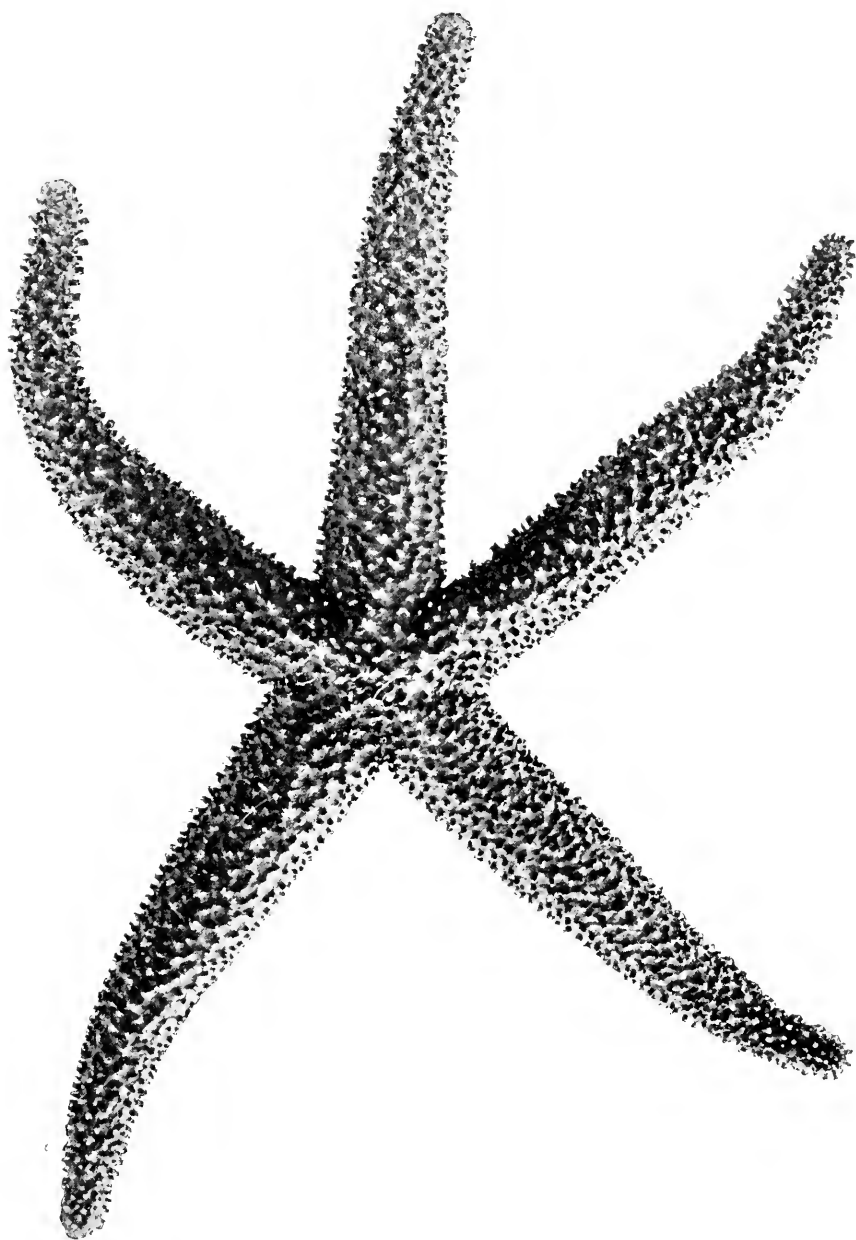
EXPLANATION OF PLATE XXIII.

Echinaster glomeratus, sp. nov. Photograph of the holotype from off Cape Marsden, Kangaroo Island, South Australia, 17 fathoms. Actinal view. Two-thirds natural size.



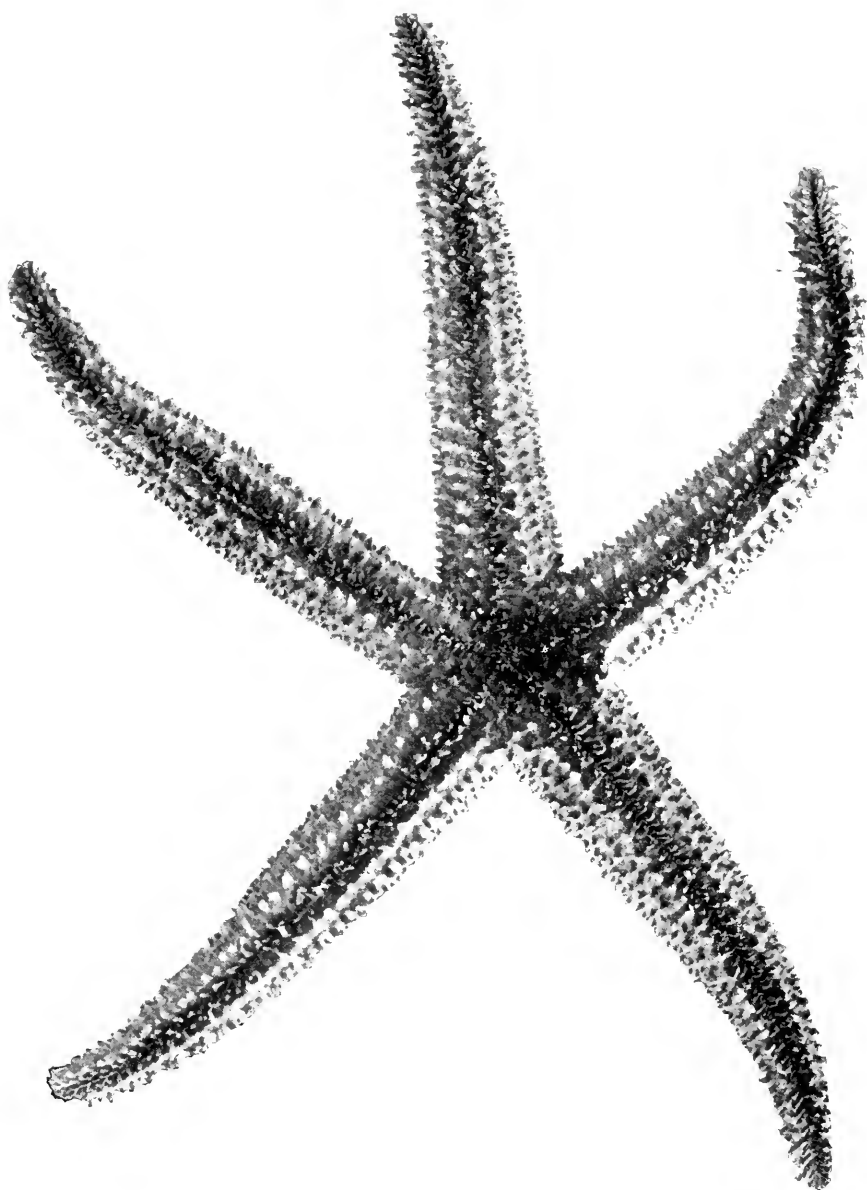
EXPLANATION OF PLATE XXIV.

Echinaster superbus, sp. nov. Photograph of the holotype from Broome, Western Australia. Abactinal view. Four-fifths natural size.



EXPLANATION OF PLATE XXV.

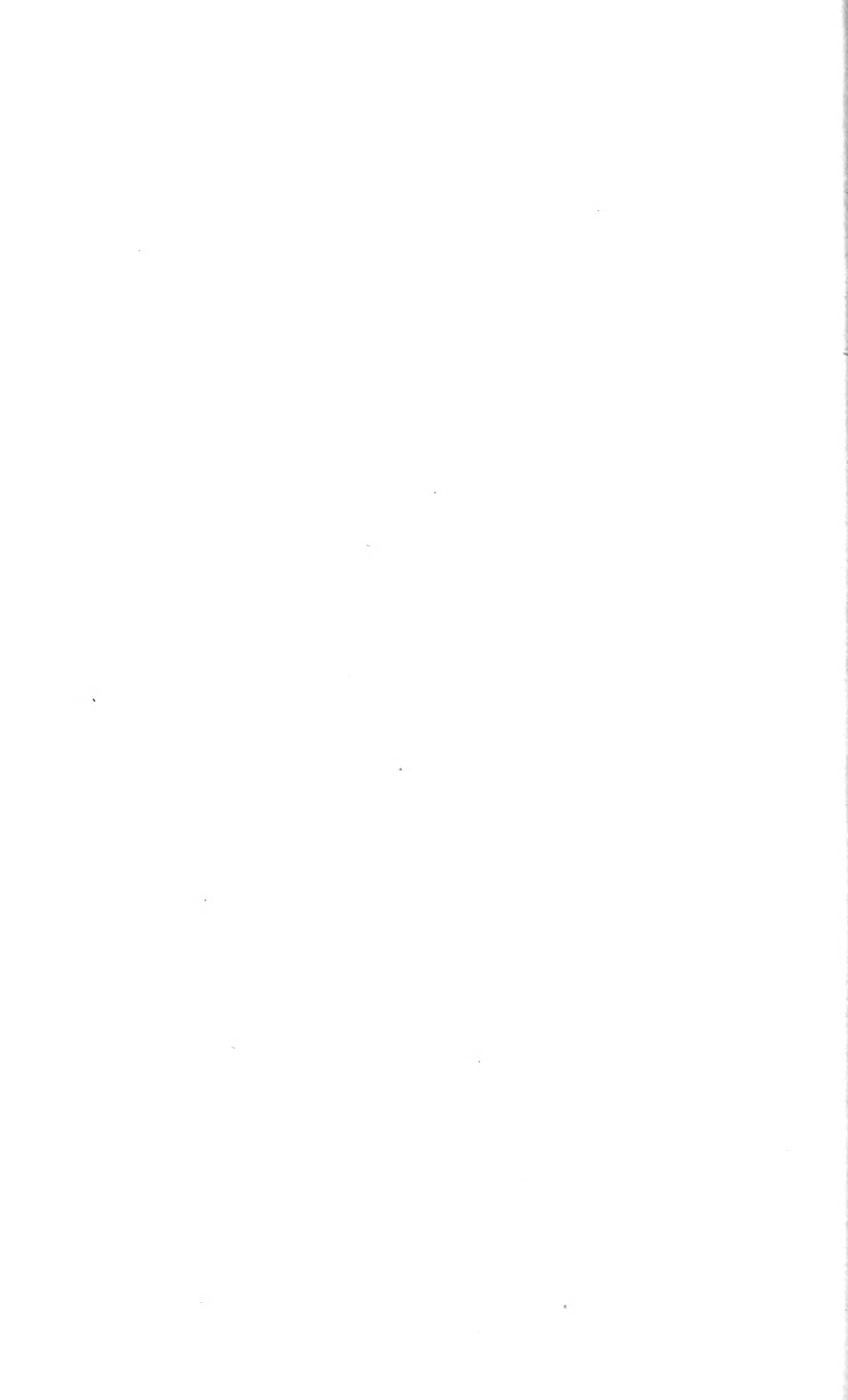
Echinaster superbus, sp. nov. Photograph of the holotype
from Broome, Western Australia. Actinal view.
Four-fifths natural size.

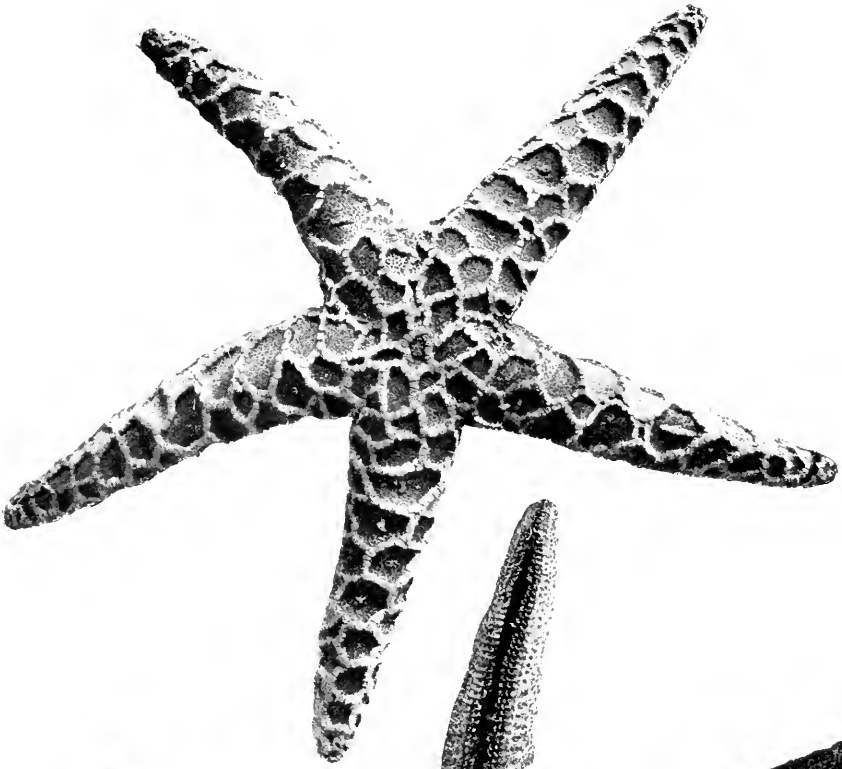


EXPLANATION OF PLATE XXVI.

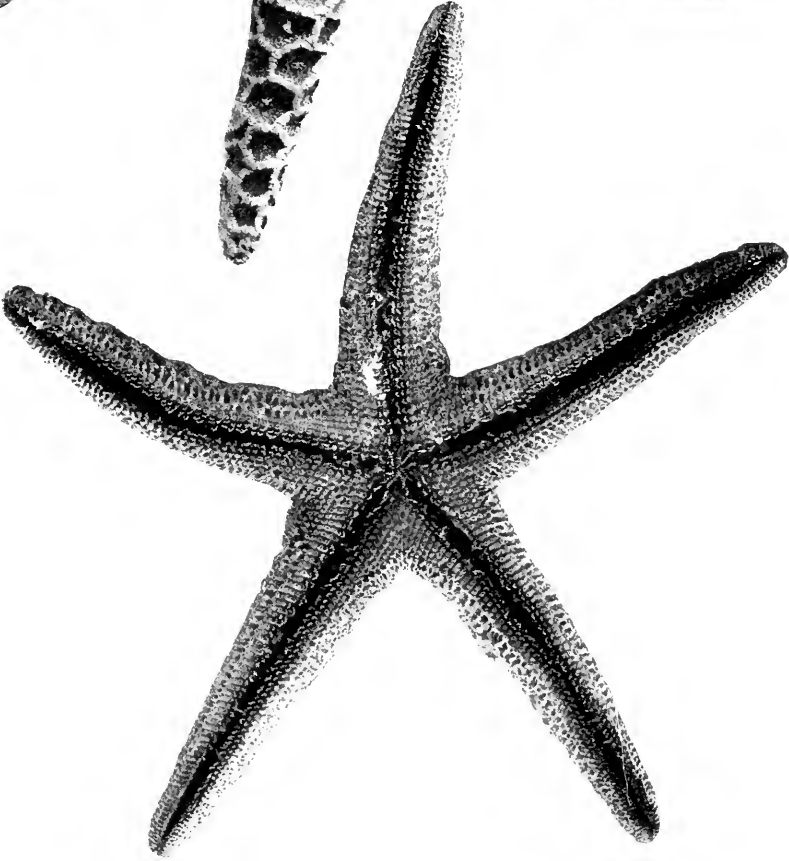
Fig. 1.—*Plectaster decanus* (Müller and Troschel). Photograph of a specimen from off George Head, Port Jackson, New South Wales. Abactinal view. One-half natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.





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EXPLANATION OF PLATE XXVII.

Fig. 1.—*Odinia australis*, sp. nov. Photograph of the holotype from south-east of Cape Everard, Victoria, 200 fathoms. Abactinal view. Natural size.

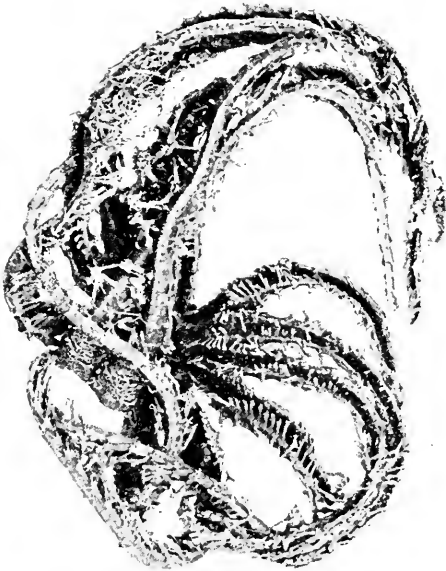
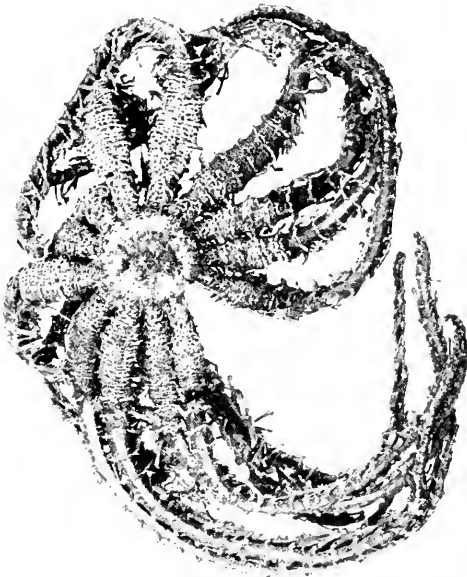
Fig. 2.—Actinal view of same specimen as Fig. 1.

Fig. 3.—*Pedicellaster reticulatus*, sp. nov. Photograph of the holotype from east of Maria Island, Tasmania, 78 fathoms. Abactinal view. Twice natural size.

Fig. 4.—Actinal view of same specimen as Fig. 3.

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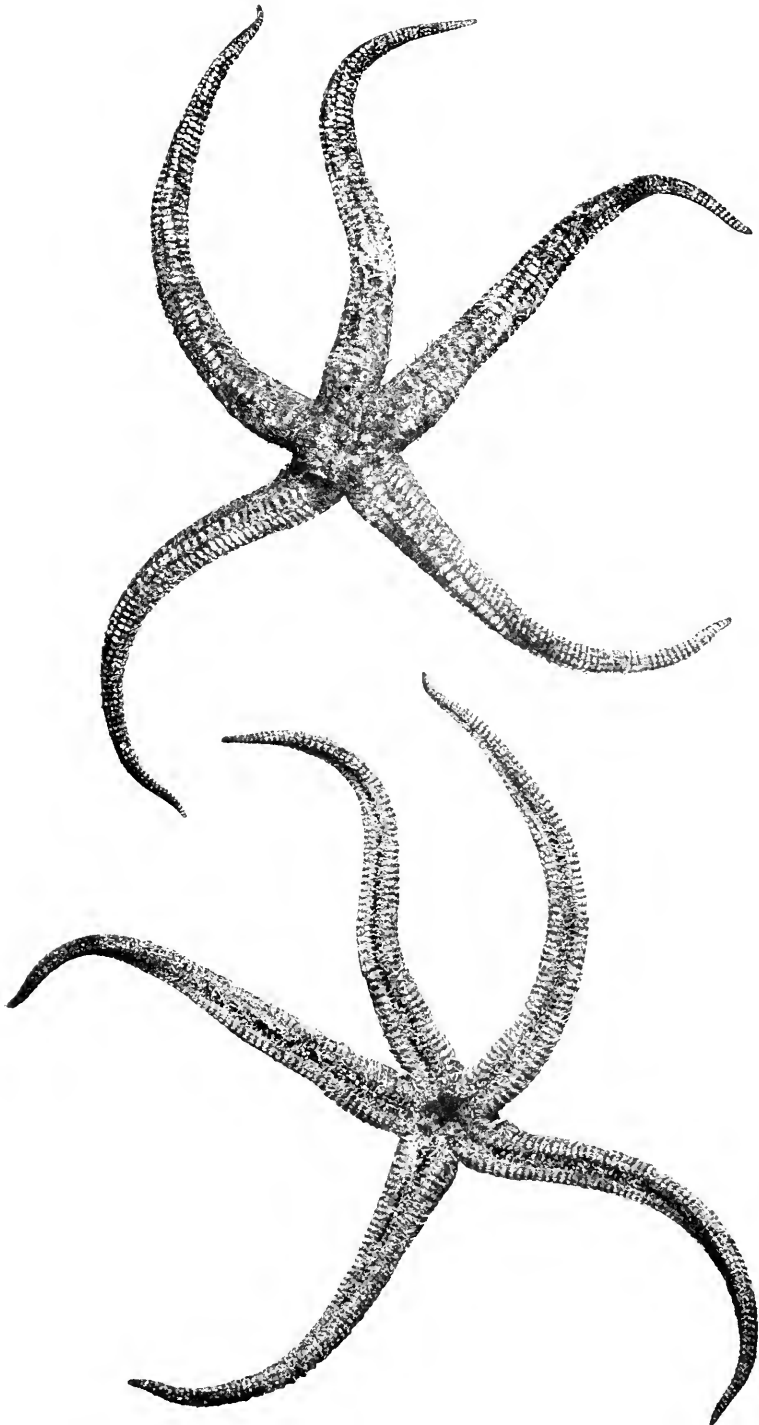
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EXPLANATION OF PLATE XXVIII.

Fig. 1.—*Zoroaster macracantha*, sp. nov. Photograph of the holotype from the Great Australian Bight, 129° 28' E., 250-450 fathoms. Abactinal view. About one-half natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



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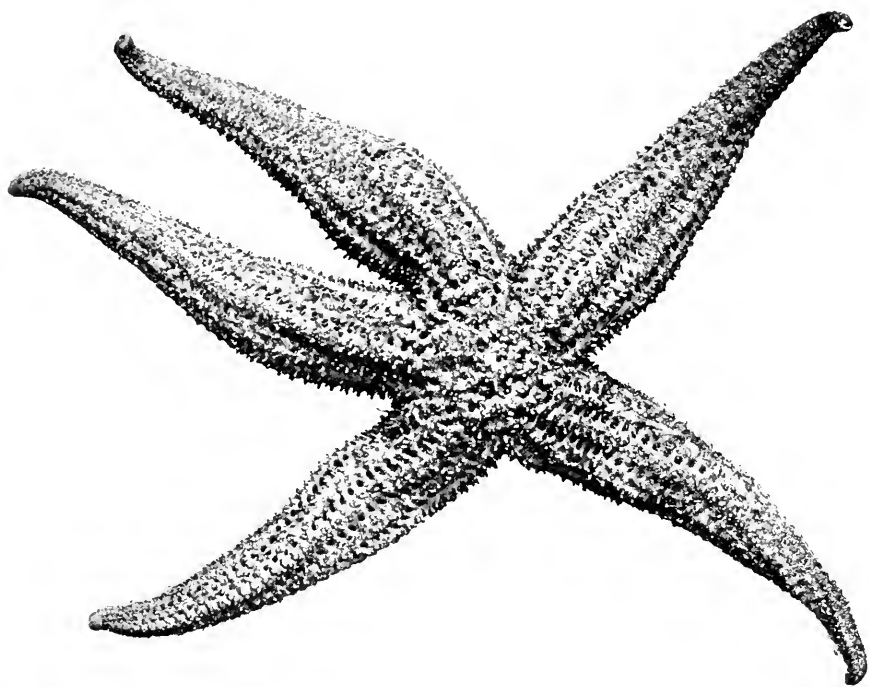
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EXPLANATION OF PLATE XXIX.

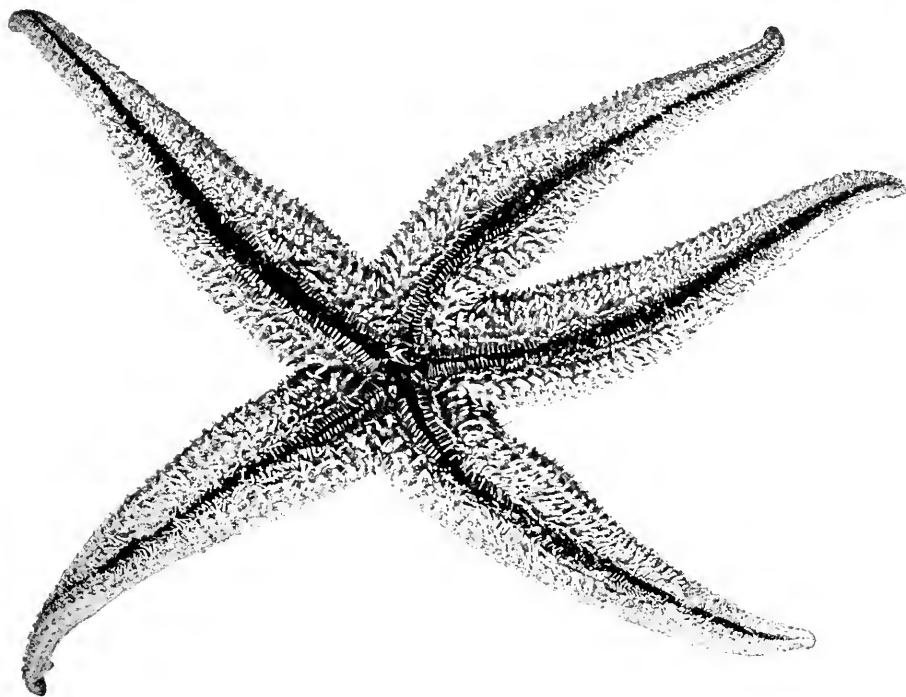
Fig. 1.—*Cosmasterias dyscrita*, sp. nov. Photograph of the holotype from south of Gabo Island, Victoria, 200 fathoms. Abactinal view. Natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.





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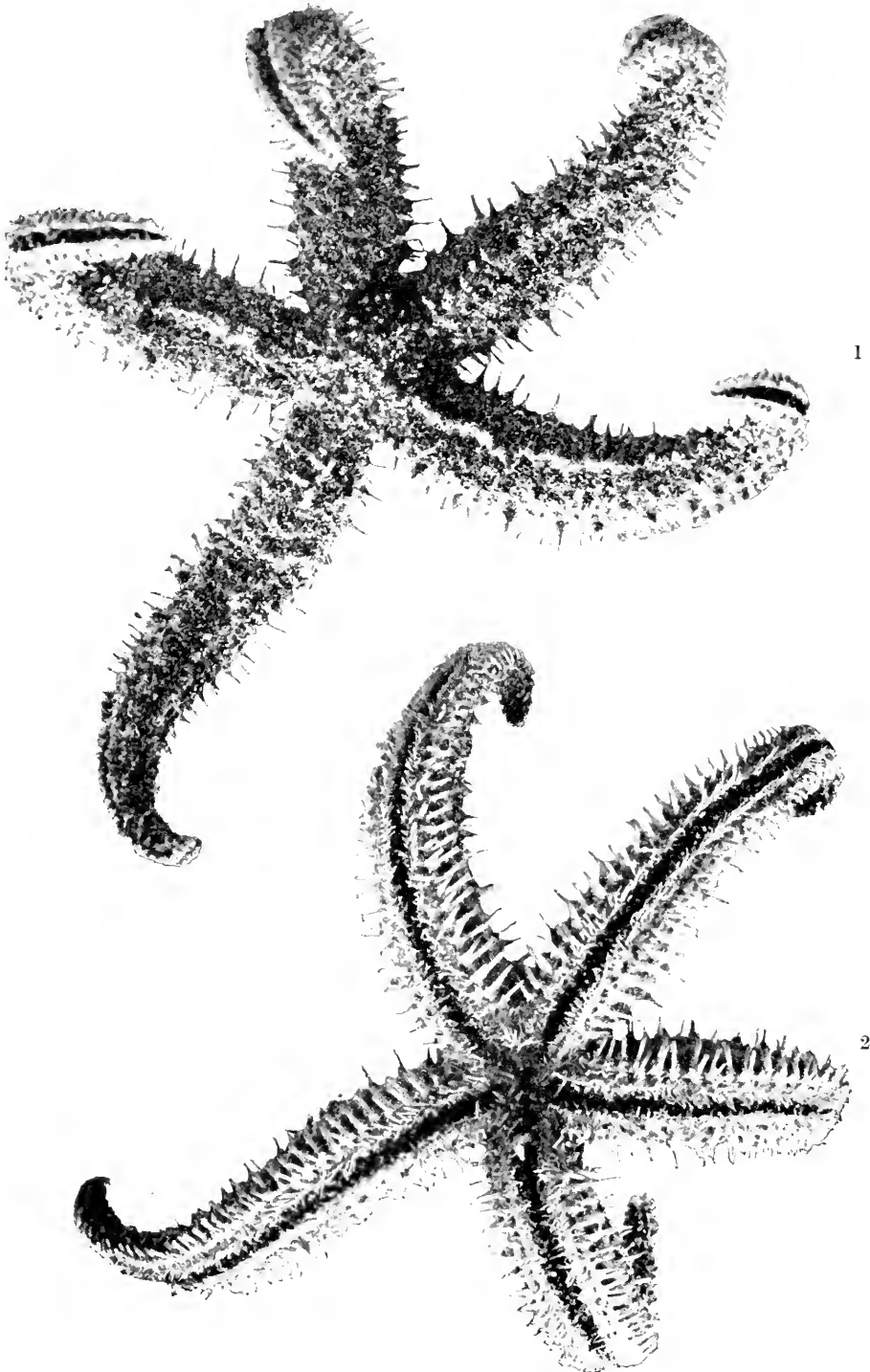


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EXPLANATION OF PLATE XXX.

Fig. 1.—*Coscinasterias dubia*, H. L. Clark. Photograph of a specimen from the southern coast of South Australia. Abactinal view. One and one-half times natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.

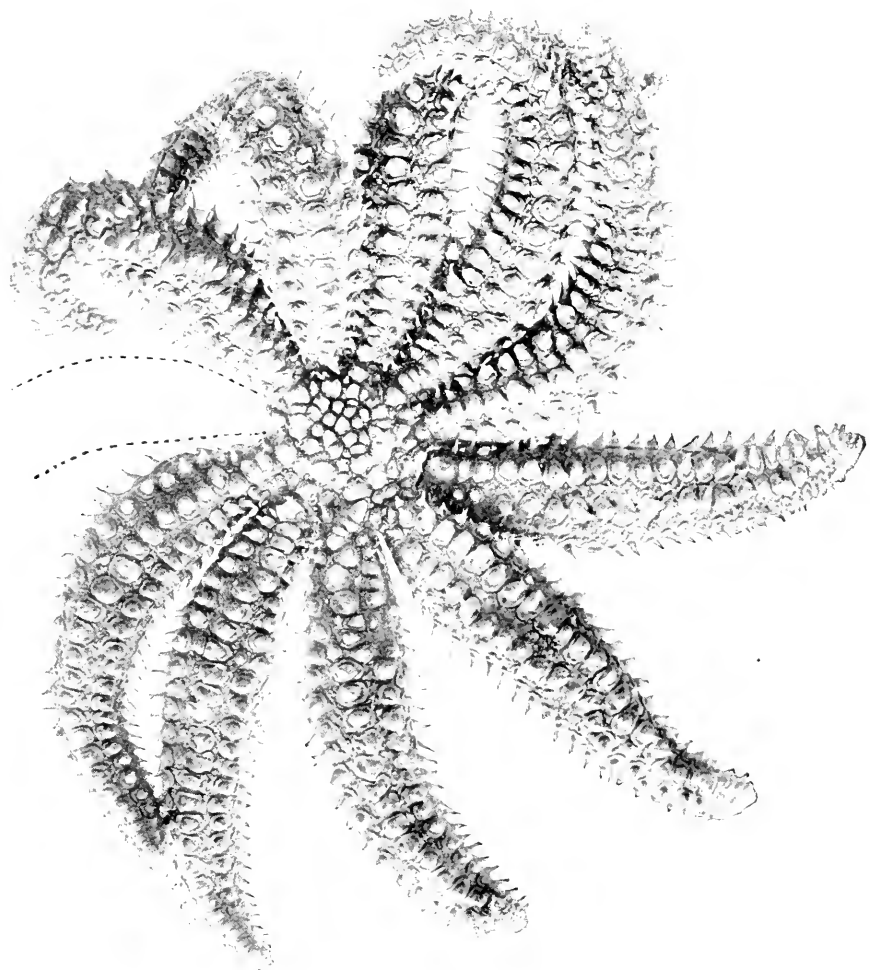


H. BARNES, JUNR., Austr. Mus., photo.

EXPLANATION OF PLATE XXXI.

Coscinasterias gemmitera, Perrier. Photograph of a specimen from Oyster Bay, Tasmania, 20-40 fathoms. Abactinal view. One-half natural size.

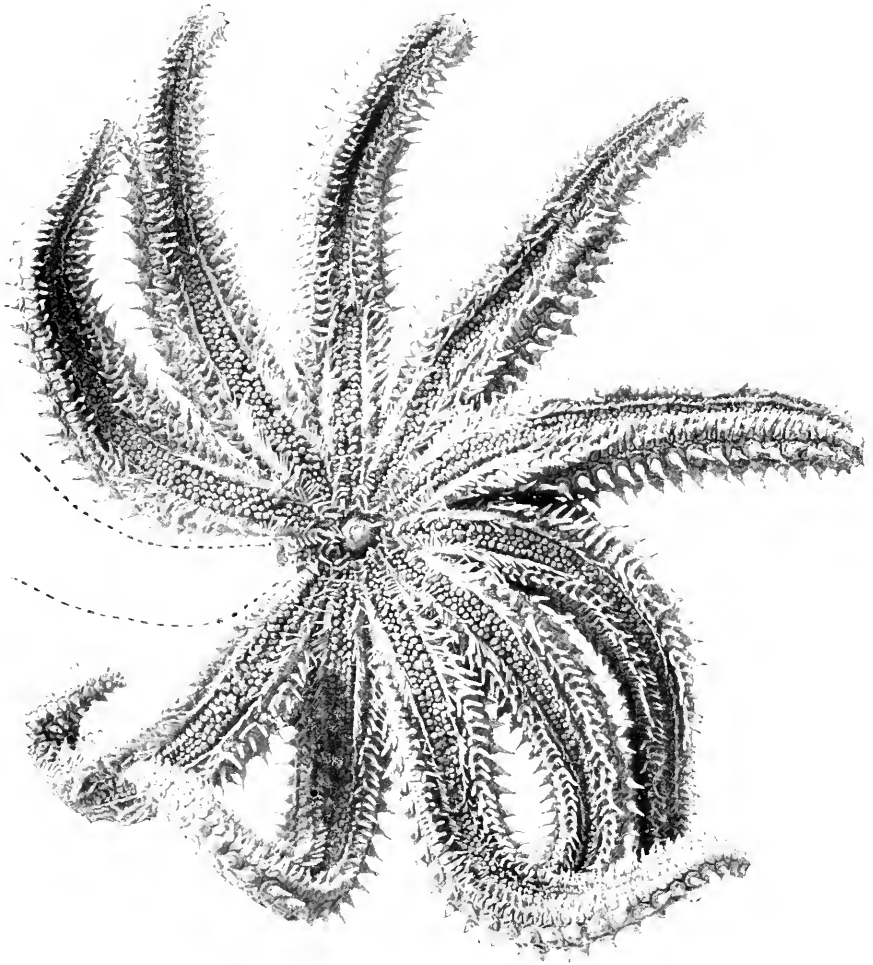




EXPLANATION OF PLATE XXXII.

Coscinasterius gemmifera, Perrier. Photograph of a specimen from Oyster Bay, Tasmania, 20-40 fathoms. Actinal view. One-half natural size.



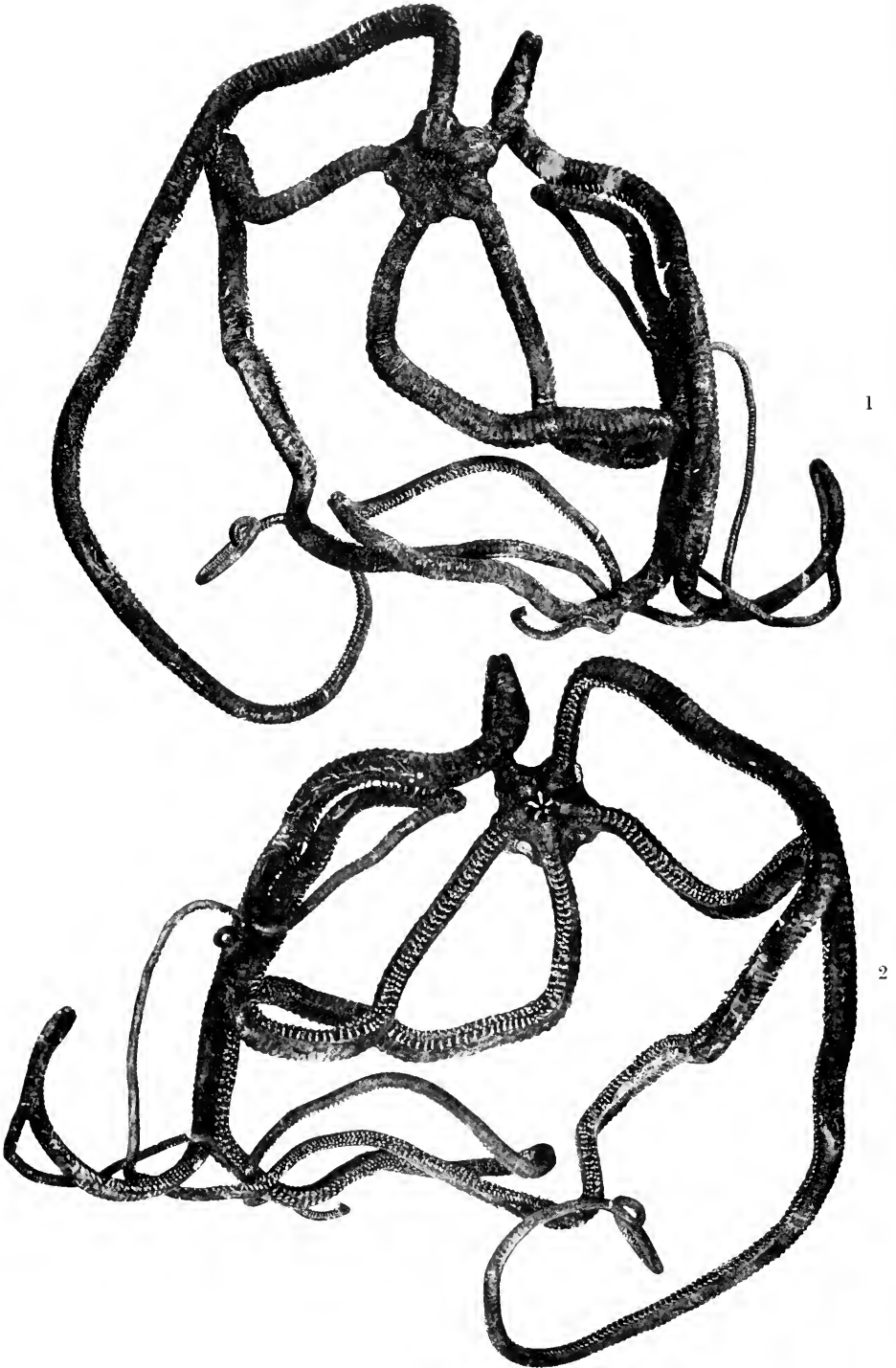


EXPLANATION OF PLATE XXXIII.

Fig. 1.—*Ophiocreas phanerum*, sp. nov. Photograph of the holotype from twenty miles off Cape Barren, Cape Barren Island, Tasmania, 70 fathoms. Abactinal view. Two-thirds natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



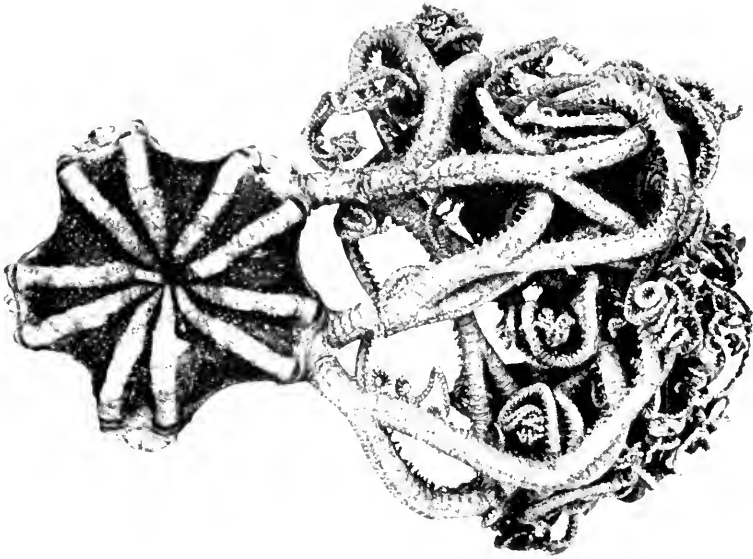


EXPLANATION OF PLATE XXXIV.

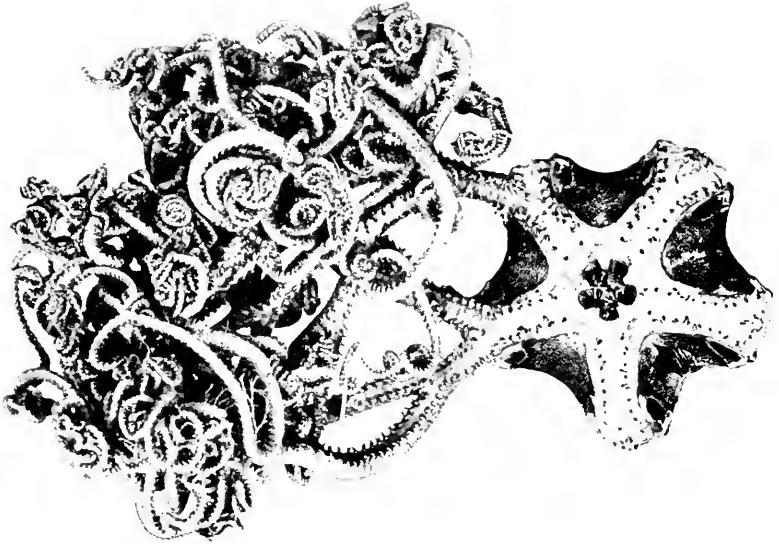
Fig. 1.—*Astrodendrum pustulatum*, sp. nov. Photograph of the holotype from east of Flinders Island, Bass Strait, 100-300 fathoms. Abactinal view. Natural size.

Fig. 2.— Actinal view of same specimen as Fig. 1.





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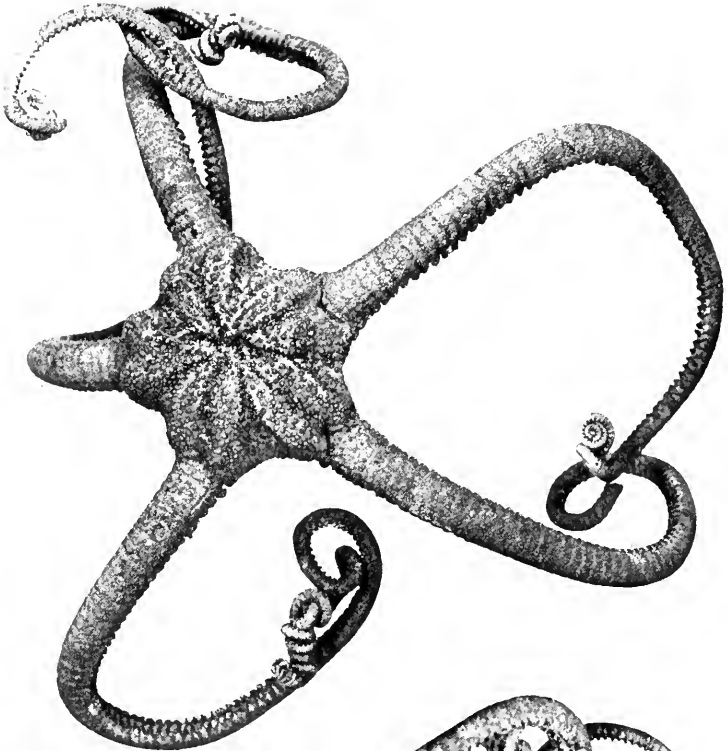


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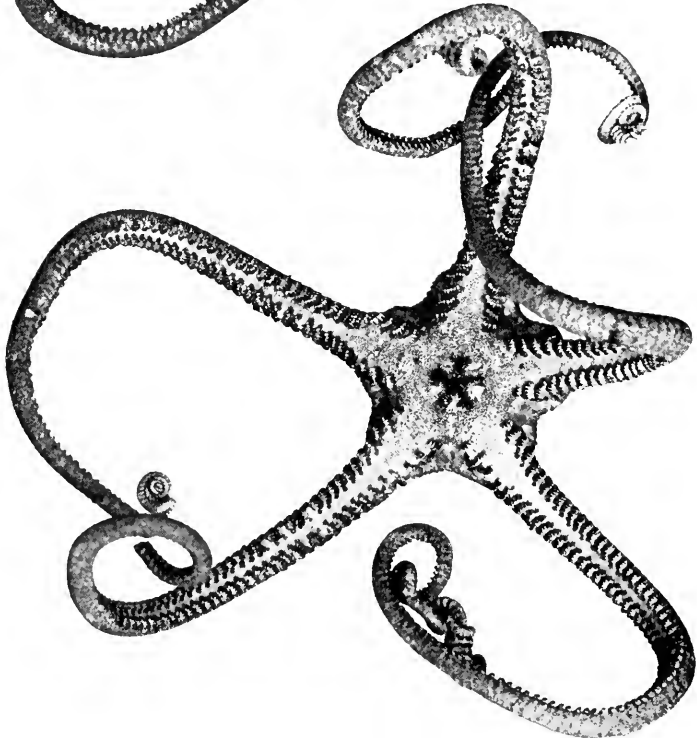
EXPLANATION OF PLATE XXXV.

Fig. 1.—*Astrothamnus rugosus*, sp. nov. Photograph of the holotype from east of Flinders Island, Bass Strait, 80-300 fathoms. Abactinal view. One and one-third times natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



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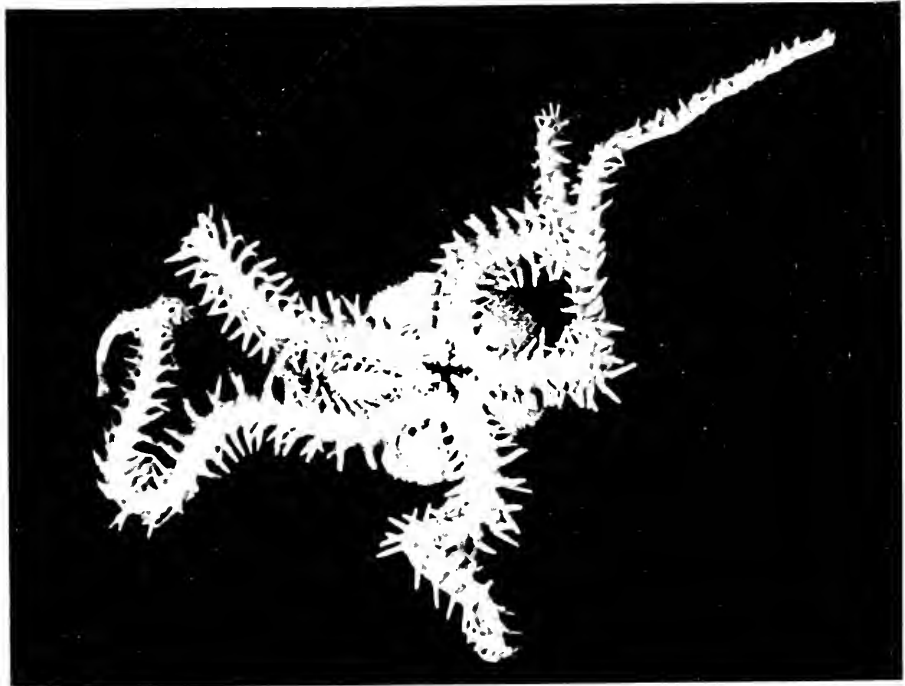
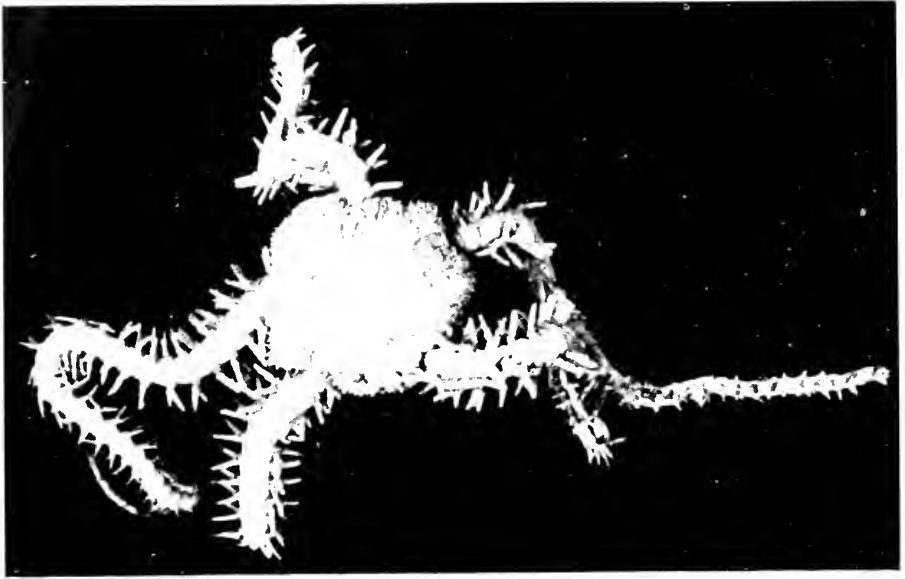


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EXPLANATION OF PLATE XXXVI.

Fig. 1.—*Ophiactis symbiota*, sp. nov. Photograph of the holotype from east of Flinders Island, Bass Strait, 100-300 fathoms. Abactinal view. Four times natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.

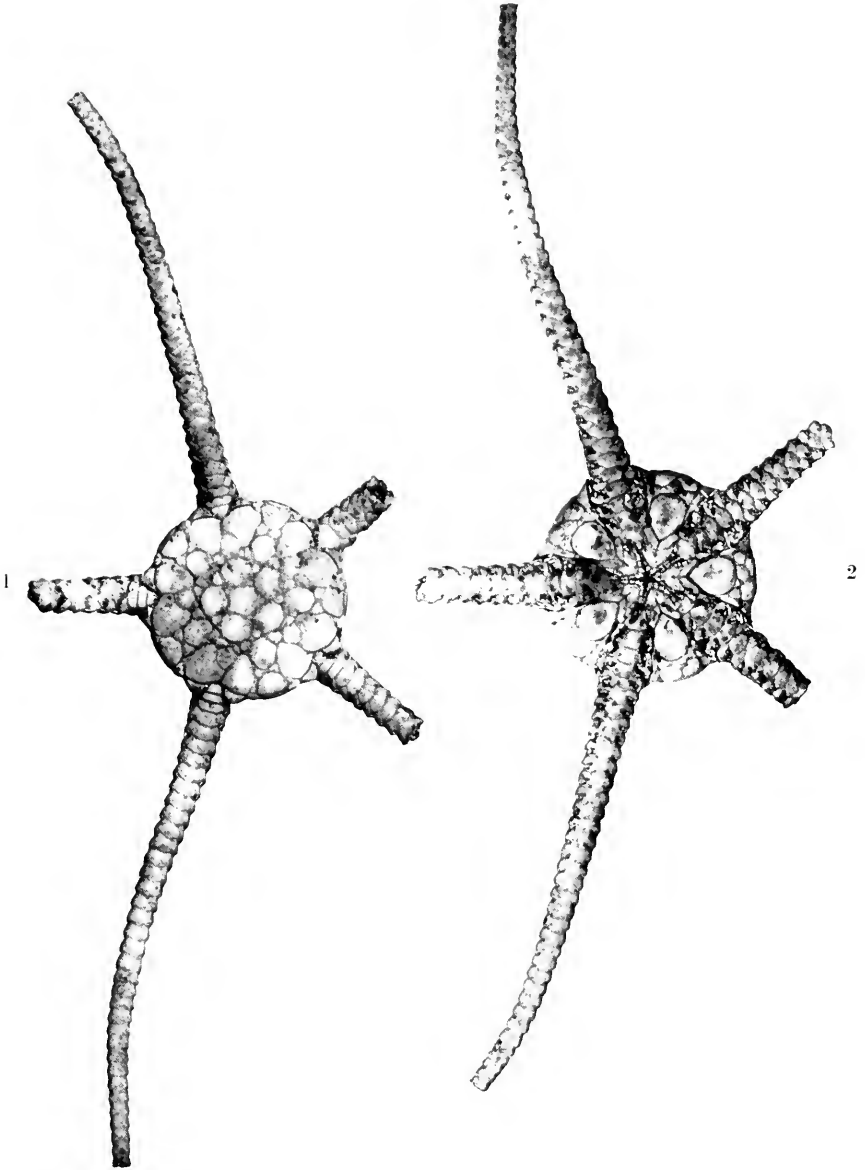


E. A. BIGGS, Austr. Mus., photo.

EXPLANATION OF PLATE XXXVII.

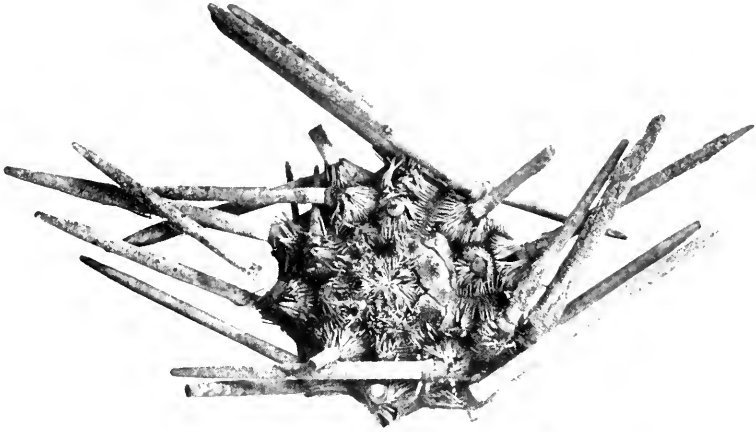
Fig. 1.—*Amphiophiura colleta*, sp. nov. Photograph of the holotype from east of Babel Island, Bass Strait, 60-80 fathoms. Abactinal view. One and five-eighth times natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.



EXPLANATION OF PLATE XXXVIII.

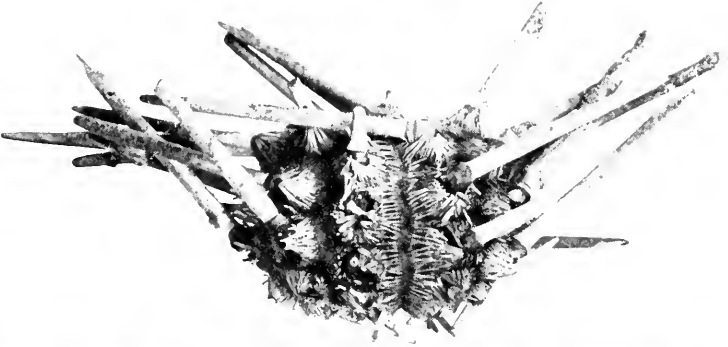
- Fig. 1.—*Cidaris conferta*, sp. nov. Photograph of the holotype from the Eastern Slope, Bass Strait, 80-200 fathoms. Abactinal view. Two-thirds natural size.
- Fig. 2.—Actinal view of same specimen as Fig. 1.
- Fig. 3.—Side view of same specimen as Fig. 1.
- Fig. 4.—Basal third of a large spine from the specimen shown in Fig. 1. Four times natural size.



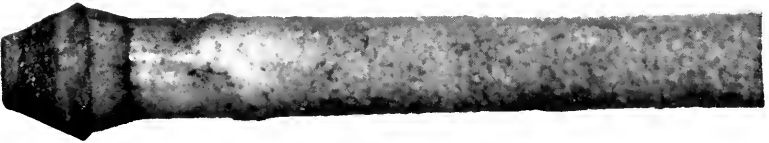
1



2



3

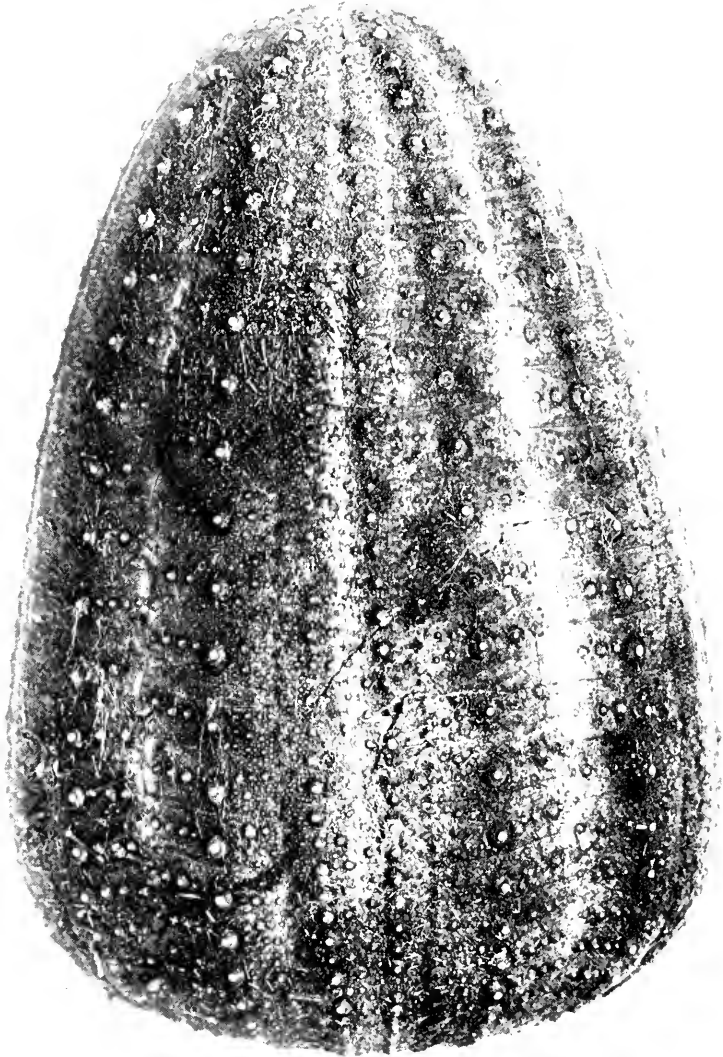


4

E. A. BIGGS, Austr. Mus., photo.

EXPLANATION OF PLATE XXXIX.

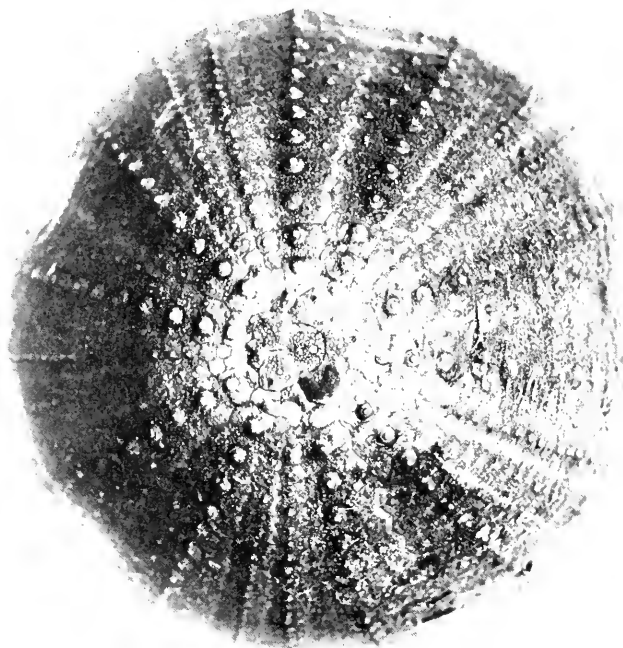
Echinus horridus. A. Agassiz. Photograph of an adult specimen from south of Gabo Island, Victoria, 100-250 fathoms. Side view. One and one-third times natural size.



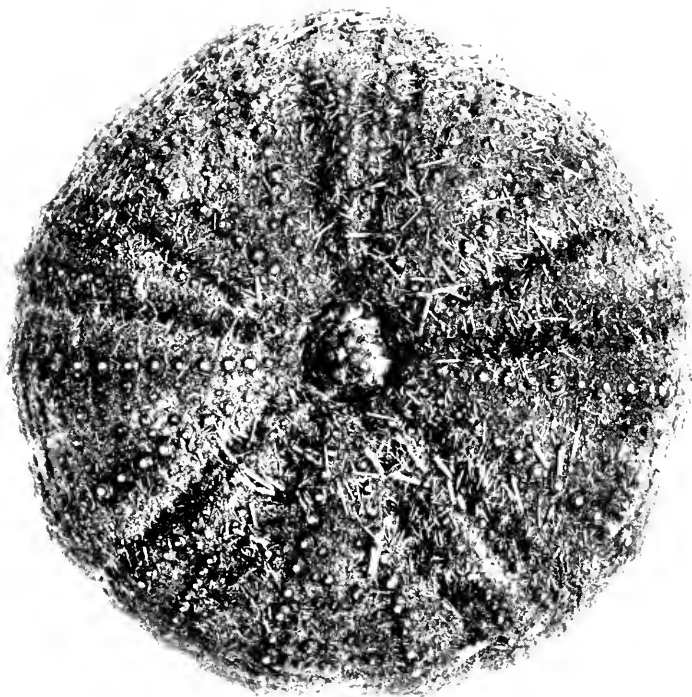
E. A. BRIGGS, Austr. Mus., photo.

EXPLANATION OF PLATE XL.

- Fig. 1.—*Echinus horridus*, A. Agassiz. Photograph of an adult specimen from south of Gabo Island, Victoria, 100-250 fathoms. Abactinal view. One and one-fourth times natural size.
- Fig. 2.—Actinal view of same specimen as Fig. 1.



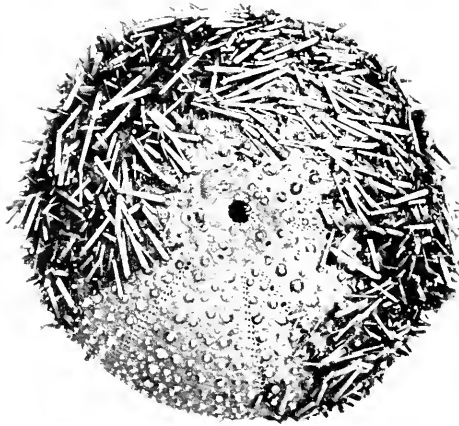
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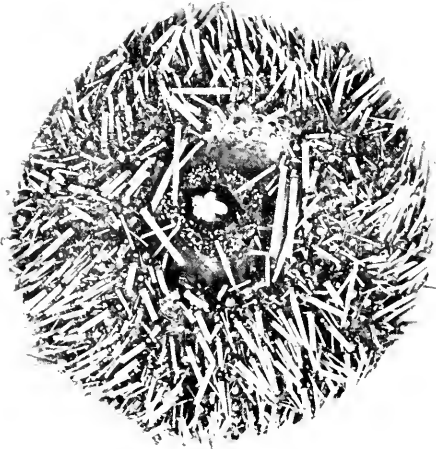
2

EXPLANATION OF PLATE XLI.

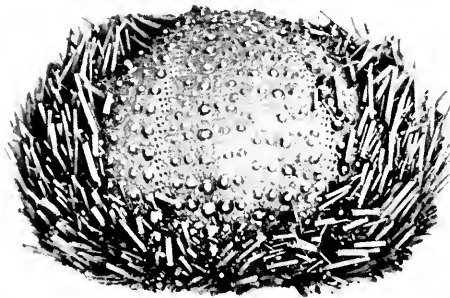
- Fig. 1.—*Parochinus notius*, sp. nov. Photograph of the holotype from south of Gabo Island to south-east of Cape Everard, Victoria, 70-80 fathoms. Abactinal view. Twice natural size.
- Fig. 2.—Actinal view of same specimen as Fig. 1.
- Fig. 3.—Side view of same specimen as Fig. 1.



1



2



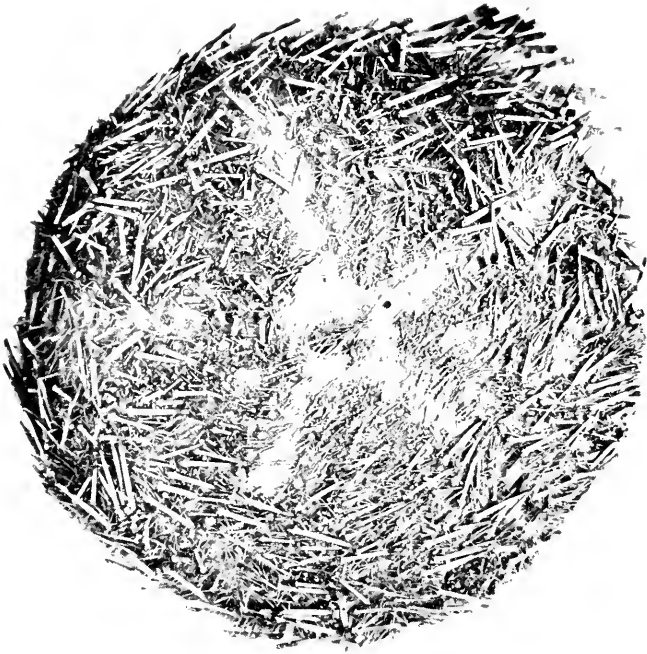
3

EXPLANATION OF PLATE XLII.

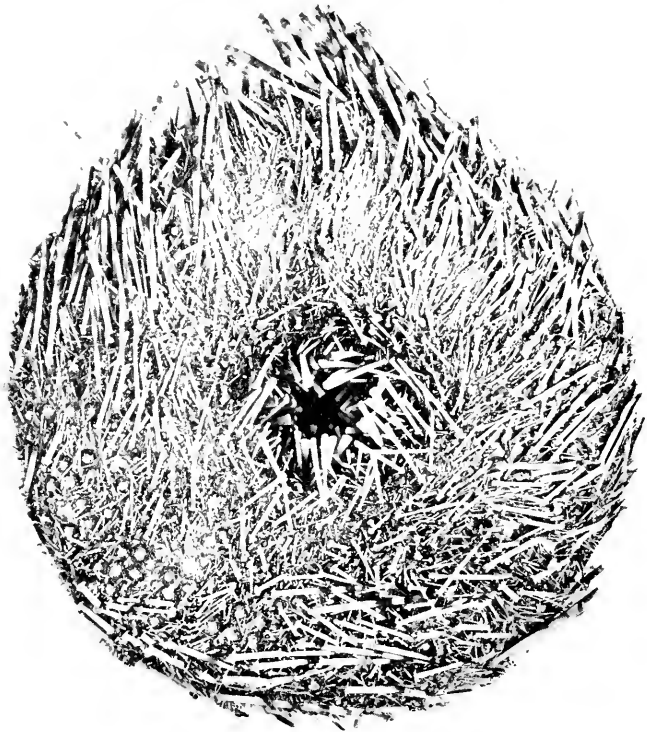
Fig. 1.—*Salmaris oligopora*, sp. nov. Photograph of the holotype from Oyster Bay, Tasmania, 20-40 fathoms. Abactinal view. Natural size.

Fig. 2.—Actinal view of same specimen as Fig. 1.





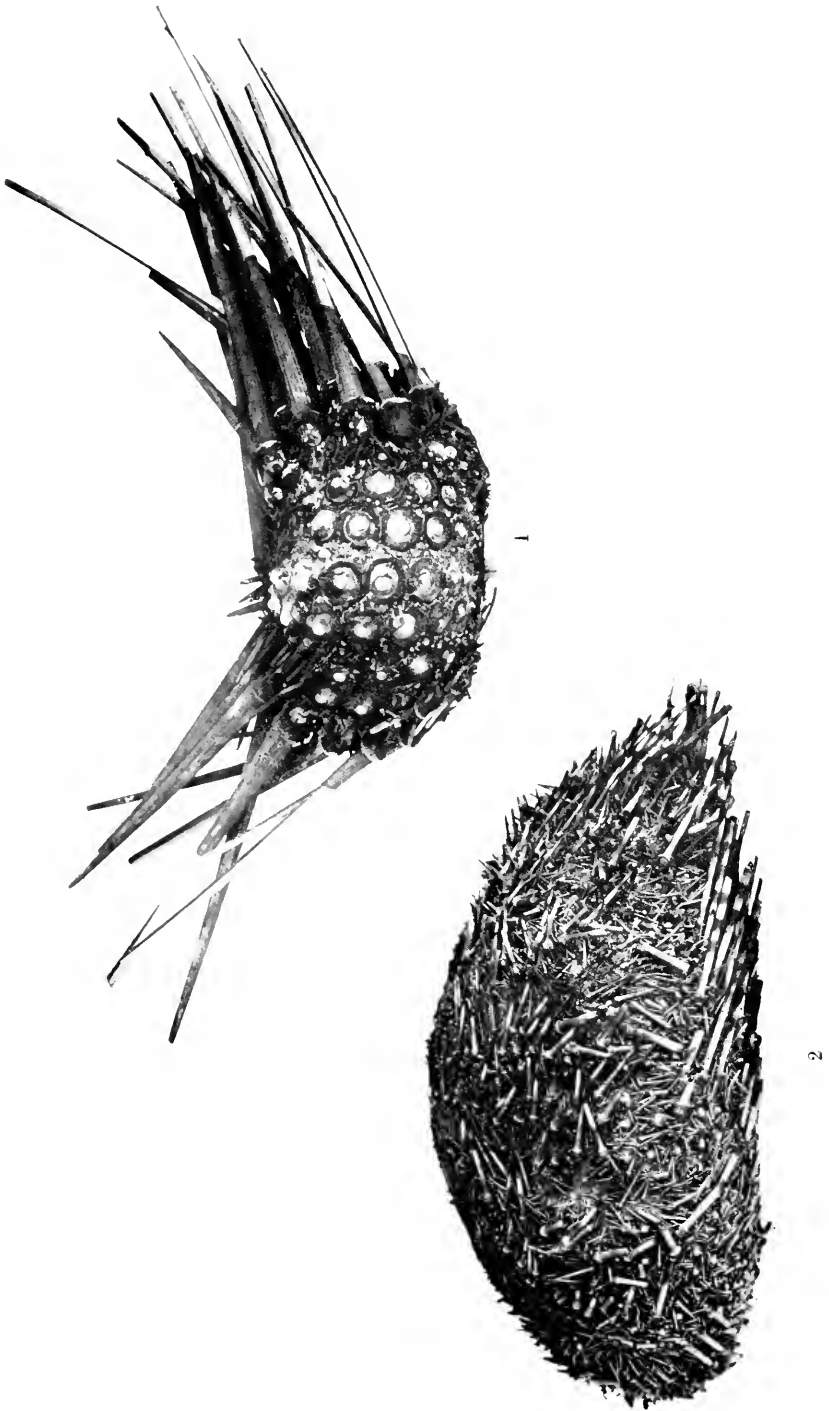
1



2

EXPLANATION OF PLATE XLIII.

- Fig. 1.—*Coelopleurus australis*, sp. nov. Photograph of the holotype from the Eastern Slope, Bass Strait, 60-112 fathoms. Side view. Natural size.
- Fig. 2.—*Salmacis oligopora*, sp. nov. Photograph of the holotype from Oyster Bay, Tasmania, 20-40 fathoms. Side view. Natural size.



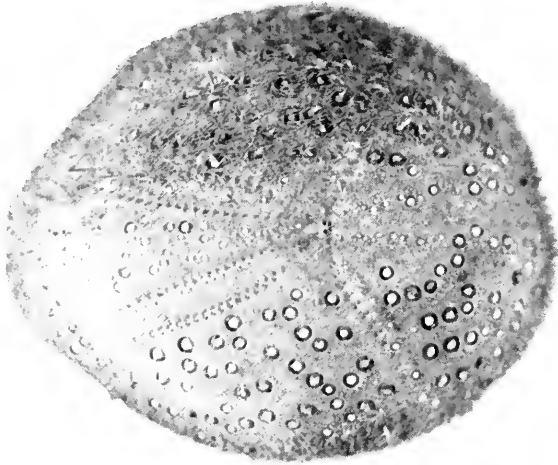
E. A. BRIGGS, Austr. Mus., photo.

EXPLANATION OF PLATE XLIV.

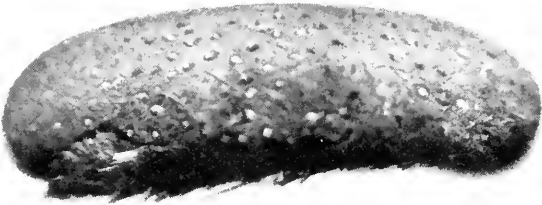
Fig. 1.—*Maretia pcloria*, sp. nov. Photograph of the paratype from twenty-six miles south-west of Cape Everard, Victoria. Abactinal view. Natural size.

Fig. 2.—Side view of same specimen as Fig. 1.

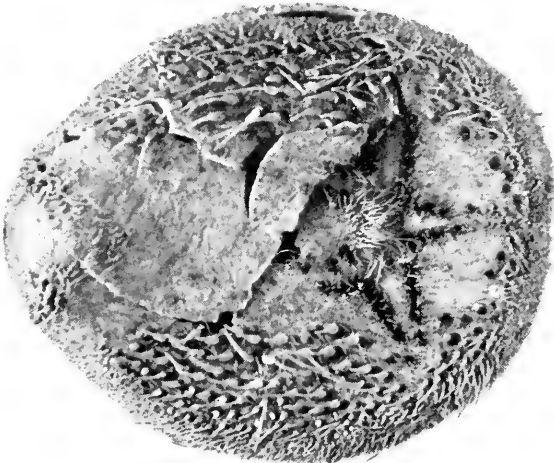
Fig. 3.—Actinal view of same specimen as Fig. 1.



1



2



3

II. Report on the Polychæta obtained by the F.I.S. "Endea-
vour" on the coasts of New South Wales, Victoria,
Tasmania and South Australia.

PART II.

BY

WILLIAM B. BENHAM, M.A., D.Sc., F.R.S.,

Professor of Biology at the University of Otago, New Zealand; Hutton
Medallist, New Zealand Institute.

Plates XLVI-XLVIII.

Having now completed the examination of the worms obtained during the cruise of the " Endeavour," it will be convenient to summarise the results of my work, which will entail to some extent a repetition of the introductory remarks in Part I. There it was noted that the " Challenger " obtained fifteen species of Polychætes in the area covered by the cruise of the " Endeavour," of which twelve were new to science.

The present collection contains forty-one species, including a fragment of a species of *Sigalion*, an indeterminate fragment of a species of Phyllodocid, and a species of *Halodora*, to which I have been unable to assign a name. Of these forty-one, five were obtained previously in this region; seventeen species hitherto recorded in various other parts of the world are now added to the southern Australian fauna; and I have found it necessary to make sixteen new species, one or two of which may, however, be merely varieties of already known forms; and to erect one new genus for a Nereid, namely *Cheilonereis*.

The " Challenger " obtained the fifteen species from four hauls; the " Endeavour " secured these forty-one species in twenty-six hauls, but it must be borne in mind that in the latter cruise the primary object was an economic one in connection with the Fisheries, and it is highly satisfactory that so many worms, many of them of small size, should have been noted and so carefully preserved by the late Mr. C. T. Harrison, the Biologist on board. In many instances a single individual of a species was received by me and, therefore, presumably the only one captured. We have a very small but fairly representative sample of the fauna of these deeper waters, for the majority of the families is represented by one or more genera; the Polynoinæ and Eunicidæ being well represented. There are some interesting omissions, however, for instance no member of the sub-family Aphroditinæ were included, which is rather unexpected, as they are deep-water forms of large size.

The families Syllidæ, Ariciidæ, Spionidæ being small worms might easily be overlooked in sorting out the contents of the dredge, and burrowing as they do for the most part in mud or others living amongst the Coralline Algæ near shore are not unnaturally absent.

One would perhaps have expected more Terebellidæ, of which only one individual was obtained, and also members of the allied families.

II.—LOCAL DISTRIBUTION.

It will be useful to tabulate the localities at which the species were obtained so as to compare the differences between the various stations.

The majority come from off the east coast of Tasmania, and this preponderance is no doubt due to the fact that more hauls were taken here than further north, at any rate to judge from the material submitted to me, though it is quite likely that in many cases no Polychætes were obtained in some of the later hauls.

I have given the depth at which the worms were found where that information was supplied, or have included information derived from other records. It will be noted that the depth varies from 17 to 1200 fathoms; only two came from a greater depth than 1000 fathoms—*Asychis victoriæ* from 1100 fathoms and *Nephtys macrura* from 1200 fathoms. The majority came from between 50 and 100 fathoms.

	" Endeavour "	
	Collection.	Other Records.
TASMANIA.		
TEN MILES NORTH OF CIRCULAR HEAD.		
<i>Nereis kerguelensis</i>	No depth given..	10-100 fathoms (Moore)
<i>Eunice bassensis</i>.....	..
<i>Eunice pycnbranchiata</i>.....	..
OYSTER BAY.		
<i>Eunice bassensis</i>	20-40 fathoms	
<i>Lumbriconereis gulielmi</i>	26 fathoms	
STORM BAY.		
<i>Eunice pycnbranchiata</i>	No depth given	
<i>Stauronereis australiensis</i>.....	..	38 fathoms (M ^r Intosh)
SOUTH CAPE.		
<i>Chloëia inermis</i>	75 fathoms	
BREAKSEA ISLAND, PORT DAVEY.		
<i>Eunice bassensis</i>	No depth given	
EAST OF MARIA ISLAND.		
<i>Eunice pycnbranchiata</i>	78 fathoms	
<i>Glycera tessellata</i>	78 fathoms	
<i>Lepidonotus willeyi</i>	78 fathoms	
<i>Physalidonotus rugosus</i>	78 fathoms	
EAST-NORTH-EAST OF MARIA ISLAND.		
<i>Protulopsis palliata</i>	100 fathoms	

	" Endeavour "	
	Collection.	Other Records.
BASS STRAIT.		
EAST COAST OF FLINDERS ISLAND.		
<i>Eunice bassensis</i>	No depth given..	38 fathoms (M'Intosh)
<i>Eunice pycnbranchiata</i>.....	..	.. 38 fathoms (M'Intosh)
<i>Oenone haswelli</i>.....	..	..
<i>Glycera tessellata</i>.....	..	31-638 fathoms (Moore)
<i>Nereis arenaceodentata</i>.....	..	.. surface (Moore)
<i>Physalidonotus rugosus</i>.....	..	..
<i>Halodora</i> , sp.....	..	..
BABEL ISLAND.		
<i>Eunice pycnbranchiata</i>	50-80 fathoms	
<i>Hyalinoecia tubicola</i>	50-80 fathoms	
<i>Lumbriconereis sphaerocephala</i>	70 fathoms	
<i>Hesione splendida</i>	50-80 fathoms	
<i>Polynoe platycirrus</i>	50-80 fathoms	
<i>Physalidonotus rugosus</i>	70 fathoms	
<i>Sabellastarte japonica</i>	60 fathoms	
<i>Spirobranchus laticarpus</i>	50-80 fathoms	
EAST-NORTH-EAST OF BABEL ISLAND.		
<i>Nephtys macrura</i>	1200 fathoms	
NORTH-EAST OF BABEL ISLAND.		
<i>Eunice pycnbranchiata</i>	100-170 fathoms	
TWENTY MILES EAST OF BABEL ISLAND.		
<i>Lumbriconereis guillemi</i>	65 fathoms	
<i>Eupompe australiensis</i>	65 fathoms	8 fathoms (M'Intosh)
<i>Physalidonotus turritus</i>	65 fathoms	
VICTORIA.		
GABO ISLAND.		
<i>Eunice siciliensis</i>	75-200 fathoms	
<i>Polynoe platycirrus</i>	200 fathoms	
<i>Physalidonotus laevis</i>	200 fathoms	
<i>Physalidonotus paucibranchiatus</i>	200 fathoms	
<i>Harmothoe ctheridgei</i>	200 fathoms	
TWENTY-FIVE MILES SOUTH-WEST OF CAPE EVERARD.		
<i>Physalidonotus laevis</i>	No depth given	
SOUTH-SOUTH-WEST OF MOUNT CANN.		
<i>Physalidonotus rugosus</i>	55-70 fathoms	
<i>Lysarete australiensis</i>	55-70 fathoms	
CAPE NELSON.		
<i>Asychis victoriae</i>	1100 fathoms	
SOUTH AUSTRALIA.		
FORTY MILES WEST OF KINGSTON.		
<i>Lepidonotus hedleyi</i>	30 fathoms	
<i>Ceratonereis falcaria</i>	30 fathoms	
<i>Scione harrissoni</i>	30 fathoms	
ELEVEN MILES SOUTH-EAST OF CAPE MARTIN.		
<i>Owenia fusiformis</i>	21 fathoms	
CAPE JERVIS.		
<i>Eunice pycnbranchiata</i>	17 fathoms	

	" Endeavour "	Other Records.
	Collection.	
KANGAROO ISLAND.		
<i>Eunice bassensis</i>	40 fathoms	
<i>Notopygos labiatus</i>	40 fathoms	
CAPE WILES.		
<i>Sigalion</i> , sp. incert.....	100 fathoms	
SOUTH OF ST. FRANCIS ISLAND.		
<i>Thalenessa oculata</i>	35 fathoms	
<i>Ophelia dannevigii</i>	35 fathoms	
<i>Notomastus eisigi</i>	35 fathoms	
ONE HUNDRED AND FORTY-TWO MILES SOUTH-SOUTH-WEST OF ST. FRANCIS ISLAND.		
<i>Sternaspis scutata</i>	No depth given..	55-260 fathoms (Moore)
GREAT AUSTRALIAN BIGHT.		
<i>Notopygos labiatus</i>	No depth given	
<i>Scaliscetosus australiensis</i>	"	
<i>Cheilonereis peristomialis</i> ...	250-450 fathoms	
Phyllodocid, gen. et sp. indet...	No depth given	
NEW SOUTH WALES.		
BETWEEN PORT STEPHENS AND NEWCASTLE.		
<i>Eunice pycnobranchiata</i>	22-60 fathoms	
<i>Oenone huxwelli</i>	22-60 fathoms	

III.—GEOGRAPHICAL DISTRIBUTION.

I have also tabulated the distribution of the species.

Apart from the five widely distributed species (*Eunice siciliensis*, *Hyalinoecia tubicola*, *Sternaspis scutata*, *Owenia fusiformis*, and *Hesionella splendida*) the relation of the Australian fauna is distinctly with that of the Pacific; a very few are Antarctic or Subantarctic, such as *Nephtys macrura* and *Nereis kerguelensis*, yet both these enter the Pacific area, as they have been recorded from New Zealand.

The most peculiar discontinuous distribution is that presented by *Nereis arenaceodentata*, hitherto found only off the coast of Massachusetts. It is, however, a small form and might readily be overlooked or regarded as an immature individual of some larger species.

Under each species its wider distribution, if any, is dealt with in the text.

It is interesting to note the great difference between the Australian and New Zealand Polychæte fauna. Of the series of species here recorded only six have been hitherto found in the latter seas, apart from the widely distributed species *Owenia fusiformis*, *Hyalinoecia tubicola*, and *Sternaspis scutata*.

The Polychæte fauna of the Pacific is but little known; Ehlers has described that of New Zealand, I have given a preliminary account of the Kermadec fauna, but otherwise it is only from the Northern Pacific that we have much information—that of the Philippines by Grube, of Japan by Marenzeller, Izuka and Moore; and of the west coast of North America by Moore, Johnson and Treadwell, references to whose papers will be found in the text.

	Tas.	Viet.	South Austr.	N. S. Wales	New Zeal.	Elsewhere.
<i>Hesionæ splendida</i>	×	Ind. Oc.; Red Sea; N.
<i>Polynoe phlycirrus</i>	×	×	.	×	.	Ind. Oc. [Pacific
<i>Leptodotus hedleyi</i>	×	.	.	
<i>L. willeri</i>	×	<i>affin.</i> Ind. Oc.
<i>Physalidonotus rugosus</i> ...	×	×	.	.	<i>affin.</i>	<i>affin.</i> Japan
<i>P. laevis</i>	×	.	.	.	
<i>P. turritus</i>	×	
<i>P. paucibranchiatus</i>	×	.	.	.	
<i>Harmothoe etheridgei</i>	×	.	.	.	
<i>Scalissetosus australiensis</i>	×	.	.	<i>affin.</i> N. Pacific
<i>Thalassessa oculata</i>	×	.	.	N. Pacific
<i>Sigalion</i> , sp. incert.....	.	.	×	.	.	<i>affin.</i> Pacific
<i>Eupompe australiensis</i>	×	Torres Strait
<i>Halolora</i> , sp. incert.....	×	
<i>Nephtys macrura</i>	×	.	.	.	×	Subantarctic
<i>Chloea inermis</i>	×	.	.	.	×	
<i>Notopygos labiatus</i>	×	.	.	
<i>Stauronereis australiensis</i> ..	×	[O.; Pacific
<i>Eunice siciliensis</i>	×	.	.	.	Med.; Red Sea; Ind.
<i>E. bassensis</i>	×	.	×	.	.	
<i>E. pycnobranchiata</i>	×	.	×	×	×	
<i>Hyalinocera tubicola</i>	×	.	.	.	×	Atlantic; Pacific
<i>Lumbriconereis sphaerocephala</i>	×	.	.	.	×	
<i>L. gulielmi</i>	×	<i>affin.</i> Japan
<i>Ocnone haswelli</i>	×	.	.	×	.	
<i>Lysarete australiensis</i>	×	.	.	.	
<i>Nereis kerquelenensis</i>	×	.	.	.	×	Subantarctic
<i>N. arenicoelentrata</i>	×	East coast N. America [Pacific
<i>Cheilonereis peristomialis</i>	×	.	×	<i>affin.</i> Japan, N.E.
<i>Crotanereis falcaria</i>	×	.	.	Ceylon [Pacific
<i>Glycera tessellata</i>	×	Med.; Atlantic; N.
<i>Owenia fusiformis</i>	×	.	×	Arctic; Med.; Pacific
<i>Scione harrissoni</i>	×	.	.	
<i>Notomastus eisigi</i>	×	.	.	
<i>Ophelia dannevirgi</i>	×	.	.	
<i>Asychis victoria</i>	×	.	.	.	
<i>Sabellastarte japonica</i>	×	Japan
<i>Spirobranchus laticarpus</i> ..	×	Japan
<i>Protulopsis palliata</i>	×	Ceylon [Pacific
<i>Sternaspis scutata</i>	×	.	×	Med.; North Sea; N.

IV.—DESCRIPTION OF THE GENERA AND SPECIES.

Family NEREIDÆ.¹Genus NEREIS, *Cuvier*.NEREIS KERGUELENSIS, *M'Intosh*.

Nereis kerguelensis, M'Intosh, Chall. Rep., Zool., xii., 1885, p. 225. *Id.*, Ehlers, Polychæten, Hamburger magalhaenische Sammelreise, Hamburg, 1897, p. 65; *Id.*, Ehlers, Neuseeländ. Annelid., 1907, p. 11. *Id.*, Gravier, Deuxieme Antaret. Exped. Francaise,—Annélides Polychètes, 1911, p. 76.

Three complete individuals, one of which is a female filled with eggs though still in the "nereid" stage.

The worms are larger than those recorded by Ehlers from South Georgia. The largest is 80 mm. by 5 mm. and 8 mm. over the parapodia, with 78 segments. A second, 65 mm. by 6 mm. and 8 mm. with 75 segments; the third is 48 mm. by 4 mm. and 6 mm. with 70 segments. There are one or two discrepancies between the figures given by M'Intosh and Ehlers, and certain slight differences between these and my own observations.

The peristomial cirri, which are relatively long in the "Challenger" figure, are in these specimens short as shown by Ehlers.

So, too, there are differences in proportion in the tentacles, which M'Intosh shows as narrow and Ehlers as stout and short; here, too, the present specimens agree with Ehlers'.

I have in a previous paper dealing with *N. australis*² pointed out that in one and the same species there is a great range of variation in the relative length of these cirri which appears to be independent of locality or age or of methods of preservation. Other features being in accord, these proportions are of less importance.

Loc.—Ten miles north of Circular Head, Tasmania.

Distribution.—New Zealand; Kerguelen Island; South Georgia; Falkland Islands; South Shetlands; and other localities hereabouts.

1. In accordance with the International Rules of Nomenclature the usual title of this family, Lycoridæ, must be replaced by Nereidæ.

2. Benham—Report on Polychæta, Subantarctic Islands of New Zealand, 1909, p. 236.

NEREIS ARENACEODENTATA, Moore.

(Plate xlvi., figs. 1-2.)

Nereis arenaceodentata, Moore, Proc. Acad. Nat. Sci. Philadelphia, 1903, p. 720.

A single complete specimen of this small species is present. Its colour is pale pinkish brown in spirit.

The body is broadest anteriorly, and tapers backwards; the parapodia are long, increasing in length posteriorly; their length is as great as the width of the body.

The worm measures 22 mm. in length by 2.25 mm. across the body, and 3.25 mm. over the parapodia anteriorly; but posteriorly these latter numbers are 1.25 mm. and 3 mm. respectively.

Although the present specimen agrees in all essentials with Moore's species, yet, since that has been recorded only from the Atlantic coast, and the occurrence of the same species in two such widely different and dissimilar areas is so rare, if not unknown amongst Annelids, it is desirable that an account of this individual should be put on record and illustrated, so that any doubts about the identity may be set at rest, or at least the material provided for criticism. These notes and figures were, I need scarcely say, made before I became acquainted with Moore's account.

The prostomium is broader than long, which may be due in part to the protrusion of the pharynx, stretching the base. The eyes are large, the anterior pair larger than the posterior. The anterior pair as usual rather more widely separated than the posterior, to which they are closely placed. Moore shows them to be of the same size and in contact.

The tentacles are short, less than half the length of the prostomium. The palps are very large, and broad.

Of the peristomial cirri the posterodorsal, that is the uppermost, is longest, reaching to the back of the fourth chaetigerous segment; the dorsal anterior, nearly as long, reaching to the anterior margin of this segment; the two ventral much shorter, scarcely reaching to the end of the second segment. In this respect there is a difference, for what it may be worth, from Moore's account and figure.

The parapodia are all alike, relatively long; the various lobes pointed, distinctly separated and somewhat divergent.

The notopodial chætophoral lip is unusually long and distinct.

The dorsal cirrus reaches only about half way along the dorsal ligule ; there is no enlargement at its base.

The chætæ are all colourless, as are also the acicula.

In the 13th foot, the dorsal chætæ are about fourteen in number, long homogomph spinigers, arranged in a fan-shaped way. The supra-acicular bundle in the ventral lobe consists of five similar chætæ, with four heterogomph falcigers, which have a long and knife-like appendix, hooked terminally, and densely setose. (Pl. xlv., fig. 22.) The sub-acicular bundle contains the same two kinds of chætæ.

All the spinigers and all the falcigers are alike throughout the worm.

This specific name was evidently derived from the nature of the denticles on the buccal region, which is covered with small conical paragnaths forming a broad band of approximately equal width all the way round. Amongst them, however, are a few rather larger ones arranged in longitudinal rows at intervals on the sides and under surface, which do not appear to correspond to the areas VI., VII., VIII.

The maxillary region presents groups of small denticles, of about the size of the larger buccal kind, which are arranged as follows :—

I. A rectangular patch formed of four transverse rows of 2, 2, 3, 4.

II. An elongated oval group of numerous densely massed denticles.

III. A patch of five or six transverse rows forming a squarish group.

IV. A broad, oval patch of densely massed points.

It is only in the details as to the number of denticles in the various patches that differences exist between this and Moore's specimens (see his Figs. 5-6, Pl. xl.). It is recognised that slight differences may exist in this matter without affecting the identity of the species ; a few more or a few less denticles in a group is a common variation.

Loc.—East coast of Flinders Island, Bass Strait.

Distribution.—Wood's Hole, Massachusetts.

Genus CERATONEREIS, *Kinberg.*CERATONEREIS FALCARIA, *Willey.*

(Plate xlvi., figs. 4-10.)

Ceratonereis falcaria, Willey, Ceylon Pearl Oyster Fisheries, pt. iv., Suppl. Rep., xxx., — Polychæta, 1905, p. 272.

A single specimen of a small worm seems to be identical with Willey's species.

Its length is 20 mm., its breadth 1.25 mm. Its diameter is nearly uniform for the 60 segments of which it consists.

The parapodia are short, less than half the diameter of the body; the dorsal cirrus is very long.

The prostomium is longer than its basal breadth and the preocular region is narrow and deeply grooved dorsally in the median line, giving the impression of a deep frontal incision, which, however, is scarcely existent in this individual (Fig 4). The tentacles are short, about half the length of the prostomium. The palps are relatively large.

The four eyes are large, nearly equal in size, and the two on each side are placed in nearly a straight fore and aft line, so that the four form a square.

The tentacular cirri appear to be short and stout, the longest reaches only to the back of the first chætigerous segment; the next only touches the hinder margin of the peristomium. They are smooth.

The parapodia have four lobes nearly equal in length, short and rounded. The notopodium and neuropodium are not very distinctly separated. The notopodial ligule is rather smaller than the middle ligule (or lip of dorsal chætophore). The neuropodial ligule is stouter than the upper one. The dorsal cirrus is more than twice the length of the uppermost ligule (Pl. xlvi., fig. 5).

The posterior feet differ a little from the anterior (Pl. xlvi., fig. 6). The upper ligule is much shorter than the middle, which is now the longest of the four lobes.

The chætæ of the notopodium exhibit the remarkable change that Willey describes in his account of the species, that is, the homogomph spinigers of the anterior feet (Pl. xlvi., fig. 7) are, in the posterior feet, replaced by a couple of thick brown homogomph falcigers, of which the appendix

is very short, brown, and bluntly bidentate: the shaft is transversely striated with a deep articular cup (Pl. xlvii., fig. 8).

In the anterior feet the dorsal bundle contains only a few (2-4) homogomph spinigers, the appendix long, with extremely fine denticulations. The change in the character of these chætæ occurs on or about the 22nd segment.

The ventral supra-acicular bundle contains also four homogomph spinigers, two of which have long and two shorter appendices. Below are four heterogomph falcigers, the shaft of which is thick and striated: the appendix is moderately long, setose along the edge, and with a feeble terminal hook (Pl. xlvii., fig. 9). The sub-acicular bundle contains four heterogomph spinigers, with a short appendix, and two or three heterogomph falcigers.

In all the spinigers, dorsal and ventral, anterior and posterior, the appendix is the same in form though it may differ in length in the same bundle.

In the first two feet, which as usual have only the neuropodial lobe, all the chætæ are spinigers; the upper bundle has two homogomphs and two heterogomphs with a short appendix; those of the lower bundle are heterogomphs.

The jaws.—The maxilla has nine blunt denticulations, and like the rest is pale brown.

The paragnaths are very pale, rounded cones (Pl. xlvii., fig. 10). The formula is:—

- I. Absent.
- II. 5 or 6, forming an oval group.
- III. Absent.
- IV. A transverse curved group of about 8 denticles.

Remarks.—At first I supposed that this worm was different from *C. falcaria*, as it differs in three points from the few details given by Willey: firstly, in the segment at which the change of chætæ begins, which is the 17th in the Ceylon worm; secondly, in the absence of denticles in the area III.; and, thirdly, in the number of denticulations on the maxilla, which Willey states to be only six. It may very likely prove that some of these features are variable. The denticles, for instance, in my species are very pale, and their absence in III. may be due to their having fallen away; while

as observations on species of *Eunice* tend to show, the segment at which the change of chaetae occurs may probably be quite inconstant.

Loc.—Forty miles west of Kingston, South Australia, 30 fathoms.

Distribution.—Ceylon.

GENUS CHEILONEREIS, *gen. nov.*

The peristomium is produced laterally and ventrally to form a large, widely extending, collar-like lip (*Cheilos*=lip) : the base of the notopodium is raised into a lamelliform expansion exceeding in height the rest of the parapodium throughout the greater part of the body.

The type species is *Nereis cyclurus*, Harrington.¹

CHEILONEREIS PERISTOMIALIS, *sp. nov.*

(Plate xlvi., figs. 11-18 ; Plate xlvi., figs. 19-22.)

A single entire specimen of a large species which, like *N. cyclurus*, Harrington, is characterised by the great development of the lower and lateral portions of the peristomium to form a great mobile collar-like lip, which partly covers even the protruded pharynx. It is a broad worm with greatly enlarged lamelliform bases of the notopodia, within the cirri, which with the lamelliform dorsal ligules; give it, at the first glance, a likeness to a Phyllodocid.

It is a female filled with eggs, which enter the parapodial lobes. The length is 130 mm. for 116 segments ; the greatest breadth is at about the 25th segment, where it is 10 mm. across the body and 13 mm. over the feet ; its height is 8 mm. The diameter increases from 4 mm. at the peristomium to this breadth and then decreases to 8 mm. at about the mid-body, and thence to 2 mm. at the hinder end.

The prostomium is rather broader than long ; the two pairs of eyes are nearly in line, close to the margin, but the posterior eye is hidden below the greatly developed anterior margin of the peristomium. The tentacles are slender, about half the length of the prostomium, and scarcely reach beyond the tips of the palps. The palps are large, with a small terminal joint, and spring from the lateral region about midway along the prostomium.

1. Harrington—Trans. New York Acad. Sci., xvi., 1898, p. 219.

The peristomium is nearly twice the length of the next segment, dorsally smooth but ventrally pleated lengthwise; whereas the sides are infolded in this individual, they are, in specimens from New Zealand, much longer than the ventral region, and expanded to form a hood or collar which projects outwards and forwards as a longitudinally folded membrane, evidently very mobile in life.

Its appearance is well seen in the figure given by Johnson¹ (Pl. iv., fig. 46) of *N. cyclurus* from American waters.

The peristomial cirri are short and approximately of equal length, the uppermost is longest, reaching to the 2nd chæti-gerous segment.

The parapodia are relatively long, especially in the posterior region of the body.

The dorsal cirrus, on the anterior feet, is rather more than twice the length of the dorsal ligule (Pl. xlvi., fig. 17), but by about the 35th foot it only exceeds it by a little (Pl. xlvi., fig. 18), and in the 50th and following it only about reaches to its apex. This relation is retained for the remainder of the body (Pl. xlvii., figs. 19-20). The actual length of the cirrus decreases, it is not merely relatively shorter.

The base of the notopodium just within the cirrus is, already in the 15th segment, quite noticeably elevated, and by about the 20th is elevated and compressed laterally to form a lamella. In the 30th this becomes much higher and continues to do so posteriorly. Meanwhile the dorsal ligule, which is at first a rounded lobe (Pl. xlvi., figs. 14-15), soon becomes pointed, elevated and compressed to form a lamella, so that the two structures, over the greater part of the body, unite to form a conspicuous lamella on the upper edge of which the dorsal cirrus is implanted in a slight notch (Pl. xlvi., fig. 18). The entire lamella is vascular and glandular, and especially the ligule.

In the 9th foot (Pl. xlvi., fig. 16) the middle ligule is a rounded, conical lobe, shorter than the dorsal, which diverges upwards from it. The ventral ligule is still shorter than the middle and even less than the lips of the ventral chætophore.

As will be seen from a comparison of the figures of successive feet a line taken along the outer margin of the ligules, which is at first nearly vertical comes to slope downwards and inwards, forming a greater and greater angle with the vertical till in the hinder feet it is about 70°.

1. Johnson—Proc. Boston Soc. Nat. Hist., xxix., 1901, p. 400.

The chætæ are as follows:—The notopodial bundle consists of very long homogomph spinigers. The neuropodial supra-acicular bundle contains homogomph spinigers and rather fewer heterogomph falcigers (Pl. xlvi., fig. 13), while in the sub-acicular bundle there are only a great number of heterogomph falcigers (Pl. xlvi., fig. 12). The spinigers have a long delicate appendix of the same length and structure throughout the body. The appendix of the falcate chætæ is rather long, and finely setose. There is a slight difference in the form of the articular cup of these chætæ in various parts of the foot and in different segments, as may be seen in the figures.

The first and second parapodia have ventral bundles only; all the appendices are broken off in the first foot, but in the second some of the sub-aciculars are heterogomph spinigers, with a shorter appendix than in the homogomphs. The third foot also has similar chætæ in the sub-acicular bundle, and the appendix of the falcate is longer than in the posterior feet.

The jaws.—The maxillæ are brown, with 7-8 denticulations on the curved exposed region, and a further 7-8 on the straight basal region.

The dental formula of the paragnaths, which are shown in Fig 21, is:—

- I. One or two rather large conical denticles in a longitudinal row, with, in some individuals, 2-3 small ones at their side.
- II. An irregular rectangular patch of about 16 large denticles in three transverse rows.
- III. A transverse patch of large and small denticles in three rows, the large ones in the second and third rows.
- IV. An obliquely rectangular patch of 16 rather large denticles in two oblique rows (on the outer side of the maxilla).
- V. Absent.
- VI. An irregular rounded group of 2-3 curved rows of rather large denticles. The group lies further forward than the rest of the proximal or buccal series.
- VII. ; VIII. Forms a band of numerous denticles, those along the anterior margin (8-10 in number) larger than the rest, which are quite small and more numerous, and irregularly disposed in 2, 3 or 4 rows. The large ones do not extend up to the group VI.

Remarks.—This species is closely allied to the Eastern Pacific species. Harrington found *C. cyclurus* in association with Hermit-crabs. The present species differs from it in the form of the parapodia both in the atokous and in the epitokous forms. In the atokous condition the dorsal ligule has a rounded instead of the sharply pointed tip of *C. peristomialis*, and the notch in which the dorsal cirrus arises is much deeper, owing to the greater height of the basal lamella. The dental formula also, if I understand Harrington's account rightly, differs in that the denticle in V. is present. His account, however, is very obscure. He writes thus:—“(5) Median dorsal proximal teeth=two points, prominent, in an ill-defined ring on proximal basal somite, which is slightly strongest at ventral side.” It may be that these “two points” are the two groups of larger denticles in the compartment VI.

The dental formula given by Izuka for *C. shishidoi* agrees closely with that in the present species.

It appears to me that the slight differences between *C. cyclurus* and the Japanese species *C. shishidoi*, Izuka,¹ are insufficient for specific distinction. Moore has recorded *C. cyclurus* from Vancouver Island² and from the Californian coast.³ Ramsay^{3a} also describes it from the N.E. Pacific. Harrington's specimens came from Puget Sound.

The two species are evidently closely allied, and it is here that the trinominal nomenclature would be useful; it has not been introduced into Polychaeta literature, but it well might be. Thus we should have *C. cyclurus cyclurus* from American waters, *C. cyclurus shishidoi* from Japan, and *C. cyclurus peristomialis* from Australasian waters.

It is perhaps rather dangerous to suggest a new generic title for any Nereid, judging from the disuse of the many names suggested by Kinberg and Malmgren, but the extraordinary development of the lower lip differs entirely from anything hitherto described, so far as I can ascertain from the literature accessible to me here.

1. Izuka—*Journ. Coll. Sci. Imper. Univ. Tokyo*, xxx., 1912, p. 177.

2. Moore—*Proc. Acad. Nat. Sci. Philadelphia*, 1908, p. 343.

3. Moore—*Loc. cit.*, 1911, p. 246.

3a. After the MS. had been sent to the Editor I came across Ramsay's account of *C. cyclurus* (*Proc. Zool. Soc.*, 1914, p. 237), wherein he suggests that the extraordinary development of the peristomium was almost worthy of generic recognition. He draws attention to the “curious homogomph jalcate setæ” which occur in the notopodial bundle of the parapodia in hinder part of the worm. I find in my MS. account, written some 10 years ago or more, that these occur also in our New Zealand species. Ramsay also discusses the relation of this species to *Alitta virens*.

There are, it is true, resemblances to *Alitta virens*, Sars, as may be seen by consulting the memoirs of Malmgren,¹ Ehlers² and Turnbull³ but from this species the present differs not only in its collar-like lip but in the form of the parapodium, especially in the much greater development of the dorsal lamella and in the proportions of this to the other parts of the foot; in the greater length of the dorsal cirrus as well as in other details which may be merely specific.

Although *A. virens*, as well as some other species such as *N. lamellosa*, Ehlers⁴ has the ventral surface of the peristomium marked by furrows, so that it resembles *C. peristomialis* when the lip is folded fan-like over the mouth, yet in none of them is there any evidence that it can be spread outwards as it is here. Even Turnbull, who studied *A. virens* alive, says nothing of this; indeed his and other figures show that it is not collar-like.

Loc.—Great Australian Bight, Long. 129° 28' E., 250-450 fathoms.

Distribution.—I have specimens from New Zealand waters, described in MS. some years ago, which agree precisely with the above. One of them is in the Heteronereid phase, which may as well be described here.

The EPITOKOUS CONDITION.

In the epitokous state this worm consists of 130 segments and measures 140 mm. Its greatest breadth is 20 mm. at the 15th segment, including the parapodia, or 10 mm. over the body alone.

The change in the parapodia occurs at the 27th segment, when the various foliaceous outgrowths appear as small structures, which gradually increase in size till the mid-body and then dwindle again and disappear at about the 85th, so that the worm is apparently not completely in the heteronereid condition (Pl. xlvii., fig. 22).

In the 40th foot the dorsal lamella is higher, more prominent than in the atokous state, and overhangs the base of the dorsal cirrus, so that the notch becomes a deep bay. The dorsal chætæ are replaced by the usual natatory bristles. The dorsal, middle and ventral ligules have undergone little change, but the ventral chætophoral lip has developed a large semicircular folium, as has also the base of the ventral cirrus.

1. Malmgren—Nordiska Hafs-annulaten, 1865, p. 183.

2. Ehlers—Die Börstenwürmer, 1864-68, p. 559.

3. Turnbull—Trans. Connecticut Acad., iii., 1876, p. 266.

4. Ehlers—*Loc. cit.*, p. 564.

The first specimens obtained in New Zealand waters were found in the topmost whorls of a gastropod shell inhabited by a Hermit-crab, but later others were met with free in the sea.

Family GLYCERIDÆ.

Genus GLYCERA, *Savigny*.

GLYCERA TESSELATA, *Grube*.

(Plate xlvii., figs. 23-25.)

Glycera tesselata, Grube, Arch. f. Naturgesch., xxix., 1863, p. 41. *Id.*, Ehlers, Die Börstenwürmer, 1864-68, p. 654. *Id.*, Treadwell, Bull. U.S. Fish Comm., xx., 2, 1903, p. 201. *Id.*, Moore, Proc. Acad. Nat. Sci. Philadelphia, 1903, p. 464; *Id.*, Moore, *Loc. cit.*, 1908, p. 348; *Id.*, Moore, *Loc. cit.*, 1911, p. 300. *Id.*, Izuka, Journ. Coll. Sci. Imper. Univ. Tokyo, xxx., 1912, p. 241.

Five individuals, from the seas around Tasmania, represent this non-branchiate species with long pointed anterior parapodial lips and two shorter rounded posterior lips, with long filamentous pharyngeal papillæ, and a terminal eyespot on the prostomium.

One specimen measures about 50 mm. in length, for it is twisted and, therefore, its actual length impossible of measurement. Its breadth is 3 mm. and the number of segments about 100.

The prostomium is short, with about 10-12 annulations; its length about twice its basal width, and as great as the length of two normal segments. It is, however, bent backwards in this individual and covers 7-8 segments, which are much shorter than the later ones. At its tip it carries the usual two pairs of short tentacles, and between them, on the ventral surface, is a black pigment spot, which, however, is absent in one specimen from Maria Island, Tasmania. The body segments are biannulate dorsally, the length of those in the anterior region about 1-5th the diameter of the body, but in the hinder half of the worm 1-4th this diameter.

The colour is in most cases a uniform yellowish brown, but in two specimens from Maria Island the anterior segments and the prostomium are speckled with brown pigment.

The parapodia are, with the exception of the anterior, of equal length, about 1-3rd the width of the body. The proportions of the length of a parapod to its height is about as 3:2. The two anterior lips are long, narrow, and pointed, the ventral slightly longer than the dorsal (Pl. xlvii., fig. 23). The two posterior lips are separated by a distinct, rather deep, incision: they are rounded and much shorter than the anterior lips. The ventral is rather longer and of less height than the dorsal.

The dorsal cirrus is nearly spherical, a little removed from the foot up the side of the body, with a deep constriction at its base. The ventral cirrus is conical, its tip reaching as far outward as the posterior lip.

The chaetae are colourless, the acicula golden.

The dorsal chaetae are capilliform, about 9-10 in number, with upturned tips and a narrow denticulated and striated flange. The ventrals are homogomph spinigers, 5 in the supra-acicular and 8 in the sub-acicular bundle; the appendix has a narrow striated and denticulated flange on one or both sides; the edge seems to have a row of minute dots along it, which, under high magnification, are seen to be minute prominences.

The dorsals have the same ornamentation.

The first two parapodia are without the dorsal cirrus; the three or four anterior feet have both the posterior and anterior lips pointed. The feet gradually increase in size till the 8th, after which they remain uniform.

The pharynx, in this specimen everted, is short and wide; its length is 5 mm., its breadth 4 mm. at the anterior end. Its base overlaps the anterior feet. In a soft specimen the everted pharynx has a length of 7 mm., a terminal breadth of 3 mm., and resembles M'Intosh's figure of *G. amboinensis*.

Its surface is covered with closely set, uniformly distributed, long filamentous papillae, giving it a velvety appearance. These papillae have a subterminal oval disc at one side of the apex, which appears sucker-like in that it is slightly hollowed out (Pl. xlvii., figs. 24-25). The apex of the papilla carries a few stiff sensory hairs. The subterminal oval disc is known from the work of Gravier,¹ but neither in this paper nor in that of Jourdan² nor Oppenheim³ are these terminal hairs shown, though the sense cells and nerve fibres are traced out.

1. Gravier—Bull. Sci., xxxi., 1890, p. 422.

2. Jourdan—Ann. Sci. Nat., Zool., (7), xiii., 1892.

3. Oppenheim—Proc. Amer. Acad. Arts and Sci., xxxvii., 1902, p. 553.

The usual four black jaws, surrounded at their base by a circle of soft stout conical processes, lie at the apex of the pharynx.

Remarks.—The occurrence of a Mediterranean species in these waters appears at first rather remarkable. But we may bear in mind that *Eunice siciliensis* and *Hyalinoecia tubicola* are instances of the same wide distribution. Moreover, the present species has already been recorded from the North Pacific and from the coasts of California and Japan by Moore.

It appears to me probable that *G. amboinensis*, M'Intosh,¹ is synonymous with this. His specimen was in a poor state of preservation, and apart from his statement that the pharyngeal papillæ are "conical" it fits well with this.

Locs.—East coast of Flinders Island, Bass Strait.

Off Maria Island, Tasmania, 78 fathoms.

Distribution.—Mediterranean; Atlantic; North Pacific.

Family OWENIIDÆ.

Genus OWENIA, *delle Chiaje*.

OWENIA FUSIFORMIS, *delle Chiaje*.

Owenia fusiformis, *delle Chiaje*, Descr. notom. animal. invert. Sicilia citeriore, 1842. (Pl. 175, figs. 1-6.)

Ammochares ottonis, Grube, Beschr. neue oder wenig bekannter Anneliden, 1846, p. 164.

Owenia filiformis, Claparède, Mém. Soc. Phys. Genève, xix., 1868, p. 446.

Owenia brachycera, Marion, Revue Sci. Nat. Montpellier, iv., 1875.

Owenia tenuis, Haswell, Proc. Linn. Soc. N.S. Wales, vii., 1883, p. 633.

A shelly tube, 22 mm. in length and 4 mm. in diameter, containing a fragment of a worm measuring 16 mm. by 2 mm., and consisting of 8 chætigerous segments without head or anal end, must be attributed to this species, which as Ehlers² has pointed out is of practically cosmopolitan distribution.

1. M'Intosh—Chall. Rep., Zool., xii., 1885, p. 345.

2. Ehlers—Die Polychæten des magellan. u. chilen. Strandes, 1901, p. 193.

The above synonymy has been taken from St. Joseph's¹ useful work in which the European Polychætes are reviewed and the references gathered together.

I have changed the name of the family, which has hitherto borne the title *Ammocharidæ* since the time when the genus was termed *Ammochares*, Grube; but as modern zoologists agree in resurrecting delle Chiaje's generic name, the name of the family according to the rules of zoological nomenclature must be derived from its type genus.

Loc.—Eleven miles S. 74° E. of Cape Martin, South Australia, 21 fathoms.

Distribution.—From Greenland and Davis Strait to the Mediterranean; Chili; Philippines; Japan; and New Zealand.

Family TEREBELLIDÆ.

Genus SCIONE, *Malmgren*.

SCIONE HARRISSONI,² *sp. nov.*

(Plate xlvii., figs. 26-31.)

A single individual in its tube of small shells and shelly fragments, Polyzoa and mud so loosely held together that it falls to pieces when the worm is removed.

The worm measures 34 mm. in length, with an anterior diameter of 3 mm., which posteriorly decreases to 1 mm. It is ill-preserved, soft and readily ruptured. There are 43 distinct segments, but the mid-body is so soft, being partially decayed, that it is not easy to be sure of the number of segments here. The hinder segments, however, are well preserved, and the last 25 carry rather high chætigerous papillæ. The colour is a dull brown, but the dorsal surface of the branchial segment is deep reddish brown.

It is a female filled with eggs.

There are 15 notopodial bundles of capilliform chætæ, each bundle inserted in a small prominence. The first bundle is in the 4th segment.

1. St. Joseph—Ann. Sci. Nat., Zool., (8), v., 1898, p. 397.

2. So named after the late Mr. C. T. Harrison, Federal Government Biologist, on board the ill-fated "Endeavour," to whose care we owe the excellent preservation of these Polychætes.

The ventral shields are 13 in number ; anteriorly they are transverse, rectangular ; posteriorly, square.

The genus is characterised by three cutaneous lateral folds at the anterior end belonging to as many segments.

The prostomium is produced into a dorsal thin upper lip, with an undulating margin, behind which is the tentacular ridge which extends downwards at each side nearly to the lower lip (Pl. xlvii., figs. 26-28). The tentacles appear short, but were so intertwined that it was impossible to measure them. There are no eyes or pigment spots. The peristomium is produced laterally and ventrally into a large thickish fold, broader laterally, where its edge is reflected ; narrow ventrally, allowing the rectangular lower lip to be seen (Pl. xlvii., figs. 26-27).

The second segment and the next are fused together.

I follow Ehlers in this analysis of the region as given for *Terrebella* (*Sciome*) *ctrata*.¹

On what is probably the 3rd segment is the single pair of arborescent gills, which spring from a nearly vertical wall in front of the first chætigerous segment (Pl. xlvii., figs. 26-28). From the hinder margin of this branchial segment rises the second lateral cutaneous flap, which extends downwards to the level of the lower edge of the tori uncinigeri of the following segments, but does not extend across the ventral surface.

The third fold, which springs from the hinder portion of the first chætigerous, is of less width but of the same extent as the second.

The arborescent gill has a thick stem which bears a few short thick branches, which in their turn divide again into a number of short twigs, so that the gill itself appears as a mass of densely aggregated branches.

In front of the base of each gill is a small conical prominence projecting forwards, and carrying at its apex a narrow cylindrical process, which is inclined outwards (Pl. xlvii., fig. 28). (Are these the representatives of a second, anterior, pair of gills ?)

The uncini commence on the second chætigerous segment as usual, and the first six are uniserial ; but on the 7th and on the eight following segments they have an "alternate" arrangement. Those in the abdomen, however, are again uniserial, all the points being turned in the same direction.

1. Ehlers—Florida Anneliden, 1887, p. 248.

The uncini are all alike, but those of the abdomen are smaller. Seen from the side, each appears to have three small teeth on the back of the main tooth, but from above it is seen that there are three rows of teeth (Pl. xlvii., figs. 29-30).

The capilliform chætæ have curved points with a flange on each side, of which that on the convex side is much broader and longer than the other (Pl. xlvii., fig. 31).

Remarks.—This worm agrees with Malmgren's¹ diagnosis of *Scione*, and though he makes no mention of the cutaneous folds in his generic diagnosis he describes them for the species *S. lobata*.

Loc.—Forty miles west of Kingston, South Australia, 30 fathoms.

Family CAPITELLIDÆ.

Genus NOTOMASTUS, Sars.

NOTOMASTUS EISIGI, *sp. nov.*

(Plate xlvii., figs. 32-35.)

A single specimen, somewhat curled and imperfect posteriorly, was enclosed in the remains of a tube of sand and shelly fragments. The incomplete worm measures about 36 mm. in length.

The thorax, which measures 12 mm. in length, consists of the usual twelve segments, bearing only capillary bristles. The diameter increases from 2 mm. at the peristomium to 3 mm. at the sixth segment and then decreases to 2.5 mm. at the twelfth.

The prostomium is small, rounded, with a minute terminal globular knob, and is retractile to some extent within the peristomium. The peristomium is nearly twice the length of one of the following segments, which are very glandular and bi-annulate, the skin being cut up into the areas by secondary fissures, as in the European species. (These two facts are not shown in the figures.) The peristomium is without chætæ, and I am unable to find any on the following segment. If they are present they must be very

1. Malmgren—Nordiska Hafs-annulaten, 1865, p. 383. Dr. Leiper (Ann. Mag. Nat. Hist., 1908, p. 468) includes this in his list of Polychæte generic names that are pre-occupied; it will do no harm to retain it for the present.

minute, for when rolling the worm over till the following segments are in profile so as to show the bristles, I can see none on the second segment. Possibly they are embedded in the glandular tissue, as in the clitellum of an earthworm at maturity. Each segment after the second bears two widely separated tufts of capillaries; all are alike, both ventral and dorsal, slightly curved, finely and simply pointed, with a small flange on each side, of which one is broader than the other, but in both the oblique striations are very faint.

In the third and fourth segments they are only few in number and quite short, while in the fifth and following they are more numerous and longer.

The ventral surface of the last seven thoracic segments is traversed by a narrow band-like ridge, about 1-6th of the diameter of the body, and bounded on each side by a narrow furrow. This ridge is continued, though in a less marked manner, on the abdomen.

The abdominal region is marked off from the thoracic by its smaller diameter; the segments are no longer than those anteriorly, but the skin is smooth, so far as one can judge in the ill-preserved, soft and rather damaged condition, for the sand and shelly fragments contained in the intestine cause the body wall to rupture on handling. The abdomen is about 2 mm. in diameter, of uniform width over the 20 segments which remain, and I can see no annulations.

The first abdominal segment, though having all the appearance of the others, is provided with capillaries in the dorsal and ventral bundles (Pl. xlvii., fig. 33).

Each of the following segments carries the usual notopodial and neuropodial tori uncinigeri, in which there is a single row of hooded hooks. The neuropodial torus extends up the whole side of the body as a distinct ridge, and ends dorsally in a free simple "gill." (Pl. xlvii., fig. 32.) Above this is the rounded "lateral organ," and on the dorsal surface the short notopodial torus, which is not at all prominent and nearly meets its fellow in the median line as in *N. lineatus*.

The hook (Pl. xlvii., fig. 34) has a long shaft curved like the chæta of an earthworm; it is bent gently at its proximal end, and terminates distally in the usual hook, with an accessory tooth on its upper surface. The whole hook is almost entirely enclosed in a large nearly circular hood, which is in reality double (Pl. xlvii., fig. 35).

Remarks.—This differs from the diagnosis of the genus *Notomastus* as given by Eisig¹ in the presence of capillaries on the first abdominal segment. It differs from *Eunotomastus* of M'Intosh² in having only 12 thoracic segments and in the presence of capillaries only in the anterior abdominal segments.

I hesitate to form a new genus, as my literature is not sufficiently modern for me to ascertain whether such a divergence is already known.

Loc.—South of St. Francis Island, South Australia, 35 fathoms (with *Thalanesa oculata* and *Ophelia dannevigii*).

Family OPHELIIDÆ.

Genus OPHELIA, *Savigny*.

OPHELIA DANNEVIGI,³ *sp. nov.*

(Plate xlvi., figs. 36-37.)

A single specimen, 20 mm. in length with a breadth of 1.25 mm. across the ventral surface, and a height of 2 mm. The body contains 32 chætigerous segments, and has the usual spindle shape.

The prostomium carries at its apex a finely pointed conical tentacle with a pair of nuchal organs at its base, appearing as little brown streaks.

The mouth is at the level of the first chætæ.

The anus is surrounded by a circlet of 16 subcylindrical tentacle-like organs, eight on each side, arising from a common basal membrane. In addition there is a couple of ventral lancet-shaped stouter processes (Pl. xlvi., fig. 37.)

The ventral surface is traversed by a broad furrow, marked with transverse muscular bands, and bounded by a well-defined rounded ridge on each side. This "sole" is continued on to the head where, however, the ridges are absent. At first narrow, it attains its full width at about the tenth segment, and retains this till near the hinder end, where it again narrows, terminating at the base of the ventral anal lobes.

1. Eisig—Die Capitelliden, Naples Monograph, 1887, p. 807.

2. M'Intosh—Chall. Rep., Zool., xii., 1885, p. 388.

3. Named after the late Mr. H. C. Dannevig, Commonwealth Director of Fisheries.

The notopodia and neuropodia are distinct lobes, except in the anterior segments, where they are very small. Each lobe is a short cylindrical structure with definite lips, and on the anterior face is a small round-topped papilla. There is no ventral cirrus (Pl. xlvi., fig. 36.)

Parapodial gills are present after the tenth segment, except on the last three: each has the usual form—simple, tongue-shaped and grooved. The first and second parapodia are very inconspicuous and carry but few chætæ: I counted three in the former and five or six in the latter. In the remainder they are numerous, all are alike, capilliform, of a shiny brownish tint.

The last three segments of the body decrease in diameter successively and abruptly, so that from the side they appear to be telescoped into one another, with a projecting posterior angle, where the chætæ arise: these are very long on these segments, and reach beyond the anal tentacles.

The body may, then, be analysed as follows:—Total, 32 segments, of which the first ten and the last three are without gills, so that there are 19 gill-bearing segments.

Remarks.—It presents a good deal of similarity to *O. neglecta*, Schneider, as described by St. Joseph,¹ but he gives eighteen anal tentacles in addition to the ventral lobes, and the number of segments is one less.

Loc.—South of St. Francis Island, South Australia, 35 fathoms (with *Thalassessa oculata* and *Notomastus isigi*).

Family MALDANIDÆ.

Genus ASYCHIS, *Kinberg*.

ASYCHIS VICTORIE, *sp. nov.*

(Plate xlvi., figs. 38-45.)

Praxilla abyssorum, McIntosh, Chall. Rep., Zool., xii., 1885, p. 408.

A fragment, consisting of the head and seven chætigerous segments, measures 53 mm. in length by 4 mm. in diameter.

The prostomium slopes downwards to the ventral surface, is convex dorsally with a broad median flat ridge or platform occupying about half its width (Pl. xlvi., fig. 38); this is transversely striated and bounded on each side by a deep

1. St. Joseph—Ann. Sci. Nat., Zool., (8), v., 1898, p. 369.

furrow, nearly longitudinal, which, however, curves outwards anteriorly and ceases before it reaches this end (Pl. xlvi., fig. 40). The anterior end is rounded, and its thin margin is somewhat upcurved. Along each side of the prostomium is an upstanding lamella, whose thin upper edge is entire, and posteriorly is continuous with the margin of the peristomium. The prostomium is dorsally overhung by a transverse flap of the peristomium, which is also entire. If this flap be lifted up the prostomial platform or flattened ridge is seen to extend below it for about half the length of the peristomium; this concealed portion is equal in length to the exposed portion of the platform.

The peristomium is biannulate, the posterior annulus being about half the length of the anterior, which is traversed by a horizontal furrow on each side dividing it into an upper and a lower portion, which latter is prolonged into the marginal lamella of the prostomium (Pl. xlvi., fig. 38).

The ventral surface of the head is flat, and the mouth is a longitudinal slit widened posteriorly into a nearly circular aperture, which lies at about the middle of the anterior annulus of the peristomium (Pl. xlvi., fig. 39).

The second segment and the four following are biannulate; the anterior annulus is chætigerous and about twice the length of the posterior. The segments gradually increase in length, so that the distance between the 6th and 7th bundles of chætæ is about twice that separating the 2nd and 3rd bundles, the actual distances being 9 mm. and 5 mm. respectively.

Each of the segments 4, 5, 6 and 7 has a lateral glandular cushion along its entire length, which reaches up the side as far as the notopodium, but on the 8th this glandular cushion is limited to a quadrate area round the torus uncinigerus.

The first chætigerous segment, which succeeds the peristomium, has only dorsal capillary chætæ, arranged in a vertical fan-shaped bundle protruding from a two-lipped notopod.

In the following segments there is, in addition, a ventral torus uncinigerus, in which the hooks are arranged in a single row. This torus is very short in the third segment, rather longer in the fourth, and attains its full development in the fifth, where it is nearly half the height of the body.

The number of chætæ in the first and second bundles as well as the vertical length of the bundle are greater than in the succeeding segments; the length of the second bundle being twice that of the sixth, but, in compensation, the height of the torus has increased.

There are two kinds of chætæ in the notopodium (Pl. xlviii., fig. 41)—(a) long, brownish capilliforms, with a very narrow flange and attenuate apex which is biserrulate (Pl. xlviii., fig. 44); and (b) much shorter, rather thinner, colourless, biflanged bristles, whose apex is also very long, but without serrulations; the flange on one side is much wider than on the other (Pl. xlviii., fig. 45). These smaller chætæ lie anteriorly to the longer.

I counted in two bundles 20 of the longer and 12 of the shorter sort.

The hooks (Pl. xlviii., figs. 42-43) have a nearly straight shaft with a long terminal tooth, with three or four successively smaller teeth on its back, and the usual tuft of delicate filaments projecting upwards in front.

Remarks.—There is, I think, reason to suppose that *Praxilla abyssorum*, M'Intosh, is identical with this species. The figures in the "Challenger" Report (Pl. xlv., figs. 10, 11) certainly disagree with the genus *Praxilla* in the form of the head and in other details. The figure is not very detailed, owing possibly to the state of contraction of the worm, but it shows the biannulate peristomium and the horizontal furrow on its side. It is true that M'Intosh states that the uncini do not begin till the 5th segment; that again is possibly due to its state of preservation, for the tori in these anterior segments are quite short and the hooks few. The figure of the hooks, however, agrees precisely with that found in the present species. It appears, moreover, that he found two kinds of dorsal chætæ in the first four segments at any rate, for he writes:—"Some of the bristles are furnished with a distinct wing, while others are simple slender tapering structures." Another fact weighs with me, viz., that the worm was obtained in nearly the same region, "midway between the Antarctic region and Australia, in 1950 fathoms."

The form of the head, as well as certain other features, agree with Ehlers' account¹ of *Asychis* (*Maldane*) *amphiglypta* from South Georgia. At first he placed it in the genus *Maldane*, but in his account of the New Zealand Polychætes² it was included in the genus *Asychis*.

1. Ehlers—Polychæten Hamburger magalhaenische Sammelreise, Hamburg, 1897, p. 179.

2. Ehlers—Neuseeländ. Annelid., 1907, p. 26.

I have duplicates of specimens which I had sent to Ehlers from Waiheke, near Auckland, New Zealand, and noticing the resemblance between the Victorian specimen and Ehlers' account, I examined the New Zealand species. I find that the second or smaller sort of dorsal chætæ are totally unlike those figured by him for the *A. amphiglypta* from South Georgia, where he describes them as acicular in form. In the Waiheke specimens, however, they are transparent bristles, with a wide flange which is not traversed by the shaft and has the striations palmately arranged, instead of pinnately—that is, they radiate from the end of the shaft. These chætæ are situated anteriorly to the longer capillaries, not posteriorly as the acicular-like chætæ in *A. amphiglypta* are stated to be.

It is possible that Ehlers overlooked these smaller chætæ, which only just project through the skin. When mounted in Canada balsam the flange is scarcely visible, and then they appear bluntly pointed; again, the capillaries, which he represents as "jointed," are, in the New Zealand as well as in the Victorian species, finely biserrulate along the fine apical point.

The present worm is quite distinct from the New Zealand species and from *A. amphiglypta*. I have placed it in Kinberg's genus *Asychis*, since it appears to agree better with that than with any of Malmgren's genera, but as I have but little recent literature on the family, I have described the external features somewhat in detail.

Loc.—Thirty miles south of Cape Nelson, Victoria, 1100 fathoms.

Family STERNASPIDÆ.

Genus STERNASPIS, *Otto*.

STERNASPIS SCUTATA, *Ranzani*.

Thalassema scutata, Ranzani, Isis, xi., 1817, p. 1457.

Sternaspis thalassemoides, Otto, Nova Acta, Acad. C.L.C., x., 1821, p. 619.

Sternaspis princeps, Selenka, Chall. Rep., Zool., xiii., 1885, p. 6.

One specimen, a good deal shrunken, with a length of 12 mm. and a width of the anterior chætigerous region 4.5 mm.

I have compared it with specimens from Naples and can find no essential differences; neither proportions of body nor of the shield, neither in the colour nor configuration of the latter, neither in the number of bundles of chætæ round its margin, nor in the number of those in the rows in anterior region of the body.

The only instance, so far as I know, of the capture of a member of the genus in these southern waters is that recorded by Selenka in his "Challenger" Report in which he describes under the title of *S. princeps* specimens from deep water east of the East Cape of New Zealand. A very brief account is given, accompanied by a figure which does not show the features used in his diagnosis. In that account two characters are mentioned—the existence of "about forty" bundles of chætæ around the shield, and the presence of an oblique ridge across the shield dividing it into two unequal areas. But this is true also of *S. scutata* from Naples.

The number of bristle-bundles varies, apparently with the size, for in a small specimen there are 28-30 bundles, and in a larger one I find 38 bundles.

I have specimens of *Sternaspis* from two widely separated parts of the New Zealand coast—from Akaroa, in the South Island, 6 fathoms, and from the mouth of Akitio River in the North Island, 20-36 fathoms. The former are smaller than the latter, but I can find no difference between them and the Naples specimens, comparing similar-sized individuals. I am compelled, therefore, to suppose either that there are two species of *Sternaspis* in our New Zealand waters, or that Selenka's species is a synonym—which is the view I take.¹

Loc.—One hundred and forty-two miles west of Kingston, South Australia, 30 fathoms.

Distribution.—European seas; Japan; North Pacific²; New Zealand.

Family SABELLIDÆ.

Genus SABELLASTARTE, *Kroyer*.

SABELLASTARTE JAPONICA, *Marenzeller*.

Laonome japonica, Marenzeller, Sud-japan. Annelid., 1884, p. 16.

The species must be removed from the genus *Laonome*, Malmgren, in which the thoracic chætæ are of two distinct forms, to that of *Sabellastarte*, in which there is but one form, though this occurs in two sizes in a bundle.³

1. I give further details about these New Zealand specimens in Trans. N.Z. Inst., vol. xlviii.

2. Moore—Proc. Acad. Nat. Sci. Philadelphia, 1903, p. 487.

3. St. Joseph—Ann. Sci. Nat., Zool., (7), xvii., 1894, p. 249.

The species is one of the giants in the family. Three individuals were received by me; two were still within the tube, the third fortunately had been removed and was in consequence well preserved.

I may add a few notes in supplement of the diagnostic description by Marenzeller.

The worm measures 168 mm. in length over all, of which the gills occupy 45 mm., but this is not their true length, for they are much contracted and twisted. In a second individual, measured in the tube, the body is 126 mm. long and the gills less twisted add 60 mm. to this. The gills are, thus, approximately half as long as the body. The thorax is 11 mm. in length, 10 mm. in width, and 7 mm. in height. In this individual there are only seven chætigerous segments, the first segment being without any chætæ; the uncini commence with the dorsal bristles on the second segment. Another specimen exhibited a still greater degree of abnormality, for it has only four bundles of chætæ with the uncini below, although the ventral gland shields and intersegmental furrows indicate the normal eight segments. In this case the 1st, 3rd, 4th and 8th are without chætæ.

The abdomen contains more than 200 segments, with an anterior diameter of 10 mm. ; it is flat ventrally, much arched dorsally, but further backwards the arching decreases till in the hinder half of the body the dorsal surface is nearly as flat as the ventral. The diameter is pretty uniform throughout, till close in front of the hinder end, when it rather suddenly tapers, the end being rounded.

As Marenzeller finds, the faecal groove does not cease at the hinder end of the thorax, but is traceable as an ill-defined shallow furrow along the dorsal surface forwards, in a curved line towards the median dorsal depression, which lies just behind the collar-gap anteriorly. The groove would probably disappear in soft specimens; it is recognisable in this well-preserved individual owing to the slight irregular foldings of the skin. A similar but narrower furrow symmetrical with it exists on the left side.

The general colour of the worm is pale brown with a purplish tint; on the thorax this tint is produced by minute dots of pigment, which are especially aggregated above the notopodia, thus producing a broad purplish band, which extends on to the posterior face of the collar lobes and on to the branchial base. The gills themselves are uniformly pale brown, without any purplish tint, as also are the edge and anterior face of the collar.

Ventrally the gland shields are darker than the neighbouring parts; the region between them and the chætigerous papillæ on the abdomen being almost white.

The gills are symmetrical, the ventral margin of the base of each is inrolled in a plane spire which describes more than a circle. The radioles (gill filaments) really arise in a single series, as Quatrefages¹ pointed out for *S. indica*, Sav., but some have broader outer edges than others, and thrust them out of series so that there appears to be an inner and an outer rank.

There are at least 130 radioles on each gill. The tip is naked for a distance equal to about twice the length of the upper pinnæ.²

The dorsal tentacles are 15 mm. in length, the so-called "palps" or buccal lobes are folded, directed forwards, and about as long as the ventral lobe of the collar.

The collar has a deep median cleft separating a right and left ventral lobe, which is triangular with rounded tip, over-arching the first segment. The lateral portion, which is continuous with this, is low, slightly reflected, and decreases in height as it passes upwards to the level of the notopodia; here a deep incision separates it from a dorsal lobe, which is directed forwards and inwards, at right angles to the former, to meet, but not to unite with, its fellow in the mid-line anteriorly.

The tube is a rich chestnut brown in colour, of tough horny material; the lower end is paler, transparent and flexible; the upper end opaque, much darker, and coated with fine grey mud. The lower end being softer is crumpled and twisted, so that the true length is difficult to determine, but it is about 220 mm., with a diameter of 12 mm. at the upper end.

As to the capilliform chætæ of the thorax, the figures given by Marenzeller exhibit some slight differences from my observations, which, however, may be due to his artist. Thus the flange on the shorter sort (Pl. iii., fig. 4B) is somewhat narrower than in the chætæ examined by myself, and the more slender sort (Pl. iii., fig. 4A) is represented as having a second flange, which is not always the case in the present specimens; while here the flange is broader than Marenzeller's figure indicates.

1. Quatrefages—Hist. Nat. Annel., ii., 1865, p. 432.

2. I follow McIntosh and Willey in the use of these terms, though it is unfortunate that they use "radiole" in a different sense from Grube.

These small differences, however, are of little importance when the general agreement is so close.

Remarks.—It seems useless to attempt to identify Baird's¹ "*Sabella grandis*" from which the gills were absent, and almost as useless to speculate as to whether the present species is or is not identical with *Spirographis australiensis*, Haswell,² from Port Jackson, for little precise anatomical detail is given. Both, however, are large forms, whatever genus they may belong to. It is possible that the large size and the inrolled gill-base led Haswell to place it in that genus.

The former is said to have come from New Zealand, but no Sabellid of this size (six and a-half inches without the gills) has been met with on these shores since that date.

Loc.—Off Babel Island, Bass Strait, about 60 fathoms.

Distribution.—Japan.

Family SERPULIDÆ.

Genus SPIROBRANCHUS, *Blainville*.

SPIROBRANCHUS LATISCAPUS, *Marenzeller*.

(Plate xlviii., figs. 46-50.)

Pomatostegus latiscapus, Marenzeller, Süd-Japan. Annelid., 1884, p. 22. *Id.*, Moore, Proc. Acad. Nat. Sci. Philadelphia, 1904, p. 173.

" ? *Pomatoceros strigiceps*," M'Intosh, Chall Rep., Zool., xii., 1885, p. 173. *Id.*, Treadwell, Bull. U.S. Fish. Comm., xxiii., 3, 1906, p. 1179.

I have transferred the species to the genus *Spirobranchus* on account of (a) the wide V-shaped ventral area on the thorax, and (b) the form of the abdominal chætæ, which are not "sickle" shaped as in *Pomatostegus*, but "trumpet" shaped,³ and (c) the larger number of denticulations on the uncini.⁴

It was Ehlers who first pointed out these differences between the two genera, which previously had been distinguished by the form of the operculum. Ehlers, Marenzeller, St. Joseph and others have relegated this feature to a

1. Baird—Jour. Linn. Soc., viii., 1865, p. 160.

2. Haswell—Proc. Linn. Soc. N. S. Wales, ix., 1885, p. 673.

3. Ehlers—Florida Anneliden, 1887, p. 299.

4. Pixell—Trans. Linn. Soc., Zool., xvi., 1913, p. 78.

secondary position, and it is this feature of the present species which led to its being placed in the genus *Pomatostegus*, for the discs are in two or more tiers and there are no outgrowths from the surface of the opercular disc such as occur usually in *Spirobranchus*, but, on the other hand, it is calcareous instead of being of horny material.

There are one or two features in which the present worm appears to differ from that described by Marenzeller—(a) in the extent of the basal denticulated area on the collar chætæ, and (b) in the presence of a distinct lateral notch in the collar.

A comparison of the worm with that briefly described by M'Intosh under the title "*? Pomatoceros strigiceps*" from New Zealand seas leads me to identify that worm with Marenzeller's. It is certainly not *Pomatoceros strigiceps*, Moreh, which is very common along our shores, and has been identified by Ehlers as *P. cocruleus*, Schmarda.¹

The few details given by M'Intosh and his figures of the chætæ agree with the present species. The figure of the side view (Pl. lv., fig. 4), though rather obscure in details, in that the outline of the collar lobes are not definitely shown, when read in association with his account of it, renders it very evident that the "peculiar region having the aspect of a partially closed fan," lying in front of the dorsal lobe of the collar, corresponds with what I term the "latero-dorsal lobe" in my account below.

It seems desirable to add a short account of the worm with some figures to supplement Marenzeller's.

The dimensions agree almost precisely with those given by him (Pl. xlvi., fig. 46). The operculum carries 3, 4 or 5 discs, which are circular, pale pinkish in colour, calcareous, with a smooth upper face, which is nearly flat or slightly concave; there are neither outgrowths nor raised radial ridges on the surface. The vertical surface between the successive discs is feebly ridged longitudinally. In one specimen, possessing five discs, the terminal one is produced to form a smooth cone (Pl. xlvi., fig. 49). (Has this been worn away in other specimens? Does this correspond to the characteristic spines of *Spirobranchus*? It is worth noting that in some species such as *S. maldivensis*, Pixell,² the disc is unarmed and flat.)

1. Ehlers—Neuseeländ. Annelid., 1904, p. 67, and 1907, p. 30.

2. Pixell—*Loc. cit.*, p. 84.

The branchial base has its ventral margin inrolled in a plane spire for about a circle; the right and left bases are connected by a membrane which reaches to the level of the origin of the filaments or radioles, of which there are 30 on each side, rather thick and arising in a single series.

The collar is on the ventral surface directed forwards so as to cover the gill bases: it is entire here, though in the median line it is folded, which gives it the appearance of an incision (Pl. xlvi.iii., fig. 47). On each side close to the dorsal surface, there is an incision separating a dorsal triangular lobe, directed forwards, which is posteriorly continuous with the thoracic membrane or "pallium."

Partially hidden by this dorsal lobe is a separate "latero-dorsal" lobe, slightly folded lengthwise, which is directed forwards and extends slightly beyond the free edge of the ventral lobe (Pl. xlvi.iii., fig. 43). This I take to be McIntosh's fan-shaped region.

The first bundle of chætæ (collar chætæ) is widely separated from the following dorsal bundles. It is situated at the upper end of an oblique tongue-shaped ridge, seen through the transparent "pallium" owing to its faint purple colour. It runs upwards from the level of the torus uncinigerus of the next segment, towards the apex of the dorsal collar lobe; it appears to be a support to this lobe or to the pallium (Pl. xlvi.iii., fig. 48).

The tori uncinigeri are so arranged on the thorax that their ventral margins reach successively lower levels, thus a wide triangular area is outlined, with its open base forwards and the apex situated on or before the last thoracic segment. Gland shields occur within this area (Pl. xlvi.iii., fig. 47).

The collar chætæ are about six in number, and have the usual shape (Pl. xlvi.iii., fig. 50), though the basal denticulated region is much more extensive than is shown in Marenzeller's figure.

In all the other features there is agreement with that species.

Loc.—Off Babel Island, Bass Strait, 50-80 fathoms.

Distribution.—Japan; Hawaii.

Genus *PROTULOPSIS*, *St. Joseph*.

PROTULOPSIS PALLIATA, *Willey*.

(Pl. *xlvi*iii., figs. 51-55.)

Protulopsis palliata, Willey, Ceylon Pearl Oyster Fisheries, pt. iv., Suppl. Rep., xxx., — *Polychæta*, 1905. p. 316.

A single female specimen of a worm in its tube. The worm measures 21 mm. excluding the gills, which are 6 mm. in length, and the thorax 6 mm.; the diameter is 2 mm. More or less cylindrical anteriorly, the body becomes flat at the hinder end, where the long capillary bristles project from each side to a distance equal to the width of the body. There is a dorsal gland at this hinder end.

There is little to add to Willey's account; the fact that the tori uncinigeri commence in the fourth chaetigerous segment is confirmed.

There are two curious structures on the base of the gill-support, one on the dorsal, the other on the ventral face.

Dorsally, the low transverse dorsal lobe of the collar seems to be continued forwards over the base of the gill as an irregular folded membrane as far as the origin of the radioles; this membrane is broadly adherent to the gill-base (Pl. *xlvi*iii., fig. 53), and I take it to be "the wide lappet, which is rolled upon itself," described by Willey as occurring in the Ceylon species. He further suggests that it "is probably able to follow the branchial spire to its termination," a statement which I don't quite understand. If, however, I am correct in ascribing the present worm to Willey's species, this "lappet" certainly cannot do this; it is by its adherence limited to the gill-base.

On the ventral face, there is on each side, well removed from the collar, a fold of skin nearly semicircular in outline which I do not remember to have seen figured or described previously (Pl. *xlvi*iii., fig. 52).

The ventral lobe of the collar is very greatly developed, forming a deep pouch in the preserved material with its opening forwards. Its connection laterally with the pallium or thoracic membrane is rather complex, and I have found it difficult to analyse in the small specimen, in which, too, the membranes very readily tear when touched. I have given figures, which I believe to be accurate representations of their relations.

I may remark that the distinction of the genus or sub-genus *Protulopsis* rests on a very uncertain feature. St. Joseph¹ separates it from *Protula* owing to the difference in the form of the abdominal bristles, which in the older genus are " sickle shaped," whereas in the new sub-genus they are less curved ; at the same time he points out in a note on p. 338 in referring to *Filograna*, that in the case of these delicate chætæ immersion in alcohol for some time tends to alter the curvature, to diminish it, so that a sickle form may straighten out, and it is easy then to confuse the chætæ. However, I have retained the name as Willey's species is easily distinguished.

Loc.—East north-east of Maria Island, Tasmania, 100 fathoms.

Distribution.—Galle, Ceylon.

1. St. Joseph—Ann. Sci. Nat., Zool., (7), xvii., 1894, p. 263.

PLATE XLV. WILL NOT BE PUBLISHED.

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Loc.—East north-east of Maria Island, Tasmania, 100 fathoms.

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1. St. Joseph—Ann. Sci. Nat., Zool., (7), xvii., 1894, p. 263.

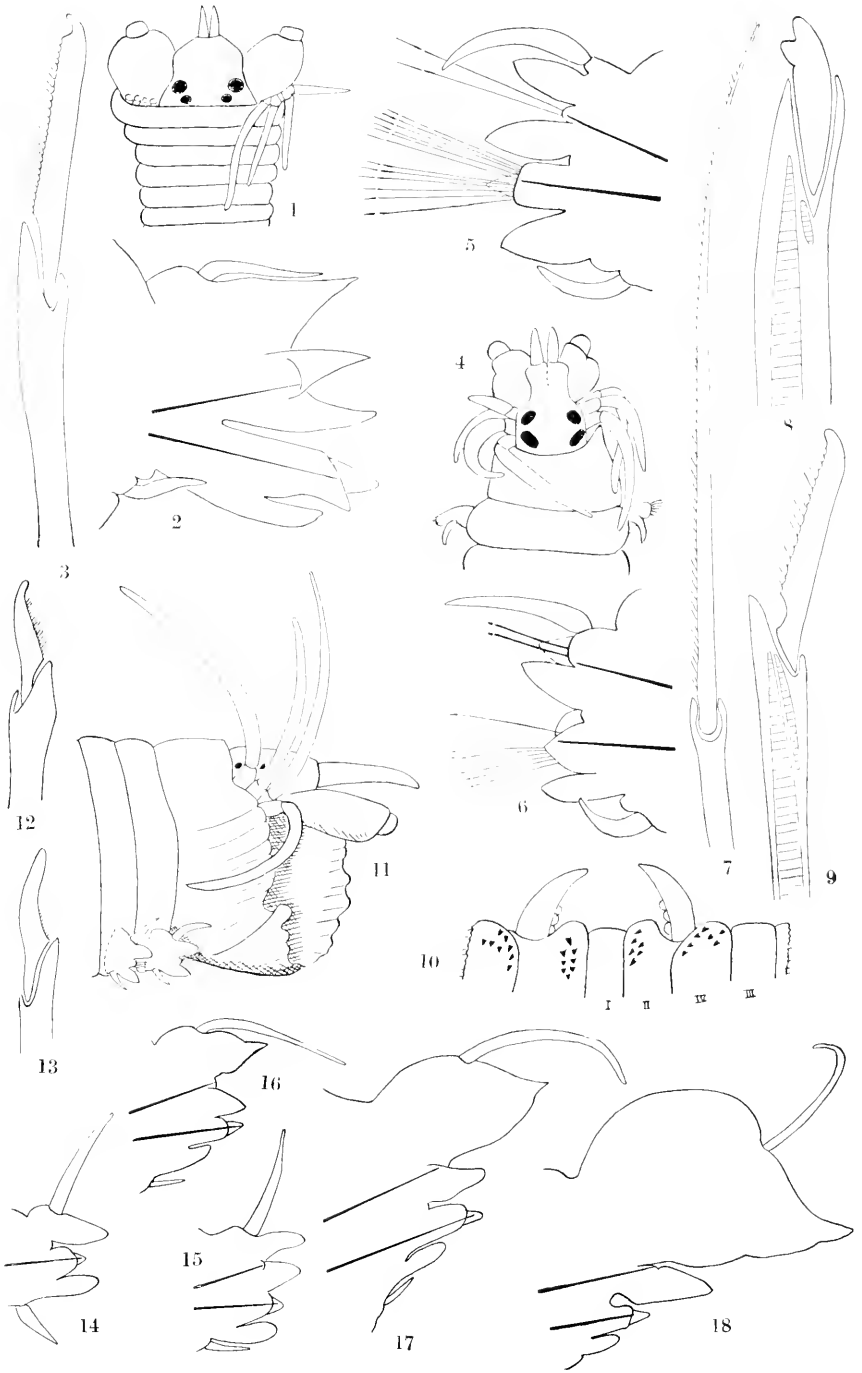
EXPLANATION OF PLATE XLVI.

Nereis arenaceodentata, Moore.

- Fig. 1.—Head ($\times 8$). The peristomial cirri are removed from the left side of the figure.
- Fig. 2.—The fifteenth parapodium ($\times 35$). The chætæ are omitted.
- Fig. 3.—A sub-acicular chæta from the neuropodium ($\times 720$).

Ceratonereis falcaria, Willey.

- Fig. 4.—Head ($\times 40$). (Camera outline.)
- Fig. 5.—The thirteenth parapodium ($\times 70$).
- Fig. 6.—A parapodium posterior to the 21st segment with the characteristic dorsal chætæ ($\times 70$).
- Fig. 7.—A notopodial chæta from an anterior segment ($\times 720$).
- Fig. 8.—A notopodial chæta from the 22nd and subsequent segments ($\times 720$).
- Fig. 9.—A neuropodial chæta ($\times 720$).
- Fig. 10.—The maxillary region of the pharynx (enlarged).
Cheilonereis peristomialis, sp. nov.
- Fig. 11.—Head from the side ($\times 4$) drawn from a specimen from New Zealand in which the peristomial lip is fully spread out.
- Fig. 12.—A sub-acicular chæta from the neuropodium ($\times 250$).
- Fig. 13.—A supra-acicular chæta from the neuropodium ($\times 250$).
- Fig. 14.—The second parapodium ($\times 10$).
- Fig. 15.—The third parapodium ($\times 10$).
- Fig. 16.—The ninth parapodium ($\times 10$). The lamella is commencing to develop.
- Fig. 17.—The twentieth parapodium ($\times 10$).
- Fig. 18.—The thirty-fifth parapodium ($\times 10$). The dorsal lamella and the dorsal ligule are now at their maximum development.





EXPLANATION OF PLATE XLVII.

Cheilonereis peristomialis, sp. nov.

- Fig. 19.—The fiftieth parapodium ($\times 10$).
Fig. 20.—The ninetieth parapodium ($\times 10$).
Fig. 21.—The everted pharynx (enlarged).
Fig. 22.—A parapodium of a female Heteronereid phase ($\times 8$)
from a New Zealand specimen.

Glycera tessellata, Grube.

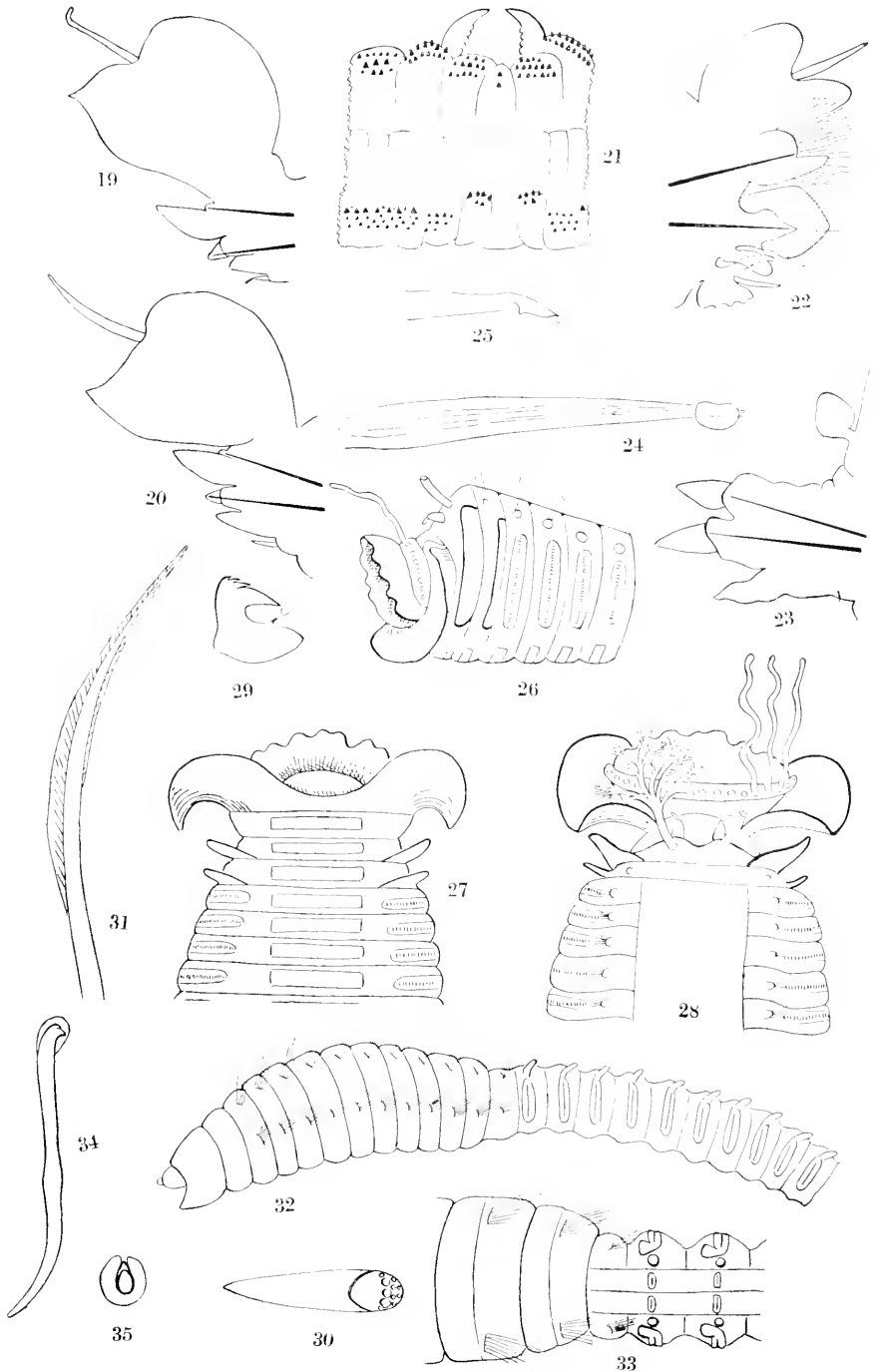
- Fig. 23.—A parapodium ($\times 35$).
Fig. 24.—A pharyngeal papilla ($\times 250$).
Fig. 25.—The tip of another papilla, side view showing the
terminal disc ($\times 250$).

Scione harrissoni, sp. nov.

- Fig. 26.—Anterior end from the side ($\times 10$). Somewhat
diagrammatic: the tentacles are removed with the
exception of one; they were broken away in order
that the structure of the head might be seen clearly;
the gill has been cut short.
Fig. 27.—Ventral view ($\times 10$).
Fig. 28.—Dorsal view ($\times 10$). The left gill is represented
diagrammatically, as it had been broken in examin-
ing the head.
Fig. 29.—A thoracic uncinus ($\times 360$).
Fig. 30.—An uncinus from above ($\times 720$).
Fig. 31.—A thoracic capilliform chaeta ($\times 360$).

Notomastus eisigi, sp. nov.

- Fig. 32.—Side view of greater part of the worm ($\times 4$).
Fig. 33.—Dorsal view of last two thoracic and anterior abdo-
minal segments ($\times 8$). The circular marks on the ab-
dominal segments are the "lateral organs," outside
which are the angular "gills" at the upper end of
the neuropodial tori. The notopodial tori are close
together dorsally.
Fig. 34.—An abdominal chaeta ($\times 45$).
Fig. 35.—View of a chaeta from above (free hand) showing
the double wing enclosing the hook.





EXPLANATION OF PLATE XLVIII.

Ophelia dannevigii, sp. nov.

- Fig. 36.—A parapodium and gill, the latter cut short (much enlarged).
Fig. 37.—Ventral view of the posterior end ($\times 20$). The chætæ and gills are cut short on the left of the figure.

Asychis victoriæ, sp. nov.

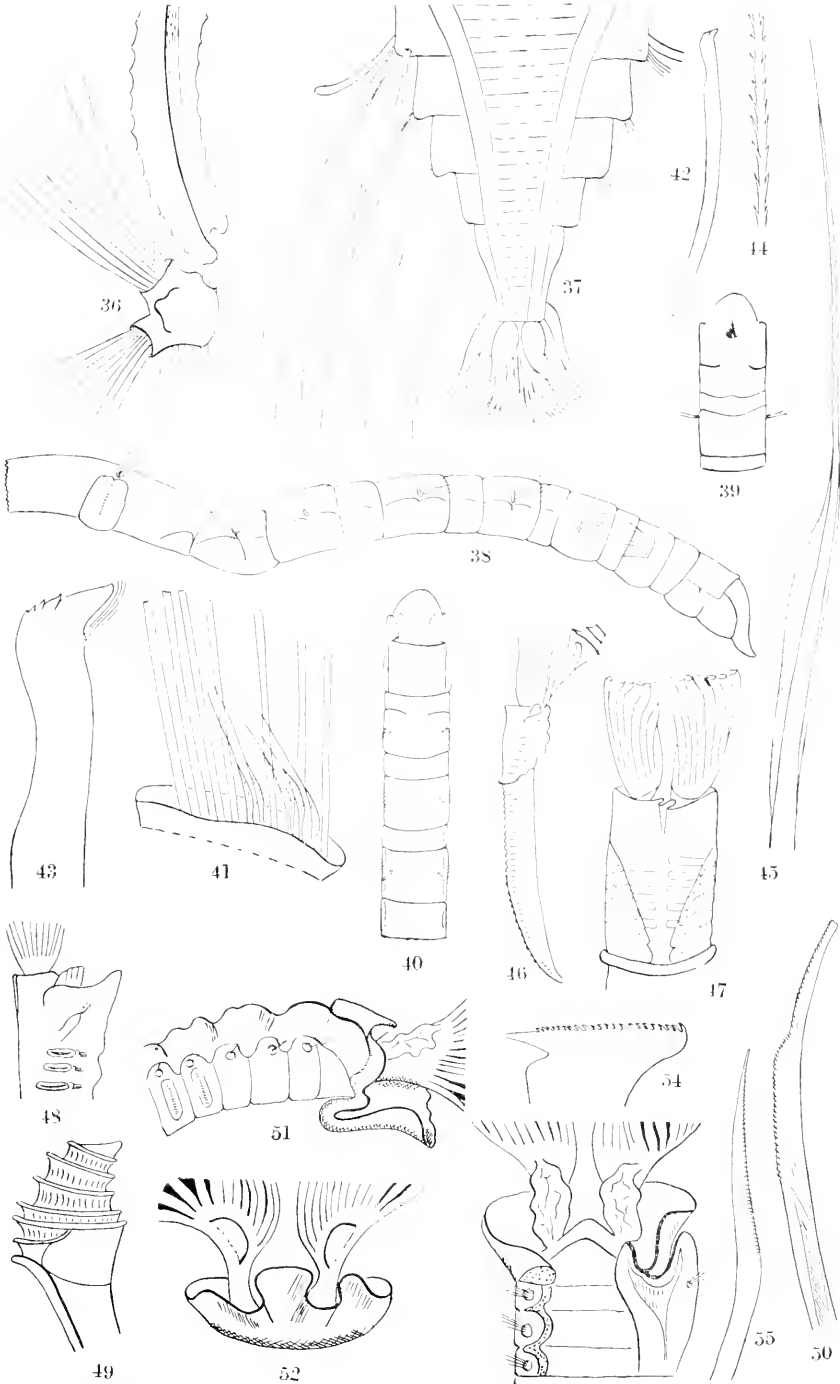
- Fig. 38.—Side view of the fragment ($\times 2$).
Fig. 39.—Ventral view of the anterior end ($\times 2$).
Fig. 40.—Dorsal view of anterior end ($\times 2$).
Fig. 41.—A notopodial bundle of chætæ ($\times 35$). The long capilliforms are cut short.
Fig. 42.—One of the neuropodial chætæ ($\times 35$).
Fig. 43.—The apex of a neuropodial chæta ($\times 250$).
Fig. 44.—A portion of a capilliform chæta near its apex ($\times 360$).
Fig. 45.—One of the shorter flanged, finely pointed chætæ from a notopodial bundle ($\times 250$).

Spirobranchus latiscapus, Marenzeller.

- Fig. 46.—Entire animal ($\times 2$).
Fig. 47.—Ventral view of the anterior end ($\times 4$), showing the V-shaped furrow in which the ventral glands lie, and behind them the transverse ventral portion of the pallium or thoracic membrane; the gills have been cut short.
Fig. 48.—Side view ($\times 4$) to show the latero-dorsal lobe of the collar. The gills and operculum are now omitted.
Fig. 49.—Operculum ($\times 6$) in its fullest stage of development with a conical terminal plate.
Fig. 50.—One of the collar chætæ ($\times 250$). The tip is broken.

Protulopsis palliata, Willey.

- Fig. 51.—Side view of the anterior end ($\times 6$). The gills cut short and the collar somewhat diagrammatically treated.
Fig. 52.—Ventral view of the collar ($\times 6$), showing the great development of the ventral lobe of the collar, which forms a pouch, the base of which overhangs the first segment. On the gill-base is a curious upstanding semicircular fold.
Fig. 53.—Dorsal view ($\times 6$). The pallium or thoracic membrane on the left side is cut away. The peculiar anterior continuation of the dorsal lobe of the collar (?) is seen passing along the gill-base to which it is adherent.
Fig. 54.—An uncinus, greatly enlarged.
Fig. 55.—An abdominal chæta ($\times 250$).



III. Report on the Gephyrean Priapulus obtained by the
F.I.S. " Endeavour " in Australian Waters.

BY

WILLIAM B. BENHAM, M.A., D.Sc., F.R.S.,

Professor of Biology at the University of Otago, New Zealand ; Hutton
Medallist, New Zealand Institute.

REPORT ON THE GEPHYREAN PRIAPULUS.

CLASS GEPHYREA.

Order PRIAPULOIDA.

Family PRIAPULIDÆ.

Genus PRIAPULUS, *Lamarck*.

PRIAPULUS CAUDATUS, *Lamarck*.

Priapulus caudatus, Lamarck, Anim. sans Vertèbres, iii., 1801, p. 467.

Priapulus caudatus, Lamarck, var. *antarcticus*, Michaelsen, Jahrb. Hamburg. Wiss. Anstalt., vi., 1889, p. 10.

A single specimen of this species was received, but without any indication of the locality at which it was obtained.

It has already been recorded from Antarctic seas, and the variety *antarcticus* differs from the specific type only in the ventral interruption of the circles of pre-branchial papillæ. The same feature has been noted in some of the varieties from the northern hemisphere, which were originally regarded as distinct species by Ehlers, so that the value of this feature in the southern forms is of no weight as a varietal character.

The matter has been discussed by Shipley,¹ Fischer,² and Storikow,³ so that there is no need for me to do more than put the occurrence on record. But it appears that *Priapulus* has not hitherto been obtained in the southern hemisphere so far north as this must have been, for the "Endeavour" did not go into the Antarctic circle.

Loc.—Not recorded.

Distribution. — Greenland; Spitzbergen; North Sea; Magellan Strait; South Georgia; Falkland Islands; Kerguelen; Cape Adare.

1. Shipley—"Southern Cross" Collections, Gephyrea, 1902, p. 284.

2. Fischer—Abhandl. aus. d. Gebiete d. Naturwiss., xiii., 1895, p. 22; *Id.*, Fischer, Hamburg. Sammelreise magalhaens., Gephyrea, 1895, p. 6.

3. Storikow—Zool. Anzeig., xxv., 1902, p. 155.

IV. Report on some Fishes obtained by the F.I.S.
"Endeavour" on the coasts of Queensland, New South
Wales, Victoria, Tasmania, South and South-western
Australia.

PART IV.

BY

ALLAN R. McCULLOCH,
ZOOLOGIST, AUSTRALIAN MUSEUM, SYDNEY.

Plates XLIX-LVIII; Text Fig. 1-2.

REPORT ON THE FISHES.

PART 4.

A CONSIDERATION of the outcome of the investigations of the "Endeavour" under the direction of the late Mr. Harald C. Dannevig proves that his contentions favouring the establishment of the trawling industry in Australia were well founded. In spite of much adverse criticism, he maintained the opinion that quantities of marketable fish were obtainable within reasonable distance of market centres, basing his arguments upon a practical knowledge of the catches of the "Endeavour" at numerous stations between Bowen on the Queensland coast, and Geraldton in Western Australia. Some of his Reports upon the work have been published¹, but he was engaged upon an analysis of the investigations, particularly those around the south and south-eastern coasts, when he was lost with his ship and all her company.

Largely owing to the influence of his work, however, and under the skilful management of Mr. David G. Stead, the Government of New South Wales has now established three trawlers, and considers the project sufficiently profitable to warrant its extension in the near future. Representatives of other States are likewise looking favourably upon the trawling industry, so that it is possible that Mr. Dannevig's hope of an abundant supply of trawled fish forming a valuable addition to the food-supply of several Australian cities may soon be realised.

Owing to the depletion of the staff of the Australian Museum, caused by the enlistment of several of its members, the difficulty of handling the large collection of fishes made by the "Endeavour" has been greatly increased. For the same reason it has not been possible to devote so much time to their study as formerly, which will account for the brevity of the following Report.

I am indebted to Mr. Stead for assistance in procuring fresh specimens of several of the rays described in the following pages. I also owe much to my assistants, Mr. Ellis Troughton and Mr. Frank McNeil for their willing help in dealing with the specimens referred to herein.

I. Reports by the Director of Fisheries—

Commonwealth Parliamentary Report,	1909, No. 69.—F.15398.
" "	" " " 1910, No. 70.—F.16668
" "	" " " 1910, No. 47.—F.13794
" "	" " " 1910, No. 61.—F.16559

Notes on Australia's Fisheries, with a summary of the Results obtained by the F.I.S. "Endeavour," Melbourne, 1913 (Dept. Trade and Customs).

Family ALOPIIDÆ.

Genus ALOPIAS, *Rafinesque*.ALOPIAS VULPINUS, *Bonnaterre*.

Alopecias vulpes, McCoy, Prodr. Zool. Vict., Dec. ix., 1884, pl. lxxxviii.

The head of a large example, with the pectoral fins attached, was picked up by the trawl of the " Endeavour " at a depth of 200 fathoms. It had been bitten off cleanly from the body by some larger animal, probably a Killer Whale, *Orca gladiator*, Bonnaterre, and was but little decomposed when secured. It had the general appearance of McCoy's illustration, quoted above, though the upper profile of the head was very gibbous, rising from the snout in a strongly convex curve.

Loc.—Off Cape Everard, Victoria.

Genus UROLOPHUS, Müller & Henle.

Urolophus, Müller & Henle, Sitzb. Akad. Wiss. Berlin, ii., 1837, p. 117 (*U. cruciatus*); *Id.*, Garman, Mem. Mus. Comp. Zool., xxxvi., 1913, p. 405.

Trygonoptera, Müller & Henle, Plagiost., 1838-41, p. 174 (*T. testacea*, Müll. & Henle); *Id.*, Garman, *Loc. cit.*, p. 409.

The presence or absence of a dorsal fin has been considered of sufficient importance to distinguish *Trygonoptera* and *Urolophus*, but this character is apparently variable even within the limits of a species. It is usually present in *T. testacea*, but an adult example in the Australian Museum having all other characters of that species is without any trace of it; *T. viridis*, on the other hand, generally lacks a dorsal fin, but it is well developed in several specimens which apparently belong to this species. Variation of this character in young examples of *Urolophus* has already been noted by Waite¹, and his observations are borne out by the " Endeavour " material.

The species of *Urolophus* differ from *Trygonoptera* in having a shorter and thicker tail, but in the absence of other differentiating structures this can scarcely be regarded as of generic value.

1. Waite—Mem. Austr. Mus., iv, pt. 1, 1899, p. 43.

Key to the Australian species.

- a. Tail short, its length less than its distance from the mouth.
UROLOPHUS.
- b. Back with dark transverse and longitudinal markings.
cruciatus.
- bb. Back nearly uniform.
aurantiacus
- aa. Tail longer than its distance from the mouth.
TRYGONOPTERA
- c. Internasal valve with a broad fringe on its posterior margin. Nostrils with broad lobes posteriorly.
- d. Tail without lateral folds.
testaceus.
- cc. Posterior margin of the internasal valve with a narrow fringe or lobules. Nostrils without broad posterior lobes.
- e. Papillæ behind lower jaw fewer, widely spaced.
- f. Disc slightly broader than long, back uniformly coloured.
viridis
- ff. Disc much broader than long, back with darker cross-bars.
expansus
- ee. Papillæ behind lower jaw numerous, close together. Back white speckled.
bucculentus

UROLOPHUS CRUCIATUS, *Lacépède*.

Banded Stingaree.

Raja cruciata, Lacépède, Ann. Mus. d'Hist. Nat., iv., 1804, pp. 201, 210, pl. lv., fig. 2.

Leiobatus cruciatus, Blainville, Bull. Soc. Philom., 1816, p. 121.

Urolophus ephippiatus, Richardson, Voy. "Erebus and Terror," Fishes, 1845, p. 35, pl. xxiv.

Urolophus cruciatus, Günther, Brit. Mus. Cat. Fish., viii., 1870, p. 485; *Id.*, Dumeril, Hist. Nat. Poiss., i. 2, 1865, p. 626; *Id.*, Macleay, Proc. Linn. Soc. N. S. Wales, vi., 1881, p. 378; *Id.*, Johnston, Proc. Roy. Soc. Tasm., 1882 (1883), p. 141, and 1890 (1891), p. 39; *Id.*, McCulloch, Zool. Res. "Endeavour," i., pt. 1, 1911, p. 14; *Id.*, Garman, Mem. Mus. Comp. Zool., xxxvi., 1913, p. 408.

I have carefully compared twenty-two specimens of this species with numerous *U. aurantiacus* of similar size, and fail to find any differences between them other than colour-marking. The dark bands and spots of *U. cruciatus* are very constant, however, being similarly disposed in all my specimens, though somewhat variable in degree of development.

In a fine example 242 mm. wide the markings are almost exactly similar to those of Richardson's figure, though the contrast between the light and dark parts is more striking; they are also well defined in two young examples and nineteen fetal specimens.

Waite¹ has noted that fetal specimens possess a small dorsal fin. It varies considerably in development in my nineteen specimens; a few have a distinct, though small fin in advance of the spine; in others it is represented by a mere fleshy tubercle, while in most it is wholly wanting.

Locs.—East of Flinders Island, Bass Strait.

Off Port Davey, Tasmania, 88 fathoms.

Near Mainwaring Cove, west coast of Tasmania, 50 fathoms.

Bay of Fires, Tasmania, 40 fathoms.

Investigator Group, South Australia, 37 fathoms.

UROLOPHUS AURANTIACUS, Müller & Henle ?

Yellow-backed Stingaree.

(Plate xlix.)

? *Urolophus aurantiacus*, Müller & Henle, *Plagiost.*, 1841, p. 173, pl. lvi.; *Id.*, Schlegel, *Faun. Japon.*, *Pisces*, 1850, p. 307.

Urolophus aurantiacus, Bleeker, *Nederl. Tijdschr. Dierk.*, ii., 1865, p. 68.

Urolophus cruciatus, Waite, *Mem. Austr. Mus.*, iv., pt. 1, 1899, p. 43, and *Mem. N.S. Wales Nat. Club*, 2, 1904, p. 10 (not *U. cruciatus*, Lacépède).

Breadth of the disc 1.01-1.06 into the length from the tip of the snout to the end of the ventral fins. Tail, measured from its end to the middle of the vent, 1.2-1.3 in the length from the same point to the tip of the snout. Interocular space a little greater than the narrowest interspiracle width, and 1.1-1.3 in the preocular portion of the head. Internasal width 2.2-2.6, and width of mouth 1.4-1.7 in the preoral portion of the head.

Disc more or less angular in front, rounded laterally. The snout forms a distinct triangular projection in some specimens, but is a mere tubercle in others which scarcely breaks the contour of the anterior profile. Anterior margins of pectorals almost straight from the snout to the broadly rounded exterior angles; postero-lateral margins convex, forming obtuse angles with the inner margins. Margins of ventrals convex, the angles rounded.

1. Waite—*Mem. Austr. Mus.*, iv., pt. 1, 1899, p. 43.

Eyes small, much smaller than the spiracles, their length $2\frac{2}{3}$ -3 in the interocular space. Postero-exterior angles of the internasal lobe separated from the hinder margin as small, rounded tubercles: posterior margin a little sinuous, and fimbriate. Nostrils large, confluent with the mouth, and separated by a thick median frenum. Teeth pavement-like in the female; each has an elongate flattened spine in the male. A median papilla behind the lower jaw, which is subdivided into two to four lobes; there is another simple or bifurcate one on each side of it, and one near each angle of the jaws.

Tail depressed, its width between the ventral fins subequal to that of the mouth; its length from the middle of the vent is usually a little less than that from the same point to the mouth, but it is longer in young examples. The spine is inserted at or slightly in advance of the middle of its length; it is depressed, with serrated edges. Caudal fin originating directly behind the end of the spine above, below the middle of its length on the lower surface: its width is subequal to that of the internasal space, but is somewhat variable.

Colour.—Rich ochreous yellow above when fresh, sometimes stained with pink towards the edges of the disc. An indefinite brown median dorsal stripe may extend from the eyes to the dorsal spine. White below, purplish towards the edges. In preservative, the disc becomes grey.

Described from eleven specimens 245-387 mm. in total length, most of which were collected by the "Thetis" Expedition. Fœtal examples differ only in having the body rather more circular, and the caudal fin almost black.

U. aurantiacus was originally described from a specimen collected by Langsdorff at the Goto Islands, Japan¹. It was united with *U. cruciatus* by Duméril,² who has been followed by most later writers, but it appears to constantly differ in its colour-marking, though a careful comparison of several specimens of both species fails to reveal any structural differences. Bleeker has identified specimens from Port Jackson as *U. aurantiacus*, while those described above appear to be very similar to Müller and Henle's figure of that species.

Loc.—Off the Manning River to Port Kembla, New South Wales, 20-84 fathoms.

1. *U. aurantiacus* has been omitted from recent papers and catalogues of Japanese fishes. It is perhaps identical with *U. juscus*, Garman.

2. Duméril—Hist. Nat. Poiss., i. 2, 1865, p. 626.

UROLOPHUS TESTACEUS, Müller & Henle.

Common Stingaree.

(Plate L.)

Trygonoptera testacea, Müller & Henle, Plagiost., 1841, p. 174, pl. lvii.; *Id.*, Dumeril, Hist. Nat. Poiss., i. 2, 1865, p. 629; *Id.*, Waite, Mem. Austr. Mus., iv., pt. 1, 1899, p. 43-44; *Id.*, Waite, Mem. N.S. Wales Nat. Club, 2, 1904, p. 10; *Id.*, Stead, Ed. Fish. N.S. Wales, 1908, p. 119; *Id.*, Fowler, Proc. Acad. Philad., 1907 (1908) p. 419; *Id.*, Garman, Mem. Mus. Comp. Zool., xxxvi., 1912, p. 410.

Urolophus (Trygonoptera) testaceus, Günther, Brit. Mus. Cat. Fish., viii., 1870, p. 486.

Urolophus testaceus, Macleay, Proc. Linn. Soc. N.S. Wales, vi., 1881, p. 379; *Id.*, Ogilby, Cat. Fish. N.S. Wales, 1886, p. 6; *Id.*, Lucas, Proc. Roy. Soc. Vict., (2), ii., 1890, p. 46.

Trygon testacea, Zietz, Trans. Roy. Soc. S. Austr., xxxii., 1908, p. 292.

Trygonoptera müllerii, *T. henlei*, and *T. australis*, Steindachner, Sitzb. Akad. Wiss. Wien, liii., 1866, pp. 479-480, pl. vi., fig. 4-5, and pl. vii.

Breadth of the disc almost equal to the length from the tip of the snout to the end of the ventral fins. Tail, measured from its end to the middle of the vent, 1.03-1.1 in the length from the same point to the tip of the snout. Interocular space subequal to the narrowest interspiracle width, and 1.1-1.2 in the preocular portion of the head. Internasal width 2.8-3, and width of mouth 2.04-2.3 in the preoral portion of the head.

Snout angular, but not produced beyond the margin of the disc. Anterior margins of the pectorals slightly sinuous or almost straight from the snout to the broadly rounded exterior angles; postero-lateral margins convex, their junction with the inner margins rounded.

Eyes of moderate size, their length 2.5-2.7 in the interocular space. Inner margin of spiracle with an obtuse angular projection. Nostrils with large free lobes posteriorly which overhang the angles of the mouth. Internasal valve with a broad free fringe of flattened tentacular processes, which are about fourteen in number on each side; the postero-external

angles form small papillæ which are hidden in the mouth. Teeth pavement-like, each with a horizontal ridge in the female, which is elevated into an obtuse spine in the male. A fimbriated lip behind the upper jaw, the median finibriæ being largest. A median, bilobed papilla behind the lower jaw, with one or two smaller ones on each side.

Tail depressed without lateral folds, its width between the ventral fins equal to that of the mouth; its length from the middle of the vent is a little less than that from the same point to the end of the snout. The spine is inserted at about the middle of its length, and is depressed with serrated edges. Dorsal fin small, but well developed, placed directly before the spine. Caudal narrow, its width equal to about two-thirds of the internasal space; it originates below the hinder fourth of the spine on the upper surface, and extends forward as a ridge below almost or quite to beneath the dorsal.

Colour.—Uniform cinnamon brown above when fresh, including the eyes and tail. The extreme edges of the disc and caudal fin are white. Lower surfaces white, with a broad pale brown margin to the pectorals and ventrals. Larger specimens are darker brown, with the intramarginal portions of the disc and caudal fin blackish.

The above description is based on two examples 157 and 225 mm. wide, the smaller of which is from Queensland and the other from Port Jackson. The figure is prepared from a female specimen 244 mm. wide taken at Botany Bay by Mr. J. H. Wright.

A large specimen 322 mm. wide differs from the others in lacking a dorsal fin, and in having the tail somewhat shorter, its length to the middle of the vent being 1.1 in the length from the same point to the end of the snout. Its colour is coffee-brown above and white below, with the edges of the disc broadly margined with brown. It is apparently not distinct from *U. testaceus*, having all the other characters of that species.

Locs.—This is the common Sting-ray of shallow water in New South Wales. It is also recorded from Queensland, Victoria and South Australia. The "Endeavour" collection includes two small examples from five miles south-west of Boomerang Hill, Fraser Island, Queensland; 15 fathoms. I have also examined three small specimens 146-184 mm. wide from Port Hacking, New South Wales, which were collected by Mr. A. Musgrave, of this Museum.

UROLOPHUS VIRIDIS, *sp. nov.**Green-backed Stingaree.*

(Plate li.)

Breadth of the disc 0.07 greater than the length from the snout to the end of the ventral fins. Tail, measured from its end to the middle of the vent 1.08 in the length from the same point to the end of the snout. Interocular space equal to the narrowest interspiracle width, and 1.6 in the preocular portion of the head. Internasal width 2.5, and width of mouth 2.3 in the preoral portion of the head.

Breadth of the disc greater than the length from the end of the snout to the hinder margin of the ventral fins. Snout more or less produced as a triangular projection beyond the margin of the disc. Anterior pectoral margins slightly sinuous or almost straight, the outer angles rounded; postero-lateral margins a little convex, their junction with the inner margins rounded. Eyes prominent, rather large, their length equal to about half the interocular width. Inner margin of the spiracle without an angular projection. Nostrils without large free lobes posteriorly overhanging the angle of the mouth. Posterior margin of the internasal valve with a narrow border which is lobulate but not fringed; the postero-external angles form papillæ which lie in a groove outside the lips. Median teeth with flattened cusps in the male. A fimbriated lip behind the upper jaw, and several widely spaced papillæ behind the lower, which are variously disposed in different specimens.

Tail depressed, with a well developed fold on either side. Its width between the ventral fins is equal to that of the mouth; its length from the middle of the vent is equal to or a little less than that from the same point to the end of the snout. The spine is inserted at about the middle of its length. No dorsal fin (see note below), though a small tubercle is sometimes present before the spine. Caudal fin large, narrow, its width equal to about four-fifths of the internasal space; it originates below the hinder portion of the spine on the upper surface, and extends forward as a ridge to beneath the anterior portion of the spine below.

Colour.—Light moss green above when fresh, the extreme edges of the disc whitish. Iris golden. Lateral folds of tail and lower surfaces porcelain white, the margins of the disc purplish. The colour of the back changes to purplish brown soon after death, and some preserved specimens have a broad blackish bar crossing the interorbital space and extending outwards on either side of the eye.

Described and figured from a specimen 255 mm. wide : six others, 232-275 mm. wide, exhibit but little variation in their proportions and general contour. I am indebted to Mr. David G. Stead, General Manager of the State Trawling Industry, and to Skipper Hoult, of the trawler "Koraaga" for these excellent specimens.

This species is distinguished from *U. testaceus* by the absence of lobes on the nostrils and a fringe on the internasal valve, while the tail has a distinct lateral fold. The dorsal fin is usually absent in *U. viridis* and present in *U. testaceus*, but in five out of fifteen specimens of the former species which I have examined, a small fin is developed ; these were at first considered to represent a distinct species, but as I have failed to find any other character to distinguish them, I believe the presence or absence of a dorsal fin is variable within the limits of a species in the genus *Urolophus*.

Locs.—The Green-backed Stingaree is very plentiful in moderately deep water off the coast of New South Wales, where it is captured by the trawlers in depths of 50-70 fathoms. I also found it common off the eastern coast of Tasmania, when on board the "Endeavour." Specimens lacking the dorsal fin were obtained north-east of Babel Island, Bass Strait, 70-100 fathoms ; north-east of Green Cape, New South Wales, 49 fathoms ; and five to eight miles off Newcastle, New South Wales, 21-48 fathoms. The specimens in which the dorsal fin is present were trawled in Jervis Bay, New South Wales, 10-11 fathoms ; in Botany Bay and Port Jackson ; and eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

UROLOPHUS BUCCULENTUS, *Macleay*.

Sandy-backed Stingaree.

Urolophus bucculentus, Macleay, Proc. Linn. Soc. N.S. Wales, ix., 1885, p. 172.

Trygonoptera bucculenta, Waite, Mem. Austr. Mus., iv., pt. 1, 1899, p. 44, pl. v.

This species is easily recognisable in the fresh state by its peculiar colouration, which is pale brown above, closely speckled with small brownish white dots on the greater part of the back. This marking is still traceable on some parts of Macleay's specimens. The State trawlers obtain a considerable number of this ray on the coast of New South Wales, and I have also seen it trawled off the eastern coast of Tasmania, but have no note as to whether it is abundant there.

Loc.—A single specimen is preserved in the "Endeavour" collection from north-east of Babel Island, Bass Strait, 70-100 fathoms.

UROLOPHUS EXPANSUS, *sp. nov.*

(Fig. 2. See p. 200.)

Breadth of the disc greater than its length, 0.1 wider than the length from the snout to the end of the ventral fins. Tail, measured from its end to the middle of the vent, 1.1 in the length from the same point to the end of the snout. Interocular space subequal to the narrowest interspiracle width, and 1.3-1.5 in the preocular portion of the head. Internasal width subequal to that of the mouth, and 2.4-2.6 in the preoral portion of the head.

Disc forming a sharp angle at the snout, rounded laterally. Snout not produced. Anterior margins of pectorals almost straight, the postero-lateral margins feebly convex and forming obtuse angles at their junctions with the inner margins. Ventrals subquadrangular, the angles rounded.

Eyes of moderate size, their length equal to about half the interocular width. Postero-external angles of the internasal valve forming small rounded tubercles; its posterior margin fimbriate. Nostrils large and narrow, without any skinny lobe posteriorly. Two or more papillæ on the median line of the mouth behind the lower jaw, and several other widely-spaced ones on either side.

Tail depressed, with a narrow keel on either side; its width between the ventral fins is subequal to that of the mouth and its length from the middle of the vent is equal to the distance from the same point to midway between the mouth and the end of the snout. The spine is inserted slightly in advance of the middle of its length. No dorsal fin. Caudal fin narrow, its width less than that of the internasal space; it originates below the end of the spine on the upper surface, and extends farther forward below.

Colour.—Drab-grey above in formalin, with two faint plumbeous cross-bars on the hinder portion of the head, and an oblique bar on either side of the disc anteriorly.

Described from two specimens, 190-208 mm. wide, the smaller of which is figured. Three smaller examples, 113-133 mm. wide, have the same colour-marking and other characters of the larger ones. In the great width of the disc they resemble *U. kaianus*, Günther,¹ but that species is described as uniform brown.

Loc.—Great Australian Bight, 80-120 fathoms.

1. Günther—"Challenger" Rept., Zool., i., 1880, p. 37.

Family CHAULIODIDÆ.

Genus CHAULIODUS, *Bloch & Schneider*.CHAULIODUS DANNEVIGI, *sp. nov.*

(Plate lii.)

D.6 ; A.12 ; P.13 ; V.7 ; C.19 ; 1. lat. 59 ; 1. tr. 5. Head, measured from the premaxillary symphysis to the end of the operculum, 7.6 in the length from the premaxillary symphysis to the hypural joint. Greatest depth of the head almost equal to its length. Depth of the body anterior to the dorsal fin 1.4 in the head. Longitudinal diameter of the eye equal to its distance from the end of the snout, 4.2 in the head. Space between the pectoral and ventral fins 1.5 in that between the ventrals and the anal, and 3.1 in the length from the end of the operculum to the hypural. Longest ventral ray once and a-half as long as the head. Longest pectoral ray 1.3, and base of anal 1.6 in the head.

Body elongate, compressed ; it is deepest directly behind the head but the depth decreases rapidly to a point in front of the dorsal fin, whence it diminishes regularly to the tail. Head short and deep, its length a little less than its distance from the vertical of the last dorsal ray ; it is rounded above, with raised bony ridges, and there is a small median ridge on the occiput. Interorbital space concave, the width of its bony portion equal to the longitudinal diameter of the eye. Snout forming a sharp conical point, its upper profile slightly concave. Eye deeper than long, placed in the upper half of the head. Preopercular border sub-vertical, formed of two bony ridges. Operculum membranaceous, forming an obtusely angular lobe posteriorly. Maxillary narrow, very oblique, and terminating in a sharp point. Barbel minute, projecting forward.

Premaxillaries with four fangs on each side ; the anterior pair is cylindrical and acute, and not so long as the second pair, which is flattened and sabre-like ; third and fourth pairs smaller, and sabre-like ; minute teeth project outward near the bases of the second and third pairs. Anterior edge of the maxillary with a row of small flattened teeth which increase in size backward. Anterior mandibular fangs flattened and curved, with minutely barbed points ; they are longer than any other teeth, and reach backward to above the middle of the eye when the mouth is closed ; there are seven more fangs on each side of the mandible, together with some secondary teeth, all of which are minutely barbed at the tips ; a transparent membrane is present between the teeth

and the tongue which encloses the unformed, secondary teeth. Two widely spaced teeth on the anterior portion of each palatine project obliquely into the mouth, and about three smaller ones are inserted vertically on their hinder portions.

Base of the dorsal raised above the back; the first ray is inserted over the eighth scale of the lateral line and is filamentous; the following rays decrease in length backwards, and all but the last are bifurcate. Base of pectoral nearly horizontal; the anterior rays are longer than the others and reach upward to the back. Ventral inserted below the twenty-third scale, and only a trifle nearer to the snout than to the anal; its rays increase in length backwards, and are mostly bifurcate. Base of anal elevated anteriorly, its length equal to its distance from the hypural; the third ray is apparently the longest, and the last is minute. Adipose dorsal opposite to, but longer than the anal. Adipose anal well developed. Caudal forked, the lower lobe longer than the upper.

The entire body is covered by a gelatinous membrane which is thickest on the ventral surface. Scale-pits arranged in five rows anteriorly, in four posteriorly; they are covered by an iridescent membrane in parts which apparently represents the scales. Where the membrane is removed, each pit shows two or three minute photophores. There are twenty photophores in the upper lateral series between the operculum and the ventral fins, and twenty-five more to the anal. The lower lateral series consists of eight on the side of the isthmus, twenty-two between the humeral symphysis and the ventrals, and twenty-five more to the anal. A long series of minute photophores commences on the side of the isthmus and forms a sinuous line between the upper and lower lateral series to the vent; the median line of the entire lower surface is marked by groups of similar luminous spots. Six larger photophores are present above the base of the anal fin, and there is a small one at the base of each ray. Five more are on the caudal peduncle, and a short series of minute spots is on the base of the lower caudal lobe. Preorbital bone with a large photophore, and another is present below the eye; a series of minute spots encircles the lower margin of the eye. Lower surface of the maxillary with a series of microscopic photophores, and a similar series is present beneath the preopercular margin. There is a group of small luminous spots on the lower portion of the preoperculum, and four larger ones occur on the lowermost part of the operculum. Each side of the tongue bears about fifteen photophores, and minute spots are present on the barbel.

Colour.—The general colour, after the scales have been rubbed off, is dark grey on the sides and black below: where the scales remain, they are highly iridescent, and show golden reflections on the anterior half of the body.

Described and figured from a specimen nearly 200 mm. in length. It differs from five examples of *C. sloani*, Bl. Schn., in the Australian Museum, from Messina, in its proportions and its dentition: the body is more elongate, and the head shorter, the latter being shorter instead of longer than its distance from the last dorsal ray, and 6.8 instead of 6.3 in the length from the operculum to the hypural: the teeth are smaller, especially the second fang of the upper jaw. It is very similar to *C. cmmclas*, Jordan & Starks, but the space between the pectorals and ventrals is 3.1 in the body-length instead of 4.2: the photophores are also more numerous between the isthmus and the ventrals. *C. dentatus*, Garman, differs from my species in having more numerous scales and photophores, and thirteen anal rays. *C. macouni*, Bean, differs in the relative positions of its fins and scales: it is also apparently a shorter form. *C. barbatus*, Garman, and *C. pammclas*, Alcock, are both of shorter form, and have fewer photophores.

The specimen described above was one of the last fishes preserved on board the "Endeavour" before she left on her ill-fated voyage to Macquarie Island. I associate with it the name of my friend, the late Mr. Harald C. Dannevig, who collected it, and whose untimely loss terminated a grand chapter in the fisheries investigation in Australia.

Loc.—Thirty miles south of Cape Everard, Victoria, 180-240 fathoms.

Family SYNGNATHID.E.

Genus HIPPOCAMPUS, *Rafinesque*.

HIPPOCAMPUS ABDOMINALIS, *Lesson*.

Hippocampus abdominalis (Lesson), McCulloch, Zool. Res. "Endeavour," i., pt. 1, 1911, p. 29, pl. vi., fig. 1, and ii., pt. 3, 1914, p. 94.

Hippocampus graciliformis, McCulloch, *Loc. cit.*, i., pt. 1, 1911, p. 29, pl. vi., fig. 2.

In the paper quoted above I have noted that the record of this species from Sydney by Günther has been omitted from all local catalogues. It is therefore of interest to record additional specimens from Port Jackson, one of which was recently collected by my colleague, Mr. E. A. Briggs, at Miller's Point: the other was secured at Quarantine Bay by Mr. L. Parker.

Family TRACHICHTHYID.E.

Genus GEPHYROBERYX, *Boulenger*.GEPHYROBERYX DARWINI, *Johnson*.

Trachichthys darwini, Johnson, Proc. Zool. Soc., 1866, p. 311, pl. xxxii.; *Id.*, Goode & Bean, Oceanic Ichth., 1895, p. 188, pl. lvi., fig. 207; *Id.*, Alcock, Cat. Ind. Deep-sea Fish. Investigator, 1899, p. 35.

A fine example of this species, 320 mm. long, was obtained by the " Endeavour " in the Great Australian Bight, south of Eucla, 350-450 fathoms; 14th May, 1913. Neither the genus nor species has been previously recognised from Australian waters.

Family THERAPONID.E.

Genus THERAPON, *Cuvier*.THERAPON THERAPS, *Cuvier and Valenciennes*.

Therapon theraps (Cuv. & Val.), Ogilby & McCulloch, Mem. Qld. Mus., v., 1916, p. 102.

Thirty-two specimens, 114-166 mm. long, are all similarly marked and exhibit no important variation.

Loc.—Four to twenty miles north-east of Gloucester Head, Queensland, 19-35 fathoms.

THERAPON SERVUS, *Bloch*.

Therapon servus (Bloch), Jordan & Thompson, Proc. U.S. Nat. Mus., xli., 1912, p. 536, fig. 1; *Id.* Ogilby & McCulloch, Mem. Qld. Mus., v., 1916, p. 104.

The " Endeavour " collection includes nine specimens, while three others were recently obtained by Messrs. C. Hedley and E. A. Briggs, near Cape Bedford, Queensland. These last are of particular interest as showing marked variation in their scale-counts, which feature, combined with other characters, has been considered by Jordan & Thompson to be of value in the differentiation of *T. servus* and *T. jarbua*, Forskal. In these three examples the number of scale-series above the lateral line varies from seventy-six to ninety, but as they were collected within a few miles of each other, and do not differ in any other detail, it seems clear that they must be referred to the one species.

The colour-marking of all the specimens is quite similar to that illustrated by Jordan & Thompson, differing from the Arabian *T. jarbua* which they describe, in having the body bands less convex.

Loc.—Seven miles north-east of Bowen, Queensland, 16 fathoms.

Genus PELATES, *Cuvier & Valenciennes*.

Pelates (Cuv. & Val.), Ogilby & McCulloch, Mem. Qld. Mus., v., 1916, p. 125.

The "Endeavour" collection includes four specimens of *P. sexlineatus*, Q. & G., and eight of *P. quadrilineatus*, Bloch. As they were all taken within a limited area of the Queensland coast, it was thought that they might be merely sexual forms of the one species, but each is represented by both males and females with the testes and ovaries in an advanced stage of development. They therefore bear out the conclusion that the two species are distinct.

The differences between them may be tabulated as follows:—

Spinous dorsal with a large black blotch, the longest spine higher than the anterior ray. Usually three dark stripes between the supraorbital margin and the occipital crest. Black shoulder-spot prominent. Maxillary reaching beyond the vertical of the hinder nostril. *quadrilineatus*.

Spinous dorsal without a black blotch, the longest spine and the anterior ray subequal in length. Two dark stripes between the supraorbital margin and the occipital crest. Black shoulder spot indistinct or absent. Maxillary not reaching beyond the vertical of the hinder nostril. *sexlineatus*.

PELATES QUADRILINEATUS, *Bloch*.

Pelates quadrilineatus (Bloch), Ogilby & McCulloch, Mem. Qld. Mus., v., 1916, p. 125.

Locs.—Twenty miles north-east of Bustard Head, Queensland, 20 fathoms.

Seven miles north-east of Bowen, Queensland, 16 fathoms.

PELATES SEXLINEATUS, *Quoy & Gaimard*.

Pelates sexlineatus (Quoy & Gaimard), Ogilby & McCulloch, Mem. Qld. Mus., v., 1916, p. 125.

Locs.—Five miles south-east of Boomerang Hill, Fraser Island, Queensland, 15 fathoms.

Twenty miles north-east of Bustard Head, Queensland, 20 fathoms.

Family NEMIPTERIDÆ.

Genus NEMIPTERUS, *Swainson*.Sub-genus EUTHYOPTEROMA, *Fowler*.NEMIPTERUS (EUTHYOPTEROMA) AURIFILUM, *Ogilby*.*Yellowlip*.

Pentapus aurifilum, Ogilby, New Fish. Qld. Coast, 1910, p. 93, and Mem. Qld. Mus., v., 1916, p. 161, pl. xx.

This species is not a *Pentapus* but a *Nemipterus*, as I have been recently informed by Mr. Ogilby. It evidently enters the subgenus *Euthyopteroma*, and is closely allied to *E. bathybiium*, Snyder¹, from which it may be distinguished by its much larger eye.

Fifty-four specimens, 103-176 mm. long from the snout to the end of the middle caudal rays, exhibit very little variation. The caudal filament is present in all, but is much longer in some than in others. Ogilby has described the fifth dorsal spine as the longest, but the succeeding ones usually increase slightly in length to the last.

Loc.—Thirteen miles south-west of North Reef, Queensland, 70 fathoms.

Family POMADASIDÆ.

Genus PLECTORHYNCHUS, *Lacépède*.PLECTORHYNCHUS (DIAGRAMMA) PICTUS, *Thunberg*.

Plectorhynchus pictus (Thunb.), Jordan & Thompson, Proc. U.S. Nat. Mus., xli., 1912, p. 546—synonymy and references.

Diagramma punctatum, Klunzinger, Sitzb. Akad. Wiss. Wien, lxxx. i., 1879, p. 351.

Diagramma labiosum, Macleay, Proc. Linn. Soc. N.S. Wales, viii., pt. 2, 1883, p. 202.

Spilotichthys labiosus, Ogilby, Proc. Roy. Soc. Qld., xxi., 1908, p. 25.

Eleven specimens, 165-224 mm. long, do not differ from examples of about the same size from India and the Philippine Islands. Some are almost uniformly spotted, while others have three narrow longitudinal bands formed of enlarged coalescent spots; the remainder are intermediate between these two forms.

A larger specimen, 300 mm. long, is evidently the same species, but has lost all traces of colour-marking on the body,

1. Jordan and Thompson—Proc. U.S. Nat. Mus., xli., 1912, p. 566, fig. 6.

the soft dorsal and caudal fins alone being crowded with small dark spots. It is doubtless the form described by Macleay as *D. labiosum*, the type of which appears to have been lost; both specimens were collected in Wide Bay, Queensland.

Locs.—Three to twenty-five miles south-east of Double Island Point, Queensland. 32-33 fathoms.

Wide Bay, Queensland.

PLECTORHYNCHUS RETICULATUS, *Günther*.

(Plate liii.)

Diagramma reticulatum, Günther, Brit. Mus. Cat. Fish., i., 1859, p. 334, and *Id.*, Ann. Mag. Nat. Hist. (3), xx., 1867, p. 58.

D. xiii. 21; A. iii. 7; V. i. 5; P. 17; C. 15. About 55 rows of scales above the lateral line between its origin and the hypural joint, and 10 between the lateral line and the base of the fourth dorsal spine. Depth 2.6, head 3.3 in the length from the snout to the hypural joint. Eye slightly longer than the interorbital width, 3.5 in the head. Snout longer than the eye, 2.8 in the head. Fifth dorsal spine 2.5, second anal spine 2.1 in the head.

Dorsal profile much more strongly arched than the ventral; the line from the snout to the first dorsal spine strongly convex. Interorbital space convex. Preorbital bone narrower than the eye. Maxillary reaching backward to below the nostrils, which are close together before the eye; the anterior with a skinny lobe. Preoperculum evenly denticulate on its posterior border, the angle rounded and almost entire. Operculum with two flat spines. Teeth villiform, in a narrow band in each jaw. Vomer and palatines toothless. Post-temporal bone exposed, serrated.

Scales finely ctenoid, arranged in oblique rows which extend upward and backward. They extend forward to before the anterior nostril on the upper surface of the snout, and onto the cheeks and opercles, leaving only the preorbital and snout bare. They form the usual sheaths at the bases of the dorsal and anal spines, and cover the lower portions of all the rayed fins except the ventrals; the latter are provided with a scaly axillary process. Lateral line following the curve of the back, straight on the middle of the caudal peduncle.

Dorsal spines increasing in height to the fifth, thence decreasing evenly backwards; the last spine is subequal to the anterior ray and is not separated from it by a notch: the margin of the soft dorsal is a little rounded, the median rays being longest; the posterior ones form an obtuse angle. Anal

inserted wholly beneath the soft dorsal, the second spine longer than the third, but shorter than the longest ray; soft anal angular. Caudal sub-truncate, the upper rays a little longer than the others. Pectoral inserted below the anterior dorsal spines, its fifth upper ray longest. Ventrals placed well behind the pectorals, the longest rays almost reaching the vent.

Colour.—Light brown, with a darker reticulating pattern on the upper half of the body. This is composed of about seven undulating, longitudinal stripes which are connected with each other by short cross-bars, enclosing rounded lighter spots. On the head the bars are broader and darker, and they cover the cheeks, opercles and snout. Basal portion of the spinous dorsal mottled with yellow, the membrane of the soft dorsal, anal, and caudal blackish. Pectorals and ventrals lighter, the outer rays of the latter darkened. When fresh, the general colour appeared olive green, the darker reticulations enclosing yellowish spots.

Described and figured from a specimen 183 mm. long, which is apparently identical with Günther's *Diagramma reticulatum*. A second specimen, 345 mm. long, has the same general type of marking, but the light spots enclosed by the darker reticulation are much smaller and more numerous, as is usual in larger specimens of *Plectorhynchus*.

Loc.—This species was originally described from Chinese specimens, but Günther later recognised it from Cape York. The example here described was taken in New South Wales waters, but the exact locality has not been recorded. My second larger specimen was obtained at Little Island, fifteen miles north of Fremantle, Western Australia.

Family SPARIDÆ.

Genus GYMNOCRANIUS, *Klunzinger*.

GYMNOCRANIUS AUDLEYI, *Ogilby*.

Collared Sea-Bream.

Gymnocranius bitorquatus (*Ogilby*), *Cockerell*, Mem. Qld. Mus., v., 1916, p. 56, description of scales only.

Gymnocranius audleyi, *Ogilby*, Mem. Qld. Mus., v., 1916, p. 170., pl. xxii.

Eleven specimens, 180-325 mm. long, exhibit some little variation in the form of the head and the colour-marking. The occipital prominence characteristic of adults, and well shown in *Ogilby's* figure, is not always developed in the

smaller specimens, which also have the preorbital narrower in relation to the eye. The young have a dark bar on the cheek similar to that shown in Bleeker's figure of *G. microdon*,¹ and the occiput and snout are also dark; some dark oblique bars and spots are present on the body scales. These markings are largely lost in the adult.

Loc.—Twenty miles off Bustard Head, Queensland, 20 fathoms.

Family OPLEGNATHIDÆ.

Genus OPLEGNATHUS, *Richardson*.

OPLEGNATHUS WOODWARDI, *Waite*.

(Plate liv.)

Hoplegnathus woodwardi. Waite, Rec. Austr. Mus., iii., pt. 7, 1900, p. 212, pl. xxxvii.

? *Hoplegnathus australis*, Regan, Ann. Durban Mus., i., pt. 3, 1916, p. 169.

Variation.—A fine series of eleven specimens, 90-455 mm. long, shows that this species varies considerably with growth in both proportions and colour-marking. The smallest example, which is figured, is much deeper than the large one figured by Waite, and has longer fin-rays and spines. The following are the proportions of the smallest and largest specimens respectively. Depth 1.8-2.4 in the length to the hypural joint; head 2.7-3.1 in the same. Eye 3.0-4.1 in the head. Seventh dorsal spine 1.4-1.9, and second dorsal ray 1.4-2.3 in the head. The ventral fins reach to the base of the second anal ray in the young, but fall far short of the vent in adults. The smaller specimens have the preopercular angle finely serrated, but it is usually entire in the larger ones, while the upper portion of the operculum is denticulated in adults and somewhat variable in form.

The disposition of the colour-marking is similar in the young and the adult, but the bands are much broader and more extensive in the smaller specimens, and are deep black instead of brown. One example 367 mm. long differs from the others in having the ground-colour very dark, and broken up by numerous irregular light bars and spots.

Synonymy.—*H. australis*, Regan, is based upon a large Tasmanian specimen, sixteen inches long, which differs from mine of similar size in having the body half as deep as long,

1. Bleeker—Atlas Ichth., vii., 1872, pl. cccvii.

and the ventral fins covering the vent.¹ As these are characters of my smaller specimens, and as Regan's example appears to agree with *O. woodwardi* in all other details, it is perhaps an aberrant specimen of that species.

Locs.—Great Australian Bight, 80-120 fathoms.
South of Kangaroo Island, South Australia.

Family MONODACTYLIDÆ.

Genus MONODACTYLUS, *Lacépède*.

MONODACTYLUS ARGENTEUS, *Linnaeus*.

Monodactylus argenteus (Linnaeus), Jordan & Seale, Bull.

U.S. Fish. Bur., xxv., 1906, p. 237, fig. 30.

A single specimen is preserved from seven miles N.N.E. of Bowen, Queensland, 16 fathoms; 3rd August, 1916.

Family SCORPIDIDÆ.

Genus ATYPICHTHYS, *Günther*.

ATYPICHTHYS STRIGATUS, *Günther*.

Atypus strigatus, Günther. Brit. Mus. Cat. Fish., ii., 1860, p. 64.

Locs.—Fifteen specimens are preserved from the following localities:—

Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms; 24th April, 1910.

Five to seven miles south-east of Cape Moreton Light, Queensland, 49-51 fathoms; 5th September, 1910.

Genus NEATYPUS, *Waite*.

NEATYPUS OBLIQUUS, *Waite*.

Neatypus obliquus, Waite, Rec. Austr. Mus., vi., pt. 2, 1905, p. 65, pl. x.

Loc.—Two specimens are in the collection from Western Australia, between Cape Naturaliste and Geraldton.

Family PLATACIDÆ.

Genus PLATAX, *Cuvier*.

PLATAX NOVEMACULEATUS, *sp. nov.*

(Plate Iv., fig. 1.)

D. ix. 29; A. iii. 22; P. 20; V. i. 5; C. 17. Depth between the first dorsal and ventral spines 1.4 in the length to

1. As I have been informed by Mr. Regan by letter.

the hypural joint; head 3.1 in the same. Eye 2.8, ninth dorsal spine 1.7 in the head. Fourth dorsal ray and third anal ray subequal, 0.08 longer than the head.

Body much compressed, rhomboidal. Profile from the snout to the first dorsal spine convex, tumid before the eye. Maxillary reaching backward to below the anterior orbital margin, but little expanded posteriorly, its greatest breadth being less than the internasal width. Preoperculum with a few rudimentary serrations on its rounded angle. Operculum with a flat spine, and a rounded bone on its upper portion. Gill-openings lateral, with a wide interval between them. Anterior nostril circular, the posterior slit-like and placed in front of the eye. Chin with a series of minute pores. Teeth compressed, trilobate, arranged in about four distinct series in each jaw; the innermost series is smaller than the others, and its teeth appear unicuspid. A small patch of teeth on the vomer; palatines and tongue toothless.

Body covered with small ctenoid scales, which extend over the bases of the fins, and cover the membrane between the dorsal, anal and caudal rays. There are about fifty-two rows in a straight line between the operculum and the hypural joint; thirteen or fourteen between the base of the seventh dorsal spine and the lateral line, and thirty-four to thirty-six more to the first anal spine. They extend forward to between the posterior nostrils on the forehead, and cover the cheeks, opercles and breast.

First dorsal spine short, situated a little behind the vertical of the operculum; the others rapidly increase in height to the fourth or fifth, and then more gradually to the eighth: the ninth is distinctly longer than the preceding one, but is little more than half as high as the longest rays. Soft dorsal rounded, with the fourth to seventh rays longest. Anal spines graduated, the first inserted below the anterior dorsal rays. Soft anal similar in form to the dorsal, its anterior portion somewhat more angular. First ventral ray produced, reaching to or a little beyond the anal. Caudal subtruncate, with the outer and median rays very slightly produced.

Colour.—Silvery, with narrow horizontal lines between each row of scales. A brown ocular band extends from the nape through the eye to the ventrals, and another less distinct one from the nuchal region across the operculum to the vent; both these may be obscure. Spinous portion of the dorsal and anal fins with darker margins, which are continued around the soft portions as well defined marginal bands. Ventral rays dusky.

Described and figured from a specimen 138 mm. long. Twenty-two others, 108-134 mm. long, do not exhibit any variation. They differ from all other species of *Platax* in having nine dorsal spines.

Locs.—Four to twenty miles N.E. of Gloucester Head, Queensland, 19-35 fathoms : 2nd August, 1910.

Seven miles N.N.E. of Bowen, Queensland, 16 fathoms ; 3rd August, 1910.

Family DREPANIDÆ.

Genus DREPANE, *Cuvier & Valenciennes*.

DREPANE PUNCTATA, *Gmelin*.

Drepane punctata (Gmelin), Day, Fish. India, 1875, p. 116, pl. xxix., fig. 5.

Loc.—Fifteen specimens, 100-139 mm. long, are preserved from seven miles N.N.E. of Bowen, Queensland, 16 fathoms ; 3rd August, 1910.

Family CHÆTODONTIDÆ.

Genus PARACHÆTODON, *Bleeker*.

PARACHÆTODON OCELLATUS, *Cuvier & Valenciennes*.

Platax ocellatus, Cuvier & Valenciennes, Hist. Nat. Poiss., vii., 1831, p. 229.

Parachætodon ocellatus, Bleeker, Atlas Ichth., ix., 1878, p. 24, pl. cccxxxvii., fig. 4 (synonymy) ; *Id.*, Ogilby, Proc. Roy. Soc. Qld., xxi., 1908, p. 25.

Chætodon oligacanthus, Bleeker, Verh. Bat. Gen., xxiii., 1850, Chætod., p. 16. ; *Id.*, Macleay, Proc. Linn. Soc. N.S. Wales, ii., 1878, p. 351, and v., 1881, p. 388 ; *Id.*, Klunzinger, Sitzb. Akad. Wiss. Wien, lxxx. i., 1879, p. 360.

Chætodon townlei, de Vis, Proc. Linn. Soc. N.S. Wales, ix., 1884, p. 454.

Colour.—Silvery, with five cross-bars. The first yellow, black-edged, and forked on the occiput, whence it sends back a spur along the median ridge of the nape ; it curves downward through the eye, across the cheek and interopercle, and backward to meet its fellow or be lost on the side of the throat. The second is olive-brown, mesially golden, and black-edged ; it extends from the first dorsal spine over and behind the opercular edge through the base of the pectoral, and bends strongly backward to behind the ventral. The third and

fourth are olive-brown, with a slight backward obliquity; the third is between the last three dorsal and the two anterior anal spines, and the fourth between the sixth and fourteenth dorsal and the sixth and ninth anal rays. The fifth is between the median dorsal and anal rays, and curves backward to cross the caudal peduncle. A large black oval ocellus on the dorsal fin is included in the golden prolongation of the fourth band. Dorsal fin yellow, except for two silvery shafts corresponding to the interspaces between the body-bands; tips of posterior dorsal and anal rays black, the rays between the black margin and the last cross-band pale blue, and the membrane golden. Caudal and pectoral fins colourless. Ventrals white, with the two inner rays blackish.

I am indebted to Mr. J. Douglas Ogilby for the above colour description, which is based on the "Endeavour" specimens. They only differ from Bleeker's figure in having the markings much more pronounced, and the snout rather less produced.

Synonymy.—Mr. Ogilby has also examined the type of *Chaetodon townleyi*, de Vis, and finds it identical with *P. ocellatus*.

Locs.—Specimens of this species are in the Australian Museum collection from the following localities: Batavia (co-type of *C. oligacanthus*, Bleeker); Manila, Philippine Islands; Port Curtis, and Moreton Bay, Queensland; near Sydney. Fourteen specimens, 85-134 mm. long, are preserved in the "Endeavour" collection from the following localities:

Twenty miles off Bustard Head Light, Queensland, 20 fathoms; 8th July, 1910.

Seven miles N.N.E. of Bowen, Queensland, 16 fathoms; 3rd August, 1910.

Genus CORADION, *Kaup*.

CORADION ALTIVELIS, *sp. nov.*

(Plate lvi., fig. 1.)

D. viii. 33-34; A. iii. 22-23; P. 17; V. i. 5; C. 17. L. lat. 47. Depth between the first dorsal and ventral spines 1.4 in the length to the hypural joint; head 2.9-3 in the same. Eye a little shorter than the snout, 3.1-3.2 in the head; snout 2.7 in the same. Last dorsal spine 0.1, and third dorsal ray 0.1-0.2 longer than the head.

Body deep, elevated, and strongly compressed. The profile from the snout to the first dorsal spine forms an almost straight, oblique line. Snout but little produced. maxillary not reaching the vertical of the anterior nostril. Preorbital bone serrated, about two-thirds as wide as the eye. Orbital

margin close to the profile, its upper part beset with spinules which are most numerous in the larger specimen; inter-orbital space almost flat. Preoperculum finely serrate on both the hinder and lower margins. Opercular membranes united across the throat, those of the branchiostegals broadly attached to the isthmus.

Scales largest on the middle of the sides, and arranged in oblique rows above the lateral line, which become more horizontal below. They commence before the nostrils and extend over the preorbital, opercles and throat, leaving only the end of the snout bare. Lateral line forming a high arch, and extending to the hypural joint; it is formed of about forty-seven tubules. There are about forty rows of scales between the scapula and the hypural joint; six between the base of the last dorsal spine and the lateral line, and twenty-two more to the first anal spine.

Dorsal spines strong, increasing in length backwards; the last is slightly longer than the head, and but little shorter than the longest rays. The soft dorsal is evenly rounded, with the hinder margin subvertical when the rays are laid back. Anal similar to the dorsal. Caudal subtruncate. Ventrals reaching the second or third anal spine.

Colour.—Ground colour whitish in formaline, probably yellow in life. A broad ocular band extends from the nuchal region through the eye, to the isthmus. A second band commences below the anterior dorsal spines and crosses the end of the operculum and base of the pectoral fin, to the ventrals; it is united below with another band extending from the bases of the posterior dorsal spines to the belly. A less definite and broader grey band crosses the body between the middle of the soft dorsal and anal, and extends onto the bases of those fins. A broad blackish band encircles the base of the tail, and has its posterior margin angular with the apex directed backward. The membrane between the second and third dorsal spines is black. Soft dorsal and anal fins with two intramarginal, narrow, dark lines, separated by a white interspace, and with broad, lighter borders. The anterior portion of the soft dorsal within the dark lines is dusky, and the smaller specimen has a large ocellus between the eleventh and seventeenth rays. Ventrals black.

Described from two specimens 107-135 mm. long, the larger of which is figured, and is selected as the type. They are closely allied to *C. chrysozonus*, Cuvier & Valenciennes, but differ in having a shorter spinous dorsal, with only eight spines, and longer and more numerous rays.

Loc.—Wide Bay, Queensland.

Genus MICROCANTHUS, *Swainson*.MICROCANTHUS STRIGATUS, *Cuvier & Valenciennes*.

Chatodon strigatus, Cuvier & Valenciennes, Hist. Nat. Poiss., vii., 1831, p. 25, pl. clxx.; *Id.*, Schlegel, Faun. Japon., Pisces, 1844, p. 80, pl. xli., fig. 1.

Eight specimens are in the collection which do not differ from Schlegel's figure of a Japanese example.

Loc.—Wide Bay, Queensland.

Genus HENIOCHUS, *Cuvier & Valenciennes*.HENIOCHUS MACROLEPIDOTUS, *Linnaeus*.

Heniochus acuminatus (Linnaeus), Jordan & Evermann, Bull. U.S. Fish. Comm., xxiii., pt. 1., 1905, p. 376, pl. lv.

Loc.—A young example, 75 mm. long, is preserved from three to five miles N.E. of Cape Byron Light, New South Wales, 17 fathoms.

Genus VINCULUM, *McCulloch*.VINCULUM OCELLIPINNIS, *Macleay*.

Chatodon ocellipinnis, Macleay, Proc. Linn. Soc. N.S. Wales, iii., 1878, p. 33, pl. iii., fig. 1.

The type of this species is preserved in the Macleay Museum, but is in very bad condition and its colour-marking has almost entirely faded. It is a species of *Vinculum*, and is probably the young of *V. sexfasciatum*, Richardson, though it differs from any examples of that species I have examined in having twenty-three dorsal rays.

Genus CHELMON, *Cuvier*.CHELMON MULLERI, *Klunzinger*.

(Plate lv., fig. 2.)

Chelmo mulleri, Klunzinger, Sitzb. Akad. Wiss. Wien, lxxx. i., 1879, p. 361.

D. ix. 27-28; A. iii. 19-20; V. i. 5; P. 15; C. 17; 1. lat. 46. Depth at the base of the first dorsal spine 1.6-1.7, and length of head 2.5-2.6 in the length to the hypural joint. Eye 1.7 in the snout, and 4-4.1 in the head. Snout 2.3, and last dorsal spine about 1.5 in the head.

Snout shorter than is usual in the genus. The upper profile is more or less gibbous on the occiput. Dorsal spines very high, increasing in height from the first to the last; soft dorsal and anal broadly rounded, caudal sub-truncate.

Colour.—Body yellowish, with broad longitudinal lines between each row of scales, and five dark cross-bands. The first, which may be indefinite, passes from the occiput through the eye to the isthmus, and is defined by darker margins. The second extends from the anterior dorsal spines, across the operculum to the ventrals, and has less distinct darker margins. The third crosses the body from the base of the three last dorsal spines to the belly anterior to the anal fin, and together with those following it, is uniform brown. The fourth extends from the middle of the soft dorsal to the anal, and the fifth across the caudal peduncle. A large black rounded ocellus is present on the soft dorsal fin above the fourth body-band, and a dark spot is situated on the upper surface of the caudal peduncle above the fifth. Ventrals black: anal very dark, with a light margin: soft dorsal with two submarginal darker lines.

Described from four specimens 113-133 mm. long, the largest of which is figured, which exhibit but little variation. They are apparently identical with *C. mulleri*, though the numbers of dorsal and anal rays, and of scales on the lateral line are less than those given in Klunzinger's brief description.

Loc.—Seven miles N.N.E. of Bowen, Queensland, 16 fathoms; 3rd August, 1910.

Genus CHELMONOPS, *Bleeker*.

CHELMONOPS TRUNCATUS, *Bleeker*.

Chaetodon truncatus, Kner, Sitzb. Akad. Wiss. Wien, xxxiv., 1859, p. 442, pl. ii.

Chelmo trochilus, Günther, Ann. Mag. Nat. Hist., (4), xiv., 1874, p. 368.

Chelmonops truncatus, Waite, Rec. Austr. Mus., v., 1903, p. 33-35; *Id.*, Ogilby, Mem. Qld. Mus., v., 1916, p. 183.

Variation.—Four specimens, 133-204 mm. long, exhibit some variation in their colour-marking and in the form of their fins. In the smaller examples there is a large and distinct ocellus on the anterior dorsal rays, and included in the fourth body-band, which becomes lost with age. The larger examples have the anterior dorsal and anal rays produced so as to form a more or less acute angular lobe on each fin, as in Kner's figure; in young specimens the rays scarcely break the even contour of the fin-margins, which have the angles more or less rounded.

Locs.—Twenty miles N.N.E. of Double Island Point, Queensland, 29-30 fathoms: 28th August, 1910.

Investigator Strait, South Australia.

Western Australia, between Cape Naturaliste and Geraldton.

Genus *HOLACANTHUS*, *Lacépède*.Subgenus *CHÆTODONTOPLUS*, *Bleeker*.*HOLACANTHUS* (*CHÆTODONTOPLUS*) *PERSONIFER*,
McCulloch.

(Plate lvi., fig. 2.)

Holacanthus (*Chætodontoplus*) *personifer*, McCulloch, Rec.
W. Austr. Mus., i., pt. 3, 1914, p. 221, pl. xxxi.*Chætodontoplus conspicillatus*, Ogilby, Mem. Qld. Mus., iii.,
1915, p. 114 (not *Holacanthus conspicillatus*, Waite).

Variation.—Five specimens, 110-193 mm. long, resemble those of similar size described by Ogilby, and differ from the typical example in the following details. Younger specimens are deeper than adults, the depth before the ventrals in the smallest being 1.8 instead of 2.3 in the length to the hypural joint. Smaller examples (Plate lvi.) have the head, nape and isthmus nearly uniform brown, this colour being only broken up by white spots in larger examples. All have the caudal fin yellow with a narrow grey margin; in the type this fin is largely black with an imperfect lunate submarginal yellow band.

Synonymy.—Ogilby has regarded *H. personifer* as a colour variety of *H. conspicillatus*, Waite, but there is apparently no justification for this supposition. Ten specimens are known, ranging from 110-290 mm. in length, which exhibit the regular alteration in both form and colour-marking described above. In none, however, do the variations encroach on the characteristic markings of *H. conspicillatus*, which are well shown in Waite's figure of that species, and which do not differ in the two typical specimens.

Loc.—Wide Bay, Queensland.

Family SCORPENIDÆ.

Genus *LIOCRANIUM*, *Ogilby*.*Liocranium*, Ogilby, Proc. Roy. Soc. Qld., xviii., 1903, p.
23 (*L. præpositum*, Ogil.).

This genus is near *Snyderina*, Jordan & Starks,¹ but differs in having four instead of five ventral rays.

1. Jordan & Starks—Proc. Cal. Acad. Sci., ii., 1901, p. 381.

LIOCRANIUM PRÆPOSITUM, *Ogilby*.

(Plate lvii., fig. 2).

Liocranium præpositum, *Ogilby*, Proc. Roy. Soc. Qld., xviii., 1902, p. 25.

A single specimen, 130 mm. long, is preserved which is figured. It differs in a few details from the original description, but I have compared it with a second example received from Mr. *Ogilby* with which it is in every way identical.

Loc.—Great Sandy Strait, Queensland, 9-11 fathoms.

Two specimens are in the Australian Museum, one from Port Curtis, and the other from Moreton Bay.

Family SYNANCHIDÆ.

Genus PELOR, *Cuvier & Valenciennes*.Subgenus INIMICUS, *Jordan & Starks*.PELOR (INIMICUS) BARBATUM, *de Vis*.

(Plate lviii.)

Pelor barbatus, *de Vis*, Proc. Linn. Soc. N.S. Wales, ix., 1884, p. 547.

Proportions of two specimens 152 and 167 mm. long. Head, from the premaxillary symphysis to the end of the opercular lobe, 2.7-2.8 in the length to the hypural joint. Height of body 1.1-1.2 in the head. Greatest length of orbit 5.2-5.6 in the head, 1.2-1.4 in the interorbital width, and 2.4-2.8 in the snout. Narrowest interorbital width, between the orbital crests, 3.7-4.4 in the head, and 1.7-2.2 in the snout. Snout, from the orbital rim to the premaxillary symphysis, much longer than the post-orbital portion of the head, and 1.8-2.1 in the head. Second dorsal spine 1.6-1.7, ninth dorsal spine 1.3 in the head. Second dorsal ray slightly longer than the second spine, 1.5-1.6 in the head. Lower free pectoral ray slightly longer than the one above it, 1.4 in the head.

D. iii, xiii-xiv/8-9 : A. ii/11-12 : P. 10+2 ; V. i/5 ; C. 12-14.

Five specimens, 150-212 mm. long, exhibit some little variation in the width of the interorbital space, it being narrower in the smaller examples : the transverse interorbital crest also varies somewhat, and is rather straighter than that of *P. didactylum*, *Pallas*. In large specimens the cirrhone appendages on the head and back, and on the dorsal and

pectoral fins are much more numerous than in the smaller ones. The disposition of the colour-marking is similar in all, and is accurately shown in the accompanying plate, but it is much better defined in some than in others.

These specimens are very similar in all structural details and proportions to two examples of *P. didactylum* with which I have compared them, but they differ consistently in the colour-marking of the inner side of the pectoral fin, which Bleeker has shown to be of value in the discrimination of the species of *Pelor*.¹ In both my examples of *P. didactylum* the fin is marked in the manner shown in Bleeker's figure of that species,² but in the "Endeavour" specimens it is as I have figured it on Pl. lviii.

Locs.—Seven to ten miles north-west of Hummocky Island, Queensland, 14-16 fathoms.

Twenty-five miles south-east of Double Island Point, Queensland, 33 fathoms.

Seventeen to twenty miles south-west of Lady Elliot Island, Queensland, 18 fathoms.

Thirteen miles south-east of Cape Capricorn, Queensland, 13 fathoms.

Eight miles south-west of Cowan Cowan Light, Moreton Bay, Queensland, 9-15 fathoms.

Family PLATYCEPHALIDÆ.

Genus PLATYCEPHALUS, *Bloch & Schneider*.

PLATYCEPHALUS MARMORATUS, *Stead*.

Marbled Flathead.

(Plate lvii., fig. 1; fig. 1.)

Platycephalus marmoratus, *Stead*, *New Fish. N.S. Wales*, 1908, p. 9, pl. iii.-v.

D. viii. 13; A. 13; P. 19-20; V. i. 5; C. 13; 1. lat. 65 (110). Head, from premaxillary symphysis to end of opercular lobe, 3.2-3.3 in the length to the hypural joint. Eye 5.7 to 5.8 in the head, and 1.8 in the snout, measured from the anterior orbital margin to the premaxillary symphysis, and a little greater than the interorbital width. Interorbital width 1.8-2.1 in the snout, which is 3-3.2 in the head. Third dorsal spine 2.2-2.4, breadth before the pectorals 1.3, and depth 2.9-3.5 in the head.

1. Bleeker—*Nat. Verh. Holl. Maatsch. Wetensch.*, 3. verz. ii., No. 3, 1874, p. 1.

2. Bleeker—*Loc. cit.*, pl. iv., fig. 1-1a, and *Atlas Ichth.*, ix., 1878, pl. cccxiv., fig. 5.

Ridges of the head fairly well defined, but low and smooth, not terminating in spines. A small anterior orbital spine. Interorbital space flat, the orbital margins upraised. Preoperculum with two stout spines, the upper oblique, the lower slightly the longer. Opercular ridges ending in minute spines, sometimes obsolete. Anterior nostril tentacular. Maxillary reaching back to below the anterior third of the eye. Teeth villiform in the upper jaw, arranged in a band, enlarged near the symphysis, a few being canine-like. They are small, and in several rows on the anterior portion of the mandible, becoming larger and uniserial posteriorly. A group of canines on either side of the vomer, joined by an arched row of smaller teeth. A single row of large teeth on each palatine, with a secondary series of minute ones outside them.



Fig. 1. *Platycephalus marmoratus*, Stead.

Body covered with small, ctenoid scales, which are also present on the operculum and post-orbital portion of the preoperculum. Lateral line scales not differentiated from the others, unarmed: about sixty-five bear tubules, and there are about one hundred and ten rows of scales above the lateral line.

Origin of the first dorsal well behind the ends of the opercles; anterior spine small but distinct, the third the highest; second ray highest, as long as or a little shorter than the third spine, the others decreasing backwards. Origin of anal a little before that of the second dorsal: its rays are lower, and they increase slightly in length backwards. Pectorals reaching to below the middle of the first dorsal: the seventh upper ray longest, the others decreasing regularly. Ventrals reaching the origin of the anal. Caudal sub-truncate, or slightly rounded.

Colour.—In formalin, brown above, the head with more or less distinct light, dark-edged areas which are symmetrically disposed. Back with five broad darker cross-bands, the first

at the origin of the dorsal, and the last at its termination. Dorsal fins translucent, the spines and rays with indications of darker annuli. Pectorals greyish with lighter margins. Ventrals dark brown, with striking white borders. Caudal dark brown, lighter at the base, with a white margin which is broadest below.

Described from two specimens, 265 and 385 mm. long : the figures are prepared from the smaller example.

Loc.—Eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.

Family TETRAODONTIDÆ.

Genus TETRAODON, *Linnaeus*, 1758.

TETRAODON ARMILLA, *Waite & McCulloch*.

Tetraodon armilla, *Waite & McCulloch*, *Trans. Roy. Soc. S. Austr.*, xxxix., 1915, p. 475, pl. xv.

Some fine examples of this species were recently secured by the State trawler "Gunnundaal" in 65 fathoms off Eden, New South Wales. One was presented to the Australian Museum by Mr. D. G. Stead, General Manager of the trawling industry. The species has not been previously recognised from this state.

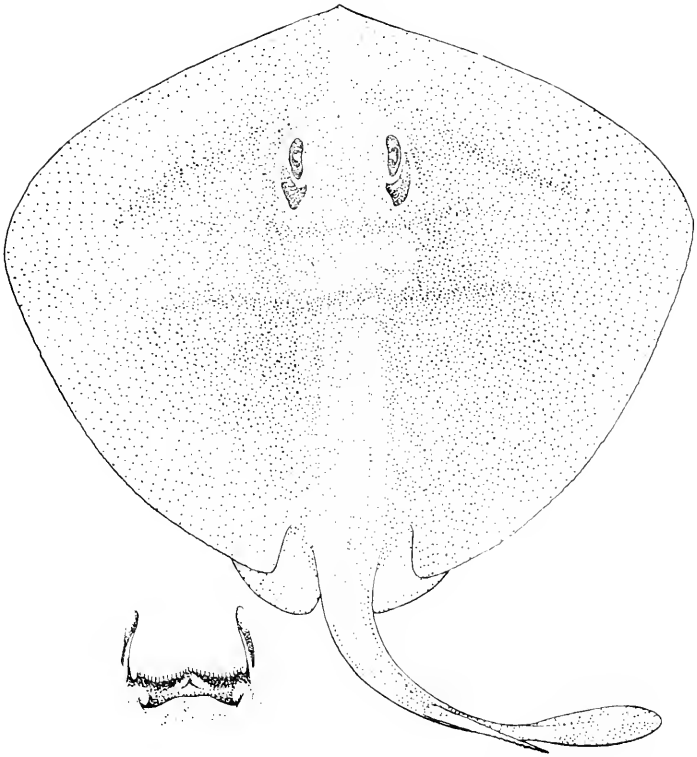
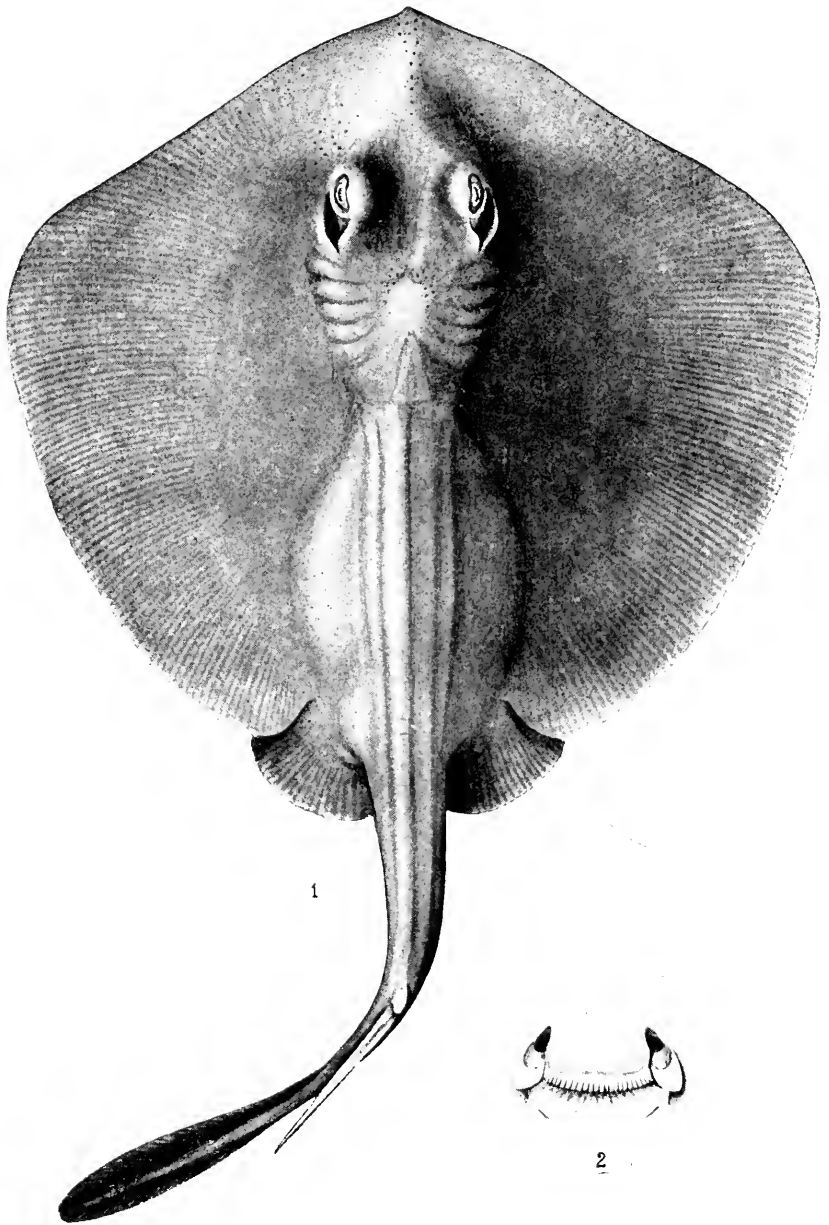


Fig. 2. *Urolophus expansus*, sp. nov.—See page 178.

EXPLANATION OF PLATE L.

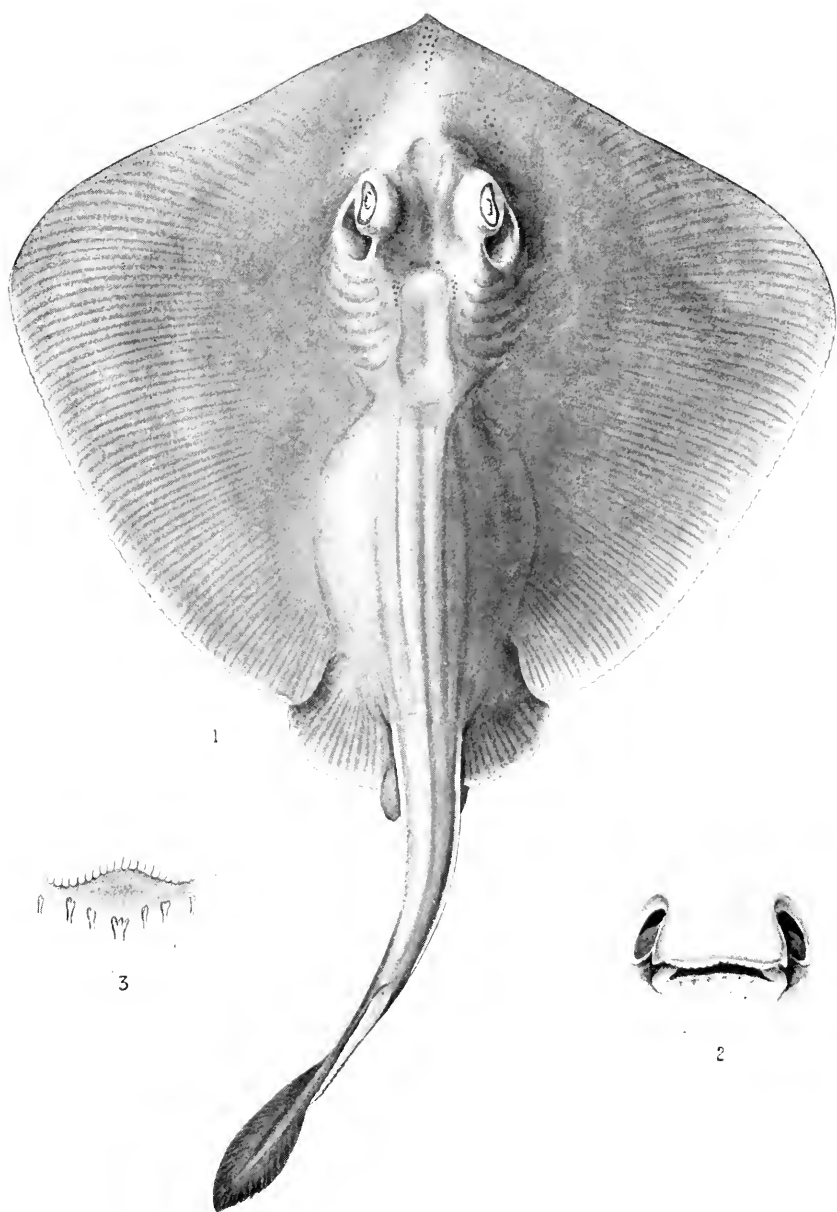
Fig. 1.—*Urolophus testaceus*, Müller & Henle. A female, 244 mm. wide, from Botany Bay.

Fig. 2.—Mouth parts of the same specimen.



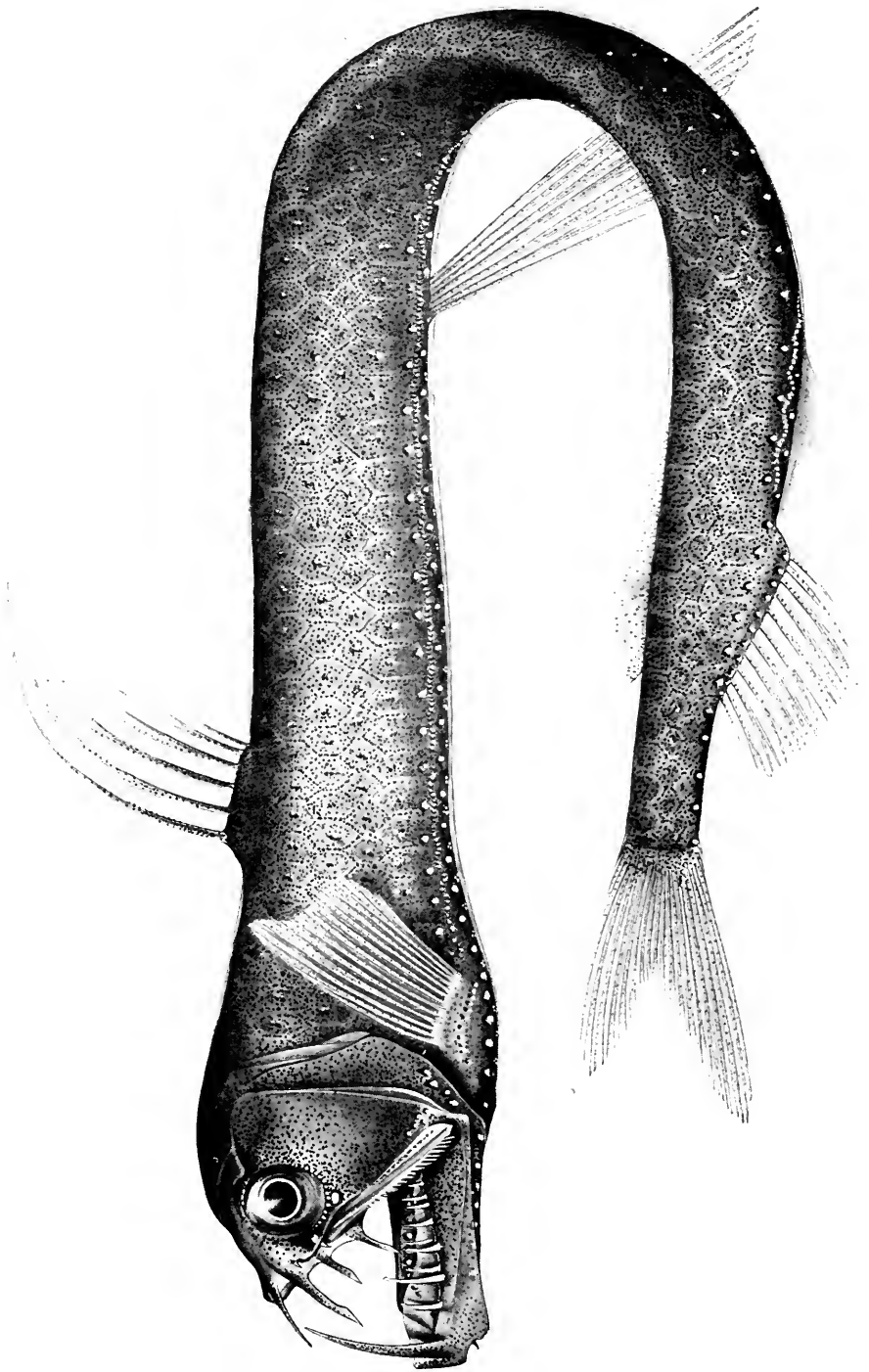
EXPLANATION OF PLATE LI.

- Fig. 1.—*Urolophus viridis*, sp. nov. Type, 255 mm. wide, from north-east of Green Cape, New South Wales, 49 fathoms.
- Fig. 2.—Mouth parts of the same specimen.
- Fig. 3.—Papilliform processes in the mouth.



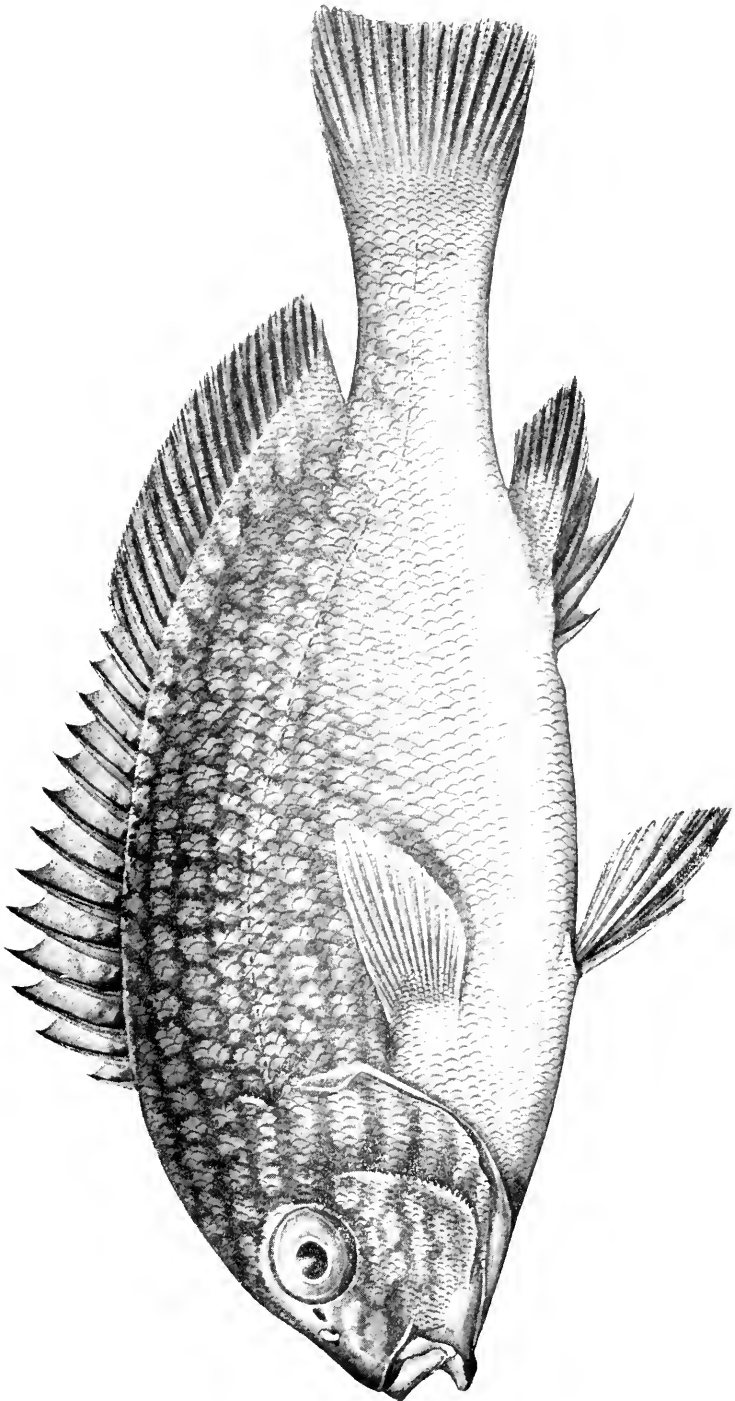
EXPLANATION OF PLATE LII.

Chauliodus dannevigii, sp. nov. Type, nearly 200 mm. long,
from thirty miles south of Cape Everard, Victoria,
180-240 fathoms.



EXPLANATION OF PLATE LIII.

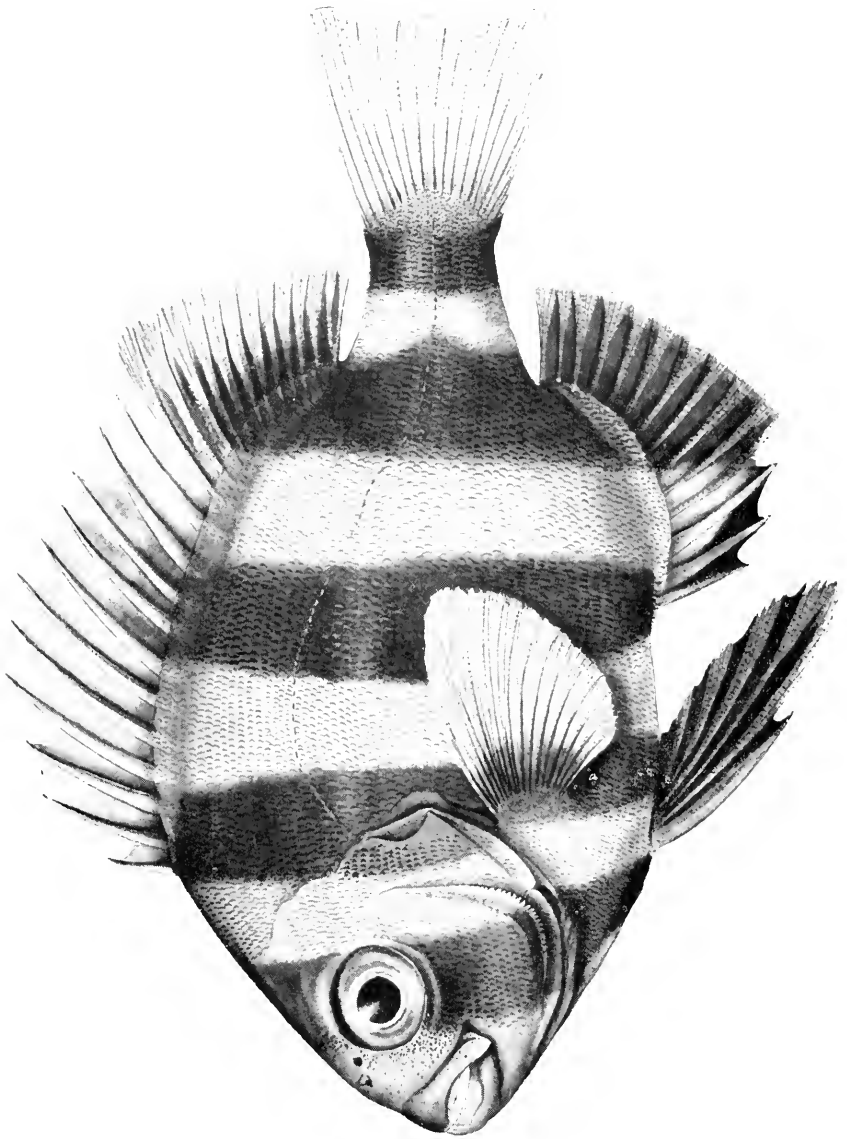
Plectorhynchus reticulatus, Günther. A specimen 183 mm.
long from New South Wales.



A. R. McCulloch, Austr. Mus., del.

EXPLANATION OF PLATE LIV.

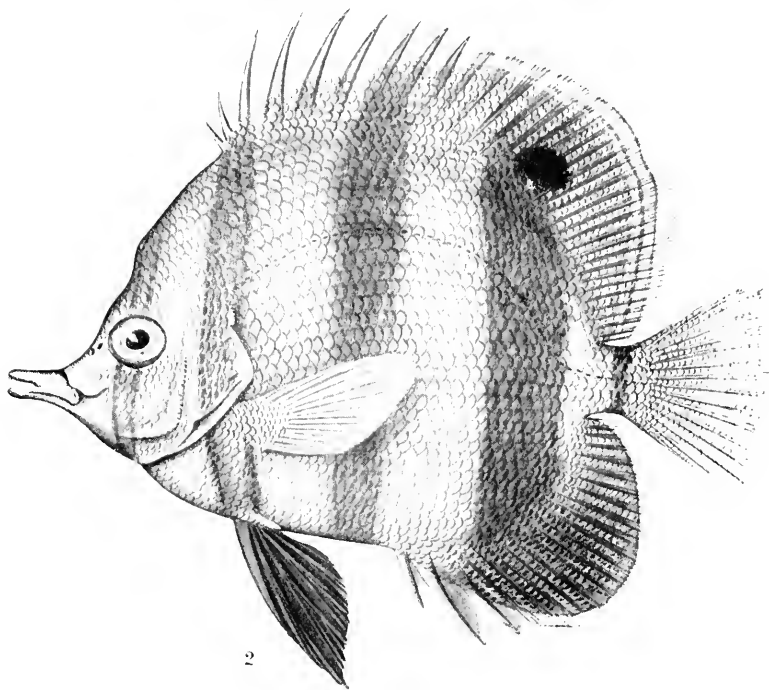
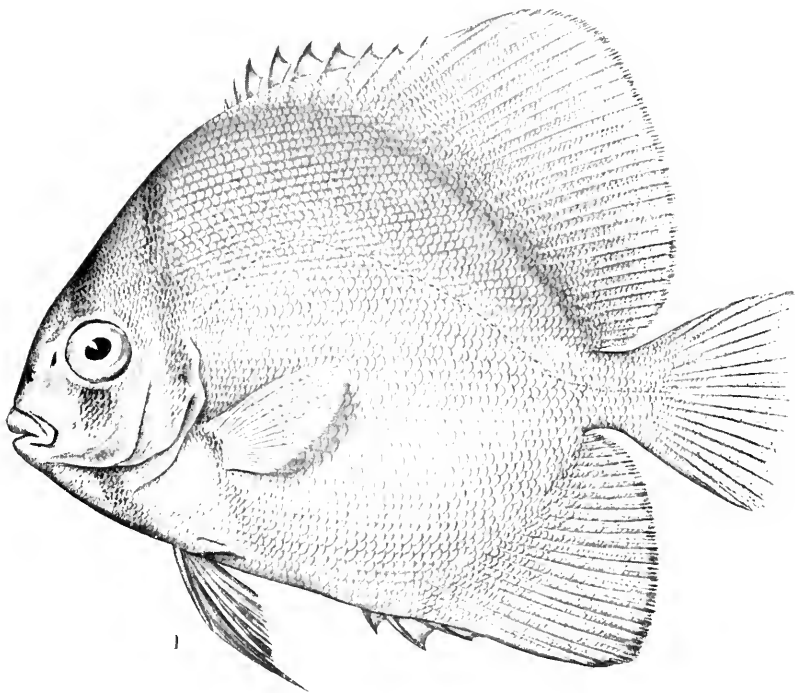
Oplegnathus woodwardi, Waite. A young example, 90 mm. long, from south of Kangaroo Island, South Australia.





EXPLANATION OF PLATE LV.

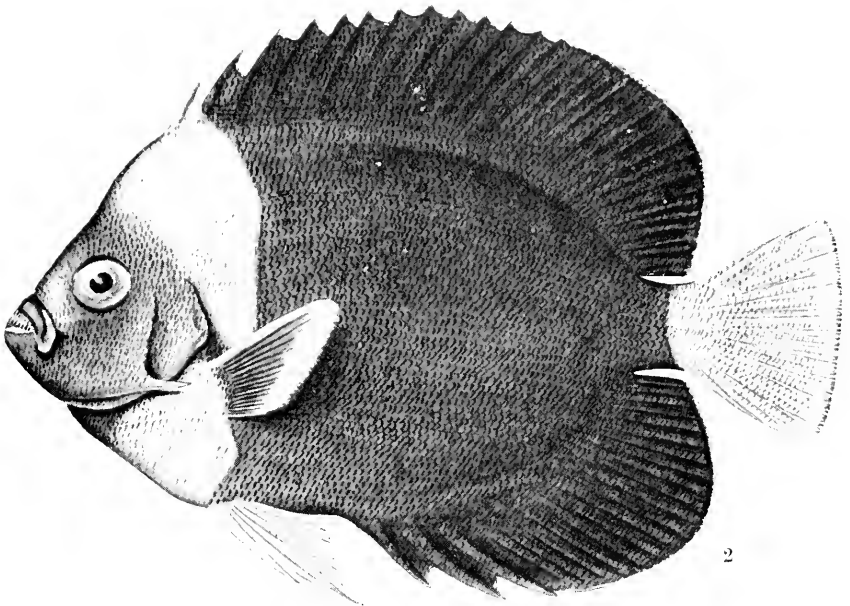
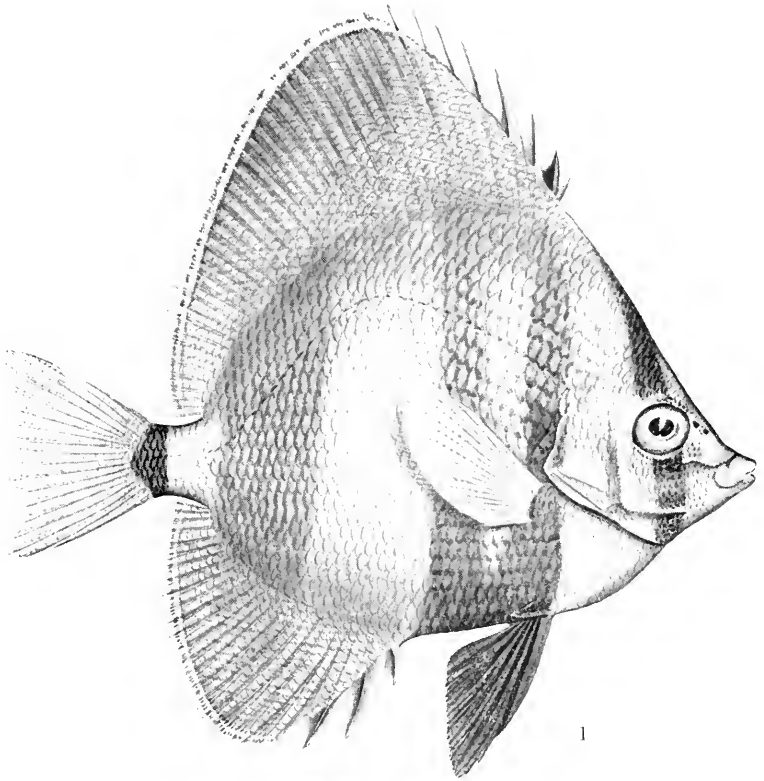
- Fig. 1.—*Platax novemaculeatus*, sp. nov. Type, 138 mm. long, from north-east of Gloucester Head, Queensland.
- Fig. 2.—*Chelmon mulleri*, Klunzinger. A specimen 133 mm. long from near Bowen, Queensland.



EXPLANATION OF PLATE LVI.

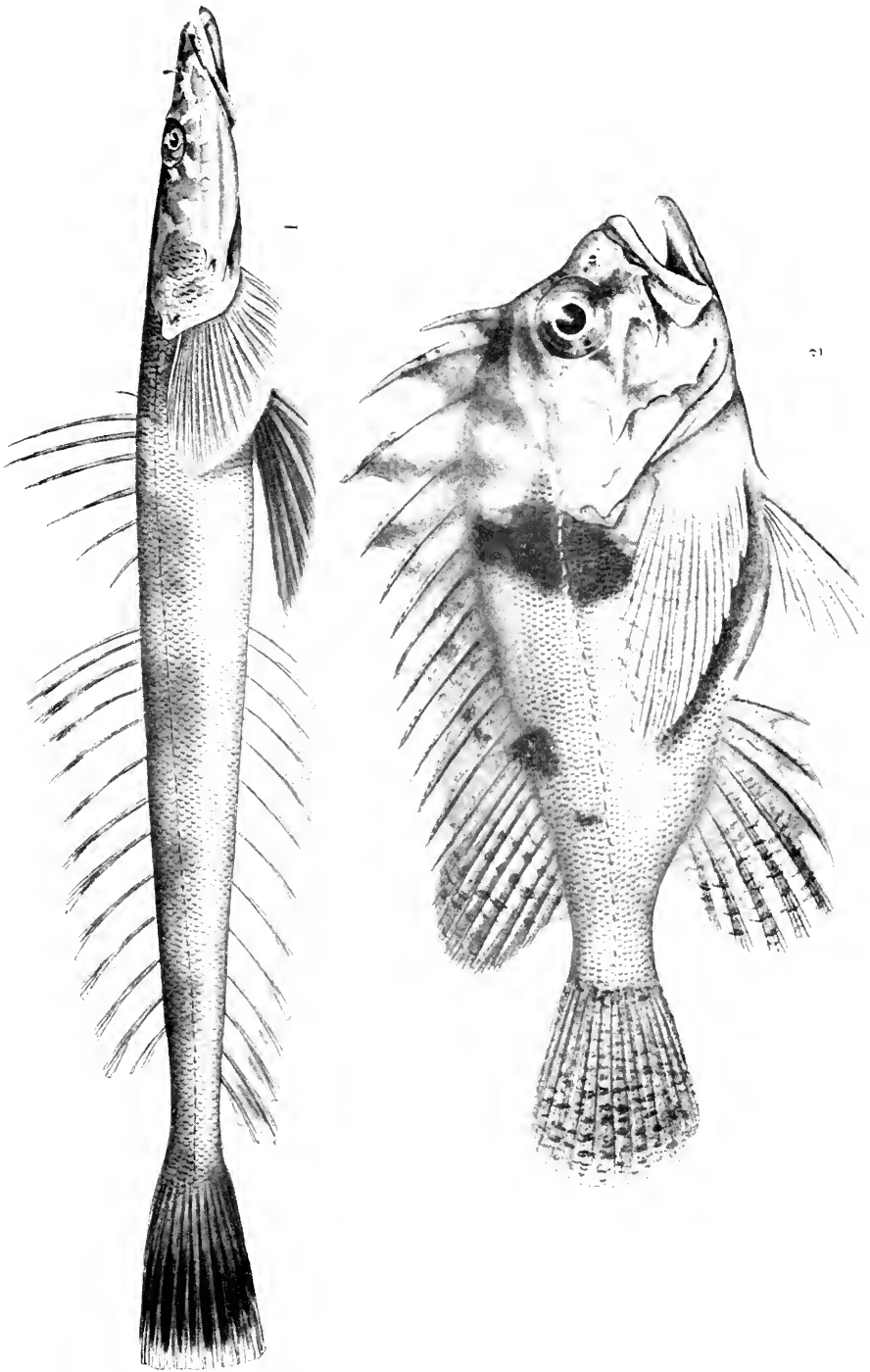
Fig. 1.—*Coradion altivclis*, sp. nov. Type, 135 mm. long, from Wide Bay, Queensland.

Fig. 2.—*Holacanthus personifer*, McCulloch. A young specimen, 111 mm. long, from Wide Bay, Queensland.



EXPLANATION OF PLATE LVII.

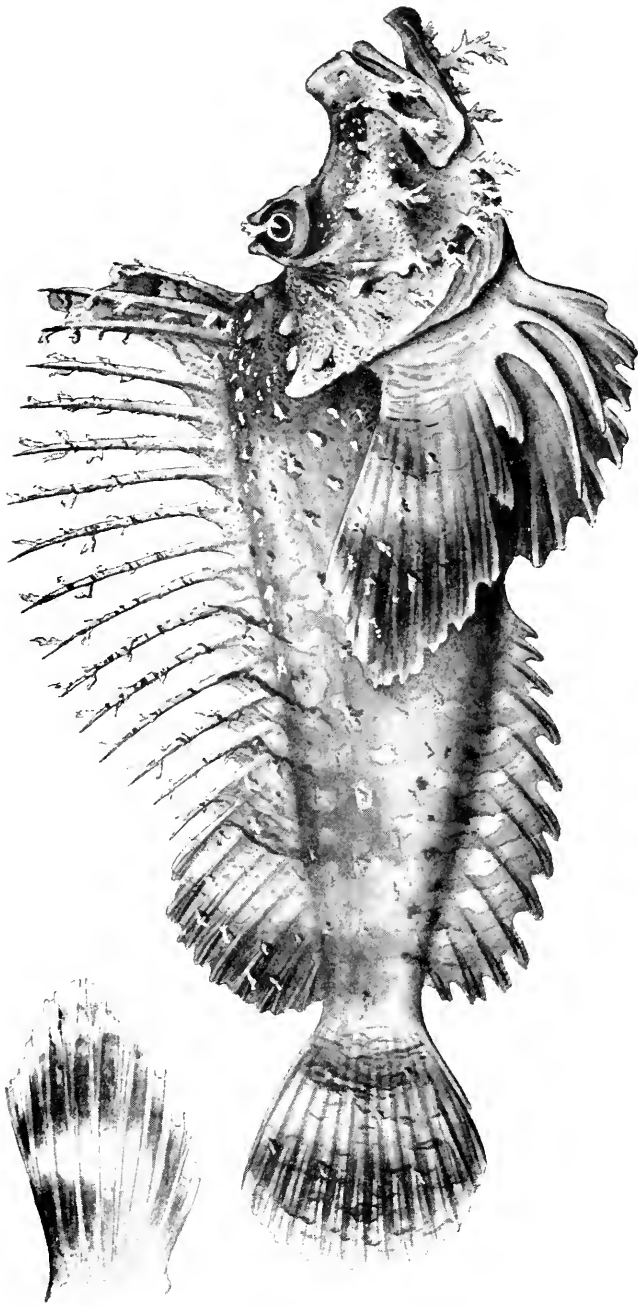
- Fig. 1.—*Platycephalus marmoratus*, Stead. A specimen 265 mm. long, from eight miles east of Sandon Bluffs, New South Wales, 35-40 fathoms.
- Fig. 2.—*Liocranium praepositum*, Ogilby. A specimen 130 mm. long, from the Great Sandy Strait, Queensland.



PHYLLIS CLARKE, del.

EXPLANATION OF PLATE LVIII.

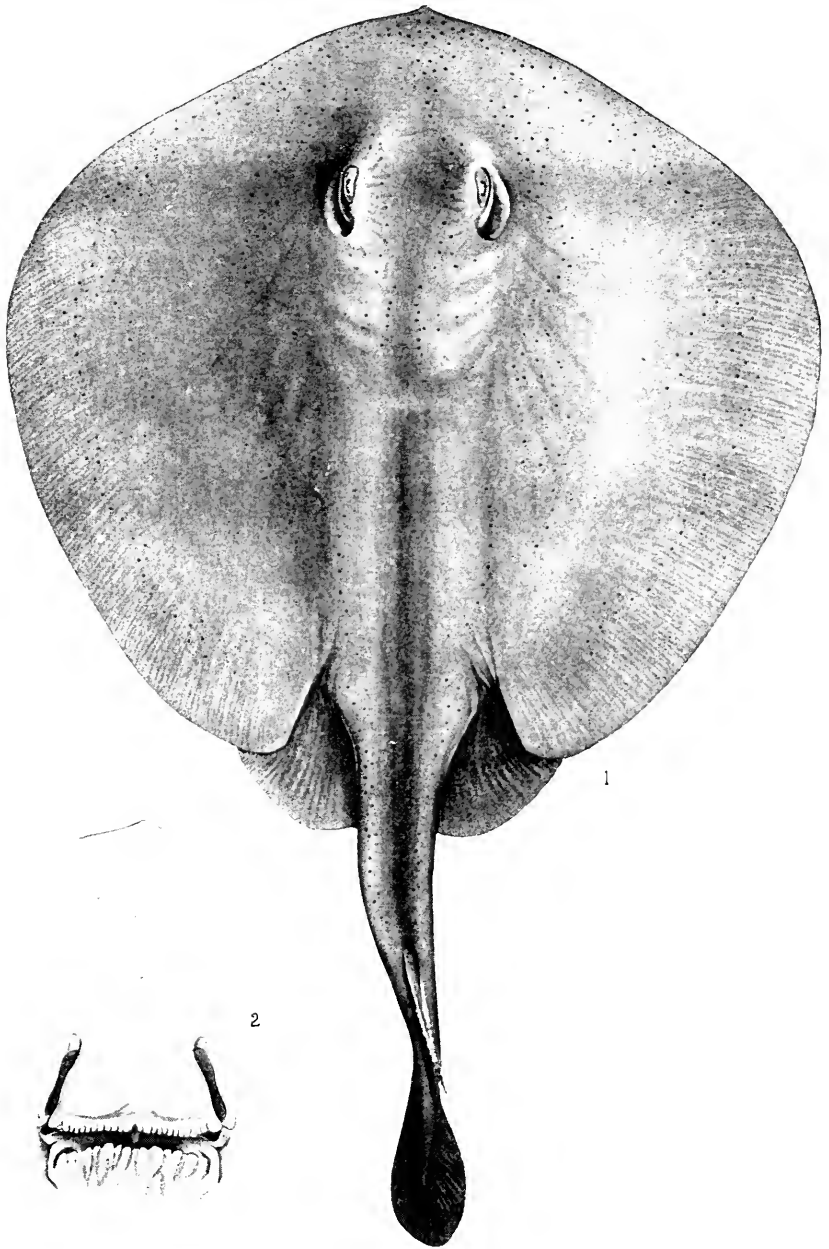
Pelor barbatum, de Vis. A specimen 163 mm. long, from south-west of Lady Elliot Island, Queensland, with figure of inner side of pectoral fin.



EXPLANATION OF PLATE XLIX.

Fig. 1.—*Urolophus aurantiacus*, Müller & Henle. A specimen 245 mm. long from 40-70 fathoms between Port Hacking and Wollongong.

Fig. 2. Mouth of the same specimen, enlarged.



Report on the Cephalopoda obtained by the F.I.S "Endea-
vour" in the Great Australian Bight and other
Southern Australian Localities.

BY

S. STILLMAN BERRY,

Redlands, California.

Plates LIX.-LXXXVIII. ; Figs. 1-67.

REPORT ON THE CEPHALOPODA.

I.—INTRODUCTION.

THROUGH the kindness of Mr. R. Etheridge, Junr., Director and Curator of the Australian Museum, I have had entrusted to me for examination and report the considerable collection of Cephalopods, about a kegful in all, taken by the F.I.S. "Endeavour" on her various expeditions prior to her last ill-fated voyage in 1914.

The collection, which comprises one hundred and four specimens, may be summarily outlined in the following table :—

TABLE I.

	Families.	Genera.	Species.	Individuals
<i>Oegopsida</i>	3	3	3	35
<i>Myopsida</i>	3	4	6	31
<i>Octopoda</i>	2	2	4	38
Total.....	8	9	13	104

On the whole the material is in good condition, though the choice of formalin solution as a preserving medium has resulted in irreparable damage to many specimens, some of which were of great value, while all have been rendered correspondingly difficult and disagreeable to work with. It is most curious how differently formalin seems to behave toward the tissues of different groups of animals. While so often satisfactory with some other groups, I can find little to commend its use with most Cephalopods, or any of them, unless it be with some of the more delicate and transparent pelagic forms, or as a temporary fixing agent.

Fortunately all except three of the species are represented in the collection by a fair number of specimens, a circumstance which has made possible much more thorough and satisfactory work than would otherwise have been the case.

II.—SYNOPSIS OF THE COLLECTION.

The following species of Cephalopods were obtained by the "Endeavour" and will be treated in the succeeding pages :—

Class CEPHALOPODA.

Order DIBRANCHIATA.

Suborder DECAPODA

Division OEGOPSIDA.

Family ENOPLOTEUTHIDÆ.

Subfamily ENOPLOTEUTHINÆ.

Genus ENOPLOTEUTHIS, *d'Orbigny* 1844.

1. ENOPLOTEUTHIS GALAXIAS, *sp. nov.*..... 4

Family HISTIOTEUTHIDÆ.

Genus CALLITEUTHIS, *Verrill* 1880.

2. CALLITEUTHIS MIRANDA, *sp. nov.*..... 1

Family OMMASTREPHIDÆ.

Genus NOTOTODARUS, *Pfeffer*, 1912.

3. NOTOTODARUS GOULDI (*McCoy* 1888)..... 30

Division MYOPSIDA.

Family LOLIGINIDÆ.

Genus LOLIGO, *Schneider* 1784.

4. LOLIGO ETHERIDGEI, *sp. nov.*..... 2

Genus SEPIOTEUTHIS, *Blainville* 1824.

5. SEPIOTEUTHIS AUSTRALIS, *Quoy and Gaimard* 1832. 1

Family SEPIOLIDÆ.

Subfamily ROSSINÆ.

Genus ROSSIA, *Owen* 1834.Subgenus AUSTROROSSIA *nov.*

6. ROSSIA AUSTRALIS, *sp. nov.*..... 5

Family SEPIIDÆ.

Genus SEPIA, *Linnæus* 1758.

7. SEPIA HEDLEYI, *sp. nov.*..... 15

8. SEPIA DANNEVIGI, *sp. nov.*..... 3

9. SEPIA CHIROTREMA, *sp. nov.*..... 5

Suborder OCTOPODA.

Family POLYPODIDÆ.

Genus POLYPUS, *Schneider* 1784.

10. POLYPUS *cf.* AUSTRALIS (*Hoyle* 1885)..... 1

11. POLYPUS VARIOLATUS (*Blainville* 1826)..... 9

- POLYPUS, *sp., juv.*..... 6

Family CIRROTEUTHIDÆ.

Genus OPISTHOTEUTHIS, *Verrill* 1883.Subgenus TEUTHIDISCUS, *nov.*

12. OPISTHOTEUTHIS PLUTO, *sp. nov.*..... 14

13. OPISTHOTEUTHIS PERSEPHONE, *sp. nov.*..... 8

Total specimens..... 104

III.—REGION INVESTIGATED.

The region covered by the explorations upon which the present paper is based includes the waters between Gabo Island, Victoria, on the east, and Cape Naturaliste, Western Australia, on the west. The bulk of the material, however, was taken in the Great Australian Bight south of Eucla, and in the immediate neighbourhood of Bass Strait.

IV.—GEOGRAPHICAL DISTRIBUTION.

The distribution of the various species, as well as a hint of their zoogeographic relationships further afield, is brought out as well as it can be at the present time in the accompanying table (Table II.). For the sake of completeness I include also such additional records for the species previously known as I have been able to glean from the literature. Explanations of the uncertainty indicated in some instances in the table will be given in proper order in the main body of the report.

TABLE II.

Species.	Torres Strait.	N. South Wales.	Victoria.	Tasmania.	South Australia.	W. Austr. (Bight).	W. Austr. (W. Coast)	Other Records.
<i>Enoploteuthis galaxias</i>			×					<i>affin.</i> Japan
<i>Calliteuthis miranda</i>			×					<i>affin.</i> Indian Ocean
<i>Nototodarus gouldi</i>		+	×	×	?	×		<i>affin.</i> New Zealand, Fiji, Hawaii (?)
<i>Loligo etheridgei</i>			?					<i>affin.</i> Indo-Malayan
<i>Sepioteuthis australis</i>	+	+	×				+	<i>affin.</i> Indian Ocean
<i>Rossia australis</i>			×			×		<i>affin.</i> Brit. E. Africa
<i>Sepia hedleyi</i>					×	×		<i>affin.</i> ?
<i>Sepia dannevigii</i>					×		×	<i>affin.</i> ?
<i>Sepia chirotrema</i>					×	×		<i>affin.</i> South Africa
<i>Polypus cf. australis</i>		×	?					New Zealand ?
<i>Polypus variolatus</i>		+	×	×		×	+	Amboina ; Ceylon
<i>Opisthotenthis pluto</i>					?	×		<i>affin.</i> Indo-Malayan
<i>Opisthotenthis persephone</i>			×		?			<i>affin.</i> Japan

× .. Records based upon material obtained by the "Endeavour."

+ .. Previous records.

V.—BATHYMETRIC DISTRIBUTION.

Most of the Cephalopods taken by the "Endeavour" are from the upper oceanic strata, that is, from above the 100 or 150 fathom line. By adopting an increment of 150 fathoms as the standard, and placing the first three such increments in successive parallel columns with their appropriate species listed below, all the "Endeavour" material arranges itself

with great simplicity in the three columns. *Nototodarus gouldi*, *Loligo etheridgei*, *Sepioteuthis australis*, all the *Sepiæ*, and the *Polypi* fall in the first column (0-150 fathoms). In the second (150-300 fathoms) appear *Enoploteuthis galaxias*, *Calliteuthis miranda*, *Nototodarus gouldi*, *Rossia australis*, *Sepia hedleyi*, the *Polypi*, and the two *Opisthoteuthids*. The third column, which includes depths from 300 to 450 fathoms, the most profound at which Cephalopods were taken, contains only a *Sepia*, *Nototodarus gouldi* and *Opisthoteuthis pluto*.

But, although the " Endeavour's " trawling data do not compose themselves in any other way quite so easily, it is apparent that a better comprehension of the true vertical distribution of the species, especially for correlation with future work, may be attained by preparing a table on the basis of 100-fathom increments. This is accordingly done in Table III, and it at once brings out what the simpler arrangement could not do, the empty spaces as well as the solid facts of our knowledge. The circumstance that *Nototodarus gouldi* is the only species appearing in all five columns is alone perhaps indicative of the incompleteness of the table. Again, were our data far more extensive than they are, they can afford us only a poor picture of the reality until we are able to take into account the complex and still almost wholly unknown phenomena of vertical migration, both seasonal and diurnal.

TABLE III.—BATHYMETRIC DISTRIBUTION.

Groups.	DEPTH IN FATHOMS.				
	0-100	100-200	200-300	300-400	400-500
<p>OEGOPSIDA</p> <p>..... <i>Nototodarus gouldi</i></p>	<p><i>Enoploteuthis galaxias</i> <i>Nototodarus gouldi</i></p>	<p><i>Enoploteuthis galaxias</i> <i>Calliteuthis miranda</i> <i>Nototodarus gouldi</i></p>	<p>..... <i>Nototodarus gouldi</i></p>	<p>..... <i>Nototodarus gouldi</i></p>	
<p>MYOPSIDA</p> <p><i>Loligo etheridgei</i> ? <i>Sepioteuthis australis</i> ? <i>Sepia hedleyi</i> <i>Sepia dannevigii</i> <i>Sepia chirotrema</i></p>	<p>..... <i>Rossia australis</i> <i>Sepia hedleyi</i> <i>Sepia dannevigii</i> <i>Sepia chirotrema</i></p>	<p>..... <i>Rossia australis</i></p>	<p>..... <i>Sepia (hedleyi) ?</i></p>	<p>..... <i>Sepia (hedleyi) ?</i></p>	
<p>OCTOPODA</p> <p>[<i>Polyopus australis</i>] <i>Polyopus variolatus</i> <i>Polyopus juv.</i></p>	<p><i>Polyopus cf. australis</i> <i>Polyopus variolatus</i> <i>Polyopus juv.</i> <i>Opisthoteuthis pluto</i> <i>Opisthoteuthis perse-</i> <i>phone</i></p>	<p>..... <i>Opisthoteuthis perse-</i> <i>phone</i></p>	<p>..... <i>Opisthoteuthis pluto</i></p>	<p>..... <i>Opisthoteuthis pluto</i></p>	

NOTE.—Entries bracketed are based on records previous to those of the "Endeavour."

VI.—RELATIONSHIP OF THE FAUNA.

It will be noted that the new or little-known species obtained all belong to genera already known from other parts of the world, for the most part widely distributed groups. The two exceptions are, however, noteworthy. *Nototodarus* is a remarkable genus of the *Ommastrephidæ*, the characters of which have but recently been made known, while its species have heretofore been reported only from Fiji and New Zealand. It is therefore very interesting to learn, through the discovery of males of this species, that the old *Ommastrephes gouldi* of McCoy is apparently referable here, its remarkable hectocotylized arms attaining a complexity in their fully formed condition beyond anything previously known for the entire family. That the material of this species includes enough growth stages to throw considerable light upon the development of these structures is a fortunate circumstance.

The other exception referred to is a beautiful new species of the typical group of *Enoploteuthis*. Until now this genus has been known only by a South Atlantic representative, a Japanese species, and a very old unconfirmed record of its occurrence in the South Pacific. The Japanese species appears to bear the closest relationship to the Australian form.

Also worthy of special mention is the occurrence of a *Rossia*, the second member of the genus to be brought to light from the southern hemisphere. Its predecessor is *R. mastigophora*, Chun, from the Indian Ocean (Lat. 0°27'S., Long 42°47'E.). The two species are very nearly allied, but appear so sharply marked off from their northern congeners that a new section or subgenus is here proposed for their reception.

The Indian Ocean fauna is brought to mind not only by this *Rossia*, but by much of the remainder of the collection. Yet our information seems still too scanty to enable us to say more than this regarding the zoogeographic relationships of the fauna as a whole. *Nototodarus* would appear to constitute an important South Pacific element.

To attempt at this time to work out a system of faunal zones on the basis of the distribution of the Cephalopoda, or even to try to bring them into correlation with those which have been established for other groups, as notably for the lower Mollusca by C. Hedley and for the Echinoderms by H. L. Clark, would be sadly premature, and could result only in confusion. This must wait for further work.

Except for the "Challenger" investigations, so little serious work has been done on the Australian Cephalopod fauna since the pioneer voyagers, and so much of the early work is uncertain and halting, even when judged by the prevailing standards of its period, that the subject is in much confusion and needs careful elucidation by someone having access to the older types. For instance, the redescription *and figuring* in modern fashion of the long list of species "described" by Gray, among them many Australian forms, would be a genuine service to science, and one far more deserving the gratitude of students the world over than any such contribution as the present one of mine can ever be. The worker with the Australian fauna is constantly handicapped and discouraged by the impossibility from the literature alone of accurate definition of so many of the older species. In the littoral groups particularly he cannot always escape a lurking fear that in describing a "new" species he is but adding another name to the burdened synonymy, however much he may feel that he cannot do otherwise without further augmenting the general uncertainty and confusion.

At any rate, few regions of equal extent in the world have a Cephalopod fauna so poorly known as is that of Australasia. For this reason, if no other, the present collection is of notable value, and while it can be regarded as only a beginning of the work which must be done, its investigation has seemed to the author worthy of the utmost care and attention within his power to bestow.

Perhaps the most surprising incident concerning the collection is the comparative scarcity of the two usually so abundant genera, *Polypus* and *Loligo*, together with the almost complete absence of *Sepiolidæ*. To find more *Opisthoteuthis* than *Polypus*, twice as many *Enoploteuthis* as *Loligo*, and no *Euprymna*, is, at the least account, unexpected.

With but one, or perhaps two, exceptions, none of the species obtained by the "Challenger" were taken by the "Endeavour."

VII.—NEW TAXONOMIC TERMS PROPOSED.

Taxonomic terms proposed for the first time in the present paper are as follow:—

Enoploteuthis galaxias, new species.

Calliteuthis miranda, new species.

Loligo etheridgei, new species.

Austrossia, new subgenus of *Rossia*, with *R. (A.) australis* as type.

Rossia australis, new species.

Sepia hedleyi, new species.

Sepia dannevigii, new species.

Sepia chirotrema, new species.

Teuthidiscus, new subgenus of *Opisthoteuthis*, with *O.*
(*T.*) *pluto* as type.

Opisthoteuthis pluto, new species.

Opisthoteuthis persephone, new species.

VIII.—ACKNOWLEDGMENT.

My thanks are due not only to Mr. R. Etheridge for rendering possible my work upon the collection in the first instance, but likewise to Mr. Charles Hedley, also of the Australian Museum, whose ever-ready helpfulness in every possible direction has kept me constantly his debtor. In spite of our distance from one another his aid has been invaluable throughout the course of my work.

I must also express my gratitude to Mr. Robert N. Wenzel, of Stanford University, whose help during a critical time accelerated by many months the completion of this report. His work with the drawings, as well as that of Mr. Herbert J. Powell, of Redlands, California, constitutes its own acknowledgment, and shows how completely each artist by his painstaking care overcame his initial unfamiliarity with the technique of zoological illustration. Without the services of these two the work in the scope in which it is now offered would certainly not have been possible.

For the gift of several items of badly needed literature I am indebted to Mr. Hedley, to Mr. Etheridge, and to Mr. James A. Kershaw, Assistant Director of the National Museum, Melbourne.

IX.—DESCRIPTION OF THE GENERA AND SPECIES.

Phylum MOLLUSCA.

Class CEPHALOPODA.

Order DIBRANCHIATA.

Suborder DECAPODA.

Division OEGOPSIDA.

Family ENOPLOTEUTHIDÆ.

Subfamily ENOPLOTEUTHINÆ.

Genus ENOPLOTEUTHIS, *d'Orbigny*, 1844.

ENOPLOTEUTHIS, *d'Orbigny*, in *Rüppell* 1844 (*teste* Hoyle).

ENOPLOTEUTHIS GALAXIAS, *sp. nov.*

(Plates lix.-lx.).

Animal small, its *Body* firm and fleshy, cylindro-conic in outline; usually widest anteriorly, thence tapering rapidly past the fins to a soft, attenuate point behind. Anterior edge of mantle smooth, but broadly emarginate ventrally between the obtuse points into which it is produced on either side of the funnel, while again in the nuchal region it is extended to a rounded obtuse point. *Fins* large and triangular, individually longer than broad: maximum length about one-half that of the mantle, the distance from tip to tip across them about two-thirds the mantle length; outer angles sharply rounded; anterior margins slightly convex and cut in where they join the body to form a somewhat angular anterior lobe; posterior margins longer, slightly convex, joining the body at a point just in front of the end of the gladius but at a distance of perhaps one-fifth the mantle length from the extreme tip of the body.

Head squarish, moderate in size, a little longer than wide; slightly convex above, concave below. Olfactory crest comprising a sinuous V-shaped fold, the dorsal segment commencing at the hinder dorso-lateral angle of the head, the ventral segment longer and more sinuous; a similar but

simple crest extending up from the ventro-lateral angle, not quite meeting the one first described. *Eyes* large,* the circular or oval lid opening with a conspicuous sinus in front.

Funnel large, broad, blunt at the apex, and notably swollen ventrally. The tip does not quite attain a level with the hinder margin of the eye-opening. Interior of funnel with a large flap-like valve on the dorsal wall near the apex. *Funnel Organ* (Pl. lx., fig. 7) of the usual triplicate form, a dorso-medial Δ -shaped organ and an elongate-oval ventro-lateral pad on each side. The organ of the specimen dissected differs from that of *E. chunii*, as figured by Ishikawa, in that the lateral pads are notably longer and narrower, while each arm of the dorsal pad bears a conspicuous elongate ridge along the middle of the anterior moiety. These ridges may possibly be an incident of the preservation, but for structures so produced the symmetry is unusual.

Arms graceful, moderately long, their formula of relative length 4, 3, 2, 1, or 4, 3=2, 1; the dorsal pair easily the shortest, thence increasing to the ventral pair, which are distinctly the longest, attaining somewhat less than two-thirds the mantle length. Dorsal arms with only traces of an outer carination near their tips; second pair with the carination developed into a narrow membranous keel, traceable along the distal half of the arm; third arms compressed, bearing a strong, broad keel all along their outer angles; ventral pair with the tentacular sheath continuing as a broad mem-

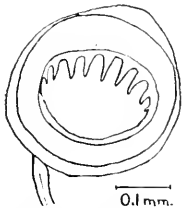


Fig. 1. — *Enoplotheuthis galacias* ♀ [462], sucker of third pair from base on right second arm; camera drawing from a mount in balsam.

branous fold along the ventral outer angles of the arms to their tips. All the arms armed for the greater part of their length with two regularly alternating series of well-spaced, medium-sized hooks, succeeded at the extreme tips of the arms by minute suckers (Pl. lx., fig. 3), the basal one-sixth or so of the arms devoid of either hooks or suckers; number of hooks varying on the different arms from 15 to 17 pairs in the ♀, and $12\frac{1}{2}$ to 15 in the ♂, these sexual differences, if they are to be regarded as such, being set forth in detail in Table IV.; distal 4.5 mm. of the arms occupied by suckers, of which 6-10

*In one of the specimens the right eye and lid opening are conspicuously larger than those of the opposite side, and while none of the other specimens show this feature to so great degree, in all the right eye and aperture are somewhat the larger. Whether this is accidental or indicates a condition approaching that characterising the *Histioteuthidae*, I am unable to state from the present material.

pairs may be distinctly counted, their horny rings having each about 9-10 long, acute, slender teeth on the upper margin (Fig. 1). Hook and sucker-bearing faces of all arms bordered by delicate trabeculate swimming membranes, the ventral membranes of the third pair perhaps a trifle the best developed.

TABLE IV.—*Enoploteuthis galaxias*.

Sex.	Specimen.	NUMBER OF PAIRS OF HOOKS PRESENT ON							
		Right Dorsal Arm.	Left Dorsal Arm.	Right Second Arm.	Left Second Arm.	Right Third Arm.	Left Third Arm.	Right Ventral Arm.	Left Ventral Arm.
♀	Type [543]	16½	16	16½	16½	17	16½	16	16½
♂	Paratype [544]	13	12½	13½	13½	15½	14	14½	15
♀	Paratype [462]	16	16½	16½	16½	16½	17	..	15
♀	[542]	16	16	16½	16½	17	17	15½	16

Hectocotylized Arm in the male (the right ventral) only slightly modified; the basal seven-tenths seemingly normal in every way; just above the 8th hook of the ventral row, the ventral marginal membrane suddenly thickened and widened to form an elongate, sinuous flap, at its maximum somewhat wider than the corresponding oral face of the arm, becoming suddenly narrower at the 13th hook and then continuing only slightly wider than usual to the sucker-bearing portion of the arm; dorsal membrane homologously modified, the enlargement beginning a little further distally, opposite about the 10th hook, at first becoming somewhat more ample and sinuous so as to give the appearance of forming two rounded lobes, but not reaching its maximum till a third lobe which begins opposite the 12th hook, continuing to the 14th; the latter membrane here semilunar in outline and at its widest point, opposite the 13th hook, about twice as wide as the arm face though not so wide as is the ventral membrane at its widest expansion. The last three pairs of hooks and the first sucker or two are crowded between the membrane so as to appear practically in single file. The modified membranes appear to lose their trabeculate structure, perhaps because the cross bars are not thickened in proportion to the intervening

regions of the membrane, since under an exceptionally favourable light, I am almost persuaded that traces of them are distinguishable. At the extreme tip of the arm seems to return to the normal condition (Pl. lx., figs. 4-5).

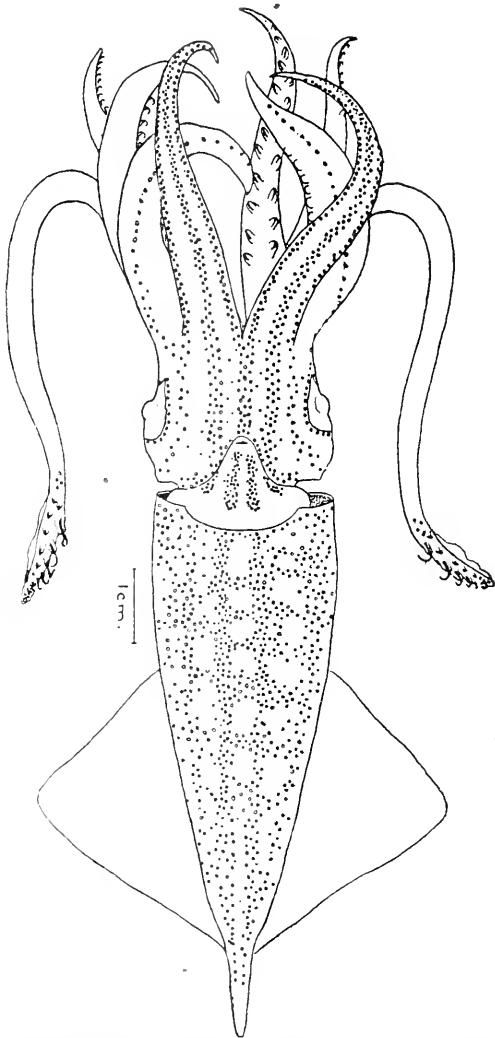


Fig. 2.—*Enoploteuthis galaxius* ♀ [543], [462], somewhat schematic drawing of ventral aspect to show arrangement of integumentary photophores; composite sketch from type and paratype.

Tentacles stout, fleshy, a trifle longer than the mantle, or a little over half as long again as the ventral arms; stalks rather flattened dorso-ventrally so as to give them a somewhat rectangular outline in cross section, while they are considerably deeper than wide at the base, whence they taper to just before the carpus, the latter region very slightly wider. Tentacle *club* again narrower than the carpus, slender, and tapering rapidly to the extremity as in previously described species of the genus. Carpus with a compact fixing apparatus of 4-6 suckers and 4-5 pads occupying (as seen by a strongly oblique lighting), a somewhat sharply delimited, flattened, oval area on the oral face, and so crowded together within this area that it is sometimes very difficult to distinguish the true pads from certain (usually more irregular) roundish swellings arising in connection with the bases of most of the suckers (Pl. lx., figs. 1, 2). Club proper (Pl. lx., fig 2) with two alternating series of hooks along its proximal four-fifths; ventral series comprising a small proximal hook succeeded by five conspicuously larger, long, slender, strongly curved hooks, the second and third the largest of the series, the remainder gradually diminishing in size; dorsal series comprising five much smaller hooks of which the second is the largest, the distal ones very gradually diminishing in size; no suckers proximal to the hooks in either series, or between the hooks and the fixing apparatus, in any specimen examined, but two of the four perfect tentacle clubs (Pl. lx., fig. 1) show a small sucker similar to the suckers of the distal portion of the club just distal to the hooks of the dorsal series and occupying a position opposite the space between the two most distal hooks of the ventral series, the presence or absence of this sucker apparently depending respectively upon whether the first hook of the dorsal or of the ventral series is the more proximal in its position upon the club and relative to the first hook of the opposite row, hence the said sucker no doubt is homologous with the sixth hook of the ventral series. Distal seventh of club occupied by four rows of small, closely-placed suckers, counting some 38-43 in all, which gradually diminish in size toward the extremity, except that a roughly defined circle of some 5-6 suckers almost at the tips (usually followed by one or two more minute suckers) are again somewhat larger than those just preceding them.

TABLE V.—ENOPLUTEUTHIS GALAXIAS.
ARMATURE OF TENTACLES.

Sex.	Specimen.	Suckers in fixing apparatus.	Pads in fixing apparatus.	Suckers proximal to hooks in dorsal row.	Suckers proximal to hooks in ventral row.	Hooks in dorsal row.	Suckers distal to hooks in dorsal row.	Largest hook in dorsal row.	Hooks in ventral row.	Largest hook in ventral row.	Total Suckers on distal part of club
♂	Paratype [544]— right..... left.....	6 5	4 5	0 0	0 0	5 5*	0 1	2 2	6* 6	3? 2	43 38
♀	Type [543]— right..... left.....	4 —	5 —	0 —	0 —	5* —	1 —	2 —	6 —	2 —	39 —
♀	Paratype [462]— right..... left.....	— 3 (+1 ?)	— 4	— 0	— 0	— 5	— 0	— 2	— 6**	— 3	— 41

*This series begins first proximally.

**One hook apparently torn away is included; this series also begins first.

NOTE.—It is difficult to state which are true pads and which irregularly swollen cushions at the sides of the sucker bases in the carpal apparatus, the table figures for these structures being therefore in some degree a guess. It should be further noted that the basalmost hook of the ventral row on the main portion of the club is, in every instance, a very much smaller organ than any of its successors, approximating the condition seen in the dorsal row.

Buccal Membrane eight-pointed, thin, delicate, strongly rugose within, and very deep in colour owing to the large number of minute dot-like chromatophores covering its outer surface.

Gladius (Fig. 3) horn-coloured, its midrib showing through the mantle integument as a conspicuous, dark, medio-dorsal line, not extending into the soft hinder extension of the body; the free rachis slightly less than one-fourth the total length; midrib flanked by a narrow thickening along it on each side and a weaker submarginal thickening on the wings; wings thin, broad, their margins obtusely angled at the widest point, somewhat less than two-fifths of the length from the anterior end.

Radula (Fig. 4) simply constructed, the marginal teeth having simple, arcuate, tapering blades; remaining teeth conical: of the latter, the median teeth broadest and longest, the first laterals narrowest and shortest.

Photophores divisible into two principal classes:—(A) those of the general integument, which are exceedingly numerous; and (B) a series of nine organs along the ventral periphery of each eyeball. Organs of the general integument (Fig. 2) distributed as follows:—(1) *Head and Arms*:—Ventral aspect of head with three bands of a depth of about three organs each, the median band splitting anteriorly into two forks running out the inner ventral margins of the ventral arms to their tips, and posteriorly into two forks along the boundary of the funnel groove: lateral bands continuing along the outer margin of the main body of the arms to their tips, each flanked outwardly by a narrower, less dense, more irregular band, this and its mate continuing along the outer ventral margins of the broad membranous keel of the ventral arms; ventral margin of eyelid on each side bordered by a single, closely-ranked series of photophores which skips across the lid-sinus and thence runs out along the outer angles of the third arms

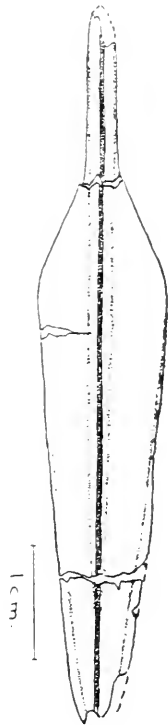


Fig. 3. — *Enoplotheuthis galvinae* ♀ [462] gladius in dorsal aspect; represented with the wings spread flat.

at the base of the outer keels. (2) *Funnel* :—Ventral aspect of funnel with two broad bands of closely-placed organs, 3-4 deep near the middle, flanked by a smaller, narrower band or patch at each side. (3) *Mantle* :—Entire ventral aspect of mantle covered with numerous, thickly scattered photophores, more so in some regions than others, but evincing slight traces

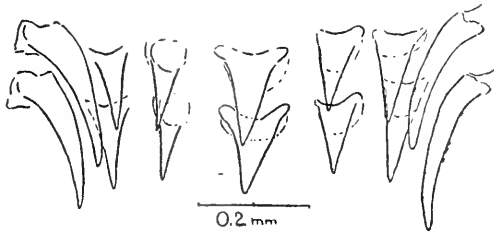


Fig. 4.—*Enoploteuthis galaxias* ♀ [462], two rows of teeth from radula of paratype; camera drawing from a mount in balsam.

of any aggregation into definite longitudinal stripes or bands, like those of the head and funnel; such traces best visible in the anterior region, but accompanied by an even stronger effect of an irregular transverse banding, so that in general the pattern here is best described as roughly checkered or reticulate; even this appearance being lost posteriorly; of the longitudinal bands the two median easiest to make out and traceable farthest back; the delicate posterior prolongation of the body adorned with comparatively few photophores, a line of the organs being evident down each side ventrally for about two-thirds of the distance to the tip, and two medio-ventral lines for about one-third the distance; the two latter series, with a space between them clear of photophores, traceable for a short distance forward on the body proper, soon losing themselves; dorsal region of mantle with a few scattered photophores; all the photophores, dorsal and ventral, unusually inconspicuous and little differentiated by their colour, though the fact that they usually form low tubercles helps to distinguish them; apparently divisible into at least two principal sizes, those of one type being very small. (B.) *Subocular photophores* (Pl. lx., fig. 6), 9 in number, occurring in a single, close ranked series on the ventral periphery of each eyeball; sufficient magnification showing them to be not exactly in line with one another, but zigzag and strongly polymorphic, the degree to which this appearance may be due to their different orientation in the encompassing tissues being somewhat uncertain; terminal organs largest, both characterised by their strongly fibroid structure with very

definite outer boundaries, in this aspect the fibres appearing radially arranged only in the anterior organ; 2nd and 8th organs little more than half the diameter of those just described, differing further (though in this as other respects similar to one another) in their granular rather than fibrillar structure within very definite circular boundaries, at one side embedded in a mass of indistinct fibrillae; 4th and 6th organs seemingly of same general type as 2nd and 8th, but somewhat larger, the 4th being strongly displaced inwardly; central organ resembling the 3rd and 7th, being considerably larger than these, though smaller than the terminal organs.

Colour of preserved specimens in general a dark purplish slate mottled with brown-red on a brownish buff ground; fins brownish buff underneath and on the edges dorsally, the dorsal region of the body being very dark between them; photogenic organs purplish slate; the very numerous chromatophores, which extend even upon the oral surfaces of the arms and tentacle club, brownish red.

TABLE VI.—MEASUREMENTS, OF *Enoploteuthis galaxias*.

Author's Register Number.....	[544]	[542]	[462]	[543]
	Paratype		Paratype	Type
Sex.....	♂	♀	♀	♀
	mm.	mm.	mm.	mm.
Total length.....	172	..	178	180
Length of body, dorsal.....	73	87	78	72
Length of body, ventral.....	68	85	73	67
Tip of body to base of dorsal arms..	91	111	95	93
Length of free tip of body.....	16	20	17	15
Length of fins.....	35	42	..	40
Width across fins.....	48	55	..	49
Width of body alone.....	21.5	23	19	25
Depth of body.....	18	20	17	15
Width of head across eyes.....	16	17.5	17	19
Length of head.....	19	22	19	20
Length of funnel, median.....	14	15	14	13
Length of right dorsal arm.....	38	39	40	34
Length of left dorsal arm.....	38	41	39	35
Length of right second arm.....	40	45	43	41
Length of left second arm.....	40	47	43	41
Length of right third arm.....	40	46	44	41
Length of left third arm.....	41	48	45	41
Length of right ventral arm.....	46	51	..	46
Length of left ventral arm.....	46	51	49	46
Length of right tentacle.....	78	..	..	78
Length of right tentacle club.....	18	..	..	19
Length of left tentacle.....	74	..	80	..
Length of left tentacle club.....	18	..	20	..

Type :—a ♀, E5723 (pars) [S.S.B.543], in the collection of the Australian Museum, Sydney. A paratype [S.S.B.544] has been retained by the writer.

Type Locality :—200-250 fathoms, Gabo Island to Everard Grounds, Victoria; (" Endeavour "); 1♂, 2♀.

Recorded Distribution :—160-250 fathoms, region of Cape Everard, Victoria.

Material Examined :—

TABLE VII.

No. of Specimen	Sex.	Depth in Fathoms.	Locality.	Original Number.	Author's Register	Remarks.
1	♀	160-200	33 m. S. × W. of Cape Everard, Victoria.	E5601	[542]	
1	♀	200-250	Gabo Island to Everard Grounds, Vic.	E5723	[543]	Type.
1	♂	[544]	Paratype.
1	♀	[462]	Paratype (dissected)

Remarks.—One of the surprises offered by the "Endeavour" material was the occurrence of no less than four adult specimens of both sexes of this rare and little known genus of Squids. Furthermore, although the species to which they belong is admittedly close to the Japanese *E. chunii*, Ishikawa (1914, p. 401), as well as to the type of the genus, the poorly understood Atlantic *E. leptura* (Leach) (cf. d'Orbigny, in d'Orbigny and Férussac, 1839, p. 337, *Onychoteuthes*, pl. 6, pl. 11, figs. 6-14, pl. 12, figs. 10-24), it still seems clearly distinct enough to be awarded a separate name. Its most conspicuous peculiarity lies in the arrangement of the photogenic organs of the ventral aspect of the body. These, although much more numerous and crowded than would seem to be the case in either of the older species, fail to show the aggregation into more or less definite longitudinal bands characteristic of both the latter. The specimens further differ from *E. chunii* in the more reduced sucker-bearing area on the sessile arms, the greatly diminished number of suckers on the terminal portion of the tentacle club, and the consequently smaller area of the organ occupied by them, the lack of small suckers between the carpal apparatus and the hooks on the main portion of the club, certain details in the number of hooks and relative position of the protective membranes on the hectocotylyzed arm, and so on. None of these peculiarities are very striking, but are relatively constant in the material

seen, and have to do with organs of established dependability for their taxonomic value in this group of Squids. The hectocotylus of *Enoploteuthis* does not appear to have been previously figured, though that of *E. chumii* has been briefly described by Sasaki (1916, p. 91).

As in the present instance all the specimens were obtained in the same general locality, nothing is known concerning their distributional limits or the faunal region to which they properly belong.

To judge from the size and abundance of the photogenic organs this little squid must be brilliantly luminous in life. It is the most graceful and attractive Cephalopod in the "Endeavour" collection, in fact one of the most beautiful of the entire known Australian fauna.

The species receives its name from a fancied resemblance in the arrangement of the numerous photophores on the ventral aspect of the body to the stars of the Milky Way or Galaxy (Greek γαλαξίας).

Family HISTIOTEUTHIDÆ.

Genus CALLITEUTHIS, *Verrill*, 1880.

CALLITEUTHIS MIRANDA, *sp. nov.*

(Plates lxi.-lxii.)

Animal of moderate size, of the form characteristic of the genus; the *Body* short, robust, broadly conical in outline, widest at or near the anterior margin, thence tapering rapidly to a stout point; mantle thick, its anterior margin rounded, with an anteriorly projecting sinuosity in the nuchal region and obtuse points at either side of the funnel, between the latter barely emarginate. Locking apparatus of the usual form, the funnel cartilages large and possessed of an unusually deep median excavation. *Fins* short, broad, semicircular; about 43/100 as long as the mantle, each separately about half as wide; meeting and fusing in the median line behind at a point well above and in front of the free tip of the body, which latter their indented margin slightly exceeds posteriorly.

Head enormous, strongly asymmetrical, though the normal deflexion of the axes of the head and body cannot be ascertained from the present material. *Eyes* large, strongly asymmetrical; right eye well developed, but the left extraordinarily so (Pl. lxii., fig. 1), its aperture approximately twice the longitudinal diameter of the right eye-opening, its lens 22.3 mm. in diameter, that of the right eye 12.3 mm.; just

back of each eye a simple cylindro-conic "olfactory papilla." *Funnel* short and broad, extending about 30% of the distance from its base to the umbrella margin; supported above by a pair of wide, thin, membranous bridles, enclosing a deep pocket between them; valve of the usual flap-like form. *Funnel Organ* (Pl. lxii., fig. 3) comprising the usual pair of large ovate ventro-lateral pads and a large Δ -shaped pad with a pointed tip occupying most of the dorsal wall of the funnel chamber.

Arms stout, rapidly tapering; in general subequal, except that the ventral pair seem distinctly, though not greatly, shorter than the others, all being obscurely keeled. Suckers of the sessile arms (Fig. 5) hood-shaped, in two well-separated

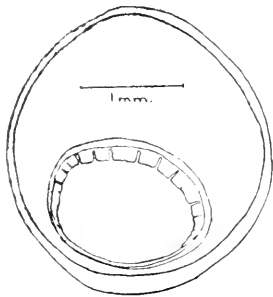


Fig. 5.—*Calliteuthis miranda* ♀ [545]. seventh sucker from base in ventral row of right third arm of type; camera outline from a mount in balsam.

rows on all the arms; their horny rings armed on the superior margin with about twelve short, wide, battlement-shaped teeth, here and there sometimes coalesced so that the notches between them are reduced to mere nicks; diameter of one of the larger suckers, 3 mm. *Umbrella* (Pl. lxii., fig. 4) well developed, though short, extending about equally between the arms of the three dorsal pairs for perhaps one-quarter of their length; attached to the *inner* angles of the arms in such

a way as to be continuous with their oral faces and quite invisible externally when the arms are closed. There is also a weak rudimentary umbrella between the *outer* angles of these arms, so that there is a sort of deep, conical pocket between the base of each arm and that of its next neighbour; this outer umbrella better developed between the third and fourth arms, where it forms the outer sheath of the tentacle, the inner umbrella here being absent, though reappearing in a rudimentary way ventrally as a triangular membrane filling the gap between the buccal membrane, its ventral buttresses, and the ventral arms. Between the latter the inner membrane is but scantily developed and about on a par with the again reduced outer membrane. Ventral oral margins of arms of third pair equipped with well developed swimming membranes, similar, though less developed membranes occurring on the free portions of the remaining arms continuously with the inner web above described.

Tentacles stout, of moderate length, perhaps a third longer than the sessile arms; at the base greatly compressed dorso-ventrally, so that their depth from the oral to the aboral surface is nearly three times the transverse dimension; gradually tapering for about two-thirds their length, then becoming more triangular in section, due to the flattening and widening of the oral face in the region where the fixing apparatus commences: oral surface of tentacle at extreme base anchored by a slender cord of muscle (Fig. 7) originating in a sort of secondary pocket lying between the buccal membrane and the true tentacle pocket, and separated from the latter by a fleshy fold connecting the bases of the ventrolateral and ventral arms; the triangular space between fold, cord, and tentacle stalk filled by an extremely tenuous,

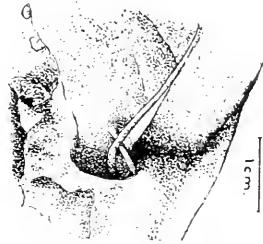


Fig. 6.—*Calliteuthis miranda* ♀ [545], base of left tentacle, showing accessory muscular cord and pouch.

transparent, veliform membrane, extending down on either side of the fold into both pockets, appearing to be firmly attached at all points; entire oral face of stalk from intersection of basal muscle cord to the carpal region marked by a shallow but narrow and quite sharply delineated longitudinal groove in the median line. *Tentacle club* (Pl. lxii., fig. 2) spatulate, expanding near its base to about double the width of the carpus, thence tapering rapidly to a rounded point; sucker-bearing area bordered on both sides by a well-developed marginal membrane, the dorsal membrane outwardly paralleled along the distal half of the club by a strong, flattened keel. Suckers on the club proper exceedingly crowded, apparently borne in six rows over the entire club except the greatly narrowed extremity where they are much reduced in size and appear in four rows, terminating in the usual apical group of 6-7 suckers somewhat larger than their immediate predecessors and circularly disposed; largest suckers about the 4th-6th from the base of the two dorso-median rows, those in the series ventral to these becoming progressively smaller; horny rings bearing numerous minute acute, pointed teeth (Fig. 6) around their entire circumferences,

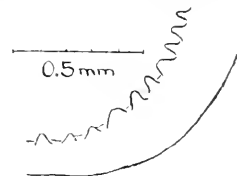


Fig. 7.—*Calliteuthis miranda* ♀ [545], portion of horny ring of tentacular sucker; camera drawing from a mount in balsam.

the number of such teeth in the larger suckers being estimated as 50-60. *Firing apparatus* (Pl. lxii., fig. 2) beginning distally on the dorsal margin of the club at its point of widest expansion, thence extending down the club and stalk for about one-fifth of the length of the tentacle; again commencing distally, said apparatus comprises—first a minute sucker, then in turn a pad, a larger sucker, a pad, a considerably larger sucker (this being at the base of the sucker-bearing portion of the club proper), four pads alternating with three suckers equal to one another in size, but smaller than either of the two preceding; alongside the last pad, though in a slightly distal horizontal plane and barely ventral to the median groove of the stalk is an exceedingly minute sucker; a short distance below it and also almost in the groove a minute pad, followed in the same series next the groove by two larger but still quite small suckers, then two pads somewhat obliquely placed so that the two larger succeeding suckers are well spaced from the groove, then two pads leading back toward the groove, close by which we find the next two suckers and the concluding pad, the interspaces between these last being much greater than those preceding them; summing up, entire apparatus divisible into (1) a dorso-marginal and distal series of six variously sized suckers alternating regularly and closely with six equal-sized pads, and (2) a ventro-median and more proximal series of seven relatively small suckers and six pads alternating in the peculiar order of 1-(1)-2-(2)-2-(2)-2-(1), the median members of the series somewhat displaced ventrally instead of all being in exactly the same longitudinal plane.

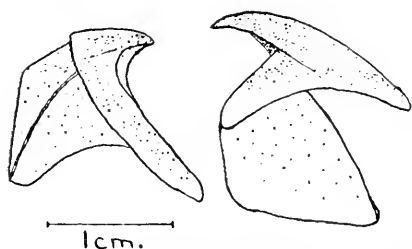


Fig. 8.—*Calliteuthis miranda* ♀ [545], camera drawing of mandibles.

Buccal membrane (Pl. lxii., fig. 4) very large, rugose within, 7-pointed, the lappets anchored by simple, unforked, membranous buttresses; the three dorsal lappets inserted opposite the interspaces of the four dorsal arms, apparently anchored directly

to the face of the inner umbrella, whereas the buttresses of the next pair of lappets are continuous with the ventral membranes of the third arms, and those of the ventral pair of lappets with the dorsal (outer) membranes of the ventral arms.

Gladius not examined, due to the crushed condition of the specimen.

Mandibles (Fig. 8) black; upper mandible with a slender curved beak; lower much shorter and stouter, and bearing a sharply raised median carina on its wings.

Radula (Fig. 9); median teeth with wide, hat-shaped bases and simple, sharp, conical cusps; first laterals also simple conic, but much smaller; second laterals conic at base, but their points attenuated to more than twice the length of the first laterals; marginals long, straight, knife-shaped, in their turn again nearly twice as long as the second laterals.

Photophores of the general integument many in number, but scattered rather than crowded, and more numerous and larger ventrally than above; partly owing, perhaps, to the condition of the specimen, any exact system of rows on the ventral aspect of the body or head I am unable to distinguish, the general arrangement having been represented by the artist as carefully as possible in the drawing (Pl. lxii., fig. 1); the series or groups capable of positive definition are:—A close-set submarginal series of seven organs between the ventro-lateral, points of the mantle, an arch of about six organs on the head bounding the apex of the funnel groove, a circlet of about sixteen bounding the right eye-opening, and at first five, then four longitudinal series of organs arranged in well-spaced transverse series along the ventral surface of each ventral arm; first two transverse series on arm proper containing five organs, next two four each, the number thereafter gradually diminishing; photophores surrounding left eye-opening fewer than on the right and greatly reduced in size, 7-8 minute ones distinguishable along the ventral border, but dorsally more difficult to make out; excluding circumorbital series, possibly the equivalents of 10-11 longitudinal series of photophores present on ventral aspect of head; on outer surfaces of the six dorsal arms, I make out two rows, one on either side of the cartilaginous ridges soon to be described; photophores absent from funnel.

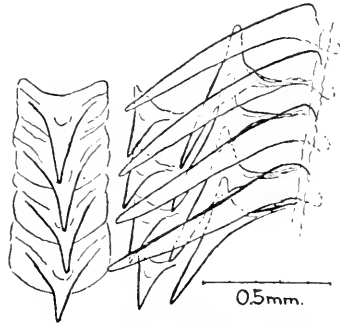


Fig. 9.—*Calliteuthis miranda* ♀ [545], four rows of teeth from one side of radula of type; camera drawing from a mount in balsam.

Surface of body smooth, except for the numerous small tubercles due to the photophores, and a longitudinal series of small, cartilaginous, tubercle-like spines beneath the skin along the medio-dorsal line extending about two-thirds of the way to the fins; these tubercles are closely placed, as I count approximately twenty within a space of 40 mm. from the anterior margin; a similar series of tubercles traceable along the basal 50 mm. of the median line of the upper surface of the dorsal arms, and traces of others are to be detected on the bases of the second and third arms.

General *colour* of specimen in formalin a dark, irregularly clouded, livid, purplish slate; oral surfaces of arms and umbrella, and outer surface of buccal membrane uniformly darker; suckers, sides of arms, sides of tentacles, and funnel grayish-brown; photophores showing the usual dark tubercle with a lighter spot in front, but as a rule very inconspicuous.

Measurements.—

TABLE VIII.—MEASUREMENTS OF *Callitenthis miranda*.

Author's Register Number.....	[545]
	Type.
Sex.....	♀
	mm.
Total length.....	450 (est.)
Length of body, dorsal.....	140
Length of body, ventral.....	135
Length of fins.....	60
Width of fin at widest point.....	30
Width across fins.....	75
Width of body.....	70
Width of head across eyes.....	50
Length of head.....	43
Longitudinal diameter of right eye opening.....	19
Longitudinal diameter of left eye opening.....	40
Length of funnel, median.....	30
Length of right dorsal arm.....	195
Length of left dorsal arm.....	200
Length of right second arm.....	200
Length of left second arm.....	210
Length of right third arm.....	200
Length of left third arm.....	195
Length of right ventral arm.....	180+
Length of left ventral arm.....	185
Length of right tentacle.....	260
Length of right tentacle club.....	35
Length of sucker-bearing area of right tentacle.....	80
Extent of fixing apparatus.....	56
Length of umbrella between dorsal arms, measured inside.....	50

Type.—A ♀, E5605 [S.S.B. 545], in the collection of the Australian Museum, Sydney. The specimen is unique.

Type Locality.—270 fathoms, S.E. × S. of Gabo Island, Victoria; ("Endeavour"); 1 ♀.

Remarks.—Although there are a good many named species of the genus *Calliteuthis*, *sensu latiore*, the great majority of these have been so ill defined that it has become exceedingly difficult to deal with the group at all. Any additional species described are therefore likely to be viewed with suspicion until it can conclusively be shown that they possess no counterpart among the melange of names applied to their various relatives. The specimen now before us I have accordingly tried to describe in as full a manner as the rather imperfect state of its preservation has permitted. Fortunately it possesses one character, the ridgepole-like series of cartilaginous tubercles on the dorsum and along the outer aspect of the four dorsal arms, which has been noticed heretofore in but two species, *C. meleagroteuthis* Chun, and *C. separata* Sasaki, both of which are members of the group *Meleagroteuthis* and thus differ conspicuously from the Australian species in many particulars, notably in the extraordinary development of their photogenic organs. In the distribution of these structures over its body *C. miranda* approaches much more nearly to *Stigmatoteuthis*, but even here does not rest comfortably unless we amend Pfeffer's diagnosis to include species with four as well as with three rows of photophores on the ventral arms. This, in fact, constitutes the second important peculiarity of *C. miranda*, and one in which, curiously enough, it would seem to stand unique. A third respect in which it differs from most if not all of the older species is in the extent and peculiar arrangement of the umbrella and accessory webs in relation to the arms, tentacles, and buccal membrane. This is most nearly resembled by the condition shown in Pfeffer's figure of his *M. hoylei*=*C. meleagroteuthis* Chun (cf. Pfeffer, 1912, Taf. 22, fig. 8), but differs in that the three dorsal lappets of the buccal membrane are not forked, but simple, and seem to spring directly from the umbrella rather than from the sides of the arms, while the umbrella itself appears somewhat more extensively developed. The apparatus at the base of the tentacles is not shown at all in Pfeffer's figure.

Just how much change these different structures undergo during the ontogeny of the organism has not yet been worked out for any of the species, save to a certain degree for *C. reversa*, so we have still to face the possibility that such

animals as *C. hoylei* Goodrich, and *C. chuni* Pfeffer are but young stages of some of the larger species. Compared to the one under discussion, however, the discrepancies are of such a nature (e.g., the *fully* toothed arm suckers of *C. hoylei*, the *partially* toothed tentacle suckers of *C. chuni*, etc.) that I doubt whether either will ever prove identical with it.

C. miranda is not a typical *Calliteuthis*, as it lacks accessory chitinous structures on the tentacle club; it is not a typical *Stigmatoteuthis*, as it possesses the series of cartilaginous tubercles on the dorsum and dorsal arms, and there are too many series of photophores on the ventral arms; it is not a typical *Meleagroteuthis*, as there are far too few photophores over the whole body. In several respects it stands midway between the two latter groups and helps materially to break up the boundary between them. It shares with all other members of the family the extraordinary asymmetry of the eyes, head, and head photophores, a phenomenon which is still as inexplicable as ever.

Family OMMASTREPHIDÆ.

Genus NOTOTODARUS, Pfeffer, 1912.

NOTOTODARUS GOULDI (McCoy), 1888.

(Plates lxiii.-lxvi.)

- ? 1849. *Ommastrephes Sloanii*, Gray, Cat. Ceph. Brit. Mus., p. 61.
1881. *Ommastrephes Sloanei*, Verrill, Trans. Conn. Acad., v, 5, p. 386 (brief note).
1888. *Ommastrephes Gouldi*, McCoy, Prodr. Zool. Viet., Dec. 17, p. 227, 255, pls. 169-170.
1897. *Ommastrephes Gouldi*, Hoyle, Cat. Rec. Ceph., 1st Suppl., p. 371 [9] (merely catalogued).
1900. *Ommatostrephes sagittatus sloanei* (pars), Pfeffer, Syn. Oegops. Ceph., p. 179.
1912. *Ommatostrephes Sloanei Sloanei* (pars), Pfeffer, Monogr. Oegops. Ceph., p. 458-460 "(Göttingen" and "Petersburg" specimens).

Animal moderately large, loliginiform; its *body* (Figs. 10-11) slightly compressed, more or less cylindrical in front, tapering at first gradually, then very rapidly between the fins to an acute point; mantle margin with only a very weak nuchal situation and an emargination below the funnel.

Locking cartilages characteristically Ommastrephid in form. *Fins* quite large; triangular when taken separately; together sagittate and very slightly produced posteriorly; their length 40-45%, their combined width 50-55% of the mantle length; point of widest expansion at about the anterior quarter; lateral angles rounded; anterior margins convex, cut in next the body to form a lobe; posterior margins at first slightly convex, then a little more strongly concave.

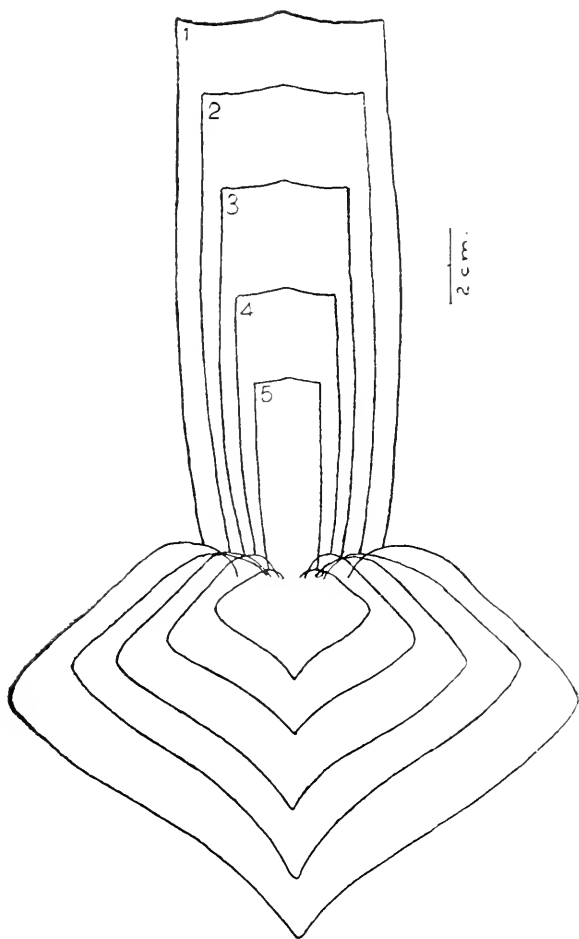


Fig. 10.—*Nototodarus gouldi* ♂, nested outlines of bodies of five specimens of various ages, dorsal aspect: 1—[549]; 2—[552]; 3—[564]; 4—[550]; 5—[563].

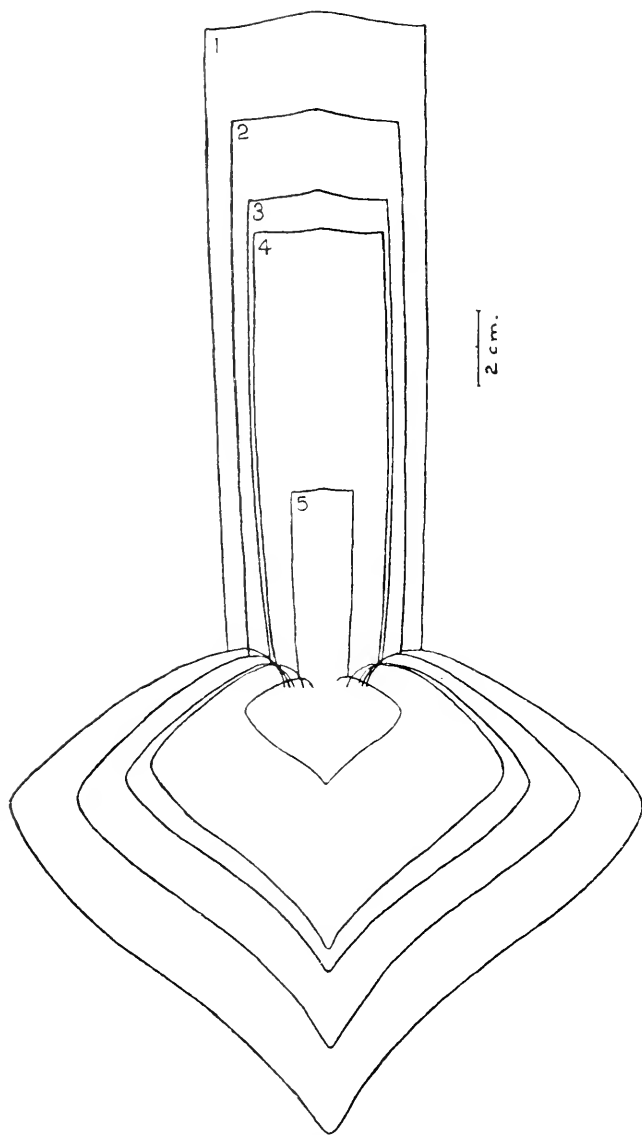


Fig. 11.—*Nototodarus gouldi* ♀, nested outlines of bodies of five specimens of various ages, dorsal aspect: 1—[548]; 2—[555]; 3—[556]; 4—[557]; 5—[563]. 5 is the specimen figured as No. 5 in the preceding figure, its uncertain sex causing it to be placed in both figures.

Head large, squarish, sometimes a little narrower than the body, but in the best preserved material probably more often a trifle wider; bounded posteriorly by a thickened ridge, corresponding to which is a less sharply defined angulation on the ventral aspect of the funnel; "olfactory crest" comprising the usual trident-shaped fold directly back of, adjoining, and pointing into the just mentioned ridge. *Eyes* large, with large lid openings, the latter having a sharply indented sinus in front (Fig. 12), at the base of which are borne little flaps (the ventral one considerably the larger) interlocking apparently so as to convert the apex of the sinus into a pseudo-pore. *Funnel* short, stout, broad; flattened, but furnished with the ventral elevation already described. *Funnel organ* (Pl. lxvi., fig. 1) very large, comprising an immense dorso-median, Λ -shaped organ and two elongate, ventro-lateral pads; phalanges of median organ long enough to jut past the lower margin of the funnel cartilages. *Funnel groove* with a distinct *foveola* (Pl. lxv., fig. 1), comprising a very shallow semicircular membranous fold cutting off the apical portion of the groove, the excluded portion bearing on its extreme apical wall a variable number (usually 6-8) of low, short, longitudinal ridges.

Arms of moderate length, fairly attenuate, their formula 2, 3, 4, 1, or, not infrequently, 2, 3, 1, 4; the second arms, which are longest, attaining about 60% the mantle length, the third pair slightly less, the dorsal and ventral pairs one-fifth to one-quarter shorter; keels well developed on the outer angles of all the arms, but reaching a maximum at about the basal third of the third pair; trabeculate marginal membranes also well developed, but those of the third pair not remarkably more than the others, except those of the ventral pair which are somewhat less conspicuous than the rest. Suckers of the sessile arms large, caldron-shaped, biserial, regularly alternating; the largest probably the 6th-7th pairs from the base on the second arms, those of the ventral arms smallest; about thirty-five pairs readily countable on the second arm of a large ♂; horny rings of larger suckers (Figs. 13, 17, 20) smooth below, but armed on their upper and lateral peripheries with a number of stout, acute, triangular teeth, varying from 9 in a ♀ of 180 mm. mantle length, to 12-13 in the larger specimens, the upper median tooth distinctly larger than the others, while

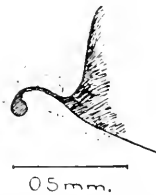


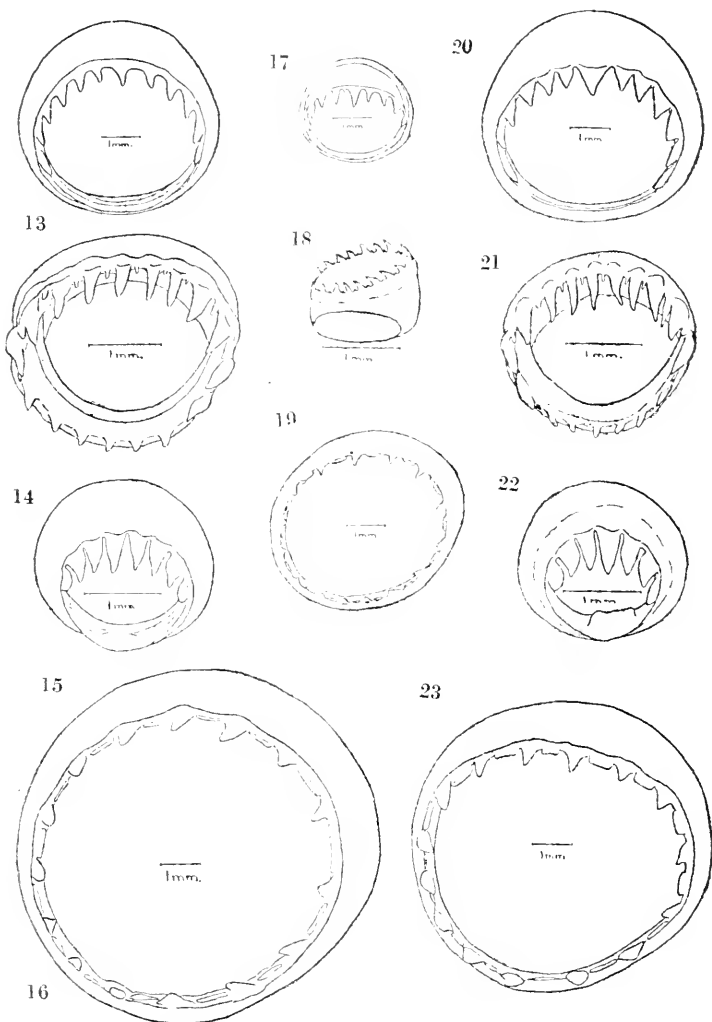
Fig. 12.—*Nototodarus gouldi* ♂, [553], sinus of left eye.

minute interpolated denticles between the ordinary teeth seem to occur only very rarely. True *Umbrella* wanting; tentacle sheath only weakly developed.

In the ♂ both arms of the ventral pair conspicuously modified (Pl. lxiv. ; Pl. lxv., figs. 2-6 ; Pl. lxvi., figs. 3-6), perhaps as clasping organs. Right ventral arm, which is the true *Hectocotylus*, conspicuously differentiated into three main divisions—a heavily tuberculate basal region, a narrowed median sucker-bearing region, and a curiously pectinated distal portion which first expands, then tapers rapidly to an attenuate point. Taking a concrete instance to avoid the confusion which might ensue from the great variation in the details of these organs—in one of the larger examples before me [549] the right ventral arm has the suckers of the five proximal pairs missing (Pl. lxv., fig. 2), their original position evident from their immensely enlarged basal cushions, especially those of the ventral series which are vertical, acutely pointed, angular, and sharply carinated on the inner side, but with their outer faces deeply excavated (Pl. lxv., fig. 6), so that they much resemble the prows of small canoes stuck on end, although the proximal ridge on the outer side of each is not quite confluent toward the tip with the more distal ridge ; on the proximal face near the point occurs a small elongate tubercle marking the original point of attachment of the sucker pedicel (Pl. lxv., fig. 2) ; corresponding cushions of dorsal row only a little more than one-half the height of the ventral cushions and more uniform in size, the former sucker bases on the other hand better developed so that the cushions are given a four-sided shape, all the ridges being very sharp ; in the dorsal row the cushions gradually increase in size to the second or third, thence diminishing again, in the ventral row to the third or fourth, the difference in the size of the cushions being likewise more marked ; sixth cushion in each series considerably smaller than those preceding it and bearing a small sucker. Next five pairs of suckers, except for their thickened, outwardly bifurcating bases and small size, relatively normal in their similarity to suckers correspondingly situated on the three dorsal pairs of arms ; sucker-bearing face of arm here much narrowed, the lower portions of the basal cushions connected by a stout, upstanding, marginal web, abruptly terminating dorsally with the last of the sucker-bearing cushions (sucker missing from this cushion in the present specimen), but continuous ventrally to the tip of the arm (Pl. lxv., figs. 2, 4) ; remainder of arm of very different structure and, except for two suckers persisting

in ventral series beyond their point of cessation dorsally, suckerless; cushions of dorsal series (Pl. lxx., figs. 2, 3, 4) immediately upon cessation of dorsal membrane more crowded, transversely compressed, their apices papillose, bases triangular, at the extreme base thin and plate-like, but swelling out almost immediately, especially on the dorso-distal angle, where a sort of raised knob is formed; proximal faces of these structures swollen and subangular, the distal faces hollowed out so as to fit each against the angle of the next distal cushion; beginning with the twelfth, the dorsal papillae increase gradually in size to about the 15th or 16th, slightly diminish to the 21st or 22nd, then again increase to about the 27th, whence they evenly diminish to the tip of the arm, a connecting web nowhere present; cushions of ventral series very differently modified (Pl. lxx., figs. 2, 3, 5), beginning with the 12th suddenly transversely-elongate, pointed, slightly sinuous, flaring out like the teeth of a comb, though connected nearly to their tips by the strongly developed marginal membrane, giving them a ridge-like appearance; each ridge flanked proximally by a strongly incurved, membranous fold, beginning near the tip and running across to the distal face of the triangular dorsal "cushion" or papilla belonging to the next proximal pair so as to enclose a deep, transverse, trough-like groove; at inner termination of each ridge is a short, conical, somewhat distally directed papilla, indicating the point of attachment of the original sucker; the ridges described attain a maximum at about the 15th or 16th unit (enumerated from the extreme base of the arm), then diminish to the tip; they are somewhat longer than the opposite papillae of the dorsal row. Left ventral arm in agreement with its mate in number, shape and size of the basal cushions, and in the lack of suckers on the five most proximal cushions, but with its distal portion normal throughout; length of this arm about one-quarter more than that of the right arm. Other adult ♂♂ agree very closely with the one described in general plan, but in the number of suckers lost and the number and position of those present as well as other minor details show so innumerable slight variations that a complete description of the hectocotylus of any one of them would not exactly coincide with that of any one of the others (an idea of the character and scope of this variation may be obtained from Table IX.). Gross number of enlarged proximal cushions, coincident point of cessation of marginal web and persistent suckers of dorsal row, and persistence of about two unpaired suckers distally in the ventral row, relatively constant in fully grown specimens.

Immature ♂♂ down to a mantle length of at least 115 mm., readily distinguishable from the ♀♀, though below a mantle length of perhaps 150 mm., their hectocotyli very different in appearance from those of adults. In the smallest specimen mentioned [550] the various types of modified cushions much less strongly developed than above described, the suckers borne the entire length of the arm; proximal cushions passing into the little-modified sucker bases of the central portion of



the arm so imperceptibly that they are scarcely to be separately distinguished except by their smaller suckers and sharper ridges on their outer surfaces, the same being true of the left arm as well; on the right arm dorsal marginal web terminating at the 12th sucker, the succeeding papillæ (Pl. lxvi., figs. 5, 6) relatively weakly developed, for the most part bearing minute terminal suckers, though here and there a few are lost; suckers of ventral series persistent to tip of arm, the ventral marginal membrane on this portion of the arm wide and trabeculate, the trabeculæ weakly duplex and very evidently the precursors of the comb-like ridges seen in the adult, although the membrane itself is here proportionally a more conspicuous part of the structure. Specimens intermediate in size between that just described and the fully formed adult give confirmatory evidence (Pl. lxvi., figs. 3, 4) that as the modified sucker bases gradually attain their final development, both the distal and proximal suckers of the arm gradually fall away, although in some specimens the loss would appear to take place in very irregular fashion (cf. Table IX.).

Fig. 13.—*Nototodarus gouldi* ♀ [548], horny ring of sixth sucker from base in ventral row of left third arm of largest specimen; camera drawing from a mount in balsam.

Fig. 14.—Horny ring from dorso-marginal sucker of left tentacle club of same specimen, taken from approximately same horizontal level on club as that shown in Fig. 16.

Fig. 15.—Horny ring of second carpal sucker of left tentacle club of same specimen.

Fig. 16.—Horny ring of largest sucker on central region of left tentacle club of same specimen.

Fig. 17.—Horny ring of sucker of sixth pair from base of right second arm of a smaller specimen [519].

Fig. 18.—Horny ring of small marginal sucker from near middle of left tentacle club of same specimen.

Fig. 19.—Horny ring of large median sucker from near middle of left tentacle club of same specimen.

Fig. 20.—*Nototodarus gouldi* ♂ (549), horny ring of sixth sucker from base of ventral row of left third arm of large male.

Fig. 21.—Horny ring from dorso-marginal sucker of left tentacle club of same specimen, taken from approximately same horizontal level on club as that shown in Fig. 23.

Fig. 22.—Horny ring of second carpal sucker of left tentacle club of same specimen.

Fig. 23.—Horny ring of largest sucker on central region of left tentacle club of same specimen.

Tentacles variable, usually differing considerably from one another in longitude, the left (in the specimens at hand) almost invariably the longer, attaining a length from 70-98% that of the mantle; more or less compressed, particularly near the base, and strongly keeled along their outer angles for their entire length, the keel reaching its maximum development on the distal half of the club; oral face of stalk not flattened at base, though at a point about half way from the base to where the suckers begin there commence a pair of slight lateral thickenings which soon pass into the trabeculate lateral membranes of the sucker-bearing area; sucker-bearing portion of tentacle about 60-70% of the entire length, about two-thirds of this comprised by the club proper. *Tentacle club* with suckers borne in four rows: all the suckers of both marginal rows small; about eight pairs of the central suckers much larger than the others, the 4th-5th pairs of these largest of all; after the 8th pair, suckers of the two median series suddenly reduced so that thenceforth those of the ventromarginal series are largest; all suckers on distal one-third or so of the club relatively small, gradually diminishing in size dorsally and distally, finally terminating in an oval group of very minute, crowded suckers just proximal to the small apical cap of the club; suckers of two median rows not changing in size with such abruptness proximally, but the eight large pairs succeeded by three pairs of evenly diminishing suckers, which, with the marginal series pass imperceptibly into two rows of very small suckers (some 4-6 pairs) on the carpus (Pl. lxvi., fig. 2); carpal suckers evincing a tendency to occur in alternating, but only slightly differentiated, sizes,

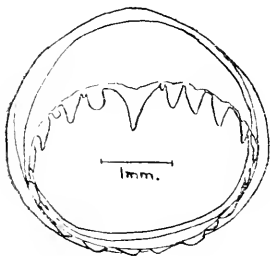


Fig. 24.—*Ommastrephes hawaiiensis* ♀ [243], horny ring of sessile arm sucker of type, viewed obliquely from upper side; camera drawing from a mount in balsam.

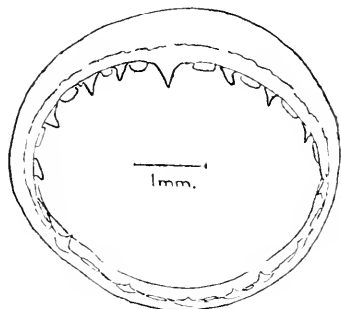


Fig. 25.—*Ommastrephes hawaiiensis* ♀ [243], horny ring from large tentacular sucker of type; camera drawing from a mount in balsam.

TABLE IX.

Author's Register Number	[562]		[563]		[549]		[559]		[547]		[5]		[534]		[564]		[569]		[550 ¹]		
	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	Dorsal	Ventral	
Right Ventral Arm—																					
Total number enlarged basal tubercles	6	6	6	6	6	6	6	6	—	—	4	5	6 ¹	6 ⁷	6	6	4	5	5 ²	5 ²	
Basal tubercles without suckers	4	4	6	5	5	5	4	5	3	4	0	15	3	4	4	5	1	2	0	0	
Basal tubercles with small suckers	1	1	0	0	0	1	1	0	2	1	3	4	2	3	1	0	1	0	2	4	
Basal tubercles with "normal" suckers	1	1	0	1	1	0	1	1	2	1	1	0	1	1	1	1	0	2	1	—	
Total number suckers	7	9	21	7	5	6 ²	7	8	9	—	17	38	8	10	6	6	—	21	—	—	
Suckers of "normal" size and with "normal" bases	5	6	11	5	4	5 ²	5	5	7 ⁴	—	7	36	5	5	4	4	7	7	0 ⁹	7	
Suckerless tubercles before dorsal web stops	0	—	3	—	1	—	0	—	0	—	0	—	0	—	0	—	0	—	0	—	
Last tubercle connected with dorsal web	11	—	10	—	11	—	11	—	12 ⁸	—	11	—	11	—	10	—	11	—	12	—	
Last paired suckers	11	11	11	11	10	10	11	11	12	—	24	24	11	11	10	10	12	12 ⁹	—	—	
Unpaired suckers persisting distally	—	2	—	1	—	2 ¹	—	2	—	3	—	2 ³	—	3	—	1	—	12	—	—	
Largest basal tubercle	2	3	2-3	4	3	4	2-3	3-4	4	3-4	2-3	4-5	3	3	3-4	3	—	3	4	3	
Largest distal tubercle	16x 29	16-17	15	16-17	15x 27	15-16	16	15	8	—	8	—	20 ⁵	19	14	15	16	15	—	—	
Left Ventral Arm—																					
Total number enlarged basal tubercles	6	6	6	6	6	6	7	7	7	7	5	6	6	7	6	6	5	5	5 ³	5 ³	
Basal tubercles without suckers	3	4	5	5	5	5	4	4	3	4	2	1	4	4	4	5	2	2	0	0	
Basal tubercles with small suckers	2	2	1	1	1	1	2	1	2	2	3	4	1	2	1	0	2	3	4	1	
Basal tubercles with "normal" suckers	1	0	0	0	—	—	1	1	2	1	0	1	1	1	1	1	1	0	1	1	
Largest basal tubercle	2-3	3-4	2	3-4	2	3	4	5	3-4	5	3	4	6	4	3	3	3-4	4	4	4	

1.—Suckers missing from tubercles 8-10.

2.— 1 median sucker missing.

3.— 1 of these paired with 11th tubercle (suckerless) of dorsal row.

4.— 10th cushion of dorsal row bears only a very minute, possibly abnormal, sucker, here included.

5.— The fifth.

6.— The 6th cushion is suckerless and is not included.

7.— Difficult to draw line here.

8.— The third. The sucker is very minute.

9.— These are the 13th, 15th, 19th, 25th, and 17th, 28th, all but the first three excessively small.

10.— 1 additional base, the 6th, from which sucker is missing.

the larger evidently a continuation of the two central rows the system just outlined), and comprising first a small pad, then three large ones in regular alternation with the suckers of this row on the basal portion of the club. Horny rings of atus sometimes so obscure as to be practically indistinguishable, but where best preserved finding its proximal beginning after the third sucker of the dorso-marginal row (counting on of the club, the smaller of the marginal rows. Fixing apparatus—largest tentacular suckers (Figs. 16, 19, 23) toothed all around with about 15 distant, short, stout, conical, pointed teeth, alternating with an equal number of short, wide, rectangular plates, the upper median tooth only very slightly larger than its neighbours. Horny rings of lateral suckers on the club proper (Figs. 14, 18, 21) very deep on the upper side and toothed all around with about 17 acute, conical teeth with swollen bases, which on the superior margin of the ring are long, slender, curved, and alternate with about 11-12 usually very minute, conical interstitial teeth becoming rudimentary and finally obsolete below. Horny rings of small carpal suckers (Figs. 15, 22) with relatively much smaller apertures than the other suckers, their upper margins armed with 7-8 very large, closely placed, conical teeth, the median apt to be somewhat the largest; lower margins of these suckers expanded, not toothed, usually bearing an irregular ridge near the middle.

Buccal membrane well developed, seven-pointed, wrinkly rugose within.

Beak (Fig. 26) with strong black mandibles; inner wings of ventral mandible with a supra-median depression, a weak ridge on the shoulder, and a narrow groove just below the summit.

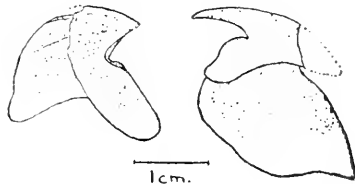


Fig. 26.—*Nototodarus gouldi* ♀ [510], camera drawing of mandibles.

Radula (Fig. 27) with tridentate median teeth, their central cusps a trifle over twice as long as the side cusps; 1st laterals also tridentate, but their inner cusps originating more deeply than the outer and only about half as long, the central cusps about as long as those of the median teeth, but slightly oblique; 2nd laterals with their principal cusps perhaps half again as long as those of the 1st laterals, each

bearing a very weak side cusp at the inner shoulder ; marginal teeth with long, simple, slightly arcuate blades, a little over twice the length of the central cusps of the median teeth.*

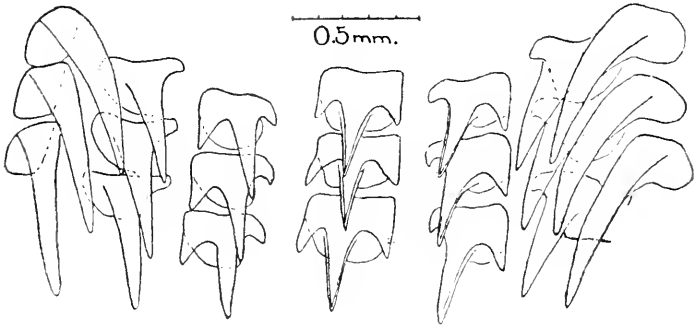


Fig. 27.—*Nototodarus gouldi* ♂ [564], three rows of teeth from radula ; camera drawing from a mount in balsam. No attempt is made in this drawing to show the marginal plates.

Gladius with the cone marked by numerous ridges and grooves, but not showing the definite division into three to four segments indicated by McCoy's figure.

Colour of preserved specimens similar to that of other *Ommastrephidæ*.

Measurements.—

TABLE X.—MEASUREMENTS OF *Nototodarus gouldi*.

Type.—In the National Museum, Melbourne (McCoy).

Type Locality.—Victoria (McCoy).

Recorded Distribution.—Sydney, New South Wales (? Pfeffer, as *Ommatostrephes Sloanei Sloanei*) ; Victoria (McCoy) ; Melbourne, Victoria (? Pfeffer, as *Ommatostrephes Sloanei Sloanei*) ; 60-220 fathoms, Bass Strait (" Endeavour ") ; 56 fathoms, Bay of Fires, Tasmania (" Endeavour ") ; 70 fathoms off Cape Barren, Tasmania (" Endeavour ") ; 75-80 fathoms, off Tasman Head, Tasmania (" Endeavour ") ; 350-450 fathoms, Great Australian Bight (" Endeavour ") ; 80-320 fathoms, off Eucla, Western Australia (" Endeavour ").

* In the radula of a large ♀ examined the teeth of the three median rows seem relatively longer and more slender than in the specimen figured.

TABLE X.—MEASUREMENTS OF *Nototolurus gaulti*.

Author's Register Number...	[562]	[565]	[549]	[559]	[518]	[552]	[547]	[553]	[554]	[564]	[566]	[558]	[550]	[548]	[561]	[510]	[516]	[555]	[517]	[551]	[560]	[56]	[46]	[41]	[563]
Sex...	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀
Total length	300	375	360	475	505	445	430	370	360	345	370	300	224	610	530	000.	000.	000.	000.	000.	000.	000.	000.	000.	000.
Length of body, dorsal...	260	260	245	225	225	215	210	189	185	172	165	140	115	300	272		250	243	238	237	218	210	180	180	76
Length of body, ventral...	250	250	240	215	210	205	204	185	177	169	205	132	110	285	263	260	240	248	235	230	210	200	178	175	72
In. of body to base of dorsal arms...	315	315	295	270	275	257	250	225	218	210	155	170	138	300	320		200	200	250	280	260	240	212	210	88
Length of fin	115	115	105	97	95	92	90	80	76	70	75	59	50	128	112	103	105	105	95	106	100	84	78	75	29
Width across fins	147	150	135	118	115	110	112	97	100	92	88	71	60	150	141	135	135	126	110	125	118	105	93	85	37
Width of body	51	..	57	44	52	49	41	34	36	32	43	31	24	64	53		45.5	46	43	48	46	39	32	30.6	17
Depth of body	62	..	57	42	42	33	30	30	32	30	43	24	24	53	46		17.2	55	40	40	39	34	29	28	16.5
Width of head across eyes...	56	50	46	43	40	40	36	34	38	26	36	26	23	54	52	52	42.3	40	41.4	48	40	33	26	29	17
Length of head	47	40	50	40	47	43	35	31	31	34	35	25	21	55	41	35	41	50	43	43	40	30	28	25	13
Length of funnel, median...	43	42	42	33	40	34	33	30	35	25	27	20	17	42	38	36	36	40	37	35	35	31	27	25	11
Length of right dorsal arm...	122	118	127	101	115	92	92	75	81	75	83	55	46	135	100	112	115	122	110	117	116	78	66	63	26
Length of left dorsal arm...	122	123	135	105	112	90	96	75	83	67	87	55	46	131	100	106	130	117	111	116	114	77	68	66	26
Length of right second arm...	125	139	160	132	130	111	123	101	106	90	104	70	58	158	125	139	135	145	130	141	124	100	92	86	32
Length of left second arm...	140	165	162	130	135	112	121	100	104	90	103	68	56	158	125	140	100	148	134	138	127	97	92	80	32
Length of right third arm...	148	130	148	119	133	105	120	100	102	90	97	70	55		120		145	143	130	127	120	92	82	85	31
Length of left third arm...	141	150	150	120	139	117	120	90	97	86	96	66	54	153	118	137	140	130	128	128	120	95	86	73	31
Length of right ventral arm...	120	125	112	99	106	85	90	72	80	76	76	53	39	125	109	115	120	115	117	114	115	81	71	72	25
Length of left ventral arm...	135	135	138	105	117	102	105	75	86	74	78	55	46	128	108	167	122	113	117	115	113	80	77	67	25
Length of right tentacle...	265	260	225	185	240	180	162	152	140	125	170	130	80		205	215	210	220	240	180	195	140	135	120	43
Length of sucker-bearing area of right tentacle...	180	179	155	130	155	113	105	102	95	80	105	80	57		140	155	150	153	150	120	125	90	85	80	28
Length of left tentacle...	215	250	270	210	220	185	195	157	140	140	178	125	86	245	185		240	240	245	208	185	162	150	120	42
Length of sucker-bearing area of left tentacle...	145	179	175	145	146	120	118	107	95	90	115	80	57	160	135		160	165	152	140	115	100	90	80	28

Material Examined.—

TABLE XI.

No. of specimens.	Sex.	Depth in Fathoms.	Locality.	Original Number.	Author's Register	Remarks.
1	♀	60-100	East edge of Bass Strait, Gabo to Babel Islands	E3076	[556]	
1	♂	"	"	E3077	[564]	
1	♂	"	"	E3078	[557]	
1	♂	"	"	E3079	[547]	
1	♀	100-220	"	E3080	[519]	
1	♀	"	"	E3081	[546]	
1	♀	130-320	Long. 126° 35¼' E., Great Australian Bight, S. × W. of Eucla, W.A.	E3608	[548]	largest ♀
1	♂	80-120	Long. 129° 28' E., Great Australian Bight, S. of Eucla, W.A.	E3610	[511]	
1	♂	"	"	E3611	[558]	
1	♂	"	"	E3612	[512]	
1	♂	"	"	E3613	[562]	large ♂
1	♂	"	"	E3614	[518]	
1	♂	"	"	E3615	[565]	large ♂
1	♂	"	"	E3616	[510]	
1	♂	"	"	E3617	[553]	
1	♂	"	"	E3618	[549]	large ♂
1	♂	350-450	Long. 129° 28' E., Great Australian Bight.	E3627	[566]	
1	♀	160-200	Long. 127° 8' E., Great Australian Bight, S. × W. of Eucla, W.A.	E4313	[517]	
1	♀	"	"	E4314	[555]	
1	♀	"	"	E4315	[559]	
1	♀	"	"	E4316	[516]	
2	♂♂	75-80	Off Tasman Head, Tasmania	E4879	[513]	
1	♀	56	Bay of Fires, Tasmania . . .	E4884	[561]	Mar. 26,
1	juv.	..	East slope of Bass Strait, between Gabo and Babel Ids.	E5342	[563]	[1914]
1	♀	70	20 m. east of Cape Barren, Tas.	E6062	[560]	
1	♀	"	"	E6063	[554]	
1	♀	64	Off Babel Island, Bass Strait	E6065	[551]	
1	♀	"	"	E6066	[552]	
1	♂	70	20 m. east of Cape Barren, Tas.	E6070	[550]	

Remarks.—I believe that this large South Australian Ommastrephid, the most plentifully represented cephalopod in the entire "Endeavour" series, is unquestionably referable to the *Ommastrephes gouldi* McCoy, although the discovery that both ventral arms in the male suffer the modifications collectively known as hectocotylization shows that the species must be transferred to the recently established genus, *Nototodarus* Pfeffer to constitute its second known species. I

believe it to be probable from McCoy's description that he, himself, observed the peculiar double hectocotylus, as he speaks (1888, p. 256) of " the replacement of the suckers by tubercles on bases of two of the arms in some specimens," inferring this to be " accidental," but from the context it is perhaps not quite apparent whether he was here referring to his own species or to Gould's description of the related *O. insignis*, much misunderstood until its recent elucidation by Pfeffer. How so elaborately developed an organ as the hectocotylized arm in this species could possibly be construed as " accidental " is a bit difficult to understand, although it should be remembered that in McCoy's time, except for the brief observations of Gould, nothing resembling it had been described in the entire class *Cephalopoda*. Even now I am aware of no other oegopsid which boasts a hectocotylus of such complexity. Without actual observation of the animal in life, it would indeed be hazardous to speculate on the functions of its innumerable special modifications, but one is quickly struck with the notion that the hard, massive, jagged, in-facing tubercles so powerfully developed on the basal segments of both ventral arms (Pl. lxx., fig. 2) might well co-operate to form a most efficient clasping organ.

O. gouldi has not been reidentified with any certainty since its original description and consequently has never been properly understood or received general acceptance, despite the fact that, though somewhat stereotyped, McCoy's description and figures are really very good. The principal points wherein the present specimens fail to accord with his diagnosis are all to be explained, it seems to me, on the basis either of incomplete representation (as in the lack of a foveola in McCoy's drawing, the small number of grooves in the cone of the gladius, and the lack of interstitial teeth or plates in the tentacular horny rings), or as being within the limits of normal variation (as where the number of teeth in the marginal tentacular suckers is given as 20). McCoy also mentions that the arms in his specimen, except on the ventral margins of the third pair, are " without membranous borders." In the " Endeavour " material the ventral membranes of the third arms are simply a trifle wider than elsewhere.

Pfeffer, in his great monograph (1912, p. 459*), describes the

*Pfeffer's description in full is as follows:—

" Das vorliegende Stück des Göttinger Museums von 170 mm. Mantellänge hat einen *hektokotylisierten rechten Ventralarm*. Die proximale Hälfte des Armes ist durchaus normal gebildet; die distale Hälfte ist stark umgebildet, und zwar in einer Weise, die sich von der Hektokotylisation des verwandten *O. sagittatus* beträchtlich unterscheidet. Betrachten wir zunächst die

hectocotylus of a small male Ommastrephid (mantle length 170 mm.) from Sydney in the Göttingen Museum, which he identifies with the New Zealand *O. sloanii*. Although the interpretation of some of his phrases is not exactly clear to me, while further he expressly states that the proximal portion of the right ventral arm is normal, leaving us to assume that the left ventral arm is entirely unmodified, his description of the distal portion of the arm so accurately describes the remarkable condition witnessed in young males, such as my 550 (Pl. lxvi., fig. 6), that I have hardly any doubt at all that his specimen is specifically the same. The "Endeavour" series is especially valuable in displaying the complete transition between the relatively little modified condition described by Pfeffer and that of the fully-grown adult.

This brings us to the question whether the South Australian species is not, after all, identical with the New Zealand form, and hence properly to be recorded under Gray's prior name *sloanii* as Pfeffer has done. This thesis I am not yet ready to support. Gray states distinctly that in his specimen from Waitemata the horny rings of the sessile arm suckers have the "higher side with *regular acute teeth*" (*italics mine*), and, while most of the rest of his description is in fair

dorsale Langshälfte des Armes. Hier vermindert sich die Dicke des Armes ganz unvermittelt und schroff auf die Hälfte; demgemäss bricht der Schutzsaum der proximalen Hälfte hier auch plötzlich ab und erscheint, der Verdünnung des Armes gemäss, an anderer Stelle wieder, um nach einem Verlaufe, der dem Langsbereich von fünf Saugnäpfen entspricht, zu verschwinden. Nach aussen von diesem Schutzsaum, und über ihn hinweg geklappt, findet sich eine niedrig lappenförmige Erhebung des Schwimmsaumes, etwa in der Art, wie sie auf dem 3. Arme der meisten Oegopsiden aufzutreten pflegt. Die Basalpolster der dorsalen Napfreihe der umgebildeten distalen Hälfte des Armes richten sich senkrecht hoch, indem sie platte, in die Quere verbreiterte Schuppen bilden. Von diesen erheben sich, und zwar nach der Mittellinie des Armes zu sich scharf winkelig von ihnen absetzend, die sehr verlängerten, quer dreieckig verbreiterten Stiele der Saugnäpfe. Diese tragen Näpfe bis an die äusserste Spitze des Armes.

Die Näpfe der Ventralreihe des hektokotylierten Armes blieben samt ihrem Stielen annähernd normal; dagegen ist der ventrale Schutzsaum mächtig entwickelt und, entsprechend den einzelnen Saugnäpfen, in einzelne zungenförmige Spitzen ausgezogen. Die Querstützen, sowohl die von der dorsalen wie ventralen Reihe der Basalkissen entspringenden, laufen als je ein Paar stark erhabener, durch eine Längsfurche voneinander getrennten Rippen über die orale Fläche und über den Schutzsaum hinweg in die zungenförmigen Zipfel hinein, schliesslich zusammenlaufend. Auf den distalen Viertel des Armes erscheinen die Zipfel zunächst weniger kräftig ausgeprägt; noch weiter distal tritt wieder der annähernd normale kontinuierliche Schutzsaum auf."

accord with the present specimens, his whole diagnosis is so brief, withal so deficient in its mention of truly critical points, that one cannot really be sure of even the generic position of his species, though I think it will very likely prove to be a *Nototodarus*. In view of these facts, science can surely gain nothing from a too hasty "lumping" of the various species. In the meanwhile Gray's type in the British Museum should be re-examined, re-described in detail, and adequately figured at the earliest opportunity. Pfeffer's statement on p. 459 (op. cit.) that "Es ist schliesslich die Möglichkeit nicht von der Hand zu weisen, dass die Form *O. Sloanei Sloanei* gar keine einheitliche systematische Einheit darstellt, sondern in sich mehrere verschiedene Formen beherbergt," I think may very likely prove to strike at the real crux of the matter. I have always been rather more inclined to split up the various Pacific races of *Ommastrephidæ* than most writers, yet it is now evident that the Japanese *O. pacificus* Steenstrup and apparently also the lately described *O. volatilis* Sasaki are perfectly distinct species, having far less relationship with the other Pacific forms than even I have formerly conceded (cf., in the case of *pacificus*, Berry, 1912, pp. 436-437; 1914, pp. 340-341).

Apparently the nearest known relative of *N. gouldi* of which we can be certain from the literature is Pfeffer's remarkable specimen from New Zealand, which he identifies with *Ommastrephes insignis* Gould, and by reason of which he erects the genus *Nototodarus* (Pfeffer, 1912, p. 434, pl. 31). Whether or not this specimen be actually the same as that described by Gould, its simpler hectocotylus indicates it to be sufficiently distinct from McCoy's species. Another interesting point to consider is the apparently close relationship evinced also by females of *N. gouldi* and my *Ommastrephes hawaiiensis* (Berry, 1912, pp. 434, 437; 1914, p. 338, text-fig. 38-39, pl. 54, fig. 2). The significance of this is, no doubt, that the discovery of males of *hawaiiensis* will necessitate its removal from *Ommastrephes* to *Nototodarus*. Although I no longer have any specimens of the latter species available for direct comparison, there appear to be certain small but constant characters sufficient to separate even female specimens from those of *N. gouldi*, notably the toothing of the horny rings. The rings of the larger sessile arm suckers (Fig. 24) are toothed all around with 19 to 21 teeth, occasional minute denticles appearing interpolated among the latter along the upper margin of the ring. The upper median tooth is much larger with respect to the other teeth than in the case of *N. gouldi*. The larger tentacular suckers (Fig.

25) show 13 to 16 acute teeth alternating with an equal number of thin, arcuate plates, here again the upper median tooth being conspicuously the largest. To better bring out these small differences I here append figures of horny rings from both a sessile arm and tentacle club of the type specimen (dorsal mantle length 138 mm.) of *O. hawaiiensis*. Figs. 17 and 19 show similar structures from a female specimen of *N. gouldi* of only slightly larger size (dorsal mantle length 180 mm.). Other differences in the two species worth noting are the relatively larger head of *hawaiiensis*, the apparently fewer and larger arm suckers, and the much shorter fins.

The radula of *N. gouldi* reminds one very much of that of *O. sloanii* as figured by Hutton (1882, pl. vi., fig. B). It is also surprisingly similar to that of *Ommastrephes sagittatus* as figured by Girard (1890, pl. —, fig. 3e), though not at all like those of the other genera of the family as he illustrates them. This bears out the evidence of other structural features that *Nototodarus* is exceedingly nearly allied to *Ommastrephes* s.s. and quite possibly to be regarded as a comparatively recently more highly specialised offshoot from the latter.

The small, round, thin transparent "window" in the integument of the ventral surface of the head covering the eye, so well shown in Pfeffer's figures of New Zealand *Ommastrephes sloanii* and other Ommastrephids, can be made out in the "Endeavour" specimens. Its probable function is a puzzle, but it puts one strongly in mind of the similarly situated transparent membrane which overlies the subocular photophores of *Watasenia*, *Enoploteuthis*, and allied genera, and permits the better escape of the light rays. On this slim ground I have made a careful search for subocular photogenic organs in *Nototodarus*, but have been unable to demonstrate their presence. On a more favourable occasion I hope by recourse to sectioning to settle the matter conclusively.

Division MYOPSIDA.

Family LOLIGINIDÆ.

Genus LOLIGO, *Schneider*, 1784.

LOLIGO ETHERIDGEI, *sp. nov.*

(Plates lxvii.-lxviii. ; Plate lxi., figs. 1-2.)

Animal of moderate size, of the characteristic *Loligo* outline. *Mantle* cylindrical in front, slightly swollen near the middle, thence tapering between the fins to a moderately acute point behind. *Fins* large, about three-fifths as long

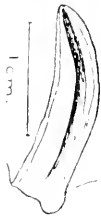


Fig. 28. — *Loligo etheridgei* ♂ [490], locking cartilage, from left side of funnel of paratype; camera outline.

as the mantle; sagittate; scarcely lobed in front, behind barely continuous above the posterior tip of the body: widest a little in front of the middle, the lateral margins obtusely angled. Anterior mantle margin projecting forward in nuchal region to a rounded angle, a similar but more acute projection on either side of the funnel. *Locking apparatus* well developed, the lateral cartilages (Fig. 28) relatively broad, with a wide central excavation.

Head small, narrower than the body, widest behind, where it is ornamented by a strong fold of the integument; distinctly tapering past the eyes to the point of junction with the arms. *Eyes* large, not protruding. *Funnel* stout, with dorsal bristles and a large terminal valve.

Arms stout, rather short; their formula of relative length, easily 3, 4, 2, 1; third pair decidedly the stoutest and longest, dorsal pair distinctly smallest and shortest, the others nearly equal; dorsal arms conspicuously keeled above; second

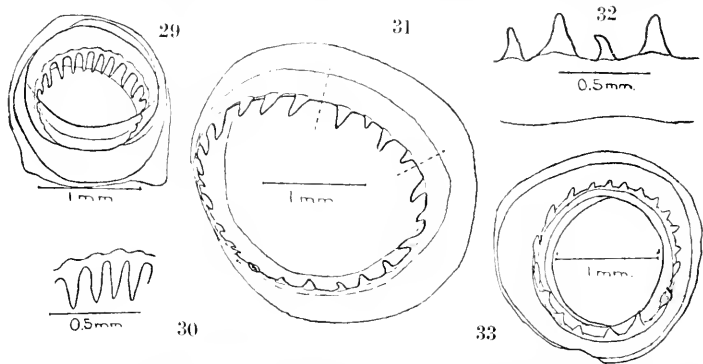


Fig. 29.—*Loligo etheridgei* ♂ [489], horny ring of sucker of 7th-8th pair from base of right third arm of type; camera drawing from a mount in balsam.

Fig. 30.—Teeth from superior margin of same, seen in greater magnification.

Fig. 31.—Horny ring of eighth sucker from base of inner ventral row of left tentacle club of paratype [490]; camera drawing from a mount in balsam.

Fig. 32.—Portion of margin of same, seen in greater magnification.

Fig. 33.—Horny ring from one of the larger suckers of the ventro-marginal series on the left tentacle club of type [489]; camera drawing from a mount in balsam.

pair of squarish outline, the dorsal outer angle subcarinate, the lower keeled; third pair roughly triangular, their conspicuous outer keels continuous with the tentacle sheaths and thus with the broad outer keel of the squarish ventral arms, the latter again keeled on their inner (*i.e.*, ventral aboral) margins. Trabeculated swimming membranes well developed on all the arms, especially the third, though quite narrow on the ventral pair. Suckers small, biserial, more or less kettle-shaped: obliquely perched on short conical pedicels: apertures notched at the apex: horny ring (Figs. 29-30) armed along their superior margins with (in the largest) 12-13 very long, narrow, pointed teeth, reduced to rudiments on the sides and obsolete below. A large sucker from near the middle of the right third arm has a maximum diameter of 1.57 mm.

Left ventral arm of male *hectocotylized* (Pl. lxxx., fig. 2), the proximal portion apparently normal for about three-fifths the total length, or about the first 17 pairs of suckers; at this point suckers of ventral series becoming much reduced and the thickened bases of their pedicels very elongate, especially the first nine to suffer the modification; first of these modified pedicels possessed of a small but unmistakable sucker with a well-developed horny ring, those following having their suckers reduced to tiny, knob-like swellings at their tips (Fig. 34): in dorsal series first 19 suckers unmodified, then giving way to stout, conical papillæ scarcely half as long as their mates of the opposite series (the second papilla, which is the longest of the ventral series, measures approximately 2.5 mm.), but like these having their suckers reduced to tiny swellings at their apices; papillæ of both series regularly diminishing in size distally, not, so far as the present material shows, again giving way to normal suckers toward the extremity. *Umbrella* rudimentary, except for the usual tentacle sheath.



Fig. 34.—*Loligo etheridgei* ♂ [489], portion of hectocotylized arm of type, showing the commencement of the modified papillæ; camera sketch.

Tentacles of moderate length; *Tentacle club* (Pl. lxxx., fig. 1) well expanded, bearing an outer keel broadened distally into a fleshy membrane, and a well developed trabeculated

membrane bordering the sucker-bearing area ; suckers bowl-shaped, numerous, in four rows, those of the two median series on the expanded portion of the club half again as large as the corresponding suckers of the marginal series ; suckers numbering about 12 in each series before the narrow distal part (the latter comprising less than one-third the length of the club) is reached, where those in all four series become very minute, those of the ventral series slightly the largest, the others diminishing slightly in size both distally and toward the dorsal margin ; number of suckers in each row on this distal part of club about 25. Horny rings of larger central suckers of club armed (Figs. 31-32) with 21-26 acute well-separated, conical teeth, largest on the upper margin,

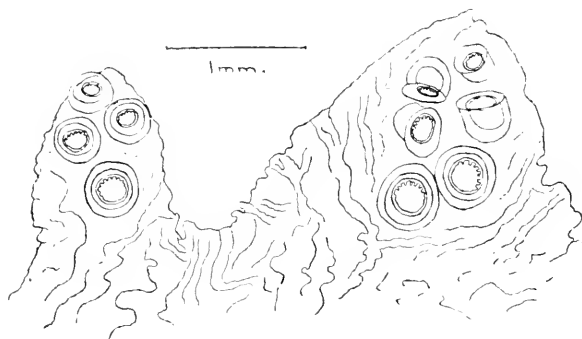


Fig. 35.—*Loligo etheridgei* ♂ [490], two ventral lappets of right side of buccal membrane of paratype ; camera drawing from a mount in balsam.

but continuing around the entire circumference, the large and small teeth as a rule in regular alternation. One of the largest of these suckers has a maximum diameter of 2.88 mm. Horny rings of the larger marginal suckers (Fig. 33) with 19-22 acute, incurved teeth, smaller on the lower margin, but not clearly in alternating sizes. One of these marginal suckers measures 1.92 mm.

Buccal membrane 7-pointed, each point bearing from 4 to 7 minute, biserially arranged suckers (Fig. 35), their horny rings toothed along the upper margin with about 8 square-pointed teeth. The largest of the suckers shown in the drawing has a maximum diameter of exactly .5 mm.

Mandibles shown in Fig. 37.

Radula (Fig. 38*) showing rhachidian teeth each with large conical, down-curved, central cusps and a small, triangular, marginal cusp on each side: first laterals with large, conical, central cusps and a small, conical

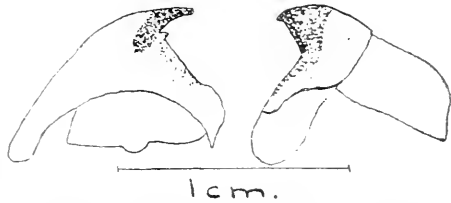


Fig. 36.—*Loligo ethridgei* ♂ [490], part camera drawing of mandibles.

cusp on the outer margin, the inner margin more or less produced but not cusped, so that they much resemble broken rhachidian teeth in shape as well as in size if allowance be made for the "break"; second laterals larger, comprising a broad, rapidly tapering knife-like blade, springing from a base shaped like an inverted chapeau; marginals with inconspicuous bases, but their slender, talon-shaped blades largest of all.

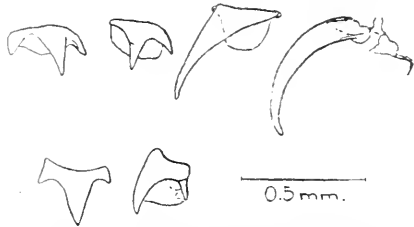


Fig. 37.—*Loligo ethridgei* ♂ [490], teeth of one side of one row of radula of paratype; camera drawing of a mount in balsam. Additional views given below of a rhachidian and first lateral tooth.

Gladius† (Fig. 36) strongly convex, the wings relatively compressed toward one another, so that in situ the outline appears much narrower than shown in the figure; anterior projection of rhachis relatively short and wide, tapering rapidly between the wings which originate from it rather abruptly; wings with a strong thickening for most of their length, but this is not marginal; midrib much darker than remaining portions.

*Unfortunately, in the specimen chosen for mounting the margins of the radula were so much curled inward that it had to be more or less torn apart before it could be drawn. As a consequence it is not certain that all the teeth shown in the figure belong in exactly the same transverse series, though all are taken from that region of the organ where the teeth are best developed and from as nearly the same horizontal level as possible.

†The gladius of the type, which is that described, was found to be badly broken. That of the paratype had been removed before the specimen came into my hands.



Fig. 38. — *Loligo etheridgei* ♂ [489], reconstructed drawing of gladius of type, represented with wings pressed flat.

Color in alcohol or formalin brownish with iridescent or metallic patches; chromatophores (most numerous along the medio-dorsal line) reddish brown.

Type.—A ♂, E6068 [S.S.B.489], in the collection of the Australian Museum, Sydney. A paratype [S.S.B. 490] has been retained by the writer.

Type Locality.—"Australian Seas (? S. E.)": ("Endeavour"); 2♂♂.

Remarks.—It is rather a gamble to describe an Australian *Loligo* until someone having access to the British Museum collections can enlighten us as to what Gray's *L. australis* really is. The original description is not only meagre, but is sufficiently broad in terms to apply about equally well to either of the two or three Australian species of the genus which I have before me at this writing. Fortunately one of these is a specimen from Port Jackson [S.S.B. 488], sent me by Mr. Hedley with a note stating that it was identified at the British Museum as *L. australis* Gray. Assuming the correctness of the determination, *australis* must be regarded as altogether different from the "Endeavour" species.

In size and the general outline of its body, *L. etheridgei* recalls Pfeffer's figures of *L. indica*, but differs in the somewhat larger fins and different dentition of the horny rings, more especially those of the sessile arms, which in *L. indica* are said to be squared ("viereckigen") and only about six in number, though comparison should be made with the notes given by Massy (1916, p. 218-221). Its type locality is Java. I agree with Goodrich (1896, p. 7) that a serious discrepancy exists between the specimens taken by the "Challenger" in the Arafura Sea, as illustrated by Hoyle, and the original description by Pfeffer.

L. edulis, Hoyle, is a stouter, more robust species. The horny rings of its sessile arm suckers are long, but are described as square-cut and but eight in number. Those of the larger tentacular suckers are said to bear about 20 large teeth, with nearly as many smaller ones in alternation.

Measurements :

TABLE XII.—MEASUREMENTS OF *Loligo etheridgei*.

Author's Register Number.....	[489]	[490]
	Type.	Paratype
Sex.....	♂	♂
Total length.....	mm. 265	mm. 263
Length of body, dorsal.....	132	143
Tip of body to base of dorsal arms.....	148	165
Length of fins, extreme.....	80	85
Width of body.....	30	29
Width across fins.....	73	70
Width of head across eyes.....	23	22
Length of head.....	18	20
Length of funnel (median).....	20	23
Length of right dorsal arm.....	32	33
Length of left dorsal arm.....	34	34
Length of right second arm.....	37	43
Length of left second arm.....	40	44
Length of right third arm.....	47	55
Length of left third arm.....	47	55
Length of right ventral arm.....	42	46
Length of left ventral arm.....	44	46
Length of hectocotylus.....	18	19
Length of right tentacle.....	120	92
Length of right tentacle club.....	35	39
Length of left tentacle.....	98	103
Length of left tentacle club.....	35	39

GENUS SEPIOTEUTHIS, *de Blainville* 1824.

SEPIOTEUTHIS AUSTRALIS, *Quoy and Gaimard* 1833.

1833. *Sepioteuthis australis*, Quoy and Gaimard—Zool. Voy. "Astrolabe," t.2, p. 77, pl. 4, fig. 1.
1839. *Sepioteuthis australis*, d'Orbigny, in d'Orbigny and Férussac—Céph. acét., p. 300, Sepiot., pl. 5, fig. 5; pl. 6, figs. 15-21.
1845. *Sepioteuthis australis*, d'Orbigny—Moll. viv. et foss., p. 324, pl. 17, fig. 15.
1849. *Sepioteuthis australis*, Gray—Ceph. Brit. Mus., p. 79.
1879. *Sepioteuthis australis*, Tryon—Man. Conch., v. 1, p. 151, pl. 61, figs. 201-205.
1883. *Sepioteuthis australis*, McCoy—Prodr. Zool. Victoria, Dec. 8, p. 5, 27, pls. 76-77.

1889. *Sepioteuthis australis*, von Martens—Forsch. Gazelle, III, p. 191 (*vide* Hedley).
1892. *Sepioteuthis australis*, Brazier—Cat. Ceph. Austr., p. 14.
1913. *Sepioteuthis australis*, Wülker—Ceph. Aru und Kei Ins., p. 461, 462, 463, 470, 482, 485.
1916. *Sepioteuthis australis*. Hedley—Journ. Roy. Soc. W. Austr., v. 1, p. 21 (merely catalogued).

Recorded Distribution.—Darnley Island, Torres Strait (Gray); Port Jackson, New South Wales (Gray); Western Port, Victoria (Quoy and Gaimard); Port Phillip, Victoria (McCoy); Mermaid Straits, Western Australia (von Martens).

Material Examined.—1 ♀, E6064 [S.S.B. 509]; "Australian Seas (? S.E.)"

Measurements.—

TABLE XIII.—MEASUREMENTS OF *Sepioteuthis australis*.

Author's Register Number.....	[509]
Sex.....	♀
Total length.....	mm. 505
Length of body, dorsal.....	265
Length of body, ventral.....	238
Tip of body to base of dorsal arms.....	295
Width of fin at widest point.....	54
Width across fins, at widest part near middle.....	170
Width of body in same region.....	64
Width of body at anterior third.....	70
Length of head.....	37
Length of funnel, median.....	47
Length of right dorsal arm.....	71
Length of left dorsal arm.....	73
Length of right second arm.....	92
Length of left second arm.....	91
Length of right third arm.....	104+
Length of left third arm.....	108
Length of right ventral arm.....	111
Length of left ventral arm.....	111
Length of right tentacle.....	196
Length of right tentacle club.....	81
Length of left tentacle.....	209
Length of left tentacle club.....	84

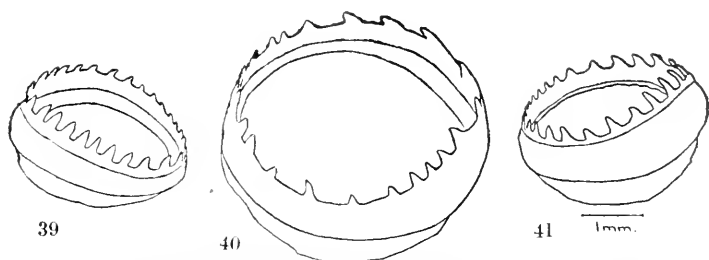


Fig. 39.—*Sepioteuthis australis* ♀ [509], horny ring of fifth sucker from base in ventral series of right third arm; camera drawing from a mount in balsam.

Fig. 40.—Horny ring of large sucker from middle of tentacle club of same specimen; same scale.

Fig. 41.—Horny ring of marginal sucker from middle region of tentacle club of same specimen; same scale.

Remarks.—Although apparently not thoroughly typical, the single specimen of this genus in the "Endeavour" collection seems referable to the long known but still not very common *S. australis*. It possesses the broad, oval fins, widest near the middle of the sharply tapering body, and the plain colouring characteristic of preserved specimens of this species, but it differs from the descriptions given by d'Orbigny and McCoy in that the ventral arms are distinctly longest, the formula being 4, 3, 2, 1, instead of 3, 4=2, 1. Their examples were also considerably larger, and there are a few minor specifications in which their descriptions and the "Endeavour" specimen fail to tally. It should further be noted for the latter that the horny rings of the suckers of the sessile arms are scarcely "trés-obtuses," as stated by d'Orbigny (1845, p. 324). Some of these discrepancies may later on prove of greater consequence than can be shown now.

A horny ring of a diameter of 2.7 mm. from one of the largest suckers (fifth from base) of the third right arm (Fig. 39) shows 27 sharp, conical teeth placed fairly closely. A ring from a lateral sucker from the central portion of the tentacle club (Fig. 41) is quite similar, but has only 24 teeth, which are a little longer, narrower, and more widely spaced than those of the sessile arm rings. This ring measures 3.3 mm. in diameter. Rings from two of the largest median suckers of the tentacle club show respectively 22 (Fig. 40) and 26 pointed, conical teeth, with relatively wide interspaces. They measure 4.3 and 4.6 mm. in diameter.

The dorsal lappet of the buccal membrane shows 5 suckers, the next pair of lappets 5 each, the succeeding pair 6 each, the right ventral 2, and the left ventral 3. One of the largest

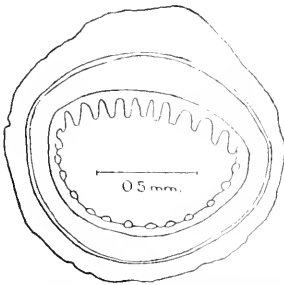


Fig. 42.—*Sepioteuthis australis* ♀ [509], horny ring of basalmost sucker from third right lappet of buccal membrane; camera drawing from a mount in balsam.

suckers from the lower lappet measures 1.36 mm. in diameter. Its ring (Fig. 42) is armed with 24 teeth, which are long, narrow, and tapering on the superior margin, though with rather truncate points, becoming, on the inferior margin, smaller, stouter, and more pointed. A curious, stiff, transversely ridged, tongue-shaped pad lies in the folds of membrane between the ventral lappets. I do not remember having noticed mention in the literature of any structure of this sort. From its position and appearance one would naturally infer an homology with the similarly situated "spermatic pad" of the female *Sepia*. The extremity of the left ventral arm lacks most of its suckers and at first glance much resembles certain forms of hectocotylus, but since a few minute suckers persist near the tip, whilst the extremity of the left third arm is similarly affected, I take it that the specimen is simply a normal ♀ which has suffered abrasion of some of its suckers.

Family SEPIOLIDÆ

Subfamily ROSSIINÆ.

Genus ROSSIA, *Owen*, 1834.

Subgenus AUSTROROSSIA, *nov.*

Characters of subgenus so far as known those of typical *Rossia* except—

- (1) The tentacle club is unusually long, more or less coiled, and armed with an immense multitude of infinitesimal suckers.
- (2) The suckers on the sessile arms are in two rows throughout.
- (3) Some of the suckers on all the sessile arms of the ♂ suffer sexual modification, *i.e.*, enlargement.

(4) The hectocotyliised arms of the ♂ are characterised not only by modifications in the size of certain of the suckers as above, but (in the type species at least) by the presence of a pocket-like gland on the outer surface of the arm.*

Type.—The following species:—

ROSSIA (AUSTROSSIA) AUSTRALIS, *sp. nov.*

(Plate lxi., fig. 3-4; plate lxx.)

Body smooth, sepioliform, moderate in size; mantle widest sometimes in the middle, sometimes in front, thence tapering to a rounded or round-pointed extremity. *Fins* relatively large, attached well in front of the middle of the body; maximum length 75-90% that of the mantle, length along line of attachment to body 56-66% the mantle length; in outline semicircular, evenly arcuate; anterior lobes conspicuous, sometimes exceeding the mantle in front; posterior margins scarcely if at all indented where they join the body. Mantle margin showing a slight nuchal sinuosity; it articulates with the head by the usual nuchal cartilage (Pl. lxx., fig. 3) and a pair of large, oval, very deeply grooved funnel cartilages (Pl. lxx., fig. 4).

Head large, distinctly wider than the body. *Eyes* large and prominent, their lower lids free. *Funnel* large, reaching to a point a little past the centre of the eyes; interior capacious, a small flap-like valve near the apex; *Funnel organ* (Pl. lxx., fig. 8) comprising the usual large, hepatiform, dorsal organ and a pair of ovate, ventro-lateral pads about two-thirds the length of the former, the dorsal organ terminating in a slender, sharp-pointed, median papilla in front.

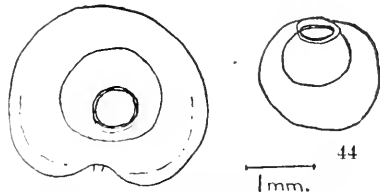


Fig. 43.—*Rossia australis* ♂ [538], large sucker from lateral arm of type; camera drawing from a mount in balsam.

Fig. 44.—*Rossia australis* ♀ [539], sucker from near middle of third arm of paratype; camera drawing from a mount in balsam.

*Pfeffer (1908, p. 32) describes the sexual differences in *Rossia* s.s. as follows (translation):—

“The dimorphism of the sexes is expressed by the suckers of the 2nd, 3rd, and 4th arm pairs, or sometimes (in those species with 4 rows) the suckers of the outer rows of the same arm pairs, being more or less greatly enlarged. Further in the true hectocotyliization, which consists in the basal cushions of the suckers of the outer rows on both arms of the 1st pair for the proximal three-fifths of their length being somewhat elongated, pressed together, and thus bringing about a pectinated appearance of that part of the lateral surface of the arm; the entire structure is more or less covered by a true protective membrane (Schutzsaum), which otherwise is almost entirely foreign to the family Sepiolidæ.”

Sessile arms rather short, the relative order of length usually 3, 2, 4, 1, though subject to some variation; lateral pairs, however, consistently rather longer than the dorsal and ventral pairs, being as long as or a little longer than the body; traces of keels present on the outer aspects of the three dorsal arm pairs, but conspicuous only on the third pair. *Suckers* nearly spherical, in two rows throughout; apertures very minute; horny rings smooth; in the ♀ (Pl. lxx., fig. 6; Fig. 44) suckers similar on all the arms, smaller near the base, fairly large along the middle, and gradually smaller again toward the extremity. In the ♂ both dorsal arms *hectocotylised* (Pl. lxix., figs. 3-4; Pl. lxx., fig. 5), and in similar fashion; basal 6 or 8 pairs of suckers exceedingly small; these followed by perhaps half-a-dozen pairs of suddenly much larger suckers, which are not, however, so large as those of corresponding position on the other arms in this sex; suckers toward tip of arms gradually diminishing in size; in all about 25 pairs readily numerable on each arm without a lens; outer (ventral) face of each arm of this pair equipped with a slightly swollen, pocket-like organ (Pl. lxix., fig. 3), consisting of soft, spongy, colourless tissue of an apparently glandular nature, and borne opposite the 6th-9th suckers of the ventral row; a little above the middle of the organ a deep, longitudinal groove; a deeper pocket present between the margin of the gland and the sucker-bearing face of the arm. Suckers on the main portion of the remaining arms of the ♂ (Pl. lxix., fig. 4) greatly crowded and enlarged (Fig. 43) over the condition seen in the ♀, those of the ventral series of the lateral arms appearing a trifle larger than the others. *Umbrella*, except for the well developed tentacular sheath, rudimentary.

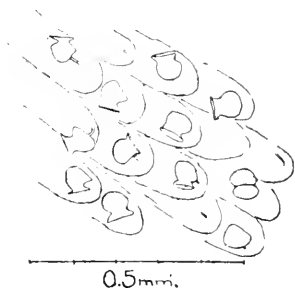


Fig. 45.—*Rossia australis* ♀ [539] portion of oral face of left tentacle club, highly magnified; part camera drawing from a mount in balsam.

Tentacles long, slender, varying from two and one-half to over three times the mantle length; in section subtriangular, the inner face sharply defined, excavated, and marked by a conspicuous central groove. *Tentacle Club* (Pl. lxx., fig. 7) elongate, comprising more than one-fourth the total length of the tentacle; not expanded, but tapering for the most part very gradually, then more suddenly to the extremity; usually more or less strongly coiled upon itself; equipped

along its entire length with a narrow dorsal membrane or keel, which is widest at about the proximal third, then gradually narrows to the tip, while proximally it extends for a considerable distance below the suckers; proximal one-sixth to one-seventh of the club, reckoning the latter as co-extensive with the dorsal keel, bare; for the remainder of its length covered on the oral aspect with a great number of excessively minute suckers so small as to appear to the eye or even under weak magnifications as a mere velvety pilosity.

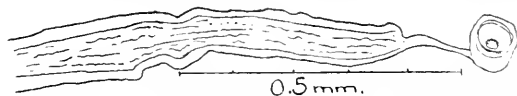


Fig. 46.—*Rossia australis* ♀ [539], isolated sucker and pedicel from central portion of left tentacle club; camera drawing from a mount in balsam.

Under higher power suckers seem to be borne on long, slender pedicels, only loosely crowded; mostly with a diameter of about 0.075 mm., but a few measuring as much as 0.09 mm., and one noted to have a diameter of 0.11 mm., though this last may have been somewhat crushed by its cover glass; counting uncertain, but about 50 apparently numerable in a transection of the club near its centre (Figs. 45-46). Under favorable light and relatively high power (170 diam.) horny rings apparently toothed with very small, acute sharp teeth for at least half their circumference, but whether these are true teeth and not merely projecting papillæ from the papillose area, I cannot be certain.

Gladius slender, lanceolate, shorter than the body.*

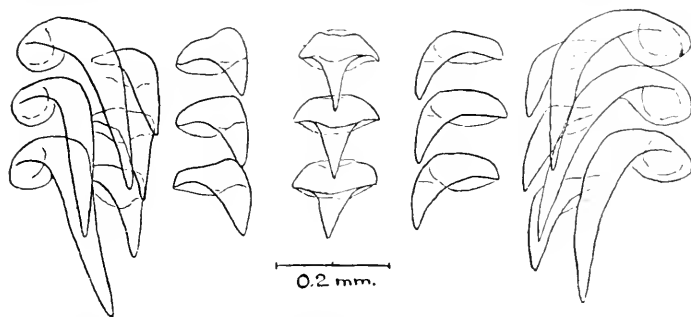


Fig. 47.—*Rossia australis* ♀ [540], three rows of teeth from radula; camera drawing from a mount in balsam.

*In the specimen dissected the gladius was found too badly broken for figuring.

Radula (Fig. 47) with seven rows of teeth of simple structure, rhaichidian teeth with short, stout, acutely conical points springing from cap-shaped bases; first laterals a little longer; second laterals still longer and relatively more slender; marginals strongly arcuate, bending sharply downward, their scimitar-like blades nearly twice as long as those of the second laterals.

Surface, except for slight wrinkles due more or less directly to the action of the preserving fluid, apparently everywhere smooth.

Color of specimens preserved in formalin a greyish buff, copiously sprinkled above and below with chromatophores of several shades of reddish brown; strongly tinged with violet on the dorsum, above the eyes, and near the tips of the arms; arms, pupils of the eyes, and certain other regions opalescent; lower part of eyeball within the lower lid with a strongly metallic, golden iridescence.

Measurements.—

TABLE XIV.—MEASUREMENTS OF *Rossia australis*.

Author's Register Number.	[538]	[539]	[537]	[540]	[541]
	Type.	Paratype	Paratype		
Sex.....	♂	♀	♀	♀	♀
	mm.	mm.	mm.	mm.	mm.
Total length.....	120	230	230	145	..
Length of body, dorsal.....	32	*50	50	34	30
Length of body, ventral.....	30	48	46	31	26
Tip of body to base of dorsal arms.....	50	73	67	45	50
Length of fin.....	27	38	37	29	28
Length of fin at point of attachment.....	29	30	28	20	20
Width of fin at widest point..	14	20	18	15	12
Width across fins.....	50	75	72	52	48
Width of body.....	21	36	33	25	24
Depth of body.....	18	26	22	17	15
Width of head across eyes....	25	32	31	27	23
Length of head	19	25	22	17	20
Length of funnel, median....	13	20	18	15	13
Length of right dorsal arm...	30	36	37	30	27
Length of left dorsal arm. ...	30	38	38	30	29
Length of right second arm...	36	41	40	30	..
Length of left second arm...	36	45	40	34	29
Length of right third arm...	38	45	38+	34	34
Length of left third arm.....	38	45	39	32	34
Length of right ventral arm..	35	39	36	28	28
Length of left ventral arm...	34	39	34	29	..
Length of right tentacle.....	75	150	168	90	..
Length of right tentacle club*	22	42	38	27	..
Length of left tentacle.....	81	123	135	95	..
Length of left tentacle club*..	21	44	37	32	..

* Measured from beginning of dorsal membrane.

Type.—A ♂, E3636 [S.S.B. 538], in the collection of the Australian Museum, Sydney. A paratype [S.S.B. 537] has been retained by the writer.

Type Locality.—250-300 fathoms, long. 130° 50' E., Great Australian Bight, south of Eucla, Western Australia; ("Endeavour"); 1 ♂, 2 ♀.

Recorded Distribution.—175-300 fathoms, Great Australian Bight; 200-250 fathoms, Gabo Island to Everard Grounds, Victoria.

Material Examined.—

TABLE XV.

No. of Specimens.	Sex.	Depth in Fathoms.	Locality.	Original Number.	Author's Register	Remarks.
1	♀	250-300	Long. 130° 50' E., Great Australian Bight, S. of Eucla, W.A.	E3635	[537]	Paratype
1	♂	"	"	E3636	[538]	Type
1	♀	"	"	E3637	[539]	Paratype
1	♀	175	Long. 128° 40' E., Great Australian Bight, S.W. of Eucla, W.A.	E4376	[540]	
1	♀	200-250	Gabo Island to Everard Grounds, Victoria.	E5724	[541]	

Remarks.—This attractive Sepiolid is of interest in being only the second member of its genus to be recorded from the Southern Hemisphere. It has no near affinity with any of the northern forms, but on the other hand is so closely similar to the lately described East African *R. mastigophora*, Chun, that at first glance I thought the two might prove specifically identical. This, however, was not borne out by more detailed study. No doubt with our present knowledge females alone of these species would be very hard, even though not impossible, to separate. Fortunately in the hectocotylized arms of the male we find structures subject to unusually definite specific modification, so that we would seem quite safe in relying on them. The recent careful studies of Naef on the Mediterranean Sepiolids, supported by my own less extended (though only partly published) investigations of *Euprymna*, indicate that in this family as much or more than in other cephalopods even relatively minor details in the morphology of these organs have considerable taxonomic significance. Here we find some very tangible differences between the two species.

Chun, in his illustrations of *R. mastigophora*, figures the dorsal arms as showing conspicuously enlarged suckers on the inner (dorsal) series only. He shows only three or four pairs of the minute basal suckers, and neither describes nor illustrates the lateral pockets which are so curiously developed in *R. australis*. That his specimen could not have been too immature to exhibit these features is shown by the fact that in gross measurements (*e.g.*, mantle length 31 mm.) it almost exactly tallies with the example before us. Another interesting difference is that in his specimen the right dorsal arm was decidedly longer (29 mm.) than the left (25 mm.). Still another difference noted between the present species and *R. mastigophora* is in the notably smaller size (and probably greater number) of the tentacle suckers. Chun (1915, p. 407) writes as follows:—

“ Die Tentakelnäpfe sind so winzig, dass sie mit blossem Auge kaum erkannt werden können. Die Ausmessung ergibt, dass sie einen Querdurchmesser von nur 0. 15-0. 17 mm. aufweisen und damit zu den kleinsten Tentakelnäpfen gehören, die wir überhaupt aus der Reihe der Decapoden kennen.”

Nevertheless suckers from a ♀ *australis* larger than Chun's largest specimen average a diameter less than half that cited by him. They must indeed rank among the most minute, fully functioning, true suckers known.

The farther I have been able to push the comparison, the more sharply differentiated from one another the northern and southern *Rossia* appear to be. The subgeneric distinction here proposed between them seems but the logical step to take. I shall not be greatly surprised in case a full anatomical investigation requires the elevation of *Austrorossia* to full generic rank. At present the most important differences are naturally to be found in the hectocotylized arms, which, in the two austral species, are constructed on an altogether different plan than in such species as *R. glaucopsis* (Lovén), *R. mölleri* Steenstrup, or *R. pacifica* Berry.

Family SEPIIDÆ.

Genus SEPIA, *Linnaeus*, 1758.

SEPIA HEDLEYI, *sp. nov.*

(Plates lxxi.-lxxii.)

Animal rather small; *Body* of only moderate width, the widest central portion only slightly exceeding the anterior region, but tapering rapidly to a point behind; anterior

margin of mantle with a broad, conspicuous, dorsal rostrum ; ventral margin evenly emarginate below the funnel. *Fins* long, narrow, their attachment not quite reaching either the tip of the body or the anterior mantle margin, though both these points surpassed by the posterior and anterior lobes of the fins themselves. *Funnel* large, deeply immersed, its apex reaching some three-quarters of the distance from its hinder margin (or a little better than half-way from the mantle margin) to the cleft between the ventral arms ; interior with a semicircular, flap-like valve ; funnel organ indistinguishable in specimen examined.

Head distinctly narrower than body. *Eyes* large, prominent.

Sessile arms rather short ; ventral pair usually distinctly the largest and longest, the others varying, but in general subequal, from one-fourth to one-third the mantle length. *Umbrella* better developed in some specimens than others, but never extending between arms for more than one-third their length ; absent between ventral pair. Suckers of arms crowded ; ostensibly in four rows, those of the inner series notably larger than the marginal ; individual suckers (Fig. 48) bowl-shaped, the largest measuring about 1 mm. in maximum diameter, notched above, their outer periphery beautifully fluted ; horny rings swollen, not dentate, but with very weakly erenate margins.

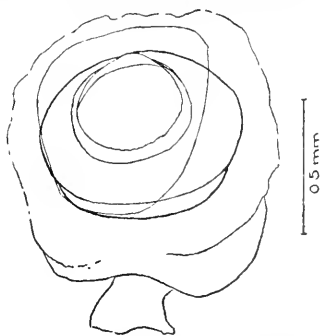


Fig. 48.—*Sepia hedleyi* ♂ [499], one of the larger suckers from right third arm of type ; camera drawing from a mount in balsam.

Left ventral arm *hectocotylized* (Pl. lxxii., fig. 6) ; basal third of arm normal, the suckers in 4 series, or better described (as is plainly indicated by the subsequent structure of the arm) as two strongly zig-zag rows, with the inwardly displaced members distinctly larger than the outer ones, much as already noted for the suckers of the remaining arms ; according to this interpretation, the dorsal of the two basal-most suckers inwardly displaced, the ventral outwardly, both being relatively small like the succeeding marginal suckers ; suckers thence regularly zigzagging as described until 11 pairs are accounted for, the flattened sucker-bearing area

first widening, then narrowing, so that in this general region this area is elongate-oval in outline; 13th sucker of dorsal series smaller than its predecessors, the 14th very conspicuously reduced and followed by 14 excessively minute suckers, normally zigzag in position, but becoming largely, by reason of their reduction in size, relatively distant from one another; 29th and 30th suckers of this row suddenly larger, the remaining suckers to the extremity of the arm appearing normal in every particular; in the ventral series, 12th sucker not only smaller than its predecessor, but also *marginal*, being succeeded by 17 very minute suckers in single file similar to those of the zigzag dorsal series, but a trifle larger, and elevated from the dorsal portion of the sucker bearing face of the arm by a narrow ridge; 30th sucker of ventral series somewhat larger, 31st still larger, 32nd again larger as well as inwardly displaced; beginning with 31st sucker members of this series normal in size and zigzag arrangement, so that the usual 4-rowed appearance prevails on this portion of the arm; central portion of face of arm where reduced suckers are borne conspicuously narrowed, again expanding with the recommencement of the normal suckers.*

Tentacles relatively short (two-thirds the length of the body), stout, in section rounded-triangular with a somewhat flattened inner face; *club* (Pl. lxxii., figs. 3-4) expanded, semilunar in outline, its inner face flattened and armed with excessively numerous, minute, crowded suckers, *slightly* and evenly graduated in size, near the centre of the club seeming to comprise about 12 series. Suckers of club (Fig. 49) deeply basin-shaped, having a wide, nearly circular papillary area and relatively small apertures; diameter of an average sucker on middle portion of club 0.3 mm.; horny rings armed all around with possibly 18-22 excessively minute, pointed teeth, so small that exact number cannot be stated surely with present facilities; two suckers larger than remainder just within the curious pocket-like flap crowning

* To avoid possible confusion the description of the hectocotylus has been drawn throughout from one specimen, the type. Other males examined show certain divergencies, chiefly in the way of slight variations in the numbers of suckers occupying the respective regions of the arm and so on. The modified suckers of the ventral row sometimes show traces of the original zigzag arrangement, while in one specimen the uniserial arrangement nowhere prevails. In none of the specimens, however, does the lateral displacement of these suckers equal that of those opposite them in the dorsal series.

the apex of the club (Pl. lxxii., fig. 5), one of them being the terminal sucker on the ordinary sucker-bearing face of the club, the other springing directly from near the middle of the otherwise suckerless dorsal membrane. Sucker-bearing area of club furnished with a delicate marginal membrane; basal outer angle of club with a strong membranous keel.

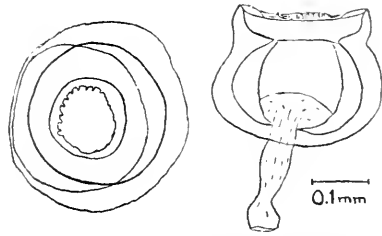


Fig. 49.—*Sepia hedleyi* ♂ [499], two suckers from right tentacle club of type; camera drawing from a mount in balsam.

Gladius (sepiostaire) absent or fragmentary in all specimens seen (see reconstruction in Pl. lxxii., fig. 2); chitinous margin and striated area relatively large; locular index about 25 or 26.

Radula (Fig. 50.) offering no very remarkable features: similar to that of the following species except that the falcate third laterals or marginals are not so long relatively to the other teeth and the rhachidians are a trifle smaller or at least no larger than the first laterals, although the last feature may depend somewhat upon their level in the radula.

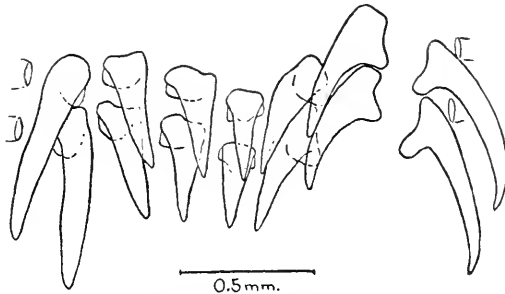


Fig. 50.—*Sepia hedleyi* ♂ [502], two rows of teeth from radula of paratype; camera drawing from a mount in balsam.

Surface nearly smooth or ornamented above by numerous very low, faint, scattered papillæ; on each side just above and parallel to the fins a series of perhaps six low, narrow, integumentary ridges.

Measurements.—

Author's Register Number.....	[497]	[499]	[502]	[503]	[500]	[507]	[5061]	[495]
	Paratype	Type	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype
Sex.....	♂	♂	♂	♂	♂	♀	♀	♀
Total length.....	mm. 150	mm. 142	mm. 200	mm. 125	mm. 180	mm. ..	mm. 150	mm. 142
Length of body, dorsal.....	83	81	79	74	98	91	86	86
Length of body, ventral.....	70	73	74	63	78	81	76	76
Tip of body to base of dorsal arms.....	90	87	95	80	103	101	99	95
Width of fin at widest point.....	6	8	8	7	9	12	10	10
Width across fins.....	..	50	56	45	..	60	66	56
Width of body.....	41	35	41	31	44	38	46	38
Depth of body.....	23.1	23.5	21	21.4	28	26.5	24.2	27.5
Width of head across eyes.....	29	30	32	25	31	38	37	31
Length of head (nuchal cartilage to base of dorsal arms).....	15	16	19	13	19	17	22	15
Length of funnel, median.....	27	23	32	21	28	25	23	27
Length of right dorsal arm.....	21	24	44	20+	28+	28	30+	28
Length of left dorsal arm.....	22	24	30	22	30	29	34	30
Length of right second arm.....	22	21	34	22	27	26	32	26
Length of left second arm.....	22	21	36	21	27	26	31	29
Length of right third arm.....	25	24	35	22	30	26	33	27
Length of left third arm.....	24	24	34	22	30	26	33	29
Length of right ventral arm.....	31	30	43	25	34	28	37	34
Length of left ventral arm.....	32	30	43	25	34	29	36	32
Length of right tentacle.....	55	33	99	49	80	..	52	48
Length of right tentacle club.....	10	8	13	11	13	..	12	11
Length of left tentacle.....	62	55	13	..	79	..	..	49
Length of left tentacle club.....	10	9	..	..	13	..	..	11

TABLE XVI.—MEASUREMENTS OF *Sepia botleyi*.

Type.—A ♂, E2464 [S.S.B. 497], in the collection of the Australian Museum, Sydney. A paratype [S.S.B. 497] has been retained by the writer.

Type Locality.—Investigator St. Area, south of Kangaroo Island, South Australia : (" Endeavour ") ; 4♂♂.

Recorded Distribution.—80-175 (450 ?) fathoms, Great Australian Bight ; off coast of South Australia.

Material Examined.—

TABLE XVII.

No. of Specimens.	Sex.	Depth in Fathoms	Locality.	Original Author's Number.	Register	Remarks.
1	♂	..	Investigator St. Area, S. of Kangaroo Isl., S.A.	E2461	[497]	Paratype
1	♂	E2462	[503]	Paratype
1	♂	E2463	[502]	Paratype
1	♂	E2464	[499]	Type
?1	♀	80-120	Great Australian Bight	E2455	[491]	
1	♀	E2456	[504]	
1	♀	E2457	[500]	
1	♂	E2458	[501]	
1	♀	..	Long. 129° 28' E., Gt. Australian Bight, S. of Eucla, W.A.	E3619	[495]	
1	♀	E3620	[498]	
1	♂	E3623	[505]	
?1	?	350-450	Great Australian Bight, S. of Eucla, W.A.	E3609	[508]	doubtful
1	♀	175	Long. 128° 40' E., Gt. Australian Bight, S.W. × S. of Eucla, W.A.	E4377	[507]	
1	♀	E4378	[496]	
1	♀	E4379(?)	[506]	

Remarks.—This, the most abundant *Sepia* in the " Endeavour " collection, is a rather small, neat-appearing species, which an exhaustive search of the literature has not enabled me to identify with any previously described cuttlefish, either from the Australian region or elsewhere. In the possession of numerous small equal-sized suckers on the tentacle club it reminds one of the species to be next described, but in other respects is abundantly distinct. In the male the peculiar hectocotylus furnishes a striking and easy means of identification.

Recognisable fragments of the sepiostaire could be secured from only one ♀ out of all the specimens seen, and even here they were scarcely in condition for description or satisfactory illustration. Because of the peculiar interest of the structure to the systematist or to the beach collector, however, the artist has done the best possible to reconstruct a characteristic

figure, and, except possibly for the posterior region, has given a sufficiently true interpretation so that "bones" of the species should not go unrecognised.

Specimen E2455 I at first classified offhand with *S. dannevigii*, but am now inclined to think it merely a more than usually short and wide *hedleyi*. Specimen E3609, from deeper water by far than any of the others, is even more doubtfully identified.

The body of one specimen [S.S.B. 507] shows considerable trace of colour in places—the grayish ground color being overlaid with an iridescent blue, showing tints of green, the whole spotted and mottled with warm sienna brown.

The species is gratefully dedicated to that master student of Australian Mollusca, Mr. Charles Hedley.

SEPIA DANNEVIGI, *sp. nov.*

(Plate lxiii; Plate lxxiv., figs. 1-2.)

Body rather wide and short, much flattened dorso-ventrally; breadth about 66% of the length, the widest point at about the anterior third; mantle margin with a broad, conspicuous, dorsal rostrum and a slight emargination below the funnel. *Fins* narrow, not quite reaching either the mantle margin or the posterior tip of the body. *Funnel* moderately long, reaching about two-thirds the distance from its posterior margin to the cleft between the ventral arms; interior furnished with a conspicuous, flap-like valve. Funnel organ not sufficiently distinguishable for description in specimen opened.

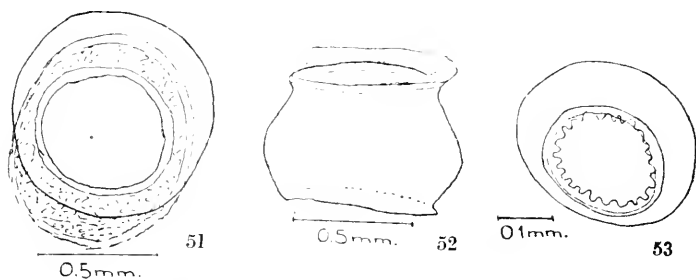


Fig. 51.—*Sepia dannevigii* ♀ [493], horny ring of one of the largest suckers (4th-5th series from base) of right third arm of type, oral aspect showing papillary corona; camera drawing from a mount in balsam.

Fig. 52.—Horny ring of similar sucker from same specimen, lateral view, showing portion of papillary corona; camera drawing from a mount in balsam.

Fig. 53.—Horny ring from sucker of right tentacle club [494]; camera drawing from a mount in balsam.

Head broad, its width varying proportionally to that of the body from as 2 : 3 to as 1 : 1. *Eyes* large.

Arms rather short, their formula 4, 3, 2, 1 : ventral pair notably the largest and longest, attaining nearly two-thirds the mantle length, the others averaging about one-half the mantle length, exact proportions varying with the preservation. Suckers in four rows throughout ; horny rings smooth (Figs. 51-52), though sometimes weakly indented or crenulate along at least the superior margin, not truly toothed ; diameter of one of the larger suckers of left third arm of type 1.06 mm.

Tentacles triangular in section ; when expanded half as long again as the body ; *club* (Pl. lxxiv., fig. 2) small and flattened, comprising about one-eighth of the entire length of the tentacle ; suckers excessively numerous and minute, in perhaps 10-12 longitudinal series at the middle of the club, the horny rings (Fig. 53) distinctly toothed all around with about 20-22 rather blunt, minute teeth ; major diameter of one of largest suckers .37 mm. of its horny ring (that figured) .32 mm.

Gladius (sepiostaire) unknown.

Radula (Figs. 54-55) with simple rachidian and first and second lateral teeth ; marginals falcate, their blades over twice as long as those of the other teeth.

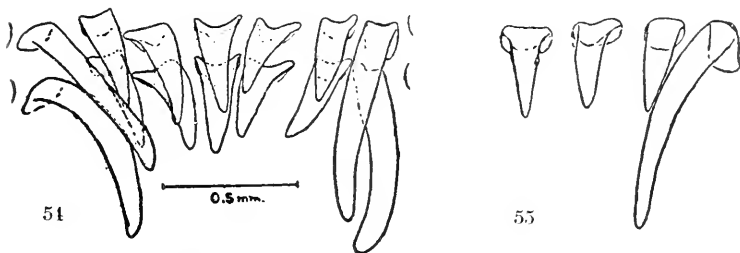


Fig. 54.—*Sepia danzevigi* ♀ [493], two rows of teeth from radula of type ; part camera drawing from a mount in balsam.

Fig. 55.—One row of teeth from one side of another part of same preparation ; same scale.

Surface of body smooth, except for a more or less obscure succession of elongate, ridge-like tubercles running down each side of the body above and parallel to the fins.

Type.—A ♀, E2466 [S.S.B. 493], in the collection of the Australian Museum, Sydney.

Measurements.—TABLE XVIII.—MEASUREMENTS OF *Sepia dannevigii*.

Author's Register Number.....	[494]	[493]
		Type.
Sex.....	♀	♀
	mm.	mm.
Total length.....	225	205
Length of body, dorsal.....	81	82
Length of body, ventral.....	66	68
Tip of body to base of dorsal arms.....	102	100
Width of fin at widest point.....	5.5	8
Width across fins.....	..	64
Width of body alone.....	54	50
Depth of body.....	16	15
Width of head across eyes.....	30	37
Length of head, nuchal cartilage to base of arms.....	20	20
Length of funnel, median.....	31	30
Length of right dorsal arm.....	39	27
Length of left dorsal arm.....	42	27
Length of right second arm.....	34+	29
Length of left second arm.....	46	29
Length of right third arm.....	41	33
Length of left third arm.....	44	33
Length of right ventral arm.....	47	40
Length of left ventral arm.....	50	43
Length of right tentacle.....	128	91
Length of right tentacle club.....	18	11
Length of left tentacle.....	122	104
Length of left tentacle club.....	18	12

Type Locality.—Investigator St. Area, south of Kangaroo Island, South Australia; (" Endeavour "); 2 ♀ ♀.

Recorded Distribution.—South of Kangaroo Island, South Australia (" Endeavour "); 20-100 fathoms, between Cape Naturaliste and Geraldton, Western Australia (" Endeavour ").

Material Examined.—

TABLE XIX.

% of Specimens.	Sex.	Depth in Fathoms	Locality.	Original Number.	Author's Register	Remarks.
1	♀	..	Investigator Strait Area, S. of Kangaroo Id., S.A.	E2465	[492]	Paratype
1	♀	..	"	E2466	[493]	Type
1	♀	20-100	Between Cape Naturaliste and Geraldton, W.A.	E2512	[494]	

Remarks.—I have been unable to identify this little species either with any of the previously recorded Australian forms or with such of those from other regions which by descriptions or figures have been available to me for comparison. It is unfortunate that the formalin used as a preserving medium has so corroded the calcareous sepiostaires that not one of the specimens retains this organ in recognisable condition, thus depriving us at the outset of a most important aid in determining the relationships of the species and defeating any possible attempt to identify it with any of the named forms heretofore known from the shell alone. We are left with the alternative of establishing a new name. Since next to nothing is known of the limits of variation in these puzzling forms, while so many of those named have been very incompletely described, I adopt this choice with the utmost diffidence. The Australian *Sepias* are in need of a thorough overhauling, but any permanent revision will necessitate abundant material from the entire circumference of the continent.

In the possession of numerous small suckers of practically similar aspect on the tentacle clubs, the present species recalls not only *S. hedleyi* but also the descriptions of such species as *S. elliptica* Hoyle, *S. cultrata* Steenstrup, *S. indica* d'Orbigny, *S. smithii* Hoyle, and *S. rostrata* d'Orbigny, but in most characters, with the exception of the unknown cuttlebone, it stands apparently nearest to *S. elliptica*. They can scarcely be identical, however, since the latter is not only from a different faunal area, but is described as having subequal arms and only eight series of tentacular suckers, the horny rings of which are smooth.

The radula of very few species of *Sepia* has been illustrated, but the few figures before me do not encourage the belief that the organ undergoes any very valuable amount of specific differentiation. That of *S. tuberculata* as figured by Hoyle (1910, text fig. 10), except for its relatively shorter third laterals, is in most essentials similar to the one here described, though I cannot see that the two species are particularly near to one another in other features. The same is true of *S. arabica* (cf. Massy, 1916, pl. 24, fig. 10). Miss Massy's figure of this organ in *Sepiella inermis* (1916, pl. 23, fig. 6), on the other hand, is so utterly different from this, yet similar to that of the various species of *Loligo*, that I cannot avoid wondering whether the figure may not have suffered interchanging with that of *Loligo indica* on the succeeding plate. Our present ignorance is, however, scarcely sufficient

ground for rejecting the radula of *Sepia* from taxonomic consideration, as has been emphasised by the results of recent investigation of other molluscan groups, notably the long-stubborn chitons.

All the specimens of *S. dannevigii* appear to be females, but none are gravid, and in both the two specimens partly dissected the ovary is small. There is a small duplex spermatid pad under the mouth.

The specific name is chosen in honor of the late Mr. Harald Christian Dannevig, Director of Fisheries, lost while on duty with the F.I.S. " Endeavour."

SEPIA CHIROTREMA, sp. nov.

(Plate lxxiv., figs. 3-9 ; Plates lxxv-lxxvii.)

Animal large, the *Body* of moderate width and depth in the ♀ (Pl. lxxvii), relatively much broader and flatter in the ♂ (Pls. lxxv.-lxxvi), the point of maximum width in both sexes a little in front of the middle, thence tapering somewhat anteriorly, and much more rapidly posteriorly to the pointed extremity ; mantle margin with a large triangular rostrum dorsally, below the funnel broadly and smoothly emarginate without distinct lateral angles. *Fins* long, quite wide for a *Sepia* ($\frac{1}{4}$ to $\frac{1}{3}$ the width of the body) ; their origin 3-5 mm. back of the mantle margin, thence sweeping back in a broad curve to swerve a little upward and terminate so that they nearly meet above and a few mm. (5 in the ♂, 15 in the ♀ paratype) in advance of the extremity of the body.*

Head slightly narrower than the body in the ♀, much narrower in the ♂. *Eyes* large. *Funnel* very large, reaching just past the base of the ventral arms.

Arms relatively short, the ventral pair about two-fifths the dorsal mantle length and much larger and longer than the other pairs, the latter regularly diminishing in size to the dorsal pair, their formula constantly 4, 3, 2, 1 ; dorsal arms relatively small, attaining only about half the length and diameter of the powerful ventral pair ; keels present on all arms, but much the most conspicuous on the ventrals. Suckers quadriserial, those of the two inner rows slightly larger than the outer, those of the four ventral arms con-

* In the ♂ referred to the posterior lobes of the fins overreach the body ; in the ♀ they fall short of it.

siderably larger than those occupying corresponding positions on the four dorsal arms; suckers of ventral pair averaging 2-3 times the diameter of those of the dorsal pair, the latter seemingly particularly minute in the ♂; horny rings of arm suckers (Fig. 56) smooth, or with faintly wavy margins.

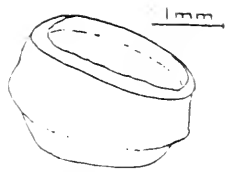


Fig. 56.—*Scpia chirotrema* ♀ [524]. horny ring of 7th sucker from base of dorso-central series of right third arm: camera drawing.

Left ventral arm *hectocotylized* (Pl. lxxiv., fig. 6): basal two-fifths of arm normal, bearing ten quartets of suckers which begin rather small, increase to a maximum by about the 5th or 6th quartets, then gradually diminish again distal; at the 11th quartet, suckers showing a considerable and more abrupt diminution in size; 12th-13th quartets similar to 11th, but once again regularly smaller; from about the 14th quartet entire remaining segment of arm strongly compressed laterally, the marginal membranes, especially the dorsal, becoming relatively wider, thickened, and elevated (Pl. lxxiv., figs. 7-9), forming between them a narrow groove, in and along which the now very minute suckers continue until all details become indistinguishable near the tip of the arm.

Umbrella short, attaining its greatest extent between the arms of the third and fourth pairs; between the ventral arms of the ♀ rudimentary, somewhat better developed at this point in the ♂.

Tentacles more or less compressed, stout, very long, the length varying in different specimens from slightly more than that of the mantle to nearly twice the mantle length; inner face smooth, flattened. *Club* (Pl. lxxiv., figs. 4-5) large flattened, well expanded, the expansion largely due to the broad, fleshy keel which, commencing on the outer angle of the carpal region, becomes deflected dorsally as it passes distal, so that its major plane comes to lie parallel to and with its face continuous with the sucker-bearing face of the club; remainder of expansion due to the very broad and delicate ventral "swimming membrane," which, near the centre of the club, attains a width somewhat greater than the club itself; companion membrane of dorsal side narrower and more thick and fleshy, unique in not being everywhere continuous with the face of the club, but perforated by three large openings or fenestræ (Pl. lxxiv., fig. 5), the median of

which is the largest, the distal smallest, the outline of the whole structure when fully elevated resembling somewhat a three-arched bridge with its approaches. Suckers borne ostensibly in three rows;* carpal region and extreme base of club destitute of suckers, the marginal membranes here united across the face of the club to form a broad-limbed "V" by their divergence; at base of the "V," either originating directly from the fused membranes themselves or with their stalks passing through the membrane substance, are four (sometimes five) rather small suckers, one of them

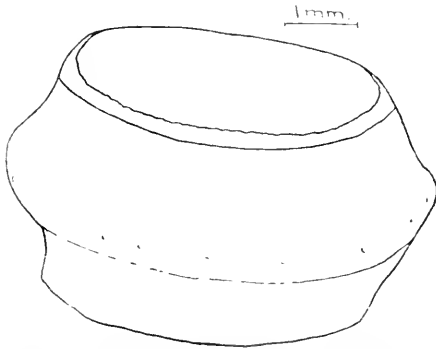


Fig. 57.—*Sepia chirotrema* ♀ [524], horny ring from central large sucker of left tentacle club; camera drawing.

quite conspicuously (twice or thrice) larger than the remainder; succeeding these in centre of club proper, three gigantic suckers, the middle one largest, borne on long pedicels originating in three large pockets just opposite the fenestræ in the dorsal membrane; flanking these and alternating with them by reason of being borne on the inner face of the dorsal membrane (one respectively just above each supporting pillar) are two suckers rather smaller than the largest of the proximal group; two fleshy folds springing from the dorsal membrane, one below each of these suckers, traverse the face of the club and are continuous with similar ridges forming the supports of the ventral membrane, finally terminating near the margin of said membrane in three small diverging buttresses: springing from the two angles of these buttresses, two very small suckers borne by each ventral ridge, or four suckers in all in the ventral row, each pair thus corresponding to a single dorsal sucker; distal one-fourth of club armed with 40-48 crowded suckers in 4-6 series, at first resembling those of the proximal group, then diminishing in size ventrally and toward the tip, though the two terminal suckers sheltered just below the apical cap are somewhat

* As will later appear, I think it evident that the fact that there are twice as many suckers in the ventralmost of these three rows than in either of the other two signifies that four rows are actually represented.

larger than those immediately preceding them, and one sucker of this pair appears to spring from the dorsal membrane; apical cap small for the size of the club. Giant median suckers elevated, cylindrical, concave beneath, with a distinct circular constriction around the middle; their apertures wide, the horny rings (Fig. 57) large and smooth-edged; smaller suckers flatter and more oblique, their horny rings also smooth. For an organ of such complexity the amount of variation in the structure of the tentacle club seems to be surprisingly small, as is indicated by Table XX.

TABLE XX.—STRUCTURE OF TENTACLE CLUB OF *Sepia chirotrema*.

Author's Register Number..	[522]		[524]		[523]		[521]	
Sex.....	♂		♀		♀		♀	
Tentacle Club.....	r.	l.	r.	l.	r.	l.	r.	l.
Approximate total number suckers on distal portion of club.....	46	42	37+	42	48	47	45	42
Suckers in dorsal series on main part of club.....	2	2	2	2	2	2	2	2
Suckers in ventral series on main part of club.....	4	4	4	4	4	4	4	4
Large median suckers.....	3	3	3	3	3	3	3	3
Suckers in proximal group.....	4	4	5	4	4	4	4	5
Fenestræ in dorsal membrane....	3	3	3	3	3	3	3	3

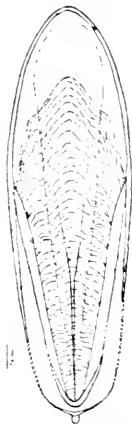


Fig. 58. — *Sepia chirotrema* ♀ [524], ventral view of gladius (sepiostaire), partially reconstructed.

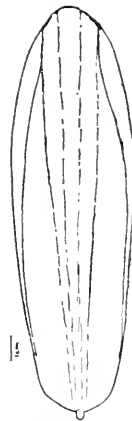


Fig. 59. — *Sepia chirotrema* ♀ [524], dorsal view of gladius (sepiostaire), partially reconstructed.

Gladius (sepiostare) elongate-oval in outline (Figs. 58-59), broadest just back of the anterior third, thence narrowing to a rounded-off angle in front, the posterior region less rapidly tapering and more truncate; dorsal surface marked by numerous curved rows of coarse, granular, more or less confluent tubercles, the rows corresponding in position to the underlying lines of growth, and further ornamented by three low, longitudinal ridges separated by shallow fossæ of about the same width, the median ridge rendered more distinct than the others by traces of a faintly incised bounding line; ventral surface not greatly elevated: striated area with a broad central excavation bounded by diverging lateral elevations, the lines of growth projected sharply forward in the median line; last loculus with an index of 16; inner cone tapering rather sharply to a rounded point behind, forming a somewhat broader, but still narrow, calloused wall across the terminal part of the inner cavity; spine short, stout, blunt, the region separating it from the shell margin, ventrally, thickened and very rugose.

Radula (Fig. 61) with simple, sharply conic rhachidian and first and second lateral teeth, very similar in general appearance, though differing slightly in detail; marginals only a little longer than the other teeth, slightly falcate in outline, their points bluntly rounded.

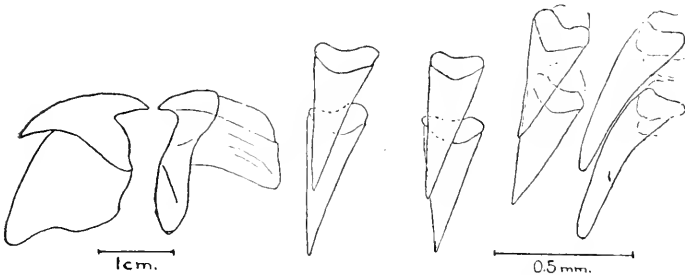


Fig. 60.—*Sepia chirostema* ♀ [523], camera drawing of mandibles.

Fig. 61.—*Sepia chirostema* ♀ [523], two rows of tooth from one side of radula of paratype; camera drawing from a mount in balsam.

*Surface** showing traces of scattered papillæ over the dorsum; a group of three more than usually large, conspicuous tubercles on each side of the head between the eye and the nuchal cartilage, besides three smaller tubercles

* In none of the specimens is the integument in condition for very detailed description.

in an arcuate line in front of the cartilage (cf. Pl. lxxiv., fig. 3); on each side of the body above and parallel to the fin traces of a series of about seven large tubercles, much flattened and circular in outline in the ♂, in the ♀ more elongate with a similar series of ridges below the fins.

Colour of specimens preserved in formalin mottled and clouded with bluish slate, chocolate, gray, and light brown; without traces of a definite color pattern except, firstly, a pair of broad, arcuate, slaty bands on the ventral surface of the mantle, beginning in front on either side of the funnel, but becoming indistinguishable before attaining the extremity of the body; secondly, a pair of straight, diverging, smooth, light colored bands on the middle of the head (Pl. lxxiv., fig. 3) pointing in the direction of the dorsal arms; these bands especially conspicuous on one of the ♀ specimens [524].

Measurements.—

TABLE XXI.—MEASUREMENTS OF *Sepia chirotrema*.

Author's Register Number.....	[522]	[524]	[523]	[521]
	Type		Paratype	
Sex.....	♂	♀	♀	♀
	mm.	mm.	mm.	mm.
Total length.....	520	360	450	330
Length of body, dorsal.....	183	168	150	145
Length of body, ventral.....	156	140	120	120
Tip of body to base of dorsal arms...	210	200	170	165
Width of fin at widest point	35	22	24	15
Width across fins.....	160	125	110	102
Width of body alone.....	110	82	73	72
Depth of body.....	34	55+	35	55
Width of head across eyes.....	65	59	56	55
Length of head (nuchal cartilage to base of dorsal arms).....	32	38	26	30
Length of funnel, median.....	63	52	45	48
Length of right dorsal arm.....	35+	31	50	33
Length of left dorsal arm.....	36	35	50	31
Length of right second arm.....	45	45	57	36
Length of left second arm.....	45	44	60	36
Length of right third arm.....	60	50	67	45
Length of left third arm.....	55	52	65	35+
Length of right ventral arm.....	87	62	80	58
Length of left ventral arm.....	85	61	75	54
Length of right tentacle.....	320	170	270	190
Length of right tentacle club.....	31	32	35	29
Length of left tentacle.....	280	175	270	160
Length of left tentacle club.....	31	35	35	29
Diameter of largest sucker of club..	8.4	7.4	8.5	7.6
Length of sepistaire.....	..	168	..	..
Width of sepistaire.....	..	50	..	..

Type.—A ♂, E2459 [S.S.B. 522], in the collection of the Australian Museum, Sydney.

Type Locality.—Investigator Strait Area, south of Kangaroo Island, South Australia (" Endeavour "); 1 ♂, 1 ♀.

Recorded Distribution.—South of Kangaroo Island, South Australia; 80-120 fathoms, Great Australian Bight.

Material Examined.—

TABLE XXII.

No. of Specimens.	Sex.	Depth in Fathoms.	Locality.	Original Number.	Author's Register.	Remarks.
1	♀	80-120	Gt. Australian Bight	E2454	[521]	Type
1	♂	..	Investigator St. Area, S. of Kangaroo Isd., S.A.	E2459	[522]	
1	♀	E2460	[523]	Paratype
1	♀	80-120	Long. 129° 28' E., Gt. Australian Bight, S. of Eucla, W.A.	E3621	[524]	
1	♀	E3622	[525]	

Remarks.—This magnificent *Sepia* I have been no more able to identify with any of the previously described forms than the two preceding species. The chief question comes in with regard to the *Sepia novae-hollandiae*, Hoyle (*S. australis*, d'Orbigny, 1834, non Quoy and Gaimard, 1832). Unfortunately this is one of the species known only from the shell, and the single published figure (d'Orbigny, 1834, Seiches, pl. 7, fig. 4) has not been accessible to me, that plate and the corresponding pages of the text being lacking from my own fragmentary copy of the Histoire. As the original locality is given as "l'île des Kangaroos, a la Nouvelle-Hollande," the specimen came from the very midst of the region explored by the "Endeavour"—excellent *prima-facie* evidence that one of the three species here described may be identical with it. As the sepiostaire of *S. dannevigii* is wholly unknown, and that of *S. hedleyi* imperfectly so, a final solution of the problem seems out of reach at the present time, but if d'Orbigny based his description upon an adult specimen, the dimensions given (long. 78 mm.) are so small as to avoid the necessity of comparison with the great *chiotrema*.

Assuming, then, that the present species is not *S. novae-hollandiae*, and I do not think it is, the only other forms which would seem to require any particular comparison

with it are the *S. capensis* of d'Orbigny and the *S. australis* Quoy and Gaimard,* names which appear to be absolute synonyms of one another. Following Hoyle (1912, p. 281, text fig. 8) in reviving Quoy's and Gaimard's name for the South African form, we find *S. chirotrema* to be particularly similar in the strongly elaborated mechanism of the tentacle club. This organ has fortunately been well figured for *australis* by Hoyle, but, if we are to be permitted judgment from the remarkable constancy in structural detail exhibited throughout by the "Endeavour" series, the differences are certainly of specific value. Not only this, but the localities are widely separated, while d'Orbigny expressly states that the horny rings of the large tentacular suckers are "dentelé sur son bord interne," and the suckers of the sessile arms "très-inégale en grosseur: celles du milieu plus grosses." He could hardly have made such statements of the species now in hand. *S. australis* further appears to be a much smaller species and to have quite a different sepiostaire.

The original figures of *S. australis*, Quoy and Gaimard (copied by d'Orbigny, 1834, Seiches, pl. 12, figs. 7-11) are very confusing when correlation is attempted with subsequent work. These ostensibly show a creature with a small, conical body, its tentacle club comparatively elongate and furnished with only two rows of quite large suckers not dimorphic in size. The sepiostaire, shown in reverse, has four strong grooves, about equally spaced, radiating forward from the spine.

Gray (1849, p. 110) follows d'Orbigny in his synonymy, but in reference to certain Australian material says:—"Var. Shell larger, scarcely so arched and with much longer spine than in M. d'Orbigny's figure. Perhaps a distinct species.

a. Sydney. Shell. Dry. Presented by J. Edwards, Esq., R.N.

b. Australia. Shell. Dry. Presented by A. Sinclair, M.D.R.N."

The Sydney specimen was subsequently figured by Hoyle (1886, p. 136, text fig. 6), who further writes: "As regards the external characters of the animal, *Sepia capensis* has three

* As the type locality of *S. australis*, Quoy and Gaimard, is "le banc des Aiguilles à trente lieues du cap du même nom," or Cape Agulhas, the name *australis* must have been adopted in a latitudinal rather than a specifically geographical sense and at first glance is therefore a bit misleading. It is not established that Quoy's and Gaimard's species so much as occurs in Australian waters. The authentic records are all South African.

suckers on the tentacle larger than the rest, and on the sessile arms the two inner series of suckers are larger than the outer," but it is evident that he is here only quoting from the older French authors.

Once more turning to Figs. 58-59, it will appear that the *sepiostaire* of the " Endeavour " species fails to agree even reasonably well with either d'Orbigny's figure of *S. australis*, Q. and G., Hoyle's illustration of *S. capensis*, or Chapman's figures called *S. capensis* (1912, pl. 1), which last are not given to great detail and may not belong to any of the forms under discussion. To sum up, the impression which one gains from such a survey of the literature as I have outlined is that probably the true *S. australis*, Quoy and Gaimard (and hence inevitably the *S. capensis*, d'Orbigny) is unknown in the Australian fauna as it has so far been elucidated; that *S. capensis*, Gray 1849, in part, and Hoyle 1886, represents another form, possibly undescribed; and that, therefore, none of these names are properly applicable to the present species.

The specific name *chirotrema* is derived from the Greek *χείρ* (hand) and *τρήμα* (perforation), having reference to the three large apertures in the dorsal membrane of the tentacle club, a feature unique so far as my own investigations have led me to inquire.

Suborder OCTOPODA.

Family POLYPODIDÆ.

Genus POLYPUS, *Schneider, 1784.*

POLYPUS, cf. AUSTRALIS (*Hoyle, 1885.*)

(Plate lxxviii., figs. 1-2; plate lxxxii., fig. 1).

1885. *Octopus australis*, Hoyle—Ann. Mag. Nat. Hist. (5), v. 15, p. 224.

1885a. *Octopus australis*, Hoyle—Proc. Roy. Soc. Edinb., v. 13, p. 98.

1886. *Octopus australis*, Hoyle—Ceph. "Challenger" Exp., p. 9, 88, 203, 219, 226, pl. 3, figs. 4-5.

1892. *Octopus Australis*, Brazier—Cat. Ceph. Austr., p. 5.

? 1916a. *Polypus australis*, Massy—Ceph. "Terra Nova" Exp., p. 142, 149, text figs. 9-10.

Recorded Distribution.—6-15 fathoms, Port Jackson, New South Wales (Hoyle); George's Beach, New South Wales (Brazier); ? 200 fathoms, off Gabo Island, Victoria ("Endeavour"); ? 11-20 fathoms, Spirits Bay, New Zealand (Massy).

Material Examined.—A small ♀, E5603 [S.S.B. 536], taken in 200 fathoms, south of Gabo Island, Victoria ("Endeavour"), seems nearer to *Polypus australis* (Hoyle) than to any other described form with which comparison has seemed advisable.

Measurements.—

TABLE XXIII.—MEASUREMENTS OF *Polypus, cf. australis*.

Author's Register Number.....	[537]
Sex.....	♀
	mm.
Tip of body to dorsal base of umbrella.....	37
Length of body.....	29
Width of body.....	27
Width of neck.....	19
Width across eyes.....	19
Length of funnel.....	20
Mouth to tip of right dorsal arm.....	95
Mouth to tip of left dorsal arm.....	93
Mouth to tip of right second arm.....	80+
Mouth to tip of left second arm.....	105
Mouth to tip of right third arm.....	90+
Mouth to tip of left third arm.....	97
Mouth to tip of right ventral arm.....	50+
Mouth to tip of left ventral arm.....	90
Mouth to margin of umbrella between dorsal arms.....	14
Mouth to margin of umbrella between ventral arms.....	14

NOTE.—The arms of this specimen proved so brittle that the measurements given are even less accurate than usual with these difficult creatures.

Remarks.—The specimen differs from Hoyle's description of *O. australis* (Hoyle 1886, p. 88, pl. 3, figs. 4-5) in the lesser extension of the umbrella between the ventral arms, the much larger funnel, the apparently finer surface papillation, and the evenly-rounded body. Here the dorsal surface of the head and body is roughened by numerous small, angular or irregularly linear papillæ, coalesced here and there to form short ridges. The ventral surface of the body is more finely wrinkly-reticulate-papillose. Over each eye is a large, rather slender, pointed tubercle, accompanied by several very small ones. The funnel organ (Pl. lxxxi., fig. 1) is W-shaped.

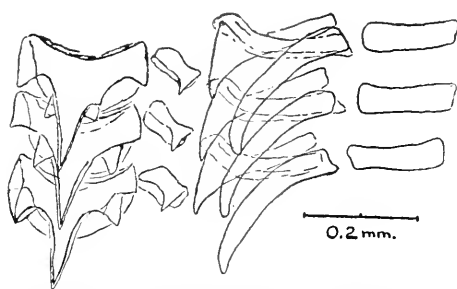


Fig. 62.—*Polypus cf. australis* ♀ [536], three rows of teeth from one side of radula; part camera drawing from a mount in balsam.

So far as the present specimen is concerned I quite fail to detect the close relationship of *P. australis* with *P. macropus* (Risso) which has been remarked upon by Joubin and Massy, a fact which would still further lead me to doubt the correctness of the identification suggested, were it not that Miss Massy expressly mentions that her New Zealand specimens lack the ventro-lateral fold of the integument originally described for Hoyle's species. I have been unable to secure as clear a representation of the radula as that offered by Miss Massy, but I think that the differences between her fig. 9 and my Fig. 62 are too great for complete explanation in this way, and strongly indicate that her material and the " Endeavour " specimen at least are not conspecific.

POLYPUS VARIOLATUS, de Blainville, 1826.

(Plates lxxix-lxxx; plate lxxxi, figs. 2-3; plate lxxxii, figs. 1-4.)

? 1821. *Sepia Boscii* Lesueur—Journ. Ac. Nat. Sci. Phila., v. 2, p. 101 (*nomen nudum*).

? 1826. *Octopus variolatus*, Blainville—Diet. Sci. Nat., v. 43, p. 186.

? 1838. *Octopus Boscii*, d'Orbigny, in d'Orbigny and Férussac—Céph. Acét., p. 68.

? 1845. *Octopus Boscii*, d'Orbigny—Moll. viv. foss., p. 186.

1849. *Octopus Boscii*, Gray—Ceph. Brit. Mus., p. 12.

1852. *Octopus tetricus*, Gould—Moll. U.S. Expl. Exp., p. 474, fig. 588.

1885. *Octopus Boscii*, var. *pallida*, Hoyle—Ann. Mag. Nat. Hist., (5), v. 15, p. 223.

1885*a*. *Octopus Boscii*, var. *pallida*, Hoyle—Proc. Roy. Soc. Edin., v. 13, p. 97.

? 1886. *Octopus boscii*, Hoyle—Ceph. "Challenger" Exp., p. 8, 82, 219 (merely catalogued).

? 1886*a*. *Octopus Boscii*, Hoyle—Cat. Rec. Ceph., p. 216 [12] (merely catalogued).

1886. *Octopus boscii*, var. *pallida*, Hoyle—Ceph. "Challenger" Exp., p. 81, 203, 219 226, 228, pl. 1; pl. 3, fig. 2.

1892. *Octopus Boscii*, Brazier—Cat. Ceph. Austral., p. 3 (no description).

1892. *Octopus tetricus*, Brazier—Cat. Ceph. Austral., p. 5 (no description).

1894. *Octopus Boscii*, Joubin—Ceph. d'Amboine, p. 32.

1904. *Polypus bosci*, Hoyle—Ceph. Gulf of Manaar, p. 195.

1909. *Polypus bosci*, Hoyle—2d Suppl. Cat., p. 259 (merely catalogued).

1916. *Polypus rugosus*, (pars), Massy—Rec. Ind. Mus., v. 12, p. 189.

1916*a*. *Polypus rugosus* (pars), Massy—Ceph. "Terra Nova" Exp., p. 147.

1916. *Polypus boscii*, Hedley—Journ. Roy. Soc. West Austral., v. 1, p. 22 (merely catalogued).

Recorded Distribution.—New South Wales : Sydney (Gould, *tetricus*); 150 fathoms, off Twofold Bay (Hoyle, *pallida*).

Victoria : 38 fathoms, off East Moncœur Island, Bass Straits (Hoyle, *pallida*); eastern slopes of Bass Strait ("Endeavour").

Tasmania : 75-80 fathoms, off Tasman Head ("Endeavour"); 56 fathoms, Bay of Fires ("Endeavour"); off Flinders Island ("Endeavour"); 60-100 fathoms, 20 miles east of Babel Island ("Endeavour").

Western Australia : 80-200 fathoms, Great Australian Bight, off Eucla ("Endeavour"); Dorre Island, Sharks Bay (Lesueur, *boscii*; Blainville, *variolatus*).

Amboina (Joubin, *boscii*); Ceylon (Hoyle, *bosci*).

Material Examined—

TABLE XXIV.

No. of Specimens.	Sex.	Depth in Fathoms	Locality.	Original Number.	Author's Register
1	♀	80-120	Long. 129° 28' E., Gt. Australian Bight, S. of Eucla, W.A.	E3625	[526]
1	juv.	"	"	E3626	[567]
1	♀	160-200	Long. 127° 8' E., Gt. Australian Bight, S. by W. of Eucla, W.A.	E4317	[520]
1	♂	deep water	Eastern slopes, Bass Strait.	E5341	[527]
1	♀	?	Australian Seas (? S.E.).	E6061	[528]
2	♀♀	75-80	Off Tasman Head, Tasmania.	E4879	[515]
1	♀	60-100	20 m. E. of Babel Id., Bass Strait.	E4880	[514]
1	♀	56	Bay of Fires, Tasmania.	E4885	[529]
1	juv.	..	E. coast of Flinders Id., Bass Strait.	E5602	[530]

Measurements.—

TABLE XXV.—MEASUREMENTS OF *Polypus variolatus*.

Author's Register Number.	[527]	[528]	[529]	[520]	[526]
Sex.	♂	♀	♀	♀	♀
Total length.	mm. 375*	mm. 320*	mm. 290	mm. 215	mm. 175*
Tip of body to dorsal base of umbrella.	116	107	103	78	60
Width of body.	69	68	75	52	47
Width of neck.	55	46	43	33	30
Width of mantle opening.	46	39	40	32	28
Width of head.	53	44	42	35	31
Length of funnel.	36	..	..	25	20
Mouth to tip of right dorsal arm.	215	185	190	140	100
Mouth to tip of left dorsal arm.	225	185	190	120	100
Mouth to tip of right second arm.	240	195	200	150	107
Mouth to tip of left second arm.	245	200	210	130	108
Mouth to tip of right third arm.	200	205	210	135	118
Mouth to tip of left third arm.	265	220	220	110+	118
Mouth to tip of right ventral arm.	260+	210	215	145	130
Mouth to tip of left ventral arm.	280	210	210	145	121
Diameter of largest suckers.	12	8	8	5.5	4
Length of hectocotylus.	18	..	..	..	..
Mouth to margin of umbrella between dorsal arms.	50	50	45	27	24
Mouth to margin of umbrella between ventral arms.	80	45	45	40	24

* Estimated.

Remarks.—The " Endeavour " collection contains a large series of the remarkably handsome *Polypus*, to which I here apply, with considerable hesitation, the name *variolatus*. They are very surely referable to the race which has generally passed under the name *boscii* in the literature, but it is evident that this old name of Lesueur can have no standing.

In the first place, Lesueur published it as a mere *nomen nudum*, and in the second place even d'Orbigny, who published the name for the first time with a brief "description," recognised the insufficiency of the latter and placed *boscii* among his "Espèces incertaines." On account of the alleged great length of the arms, the species is compared by d'Orbigny with *O. cuvierii* (= *macropus* Risso), a parallel which if valid certainly signifies that it is very different from the forms which more recently have been awarded the same name.

Gray (1849) gives a more complete description than that of d'Orbigny, and it is in some accord with our specimens, but how he arrived at his determination of his material is not stated. It is clear that even assuming the correctness of Gray's general conclusions, it is impossible to date *boscii* as from Lesueur 1821. It can only hold from d'Orbigny 1838. Meanwhile de Blainville in 1826 had already published a short diagnosis of the same form under the name *Octopus variolatus*,* basing it as Lesueur originally did upon Péron's manuscript and specimens. D'Orbigny's diagnosis in fact seems throughout to be founded upon that of Blainville. Under these circumstances, if we are to recognise the older species at all, I see no escape from the rehabilitation of de Blainville's long forgotten name. The temptation to reject both names as impossible of determination is augmented by the fact that we are really not at all sure that the West Australian race to which these names must apply is identical with the lighter-colored southern and eastern specimens since described by Gray, Gould, Hoyle, *et al.* In this eventuality the next available name would seem to be *tetricus*, Gould, 1852. Though here again the description leaves much to be desired, it fits the common eastern Australian species, at least in a general way. Next comes Hoyle's *O. boscii* var. *pallida*, with which the present material is certainly conspecific.

* I am indebted to Mr. Ellis L. Michael, of the Scripps Institution for Biological Research, for a copy of de Blainville's description in the Dictionnaire (1826, p. 186), which is as follows:—

"Le Poulpe variolé; *O. variolatus*, Péron. Corps très-grand; peau couverte de tubercules très-serrés et très-nombreux; appendices tentaculaires extrêmement longs, très-épais, armés de deux rangs de ventouses arrondies et aplaties; couleur d'un brun noir; longueur totale, 0,60m. ou près de deux pieds.

Cette grande espèce de poulpe a été trouvée par Péron et Lesueur abondamment dans les excavations des roches qui bordent la petite île de Dorre, dans la baie de Chiens marins à la Nouvelle-Hollande. Je ne la connois que d'après une note de M. Péron, qui la rapportoit au *P. rugueux* de M. Bose."

Another alternative has recently been advanced by Miss Massy in referring Hoyle's form (she does not mention the older names) to the widespread *P. rugosus* (Bosc)=*granulatus* (Lamarek). Whether one adopts this view or not it should be remembered that she has had the immeasurable advantage of access to many of the historic specimens in the Paris and British Museums with which to fortify her opinion.

The most remarkable feature of the " Endeavour " specimens is the ornamentation of the integument. The larger dorsal tubercles show a remarkably symmetrical arrangement which does not seem to have been described by other authors, though it is a conspicuous and constant feature. On the dorsum in the median line appears a series of four large, evenly spaced, branched tubercles, flanked on each side by a similar series of three to four tubercles, the middle one somewhat displaced ventrally, and by a few smaller tubercles below these. The lateral series are so placed with reference to the median that the tubercles have an appearance of being

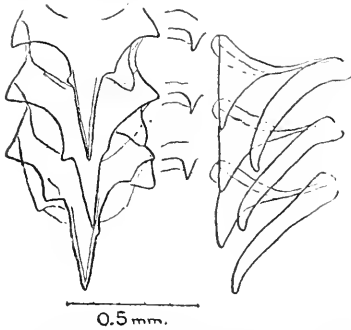


Fig. 63.—*Polypus variolatus* ♂ [527], three rows of teeth from one side of radula; part camera drawing from a mount in balsam.

arranged in transverse as well as longitudinal rows. A similar tubercle is often borne on the base of each dorsal arm, with a more constant, larger, central one behind them. There is a somewhat smaller tubercle at the extreme posterior tip of the body. Above and behind each eye (Pl. lxxxii, figs. 2, 4) is a very large, soft, branched tubercle, accompanied by some 5-7 smaller ones.

The variations observed in this general pattern as outlined are only minor. In addition to these major ornaments, the entire dorsal surface of the head and body, and the outer aspect of the arms and umbrella are covered by numerous, large, crowded papillæ (Pl. lxxxii., fig. 3), of characteristic stellate structure as described by Hoyle (1886, p. 81). These papillæ are in some specimens, such as E3625, flattened out to resemble a sort of reticulated pavement, but seem always unmistakably present, and when well preserved (cf. Pl. lxxix.) are a very beautiful feature. The papillation extends also over the entire ventral surface of the head, body, and funnel over the inner surface of the umbrella,

and between the suckers over the oral faces of the arms, but in all these regions the papillæ are much more weakly developed than dorsally, become more numerous and crowded, and are less distinctly stellate (cf. Pl. lxxx.). The large ♀ figured (E6061) is a most beautifully preserved specimen and truly handsome.

For the specimens listed in synonymy the relative length of the arms is variously given, but in the "Endeavour" specimens, unless mutilated or indifferently preserved, the formula is quite constantly 4, 3, 2, 1. This in spite of the fact that the differences between the arms are nowhere very great and might conceivably be overbalanced at times by irregularities in the degree of contraction. In the ♂ the 10th-14th suckers on all the arms show more or less enlargement (Pl. lxxxii., fig. 3), except on the ventral pair, where it seems to be the 11th-14th.

The very large and powerful hectocotylus (Pl. lxxxii., fig. 1) does not seem to have been previously figured.

The funnel organ (Pl. lxxxii., fig. 2) is duplex. Each component is V-shaped, with broad wings and a more or less rounded posterior angle.

An illustration of the radula is given in Fig. 63.

POLYPUS, *sp. juv.*

The specimens listed in Table XXVI. are either too young or too poorly preserved to be accurately determined at this time as to species, though most of them should very probably be referred to *P. variolatus*.

TABLE XXVI.

No. of Specimens.	Sex.	Depth in Fathoms	Locality.	Original Number.	Author's Register	Remarks.
1	?	80-120	Long. 129° 28' E., Gt. Australian Bight, S. of Eucla, W.A.	E3624	[533]	juv.
2	?	26	Oyster Bay, Tas.	E4881	[534]	juv.
1	?	70-100	S. of Mt. Cann, Vic.	E5727	[535]	juv.
1	?	70-80	36 m. S. by 58 m. W. of Cape Wickham, King Id., Bass Str.	E6067	[531]	juv.
1	?	60-100	20 m. E. of Babel Id., Bass Strait.	E6069	[532]	juv.

E6067 and E6069 are young Polypi, having a mantle length of 15 and 20 mm. respectively, and characterised by their dark, cloudy coloration, rounded-oval body, faintly papillose surface with a few scattered tubercles, and long and slender arms, the third pair a little the longest. One large tubercle and several smaller ones are evident in the neighbourhood of each eye.

Two very small, dark Polypi (E4881), each with a mantle length of about 10 mm., are possibly referable here, as also E5727, another rather more tuberculate specimen of similar size and general appearance. It seems likely that these are all only variant juvenals of the preceding species, but as they have quite a different aspect it seems safer to mention them separately.

Specimen E3624 (Pl. lxxviii., fig. 3) has an aspect of its own. It may be the same as the above, but differs in its smoother skin, softer consistency, and more elongate body; all, however, features which might conceivably be affected by the manner of preservation.

Family CIRROTEUTHIDÆ.

Genus OPISTHOTEUTHIS, *Verrill*, 1883.

Subgenus TEUTHIDISCUS, *nov.*

Opisthoteuthids differing from the typical species (*O. agassizii*, *Verrill*) in the possession of a single, more or less crescentic, bar-shaped cartilage for the support of the fins, and further in the extreme degree to which the antero-posterior flattening of the body has been developed. It possibly should include all the described species of *Opisthoteuthis* excepting *O. agassizii*.

Type.—The following species.

OPISTHOTEUTHIS PLUTO, *sp. nov.*

(Plate lxxxi., figs. 4-5; Plate lxxxii., figs. 5-8; Plates lxxxiii-lxxxiv.)

Animal large, in outline subdiscoid to vasiform, according as the arms and umbrella are expanded or closed: tissues in preserved specimens wrinkled and flabby. *Body* much compressed in the peculiar fashion of the group; so completely confluent with the head, umbrella, and arms as to appear externally only as a low, rounded swelling in the centre of the disk (Pl. lxxxiii.). Fins rather large, flabby, oblong, about twice as broad as long.

Eyes moderately large, appearing as antero-lateral swellings on the central hump. *Funnel* posterior in position and direction; apparently minute as seen from the exterior, but in reality long and narrow, only the apical portion protruding; interior similarly narrow, its walls lined by a wrinkled epithelium.

Funnel organ (Fig. 64) very simple, comprising merely a pair of small, well separated, oblique, oval pads situated well back on the dorso-lateral walls of the chamber.

Arms moderate, practically equal in length; little or not at all evident outwardly, and within only as sucker-bearing thickenings in the umbrella: inconsistency not much firmer than the interbrachial membrane itself. Suckers uniserial, relatively firm and hard, moderate in size, the 5th to 7th from the mouth usually the largest, thence rapidly diminishing in size proximally and more gradually distally to the extremity of the arm; first three at base very small in relation to those succeeding them; flanked on each side by an equal number of alternating cirri as usual in the genus, both suckers and cirri apparently more or less completely retractile within a circular fold of the integument sometimes forming a sort of pocket-like sheath; the pockets for receiving the cirri, sometimes, though not always, visible from the exterior through the integument, extending transversely or somewhat obliquely inward almost to the line of suckers (Pl. lxxxii., fig. 6); total number of suckers to be readily counted on each arm of a large specimen, 80-85. *Umbrella* (Pl. lxxxiv.) exceedingly ample; its greatest extension usually in front where it webs the arms (in the type) to within about 2 cm. of their tips; dorsal arms more or less curved, the concavities of the curves facing so that the margin of the web between them is relatively short; remaining arms usually evincing a tendency to curve forward, the ventral arms therefore just the reverse of the dorsal in this particular, and with the web connecting them correspondingly wide.*

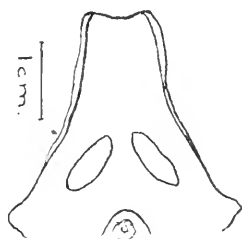


Fig. 64.—*Opisthotentis plato* [468], funnel laid open along medio-ventral line to expose funnel organ.

*The result of all this is that the umbrella, in fact, the entire disk, shows a much stronger bilateral symmetry than would otherwise be the case. A thoroughly similar condition, with only minor points of differ-

Colour. of specimens preserved in formalin solution, in general dark; upper surfaces finely clouded with chocolate and dark slaty gray, the slate tone predominating, all the specimens further showing traces of a system of small, pigmented oculations as described below: oral surface of umbrella a cloudy chocolate brown, in the larger specimens more or less overshoot with dark slaty purple, the color a little paler around the mouth, deepest in the broad zone next succeeding, thence rapidly paling to the edge of the umbrella; suckers and cirri light brownish, but the regions immediately surrounding them not usually especially lighter in hue than the interbrachial areas. Areolar spots of dorsal surface small, their size, and inversely their prominence, dependent upon their degree of expansion (Pl. lxxxii., figs. 4-5); typically showing a small, clear, sharply defined nucleus surrounded by a narrow zone of dark chocolate, then a wider, paler region, succeeded finally by a poorly defined zone of bluish slate, somewhat darker than and blending off into the general surface color of the surrounding integument; in specimens at hand exact arrangement of areolæ difficult to make out; body itself apparently free of them, but two series beginning on head between eyes extend along or nearly along the upper side of the dorsal arms, one series to each arm; similar, but less numerous series extending along the remaining arms as well, those corresponding to the ventral pair appearing to originate near the bases of the fins, the others anterior to this point; correspondence to all the arms usually more approximate than exact, owing to the soft, loose integument and varying state of contraction of the arms themselves.

ence, has been described in detail by Ijima and Ikeda (1895, p. 7) for *Opisthoteuthis depressa*, so further description is not necessary here. In the largest specimens the extremities of the arms seem to extend past the web somewhat, but in small specimens the webbing extends almost to the tips, which are never excessively attenuate.

In the type the umbrella between the dorsal arms is somewhat torn on the right side at the margin where it joins the arm. The fragment remaining attached to the arm is somewhat thickened, and at first glance reminds one of the nodules which have been described in analogous positions on other species of Cirroteuthidæ by several observers, notably Hoyle and Verrill. However, since no trace of anything similar is to be found upon the remaining specimens, I believe the explanation given is correct in this instance.

Branchiæ with eight segments each.

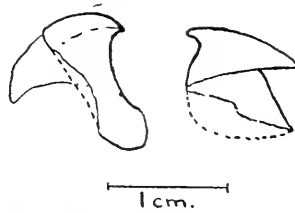


Fig. 65.—*Opisthoteuthis pluto* [472], camera drawing of mandibles.

Mandibles as in Fig. 65.

Radula absent.

Measurements.—

TABLE XXVII.—MEASUREMENTS OF *Opisthoteuthis pluto*.

Author's Register Number.	[464]	[468]	[465]	[466]
	Type		Paratype	
	mm.	mm.	mm.	mm.
Maximum expansion (tip of right dorsal arm to tip of left ventral arm)	540	350	275	195
Width across fins	210	115	115	70
Width of fin (right)	60	30	20	10
Maximum length of fin	30	15	10	5
Width across eyes	100	70	75	30
Length of funnel . . . . .	..	28	21	..
Mouth to tip of right dorsal arm	260	160	145	85
Mouth to tip of left dorsal arm	260	160	145	85
Mouth to tip of right second arm	250	155	150	85
Mouth to tip of left second arm	250	155	140	85
Mouth to tip of right third arm	270	170	140	90
Mouth to tip of left third arm	245	145	145	90
Mouth to tip of right ventral arm	245	160	115+	85
Mouth to tip of left ventral arm	250	160	130	90
Diameter of body of 5th sucker from base, right dorsal arm	7	4	3.5	2
Mouth to margin of umbrella between dorsal arms	170	105	95	60
Mouth to margin of umbrella between second and third arms	145	95	100	55
Mouth to margin of umbrella between ventral arms	140	100	80	55

NOTE.—Though great care was taken, the very nature of the animals renders most of the above measurements extremely uncertain. They are, in fact, as a rule, little more than estimates, and hence of value only in the most general way.

*Pteropallial cartilage** (Pl. lxxxii., figs. 7-8) broadly U-shaped, posterior in position, its pointed horns extending past the base of but not into the fins; fins muscles large, broadly attached at the base to the tough, ensheathing membrane of the cartilage, the latter at this region showing a vertical thickening, then a rapid tapering, the outer surface here abruptly flattened and even slightly excavated at the point of expansion: a groove, broad and shallow at first, but gradually narrowing and deepening posteriorly, extends around the entire periphery of the cartilage between the two flattened areas (Pl. lxxxii., fig. 8).

Type.—Specimen E3628 [S.S.B. 464], in the collection of the Australian Museum, Sydney. A paratype [S.S.B. 465] has been retained by the writer.

Type Locality.—350-450 fathoms, long. 129° 28' E., Great Australian Bight ("Endeavour"); one specimen.

Recorded Distribution.—150-350 fathoms, Great Australian Bight, off coasts of South and Western Australia ("Endeavour").

Material Examined.—

TABLE XXVIII.

No. of Specimens.	Depth in Fathoms	Locality.	Original Author's Number. Register		Remarks.
1	350-450	Long. 129° 28' E., Gt. Australian Bight.	E3628	[464]	Type
1	200	Long. 126° 10' E., Gt. Australian Bight, S. of Eucla, W.A.	E3629	[465]	Paratype
1	"	"	E3630	[466]	
1	"	"	E3631	[467]	juv.
1	150	Long. 130° 10' E., Gt. Australian Bight, S. of Eucla, W.A.	E3632	[468]	
1	160-200	Long. 127° 8' E., Gt. Australian Bight, S. by W. of Eucla, W.A.	E4318	[469]	juv.
1	"	"	E4319	[470]	juv.
1	"	"	E4320	[471]	
1	"	"	E4321	[472]	dissected
1	"	"	E4322	[473]	
1	175	Long. 128° 40' E., Gt. Australian Bight, SW. by S. of Eucla, W.A.	E4373	[474]	juv.
1	"	"	E4374	[475]	juv.
1	"	"	E4375	[476]	juv.

* This term is probably here used for the first time. It is the equivalent of the "dorsal cartilage" or "Rückenknorpel" of various authors, and the "Flossenstütze" of Meyer.

Remarks.—*Opisthoteuthis* is not, even after all the years since its original description, so common a genus but that the discovery of specimens is almost *per se* a matter of considerable interest. Their comparative abundance in the present instance is therefore rendered especially noteworthy. These Australian examples differ from the type of the genus and approach the Japanese *O. depressa* in the very great extent to which the compression of the body has been carried. *O. agassizii* further differs in that its pteropallial cartilage is a *paired* organ, its components being said to extend into the fins on either side. This feature would certainly seem important enough for taxonomic recognition, and is the principal basis for the establishment of the subgenus here proposed. *O. depressa* also falls under *Teuthidiscus* rather than the typical group, and I suspect that both the other described species, *O. medusoides*, Thiele and *O. extensa*, Thiele, belong here likewise, though their skeletal characters have not yet been made known. Superficially at least, *O. extensa* seems nearer to the form now described than do any of the other species, so much in fact that it is not impossible that it may prove conspecific when better known. However, from Thiele's description and figures it would appear to have smaller, more median fins, a less extensive umbrella, more attenuate arms, and smaller, more uniform suckers. It is not represented as areolate. The gills are said to have only six divisions, as against eight in *O. pluto*. But it must be said that none of these differences are very striking.

Even small specimens of *O. pluto*, down at least to a diameter of 75 mm., are readily distinguishable by their characteristic coloration, as well as usually by their usually flabbier, stringier, and less gelatinous consistency than that shown by (*e.g.*) specimens of *O. persephone*. The depressed, discoid outline, however, does not invariably hold in preserved material. In several specimens, notably E4321, the body is elevated and slightly constricted at the junction with the umbrella, while in a few specimens, as E4319 and E4320, the umbrella is closed and the body pushed out so that the general shape more approaches that of a *Cirroteuthis*.

Portions of skin containing areolæ were delaminated and mounted. Both stained (DeLafield's hæmatoxylin) and unstained preparations were made in the hope of obtaining some clue as to their nature or the possibility of the nuclear mass containing photogenic tissue. But the tissues proved to have suffered too much disorganisation to show their true character or to justify further investigation by sectioning. The central clear region was conspicuous as a circular or

ovate mass of pale, flocculent material lying beneath the surface membrane and surrounded by a narrower line of a clearer substance as though perhaps enclosed in a transparent sac. The flocculent material was better seen in the unstained, the sac-like boundary in the stained preparation. Superficially the areolae remind one somewhat of the oculations occurring in the integument of such octopods as *Polypus marmoratus*, *P. bimaculatus*, etc., but a similar mounted preparation of one of the areolae of a specimen of *P. bimaculatus* from Laguna Beach, California [S.S.B. 324] shows no trace of either a sac-like organ or submerged flocculent tissue. In the case of the *Polypus* the oculation seems to be mainly, if not wholly, a matter of the arrangement, number, and color of the chromatophores.

The Australian records constitute a considerable and interesting extension of the known range of the genus.

OPISTHOTEUTHIS PERSEPHONE, *sp. nov.*

(Plate lxxxii., figs. 6-7; Plate lxxxiii., figs. 9-10; Plates lxxxv.-lxxxviii.)

Animal of moderate size, in outline subdiscoid when fully expanded (Pl. lxxxvii., fig. 1), otherwise more or less vasiform (Pl. lxxxvii., fig. 2); tissues wrinkled and flabby. *Body* compressed, completely confluent with the head, the whole blending into the arms and umbrella so as to appear in the expanded phase but a poorly defined elevation or thickening in the centre of the disk. *Fins* minute, tenuous, more or less median in position; usually more than twice as broad as long.

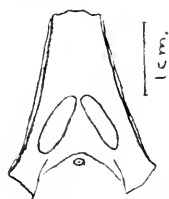


Fig. 66.—*Opisthoteuthis persephone* [481], funnel laid open along medio-ventral line to expose funnel organ.

Eyes rather small and inconspicuous. *Funnel* posterior in position and direction in the discoid phase; tubular; very narrow and slender; aperture small; interior lined with a very delicate epithelium.

Funnel organ in general outline and position similar to that of the preceding species, comprising a pair of small, oval pads placed well back on the dorsal wall of the cavity and pointing toward one another in front, but the component pads apparently much larger in proportion to the general dimensions of the cavity, as well as more slender than in *O. pluto* (Fig. 66).*

* The funnel organ proved extremely difficult to make out satisfactorily because of the mass of mucus which, in the specimen figured, filled the funnel chamber. In a second specimen examined, the organ was quite indistinguishable.

Arms rather short ; sometimes apparent from above, but usually evident only as stout cartilage-like thickenings in the umbrella. Suckers uniserial and very small ; essentially equal in size over almost the entire length of the arm, only the three basalmost and those toward the tip being appreciably, though gradually, smaller than the remainder ; 12th-18th possibly largest in the series, but this a point difficult if not impossible to specify : usually well elevated ; in the vasiform stage with umbrella closed the suckers very close together in a given series, more distant in the fully expanded phase, as also in the preceding species : each series flanked on each side at a distance of perhaps three sucker-diameters by a series of small, retractile, glove-finger-like, pointed cirri corresponding in number to and occurring in apparent alternation with the suckers ; the narrow pockets into which the cirri retract very conspicuous in this species (Pl. lxxxii., fig. 9), due very likely to the pale color of the contained portion of the cirri as contrasted with the dark pigmentation of the subjacent tissues, in outline straight, extending transversely from the small, crescentic openings about two-thirds the distance to the row of suckers, or sometimes obliquely backward, depending upon the position or state of contraction of the surrounding tissues ; suckers themselves likewise more or less retractile, though rarely, so far as seen, to the same degree as in *O. pluto* ; total number of suckers to be made out clearly by the naked eye on the arms of the right side of type 1-78, 2-78, 3-72, 4-72. *Umbrella* (Pls. lxxxvi, lxxxviii) ample, its greatest extension usually in front, though it extends between all the arms nearly to their extremities, the latter being more attenuate and free of the web for a slightly greater distance than in *O. pluto*. A bilateral symmetry in the disposition of the arms and web is to be found here as in *O. pluto*, but the peculiar curvatures of the arms noted in the case of the latter species are not so evident in the present series of specimens.

Colour of specimens preserved in formalin solution ; outer or aboral surfaces of the type and other Victoria specimens practically colorless, or a sort of dirty gray, except for traces of small areolae and of a delicate, much torn, superficial membrane lightly pigmented with streaks of brown ; oral surfaces with the superficial integument colorless and transparent, its interbrachial portions *very loose*, lying in soft folds and wrinkles over the smooth, pigmented layer beneath, the dark bluish slate of the pigmented layer showing through everywhere except that it is paler along the arms and over a ring-like zone a little distance from the mouth ; suckers

and cirri light yellowish brown, contrasting strongly with the general slaty hue. Small specimens from off Eucla differing in that the light ring round the mouth is more sharply marked off from the dark mouth region and the dark area outside; the aboral surface furthermore a uniform grayish white without evident pigmentation, except for a series of 3-7 tiny ocellar spots running from the body out toward the tip of each arm, each areola (Pl. lxxxi., figs. 6-7) showing a small, clear central area as in *O. pluto*, often appearing slightly elevated, but each areola as a whole much more minute.

Pteropallial cartilage (Pl. lxxxii., fig. 10) in general similar to that described for *O. pluto*, but relatively shallower, broader, and thinner, the fin attachments narrower, and the lateral flattenings, though somewhat more excavated, not so abrupt; peripheral groove also apparently somewhat shallower, though a more accurate description and drawing than that offered is prevented by the extremely soft and brittle condition of the specimens.

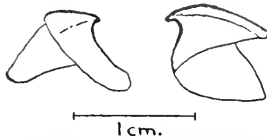


Fig. 67.—*Opisthotectis persephone* [484], camera drawing of mandibles.

Mandibles (Fig. 67) and buccal mass relatively small, much smaller than in the dissected specimen of *O. pluto*, though the latter is a smaller animal; upper mandible also differing in the possession of a distinct angle along each outer side of the beak at the shoulder.

Branchiae six on one side, six + one poorly developed on the other. *Pallial muscle* back of funnel extremely weak.

Type.—Specimen E5718 [S.S.B. 480], in the collection of the Australian Museum, Sydney. A paratype [S.S.B. 482] has been retained by the writer.

Type Locality.—260 fathoms, 42 miles south and east of Genoa Peak, Victoria ("Endeavour"); three specimens.

Recorded Distribution.—232-260 fathoms, off Genoa Peak, Victoria ("Endeavour"); 150-300 fathoms, off Eucla, Western Australia ("Endeavour").

Remarks.—The more tangible characteristics by which this exceedingly interesting octopod may be distinguished from its accompanying relative, *O. pluto*, are the small, even-sized suckers, the distinctive coloration more especially over the oral aspect of the arms and web, the firm composition of the

Measurements.—

TABLE XXIX.—MEASUREMENTS OF *Opisthotentis persephone*.

Author's Register Number.....	[480]	[484]	[477]
	Type.		
	mm.	mm.	mm.
Maximum expansion (tip of right dorsal arm to tip of left ventral arm).....	330	225	170
Width across fins.....	75	..	..
Width of fin.....	20	15	15
Maximum length of fin.....	14	7	6
Width across eyes.....	50	40	35
Length of funnel.....	..	8	..
Mouth to tip of right dorsal arm.....	165	110	80
Mouth to tip of left dorsal arm.....	150	110	80
Mouth to tip of right second arm.....	160	115	85
Mouth to tip of left second arm.....	160	115	85
Mouth to tip of right third arm.....	175	125	90
Mouth to tip of left third arm.....	170	120	75—
Mouth to tip of right ventral arm.....	165	125	90
Mouth to tip of left ventral arm.....	165	110	90
Diameter of body of 5th sucker from base, right dorsal arm.....	2+	2	1.1
Mouth to margin of umbrella between dorsal arms.....	100	80	60
Mouth to margin of umbrella between second and third arms.....	105	85	60
Mouth to margin of umbrella between ventral arms.....	115	85	60

Material Examined.—

TABLE XXX.

No. of Specimens.	Depth in Fathoms	Locality.	Original Number.	Author's Register	Remarks.
1	150	Long. 130° 10' E., Gt. Australian Bight, S. of Eucla, W.A.	E3633	[477]	discoid
1	..	..	E3634	[478]	..
1	250-300	Long. 130° 50' E., Gt. Australian Bight, S. of Eucla, W.A.	E3638	[479]	..
1	260	42 m. S. and E. of Genoa Peak, Victoria.	E5718	[480]	Type
1	..	..	E5719	[481]	Paratype
1	..	..	E5720	[482]	Paratype
1	232	40 m. S.E. and S. of Genoa Peak, Victoria.	E5721	[483]	
1	..	..	E5722	[484]	dissected

arms, and *perhaps* the smaller size. The sum total of these features is an *ensemble* rather difficult to describe, but which very soon enables one to separate the two species with considerable accuracy almost as rapidly as the specimens can be handled, and this seems to be true even aside from the differences in color.

The three small specimens from off Eucla have a certain facies of their own (Pl. lxxxvii., fig. 1; pl. lxxxviii., fig. 1), and I at first felt some doubt as to whether they might not represent a third species. I am now inclined to think them simply young *persephone* which have chanced to be preserved in the discoid phase.

This species, particularly if the conclusions in the last paragraph are true, finds its nearest relatives in the well-known Japanese *O. depressa*, and perhaps the curious little *O. medusoides*, Thiele. At any rate these are the only species with which it would seem to require any special comparison. It resembles both in the concentrically bicolored oral surface and the pale aboral area, but *O. medusoides*, which impresses one as more or less juvenile in many of its characteristics, is rather differently shaped and has larger fins, besides having the inside of the web figured as reddish brown rather than slaty. *O. depressa* differs notably in the simple, straight, bar-like form of the pteropallial cartilage, which does not seem to extend forward to the fins as in the Australian species.

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EXPLANATION OF PLATES.

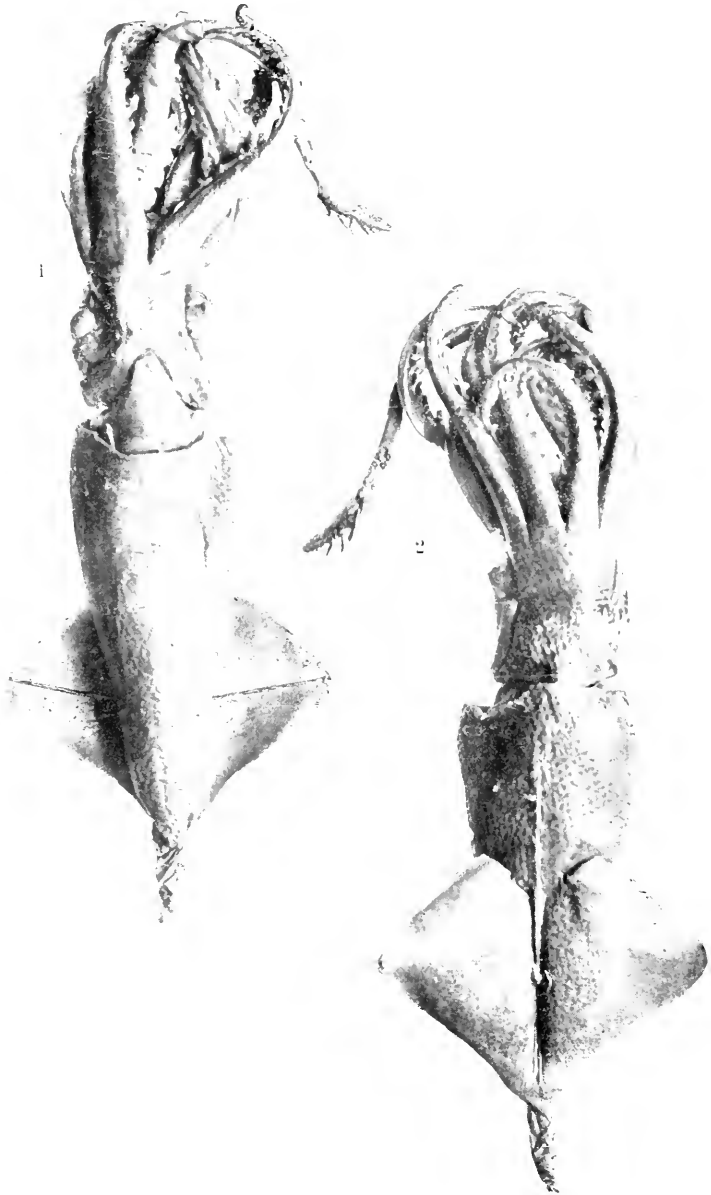
NOTE.—Except where otherwise indicated, practically all the drawings in the following plates are from the pen of Mr. Herbert J. Powell, of Redlands, California. The wash drawings and certain others designated are by Mr. Robert N. Wenzel, of Stanford University. The photographs are by Mr. E. F. Everitt, of Redlands, California. They have not been retouched except as to the backgrounds.

EXPLANATION OF PLATE LIX.

Enoploteuthis galaxias, ♀.

Fig. 1.—Ventral aspect of type specimen [543]: approximately natural size.

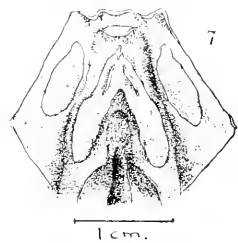
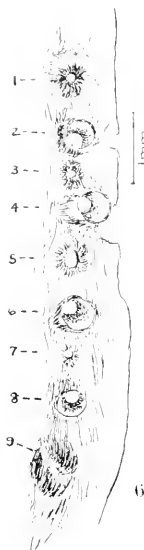
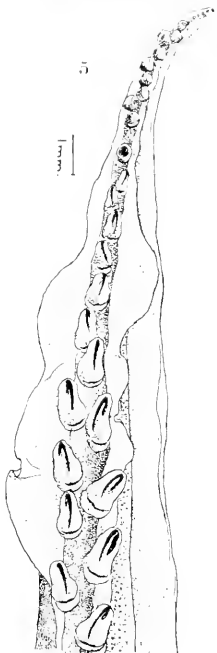
Fig. 2.—Dorsal aspect of same: same scale.



EXPLANATION OF PLATE LX.

Enoploteuthis galaxias.

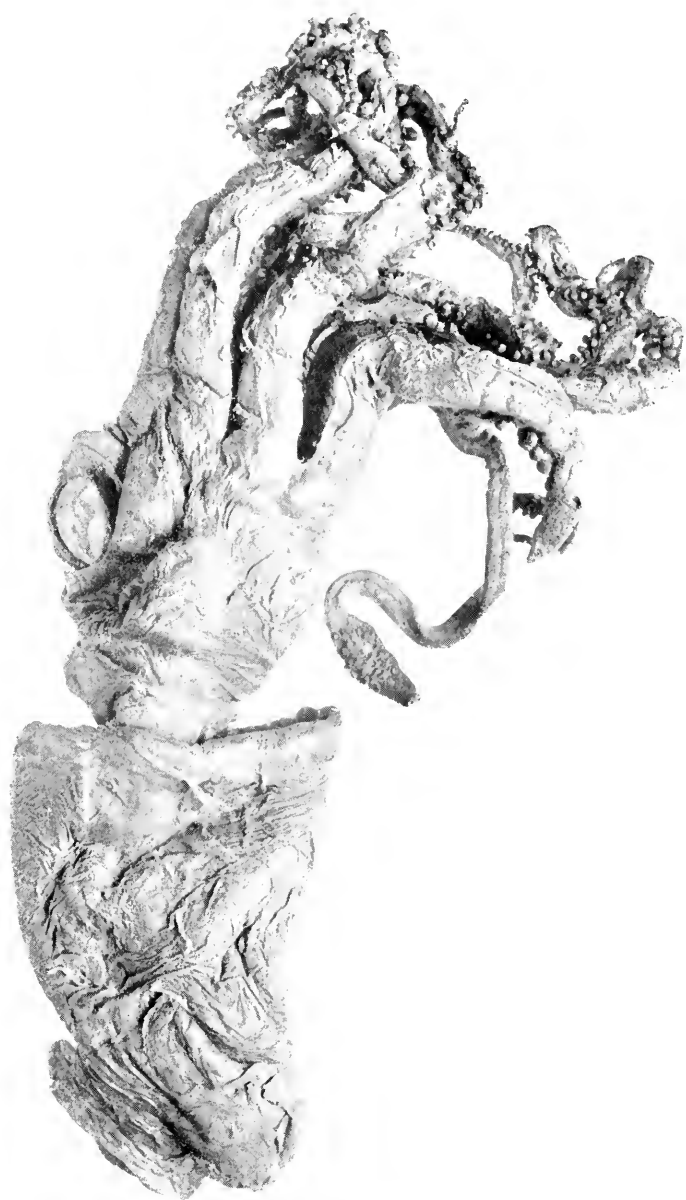
- Fig. 1.— Oral face of right tentacle club of type specimen, ♀ [543].
- Fig. 2.— Oral face of right tentacle club of paratype, ♂ [544], same scale.
- Fig. 3.— Tip of right third arm of type, ♀ [543].
- Fig. 4.— Oral aspect of right ventral arm of paratype, ♂ [544].
- Fig. 5.— Distal portion of same, seen under greater magnification.
- Fig. 6.— Photophores from ventral periphery of right eyeball of paratype, ♀ [462]; part camera sketch from mount in balsam.
- Fig. 7.— Funnel of paratype, ♀ [462], laid open along medio-ventral line to show the funnel organ.



EXPLANATION OF PLATE LXI.

Callitoothis miranda, ♀.

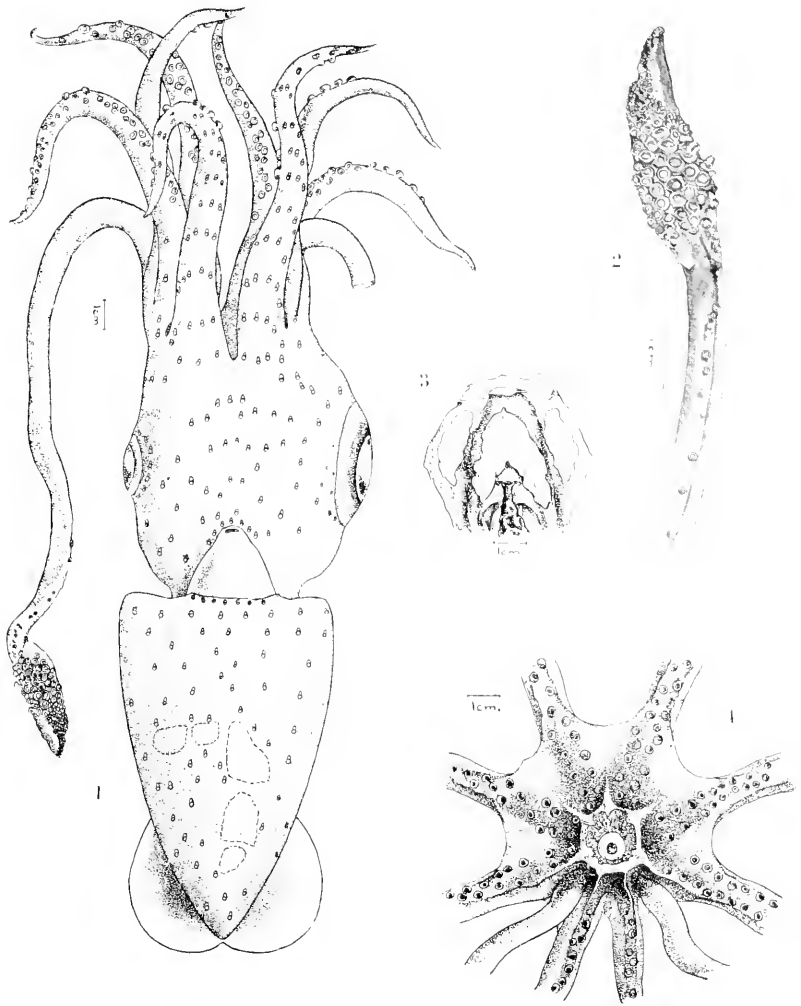
Dorsal aspect of type specimen [545]; $\times \frac{1}{2}$.



EXPLANATION OF PLATE LXII.

Callitoothis miranda, ♀.

- Fig. 1.—Ventral aspect of type specimen [545].
- Fig. 2.—Oral aspect of right tentacle club of type specimen [545]. Drawn by R. N. Wenzel.
- Fig. 3.—Funnel of type specimen [545] laid open along medio-ventral line to show funnel organ. Drawn by R. N. Wenzel.
- Fig. 4.—Oral region of type specimen [545].



EXPLANATION OF PLATE LXIII.

Nototodarus gouldi.

Fig. 1.—Dorsal aspect of young ♂ [554]; $\times \frac{1}{3}$.

Fig. 2.—Ventral aspect of same; same scale.



EXPLANATION OF PLATE LXIV.

Nototodarus gouldi.

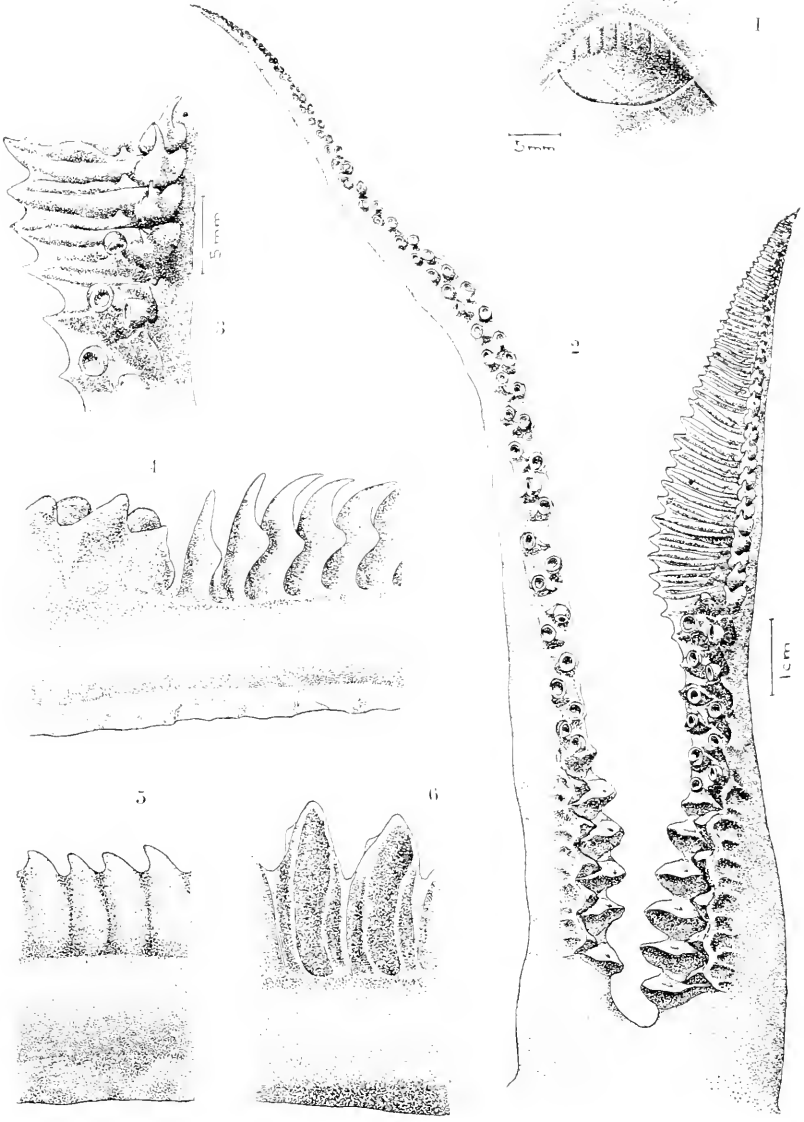
Ventral aspect of head and arms of adult ♂ [562]; 4



EXPLANATION OF PLATE LXV.

Netotodarus gouldi.

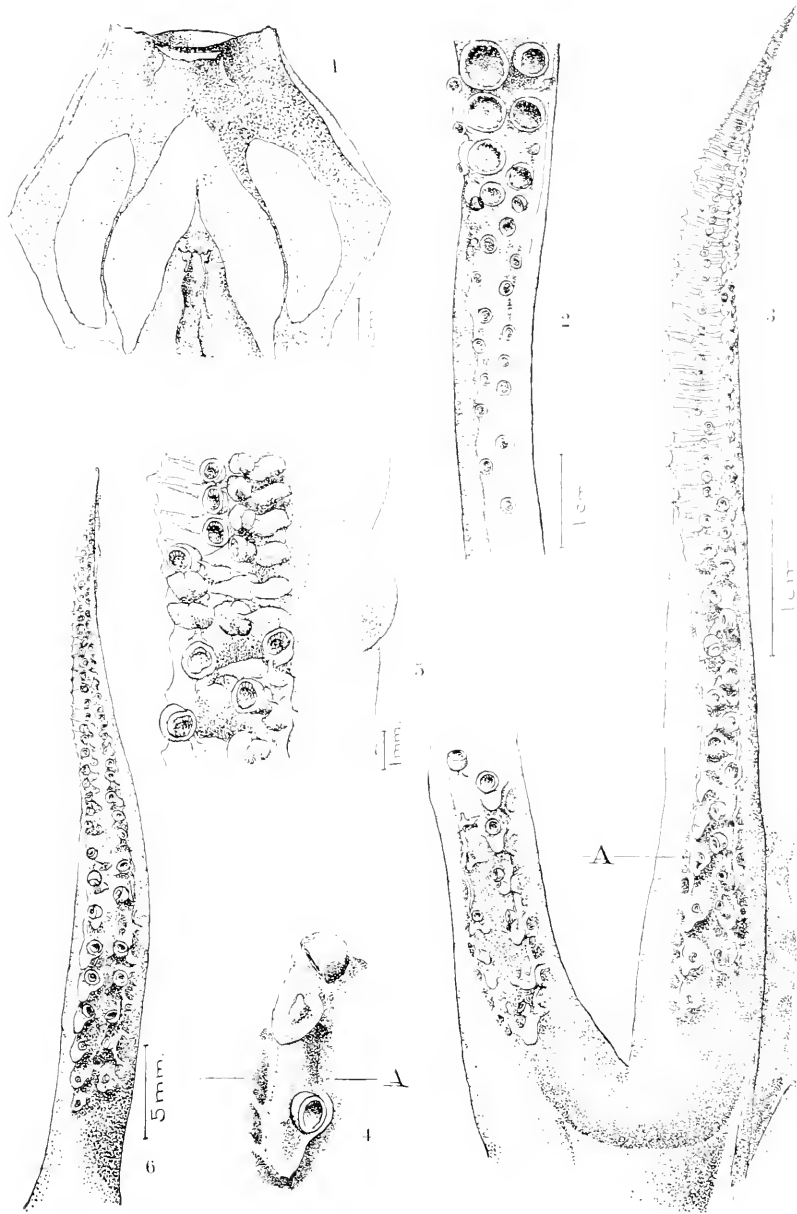
- Fig. 1.—Apical portion of funnel groove of large ♀ [548], showing foveola.
- Fig. 2.—Oral aspect of ventral arms of adult ♂ [549], showing hectocetylation.
- Fig. 3.—10th-15th pairs of the tubercle-sucker-papilla series of right ventral arm of same specimen, seen in greater magnification, oral aspect.
- Fig. 4.—Lateral aspect of same region of same arm, showing units 9-17 of the dorsal series of suckers and papillæ; same scale.
- Fig. 5.—Outer aspect of units 18-21 of ventral row of same arm; same scale.
- Fig. 6.—Outer aspect of tubercles 3-4 of ventral row on basal portion of same arm; same scale.



EXPLANATION OF PLATE LXVI.

Nototodarus gouldi.

- Fig. 1.—Funnel of large ♀ [510], laid open along medio-ventral line to show funnel organ.
- Fig. 2.—Carpal region of left tentacle club of large ♀ [560], oral aspect, showing the fixing apparatus.
- Fig. 3. Right ventral arm and basal portion of left ventral arm of an immature ♂ [553], showing advanced stage in development of hectocotylus.
- Fig. 4.—Units 4-5 of ventral sucker-papilla series of right ventral arm seen in greater magnification.
- Fig. 5.—Oral face of right ventral arm of an immature ♂ near base of modified distal portion (Cf. Pl. LXV., fig. 3).
- Fig. 6.—Oral aspect of right ventral arm of young ♂ [550], showing early stage of development of hectocotylus.



EXPLANATION OF PLATE LXVII.

Loligo etheridgei, ♂.

Dorsal aspect of type specimen [489], \times ca. $\frac{9}{16}$.



EXPLANATION OF PLATE LXVIII.

Loligo etheridgei, ♂.

Ventral aspect of specimen figured on preceding plate ;
same scale.



EXPLANATION OF PLATE LXIX.

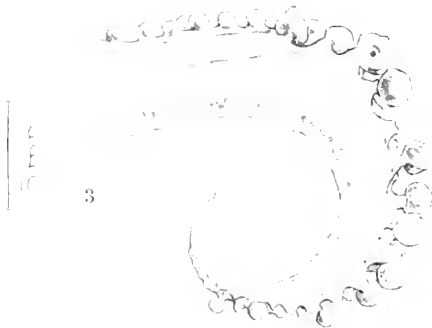
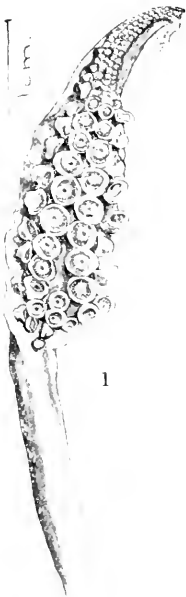
(All the figures on this plate were drawn by R. N. Wenzel.)

Fig. 1.—*Loligo etheridgei* ♂ [489], oral face of right tentacle club of type.

Fig. 2.—*Loligo etheridgei* ♂, distal portion of left ventral arm of same specimen, showing hectocotylization.

Fig. 3.—*Rossia australis* ♂ [538], outer lateral aspect of left dorsal arm of type, showing hectocotylization. Several missing suckers are not supplied in the drawing.

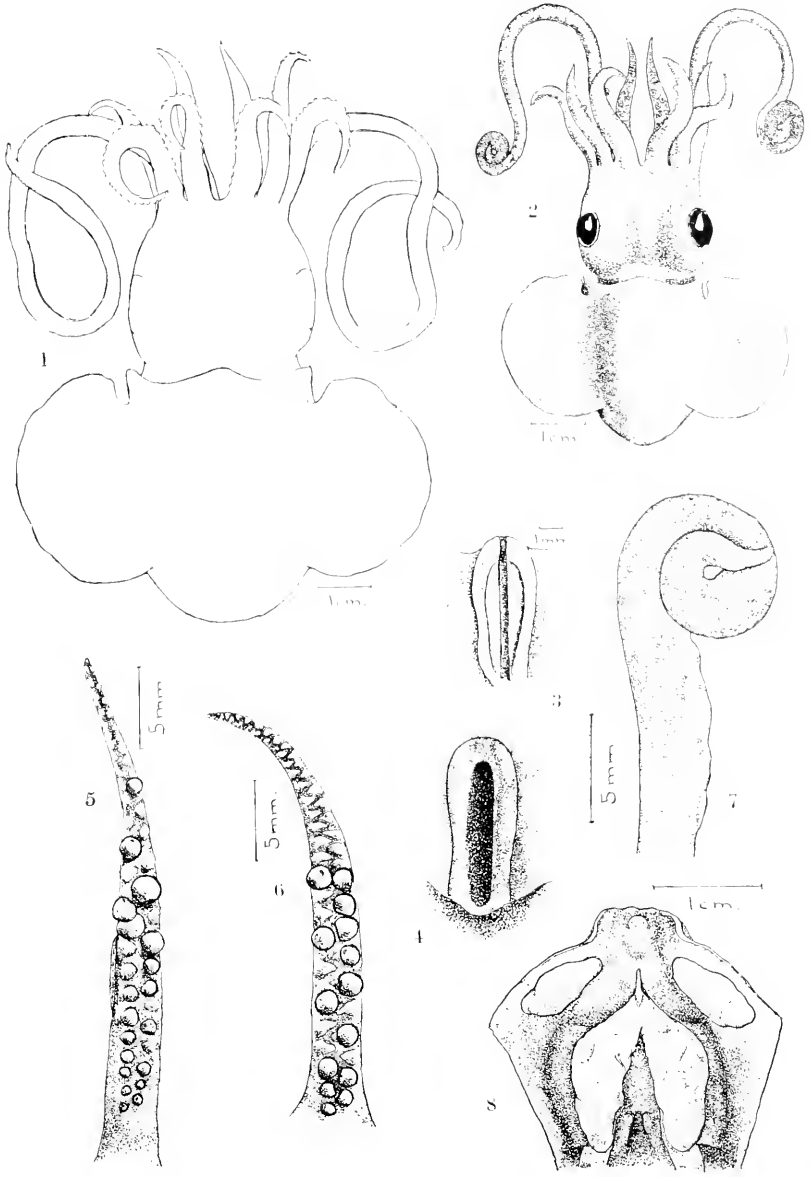
Fig. 4.—*Rossia australis* ♂ [538], oral aspect of arms and tentacle of right side of type. Several missing suckers are not supplied in the drawing.



EXPLANATION OF PLATE LXX.

Rossia australis.

- Fig. 1.—Outline view of ♀ paratype [539], dorsal aspect.
Fig. 2.—Dorsal aspect of type specimen, ♂ [538].
Fig. 3.—Nuchal cartilage of ♀ [540].
Fig. 4. Right funnel cartilage of same specimen; same scale.
Fig. 5.—Oral aspect of right dorsal arm of type specimen ♂ [538], showing hectocotylization.
Fig. 6.—Oral aspect of left second arm of ♀ [540].
Fig. 7.—Oral aspect of right tentacle club of same specimen.
Fig. 8.—Funnel of ♀ [540], laid open along medio-ventral line to show funnel organ



EXPLANATION OF PLATE LXXI.

Sepia helleyi, ♂.

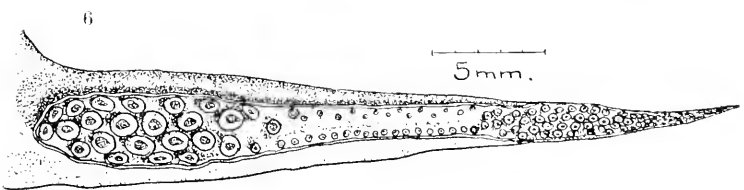
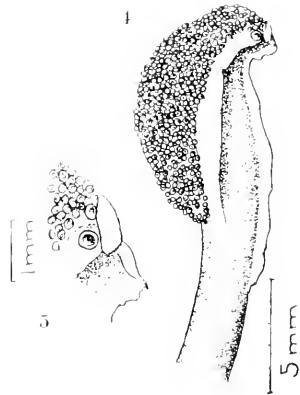
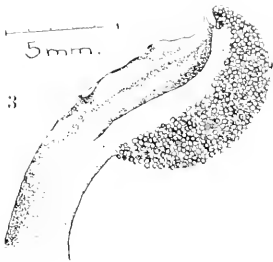
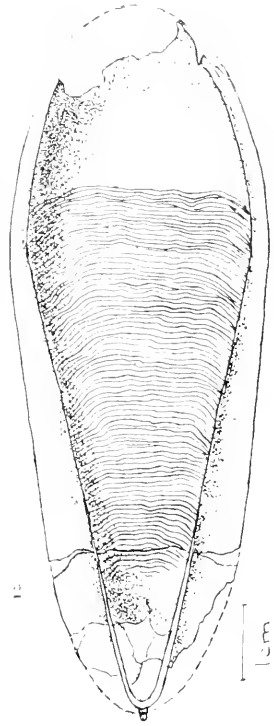
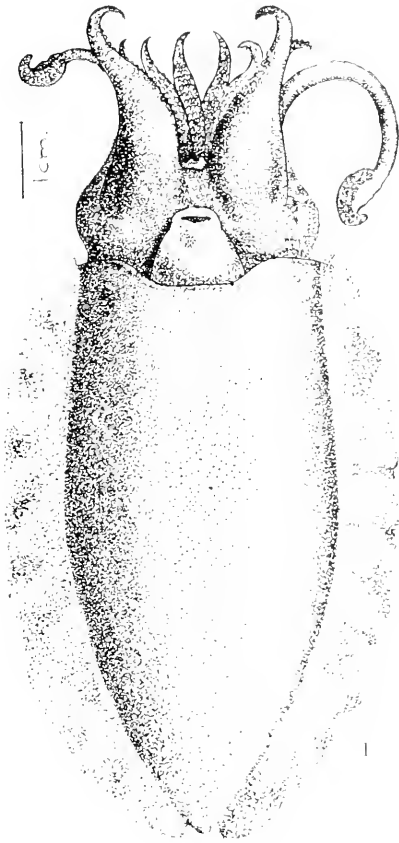
Dorsal aspect of type specimen [499]; approximately
natural size.



EXPLANATION OF PLATE LXXII.

Sepia hedleyi.

- Fig. 1. Ventral aspect of type specimen ♂ [499].
- Fig. 2.—Reconstructed figure of sepiostaire of ♀ [507], ventral aspect.
- Fig. 3.—Left tentacle club of type specimen ♂ [499].
- Fig. 4.—Right tentacle club of ♀ [491].
- Fig. 5.—Apical region of same, drawn under higher magnification.
- Fig. 6.—Oral face of left ventral arm of type specimen ♂ [499], showing hectocotylization.



EXPLANATION OF PLATE LXXIII.

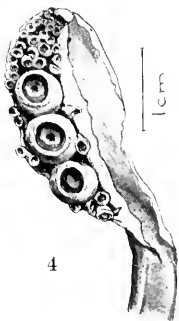
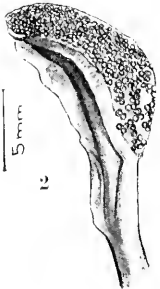
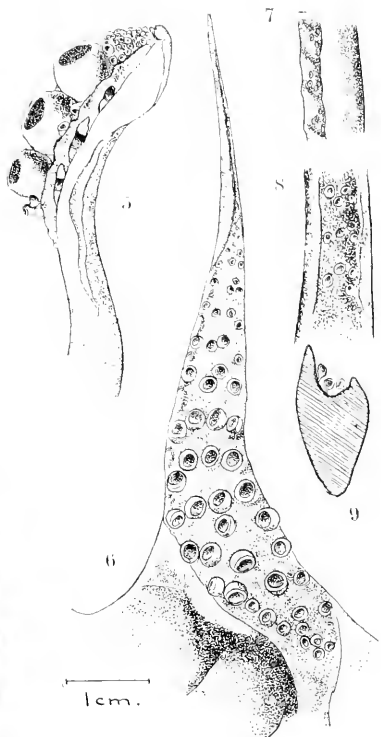
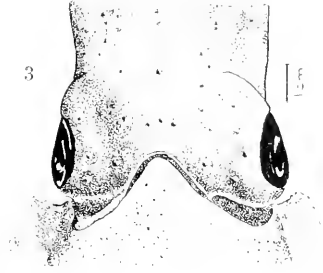
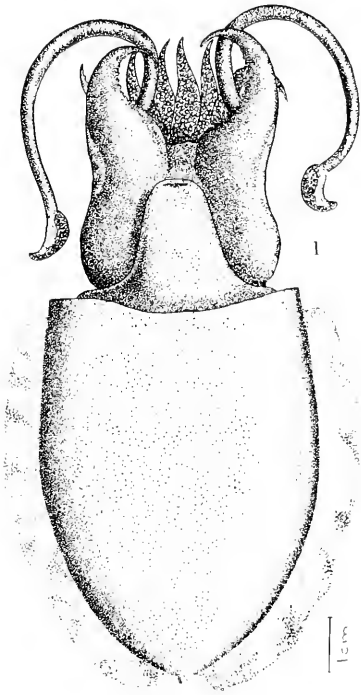
Sepia daumevigi, ♀.

Dorsal aspect of type specimen [493]; approximately
natural size.



EXPLANATION OF PLATE LXXIV.

- Fig. 1.—*Sepia dannevigii* ♂ [493], ventral aspect of type specimen.
- Fig. 2.—*Sepia dannevigii* ♀ [495], left tentacle club of type specimen. Drawn by R. N. Wenzel.
- Fig. 3. *Sepia chirotrema* ♀ [524], dorsal aspect of head.
- Fig. 4.—*Sepia chirotrema* ♀ [524], right tentacle club of same specimen. Drawn by R. N. Wenzel.
- Fig. 5.—Same in lateral view to show the fenestræ in the marginal fold; same scale.
- Fig. 6.—*Sepia chirotrema* ♂ [522], oral face of left ventral arm of type specimen, showing hectocotylization.
- Fig. 7.—Oblique lateral view of portion of distal region of same under greater magnification.
- Fig. 8.—Oral aspect of distal portion of same; same scale as Fig. 7.
- Fig. 9.—Schematic cross-section of arm in same region; same scale.



EXPLANATION OF PLATE LXXV.

Sepia chirotrema, ♂.

Dorsal aspect of type specimen [522]; \times ca. $\frac{1}{2}$.



EXPLANATION OF PLATE LXXVI.

Sepia chirotrema, ♂.

Ventral aspect of type specimen [522]; \times ca. $\frac{1}{2}$.



EXPLANATION OF PLATE LXXVII.

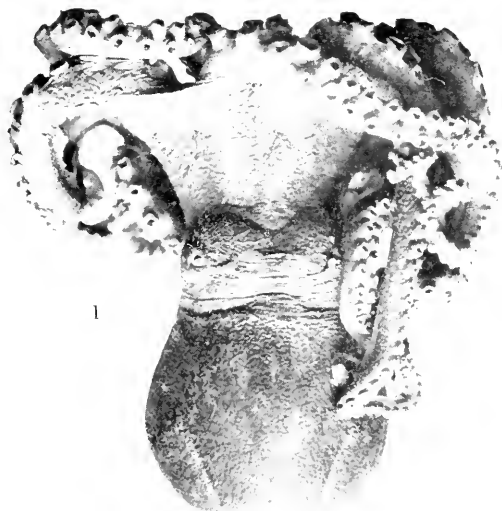
Sepia chirotrema, ♀.

Ventral aspect of large ♀ [524]; × ca. $\frac{2}{3}$.



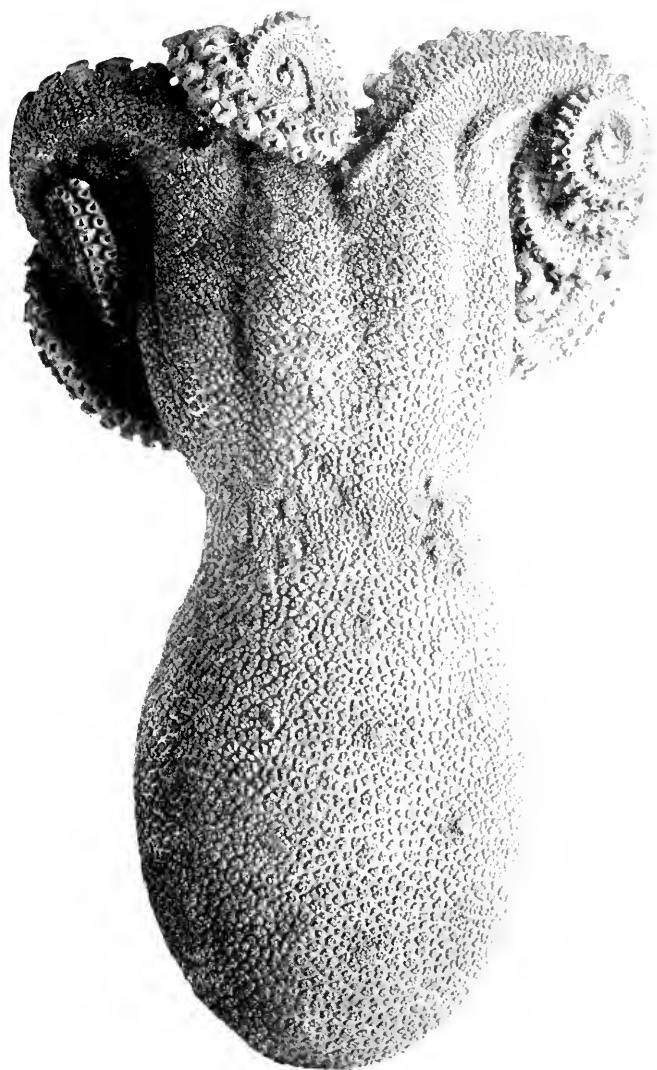
EXPLANATION OF PLATE LXXVIII.

- Fig. 1.—*Polypus, cf australis* ♀ [536], dorsal aspect of small specimen from 200 fathoms, south of Gabo Island ; slightly more than natural size.
- Fig. 2.—Lateral aspect of same ; same scale.
- Fig. 3.—*Polypus* sp. juv. [533], lateral aspect ; slightly more than natural size.



EXPLANATION OF PLATE LXXIX.

Polypus variolatus, ♀.
Dorsal aspect [528]; $\times \frac{3}{4}$.





EXPLANATION OF PLATE LXXX.

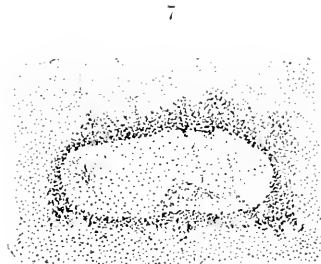
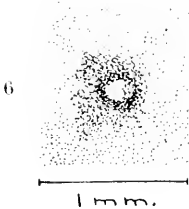
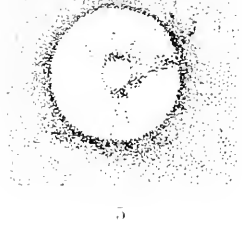
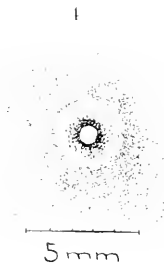
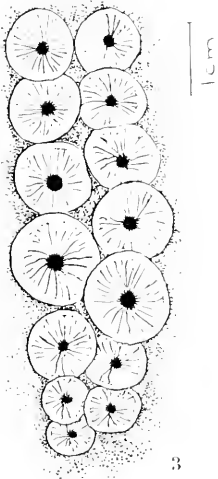
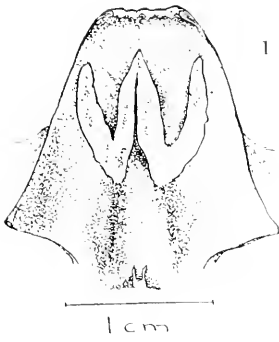
Polypus variolatus, ♀.

Ventral aspect [528]; $\times \frac{3}{4}$.



EXPLANATION OF PLATE LXXXI.

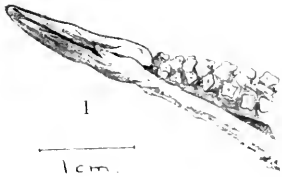
- Fig. 1.—*Polypus*, cf *australis* ♀ [536], funnel laid open along medio-ventral line to show the funnel organ. Drawn by R. N. Wenzel.
- Fig. 2.—*Polypus variolatus* ♂ [527], funnel laid open along medio-ventral line to show the funnel organ. Drawn by R. N. Wenzel.
- Fig. 3.—*Polypus variolatus* ♂ [527], portion of oral face of left second arm (sucker pairs 6-19 inclusive), showing enlargement of certain suckers.
- Fig. 4.—*Opisthoteuthis pluto* [468], an areola in the systole state from integument of aboral surface of a medium sized specimen.
- Fig. 5.—Another areola from same specimen, showing diastole condition ; same scale.
- Fig. 6.—*Opisthoteuthis persephone* [478], an areola in the systole state from integument of aboral surface of small specimen from 150 fathoms, south of Eucla.
- Fig. 7.—*Opisthoteuthis persephone* [480], an areola in the diastole state from integument of aboral surface of type specimen ; same scale as last.



EXPLANATION OF PLATE LXXXII.

(All the figures on this plate were drawn by R. N. Wenzel.)

- Fig. 1.—*Polypus variolatus* ♂ [527], oral aspect of hectocotylus.
- Fig. 2.—*Polypus variolatus* ♀ [528], large supraocular cirrus of left side.
- Fig. 3.—Papillæ from near middle of dorsum of same specimen ; same scale.
- Fig. 4.—Region of left eye of same specimen.
- Fig. 5.—*Opisthoteuthis pluto* [464], 14tu-16th suckers of right dorsal arm of type specimen ; cirri extruded.
- Fig. 6.—*Opisthoteuthis pluto* [468], 21st-22nd suckers of right dorsal arm ; cirri partially retracted.
- Fig. 7.—*Opisthoteuthis pluto* [468], pteropallial cartilage seen in situ from above (muscle of left side removed).
- Fig. 8.—Right lateral portion of same preparation after excision, oblique lateral view ; same scale.
- Fig. 9.—*Opisthoteuthis persephone* [480], 7th-22nd suckers of right dorsal arm of type specimen ; cirri retracted.
- Fig. 10.—*Opisthoteuthis persephone* [484], pteropallial cartilage seen in situ from above.



5 1cm

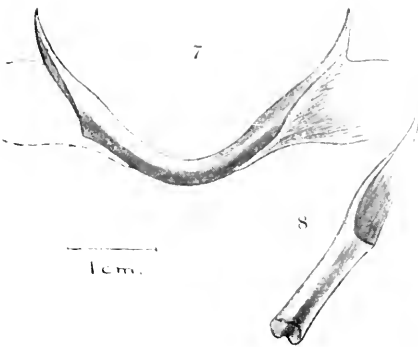


6 1cm

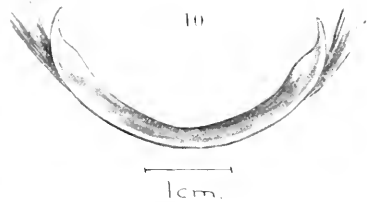


9

1cm



7 1cm.

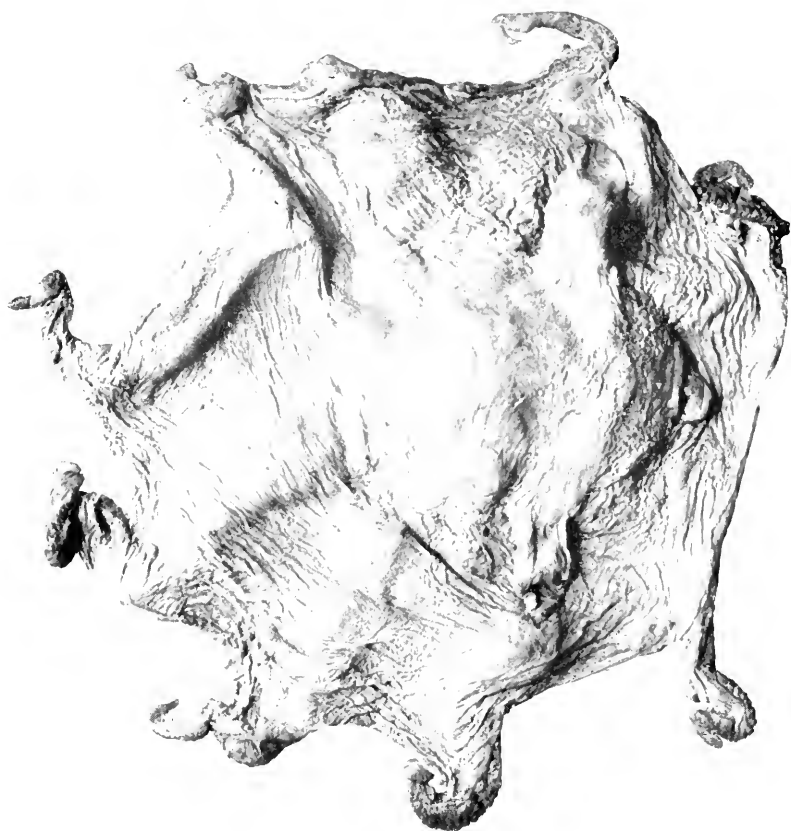


10 1cm.

EXPLANATION OF PLATE LXXXIII.

Opisthoteuthis pluto.

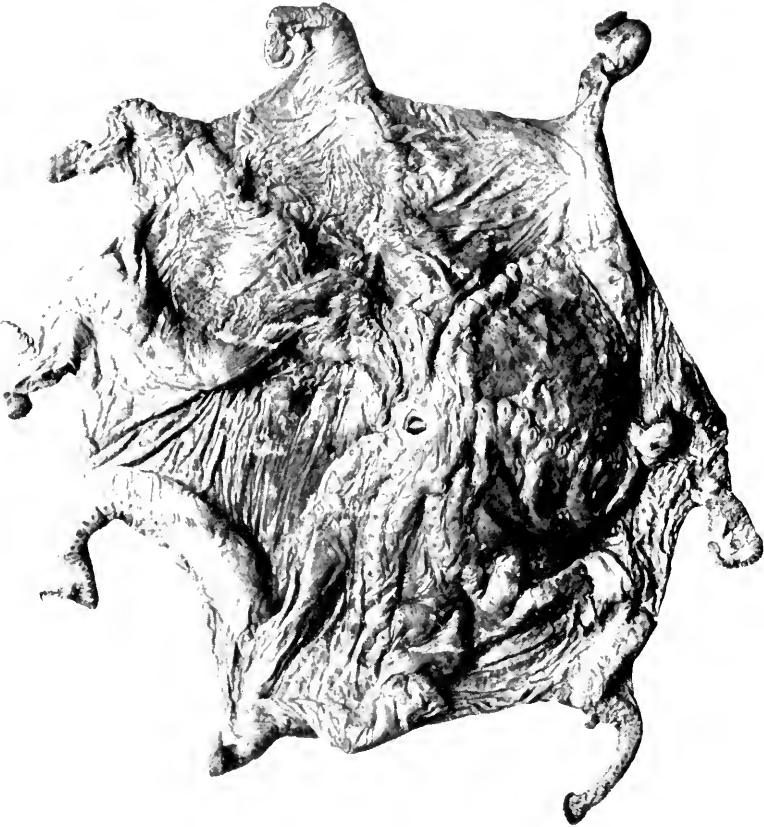
Aboral aspect of type specimen [464]; $\times \frac{1}{3}$.



EXPLANATION OF PLATE LXXXIV.

Opistholeuthis pluto.

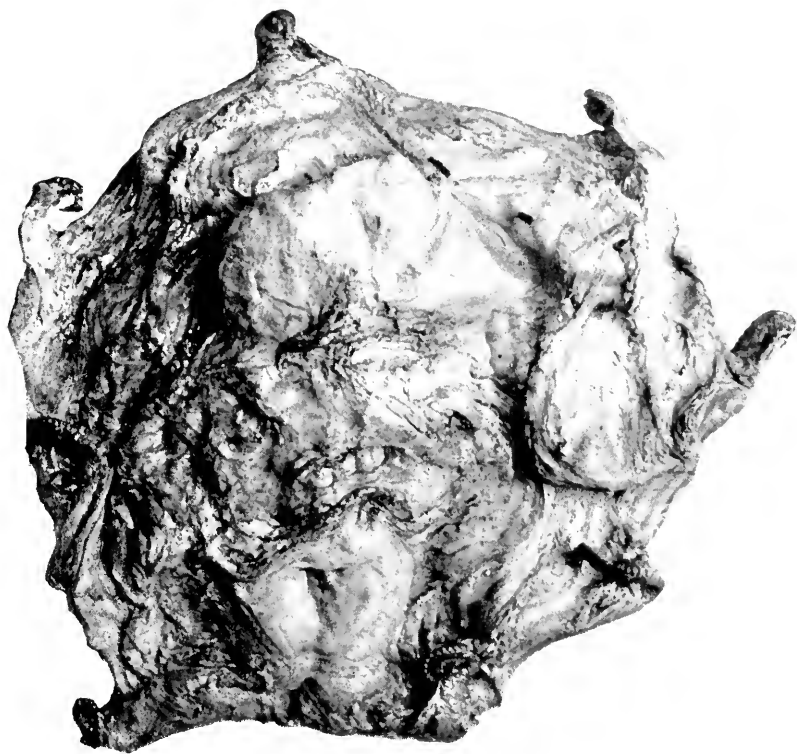
Oral aspect of type specimen [464]: $\times \frac{1}{3}$.



EXPLANATION OF PLATE LXXXV.

Opisthoteuthis persephone.

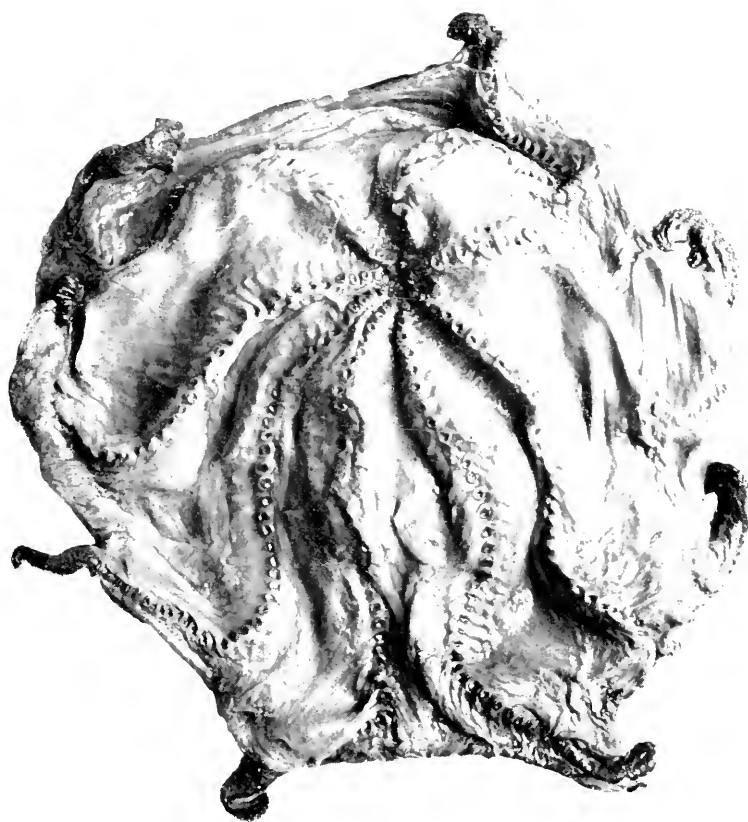
Aboral aspect of type specimen [480]; much reduced.



EXPLANATION OF PLATE LXXXVI.

Opisthotectis persephone.

Oral aspect of type specimen [480]; much reduced.

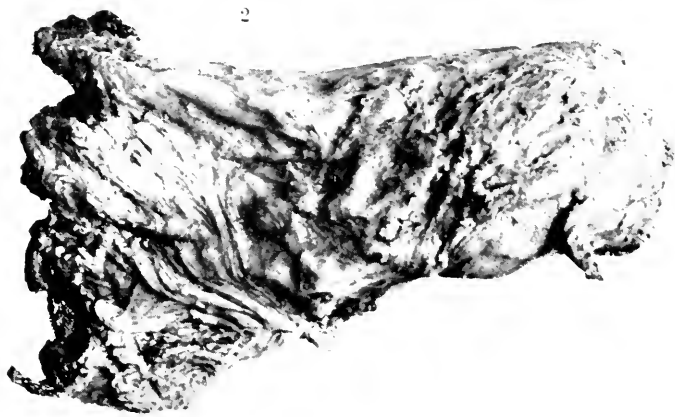


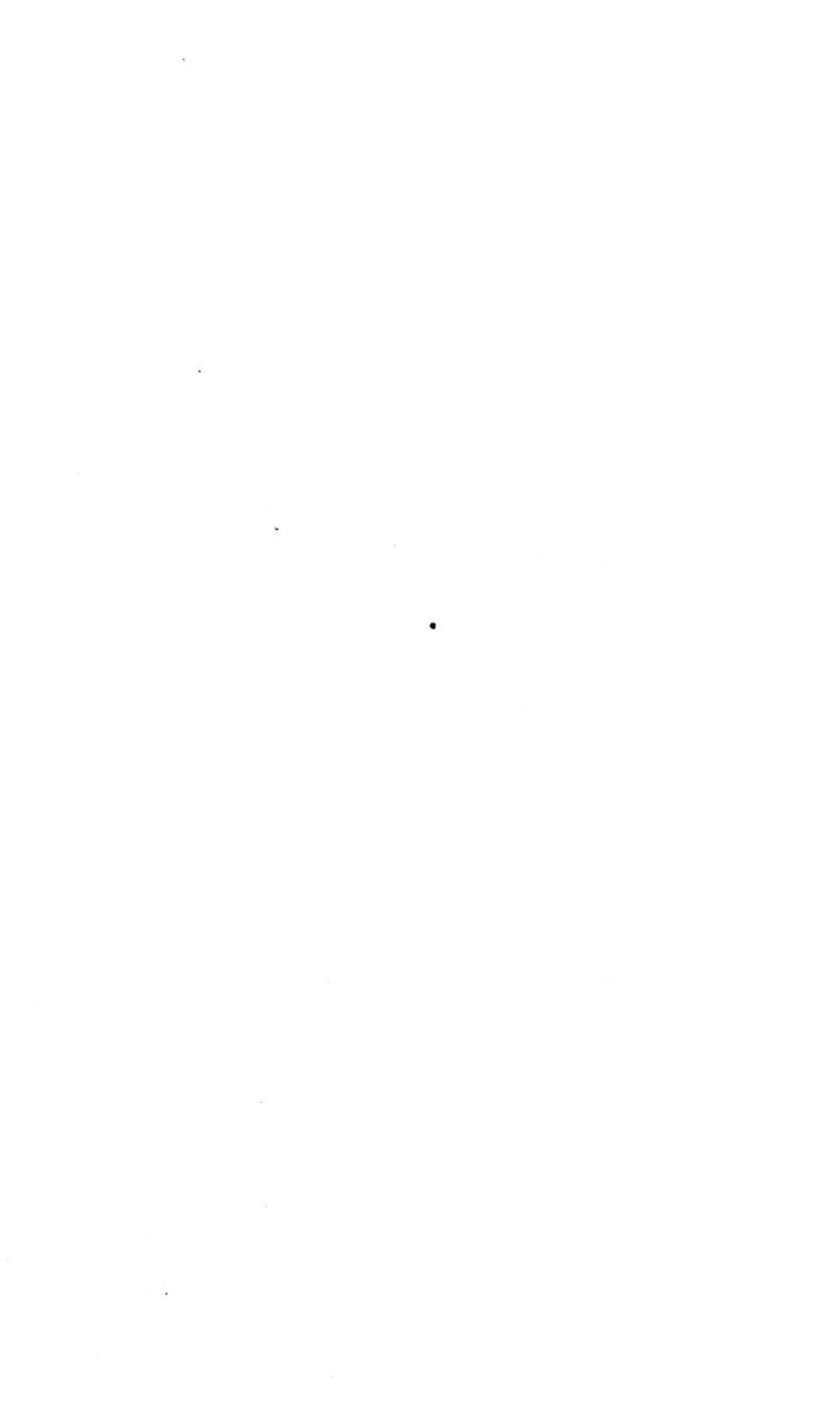
EXPLANATION OF PLATE LXXXVII.

Opisthotecthis persephone.

Fig. 1.—Aboral aspect of small discoid specimen from 150 fathoms south of Eucla [477]; somewhat reduced.

Fig. 2.—Lateral aspect of paratype [481]; same scale.

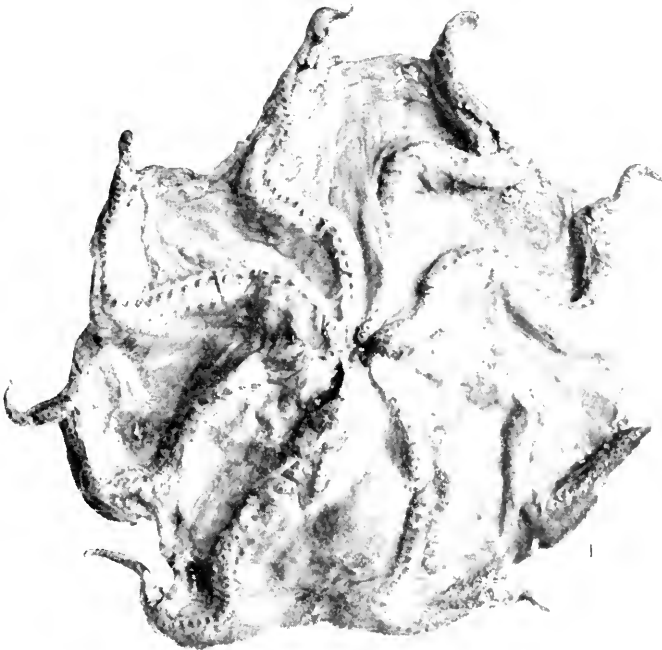




EXPLANATION OF PLATE LXXXVIII.

Opisthoteuthis persephone.

- Fig. 1.—Oral aspect of small discoid specimen from 150 fathoms, south of Eucla [477]; somewhat reduced.
- Fig. 2.—Oral aspect of paratype [481]; same scale.



2



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