RECORDS

OF THE

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MUSEUM AND ART GALLERY

EDITED BY THE DIRECTOR,

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WESTERN AUSTRALIAN ECHINODERMS

BY

W. B. ALEXANDER, M.A.

In the two papers which follow (Crinoids, by A. H. Clark, and Echinoderms, by H. L. Clark) will be found descriptions of most of the Echinoderms in the Western Australian Museum. To prevent any misunderstanding it seems necessary to mention the circumstances under which the papers were written.

During June, 1912, the F.I.S. *Endeavour* was engaged in trawling operations off the Western Australian coast between Fremantle and Geraldton, and the Director obtained permission from the Federal authorities for the writer to accompany her on two of her trips to obtain specimens for this Museum.

Perhaps the most striking feature of the hauls made by the *Endeavour* was the very large number of Crinoids which were brought up on many occasions. In number of individuals they surpassed all the other groups of Echinoderms put together. In view of the fact that Mr. Austin H. Clark, of Washington, had recently published a paper on the Crinoids of Australia, the collection was sent to him for identification, and his report on this collection constitutes the first of the papers which follow.

In the meantime, Mr. H. Lyman Clark, of Harvard, had offered to determine the Echinoderms already in the Museum, and the remainder of the Echinoderms including all those obtained by the *Endeavour*, except the Crinoids, were therefore sent to him. A few species which had been named by the authorities of the Australian Museum in Sydney, and a few of the *Endeavour* specimens of the same species, together with some Crinoids which had previously been identified by Mr. A. H. Clark, along with those collected by the Hamburg Expedition, were not sent away.

In the introduction to his paper dealing with this material Mr. Clark drew a number of conclusions as to the relative proportions

in which the different orders were represented in Western Australian waters. As, however, the numbers he used were vitiated by the assumption that he had the whole of the Museum collection before him, with his permission the numbers have been removed from the paper as written by him and the true totals set out in this place.

It seems better to consider the collection in two portions. The first of these has been slowly accumulating for a number of years and is composed of specimens found on the shore in various parts of the State and on the reefs of the Abrolhos Islands. Excluding specimens too imperfect for complete identification, 46 species are represented distributed among the different classes thus: Crinoids 7, Asteroids 16, Ophiurans 2, Echini 15, Holothurians 6.

The second portion of the collection consists of the specimens trawled by the *Endeavour* in depths varying from 19 to 120 fathoms, on the slope of the Continental shelf; most of these come from a depth of more than 50 fathoms. It contains 36 species distributed thus: Crinoids 12, Asteroids 7, Ophiurans 10, Echini 7. Only 7 species are represented in both portions of the collection.

It is doubtful whether these numbers give a true idea of the real proportions in which the classes occur in Western Australian waters. The first portion of the collection is evidently a selected one, the larger and more striking Echini and Asteroids predominate. Holothurians have a commercial interest, whilst some of the Crinoids are very beautifully coloured. The Ophiurans, which are mostly small and fragile, do not appeal to the ordinary individual for any of these reasons and are unrepresented.

The collection which was made on board the *Endeavour* probably approximates much more closely to the true proportions existing amongst the forms found in deeper water, on a sandy bottom, though it is probable that here again the larger forms predominate unduly, as a trawl is not the best instrument with which to collect small and fragile specimens.

The following table will give an idea of the comparison between these collections and that made by the *Thetis* on the coast of New South Wales.

	Collection in W.A. Museum.	*Endeavour* Collection from W. Australia.	*Thetis* Collection from New South Wales	Percentage of recent Species known in each Class
Crinoids ...	7	12	3	11
Asteroids ...	16	7	9	25
Ophiurans ...	2	10	18	34
Echini ...	15	7	15	12
Holothurians	6	—	8	18
Totals ...	46	36	53	100

As far as they go these figures seem to prove that on both the Western and Eastern coasts of Australia Echini are unusually numerous, while the number of Crinoids found in Western Australia is a long way above the normal.

A list of all the identified Echinoderms in the Museum, with their localities when known, is attached. In addition to the sources already referred to, Dr. Michaelsen has presented a number of Ophiurans and Crinoids collected in this State by the Hamburg Expedition in 1905. These are included in the list.

[The Classification followed is that of Bronn's "Tier-reichs" for all the groups except the Crinoids. The later class are arranged according to Mr. A. H. Clark's Monograph of the Recent Crinoids of Australia.]

WESTERN AUSTRALIAN ECHINODERMATA

IN THE

WESTERN AUSTRALIAN MUSEUM.

Class CRINOIDEA (Sea Lilies, Feather Stars).

Order Comatulida.

Family Comasteridae.

Capillaster sentosa, Carp.	Between Fremantle and Geraldton.
Capillaster multiradiata, Linn.	,, ,, ,,
Comatulella brachiolata, Lamk.	,, ,, ,,
Comatula purpurea, Müll.	,, ,, ,,
Comatula solaris, Lamk.	——
Comanthus alternans, Carp.	Abrolhos Islands.
Comanthus belli, Carp.	Port Hedland.
Comanthus annulata, Bell,	Between Fremantle and Geraldton.
Comanthus parvicirra, Müll.	,, ,, ,,
Comanthus polycnemis, A. H. Clark	——

Family Zygometridae.

Zygometra elegans, Bell. Between Fremantle and Geraldton.

Family Himerometridae.

Amphimetra discoidea, A. H. Clark. Between Fremantle and Geraldton

Family Mariametridae.

Dichrometra gyges, Bell. Inner Bar, Shark Bay.

Family Tripiometridae.

Tropiometra afra, Hartl. Between Fremantle and Geraldton.

Family Calometridae.

Neometra gorgonia, A. H. Clark. Between Fremantle and Geraldton.

Neometra conaminis, A. H. Clark. ,, ,, ,,

Family Thalassometridae.

Ptilometra macronema, Müll. Off Geraldton.

Class ASTEROIDEA (Star Fishes.)

Order Phanerozonia.

Family Astropectinidae.

Astropecten triseriatus, Müll & Trosch. — Garden Island.

Lindiamaculata, Müll & Trosch. — Between Fremantle and Geraldton.

Family Pentagonasteridae.

Pentogonaster stibarius, H. L. Clark. — Between Fremantle and Geraldton.

Tosia australis, Gray. — Fremantle.

Iconaster longimanus, Möbius — Broome.

Nectria ocellifera, Lamk. — Between Fremantle and Geraldton.

Stellaster incei, Gray. — Carnac Island. Between Fremantle and Geraldton.

Stellaster megaloprepes, H. L. Clark — Port Hedland.

Family Antheneidae.

Anthenea tuberculosa, Gray. ———

Family Pentacerotidae.

Oreaster gracilis, Lütken. ———

Oreaster nodulosus, Perrier. ———

Culcitaster anamesus, H. L. Clark. ———

Family Asterinidae.

Nepanthia brevis, Perrier. — Fremantle, Cottesloe.

Anseropoda rosacea, Lamk. — Port Hedland.

Asterina gunnii, Gray. — Fremantle, Cottesloe.

Order Cryptozonia.

Family Linckiidae.

Linckia tyloplax, H. L. Clark. — Between Fremantle and Geraldton.

Family Echinasteridae.

Echinaster arcystatus, H. L. Clark. — Between Fremantle and Geraldton.

Echinaster purpureus, Gray. — Fremantle, Broome.

Echinaster vestitus, Perrier ? — Port Hedland.

Plectaster decanus, Müll & Trosch. — Albany.

Family ASTERIIDAE.

Asterias polyplax, Müll & Trosch. Between Fremantle and Geraldton.
Asterias calamaria, Gray. ———

Class OPHIUROIDEA (BRITTLE STARS).

Order ZYGOPHIURAE.

Family OPHIODERMATIDAE.

Pectinura discryta, H. L. Clark. Between Fremantle and Geraldton.

Family AMPHIURIDAE.

Ophiactis savignyi, M.T.	Freycinet Estuary, Shark Bay.
Amphiura constricta, Lym.	Champion Bay, Geraldton.
Amphiura squamata, Chiaje.	Oyster Harbour, Albany.

Family OPHIACANTHIDAE.

Ophiacantha clavigera, Kochler. Koombana Bay, Bunbury.

Family OPHIOCOMIDAE.

Ophiocoma brevipes, Peters.	Shark Bay.
Clavigera wendti, M.T.	Shark Bay.

Family OPHIOTRICHIDAE.

Ophiothrix stelligera, Lym.	Cockburn Sound, Fremantle. Between Fremantle and Geraldton.
Ophiothrix spongicola, Stimpson.	Between Fremantle and Geraldton.
Ophiothrix hirsuta, M.T.	Freycinet Reach, Shark Bay.
Ophiothrix longipeda, Lamk.	Abrolhos Islands.
Ophiothrix hartmeyeri, Kochler.	Sunday Island, Shark Bay.
Ophiothela danae, Verrill.	Surf Point, Shark Bay.

Order STREPTOPHIURAE.

Family OPHIOMYXIDAE.

Ophiomyxa australis, Lütk. Between Fremantle and Geraldton.

Order CLADOPHIURAE.

Family ASTROPHYTIDAE.

Astrogymnotes catasticta, H. L. Clark. Off Jurien Bay.

Ophiocreas melambaphes, H. L. Clark.	Off Jurien Bay.
Ophiocreas rhabdotum, H. L. Clark.	Off Jurien Bay.
Conocladus microconus, H. L. Clark.	Between Fremantle and Geraldton.
Astroboa ernae, Död.	Off Geraldton.
Euryale aspera, Lamk.	Off Geraldton.

Class ECHINOIDEA (SEA URCHINS).

Order CIDAROIDA.

Family CIDARIDAE.

Tretocidaris bracteata, A. Ag.	Between Fremantle and Geraldton.
Goniocidaris tubaria, Lamk.	,, ,, ,,
Phyllacanthus annulifera, Lamk.	Port Hedland.
Phyllacanthus magnificus, H. L. Clark.	Between Fremantle and Geraldton.

Order DIADEMATOIDA.

Family DIADEMATIDAE.

Centrostephanus tenuispinus, H. L. Clark.	Between Fremantle and Geraldton.

Family TEMNOPLEURIDAE.

Salmacis alexandri, Bell.	Off Geraldton.
Salmacis sphaeroides, Linn.	Port Hedland.
Salmacis bicolor, Ag.	———
Amblypneustes griseus, Blainv.	Fremantle.
Amblypneustes grandis, H. L. Clark.	Between Fremantle and Geraldton.
Holopneustes porosissimus, Ag.	Fremantle.
Holopneustes purpurescens, A. Ag.	———

Family ECHINOMETRIDAE.

Heliocidaris armigera, A. Ag.	Fremantle, Cottesloe.
Heliocidaris erythrogramma, Val.	———
Echinometra mathaei, Blainv.	———

Order CLYPEASTROIDA.

Family CLYPEASTRIDAE.

Clypeaster telurus, H. L. Clark. Between Fremantle and Geraldton.

Family LAGANIDAE.

Laganum peroni, Ag. Swan River.

Peronella aphnostina, H. L. Clark. Carnac Island.

Order SPATANGOIDA.

Family SPATANGIDAE.

Linthia australis, Gray. Fremantle, Cottesloe.

Echinocardium australe, Gray. Safety Bay.

Breynia australasiae, Leach. Abrolhos Islands, Broome.

Class HOLOTHURIOIDEA (SEA CUCUMBERS, BECHE-DE-MER).

Order ACTINOPODA.

Family ASPIDOCHIROTAE.

Actinopyga miliaris, Q. & G. ———

Holothuria atra, Jaeger. ———

Family DENDROCHIROTAE.

Colochirus axiologus, H. L. Clark. Port Hedland.

Colochirus quadrangularis, Less. ———

Colochirus tuberculosus, Q. & G. ———

Family MOLPADIIDAE.

Caudina tetrapora, H. L. Clark. Cottesloe Beach.

THE CRINOIDS

COLLECTED BY THE *ENDEAVOUR* BETWEEN FREMANTLE AND GERALDTON

(WESTERN AUSTRALIA).

By AUSTIN HOBART CLARK.

PREFACE.

Mr. Bernard H. Woodward, the Director of the Western Australian Museum and Art Gallery at Perth has recently honoured me with a request to examine a collection of comatulids or unstalked crinoids brought together by the *Endeavour* while working along the coast of Western Australia between Fremantle and Geraldton.

Mr. Wilfrid B. Alexander accompanied the *Endeavour* at the time the collection described herein was made, taking careful colour notes on many of the specimens. These he has been kind enough to permit me to incorporate herein.

Within the past two years the Australian crinoid fauna has received a considerable amount of attention; in 1911 there was published at Sydney a comprehensive monograph on the crinoids of Australia, including a historical introduction, a complete synonymy and a bibliography; every Australian record of a crinoid or of a supposed crinoid is given. At the same time there was published a memoir upon the crinoid fauna of Australia west of 140°E. long., based upon the collection made by the Hamburg West Australian Expedition under Drs. W. Michaelsen and R. Hartmeyer in 1905. In this memoir every record of a crinoid in the region under consideration is included, and the faunas of the various coasts of the continent are compared. In 1912 a paper on the crinoids preserved in the Naturhistorisches Museum, at Hamburg, appeared in which the following new records were included: *Comaster belli*, from Houtman's Rocks; *Comanthus samoana*

(not previously known from Australia), from Houtman's Rocks; and *Petasometra helianthoides* (gen. et. sp. nov.) from Shark Bay; other species were listed from localities where they were already known to occur, or from localities within their ascertained range. In another paper a new species of *Zygometra*, *Z. punctata*, was described from the Aru Islands where it had been collected by the *Siboga*, and at the same time was recorded from Port Curtis, Queensland, and from Holothuria Bank in north-western Australia. In 1913 a supplement to the memoir on the crinoids of south-western Australia was published in which some additional specimens collected by Drs. Michaelsen and Hartmeyer were recorded and the information regarding the crinoid fauna of this region was brought up-to-date.

THE *ENDEAVOUR* COLLECTION.

The present collection contains representatives of twelve species included in nine genera and eight families and sub-families, as follows:—

Family: COMASTERIDAE.

Sub-family: CAPILLASTERINAE.

Capillaster sentosa (P. H. Carpenter).

Capillaster multiradiata (Linné).

Sub-family: COMACTINIINAE.

Comatulella brachiolata (Lamarck).

Comatula purpurea (J. Müller).

Sub-family: COMASTERINAE.

Comanthus (*Vania*) *annulata* (Bell).

Comanthus (*Vania*) *parvicirra* (J. Müller).

Family: ZYGOMETRIDAE.

Zygometra elegans (Bell).

Family: HIMEROMETRIDAE.

Amphimetra discoidea (A. H. Clark).

Family: TROPIOMETRIDAE.

Tropiometra afra (Hartlaub).

Family: CALOMETRIDAE.

Neometra gorgonia, sp. nov.

Neometra conaminis, sp. nov.

Family: THALASSOMETRIDAE.

Ptilometra macronema (J. Müller).

These species fall naturally into the following classes:—

EAST INDIAN SPECIES.

Capillaster sentosa.	*Comanthus annulata.*
Capillaster multiradiata.	*Comanthus parvicirra.*

AUSTRALIAN TROPICAL SPECIES.

Comatula purpurea.	*Tropiometra afra.*
Zygometra elegans.	? *Neometra gorgonia.*
Amphimetra discoidea.	? *Neometra conaminis.*

SOUTH AUSTRALIAN SPECIES.

Comatulella brachiolata.	*Ptilometra macronema.*

The family Calometridae was not previously known to occur on the Australian coasts, though it was to be expected that it would be discovered as soon as dredging operations were carried into sufficiently deep water.

Capillaster sentosa also is new to the Australian coasts, though in view of its wide range in the East Indian region its presence here is not surprising.

Tropiometra afra, though only known from Australia, has been previously reported only from Bowen, Queensland; its occurrence on the west coast, and so far to the southward is therefore a matter of considerable interest.

The known range of *Capillaster multiradiata* has been extended southward from Dirk Hartog Island, and the occurrence of *Comatulella brachiolata*, *Comatula purpurea*, *Comanthus annulata*, *Zygometra elegans* and *Amphimetra discoidea* in the vicinity of Perth, about which there had previously been some question, has been established.

DESCRIPTION OF SPECIES COLLECTED.

Fam.: COMASTERIDAE, A. H. Clark.
Sub-fam.: CAPILLASTERINAE, A. H. Clark.
Genus: CAPILLASTER, A. H. Clark.

CAPILLASTER SENTOSA, P. H. Carpenter.

Comatula multiradiata (part) 1816. Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, p. 533.

Comatula (Alecto) multiradiata (part) 1849. J. Müller, Abhandl. d.k. preuss. Akad. d. Wiss. (1847), p. 261.

Actinometra sentosa, 1888. P. H. Carpenter, *Challenger* Reports, vol. 26, Zoology, p. 325, pl. lxvi., figs. 4-6.

Capillaster sentosa, 1912. A. H. Clark, The Crinoids of the Indian Ocean, p. 73.

Differential Characters. *Capillaster sentosa* has the same curious arm structure as *C. multiradiata;* the IIBr series (the series following the first or "radial" axillary) are 4 (3 + 4), and all the succeeding division series are 3 (2 + 3); the first brachial of the free undivided arms, and the first ossicles following all the axillaries except the first (IBr or "radial" axillary), bear pinnules. It differs from *C. multiradiata* in possessing a much larger centrodorsal, which bears longer and stouter cirri, with between 30 and 40 (commonly about 35) segments, and much more numerous arms, these ranging from thirty to about eighty (most commonly between forty and sixty-five in number.

Locality. Between Fremantle and Geraldton.

Material. Two specimens; one of these is small, but typical, with seventy-three arms; one of the IIBr series is 2, and the remaining nine are 4 (3+4); the following series are all 3 (2+3); the other has thirty-three arms 115 mm. long.; there are nine IIBr series, all 4 (3+4), and thirteen IIIBr series, all 3 (2+3); the centrodorsal is typically large and hemispherical; the cirri are 27 mm. to 30 mm. long, and are composed of 28-30 segments.

Distribution. *Capillaster sentosa* ranges from the Maldive Islands eastward as far as the Philippines and the Moluccas, and southward to south-western Australia.

Remarks. This is the first record for this species in Australia, though its occurrence there was to have been expected.

CAPILLASTER MULTIRADIATA (Linné).

Capillaster multiradiata, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 736. 1911. A. H. Clark, Ergebnisse der Hamburger sudwest-Australischen Forschungsreise, 1905, Bd. 3, Lief. 13, S. 445. 1912. A. H. Clark, The Crinoids of the Indian Ocean, p. 74.

Locality. Between Fremantle and Geraldton.

Material. Three specimens. One of these has twenty-five arms 110 mm. long; there are eight IIBr. series present, four of them 4 (3+4) and four 2; there are six IIIBr. series, five 3 (2+3) and one 2; there is one IVBr. series of 3 (2+3) following a IIIBr. series of 2: the cirri are XIII, 22+26, 15 mm. to 20 mm. long; the second has twenty-five arms about 100 mm. long; of the ten IIBr. series eight are 4 (3+4) and two are 2; the five IIIBr. series are 3 (2+3); the cirri are XVI, 20+21, 17 mm. long; the third is smaller and broken, but is similar to the others.

Remarks. This species has not previously been recorded from further south than Dirk Hartog Island, where the German steamer *Gazelle* dredged it in 7 fathoms.

Sub-fam.: COMACTINIINAE, A. H. Clark.
Genus: COMATULELLA, A. H. Clark.

COMATULELLA BRACHIOLATA (Lamarck).

Comatula brachiolata, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 742. 1912. A. H. Clark, The Crinoids of the Indian Ocean, p. 79.

Comatulella brachiolata, 1911. A. H. Clark, Ergebnisse der Hamburger sudwest-australischen Forschungsreise, 1905, Bd. 3, Lief. 13, S. 447.

Locality. Between Fremantle and Geraldton.

Material. One fine specimen; the centrodorsal is thick discoidal, the dorsal pole large, very slightly convex (almost flat), 5 mm. in diameter.

The cirri are XVIII, 35-37 (usually the latter), 15 mm. to 18 mm. long; they are arranged in one (with a partial second) irregular marginal row. All of the component segments are much broader than long. The cirri taper markedly for the first seven segments.

The mouth is radial, situated at the base of the anterior arm pair.

The arms are all of equal length and size, 85 mm. long, 2·5 mm. wide at the base, and 4·3 mm. wide at the broadest place, between the twelfth and fourteenth brachials.

The terminal comb on the proximal pinnules is composed of fifteen teeth which are long and slender, shaped like an arrow head with the point truncated.

All the arms bear ungrooved pinnules in equal numbers. In the proximal portion of the arms the pinnules on either side typically alternate, grooved and ungrooved; further out there are two grooved pinnules between adjacent ungrooved pinnules, and toward the arm tips all the pinnules are grooved.

There is a very great difference in the structure of the grooved and ungrooved pinnules, which is well shown in the more proximal portion of the arm where the two types regularly alternate. The grooved pinnules, after the first two segments, which are rather large, are slender, delicate and very flexible; the ungrooved pinnules have slightly larger basal segments than the grooved and taper very gradually so that they are much stouter than the delicate grooved pinnules; at first they lie horizontally, but in the distal half or third they curve dorsally into the form of a hook or spiral, exactly as do the cirri, forming tendril-like attachments all along the arm whereby the animal fixes each arm securely to the organisms on the sea-floor in addition to fixing its central portion by means of its cirri.

The segments of the stout grooveless pinnules are produced dorsally into blunt rounded processes exactly resembling the dorsal convex swellings on the outer cirrus segments; these are perfectly smooth, with no trace of spines; these processes are entirely absent from the slender grooved pinnules which, instead, bear on the dorsal side of the terminal segments the long recurved spines characteristic of the pinnules of all the species of this family.

The colour in life was purplish red, the centrodorsal and first seven segments of the cirri darker and more brownish, the distal portion of the cirri bright red.

Remarks. Morphologically the first two segments of the pinnules are merely atrophied brachials, while the remaining

portion of the pinnules, including the third and succeeding segments is merely a tentacular body process, exactly comparable to the cirri, but carrying ambulacral structures on its ventral side.

Each brachial originates as, and is fundamentally, an axillary; one of the two derivatives from this axillary, after the formation of two ossicles, which are united to each other just as are the paired ossicles in the division series, abruptly ceases its development, while the other continues to increase in size, its basal segment attaining the same diameter as the brachial upon which it rests. The atrophied branch from the original axillary stage of the growing brachial serves as the base from which there extends outward a long tentacular structure with no phylogenetic history, which forms within itself a series of skeletal braces as necessity requires, and which is in every way exactly comparable to a cirrus, which also is a long tentacular structure with no phylogenetic history forming within itself a series of skeletal braces as necessity requires, excepting only that it bears ambulacral structures along its ventral surface.

Since pinnules beyond the second segment are merely elongate tentacular processes in which a skeleton is formed as needed, and cirri are also elongate tentacular processes in which a skeleton is formed as needed, it necessarily follows that the skeleton of the two sets of organs will be essentially identical, differing only in such modification as will enable the pinnule to carry ambulacral organs on its ventral side; and, further, that if for any reason the pinnules are not supplied with ambulacral organs on their ventral side the difference between the cirri and the pinnules beyond the second segment will almost or entirely disappear.

In this connection it is most instructive to see that in this specimen the ungrooved pinnules have approached so closely to the cirri in structure that they have taken upon themselves the performance of exactly the same functions.

Genus: COMATULA, Lamarck.

COMATULA PURPUREA, J. Müller.

Comatula purpurea, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 746, 1911. A. H. Clark, Ergebnisse der Hamburger sudwest-Australischen Forschungsreise, 1905, Bd. 3, Lief. 13, S. 451. 1912. A. H. Clark, The Crinoids of the Indian Ocean, p. 81.

Locality. Between Fremantle and Geraldton.

Material. Four specimens; one of these is typical, with VIII cirri, three in interradial pairs and two single; another has XI cirri; the cirri in the other two are more numerous than usual, but are evidently undergoing reduction toward the condition normal for the species, indeed in the larger the normal arrangement occurs on about four-fifths of the periphery of the centrodorsal.

In the largest specimen the anterior arms are about 100 mm. long.

The colour in life was reddish purple.

Sub-fam.: COMASTERINAE, A. H. Clark.
Genus: COMANTHUS, A. H. Clark.
Sub-genus: COMANTHUS, A. H. Clark.
Specific Group: VANIA, A. H. Clark.

COMANTHUS (VANIA) ANNULATA, Bell.

Comanthus (Vania) annulata, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 757. 1911, A. H. Clark, Ergebnisse der Hamburger sudwest-Australischen Forschungsreise 1905, Bd. 3, Lief. 13, s. 457.

Comanthus annulata, 1912. A. H. Clark, The Crinoids of the Indian Ocean, p. 96.

Locality. Between Fremantle and Geraldton.

Material. Nine specimens; two of these are uniform light yellowish brown; the other seven are yellowish brown, darkest on the calyx, division series and arm bases where they are thickly covered with small uniform round green spots; according to the label these were dull green in life.

The details of the specimens are as follows: (1) about forty-five arms about 110 mm. long; VI cirri; (2) forty arms about 110 mm. long; X cirri; (3) about forty arms; one of the IIIBr.

series is 7 (3+4, 6+7); the centrodorsal is a pentagonal plate slightly raised above the surface of the radials, with a few obsolete cirrus sockets about its periphery; (4) about forty arms; the centrodorsal is very thin discoidal, pentagonal in outline; there are III cirri; (5) about thirty-five arms about 110 mm. long; (6) about thirty-five arms about 90 mm. long, the centrodorsal is greatly reduced; there are III cirri; (7) about thirty-five arms; VIII cirri; the centrodorsal is greatly reduced: (8) about thirty arms; V cirri; (9) about twenty-five arms about 115 mm. long.

Remarks. These specimens agree with those taken by the Hamburg West Australian Expedition at Shark Bay, and with others which I have examined from the vicinity of Perth.

COMANTHUS (VANIA) PARVICIRRA, J. Müller.

Comanthus (Vania) parvicirra, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 758. 1911, A. H. Clark, Ergebnisse der Hamburger sudwest-Australischen Forschungsreise 1905, Bd. 3, Lief. 13, s. 446.
Comanthus parvicirra, 1912, A. H. Clark, The Crinoids of the Indian Ocean, p. 97.

Locality. Between Fremantle and Geraldton.

Material. One typical specimen with twenty-two arms 70 mm. long; of the ten IIBr. series seven are 4 (3+4) and three are 2; there are two IIIBr. series, one 2, developed internally, and one 4 (3+4), developed externally; the cirri are VIII, 14, 7 mm. long.

Remarks. This species has previously been recorded from Fremantle.

Fam.: ZYGOMETRIDAE, A. H. Clark.
Genus: ZYGOMETRA, A. H. Clark.

ZYGOMETRA ELEGANS, Bell.

Zygometra elegans, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 762. 1911, A. H. Clark, Ergebnisse der Hamburger sudwest-Australischen Forschungsreise 1905, Bd. 3, Lief. 13, s. 458. 1912, A. H. Clark, The Crinoids of the Indian Ocean, p. 104.

Locality. Between Fremantle and Geraldton.

Material. Eight specimens; the details of these are as follows: (1) forty-five arms 110 mm. long; of the ten IIBr. series

nine are 4 (3+4) and one is 2; of the twenty IIIBr. series seventeen are 2 and three are 4 (3+4); the five IVBr. series are all 4 (3+4); four of them are developed on the outermost side of the ray, the fifth being by the side of one of these; the centrodorsal is large, thick discoidal, the dorsal pole slightly concave, 5 mm. in diameter; the cirri are 30 mm. to 35 mm. in length, and are composed of 44-47 segments; PD is rather slender, about 15 mm. long, composed of from twenty-seven to twenty-nine segments; (2) forty arms about 100 mm. long; of the ten IIBr. series seven are 4 (3+4) and three are 2; sixteen of the IIIBr. series are 4 (3+4) and two are 2; two are missing; the cirri are 30 mm. to 33 mm. long, and are composed of 37-42 segments; PD is 18 mm long, rather slender, composed of thirty-seven segments; (3) forty arms about 100 mm. long; the ten IIBr. series are 4 (3+4); twelve of the IIIBr. series are 2 and six are 4 (3+4); the two IVBr. series are 4 (3+4); the cirri are about 30 mm. long and are composed of 38-39 segments; the elongate proximal pinnules are slender; (4) two of the post-radial series are missing; the three post-radial series present consist of eight arms each, two IIBr. and four IIIBr. series being present in every case; all of the IIBr. series are 4 (3+4); nine of the IIIBr. series are 2 and three are 4 (3+4); (5) thirty-eight arms, with one IIBr. series missing; the ten IIBr. series are 4 (3+4); ten of IIIBr. series are 2, six being 4 (3+4); (6) thirty-six arms about 100 mm. long; the ten IIBr. series are 4 (3+4); nine of the IIIBr. series are 2 and seven are 4 (3+4); nine of the IIIBr. series are 2 and seven are 4 (3+4) the cirri are 25 mm. to 35 mm. long, composed of 34-42 segments; (7) thirty-six arms about 100 mm. long; five of the IIBr. series are 2 and five are 4 (3+4); eight of the III Br. series are 2 and eight are 4 (3+4); the cirri are 25 mm. to 30 mm. long, composed of 36-40 segments; (8) thirty-four arms about 100 mm. long; the ten IIBr. series are 4 (3+4); the fourteen IIIBr. series are 2; the cirri are 25 mm. to 30 mm. long, composed of 36-43 segments. The colour in life is recorded as very variable.

Remarks. Unfortunately both *Zygometra elegans* and *Z. microdiscus* vary very considerably in their arm structure, and examples of both may easily be found which possess more or less completely developed the arm structure of the other. For instance, the second specimen listed above has seven of the ten IIBr. series

4 (3+4) and sixteen of the eighteen IIIBr. series 4 (3+4); this would indicate the species *microdiscus*; but there are only forty arms, and the character of the proximal pinnules and of the cirri is identical with that of the proximal pinnules and of the cirri of the eighth specimen, which is in every way a typical example of *elegans*.

In *Zygometra comata* from the East Indies, *Z. andromeda* from India and *Z. punctata* from north Australia and the Aru Islands the characters are very stable and variation is reduced to a minimum; but in the larger forms, as in almost all comatulids with a very large number of arms, the arm structure becomes more or less uncertain and less reliable as a systematic guide than the structure of the lower pinnules or of the cirri.

There appear to be two definite and distinct structural types about which all of the large specimens of Zygometra centre, and it therefore seems most logical to recognise two species each with a definite pinnule and cirrus structure, and a definite *average* arm structure.

Zygometra multiradiata I believe, from an examination of the type in London, to be merely an undeveloped specimen of *Z. microdiscus*. I would now refer to *Z. microdiscus* the specimens which I recorded from northwestern Australia, and from Lewis Island in the Dampier Archipelago.

Fam.: HIMEROMETRIDAE, A. H. Clark.
Genus: AMPHIMETRA, A. H. Clark.

AMPHIMETRA DISCOIDEA, A. H. Clark.

Amphimetra discoidea, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 766 1911, A. H. Clark, Ergebnisse der Hamburger sudwest-Australischen Forschungsreise 1905, Bd. 3, Lief. 13, s. 459. 1912, A. H. Clark, The Crinoids of the Indian Ocean, p. 112.

Locality. Between Fremantle and Geraldton.

Depth. 60-100 fathoms.

Material. Six specimens. These are all large and well developed, the arms being between 185 mm. and 195 mm. long; the centrodorsal is from 6 mm. to 8 mm. in diameter, very broad, with a flat or more or less convex dorsal pole in the centre of

which there is sometimes to be seen a small pit; the cirri are XX-XXXII, the longest with 37-44 segments, and 35 mm. to 40 mm. in length; they are moderately stout and are composed of approximately sub-equal segments of which the longest (in the proximal portion) are from half again to twice as broad as long, and the distal are slightly shorter.

Remarks. The ten armed species of the genus *Amphimetra* are as yet very imperfectly understood. A considerable number of them have been described, mostly based upon single specimens which in several cases are small and probably immature. Extensive material from any one locality commonly shows great variation in one or more of the characters ordinarily used in specific differentiation.

As we know them at present these species appear to fall into three groups; (1) species in which the cirri are very stout with all of the component segments much broader than long, the distal being slightly longer than the proximal (typified by *A. milberti*); (2) those in which the cirri are comparatively slender with the proximal segments never more than twice as broad as long, usually about as long as broad, and always longer than the distal, and in which the dorsal spines on the cirrus segments are small, short and inconspicuous, developed only in the outer portion of the cirri (typified by *A. discoidea*) and (3) those in which the cirri, while in general resembling the cirri of the preceding group, possess large, long and conspicuous dorsal spines which are developed to well within the basal third (typified by *A. jacquinoti*).

The specimens under consideration appear undoubtedly to be exceptionally large and well developed examples of *A. discoidea*; typically *discoidea* has more slender and more tapering cirri in which the longer proximal segments are very nearly or quite as long as broad, but the distal are shorter, broader than long; in typical *milberti* the cirri are much stouter than in these specimens, the segments all being approximately of equal length, though the outer are a trifle longer proportionately, about four times as broad as long.

Fam.: TROPIOMETRIDAE, A. H. Clark.
Genus: TROPIOMETRA, A. H. Clark.

TROPIOMETRA AFRA (Hartlaub).

Tropiometra afra, 1911. A. H. Clark, The Recent Crinoids of Australia, p. 780. 1912, A. H. Clark, The Crinoids of the Indian Ocean, p. 176. 1912, A. H. Clark, The Crinoids of the Natural History Museum at Hamburg, p. 28.

Locality. Between Fremantle and Geraldton.

Depth. 60-80 fathoms.

Material. Two specimens; one of these has an arm length of about 220 mm.; the centrodorsal is thick discoidal, 10 mm. in diameter and 4 mm. high interradially; the cirri are XXIII, 34-35, 35 mm. to 40 mm. long; the other is similar, with arms 225 mm. long. The colour in life was dark purplish brown.

Remarks. This species differs from *T. macrodiscus* of southern Japan in its smaller and more slender cirri; *T. afra*, which is represented in the museums of the world by only three specimens other than the two described above, was previously known only from Bowen, Qeeensland, where two specimens were collected, more than fifty years ago, by the representatives of the famous Godeffroy company of Hamburg; the third specimen was brought home from the "South Pacific" by the United States Exploring Expedition.

Fam: CALOMETRIDAE, A. H. Clark.
Genus: NEOMETRA, A. H. Clark.

NEOMETRA GORGONIA, Sp. Nov.

Locality. Between Fremantle and Geraldton.

Depth. 80-120 fathoms.

Material. Seven specimens.

Description of the type specimen. The centrodorsal is discoidal, broad, with a broad and flat dorsal pole 5 mm. to 6 mm. in diameter; the cirrus sockets are arranged in one and a partial second crowned and irregular marginal row.

The cirri are XIX, 39-50, 35 mm. to 45 mm. (usually about 40 mm.) in length, long, large and stout, with a pronounced taper in the distal half; the first nine or ten segments are half again to twice as broad as long (usually nearer the latter) the first segment being similar to those succeeding; the segments following the ninth or tenth gradually become shorter, but at the tip of the cirrus slowly increase in length again; the tenth has on the dorsal side just within the distal border an inconspicuous slightly elongated median tubercle which on the succeeding slowly transforms into a narrow and low, though prominent, median carination running the entire length of the segment; on the fifteenth two small tubercles appear, one on either side of the median carination just within the distal edge of the segment; these increase in size and elongate, after two or three segments, becoming prominent low narrow keels which resemble the median keel, though they are slightly less in height and do not extend quite so far toward the proximal border of the ossicle; they are not quite parallel to the median keel, but converge slightly toward the proximal end of the segments; distally all three carinate processes increase in height, especially the median, and a tubercle, which may be more or less elongate, usually appears just outside of the distal end of each of the lateral keels; on account of the terminal taper of the cirri the opposing spine and terminal claw are rudimentary.

The radials are short in the median line, but extend upward in the angles of the calyx in the form of broad processes with parallel or slightly converging sides which entirely and widely separate the bases of the IBr.1; these processes are sharply truncated distally, and are not expanded or spatulate.

The division series and arms extend outward almost horizontally from the calyx, as in *Neometra sibogae*.

The IBr.1; are short, oblong, four or five times as broad as long; the ventrolateral edge is produced into a thin border which, viewed dorsally, is seen to run from the distal edge of the interradial process of the radials to the distal lateral angles of the IBr.1 where it disappears from dorsal view, being continued along the ventral side of the axillary and of the division series forming a deep trough in which the "soft parts" lie. The IBr.2 (axillaries) are broadly pentagonal, nearly twice as broad as long; the lateral

edges are little, if any, shorter than those of the IBr.1, making with them a broadly obtuse angle. The IIBr. and IIIBr. series are 2, and all of the latter are developed.

There are forty arms (thirty-nine in the type) 95 mm. long, resembling those of other species of the genus; there is little or no overlapping of the distal edges of the brachials.

P1 is 14 mm. long with twenty-eight segments, of which the first two are greatly enlarged, over twice the breadth of the succeeding, with the distal edge more or less convex, the third or third and fourth are slightly broader than long, and the remainder are subequal, slightly longer than broad; as a whole the pinnule is proportionately longer and somewhat stouter and stronger, than is usual in the genus.

P2 is 18 mm. long and is composed of nineteen segments: it resembles P3 but is very slightly less stout.

P3 is 19 mm. long, very stiff and spine-like, composed of nineteen segments of which the first two are broader than long, slightly enlarged, with distal carinate processes the edges of which are straight and parallel to the longitudinal axis of the pinnule or nearly so, the third is nearly as long as broad, and the following are elongate with, after the eighth, produced distal edges which at the prismatic angles are provided with prominent spines.

P4 is 14 mm. long and is composed of fifteen segments; it resembles P3, but is less stout and the two first segments are less enlarged.

P5 is 10 mm. long, composed of twelve segments; it is more slender than P4.

The distal pinnules resemble those of the other species of the genus; they are very sharply triangular in cross section and their ambulacra are provided with very highly developed side and covering plates; they measure 9 mm. in length, and are composed of fifteen segments of which the terminal four or five, upon which the ambulacral grooves do not extend, are abruptly smaller than the preceding.

The color in life is white, with purple bars and blotches on the pinnules.

The specimens other than the type. (1) Forty-two arms; there are two IVBr. series, both developed on the inner side of

external IIIBr. series; the dorsal pole of the centrodorsal is 6 mm. to 7 mm. in diameter; the cirri are XXII, 44-46, 35 mm. to 40 mm. long; the colour is white, the outer part of the arms narrowly banded, and the pinnules broadly blotched, with purple; (2) forty-one arms about 75 mm. long; the cirri are XX, 39-44, 35 mm. to 40 mm. long; (3) about forty arms 65 mm. long; the cirri are about 30 mm. long; the colour is white, the arms beyond the division series narrowly and regularly banded with purple, the bands being continued on to the pinnules; (4) forty arms 60 mm. long; dorsal pole of the centrodorsal is 5 mm. in diameter; the cirri are XXI, 34-39, 25 mm. long; (5) about forty arms, there are two IVBr. series; (6) forty arms, similar to the preceding.

Comparison with related species. *Neometra gorgonia* is very different from all of the other described species of the genus. As now known the species of this genus, on the basis of the number of their arms, fall into five groups: (1) species having from fifteen to twenty arms (*alecto*); (2) species having twenty arms (*multicolor spinosissima, conaminis*); (3) species having thirty arms (*acanthaster*); (4) species having from thirty to forty arms (*sibogae*); and (5) species having forty arms (*gorgonia*). The only species with which this can possibly need comparison is *N. sibogae.*

On the terminal twelve or thirteen cirrus segments in *N. sibogae* the high median carination is accompanied on either side by a usually more or less elongate tubercle which, however, is comparatively small and inconspicuous. I did not notice this until my attention was called to the similar, but far more prominent, processes in *N. gorgonia.*

In *N. sibogae* the edges, both proximal and distal, of the elements of the division series and the proximal brachials, and the distal edges of the brachials and of the cirrus segments are prominently everted, giving the animal a curiously ornate appearance; in *N. gorgonia* the edges of the elements of the division series, brachials and cirrus segments are smooth, so that the general aspect of the two forms is strikingly different; the cirri of *N. gorgonia* are very much longer than, in fact nearly twice as long as, the cirri of *N. sibogae,* and the three keels on the dorsal side of the outer segments are very much more strongly marked; the cirrus segments in *N. gorgonia* are much more numerous than in *N. sibogae.*

NEOMETRA CONAMINIS, Sp. Nov.

Locality. Between Fremantle and Geraldton.

Depth. 80-120 fathoms.

Material. Four specimens.

Description of the type specimen. The centrodorsal is of medium size, discoidal, the dorsal pole flat, 4·5 mm. in diameter; the cirrus sockets are arranged in a single more or less irregular marginal row (in one of the other specimens there is also a very deficient second row).

The cirri are XIV (in the other specimens varying from XIV to XIX), 40-45, 25 mm. long; the longer earlier segments are half again as broad as long to nearly as long as broad, and the shorter distal segments are about three times as broad as the median length, becoming longer again terminally; the cirri are not particularly stout; they taper slowly and gradually throughout their whole length; on the sixth or seventh segment the median dorsal portion of the distal edge becomes slightly prominent; this prominence rises in height and slowly extends itself proximally until on about the tenth there results a narrow median keel running the whole length of the dorsal surface; on the succeeding segments this gradually increases in height, becoming the high thin median carination characteristic of the outer cirrus segments of the species of this genus; the ventral surface of the cirri is rather narrowly rounded so that in cross section the cirri are seen to approach a rhombic shape, but with the four angles of the rhombic outline very broadly rounded.

The radials are concealed in the median line, but extend upward in the angles of the calyx in the form of triangular processes of which the sides, which are about as long as the bases, are concave and the apices are truncated; the apices of these triangular processes entirely, though not very widely, separate the bases of the IBr.1.

The IBr. 1 are very slightly trapezoidal, almost oblong, from three to four times as broad as long; the ventrolateral edges, though sharp, are only very slightly if at all produced; these ossicles occasionally bear an obscure low median keel; the IBr.2 (axillaries) are broadly pentagonal, slightly broader than long, the lateral edges usually slightly shorter than those of the IBr.1.

The twenty arms, which resemble those of related species, are from 85 mm. to 90 mm. long.

P1 is 9 mm. long, composed of from twenty-five to thirty segments of which the first two are greatly enlarged and the remainder are slightly longer than broad; P2 is 12 mm. long, with sixteen or seventeen segments which after the third become much elongated, those in the outer part of the pinnule having produced distal edges bearing prominent spines at the prismatic angles; the pinnule is stiff and spine-like; P3 is from 15 mm. to 17 mm. long with from sixteen to eighteen segments, resembling P2 but proportionately larger; P4 is 17 mm. long with eighteen segments, similar to P3; P5 is 12 mm. long with fifteen segments, similar to the preceding; P6 is 10 mm. long with fourteen segments; the distal pinnules are about 11 mm. long.

The colour in life is white with yellow bands on the arms and pinnules, more rarely on the cirri.

The specimens other than the type. Three, all with twenty arms, and all resembling the type.

Comparison with related species. The species of the genus *Neometra* at present known are seven in number; they may be briefly diagnosed as follows:—

Neometra alecto; Fifteen to twenty arms, 60 mm. to 70 mm. long; cirri IX-XV, 39-46, 25 mm. to 30 mm. long (Philippine Islands; 42-58 fathoms).

Neometra multicolor; Twenty arms, 60 mm. long, cirri XV, 35, 20 mm. long (southern Japan; 20-110 fathoms).

Neometra conaminis; Twenty arms, 85 mm. to 90 mm. long; cirri XIV-XIX, 40-45, 25 mm. long (southwestern Australia; 80-120 fathoms).

Neometra spinosissima; Twenty arms, 130 mm. long; cirri XI, 42-55, 25 mm. long (Andaman Islands).

Neometra acanthaster; Thirty arms, 60 mm. long; cirri 20 mm. long, ventrally carinate (Philippine Islands; 49 fathoms).

Neometra sibogae; Thirty to forty arms, 70 mm. to 75 mm. long; cirri XV, 31-36, 25 mm. long; edges of all the ossicles produced; terminal cirrus segments with triple dorsal processes (Solor Strait, east of Flores; 113 metres).

Neometra gorgonia; Forty arms, 95 mm. long; cirri XIX, 39-50, 35 mm. to 45 mm. long; edges of all the ossicles smooth; all of the dorsal processes on the cirrus segments triple, the terminal often with two additional elements (south-western Australia; 80-120 fathoms).

From an examination of the data given above it is evident that *N. conaminis* belongs to the group of species characterized by the possession of twenty arms, including *N. alecto*, *N. multicolor*, and *N. spinosissima*.

The Japanese *N. multicolor* is much smaller than *N. conaminis*, and possesses shorter cirri with considerably fewer segments; *N. spinosissima* from the Andaman Islands is much larger with proportionately shorter cirri which have more numerous segments; *N. alecto* is of about the same size as *N. conaminis*, and possesses cirri with the same number of segments; the cirri of *N. alecto* are proportionately noticeably longer and more slender than are those of *N. conaminis*, while the brachials and cirrus segments have slightly produced distal edges, these being smooth in *N. conaminis*.

Fam: THALASSOMETRIDAE, A. H. Clark.
Genus: PTILOMETRA, A. H. Clark.

PTILOMETRA MACRONEMA, J. Müller.

Ptilometra macronema, 1911. A. H. Clark, Bull. du mus. d'hist. nat. de Paris, No. 4, 1911, p. 255, fig. i B, p. 256. 1911, A. H. Clark, The Recent Crinoids of Australia, p. 781. 1911, A. H. Clark, Ergebnisse der Hamburger sudwest-Australischen Forschungreise, 1905, Bd. 3, Lief. 13, S. 461. 1912, A. H. Clark, The Crinoids of the Indian Ocean, p. 189.

Locality. Off Geraldton; "very abundant."

Depth. 25-40 fathoms.

Material. Ten specimens, all of medium size, the arms being 45 mm. to 55 mm. in length from the radials and the longest cirri about 45 mm. long, composed of 69-78 segments; six of the examples have twenty arms, two have nineteen, one has sixteen and one has fourteen.

The colour in life is recorded as purple, the cirri red. In spirits the colour is yellowish-brown, the cirri becoming deep purple in the outer half.

THE ECHINODERMS
OF THE
WESTERN AUSTRALIAN MUSEUM.

HUBERT LYMAN CLARK, PH.D.
Museum of Comparative Zoölogy, Cambridge, Mass., U.S.A.

The authorities of the Western Australian Museum at Perth, having entrusted to me their collection of echinoderms for identification and study, I beg to offer here my sincere thanks for the honor they have thus done me. My obligation to Mr. Bernard H. Woodward, the director of the Museum, is particularly heavy, for his uniform courtesy and for the many favours he has shown me.

The collection itself is not a large one but it is of extraordinary interest, not only for some of the hitherto undescribed species it contains, but also for the light it throws on the range of many East Indian and Australian echinoderms. The number of specimens sent me is only 99, but the number of species is more than half that, no less than 58 being represented. The collection is thus a selected one, usually only one or two specimens representing each form. There is thus no opportunity for me to comment on the variability of these West Australian species.

The collection is notable for the large number of new and remarkable species it contains. There are no new crinoids, but five starfishes are undescribed, and one of these represents a new and remarkable genus, while three others are notably distinct forms. Of the ophiurans, four are new, one representing a new genus and the other three being very different from any near allies.

Of the echini, four, and probably five, are undescribed, and it is interesting to note that one of these is a cidarid, and another a centrechinid, the two oldest groups of Recent echini, while the other two are clypeastroids, a group particularly abundant and widespread in Tertiary times. Of the holothurians, certainly two, and

probably three, represent new forms, one of which may ultimately require a new generic name to emphasise its peculiarities. There are thus not less than 15 new species in this small collection, or more than a fourth of the total number. Of the others, at least 22 are not known from outside the Australian region. As 5 are not certainly identified, it follows that of 53 species, 37 or 70 % are characteristic of Australia, certainly a very notable fact. Of course, further knowledge of both the Australian and East Indian faunæ, will alter these figures, perhaps materially, but they are at least suggestive of the remarkable echinoderm fauna which awaits further study on the western coast of Australia.

Finally, the collection at hand is notable for the presence of many species whose occurrence on the western side of Australia was not previously known, and in some cases at least was hardly to be expected. Among the starfishes, the most notable case is that of *Anseropoda rosacea*, previously known from Japan and the Bay of Bengal. Among ophiurans, there are two species, *Pectinura dyscrita* and *Ophiothrix spongicola*, previously known only from New South Wales. Among echini, the occurrence of a Temnopleurus is particularly remarkable, while the presence of *Tretocidaris bracteata*, previously known only from the East Indies and Japan, is most interesting.

Holotypes of the new species described in this paper are in the Western Australian Museum at Perth, but cotypes of ten of them (wherever the holotype was not the only specimen) are now in the Museum of Comparative Zoölogy.

CRINOIDEA.

There are only five crinoids in the collection. One of these (No. 4922) is a damaged calyx with only the basal part of the arms, and hence is not identified, but it is certainly not one of the Comasteridae. The other four represent four different species, but all belong to the single family Comasteridae. The chief interest of these crinoids lies in the fact that one of the species is new to the fauna of Australia, not being included in the list of "Recent Crinoids of Australia" published in 1911 by Mr. Austin Hobart Clark.[1]

1 Clark, A. H., 1911. "The Recent Crinoids of Australia," Mem. Austr. Mus., IV, pt. 15.

COMATULA SOLARIS.

Lamarck, 1816. Hist. Nat. Anim. s. Vert., vol. 2, p. 533.

This species is well-known from Queensland and Torres Strait, and has been recorded from as far west as Holothuria Bank. Its occurrence on the western coast of Australia is therefore not remarkable. The specimen in the present collection is in what Mr. Clark (l.c.) calls the "broad-armed and generally robust phase" and is unicolor—almost black.

Coast of West Australia. One specimen. No. 260.

COMANTHUS ALTERNANS.

Actinometra alternans, P. H. Carpenter, 1881. Notes from Leyden Mus., vol. 3, p. 208.

This species has been recorded from the Philippines and from Port Molle, Queensland. Its occurrence, therefore, at the Abrolhos Islands, North-western Australia, is of no little interest. The specimen before me is small, having only 34 arms, each about 60 mm. long, which is an inaccurate way of saying that the tip of each ray is a little more than 60 mm. from the centre, of the disk. There are two cirri, attached to the margin of a flat centre-dorsal less than 3 mm. in diameter; the larger cirrus is broken; the smaller has 15 very short, slightly swollen joints. In three of the rays the II Br series is 4 (3+4), the III Br is 2, and the IV Br is 4 (3+4) again; in a fourth ray, on one side, III Br is 4 (3+4) and IV Br is 2; in the fifth ray, on both sides II Br is 2; and III Br is 2 also. The colour of this specimen is light wood-brown. On account of its small size and the fact that the two arms fail to show the regular alternation of the division series, I have hesitated in calling this specimen *alternans*, but I think there is really little doubt that it is a young example of that species.

Abrolhos Islands, Western Australia. One specimen, No. 125.

COMANTHUS PARVICIRRA.

Alecto parvicirra, J. Müller, 1841, Arch. f. Naturg., Jhrg. 7, vol. 1, p. 145.
Comanthus parvicirra, A. H. Clark, 1911. Mem. Aust. Mus., IV, pt. 15, p. 758.

The occurrence of this species in the collection is quite to be expected since it has been previously recorded from Fremantle.

Coast of West Australia. One specimen, without number.

COMANTHUS POLYCNEMIS.

A. H. Clark, 1910. Proc. U.S. Nat. Mus., vol. 36, p. 396.

The specimen which I refer to this species is a small one, scarcely 120 mm. across, with 57 arms. The colour is a very deep olive-green, but the young arms and the cirri are pale brown or a dirty cream colour. There are 15 cirri, each with 15 joints, but they have the appearance of being fugaceous and the small thin centrodorsal adds weight to such an impression. Unfortunately, Mr. Clark's description is rather unsatisfactory, no statement as to size, colour, or number of arms being made. There is a vague reference "to my previous list," but I have not succeeded in finding the list to which he refers. It is possible, therefore, that I am wrong in referring this specimen to *polycnemis* (especially in view of the presence of numerous cirri) but the arrangement of the division series is a very noticeable character.

Abrolhos Islands, Western Australia. One specimen, No. 124.

ASTEROIDEA.

The starfishes are a most interesting section of this collection, since five of the sixteen appear to be undescribed, and one of these represents a new and interesting genus. Of the sixteen species, only three are certainly known from outside of the Australasian region.

LINDIA MACULATA.

Müller and Troschel, 1842. Sys. Ast. p. 77.

A small specimen, with four of the seven arms broken, proves this widespread species to be a native of the West Australian coast. The colour in life is recorded as "buff with dark bands." R.= 80 mm.

Between Fremantle and Geraldton, W.A., 80-120 fms., No. 4919.

TOSIA AUSTRALIS.

Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 281.

Since the type of this species was from Swan River, Western Australia, it is not strange that it should be represented in the present lot.

From piles of an old jetty, Fremantle, W.A. Two specimens, No. 6045.

PENTAGONASTER STIBARUS,[1] sp. nov.

PLATE XVII.

Rays 5. R=52 mm., r=28 mm. R 2r. Interbrachial arcs well rounded. Rays broad and flat. Breadth at base, 29 mm. Disc large, very little arched; vertical diameter only about 13 mm. Superomarginal plates, 40, that is, eight on each side or four on each margin of each arm; the terminal pair the largest and much swollen; the others are subequal and little swollen. Each plate is surrounded by a single, double or even triple series of minute, crowded, flat-topped granules, but the surface of each plate is perfectly smooth. Inferomarginals 60, that is, twelve on each side or six on each margin of each arm; on each side of the starfish, the six median inferomarginals correspond exactly in position with the superomarginals above them, but the swollen terminal superomarginal overlies three inferomarginals, of which the antepenultimate (and not the penultimate nor the last) is the largest and is slightly swollen. The penultimate is distinctly smaller but is equally swollen, while the last is quite small and is almost or quite flat. The inferomarginals are smooth and surrounded by granules exactly as are the superomarginals.

The plates covering the abactinal surface are smooth, polygonal or rounded and surrounded, like the marginals, by a series of flat-topped granules. The largest are in the interradial areas and are four or five millimetres across; the smallest are near the tips of the rays. Distally, the median radial series are slightly swollen, while proximally, in the type (the larger specimen), each plate bears a blunt low spine, or high tubercle. Two or three plates not in the median radial series, but near the centre of the disk, bear similar but small tubercles. In the smaller specimen (R=41 mm.) such a tubercle is indicated on only one plate, the dorso-central, while the five primary interradial plates are much larger and more conspicuous than in the type. In both specimens, the rounded triangular madreporic plate lies just distal to one of the primary interradials; in the type, it is much swollen.

The actinal surface is covered by polygonal plates similar to those of the abactinal side and like them surrounded by series of granules. Adjoining each mouth angle is a single plate, distal to

[1] GR. *stibaros*—compact, sturdy.

which are a pair of plates of about equal size. Distal to them is a series of three or four plates. Theoretically this series is succeeded by one of six and that by one of eight plates, the median four of which abut on the inferomarginals. Actually, however, these last two series are irregular in number, form, size and position of the plates. In any case, however, the plates which abut on the inferomarginals are the smallest and those next the mouth plates are the largest of the actinal intermediate plates.

The adambulacral plates are about twice as wide as long. Their armature consists of a series of three stout, blunt, somewhat prismatic, furrow-spines, of which the middle one is either the largest or the smallest. This series is parallel to the furrow, and directly back of it, on the surface of the plate, is a second series of similar, but shorter and stouter spines. There may be either two or three spines in this series but three seems to be the typical number and when there are only two they are exceptionally stout. The remaining surface of each plate is covered by six to ten small, low, truncate, prismatic spines, arranged in series of three (rarely two or four) parallel to the furrow; the outermost are very similar to the granules surrounding the actinal plates. The armature of the oral plates consists of six large marginal spines on each side of the "jaw," the two at the apex being the largest. On the surface of each jaw there are six to ten similar but smaller spines (three to five on each side) while the low keel of the jaw is concealed by about eight thick prismatic spinules arranged in a double series.

Excavate pedicellariae, similar to those of *P. pulchellus* and *P. dübeni*, but smaller than those of the former and larger than those of the latter, occur on many of the abactinal plates. None were found on the actinal surface of either specimen. They occur irregularly scattered and may be present on any plate, but no plate carries more than one. They may have either two or three valves; in the smaller specimen they are mostly two-valved, but in the type, the three-valved form predominates.

Colour of type, very pale fawn; the smaller specimen is brown-yellow. In life, the colour of both was "bright orange."

Between Fremantle and Geraldton, W.A. 40-100 fms. Two specimens, No. 4916. The larger specimen is the Type.

This species is obviously related to *P. dübeni*, Gray, but is at once distinguished by its much broader rays, covered by nearly

circular plates, in three-five longitudinal series, and the much larger terminal superomarginal plates. In *dübeni* when R=41, r=only 17; the arm is 20 mm. broad at base and only 11 mm. at a point halfway between tip and centre of disk; there are 50-60 superomarginals. In *stibarus* with R=41 mm., r=23, br=26 and br at the middle of arm=20 mm. there are only 40 superomarginals. In *dübeni*, the abactinal plates on the rays are in only 1-3 series, swollen and much elongated parallel to the axis of the ray, but in *stibarus*, they are nearly or quite flat and more or less circular. From *pulchellus*, the type of the genus, *stibarus* differs greatly in the much closer plating of both surfaces, with smaller granules between the plates, and in the pedicellariae being abactinal instead of actinal. If the abactinal tubercles are a constant feature of adult *stibarus*, they will serve as an additional specific character.

Fisher[1] has stated as a character of Pentagonaster that it is the *last* plate of each marginal series which is largest and not the penultimate or antepenultimate. Examination of four specimens of *pulchellus* and three of *dübeni* shows that while it is the last of the superomarginals which is largest, of the inferomarginals, the last is smallest and the penultimate is largest, though sometimes approximately equalled by the antepenultimate. In the type of *stibarus* as already stated, the antepenultimate superomarginal is largest, but in the smaller specimen in only two of the ten possible cases is the antepenultimate largest, in the other eight it is the penultimate which exceeds. This difference, however, is more important on paper than in reality for in every series in the two specimens it is the *fourth* plate from the median interradial line which is enlarged and the apparent difference is due to whether one or two small plates are developed distal to it. The characteristic arrangement of the marginals in Pentagonaster may then be stated thus: The last superomarginal plate is enlarged and swollen and overlies the last two or three inferomarginals; of these the penultimate, or sometimes the antepenultimate, is largest.

[1] 1911. Bull. U.S. Nat. Mus., No. 76, pp. 166 and 171.

NECTRIA OCELLIFERA.

Asterias ocellifera, Lamarck, 1915. Anim. s. Vert. vol. 2 p. 553.
Nectria ocellifera, Gray, 1840. Ann. Mag. Nat. Hist. vol. 6, p. 287. (*oculifera lap. cal.*)

The number of species in the genus Nectria has for many years been a matter of dispute. Perrier first called attention to the differences between the original specimens at Paris and the specimens in the British Museum. He [1] was sure they represented two different species and suspected that there was possible a third in the Paris Museum. Sladen, [2] however, on the basis of the *Challenger* material was inclined to think that there was only a single species, the differences to which Perrier called attention not being of specific value. Fisher, in a recent discussion of the genus, points out that the material in the M.C.Z. collection indicates the existence of two species. Very recently the M.C.Z. has received from Mr. Joseph Gabriel some well preserved specimens of Nectria from Victoria, and these, on comparison with two specimens from West Australia in the present collection, enable me to throw some light on the question.

The West Australian specimens are essentially alike except that one has six rays, and is somewhat smaller than the other. These specimens agree well with Perrier's description of *ocellifera* and I feel little hesitation in referring them to that species. The specimens from Victoria, on the other hand are obviously different and seem to agree very well with Ferrier's description of his species *ocellata* which was based on Gray's specimen in the British Museum. As all my specimens are well-grown and of approximately the same size, it is clear that the differences are not in any way to be correlated with age, and I believe both species are fully entitled to recognition. The most striking difference between them is in the appearance of the dorsal paxilliform ossicles; in *ocellifera* the top of each ossicle is covered by a group of 10-30 flat, irregularly polygonal, well-spaced granules, surrounded by a marginal crown of 10-25 large spaced, flaring flattened scale-like projections; in *ocellata* the top of each ossicle is much smaller and bears 10-30 rounded, well-spaced hemispherical grains, surrounded by a crowded series of

1 C. Perrier, 1876. Arch. Zool. Exp. vol. 5, pp. 1-6.
2 W. P. Sladen, 1889. *Challenger* Asteroids, pp. 318-321.
3 W. K. Fisher, 1911. Bull. U.S. Nat. Mus., No. 76, pp. 163, 164.

15-30 grains, a little higher than, but not essentially different from, those on the top. As a result of this difference in the ossicles the madreporic plate in *ocellata* is plainly visible and the papulae seem larger and more conspicuous than in *ocellifera* where also the madreporic plate is more or less concealed. The marginal plates are more numerous in *ocellata* than in *ocellifera* ; in a specimen of the former having R=70 there are 23 superomarginals on one side of a ray, while in an *ocellifera* with R=83, there are only 18. The actinal intermediate areas are much more closely granulated in *ocellata* than in *ocellifera*, in the latter the separate plates are quite distinctly indicated by the groups of granules which they bear. The figures given by Sladen in the *Challenger* Report are all illustrations of *ocellata* and it seems to me probable that he had not seen *ocellifera*.

Whether the large specimen in the M.C.Z. collection (No. 1932) upon which Fisher made his anatomical investigations is *ocellata* or represents a new species, I am unable to decide. It is much larger than any *ocellata* I have seen, and its peculiarities may be a matter of age, but I confess that I think it likely it represents a third species. The dorsal paxilliform ossicles are close fitting polygons unlike any that I have seen in other Nectrias. On the other hand, the larger specimen of *ocellata* have pedicellariae and occasionally show inter-marginal papulae in the interbrachial arc (though, it must be added, very rarely), while both of these features, particularly emphasised by Fisher, seem to be wanting in the specimens of *ocellifera*. It seems to me that neither is a constant generic character.

Whether *ocellata* and *ocellifera* have distinct geographical ranges remains to be determined. The exact locality whence Lamarck's type came from is not known. The British Museum specimens described by Gray and by Perrier, the *Challenger* material and all of the specimens in the M.C.Z. are from south-eastern Australia or Tasmania, and these are all *ocellata*. The two specimens before me from West Australia are *ocellifera*. So far as the evidence goes, then, the areas occupied by the two species do not overlap.

The West Australian specimens have the following data : Between Fremantle and Geraldton, W.A., 60-100 fms. Colour orange. No. 4914. Two specimens.

STELLASTER MEGALOPREPES,[1] sp. nov.

PLATE XVIII.

Rays 5. R=120 mm. r.=45 m. R.=2⅔r. Br at base=40 mm.; at half-way point, 24 mm. Interbrachial arcs well rounded. Disk large, not highly arched, yet distinctly convex; vertical diameter about 20 mm. Entire abactinal surface covered by a closely granulated membrane, obscuring but not actually concealing the outlines of the underlying plates. Superomarginals, 22 on each side of ray; median interradial pair about 12 mm. high by 4 mm. wide, but distally the height decreases with little change in width, the fifteenth plate from the interradius being about 6 mm. high by 3.5 mm, wide (or long). At the tip of the ray the 19-21 superomarginals of the two sides are in contact abactinally but the twenty-second pair are so small, they are completely separated from each other by the twenty-first pair being in close contact with the rather large terminal plate. Abactinal ends of superomarginals (except distalmost) rounded wedge-shape, with a group of papulae on either side. No spines, tubercles or pedicellariae on any superomarginals. Abactinal skeletal plates small, largest in interradial areas, where they may measure nearly five millimetres across. Median radial series consists of about forty plates and runs to a point about nine or ten millimetres proximal to tip of ray, where meeting of superomarginals of opposite sides puts an end to abactinal plating. On each side of median radial series, at base of arm, are two parallel series of somewhat smaller plates; the one adjoining the median series runs about as far as the fifteenth superomarginal while the outer one ends at the eleventh or twelfth. Excepting thirty (more or fewer) distal, medial radial plates and about ten or a dozen distal plates in each of the two adjoining series, all abactinal plates carry sharp conical spines; the largest are situated one at the base of each ray on the first of the median radial plates; these five spines are about five millimetres high and two in diameter, at base; most of the spines are two millimetres high or less, but all if uninjured are very sharp. Papulae numerous but rather small, in groups of 3-20, all over abactinal surface; largest groups between upper ends of superomarginal plates. Madreporic plate, 7mm. long by 6 wide, rounded triangular, its proximal margin 12 mm. from centre of disk. Arms very distinct.

[1] GR. *megaloprepes*—magnificent, splendid.

Actinal surface, covered, like abactinal, with a closely granulated membrane, but outlines of plates quite distinct in dried specimen. Inferomarginal plates, 22 on each side of a ray, corresponding exactly in position to superomarginals, and approximating them in size; the distal margin of each is greatly modified by the series of spines borne thereon. Beginning at tip of ray (to pass from simple to complex conditions), each inferomarginal plate carries at or below the middle of its distal margin a stout, flattened, bluntly pointed spine, rather longer than the plate and lying appressed to the surface of the ray and parallel with its long axis. On plates 4-8 a second similar but smaller spine is present, below (*i.e.* actinal to) the first; on plates 9-11, a third spine still smaller arises below the second; on plates 12-14 there is a fourth; on plates 15-18, a fifth; and on plates 19-22, a sixth. On plates 20-22 a second series of two or three spines appears, proximal to the first, at the base of the second and third spines of that series. With increase in number, there is a change of position and a marked increase in length of these marginal spines, so that on the median interradial inferomarginals, each of which bears 8 or 9 spines, the original first spine is 7 or 9 mm. long, and is borne on the outer proximal corner of the plate.

Actinal intermediate plates rather few (25-30) aside from the actino-lateral series, which reaches scarcely to the middle of the ray; very rarely a small spine, similar to those on the inferomarginals may be seen on one of the distal intermediate plates. Adambulacral plates, about as long as wide; armature in two series, parallel to furrow; an inner series of 6 or 7 slender spines, median longest, adoral and aboral, shorter and subequal; and an outer of 2 (or rarely 3) very broad thin and flat, truncate spines, erect on surface of plate; these flat spines are 3-4 mm. long and 1-1·5 mm. wide. Oral plates with about 7 spines on each side, of which the innermost are longest and stoutest, and are distinctly prismatic; surface of each jaw with about 3 large, flat, thin spines similar to those in outer adambulacral series.

Pedicullariae abundant and of two kinds. Scattered irregularly over the abactinal surface are small *bivalved* pedicellariae (using Fisher's terminology), with jaws about half a millimetre long. Less common, and generally situated near a spine, are tall, 2-valved *spatulate* pedicellariae, with jaws nearly a mllimetre high. Bi-

valved pedicellariae sometimes occur with three jaws and they often have the jaws as high as wide. It is easy to follow the transition from bivalved to spatulate pedicellariae, in this starfish. Both kinds of pedicellariae occur on the inferomarginal plates, but the bivalved are much the more common. Large spatulate pedicellariae occur on many adambulacral plates usually at the adoral end between the two series of spines. Groups of 8-20 large bivalved pedicellariae cover the surface of the actinolateral plates and give them a rough appearance ; some of these pedicellariae have jaws more than a millimetre long.

The colour of this fine starfish in life is said to have been "buff above, purple star around mouth." The dry specimen is light reddish-buff above and reddish-white below; the oral plates and first four or five actinolaterals on each side of each ambulacral furrow are dull rose-red, but more or less of the centre of each actinolateral plate is whitish, the area increasing on the more distal plates; inferomarginal and adambulacral spines white.

Off Port Hedland, W.A. One specimen, No. 4030. Type.

This beautiful starfish is quite distinct from any other member of the genus, yet seems to be a true Stellaster. The inferomarginal spines and the numerous sharp conical spinules on the abactinal surface are characteristic, while the adambulacral armature and the coloration add important distinctive marks.

OREASTER GRACILIS.

Lütken, 1871. Vid. Med. f. 1871, p. 260.

This West Australian specimen equals in size that in the British Museum, described by Bell, for R. = 220 mm., but there are only 25 or 26 marginal plates as against 30 in that specimen. There are no data with the present specimen other than the geueral statement that it is from West Australia.

OREASTER NODULOSUS.

Pentaceros nodulosus, Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 53.
Oreaster nodulosus, Bell, 1884, Proc. Zool. Soc., London, p. 66.

Although this specimen is much larger than either of those mentioned by Bell, for R. = 120 mm. as against 70 in his larger specimen, there are only two more marginal plates, 19 instead of 17

on each side of a ray. This species is notable, judging from the present individual, for its smooth surface, the plates being flattened, the tubercles rounded and the granulation so even that at a little distance the specimen looks water-worn, an illusion which examination with a lens dispels. The papular areas are small but very sharply defined. There are 14 or 15 tubercles on each median radial ridge ; the largest, which is about 13 mm. in diameter and 8 mm. high, is at the radial angle of the disk, the others being successively smaller distally. There are no data with the specimen, but it is from West Australia.

CULCITASTER,[1] gen. nov.

Form stellate, but rays short and disk disproportionately large. Marginal plates concealed, except on terminal third of ray. No large terminal marginals. Abactinal skeleton, coarsely reticulate with numerous large papular areas, regularly arranged in sixes or sevens around each plate. Entire animal covered by a closely granulated skin. No large spines or tubercles. Actinal intermediate areas very large covered with a flat pavement of polygonal plate, arranged in very regular series. Bivalved and spatulate pedicellariae present, at least actinally. Type species—*Culcitaster anamesus* sp. nov.

This remarkable genus is so perfectly intermediate between Oreaster and Culcita, when seen from above, one might find justification for putting the present species in either of those genera. The actinal surface, however, is more distinctive and makes it desirable, if not positively necessary, to establish a new genus. One can easily imagine the rays of an *Oreaster gracilis* being shortened and the disk enlarged and puffed out until its appearance would be very much like that of Culcitaster, in its dorsal aspect, and if the process continued until the virtual disappearance of the ray, there would be difficulty in distinguishing such a specimen from *Culcita schmideliana*. But a glance at the actinal surface would be sufficient to distinguish Culcitaster, for no Oreaster or Culcita, now known, has any such regularly tessellated intermediate areas as characterise this new genus.

1 *Culcita*, a well-known genus of starfishes + *aster* a common termination for starfish genera.

CULCITASTER ANAMESUS,[1] sp. nov.

PLATE XIX.

Rays 5. R.= 185 mm. r = 110 mm. Br. at base=70 mm. Br. at 20mm. from tip of ray, 28 mm. Disk circular somewhat swollen, at least 200 mm. in diameter, and projecting beyond superomarginals in all interradial areas. Entire animal covered with a closely though rather coarsely granulated skin, which conceals many of the marginal plates but through which most of the abactinal plates are discernible. These plates seem to be rounded or stellate and are united with each other by narrow radiating plates, six or seven to each central plate. All the space between these radiating plates is occupied by papulae, so that the papular areas, each with dozens of papulae, are more or less triangular in shape and are arranged in groups of six or seven around each primary abactinal plate. On the rays, distal to the disk, one can distinguish at least three longitudinal series of plates and hence the papular areas have a linear arrangement. Six or eight superomarginal plates on each side of the tip of the ray are easily recognisable; the last four or five are high and narrow and at least on two arms, the two distalmost pairs meet abactinally in the median line. Terminal plates relatively very small. Tip of ray turned up so far that as in Culcita, the ambulacral grooves extend on to the abactinal surface.

Actinal surface flat, tessellated, covering-membrane not concealing the outlines of the plates. Distal to each mouth angle is a large rhomboidal plate about 18 mm. across; from its two distal sides extend the series of conspicuous actinolateral plates, at first nearly square but soon becoming evidently wider than long. Distal to the large rhomboidal plate is a similar but smaller plate, its two proximal sides in contact with the first actinolateral plates; from its two distal sides extend series of plates adjoining and parallel to the actinolaterals. Distal to the second rhomboidal plate is a similar but smaller plate from whose distal sides, series parallel to the actinolaterals again arise. Distal to the third rhomboidal plate is a pair of narrow plates lying side by side, from the distal ends of each of which a series of four or five similar plates extends to the margin of the area. Adjoining each of these series are parallel rows which

[1] GR. *anamesos*—in the middle; in reference to its intermediate position.

extend from the actinolaterals (beginning with the third) to the margin. At the margin of each interradial area, the regular serial arrangement of actinal plates is interrupted by the intercalation of small rounded or polygonal plates, some of which also crowd in between the lower ends of the inferomarginals.

Adambulacral plates short and not very wide ; there are about two to each actinolateral plate. Armature in a double series ; inner of 7-9 rather slender spines, parallel to furrow, median longest and adoral and aboral shortest and subequal ; outer of two or three very short blunt spines about 2 mm. long and 1-2 mm. thick, on actinal surface of plate, parallel to furrow, median (or adoral of two) longest and stoutest. Oral plates with about a dozen spines on each margin ; proximal very large, 7 or 8 mm. long, 3 or 4 mm. thick at tip ; distal spines smaller : distalmost grading into inner series of first adambulacral plate ; each oral plate bears on its surface 3 or 4 very stout, low spines, similar to those of the outer adambulacral series.

Pedicellariae abundant on actinal surface, but not observed in this specimen abactinally. On adambulacral plates are very heavy *spatulate* pedicellariae with two jaws ; these are at adoral end of plate and may be one, two or three in number ; if there are two or three, one is usually much the largest. Scattered all over the actinal interradial areas, but most abundant on the radial ends of the actinolateral plates are *bivalved* pedicelloriae with jaws a millimetre wide or less.

Colour above, light grey ; actinal surface more yellow-brown.

There are no data with this extraordinary starfish, but it is said to have been taken on the coast of West Australia. It is difficult to understand how so large and conspicuous a form should have so long been undescribed, but I can find nothing in the literature which would warrant the belief that specimens had ever been seen by European zoologists. The swollen circular disk beyond which project the short stumpy rays give the animal a very odd appearance, while the regular actinal plating covered with a closely granulated membrane is remarkably distinctive.

There can be little doubt that the genus is intermediate between Oreaster and Culcita.

LINCKIA TYLOPLAX,[1] sp. nov.

PLATE XX.

Rays 5, R. = 150 mm. r. 25 mm. R. = 6r. Br. at base = 27 mm. Br. at half-way point = 18 mm. Disk small, but much elevated vertical diametre about 20 mm. Rays tapering to a blunt point. Whole body surface covered by a granular membrane; granules largest near the centres of abactinal plates smallest on papular areas. Abactinal skeleton composed of 3-5 irregular series of rounded plates, with smaller plates scattered among them. Larger plates, nearly all swollen into rounded or flat-topped knobs, 2-5 mm. in diameter and about 2 mm. high. Between the plates are papular areas, 2-3 mm. across, with numerous small papulae. Madreporic body large, 7 mm. in diameter, about 15 mm. from centre of disk. Marginal plates fairly distinct, especially near tip of ray. Superomarginals about 43 on each side of a ray, the basal ones at least, knobbed. Inferomarginals of about the same number but less distinctly knobbed. Intramarginal papular areas well developed, nearly to tip of ray. Two series of actinal intermediate plates extend nearly or quite to tip of ray; actinolateral series adjoining adambulacral plates much larger than the second series, except near tip of arm. Papular areas present on actinal surface not only between inferomarginals and actinal intermediate plates but also between the two series of the latter, even on the actinal interradial areas.

Adambulacral plates small; armature characteristically Linckian; each plate bears two short, thick, blunt spines on its furrow margin and a larger tubercle-like spine, 2 mm. long by 1 mm. thick, on its actinal surface. Armature of oral plates similar and equal to that of two adambulacrals. No pedicellariae.

Colour, light brown above, darkest on knobs; actinal surface nearly white.

Between Fremantle and Geraldton, W.A., 80-120 fms.

Two specimens. No. 4931. The larger specimen is the Type.

The presence of actinal papulae would almost warrant a new genus for this interesting starfish. Its abactinal aspect is much like some species of Nardoa, but the adambulacral armature precludes its inclusion in that genus. It does not seem to be very nearly related to any other previously known member of the family.

[1] GK. *tudos*—a knob; *plax*—a plate.

ASTERINA GUNNII.

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

The occurrence of this species on the West Australian coast is quite to have been expected. All the specimens have six rays.

From piles of old jetty, Fremantle, W.A. Two specimens.

No. 6044. Without data, two specimens in poor condition.

Nos. 146 and 148.

ANSEROPODA ROSACEA.

Asterias rosaceus, Lamarck, 1816, Anim. s. Vert. vol. 2, p. 558, par. 3.
Anseropoda rosacea, Fisher, 1906. Bull. U.S. Fish. Comm. for 1903, p. 1089.

This is one of the notable starfishes in the collection, for its occurrence off West Australia is very interesting, even if not surprising. The present specimen is 168 mm. across, and thus somewhat smaller than the specimen described by Müller and Troschel (1842) but larger than the one so finely figured by Koehler in his account (1910) of the shallow-water starfishes of the Indian Museum (Pl. XX). The individual from West Australia is, in its dry condition, dull, deep cream-colour with not very numerous, well scattered small spots of deep purple on the upper surface. It is remarkable for having 16 rays instead of the typical number, 15.

From Port Hedland, W.A. No. 4029.

ECHINASTER ARCYSTATUS,[1] sp. nov.

PLATE XXI.

Rays 5. R.=130 mm. r.=20 mm. R.=6.5r. Br. at base =24 mm. Br. at half-way point=18 mm. Disk small; vertical diameter about 20 mm. Rays rounded, tapering to a rather blunt point. Abactinal skeleton and that of sides of rays forming a very distinct net-work with meshes 4-10 mm. in diameter, and occupied by 10-60 papulae. The skeletal ridges carry numerous, but well-spaced, bluntly pointed spinelets about a millimetre high. These

[1] GR. *arkustatos*—surrounded with nets, in allusion to the conspicuous reticulations of the abactinal skeleton. By an unusual typographical error in Hinds and Noble's Classic Greek Dictionary, 1901, p. 102, I was led to write the word *acrystata* in naming a brittle star in 1911, Bull. U.S. Nat. Mus. No. 75, p. 145. Under the circumstances, the name given is obviously a typographical error and the brittle-star should be known as *Amphiura arcystata*.

are most numerous and sharpest near tips of rays. Madreporic plate small, only 3 mm. across, and situated only 7 or 8 mm. from centre of disk.

Adambulacral plates short and numerous; each bears a pointed spine, deep in the furrow, and two blunt spines on the furrow margin; these two spines are 1.5-2 mm. long, about .5 mm. wide and are somewhat flattened; the aboral is a trifle smaller and stands further back from the furrow margin. Oral plates each with four marginal spines similar to those of the adambulacral plates, but somewhat larger.

Actinal surface with numerous papulae everywhere. Actinal intermediate areas without spines. Opposite the fifth adambulacral plate, there begins a very distinct series of small sharp spines which runs to the tip of the ray. The fifth adambulacral spines are 5 mm. from the first spine of this series, but at the tip of the ray the distance between the two series is little more than a millimetre. The whole starfish is covered by a skin which is particularly thick and noticeable orally. On the basal half of the arms, very distinct furrows run out at right angles to the long axis of the ray between the adambulacral plates for some distance beyond the actinolateral series of spines just described. In the dry specimen these furrows are very conspicuous because of their lighter colour. There are of course no pedicellariae.

Colour of dry specimen, reddish-brown. In life the colour is said to have been purple.

Between Fremantle and Geraldton, W.A. One specimen, No. 4918. Type.

If we are to distinguish Othilia as a separate genus from Echinaster, on account of the actinal papulae, then this species belongs to Othilia, for the actinal papulae are a very noticeable feature. But the type of Othilia is *Edhinaster spinosus* of Brazil, and the present species does not resemble that species in general appearance so much as it does some of the East Indian Echinasters. For the present therefore, I have concluded to ignore Othilia and describe this specimen as an Echinaster. It does not seem to be very closely related to any of the previously known species, but it must be granted that Echinaster is a perplexing genus and specific differentiation is not very complete within it. Individual variation

is considerable and there are few characters which seem well to separate the species. A revision of the described species is much needed.

ECHINASTER VESTITUS.

Ophidiaster (?) *vestitus*, Perrier, 1869. Arch. Sci. Nat., vol. 12, p. 254.
Echinaster vestitus, Perrier, 1875. Arch. Zool. Exp., vol. 4, p. 372.

This specimen has been compared with specimens from Mauritius and Zanzibar labelled *vestitus* by Perrier himself, but owing to its poor condition, due to a peculiar scurfy encrustation all over the surface, I am not wholly satisfied that it is identical with them. There are 5 rays about 120 mm. long, and nearly 20 mm. in diameter at base; they are nearly cylindrical but taper somewhat to a blunt point; r=16 mm. The abactinal surface and sides of the rays are covered with papulae and numerous small spines, while the skeleton itself is pretty well concealed by the overlying skin. The spinelets are rarely a millimetre long. The adambulacral plates carry only two spines each, one deep in the furrow and a larger blunt, or even slightly clavate spine on the margin. Papulae are not present below what seems to be an inferomarginal series of spines; between this series and the adambulacrals there is a more or less well-marked series of somewhat smaller actinolateral spinelets. Colour, bright yellow-brown.

Off Port Hedland, W.A. One specimen, No. 4031.

The peculiar encrustation on this specimen prevents a satisfactory study of its characters. The nature of this encrustation I have not been able to determine, but it appears to be organic.

PLECTASTER DECANUS.

Echinaster decanus, Müller and Troschel, 1843. Arch. f. Naturg. Jhrg. 9, vol. 1, p. 114.
Plectaster decanus, Sladen, 1889. *Challenger* Asteroids, p. 535.

The occurrence of this species on the south-western coast of Australia is not surprising, though it is a considerable extension of its known range.

Albany, W.A. One specimen, in poor condition. No. 4859.

ASTERIAS CALAMARIA.

Gray, 1840, Ann. Mag. Nat. Hist., vol. 6, p. 179.

This species has not been recorded from West Australia hitherto, though its occurrence there is quite to have been expected if Gray's original specimens were really from such widely separated places as Mauritius and Australia.

No data. One specimen, No. 133.

ASTERIAS POLYPLAX.

Asteracanthion polyplax, Müller and Troschel, 1844. Arch. f. Naturg. Jhrg. 10, vol. 1, p. 178.
Asterias polyplax, Perrier, 1875. Arch. Zool. Exp., vol. 4, p. 327.

This is one of those perplexing starfishes, which it is almost impossible to distinguish from Asterias, in a broad sense, and which nevertheless seems to belong in the Stichasteridae if that family is to be recognised. As I very much question the validity of this latter family, it seems to me better to keep *polyplax* in the genus Asterias, until that assemblage of species is properly broken up into its component parts. As both Verril and Fisher are now at work on this problem, the name *Asterias polyplax* may well be used for a few years more for the present Australasian species.

Between Fremantle and Geraldton, 80-120 fms. One specimen, No. 4917.

OPHIUROIDEA.

Although four of the nine species of ophiurans appear to be undescribed and one of these requires the formation of a new genus, the collection from the Western Australian Museum is remarkable for what it does not contain, to nearly as great a degree as for what composes it. The ophiurans of West Australia have recently been the subject of a paper by Koehler [1] based on the collection made by Michaelsen and Hartmeyer in 1905. That collection contained 28 species, of which only three were considered as previously undescribed; one of these was an Ophiacantha and the other two belonged to Ophiothrix, both large, diversified and widespread genera. A fourth species was subsequently described as new by Döderlein [2], an astrophyton of the genus Astroboa. Of the 28 species, only 3 are in the collection before me. Of the 14 genera collected by Michaelsen and Hartmeyer, only 4 are in this collection; such common genera as Amphiura, Ophiactis, Ophionereis, Ophiocoma and Ophiacantha are entirely unrepresented. On the other hand the two collections contrast with each other sharply in the fact that only one of Michaelsen's and Hartmeyer's species was a Euryalid while five of the nine species before me represent that group. It would be hard to collect two series of Ophiurans from the same region which would differ more strikingly from each other than do the two under discussion. Nor is it easy to suggest any reason for such an extraordinary difference. Possible further studies, made on the ground, may explain the matter.[3]

PECTINURA DYSCRITA.

H. L. Clark, 1909. *Thetis* Echinoderms. Mem. Aust. Mus., vol. 4, p. 534.

This species, previously known only from New South Wales, is represented by a single specimen in poor condition.

Between Fremantle and Geraldton, W.A. One specimen, No. 4929.

1 Koehler, 1907. Die Fauna Südwest-Australiens; Ophiuroidea, vol. 1, pp. 241-254.

2 Döderlein, 1911. Über japanische und andere Euryalae, p. 82.

3 The explanation of the difference between these two collections appears to be simple. The collection sent to Mr. Clark was entirely composed of specimens trawled by the *Endeavour*, chiefly in depths approaching 100 fathoms. Drs. Michaelsen and Hartmeyer obtained their specimens by dredging in comparatively shallow water in sheltered localities.—W. B. A.

OPHIOTHRIX SPONGICOLA.

Stimpson, 1855. Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 385.

This is another of the New South Wales species, which might naturally be expected in West Australian waters. For an account of its more recent history see *Thetis* Echinoderms, Mem. Aust. Mus. vol. 4, p. 546.

Between Fremantle and Geraldton, W.A. One specimen in poor condition. No. 4930.

OPHIOTHRIX STELLIGERA.

Lyman, 1874. Bull. M.C.Z., vol. 3, p. 237.

This species, which was taken by Michaelsen and Hartmeyer at five stations, is represented by a rather large specimen, with disk 8 mm. across, and the most nearly complete arm from 32-35 mm. long. It is in fairly good condition. It seems to have been taken with the previous species, as it was in the some vial and bears the same catalogue number.

Between Fremantle and Geraldton, W.A. One specimen, No. 4930.

OPHIOMYXA AUSTRALIS.

Lütken, 1869. Add. ad Hist. Oph., pt. 3, p. 45.

This is the second of the three species in this collection, which were also taken by Michaelsen and Hartmeyer; they found it at four stations. It was also taken by the *Thetis* and by the *Challenger*, so it may naturally be considered one of the commonest Australian brittle stars.

Between Fremantle and Geraldton, W.A. One specimen in poor condition, No. 4928.

ASTROGYMNOTES,[1] gen. nov.

Disk and arms covered with a skin, which apparently contains no calcareous plates, except numerous rounded granules on the upper surface of the arms. No radial shields on upper or under arm-plates are visible. No madreporite. Teeth well developed, but oral papillæ rudimentary. Arm spines and tentacle scales both present and easily distinguishable from each other.

[1] GR. *aster*—a star; *gymnotes*—nakedness, in allusion to the absence of plates on disk and arms.

Type species, *Astrogymnotes catasticta*, sp. nov.

This interesting new ophiuran, noticeable for being jexamerous, appears to be one of the sub-family Astroscheminæ as restricted and defined by Doderlein in 1911. But it is easily distinguished from the other members of that family by the absence of both upper and under arm plates, and the presence of both tentacle scales and arm spines.

ASTROGYMNOTES CATASTICTA,[1] sp. nov.

PLATE XXII.

Rays 6, rarely 7. Disk about 9 mm. across; rays about 45 mm. long. Entire animal covered by a smooth skin, which is perfectly bare, except on the upper surface of the arms and the adjoining portions of the disk, where it is more or less crowded with minute circular bits of lime; about a dozen series of these occupy the width of the arm. Radial shields not visible but indicated through the skin by short radial elevations, a pair at the base of each arm; these are about 3 mm. long. No upper or under arm-plates to be seen even in a dried specimen. Teeth well formed, in a vertical series of five; oral papillae rudimentary, about three on each side of each jaw. No madreporic or oral shields present. Arm-spines present, one on each of the three basal segments, but two on each of the remaining segments; they are less than a millimetre long, cylindrical, blunt and subequal. Tentacle-pores evident, each one guarded by a flat, nearly circular tentacle scale. Genital slits small and oblique, about equal to the length of an arm-joint; two in each interradius. Colour yellow-brown, indistinctly speckled on radial areas of disk, and conspicuously spotted all over the lower surface of disk and arms with pale yellowish white. In dry specimens the colours are dull, the spotting is not so noticeable and the calcareous granules give the upper surface of the arms a whitish cast.

Off Jurien Bay, W.A., 80-100 fms. Ten specimens, No. 4,924.

It is a real satisfaction to have such a good series of this remarkable ophiuran for study. It is probably as nearly related to Astroschema as to any known genus, but still retains a distinction between arm spines and tentacle scales. The arms are also

[1] GR. *catastictos*—spotted.

relatively much shorter than is usual in that genus. Several of the specimens show by their unequal development that reproduction by fission is normal for the species.

OPHIOCREAS MELAMBAPHES,[1] sp. nov.

Rays 5. Disk about 6.5 mm. in diameter, with arms about 120 mm. long and 2 mm. thick. Entire animal covered with a thick smooth skin, through which, in dried specimens, the radial shields and side arm-plates are revealed. The radial shields are about 3 mm. long by one mm. broad, and are perfectly smooth, though slightly swollen. There are no calcareous granules in the skin of the dorsal surface on either disk or arms. Teeth 4 or 5, the lowest often displaced and somewhat deformed. Oral papillae wanting. No oral shields or madreporite. First two pairs of the very small tentacle-pores bare, but all subsequent pores guarded by two spine-like tentacle-scales of which the inner is a trifle the longer and is about half a millimetre long. Genital slits very small, less than a millimetre long, oblique, cresentic ; two in each interbrachial space.

Colour, deep purple or purplish black above and on sides, but actinal surface of disk and arms dull cream colour.

Off Jurien Bay, W.A., 80-100 fms. Two specimens, No. 4,925.

The smaller specimen is the Type.

Although this species resembles *O. silogae*, Koehler, in many characteristic features, it is distinguishable from that species at a glance by its different proportions, different tentacle-scales and strikingly different colour. Döderlein does not consider the character by which Astroschema differs from Ophiocreas sufficiently constant to warrant the maintenance of the two genera, but I am inclined to think that while our definitions will need to be readjusted, the two groups had better be retained. The present species is a typical Ophiocreas so far as its external covering is concerned.

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[1] Gr. *melambaphes*—dark-dyed.

OPHIOCREAS RHABDOTUM,[1] sp. nov.

Rays 5. Disk 5 mm. in diameter, with arms about 78 mm. long. Very similar to the preceding species, but arms shorter and more slender, radial shields shorter and less prominent and teeth sharper and more regular. Only the first pair of tentacle-pores lacks tentacle-scales.

Colour dull yellow, speckled and streaked on disk with blackish: a broad blackish stripe runs the length of the arm in the median line abactinally, but under the lens, even this stripe is found to be finely speckled with yellowish; just above the tentacle-scales there is on each side of the arm, a very narrow and often indistinct blackish stripe.

Off Jurien Bay, W.A., 80-100 fms. Two specimens, No. 4,926.

The larger specimen is the Type.

As this form was taken at the same station with the preceding, I think it quite possible that it is only a colour phase of that species. But the colour difference is so marked, and the two specimens of each species are so distinctly characterised thereby, I have felt it was more satisfactory to designate them by different names. Further investigation on the West Australian coast is necessary for a correct settlement of the question.[2]

CONOCLADUS MICROCONUS.[3] sp. nov.

PLATE XXV.

Rays 5, but in the type specimen there are 6. Disk, 35 mm. in the type, in the smaller specimen 27 mm. in diameter, with arms about 90 or 100 mm. long and 10 mm. wide at base; height of arm near disk, 5-6 mm. Radiating wedges of disk separated from each other by five (in the type, six) narrow deep grooves, which are

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[1] GR. *rabdotos*—striped.

[2] The two supposed species of Ophiocreas were obtained together in large quantities attached to one particular species of Hydroid, with which their arms were so much intertwined that it was very difficult to remove them, except in fragments. Whilst I entered them under two numbers, I made a note at the time that they were "probably colour varieties of one species"—W. B. A.

[3] GR. *mikros*—little; *konos*—cone; in reference to the small size of the cones on the disk.

practically filled up by the small, rough cones of the disk plates. Each wedge is covered by a rough, uneven pavement of plates, grains and granules, rarely smooth, but usually bearing a ridge, lump or small cone. These cones are of very diverse sizes and shapes; they are rarely a millimetre high and are very seldom pointed; they commonly terminate in a group of 3-15 little spinules. This irregular and very rough pavement extends out on the area so that there is no line of division between the latter and the disk. None of the cones are enlarged nor have they any definite arrangement. The arms branch about eight times; the first division being about 22-27 mm. from the disk; the resulting branches after each division are often very unequal. Beyond the second fork the branches become long and very slender and are covered by alternating paired half-circles of granules and glassy hooklets. Oral surface of disk and arms covered with small roundish flat granules, most numerous on the mouth angles and bases of the arms. Tentacle-pores small; first pair (not counting buccal tentacles) well within disk, with no tentacle-scales. Each succeeding pore is more or less concealed by a slight ridge on its adoral side, which carries 4 (rarely 3 or 5) short, slightly curved peg-like spines, rather more than half a millimetre long. Each spine is compressed and its terminal margin divides into 3-5 little glassy spinelets. Each mouth angle carries a cluster of twenty or more spiniform teeth and similar but shorter papillae. Genital slits small, hardly 2 mm. long, and more or less concealed. Madreporic plate distinct, hardly 2 mm. across.

Colour, uniform light brown; in life, "dull brown."

Between Fremantle and Geraldton, W.A., 80-120 fms. Two specimens, No. 4921.

The larger specimen, although 6-rayed, is selected as the Type.

The occurrence of a new species of Conocladus in West Australian waters is most interesting, the two previously known species having been reported only from New South Wales. As Döderlein (1911, Über Japanische und andere Euryalae, p. 68) has pointed out Conocladus is in certain respects a very primitive form mostly nearly allied to *Astroconus australis*, Verr. This discovery of a third well-marked species would seem to indicate that Australia is emphatically the home of these primitive Eurylids and even suggests that it may have been the ancestral home of the whole order.

The West Australian species is very easily distinguished from its New South Wales congeners by the entire absence of large cones or tubercles on the disk.

ASTROBOA ERNAE.

Döderlein, 1911. Über japanische und andere Euryalae, p. 82.

It is interesting to find specimens of this species in the collection since it was hitherto known only from the holotype, a specimen 22 mm. across the disk. One of the present specimens is only 15 mm. across the disk while the others are nearly 40. But I have nothing to add to Döderlein's careful description. The colour of these individuals in life is said to have been "buff or leaden." In alcohol, they are a peculiar shade of purplish brown, which is hard to name. On drying, they become very light, almost a dirty white, with a purplish cast.

Off Geraldton, W.A., 29 fms. Three specimens, No. 4923.

ECHINOIDEA.

Although the collection of Echini is remarkable for the large number of species it contains, yet eleven species which were in the *Thetis* collection from New South Wales are not represented here. Several of these are common littoral forms of wide distribution and will probably be found hereafter on the West Australian coast. As already noted, four and possibly five of the nineteen species are new to science, and belong in groups of more than usual palaeontological interest.

PHYLLACANTHUS MAGNIFICUS,[1] sp. nov.

PLATE XXVI.

Test nearly spherical, 92 mm. in horizontal diameter and 72 in vertical; hence v.d.=.78 h.d. Longest primary, about 75 mm. in length, 10 mm. in diameter near base and 5 mm. in diameter at tip. Interambulacral plates 10 in each column, all, except sometimes, the uppermost with a long, stout primary spine. Interambulacra

[1] The origin and significance of this name are obvious.

43 mm. wide; ambulacra nearly 13 mm.; hence interambulacra more than three times as wide as ambulacra. But median interambulacral space only 11 mm. wide, and hence only one-fourth of interambulacrum. Median ambulacral area less than 6 mm. wide, and hence less than half the ambulacrum. Abactinal system 28 mm. in diameter and actinostome the same.

Genital plates moderately large, about 11 mm. wide by 7 mm. high, but madreporic genital very large, nearly 16 mm. wide by 11 mm. high. Oculars small and low; ocular V insert, and I nearly so; in the smaller specimen, all the oculars are exsert but V is nearly in. Genital pores large, near centre of plate, surrounded by a circle of about a dozen broad flat spinelets larger than the others on the plate; as these spines are closed over the pores, they form a conspicuous conical elevation. Ocular pores small near distal margin of plate. Interambulacra, median areas of ambulacra, abactinal system and actinostome, densely covered with small flattened bluntly pointed spinelets and pedicellariae. Secondary spines of interambulacra in circles of 15-20 around the bases of the primary spines; they are broad, flat and truncate, about 8 mm. long by 2 mm. broad. Along the margin of the median area of each ambulacrum is a series of narrow, flat spines, about 4 mm. long and .5 mm. wide, which lie flat across the poriferous areas. Between these marginal series are four or five series of smaller spines or spinelets similar to those on the interambulacra. Pores of a pair rather large wider than high, separated by a space wider than the width of a pore and connected by the groove characteristic of the genus.

Pedicellariae present in great numbers. The tridentate show little diversity in size, but are chiefly actinal in position and on the interambulacra. Their valves are about two millimetres long, but the blade is only about .25 mm. wide, so they are very slender; the valves meet only at or near the tip. There is a single vertical ridge extending the length of the blade in the median line on its inner surface similar to those found in the tridentate pedicellariae of *P. imperialis*, but rather more prominent; it is sharply serrate, more coarsely so than the margins of the blade. The *small globiferous* pedicellariae are abundant almost everywhere and are very similar to those figures by Mortensen for *P. Imperialis*. Their valves are about .30 mm. long. The *large globiferous* pedicellariae are very common, particularly on the ambulacra; the valves are .80-.90 mm.

long, but the stalk is little more than half that ; it has no " limb." The valves are shaped very much like those of the small globiferous pedicellariae, but the terminal opening is surrounded by coarse, curved teeth. This opening is very variable in size and form ; it may be less than one-fourth the length of the valve or it may be nearly two-fifths ; it is often of some peculiar shape and not rarely is divided vertically into two openings ; even when the opening is short there is little tendency towards a " snout-like " blade. The large globiferous pedicellariae vary very little in size and do not seem to intergrade at all with the small ones.

Primary spines very stout, rough with small rounded granules, which soon become more or less completely concealed by a spongy alteration in the outer layer of the spine and the profuse growth of bryozoa, sponges and other organisms which cover the old spines. At the tip, the series of rounded granules are arranged longitudinally and pass into ridges which surround the blunt end of the spine. Young spines are bluntly pointed but become more and more flaring with age and the actinal primaries are particularly notable for their stoutness and flaring tips. The thickness of some of these at tip may be equal to one fourth or even almost one-third the total length of the spine. There are 24-36 longitudinal ridges around the tips of the larger primaries. The collar is low, seldom over 3 mm. in height.

Colour, deep red-brown, so far as secondaries, miliaries and pedicellariae are concerned ; young primary spines yellow-brown, but rapidly darkening with age ; the collar remains yellow-brown throughout life, but the rest of the spine, where not covered by foreign growths, has a marked purplish-red shade.

Between Fremantle and Geraldton, W.A. Two specimens, No. 4935. The larger is the Type.

The type specimen of this fine new species is one of the largest and most perfectly preserved cidarids I have ever seen. The other specimen is 75 mm. h.d. and 51 v.d., so that v.d. is little more than .66 h.d. There are 8 or 9 interambulacral plates in each column. In other particulars the specimens differ little from each other While the relationship to *imperialis* is obvious, this species is easily distinguished by the remarkable actinal primaries and the large number of coronal plates. To no other of the Recent species of the genus does it show any close relationship.

PHYLLACANTHUS ANNULIFERA.

Cidarites annulifera, Lamarck, 1816. Anim. s. Vert., vol. 3, p. 57.
Phyllacanthus annulifera, A. Agassiz, 1872. Rev. Ech., Pt. 1, p. 150.

There is a beautiful cidarid in the collection which seems to belong to this species although the coloration is different from that of any *annulifera* I have seen. The test is 30 mm. i.d., and the primaries, which are very thorny and quite free from foreign matter are about 40-45 mm. long; the collar is 4 mm. high. The ocular plates are all insert, but II and III are only barely so.

The test is cream-colour, or almost pure white on the bare median ambulacral area; the miliary and secondary spines are almost white, or at least very light coloured, with a broad longitudinal stripe on their upper (or outer) surface of bright brown, which is darkest on the smallest spines and palest on the largest; actinally the brown is almost brownish-red. The primary tubercles and the collars of the primaries are bright pinkish lavender. The primary spines are light coloured with a markedly greenish cast, and with almost eight bands of dull purplish-red; these bands are broken on the sides of the spine and are faint on the lower surface; the thorns on the actinal primaries are red, often with white tips, and the primaries close to the actinostome have the entire tip red.

Port Hedland, W.A. One specimen, No. 4026.

TRETOCIDARIS BRACTEATA.

Dorocidaris bracteata, A. Agassiz, 1879. Proc. Amer. Acad., vol. 14, p. 197.
Tretocidaris bracteata, H. L. Clark, 1907. Bull, M.C.Z., vol. 51, p. 206.

These specimens are larger than any previously known, having h.d.=35 mm. The primaries are 50 mm. or more in length, and are 4 mm. broad near the base; they are somewhat flattened there and the longitudinal ridges are very prominent; these latter are broken up into flattened truncate or sharp teeth, making the spines conspicuously and coarsely rough. The collar on the primaries is very low, which is one of the best characteristics of the species. Another useful character is the spotting of the primaries, at least near base, with longitudinal series of red-brown dots. The pink secondary spines are also a noticeable character, those of the interambulacra in these specimens being evidently tipped with yellowish. The large globiferous pedicellariae are very uncommon but are to

be found abactinally. The heads are less than a millimetre in length, but the stalk is nearly two millimetres; the latter has a conspicuous "limb," the branches of which are about .2 of a millimetre long. The valves resemble closely those of *T. affinis*. The tridentate pedicellaria are very slender, the valves, which are hardly .05 mm. wide, range from .9 to 1.25 mm. in length and meet only near tip. The small globiferous pedicellariae have valves ranging from .25 to .55 mm. in length and are provided with an end tooth.

Between Fremantle and Geraldton, W.A., 60-100 fms. Two specimens, No. 4,933.

The occurrence of this distinctly East Indian species off West Australia is notable and hardly to be expected. These large specimens bear a striking superficial resemblance to *Phyllacanthus annulfera*, but even hasty examination distinguishes them. The low collar and the red-brown spots, not to mention the pedicellariae, are sufficiently marked differences to be obvious to even a casual observer.

GONIOCIDARIS TUBARIA.

Cidarites tubaria, Lamarck, 1816. Anim. s. Vert., vol. 3, p. 57.
Goniocidaris tubaria, Lütken, 1864. Vid. Med. f, 1863, p. 137.

The occurrence of this species on the west coast is interesting, even though the specimens are small (20 mm. h.d.).

Between Fremantle and Geraldton, W.A., 100 fms. Two specimens, No. 4,938.

CENTROSTEPHANUS TENUISPINUS,[1]

sp. nov.

PLATE XXVI.

This species is so nearly related to *C. rodgersii* of New South Wales that an extended description would be superfluous. The test is essentially alike in the two species, but there are more coronal plates in the one from West Australia. The actinostome is noticeably smaller and the abactinal system is somewhat larger. Thus in an eastern specimen, 84 mm. h.d., there are 16 interambulacral plates in each colnmn, the actinostome is 36 mm. across and the abactinal system is 18 mm., while in a western specimen of the same size, there are 18 interambulacral plates in each column, the

[1] GR. *tenuis* = slender + spinus = a spine.

actinostome is 32 mm. across and the abactinal system is 24 mm. When other adult specimens (*i.e.*, over 60 mm. L.d.) are taken into account, we find that these differences sum up to about this; in the eastern species the abactinal system is .50-.60 of the actinostome, while in the western form it is .65-.75. The most obvious character of the new species, however, is seen in its slender spines; the largest primaries are from 1.3 to 1.6 mm. in diameter where thickest (near base) and as they are 75-80 mm. long, they appear very slender as compared with *rodgersii*; in *rodgersii* the primaries are 2-3 mm. in diameter, at least near base, and seldom exceed 75 mm. in length. This difference in the primary spines gives the two species totally different facies. There is also a noticeable difference in colour, in the specimens I have seen, though it may not prove a constant one; in *rodgersii*, the colour is more or less purple, sometimes almost black, again deep crimson rarely brownish-red; in *tenuispinus*, the colour is reddish-brown or dull greenish, with no trace of purple.

The pedicellariae in the two species do not seem to differ except in relative frequency. Thus in specimens of *rodgersii, slender tridendate* pedicellariae seem to be very rare. Mortensen did not find them, and I have only found one on six specimens from New South Wales. But in *tenuispinus* they are very common all over the test and the valves may exceed 3 mm. in length. On the other hand, the stout tridentate pedicellariae with curved valves seem to be rather uncommon in *tenuispinus*.

Between Fremantle and Geraldton, W.A. Two specimens, No. 4,936. The light-coloured one is the Type.

It is of course possible that larger series of specimens than are available to me, will show that this supposedly new species is only a form of *rodgersii*, but the general appearance is so different, I have little hesitation in giving it a new name. And I am confirmed in this by finding that the specimens of *C. rodgersii* recorded by A. Agassiz (Rev. Ech. pt. 1, p. 98) from "Houtman's Abrolhos" are the slender spined western form and not typical *rodgersii*; at any rate this is true of the specimen in the M.C.Z. collection. This specimen is young (only 47 mm. h.d.) but when compared with a specimen from Port Jackson, 43 mm. h.d., its smaller actinostome and its much more slender primary spines are noticeable.

SALMACIS ALEXANDRI.

Bell, 1885. Proc. Linn. Soc. N.S.W., vol. 9, p. 505.

A very fine specimen of this species is in the collection from off Geraldton, W.A., 29 fms., No. 4932. It is deep rose-purple, the spines tipped with white.

SALMACIS SPHAEROIDES.

Echinus sphaeroides, Linne, 1758. Sys. Nat. ed. 10, p. 664.
Salmaceris sphaeroides, Lorén, 1887. Ech. Linn. p. 69.

There are two fine specimens (Nos. 4027 and 4028) from Port Hedland, W.A.; in one the test has a greenish cast and the bases of all the spines are conspicuously dark green, in the other the green colour is confined to the spine bases and is reduced to a minimum there; as a result of this seemingly slight difference the specimens look quite unlike.

TEMNOPLEURUS, sp. ?

There are a couple of bare tests of a temnopleurid (No. 5007) in the collection, with no data other than that they are from Fremantle Beach, West Australia, which cannot be referred to any known species. I think they undoubtedly represent a temnopleurus and probably an undescribed species, but I cannot see that anything is gained by giving them a name. They are 24 or 25 mm. h.d. and 13 or 14 v.d. The colour is dull green, with the median ambulacral and interambulacral areas cream-colour, gradually widening actinally, so that the whole lower surface is of that light shade. The base of one primary spine remains attached to the test, and it is pale red in colour. Until the spines and pedicellariae can be examined, this species may well be nameless.

AMBLYPNEUSTES GRANDIS.

H. L. Clark, 1912, Mem. M.C.Z., vol. 34, p. 329.

There is a single specimen (No. 4932) in the collection. It is about 60 h.d. and has lost most of its spines. It is from off Geraldton, 29 fms.

AMBLYNEUSTES GRISEUS.

Echinus griseus, de Blainville, 1825. Dict. Sci. Nat. Oursin, vol. 37, p. 81.
Amblyoneustes griseus, L. Agassiz, 1841. Intro. Mon. Scut., p. IX.

A rather small specimen (No. 5008) of this species is in the collection. From Fremantle Beach, W.A.

HOLOPNEUSTES POROSISSIMUS.

L. Agassiz and Desor, 1846. Ann. Sci. Nat. (3) vol. 6, p. 364.

A specimen from Fremantle Beach, bearing the same number as the specimen of the preceding species from the same place (viz. 5008), proves to be one of this species.

HELIOCIDARIS ARMIGERA.

Strongylocentrotus armiger, A. Agassiz, 1872. Bull, M.C.Z., vol, 3, p. 55.
Heliocidaris armiger, H. L. Clark, 1912. Mem. M.C.Z., vol. 34, p. 350.

Although the primary spines in these specimens are not quite so stout as in the type specimen, they are sufficiently so to distinguish them at a glance from their nearest ally, *H. erythrogramma*. None of the specimens is large (h.d. ranges 25-38 mm.) but all seem adult. The longest primaries do not exceed 15 mm., and their thickness is from 1.5 to 2 mm.

Fremantle Beach, W.A. One specimen, No. 5006.

Fremantle, W.A. One specimen, No. 149.

Cottesloe Beach, W.A. One specimen, No. 5036.

HELIOCIDARIS ERYTHROGRAMMA.

Echinus erythrogrammus, Valenciennes, 1846. Voy. Venus., Zooph pl. VII, fig. 1.
Heliocidaris erythrogramma, L. Agassiz and Desor, 1846 (3) Ann. Sci. Nat., vol. 6, p. 371 (*eurythrogrammus lap. cal.*)

Although these specimens are a little larger than those of *armigera*, the spines do not exceed 15 mm. in length, but few of them are as much as 1 mm. in thickness, so that they seem longer than they are. There are no data with the two specimens, but they bear the numbers 171 and 179, and are said to be from West Australia.

ECHINOMETRA MATHAEI.

Echinus mathaei, de Blainville, 1825. Dict. Sci. Nat. Oursin, vol. 37, p. 94.
Echinometra mathaei, de Blainville, 1830. Dict. Sci. Nat., Zooph., vol. 60, p. 206.

The two specimens of this very common and widely distributed sea-urchin have no data with them. They bear the numbers 165 and 167 and are said to be from West Australia.

CLYPEASTER TELURUS,[1] sp. nov.

PLATE XXIII.

Test broadly oval, widest posteriorly, very flat, 96 mm. long, 89 mm. wide and 13 mm. high ; its breadth is thus nearly .93 of its length, while its height is less than .14. Test thin and fragile, its margin only 3 mm. thick. Abactinal system at centre of test, but the latter slopes more abruptly posterior to the apex than it does anteriorly or laterally. Posterior interradial margin distinctly depressed below posterior radial margins. Lower surface slightly but very uniformly concave : the slope begins very near or at the margins and the mouth which is perfectly central, is nearly 4 mm. below (*i.e.* above, of course !) the lateral margins. Petaloid area 49 mm. long and 24 mm. wide. Anterior or unpaired petal 26 mm. long, 12 mm. wide, rather broadly open at distal end, the converging poriferous areas each about 2 mm. wide. Anterolateral petals 22 mm. long, 11 mm. wide, and nearly closed (open by 1 mm.) poriferous area about 2 mm. wide. Posterolateral petals 23 mm. long, 12 mm. wide, well open (by 3 mm.): poriferous area 2 mm. wide. Ridges between pore-pairs of unpaired petal, each with a single series of six or more primary tubercles. Median area of petals not at all abovate but as wide at middle as anywhere. Anal system, trigonal with rounded angles or oval, about 4.5 mm. broad by 3.75 mm. long ; its distal margin 10 mm. from distal margin of test, or more than .20 of the long radius. Madreporic body small, only 2.5 mm. across. Genital and ocular pores indistinguisable. Auricles well developed, well separated.

Abactinal primary spines very small. Scarcely a millimetre long, thickened at tip. Actinal primaries 3 mm. long (those about mouth 4 mm.) terete and bluntly pointed. Miliary spines minute and abundant, slightly thickened at tip. Pedicellariae rather scarce, except around mouth and anus where tridentate are fairly common. Valves of tridentate rather stout, the blades broad, meeting only at tip ; in the largest ones seen the valves are about .30 mm. long. Ophicephalous pedicellariae very scarce, small but not peculiar.

Colour of test, abactinally, dull purplish brown of a light shade ; actinally the test has a slight greenish cast ; abactinal spines under

[1] GR. *telouros*—remote ; in reference to the unusual distance of the anal system from the margin of the test.

a lens, nearly white; actinal spines whitish, the largest ones with a faint broad band of purplish, near middle.

Between Fremantle and Geraldton, W.A. One specimen, No. 4937. Type.

This interesting new species is in many particulars like *C. rotundus*, A.Ag. from the west coast of Mexico and Central America, but there are some important differences. Chief of these is the position of the anus which in *rotundus* is rarely more than 3 mm. from the margin of the test. In *rotundus*, too, the poriferous areas of the petals are much wider in specimens of the same size; thus in a specimen of *rotundus* of the size of the *telurus* above described, the poriferous area would be about 3 mm. wide, or nearly 50% broader. The test is much more fragile and the margin is thinner in *telurus* than in *rotundus*.

PERONELLA APHNOSTINA[1] sp. nov.

PLATE XXIV.

Test somewhat elongated, abruptly narrowed posterior to middle, very flat, finely and evenly granulated; length 137 mm.; greatest breadth, slightly anterior to mouth, 112 mm.; breadth equals less than .82 of length; 15 mm. back of mouth, width is only 95 mm. and 30 mm. back of mouth it is only 88 mm.; at anus, it is 55 mm. Apex of test coincides with centre of madreporic body, 64 mm. from anterior margin of test. Mouth directly beneath apex. Apical-oral diameter, 13 mm. Test thinnest at margin where it is scarcely 3 mm. thick. Oral surface flat; mouth scarcely at all sunken. Auricles fused into a single stout piece on each interambulacrum. Anal system small, about 4 mm. in diameter, its distal margin about 6 mm. from test margin; it is covered with small spine bearing plates.

Petaloid area, about 72 mm. long and 68 mm. broad. Anterior or unpaired petal, 36 mm. long; antero-lateral, 32 mm.; postero-lateral, 37 mm. Each petal is about 10 mm. wide. Unpaired petal broadly open (by 4.5 mm.); paired petals open by about 3 mm. Madreporic body about 4 mm. across. Genital pores 4, there being none in posterior interradius. Primary spines 3-4 mm. long actin-

[1] GR.=*Aphno*, of a sudden+*steino*=to make narrow, in reference to the shape of the test.

ally, much smaller abactinally, terete, nearly smooth, those about mouth stoutest. Miliary spines minute, abundant, similar to those of *P. lesueuri*. Pedicellariae very scarce; the single tridentate that was found, was similar to those of *lesueuri*.

Colour abactinally, light reddish brown; the red is very marked when the test is moistened; actinally the colour is more yellow-brown.

Carnac Island, near Fremantle, W.A., Dec. 11, 1909. One specimen, No. 3936. Type.

I have been greatly in doubt as to whether this specimen represents a new species or is a peculiar individual variant of *P. lesueuri*, Agass. Comparison with numerous specimens from Queensland and from the East Indies has failed to satisfy my doubts, but as *lesueuri* has hitherto been found only on the eastern coast of Australia and does not reach so far south as Bass Strait, I have decided to give this West Australian specimen a new name indicative of its strikingly peculiar shape. Compared with a specimen of *lesueuri* from Queensland, of the same length, the following peculiarities are noted:—

1. The test is remarkably narrow; its greatest width is not much over 80 % of its length, while in *lesueuri* it is distinctly over 90 %.
2. The test is abruptly narrowed back of the mouth; its width 30 mm. back of mouth is less than 65 % of its length while it is more than 78 % in *lesueuri* at the same point.
3. The petals are shorter, wider and much more open at the tip; in *lesueuri* the petals are open only 1 mm. or less.
4. The test is thinnest at the margin; in *lesueuri* the test is a trifle swollen at the margin and is thinnest several millimetres proximal to margin.
5. The test seems to be more finely and uniformly granulated than in *lesueuri*.

While the last three of these characters are certainly more or less variable in *lesueuri*, and hence of doubtful value, the combination of the five in this Carnac Island specimen gives it a general appearance totally unlike that of any Peronella I have ever seen. The collection of a few more specimens on the West Australian coast would show whether *aphnostina* is a valid species or not.

LINTHIA AUSTRALIS.

Desoria australis, Gray, 1851. Ann. Mag. Nat. Hist. (2), vol. 7, p. 132.
Linthia australis, A. Agassiz, 1872. Rev. Ech. pt. I, p. 138.

A single bare test (No. 5005) from Fremantle Beach shows that this is a West Australian species, although it was previously known only from South-western Australia and Tasmania. It is still a rarity in Museums and specimens with spines are greatly to be desired.

ECHINOCARDIUM AUSTRALE.

Gray, 1851. Ann. Nat. Hist. (2), vol 7, p. 131.

It is not at all surprising to find this widely distributed species in the collection.

Safety Bay, W.A. Three specimens, Nos. 239, 240, 241.

BREYNIA AUSTRALASIAE.

Spatangus australasiae, Leach, 1815. Zool. Misc., vol 2, p. 68.
Breynia australasiae, Gray, 1851. Ann. Mag. Nat. Hist. (2), vol. 7, p. 131.

The larger of these bare tests (No. 4562) measures 120 mm. long, by 100 mm. wide and 60 mm. high, showing that Breynia grows to a larger size than has hitherto been known. Although these specimens differ from those taken at Lord Howe Island, N.S.W., by the very characters on which Gray based his *Breynia desorii*, other specimens in the M.C.Z. collection are intermediate and I do not feel satisfied that *desorii* is a valid species.

Abrolhos Islands, W.A. One specimen, No. 4562.

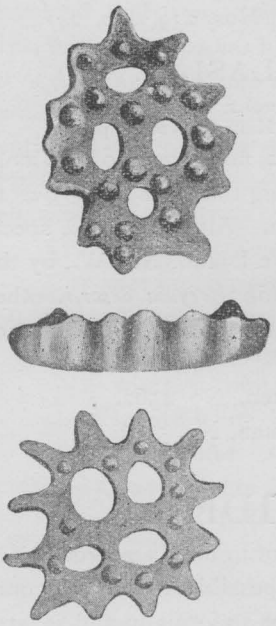
Fremantle Beach, W.A. One specimen, No. 5004.

HOLOTHURIOIDEA.

The holothurians unfortunately are not in nearly as good condition as the dry echinoderms, and it is impossible to identify one-third of them. They seem to have been in formalin and several are more or less decalcified. Nevertheless all are of interest for we have hitherto known almost nothing of the holothurians of the western half of Australia—indeed we know little enough of those of the eastern coast. Of the six identified species, three belong to the genus Pentacta (=Colochirus) and one of these seems to be a remarkable new species, which, should the characters shown by these specimens prove real and constant, might well be given a genus of its own. The other new species is an apodous holothurian of the genus Caudina.

CAUDINA TETRAPORA,[1] sp. nov.

Tentacles 15, each with 4 slender, sharply pointed digits, the terminal pair the longer. Calcareous ring well developed, about 2 mm. broad (high); posterior prolongations of radial pieces very conspicuous, nearly 4 mm. long. Stone-canal single, well-developed. Polian vessel single, long and cylindrical. Genital glands rather sparingly dichotomously branched. Respiratory-trees very fully developed. Body not very stout, passing gradually and not abruptly into the tail. The tip of the tail is damaged in both specimens, so the condition of the anal papillae could not be determined. Calcareous particles *knobbed buttons perforated with four holes* and with more or less conspicuous projections around the margin (text, fig. I); they are about .1 of a millimetre long. Most of the particles are of comparatively regular form, but more or less variation from the typical condition may be noted; buttons with fewer than four holes are more frequent than those with more.



TEXT-FIGURE I.

Calcareous particles from body-wall of *Caudina tetrapora*. x 350.

a. A typical button seen from the outer surface.

b. A similar button from the side.

t. A button with long marginal projections.

Colour white or pale brown. Length about 75 mm., of which about one-third is tail; diameter at middle of body 15 mm.: diameter near tip of tail, about 3 mm.

Cottesloe Beach, W.A., July 6, 1912. One specimen, No. 5035. Type.

Abrolhos Islands, W.A. One specimen, No. 229.

This species is readily distinguished from the other members of the genus by its perfectly distinctive calcareous particles. It is no doubt most nearly related to *C. chilensis*, the common New Zealand species, as might have been expected from its geographical propinquity.

[1] GR. *Tetraporos*=having four pores, in reference to the calcareous particles of the skin.

MOLPADIA, sp. ?

A specimen from Cottesloe Beach [No. 233 (2983)] is in such poor condition that its identification is impossible, but the stout calcareous ring with comparatively short posterior prolongations on the radial pieces is suggestive of Molpadia rather than Caudina, and the fifteen tentacles and absence of tube-feed, taken in connection with its general appearance, show that it is certainly a molpadid. The tail is missing: the remaining body measures about 40 mm. long by 17 in diameter.

COLOCHIRUS QUADRANGULARIS.

Holothuria quadrangularis, Lesson, 1830. Cent. Zool., p. 90.
Colochirus quadrangularis, Selenka, 1868. Zeit. f.w.zool., vol. 18, p. 112.

A single specimen, well preserved and about 55 mm. long, but without data, other than "West Australia," is the sole representative of this species.

COLOCHIRUS TUBERCULOSUS.

Holothuria tuberculosa, Quoy and Gaimard, 1833. Voy. de l'Astrolabe, Zool. vol. 4, p. 131.
Colochirus tuberculosa, Semper, 1868. Reis. Arch. Phil.: Holothurien, p. 239.

A specimen about 50 mm. long, and without other data than the simple "West Australia," represents this species.

COLOCHIRUS AXIOLOGUS,[1] sp. nov.

PLATE XXV.

Tentacles 10, large and arborescent, the two ventral ones much smaller than the other eight. Calcareous ring only moderately stout, about 3-4 mm. broad (high), with no posterior prolongations, Polian vessel single, rather large and nearly spherical. Stone-canal single, in the dorsal mesentery. Genital glands unbranched, 40-50 mm. long, in a thick tuft on each side of the mesentery, near the middle of the body cavity. Respiratory trees short, but well-developed and much branched. Ambulacral appendages nearly or quite confined to the ventral ambulacra; each of these ambulacra at the middle of the body carries about eight longitudinal series of well-formed, rather large pedicels, the entire band being about 10 mm. wide. As the ends of the body are approached, the series of

[1] GR. *Axiologos*=remarkable.

pedicels rapidly, almost abruptly decrease to only four or three and then disappear altogether, so that there are no pedicels near either mouth or anus, even in the ventral ambulacra. Dorsal ambulacra (except to some extent near mouth) and all interambulacral areas, entirely free from pedicels or appendages of any kind. Body wall thick (in the type which has been preserved in alcohol, it is 2-3 mm thick) but entirely without calcareous deposits of any kind ; a few minute calcareous rods are to be found in the finer branches of the tentacles, and the anus is guarded by five conspicuous calcareous teeth. Interambulacral areas somewhat pointed and projecting at both their anterior and posterior ends, forming valve-like folds which, in the contracted condition, conceal both mouth and anus.

Colour rose-purple, dull in the type and passing into brown on the tentacles, but rather bright in the other specimen, which might perhaps better be described as purplish-rose; in this specimen the tentacles are fully contracted and drawn into the body cavity and the neck-skin thus protected is bright purple, which is perhaps the natural colour of the entire animal in life.

The form of this species is notable and is better shown in the type, which is approximately 90 mm. long. The distance from mouth to anus along the mid-dorsal interambulacrum is however less than 70 mm. while along the mid-ventral ambulacrum it is 210 mm. The girth of the body is 190 mm.

Port Hedland, W.A. Two specimens, Nos. 4032 and 4033. No. 4033 is the Type.

It is difficult to decide whether the absence of calcareous particles in the body-wall is the natural condition or is due to decalcification. The type is so well preserved it is hard to believe it has been decalcified, but the other specimen was preserved in formalin and has the appearance of having been decalcified. If decalcification has occurred artifically it is hard to understand why the anal teeth and calcareous ring should persist apparently uninjured. On the other hand, the species of Colochirus, hitherto known, have an excessive amount of calcareous matter in the body-wall and its absence would therefore be an extraordinary specific character, should it prove to be natural and constant. The form of the body in these two specimens and the absence of pedicels on the dorsal surface are also extraordinary characters and should further

collecting produce additional specimens showing essentially the same combination of remarkable features, I should consider the species entitled to separate generic rank.

ACTINOPYGA MILIARIS.

Holothuria miliaris, Quoy and Gaimard, 1833. Voy. de l'Astrolabe, Zool., vol. 4, p. 137.
Mülleria miliaris, Brandt, 1835. Prod. Desc. Anim., p. 74 (et auct.)

Two large specimens (Nos. 218, 219) without data, except "West Australia," are in the collection. The generic name Mülleria has so often been shown to be preoccupied, so far as holothurians are concerned, there can be no justification for its further use instead of Brown's suggested substitute, Actinopyga.

STICHOPUS, sp. ?

Three large holothurians (No. 4939) from between Fremantle and Geraldton seem to belong to the genus Stichopus, but they are so contracted and distorted and the body surface is so rubbed that it is impossible to determine them satisfactorily. They do not seem to be *S. variegatus* and I think they probably represent an undescribed species.

HOLOTHURIA ATRA

Jaeger, 1833. De Holoth., p. 22.

These specimens which range from 100 mm. to 250 mm. in length seem to be identical with similar individuals from the Philippine Islands, and I see no reason to doubt that they are *atra*. There are no data with them but they are from "West Australia" and bear the Nos. 213, 215 and 216. Three specimens.

HOLOTHURIA. sp. ?

There is a small, decalcified holothurian (No. 251) from "Pelsart Island, Abrolhos, W.A.," which unfortunately cannot be determined.

Museum of Comparative Zoology,
Cambridge, Mass., U.S.A.,
June 1st, 1913.

ON A COLLECTION OF

REPTILES AND BATRACHIANS

FROM WESTERN AUSTRALIA

By DENE B. FRY
Junior Assistant, Australian Museum, Sydney.

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PLATES XXVII-XXVIII. AND TEXT FIGURES 1-11.

In continuation of the arrangement with Mr. Bernard H. Woodward, Director of the Western Australian Museum, Perth, the Trustees have received a large collection of Reptiles and Batrachians from that State for identification. The present paper forms a report on those species contained which are of special interest, some being regarded as new, whilst others are re-described or recorded from Western Australia for the first time.

LACERTILIA (LIZARDS).

Diplodactylus woodwardi, sp. nov.
,, *lucasi*, nom. nov.
Peropus variegata, var. *punctata*, var. nov.
Ophioseps repens, sp. nov.
Amphibolurus scutulatus, Stirling and Zietz.
Egernia formosa, sp. nov.
Lygosoma (Rhodona) picturatum, sp. nov.
Cryptoblepharus rhodonoides, L. & F.

OPHIDIA (SNAKES).

Liasis olivaceus, Gray?
Demansia psammophis, var. *reticulata*, Gray.
,, *modesta*, Günther.
,, *affinis*, Günther.
,, *nuchalis*, Günther.
Pseudechis australis, Gray.
Furina bimaculata, D. & B.

BATRACHIA (FROGS AND TOADS).

Limnodynastes ornatus, Gray.
,, *dorsalis*, Gray, var. *typica*.
Crinia georgiana, Bibr., var. *stolata*, Cope.
,, *leai*, Fletcher.
Phractops australis, Gray.
Helioporus albopunctatus, Gray.
Myobatrachus gouldii, Gray.
Hyla caerulea, White.
,, *rubella*, Gray.
,, *adelaidensis*, Gray.
,, *latopalmata*, Günther.
,, *nasuta*, Gray.

I wish to express my thanks to Mr. Woodward for his kindness in allowing me to examine this collection, and for undertaking the publication of my report.

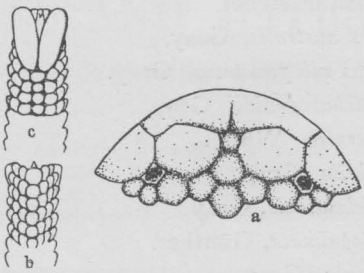
LACERTILIA
(LIZARDS).

DIPLODACTYLUS WOODWARDI, Sp. nov.

PLATE XXVII., FIG. I. AND TEXT FIG. 1.

Head elongate-oviform, very convex, three-fourths as broad as long (the length of the head is measured from the tip of the snout to the ear opening). Snout rounded, one-third longer than the orbital diameter, as long as the distance between the eye and the ear orifice. Ear opening hardly distinguishable, very minute. Loreal region grooved; forehead not grooved. Rostral twice as broad as high, highest in the middle line where it is nicked; a small groove above, extending on the upper third of the rostral. Nostril situated between the first upper labial, a supranasal, and three small postnasals; supranasals separated from one another by two enlarged hexagonal granules; postnasal granules not enlarged; granules bordering supranasals enlarged, hexagonal. The posterior border of the upper eyelid (seen under a lens) bears six to seven small,

soft conical spines. Labials $\frac{11}{11}$, anterior largest. Mental longer than broad, broader in front than behind, slightly longer than the adjoining labials. Angle of the mouth slightly in front of the hinder border of the eye. A small fold from below the eye to



TEXT FIG. 1.—*Diplodactylus woodwardi*, sp. nov. (from type).

a. Dorsal view of tip of snout, enlarged.
b. Dorsal view of tip of fourth toe, enlarged.
c. Ventral view of tip of fourth toe, enlarged.

behind the angle of the mouth ; another, possibly due to preservation, above the ear opening. Scales of head granular, very convex, uniform, those near the labials enlarged. Scales of back like those of the head, slightly larger than those of the sides. Belly scales flatter than dorsal scales, with a tendency, like those of the sides, to overlap. Scales of limbs uniform. Scales of tail squarish, larger than body scales, arranged in transverse rows. Digits cylindrical, not depressed at tips ; inferiorily with transversely oval granules ; two enlarged, elongate, slightly diverging plates at the apex.

Colour (Spirits) :—Back light brownish, with eight or nine alternating darker brown bands consisting of a network enclosing occasional white spots. Large white spots on the sides between the bands. A band of reticulations on the loreal region and behind the eyes, connecting with its fellow in the occipital region. Upper surface of limbs with faint reticulations. Tail with alternating brown bands dorsally connected with each other laterally. Under surfaces uniform creamish.

Total length (from tip of snout to tip of tail) 51 mm.

This handsome species is allied to *D. alboguttatus*, Werner, [1]

1 Werner—Fauna Südwest-Austr., II, 1910, p. 462, fig. 4.

recently described from Denham on the Peron Peninsula, Shark Bay. The following short definition will distinguish the two species.

D. alboguttatus, Werner.

Snout a little longer than the distance of the eye from the ear opening. Ear opening obliquely elliptical. Rostral almost twice as broad as high, rectangular. Mental not longer than the adjoining labials. Nasal opening in contact with the rostral, one upper labial and four nasals, the upper (supranasals) in contact mesially.

D. woodwardi, sp. nov.

Snout as long as the distance between the eye and the ear opening. Ear very minute. Rostral twice as broad as high, roughly pentangular, nicked above. Mental slightly longer than the adjoining labials. Nasal opening not in contact with the rostral, and the supranasals are separate mesially by two hexagonal enlarged granules.

There are also colour differences which, however, are better shown by a comparison of the two figures.

Locality.—I have examined only a single young example from Western Australia.

Type.—In the W.A. Museum.

DIPLODACTYLUS LUCASI, nom. nov.

Diplodactylus bilineatus, Lucas and Frost, Proc. Roy. Soc. Vict., Ser. 2, XV., 1903, p. 146 (not *Diplodactylus bilineatus*, Gray, Cat. Liz. Brit. Mus., 1st ed., 1845, p. 149, and Zool. Erebus & Terror, Reptiles, pl. XV, fig. 3.)

The name *Diplodactylus bilineatus*, Lucas and Frost, is antedated by the same name proposed by Dr. J. E. Gray for a Gecko which Dr. Boulenger now regards as synonymous with *Phyllodactylus ocellatus*, Gray. As it becomes necessary to propose a new name for Messrs. Lucas and Frost's species, I have much pleasure in associating the name of Mr. A. H. S. Lucas with it.

It is worthy of remark that *Diplodactylus michaelseni*, described and figured by Dr. Werner [1], bears a general resemblance to Dr. Gray's figure of *Diplodactylus bilineatus*, but differs materially in structural characters.

[1] Werner—Fauna Südwest-Austr., II, 1910, p. 460, fig. 4.

Diplodactylus michaelseni, Werner, was described from Denham, while Messrs. Lucas and Frost's type of *D. bilineatus* came from Carnarvon. The type specimen of Dr. Gray's *D. bilineatus* (*Phyllodactylus ocellatus*, Gray, *fide* Boulenger [1]) was described from Houtman Abrolhos, and recorded by Dr. Günther [2] from Champion Bay, and by Dr. Werner [3] from Boorabbin, Coolgardie Goldfield.

PEROPUS VARIEGATUS, Dum. and Bibr., var. PUNCTATUS, var. nov.

Gehyra variegata, Gray, Lucas and Frost, Rep. "Horn" Sci. Exped. Centr. Austr., II, 1896, p. 124, pl. IX, fig. 3 (part only).
? Gehyra variegata, Gray, Werner, Fauna Südwest-Austr., II. 1910, p. 467 (part only).

In the collection is a single female example of this widely distributed species from the Strelley River, Pilbara. It presents the colour variety noted and figured by Messrs Lucas and Frost. In all structural characters it agrees with the variable *P. variegatus*, but the colour pattern is so different that I propose to distinguish it under the varietal name of *punctatus*. The following short diagnosis will serve to define this form.

Upper surfaces russet brown, lighter on the snout, with transverse rows of silvery and yellowish spots. The spots are more abundant on the limbs. Black spots may be distributed all over the dorsal surface or they may be confined to two rows, one each side of the vertebral column, between the rows of lighter spots. Sometimes two faint streaks of brown on the loreal region, the upper continuing behind the eye to above the ear opening.

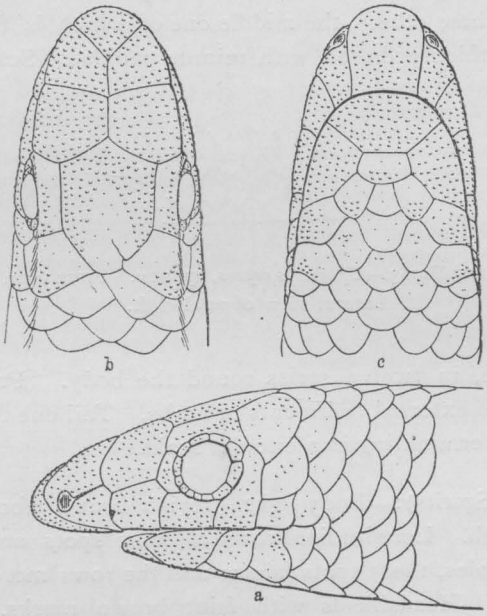
OPHIOSEPS REPENS, sp. nov.

TEXT FIGURES 2 AND 3.

Snout projecting, slightly hooked and trilobed; a little more than three times the diameter of the eye. Eye considerably longer than its distance from the mouth, surrounded by a ring of small scales, of which the posterior are the largest. Portion of the rostral seen from above is once and one half as long as its distance from the frontal, once and a quarter as broad as long, as long as the

1 Boulenger—Brit. Mus. Cat. Liz., 2nd ed., I, 1885, p. 93.
2 Günther—Ann. Mag. Nat. Hist., Ser. 3, XX, 1867, p. 49.
3 Werner—*loc. cit.* p. 456.

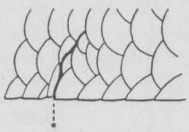
diameter of the eye; the portion seen from below longer than broad and slightly narrower behind than in front. Nasals apparently fused with the first supralabial of each side, in contact behind the rostral; a little shorter than the praefrontals, their suture being the



TEXT FIG. 2.—*Ophioseps repens*, sp. nov. From type.
a. Side of head, enlarged.
b. Dorsal view of head, enlarged.
c. Ventral view of head, enlarged.

same length as that of the praefrontals. Nostril large, not visible from above; a very distinct groove runs from its posterior edge to the lower anterior border of the praefrontal. Praefrontals a little larger than the nasals, a little more than half the length of the frontal, forming a suture in the median line and with the first supralabial (the second supralabial if we count the first as fused with the nasal). Frontal six-sided; broader in front than behind; almost once and a half as long as broad, as long as its distance from the end of the snout. Supraocular narrow, extending down behind the eye and meeting the third supralabial. A pair of parietal shields larger than the adjoining scales, in contact behind the eye with the third supralabial. A small praeocular; no postocular.

Four supralabials distinct; the third very high and bandlike, in contact behind the eye with the supraocular and the parietal scale, the fourth smallest, squarish. Mental large, nearly twice as broad as long. Four sublabials, the anterior pair the largest and separated from each other in the median line by a small shield which is followed by three others, the middle one of which is the smallest. Headshields thickly dotted with minute papillae. Scales smooth,



TEXT FIG. 3.—*Ophioseps repens*, sp. nov. From type. Lateral view of anal cleft.

Typhlops-like, in twelve series round the body. Praeanals not enlarged. No external rudiments of limbs. Tail one third as long as the body, terminating in a circular scale.

Colour (Spirits):—Body light greyish brown above, slightly lighter beneath. Longitudinal rows of faint spots on the dorsal and lateral scales, these spots fainter and the rows more numerous on the sides. Headshields with faint brown marks. Tail yellowish, the rows of spots of a reddish colour.

Total length 145 mm., Tail 45 mm.

This new species is distinguished from *O. nasuta*, Bocage, mainly by the longer snout, which is hooked in profile; the much larger nostril and the presence of a very distinct groove which connects with the praefrontal, not with the first supralabial; the different proportions and shapes of the headshields, which in *O. repens* are covered with minute papillae, and the smaller number of scales round the body. The two species are here compared side by side.

Ophioseps repens.	*Ophioseps nasutus.*
1. Snout slightly hooked and trilobed: more than three times the diameter of the eye.	1. Snout not hooked, broadly rounded. Two and one half times the diameter of the eye.
2. Portion of the rostral visible from below longer than broad.	2. Portion of the rostral visible from below broader than long.
3. Nostril large, the groove connecting it with the praefrontal.	3. Nostril small, the groove, when present, connecting it with the first supralabial.
4. Praefrontals and nasals seen from above longer than broad.	4. Praefrontals and nasals seen from above much broader than long.
5 Fontal broader in front than behind, just as long as its distance from the tip of the snout.	5. Frontal broader behind than in front, more than twice as long as its distance from the tip of the snout.
6. Supraocular in contact with the third supralabial behind the eye.	6. Supraocular separated from the third supralabial by a postocular or several small scales.
7. Headshields with minute papillae.	7. Headshields quite smooth.
8. Scales in twelve series round the body.	8. Scales in fourteen series round the body.

Dr. Werner shows[1] that there is considerable variation in *O. nasuta*. In his *Aprasia brevirostris*[2] which he has later shown[3] to be synonymous with *O. nasuta*, the small scales which surround the eye are fused into a narrow band, and the portion of the rostral seen from above is sometimes half as long as its distance from the frontal while Jensen's figure[4] of *O. nasuta*, shows it to be almost as long as its distance from the frontal. The nasal cleft may be present or absent. In Jensen's specimens and in Du Bocage's type[5] there is a postocular, while in Dr. Werner's types of *A. brevirostris* there are two small undifferentiated scales behind the eye. The praeanals may or may not be enlarged.

This remarkable variation within the one species is only in keeping with the extraordinary individual variation of other members of the family Pygopodidae, to which family Dr. Werner has referred this genus. The above proposed new series however,

1 Werner—Das Tierreich, Lief 33, 1912, p. 26.
2 Werner—Fauna Südw.-Austr. II, 1909, p. 266, figs.
3 Werner—Das Tierreich, Lief 33, 1912, p. 26.
4 Jensen—Vid. Meddel., 1899, p. 317, pl. iii.
5 Bocage—Jorn. Sc. Lisb., IV, 1873, p. 321.

differs too much to be considered a degree in variation of the type species, and in some respects is close to *Aprasia pulchella*, Gray.

Locality.—A single specimen from W.A. without exact locality is in the collection.

Type.—In the W.A. Museum.

AMPHIBOLURUS SCUTULATUS, Stirl. & Zietz.

Amphibolurus scutulatus, Stirling & Zietz, Trans. Roy. Soc. S. Austr., XVI., 1893 p. 165, pl. VII., figs. 1 and 2.

Snout almost twice as long as the diameter of the eye opening, with projecting canthus rostralis and very concave lores. Nostril slightly nearer the eye than the tip of the snout, directed upwards and backwards, pierced in an enlarged nasal situated below the angle of the canthus rostralis. Rostral small, broader than long, roughly hexagonal. Tympanum large, vertically elliptic but slanting slightly forwards, its vertical diameter equal to that of the eye opening. Upper head scales sub-equal, smallest on the supra-orbital region, mostly tricarinate, the keels meeting at the posterior extremity of each scale. A superciliary ridge with elongate unicarinate scales. Scales much smaller on the temporal region. Scales bordering the upper lip, regular, not enlarged. A ridge of enlarged scales runs from beneath the eye to above the tympanum. Several small folds of skin on the neck bearing groups of small conical spines. Gular scales small, flat, sometimes faintly keeled, enlarged and hexagonal towards the lower labials. Mental longer than broad, slightly larger than the rostral. Scales of the upper surfaces strongly keeled, very slightly enlarged towards the vertebral region. A very distinct nuchal crest continuous behind with a vertebral series of slightly enlarged scales, or a distinct dorsal crest. Scales of limbs larger than body scales. Ventral scales keeled, larger than dorsal scales. Fore limb moderate; hind limb long, the toes of the adpressed limb reaching to the eye or the loreal region; the length of the foot equals that of the fore limb. The male with fifty to fifty-three praeanal and femoral pores forming an uninterrupted series on each side. Tail depressed at the base, with a serrated ridge not distinguishable on the posterior third of its length.

Colour (Spirits):—Upper surface of head rusty brown with black spots on the keels of the scales. Sides of head lighter, shading to yellow, sometimes with several fine black temporal streaks. A single median series of large black spots on the neck and anterior part of the back, breaking up into a double series of dorso-lateral spots towards the posterior part of the body. These spots sometimes enclose (towards the posterior part of the body) a light area of yellowish or brownish with a variegated centre. External to this series of spots is a light reddish, dark-edged band of lozenge-shaped spots, or a series of definite dark-centred light-edged ocelli. A series of about six narrow, light ashy-grey transverse bars cross the back, dividing the ocelli or separating the lozenge-shaped spots. Sides yellowish, reticulated with greyish or black. Tail sometimes with a distinct lateral band of lozenge-shaped spots and a light dorsal band, or variegated brownish. Numerous light ashy-grey bands cross the tail, completely dividing the dark lateral band. Under surfaces uniform yellowish, or more or less densely clouded with black on the throat, chest and abdomen. Limbs reddish-brown with yellow lines enclosing more or less regular shaped spots. Under surfaces sometimes clouded with black. Feet and hands rusty-red.

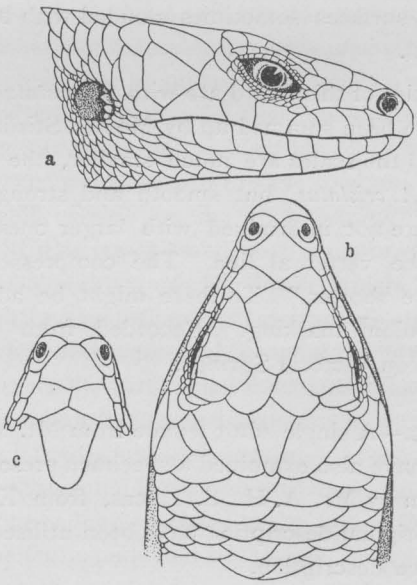
The affinities of this lizard are with *A. cristatus*, Gray, and the differences have been summed up by Messrs. Stirling and Zietz as follows:—"All the scales are much smaller, the head scales not rugose as in *A. cristatus*, but smooth and strongly keeled. The dorsal scales are not intermixed with larger ones, but increase in size towards the vertebral line. The compressed spines of the nuchal crest are shorter." To these might be added the marked difference in colour marking. Recorded from between Fraser Range and Queen Victoria Springs.

Localities.—A single adult female from Mt. Malcolm is in the collection. I have also examined a specimen presented to the Australian Museum by Mr. A. H. S. Lucas, from Kalgoorlie. Both these and the original description have been utilised in the preparation of the above description.

EGERNIA FORMOSA, sp. nov.

PLATE XXVII, FIG. 2 AND TEXT FIG. 4.

Head rather broad. Head shields smooth. Rostral once and a half as high as broad, pentagonal, forming an arcuate suture with each nasal. Nasals slightly swollen, separated or just in contact with the rostral. A curved groove behind the nostril. Frontonasal slightly broader than long. Praefrontals moderate, forming a short median suture or just separated by the frontal. Frontal once and a third to once and a half as broad as long, separated from, or narrowly in contact with, the frontonasal; in contact with the first and second supraoculars. Four supraoculars, second largest; six to eight supraciliaries. A group of imbricate prae- and postoculars. Frontoparietals forming a median suture; in contact with the second, third and fourth supraoculars. Interparietal almost twice as long as broard, as long as or longer than the frontal. Parietals separated by the interparietal. Three pairs of enlarged nuchals



TEXT FIG. 4.—*Egernia formosa*, sp. nov.

a. Side view of head, enlarged.
b. Dorsal view of head, enlarged.
c. Tip of snout of a specimen showing variation in shields.

normally. Labials $\frac{7}{7}$ or $\frac{7}{8}$, the seventh upper and the seventh lower largest, the fifth and sixth below the orbit. Three enlarged temporals. Ear opening oval, with two to four projecting lobules anteriorly, its vertical diameter almost as long as the eye opening. Twenty-eight smooth or feebly straited scales round the body, those on the verterbral line slightly enlarged, those on the sides smallest. Praeanals not or but feebly enlarged. Limbs moderate; when adpressed they just meet or slightly overlap. Toes slender, compressed; eighteen to twenty lamellae under the fourth. Tail cylindrical or very slightly depressed at the base, a little longer than the head and body; no series of transverse scales dorsally except in reproduced portions.

Colour (Spirits):—Dark or yellowish olive above. Head shields with irregular dark brown markings. Two dark brown bands which sometimes coalesce, start on the parietals and extend on to the back, where they break up into spots. Numerous transversly arranged yellow spots on the back and tail. A dark brown band starts on the loreal region and extends on to the side where it breaks up into spots. Labials yellow, sometimes barred with brown Throat reticulated with brown. Under surfaces uniform yellowish.

Length of largest specimen, from snout to vent, 95 mm.

Egernia formosa has the general appearance of *E. striolata*,[1] Peters, but in reality is widely separated from that species. In Dr. Werner's key [2] to the species of the genus Egernia it must be placed in the division I. A., the species of which are characterised by the cylindrical tail and the smooth scales. Of the five species in this division it shows affinity with the first two only, *Egernia luctuosa*, Peters [3] and *E. lauta*, de Vis.[4] From the former it is distinguished by the presence of a curved groove behind the nostril and in having twenty-eight scales round the body; from *E. lauta* it also differs by the possession of a post-narial groove, while there are no infraoculars in *E. formosa* and much longer limbs.

The separation of the palatine bones by the palatal notch is characteristic of Egernia.[5] Though this condition is maintained in all my specimens yet the fleshy intergument covering them over-reaches their edges so that they appear to be in contact in the median line.

1 Peters—Mon. Berl. Acad., 1870, p. 642 (*Tropidolepisma striolatum*).
2 Werner—Fauna Südwest-Austr., II, 1910, p. 472.
3 Peters—*loc. cit.* 1866, p. 90 (*Cyclodus* [*Omolepida*] *luctuosus*).
4 de Vis—Proc. Linn. Soc., N.S.W., 2nd ser., II, 1887, p. 813.
5 Boulenger—Brit. Mus. Cat. Liz., 2nd ed., III, 1887, p. 134.

I have also found the same structure in *E. striolata* and *E. whitei*. A knife passed between the fleshy lobes, however, shows the true condition of the bones.

Localities.—Eight specimens are before me, six adults and two young. The Type, together with three other specimens, was presented to the Trustees of the Australian Museum by Mr. W. D. Campbell, who collected them at Perth. There are also three other specimens collected by the same gentleman at Boulder. A single specimen, figured on Pl. XXVII, Fig. 2, and Text Fig. 4, is in the Collection forwarded by Mr. Woodward, but is unfortunately without data.

Type:—In the Australian Museum, Sydney. Reg. No. R. 3058. A co-type is deposited in the Western Australian Museum

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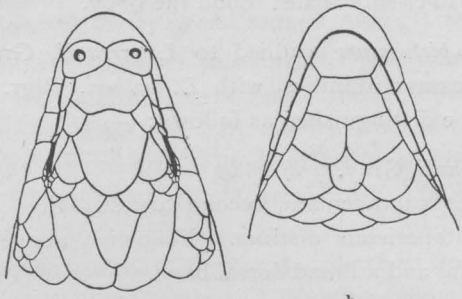
LYGOSOMA (RHODONA) PICTURATUM, sp. nov.

PLATE XXVII. FIG. 3, AND TEXT FIGURE 5.

Head small, sub-cuneiform. Snout rounded, acutely produced in profile, three to four times as long as the obital diameter, with a slightly projecting labial ridge. Eye small; the lower eyelid with a transparent disc. Ear visible, minute, but generally covered with scales. Rostral twice as broad as high, highest in the mid-line; forming an arcuate suture with each nasal. Nostril pierced in the centre of a large swollen nasal which forms a moderate suture with its fellow. Fronto-nasal once and one-quarter to once and three-quarters as broad as long, forming a broad, curved suture with the frontal. Praefrontals small and widely separated; sometimes united with the posterior loreal and in contact with the second and third, or the third upper labial. Frontal large, much broader than the supraocular region; a little longer than broad; almost as long as its distance from the end of the snout; in contact with the first supraocular. Supraoculars two, first much the larger. Three or four supraciliaries, the first one sometimes very long. Upper eyelid represented by a row of very small inbricate scales between the supraciliaries and the orbit. A group of small, irregular prae- and postocular scales. Frontoparietals separated by the interparietal; about as large as the first supraocular, larger than the praefrontals. Interparietal moderate, narrowly in contact

with the frontal. Parietals rather narrow, forming a suture behind the interparietal. Two to four pairs of indefinitely enlarged nuchals. Temporal shields three, the two bordering the parietals large.



TEXT FIG. 5.—*Lygosoma* (*Rhodona*) *picturatum*, sp. nov.
a. Dorsal view of head, enlarged.
b. Ventral view of head, enlarged.

Labials $\frac{6}{6}$, the fourth upper entering the orbit, the fifth largest. Two elongate loreal shields, one, the posterior, sometimes united with the praefrontal. Eighteen to twenty polished scales round the body. Praeanals distinctly enlarged. Fore limbs very minute, represented by a scarcely visible papilla situated in a depression, or by a styliform rudiment which may be as long as the eye. Hind limbs didactyle as long as, or nearly as long, as the distance between the eye and the fore limb ; contained almost four, to nearly five times in the distance between the axilla and the groin. Toes compressed ; twelve to fourteen lamellae under the longest. Tail as thick as the body.

Colour (Spirits):—Buff-coloured above. Head shields edged with brown. Two to four rows of spots confluent into distinct lines on the back and tail. A dark brown lateral band runs from the nostril, along the side, to the end of the tail. Uniform yellowish beneath.

Length of largest specimen, from snout to vent, 92 mm.

This species presents two more or less distinct varieties which may be separated as follows:—

Variety A (typical form).—Rows of spots forming four lines down the back. Fore limb a distinct styliform rudiment at least as long as the eye. Twenty scales round the body.

Variety B.—Only two distinct lines down the back. Fore limb represented by a minute papilla, situated in a small depression, below the general surface. Eighteen to twenty scales round the body.

Lygosoma picturatum is allied to *L. gerrardi*, Gray,[1] but also appears to possess affinities with *L. walkeri*, Blgr.[2] The three species may be distinguished as follows:—

Lygosoma gerrardi, Gray.

Three supraoculars, second largest. Five supraciliaries. Frontoparietals distinct. Yellowish above with a dark lateral and a broad dorsal band.

Lygosoma picturatum, sp. nov.

Two supraoculars, the first much the larger. Three or four supraciliaries. Frontoparietals distinct. Buff coloured above, with a dark lateral band and two to four rows of spots confluent into lines on the back and tail.

Lygosoma walkeri, Blgr.

Three supraoculars, second largest. Five supraciliaries. Frontoparietals fused into a single shield. Greyish above, each scale with a black dot, which is largest on the fourth scale from the mid-dorsal line.

Localities.—I have examined nine specimens of this new species. Two, including the Type, were presented to the Trustees of the Australian Museum by Mr. W. D. Campbell, who collected them at Boulder. A third specimen was collected by the same gentleman at Perth. Five other specimens are without locality, and differ somewhat from the typical form in having only two lines down the back. In the collection forwarded by Mr. Woodward is a single large specimen, figured on Plate XXVII, fig. 3, and Text fig. 5. This specimen is unfortunately without data.

Type.—In the Australian Museum at Sydney, Reg. No. R. 3101. A co-type is in the W.A. Museum.

[1] Boulenger—Brit. Mus. Cat. Liz., 2nd ed., III, 1887, p. 335, pl. XXVII, fig. 3.

[2] Boulenger—Ann. Mag. Nat. Hist. (6), VIII, 1891, p. 405.

CRYPTOBLEPHARUS RHODONOIDES. L. & F.

Ablepharus rhodonoides, Lucas and Frost, Proc. Linn. Soc. N.S. Wales, XXI., 1896, p. 281.

? *Ablepharus distinguendus*, Werner, Faun. Südwest. Austr., II., 1901, p. 490.

The resemblance between this small *Cryptoblepharus* and *Lygosoma* (*Rhodona*) *fragile*, Günther, is very striking indeed, rendering the specific name proposed for it by Messrs. Lucas and Frost a very appropriate one. It was originally described from Mildura, a township on the Victorian side of the Murray River. I am now able to extend its range to both Western Australia and New South Wales. In the Western Australian Collection is a specimen from the Strelley River. The Australian Museum Collection contains numerous specimens from the following localities:—Perth and Boulder, Western Australia; Mildura, on the Murray River, Victoria (one of the types); Darling River, Moloch, Bindogmidra and Narramine, on the Western Plains of New South Wales.

A careful examination of all my specimens shows that this species is not a variable one, indeed I can find no point in which they differ from the original description, or from the co-type specimen in the Australian Museum.

It seems to me very probable that the scink described by Dr. Werner as *Ablepharus distinguendus* really belongs to this species. Dr. Werner's description is very meagre however, and I cannot be sure of this. The only difference that I can detect is in the number of scale rows, which in his new species are eighteen in number whereas in all my specimens of *C. rhodonoides* they are in twenty. *A. distinguendus* is stated to be very closely allied to *Cryptoblepharus muelleri*, Fischer, with which species Messrs. Lucas and Frost also compare *C. rhodonoides*.

OPHIDIA.

(SNAKES.)

LIASIS OLIVACEUS, Gray ?

Liasis olivaceus (Gray), Boulenger, Brit. Mus. Cat. Sn., I., 1893, p. 79, pl. IV., fig. 2.

There is a large skin in the collection which differs so much from Boulenger's description that it should perhaps be regarded as a distinct species. With our limited knowledge of the variations of this snake however it is safer to merely record these variations and await additional material. The differences will be seen from the following table.

L. olivaceus.	*L. olivaceus.* ?
V. 349-361.	V. 357.
S. C. 100-102.	S.C. 101.
Scales in 69-75 rows.	Scales in 56-64 rows.
Labials $\frac{13}{13}\frac{15}{15}$	Labials $\frac{11}{11}$.
Rostral broader than high.	Rostral higher than broad.
Eye larger than its distance from the mouth.	Eye smaller than its distance from the mouth.
Frontal $1\frac{1}{3}$ as long as broad.	Frontal $1\frac{1}{4}$ as long as broad.
A small azygous shield (often absent) separates the praefrontals.	A large well defined six-sided azygous shield separates the praefrontals.
Internasals more than half as long as anterior praefrontals.	Internasals half as long as anterior praefrontals.

There are five lower labials pitted, the pits being decidedly stronger than those figured by Boulenger. The parietals are in contact behind the frontal and are considerably larger than he shows them.

DEMANSIA, Gray.

Demansia, Gray, Zool. Miscell., 1842, p. 54 (for *Elaps psammophis*, Schleg.)
Diemansia, Günther, Cat. Col. Sn., 1858, p. 254.
Diemenia, Günther, Ann. Mag. Nat. Hist., (3), XII., 1863, p. 350. *et auctorum.*

The generic name *Diemenia* used by recent authors is untenable. It was originally spelt *Demansia* by Dr. Gray but was

afterwards altered to *Diemansia* and *Diemenia* by Dr. Günther. *Diemenia* has been used by all recent authors but the name as originally spelt must be used.

The following pages include descriptions and notes on the Western Australian species of the genus, based on the material forwarded by Mr. Woodward together with numerous specimens in the collection of the Australian Museum.

Key to the Western Australian specis of Demansia.

A. Scales in fifteen rows.....*D. psammophis* var. *reticulata*, Gray.

B. Scales in seventeen rows.

c. Portion of rostral visible from above measuring about half its distance from the frontal. V. 154-178, S.c. 38-51 pairs.....*D. modesta*, Günther, p.

cc. Portion of rostral visible from above about three quarters as long as its distance from the frontal. Snout broadly rounded. Head with brown smudges; back with scattered brown spots. V. 215-225, S.c. 52-63 pairs, *D. affinis*, Günther, p.

ccc. Portion of rostral visible from above as long as its distance from the frontal. Head tapering, sides nearly straight, snout more or less truncate. V. 184-224, S.c. 49-66 pairs.....*D nuchalis*, Günther, p.

DEMANSIA PSAMMOPHIS, Schl., var. reticulata, Gray.

Diemenia psammophis, var. *reticulata*, Boulenger, Cat. Sn. Brit. Mus. III., 1896, p. 323.
Diemenia reticulata, Lucas and Frost, Rept. "Horn" Sci. Expdn., II., 1896, p. 147.
Diemenia psammophis, Werner, Fauna Südwest-Austr., II., 1909, p. 257.

Scales 15 rows on anterior half, 13 on posterior half of body. Oc. 1 + 2 or 3. Temp. 2 + 2. V. 176-197. S.c. 65-79 pairs

Several specimens of var. *reticulata* are in the collection. They are all a light olive with a very distinct reticulated pattern. The hinder third of the body is somewhat lighter, shading to yellowish brown at the tip of the tail. A black, yellow edged, streak passes from eye to eye round the rostral, and another larger one beneath the eye passes obliquely downwards and backwards. A yellow spot on the praeocular; labials yellow. Yellowish or creamy white beneath

Localities.—This well marked variety is confined to Central and Western Australia. Messrs. Lucas and Frost record it from Alice Springs and Charlotte Waters, Central Australia, and Dr. Werner from Northam, W.A. In the Australian Museum are specimens from Perth and Strelley River, Pilbara. Several specimens of *D. psammophis* from Bourke and Moree, western N.S.W., belong to the typical variety, while one from North Australia is the form described by Macleay as *D. papuensis*.

DEMANSIA MODESTA, Günther.

Cacophis modesta, Günther, Ann. Mag. Nat. Hist. (4), IX, 1872, p. 35, pl. III, fig. C.
Furina ramsayi, Macleay, Proc. Linn. Soc. N.S.W., X, 1885, p. 61.
" " Lucas and Frost, Rept. " Horn " Sci. Expdn., II, 1896, p. 149.
? *Brachysoma sutherlandi*, de Vis, Proc. Roy. Soc. Q'land., I, 1884, p. 139.
? *Pseudelaps sutherlandi*, Boulenger, Cat. Sn. Brit. Mus., III, 1896, p. 320.
? *Pseudelaps sutherlandi*, Longman, Mem. Q'land. Mus., I, 1912, p. 24.
Diemenia modesta, Boulenger, Cat. Sn. Brit. Mus., III., 1896, p. 320.

Scales 17 rows. Temp. 1 + 1 or 2, V. 154-178, S.c. 38-51 pairs.

This species is at once distinguished from its congeners, *D. textilis* and *D. affinis*, by its smaller number of ventral and subcaudal plates. In the specimens before me, all of which are young, the dark cross bands vary considerably according to the age of the specimen. They become indistinct, in some cases quite obsolete, at a somewhat earlier stage than do the bands in young examples of *D. textilis*. I have not seen any fully adult examples of this species, but, judging from Dr. Boulenger's description, the cross bands in some specimens remain throughout life, as in exceptional cases in *D. textilis*.

I have examined the three specimens from Milparinka, western N.S.W., labelled types of *Furina ramsayi*, Macleay, and find they are identical with the young of *D. modesta*. There are some discrepancies in Macleay's description. According to that author the ventrals are 162 and the subcaudals 38 pairs in the largest specimen, whereas I find them to be 178 and 43 pairs respectively. In the second largest specimen they read V. 165, S.c. 49 pairs, and in the smallest, V. 169 ?, and S.c. 45 pairs. In the latter specimen, which is apparently just hatched, the frontal is twice as broad as the supraocular, and proportionately large. This feature I have observed in very young snakes of other species.

Localities.—*D. modesta*, Günther, is recorded from the following localities :—Perth ; the North-West (types, Günther, 1872, and Boulenger, 1896) ; Geraldton (Boulenger, 1896), Milparinka, Barrier Range, Western N.S.W. (types of *Furina ramsayi*, Macleay, Austr. Mus.); Crown Point, Horse Shoe Bend, Finke River, Central Australia (Lucas and Frost, 1896); Norman River, North Queensland (types of *Brachysoma sutherlandi*, de Vis, 1884, Q'land. Mus.) ; Lawlers and Boulder, W.A. (Austr. Mus.).

DEMANSIA TEXTILIS, D. & B.

Diemenia textilis, Boulenger, Cat. Sn. Brit. Mus., III., 1896, p. 325.

Although there are several mentions of *D. textilis* occurring all over Australia, I know of no authentic record of its occurrence in Western Australia. Krefft [1] gives "Australia generally" as the habitat of *Diemenia superciliosa*, as it was then called. Again he says, [2]—"A species which . . . ranges from the East to the West Coast, and perhaps extends all over the whole continent." Speaking of *D. nuchalis*, Waite [3] is of the opinion that "it is possible that the Brown Snakes (*D. textilis*) recorded from Western Australia are referable to this species."

DEMANSIA AFFINIS, Günther.

PLATE XXVII, FIG. 4, AND TEXT FIG. 6A.

Pscudonaja affinis, Günther, Ann. Mag. Nat. Hist., (4), IX, 1872, p. 35, pl. IV, fig. C.
" " Macleay, Proc. Linn. Soc. N.S.W., II, 1878, p. 29.
" " Lucas and Frost, Rept. "Horn" Sci. Expdn., II, 1896, p. 148,
Diemenia nuchalis (part), Boulenger, Cat. Sn. Brit. Mus., III, 1896, p. 326.

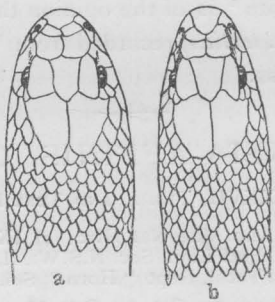
Head broad ; snout not truncate but broadly rounded. Eye moderate. Rostral broader than deep, the portion visible from above almost as long as its distance from the frontal ; internasals two-thirds to four-fifths the length of the praefrontals ; frontal broader than the supraocular, once and a half as long as broad two-thirds the length of the parietals ; nasal entire or semi-divided. Two or three postoculars ; temporals 1 + 2. Six upper labials, last very large, third and fourth entering the eye. Scales in seventeen to twenty-one rows. V. 215-225. S.c. 52-63 pairs.

1 Krefft—Austr. Vertebr., Foss. and Recent, Sydney, Feb. 1871, p. 54.
2 Krefft—Vertebr. Lower Murray, 1865, p. 31.
3 Waite—Australian Snakes, 1898, p. 51.

Colour (Spirits):—Uniform brownish above, lighter on the head and the sides. Head with dirty smudges and a few scattered, irregularly placed dark brown spots. Sides and back with irregularly distributed, more or less abundant dark brown spots, which in many cases exactly cover one scale. Under surfaces uniform yellowish olive, or finely peppered with grey. Throat yellowish or dark bluish grey.

Total length of largest specimen, 1525 mm., tail, 250 mm.

I have examined four specimens of this Demansia and think it will prove constantly distinct from *D. nuchalis*. After examining Dr. Günther's type specimen Dr. Boulenger placed this species in the synonomy of *D. nuchalis*, possibly regarding such slight differences founded on a single specimen as not of specific value. With four additional specimens at hand however, all of which differ in the same characters from *D. nuchalis*, I propose to raise *D. affinis* to specific rank. When placed side by side the two forms appear



TEXT FIG. 6.

a. *Demansia affinis*, Gthr.
(After Günther, from type specimen, reduced.)

b. *Demansia nuchalis*, Gthr.
(After Günther, reduced.)

strikingly different, but a closer examination shows that the differences are mainly in the general appearance, the outline of the head (see Text figs. 6a and 6b), and the colouration. Also, Messrs. Lucas and Frost record a specimen in which the scales are in twenty-one rows, the greatest number recorded for the genus.

Localities.—*Demansia affinis* in known from the following localities:—Australia (type, Günther, 1872). Reedy Creek, George

Gill Range, Central Australia (Lucas and Frost, 1896). Western Australia (W. A. Mus.); S.W. Australia (Austr. Mus.) King George Sound (Macleay Mus.)

DEMANSIA NUCHALIS, Günther.

(FIG. 6b.)

Pseudonaja nuchalis, Günther, Cat. Col. Sn., 1858, p, 227.
,, ,, Günther, Proc. Zool. Soc., 1863, p. 17, fig.
,, ,, McCoy, Ann. Mag. Nat. Hist., (3), XX., 1867, p. 182.
,, ,, Krefft, Sn. Austr., 1869, p. 44, pl. XII., fig. 13.
,, ,, Macleay, Proc. Linn. Soc., N.S.W., II., 1878, p. 219.
,, ,, de Vis, Proc. Roy. Soc. Q'land., I., 1884, p. 58.
,, ,, Lucas and Frost, Rept. "Horn" Expdn., II., 1896, p. 148.
Diemenia aspidorhyncha, McCoy, Prodr. Zool. Vic., 3., 1879, p, 13, pl. XXIII., fig. 4.
Diemenia nuchalis, Boulenger, Cat. Sn. Brit. Mus., III., 1896, p. 326.
,, ,, Werner, Fauna Südwest-Austr., II., 1909, p. 257.
Pseudelaps bancrofti, de Vis, Ann. Q'land. Mus. X., 1911, p. 25.
,, ,, Longman, Mem. Q'land. Mus., I., 1912, p. 24.

Head tapering and truncate at the snout, the sides almost straight in the adult but somewhat curved in the young. Eye moderate. Rostral broader than deep, the portion visible from above may be a little longer than its distance from the frontal or not quite as long; internasals shorter than the praefrontals; frontal considerably broarder than the supraocular, once and a half to almost twice as long as broad, a little shorter to a little longer than its distance from the tip of the snout, two-thirds to four-fifths the length of the parietals. Nasal entire or semi-divided, in contact with a single praeocular two or three postoculars; temporals 1 + 2 or 3; six upper labials, third and fourth entering the eye, sixth very large. Scales in seventeen to nineteen rows. V. 184-224; anal divided; S.c. 49-66 pairs.

Colour (Spirits):—

Var. A. Body uniform light or dark brown above. A. nuchal collar may be present. Under surfaces greenish grey or yellowish; throat slightly darker A melanotic form, in which the head, neck and anterior parts of the body are rich brown or black, occurs in this variety.

(Vars. A. and C. of Lucas and Frost; vars. A. and B. part only ? of Boulenger; vars. I, II, III of Werner.)

Var. B. Body light or dark brownish above, variegated with black or dark brown. The scales may be edged with darker (edged with lighter according to McCoy in *D. aspidorhyncha*), or there may be bands of darker colour or zig-zag lines of dark brown. These markings, if not confined to the posterior two-thirds of the body are most distinct in that region. One or two black nuchal bands are rarely present. Ventrals olive, greyish or yellowish, uniform or with round dark spots on those of the posterior moiety. Throat sometimes peppered with grey.

A melanotic form also occurs in this variety. (Vars. B. and E. of Lucas and Frost ; var. B. part only ? of Boulenger; vars. IV and V of Werner).

Total length of largest specimen (Krefft), 1600 mm., tail 300 mm.

Demansia nuchalis is an extremely variable species both in colouration and in structural characters. The youngest specimen I have seen is sixteen inches in length, in which the colouration is like that of some of the adult specimens. This suggests that the young of this species, unlike the young of *D. textilis*, and *D. modesta*, may not have distinct black bands round the body. I have examined two melanotic specimens which do not otherwise differ from the typical form, and, as this form is present in both varieties it would appear to be quite sporadic in its occurrence.

Localities.—This species is known from the following localities :—Swan River and Geraldton ; North-Western Australia ; Port Essington, Northern Territory (Boulenger, 1896); Edel Land, Baba Head and Rottnest Island, W.A. (Werner, 1909); Alice Springs and between Laurie's Creek and Glen Edith, Central Australia (Lucas and Frost, 1896); Port Darwin, Northern Territory (Macleay, 1878); Stannary Hills, Central Eastern Queensland (de Vis, 1911, as *Pseudelaps bancrofti*). In the Australian Museum are specimens from Perth, 80 miles south of Perth, and Beverley, W.A.; Hermidale, near Nyngan, Western N.S.W., and Yandembah, Riverina, N.S.W.

PSEUDECHIS AUSTRALIS, Gray.

A very large specimen is in the collection which is of interest as the characters exhibited show an overlapping between *P. denisonioides*, Werner[1] and *P. australis*, Gray. The ventrals are 189 and the subcaudals 40 + $\frac{14}{13}$ (54 in all), thus agreeing almost exactly with the scaling of *P. denisonioides*, V. 189, S.c. 34 + $\frac{19}{19}$ + 1, (54 in all). In *P. denisonioides* the internasals are one-third as long as the praefrontal, a condition exhibited by none of the specimens of *P. australis* that I have seen. The frontal is half as long as the parietal in Werner's new species, but in my specimen it is only three-fifths as long, the normal for *P. australis* being two-thirds the length of the parietals. Other differences in Werner's species are a single anal and the greater extension of the rostral on the dorsal surface of the snout.

I have examined a number of specimens of *P. australis* and find that this species varies very considerably. *P. denisonioides*, however, differs so much that the above could not be regarded as uniting the two species, but shows at least that the scaling overlaps.

The scale formulae of *P. australis* should now stand:—V. 189-220; Anal 2, S.c. 8-41 single + 14-54 paired. Total 53-70. Temporals 1-2 + 2.

FURINA BIMACULATA, D. and B.

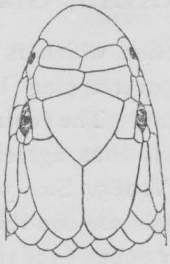
TEXT FIG. 7.

Furina bimaculata. Dum. and Bibr., Erp. Gen., VII, 1854, p. 1240.
,, ,, Jan., Rev. and Mag. Zool., 1859, p. 125, pl. VI.
Pseudelaps bimaculatus, Jan., Icon. Gen., Livr. 43, 1873, pl. V., fig. 2.
Furina bimaculata, Boulenger, Cat. Sn. Brit. Mus., III, 1896, p. 406 (see synonomy).
,, ,, Werner, Fauna, Südw.-Austr., II., 1909, p. 262.

There are two specimens of this rare snake in the collection. The largest 317 mm. long and has 181 ventrals, 30/29 subcaudals, 2 anals, 1 + 1 temporals, the first very long. The smaller specimen which is 230 mm. long differs somewhat from Boulenger's descrip-

[1] Werner—Fauna Südw.-Austr., II, 1909, p. 258.

tion in having 217 ventrals, 20/19 subcaudals, and in being uniformly coloured on the body. The two characteristic black bands on the nape and head are present in both specimens, but the smaller one has a black blotch on the rostral. With these variations and those noted by Werner the scale formulae should now stand:—Sc. 15 rows, V. 181-217, S.c. 20/19 to 30/29. Anal 2. Labials $\frac{5}{6}$. Temporals 1 + 1-2.



TEXT FIG. 7.
Furina bimaculata, D. and B.
Dorsal view of head enlarged.

The upper head shields of the larger specimen are figured.

BATRACHIA.

(FROGS AND TOADS).

KEY TO THE WESTERN AUSTRALIAN FROGS AND TOADS.

A. Toes free or fringed only,[1] the fringe sometimes forming a very membrane at the base of the toes.

B. Inner metatarsal tubercle large, *shovel-shaped*.

C. Teeth in two transverse series *behind* the choanae.

D. A large parotoid-like gland on the calf of the leg. Brown above with dark brown spots or bands and a light dorsal stripe.

Limnodynastes dorsalis, Gray, var. *typica*.

DD. *No* parotoid-like gland on the calf of the leg. Back beautifully variegated with symetrical greyish and yellowish marks. Rarely a dorsal band.

Limnodynastes ornatus, Gray.

CC. Teeth in two groups *between* the choanae.

E. Back granulated. Brown or purplish-black above, uniform or with lighter spots.

Heleioporus albopunctatus, Gray.

[1] In the case of *Limnodynastes ornatus* the toes may be fringed only, or as much as two-thirds webbed. This species is therefore placed in both divisions of the Key, A. and A.A.

BB. Inner metatarsal tubercle *moderate or small*; not or but little larger than the other.

F. Under surfaces *smooth*.

G. A large *white spot* on the hinder side of the thighs.

H. A large swollen parotoid gland on the shoulder. Two rather large sub-equal metatarsal tubercles. Dark spotted beneath.
Uperoleia marmorata, Gray.

GG. No large white spot on the hinder side of the thigh.

I. *Smooth above.* No parotoid gland. A broad dark brown band starts between the eyes and extends to the sacral region where it bifurcates. Beneath spotted with darker.
Crinia leai, Fletcher.

II. Upper surfaces with *prominent smooth warts*. An indistinct subcircular parotoid gland on the shoulder. Brown or olive above, lighter on the forehead and a few large patches on the back. Beneath with faint marks
Pseudophryne guentheri, Boulenger.

FF. Under surfaces coarsely *wrinkled, not granular*.

J. Tympanum hidden. Habit extremely stout. Limbs excessively short. Toes not longer than the fingers.
Myobatrachus gouldii, Gray.

FFF. Under surfaces *granular*.

K. Tympanum slightly distinct. Vomerine teeth present or absent. Belly *immaculate*. Hinder side of thighs *carmine*.

L. Back with warts or folds. Middle of back dark brown. A broad dorso-lateral yellowish band, sometimes divided by fine lines.
Crinia georgiana, Bibr., var. *stolata*, Cope.

LL. Back quite smooth. A dark lateral streak.
Crinia georgiana, Bibr., var. *affinis*. Günth.

KK. Tympanum quite hidden. Vomerine teeth none. Belly dark *spotted or marbled*. Hinder side of thighs *dark*, uniform or variegated.

M. Snout rounded, as long as the orbital diameter. Sub-articular tubercles rather small. A slight tarsal fold.

Crinia signifera, Girard.

AA. Toes distinctly *webbed* from one third to fully so.

N. Toes not more than half webbed. *A large oval, compressed*, inner metatarsal tubercle.

O. Teeth *between* the choanae.

P. Habit stout. Head rather pointed. Back with *large warts*. Toes short, one third to one half webbed Brownish variegated above ; sometimes a fine dorsal stripe.

Phractops brevipalmatus, Günther.

PP. Habit stout. Head *very large* ; snout broadly rounded. Back finely *granulated* and with fine dorso-lateral fold. Toes short, broadly fringed, about half webbed. Greyish peppered with black above. Hinder side of thighs uniform. Head variegated. Young spotted above.

Phractops australis, Gray.

PPP. Habit rather *slender*. Head long and pointed. Back warty, with longitudinal folds. Toes *long* nearly *entirely* webbed. Uniform or marmorated brown above. A canthal streak. Hinder side of the thighs and groin with black and white spots.

Phractops alboguttatus, Günther.

OO. Teeth in two transverse series *behind* the choanae.

Q. Tympanum very indistinct. Head high ; snout very short. Back beautifully variegated.

Limnodynastes ornatus, Gray.

NN. Toes webbed to or almost to the discs. Inner metatarsal tubercle *not shovel-shaped*, generally not different from the outer when present.

R. Fingers *at least one-third webbed*. Discs *very large*.

S. *Uniform* green above (bluish in spirits). Vomerine teeth in two groups on a level with the *hinder edge* of the choanae.

Hyla caerulea, White.

SS. *Variegated* brown above ; hinder side of thighs black marbled. Vomerine teeth in two groups *between* the choanae.

Hyla peronii, Bibron.

SSS. Finger discs two-thirds the tympanum ; discs of toes *small*. Front and hinder side of thighs, groin and axilla, *excessively* blotched with black.

Hyla peronii, Bibr., var. *rothii*, de Vis.

RR. Fingers *free or webbed at the base*. Discs generally small, sometimes not enlarged.

T. Fingers *webbed at the base*. Discs distinctly enlarged, as large as the tympanum or only half so.

U. Discs of fingers as large as the tympanum. Head broader than long ; snout *rounded*. Hinder side of thighs and groin with large purplish black spots.

Hyla ewingii, D. and B., var. *calliscelis*, Ptrs.

UU. Discs of fingers distinct, only half the tympanum. Head longer than broad ; snout *prominent*. Hinder side of thighs dark, uniform or with white spots.

Hyla adelaidensis, Gray.

TT. Fingers *quite free*. Discs of fingers never more than half the size of the tympanum, sometimes scarcely enlarged. Generally a small outer metatarsal tubercle.

V. Habit *moderate*. The tibiotarsal articulation of the outstretched limb reaches the nostril or not so far.

W. Hinder side of thighs bluish or greenish, *uniform*. A broad dorsal and a lateral stripe. Under surfaces *uniform* creamish-white.

Hyla aurea, Lesson, var. *typica*.

WW. Hinder side of thighs *black with white spots.* Belly and under surfaces of thighs with dense black and brown *reticulations* (absent in young).

Hyla aurea, Less., var. *cyclorhynchus*, Blngr.

VV. Habit *very slender.* The tibiotarsal articulation of the outstretched limb reaches the tip of the snout or far beyond.

X. Back *smooth* or with very *faint* smooth *warts.* Hinder side of thighs with very accentuated black markings.

Hyla latopalmata, Günther.

XX. Back with *longitudinal folds* and dark with light brown stripes. Hinder side of thighs longitudinally striped with black or brown. Snout and toes excessively long, the tibiotarsal articulation of the outstretched limb reaching far beyond the tip of the snout.

Hyla nasuta, Gray.

LIMNODYNASTES ORNATUS, Gray.

Limnodynastes ornatus, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 262.
,, ,, Spencer, Rept. "Horn" Sci. Exped. Centr. Austr., II., 1896, p. 156, pl. XII., figs 3 and 4 and pl. XV., figs. 18-25.
,, ,, Fletcher, Proc. Linn. Soc. N.S.W., XXII., 1897 (1898), pp. 676 and 682.

Locality.—Napier Broome Bay, Northern coast of W.A. One specimen.

LIMNODYNASTES DORSALIS, Gray, var. TYPICA, Fry.

Limnodynastes dorsalis, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 261.
,, ,, Fletcher, Proc. Linn. Soc. N.S.W., XXII., 1897 (1898), p. 675.
,, ,, var. *typica*, Fry, Rec. Austr. Mus., X., 1913, p. 24, pl. II., fig. 2.

Ten specimens are in the collection. I have utilised these in an already published account of the variations of *L. dorsalis.*

CRINIA GEORGIANA, Bibr., var. STOLATA, Cope.

(PLATE XXVIII., FIG. 1.)

Crinia georgiana var *stolata*, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 264.

Vomerine teeth in two indistinct, convergent groups, behind the level of the choanae. Tongue rather large, elongate oval and entire. Tympanum slightly distinct. Fingers and toes with a slight fringe. Subarticular tubercles well developed; palmar and plantar surfaces with numerous distinct granules. Two distinct metatarsal tubercles. Tarsal fold very indistinct. Upper surfaces with longitudinal folds and warts. Under surfaces coarsely granular.

Colour (Spirits).—Back with a broad dark median area which is variegated with darker. A yellow dorso-lateral band, divided by numerous thread-like lines, starts behind the eye and bifurcating, runs to the groin. Sides of body and head variegated and striped. Legs barred and beautifully variegated with light and dark brown. Groin and hinder side of thigh bright carmine. Under surfaces with a few faint grey spots, most distinct on the throat.

Total length from snout to vent ...	24 mm.
Width of head	8.5 mm.
Length of head to level of tympana	8 mm.
Length of the outstretched hind limb	34 mm.

This is a very beautiful variety and is very distinct. The specimen figured on Plate XXVIII, fig. 1, agrees in all essentials with Bell's figure [1] of *Cystignathus georgianus*, but I regret that I am unable to refer to Cope's original description [2] of *Crinia stolata*.

Locality.—A single specimen from the Margaret River in the collection.

CRINIA LEAI, Fletcher.

(PLATE XXVIII., FIGS. 2 and 2a.

Crinia leai, Fletcher, Proc. Linn. Soc. N.S.W., XXII., 1897 (1898), p. 677.

Vomerine teeth in two distinct, convergent groups behind the choanae, or they may be entirely wanting. Tongue rather large, elongate oval and entire. Tympanum quite hidden. Fingers

1 Bell—Zool. "Beagle" Rept., 1843, p. 33, pl. XVI., fig. 4.

2 Cope—Journ. Acad. Philad. (2), VI., 1867, p. 201.

cylindrical, not fringed, first shorter than second. Toes with a distinct fringe or devoid of a fringe. Subarticular tubercles low and flat, rather indistinct. Palmar and plantar surfaces devoid of granules. A small inner metatarsal tubercle. No tarsal fold. Upper and lower surfaces smooth except for a granulated area on the under surface of the thighs.

Colour (Spirits).—Dark or light blackish-grey above, forehead lighter. A broad black, sometimes light edged band starts between the eyes and runs to the sacral region, bifurcating to a varying extent. This band may be represented by spots only. A dark streak on the canthus rostralis. Lips spotted. Legs and arms transversely barred with black, sometimes absent. A dark, light-edged streak or triangular spot on the hinder side of the thighs near the anus. Under surfaces with numerous blackish-grey spots, the shank, tarsus and metatarsus being much darker, sometimes blackish.

Total length from snout to vent ...	22 mm.
Width of head	8 mm.
Length of head	8 mm.
Length of outstretched hind limb ...	34 mm.

Locality.—A single specimen is in the collection from the Margaret River, which agrees well with Mr. Fletcher's description.

PHRACTOPS AUSTRALIS, Gray.

Chiroleptes australis, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 269.
" " Fletcher, Proc. Linn. Soc. N.S.W., XXII., 1897 (1898), pp. 678 and 682.

There is a single example in the collection which differs from eastern specimens in having a smoother back, slightly narrower head, and a very accentuated canthal and temporal streak.

Locality.—Napier Broome Bay.

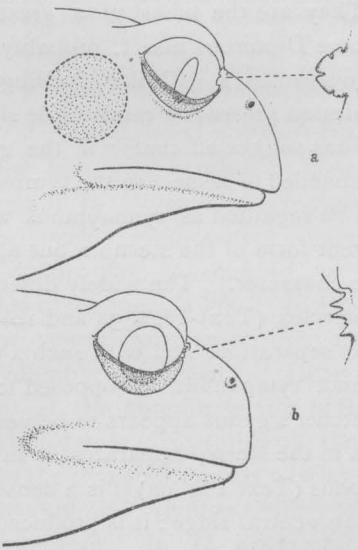
HELIOPORUS ALBOPUNCTATUS, Gray.

TEXT FIGS. 8b. AND 10.

Heleioporus albopunctatus, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 271.
" " Fletcher, Proc. Linn. Soc. N.S.W., XXII., 1897 (1898), p. 678.

I find a small but constant structure in this species which appears to have hitherto escaped notice. At the anterior corner of

the eye (see Text Fig. 8b) is a small fold of integument, beset with three or four conical papillae, which when the eye is closed, fits over the anterior junction of the upper and lower eye-lids. This structure is apparently of secondary importance during burrowing operations which have unfortunately never been observed in this species. However, in allied burrowing forms, and in particular *Philocryphus flavoguttatus* and *Limnodynastes dorsalis*, var. *dumerilii* burrowing has been carefully observed and there is no reason to believe that it differs to any extent in *H. albopunctatus*. The large eyes which under normal conditions protrude considerably, can be withdrawn well into the orbits and even to below the general surface of the head. This is done during the burrowing process by the two species mentioned above, just before the frog's head disappears beneath the surface of the earth, and it will be found if the mouth be opened and examined at this stage that its cavity is nearly filled by the downward bulge of the orbits. The upper eyelid has little power movement, but by the contraction of the eye into the orbit it is drawn considerably over the eye, while the thin semi-transparent lower lid is drawn up under its outer edge. When so closed, this serrated flap of skin



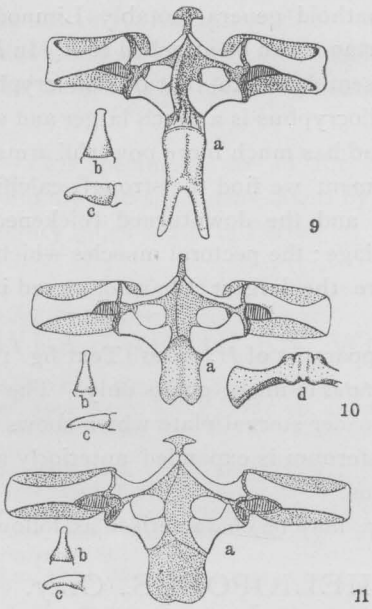
TEXT FIG. 8.
a. *Philocryphus flavoguttatus*, Fletcher. Side view of head, enlarged.
b. *Helioporus albopunctatus*, Gray. Side view of head, enlarged.

which is a direct downward continuation of the upper eye-lid, would function as a valve to prevent the small particles of grit from entering the eye during the frog's passage through the earth. In *Philocryphus flavoguttatus* (Text-fig. 8a) an homologous structure occurs, but differs from that of *H. albopunctatus* (Text-fig. 8b) in being larger and semi-circular in outline, with several nicks on its free edge. It is also to be regarded as of an accessory nature as it is not a direct continuation of the upper eyelid, but quite separate from that structure. *Helioporus pictus* and *Limnodynastes dorsalis*, which are both burrowers, possess no such apparatus, but in the former, the anterior free edge of the upper eye-lid overlaps the lower to an unusual extent, and apparently serves the same purpose. In *Pomatops valvifera*, a New Guinea representative of the Family Engystomatidae. Dr. Barbour[1] records an interesting development of this nature. The upper eye-lid is in the form of a flap of skin which extends for some distance anterior and posterior to the eye, and which is sufficiently developed to allow of its laying down so that it covers the whole eye. By analogy Dr. Barbour regards this frog as a burrower.

The two specimens in Mr. Woodward's collection are from the Margaret River. They are the hosts of a great number of the maggot larvae of some Dipterous insect, probably Batrachomyia.[2] Each of these maggots causes a gall-like swelling of considerable size and a frog so infested presents a remarkable sight.

Mr. Fletcher[3] has suggested that "if the generic definition of Heleioporus be amended in respect to the tympanum" his genus Philocryphus might be regarded as synonymous with it. He also notes the very different form of the sternum but apparently did not value it as a generic character. The widely different nature of the sterna of these two species (Text-Figs. 9a and 10a) seems to me to justify their generic separation, and with such a tangible external character as a distinct tympanum, as opposed to a hidden one in Helioporus, Mr. Fletcher's genus appears to be very well founded. The chief differences in the sternal apparatus lie in the sternal plate itself. In Philocryphus (Text Fig. 9a) it is a densely calcified plate with a slight median ventral ridge; it is produced backwards into two cylindrical, diverging, bony horns nearly as long as the sternal

[1] Barbour—Proc. Biol. Soc. Wash., XXIII, 1910, p. 89, pl. 1.
[2] Skuse—Proc. Linn. Soc., N.S.W. (2), IV, p. 172.
[3] Fletcher—Proc. Linn. Soc., N.S.W., XXII., 1897 (1898), p. 678.



TEXT FIGS. 9, 10 and 11.

Text fig. 9.—*Philocryphus flavoguttatus*, Fletcher.
Text fig. 10.—*Helioporus albopunctatus*, Gray.
Text fig. 11.—*Helioporus pictus*, Ptrs.

a. Ventral view of sternal apparatus.
b. Dorsal view of terminal phalanx of fourth toe.
c. Lateral view of same.
d. Dorsal view of sacral vertebra.

plate, and separated from one another at their tips by a distance equal to their length. In *Helioporus albopunctatus* (Text Fig. 10a), the sternum is a weak, semi-ossified plate, slightly nicked posteriorly; the ossification is confined to two longitudinal tracts one each side of the median line. In Philocryphus the free edge of the left or ventral-most epicoracoid cartilage is slightly calcified and considerably thickened; it forms a prominent ridge for the attachment of the anterior section of the pectoralis major muscle. No such ridge is discernible on the epicoracoid of *H. albopunctatus*, nor do the two epicoracoids overlap to nearly the same extent as in Philocryphus. Another difference is apparent in the shape of the omosternum. In *H. albopunctatus*, it is a simple narrow band of cartilage, while in Philocryphus it is expanded anteriorly into a semi-circular plate. The omosternum, however, shows considerable variation in this (see Text Fig. 11a, *H. pictus*)

and other Cystignathoid genera, notably Limnodynastes, so that only specific importance can be attached to it. In *H. pictus*, it bears a much closer resemblance to that of Philocryphus than does *H. albopunctatus*. Philocryphus is a much larger and stouter form than its western ally, and has much more powerful arms. In correlation with this development we find the strongly calcified sternum with its ventral ridge, and the downturned thickened edge of the left epicoracoidal cartilage; the pectoral muscles which find attachment at these ridges are the largest I have observed in any Australian frog.

The sternal apparatus of *H. pictus* (Text fig. 11a) differs from that of *H. albopunctatus* in minor points only. The most important difference is the broader sternal plate which shows no sign of ossification. The omosternum is expanded anteriorly and is not unlike that of Philocryphus.

The two genera may be characterised as follows:—

HELIOPORUS, Gray.

Pupil erect. Tongue subcircular, slightly nicked behind. Vomerine teeth between the choanae. Tympanum concealed. Toes sometimes as much as half-webbed. Outer metatarsals united. Omosternum cartilaginous; sternum a cartilaginous or semi-ossified plate, nicked behind. Sacral vertebra dilated. Terminal phalanges stout, simple.

PHILOCRYPHUS, Fletcher.

Pupil erect. Tongue subcircular, slightly nicked behind Vomerine teeth between the choanae. Tympanum quite distinct Toes with a thick basal web. Outer metatarsals united. Omosternum cartilaginous; sternum a strongly calcified plate with a slight median ventral ridge and two strong xyphisternal horns. Sacral vertebra dilated. Terminal phalanges moderate, simple.

MYOBATRACHUS GOULDII, Gray.

Myobatrachus gouldii, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 329.
" " Fletcher, Proc. Linn. Soc. N.S.W., XXII, 1897 (1898), pp. 680 and 681.

I have examined four specimens of this species and find that they differ in several points from Dr. Boulenger's description. The

pupil is in every case horizontal, and the tympanum is hidden. The under surfaces are coarsely wrinkled, and although not granular, could hardly be described as smooth. An examination of further specimens will be necessary to decide whether this condition is natural.

Localities.—Two specimens are in the collection. In the Australian Museum are two specimens taken by Mr. H. Richards at the Harvey, eighty miles south of Perth.

HYLA CAERULEA, White.

Hyla caerulea, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 383.
,, ,, Fischer, Zool. Gart., XXIV., 1883, pp. 21 and 55 (habits).
,, ,, Fletcher, Proc. Linn. Soc. N.S.W., XXII., 1897 (1898), pp. 669 and 681-2.
,, ,, Garman, Bull. Mus Comp. Zool., XXXIX., 1901, p. 14 (note only).
,, ,, Boulenger, Zool. Jahrb., Supplm., XV., Bd. I., 1912, p. 211.
,, *irrorata*, de Vis, Proc. Roy. Soc. Q'land., I., p. 128.
,, ,, Boulenger, Ann. Mag. Nat. Hist. (5). XVI., 1885, p. 387 (=*H. infrafrenata* ?).
,, ,, Fry, Rec. Austr. Mus., IX., 1912, p. 100 (=*caerulea*).

Locality.—A single specimen is in the collection from Napier Broome Bay.

HYLA RUBELLA, Gray.

Hyla rubella, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 405.
,, ,, Spencer, Rept. "Horn" Sci. Expdn., II., 1896, p. 170, pl. XV., figs. 26-28.
,, ,, Fletcher, Proc. Linn. Soc. N.S.W., XXII., 1897 (1898), p. 669.

Locality.—A single specimen from Napier Broome Bay.

HYLA ADELAIDENSIS, Gray.

Hyla adelaidensis, Boulenger, Brit. Mus. Cat. Batr., 2nd ed, 1882, p. 408.
,, ,, Fletcher, Proc. Linn. Soc., N.S.W., XXII., 1897 (1898), p. 681.

Locality.—Several specimens are in the collection from Harvey.

HYLA LATOPALMATA, Günther.

Hyla latopalmata, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 414, pl. XXVI., fig. 4.
,, ,, Fletcher, Proc. Linn. Soc., N.S.W., XXII., 1897 (1898) pp. 681-2.
,, ,, Fry, Rec. Austr. Mus., X., p. 20, pl. I and Fig. 12.

Locality.—Four specimens from Napier Broome Bay.

HYLA NASUTA, Gray.

Hyla nasuta, Boulenger, Brit. Mus. Cat. Batr., 2nd ed., 1882, p. 415.
,, ,, Fletcher, Proc. Linn. Soc. N.S.W., XXII, 1897 (1898), p. 682.
,, ,, Kampen, Nova Guinea, V., 1909, p. 35.
,, *peninsulae*, de Vis, Proc. Roy. Soc. Q'land., I, 1884, p. 129.
,, ,, Boulenger, Zool. Rec., 1885, Rept., p. 24 (= *nasuta*.)
? ,, *semoni*, Böttger, in Semon's Zool. Forsch., V., 1894, p. 112, pl. V, fig. 1.

Locality.—Three specimens from Napier Broome Bay. Collected by Mr. G. F. Hill. This species has not been previously recorded from Western Australia.

NOTES ON SOME WESTERN AUSTRALIAN FISHES.

— BY —

ALLAN R. McCULLOCH,

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PLATES XXIX.-XXXI., and FIG. 1.

The specimens on which the following notes are based are part of the collections referred to in my previous paper dealing with fishes from Western Australia.[1] Most of them are from South-western Australia, but a few from Port Hedland add a little to our knowledge of the fauna of the great North-western Coast, which is, at present, largely unknown.

Family RHINOBATIDAE.

RHINOBATUS BANKSII, Müller and Henle.

Rhinobatus banksii, Waite, Mem. Austr. Mus., IV., pt. I., 1899, p. 38, pl. III. *Id.*, Zietz, Trans. Roy. Soc. S. Austr., XXXII, 1908, p. 292.

A young male, 580 mm. long, from Western Australia, does not differ from Port Jackson specimens of this species. *R. banksii* has been identified in South Australia by Zietz.

Family CLUPEIDAE.

ETRUMEUS JACKSONIENSIS, Macleay.

PLATE XXIX.

Etrumeus jacksoniensis, Macleay, Proc. Linn. Soc. N.S.Wales, III., 1878, p. 36, pl. IV, fig. i, and *loc. cit.*, IV., 1879, p. 382. *Id.*, Ogilby, Ed. Fish. N.S.Wales, 1893, p. 186. *Id.*, Zietz, Trans. Roy. Soc. S. Austr., XXXII., 1908, p. 294.

D.21; A.11? P.16; V.9; C.17. Head 4.45 in the length to the hypural; height before the dorsal fin 5 54 in the same, and 1.24 in the head. Snout and eye subequal in length, the latter 3.06 in the

[1] McCulloch.—Rec. W. Austr. Mus., I., pt. 2, 1912, pp. 78-97, pls. IX-XIII.

head. Interorbital width equal to the depth of the caudal peduncle, 3.83 in the head. Mandible 2, maxillary 2.87, highest dorsal ray 1.53, and pectoral 1.53 in the head.

Body elongate, subcylindrical and slightly compressed. Head deeper than broad, pointed and flattened above. A thick, transparent membrane extends from the snout, over the eye to the preoperculum. Jaws subequal. Maxillary almost entirely exposed, only the upper edge slipping under the preorbital ; it reaches back almost to below the anterior orbital border, and though broad, is scarcely expanded posteriorly. Hinder margin of preoperculum sloping very obliquely backwards and downwards, the angle sharply rounded. The opercular margin forms an obtuse angle posteriorly. No teeth are visible, even under a lense, but the jaws and bones of the palate are a little rough to the touch. Gill openings large, the membranes free from the isthmus.

Origin of dorsal almost midway between the tip of the snout and the vertical of the end of the anal. Ventrals inserted behind the tip of the adpressed dorsal and somewhat nearer the hypural than the pectorals ; the first ray is more than one-third as long as its distance from the anal. Anal very small, its origin much nearer the hypural than the ventrals. Pectorals opening horizontally, the anterior rays as long as those of the dorsal ; their hinder borders are a little emarginate.

Scales of moderate size, cycloid, and they appear to have fine longitudinal striations on their exposed surfaces. They are nearly all missing in my specimen, but there seem to have been eighteen on the back before the dorsal fin, and about fifty-six between the hinder margin of the head and the hypural. The bases of the dorsal and anal fins are enveloped in scaly sheaths, and the pectorals and ventrals each have a long flap composed of axillary scales.

The colour appears to have been dark blue on the back, sharply separated from the silvery sides and belly. Tips of the jaws blackish.

Described from a single specimen, 220 mm. long, from Albany. A few specimens of this species have been taken in Port Jackson, and it is recorded from South Australia by Zietz.

Family ENGRAULIDAE.

ENGRAULIS ANTIPODUM, Günther.

Engraulis encrasicholus var. *antipodum*, *Günther, Brit. Mus. Cat. Fish., VII., 1868, p. 386.

Eight examples from Freshwater Bay, Swan River, do not differ from Tasmanian specimens in the Australian Museum.

Family PLOTOSIDAE.

CNIDOGLANIS MEGASTOMUS, Richardson.

Plotosus megastomus, Richardson, Zool. "Erebus and Terror," Fishes, 1845, p. 31, pl. XXI., fig. 1-3.

Cnidoglanis megastoma, Günther, Brit. Mus. Cat. Fish., V., 1864. p. 27. *Id.*, Klunzinger, Sitzb. Akad. Wiss. Wien., LXXX., i., 1879, p. 410.

Cnidoglanis bostockii, Castelnau, Proc. Zool. Soc. Vict., II., 1873, p. 140.

A young example, 177 mm. long, from the Swan River, does not differ from Port Jackson specimens of this species. It also agrees very well with Castelnau's description of *C. bostockii*, so that Klunzinger's suggestion of the identity of that species with *C. megastomus* is proved correct.

Family MURAENIDAE.

GYMNOTHORAX PRASINUS, Richardson.

Gymnothorax prasinus, Waite, Rec. Austr. Mus., V., pt. 3, 1904, p. 144.

Two specimens from Fremantle agree in every detail with others in the Australian Museum from near Sydney.

Family ATHERINIDAE.

ATHERINA PINGUIS (Lacépède) Ogilby.

Atherina pinguis, Ogilby, Mem. Qld. Mus., I., pt. I, 1912, p. 38, pl. XII., fig. 1.

Two examples are in the collection from Fremantle. Waite examined specimens from the same locality, and recorded them as *A. lacunosa*, Forster.[1]

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[1] Waite, Rec. Austr. Mus., IV., 1902, p. 180.

Family POLYNEMIDAE.

Genus POLYDACTYLUS, Lacépède.

POLYDACTYLUS (ELEUTHERONEMA) TETRADACTYLUS, Shaw.

Polynemus tetradactylus, Günther, Brit. Mus Cat. Fish, II., 1860, p. 329. *Id.*, Day, Fish. India, 1878, p. 180. *Id.*, Macleay, Proc. Linn. Soc. N.S. Wales, VIII, 1883, p. 203. *Id.*, Kent, Gt. Barrier Reef, 1893, p. 287, pl. XLVI, fig. 2, and Nat. in Austr., 1897, p. 168-9.

Polynemus coecus, Macleay, Proc. Linn. Soc. N.S. Wales, II., 1878, p. 354, pl. IX, fig 1.

Having examined the type of *P. coecus* in the Macleay Museum, I have to support Klunzinger's opinion that that species is synonymous with *P. tetradactylus*.

A large specimen is preserved from Fremantle.

Family GADIDAE.

PHYSICULUS BARBATUS, Günther.

Physiculus barbatus, Zietz, Trans. Roy. Soc. S. Austr., XXXIII., 1909, p. 266. *Id.*, McCulloch, Zool. Res. "Endeavour," pt. I, 1911, p. 38—synonymy.

Albany. One specimen, 345 mm. long.

Family PEMPHERIDAE.

Genus LEPTOBRAMA, Steindachner.

LEPTOBRAMA MÜLLERI, Steindachner.

Leptobrama mülleri, Steindachner, Sitzb, Akad. Wiss. Wien, LXXVIII, i., 1878, p. 388, and Denks. Akad. Wiss. Wien, XLI, i., 1879, pl. III, fig. 1. *Id.*, Klunzinger, Sitzb. Akad. Wiss. Wien, LXXX, i., 1879, p. 381.

Neopempheris ramsayi, Macleay, Proc. Linn. Soc. N.S.Wales, V., 1881, p. 517, pl. XIV.

? *Neopempheris pectoralis*, Ramsay and Ogilby, Proc. Linn. Soc. N.S.Wales, (2), II., 1887, p. 563.

A comparison of the type of *Neopempheris ramsayi* with Steindachner's figure of *Leptobrama mülleri* leaves no doubt as to the identity of the two species.

Mr. Ogilby has examined several specimens from Moreton Bay and informs me that he considers *N. pectoralis*, may be synonymous with *N. ramsayi*. I have compared the two type specimens and find only a few differences between them which are probably not specific. Mr. Ogilby will give details in his paper in the memoirs of the Queensland Museum.

A fine specimen, 297 mm. long, from Port Hedland, is in the Western Australian Museum collection.

Family SERRANIDAE.

EPINEPHALUS MEGACHIR, Richardson.

Epinephalus megachir, Boulenger, Brit. Mus. Cat. Fish., (2 ed.), 1895, p. 219.

Port Hedland. One specimen, 230 mm. long.

PSAMMOPERCA WAIGIENSIS, Cuvier and Valenciennes.

Psammoperca vaigiensis, Boulenger, Brit. Mus. Cat. Fish, (2 ed.), I, 1895, p. 365.

A small specimen, 210 mm. long, from Geraldton, differs from larger ones in the Australian Museum from Torres Strait in having the snout more pointed, and its upper profile more concave.

Family PSEUDOCHROMIDIDAE.

GNATHYPOPS INORNATUS, Ramsay & Ogilby.

PLATE XXX.

Opisthognathus inornatus, Ramsay and Ogilby, Proc. Linn. Soc. N.S.Wales, (2), II., 1887, p. 561.

A very large specimen, 485 mm. long, from Port Hedland, differs from the type in having a much smaller eye, the head very much more tumid, and the pectorals more rounded. The scales are obsolete anteriorily and the whole head, body and fins are covered with soft, plicated skin; on the anterior portion of the ventrals and the margin of the spinous dorsal the skin is particularly thick and convoluted. All these differences are doubtless due to the age of the specimen.

I have figured one of the two type specimens, which are in bad condition; only the spots on the body are copied from the larger example.

The following is a key to the Australian species of *Gnathypops*, Gill, and *Merogymnus*, Ogilby, all of which are represented in the Australian Museum.

a. Outer row of teeth considerably larger than the others. Scales extending forward to below origin of soft dorsal. *Gnathypops.*

b. Body and fins light with numerous small dark brown spots - - - - - *maculatus.*[1]

bb. Body and fins dark, sometimes with irregular scattered dark spots - - - - - *inornatus*

bbb. Head with small, body with large incomplete brown rings, dorsal, anal and caudal with oblique bars, the former with a large black spot anteriorily. *darwiniensis.*[2]

aa. Outer row of teeth scarcely larger than the others. Scales not extending forward beyond middle of pectorals. *Merogymnus.*

c. Scales very small, covering the greater part of the sides and belly - - - *eximius.*[3]

cc. Scales larger, confined to hinder half of body, belly naked - - - *jacksoniensis.*[4]

I have compared the types of *Batrachus punctulatus*, Ramsay[5] and *Opisthognathus maculatus*, Alleyne and Macleay[1] and find them to be the same species.

Family GERRIDAE.

Genus PAREQUULA, Steindachner.

PAREQUULA MELBOURNENSIS, Castelnau.

Gerres melbournensis, Castelnau, Proc. Zool. Soc. Vict,, I., 1872, pp. 158, 245, and *loc. cit.*, II., 1873, p. 37. *Id.*, Macleay, Proc. Linn. Soc. N.S.Wales, V., 1881, p. 380.

Parequula bicornis, Steindachner, Denks. Akad. Wiss. Wien, XLI, i., 1879, p. 8. *Id.*, Klunzinger, Sitzb., Akad. Wiss, Wien, LXXX., i., 1879, p. 380.

Chthamalopteryx melbournensis, Ogilby, Proc. Zool., Soc., 1887, p. 616, figure. *Id.*, McCulloch, Zool. Res. "Endeavour" I., pt. 1., 1911, p. 63.

Having compared the description of *Parequula bicornis* with the specimens on which Ogilby based his genus *Chthamalopteryx*, I have no doubt that the two names refer to the one species. According to Steindachner the scales are ctenoid (ciliated) along the edge and

[1] Alleyne and Macleay, Proc. Linn. Soc. N.S. Wales, I, 1877, p. 280, pl. IX, fig. 3.
[2] Macleay, Proc. Linn. Soc. N.S. Wales, II, 1878, p. 355, pl. IX, fig. 3.
[3] Ogilby, Proc. Roy. Soc. Qld., XXI, 1908, p. 18.
[4] Macleay, Proc. Linn. Soc., N.S. Wales, V, 1881, p. 570.
[5] Ramsay, Proc. Linn. Soc. N.S. Wales, VIII, 1883, p. 177.

on the outer surface near the margin, while Ogilby described them as cycloid. This discrepancy is explained by the fact that they appear cycloid to the naked eye, the very minute teeth being only visible under a microscope; some scales, also, particularly in young specimens, are quite smooth.

Nine specimens, 142-185 mm. long, are in the collection from Albany.

Family CHEILODACTYLIDAE.

DACTYLOPHORA, de Vis.

Dactylophora, de Vis, Proc. Linn. Soc. N.S.Wales, VIII., July 1883, p. 284 (*D. semimaculata*, de Vis).

Psilocranium, Macleay, Proc. Linn. Soc. N.S.W., VIII, Feb., 1884, p. 439 (*P. coxii*, Macleay).

This genus is apparently distinguished from all others of the family Cheilodactylidae in having the cheeks naked. In its short and high anal fin, large scales, and general form, it appears to be related to *Chirodactylus*, Gill.[1]

De Vis has described the teeth as arranged in several rows in the upper jaw, and in one in the lower. Mr. Ogilby has, at my request, re-examined the type specimen in the Queensland Museum, and finds a band of villiform teeth in the upper jaw, which is much broader in front than laterally, and three series of small curved teeth in the lower jaw. In full-grown specimens the teeth become much more numerous.

DACTYLOPHORA NIGRICANS, Richardson.

Cheilodactylus nigricans, Richardson, Proc. Zool. Soc., 1850, p. 63, and Ann. Mag. Nat. Hist., (2), VII, 1851, p. 279.

Chilodactylus nigricans, Günther, Brit. Mus. Cat. Fish, II., 1860, p. 79. *Id.*, Gill, Proc. Acad. Nat. Sci. Philad., 1862, p. 118. *Id.*, Günther, Ann. Mag. Nat. Hist., (3) XX, 1867, p. 59. *Id.*, Canestrini, Arch. Zool. l'Anat (2), I., 1869, p. 155. *Id.*, Castelnau, Proc. Zool. Soc. Vict., I., 1872, p. 75. *Id.*, Macleay, Proc. Linn. Soc. N.S.Wales, V., 1881, p. 423. *Id.*, Johnston, Proc. Roy. Soc. Tasm., 1890 (1891), p. 31. *Id.*, Waite, Rec. Austr. Mus , VI., 1905, p. 63.

Chilodactylus nebulosus, Klunzinger, Arch. Naturg., XXXVIII, i., 1872, p. 26, and Sitzb. Akad. Wiss. Wien., LXXX, i., 1897, p. 364. *Id.*, Steindachner, Sitzb. Akad. Wiss. Wien., LXXXVIII, i., 1884, p. 1078, pl. II., fig. 1. *Id.*, Macleay, Proc. Linn. Soc. N.S.Wales, IX, 1884, p. 17.

Dactylophora semimaculata, de Vis, Proc. Linn. Soc. N.S.Wales, VIII 1883, p. 284. *Id.*, Macleay, Proc. Linn. Soc. N.S.Wales, VIII., 1884, p. 441.

Psilocranium coxii, Macleay, *loc. cit.*, p. 440, pl. XXII.

Psilocranium nigricans, Macleay, *loc. cit.*, p. 441.

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[1] Gill, Proc. Acad. Nat. Sci. Philad., 1862, p. 119.

D. XV-XVI. 24-26; A.III. 9-10; P. 9 + 5-6; V.I.5; C.14-15; l. lat. 48-51. Body moderately elongate, deeper in the young than in the adult, 3.24-4.10 in the length to the hypural. Head 3.3-4.10 in the same. Eye 4.38-6.23 in the head, and 1 61-2.23 in the snout. Snout 2.71-3, greatest breadth 2.11-1.77, caudal peduncle 3.56-2.84, longest pectoral ray 1.05-1.1, sixth dorsal spine 2.45-2.59 in the head. Eye 1.07-1.47 in the interorbital width.

Body covered with large cycloid scales, which become extremely small on the chest, and form a sheath at the bases of the dorsal and anal fins. Postorbital portion of head and opercles covered with small scales; remainder of the head naked. Fleshy eye-opening almost equal to the interorbital width in young specimens, much narrower in adults. Nostrils close together, in the hinder half of the snout; the anterior has a short skinny lobe. Lips very thick, maxillary reaching to below the anterior or posterior nostril A band of small cardiform teeth in each jaw which is broad in front, but becomes very narrow on the sides; vomer and palatines toothless.

Spinous dorsal a little shorter than the soft, and its margin is a little arched; the sixth spine is usually the longest, the others decrease regularly in length. Anterior dorsal rays equal to or higher than the longest spine; they become regularly shorter, and the margin of the fin is straight. Third anal spine longer, but much weaker than the second; anterior rays much higher than those of the dorsals, the posterior ones very short, so that the margin is a little excavated. Pectoral, with five or six simple rays, the fifth from the bottom the longest, reaching backwards to above the vent in young specimens and not so far as the ends of the ventrals in adults. Caudal forked.

Lateral line almost straight from the operculum to the upper portion of the caudal peduncle; it is formed of very small scales intercalated between the larger ones of the body, each of which bears a simple or bifurcate tube.

The colour markings are very distinct in the young, less so in adults. They consist of six broad brown bands, with darker edges, which descend from the back and run obliquely forward on the sides; a seventh less distinct one is present on the caudal peduncle. In addition, irregular rows of large dark spots are present on the lower parts of the sides. Two brown bands extend backwards

from the eyes, and one below it; the spaces between them are silvery. All the fins are dusky with narrow white edges; the soft dorsal may bear several rows of rather large brown spots, while several still larger ones are present on the caudal.

I have examined fifteen specimens, including a well graduated series, varying in length from 163-575 mm. from the tip of the snout to the end of the middle caudal rays. Of these, four are from South Australia. Seven, including the type of *Psilocranium coxii* are either from the neighbourhood of Sydney, or purchased in the Sydney markets, and one is from the Melbourne market. The three others are said to have come from the Clarence River, New South Wales, but I do not consider the evidence of their capture so far north as satisfactory.

Macleay compared his type of *Psilocranium coxii* with the four South Australian specimens mentioned above which he identified as *Chilodactylus nigricans* and *Dactylophora semimaculata*.[1] He noted its generic identity with Richardson's species, but did not recognise that they were all merely growth stages of the one species. I forwarded one of the smallest of these to Mr. Ogilby for comparison with the type of De Vis' *Dactylophora*, and he informs me that it cannot be separated from that species. He also agrees that it is the young of *C. nigricans*.

Klunzinger has also described this young stage as *C. nebulosa*, and Steindachner has given a beautiful figure of it under that name This may be compared with the very rough figure of *Psilocranium* to show the difference between the young fish and the adult.

Family KYPHOSIDAE.

KYPHOSUS SYDNEYANUS, Günther.

Pimelepterus sydneyanus, Ogilby, Ed. Fish. N.S.Wales, 1893, p. 40, pl. XVI.
Kyphosus sydneyanus, Zietz, Trans. Roy. Soc. S. Austr., XXXIII, 1909, p. 267.

A single specimen, 235 mm. long, from Houtman Abrolhos, is similar to others from Port Jackson. Zietz has recorded the species from St. Vincent Gulf.

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[1] See Macleay, Proc. Linn. Soc. N.S.Wales, VIII., 1883, p. 441.

TEPHRAEOPS TEPHRAEOPS, Richardson.

Crenidens tephraeops, Richardson, Zool. "Erebus" and "Terror," Fishes, 1847, p. 69, pl. LXI, figs. 1-2.

Tephraeops richardsonii, Günther, Brit. Mus. Cat. Fish, I., 1859, p. 432. *Id.*, Klunzinger, Sitzb. Akad. Wiss. Wien., LXXX, i., 1879, p. 356. *Id.*, Macleay, Proc. Linn. Soc. N.S.Wales, V., 1881, p. 410.

Tephraeops tephraeops, Waite, Rec. Austr. Mus., VI., 1905, p. 63.

I count about 84 pores along the lateral line and 116 directly above it. Some notes on the teeth are given under *Melambaphes*.

Fremantle. One specimen, 290 mm. long.

MELAMBAPHES, Günther.

Melambaphes, Günther, Ann. Mag. Nat. Hist., (3), XI, 1863, p. 115 (*M. nigroris*, Günther=*Girella zebra*. Rich.; not *Glyphisodon nigroris*, Cuv. and Val.)

Girellichthys, Klunzinger, Arch. Naturg., XXXVIII, i., 1872, p. 22 (*G. zebra*. Rich.)

Neotephroeops, Castelnau, Proc. Zool. Soc. Vict., I., July, 1872, pp. 68, 248 (*N. zebra*, Richardson).

This genus differs from *Tephraeops* only in having the whole operculum scaly, the body scales somewhat larger, and the anal fin with an even margin, the anterior rays not being produced beyond the general line of the fin.

The teeth of the two are similar. Richardson described the vomer and palatines as toothless in *Tephraeops*, while Klunzinger found a group of small teeth on the vomer in *Girellichthys*. In my specimens of both genera, there are two or three minute, isolated, fixed teeth on the vomer, and a similar patch on the hinder end of each palatine bone; besides these, there are numerous microscopic setiform, dermal teeth, which are quite soft, surrounding the stronger fixed ones. All these teeth are very difficult to find, and might be easily overlooked.

MELAMBAPHES ZEBRA, Richardson.

Crenidens zebra, Richardson, Zool., "Erebus" and "Terror," Fishes, 1847, p. 70.

Tephraeops zebra, Günther, Brit. Mus. Cat. Fish., I, 1859, p. 432. *Id.*, Ogilby, Cat. Fish. N.S. Wales, 1886, p. 18.

Melambaphes nigroris, Günther, Ann. Mag. Nat. Hist., (3) XI, 1863, p. 115. (Not *Glyphisodon nigroris*, Cuvier and Valenciennes.)

Girella zebra, Steindachner, Sitzb. Akad. Wiss. Wien., LIII, 1866, p. 430, pl VI, fig 2.

Neotephroeops zebra, Castelnau, Proc. Zool. Soc. Vict., I, 1872, p. 69. *Id.* Macleay, Proc. Linn. Soc. N.S. Wales, V., 1881, p. 410.

Girellichthys zebra, Klunzinger, Arch. Naturg., XXXVIII, i., 1872, p. 22, and Sitzb. Akad. Wiss. Wien, LXXX, i. 1879, p. 356.

Mr. C. Tate Regan has, at my request, very kindly compared Günther's type specimen of *Melambaphes nigroris* with Steindachner's figure of *Girella zebra*, and writes to say that he has no doubt they represent the same species. Castelnau (*loc. cit.* p. 68) has given reasons for supposing that Günther's determination of the Victorian fish as *Glyphisodon nigroris*, Cuvier and Valenciennes, is incorrect. I fully agree with this conclusion, particularly as the latter species is said to generally resemble *G. rahti* and *G. bengalensis*, which are very different in appearance to *Melambaphes*.

I have examined four specimens from Albany, 180-290 mm. long. Of these one has thirteen dorsal spines, two have fourteen, and one has fifteen. There are 64-70 pores along the lateral line, and 90-100 scales immediately above it. A skin received from Count Castelnau as *Neotephroeops zebra*, is also in the Australian Museum.

Family CHAETODONTIDAE.

HOLACANTHUS (CHAETODONTOPLUS) PERSONIFER, sp. nov.

PLATE XXXI.

D.XIII.19; A.III.19; V.I.5; P.19; C.15. Body more elongate than is usual in the genus, the depth before the ventrals 2.3 in the length to the hypural. Head 4.7 in the same.[1] Eye $3\frac{3}{4}$ in the head, as long as the snout without the upper lip. Interorbital space convex, about half as wide again as the eye. Suborbital bone a little wider than the eye. Maxillary vertical, lower jaw the longer. Posterior preopercular margin finely dentate, lower entire; the spine is very large, longer than the width of the interorbital space. Teeth cardiform, tricuspid, the median cusp much larger than the others; they are arranged in about five rows in each jaw of which the outer ones are the longest.

Entire head, body and fins, with the exception of the ventral rays, covered with minute, strongly ctenoid scales which are very irregularly arranged. Lateral line distinct anteriorly, scarcely

[1] The anterior portion of this specimen having been partially cleaned out and refilled with straw, the head is somewhat distorted, and these measurements may not be quite accurate.

traceable posteriorly; it originates above the operculum and is curved upwards towards the back, with which it appears to run nearly parallel to the end of the dorsal fin.

Dorsal commencing above the end of the operculum, the first spine rather short, the next two increasing rapidly in length, the others becoming gradually longer to the last. The margin of the fin is almost straight, the soft portion broadly rounded behind. Anal of similar form to the dorsal. Upper pectoral rays longest; the margin of the fin rounded. First ventral ray a little produced, and somewhat longer than the pectoral fin. Caudal slightly emarginate.

Colour.—Head grey, with large yellow spots. The anterior portion of the body and chest is bright yellow shading into white, this colour forming a sharp line with the deep black of the rest of the body which forms a backward curve from the first dorsal spine to the ventral fin. The black colour projects forward behind the pectorals on to the coracoid bone, and the basal half of the pectoral fin is also of this colour. Ventrals yellow with white tips. Dorsal and anal black like the body, as is the greater part of the caudal which bears a lunate, yellow, submarginal band with a narrow blackish border.

Described from a single example, 290 mm. long, from Shark Bay.

I am indebted to Mr. W. B. Alexander for notes on the life-colours of this specimen.

The colour pattern distinguishes this species from all others of the genus known to me, though I have been unable to compare it with *H. zebra*, *H. reginae*, and *H. caudibicolor* of Lienard.[1] It appears to be nearest allied to *H. conspicillatus*, Waite.[2]

HOLACANTHUS DUBOULAYI, Günther.

Holacanthus duboulayi, McCulloch, Rec. Austr. Mus. IX., pt. 3, 1913, p. 360, pl. XIV.

Port Hedland. Two specimens, 130-140 mm. long.

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1 Lienard in Sauvage, Hist. Madagascar, XVI., 1891, pls. XXIX., XXXII., and XXXIV.

2 Waite, Rec. Austr. Mus., III., 1900, p. 203, pl. XXXV.

Family CARANGIDAE.

TRACHINOTUS RUSSELII, Cuvier and Valenciennes ?

Trachynotus russellii, Day, Fish. India, 1878, p. 233, pl. LI, b, fig. 3.
Trachinotus russelli, Stead, Ed. Fish N.S.Wales, 1908, p.29, pl. LXII.

D.VII. 24 ; A.II.I.20. Head 3.53, depth 2.24 in the length to the hypural. Eye a little shorter than the snout, 4.3 in the head. Maxillary reaching to below the anterior portion of the pupil. Pectoral 1.3, ventral 2 in the head and reaching to the vent. Dorsal lobe a little shorter than the base of the soft portion of the fin ; anal lobe longer, longer than the base of the fin. Caudal lobes, measured from the hypural, almost equal to the height of the body; 2.26 in the length. An indefinite dark spot above the origin of the lateral line followed by four others placed just above the line, the last very indistinct. Dorsal and anal lobes dark as are the outer margins of the caudal.

One specimen, 265 mm. long, from Bernier Island.

An examination of the specimens of *T. russelii* available to me indicates considerable variation in this species and particularly in the depth of the body, length of the fin-lobes, etc., but the West Australian example has a larger head and more obtuse snout that others from Port Jackson and Lord Howe Island.

Ogilby has suggested[1] that the records of *T. russelii* and *T. baillonii*, Lacépède, from Australia require verification. It is of interest to note, therefore, that I have collected the latter at Murray Island in the Torres Strait, while I cannot separate Port Jackson and Lord Howe Island examples from *T. russelii*.

Family BLENNIIDAE.

BLENNIUS TASMANIANUS, Richardson.

Blennius tasmanianus, Waite, Rec. Austr. Mus., VI., 1906, p. 205, pl. XXXVI., fig. 5. *Id.*, Hall, Proc. Roy. Soc. Tasm., 1902, p. 1.

Seven examples of this extraordinarily variable species from Fremantle, do not differ from some Tasmanian specimens in the Australian Museum. Length 47-77 mm.

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[1] Ogilby, Proc. Roy. Soc. Qld., XXI, 1908, p. 15.

Family BATRACHOIDIDAE.

Genus PSEUDOBATRACHUS, Castelnau ?

? Pseudobatrachus, Castelnau, Res. Fish. Austr. (Vict. Offic. Rec. Philad. Exhib.), 1875, p. 24 (*P. striatus*, sp. nov.)
Batrachomoeus, Ogilby, Ann. Qld. Mus., No. 9, 1908, p. 46 (*B. minor*, sp. nov. =*Batrachus dubius*, Shaw).

I follow Ogilby in regarding *Pseudobatrachus* and *Batrachomoeus*, as probably identical, but prefer to use the earlier name until they can be shown to be distinct.

PSEUDOBATRACHUS DUBIUS, Shaw.

Lophius dubius, Shaw in White, Voy. N.S. Wales, 1790, p. 265 and plate.
Batrachus dubius, Richardson, Voy. "Erebus" and "Terror" Fishes, 1844. p. 16, pl. X, figs. 1-2. *Id.*, Günther, Brit. Mus. Cat. Fish, III, 1861, p. 169, and Ann. Mag. Nat. Hist. (3), XX, 1867, p. 61. *Id.*, Castelnau, Proc. Linn. Soc. N.S. Wales, III, 1879, p. 353. *Id.*, Macleay, Proc. Linn. Soc. N.S. Wales, V. 1881, p. 572. *Id.*, Ogilby, Cat. Fish. N.S. Wales, 1886, p. 31.
Batrachoides dubius, Waite, Mem. N.S. Wales Nat. Club, 1904, p. 54.
Thalassophryne coeca, de Vis, Proc. Linn, Soc. N.S. Wales, IX, 1884, p. 547.
Batrachomoeus coecus, Ogilby, Ann. Qld. Mus., No. 9, 1908, p. 49.
Batrachomoeus minor, Ogilby, Ann. Qld. Mus., No. 9, p. 47.
? Batrachus trispinosus, Kner, Reise "Novara," Zool., I., 1865, p. 189 (not of Günther).

[? Not *Batrachus dubius*, Alleyne and Macleay, Proc. Linn. Soc. N.S. Wales, I., 1877, p. 335. *Id.*, Macleay, *loc. cit.*, VIII, 1883, p. 267.

Opsanus dubius, Jordan and Seale, Bull. U.S. Fish. Bur., XXV, 1906, p. 416 after Macleay.

Pseudobatrachus striatus, Castelnau, Res. Fish. Austr. (Vict. Offic. Rec. Phliad. Exhib.), 1875, p. 24.

Batrachus striatus, Macleay, Proc. Linn. Soc. N.S. Wales, V., 1881, p. 574.]

The first notice of this fish consists of a few lines of descriptive matter, accompanied by a very defective figure. No definite locality is given for it, though judging from White's narrative, it was almost certainly collected in, or very near, Port Jackson. Only one species of the Batrachoididae occurs near Sydney, where it is not uncommon, and is doubtless identical with that figured by Shaw. Ogilby[1] has placed *B. dubius* in the synonymy of *Coryzichthys diemensis*, Le Sueur, but I see no reason to accept this especially as that species is not so far known from New South Wales.

Ogilby described specimens from Moreton Bay as *Batrachomoeus minor*, and while recognising their probable identity with the

[1] Ogilby, Ann. Qld. Mus., No. 9, 1908, p. 51.

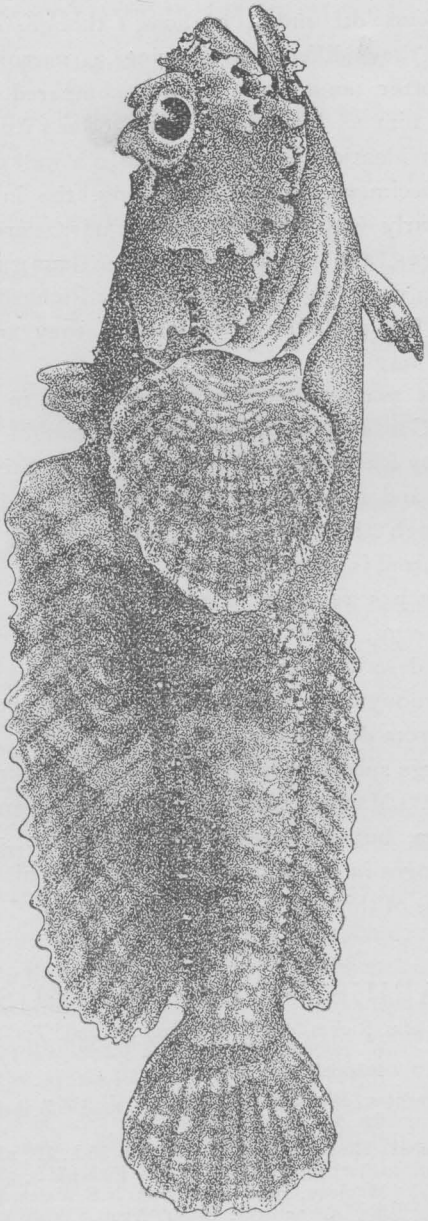

FIGURE I.

Pseudobatrachus dubius, Shaw.

Batrachus dubius of most authors, though not of Shaw, he considered they differed in having a narrower interorbital space and shorter tentacles. I have compared two specimens received from him as his species, with others from Port Jackson and find them identical in every way. In a well graduated series of fourteen specimens, 45-320 mm. long, the interorbital width increases regularly with size, being much narrower than the eye in young specimens, and considerably wider than it in adults. The tentacles are always short and thick. In Richardson's figure, by which Ogilby has probably been guided, they are shown much too long and straggling.

There is a young specimen 102 mm. long, in the Australian Museum from Garden Island, Port Jackson, caught and beautifully preserved by my friend Staff Paymaster P. B. Stevens, R.N. It shows the form and arrangement of the tentacles and colour particularly well, though the former are proportionately larger than in older examples, and is figured above.

Mr. Ogilby has recently informed me he is now sure that *Thalassophryne coeca*, de Vis, is merely the adult of the estuarine form which he described as *Batrachomoeus minor*. He also agrees that both are synonymous with *P. dubius*, de Vis' specimen being a large example from deep water.

A single large specimen is in the Western Australian Museum from Fremantle. Macleay recorded specimens from Torres Strait and New Guinea, but the records need verification, since his specimens are no longer in the Macleay Museum and his identifications of all specimens of this family were very faulty.

Family ANTENNARIIDAE.

ANTENNARIUS UROPHTHALMUS, Bleeker.

Chironectes caudimaculatus, Richardson, Zool. "Erebus" and "Terror," Fishes, 1848, p. 125, pl. LX., figs. 8-9 (perhaps not *C. caudimaculatus*, Rüppell.)

Antennarius caudimaculatus, Bleeker, Atl. Ichth., V., 1865, p. 15, pl. CXCVII. fig. 6.

Antennarius urophthalmus Bleeker, Nat. Tyd. Ned. Ind., II., 1851, p. 488. *Id.*, Günther, Brit. Mus. Cat. Fish., III., 1861, p. 192. *Id.*, Macleay, Proc. Linn. Soc N.S.Wales, II., 1878, p. 356. *Id.*, Klunzinger, Sitzb. Akad. Wiss. Wien., LXXX, i., 1879, p. 388.

A specimen from Broome, 120 mm. long, agrees very well with Richardson's and Bleeker's figures of this species. It has not previously been recorded from Western Australia.

PTEROPHRYNE HISTRIO, Linnaeus.

Antennarius marmoratus, Günther, Journ. Mus. Godeffroy, V., 1876, p. 162, pl. C. fig. a.

One specimen from Western Australia without definite locality. Length 67 mm.

Family TETRAODONTIDAE

SPHEROIDES PLEUROGRAMMA, Regan.

Tetrodon hypselogeneion, Steindachner, Sitzb. Akad. Wiss. Wien, LIII, 1866, p. 478, *Id.*, Günther, Brit. Mus. Cat. Fish., VIII, 1870, p. 277 (part). *Id.*, Macleay, Proc. Linn. Soc. N.S.Wales, VI. 1881, p. 337. *Id*, Waite, Rec. Austr. Mus., V., 1903, p. 38 (not *T. hypselogeneion*, Bleeker).

Tetrodon pleurogramma, Regan, Proc. Zool. Soc., 1902 (1903), II., p. 300, pl. XXIV fig. 2.

A large example, 165 mm. long, from Fremantle, differs from smaller ones from Eastern Australia only in having the white spots on the back larger and more distinct. The Australian Museum collection includes specimens from near Sydney, New South Wales; Moreton Bay, Queensland; and Lord Howe Island.

Family BALISTIDAE.

ABALISTES STELLARIS, Bloch and Schneider. var. PHALERATUS, Richardson.

Balistes phaleratus, Richardson, Stokes' Discov. in Austr., I., 1846, p. 484, pl. V., fig. 4.

Balistes stellatus, Günther, Brit. Mus. Cat. Fish., VIII., 1870, p. 212.

Two young specimens from Port Hedland, 110-115 mm. long, differ from Indian specimens of the typical *stellaris* in some details of colour marking. Instead of the small light spots on the body, the sides bear numerous large angular grey spots, and the blackish marking on the upper parts is formed of similar darker spots placed closer together. The first dorsal is largely black, and the second dorsal, anal, and caudal are marked with large greyish spots and bands, the last named fin also having a blackish margin. This form is evidently a variety of *A. stellaris*, and was described and figured from Western Australia by Richardson as *B. phaleratus*.

REVISION OF THE FRESHWATER CRAYFISHES OF SOUTH-WESTERN AUSTRALIA.

BY

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ZOOLOGIST, AUSTRALIAN MUSEUM.

PLATES XXXII TO XXXV.

Most of the material on which the following notes are based, was received in January 1912 from Mr. Bernard H. Woodward, Director of the Western Australian Museum. At my request, he very kindly collected together a large series of specimens of all sizes from various scattered localities. These prove to belong to three species of the genus *Cheraps*, and may be reasonably supposed to be representative of the fresh-water crayfishes of South-western Australia. I am indebted, also, to Mr. W. B. Alexander for information on other specimens, since received by the Western Australian Museum. There are also a few examples in the Australian Museum which were collected near Perth and at Albany by Mr. A. Abjornssen, Inspector of Fisheries, Western Australia.

While engaged on the preparation of these notes I learnt that Mr. Geoffrey Smith was to read a paper before the Zoological Society of London on the crayfishes of Australia, and I preferred to avoid confusion by waiting until it had been published.[1] The greater part of the material available to him was collected in Tasmania and Victoria, though he had a few specimens from South-western Australia. Those I have examined belong to the same species as identified by him, but having a large and apparently representative series of each, I have been able to describe and figure some noticeable variations in their specific characters.

[1] Smith, Proc. Zool. Soc., 1912, pt. I., pp. 144-171, pls. XIV-XXVII.

CHERAPS, Erichson.

Cheraps, Erichson, Arch. fur Naturg., XII, i., 1846, p. 101. *Id.*, Von Martens, Monastb. Ak. Wiss. Berlin, 1868 (1869), p. 616.

Chaeraps, Smith, Proc. Zool. Soc., 1912, p. 165.

(Not *Cheraps*, Huxley, Proc. Zool. Soc., 1878 (1879), p. 768.)

The genus *Cheraps* was first defined by Erichson as a sub-genus of *Astacus*, Milne Edwards, for his *C. preissii*, but his definition does not include some of the most important characters by which the several genera of the family Parastacidae are distinguished.

Huxley, in 1868, raised it to the rank of a genus, and described the branchial structures in detail, but he only had a specimen from the Yarra River, Victoria, which he could not, with certainty, identify as a true *Cheraps*. Taking into consideration Smith's recent investigations on the Crayfishes of Australia, it is almost certain that Huxley's specimen was *Astacus bicarinatus*, Gray, which Smith made the type of his *Parachaeraps*. Therefore, *Cheraps* of Huxley, but not of Erichson, is identical with *Parachaeraps*.

Smith has again defined *Cheraps*, his definition being based on *C. quinquecarinatus*, Gray, *C. tenuimanus*, Smith, *C. quadricarinatas*, Von Martens, and *C. intermedius*, Smith, but unless these can be shown to be generically identical with the lost *C. preissii*, their claim to inclusion in *Cheraps* cannot be proved. For reasons given below, however I regard *C. intermedius* as synonymous with *C. preissii*; if this conclusion be accepted, it follows that Smith's definition correctly applies to *Cheraps*, Erichson.

CHERAPS PREISSII, Erichson.

Astacus (Cheraps) preissii, Erichson, Arch. fur Naturg., XII, i., 1846, p. 101. *Id.*, Von Martens, Monatsbr. Ak. Wiss. Berlin, 1868 (1869), p. 617.

Astacopsis preissii, Haswell, Cat. Austr. Crust., 1882, p. 177.

Chaeraps intermedius, Smith, Proc. Zool. Soc., 1912, p. 168, pl. XXIV., fig. 2, and pl. XXVII., fig. 34.

C. preissii was very imperfectly described from a specimen taken in South-Western Australia and has not again been recognised.[1] This unique specimen is apparently lost since Dr. Von

[1] I consider the specimens from Victoria which Ortmann (Zool. Jahrb. VI., 1891, p. 8, pl. I., fig. 1.) identified as *C. preissii* to be almost certainly *Parachaeraps bicarinatus*, since it is improbable that a species occurring in the fresh waters of South-western Australia would also be found in Victorian rivers. Some notes on the distribution of *P. bicarinatus*, are given under the heading of that species.

Martens was unable to find it in the Berlin Museum in 1868, and Professor A. Brauer, Director of that Institution, has very kindly informed me that it is not there now, and that he does not know where it is.

For the purpose of this paper, I have examined over one hundred crayfish from several widely separated localities in South-western Australia. Most of these were received from Mr. Woodward who made special efforts to secure good series of as many different species as possible. They represent only three species—*C. quinquecarinatus*, *C. tenuimanus*, *and C. intermedius* and hence I suppose that no other occurs in that part of the Continent. Therefore, the lost *C. preissii* is identical with one of these, and for reasons given below, I believe that one to be *C. intermedius*.

According to Erichson the margins of the rostrum are entire while he does not note the presence of any keels on the carapace. In *C. tenuimanus* the rostrum is armed with several strong lateral teeth, and the carpace bears three keels in addition to the two extending backwards from the rostrum. *C. quinquecarinatus* also has five keels. *C. intermedius*, on the other hand, has only two which are more obtuse and less elevated than those of the other species, while the teeth of the rostrum are sometimes so small as to be easily overlooked; in addition to these facts, such other characters as Erichson has given, agree very well with my specimens of *C. intermedius*. Erichson's specimen was only three inches five lines long, and the chelae measured one inch in length and five lines in breadth. These proportions agree much better with Smith's *C. intermedius* than with another which I propose to separate as var. *angustus*, in which the chelae are much narrower, particularly in young specimens.

The following are the principal characters of the species as exhibited by eighteen specimens 95-161 mm. long from the tip of the rostrum to the end of the telson.

Carapace finely pitted above, minutely tubercular on the lower parts of the sides, the tubercles a little larger anteriorly; a series of slightly enlarged tubercles on the sides behind the cervical groove. Two obtuse keels, each terminating anteriorly in a very blunt spine or tubercle. Rostrum almost horizontal or obliquely deflexed, not reaching the end of the antennal scales; it is flat above and the margins are defined by very narrow, scarcely raised keels.

It ends in a spine and there are two, inconspicuous, lateral serrations on each side near the tip. Abdomen with pits, but otherwise smooth.

Chelipeds massive, the hand either half, or usually more than half as broad as long. It is smooth and rounded above with minute, rather scattered pits which become larger and more crowded on the outer surface. Inner margin raised, with seven to nine serrations which form rounded tubercles in large specimens; a tomentose patch inside this margin. Fingers either meeting along their whole length or more or less widely gaping. Mobile finger with a rounded tubercle about the middle of its length, which may be either extremely small, or large and followed by several smaller ones. Immobile fingers with a row of larger or smaller tubercles along the basal half. Wrist with a large blunt internal spine and sometimes a second smaller one at its base.

The colours are faded, but the chelae appear to have been purplish with many lighter spots.

Of the eighteen specimens, eleven are from Kojonup; six were collected in a billabong at Harvey, Harvey River; and one from Guildford, near Perth. Mr. Alexander has also seen it from streams outside the Mammoth Cave and inside the Calgardup Cave, in the cave district, South-western Australia. The specimens from the latter were living absolutely in the dark.

CHERAPS PREISSII, var. ANGUSTUS, var. nov.

PLATE XXXII.

This variety differs from the typical form only in having more slender chelipeds and legs, and a slightly narrower carapace. The chelae are particularly narrow in my smallest specimen, and in this respect differ greatly from others of the typical form of about the same size in which they are almost similar to those of the adults. The colour, after long preservation, is a dark violet with light bluish areas on the sides and under parts.

The plate illustrates the only three specimens I have seen which were collected for the Australian Museum by Mr. A. Abjornssen, near Albany. They are 141, 102, and 78 mm. long from the tip of the rostrum to the end of the telson, and the largest and smallest are females.

CHERAPS QUINQUECARINATUS, Gray.

PLATE XXXIII.

Astacus quinque-carinatus, Gray, in Eyre, Journ. Exped. Centr. Austr., I, 1845, p. 410, pl. III, fig. 3.
Astacus (Cheraps) quinquecarinatus, Von Martens, Monatsbr. Akad. Wiss. Berlin, 1868 (1869), p. 616.
Astacopsis quinque-carinatus, Haswell, Cat. Austr. Crust. 1882, p. 176.
Chaeraps quinque-carinatus, Smith, Proc. Zool. Soc., 1912, p. 165, pl. XXIII and XXVII, fig. 25-29.

I have examined thirty-eight specimens of all sizes between 45 and 131 mm. long, from the tip of the rostrum to the end of the telson, and find but little variation in the essential characters of this species. There are some differences in the form of the chelae, which consist chiefly of an alteration in the shape of the fingers, they being narrow and somewhat pointed in some, and much broader and more obtuse in others. A tomentose patch on the upper surface of the hand, near the inner margin, is usually present, but may be absent.

Carapace finely pitted above; large specimens with some very minute tubercles on the lower anterior parts of the sides. A row of enlarged tubercles behind the cervical groove. Back with five keels, of which two are backward extensions of the lateral margins of the rostrum. The median keel arises between these last, and may run backward to the cervical groove or terminate well before that point; the outer keels form two sharper or blunter points anteriorly. Rostrum either horizontal or rather obliquely deflexed not reaching the ends of the antennal scales; its sides are elevated, leaving the upper surface more or less concave. It ends in a spine, and there are usually two, rarely one or three denticulations on each side near the tip. Its length and breadth is subject to a little variation. Abdomen pitted but otherwise smooth.

Chelipeds rather massive. The hand is comparatively elongate, its breadth being always distinctly less than half its length. It is smooth and rounded above with small scattered pits, which are a little larger and more crowded on the outer surface; the two largest specimens have a narrow, irregular groove along the middle of the upper surface. The inner margin is raised with seven to nine serrations; usually there is a tomentose patch just within this margin. Fingers either meeting along their entire length, or with a larger or smaller gape between them. They are armed with one or

more small rounded tubercles on their inner margins which are scarcely developed in the smaller examples. Wrist with a sharp internal spine, and often several smaller ones near its base.

Such specimens as retain any traces of colour appear to have been purplish with minute pale dots on the chelae.

The material described above was collected at the following localities in South-western Australia:—Chidlow's Well, north-east of Perth; near Perth; Cannington, south of Perth; seven miles above Harvey, Harvey River; Korijekup, Harvey River. According to Mr. Alexander, this species. which is known as the gilgie, is probably restricted to the smaller streams which do not dry up in the summer. In addition to the above noted localities, he has identified specimens from the Vasse River.

CHERAPS TENUIMANUS, Smith.

PLATES XXXIV & XXXV.

Cheraps tenuimanus, Smith, Proc. Zool. Soc., 1912, pt. I., p. 166, pl. XXII., and pl. XXVII., fig. 30.

A well graduated series of forty specimens, ranging from 57-296 mm. long from the tip of the rostrum to the end of the telson, shows considerable variation in the form of the chelae and rostrum, as well as in the armature of the latter.

The chelae are always much more slender in young specimens than in adults, while large specimens always have the fingers bent more or less obliquely inwards. The teeth on the inner margin of the palm are scarcely developed in small specimens, but become very prominent in adults; there are usually seven or eight, but may be as few as three. Though these alterations are correlated with growth, yet specimens of the same size are not always equally changed, some retaining their juvenile characters longer than others. Some different forms of chelae are illustrated on plate XXXV.

The rostrum has from three to six denticulations on either side which, as often as not, are not paired but more or less alternate. Its length and breadth are also variable; it may reach well beyond the antennular peduncle, or only to the middle of the last joint, but it never attains the tip of the antennal scale. A few of the most striking variations shown in my series are figured on plate XXXV.

The following are the principal characters of the species.

Carapace finely pitted above; large specimens have numerous sub-acute tubercles on the back and sides behind the cervical groove which can be traced more or less distinctly in all but the smallest specimens. There are usually four sharp spines on the sides directly behind the cervical groove. Back with five keels, of which two are backward extensions of the lateral margins of the rostrum. The median keel rises between these last and may run back to the cervical groove, or terminate well before that point. The outer keels each end in an acute spine anteriorly. Rostrum nearly horizontal or obliquely smooth in younger specimens but with numerous large and rounded tubercles in adults.

Chelae slender in young, massive in adults; the breadth varies from more than four to about two-and-a-half in the length, according to age. They are smooth and rounded above, with minute scattered pits which are more crowded on the outer surface. The inner margin is not raised upwards, and is usually provided with seven or eight tubercular denticulations. There is no tomentose patch on the upper surface in any of my specimens. Fingers either meeting along their whole length or with a greater or smaller gape between them. They each have a large tubercle on the basal halves o their inner margins, with one or two smaller ones behind them. Wrist with a moderately large internal spine.

This large and handsome species is apparently confined to the rivers of South-western Australia. Of the series examined the greater number were obtained in the Harvey River, seven miles above Harvey; one is from Korijekup, Harvey River; one from Margaret River; one from Balingup Brook; and three from the Warren River. Mr. W. B. Alexander informs me that it is known as the Marron, and that he has also seen it from Kojonup.

Genus PARACHAERAPS, Smith.

PARACHAERAPS BICARINATUS, Gray.

Parachaeraps bicarinatus, (Gray) Smith, Proc. Zool. Soc. 1912, pt. I., p. 163, pl XXI., and pl. XXVI., figs. 15-24.

Smith has described specimens of this species from Victoria, and states that "it is widely distributed all over Central, Northern, and Western Australia and in Queensland." Unfortunately, the

only definite localities he gives are a few in Eastern Australia. I am unable to find any records of its occurrence in Western Australia, though since it lives in the deserts of Central Australia, and at Port Essington it possibly extends into the central and northern parts of the Western State. As already stated it is not represented in a series of more than one hundred specimens from several widely separated localities in South-western Australia, its place being apparently taken by *Cheraps preissii* which resembles it both in appearance and in habits.

ON A SPECIMEN OF REGALECUS GLESNE, ASCAN., OBTAINED IN WESTERN AUSTRALIA.

— BY —

W. B. ALEXANDER, M.A.

PLATE XXXVIII.

On January 8th, 1913, the Museum obtained through Captain A. Abjornssen, Inspector of Fisheries, a fine specimen of an Oar-fish. It had been found on the shore of Rottnest Island a few days previously in a dying condition by a boy named Backhouse. As this curious fish is so rarely met with, as some doubt exists as to whether there is only one cosmopolitan species of Oar-fish, or whether there are a number of closely allied forms, and as this is the first authenticated record for the west coast of Australia, it seems worth while to give a short description of the present example.

Before doing so it will be well to notice briefly the records of previous occurrences of *Regalecus* in Australasian waters. The first example seems to have been obtained at Nelson, N.Z., in 1860, and since then some 15 other examples have been recorded from New Zealand. Of these, three are of special interest since they were made types of new species.

One obtained at New Brighton near Christchurch in 1876 was described by von Haast as *R. pacificus* (Trans. N.Z. Inst. X., p. 246) whilst one obtained at Moeraki in Otago Harbour was described by Parker as *R. argenteus* (Trans. N.Z. Inst., XVI, p. 284). Another, also obtained in Otago Harbour was made the type of *R. parkeri* by Benham (Trans. N.Z. Inst., XXXVI, p. 198). Other New Zealand specimens have been referred to *R. gladius* and *R. grillii*.

I can only find references to four previous occurrences of *Regalecus* in Australia, all from the East or South-east. The first obtained in Bass Strait in 1878 was described and figured by McCoy (Prodr. Zool. Vict., vol. II., p. 169) under the name of *R. banksi*. The second, found on the beach in the Tweed River District of Queensland, was made the type of a new species, *R. masterii*, by de Vis (Proc. Roy. Soc. Q'land, 1892, p. 109). The

third, obtained at Shark Beach in Port Jackson, N.S.W., in 1899, was described under the name of *R. glesne* by E. R. Waite (Rec. Austr. Mus., III, p. 163), whilst it appears that a fourth was stranded below the lighthouse at Cape Everard, in Victoria, in 1896 (Melbourne *Leader*, Aug. 1, 1896, p. 7). The present is therefore the fifth Australian specimen to be recorded in print, but from information obtained by Mr. O. Lipfert it would appear that a specimen was washed up on the beach at Bunbury, W.A., some ten or twelve years ago. Mr. Lipfert's informant states that he was on the beach with one or two other men when they observed the fish swimming on the surface, that as it neared the shore a shark bit the middle portion of the body right through, that the two halves were soon afterwards washed upon the beach and that he had the long oar-bones in his possession for many years afterwards.

The only specimen of *Regalecus* which has previously been recorded from the Indian Ocean was obtained at Vizagapatnam, in March, 1788. It remains the unique specimen of *Regalecus russellii*, Shaw, characterised especially by the presence of a distinct caudal fin. As it was only 2 feet 8 inches long it is possible that *R. russellii* was founded on a very young example and that the caudal fin is lost in later life. The tail is, however, so fragile that very few, if any, other examples have been obtained in which it is perfect.

Most recent authorities who have dealt with the genus have agreed that it is better to regard all the examples known, with the possible exception of *R. russellii*, as forms of one variable species, *R. glesne*, Ascan.

The present example falls within the limits of variability assigned to this species by Goode and Bean in their "Oceanic Ichthyology" in all respects, except the smaller number of dorsal rays, but it would not agree with any one of the other species described from Australasia.

As in most other examples our specimen was not perfect, as the fragile crest, the long ventral fins and the tip of the tail were all broken. The two former breakages had evidently occurred when the fish was washed ashore, and portions of the crest and oars were obtained with the fish. The tail, however had been broken at some former period, within a few inches of the tip and had subsequently healed.

The specimen is a comparatively small one, the total length being nine feet seven inches.

The following features are those in which different examples of *Regalecus* vary :—

Height from 1/12 to 1/24 of the length (Goode and Bean); the present example was 8¾ inches in height and 9 ft. 7 ins. long, hence the height was 1/13 of the length.

Length of the head contained from 16 to 20 times in the length of the body (Goode and Bean); the present example had a head 7 inches long, or 1/16 of the length of the body.

Teeth minute or absent (Goode and Bean); in this case they are absent.

Diameter of eye 4 to 6 times in length of head (Goode and Bean); the eye has a diameter of 1¼ inches or 5.6 times in length of head.

Dorsal rays 275 to 400 (Goode and Bean) ; our specimen has only 205 dorsal rays, and the small missing portion of the tail could not possibly have borne more than another 20.

Pectoral rays 11 to 14 (Goode and Bean); they are 12 in this example.

Goode and Bean also state that the skin has numerous bony tubercles, Parker points out in his description of *R. argenteus* that the tubercles which appear to be bony as long as the skin is moist, disappear when it is allowed to become completely dry. I found that this was the case with the present specimen.

The bases of the rays of the crest also agree precisely in their arrangement and relative thickness with those so caerfully described by Parker (loc. cit. and Trans. N.Z. Inst., XX, p. 20.)

On the other hand, the shapes and relative sizes of the opercular bones differ very markedly from those figured by Parker, and indeed from those in all the other figures which I have been able to find. The accompanying photographic illustration will show this better than I can describe it (cf. Benham, P.Z.S., 1906, p. 544.)

Unfortunately I was absent when the specimen reached the Museum and the sex was not determined nor the contents of the stomach noted. A plaster cast was prepared and the missing fins added and coloured from the details given by Clarke (Trans. N.Z. Inst., XXX, p. 253). The head and skin are preserved in the Museum collection. (Registered No. P 23).

A BRACHIOPOD NEW TO AUSTRALIAN WATERS.

— BY —

W. B. ALEXANDER, M.A.

On July 26, 1913, I visited Cottesloe Beach to look for marine animals which might have been washed up by the stormy weather of the earlier part of the week. My search was well rewarded by the discovery of a Brachiopod shell in good condition which I was able to identify from Davidson's work on "Recent Brachiopoda" as *Terebratulina radiata*, Reeve.

The species is characterised by the pair of ribs which run forwards along the dorsal valve, separated by a deep groove. On the ventral valve the middle line is occupied by a strong rib, with a groove on each side. The deltidial plates in my specimen are united, thus completing the foramen; Davidson states that this condition "appears to be the exception and not the rule." My specimen is 11 lines long, 8 broad and 6 deep; these dimensions agree with those given by Davidson except that for breadth, which he gives at 9 lines. He states, however that he had seen "a great many specimens of the shell, some as wide as long, others longer than wide", so that the width is a very variable feature.

It is possible that this species is really a variety of *Terebratulina cancellata*, Koch, which appears to be the only Brachiopod previously recorded from Western Australia, from which country the type-specimens were said to have been brought previous to 1843. This latter species occurs on the coasts of New South Wales, Tasmania and South Australia, and one would suppose that if *T. radiata* were only a variety of that species it would have been found with it in the other States.

Davidson says on this subject: "Mr. Lovell Reeve considers this to be a good and well-marked species, and in this statement I feel disposed to concur. I have seen a great many specimens of the shell . . . all presenting a more or less well-marked biplication. It is a smaller shell than *T. cancellata*, its nearest ally."

The latter attains a length of 1 inch 7 lines. With regard to habitat, Davidson states: "Mr Cuming possesses two or three specimens, all exactly alike, procured, he fancies, from the dredgings of Sir E. Belcher in the Strait of Corea. I have seen and possess a number of specimens of this shell, which Mr Sowerby assures me were obtained near the Cape of Good Hope, its probable habitat."

Since Davidson's work was published 25 years ago, it is quite possible that the species may have been found in the interval. I have looked through the papers dealing with Australian Brachiopoda by Dr. Verco and Mr. Hedley, neither of whom records this species in the lists for other parts of Australia. I think, therefore, that I can safely claim *Terebratulina radiata*, Reeve, as a species new not only to this State, but to the whole of Australia.

A NEW SPECIES OF EMBIID FROM WESTERN AUSTRALIA

— BY —

Dr. K. FRIEDERICHS (Apia, Samoa).

(The English translation has not been revised by the Author).

The following description is founded on two dry examples which I received for identification from the Western Australian Museum at Perth.

OLIGOTOMA HARDYI, n. sp.

Male. Winged. Posterior branch of the radial ramus[1] not forked in either wing, rather strongly developed, but not reaching the tip of the wing; the same remarks apply to the median, whilst the cubital is absent. Anal present.

The wing-veins which are present, as well as the line of the absent cubital, are brown-edged; so that, apart from the anal, five double brown longitudinal lines are present and the wings look rather darkly striped to the naked eye.

Transverse veins numerous. In the forewing six between the anterior margin of the wing and the first radial branch (these are only weak, the rest are stronger); four between the first and second radial branches; three between the latter and its successor; and two in the space to the median. In the hindwing the corresponding numbers are: three, four, two, two. As in the other species the number of transverse veins varies. This species may be said to have much better developed wing-veins than all other known species.

Antennae with 21 segments. Eyes large, projecting, kidney-shaped, broader than long (as seen from above). The whole head about $4\frac{1}{2}$ times as long as the eye. Lateral borders of the head converging posteriorly and slightly rounded.

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[1] The terminology employed is that of Enderlein's Monograph of the Embiidae.

Prothorax somewhat narrower than the posterior margin of the head, the apotom separated off by a distinct constriction. Meso- and meta-notum naked (the rest of the body covered with stiff hairs.)

Legs without peculiarities (so far as I could ascertain from these dry specimens). Front tarsi with the normal oval metatarsus, convex above, for use in spinning.

Extremity of the abdomen; 10th tergite divided longitudinally; the right half produced into a long pointed process, the left with a short round termination. The appendage of the 9th sternite (penis ?) projects straight back and appears to be bifid; its anterior portion is hidden by the middle part of the 10th tergite. Basipodite of the left cercus flattened, produced inwards; the first joint of the left cercus strongly club-shaped, posterior half produced inwards and toothed on that side; the second joint short, thick and cylindrical. (It is difficult to determine the precise structure of the extremity of the abdomen in dry specimens).

Colour.—Dark brown, meso and meta-notum and parts of the legs lighter; the first segments of the antennae yellowish brown.

Dimensions.—Specimen 1—length 11½ mm.

Specimen 2—length 10 mm.

Wings the same size in both specimens—length 11-10 mm., breadth 2½-2¼ mm.

Habitat.—Western Australia. Captured in Perth by Mr. G. H. Hardy, now at the Tasmanian Museum, Hobart. They flew into a room in company with several other individuals attracted by the light of a lamp in June, 1912.

Remarks.—This species does not agree with the diagnosis of the genus Oligotoma given in either of the Monographs (those of Krauss and Enderlein). Yet, there is no doubt that *O. hardyi* is an Oligotoma.

It differs from Enderlein's diagnosis in the strong development of the median and the posterior branches of the radial ramus, and in the absence of a process on the left half of the 10th tergite. From Krauss' diagnosis it differs in possessing teeth on the much-thickened first joint of the left cercus. *O. heymonsi*, End., also differs from this diagnosis in having the same organ toothed, whilst in *O. greeniana*, End., the left process of the 10th tergite is also absent.

Whilst in Sydney I had the opportunity of examining the type (male) of Froggatt's Australian Embiid (*O. gurneyi*) in the Agricultural Museum. It is a dry specimen without an abdomen. The neuration characterises the species as an Oligotoma. From the present species it may be distinguished by its smaller size and lighter colour (the whole body is light brown, the head no darker than the thorax) as well as by the wing-veins. The (unforked) posterior portion of the radial ramus is only well-developed at its proximal end, the remaining part being only faintly indicated. The same is true of the median and the cubitus. The eye as seen from above is almost circular (as in Enderlein's figure of *O. saundersi*). It is possible that it may be one of the cosmopolitan species (*saundersi* or *latreillei*) but a reliable identification of this specimen is obviously out of the question.

THE MAMMOTH CAVE

(*Continued*).

By LUDWIG GLAUERT, F.G.S., etc.

ORDER MONOTREMATA. Fam. Tachyglossidae.

Zaglossus Gill (1877).[1]

Proechidna, Gervais .. Ostéog. Monot. Viv. et Foss., p. 43, 1877.
Acanthoglossus, Gervais .. Comptes Rendus, Paris LXXXV No. 19, p. 838, 1877.
Bruijnia, Dubois .. .. Bull. Soc. Zool. Franc. VI for 1881. No. 6, p. 267-270, 1882.

ZAGLOSSUS HACKETTI, sp. nov.

HACKETT'S GIANT ECHIDNA.

Plates XXXVI-XXXVII.

The bones about to be described were collected in the Mammoth Cave, where they where found intermingled with the remains of *Sthenurus*, *Macropus*, etc., in the older portion of the deposit first examined in 1909.

They comprise the atlas vertebra, the clavicles and episternum, the pelvic girdle, two femora, a tibia and a radius.

The limb bones are all twice the length of those of the living species of Echidna (*Tachyglossus aculeatus*) and in addition are stouter in proportion. The bones of the trunk show a similar superiority in dimensions.

Fossil Echidnas of large size have been known in Australia for many years. In 1868[2] Krefft described the proximal end of a humerus which he named *Echidna oweni*, and in 1884[3] Prof. Owen examined the cast of a more perfect example (*E. ramsayi*) which is now regarded as identical with the former species, to which have also been ascribed the other remains of large fossil Echidnas in the Australian Museum, Sydney. In 1895[4] Mr. W. S. Dun fully described the imperfect skull and atlas vertebra of a larger animal, which he named *Echidna* (*Proechidna*) *robusta*.

[1] Ann. Record Science and Industry for 1876, p. clxxi, which appeared on May 5th, 1877. Gervais Ostéog. Monotrémes Viv. et Foss., p. 43, was published on Nov. 30th, 1877, hence Gill's name has priority over that proposed by Gervais. *Fide* Palmer.
[2] Ann. Mag. Nat. Hist. (4) Vol. 1, p. 113 (1863).
[3] Phil. Trans. 1884, p. 273.
[4] Rec. Geol. Surv. N.S. Wales, vol. IV, part 3, p. 121 (1895).

Description of the Remains.

The atlas vertebra is perfect, its inferior arch completely ossified and the transverse processes fused to the rest of the vertebra. Its neural arch is well developed antero-posteriorly, it has a steeply inclined anterior surface and a gradually sloping posterior one. The neural spine is represented by an anteriorly directed tubercle from the base of which a rounded ridge extends to the anterior border of the transverse processes. The greatest width of the anterior surface of the arch is but 6.5 mm. compared with 10.5 in *E.* (*P.*) *robusta*. The extent of the posterior surface, measured from the tip of the neural spine to the posterior margin is 15 mm., the arch is not as flat as in Dun's specimen and is much more slender, although it helps to form a larger concavity for the reception of the odontoid process of the axis. The inferior arch is slender and agrees with Dun's figures,[1] but the curve is not quite so regular, resembling *Tachyglossus* in this respect. Both the anterior zygapophyses are large, irregular in outline, with an anterior lobe, their lower end passes imperceptibly into the inferior arch. They are concave vertically and almost flat horizontally. The posterior zygapophyses are ear shaped and possess well-marked posterior lobes; downwards they merge gradually into the inferior arch, their apex projects from the lateral mass to a marked degree; they are but slightly concave vertically and horizontally. The transverse processes are complete, they extend outward and backward with a slight downward curve and a well marked ridge on their external border; there is a slight concavity in the anterior region of their upper surface, but the main mass of each process is convex above and below.

The area bounded by the neural and inferior arches is deeper and broader than in *E.* (*P.*) *robusta*. The extreme width of the vertebra, including the transverse processes is 59 mm. and the heighth to the tip of the neural tubercle 33 mm.

The united clavicles and episternum form a bow-shaped mass whose constituents are completely fused, rendering it impossible to distinguish the individual clavicles and the upper part of the T-shaped episternum. It is roughly tribedral in section, the well marked antero-superior ridge gradually passing downwards to the

[1] *Loc. cit.* pl. XI, figs. 5 and 6.

origin of the vertical member of the episternum. The inferior and the postero-superior angles are more rounded and constant in position.

The imperfect pelvic girdle comprises two fused sacral vertebrae and part of the right innominate bone with the complete, perforated articular cavity and the adjacent portions of the ilium and ischium. The sacral vertebrae, the second and third of the series, have marked intervertebral cavities and their neural spines fused together at their tips, the neural arches also send out bony processes forwards and backwards to completely cover the neural canal. There are the usual lateral openings for the passage of the nerves. The anterior vertebra is attached to the ilium by the usual lateral growths from centrum and neural arch and the posterior one by the pleurapophysial ossification only. The vertebrarterial passage on the right side is larger than the neural canal.

The ilium is trihedral; its fusion with the other components of the innominate bone complete, its acetabular border short and concave, with the prominence for the attachment of the rectus (extensor) muscle of the leg forming a prominent compressed sublunate area close to the rim of the acetabulum—in the Australian *Tachyglossus* this surface is markedly triangular. The acetabulum is large, more ovate than in *Tachyglossus*, somewhat flattened on the dorsal surface, incompletely ossified but with an entire margin; its dimensions are 40 mm. x 34 mm. The pubis has a well-marked pectineal process which is comparatively more developed in *Tachyglossus*. Very little of the broad flat ischium is preserved.

Both femora are present in the collection. The complete right one (plate XXXVI, fig. 1) is short and broad, flattened from before backwards with a well defined head that rises but little above the great trochanter on a short and indistinct neck; in this it differs from the femur of *T. a. ineptus* (plate XXXVI, fig. 2), and from the fossil *Z.* (*Echidna*) *oweni* specimen F13580 of the Australian Museum, represented in this collection by a cast, whose heads rise considerably above the trochanter. The great trochanter is much more massive than in the living form and gives rise to a strong, rough, projecting ridge that extends along two-thirds of the shaft, where it ends abruptly. The lesser trochanter on the inner side of

the shaft is situated more distally then in the living Echidna, rising sharply at a point 20 mm. from the head, from this point a well-defined ridge runs to the distal end of the shaft.

At the longitudinally compressed, and transversely expanded distal extremity, the trochlear articular surface is well marked, in front it is slightly curved transversely and convex vertically, posteriorly it is divided into two condyles by a wide and deep intercondylar notch, which in comparison is deeper and broader than in the living Echidna.

The tibia (plate XXXVII) is straight, laterally expanded at the proximal and distal ends with a relatively slender shaft; the anterior convexity of the proximal end of the shaft (the tuberosity for the tendons of the extensor muscles) is separated from the lateral expansions by two shallow grooves which gradually diminish as the shaft becomes more slender, till finally the anterior surface becomes a regular convexity.

At the distal end of the bone and at some distance above it on the posterior aspect (plate XXXVII, fig. 3) the concavities and convexities for the reception of the bones of the ankle joint and of the adjacent fibula are very prominent; they show no material difference in arrangement from the corresponding features in the Echidna *T. a. ineptus* represented in the Museum Collection.

The fore limb is represented by the right radius only. The bone is more slender than the tibia, has its heads much expanded laterally; these are excessively developed in directions at right angles to one another. The oval hollow for the reception of the humerus is deep with a marked thickening at its posterior margin. The distal end has two concavities separated by a convex ridge to fit into the convexities of the scapholunar, and the small sesamoid bone developed in the tendon of the flexor carpi radialis, the concavities are sub-equal, but in *Tachyglossus aculeatus ineptus*, the living species of Western Australia, the outer one is much the larger. The interosseous ridge and the tracts for the attachment of the muscles are also situated more distally, but the most noticeable difference between the species is the extreme robustness of the fossil form.

The minimum antero-posterior diameter of the radius of the living species is 3.5 mm., whereas, in the bone of the fossil species

which is approximately twice the length, the least diameter in the same direction is 9.5 mm., the other dimensions of the shaft are in proportion.

On account of this striking characteristic noted in all the bones at present collected, and of its excess in size over the largest known forms, it is proposed to regard this animal from the Mammoth Cave as the type of a new species to which the name of *Zaglossus hacketti* has been given, in honour of Sir J. Winthrop Hackett, K.C.M.G., etc., the President of the Board of Trustees, as a slight acknowledgement of his generous support which alone rendered the exploration of these caves possible.

ORDER MARSUPIALIA. SUB-ORDER POLYPROTODONTIA.

Family DASYURIDAE Sub-Family DASYURINAE.

Thylacynus, Temm. (1827) [1]

THYLACYNUS CYNOCEPHALUS, Harris (1808) [2]

THE TASMANIAN WOLF OR TIGER.

An interesting specimen from the upper layer [3] in the Mammoth Cave consists of an almost complete left mandible with four cheek teeth in position. Of these teeth two premolars, p3 and p4 have been subjected to a certain amount of wear; the molars m1 and m2 are missing, but m3 is present, rising from its alveolus, and the last cheek tooth m4 is still in its formative cavity.

The general outline of the ramus is similar to that of *Thylacynus;* it is slender and is slightly curved horizontally with its convexity downwards. The coronoid is short and delicate with a thickened anterior margin, the angle of the jaw is large, broad and prominent. The condyle is strong, broad transversely and has its upper surface below the line of the crests of the teeth; it is separated from the coronoid by a deep notch.

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[1] Mon: Mammalogie, Vol. I, 3e Mon: pp XXIII, 23-24 footnote, 267, pl. 7, figs. 1-4, on pages 60-65 of the same volume the spelling is *Thylacinus*. Trouessart Cat. Mamm. Vol. II, p. 1216 (1898/9) does not include the form *Thylacinus* in the synonymy of the genus *Thylacynus*, regarding it as a misprint.

[2] Trans. Linn. Soc. IX, p. 174, pl. 19 (1808).

[3] *vide ante* p. 12.

The dentition is imperfect, it is possible to recognise the sockets of three incisors, one canine, one small premolar in advance of the two still present and two molars between these two teeth and the rising m3.

The premolars resemble the corresponding teeth of *Thylacynus cynocephalus*; they are much longer than broad, sharp and pointed, the blade is curved slightly backwards and inwards, the posterior ledge cuspless. P4 is considerably larger than p3.

The molar m3 is slender and narrow; it consists of a sharp, slightly incurved central cusp, a small anterior cusp and a less developed posterior one associated with which is a rudimentary postero-internal swelling. The posterior cusp is broader than the anterior one and has a subquadrate, not triangular outline. The two main secondary cusps are in contact with the central one on the outer surface. This tooth also more nearly approaches the type of the genus *Thylacynus* than that of the closely related *Sarcophilus*.

On account of its general outline the jaw cannot be regarded as that of *Sarcophilus*, whilst the crowded nature of the teeth, which however may be regarded as an individual character in a young animal, distinguishes it from *Thylacynus*, to which it has nevertheless been ascribed on account of the numerous resemblances the fossil bears to a typical Tasmanian Tiger or Wolf, *Thylacynus cynocephalus*.

A fragment of an atlas vertebra and an imperfect humerus of *Thylacynus* probably of the same animal were found associated with the mandible. A fragment of the skull with several cheek teeth *in situ* was obtained in the Museum Cave in November, 1912.

SARCOPHILUS, Cuv. (1838).[1]

SARCOPHILUS HARRISI, Boitard (1842).[2]

THE TASMANIAN DEVIL.

Some time ago Mr. T. Connelly, the Caretaker of the Margaret River Caves, whilst undertaking explorations in the Bride's Cave,

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[1] *Vide ante*, p. 40 footnote. [1]

[2] Jardin des Plantes, p. 290, 1842, *fide* Oldfield Thomas, Proc. Biol. Soc. Washington, vol. XXV, pp. 115-118. June 29th, 1912.

which is some three or four miles south of the Mammoth Cave, discovered an unfamiliar skull lying uncovered upon a large talus of coarse sand and fragments of limestone and stalactite.

When Mr. W. B. Alexander, M.A., of this Museum, visited the locality in October, 1912, he noticed the striking difference between this skull and those of known indigenous mammals of the district, and therefore made a rough sketch of the specimen, as he was unable to remove it from the Cave. This sketch was subsequently shown to me and I was able to report that the remains were those of some species of *Sarcophilus*.

In November, 1912, I was instructed to proceed to the Caves in order to obtain this specimen and to collect, among other things, as many remains as possible from this and other Caves in the neighbourhood within the time at my disposal.

Soon after my arrival in the area, the Bride's Cave was visited and the skull removed from its precarious position. A large amount of sand and debris in the vicinity of the discovery was carefully sifted and examined, with the result that a small fragment of the lower jaw, with a molar *in situ* and several limb bones, presumably of the same animal, are now in the Museum Collection.

The bones are all in a fragile state and are not at all mineralised, suggesting that the animal was entombed within comparatively recent times. The bones adhere to the tongue as do those of the extinct *Phascolomys hacketti* from the Mammoth Cave, with which they may perhaps be considered contemporaneous.

The skull is not quite perfect, the left zygomatic process and the left auditory bulla are damaged, and the incisors and canines wanting.

An interesting feature in connection with this specimen is the abnormal outline of some of the bones of the nasal region ; the left and right nasals and the right maxilla and premaxilla being the bones affected. Apparently at some period of the animal's life the bones on the right side of the muzzle were crushed and broken, parts of the right nasal being lost. In consequence of nature's attempt to repair the damage, a secondary growth of the maxilla extends to the median line of the skull, thus separating the anterior and posterior portions of the broken nasal and confining the area of the upper extension of the premaxilla, a detached piece of which seems to occupy the position of a lost fragment of the nasal.

The skull is larger than any preserved in this Museum but is slightly smaller than one from Tasmania, of which the measurements are given on p. 261 of the B. M. Catalogue of Marsupialia and Monotremata; on the other hand, it has a longer nasal bone, a larger palatal foramen, a wider construction and a much smaller m4 than the specimen in the British Museum, points of difference which may be safely regarded as due to individual variation and the greater age of the Tasmanian animal described by Mr. Thomas.

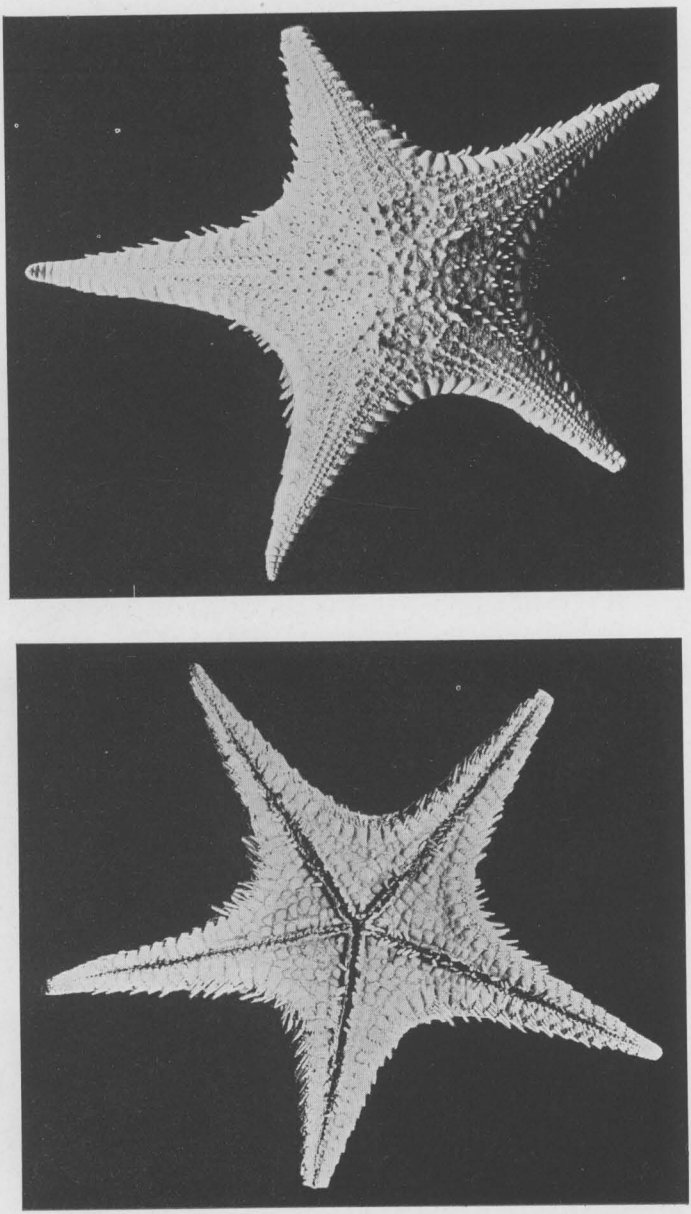
In addition to this cranium the Bride's Cave has yielded a fragment of the right mandible with an imperfect m3 *in situ* and the incomplete socket of m2 and the following limb bones, right humerus, right ulna, right femur, the distal end of the left femur and the left fibula. All these bones represent an animal that is not yet full-grown.

Remains of the Tasmanian Devil have been found in parts of Eastern Australia and the animal itself has been recorded recently from Tooborac beyond Kilmore about 63 miles from Melbourne[1] where a large female was killed in September, 1912, and sent to the National Museum, Melbourne. It would therefore appear that this creature, long regarded as extinct on the Australian mainland, may still inhabit certain wild and secluded districts, rarely, if ever, visited by man.

Measurements of the large male skull in the Collection of the British Museum (Natural History) from Tasmania, and of the skull from the Bride's Cave, Margaret River, South-Western Australia, with the percentage proportions of the latter to the former :—

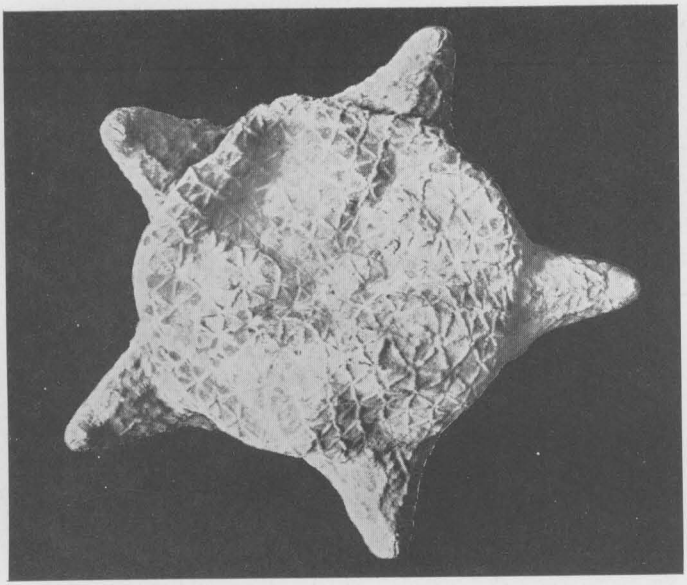
	B.M. Cat. p. 261.	Bride's Cave.	Proportions.
Basal length	123	114	92.7
Greatest breadth	104	99 approx	95.1
Nasals, length	51	52	101.95
,, greatest breadth	20	19.5	97.5
Constriction, breadth	17.5	17.5	100.0
Palate, length	75	70	93.3
,, width between outer corners of M3	62	53.7	86.6
Palatal foramen	6 7	13.5 immaterial, depends upon age	..
Basi-Cranial axis	38	35.5	93.4
Basi-Facial ,, ...	85	79	92.94
Facial index	224	222.5	99.3
Teeth length, p3	6.8	6.5	95.6
,, ,, p4	..	..	..
,, ,, m1-3	35.2	32 5	92.3
,, breadth, m4	9 5	6.	52.0

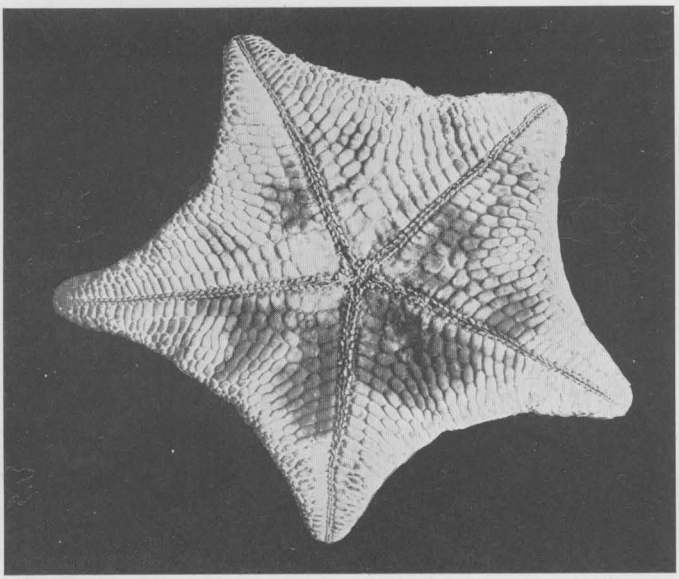
[1] J. A. Kershow, Vic. Nat. XXIX, p. 76, 1912.



Stellaster megaloprepes.

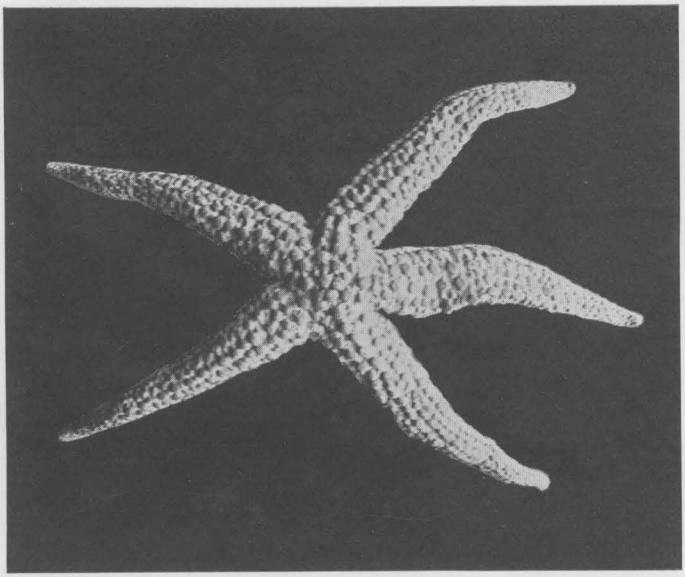
PLATE XVIII.

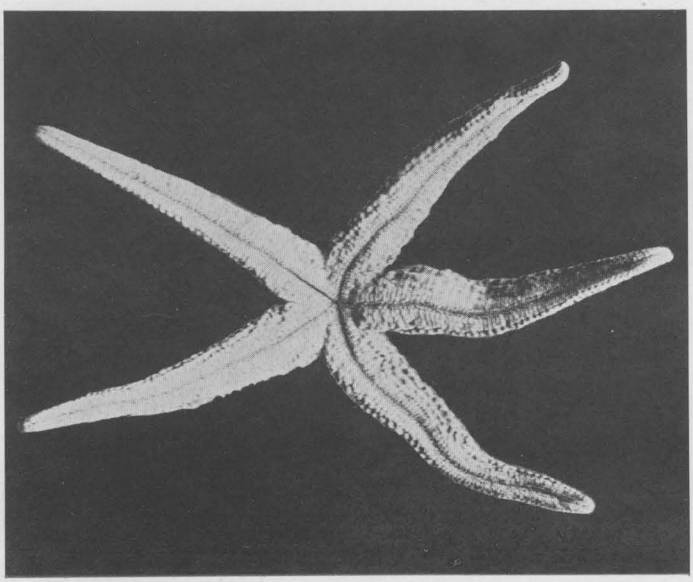




Calcitaster anamesus

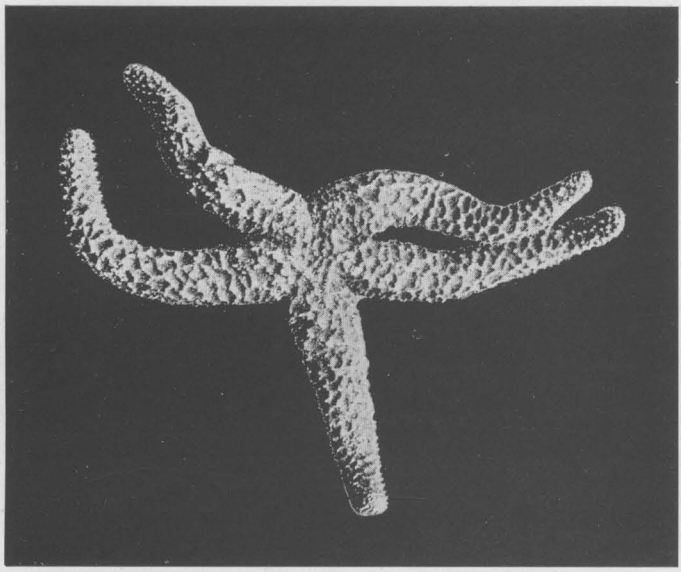
PLATE XIX.

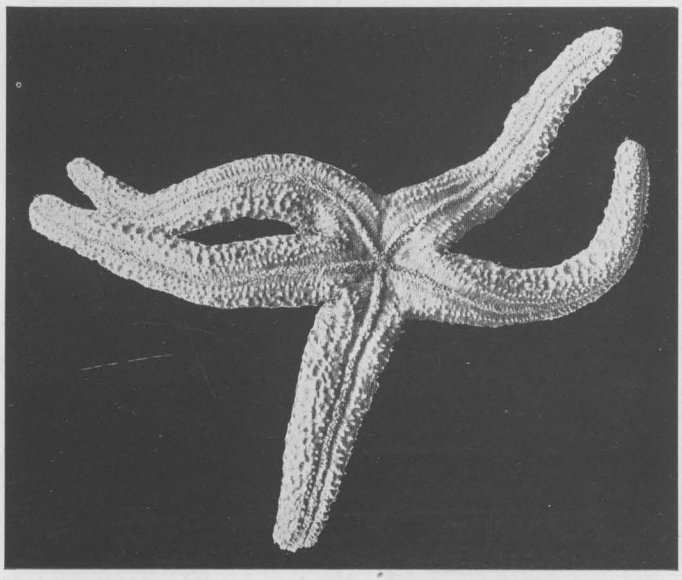




Linckia tyloplax.

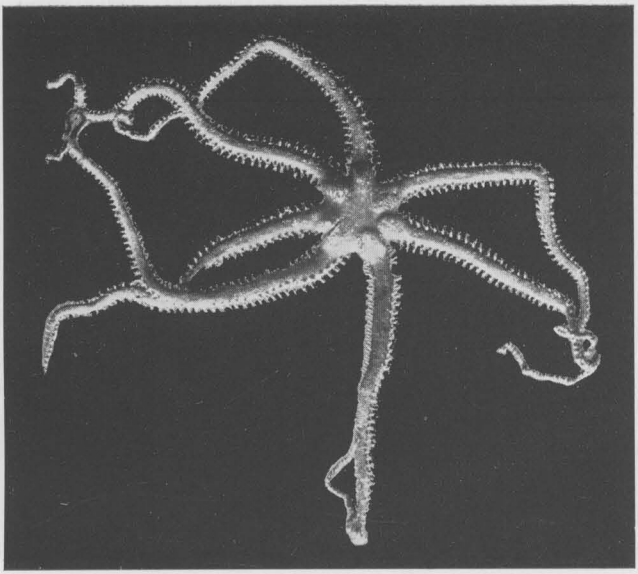
PLATE XX.

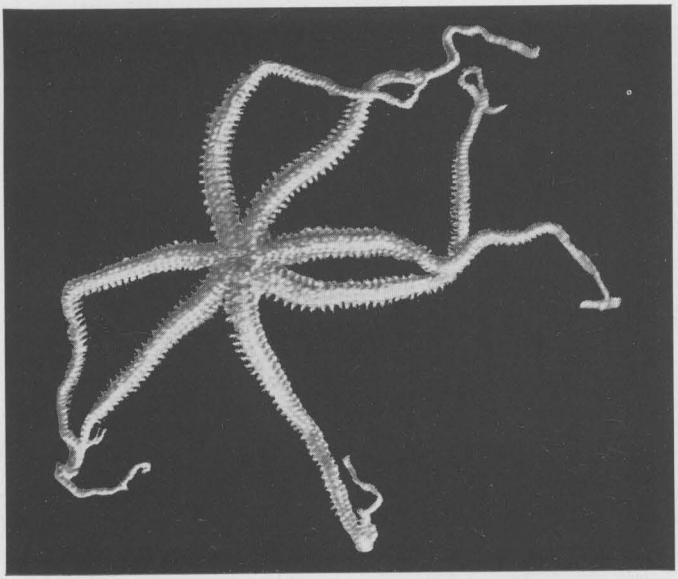




Echinaster arcystatus.

PLATE XXI.



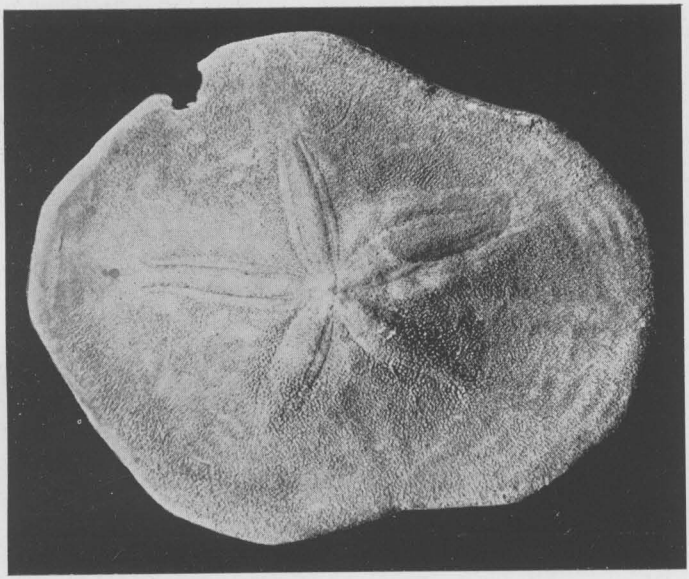


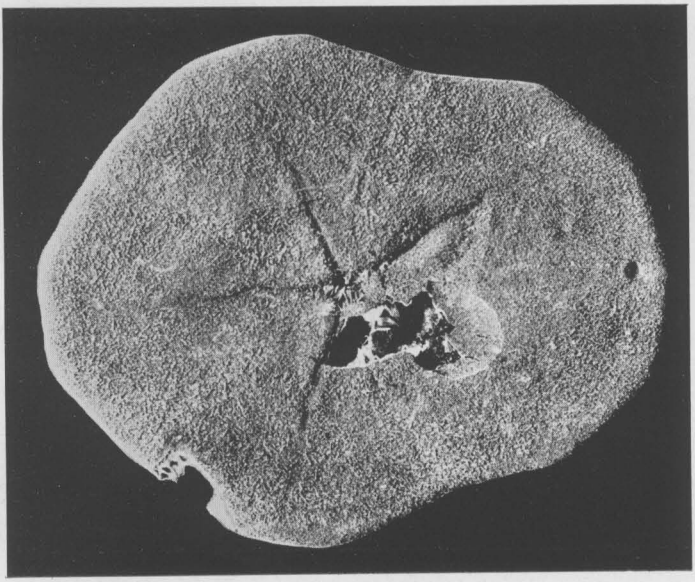
Astrogymnoies catasticta.

PLATE XXII.

Clypeaster telurus.

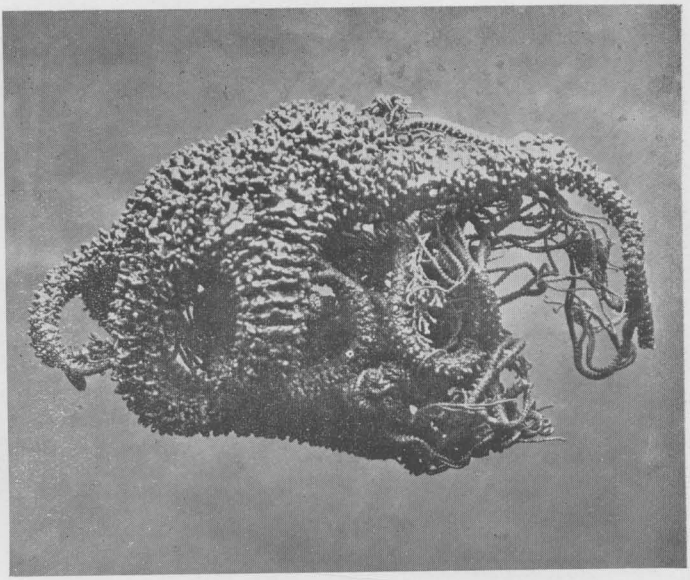
PLATE XXIII.





Peronella aphnostina.

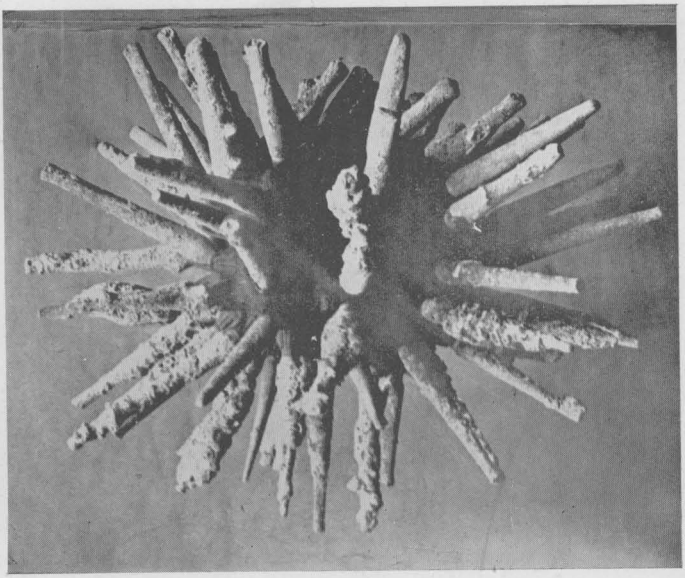
PLATE XXIV.



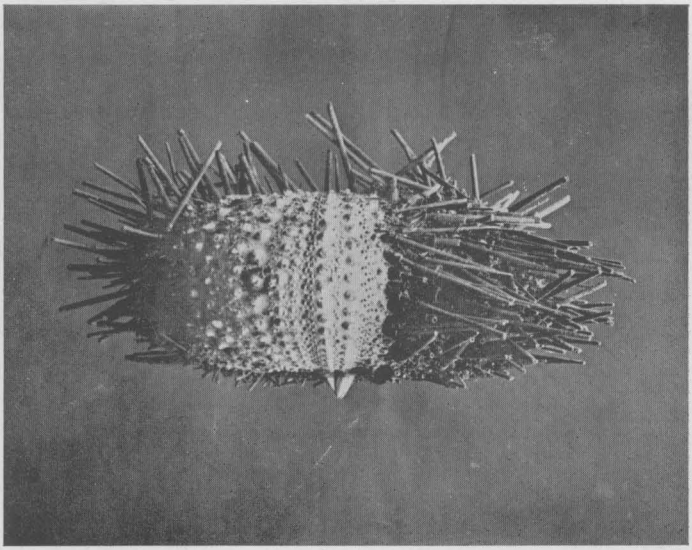
Conocladus microconus.

Colochirus axiologus.

PLATE XXV.

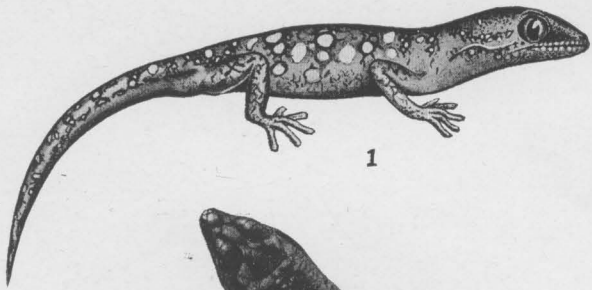


Phyllacanthus magnificus.



Centrostephanus tenuispinus.

PLATE XXVI.



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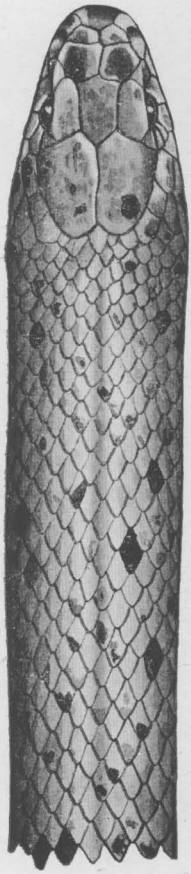
2



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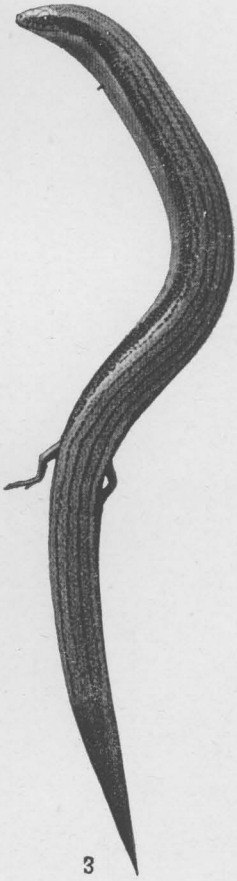


3

D. B. Fry, del] [H. Barnes, photo

PLATE XXVII.

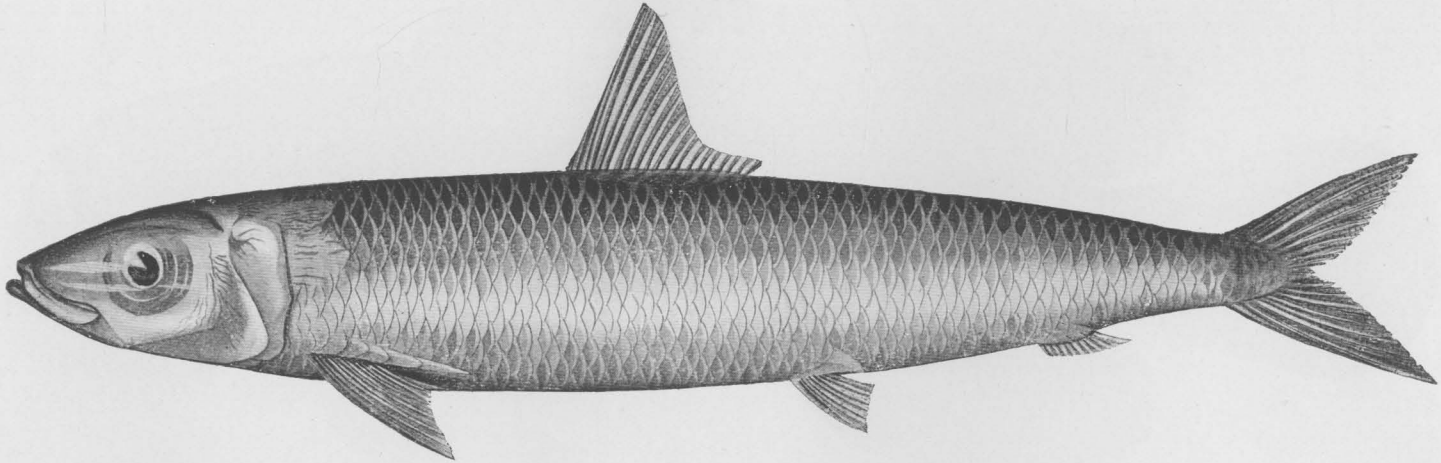
FIG. 1—*Diplodactylus woodwardi*, sp. nov. Twice natural size (from type).
FIG. 2—*Egernia formosa*, sp. nov. About natural size.
FIG. 3—*Lygosoma* (*Rhodona*) *picturatum*, sp. nov. About natural size.
FIG. 4—*Demansia affinis*, Günther. Natural size.

D. B. Fry, del.]

PLATE XXVIII.

FIG. 1.—*Crinia georgiana*, Gray, var. *stolata*, Cope. Twice natural size.

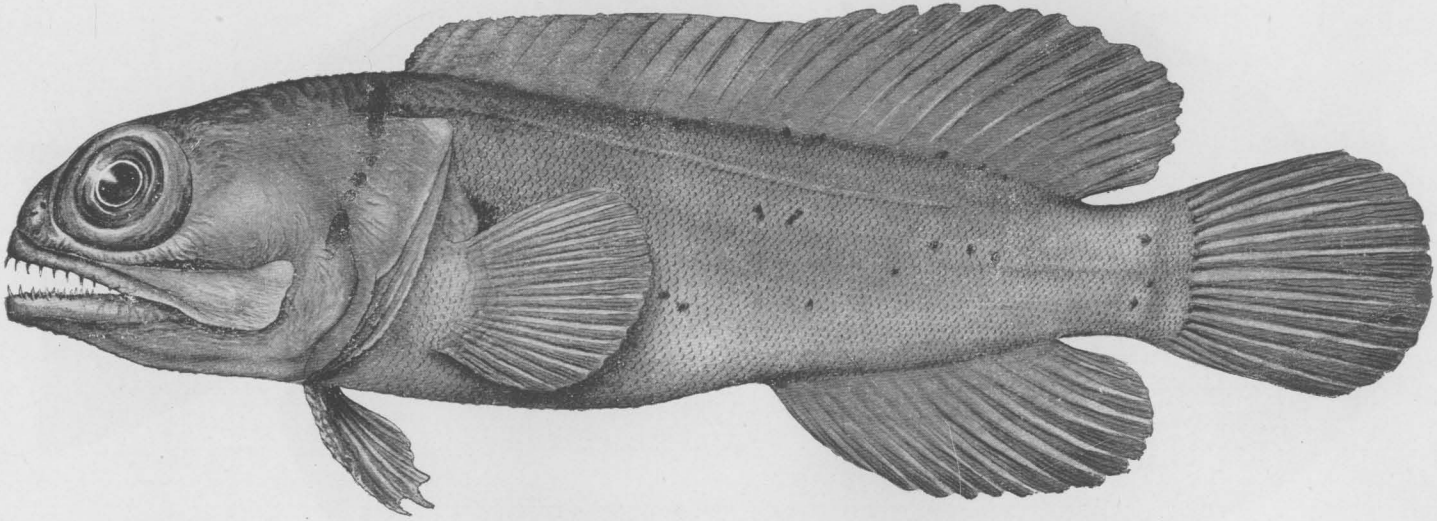
FIG. 2 and 2 a.—*Crinia leai*, Fletcher. Twice natural size.



A. R. McCulloch. del.]

Etrumeus jacksoniensis, Macleay.

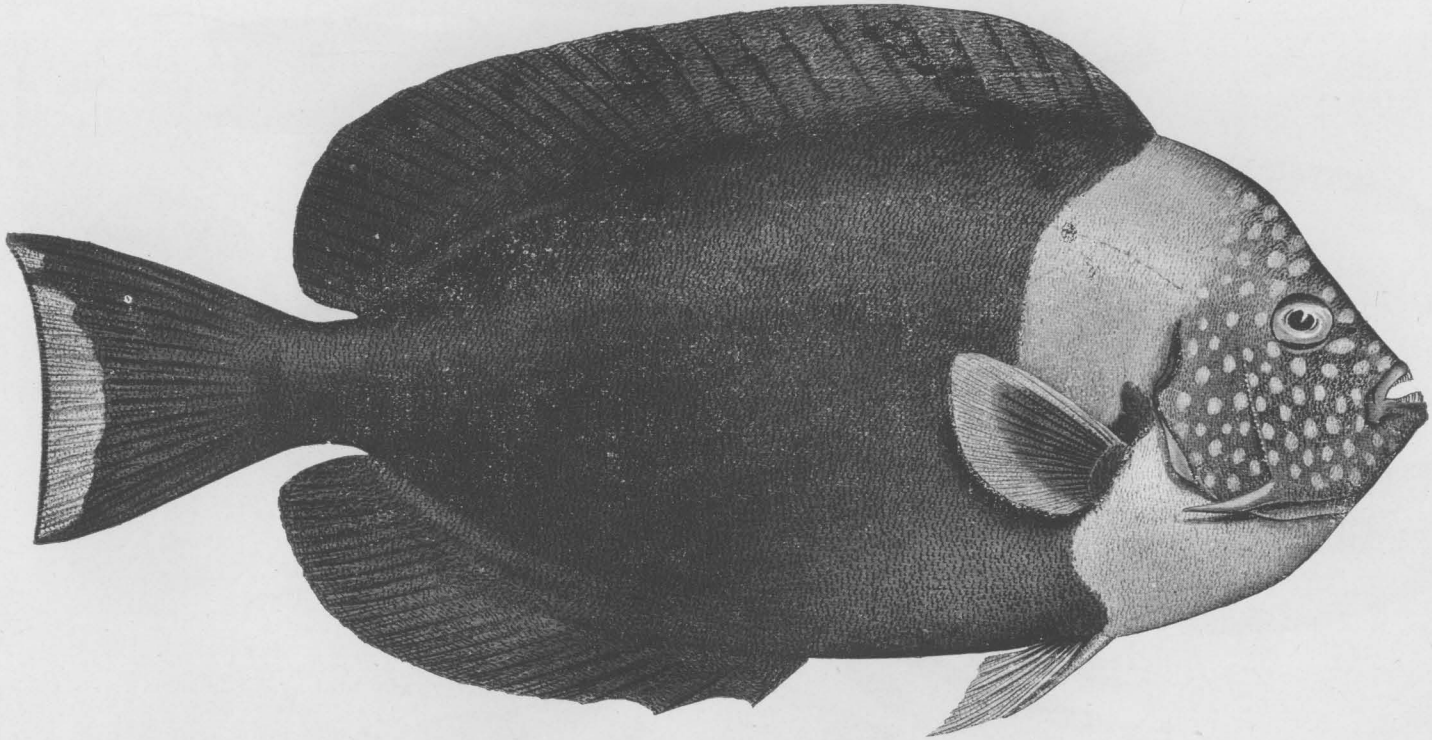
PLATE XXIX.



A. R. McCulloch, del.]

Gnathypops inornatus, Ramsay and Ogilby.

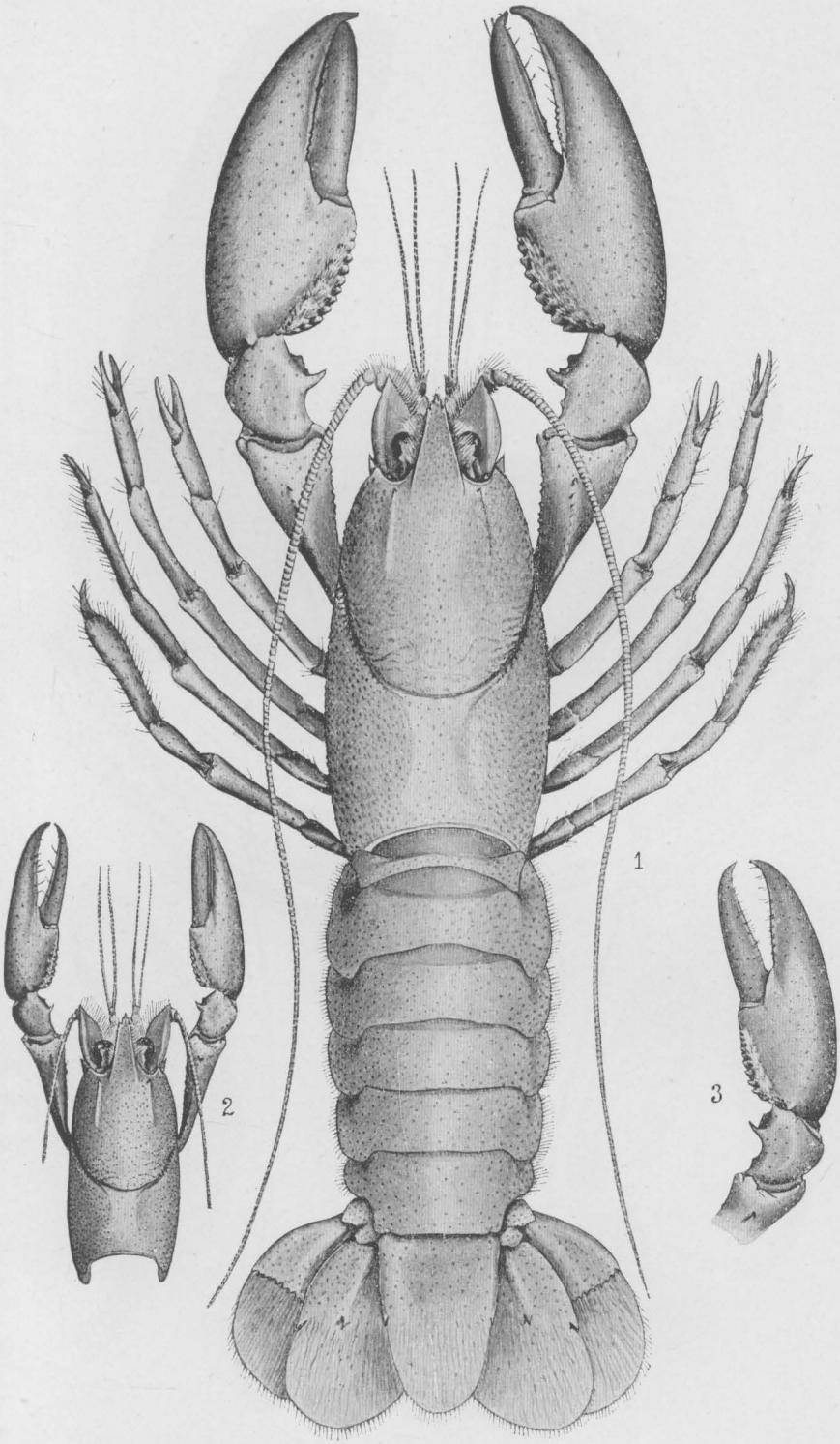
PLATE XXX.



A. R. McCulloch, del.]

Holacanthus personifer, McCulloch.

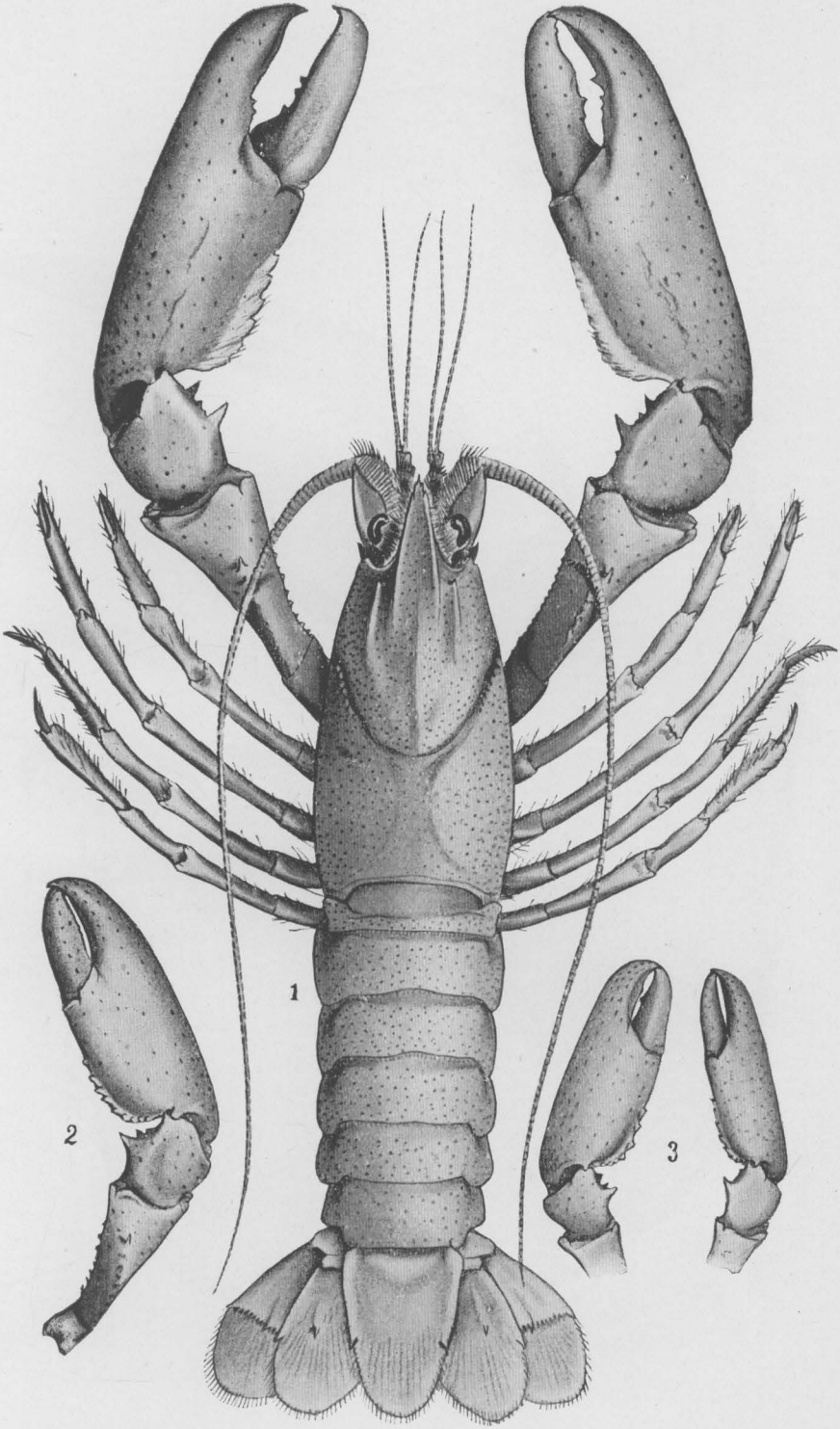
PLATE XXXI.



A. R. McCulloch, del.]

Cheraps preissii, var. *angustus*.

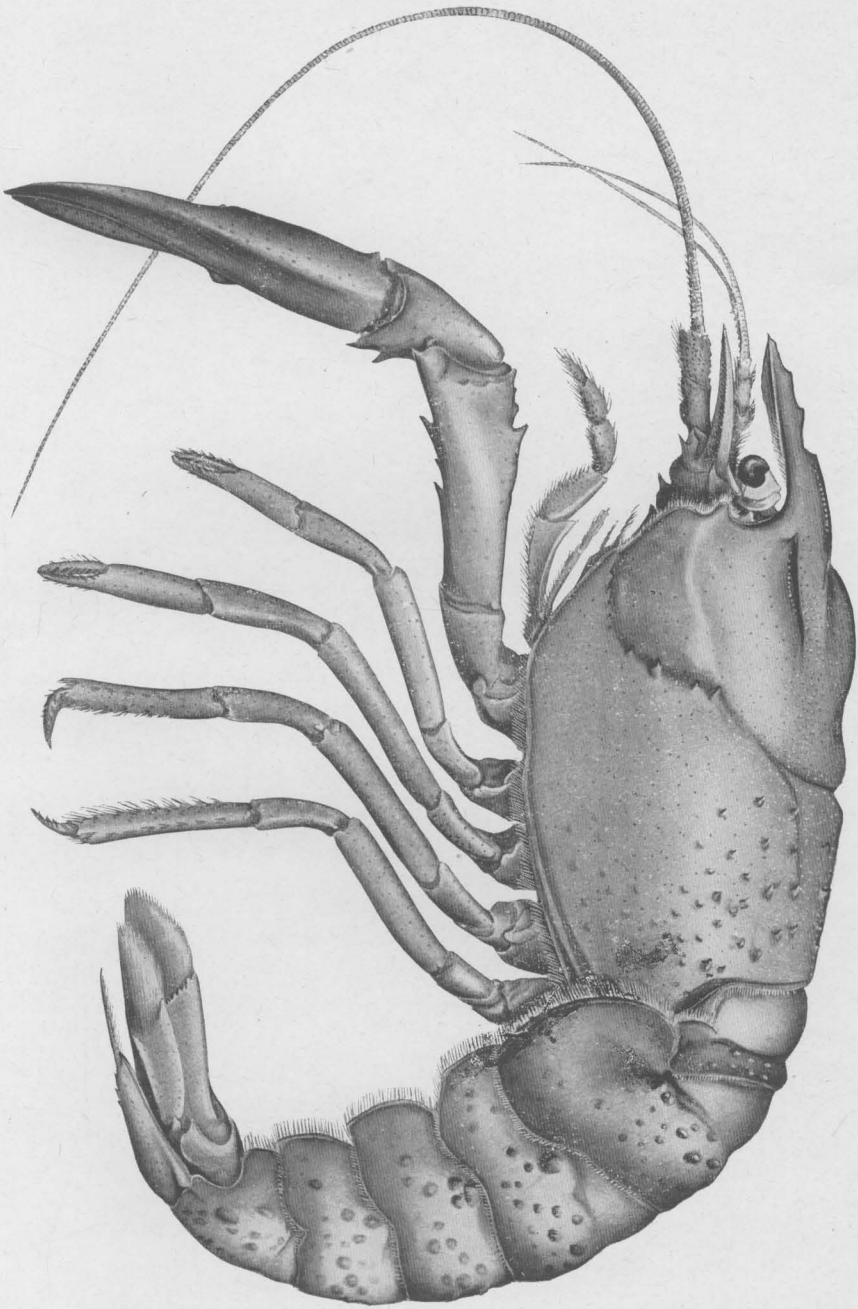
PLATE XXXII.



A. R. McCulloch, del.]

Cheraps quinquecarinatus.

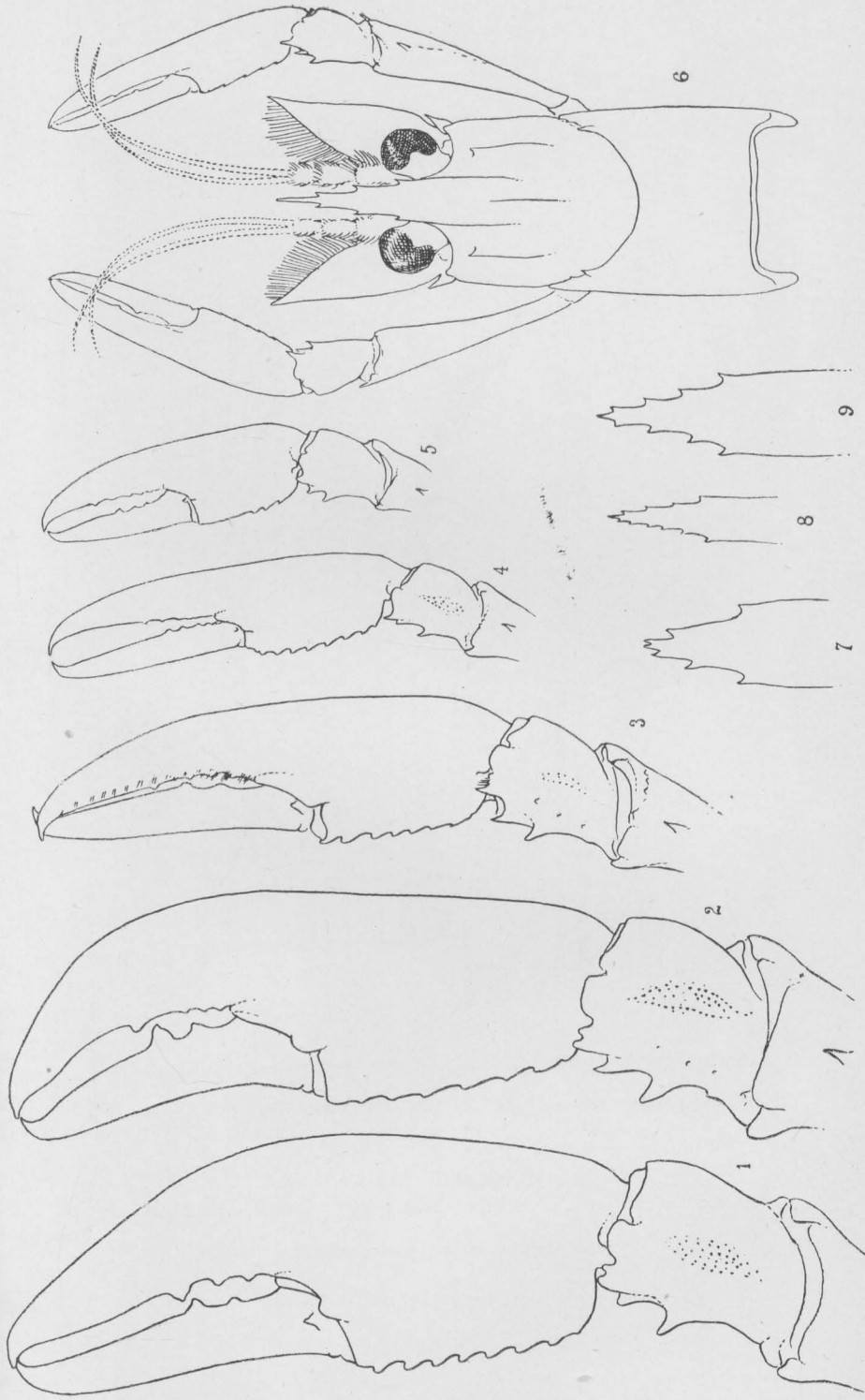
PLATE XXXIII.



A. R. McCulloch, del.]

Cheraps tenuimanus, Smith.

PLATE XXXIV.



A. R. McCulloch, del.]

Cheraps tenuimanus, Smith.

PLATE XXXV.

G. P. Morison, del.]

Fig. 1. *Zaglossus hacketti*, sp. nov., right femur, anterior aspect.

Fig. 2. *Tachyglossus aculeatus ineptus*, Thos., right femur, anterior aspect.

LETTER REFERENCES

h. Head of the femur. gt. Great trochanter. lt. Lesser trochanter.

Scale—Three-quarter natural size.

PLATE XXXVI.

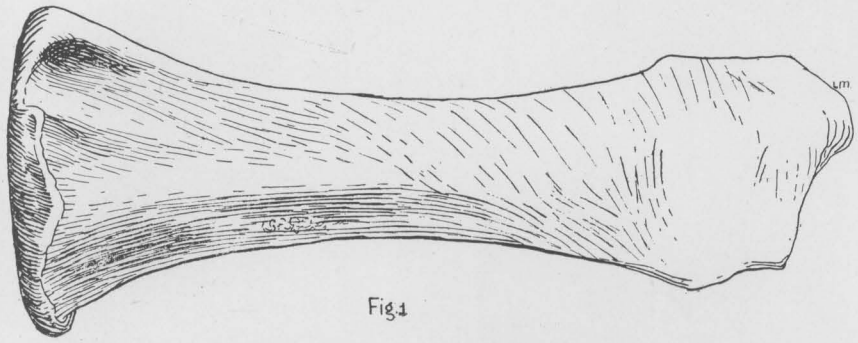


Fig.1

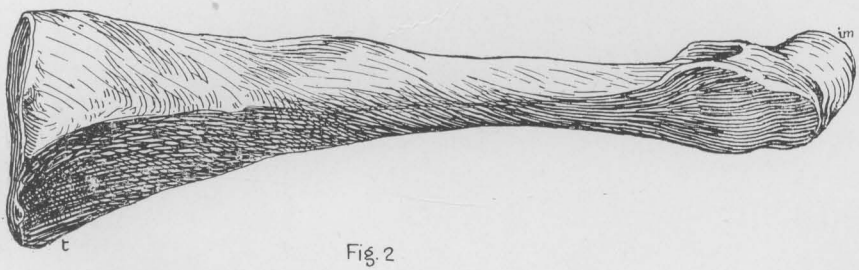


Fig. 2

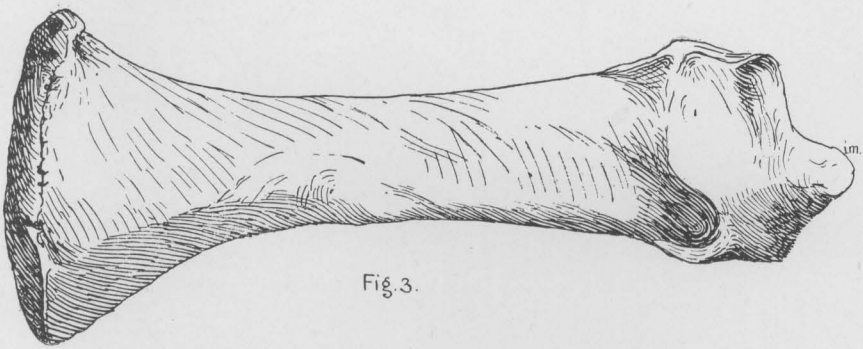


Fig. 3.

G. P. Morison, del.]

Zaglossus hacketti, sp. nov.

Fig. 1. Right tibia, anterior aspect.
Fig. 2. Right tibia, internal aspect.
Fig. 3. Right tibia, posterior aspect.

Letter Reference—i.m. Internal malledus.
Scale—Natural size.

PLATE XXXVII.