RECORDS

OF THE

WESTERN AUSTRALIAN

MUSEUM AND ART GALLERY.

EDITED BY THE DIRECTOR,

BERNARD H. WOODWARD, F.G.S., C.M.Z.S.

VOLUME I.
PART II.

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PRINTED BY ORDER OF THE TRUSTEES

BY

THE PARAGON PRINTING AND PUBLISHING CO., HAY STREET, PERTH.

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1912.

PRICE, 2s. 6d.

THE MAMMOTH CAVE

(Continued).

By LUDWIG GLAUERT, F.G.S., etc.

1. MAXILLARY TEETH OF A NEW VARIETY OF *NOTOTHERIUM.*
2. REMAINS OF *DIPROTODON AUSTRALIS* (Owen).

Order MARSUPIALIA.
Sub-Order DIPROTODONTIA.
Fam. Phalangeridæ. Sub-Fam. Nototherinæ.
Nototherium, Owen (1845)[1].
Nototherium, sp.
Syn. *Zygomaturus*, De Vis, Proc, Royal Soc., Queensl., Vol. V., p. 114, 1889.

NOTOTHERIUM.

(Plate vi., Figs. 8, 9, 10)

The genus *Nototherium* was established by Prof. Owen in 1845, and comprises animals which are somewhat less in size than the better known genus *Diprotodon.*

The animal closely resembled its larger companion, but also had many points in common with the Wombat (*Phascolomys*). In referring to the limb bones and skeleton, Lydekker[2] states: "The limbs are of equal length; the humerus has an entepicondylar foramen, and closely resembles that of *Phascolomys*; the olecranon is well developed, and the other limb bones and vertebræ are of the type of those of the latter genus. The structure of the feet is not fully known, but it apparently approximated to that of *Phascolomys.*

This family (the *Nototheriidæ*) connects the *Phascolomyidæ* with the *Diprotodontidæ*; the cranium, limb bones, and vertebræ being

1 Rep. Brit. Ass. Adv. Sci. for 1844, XIV., pp. 231-235, 1845; and Cat. Mamm. and Aves, Mus. Royal Coll. Surg., p. 314, 1845.
2 Cat. Foss. Mamm. Brit. Mus. (N.H.), Part V., page 161.

nearest to those of the former, the mandible showing characters common to the two, while the cheek-teeth are of the type of the latter.

It is easy to see how the structure of the cheek-teeth could pass into that of the *Phascolomyidæ*; and it is not improbable that the two families may have diverged from a common ancestor.

The structure of the humerus apparently indicates fossorial habits."

Two teeth from the upper jaw of a large *Diprotodontoid* marsupial were obtained from the lower stratum.[1] The one tooth is a premolar and the other a molar. They both belong to the left series.

The bilobed molar (plate VI., figs. 8 and 9) has a rhomboidal outline, narrower posteriorly, with the angles obtusely rounded; the anterior surface and the sides measure from 35 to 36mm. in linear extent, the length of the posterior face is 32mm.

The two lobes of the tooth are parallel and *en échelon*, the hind lobe projects farther inwards and is rather shorter and narrower; each lobe shows a slight swelling at the inner extremity, is convex on the anterior face and concave backwards. The crest of each lobe is obliquely truncated, the exposed dentine sloping anteriorly. As the fore lobe is more worn than the hind one it has developed a larger tract of bared dentine.

Distinct anterior and posterior basal ridges are present, each terminates in a tuberosity at its outer end, and does not ascend the outer side of the lobe. The posterior ridge and tuberosity are less developed than the anterior ones. The inner continuation of the anterior basal ridge ascends the interior face of the lobe, gradually diminishing as it approaches the summit, on the posterior face of this lobe it descends to form a ridge closing the inner end of the mid valley, it then rises on the fore side of the hind lobe, subsiding towards the summit. A continuation of the posterior basal ridge rises upon the interior face of the hind lobe. On the outer aspect of the tooth a distinct isolated ridge closes the outer end of the mid valley.

[1] *Ante* p. 12.

At a point in the mid valley of the tooth, about one-fourth from the outer border, a slight swelling or rudimentary link connects the two lobes, from this point the surface of the valley slopes gradually to the inner and outer confining ridges.

The unworn enamel seen on the floor of the mid valley and near the anterior and posterior ridges is punctate.

The tooth differs from the upper molars of the two species of *Diprotodon*, *D. australis* (Owen) and *D. minor* (Huxley) in having its lobes placed more obliquely across the tooth, in the inward projection of the posterior lobe and the form of the anterior and posterior basal ridges. The upper molars of *D. australis* (Owen) are also much larger.

Prof. Owen's genus *Nototherium* possesses upper molars with obliquely directed lobes, anterior and posterior basal ridges, enclosed mid valley and enamel punctate when unworn. The second upper molar (M1 of Owen's monographs), as described and figured, agrees with the tooth under consideration in size, outline, and ornamentation, but the anterior basal ridge is stated to be "continued at both ends upon the corresponding border of the anterior lobe[1]" without a tuberosity externally.

In view of the close resemblance, this molar has been identified as belonging to a species of *Nototherium* and the presence of the tuberosity on the anterior basal ridge regarded as an individual or specific character.

The premolar (plate VI., fig. 10) may be described as under:—

Outline sub-triangular, the outer side being the longest. The anterior portion, or talon, is occupied by a cusp having the form of an equilateral triangle with one of the angles situated posteriorly and a slightly rounded side forming the anterior aspect. The crown of the tubercle is worn obliquely, so that the dentine is slightly exposed. This surface is considerably lower than the posterior portion of the tooth, showing that the opposed tooth of the mandible must have had a bulky anterior prominence such as shown in all Owen's figures of D3 of the lower jaw of *Nototherium*.

1 Phil. Trans. Royal Soc., Part 1, 1872, p. 68; and Ext. Mamm. Australia, p. 276, 1877.

The rest of the tooth consists of two ridges at right angles united in front and enclosing a simple valley behind. The outer ridge occupies about two-thirds of that side of the tooth and contains an anterior tubercle, the enamel of which is partly worn away, exposing a ridge-shaped surface of dentine having its apex posteriorly. The interior angle of the tooth is occupied by a tubercle which, too, is so worn as to expose the dentine; in this instance also triangular, but with the base situated intero-posteriorly and covering a much larger area than the other two patches already referred to. The surface of this patch is much lower than the others and slopes so that the base is considerably lower than the apex of the triangle. There is a slight swelling at the base of the posterior aspect which may represent a rudimentary cusp or tubercle.

The anterior tubercle is divided from the posterior crown by two valleys, each falling from a slight bridge which connects this cusp with the rest of the tooth and each closed by a slight ridge. The valley enclosed by the two posterior ridges slopes very abruptly to the posterior margin of the tooth, where it also was enclosed by a confining cingulum or ridge which has its origin at the base of the anterior tubercle of the longitudinal ridge; it runs along the base of the exterior, and at the extero-posterior angle rises half way up to the summit of the tooth, then it again descends to enclose the posterior valley, and appears to ascend to the present worn surface of the internal tubercle. It can then be traced down the anterior face, across the mouth of the antero-internal valley and into the mass of tubercle of the anterior talon.

The fangs are typical of *Diprotodon* and *Nototherium* premolars. The premolars of *Diprotodon* and *Nototherium* have led to a great amount of confusion. The milk teeth have been mistaken for permanent ones, and teeth of the one genus have been ascribed to animals of the other. The upper premolar (D3 of Owen) of *Diprotodon* is not often found in the jaw as, being deciduous, it is shed as the animal approaches maturity. Prof. Owen figures a tooth from the lower jaw[1] in its natural position—taken from a sketch transmitted to him by a Dr. E. A. Hobson—which shows

[1] Ext. Mamm. Australia, p. 204, 1877

that, like the permanent cheek teeth, it consists of two lobes separated by a mid-valley. From the state of wear of the crown, this great authority considered that the upper premolar also had two parallel lobes. The following tooth (D4 of Owen) has a somewhat similar shape, but is of greater size.

Prof. Owen was so thoroughly convinced of the accuracy of his determinations and conclusions that he never agreed with the views expressed by Prof. Huxley[1]. As late as 1877 he states[2]: "The *Diprotodon minor* of Huxley is founded on the teeth of the species of *Nototherium*." It will be seen he did not fall in with the suggestion that there had been a second, smaller species of *Diprotodon* coeval with the larger *D. australis*, but stated most positively that the specimens to which Prof. Huxley referred were really species of *Nototherium* (*N. mitchelli* and *N. victoriæ*).

At a later date De Vis, when attempting to identify and name the large number of Pleistocene marsupial remains in the Queensland Museum, was able to extend our knowledge of the identity of these premolars. In 1888 he sent a contribution to the Royal Society of Queensland "On *Diprotodon minor* (Huxley)[3]," in which he summarises his conclusions in the following terms[4]: "The premolars figured by Prof. Huxley are unmistakably teeth of *Diprotodon*. The distinctness of the animal they represent from *D. australis*, affirmed with some reserve by Prof. Huxley, and practically without reserve by Sir R. Owen, is confirmed by fresh evidence. The differences between the three premolars made known are reconcilable, the difficulty raised by them less than that of admitting three allied species in the same habitat. They represent one form, *D. minor*, which is a species, and not the female of *D. australis*. The genus therefore contains two Queensland species, *D. australis* (Owen) and *D. minor* (Huxley)."

The plate which illustrates the conclusion of De Vis shows the upper premolars of *D. australis* and of *D. minor*—this latter including the *D. australis* (?) of Prof. Huxley's contribution of 1862. The

[1] Quart. Journal Geol. Soc., XVIII., p. 422, *et seq.*, 1862.
[2] Loc. cit., p. 511.
[3] Proc. Royal Soc. Queensland, Vol. V. 1888; p. 38, 1889.
[4] Loc. cit., p. 44.

two parallel lobes are a striking feature in the premolar of *Diprotodon* and can be seen in every figure. As they are not present in the Mammoth Cave premolar, it is impossible to regard this tooth as belonging to this genus.

Premolars of *Nototherium* as well as the upper premolar of Macleay's *Zygomaturus trilobus*, are figured by De Vis in the same volume.[1] The Mammoth Cave premolar is unlike the *Nototherium* or *Owenia*[2] teeth shown, and differs from the *Zygomaturus* tooth in the absence of the posterior cusp. In fact, the tooth has a triangular outline like *N. inerme* shown in figure 5, plate XLIII., of Owen's "Extinct Mammals of Australia," which it resembles more than the other *Nototherium* premolars shown on plate LXXXVIII., figures 11-17, or in miniature on plates XXXVI. and XXXVII., or in full size in figures 3 and 4, plate XLIII. It differs, however, from Owen's *N. inerme* in several important points. This author describes the upper premolar of that species as follows, on p. 277. The tooth "is relatively smaller and less complex on the grinding surface than in the corresponding tooth in *N mitchelli*, the transverse and antero-posterior diameters are alike. The outer lobe or division has one coronal prominence upon which a slender triangular tract of dentine is exposed on the shorter, inner lobe; an anterior and a posterior basal ridge bounds corresponding depressions divided by the confluence of the apices of the outer and inner divisions at the centre of the crown; a short external basal ridge closes the concavity impressed upon the hind half of the outer surface of the crown." Owen described (loc. cit., p. 275) the tooth D3 of the upper jaw of *N. mitchelli* in the following terms. The tooth "may be said to be two-lobed, but is divided in an opposite direction to that in the rest of the series, viz., into an outer and an inner, rather than a front and a back lobe. The working surface is sub-triangular in form, the angles obtusely rounded . . . The outer lobe or division is the chief one and constitutes the outer two-thirds, and the whole fore-and-aft extent of the tooth; the outer side of its base swells out like part of a cingulum or ridge; the summit is sub-compressed and seems to have been trituberculate; the inner and lower division consists of a larger hind tubercle and a smaller front one. . . . . It is

[1] Proc. Royal Soc. Queensl., Vol. V., 1888, p. 111, *et seq.*, and plate —, 1889.
[2] Renamed "Euowenia," as "Owenia" was previously occupied.

implanted by two roots, one behind the other, the posterior one being the larger and grooved anteriorly, as if preparatory to further transverse subdivision." De Vis defines the upper premolar of *Zygomaturus* in these words[1]: "Its posterior two-thirds are occupied by a longitudinal ridge on the outer side, and two tubercles on the inner, the outer ridge and anterior tubercle being joined by a low link over which passes the longitudinal sulcus dividing the ridge from the tubercles. The anterior third supports a single large tubercle or rudimentary lobe."

The Mammoth Cave tooth is thus seen to resemble this premolar very closely, differing only in the state of development of the posterior tubercle of the hind lobe; in the *Zygomaturus* of De Vis it is prominently shown, but in the tooth from the Mammoth Cave it is only rudimentary.

Mr. Lydekker states[2] that the premolars of *Nototherium* are very variable, and therefore includes under one specific name Owen's various forms of *Nototherium* as well as the fossils known as *Zygomaturus trilobus* by some authorities. This tooth is therefore classed at the upper premolar of *Nototherium*, and to show its close affinity to the *Zygomaturus* premolar the name *Zygomaturus* is entered as a synonym.

There seems no doubt that the molar and the premolar from the Mammoth Cave have both belonged to the left upper tooth series of the same animal, a species of *Nototherium*.

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[1] Loc. cit., p. 114.

[2] Ann. and Mag. Nat. Hist., series 6, Vol. III., p. 149, *et seq.*, 1889.

Sub-Fam. DIPROTODONTINÆ.
Diprotodon, Owen (1838)[1]
Diprotodon australis, Owen (1838)[2]

THE DIPROTODON.

There are many fragments of large bones which are very difficult to identify, but it is not at all unlikely that a number of them belong to this species, the largest Australian marsupial.

Up to the present, those specimens which undoubtedly belong to *D. australis* consist of the head of a femur, several fragments of the ilium, including the socket which received the head of the thigh bone.

It is quite possible that some of the other fractured and much decayed bones and bone fragments may belong to this animal, but there is so little material of value to work on that it would be too hazardous to express any opinion on the subject of their definite identity. Some of the portions of ribs certainly are of very great size, and seem to have belonged to an animal quite as large as the creature which yielded the bones from which the cast of the *Diprotodon australis* skeleton in the Mammalian Gallery was taken.

A number of bones in a more perfect state of preservation but presumably all belonging to a smaller animal, have also been classed as bones of *D. australis*. They comprise radius, ulna, femur, clavicle, imperfect ribs, and cervical vertebræ—of these, the limb bones show all the *Diprotodon* features. The olecranon of the ulna is short, not prolonged as in *Phascolomys* (the Wombat), and the radius has a characteristic twist.

The dimensions of the limb bones are as under :—

Total length of ulna, including the olecranon	..	36 cm.
,, ,, radius	..	32·5 cm.
,, ,, femur	about	46 cm.

They are much smaller than the corresponding bones of *D. australis*, when fully grown, but evidently do not belong to the *Nototherium* whose teeth were found in the deposit, as the ulna and radius do not indicate fossorial habits.

[1] In Mitchell's "Three Expeditions into Eastern Australia," 2nd Edition, Vol. II., p. 362 (1838).
[2] Loc. cit.

FOSSIL MARSUPIAL REMAINS FROM BALLADONIA IN THE EUCLA DIVISION.

The Balladonia "Soak."

The Balladonia Soak, which has yielded the rich variety of fossilized animal bones and teeth about to be described, is situated at the foot of the outcrop of the Granite Rocks at Balladonia, in the Eucla Division of this State. These rocks cover an area of approximately 200 acres, and rise to a height of about 50 ft. above the surrounding limestone plain.

During the rainy season the water from this catchment area drains into the encircling superficial deposits, where it is retained for some considerable period. In this, as in many other soaks, the loss by drainage and evaporation during the year is less than the quantity of water yielded by the annual rainfall, so that the store of water is practically permanent in character.

In the winter time the rocks are surrounded by an expanse of water, which gradually decreases in area and becomes fringed by a border of swampy land, in which animals often become entombed in their efforts to reach the pools of water beyond.

Carnivorous animals such as *Thylacoleo* and *Sarcophilus* would also make the country surrounding the water their haunt, and in addition to their own remains, would leave behind them bones of the animals upon which they preyed. That both *Thylacoleo* and *Sarcophilus* lived in the locality is proved by the presence of their bones and teeth among the other remains presented by Messrs. Wm. Ponton and John Sharp of Balladonia. Broken bones with undoubted tooth-marks upon them have been recognised, but up to the present it has not been possible to make those careful and painstaking investigations necessary to determine the identity of the animal which left the markings upon the fragments. When opportunity offers, however, experiments similar to those recorded

by Prof. Baldwin Spencer and Mr. R. H. Walcott, in the proceedings of the Royal Society of Victoria, Vol. XXIV., Part I., 1911, pp. 92-123, will be undertaken.

The Museum and Science generally are greatly indebted to Messrs. Wm. Ponton and John Sharp for these collections, the value and significance of which cannot be estimated until all the specimens have been subjected to examination.

Up to the present eight species of extinct Marsupials have had their range extended into Western Australia, and of these several do not appear to have been recorded in the adjoining State of South Australia.

ORDER MARSUPIALIA.

SUB-ORDER POLYPROTODONTIA. Fam. DASYURIDÆ.

Sarcophilus, Cuv. (1838) [1].

Sarcophilus laniarius, Owen (1838). [2]

Dasyurus laniarius—Owen	..	Owen in Mitchell's "Three Expeditions into Australia," 2nd edition, Vol. II., p. 363, 1838.
Sarcophilus laniarius—Owen	..	Lydekker Cat. Foss. Mamm. Brit. Mus., Pt. V., p. 265, 1887.

SARCOPHILUS LANIARIUS.

This species is represented by eight specimens, the most perfect being a portion of the skull comprising the maxilla and part of the premaxilla with the right upper tooth series from I3 to M4 and showing a portion of the outline of the infraorbital foramen and the palatal vacuity. This specimen agrees in size with Prof. Owen's figures on Plate V. of Ext. Mamm. Aust. The length of space occupied by M1 to M3 is 39mm.

Four other fragments show portions of the upper tooth series; in every case the teeth are well worn, the animals to which they belonged were therefore adult or aged. The largest specimen has the infraorbital foramen perfect.

A piece of the left lower jaw shows the four molar teeth in

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[1] F. Cuvier. Hist. Nat. des Mammiferes, pl. 70, 1838.

[2] Sir T. Mitchell's "Three Expeditions into the Interior of Eastern Australia," 2nd edition, Vol. II., p. 363, 1838, as *Dasyurus laniarius*.

position, one of them perfect and the others more or less damaged. The mandible agrees in dimensions with Owen's figured specimens and exhibits the posterior predental foramen beneath the fore part of the second molar (M3) as in the type.

The three remaining specimens, a right mandible with sockets of the four molars, the anterior portion of the right lower jaw with the teeth P1, P3 and M1 and a fragment containing in situ the canine (C) and the two premolars (P1 and P3) bear a strong resemblance to the *S. ursinus* described by McCoy [1]; they all show a posterior predental foramen below the anterior part of the first molar as is usual in this species, but in view of the opinion expressed by R. Lydekker [2] have been classed as *S. laniarius* (Owen).

This species has not previously been recorded for Western Australia.

SUB-ORDER DIPROTODONTIA.

Fam. PHALANGERIDÆ. Sub-Fam. DIPROTODONTINÆ.

Diprotodon, Owen (1838) [3]

D. australis, Owen (1838) [4]

THE DIPROTODON.

The abundance of remains of *Diprotodon* found in deposits similar to those of Balladonia would suggest that a number might be expected in the soaks at that locality.

Although the bones presented by Messrs. Ponton and Sharp are all fragmentary, it has been possible to indentify many of them as belonging to this animal. They include fragments of ribs, vertebræ, shoulder blades, leg bones and the pelvis, as well as small portions of the maxilla and mandible containing the roots of cheek teeth.

The first lot of specimens, consisting of teeth only, had been exposed to the surface for a considerable period, and were, therefore,

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1 Prodromus of the Palæontology of Victoria, Decade VII., pp. 11-13 and figures on Plates LXII. and LXIII., 1882.

2 Catalogue of the Fossil Mammals in the British Museum (N.H.) Part V., p. 265, 1887.

3 In Mitchell's "Three Expeditions into Eastern Australia," Vol. II., p. 362, 1838.

4 Loc. cit.

very much weathered. They were, without exception, the teeth of a full grown and aged animal, as they showed signs of having been in use for some time. In all of them the dentine is exposed to a marked extent, some even have all traces of the original mid-valley obliterated. The teeth indentified include the first incisor and the first, second and fourth molars of the upper jaw, and the incisors and first true molar (M1) of the lower.

The whole series of specimens so closely resemble the figures in Owen's various papers[1] that there is no doubt that they belong to *Diprotodon australis.*

Remains of *Diprotodon* have been found in various localities. In 1883, the late E. T. Hardman[2] collected a leg bone in the Lennard River, near the Devil's Pass in West Kimberley; in 1892, the Elder Exploring Expedition[3] obtained a fragment of a bone in the Great Victoria Desert; Mr. F. R. Arthur found the greater part of a mandible to the west of Lake Darlôt in 1895[4]; and in 1909 the writer had the good fortune to uncover a number of fairly perfect *Diprotodon* bones in the Mammoth Cave, near the Margaret River. Teeth however, are now recorded for the first time, and are a valuable addition to our knowledge of the West Australian form of the species, the identity of which is now beyond doubt.

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[1] In Phil. Trans. Royal Soc.

[2] Hardman's Report on Geology of the Kimberley Districts 1884, p. 21:—"this bone was identified by the late Prof. McCoy as the long head of a femur of *Diprotodon australis.*

[3] Dr. E. C. Stirling, Director, National Museum, Adelaide, S.A.

[4] This specimen is in the Museum Collection.

SUB-FAMILY PHASCOLOMYINÆ.

Phascolonus, Owen (1872).[1]

Phascolonus gigas, Owen (1859).

Phascolomys gigas—Owen .. Encyclopædia Britannica, 8th Edition, Vol. XVII., p. 175, 1859.

? Sceparnodon ramsayi—Owen .. Proc. Royal Soc., XXXVI., No. 228, 1884, Phil. Trans. Royal Soc., Vol. CLXXV. pp. 245-248, 1885.

GIANT WOMBAT.

This animal is represented by a number of teeth, of which several are practically perfect. They include the right lower premolar (PM4), the right lower first molar (M1), the left lower first molar (M1), a lower molar which could not be definitely placed, and seven or eight fragmentary cheek teeth. In size these teeth are rather smaller than most of the examples figured by Prof. Owen in the Phil. Trans. of 1872, but the teeth shown in figure 6, plate XL., of that volume have the same dimensions as the Balladonia specimens, which, therefore, may be regarded as belonging to an animal of the same species. In life it must have equalled a tapir or donkey in size.

The discovery of these remains considerably extends the known area of distribution of *P. gigas*, for the animal has not previously been recorded from Western Australia. Possibly the collection of further specimens may enable a final decision to be arrived at in reference to the relationship of *Phascolonus* and *Sceparnodon*.

[1] Owen, Phil. Trans. Royal Soc., CLXII., p. 251, footnote p. 257, 1872; also Lydekker Cat. Foss. Mamm. Brit. Mus., part V., pp. 157-160, 1887; raised to generic rank.

Phascolomys, Geoff. (1803).[1]

Phascolomys latifrons, Owen (1845).[2]

Phascolomys lasiorhinus, Gould	..	Mamm. Austr. pls. LIX., LX., 1863
Lasiorhinus m'coyi, Gray ..	..	Ann. Mag. Nat. Hist. (3) XI., p. 458, 1863
Phascolomys niger, Krefft ..	..	Mamm. Austr., text to plate v., 1871
,, *lasiorhinus* var. *niger*, Krefft		Proc. Zool. Soc., p. 796, 1872

THE HAIRY-NOSED WOMBAT.

A number of Wombat teeth have been identified as belonging to an animal of this species. They mostly showed the working surface, the outline of which, together with the extent of the external enamel and the nature of the longitudinal grooving, render the determination a matter of comparative certainty.

Several fragments of bone, including portions of the humerus, ulna, radius, and tibia, are undoubtedly phascolomine, and when compared with Prof. Owen's figures in "Extinct Mammals of Australia," plate XCIX., etc., they are seen to approach more nearly to the latifront type than to the more slender *P. mitchelli*. The *P. hacketti* from the Mammoth Caye is larger in size, with teeth which are narrower in comparison to their length, antero-posteriorly, and without the faint longitudinal grooving.

Phascolomys parvus, Owen (1872).[3]

THE DWARF WOMBAT.

Four very worn molar teeth much smaller than those of adult *P. mitchelli* or *P. latifrons* were found amongst the second donation of specimens. They were at first taken to belong to a young *P. mitchelli* but there seems no doubt that they should be attributed to an example of the species, *P. parvus* of Owen figured in plate XIX., figs. 6 and 7, and XX., figs. 6, 7 and 8 of the Philosophical Transactions, 1872, of which the founder of the species says on p. 193, "with

[1] *Vide ante*, p. 15, for synonymy.
[2] Owen, Proc. Zool. Soc. for 1845, p. 82, 1845.
[3] Owen. Phil. Trans. Royal Soc. 1872, p. 193.

present evidence of the constancy of size, of the molar series of teeth in existing and extinct species of wombat, such series fully in place and well worn, having a longitudional extent of 1 inch 5 lines (36mm.) cannot be referred to a species with a longitudinal extent of molars never less than 1 inch 9 lines (44.5mm.) and usually more; as *e.g.* in the Tasmanian Wombat, which is the smallest of the known existing species. [1]

The four small molars of this collection when placed side by side measure 30mm. which, making allowance for the missing premolar, practically coincides with Prof. Owen's measurement of 1 inch 5 lines for the whole cheek series.

Diligent search among the material in this collection has failed to reveal the presence of any premolar teeth that might be referred to this species and none of the many fragmentary phascolomine bones identified show sufficient variation from the latifront type to warrant their inclusion under another species.

This animal which has previously been recorded from New South Wales and Queensland must have had a range extending over the whole of the Continent. It is new to this State.

SUB-FAM.: THYLACOLEONTINÆ.

Thylacoleo, Owen (1849-1852). [2]

Thylacoleo, Sp.

THE MARSUPIAL LION.

(PLATES VII., VIII., FIGS. 1-7).

From the time that the first recognised remains of animals of this genus were described in the Philosophical Transactions of the Royal Society for 1859, there has been a great amount of discussion as to the nature of the food of this gigantic relation of the Phalangers.

Prof. Owen stoutly asserted that the animal was a carnivore, pointing out the great resemblance between its sectorial cheek

[1] The *P. ursinus* Coll. Journey of the Fly, J. B. Jukes, has a tooth series 47mm. in length, equal to 1 inch 10 lines.

[2] Owen, in Gervais's Zool. et Pal., Franc., 1st edition, Part 1, p. 192, 1849-52.

teeth and the highly-developed premolars of the Lion and other carnivora. Some authorities of repute, such as Falconer, Flower, Huxley, Krefft, and Boyd Dawkins, were of opinion that the animal was a vegetable feeder, "being not much more carnivorous than the Phalangers of to-day," and after years of discussion a compromise was suggested in the words of Lydekker[1]: "Fuller acquaintance with the anatomy revealed, however, its intimate kinship with the Phalangers, and when it was fully realised it was argued that *Thylacoleo* must be a purely vegetable eater. Many of the Cuscuses are, however, partly carnivorous in their habits, and in our own opinion it seems probable that in this respect their gigantic extinct cousin resembled them to a certain extent."

In Australia C. W De Vis, late of the Queensland Museum, and the late G. Krefft, of the Australian Museum, actively championed the two theories; the former was greatly in favour of the "carnivore" theory, bringing forward as proof bones showing what were believed to be marks of the teeth of *Thylacoleo*; the latter authority was, it seems, the original propounder of the theory which found the more general acceptance in spite of Owen and his followers.

In support of his assertions, Owen declared that the highly-developed incisors had assumed the functions of the canines—a very unusual feature, which, however, in the opinion of the writer, is more easily explained than the presence of highly specialised premolars and degenerate molars in the cheek series of a vegetable-feeding animal, where the molar teeth are usually of such great importance in the task of crushing and pounding food.

For a predatory animal, the well-developed canine teeth, separated by the incisor series, form an ideal mode of seizing, retaining, and killing prey; a double grip is thus obtained, which is much more satisfactory than any hold that could be secured with the help of well-developed median incisors, such as those of the rodents and of *Thylacoleo*.

This was a strong point brought forward in the arguments of Krefft and his supporters, for the examples of carnivorous rodents—

1 Lydekker, Lloyd's Natural History, Handbook to the Marsupialia and Monotremata, p. 260, 1896.

the shrews and the insectivorous hedgehog, which is known to kill young rabbits by means of its incisors—are by them regarded as exceptions to the general rule, and not to be compared with *Thylacoleo*, which was said to hunt the *Diprotodon*, *Nototherium*, and Giant Wombat, creatures equalling or surpassing itself in size.

That *Thylacoleo* should be a vegetable feeder seems to be improbable, on account of its diminutive or suppressed molars; these are quite useless for the purpose of pounding and crushing, nor can these functions be performed by the abnormally developed sectorial premolars.

As Prof. McCoy quite rightly observes (Prod. Pal. Vict., Dec. III., p. 8), the opponents of Owen's theory seem to overlook this point when emphasizing the resemblances between *Thylacoleo* and the Rat Kangaroos, which have four, or occasionally three, well-developed molars behind each large premolar.

Again, we have now abundant evidence pointing to the fact that *Thylacoleo* was in the habit of crushing the bones of animals which were its contemporaries. De Vis,[1] Anderson,[2] and Baldwin Spencer and Walcott[3] have described bones which bear undoubted impressions of the upper and lower premolars of the animal. Crushed and broken bones, many bearing tooth-marks, are so plentiful in certain localities that it is quite out of the question to consider them the result of playful antics of the young of *Thylacoleo*; they must rather be regarded as the refuse after a meal partaken of by this Marsupial Lion. In the writer's opinion the animal obtained its food, not after the manner of the lion, tiger and dingo, but rather after the fashion adopted by the hyæna, acting as a scavenger and feeding upon the dead and dying. This would explain the presence of its tooth marks on bones found in the

1 De Vis, C. W., "On Tooth-marked Bones of Extinct Marsupials," Proc. Lin. Soc., N.S.W., Vol. VIII., 1883/4, p. 187.
"On a Femur, probably of *Thylacoleo*," Proc. Roy. Soc. Q'land, Vol. III., 1886, p. 122.
"Remarks on a Fossil Implement and Bones of an Extinct Kangaroo," Proc. Roy. Soc. Vict., Vol. XII., 1889, p. 81.
"Bones and Diet of *Thylacoleo*," Annals Q'land Museum, No. 5, 1900, p. 7.

2 Anderson, W. "On Post-tertiary Ossiferous Clays near Myall Creek, Bingera," Rec. Geol. Surv., N.S.W., Vol. I., 1889/90, p. 116.

3 Baldwin Spencer, Dr. W., and Walcott, R. H., "The Origin of Cut on Bones of Australian Extinct Mursupials," Proc. Roy. Soc. Vict., Vol. XXIV., Pt. 1, 1911, p. 92.

lakes and soaks, and if we regard it also as in the habit of forming its lair in caves, and dragging thither the more or less mutilated bodies of its victims, we could understand the discovery of gnawed bones and bone-bearing coprolites in cave breccias as recorded from Queensland and New South Wales.

Geological Surveyor Anderson [1] described the tooth-marked bones in the following terms: "Occurring in the ossiferous portions of the clays were numerous small fragments of bones, generally a few inches in length, and chiefly pieces of the longer limb bones, which had been broken into fragments prior to their deposition in the clays. In almost every case the sharp fractured edges and angles of these fragments had been slightly rounded by attrition, but they were by no means so well water-worn as the pebbles which occurred along with them. The fragments of the thicker bones rarely showed an entire transverse section of the bone, which had not only been fractured transversely, but also longitudinally. In the case of fragments of the thinner bones, the transverse section is generally complete, the bone not having been fractured longitudinally. The large majority of the broken fragments show unmistakably the teeth-marks of some carnivorous animal, or animals. Most of these marks are, however, too fine to have been produced by the carnassial teeth of *Thylacoleo*, although there are some of them which seem large enough and coarse enough to have been so produced. The fragments of bones which show evidences of having been gnawed, are chiefly pieces of the shafts of the longer limb-bones and ribs. The teeth-marks occur singly along the surface of the fragments, corresponding marks being often present on the opposite surface, indicating the action of the teeth of both jaws on the bones. Generally, however, the marks are confined to one or both ends of the fragments, which often bears evidence of having been bitten sharp off, while close to the sharply bitten end the surface is furrowed with teeth-marks, showing that whatever the animal was, by the action of whose teeth the marks were produced, it had a similar habit to that of a dog, and other carnivora possess, of holding one end of the bone on the ground between the forepaws while it gnawed the opposite free end."

[1] Loc. cit., p. 122.

The specimens identified as belonging to *Thylacoleo* are not numerous, they include however, the large upper and lower incisors, the third upper incisor, formerly regarded by Prof. Owen as the canine, the characteristic upper and lower PM4 and a fragment of the maxilla and malar bearing in situ a perfect left upper premolar (PM4) with the adjacant first molar, both these teeth are very much worn and evidently belong to a fully developed animal.

In addition to these there is a small fragment of the left lower jaw with sockets of the last molar and a portion of the anterior border of the coronoid.

These teeth and fragments, in showing signs of much wear, all suggest that the aged animal (or animals) to which they belonged was from 1-4th to 1-5th smaller than the animals described and figured by Prof. Owen and Prof. McCoy.

The first upper incisors, plate VII., figs. 1 and 2, are mostly fragmentary ; they show that the perfect tooth is curved and compressed, and the enamelled area practically confined to the anterior and exterior surfaces, as in the wombat and the Rodentia. The greatest vertical extent is at the antero-exterior angle of the tooth. On the inner side there is a wedged shaped border confined to the anterior margin, and with its base at the cutting edge. On the posterior aspect the condition was originally similar, but continuous wear has removed much of the enamel which is now almost entirely confined to the cutting edge, a groove in the dentine, presumably caused by the friction of the lower incisor is most distinct.

The distribution of the enamel is entirely different on the canine teeth of the Carnivora, which are completely covered on their exposed surfaces and therefore much more powerful than these incisors.

The third upper incisor in the collection closely resembles the tooth figured by Prof. Owen in Phil. Trans., 1871, Plate XI., fig. 11, which Krefft states is the third incisor [1], but which according to plate XII., figs. 15-18, accompanying his article, should be one of the premolars [2]. This latter designation is evidently an error, for

1 Krefft. Ann. and Mag. Nat. Hist., Series 4, Vol. X., 1872, p. 172.
2 Loc. cit., p. 182.

Krefft states[1] with reference to Prof. Owen's determinations "though he figures the small tubercular premolars with the nail headed crowns right enough."

The large upper premolars (Plate VI., fig. 3) has the typical outline; it is slightly grooved vertically on the outside as well as the inside, the ridges becoming somewhat inflated towards the base. The enamel is worn down obliquely, particularly at the posterior region where the dentine is exposed; the worn surface is on the inner side of the tooth.

As is usually the case in *Thylacoleo*, the small, obliquely denuded first molar is situated on the inner side of the posterior extremity of the premolar. It has suffered much more than this latter, being worn down to the root on its inner surface; the tooth is clearly the last of the upper cheek series.

The first teeth in the mandibular series are the incisors; of these, one, the right of a fairly young animal (plate VIII., fig. 4), and another, the left of an older individual (plate VIII., fig. 5, 6 and 7), are fairly perfect. Like all the other teeth from Balladonia, they are smaller than those figured by Prof. Owen. The right incisor has its posterior surface rather more curved than Prof. Owen's figures; it has the same number of serrated strengthening ridges, but the point of the tooth is considerably worn, so that an oblique, roughly circular patch of dentine about 4mm. in diameter is exposed. It is unlikely that the origin of this worn tip was a fracture.

Krefft in his paper states[2]: "In drawing a few of the lower incisors of *Thylacoleo* . . . I noticed, to my astonishment, clear evidence of attrition on the inner side of several. There was no doubt about it, they had touched each other during the lifetime of the animal (as kangaroo teeth do), but generally at the tips only. In one specimen, however, the surface of the inner side was observed to be quite smooth to the extent of one inch on the lower margin. The ridge so prominent in young or immature specimens has totally disappeared, and my supposition that the jaws were loosely attached is clearly borne out." No other authority appears to have referred to this feature.

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[1] Loc. cit., p. 172.

[2] Krefft. Ann. and Mag. Nat. Hist., Series 4, Vol. X., 1872, p. 181.

The Balladonia specimens both show this polished surface; in the younger tooth it has only just commenced, but on the inner surface of the other, one of the serrated ridges has quite disappeared —the action seems to commence at the point of the tooth and extend along the anterior edge, and then backwards towards the posterior border. The irregular area of the worn and polished surface is shown at *b* in figs. 4 and 6 of plate VIII.

The presence of these polished surfaces on the incisors of carnivorous or ossivorous animals is, I believe, unique. A carnivore would not require its lower median incisors to work against one another in a scissor-like manner, as do those of the phytivorous Kangaroo, and if traces of attrition are present an explanation must be sought in another direction. On examining the mandibles of the *Dasyuridæ*, among the marsupials, and of the *Canidæ*, which may be considered their Placental equivalents, it will be found that the two halves of the lower jaw are but loosely connected for a longer or shorter period of the animal's existence. A number of these mandibles in the Museum Collection were carefully inspected, but no marks of attrition could be seen on the inner sides of the first incisors. It was, however, noted in these animals that during the process of crushing the food the upper cheek teeth are directly and alternately above the lower ones, hence any movement of the mandible due to the force used in crushing or masticating food would be outwards, that is to say, the two median incisors would be forced apart.

In *Thylacoleo*, as restored by Prof. Owen, on the other hand, the relative positions of the large functional upper and lower premolars are such that the upper teeth pass outside the lower ones. The crushing of food between the cheek teeth would therefore tend to press the lower mandibles together, and cause the incisors to rub against one another. In this way, flat surfaces might be worn on the inner sides of the two median incisors.

It is to be hoped that more abundant remains of this animal will be found in the near future, for, could an almost perfect skeleton be examined, many points which are at present difficult to interpret would be made clear.

At various dates, odd skeletal bones have been determined as probably belonging to *Thylacoleo*, and suggestions made concerning

the outline of the perfect animal. According to one of these, the Marsupial Lion, unlike the other Phalangers, would have progressed after the manner of Kangaroos and Wallabies, and not on all fours as Prof. Owen had determined. Our knowledge of the animal, its food and habits is very incomplete, and theories concerning its life-history must at present be partly conjectural, but the discovery of a more perfect skeleton would soon definitely determine the nature of the creature's food.

The other lower incisor, besides possessing the obliquely truncated tip and the worn surface on the inner aspect, shows distinct signs of attrition on its posterior face. For a distance of 12.6mm. near the outer edge a lenticular mass of enamel has been removed and a distinct hollow worn in the underlying dentine. Judging from the British Museum (Nat. Hist.) Cast M1958, this area ultimately becomes connected with the gradually increasing patch of dentine exposed at the worn tip.

Of the lower functional premolars there is a fragment comprising the anterior half of the enamelled crown, showing but little wear. Of the left mandibular P4, one tooth, still inserted in a fragment of the mandible, is almost perfect, the enamel coating of the antero-internal angle alone being absent; the two other fragments are the anterior and posterior halves of the enamelled crowns, both showing longitudinal strips of dentine where the enamel has been removed by attrition.

As was the case with the other teeth described, these worn premolars are less than the corresponding teeth figured by Prof. Owen; in this instance, the Balladonia teeth are from .72 to .8 the size of those from the Eastern States.

The discovery of more abundant remains in a better state of preservation will, no doubt, show that the Western Australian Marsupial Lion was distinct from the Eastern species, *Thylacoleo carnifex* (Owen) of Victoria, and *Thylacoleo oweni* (McCoy)[1] of Queensland and New South Wales.

Remains of *Thylacoleo* have not previously been recorded from Western Australia.

1 McCoy, Prod. Pal. Vict., Dec., III., p. 9, 1876.

Fam. MACROPODIDÆ. Sub-Fam. MACROPODINÆ.

Macropus, Shaw (1790).[1]

Macropus magister, De Vis (1895).[2]

Macropus titan, Owen (*in parte*) .. Owen. Phil. Trans., 1874, p. 248, *et seq.*, plate XXII., figs. 17, 18.
Lydekker Cat. Foss. Mamm. Brit. Mus., Part V., p. 225, 1887.
Lydekker Handbook Marsup. p. 254, 1896.

MACROPUS MAGISTER.

At the time of founding this new species, De Vis went fully into the points of resemblance and difference of *M. titan* (Owen) and this form of extinct Kangaroo. The specimen from Balladonia consists of a fragment of the left lower jaw containing one perfect molar, presumably M2, and the stumps of the two anterior teeth; the perfect tooth cannot be distinguished from the teeth M2 shown in figures 13 and 14, plate XXII., and figure 10, plate XXVI. of Phil. Trans., 1874, nor does it differ from several of the second molars of *M. magister* from Queensland, presented to this Museum by Mr. C. W. De Vis some thirteen years ago. The dimensions of the crown are 14.4 and 8.4; the crest of the hind lobe is somewhat worn, so that the tooth must have been in use for some time. The anterior talon has straight converging sides and a slightly sinuous, almost straight, anterior edge; the lobes are thick, with rounded angles and rounded crests, having their convexity backwards; the connecting links or bridges are slightly curved, the exterior face being concave. A vertical fold and a groove are present on the posterior aspect of the tooth. There is a bulging of the base and to erect plate.

This is the first recorded specimen of this Queensland form for Western Australia. The fact that an undoubted *M. titan* was obtained in the Mammoth Cave in 1909 is of importance when considering the distribution of the two kindred species.

1 Nat. Misc., i. text to plate XXXIII., 1890.

2 Proc. Linn. Soc. N. S. Wales, 2nd Series, Vol. X., p. 120, 1895.

Macropus anak, Owen (1859).[1]

Protemnodon anak, Owen (in parte) ..	Phil. Trans., 1874, p. 275.
,, *og*, Owen	l.c. 1874, p. 277.
,, *roechus*, Owen .. .	l.c. 1874, p. 281.
,, *mimas*, Owen	l.c. 1874, p. 278.
,, *antaeus*, Owen	Ext. Mamm. Aust., p. 448, 1877.
Sthenurus brehus, Owen	Phil. Trans., 1874, p. 272.
,, *atlas*, Owen (in parte) ..	l.c. 1874, p. 265.
Micropus mimas, Owen sp.	Flower, Cat. Vert. Anim. Mus. Royal Coll. Surg., Part II., p. 720, 1884.
,, *brehus*, Owen sp.	Lydekker, Cat. Foss. Mamm. Brit. Mus. (N.H.), Part V., p. 207, 1887.
,, *roechus*, Owen sp.	Lydekker, Cat. Foss. Mamm. Brit. Mus. (N.H.), Part V., p. 212, 1887.
,, *anak*, Owen sp.	Lydekker, l.c., p. 214.
Halmaturus anak, Owen sp. ..	Troussart, Cat. Mamm. Tom. II., p. 1181, 1898-9.

MACROPUS ANAK.

Two fragmentary mandibles are conspicuous by the size of the teeth they bear and the limited depth of the horizontal ramus. The portion of the left jaw contains two molars(M2 and M3 in situ.) These teeth are almost perfect; they are but little worn, and therefore show the very faint verticle folds on the anterior aspects of the lobes. The other specimen—a part of the right ramus—shows the last molar rising from its alveolus, and the preceding one up in position; this exhibits signs of wear on the posterior lobe, but the very faint vertical folds or grooves are still visible.

The teeth are much larger than those of *Sthenurus*, and can readily be distinguished from the molars of the living species of *Macropus*; they differ somewhat from all Owen's figures of teeth of the species included in the above synonym, being very broad in comparison with their length.

A specimen of *Macropus anak* (c. 112, Q.M. 10731) in the Museum Collection, presented by Mr. C. W. De Vis of the Queensland Museum some 13 years ago, very closely resembles the Balladonia fossils. Upon referring to a paper by this authority,[2] "A Review of the Fossil Species of the Macropodidæ in the Queensland Museum," this species is defined, as follows: "Molars smooth,

[1] Proc. Geol. Soc., XV., p. 185 (part), 1859.

[2] Proc. Linn. Soc. N. S. Wales, 2nd Series, Vol. X., p. 75, 1895.

with rectilinear crests, feeble lines and sharp angles, upper molars without distinct anterior links, lower seldom without posterior talons. . . . These posterior basal talons are generally present as erect plates, raised rims, or a mere but decided bulging of the base."

This description applies to the specimens under consideration, and is made to embrace a number of Owen's species, as De Vis found, after examining 330 specimens, that there was a good deal of variation, and that intervening forms made the gradations so minute that it was quite impossible to draw any hard and fast line of separation. He states[1]: "The degree of variation in the length of the cheek teeth found in this species is less than that shown by *Halmaturus ruficollis*, and the premolar has a more restricted range of length than in most of the larger existing Wallabies. On the other hand, the width of the teeth and the depth of the mandible have a somewhat greater range of measurement than in living species, and in thickness the ramus is decidedly more variable; but, as in all the dimensions, the extremes are reached by insensible gradations, excess even in the width of the teeth must be considered a peculiarity of the species. . . . It is quite the most abundant macropod of its period."

The specimens from Balladonia resemble the mandible figured by Owen in Phil. Trans., 1874 (plate xxv., figures 7 and 8), as *M. anak*, and as regards the teeth they most nearly approach those of *P. mimas* of plate xxvi., figures 1, 2 and 3, which they slightly exceed in width.

The teeth of *P. mimas* (plate xxiv., figs. 13 and 14, and plate xxvi., figs. 4, 5 and 6), the *P. roechus* (plate xxvii., figs. 10, 11 and 12), and the *P. antaeus*, figured on plate cx. of "Extinct Mammals of Australia," all show points of resemblance to the teeth from Balladonia, but differ in the relatively less width of the crowns.

Remains of this species have been obtained in all the Eastern States and South Australia, but are now recorded for the first time from deposits in Western Australia.

It was probably one of the largest Kangaroos, rivalling the huge *M. titan*, but giving pride of place to its contemporaries, the genera *Procoptodon* and *Palorchestes* which have likewise become extinct.

1 Loc. cit., p. 106.

Sthenurus, Owen (1873).[1]

Sthenurus atlas, Owen (1838).[2]

Macropus atlas, Owen .. .. Mitchell's "Three Expeditions into the Interior of Eastern Australia," 2nd Ed., Vol. II., p. 359, 1838.

Protemnodon anak, Owen (in parte) .. Phil. Trans., 1874, p. 275.

STHENURUS ATLAS.

There are several specimens which have been identified as belonging to this species.

A small fragment consisting of the anterior portion of the left ramus with the root of the incisor, the diastema, and the permanent premolar rising from its alveolus, has this important tooth in perfect condition. The tooth closely resembles the rising premolar figured by Prof. Owen on Plate XXII. (figs. 5 and 6) in the Philosophical Transactions of 1874, but has a somewhat different tooth sculpture, suggesting that this feature is subject to a certain amount of variation (see also Owen's various figures of this premolar). The size of the diastema, the dimensions of the mandible, and the position of the predental foramen agree exactly with Owen's drawings.

The differences between the lower permanent premolar of this species and the corresponding tooth of *S. occidentalis* have been fully discussed,[3] but are more readily discernible when specimens of the two species are placed side by side.

Another example (in three fragments) comprises the major portion of the right horizontal ramus, with the base of the coronoid, the extent of the cheek teeth, part of the diastema, and the perfect incisor. The first and second molars, both much worn, are the only perfect cheek teeth present. The longitudinal links have disappeared, and the crown of the tooth is practically reduced to a flat grinding surface; there is no trace of any verticle grooving or folding. A portion of the outer surface of the permanent premolar is preserved, the other teeth are represented by roots only. The

[1] For synonymy of the genus, *vide ante*, p. 31.
[2] In Mitchell's "Three Expeditions," 2nd Ed., p. 359, 1838.
[3] *Vide ante*, pp. 32, 33 and 34.

incisor which has lost the tip of its root is very much worn, more than half the enamel on the inner side having been removed. The ower portion of the enamelled surface on this face is worn and polished by the friction of the other incisor, showing that the symphysis was lax and that, by a motion of the jaws, the two incisors worked against one another in a scissor-like manner.

The jaw differs from *S. occidentalis* in its general outline, the contour of its inner and outer surfaces, the greater extent of the cheek teeth (P4 M4), which is 70mm. against 62mm. in the other species, and by the greater dimensions, both longitudinal and transverse, of all the individual teeth. On the other hand, this Balladonia animal has many points in common with the one whose broken mandible is figured by Owen (loc. cit., plate XXII., fig. 9, and plate XXIV, figs. 7 and 8). The extent of the tooth series and of P4-M2, the contour of the bone and the dimensions of the individual teeth are identical.

The length of the tooth series and the measurements of the mandible do not come within the limits given by De Vis[1] in his description of the species, but, as the specimen figured by Owen has not been excluded by this authority when he restricted the species, and has been allowed to stand by Lydekker[2] in his catalogue, this jaw may be regarded as a true *S. atlas*.

A third specimen, consisting of the greater part of the horizontal jaw with roots of the four molars, may be included; it has an outline similar to the preceding, but has its lower margin perfect.

This animal is new to the State. Its home has, up to the present, been considered to be in Queensland and New South Wales. The finds at Balladonia have greatly extended its range.

[1] Proc. Linn. Soc., N. S. Wales, 2nd Series, Vol. X., p. 98, 1895.

[2] Loc. cit., p. 233.

DETERMINATION OF THE EXACT LOCALITIES WHERE CAMBRIAN FOSSILS WERE COLLECTED BY E. T. HARDMAN IN 1884.

By LUDWIG GLAUERT, F.G.S.

In 1884, the late Mr. E. T. Hardman, F.G.S., visited the valley of the Ord River in the Kimberley district, where he collected a number of specimens which, together with many others obtained during that and the previous expedition into the Kimberleys, were mostly deposited in the Geological Museum, Fremantle, and the Swan River Mechanics' Institute, Perth.

The pieces of limestone which were consequently found to contain Cambrian fossils were placed in the hands of Mr. R. Etheridge, Curator of the Australian Museum, Sydney, for examination. His manuscript notes, afterwards handed to Mr. A. H. Foord for incorporation in his "Description of Fossils from the Kimberley District, Western Australia,"[1] first demonstrate the presence of Cambrian beds in this State. The fossils described are the Pteropod *Salterella hardmani* and the Trilobite *Olenellus* (?) *forresti*.

The localities given with the published descriptions are "Kimberley District" for the former, and "River south of Base Line, Kimberley District" for the latter. These, it must be admitted, are very vague.

Numerous attempts have been made to discover the spot where the specimens were collected but without avail.

Mr. R. Etheridge stated in 1906[2] that Mr. Hardman's "specimens were very poorly localised, and I have quite failed to identify his precise locality."

Dr. R. Logan Jack had an opportunity of traversing a great deal of the country surveyed by Hardman, but he, too, was

1 Geol. Mag. Dec. III., Vol. VII., p. 98, *et. seq.*

2 Northern Territory of South Australia; N.-W. District Reports (Geological and General) resulting from the Explorations made by the Government Geologist and Staff during 1905; General Geology, p. 42, 1906.

constrained to admit that he had failed to trace the Cambrian limestone beds from which the *Salterella* and the *Olenellus* were collected. In fact, he considered the task so hopeless that he remarked in 1906[1]: "The palæontological evidence is also exceedingly meagre and, scientifically speaking, ought to be ignored, as the two localities from which Hardman collected Cambrian fossils . . . have been defined too vaguely for identification as Kimberley District and River south of Base Line."

In his presidential address to Section C (Geology) at the Adelaide Meeting of the Australian Association for the Advancement of Science in 1907, Mr. A. Gibb Maitland gives as his opinion[2]: "Despite the fact of poor localisation of Hardman's fossils, it may, I think, be taken for granted that Cambrian beds do occur somewhere in Kimberley about South latitude 18°. The recent discovery of *Olenellus* and *Salterella* in the limestones of the Daly River in the Northern Territory by Messrs. Brown and Basedow is of considerable geological importance, indicating a somewhat wide distribution of Cambrian strata in Northern Australia, and makes the solution of the Hardman puzzle almost imperative."

Mr. H. W. B. Talbot visited the Elvire and Ord rivers in his traverse of the route followed by the Canning Survey Party, 1907-1909.[3] In the course of his journey from Flora Valley Station to Wyndham he collected several pieces of fossiliferous limestone from the Ord River Station. I had the good fortune to handle these specimens for a few moments, and as far as I could judge, the fossils consisted of *Salterella hardmani* in a hard sub-crystalline limestone of a greyish colour.

These specimens are now in the hands of Mr. R. Etheridge of Sydney, and when his report is available I have no doubt that my determination of the age of the rock and the nature of its fossil contents will be confirmed.

The subject first came under my notice when preparing the "List of Western Australian Fossils," which was offered to the Government Geologist and published by him in Bulletin 36 (III.

1 "The Prospects of obtaining Artesian Water in the Kimberley District." G. S. W. A. Bulletin, No. 25, p. 15, 1906.

2 Reo. Austr. Assoc. Adv. Soc., Adelaide Meeting, 1907, p. 140, 1908.

3 G. Survey (W.A.) Bulletin, No. 39, Perth, 1910.

Palæontological Contributions to the Geology of Western Australia, 1910). Some of the notes then made were recently discovered among other papers, and I decided to investigate matters more thoroughly as I now had the necessary leisure.

It was found that, whereas the locality mentioned in the description of *Salterella hardmani* was correct, the record on the label attached to the *Olenellus* had been inaccurately copied. In a list of Western Australian Fossils in the Collection of the British Museum (Nat. Hist.) obtained for my assistance by the Acting Government Geologist, Mr. H. P. Woodward, F.G.S., in 1908, the locality for the Trilobite is given as "River south of Base Line Camp" and "Ord River"—that is to say, the Trilobite remains were collected in *two* localities, a fact confirmed by the following paragraph in Mr. Etheridge's description.[1] "On the weathered surface of a similar limestone rock, and from the same locality as the head just described, there is a short spine probably belonging to the present species; if so, it would be the telson. In another piece of limestone, similar to those containing the head and telson, there is a portion of a thoracic segment which agrees in form with the first two segments of an *Olenellus*; this may also belong to the present species."

The addition of the single word "Camp" simplifies the localisation of the Cambrian beds from which the fossils were obtained.

As the specimens collected in 1883 and 1884 and deposited in the Geological Museum at Fremantle are tabulated in the form of an appendix to Hardman's 1884 Report, published in 1885, a search was made, with the result that an entry, "Hb 27. Limestone with lead, zinc, and fossils, from river south of Base Line Camp; several specimens,[2]" was discovered.

No "Base Line Camp" is referred to in the Report for 1883, but in that for the succeeding year, paragraphs 295[3] to 299 describe "Section between J 34 and the *Base Line Camp*," and in paragraph 298 we read "Base Line Camp, Z 27," which an examination of Hardman's map shows was placed on the left (north) side of the

[1] Geol. Mag. Dec., III., Vol. VII., p. 99, 1890.

[2] Report on the Geology of the Kimberley District, Western Australia; Perth, 1885, p. 36.

[3] Loc. cit., p, 32.

river, *north* of the Base Line W.B.-E.B.[1] This would account for the omission of the name of the river, for Hardman would, no doubt, consider this localisation sufficiently distinctive.

In paragraph 302 of this Report, Hardman writes, "Base Line Camp to Hardman Range. On this side of the river the prevailing rock is limestone, which crops out from under the alluvium and soil in low ridges, bearing a little N. of E. In the present section, only one of the ridges is visible. It is about half a mile wide, and has been traced for 10 or 12 miles in a direction to E.-N.E., about two miles from the river and parallel to it."

It may be that these limestone beds do not outcrop in the bed of the river close to Camp Z 27, for the only rocks mentioned in paragraph 298 as having been observed in the river bed between the Base Line Camp and J 34 are "a few beds of red shales and micaceous mudstones." The limestone may extend north of the patch mapped by Hardman, but it must be admitted that some of Hardman's localisations are not very precise. As an example of this it may be mentioned that in paragraph 322 he states: "Lead, zinc, etc., have been noticed in the form of Galena in the limestone rocks *a little south of the Base Line* (Ord River)," whereas in the Appendix we read that specimens "Hb 27. Limestone with lead, zinc, and fossils" came from "*River south of Base Line Camp.*" Therefore, as these minerals and fossils were collected either in the (Elvire) *river* south of Base Line Camp or (Limestone) *ridge* south of the Base Line (see specimen HB 18) it may, I think, be concluded that the Hardman Trilobite also came from one of these two localities, presumably from the former.

As stated above, one of the *Olenellus* fragments was obtained from a locality some distance away from the Base Line Camp specimens. This is taken to be the one referred to as "Ord River" in the British Museum List of 1908, and is doubtlessly specimen HB 48 of Hardman's Appendix, localised as "River bed Ord, near J 38"[2] In paragraph 304 Hardman writes: "About five miles below the junction of the Elvire and the Ord, limestone crops out in the river bed, and in low ridges through the alluvium to the

[1] In Mr. Maitland's Presidential Address this line is incorrectly referred to as W.B.-E.F.; loc. cit., p. 141.

[2] Loc. cit., p. 37.

south, their general trend being E.N.E." The position of these exposures is opposite J 38.

The only other catalogued fossiliferous limestone from the river bed is "$\frac{HB\ 2}{32}$ limestone with fish palate, Camp Z 31, river bed Ord," which obviously is not the specimen named by Mr. Etheridge.

The specimen of *Salterella hardmani* in the Museum Collection is labelled HB 33, and was obtained from Mt. Panton.

Hardman's palæontological observations in the field do not in any way lead to the belief that his locality south of Base Line or Base Line Camp refers to the Base Line laid down in 1883. Firstly, his list of specimens collected in 1883, in the Appendix of his Report for 1884, does not include a single fossil or fossiliferous specimen collected from or near Mt. Campbell, where the Base Line was situated[1]; and, secondly, the fossils observed in the rocks near that locality show a purely Carboniferous facies, for they include *Poteriocrinus*, *Athyris*, and *Lithodendron*[2] in a good state of preservation.

In the Report for 1884, numerous fossils are recorded from the Ord river district, including some purely Carboniferous genera, but there is some likelihood of Hardman's field observations being at fault, for, unlike the fossils from the Western district, these latter were "usually so worn by the excessive action of the weather in this tropical climate that identification as to species is almost impossible in many cases."[3] Of the genera mentioned, only one, *Athyris*, is more or less confined to the Carboniferous.

LITHOLOGICAL EVIDENCE.

In describing the Limestone Series (L) of the Ord District, Hardman says[4]:—

"123. This portion of the limestone country rises in a succession of low and almost imperceptible terraces into high tablelands. One of these extends to the east of the Ord, near the 'Cattle Station,' and another to the north and east of the Negri River, where it is capped by Mt. Panton.

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[1] Mr. Gibb Maitland's Presidential Address, loc. cit., p. 141.
[2] Hardman's 1883 Report (Perth, 1884), p. 16.
[3] Hardman's 1884 Report (Perth, 1885), p. 17.
[4] Loc. cit., p. 17.

"124. The Ord limestones are for the greater part hard and flaggy, rarely massive, usually grey in colour, sometimes sandy or magnesian, and seldom fossiliferous. In many parts of the district they are interbedded with red shales, marls, and sandstones, the former of which contain occasionally layers of gypsum, together with traces of rock salt. . . .

"125. Over the great part of this country the limestone crops out in bare masses, cut through by numerous gullies and water-courses, along which the rock forms high cliffs and scaurs, showing the stratification—which dips at a very low angle in various directions—very distinctly."

Dr. R. Logan Jack states[1]: "The strata [of the limestone] which at the south-western and south-eastern boundary of the formation dip to the north-east and north-west, are practically horizontal on the Ord River below its junction with the Elvire, and probably continue to be horizontal where they are covered, on the left bank of the Ord."

These descriptions enable us to define the known outcrops of Cambrian limestones of Western Australia as being hard and flaggy, usually grey in colour, either horizontally bedded or dipping at a very low angle in various directions.

Evidence of confirmatory nature is found in the record of the explorations made by the Government Geologist of South Australia and his Staff in 1905. Mr. H. Y. L. Brown reports[2]: "During the present examination of the belt of limestone, extending south-easterly from east of Mt. Litchfield to the Katherine River, was proved to be of Cambrian age by fossil evidence. Outcrops of the rock, two miles north of Noltenius Billabong, and about nine miles from the Daly River, consist primarily of a compact blue-grey and yellow sub-crystalline limestone, parts of which are rich in pteropod tests of *Salterella*, weathering slightly in relief. The beds are horizontal, and the line of outcrop trends north-westerly. No deep section is available, and, wherever encountered, the outcrops rise but a few feet above he surface. The physical features are low, banked, denuded tables, separated by horizontal joint planes, and piled one upon the other, the uppermost being very much smaller

[1] Loc. cit., p. 26.
[2] Loc. cit., p. 14.

than the lowest visible, which rests upon massive beds of the same rock below.[1] The exposed surfaces have been eroded in a remarkable manner by the atmosphere, and appear in the form of sharp, confluent, serrated ridges, grading downwards on all sides, the whole giving the effect of a model of mountain chains on a small scale. The rock decomposes comparatively readily, and produces a rich red clay soil.[2] The beds overlie unconformably the schistose Pre-Cambrian rocks on the east and west. . . . In lithological characters, this formation is similar to that covering large areas between the Katherine Station and Flora Falls; also to that at Jasper and Timber Creeks, off the Victoria River: between the Elsey and Daly Waters Stations on the Transcontinental Telegraph Line; at Anthony's Lagoon, Brunette Downs, Alexandria Station, and other places. It is most probably continuous beneath the basalt, sandstone, and other later formations. The occurrence of Cambrian fossils near the Daly River and Alexandria Station prove that these widely separated expanses of limestone are identical in age."

CONCLUSIONS.

Hardman collected his Cambrian fossils :—

At River bed (Elvire) South of Base Line Camp Z27 (HB27).

At river bed (Ord) 5 miles below its junction with the Elvire, opposite the Hill J38 (HB 48).

And at Mt. Panton, Northern Territory (HB33).[3]

Mr. H. W. B. Talbot collected Cambrian fossils (*Salterella*) at the Homestead, Ord river Station.

The stratigraphical results may be summarised as follows :—

Cambrian rocks are exposed in Kimberley along the valleys of the Elvire and Ord rivers from near the North-western extremity of the Hardman Range to the Ord River Station, and so on to Mt. Panton (N.T.),[4] thence they will no doubt be found to

1 This admirably describes the outcrop in the Ord River Valley, and at Mt. Panton.

2 A marked feature round the Ord River Station homestead.

3 The "Limestone with Fish Palate," $\frac{HB2}{32}$ is also of Cambrian age (*postea* p. 74).

4 An outlier of carboniferous age as a capping to Mt. Panton would explain the presence of carboniferous fossils at that locality.

extend to Jasper and Timber Creeks off the Victoria River, where the beds have been recognised by Mr. H. Y. L. Brown. In due course, when the mapping of the beds is extended, it it will probably be joined up to the Cambrian Limestone of Flora river, the Katherine river, and the Daly river valley, and the other localities further east and south in the Northern Territory and Central Australia.

The exact localisation of these Cambrian beds will have a profound effect upon the Geological mapping of this State. When the matter has been further worked out it will doubtlessly be found necessary to regard most of the beds marked "S" on the eastern half of Dr. Jack's map of 1906 as of Ordovician age[1]. Beds mapped as "D" would become pre-Cambrian[2] to distinguish them from the still older metamorphics (M) which might be regarded as Archæan[3].

The Cambrian Limestone beds of Northern Australia, extending from the Elvire river near the north-western extremity of the Hardman Range to the Daly river (Noltenius Billabong) and Alexandria Cattle Station in the Northern Territory are thus seen to present a remarkable uniformity of character throughout the course of their outcrops, and to be almost, if not quite, horizontally bedded wherever they appear at the surface.

NOTE BY THE EDITOR.

19th March, 1912.

I have just received the following communication from Dr. F. A. Bather, F.R.S., Assistant Keeper of Geology in the British Museum:—

[1] Mr. Talbot has found similar beds to the south of those just mentioned, they extend from lat. 23deg. S. to 25deg. S., with two smaller patches further south.

[2] Mr. H. W. B. Talbot has shown that beds similar to these, and also horizontally bedded, extend southwards to lat. 23deg. S., long. 124deg. E. (Bulletin No. 39).

[3] A band of these ancient metamorphic rocks was seen by Mr. Talbot to cross his route and extend from Mt. Methwin to Lake Nabberu, a little to the north of Wiluna.

Geological Department,
British Museum (Natural History),
Cromwell Road,
London, S.W.

19th February, 1912.

Memorandum to the Director of the Western Australian Museum and Art Gallery, Perth.

The following is an exact copy of all labels, numbers, etc., attached to the specimens of *Olenellus forresti* and *Salterella hardmani* collected by Hardman in the Cambrian rocks of Kimberley, and preserved in the Geological Department of the British Museum:—

(I 2346A) *Olenellus ? forresti* (Etheridge Jnr. M.S.) Foord
Cambrian. "River south of Base Line Camp." Kimberley, W. Australia.
Figd. Geol. Mag. 1890, pl. IV., fig. 2a
Presd. E. T. Hardman, 1886.

R
S. of
Base line
H B 27

(I 2346) Do. do. do. fig. 2
Presd. E. T. Hardman, 1886.

River
S. of
Base line
H B 27

(I 2347) *Olenellus forresti* (Etheridge Jnr. MS.) Foord
Cambrian. Ord River, Kimberley District, W. Australia.
Figd. Geol. Mag. 1890, pl. IV., fig. 2b
Presd. E. T. Hardman, 1886.

Ord River
Palæzoic
H B 2/32

(G 7428) *Salterella hardmani.*
Spec. fig. in Geol. Mag. 1890, pl. IV., ff. 1a-b
Presented by Gov. W. Australia per H. P. Woodward, Esq.

No. 1
K 5

Salterella hardmani
(Ether.)
Lr. Palæzoic
Kimberley
Exhibitor, E. T. Hardman

PERMO-CARBONIFEROUS FOSSILS FROM BYRO STATION, MURCHISON DISTRICT.

By L. GLAUERT, F.G.S.

A number of fossils of Permo-Carboniferous age, obtained in the course of sinking a bore at Byro Station, on the Byro plains south of the Carrandibby Range in the Murchison, were presented to the Museum by Mr. L. Landauer of Day Dawn.

The majority of the fossils have the shell preserved, but others appear as more or less glossy internal or external casts; they include *Spirifer convolutus* (Phillips), *S. musakheylensis v. australis* (Foord), *Chonetes pratti* (Davidson), *Deltopecten subquinquelineatus* (McCoy), and *Aviculopecten sprenti* (Johnston). Two new forms have been recognised; the *Spirifer* is represented by a number of specimens which render a diagnosis possible, but the *Conularia* is imperfect and fragmentary.

BRACHIOPODA.

Genus Spirifer.

Spirifer byroensis, sp. nov.

Spirifer lata (?) .. Eth. fil. Geol. Surv. W.A., Bulletin 10, p. 15, plate 1., fig. 8 (1903).

SPIRIFER BYROENSIS.

This species is represented by specimens more or less spindle-shaped, with sub-acute alar angles, beaks not prominent, rising but little above the cardinal edge, slightly incurved. Hinge line straight, cardinal area moderately wide, concave, transversely striated, as wide as the shell. Ribs radiating, numerous—about 40 on each valve—usually grouped in bundles of three, grouping becomes indistinct towards the wings—where the ribs are irregular and gradually fade away,—alar extremities curved, smooth wing-like. Lines of growth distinct towards the margin. Sinus and fold ribbed. Sinus of the ventral valve extends to the apex of the beak.

Dorsal valve: the cardinal area is rather narrow, cardinal process small, flattened and vertically striated, cardinal sockets long, grooved above, expanded distally. Denticles not observed.

Dimensions of the shell, 37mm. by 103mm.

The *S. lata?* of Etheridge[1] has a costate sinus, acutely extended and nearly smooth alations, which differ in several details from the shell under consideration. The sinus broadens much more rapidly and is less distinct, the alar angles are more acute, the beak is much more prominent, and the ribs lack the tendency to group themselves in bundles.

The fold of the dorsal valve is not grooved as in the *S. lata* from the Queensland Permo-Carboniferous,[2] which shell also possesses plain sulcus and median fold, as well as stronger ribs.

The shell differs from *S. latus* (McCoy) in having fold and sulcus ribbed, in the number of ribs on each valve, and in possessing a cardinal area transversely concave.

S. convolutus (Phillips) differs from the new species in the nature and extent of the ribbing, and in possessing much more attenuated (acute) alar angles.

S. musakheylensis v. australis (Foord), when young, is an alate form with ribs arranged in bundles, but its costation is much finer and the wings are not smooth; it also has a much more prominent beak.

There are five specimens (Nos. 1650-1654) in the collection. The two shells chosen as types (Nos. 1650 and 1651) show the features described above.

GASTEROPODA PTEROPODA.

Genus Conularia.

Conularia, sp. nov. (?)

c. f. *C. Warthi* .. Waagen, Pal. Ind., Series XIII., Salt Range Fossils, Vol. IV., p. 126, plate IV., fig. 6, plate V., fig. 1 (1889-1891).

CONULARIA, sp. nov.

Three crushed fragments on a piece of ironstone (No. 1660) present the following features:—

Elongated pyramidal shell, quadrangular; faces sub-equal (?), almost flat, slightly grooved in the middle, apical angle unknown,

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[1] Loc. cit.

[2] Jack and Etheridge. Geol. and Pal., Queensl., p. 229, 1892.

probably small; folds sharp, narrow, punctate, slightly arched, with the concavity towards the apex, alternating at the side angles, interrupted in the middle of their length but rarely alternating, furrows wide—ten to twelve in the space of 10mm., becoming narrower and more crowded towards the apex—side angles depressed, indistinctly preserved.

This *Conularia* is nearly related to the two Australian species *C. levigata* (Morris)[1] and *C. inornata* (Dana).[2] It differs from both in having its thin, sharp folds punctate; the section of the shell is unknown, as the examples are all fragmentary, but one worn example suggests that the tube was rectangular in section. *C. quadrisulcata* (Miller)[3] has a much greater apical angle, with folds punctate but much more crowded than on the Byro Station fossils.

Conularia warthi (Waagen),[4] collected by Dr. Warth in Chél Hill and at Dillur, can hardly be distinguished from the Byro plains shell in its general features, but a most careful examination with a lens failed to reveal the "fine, somewhat irregular, plication that extends transversely over the spaces or valleys between the single ribs," visible on the Indian fossil.

The presence of the inter-costal tubercle at the angles of the tube could not be definitely asoertained owing to the imperfect nature of the fossil.

The *Conularia* clearly shows a closer affinity to this Indian form than to the Permo-Carboniferous species of Eastern Australia.

In his monograph, Dr. Waagen states that the Indian *C. warthi* is associated with the so-called Boulder Beds, which are now considered to be the result of a glacial period of Permo-Carboniferous age. It is of the utmost geological and palaeontological importance to find that a closely allied, if not identical, species of *Conularia* has been obtained from strata intimately connected with the Western Australian Boulder Beds.

The genus has not previously been recorded from Western Australian Sediments.

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1 J. Morris, in Strzetecki's Physical Descriptions of N.S. Wales and Van Diemen's Land, p. 290, plate XVIII., fig. 9, 1842.

2 J. D. Dana. Geol. Wilkes U.S. Expl. Exped., p. 709. plate X., fig. 8, 1849.

3 Sowerby's Min. Conch. III., p. 107, plate CCLX., fig. 5, 1821.

4 Palæontologia Indica, Series XIII., Salt Range Fossils, Vol. IV., p. 126, plate IV., fig. 6 a, b, c, d; plate V., fig. 1 a, b.

NOTES ON SOME WESTERN AUSTRALIAN FISHES.

By ALLAN R. McCULLOCH, Zoologist, Australian Museum.

PLATES IX. to XIII.; text-figures 1, 2.

The Australian Museum has received for identification a large collection of fishes from the Director of the Western Australian Museum and Art Gallery, while several smaller ones have been presented to the Trustees by Mr. A. Abjornssen, Chief Inspector of Fisheries, Western Australia. They include a considerable number of new and little-known species, of which some are dealt with in the following pages. Others not previously recognised from the Western State are recorded.

I wish to express my thanks to Mr. Bernard H. Woodward for enabling me to examine and write upon this extremely interesting collection, and also for various kindnesses connected with the publication of the paper. My thanks are also due to Mr. Abjornssen, who has made special efforts to secure several species I have particularly asked him for.

GONORRYNCHUS GREYI, Richardson.

Rynchana greyi, Richardson—Zool. Ereb. and Terr., 1845, p. 44, plate XXIX., figs. 1-6.

Gonorhynchus greyi, Günther—Brit. Mus. Cat. Fish, VII., 1868, p. 373 (part); *Id.*, Castelnau, Proc. Zool. Soc. Vict., I., 1872, p. 182; *Id.*, Klunzinger, Arch. fur Nat., XXXVIII., 1872, p. 42, and Sitzb. Akad. Wiss. Wien., LXXX. i., 1879, p. 415; *Id.*, Macleay, Proc. Linn. Soc. N. S. Wales, VI., 1881, p. 255; *Id.*, Johnston, Proc. Royal Soc. Tasm., 1882 (1883), p. 132, and 1890 (1891), p. 37; *Id.*, Ogilby, Proc. Linn. Soc. N. S. Wales, XXIV., 1899, p. 154; *Id.*, Waite, Rec. Austr. Mus., III., 1900, p. 211.

Gonorhynchus gonorhynchus, Stead—Proc. Linn. Soc. N. S. Wales, XXXII., 1908, p. 744, and "The Beaked Salmon" (Dept. Fish. N. S. W.), 1908, pp. 1-8, plate 1.; *Id.*, Zietz, Trans. Royal Soc. S. Austr., XXXII., 1908, p. 295.

Gonorhynchus gonorynchus, Waite—Trans. N. Zeal. Inst., XLII., 1910, p. 374.

Gonorrynchus greyi, Ogilby—Ann. Queensl. Mus., No. 10, 1911, p. 34.

? Gonorrynchus forsteri, Ogilby—*Loc. cit.*, and synonymy.

I have compared three Western Australian examples with four others from New South Wales, one from Victoria, and twelve from Lord Howe Island, and find them to be identical. They all differ from Richardson's figure, however, in the proportional lengths of the head and pectoral fins. My series includes specimens from 86-255mm. long. The pectorals are from $2\frac{1}{4}$-$2\frac{3}{4}$ in their distance from the ventrals, not $3\frac{1}{2}$, as figured. The head varies from $4\frac{1}{4}$-$4\frac{3}{4}$ in the length to the hypural; in the figure it is almost six times. The insertion of the dorsal fin also is farther forward in my specimens than shown. It must be noted, however, that Stead figures New South Wales examples, the proportions of which approach Richardson's specimens, while they also agree very well with Hector's figure of one from New Zealand, which Ogilby has called *G. forsteri*.

It therefore seems to me that the length of the body is very variable, as in many other elongate fishes, and that *forsteri* must be regarded as a synonym of *greyi*. If this be accepted, the species is recorded from South-Western Australia, South Australia, Victoria, Tasmania, New Zealand, New South Wales, Lord Howe Island, and the Kermadecs.

Specimens of *G. parvimanus* (Ogilby),[1] of the same size as others of *G. greyi*, have very much smaller heads and pectoral fins, while the scales are cycloid instead of ctenoid. Waite[2] considers the one to be merely the young (larval form) of the other, and the close association of the two over a wide geographical area lends considerable support to the hypothesis. Specimens of the *parvimanus* form are recorded from the following localities:—Lord Howe Island and Narrabeen, New South Wales; Kermadec Islands[3]; Moreton Bay, Queensland. Another is in the Australian Museum from Manly, near Sydney.

The type, which is the largest specimen known, is 88mm. long.

1 Ogilby. Ann. Queensl. Mus., No. 10, 1911, p. 34.
2 Waite. Rec. Austr. Mus., V., 1904, p. 147, plate XVII., fig. 3.
3 Waite. Trans. N. Zeal. Inst., XLII., 1910, p. 374.

GYMNOTHORAX WOODWARDI, sp. nov.

FIGURE 1.

Muraena nubila, Richardson—Zool Ereb. and Terr., Fishes, 1848, p. 81, part—specimen from Houtmans Abrolhos.

Muraena richardsonii, Günther—Brit. Mus. Cat. Fish, VIII., 1870, p. 118—same specimen (not of Bleeker).

Gymnothorax punctatofasciatus, Waite—Rec. Austr. Mus., VI., 1905, p. 58 (not of Bleeker).

Head $2\frac{2}{3}$ in the trunk; head and trunk $1\frac{1}{4}$ in the tail. Snout $5\frac{1}{2}$ in the head, mouth $2\frac{1}{4}$, eye $1\frac{2}{3}$ in the snout, and almost equal to the interorbital space.

Body compressed, snout pointed, the tip rounded. Teeth of adults uniserial in both jaws; they are small anteriorly in the upper jaw, then large, and decreasing again backwards. In a small example there are one or two large canines inside the others near the middle of the jaw. Mandibular teeth decreasing regularly from front to back. One or two large depressible teeth on the median line of the mouth anteriorly; vomerine teeth uniserial, small, and mostly rounded. Gill-opening smaller than the eye. Origin of the dorsal, midway between the end of the mouth and the gill-opening.

Colour.—Light brown after long preservation in spirits, darker posteriorly, with a wide meshed network of dark lines on the upper half of the body. A dark line near the back begins with the dorsal and follows it until it is lost on the tail; this line is not very distinct in my smallest specimen. Some black lines extend from behind the mouth towards the gill-opening; head otherwise plain. Anteriorly the dorsal and anal fins are marked like the body, but posteriorly they are very dark with whitish margins.

Described from five specimens, 325-720mm. long, from near Fremantle, Houtmans Abrolhos, and Pelsart Island. The type, which is 515mm. long, is from the latter locality, and is in the Western Australian Museum.

An eel in the British Museum, from Houtmans Abrolhos, was identified by Richardson as his *Muraena nubila*, and later by Günther as *M. richardsonii*, Bleeker; it is probably of the same species as the specimens described above. Mine differ from the figures of both *nubila* and *richardsonii*, however, in the arrangement of the dark marking

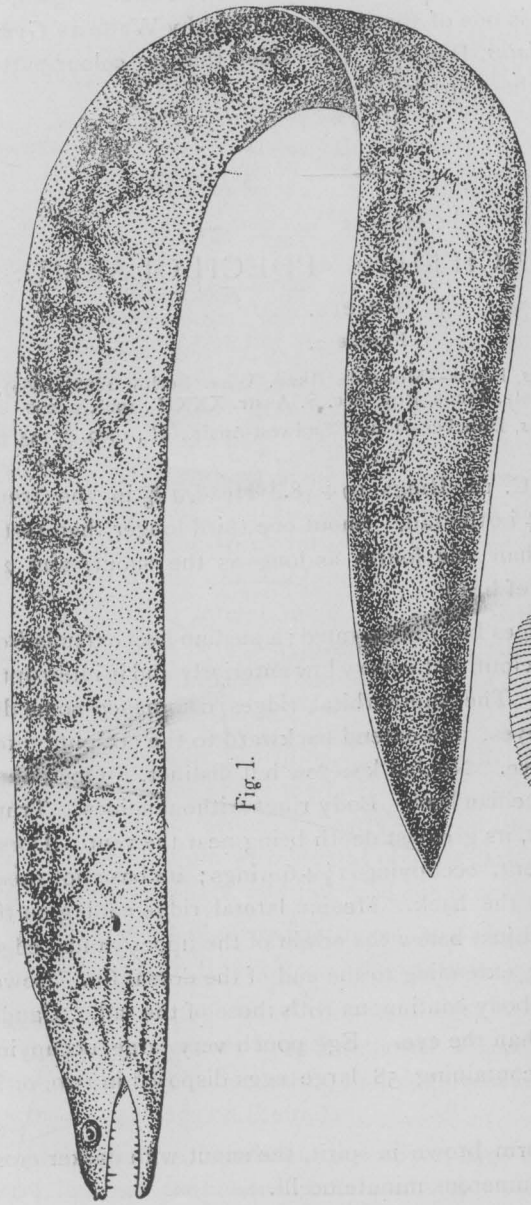


Fig. 1.

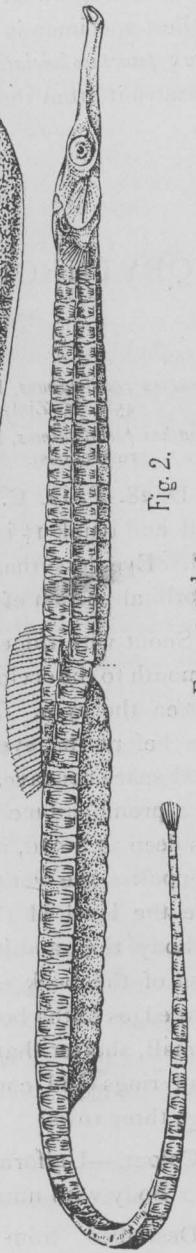


Fig. 2.

FIGS. 1 and 2.

on the body, which is apparently very characteristic. Again, my smallest specimen is one of the three identified by Waite as *Gymnothorax punctatofasciatus*, Bleeker; I consider that its colour pattern separates it from these species also.

CORYTHROICHTHYS POECILOLAEMUS, Peters.

FIGURE 2.

Syngnathus poecilolaemus, Peters—Monatsb. Akad. Wiss. Berlin, 1868 (1869), p. 458; *Id.* Zietz, Trans. Roy. Soc. S. Austr. XXXII., 1908, p. 298.

Syngnathus poekilolaemus, Duncker—Faun. Sudwest-Austr., II., 1909, p. 245 (see references).

D. 28. P. 12. C. 10. Rings 19+48. Head $1\frac{9}{10}$ in the trunk. Head and trunk $1\frac{1}{4}$ in the tail. Snout one third longer than rest of head. Eye less than one fourth as long as the snout, and 2 in postorbital portion of head.

Snout with ridges but not serrated; a median keel extends from the mouth to the occiput, but is very low anteriorly and is interrupted between the eyes. The supraorbital ridges commence some distance before the eyes, and extend backward to the occiput; interorbital space concave. Nuchal keel low but distinct. Operculum with a prominent median keel. Body rings without spines. Trunk $1\frac{1}{2}$ as deep as broad, its greatest depth being near the vent. Dorsal fin opposite the vent, occupying $1\frac{1}{2}+6$ rings; its base not raised above the level of the back. Median lateral ridge ending on the last body ring, and just below the origin of the upper caudal edge. Edges of the back extending to the end of the dorsal fin. Lower lateral edges of the body continuous with those of the tail. Caudal fin, small, shorter than the eye. Egg pouch very large, occupying 18 tail rings and containing 58 large eggs disposed in two, or in places, three rows.

Colour.—Uniform brown in spirit, the snout with darker cross bars. Body with numerous minute ocelli.

Described from a single example, 197mm. long, from Fremantle, and the property of the Western Australian Museum.

SYNGNATHUS (YOZIA) TIGRIS, Castelnau.

PLATE, XI.; FIG. 2.

Syngnathus tigris, Castelnau—Proc. Linn. Soc. N. S. Wales, III., 1879, p. 397; *Id.*, Macleay, *loc. cit.*, VI., 1881, p. 227; *Id.* Stead, *loc. cit.*, XXXI., 1906, p. 428; *Id.*, Duncker, Faun. Südwest-Austr. II., 1909, p. 245.

D. 24-25. P. 15. C. 8. Rings 17+36. Head 3-3⅓ in the trunk. Head and trunk 1⅔ in tail. Snout 1¾-1⅞ in rest of head. Eye 2⅓-2¾ in snout, and 2 in postorbital portion of head.

Snout rugose but not serrated, with a median keel before the eyes which is more or less bifurcate between the eyes. Interorbital space concave. Head granular, operculum with radiating lines, but without a median keel. Occiput and nape with a sharp, raised keel; body rings without spines. Trunk deeper than broad, the breast more or less swollen; depth between the upper and lower lateral edges of the trunk rather less than the length of the snout. Dorsal fin opposite the vent, occupying 2½-3+2-2½ rings, its base elevated. Median lateral ridge continuous with the lower caudal edge; upper edge extending over 1-1½ body rings. Lower surface of the tail much broader than the upper. Caudal fin, large, two-thirds as long as the snout.

Colours.—Light brown in spirits, each ring with a more or less distinct ocellus above the lateral ridge, and on the sides of the tail; a dark-edged, semioval pearly spot on the edge of each body segment. Operculum with several oblique dark lines. Body with three darker cross bars, and tail with about seven more.

Described from three specimens 265-280mm. long, from Port Jackson, the largest of which is the specimen figured (Reg. No. 1. 12073).

A single specimen from Fremantle differs only in having the head more rugose, the opercular markings broader, and nine instead of seven cross bands on the tail.

According to Castelnau, the upper edge on the tail and the lateral line are continuous, but in all the specimens I have seen, the latter joins the lower edge above the vent. Through the kindness of Mr. Stead, I have examined the specimen he recorded from

the Hawkesbury River, while Mr. Ogilby informs me that according to his notes, the lateral ridge is always continuous with the lower caudal edge. I therefore regard the original description as incorrect in this detail.

CYPSELURUS KATOPTRON, Bleeker.

Exocoetus katoptron, Bleeker—Ned. Tydschr. Dierk., III., p. 115; *Id.*, Günther, Brit. Mus. Cat. Fish, VI., 1866, p. 289; *Id.* Bleeker, Atl. Ichth., VI., 1871, p. 72, pl. CCXLVII., fig. 3.

Cypsilurus katoptron, Jordan and Seale—Bull. U.S. Bur. Fish, XXV., 1906, p. 211, fig. 16.

A large specimen from Fremantle differs from Jordan and Seale's excellent figure only in having a slightly larger eye, and thirteen instead of fourteen dorsal rays, but in both these details it is in agreement with Bleeker's description.

It differs from Günther's description of *Exocœtus robustus* [1] in having the interorbital space concave instead of flat, and in the position of the ventral fin which is inserted farther back. Jordan and Seale consider *C. robustus* and *C. katoptron* identical, notwithstanding that Günther had Bleeker's type before him for comparison.

PARAPLESIOPS MELEAGRIS, Peters.

PLATE IX.

Plesiops meleagris, Peters—Monatsb. Akad. Wiss. Berlin, 1869 (1870), p. 708.

Ruppelia prolongata, Castelnau—Res. Fish. Austr. (Vict. Rec. Philad. Exhib.), 1875, p. 29 (not *R. prolongata*, Cast., 1873).

Paraplesiops meleagris, Boulenger—Brit. Mus. Cat. Fish., 1895, p. 339.

A specimen from near Fremantle is in the Western Australian Museum, and another from the same locality was presented to the Australian Museum by Mr. A. Abjornssen. It is figured on plate I. (Reg. No. I. 11232).

Though the species has not been recognised from Western Australia under this name, there can be no doubt that the second specimen identified by Castelnau as *Ruppelia prolongata*, was really *P. meleagris*.

[1] Günther, *loc. cit.*

BOSTOCKIA HEMIGRAMMA, Ogilby.

PLATE X; FIG. 3.

Bostockia hemigramma, Ogilby—Proc. Linn. Soc. N. S. Wales, XXIV., 1899, p. 168.

The collection includes a small specimen of this species from the Helena River, near Perth, and two others from the same locality are in the Australian Museum. The largest of these, 155mm. long, is the one selected for illustration. I have compared it with a co-type in the museum collection, so that, although its proportions differ somewhat from the smaller ones described by Ogilby, I have no doubt of its correct identification.

EDELIA, Castelnau.

Edelia, Castelnau—Proc. Zool. Soc. Vic., II., 1873, p. 123 (*vittata*); *Id.*, Ogilby, Proc. Linn. Soc. N. S. Wales, XXIV., 1899, p. 175.

As all my specimens, including two examined by Ogilby, differ in some important details from that author's definition of this genus, I have drawn up the following corrected diagnosis. The items in brackets are as stated by Ogilby.

Body oblong, compressed. Scales, large, adherent, finely ciliated, concentrically striated. Lateral line interrupted below the second dorsal (complete), the tubes few, irregular, simple, extending along the entire exposed surface of the scale. Head moderate, largely scaly, snout and lower jaw naked. Mouth with small oblique cleft; jaws equal. Premaxillaries protractile; maxillary exposed at distal extremity only, naked. Bands of slender villiform teeth in the jaws, a large patch on the vomer, and a few on the anterior part of the palatines (not seen by Ogilby); pterygoids and tongue smooth. Nostrils distant, simple. Eyes moderate, lateral, high. Preorbital denticulate. Preopercle entire. Operculum with two spines. Gill-openings wide, the membranes united in front, free from the isthmus; 5-6 branchiostegals. Pseudobranchiae present. Gill-rakers moderate, few. Two dorsal fins connected at the base, the first with 7-8 spines and longer than the second; the

second with 1 spine and about 9 rays. Anal short, with 3 spines and about 8 rays. Ventrals inserted behind the base of the pectorals, close together, with a strong spine and 5 rays. Pectorals rounded, with 11-13 rays. Caudal slightly rounded. Vertebrae 13+15 (12+18).

This genus is evidently closely allied to *Nannoperca*, Günther.

EDELIA VITTATA, Castelnau.

PLATE X.; FIG. 2.

Edelia vittata, Castelnau—Proc. Zool. Soc. Vict., II., 1873, p. 124; *Id.* Ogilby, Proc. Linn. Soc. N. S. Wales, XXIV., 1899, p. 176.

Edelia viridis, Castelnau—*loc. cit.*, p. 125.

There are twenty specimens in the Australian Museum, of which two from the Leschenault Inlet were received from Mr. A. Abjornssen. Two more from Donnybrook, in the County of Wellington, were some of those used by Ogilby in drawing up his description, while sixteen others without a definite locality were received from Mr. Albert Gale.

GLAUCOSOMA HEBRAICUM, Richardson.

Glaucosoma hebraicum, Richardson—Voy. Ereb. and Terr., Fishes, 1846, p. 27, pl. XVII.; *Id.*, Saville Kent, Nat. in Austr., 1897, p. 177, pl. XXX.

Glaucosoma burgeri, Günther—Brit. Mus. Cat. Fish, I., 1859, p. 211 (part).

Fresh specimens of this species show striking dark longitudinal bands, the most prominent of which follows the lateral line, and is rather wider than the scales it covers. There are two broader ones between it and the back, each covering two rows of scales, while below it are three others which are still broader. A dark bar passes obliquely from the eye to the interopercle. The fins are dusky, but the tips of the anal and dorsal spines and the anterior margins of the fins are whitish, and there are oblique whitish bars on the ends of the caudal lobes.

Although I have carefully compared my two specimens with Jordan and Thompson's [1] excellent description and figure of *G. burgeri*, Richardson, I am unable to find any satisfactory differences

[1] Jordan and Thompson, Proc. U. S. Nat. Mus., XXXIX., 1911, p. 440.

between the two species that may not possibly be accounted for by variation with growth, etc. Both my specimens, however, have the fourth dorsal rays longest, so that the fins are angular in form instead of rounded. Minute palatine teeth are present in both, but are very indistinct and easily overlooked in one of them. As suggested by Jordan and Thompson, it will be necessary to compare specimens of both species before the characters separating the two can be positively determined.

Both specimens were obtained near Fremantle, W. Australia.

SILLAGO BOSTOCKII, Castelnau.

PLATE X., FIG. 1.

Sillago ciliata vel bostockii, Castelnau—Proc. Zool. Soc. Vict., II., 1873, p. 133.
Sillago bostockii, McCulloch—"Endeavour Report," fishes (in press), pp. 60, 63.

D. XI., 21-22; A. 19-22; P. 15-16; V. I., 5; C. 17; l. lat. 69-74; l. tr. 6+14.

Head $3\frac{1}{2}$-$3\frac{3}{4}$, depth 5-$5\frac{1}{2}$ in the length to the hypural. Eye 5-$5\frac{1}{2}$, snout $2\frac{3}{5}$, pectoral $1\frac{2}{3}$-$1\frac{3}{4}$ in the head. Interorbital width $\frac{2}{3}$-$\frac{3}{4}$ the eye.

Body elongate, compressed, the dorsal profile rather more arched than the ventral. Caudal peduncle much compressed, its depth almost equal to the postorbital portion of the head. Eye large, nearer the end of the operculum than the tip of the snout. Interorbital space flat. Preoperculum crenulate, a broad flat spine on the operculum. Mouth small, oblique, the maxillary a little longer than half the snout. Nostrils close together, near the eye, the anterior with a skinny lobe. A broad band of villiform teeth on each jaw, the outer ones of the upper jaw somewhat enlarged; a broad horseshoe shaped band on the vomer. Gill-rakers short and thick, tubercular below, nine on the lower limb of the first arch.

Scales finely ctenoid, extending forward to the nostrils on the upper surface of the head; arranged in four rows on the cheeks. Snout and lower part of the head bare. Basal portion of the caudal fin densely scaly, while rows of small scales are present behind each ray of the other fins. Lateral line a little arched anteriorly, thence straight to the caudal peduncle, and continued on to the fin to the end of the middle rays.

Dorsal fins separate or united by a low membrane; the first is inserted well behind the ventrals, the second just in advance of the vent and terminating far behind the anal. Pectoral and ventral pointed, the outer ray of the latter sometimes produced. Caudal emarginate.

Colour.—Sandy yellow, the upper parts closely speckled with minute grey dots. Both dorsal fins have from three to five longitudinal rows of large grey spots. Well preserved specimens have a dark (silvery?) band from above the base of the pectoral to the caudal peduncle. No dark mark at the base of the pectoral.

This is apparently the common whiting near Fremantle; a large number of specimens being included in the Western Australian Museum collection, while an excellent series was secured for the Australian Museum by Mr. Abjornssen. Specimen selected for illustration registered I. 11334.

THERAPON CAUDAVITTATUS, Richardson.

Datnia caudavittata, Richardson—Voy. Ereb. and Terr., Fishes, 1848, p. 24, pl. XVIII., fig. 3-5.

Therapon caudovittatus, Günther—Brit. Mus. Cat. Fish. I., 1859, p. 284; *Id.*, All. and Macl., Proc. Linn. Soc. N. S. Wales, I., 1877, p. 270; *Id.*, Macl. *loc. cit.*, II., 1878, p. 348; *Id.*, Castelnau, *loc. cit.*, III., 1878, pp. 42 and 47; *Id.*, Klunz. Sitzb. Ak. Wiss. Wien., LXXX., I., 1879, p. 350; *Id.*, Waite, Rec. Austr. Mus., III., 1900, p. 210.

Therapon caudovittatus? vel bostockii, Castelnau.—Proc. Zool. Soc. Vict., II., 1873, p. 128.

I have examined nine specimens of this fish from Fremantle, W. Australia, and two from Murray Island, Torres Strait, but in none are the sub- and interoperculum serrated as described by Richardson. There are also 25 instead of 20 transverse series of scales, so that in both these details they agree better with his figure than his description.

Castelnau proposed the name *bostockii* for Fremantle specimens of *caudavittatus*, which differed from the description given by Günther in having the dorsal fin notched, and the last spines much shorter than the rays. This, however, is the normal form, and it is doubtful if Günther has correctly described his specimens.

SPARUS SARBA, Forskal.

Pagrus sarba (Forskal), Ogilby—Ed. Fish. N.S. Wales, 1893, p. 50, pl. XIV.
Chrysophrys sarba, Stead—Ed. Fish, N. S. Wales, 1908, p. 78, pl. XLVII.

Eight specimens are in the collection, from the neighbourhood of Fremantle, which agree in every way with others from Port Jackson. This species does not appear to have been recognised from the western coast of Australia.

SPARUS AUSTRALIS, Günther.

Chrysophrys australis, Günther—Brit. Mus. Cat. Fish. I., 1859, p. 494; *Id.*, Stead, Ed. Fish, N. S. Wales, 1908, p. 77, pl. XLVI.

I am unable to separate four specimens, from Fremantle, from this species. It has been recorded from the Harvey River, Western Australia, by Günther.

PLATAX TEIRA, Forskal.

Platax teria (Forskal), Jordan and Fowler—Proc. U. S. Nat. Mus., XXV., 1902, p. 256.

A very small specimen, one and a half inches long, from Fremantle, is of interest as being apparently the first of the species recognised from Western Australia.

LEPIDAPLOIS VULPINUS, Richardson.

Cossyphus vulpinus, Richardson—Proc. Zool. Soc., 1850, p. 71.
Harpe vulpina, Waite—Rec. Austr. Mus., IV., 1902, p. 269, pl. XLIII. and VI., 1905, p. 70.
Trochocopus rufus, Macleay—Proc. Linn. Soc. N. S. Wales, III., 1878, p. 35, pl. V., fig. 3.
Cossyphus frenchii, Klunzinger—Sitzb. Akad. Wiss. Wien, LXXX., i., 1879, p. 400; *Id.*, Macleay, Proc. Linn. Soc. N. S. Wales, IX., 1884, p. 46.
Cossyphus aurifer, De Vis—Proc. Roy. Soc. Qld., I., 1884, p. 146.

The collection includes a specimen from Abrolhos Island, which agrees very well with Waite's figure of *Harpe vulpina*. I have compared it with the types of *Trochocopus rufus*, Macleay, with which it is identical. According to Mcleay's description there are 45 scales on the lateral line, but in both his specimens there are only 36. This detail is referred to by Klunzinger, and as *Trochocopus* has 45 or more, he placed the species in *Cossyphus*. Further,

there being already a *Cossyphus rufus*, and as he did not recognise its identity with the earlier *C. vulpinus*, he changed the name to *C. frenchii*.

Mr. Ogilby has kindly examined the type specimen in the Queensland Museum of *Cossyphus aurifer*, De Vis, for me, and writes that he considers it identical with the species figured by Waite.

PSEUDOLABRUS PARILUS, Richardson.

PLATE XII.

Tautoga parila, Richardson—Proc. Zool. Soc., 1850, p. 70.
Labrichthys parila, Castelnau—Proc. Zool. Soc. Vict., II., 1873, p. 137.

D. IX., 11.; A. III., 10; P. 13; V. I., 5; C. 12-13; l. lat. 26; l. tr. 3-4+9. Height $3\frac{1}{4}$ in the length to the hypural, and equal to the length of the head including the opercular flap. Eye 5, snout $3\text{-}3\frac{1}{2}$, caudal peduncle $1\frac{8}{10}$ in the head.

Body moderately elongate, compressed, covered with large scales which extend on to the nape and the caudal fin, but not over the bases of the dorsal and anal. A single series of small and imperfect scales from behind the eye to the cheek, and other large and irregular ones covering the operculum; head otherwise naked and closely pitted with minute pores. Preorbital narrower than the eye. A pair of strong canines in front of each jaw, those of the upper separated; sides with a single series of smaller canine-like teeth decreasing in size backwards, and a second inner series of very small ones anteriorly. Posterior canines present. Nostrils close together near the supero-anterior angle of the eye; the anterior tubular, posterior simple. Lateral line following the curve of the back over 20 scales, then bending downward, two rows to the middle of the caudal peduncle; the ramifications of the tubules cover all the exposed portions of the scales except the extreme edges.

Dorsal fin commencing above the hinder half of the operculum. Spines increasing in length backwards, the last $2\frac{3}{4}\text{-}3$ in the head, and each topped by a prolongation of the membrane. Soft portion of the pin angular behind, the anterior rays longer than the posterior; $2\frac{1}{4}$ in the head. Anal similar to, and terminating a little in advance of the dorsal. Pectoral $1\frac{3}{5}$ in the head, the upper rays longest, margin rounded. Ventral pointed, second ray not quite reaching to the vent. Caudal rounded.

Colour.—Greenish, spotted with brown, the spots tending to form indistinct bands in one specimen but not in the other. Brown lines radiate from the eye and on to the operculum. Broad darker markings enclosing light interspaces are distinct in one specimen on the lower parts of the head. Dorsal and anal with darker and lighter spots on the rays, and there is a larger spot between the first and second spines of the former.

Described from two specimens, 200 and 225mm. long, in the Australian Museum (I. 11459 and 11461), received from Mr. A. Abjornssen who collected them at Fremantle.

Castelnau recorded this species from Port Jackson,[1] but it has not been again recognised from eastern Australia by any other author. I suggest that his specimen was merely one of the variations of *P. gymnogenys*, Günther, as I have a local example of that species with which his colour-notes agree very well.

Having compared the specimens identified by Waite[2] as *P. ruber*, Castelnau, with the two described above, I think it possible that the former will prove to be either an older or sexual form of *P. parilus*. Though the differences between Waite's figure and my own appear very great, some of the specimens nevertheless exhibit certain characters which are intemediate between the two extremes, while Castelnau's notes on the colour of Western Australian examples of *P. parilus* agree as well with his own as with Richardson's species.

PSEUDOLABRUS BOSTOCKII, Castelnau.

PLATE XI.; FIG. 1.

Labrichthys tetrica, Günther—Brit. Mus. Cat. Fish, IV., 1862, p. 116 (part).

Labrichthys bostockii, Castelnau—Proc. Zool. Soc. Vict., II., 1873, p. 137; *Id.* Macleay, Proc. Linn. Soc. N. S. Wales, VI., 1881, p. 85.

Labrichthys biserialis, Klunzinger—Sitzb. Akad. Wiss. Wien, LXXX. I., 1879, p. 402.

Pseudolabrus tetricus, Waite—Rec. Austr. Mus., VI., 1905, p. 70 (*nec* Richardson)

D. IX., 11; A. III., 10; P. 12; V. I., 5; C. 13-14; l. lat. 25-27; l. tr. 4+8.

Height of body 3-3¼ in the length to the hypural, a little

[1] Castelnau, Proc. Linn. Soc. N. S. Wales, III., 1879, p. 389.

[2] Waite, Rec. Austr. Mus. IV., 1902, p. 185, pl. XXVIII.

greater than the length of the head without the opercular flap. Eye $4\frac{1}{2}$-5, snout 3, caudal peduncle $2\frac{1}{4}$ in the head. Interorbital width $1\frac{1}{2}$ in the snout.

Body moderately elongate, compressed, covered with large scales which extend forwards on to the nape, and on to the bases of the dorsal, anal, and caudal fins. Two oblique rows of small scales from behind the eye to the cheek, and other larger and irregular ones covering the operculum; head otherwise naked. Preorbital either a little broader than or narrower than the eye. A pair of strong canines in front of each jaw, those of the upper being widely separated; sides with a single series of smaller canine-like teeth decreasing in size backward, and usually a second inner series of very small ones anteriorly. Posterior canines present, sometimes double. Nostrils placed close together near the supero-anterior angle of the eye; the anterior tubular, posterior slit-like. Lateral line following the curve of the back over 19-20 scales, then bending downward two rows to the middle of the caudal peduncle; anteriorly the tubes are much branched, simpler posteriorly.

Dorsal fin originating over the hinder half of the operculum. Spines low, each topped by a prolongation of the membrane; rays subequal, soft portion of the fin angular posteriorly. Anal similar to the dorsal. Caudal truncate, the tips usually a little produced. Upper rays of pectoral longest, the lower half of the fin rounded. Ventrals pointed, not reaching to the vent.

Colour.—Red, darker above, each scale with a large carmine spot. A yellow band extends from above the base of of the pectoral to the middle of the caudal peduncle. Dorsal black basally, then clear orange, and margined with a narrow violet line. Anal blood red with a broad violet edge, and with or without indications of a darker median band. Caudal orange with a darker edge. Pectorals and ventrals pink, the former with a black basal band. After long preservation almost all traces of the colour markings disappear, leaving only the darker fin markings.

Described from six specimens, 160-200mm. long, one of which is from near Albany, another from Mandurah, and four from Fremantle. I am indebted to Mr. A. Abjornssen for beautifully preserved examples of this species from which the accompanying figure has been prepared.

I follow Klunzinger in regarding his *P. biserialis* distinct from *P. tetricus*, Richardson, but consider that it is identical with *P. bostockii*. Waite united the latter with *P. tetricus*, but they appear to differ in the arrangement of the scales on the cheeks and in the form of their fins.

MUCOGOBIUS, gen. nov.

Body oblong, compressed behind. Head a little compressed, scaleless, but with many horizontal and vertical raised mucous ridges, which also extend on to the body; no true barbels. Snout rounded, lower jaw the longer; mouth oblique. Eyes large, close together. Opercles unarmed. A band of simple villiform teeth in each jaw, the outer ones somewhat enlarged; vomer and palatines toothless. Tongue rounded. Isthmus broad. Scales moderate, largest posteriorly, cycloid. Dorsal with six spines and about ten rays. Anal similar to the soft dorsal. Ventrals I. 5, united, not adnate to the belly. Pectorals pointed, without free silk-like rays. Caudal rather lanceolate, produced.

Type.—*Gobius mucosus*, Günther.

MUCOGOBIUS MUCOSUS, Günther.

Gobius mucosus, (Günther), Waite—Rec. Austr. Mus., VI., 1906, p. 200.

The collection includes three from Fremantle, while another was collected by Mr. Abjornssen near Albany.

I am unable to associate this species with any genus known to me, and therefore propose *Mucogobius* for it as above.

SCORPAENA, Linnaeus.

Scorpaena, Linnaeus—Syst. Nat., 10th Ed., 1758, p. 266 (*porcus*); *Id.*, Jordan and Starks, Proc. U.S. Nat. Mus. XXVII., 1904, p. 131.

Sebastapistes, Gill, in Streets—Bull. U.S. Nat. Mus., No. 7, 1877, p. 62 (*strongia*); *Id.*, Jordan and Evermann, Bull, U.S. Fish., Comm., XXIII., pt. 1, 1905, p. 455.

The genus *Sebastapistes*, is apparently distinguished from *Scorpaena* only by the armature of the preorbital and its smaller size. Some large Australian species have strong recurved spines on the

preorbital, and being unable to satisfactorily divide up those I have examined into the two genera, I prefer to regard Gill's genus as a synonym of *Scorpaena*.

The following is a key to the Australian species available to me.

a. 50-55 rows of scales just below the lateral line. A more or less prominent median keel on the anterior portion of the interorbital space. *cardinalis.*

aa. 45 or fewer rows of scales.

b. Transverse hollow behind the eyes, distinct but shallow.

c. Two prominent interorbital ridges ending in spines. Third dorsal spine generally longest. *cruenta.*

cc. Interorbital ridges low, without spines. Fifth dorsal spine generally longest.

d. Head and body with numerous tentacles. *bynoensis.*

dd. Head and body with but few tentacles. var. *laotale.*

bb. Transverse hollow very deep. Interorbital ridges almost obsolete. *sumptuosa.*

SCORPAENA CARDINALIS, Richardson.

Scorpaena cardinalis, Richardson—Ann. Mag. Nat. Hist., IX., 1842, p. 212; *Id.*, Günther, Brit. Mus. Cat. Fish., II., 1860, p. 116.

Scorpaena jacksoniensis, Steindachner—Sitzb. Ak. Wiss. Wien., LIII., I., 1866, p. 438, pl. III., fig. 2, 2a.

Scorpaena cruenta, Ogilby—part, Ed. Fish, N. S. Wales, 1893, p. 63, pl. XX.; *Id.*, Waite, Mem. Austr. Mus., IV., 1899, p. 99; *Id.*, Stead, Ed. Fish. N.S. Wales, 1908, p. 108, pl. LXXV. (not *S. cruenta*, Richardson).

This species, and not *S. cruenta*, Richardson, is apparently the common Red Rock Cod of the Sydney fishermen. I have examined the specimens identified by Ogilby, Waite, and Stead as *cruenta*, and regard almost all of them as being *cardinalis*; only two small ones from Port Jackson being the former species. Mr. Stead informs me that there is but one common species in the Sydney Markets, of which his specimens are representative, so that *S. cruenta* will probably prove to be a rare species here. Besides the two Port Jackson specimens, I have examined several others from Tasmania, and find that they differ from *cardinalis* in having much larger scales, and in having the interorbital ridges ending in acute spines.

Günther[1] has united *S. jacksoniensis*, Steindachner, with *S. bynoensis*, Richardson, but Klunzinger[2] has shown that this is

[1] Günther, Zool. Rec., 1866 (1867), p. 143.

[2] Klunzinger, Sitzb. Ak. Wiss. Wien, LXXX. I., 1879, p. 366.

incorrect. It differs in the form and disposition of its cephalic spines, smaller scales, general proportions, and colouration. I can find no difference between it and *S. cardinalis.*

SCORPAENA SUMPTUOSA, Castelnau.

PLATE XIII.

Scorpaena sumptuosa, Castelnau—Res. Fish., Austr. (Vict. Offic. Rec. Philad. Exhib.), 1875, p. 17; *Id.*, Macleay, Proc. Linn. Soc., N. S. Wales, V., 1881, p. 432.

D. XI., I. 9-10; A. III., 5; V. I. 5; P. 16; C. 13.

Depth $2\frac{1}{3}$-$2\frac{1}{2}$, head $2\frac{1}{2}$ in the length to the hypural. Eye 4-$4\frac{1}{3}$, caudal peduncle $3\frac{1}{4}$ in the head.

Dorsal profile highest at the base of the third dorsal spine, thence descending rapidly to the tail. Head armed with strong spines and largely covered with glandular skin, only a few scales being present on the end of the operculum. Interorbital space deeply concave with a very low median ridge anteriorly, and defined posteriorly by a raised sinuous bone. A deep transverse hollow behind the eyes divided into four parts by three longitudinal ridges, the two exterior of which have each a small spine in front. Eye with a broad spine anteriorly, and two on the upper margin. Nasal spines simple or bifurcate. Preorbital with a rosette of sinuous bony ridges. A ridge with three or four spines extends across the cheek, and there are two more on the preopercular margin on the same line; below these the margin is armed with four more points. Superior opercular spine inclined upwards, the lower extending forwards as a prominent curved ridge. There is a small bifurcate spine behind the eye, and two larger ones with broad bases between it and the upper opercular margin. Nuchals large, each with two points; a very small spine between them and the operculum. Maxillary extending beyond the eye, and two-thirds as wide as it posteriorly. Bands of villiform teeth on the jaws, vomer, and palatines. Gill-rakers short, thick, and spiny.

Scales large, cycloid, extending forward to just in front of the dorsal fin; six or seven between the lateral line and the twelfth dorsal spine, and about fifteen more to the vent. The lateral line is formed of about twenty-one tubes, and there are forty-four rows of scales directly below it. Skinny lobes are distributed at intervals all over the body, but are most numerous on the back and the lateral line.

First dorsal high, the third spine the longest and about two-thirds as long as the head; eleventh spine very short, one third as long as the twelfth. Anterior rays of the soft dorsal sub-equal, the margin rounded posteriorly. Second anal spine longest, very strong and laterally grooved; soft portion of the fin rounded. Pectoral reaching to, or not so far as the origin of the anal; it has nine or ten simple lower rays. Ventrals rounded, reaching to, or almost to the vent. Caudal rounded.

Colour.—Yellowish or reddish with darker marblings. Lower parts of the head and body with numerous irregular dark spots. Spinous dorsal marbled with reddish brown, and with or without a large dark blotch on the hinder part. Soft dorsal, caudal, and anal with red and brown spots forming irregular rows. Pectorals also spotted, ventrals plain.

Described from two specimens 310mm. and 300mm. long, the first from Fremantle, and the property of the Western Australian Museum, and the second from Albany, and in the collection of the Australian Museum. A third is also in the Australian Museum from Houtmans Abrolhos.

This species is allied to *S. cardinalis*, Richardson, but is at once distinguished by having only forty-four instead of fifty-five rows of scales below the lateral line, and in lacking the high median keel on the anterior part of the interorbital space. According to Castelnau his specimen had only ten spines in the first dorsal, but as this is an unusual number in the genus, and as my specimens agree in every other detail, I have no doubt that they are really *S. sumptuosa.*

SCORPAENA BYNOENSIS, Richardson.

Scorpaena bynoensis, Richardson—Voy. Ereb. and Terr., 184[illegible], p. 22, pl. XIV., fig. 3-4; *Id.*, Klunzinger—Sitzb. Ak. Wiss. Wien., LXXX. I., 1879, p. 366 (synonymy).

Sebastapistes laotale, Jordan and Seale—Bull, U.S. Fish, Bur., XXV., 1906, p. 376, fig. 72 (variety).

I have very carefully compared thirty-two examples of this species from various localities and find that they vary considerably in the development of the tentacles and cirri on the head and body. In one from Dunk Island, Queensland, the orbital tentacles are nearly twice as long as the eye, and other large ones are present on

the spines and margins of the bones; in others from Murray Island, Torres Strait, all but the nasal tentacles are wanting. The first represents the form named *bynoensis*, while the others agree with *laotale*, of which I have examined a co-type, but as my series exhibits every stage between the two, the latter must be regarded merely as a variety of the former.

Of the thirty-two specimens, one has thirteen spines and nine dorsal rays, another eleven spines and ten rays, while all the rest have twelve spines and ten rays. The length of the posterior spine is variable, while the colour may be anything from ashy grey to brilliant brown and white, though the characteristic colour pattern is always more or less maintained.

My specimens come from Dunk Island and Green Island near Cairns, Queensland; Murray Island, Torres Strait; Mapoon, Gulf of Carpentaria; Port Darwin and Western Australia.

I regard the New South Wales and New Zealand records of this species as very probably incorrect since it is an inhabitant of coral reefs, etc., and is doubtless confined to the tropics. Günther's association of *S. jacksoniensis*, Steindachner, with *bynoensis* seems to have been the cause of its first inclusion in the New South Wales lists, but this is shown to be incorrect (see *ante*). Ogilby included it in his Edible Fishes of N. S. Wales,[1] but as there are no local specimens in the collection of the Museum, and as Mr. Stead informs me that he has not seen any specimens in the markets, I think its occurrence here needs verification.

S. bellicosa, Castelnau,[2] from Nicol Bay, Western Australia, and Queensland is apparently very similar to *S. bynoensis*, but is described as having prominent interorbital ridges, whereas they are low in Richardson's species. Castelnau's specimens may have been dried, as were many others in his collection, in which case the flesh shrinking from the bones would make the ridges appear more prominent, so that this difference is probably of little importance.

[1] Ogilby, Edible Fish, N. S. Wales, 1893, p. 65.

[2] Castelnau, Res. Fish., Austr. (Vict. Offic. Rec. Philad. Exhib.), 1875, p. 17.

A VISIT TO BERNIER AND DORRÉ ISLANDS

DURING AUGUST AND SEPTEMBER, 1910.

BY
OTTO LIPFERT.

PLATES XIV. TO XVI.

The best time to visit Bernier and Dorré Islands is immediately after the rainy season, when the wild flowers are in full bloom. Parts of Dorré Island then resemble a brilliant flower garden; however, the blooms do not last long, for during October the sun scorches everything except the salt bush and spinifex.

There is little animal life; even the sea birds are by no means abundant, and as the aborigines, for whose benefit these islands have been reserved, are to some extent dependant for food on the result of their success in hunting, the wallabies and bandicoots will soon become extinct.

The Wallabies, of which three species are to be found, are not at all numerous. They are *Lagostrophus fasciatus*, the Banded Wallaby; *Lagorchestes hirsutus*, the Hare Wallaby, of which there are two sub-species, *bernieri* and *dorreae*; and *Bettongia lesueuri*, commonly called Lesueur's Rat-Kangaroo."

The striped Bandicoot, *Perameles bougainvillei*, was reported some years ago by Mr. Shortridge as extinct. Fortunately this is not the case, for I was able to get twelve good specimens.

The Mouse, *Pseudomys (Gyomys) albocinereus squalorum*, is plentiful. It has a beautiful soft whitish-grey fur, white feet and tail.

The only other mammals were Bats, but as it was so early in the summer I only saw two or three, of which, thanks to Mr. Sheriefs I was able to obtain one *Nyctinomus planiceps*, Peters.

The nesting season of the eagles and ospreys was well advanced. On Dorré Island I located three nests of *Haliaetus leucogaster*, the white-bellied Sea Eagle. One contained eggs, and the other two fledgelings; while there were ten or more nests of *Pandion leucocephalus*, the white-headed Osprey. Owing to the rocky nature

of the country, the nests are difficult of access. One sea eagle's nest (Plate XIV., figs. 1 and 2) found on the east coast contained two eggs. It was a very bulky structure, the diameter on the top being 183 c.m., at base 240, height 52; the mould was only 65 wide by 12 deep. To reach the nest it was necessary to make a detour of at least a quarter of a mile to find a spot where one could climb down to the shore, about 40 feet below. Both eggs were slightly incubated. Two other nests of this eagle which I found on August 27th, contained young birds at least a fortnight old. On August 20th, during an excursion southwards, I found eight nests of the Osprey, of which several were old and deserted. It is more plentiful than the Sea-eagle, for five of these fine birds were in sight at once. A nest visited on August 7th was on a projecting cliff, and contained three young, two about a fortnight old, and the other about a week. It measured across the top 141cm., base 160cm., mould 59cm., depth of same 6cm., height of nest 88cm. Both parent birds and their young were secured (Plate XV.)

A remarkable find on this island was the nest with two young of *Uroaetus audax* (Plate XVI.), for owing to the total absence of trees, it was built on the side of a hill to secure a good outlook. It was situated about 15 yards from the top of the hill, and 35 from the foot. Across the top the nest measured 196 cm., at bottom 244 cm. The height on the upper side, top, was 53cm., and on the lower, 260cm.

Besides eagles, there were large colonies of Cormorants, Seagulls and Terns; these had quite finished their nesting.

The breeding season of the smaller birds, *Malurus*, *Sericornis*, *Megalurus*, etc., had finished about the end of May. They were always to be found in family groups of two old and three or four young birds. These were not common, for one often tramped mile after mile without seeing a single bird.

Bernier Island has the same desolate appearance as Dorré, perhaps even worse, as there are no flowers and the scrub is thicker. To travel a mile and a half per hour may be considered good work, and even that is very tiring.

The animal life is nearly the same as on Dorré Island, with the exception of *Megalurus*, which is not to be found here, and the Eagles and Ospreys are not so numerous as on Dorré Island. I

found only one nest of *Haliaetus leucogaster* and four of *Pandion leucocephalus*. On the north end Knock's Island, numbers of Terns, both *Sterna bergii* and *S. nereis* had been breeding. The Cormorants had no breeding place.

As will be seen from the list appended, I secured a very good collection, and I desire to place on record my sincere thanks to Dr. Lovegrove and to Mr. Sheriefs for the valuable assistance they gave me.

LIST OF BIRDS OBSERVED ON DORRÉ AND BERNIER ISLANDS.

BY

O. LIPFERT, September, 1910.

Puffinus chlororhynchus	...	B. Seen flying around steamer on returning to Carnarvon.
Sterna bergii ...	...	D.B. br. (young, fully fledged on 17th Sept.)
Sterna nereis ...	...	D.B. br. do.
Larus novae-hollandiae	...	D.B. br.
Gabianus pacificus	...	D.B. br.
Arenaria interpres	...	B.
Haematopus longirostris	...	D.B. br.
Haematopus fuliginosus	...	D.B. br.
Charadrius dominicus	...	B.
Peltohyas australis	...	B.
Numenius cyanopus	...	B. Visitor (seen by Dr. Lovegrove).
Limonites (Pisobia) ruficollis	...	B.
Eupodotis australis	...	B. Visitor only.
Demigretta sacra	...	D.B. br.
Phalacrocorax hypoleucus	...	D.B. br. Large colony on Dorré Island.
Circus assimilis ...	...	D. Only seen once near S. end.
Uroaetus (Aquilla) audax	...	D. br.
Haliaetus leucogaster	...	D.B. br.
Cerchneis cenchroides	...	D.B.
Pandion leucocephalus	...	D.B. br.

Podargus sp ? ...	...	B. Only seen once on W. coast.
Cypselus pacificus	...	B. Visitor during April, May and June.
Hirundo neoxena	...	D.B. br.
Megalurus striatus	...	D.
Sericornis maculata	...	D.B.
Malurus bernieri	...	D.B.
Zosterops gouldi ...	...	B. Visitor.
Ptilotis sonora ...	...	D.B.
Anthus australis ...	...	D.B.

D.—Dorré Island.
B.—Bernier Island.
br.—Breeding in August and September.

MUSEUM NOTES.

THE TRUSTEES ACT (1 GEO. V., 1911, No. 27).

The Museum on its establishment in Perth in 1889, was directly under the control of the Hon. the Commissioner of Crown Lands; in 1894 on the appointment of a Minister of Mines, it was transferred to his charge; in 1895 it was placed under the control of a Committee of eight gentlemen nominated by the Government.

On the 16th February, 1911, assent was given to:—"An Act to provide for the appointment and incorporation of Trustees for the Public Library of Western Australia, and the Western Australian Museum and Art Gallery, and for purposes consequent on and incidental to that object."

This Act came into operation on the 20th November, 1911, by Proclamation of His Excellency the Governor, Sir Gerald Strickland, K.C.M.G. (Gov. Gazette No. 63, 10th November, 1911). At the same time the Governor in Executive Council nominated twelve Trustees, of whom seven, the Hon. Henry Briggs, M.L.C.; M. F. A. Canning, Esq.; Hon. Sir J. Winthrop Hackett, Kt., M.L.C., etc.; Dr. H. F. Harvey; Dr. H. T. Kelsall; The Hon. Mr. Justice McMillan; and the Rt. Rev. Dr. Riley had been members of the Committee; the remaining five are F. W. Burrows, Esq.; Walter Dwyer, Esq., M.L.A.; R. S. Haynes, Esq., K.C.; Sir Walter James, Kt., K.C.; and H. S. King, Esq.

On the 24th November, these Trustees met for the co-optation of two Trustees under Clause IV. of the Act, when the Hon. Sir Edward A. Stone, K.C.M.G., and W. Somerville, Esq., were nominated.

On the 27th November, the Hon. Sir J. Winthrop Hackett, Kt., M.L.C., M.A., LL.D., *Officier de l'Academie Française*, was elected President of the Board.

C. G. Morris, Esq., of the Lands Department has been appointed a Trustee in place of the late Mr. M. F. A. Canning.

RECENT ADDITIONS TO THE COLLECTIONS.

SCULPTURE.—A cast of the Monasterboice Cross received in exchange from the National Museum, Dublin. The Laocoon presented by the Hon. Sir J. Winthrop Hackett, and Augustus Cæsar purchased.

PAINTINGS.—An Australian Landscape "Summer," Gumeracha, S.A., 1910-11, by Will Ashton of Adelaide, purchased by the Committee aided by public subscription. "Love under the Rose," by Franceso Vinea of Florence, purchased on the recommendation of Sir J. D. Linton, P.R.I.; "Idleness," by Rupert C. W. Bunny; this and four water colours, "The Nursery," by Sir E. Waterlow, R.A., P.R.W.S.; "Old Harbour, Genoa," by J. McWhirter, R.A.; "A Windy Day," by J. W. Herald, and "Mauve and Greys," by Francis E. James, A.R.W.S., were presented by the President, the Hon. Sir J. Winthrop Hackett, M.L.C., etc.

ANTIQUITIES.—Repliquas of the Vaphio Bull Cups, of Bronze Daggers, and gold tiara and plaques of Aegean (Mycenean) origin.

ZOOLOGY.—A specimen of *Notoryctes typhlops*, the Marsupial Mole from Wollal on the 90-Mile Beach, on the North-west Coast, was presented by Mr. S. J. Pryon; this is the second obtained in this State, the first being found at Joanna Springs, about midway between Wollal and the South Australian border. Skins of a kangaroo collected by Mr. J. P. Rogers in the McClintock Range, South-east Kimberley, in 1909, were sent to Mr. Oldfield Thomas, who in the "Annals and Magazine of Natural History," June, 1911, described them as a new sub-species of Wallaroo under the name of *Macropus robustus bracteator*. The fur is longer and darker than that of *M. r. woodwardi* from Grant Range, West Kimberley. Mr. Rogers at the same time obtained an example of *Phascogale penicillata pirata*, not hitherto known to occur in this State.

REPTILIA.—Descriptions of some new species will be published in Part III.

FREE POPULAR LECTURES ON SCIENCE AND ART.—The Eighth Series will be opened on Friday the 26th April next. These Lectures are attracting larger audiences every year, and it is hoped that the Government will provide a Lecture-room in the near future, for at present the Art Gallery has to be used for that purpose.

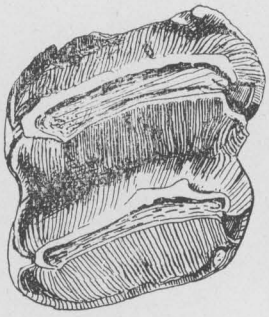


Fig. 8.

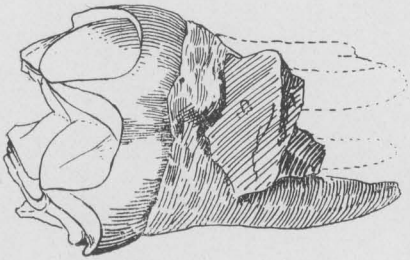


Fig. 9.

Fig 10.

G.P.Morison. del.

10 0 1 2 3 4 5 6

Scale of Centimetres.

Nototherium, sp.

Fig. 8—Working surface of left upper molar.

Fig. 9—Outer aspect of same tooth.

Fig. 10—Working surface of left upper premolar.

PLATE VI.

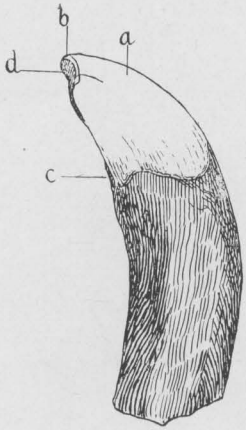
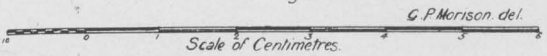


Fig. 1

Fig. 2

Fig. 3



Thylacoleo, sp.

Fig. 1—Outer aspect of left upper incisor.

Fig. 2—Inner aspect of same.

Fig. 3—Outer aspect of left upper functional premolar.

a Unworn enamel.
b Worn enamel.
c Unworn dentine.
d Exposed and worn dentine.

PLATE VII.

Fig.4

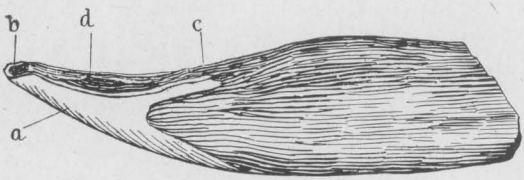
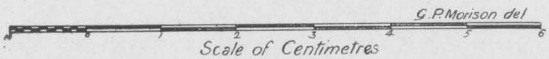


Fig.5

Fig.6

Fig.7



Thylacoleo, sp.

Fig. 4—Inner aspect of right lower incisor showing the polished and scratched enamel at *b*.

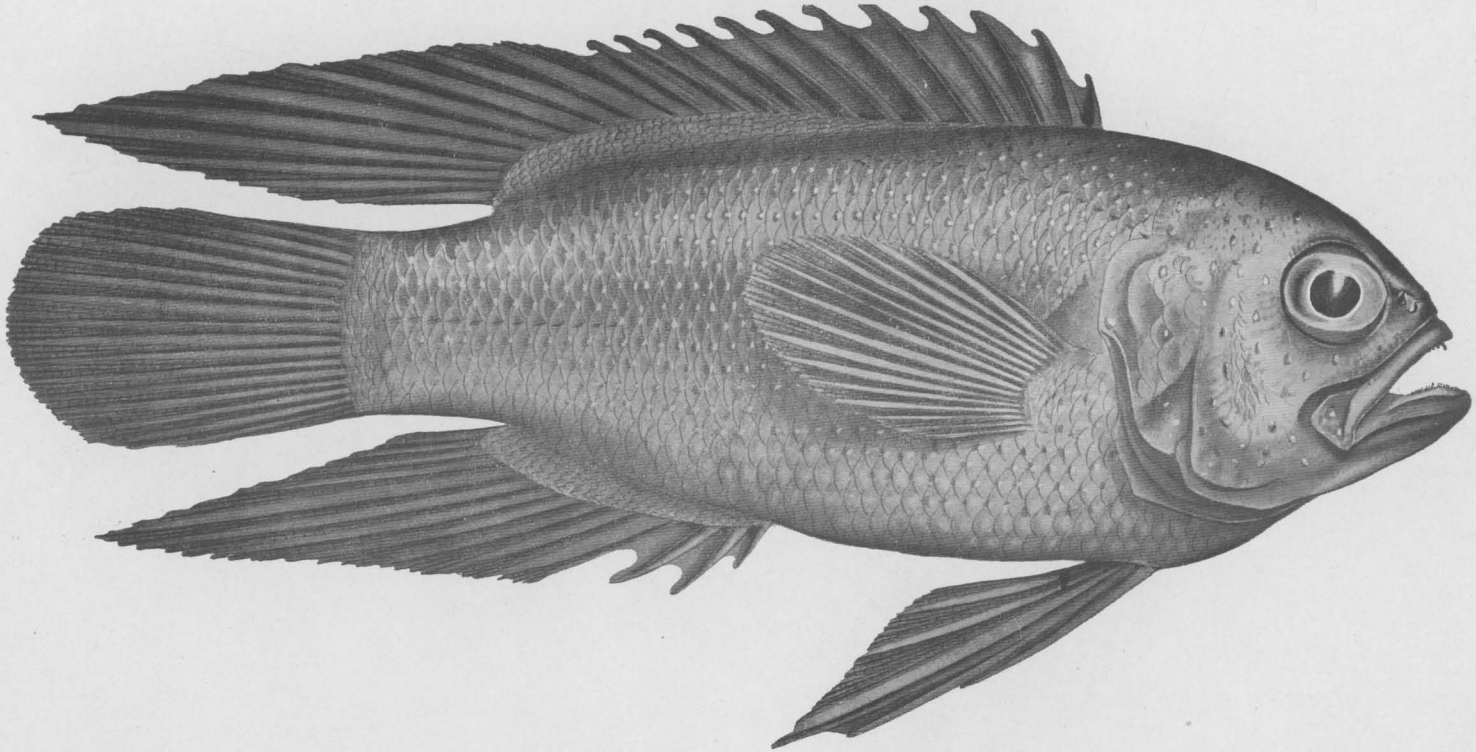
Fig. 5—Outer aspect of left lower incisor.

Fig. 6—Inner aspect of same showing the large area of worn enamel at *b*.

Fig. 7—Upper view of the same tooth

a Unworn enamel.
b Worn enamel.
c Unworn dentine.
d Exposed and worn dentine.

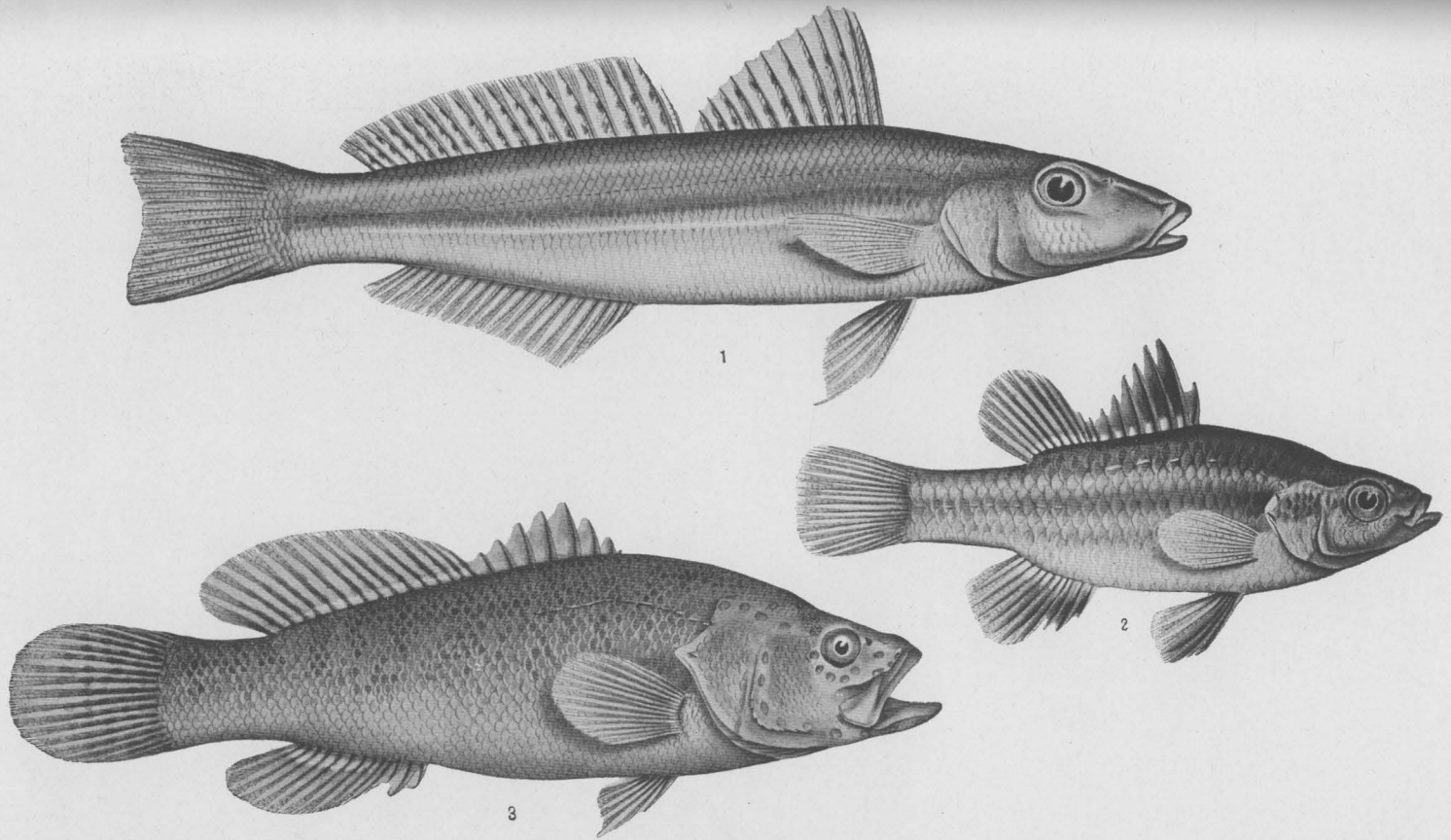
PLATE VIII.



A. R. McCulloch, *del.*]

Paraplesiops meleagris, Peters.

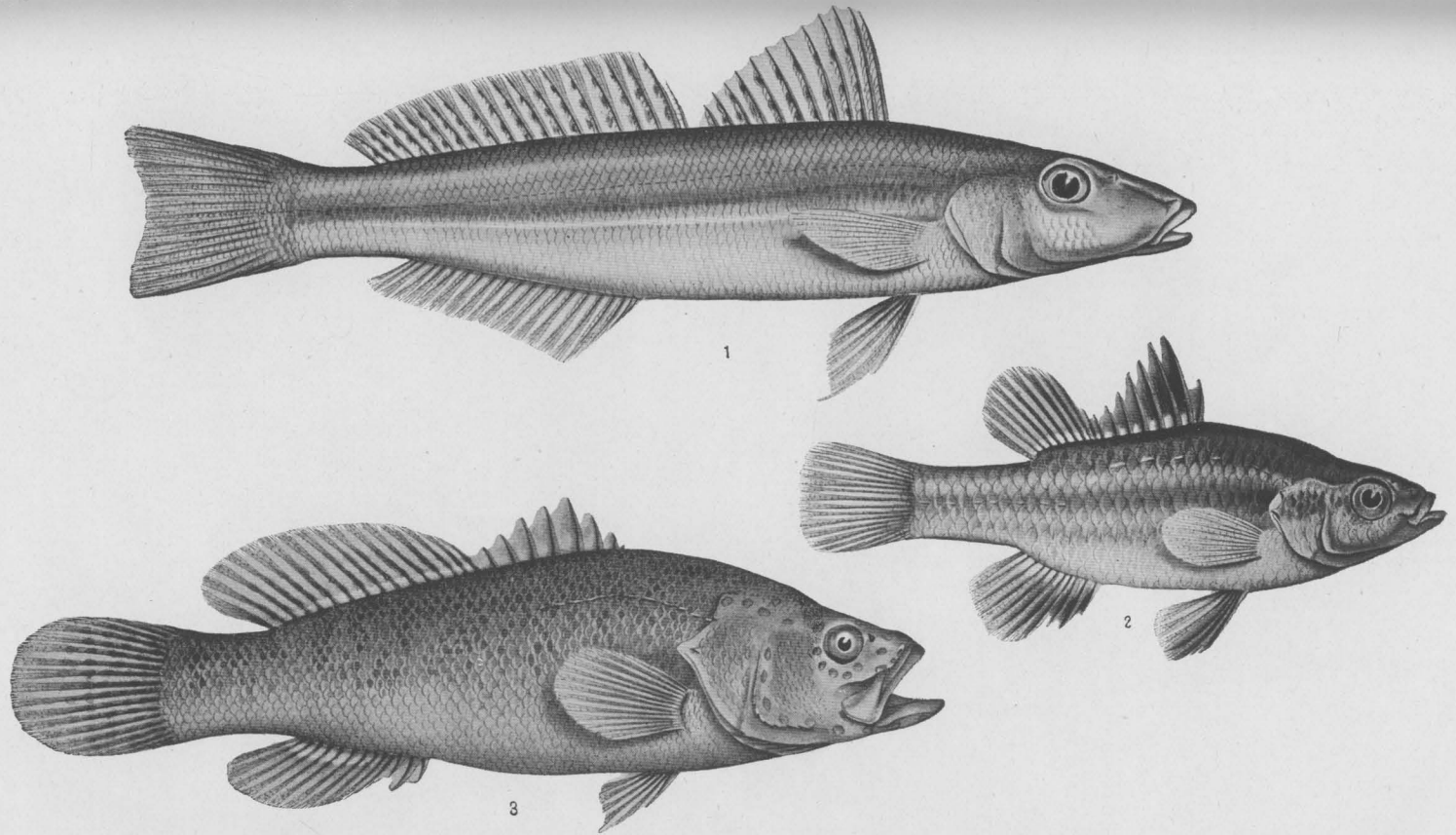
PLATE IX.



A. R. McCulloch, *del.*]

Fig. 1—*Sillago bostockii*, Castlenau.
Fig. 2—*Edelia vittata*, Castlenau.
Fig. 3—*Bostockia hemigramma*, Ogilby.

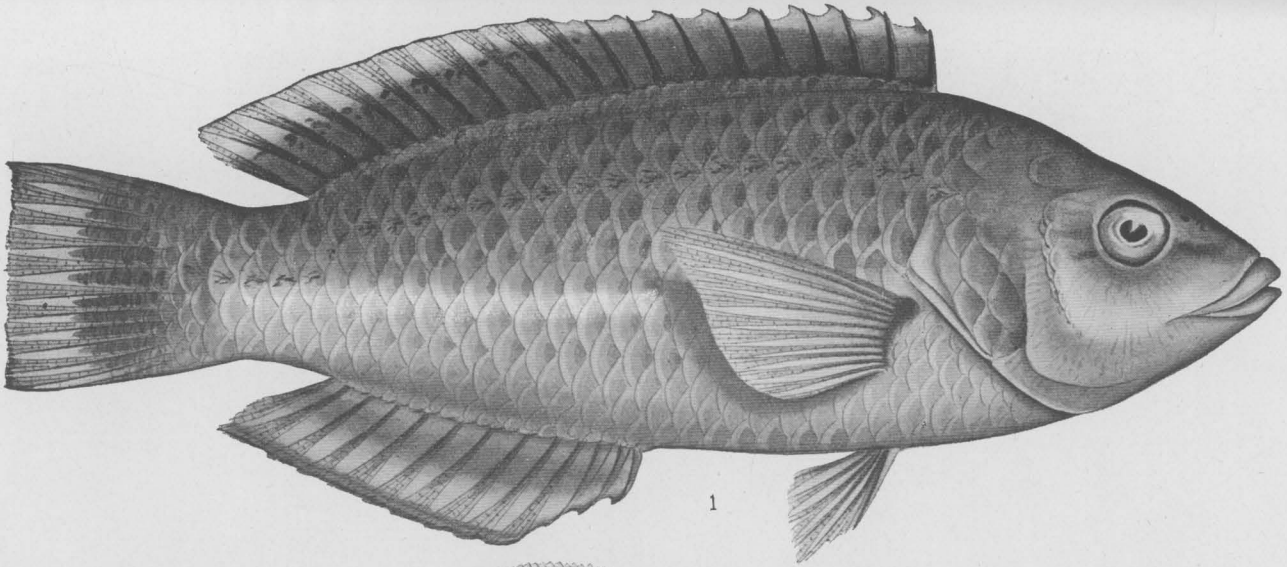
PLATE X.



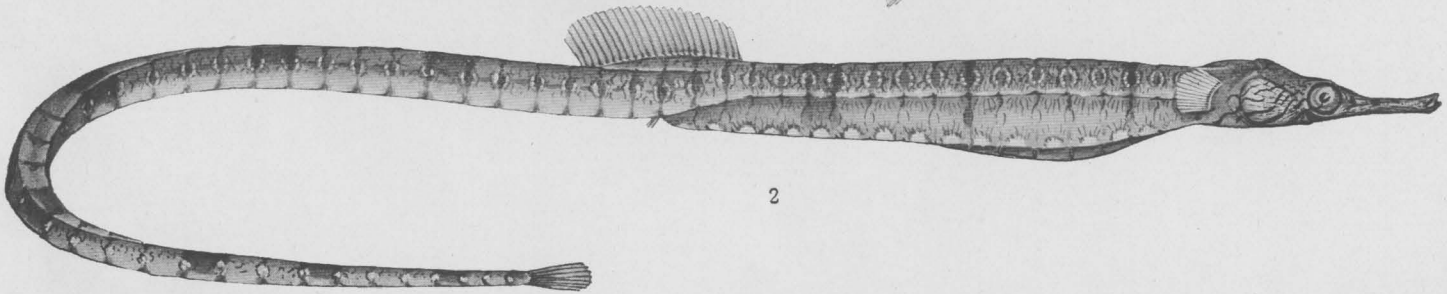
A. R. McCulloch, *del.*]

Fig. 1—*Sillago bostockii*, Castlenau.
Fig. 2—*Edelia vittata*, Castlenau.
Fig. 3—*Bostockia hemigramma*, Ogilby.

PLATE X



1

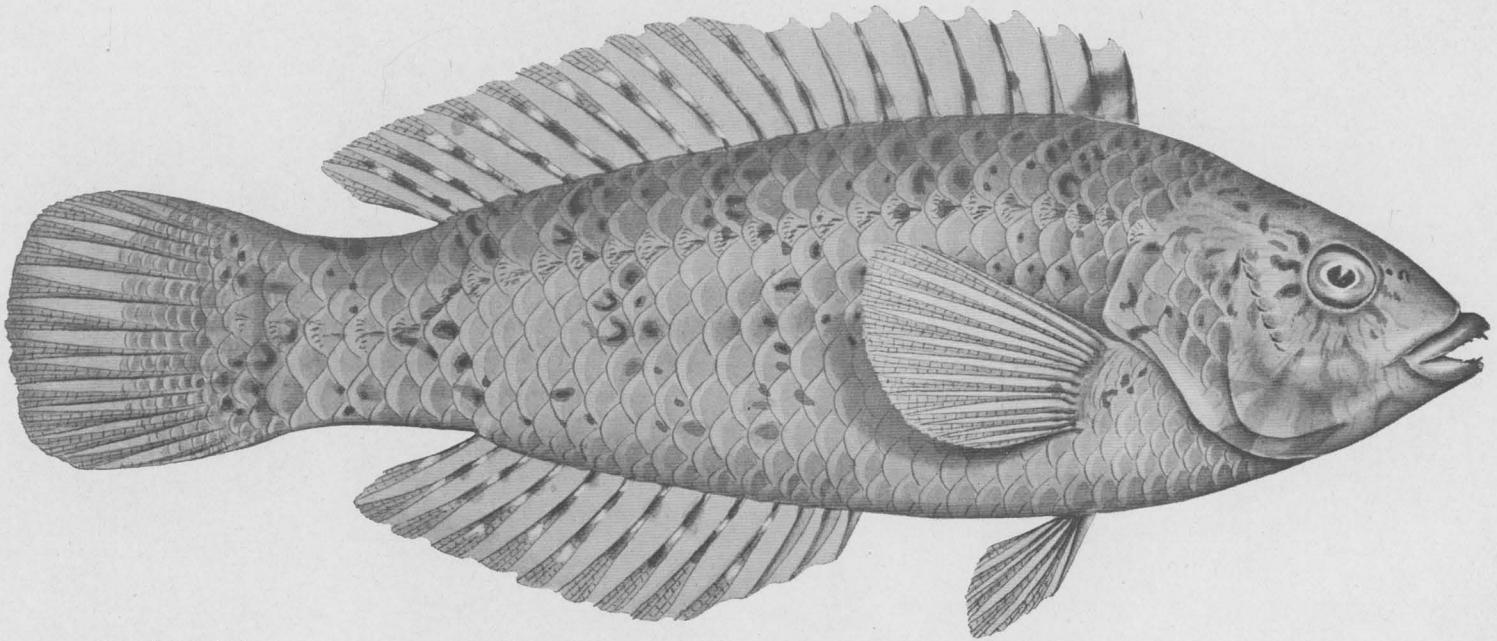


2

A. R. McCulloch, *del.*]

Fig. 1—*Pseudolabrus bostockii*, Castlenau.
Fig. 2—*Syngnathus tigris*, Castlenau.

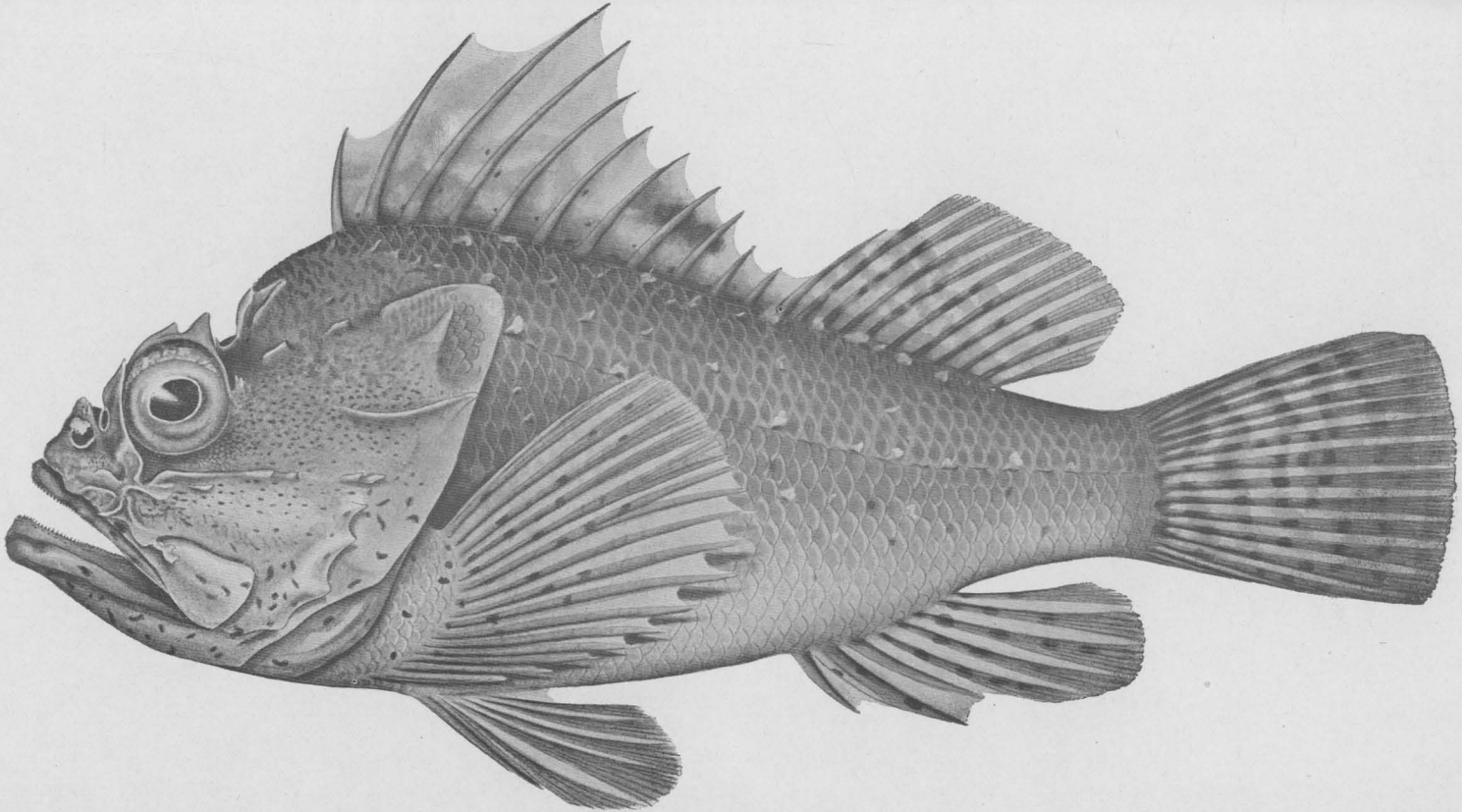
PLATE XI.



A. R. McCulloch, *del.*]

Pseudolabrus parilus, Richardson.

PLATE XII.



A. R. McCulloch, *del.*]

Scorpaena sumptuosa, Castlenau.

PLATE XIII.

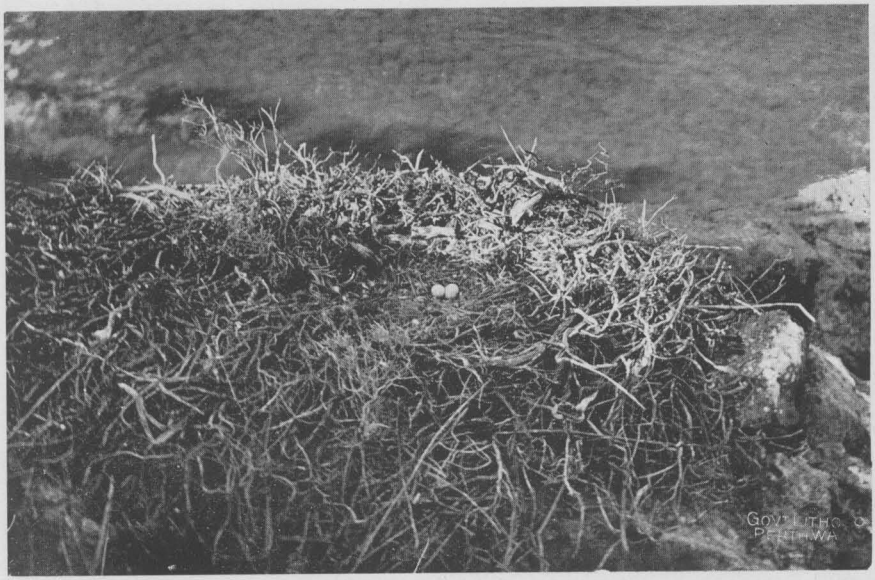
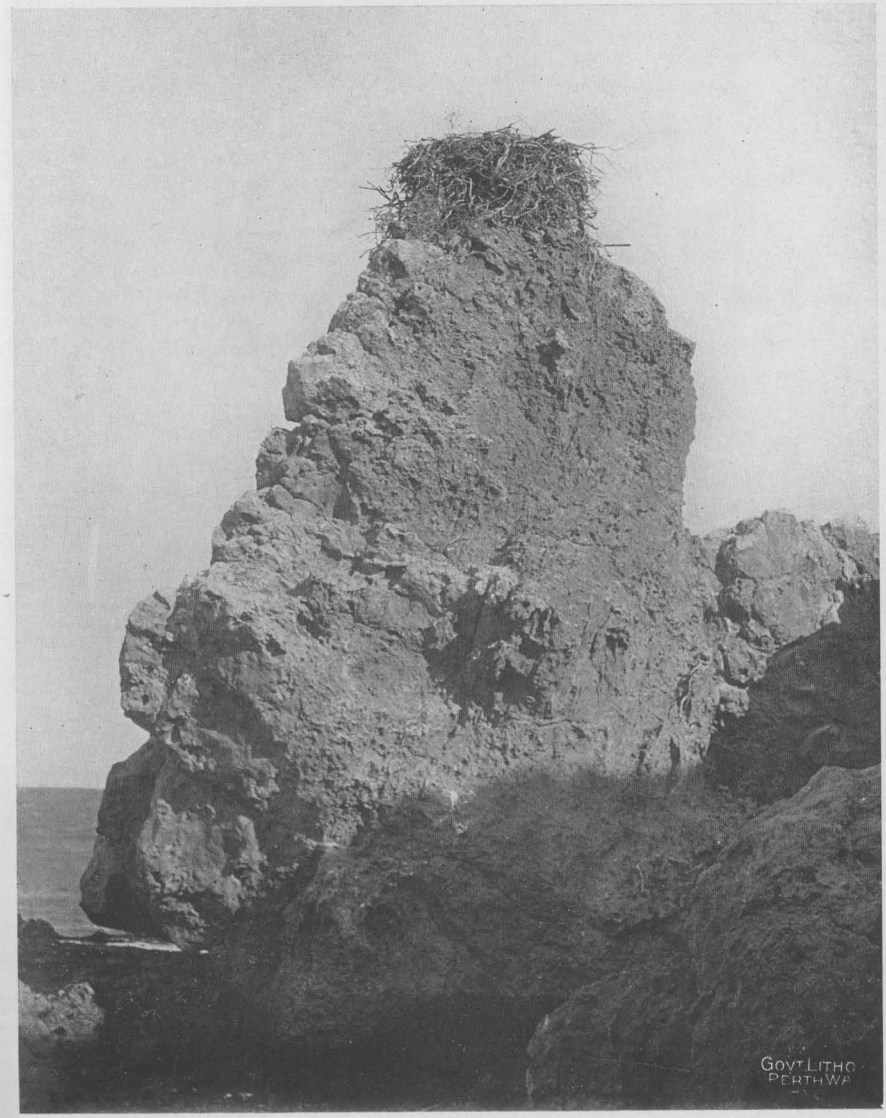


FIG. 1—Nest and Eggs of the White-bellied Sea Eagle.

FIG. 2—Distant view of the same Nest; its position is indicated by the white cross.

Haliaetus leucogaster.

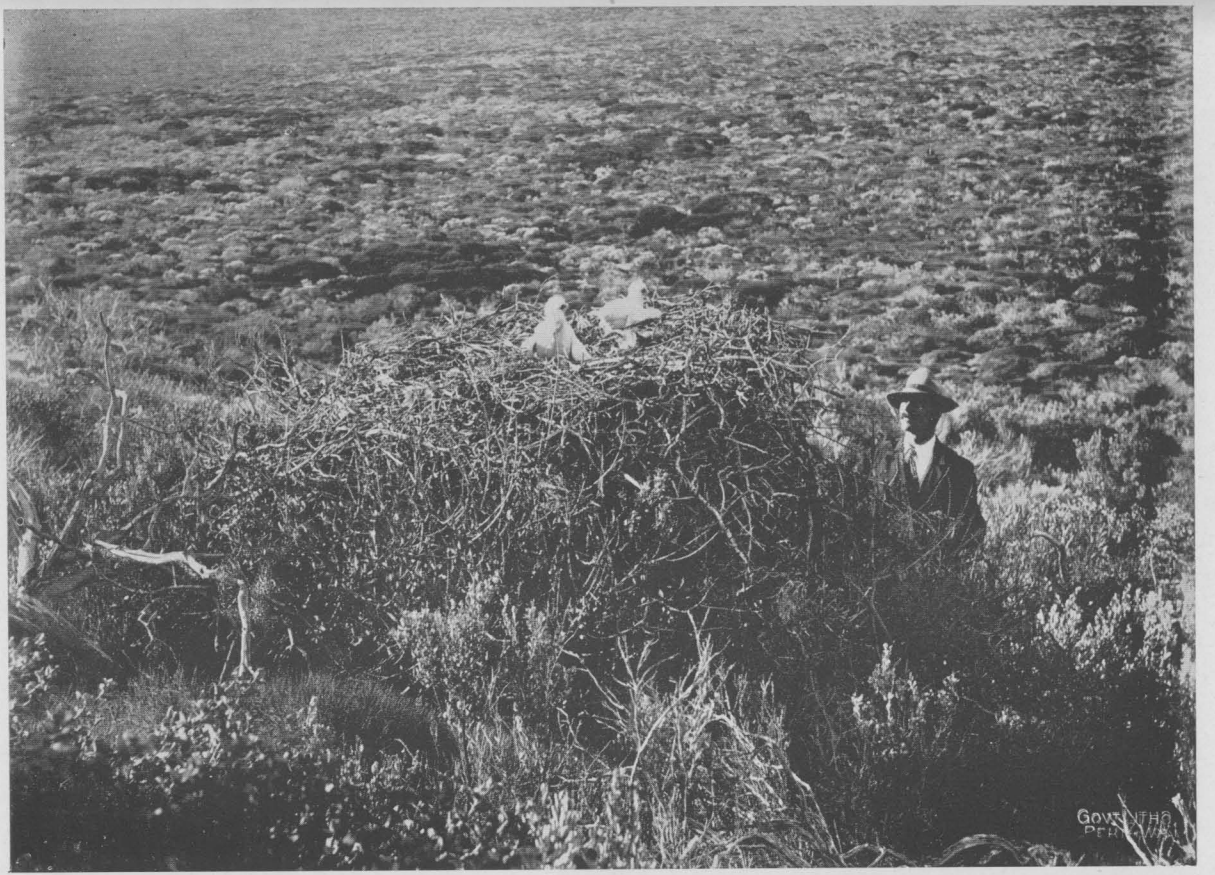
PLATE XIV.



Pandion leucocephalus.

Nest of the White-headed Osprey.

PLATE XV.



Uroaetus (aquilla) audax.

Nest and two young of the Wedge-tailed Eagle.

PLATE XVI.