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No. 1.—On a Carboniferous Fish Fauna from the Mansfield District, Victoria.

BY ARTHUR SMITH WOODWARD, LL.D., F.R.S.;

KEEPER OF THE DEPARTMENT OF GEOLOGY IN THE BRITISH MUSEUM;
SECRETARY OF THE PALAEONTOLOGICAL SOCIETY.

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NOTE.

In the year 1888 at the request of Sir F. McCoy, then Director of the National Museum, Mr. George Sweet, F.G.S., undertook a careful investigation into the rocks of the Mansfield district in Victoria. The great majority of the specimens now described were secured by Mr. Sweet, who generously placed his time and experience at the disposal of the Museum—in fact, except for a certain amount of assistance in actual manual labour, which Mr. Sweet supervised, the collection was almost entirely made at the expense of this gentleman, to whom the Museum is much indebted. On the death of Sir F. McCoy it was found that, though the plates which illustrate this memoir had been drawn and printed off under his supervision, there was no letterpress referring to them other than the very brief notice which was published in the Annual Report of the Secretary for Mines in Victoria for the year 1889. Under these circumstances they were placed in the hands of Dr. A. Smith Woodward, who cordially consented to make use of the plates already printed off, though it must be understood that Dr. Smith Woodward is not responsible for these, and that it would undoubtedly have been advantageous to him if they could have been executed under his own supervision. This, however, was not practicable, and the Trustees are indebted to Dr. Smith Woodward for undertaking the work under circumstances which could not have been altogether satisfactory to himself.

Melbourne, January, 1906.

ON A CARBONIFEROUS FISH-FAUNA FROM THE MANSFIELD DISTRICT, VICTORIA.

By Arthur Smith Woodward, LL.D., F.R.S.

I.—INTRODUCTION.

The fossil fish-remains collected by Mr. George Sweet, F.G.S., from the red rocks of the Mansfield District, are in a very imperfect state of preservation. They vary considerably in appearance according to the nature of the stratum whence they were obtained. The specimens in the harder calcareous layers retain their original bony or calcified tissue, which adheres to the rock and cannot readily be exposed without fracture. The remains buried in the more ferruginous and sandy layers have left only hollow moulds of their outward shape, or are much decayed and thus very difficult to recognise. Moreover, the larger fishes are represented only by scattered fragments, while the smaller fishes, even when approximately whole, are more or less distorted and disintegrated.

Under these circumstances, with few materials for comparison, it is not surprising that the late Sir Frederick McCoy should have failed to publish a satisfactory account of the Mansfield collection. With great skill, he selected nearly all the more important specimens to be drawn in the series of plates accompanying the present memoir. He also instructed and supervised the artist, so that most of the principal features of the fossils were duly emphasised. His preliminary determinations, however, published in 1890,[1] are now shown to have been for the most part erroneous; while his main conclusions as to the affinities of

1 F. McCoy, "Report on Palæontology for the Year 1889," Victoria.—Ann. Rep. Sec. Mines, 1889 (1890), pp. 23, 24.

the fish-fauna are proved to be without real foundation. Far from displaying a "Mixture of Lower Devonian, Upper Devonian, and types related to some of the Calciferous Sandstone series," as McCoy supposed, the Mansfield fishes are typically and essentially Carboniferous, as the following technical descriptions will demonstrate. Of the six genera represented in the collection, one (*Eupleurogmus*) is too imperfectly known for discussion; four of the others (*Acanthodes, Ctenodus, Strepsodus,* and *Elonichthys*) have hitherto been discovered only in the Permian and Carboniferous of Europe, and in the Carboniferous of North America; while the sixth (*Gyracanthides*) is related to an essentially carboniferous fish in the northern hemisphere and bears every mark of belonging to the same late Palæozoic period.

The genus *Gyracanthides* is, indeed, a remarkable discovery. As correctly recognised by McCoy, it is closely allied to *Gyracanthus*, which is widely distributed as a characteristic fossil in the Carboniferous of the northern hemisphere and seems to be also represented by a few small spines in the Lower Devonian. The new specimens prove that *Gyracanthides* is a typical Acanthodian, belonging either to the Diplacanthidæ or to a distinct family which marks the culmination of the Diplacanth series. The enlargement of the pectoral fins, the reduction and forward displacement of the pelvic fins, and the absence or peculiar modification of the intermediate spines, are features indicating its high degree of specialisation. It occupies the same position among Diplacanths as that occupied by the Permian species of *Acanthodes* among the Acanthodians with one dorsal fin.[1] It shows that the direction of specialisation was identical in the two great groups of Acanthodians, and was analogous to the specialisation observable in later geological periods among Selachians and Teleosteans.

The total assemblage of fishes in the red rocks of Mansfield is such as occurs usually in estuarine or freshwater strata in the northern hemisphere; but all the genera are likewise met with

1. A. S. Woodward, "Catalogue of Fossil Fishes in the British Museum," pt. ii. (1891), p. 5.

occasionally in marine sediments. Their association with numerous remains of land-plants at Mansfield, however, is suggestive at least of estuarine conditions. They do not appear to exhibit any essential change as they are traced through the successive beds in the section so carefully worked and described by Mr. Sweet.[1]

II.—SYSTEMATIC DESCRIPTIONS.

Subclass ELASMOBRANCHII.

Order Acanthodii.

Family GYRACANTHIDÆ.

An imperfectly definable family of round-bodied and depressed Acanthodians, with the pectoral fins very large and the pelvic fins advanced far forwards. Dorsal and anal fins much reduced and sometimes apparently without spines.

This family has hitherto been known only by detached paired fin-spines, other paired spines or plates, and small dermal tubercles, the majority belonging to one genus, *Gyracanthus* of Agassiz. The specimens of the new genus *Gyracanthides* now described, show for the first time the depressed, rounded form of the trunk and the relative position of the fins.

Genus Gyracanthides, McCoy.

[Ann. Rep. Sec. Mines, Victoria, 1889 (1890), p. 24.]

Body short and broad. Teeth minute or absent; no circumorbital plates. Both pectoral and pelvic fins with spines, the latter about half as large as the former. Pectoral fin-spines much compressed from above downwards, arched from side to side; their base of insertion extensive, with the internal cavity open for a considerable length posteriorly; the longitudinal mesial line of their narrow anterior face defined by the superficial

1 G. Sweet, "On the Discovery of Fossil Fish in the Old Red Sandstone Rocks of the Mansfield District."—Proc. Roy. Soc. Victoria, n.s., vol. ii., (1890), pp. 1-14, pls. 1-3.

ornament, which consists of parallel, oblique, transverse ridges, diverging in pairs from this line over the flattened upper and lower faces and inclined towards the inserted extremity; their narrow posterior face impressed by a median longitudinal groove but without denticles. Pelvic fin-spines ornamented like the pectorals, but rounded in transverse section at the base and nearly straight. Posterior dorsal and anal fins relatively small, with a broad, laterally-compressed anterior spine, which is ornamented with longitudinal tuberculated ridges; caudal fin slightly forked. Two pairs of hollow, broad, triangular, free spines, of fibrous texture, fixed near the insertion of the pectoral fin-spines.

This fish agrees with *Gyracanthus* in the ornamentation of its pectoral fin-spines and the nature of its free spines; but there is as yet no evidence that the last-mentioned genus possessed pelvic fin-spines or any median fin-spine. It may also be added that the pectoral fin-spines of *Gyracanthides* hitherto discovered do not exhibit any worn surfaces, while the corresponding spines of *Gyracanthus* are often much abraded and destroyed at the tip.

GYRACANTHIDES MURRAYI, sp. nov. Plates I, II, III, IV; Plate V, figs. 1, 2; Text-figures 1, 2.

1890. *Rhytidaspis murrayi*, F. McCoy. *Loc. cit.* p. 23 (name only).

1890. *Chiraropalus langtrei*, F. McCoy. *Loc. cit.* p. 24 (name only).

Type.—Head and abdominal region of fish showing pectoral spines (partly shown in Pl. I, fig. 1).

Specific Characters.—The type species, usually attaining a length of about 0.5 m., sometimes perhaps much larger, with the pectoral fin-spines extending nearly half of this length. Width between the insertion of the pectoral fin-spines probably exceeding the length of the head and branchial region in front of them; the same measurement slightly more than twice as great as the width between the insertion of the pelvic fin-spines, of which the

Fig. 1.—*Gyracanthides murrayi*, A. S. Woodw.; restored drawing of fossil, much reduced, head and abdominal region seen from below, tail twisted to exhibit side-view.

distal ends do not appear to have extended further back than the tips of the pectoral spines. Ridged ornament of both paired spines tuberculated; the number of ridges cut by a cross-section of a full-grown pectoral fin-spine just behind its base of insertion about 13 to 15 on each face.

General Form.—The specimens of the head and abdominal region of this species are always exposed either from above or below, and prove that the greater part of the body was originally rounded or depressed in transverse section. The only known example of the hinder part of the caudal region (Pl. V, fig. 1) is displayed in side-view, and indicates that this part was more laterally compressed. The type-specimen seems to show the complete extent and shape of the head and branchial region, while this and another imperfect fossil (Pl. I, fig. 7), with the caudal region just mentioned, appear to justify the specific diagnosis, which is illustrated by the accompanying restored sketch (text-fig. 1).

Head.—So far as preserved in the type-specimen, the head exhibits nothing but the usual close armour of dermal tubercles, without any traces of teeth or circumorbital plates. It also lacks indications of branchial arches. The cartilage of the endoskeleton cannot have been sufficiently well calcified for preservation.

Pectoral Fin-spine.—The paired fins are represented in the fossils solely by their anterior spines, which are always imperfect and often preserved only in the form of natural moulds or impressions. Owing to its vertically-compressed shape the pectoral fin-spine is invariably exposed either from above or below, and it is shown on both sides of the type-specimen, of which the left portion is seen in Pl. I, fig. 1 (*c*). Parts of this spine are also seen on both sides of the fossil in Pl. I, fig. 7 (*b*), Pl. II, fig. 2 (*b*), and Pl. III, fig. 1. More satisfactory examples for description are drawn in Pl. II, fig. 1 (*c*) and Pl. IV. As indicated by the two specimens last mentioned, the base of insertion is much extended, its extent being probably greater than one-third of the total length of the spine; but this base is not very deep, and it appears to have been only quite slightly produced forwards in front of the exserted and ornamented portion. The width of the exserted portion gradually increases to its maximum opposite the hinder part of the inserted base, and then the spine gradually tapers as it curves into the long and slender extremity, which is observable through a thin film of intractable matrix in the fossil represented in Pl. III, fig. 1. There is no evidence of the shortening of the spine by wear during life, such as occurs commonly in *Gyracanthus.* The vertical compression of the spine is well seen in a fragment of the type-specimen, which indicates that just at the hinder end of the inserted base the maximum vertical diameter equals nearly one-third of the width, while the dorsal and ventral faces are about equally flattened. These two faces are also similar in their ornamentation, which consists of oblique ridges, all surmounted with a regular row of smooth, rounded tubercles (Pl. IV, fig. 1*d*), and separated by shallow, smooth grooves, which are wider than the ridges themselves. All the ridges are complete from edge to edge of the spine, and thirteen to fifteen of them are cut by a transverse section at the hinder end of the base. Their direction tends to become more and more longitudinal as they are traced from the base towards the apex of the spine, and they may have been absent on the terminal portion. The anterior margin of the spine (Pl. IV, fig. 1*b*) is compressed to a sharp edge, along which the several ridges of the dorsal and ventral faces meet exactly in pairs. The posterior margin (Pl. IV, fig. 1*c*) is a narrow smooth area impressed by a deep longitudinal groove, which is represented by a ridge of sandstone in the fossil-casts (Pl. II, figs. 2*a*, 2*e*). It is evident that this groove was not quite median or bilaterally symmetrical. Its borders are not provided with any denticles. The calcified tissue of the spine is rather coarse, longitudinal vascular canals being visible to the naked eye, and imparting to longitudinal sections (Pl. III, fig. 1*b*) a fibrous appearance. The internal cavity is large, and a remnant of it seems to extend to the apex of the spine.

Anterior Free Pectoral Spine.—There is no clear evidence of fin-supports or a pectoral arch at the base of the pectoral fin-spines; but there are two pairs of wide, hollow, triangular spines, which may have projected freely from the ventral aspect of the body in a manner not unusual among Acanthodians. Remains of the anterior pair of these peculiar spines are observable on both sides of the type-specimen just in front of the base of the pectoral fin-spine (one shown at *a* in Pl. I, fig. 1). An internal cast of the corresponding spine in a second specimen is shown in Pl. I, figs. 7 (*a*), 7*a*. An imprint of one face evidently of the same spine, somewhat displaced, is also seen in Pl. III, fig. 1 (*c*); and variously imperfect detached specimens are represented in Pl. I, figs. 2-6. The structure is clearly a thin-walled, hollow, laterally-compressed cone, the length of its base-line equalling twice its height. Part of its calcified tissue is actually preserved in the type-specimen and in the original of Pl. I, fig. 4, exhibiting a very porous texture (see especially Pl. I, figs. 4*a*, 4*b*); and impressions are marked by the appearance of fibres radiating from the apex, crossed by certain lines of growth which are concentric with the basal edge. There are traces of a coarse tubercular ornament at the apex of the best-preserved spine in the type-specimen; and this ornament is shown to be confined to one face of the spine in the detached example of which one lateral impression is represented in Pl. I, fig. 2. The ornament consists of large, smooth tubercles arranged in ten to fourteen rows, which radiate from the apex and terminate at a short distance from the base of the spine, leaving a smooth area which was evidently the part originally inserted in the soft tissues. The tubercules increase in size towards the base of the spine, where they sometimes subdivide. As shown by various impressions (Pl. I, figs. 2, 3, 5), this ornamented face bears much resemblance to a dental plate of the Dipnoan fish, *Dipterus;* but even when the rest of the spine is not seen, the fossil is distinguished from a Dipnoan dental plate by its sharply-defined smooth area beyond the termination of the radiating ridges. The base-line of this spine seems to have been more or less coincident with the long axis of the trunk, while its apex, as crushed in the best-preserved fossils, is turned outwards.

Posterior Free Pectoral Spine.—The spine just described is not very large, the length of its base-line equalling only one-and-a-half times the maximum width of the pectoral fin-spine. The free spines of the second pair are much larger and more elevated, the basal extent of each being about one-and-a-half times as great as that of the anterior spine, while the height somewhat exceeds this measurement. Parts of both of these large spines are seen in the type-specimen, that of one side being represented solely by its apex, while that of the other side is better displayed in several broken surfaces. Another good example is well shown in Pl. II, fig. 1, and lacks only the apex. A more imperfect specimen is seen near the front of the fossil represented in Pl. V, fig. 1. This spine is situated opposite and just on the inner side of the inserted part of the pectoral fin-spine. Like the smaller spine in front, it is a thin-walled, hollow, laterally-compressed cone, with its base-line more or less coincident with the long axis of the trunk, that is, parallel with the basal edge of the fin-spine. Its outer side (Pl. II, fig. 1*a*) is gently convex, with a sharply-bevelled area in front (resembling that of the corresponding spine in *Gyracanthus* and *Oracanthus*[1]); its inner side is flattened or even slightly concave, and seems to be emarginate or excavated at its basal edge; its posterior aspect (Pl. II, fig. 1*b*) indicates the amount of the lateral compression. Remains of the actual tissue of the spine in the type-specimen show that it was very porous, with an appearance of fibres radiating from the apex towards the irregularly-crimped base (shown in internal cast in Pl. II, fig. 1*a*). An impression of the outer face in Pl. II, fig. 1 (*a*) reveals a close ornament of small, rounded tubercles, not clearly arranged along the radiating structural lines, which are here very conspicuous. These tubercles (Pl. II, fig. 1*e*) are not noticeable in any other specimen, probably on account of the state of preservation. They might even be marks of the shagreen granules of a piece of skin pressed against the spine in the fossil, like the tubercular impressions covering the base of the adjoining pectoral fin-spine; but they are more probably true ornament, for similar tubercles occur on the corresponding spines both of

1 J. W. Davis, "On the Fossil Fishes of the Carboniferous Limestone Series of Great Britain."—Trans. Roy. Dublin Soc. [2], vol. i. (1883), p. 529, pl. lxiii., fig. 1.

Gyracanthus[1] and *Oracanthus*[2]. The narrow-ovoid basal opening of the large internal cavity of this spine is closed in two specimens by a separate basal plate, which seems to be in its natural position. This plate is well shown in the drawing of one side of the type-specimen (Pl. I, fig. 1*b*), and again in Pl. II, fig. 1*c*. It is quite as thin as the conical wall of the spine itself, and is clearly a separate element, calcified from its centre, from which structural lines radiate outwards. It exhibits traces of a tubercular ornament or of overlying shagreen-granules in both specimens. Its true nature is thus very difficult to understand, and it may even have been somewhat displaced in the fossils.

Pelvic Fin-spine.—The spines of the pelvic fins are very little more than half as large as those of the pectoral pair, while they are much more rounded in transverse section and straighter than the latter. The pelvic fins themselves are advanced so far forwards that the points of their spines scarcely extend backwards beyond those of the pectoral spines. Only one displaced pelvic spine is partly seen in an accidental fracture of the type-specimen, but the relative position of the pair is indicated in Pl. I, fig. 7 (*c*, *c*[1]), Pl. II, fig. 2 (*a*), Pl. III, fig. 1 (*b*), and Pl. V, fig. 1. In the first two figured examples just mentioned, each spine is represented solely by a natural mould of its internal cavity with scarcely any impression of the ornamented exterior face. In the original of Pl. III, fig. 1, however, where the spines are somewhat crushed together, fragments of their actual tissue are preserved, and impressions of their basal ends show the characteristic ornament forming parallel V-shaped ridges on the rounded lower face. In the original of Pl. V, fig. 1, there is also the basal end of the spine itself (*a*). These specimens, and the impression of one side of a detached example (text-fig. 2), show that the pelvic fin-spine was ornamented like the pectoral fin-spine, with continuous, tuberculated ridges, which are separated by comparatively wide, smooth grooves. The ridges tend to a more and more longitudinal direction as they are

1 A. S. Woodward, "Catal. Foss. Fishes, B.M.," pt. ii. (1891), p. 143.
2 J. W. Davis, *loc. cit.*

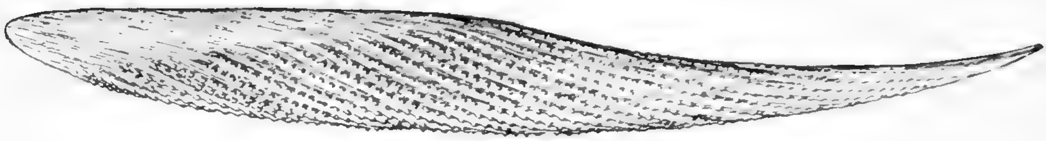


Fig. 2.—*Gyracanthides murrayi*, A. S. Woodw.; pelvic fin-spine, side-view, nat. size.

traced from the base towards the slender apex of the spine, where there is an indication of a worn surface. The base of insertion is very extensive, as usual, its length probably equalling one-half the total length of the spine. One fine example apparently of this spine, obtained by Mr. Sweet from Bed W in the Mansfield section, is nearly twice as large as the original of text-fig. 2. Its outer ornamented face is broken away on the exposed side, but the tissue of the spine is sufficiently well preserved for microscopical examination. It exhibits a remarkably coarse vascular structure, identical with that described by Agassiz in *Gyracanthus.*[1]

Median Fins.—The specimen represented in Pl. V, fig. 1, is very imperfect anteriorly, showing only a hollow mould of parts of the pectoral fin-spines, one displaced large free pectoral spine, and part of one of the pelvic fin-spines; but it is important as displaying the caudal region of the fish, with traces of the median fins. This fossil seems to have been selected by McCoy (*loc. cit.*, p. 24) as the type of a species which he intended to describe under the name of *Chiraropalus langtrei;* but the paired spines already mentioned prove that it really belongs to the *Gyracanthides* now under consideration. As shown by the figure, there is part of a fin-spine above the dorsal border of the trunk (at *c*) opposite the insertion of the pelvic fin-spine. In another more fragmentary specimen (Pl. V, fig. 2) there is also a small spine, chiefly shown by the mould of its internal cavity (*b*) nearly opposite a piece of spine (*a*) which seems to represent the pelvic fin-spine. The first example might possibly be the tip of one of

1 L. Agassiz, "Reçh, Poiss. Foss.," vol. iii. (1843), p. 214, pl. A, fig. 6.

the pectoral fin-spines, but the second specimen cannot be explained in this manner. It is thus probable that there was a small anterior dorsal fin, with a spine, situated opposite to the insertion of the pair of pelvic fins. A posterior dorsal fin, opposed to the space between the pelvic and anal fins, is more satisfactorily preserved (Pl. V, fig. 1). Its slender anterior spine is nearly straight, and shown in a broken longitudinal section, which exposes the large internal cavity and appears to suggest that it bore an external coarse tubercular ornament of some kind. The fin itself is covered with dermal tubercles like those of the trunk. The length of its base-line seems to have slightly exceeded the height of its anterior spine, which can scarcely have equalled less than two-thirds the depth of the trunk at its insertion. The anal fin-spine, inserted opposite the hinder end of the posterior dorsal fin, is not much more than half as long as the dorsal fin-spine just described; but it is similar in character, with a very large central cavity. Its outer face is not seen in Pl. V, fig. 1, but an impression of it on the counterpart of the specimen represented in Pl. I, fig. 7 (see fig. 7*d*) exhibits an external ornament of a few large, tuberculated ridges, which are disposed longitudinally parallel with the hinder border and successively terminating at the front edge. One of the two specimens showing the anal fin-spine must be distorted, for in Pl. I., fig. 7, this spine (*e*) is observed quite near the apex of the pelvic fin-spines, while in Pl. V, fig. 1, it is further back (probably its natural position). The very stout caudal fin (Pl. V, fig. 1) is of the usual Acanthodian type, with no clear line of demarcation in the fossil between the upper caudal lobe and the dermal expansion beneath it.

Dermal Tubercles.—Both head and trunk are enveloped in a close and uniform covering of calcified dermal tubercles, which are not enlarged or modified even along the course of the lateral line. They are rhombic, usually almost equilateral in shape, and closely pressed together. Their inner face, seen on parts of the type-specimen, is flattened or even slightly concave, and it is pierced in the middle of the opening of a small, persistent pulp-cavity (Pl. I, fig. 1*a*). Their outer face is raised in the middle into a rounded boss, which sometimes exhibits a feeble radiating crimping round the base. This is best shown in the original of Pl. II, fig. 2 (enlarged in fig. 2*c*), but is also observable in impression in other specimens from which the diagrams, Pl. I, fig. 7*b* and Pl. II, fig. 1*f*, have been made. Less accurate drawings are given in Pl. V, figs. 1*b*, 2*a*. The imperfect fossil represented in Pl. VI. also seems to be an impression of a fragment of this dermal armour, but the drawing exaggerates the crimping of the tubercles and gives a false appearance of lines bounding polygonal tesseræ. This specimen may possibly have been interpreted by McCoy as part of the shield of his supposed Cephalaspidian, *Rhytidaspis murrayi.*

Observations.—This species is named in honour of Mr. Reginald Murray, who discovered the first evidence of it at Mansfield many years ago. Most of the remains of *Gyracanthides* in the collection evidently belong to it, though some fragments may perhaps represent other species which cannot yet be distinguished.

Family ACANTHODIDÆ.

Genus Acanthodes, Agassiz.

[Reçh. Poiss. Foss., vol. ii., pt. i., 1833, p. 19.]

A typical slender species of this genus is represented in the Mansfield collection by an imperfect trunk and other fragments. It evidently belongs to the group which is characteristic of the Carboniferous and Permian formations in the northern hemisphere.

Acanthodes australis, sp. nov. Plate V, fig. 3; Plate VII, fig. 1.

Type.—Caudal region of fish (Pl. VII, fig. 1).

Specific Characters.—A very slender species probably attaining a length of not less than 0.3 m. Anal fin-spine much larger than the dorsal fin-spine, which is more curved and inserted further back than the former. Depth of hinder end of caudal pedicle somewhat exceeding one-third of the length between the anal fin-spine and the lower lobe of the caudal fin. Scales very small, equilateral, flat and smooth.

Description of Specimens.—The type-specimen, of which the greater part is shown in Pl. VII, fig. 1, is associated with the imperfect trunk of a similar fish on a small block of sandstone which has unfortunately been weathered. The extreme slenderness of the trunk and the elongation of the upper caudal lobe are indicated; but the only remains of fins are fragments of the dorsal, anal and caudal. The dorsal fin-spine, just in front of a crack in the fossil, is clearly much smaller, more curved, and more remote than the anal fin-spine, which is incomplete distally. Both these spines are broken, and the anal spine (enlarged in fig. 1*b*) displays its extensive internal cavity. The caudal fin (enlarged in fig. 1*a*) seems to be nearly complete in the upper lobe, but lacks the greater part of the lower lobe. A larger specimen of the tail (Pl. V, fig. 3) is similarly imperfect. The very small scales are nearly or quite square, and most of them are exposed from the inner face, which exhibits its usual convexity (Pl. VII, figs. 1*c*, 1*d*). In one part of the fossil their outer face is distinctly shown to be flat and smooth (Pl. VII, fig. 1*e*). On the membranous expansion of the caudal fin they become minute (Pl. V, fig. 3*a*). In the original of Pl. V, fig. 3, the lateral line can be traced to the basal portion of the upper caudal lobe, and is only marked by a ridge-like displacement, not by an enlargement of the scales.

Genus Eupleurogmus, McCoy.

[Ann. Rep. Sec. Mines, Victoria, 1889 (1890), p. 24.]

An indefinable large Acanthodian with smooth scales, of which two series are deepened and meet chevron-wise along the course of the lateral line.

The peculiar enlargement of the scales of the lateral line characterising this genus, has only been observed hitherto in certain primitive species of Diplacanthidæ from the Lower Old Red Sandstone of Scotland, described under the generic name of

Euthacanthus by Powrie[1]. The resemblance, however, does not necessarily imply any close affinity. The fins must be discovered before the precise systematic position of this fish can be determined.

EUPLEUROGMUS CRESSWELLI, McCoy. Plate V., fig. 4.

1890. *Eupleurogmus cresswelli*, F. McCoy. *Loc. cit.*, p. 24.

Type.—Portion of squamation (Pl. V, fig. 4).

Description of Specimen.—As shown by the figure, which is of the natural size, this must have been a rather large Acanthodian; but it is only known by scattered remains of the scales and a fractured fin-spine of one individual. Many of the scales of the flank are in undisturbed order and exhibit their regular arrangement. They are square and apparently solid, with a smooth outer face. Immediately above and below the course of the lateral line, two of them are fused into an elongated scale; the upper fusion being of scales in contiguous transverse series, while the lower fusion affects two scales of one and the same series, the result being that the enlarged scales are disposed chevron-wise, pointing forwards. At the lower left-hand corner of the figure the tip of a fin-spine is represented. The adjoining part of the fossil exhibits the remainder of this spine, which is only seen in longitudinal section. It is as stout and straight as some of the fin-spines of the Lower Devonian *Euthacanthus*, and has a large internal cavity.

Subclass **DIPNOI**.

Order **Sirenoidei**.

Family CTENODONTIDÆ.

Genus CTENODUS, Agassiz.

[Reçh. Poiss. Foss., vol. iii., 1838, p. 137.]

The characteristic cranial roof and scales of this typically Permo-Carboniferous genus occur in the collection from Mansfield, and permit its identification with certainty.

1 J. Powrie, Quart. Journ. Geol. Soc., vol. xx. (1864), p. 425.

CTENODUS BREVICEPS, sp. nov. Plate VIII, fig. 12; Text-fig. 3.

Type.—Hinder part of cranial roof (Text-fig. 3).

Specific Characters.—Median occipital plate more than two-thirds as broad as long, and its extreme length about equalling that of the pair of plates immediately in front.

Cranial Roof.—The roofing bones of the hinder half of the skull are partly preserved in the type-specimen (Text-fig. 3), partly shown as an impression of their outer face on the matrix. The impression proves that they were not externally ornamented, their only markings being the usual fine radiating lines of growth, which cause the sutures between the various elements to be plainly visible. The median occipital plate (O) is shaped as in the typical *Ctenodus cristatus* from the English Coal Measures,[1] but differs in being rather broader in proportion to its length. The posterior median pair of plates (I) also agree with those of the type-species except that they are relatively broader; and there seems to have been the usual small median plate (O^1) between their divergent anterior ends. There is nothing worthy of remark concerning the lateral paired plates (II, III) so far as they are preserved, except that they likewise proove the skull to have been shorter and broader than in the type-species just mentioned.

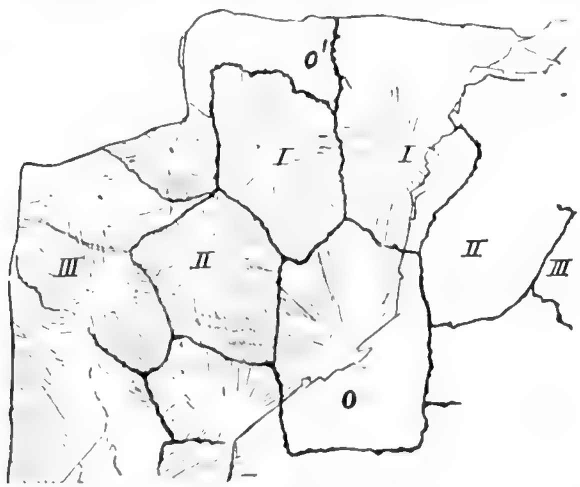


Fig. 3.—*Ctenodus breviceps*, A. S. Woodw.; part of occipital end of cranial roof, three-quarters nat. size. O, median occipital plate; O^1, position of small median plate further forwards; I., II., III., paired plates.

[1] A. S. Woodward, "Catal. Foss. Fishes B.M.," pt. ii. (1891), p. 252, pl. iv., fig. 1.

Vertebral Axis.—One fragment of the abdominal region of a Dipnoan large enough to have belonged to the head just described, exhibits a few very stout, curved ribs like those of the typical *Ctenodus* and *Sagenodus*. These ribs are round in section, with the central cavity which is always observable in the fossilised state. Two portions of a corresponding type of caudal region occur, one being an obscure fragment represented in Pl. VIII, fig. 12, the other a tolerably well-preserved extremity of the tail. These specimens demonstrate the absence of vertebral centra, and exhibit stout, mesially-constricted, neural and hæmal arches and fin-supports, which are only superficially calcified. The tail is clearly diphycercal.

Squamation.—The portion of abdominal region already mentioned exhibits impressions of large, thin scales, resembling those of *Ctenodus* found in the English Coal Measures.[1] The characteristic shape, thinness, and flexibility of these scales are still better seen in another piece of limestone, which contains some fragments of them. They display the usual very fine, radiating structural lines, which are crossed by the coarser and more irregular concentric lines of growth, without any enamel or ornamentation.

Subclass TELEOSTOMI.

Order Crossopterygii.

Family RHIZODONTIDÆ.

Genus Strepsodus, Young.

[Quart. Journ. Geol. Soc., vol. xxii, 1866, p. 602.]

Numerous remains of a large Rhizodont fish are contained in the collection, and among them it is easy to recognise the scales and teeth of a new species of *Strepsodus*. This genus has hitherto been found only in the Carboniferous of the northern hemisphere.

1 Hancock and Atthey, Nat. Hist. Trans. Northumb. and Durham, vol. iv. (1872), p. 398, pl. xiii, fig. 3; p. 417, pl. xvi.

STREPSODUS DECIPIENS, sp. nov. Plate VII., figs. 2, 3; Plate VIII, figs. 1-11.

Type.—Scales (Pl. VIII, fig. 10).

Specific characters.—Scales with the radiating ridges and furrows on the exposed portion more numerous than in the European Carboniferous species; the small pits and tubercles on the attached face also apparently more numerous than in the latter. Teeth [from same horizon as scales and presumably of same species] rather large, stout, and nearly or quite smooth, with the apex a little incurved but not sigmoidally bent.

Scales.—The scales exhibit the usual variations in form, according to their original position on the trunk of the fish, and are all more or less round or oval, with a slight truncation at the anterior border. Most of them are preserved in a partially decayed condition, and they then exhibit their internal structure, as represented in Pl. VIII, figs. 5, 6, 6*a*, 7, 10, 11. The exposed sector, seen in the lower half of these figures, is not very wide. Its tissue is coarser than that of the rest of the scale, consisting of stout radiating rods, which are closely apposed and crossed by a few feeble strands concentric with the border. The other part of the scale consists of very numerous radiating and concentric strands of tissue of about equal fineness. The difference between the two structures is well shown in the magnified drawing, fig. 6*a*, where a portion of the covered area is seen to the left, a larger portion of the exposed sector to the right. The outer face of the scale is rarely observable, even as an impression on the rock; but an imperfect scale associated with the original of fig. 10 (the type specimen) seems to show that each radiating rod of the exposed sector was surmounted by a delicate superficial ridge, the total number of ornamental radiating ridges being thus considerably more than in any scale of *Strepsodus* hitherto described. When a complete view of an impression of the inner face is obtained (as in the group represented in fig. 9), there is clear evidence of the large, antero-posteriorly elongated tubercle so characteristic of the middle of the scale in this and some allied genera. Occasionally, as in the piece of undisturbed squamation impressed on the original of fig. 8, the hinder sector of the inner face is shown to have been covered by fine pittings and tubercles, which are apparently more numerous than in the known scales of *Strepsodus*. The slime-canal of the lateral line must have been large, as shown by its mould (fig. 10).

Jaws and Teeth.—The collection includes only two portions of mandible and a few imperfect teeth, which are noteworthy as being large compared with the scales just described. The height of the largest laniary tooth is 0.05 m., while the maximum diameter of the largest scale is 0.015 m. The remains are sufficiently well preserved to exhibit the characteristic form and structure of a Rhizodont mandible, and the larger of the two specimens is represented from the outer aspect in Pl. VIII., fig. 1. The dentary bone is a thin lamina with traces of an external tubercular ornament. Its oral margin bears a single regular series of small conical teeth, which are very slightly compressed antero-posteriorly and are scarcely incurved at the apex. These teeth are typically Rhizodont, with folded base and small pulp-cavity. Evidence of the shuttle-shaped bones bearing the laniary teeth is seen in both specimens; and one of these elements bearing two teeth (namely, one laniary with the successor by its side) is imperfectly represented near the front end of Pl. VIII, fig. 1. Like the smaller teeth the laniaries are not sigmoidally bent, but only incurved at the apex. They are rather stout, and when viewed in longitudinal section (figs. 1*a*, 2, 3) they exhibit the usual pulp-cavity with simple foldings of the wall at the base. Transverse thin sections of the teeth, when magnified, show clearly the simple character of the basal folds (fig. 4) and the absence of all folding in the upper part where the pulp-cavity still persists (fig. 4*c*). The ordinary thin vertical splenial lamina occurs on the inner face of the mandible.

Jugular Plates.—There are several remains of the characteristic paired jugular plates of a large Crossopterygian fish, and the two best specimens are shown in Pl. VII, figs. 2, 3, They also probably belong to *Strepsodus decipiens*, since it is the only large Crossopterygian identifiable in the collection from Mansfield. The original of Pl. VII, fig. 2, is an impression of the inner face of a plate, which must have been about three times as long as broad, with sharply rounded ends and a feebly crimped or folded edge. The original of fig. 3 is an imperfect ferruginous fossil, evidently incomplete at one end and at one lateral margin. A third specimen shows the actual spongy tissue of the bony plate, with indications of an irregular tubercular ornament on the outer face. It seems likely that these specimens were misinterpreted by McCoy, and were intended for description under the name of *Pteraspis ? mansfieldensis* (*loc. cit.*, p. 24).

Appendicular Skeleton.—In addition to the Rhizodont fragments just described, there is a typical small clavicle, bearing an external ornament of radiating rugæ and tubercles. There are also three stout, hour-glass-shaped internal bones, exactly resembling the basal supports of the paired, dorsal, and anal fins in the Rhizodonts and their allies.

Order **Actinopterygii**.

Family PALÆONISCIDÆ.

Genus Elonichthys, Giebel.

[Fauna der Vorwelt, Fische, 1848, p. 249.]

Syn. *Cosmolepides*, F. McCoy, *loc. cit.*, 1890, p. 24 (name only).

All the remains of Palæoniscidae from Mansfield appear to belong to this genus, which is found both in Europe and North America, and ranges from the Lower Carboniferous to the Lower Permian.

Elonichthys sweeti, sp. nov. Plate IX, figs. 1-3; Plate X.

1890. *Cosmolepides sweeti*, F. McCoy, *loc. cit.*, p. 24 (name only).

Type.—Imperfect fish, the greater portion of the trunk in counterpart (Pl. IX, fig. 1; Pl. X, fig. 1).

Specific Characters.—A slender species attaining a length of at least 0.3 m., probably sometimes larger. Length of head with opercular apparatus equalling nearly one-quarter of the total length of the fish and somewhat exceeding the maximum depth of the trunk; caudal pedicle slender, less than half as deep as the abdominal region. Distance between the origin of the paired fins equal to that between the origin of the anal and caudal fins; dorsal completely in advance of anal fin. External ornament chiefly of striæ; teeth stout. Principal scales of flank not deeper than broad, with straight upper and lower edges; outer face of all the scales completely ornamented with fine, somewhat oblique ridges, which terminate in the delicate serrations of the posterior border; the ridges on the flank-scales nearly parallel, though often bifurcating and intercalated; those on the lower half of the narrow ventral scales curved upwards at the front border, and most of them terminating behind at the diagonal which joins the antero-superior and postero-inferior angles.

General Form.—The type-specimen is distorted in the ventral part of the abdominal region and incomplete dorsally; but the original outline of the fish would probably be almost as represented in the diagrammatic sketch, Pl. IX, fig. 3. The tail is shown to be inequilobate, as usual in *Elonichthys.*

Head.—Although the form and proportions of the head are indicated in the type-specimen, its details are obscure and only in part traceable. The greater portion of the cranial roof is shown as an internal cast, with the mark of the longitudinal slime-canal traversing its frontal element; but a fragment of a plate posteriorly bears a finely rugose or striated ornament. The orbit was situated far forwards, as proved by an impression of two of the circumorbital plates. The outer face of the maxilla is not preserved, but its oral border is distinct, curving downwards at the hinder end and bearing impressions of very stout conical teeth (Pl. IX, fig. 1*c*). Its great postorbital expansion is about three times as long as deep. The slender mandible is very imperfect, but fragments of the bone in its hinder part seem to show an ornament of longitudinal striations. The characteristic narrow opercular apparatus is recognisable, with occasional traces of a striated ornament. The forwardly-curved preoperculum is traversed by the usual well-developed slime-canal, while the suboperculum is relatively deep.

Appendicular Skeleton.—The supraclavicle and clavicle are seen in the type-specimen as moderately wide plates, which are ornamented with fine ridges or striations disposed in the direction of the long axis of these bones. There are also remains of the pectoral fins, which show that all their rays were articulated, though not very closely, for the greater part of their length. Both pelvic fins are likewise imperfectly preserved, arising slightly nearer to the anal fin than to the pectorals. Each comprises at least 28 rays, of which all are articulated to the base, although the length of the spaces between the joints considerably exceeds their width. The dorsal and anal fins must have been nearly equal in size and shape, the former completely in advance of the latter. They are short and deep, comprising from 25 to 30 rays, which exhibit distant articulations. Traces of the fringe of small and delicate fulcra are seen on the anal fin in the type-specimen. The caudal fin is imperfect in this specimen, and the inequality of its lobes is better seen in the original of Pl. IX, fig. 1*a*. The lower lobe is fringed with a close series of delicate fulcra, and its rays are very finely divided distally. It is uncertain whether any of the fin-rays were ornamented, but sometimes they appear to bear indications of fine longitudinal ridges.

Scales.—The principal scales on the flank of the abdominal region are shown by the type-specimen to be about as deep as broad. Those on the caudal region are somewhat broader than deep, while those near the ventral edge of the fish are at least twice as broad as deep. Those of the flank are united by a large and broad peg-and-socket articulation (Pl. X, figs. 1, 1*a*, 1*b*). Isolated scales on several specimens show that their overlapped anterior border was narrow, as usual in *Elonichthys*. The outer face of all the scales is completely covered with ganoine, which forms numerous delicate rounded ridges separated by little sharp clefts. These ridges have a general oblique, antero-posterior trend, and terminate at the hinder edge of each scale in feeble serrations. They often exhibit a tendency to curve upwards in front; while not uncommonly they are inconspicuous on the middle of the scale, which then becomes smooth (Pl. IX, fig. 1*b*; Pl. X, figs. 1*c*, 1*d*, 1*e*, 1*f*). The direction of the ornamental ridges is least oblique and most regular on the principal abdominal flank-scales (Pl. IX, fig. 1*b*; Pl. X, figs. 1*e*, 1*f*); much more oblique or even diagonal on the principal caudal scales (Pl. X, figs. 1*c*, 1*d*, 2*a*, 2*c*). The characteristic arrangement on the ventral scales is indicated in Pl. X, fig. 2*b*. The narrow, diamond-shaped, small scales of the upper caudal lobe are ornamented by fine, diagonal ridges, as shown by impressions in the type-specimen and in the original of Pl. IX, fig. 1*a*. The enlarged ridge-scales are not seen in the type-specimen, but some of those in advance of the anal fin are shown in the original of Pl. X, fig. 2.

Remarks.—The impression of an imperfect, relatively large trunk represented in Pl. X, fig. 2, is not referable to this species with certainty; but the shape and ornamentation of the scales seem to agree precisely with those of the fish now described. This and the type-specimen were found by Mr. George Sweet, in whose honour the species is named.

Elonichthys gibbus, sp. nov. Plate IX, fig. 4; Plate XI.

Type.—Imperfect fish, lacking end of tail (Pl. XI, fig. 1).

Specific characters.—A short, deep-bodied species with comparatively small head, attaining a length of about 0.2 m. Length of head with opercular apparatus somewhat less than the maximum depth of the trunk, which is contained twice in the length from the pectoral arch to the base of the caudal fin. Pelvic fins arising about midway between the pectorals and the anal; dorsal and anal fins at least as long as deep, the former not completely in advance of the latter. Principal scales of flank in abdominal region slightly deeper than broad; outer face of all the scales completely ornamented with fine, somewhat oblique ridges, which terminate in the delicate serrations of the posterior border. Enlarged dorsal ridge-scales apparently extending as far forwards as the occiput.

General Form.—As shown by the type-specimen and the original of Pl. IX, fig. 4, the deepest part of the trunk of this species is at the origin of the dorsal fin, which is remarkably large and extended. The other specimens are more imperfect or distorted during fossilisation.

Head.—The small head is partly indicated in the type-specimen, but better shown in another impression (Pl. XI, fig. 3). The fine ornament on at least the frontal region of the cranial roof is partly subdivided into tubercles. The other external bones are only striated, the striae on the maxilla and mandible being mainly horizontal or longitudinal, those on the circum-orbital plates (Pl. XI, fig. 3*b*) radiating. The maxilla bears large, stout teeth, and its postorbital expansion is about two-and-a-half times as long as deep. The opercular apparatus must have been very narrow.

Appendicular Skeleton.—The supraclavicle, clavicle and infra-clavicle, seen in the type-specimen (Pl. XI, fig. 1), are moderately wide plates, ornamented with fine ridges or striations disposed in the direction of the long axis of these bones. The length of the pectoral fins can scarcely have exceeded half that of the head with opercular apparatus. The pelvic fins seem to have been as large as the pectoral pair. The dorsal and anal fins are remarkably large and extended, the former arising at the highest point of the back and always depressed backwards in the fossils. More than 40 rays are indicated in the imperfect dorsal fin of the type-specimen, and more than 30 rays are seen in the anal fin in the original of Pl. IX, fig. 4. The articulations of all the fin-rays are distant.

Scales.—The slight deepening of the principal scales of the flank in the abdominal region is observable both in the type (Pl. XI, fig. 1*a*) and in other specimens. The finely-striate ornamentation of the scales resembles that already described in *Elonichthys sweeti*, but there is never an indication of median smoothness.

EXPLANATION OF PLATES.

Plate I.

Fig. 1.—*Gyracanthides murrayi*, sp. nov.; one side of type-specimen, showing anterior free pectoral spine (*a*), oval plate closing base of posterior free pectoral spine (*b*), pectoral fin-spine chiefly in impression (*c*), and dermal tubercles (*d*); nat. size.

1*a*.—Diagrammatic drawing of horizontal section of dermal tubercles, showing the pulp-cavity; about three times nat. size.

Fig. 2.—Ditto; impression of anterior free pectoral spine, showing external tubercular ornament and narrow smooth inserted base; nat. size.

Fig. 3.—Ditto; impression of a larger incomplete specimen; nat. size.

Fig. 4.—Ditto; abraded imperfect specimen, outer aspect, showing texture, nat. size; also the same, twice nat. size (4*a*), and one ridge further enlarged (4*b*).

Fig. 5.—Ditto; imperfect impression of outer aspect; nat. size, and also twice nat. size. (5*a*).

Fig. 6.—Ditto; two ridges of the preceding specimen; much enlarged.

Fig. 7.—Ditto; ventral aspect of trunk, lacking head and end of tail, showing internal mould of one anterior free pectoral spine (*a*), impressions of part of both pectoral fin-spines (*b*, *b*[1]), internal moulds of the pelvic fin-spines (*c*, *c*[1]), impressions of some ventral dermal tubercles (*d*), and both internal and external moulds of the small, apparently displaced, anal fin-spine (*e*); two-thirds nat. size.

7*a*.—Internal mould of anterior free pectoral spine; nat. size.

7*b*.—Outer view of dermal armour, showing rounded bosses on the tubercles; magnified.

Fig. 7*c*.—Mould of anal fin-spine, indicating the large dimensions of its internal cavity; nat. size.

7*d*.—Impression of ornament of lateral face of anal fin-spine, showing the nearly parallel tuberculated ridges terminating successively at its anterior edge; nat. size.

Plate II.

Fig. 1.—*Gyracanthides murrayi*, sp. nov.; impression of region of pectoral fin, showing the finely tuberculated outer face of the posterior free pectoral spine (*a*); the greater part of a pectoral fin-spine, with its base (*b*) partly marked by overlying dermal tubercles, its exserted portion (*c*) slightly incomplete at the outer edge and at the distal end; also a small patch of dermal tubercles (*d*); nat. size.

1*a*.—Internal mould of the posterior free pectoral spine, taken from the hollow marked (*a*) in fig. 1; seen from the outer-lateral face, lacking the apex but showing the radiating structural lines and the bevelling of the anterior margin of the spine; nat. size.

1*b*.—The same spine, with piece of matrix, seen from behind, showing its lateral compression; nat. size.

1*c*.—The elongate-oval plate, with radiating structural lines, closing the aperture of the central cavity of the same spine; nat. size.

1*d*.—Structural lines of the same spine; magnified.

1*dd*.—Diagram of hollows in matrix left by decay of dermal tubercles, the sharp separating lines not seen in the original; magnified.

1*e*.—Fine tubercular ornament seen in cavity of fossil at *a*.

1*f*.—Diagram of outer aspect of dermal tubercles; magnified, the crimping somewhat exaggerated.

Fig. 2.—Ditto; impression of part of abdominal region, showing mould of pelvic fin-spines, incomplete behind (*a*, *a*), part of both pectoral fin-spines (*b*, *b*), and some dermal tubercles (*c*); nat. size.

2*a*.—Cross-section of mould of pectoral fin-spine just beyond the hinder end of its inserted portion, with matrix occupying position of the groove on its narrow posterior face; nat. size.

2*b*.—Similar cross-section near hinder end of pelvic fin-spine, showing its slight compression and an indication of the postero-internal groove; nat. size.

2*c*.—Diagram of outer aspect of dermal tubercles with rounded bosses; five times nat. size.

2*d*.—Diagram of tuberculated ridges of paired fin-spine; magnified (not satisfactory, the intervening grooves scarcely wide enough).

2*e*.—Cross-section like 2*a*, but near the anterior end of the pectoral fin-spine; nat. size.

Plate III.

Fig. 1.—*Gyracanthides murrayi*, sp. nov.; portion of abdominal region showing remains of pectoral fin-spines with their slender distal end appearing vaguely through the hard matrix; numerous dermal tubercles (*a*); the pelvic fin-spines, evidently approximated by crushing, in part preserved, in part as impressions of the outer face (*b*); and a trace of the plate at the base of the posterior free pectoral spine (*c*); nat. size.

1*a*.—Gutta-percha impression of the same specimen, showing the rounded shape and characteristic ornament of the bases of the pelvic fin-spines; nat. size.

1*b*.—Longitudinal broken section of the pectoral fin-spine of the same specimen, showing its fibrous structure; nat. size.

Plate IV.

Fig. 1.—*Gyracanthides murrayi*, sp. nov.; impression of part of large pectoral fin-spine, incomplete at both ends, but showing a long extent of the narrow, smooth base of insertion (top of figure); nat. size.

1*a*, 1*b*, 1*c*.—Gutta-percha impression of the same fossil, upper or lower view, sharp outer edge, and grooved inner face respectively; nat. size.

1*d*.—Part of the tuberculated, ridged ornament of the same; thrice nat. size.

Plate V.

Fig. 1.—*Gyracanthides murrayi*, sp. nov.; caudal region in side view, with remains of abdominal region, showing part of one pelvic fin-shape (*a*) with the tip of the other (*b*); traces of the anterior dorsal fin and its spine (*c*); the posterior dorsal, anal, and caudal fins; also part of one of the posterior free pectoral spines; nat. size.

1*a*.—Fragment of basal end of pelvic fin-spine, showing hollow mould before it was completely uncovered; slightly magnified.

1*b*.—Diagram of outer aspect of dermal tubercles; four times nat. size, with the bosses represented of too angular a shape.

Fig. 2.—Ditto; fragment of trunk, apparently drawn upside down, displaying dermal tubercles, the base of a pelvic fin-spine (*a*), and the mould of part of the anterior dorsal fin-spine (on the edge of the fossil but shown separately at *b*); nat. size.

2*a*.—Partially fractured dermal tubercles, thrice nat. size.

Fig. 3.—*Acanthodes australis*, sp. nov.; caudal fin; nat. size.

3*a*.—Scales; magnified.

Fig. 4.—*Eupleurogmus cresswelli*, McCoy; portion of type specimen, showing squamation, and also the apex of a fin-spine in the left lower corner; nat. size.

4*a*.—Scales of middle of flank, showing enlarged scales of lateral line; thrice nat. size.

4*b*.—Other scales of the same; about twice nat. size.

Plate VI.

Fig. 1.—*Gyracanthides murrayi*, sp. nov.; impression of tubercular dermal armour; nat. size. Specimen probably intended by McCoy to represent his supposed Cephalaspidian, *Rhytidaspis murrayi*, and the figure wrongly indicating an appearance of polygonal tesseræ; nat. size.

1*a*.—Diagrammatic sketch of impressions of dermal tubercles; thrice nat. size.

Plate VII.

Fig. 1.—*Acanthodes australis*, sp. nov.; caudal region of type-specimen, showing parts of dorsal, anal, and caudal fins; nat. size.

1*a*.—Upper lobe of caudal fin; twice nat. size.

1*b*.—Imperfect anal fin-spine and fin; twice nat. size.

1*c*, 1*d*.—Inner aspect of scales; magnified.

1*e*.—Outer aspect of scales; magnified.

Fig. 2.—*Strepsodus decipiens*, sp. nov.; impression of inner face of jugular plate; nat. size. Specimen probably intended by McCoy to represent his supposed Pteraspidium, *Pteraspis ? mansfieldensis*.

Fig. 3.—Ditto; imperfectly preserved jugular plate, incomplete at one side and at one end; nat. size. Also probably regarded as Pteraspidian by McCoy.

Plate VIII.

Fig. 1.—*Strepsodus decipiens*, sp. nov.; portion of left mandibular ramus, outer aspect, showing a row of small teeth on the dentary bone, with two imperfectly preserved laniary teeth in close apposition (one tooth and its successor) on an internal bone in front; also another imperfect bone crushed on the anterior end of the jaw; nat. size.

1*a*.—Section of jaw, showing vertical section of laniary tooth with its basal folds.

Fig. 2.—Ditto; vertical section of upper part of tooth, with indications of pulp-cavity; nat. size.

Fig. 3.—Ditto; vertical section of laniary tooth in matrix, showing basal folds; nat. size.

Fig. 4.—Ditto; magnified transverse sections of laniary tooth, showing nature of folds at base (4), minute structure of dentine (4*a*, 4*b*), and absence of folds in the upper part where the pulp-cavity still persists (4*c*).

Figs. 5–7.—Ditto; abraded and partially decayed scales, displaying inner structure, the originally-exposed sector directed downwards; nat. size.

6*a*.—Scale-structure magnified, part of the exposed sector to the right, covered portion to the left.

Fig. 8.—Ditto; impression of inner face of undisturbed squamation; nat. size.

Fig. 9.—Ditto; impression of inner face of scattered scales, showing internal median tubercle; nat. size.

Fig. 10.—Ditto; abraded and partially decayed scale of lateral line, showing infilled slime-canal; associated with the type-scale, which is not figured; nat. size.

Fig. 11.—Ditto; scale.

Fig. 12.—*Ctenodus breviceps*, sp. nov.; impression of part of caudal region, exhibiting neural and hæmal elements of vertebral axis; nat. size.

PLATE IX.

Fig. 1.—*Elonichthys sweeti*, sp. nov.; type-specimen, fish in lateral aspect, lacking dorsal part of abdominal region; nat. size.

1*a*.—Caudal fin of another specimen, showing its inequilobate shape; nat. size.

1*b*.—Imperfect flank scales; thrice nat. size.

1*c*.—Impressions of upper and lower teeth on edge of jaws; about twice nat. size.

Fig. 2.—Ditto; undetermined.

Fig. 3.—Ditto; unsatisfactory attempt at restoration, much reduced, the general outline probably almost correct, but squamation very inaccurate and some other characters doubtful. *br.*, broad branchiostegal rays; *cl.*, clavicle; *d.*, mandible; *f.*, anterior part of frontal; *icl.*, infraclavicle; *io.*, suboperculum; *mx.*, maxilla (expansion too deep); *op.*, operculum; *p.*, hinder part of frontal (internal impression, thus showing longitudinal slime-canal); *pmx.*, bone below the orbit, which is represented too small; *po.*, preoperculum; *pt.*, post-temporal; *scl.*, supra-clavicle; *so.*, circumorbital ring; *zb.*, undetermined bone (no clear evidence).

Fig. 4.—*Elonichthys gibbus*, sp. nov.; imperfect trunk, showing inner aspect of many flank-scales with peg-and-socket articulation, also part of pelvic, dorsal, and anal fins; nat. size.

4*a*.—Remains of scales showing ornamentation; enlarged.

PLATE X.

Fig. 1.—*Elonichthys sweeti*, sp. nov.; imperfect counterpart of trunk of type-specimen, showing some scales from inner aspect, with peg-and-socket articulation (A, B), pectoral fin (C), pelvic fin

upturned (D), part of dorsal fin (E), anal fin (F), and caudal fin; nat. size.

1*a*, 1*b*.—Inner aspect of scales; about twice nat. size, to show peg-and-socket articulation, and some of the pegs further magnified.

1*c*.–1*f*.—Impressions of scales; three or four times nat. size, showing nature of external ornamentation.

Fig. 2.—Ditto; impression of part of large trunk, showing traces of displaced pectoral fin (G), pelvic fins (H), dorsal fin (I), and anal fin (K); nat. size.

2*a*–2*f*.—Impressions of scales; thrice nat. size, showing nature of external ornamentation (long axis of figs. 2*a*–2*d* wrongly placed vertically).

Plate XI.

Fig. 1.—*Elonichthys gibbus*, sp. nov.; type-specimen, lacking hinder half of caudal region; nat. size.

1*a*.—Impression of flank-scales; magnified.

1*b*.—Restored drawing of dorsal ridge-scales; magnified.

Fig. 2.—Ditto; distorted fish; nat. size.

Fig. 3.—Ditto; impression of part of head and trunk; nat. size.

3*a*.—Impression of scales; magnified.

3*b*.—Impression of circumorbital plates, showing radiating ornamentation; thrice nat. size.

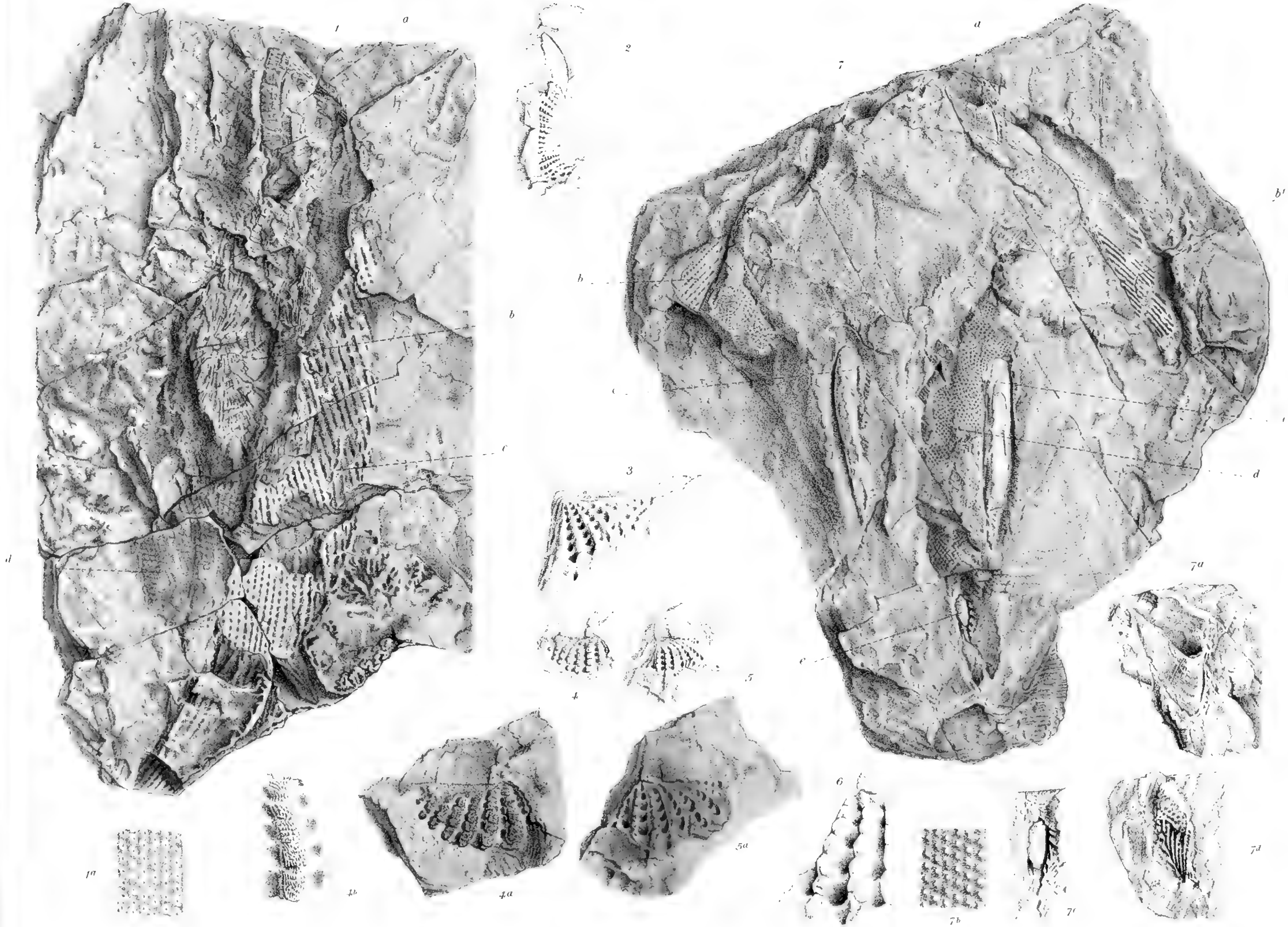
Fig. 4.—Ditto; part of trunk and fins; nat. size.

4*a*.—Impression of part of two dorsal ridge-scales; magnified.

4*b*.—Impression of flank-scales; magnified (long axis wrongly placed horizontally).

Fig. 5.—Ditto; fragmentary remains of fish; nat. size.

Fig. 6.—Ditto; unsatisfactory attempt at restoration; much reduced, the general outline probably almost correct, but squamation inaccurate and restored; extent of paired, dorsal, and anal fins too large.



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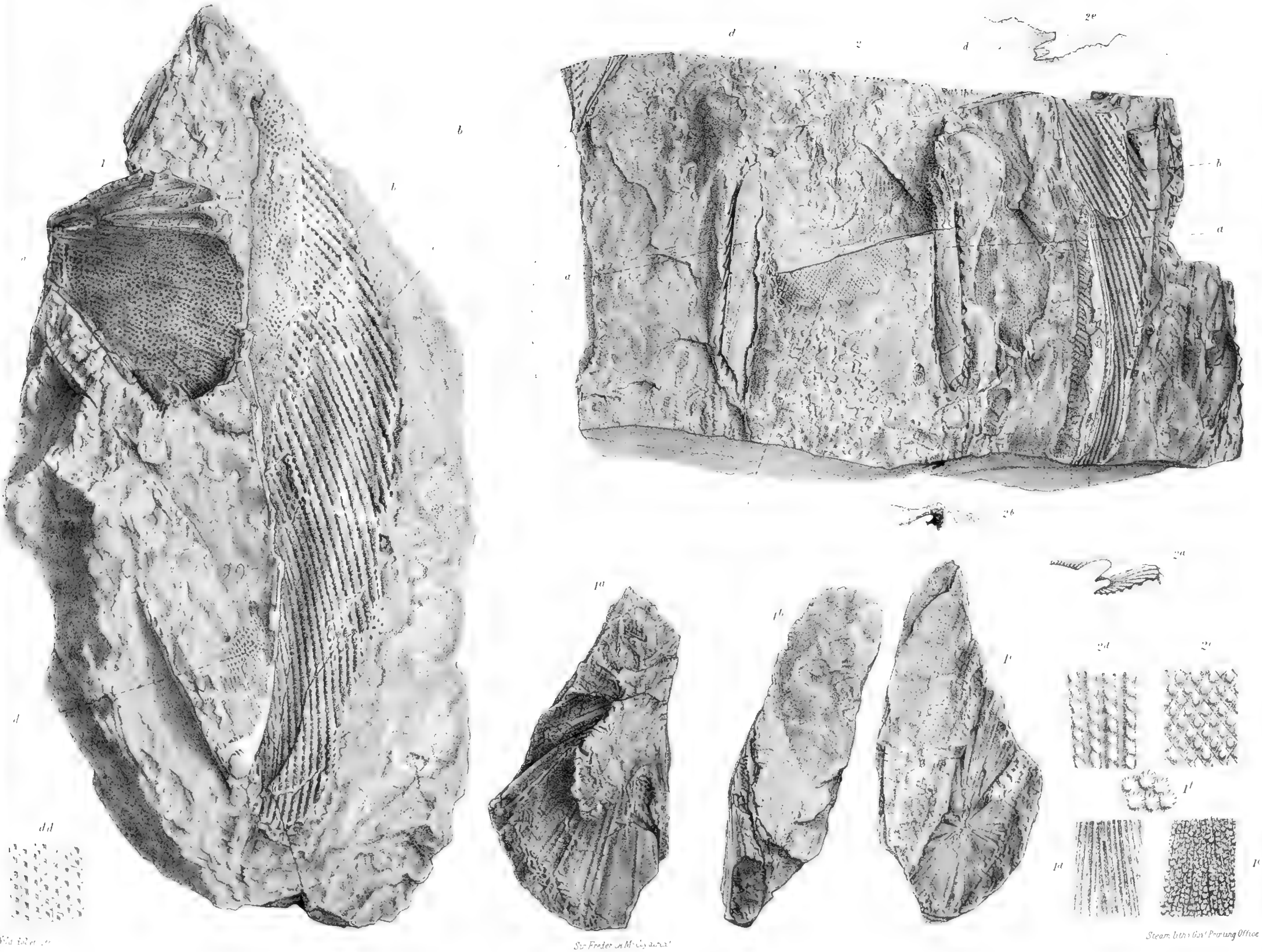

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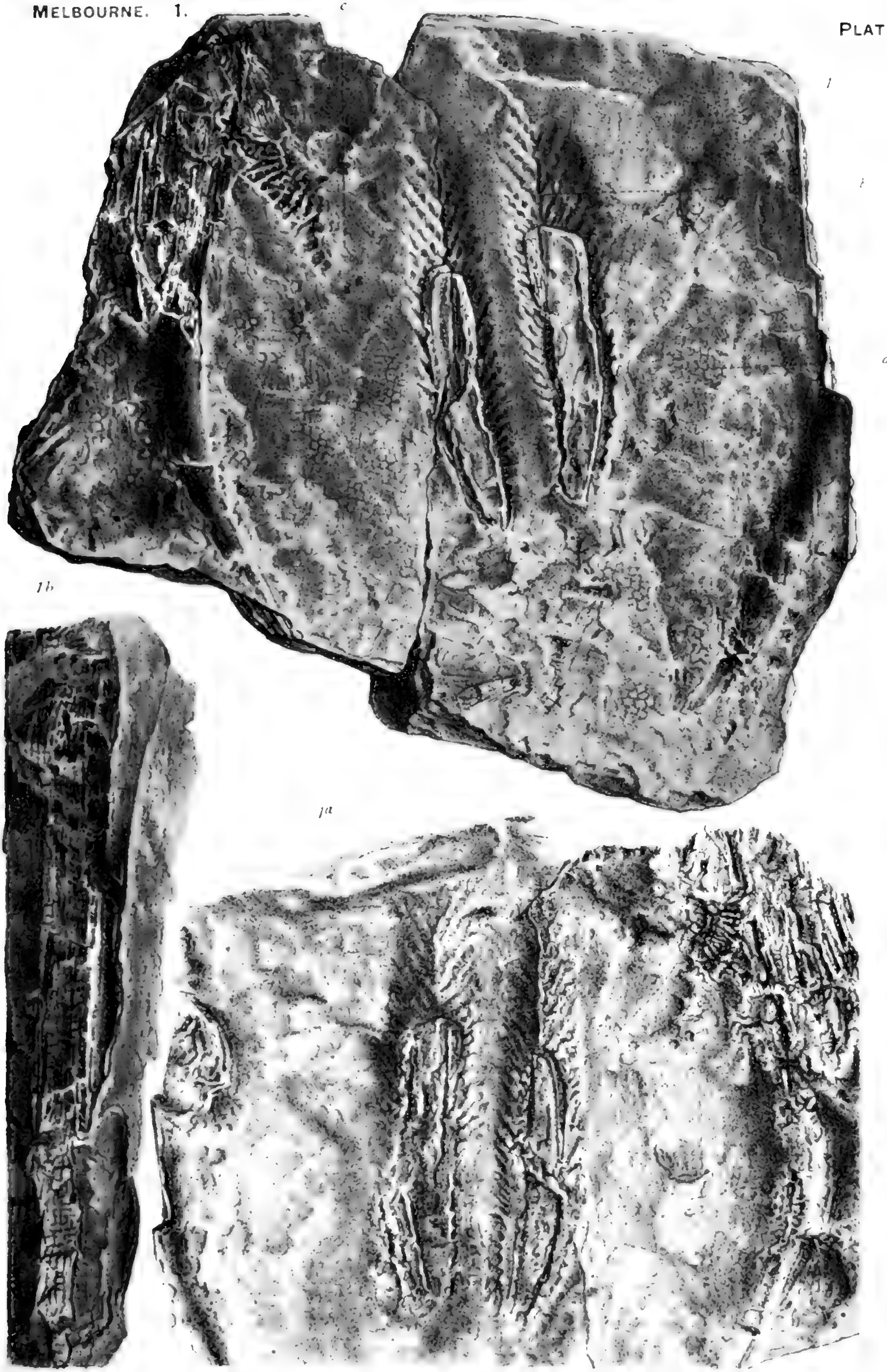
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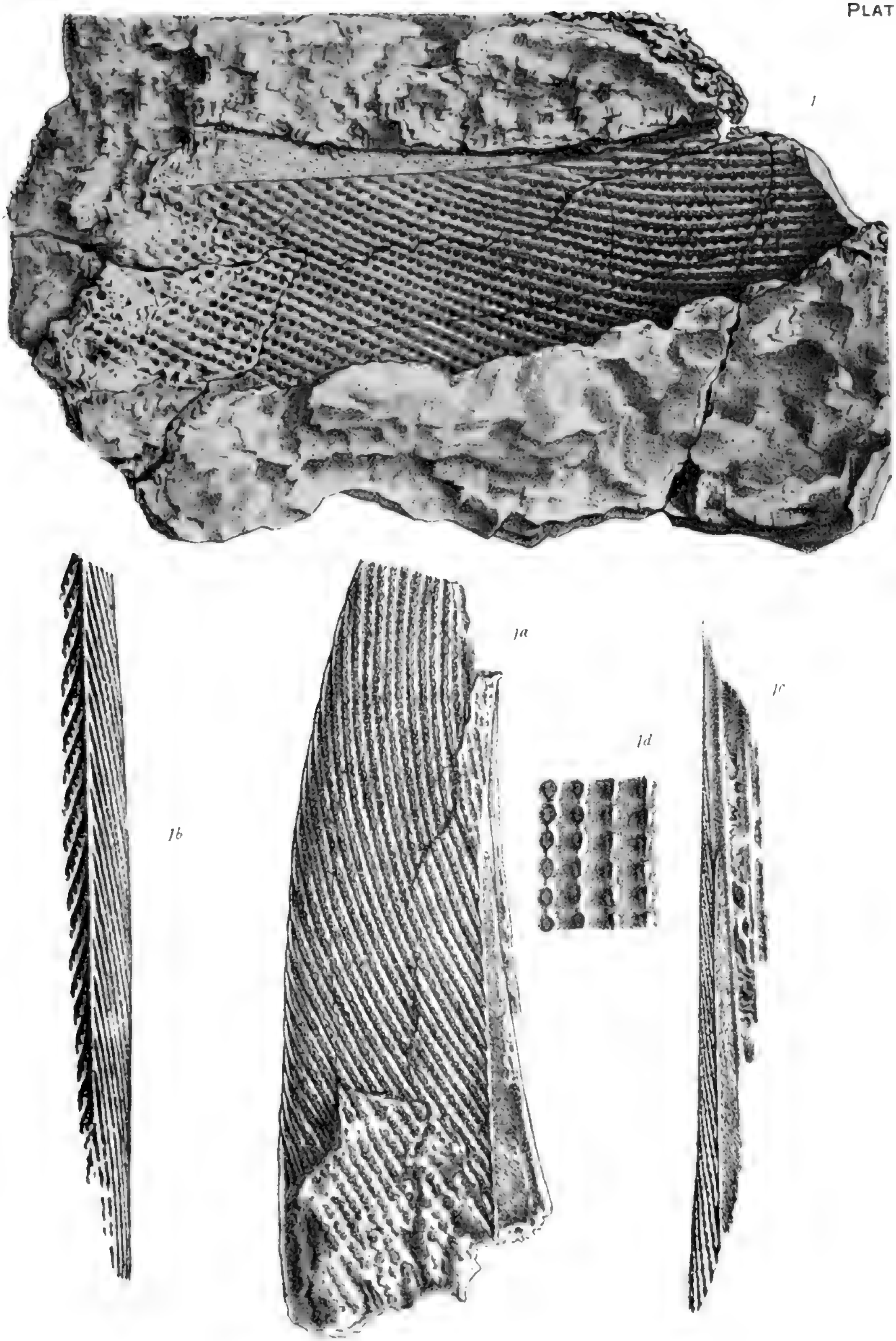

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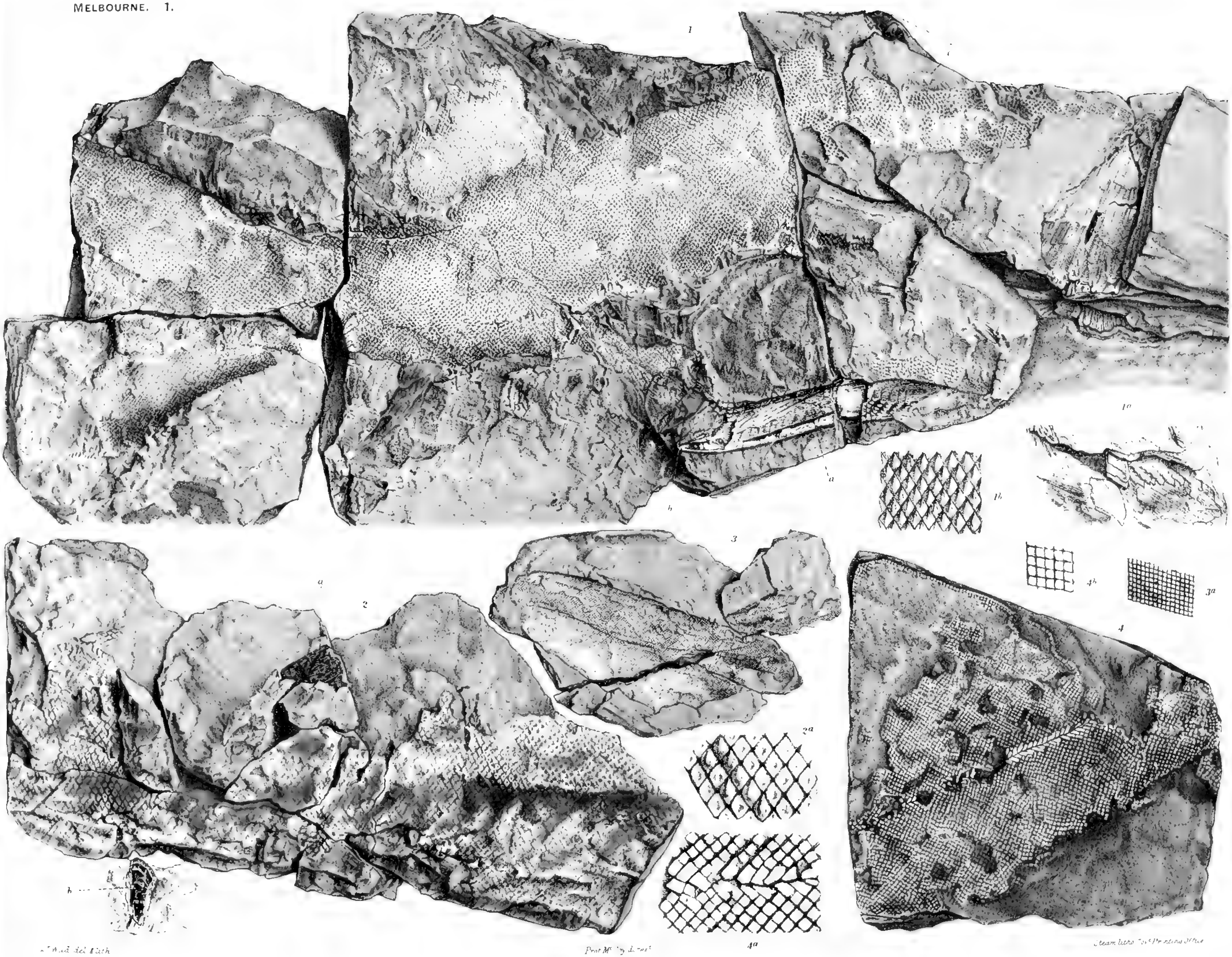
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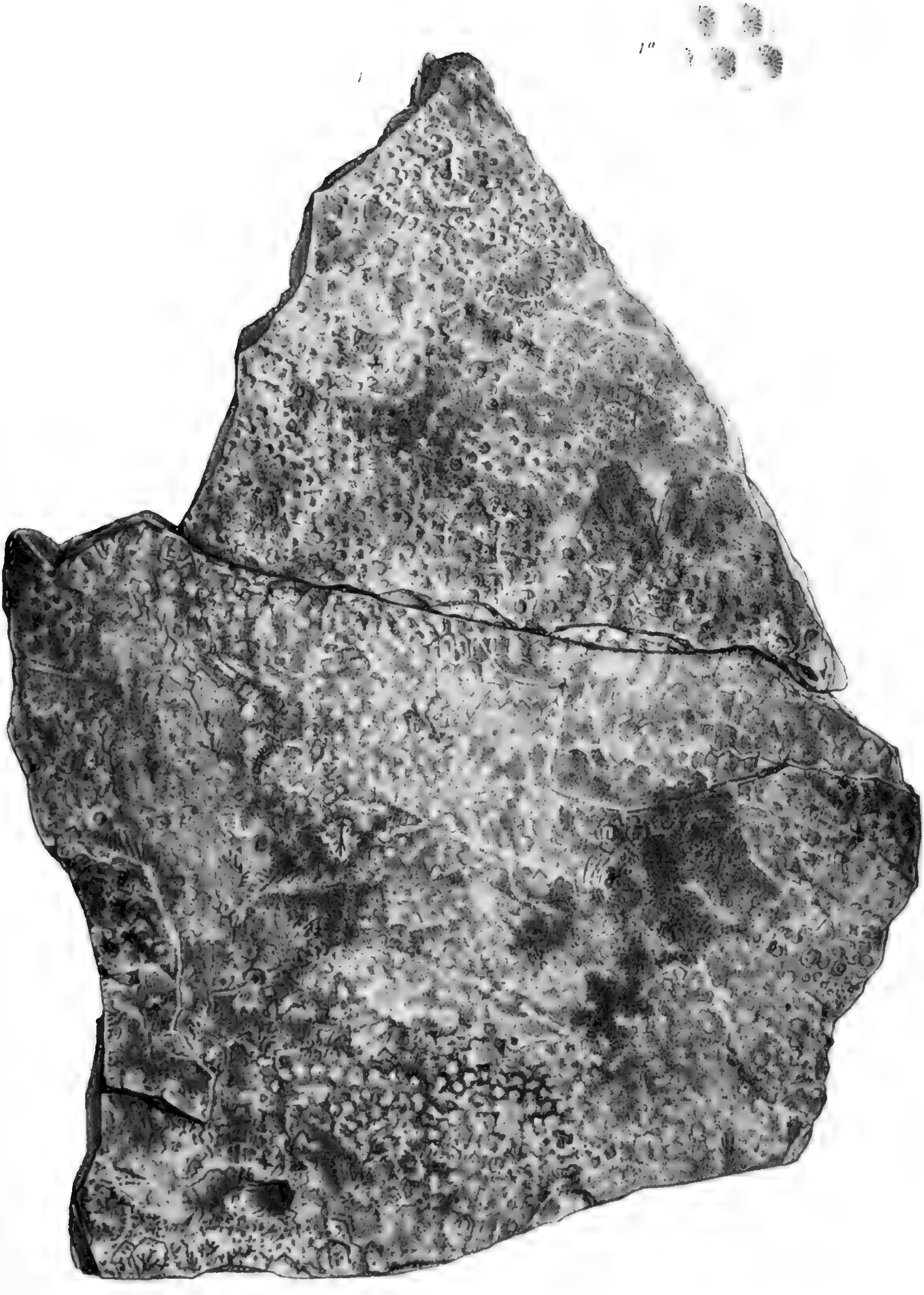

Dr J. J. Wild del. & lith.

Prof. McCoy, direxᵗ

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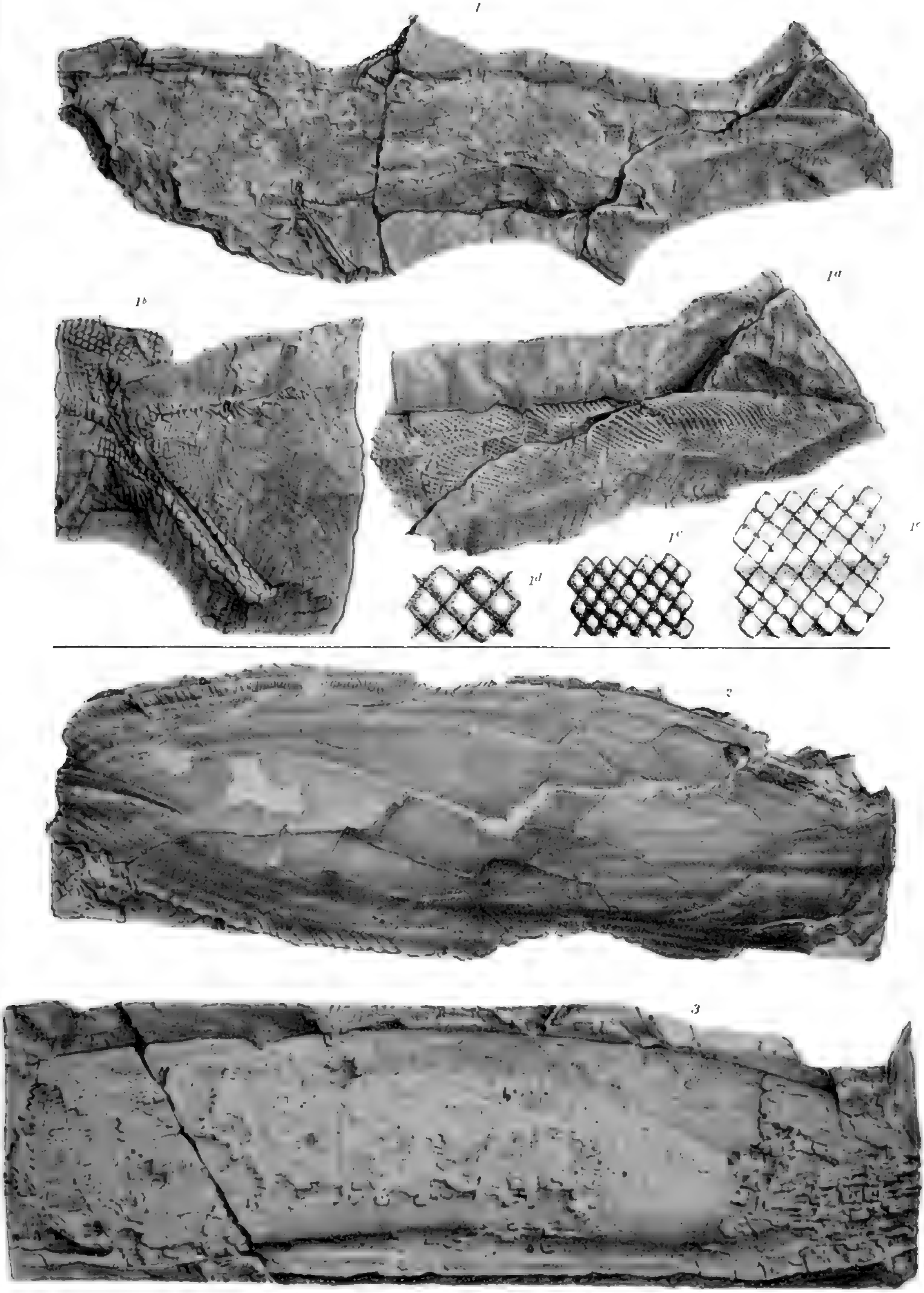
PLATE VII.



Dr Wild, del. et lith. Sir Frederick McCoy, direx. Steam litho Govt Printing Office

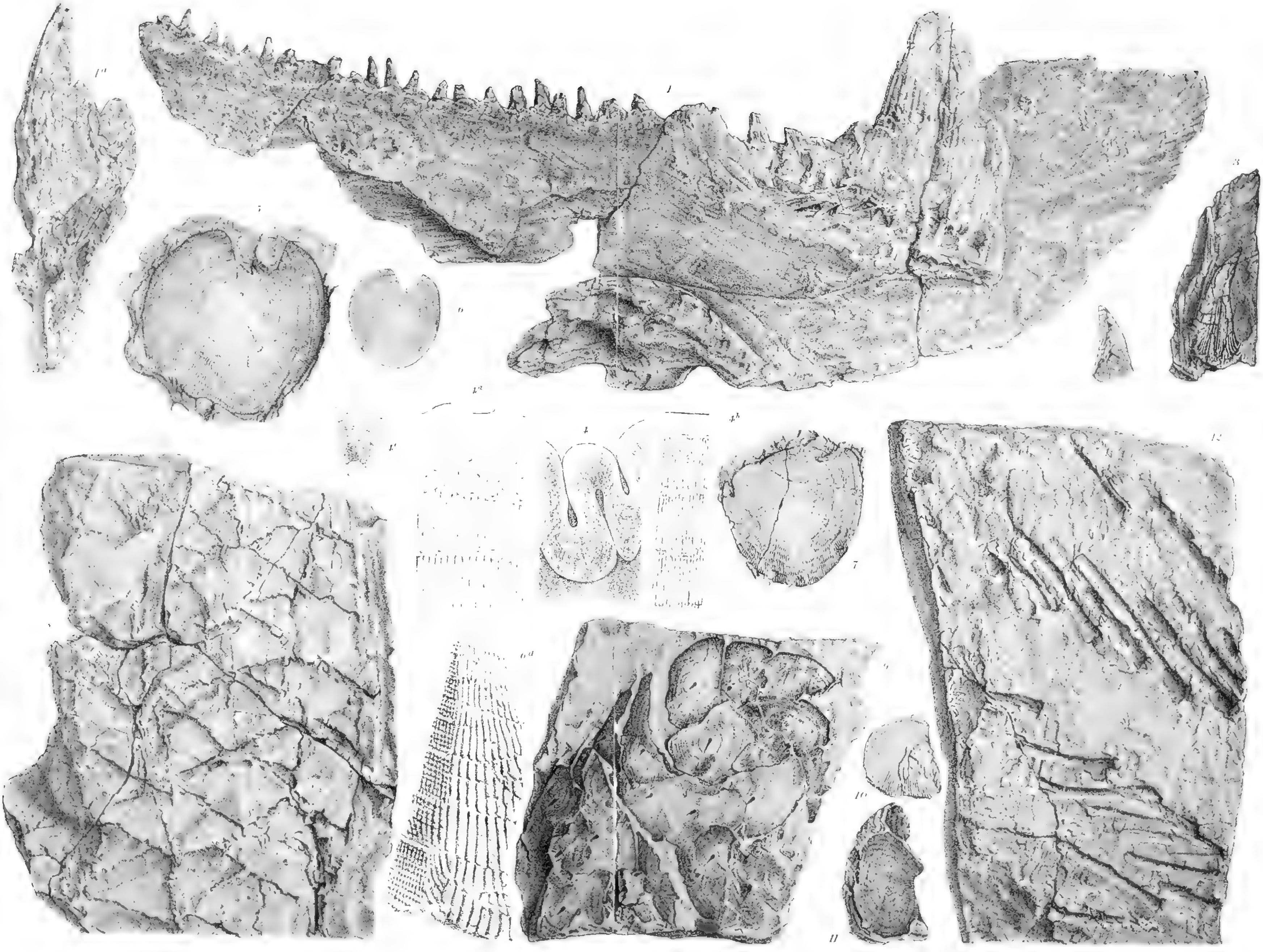
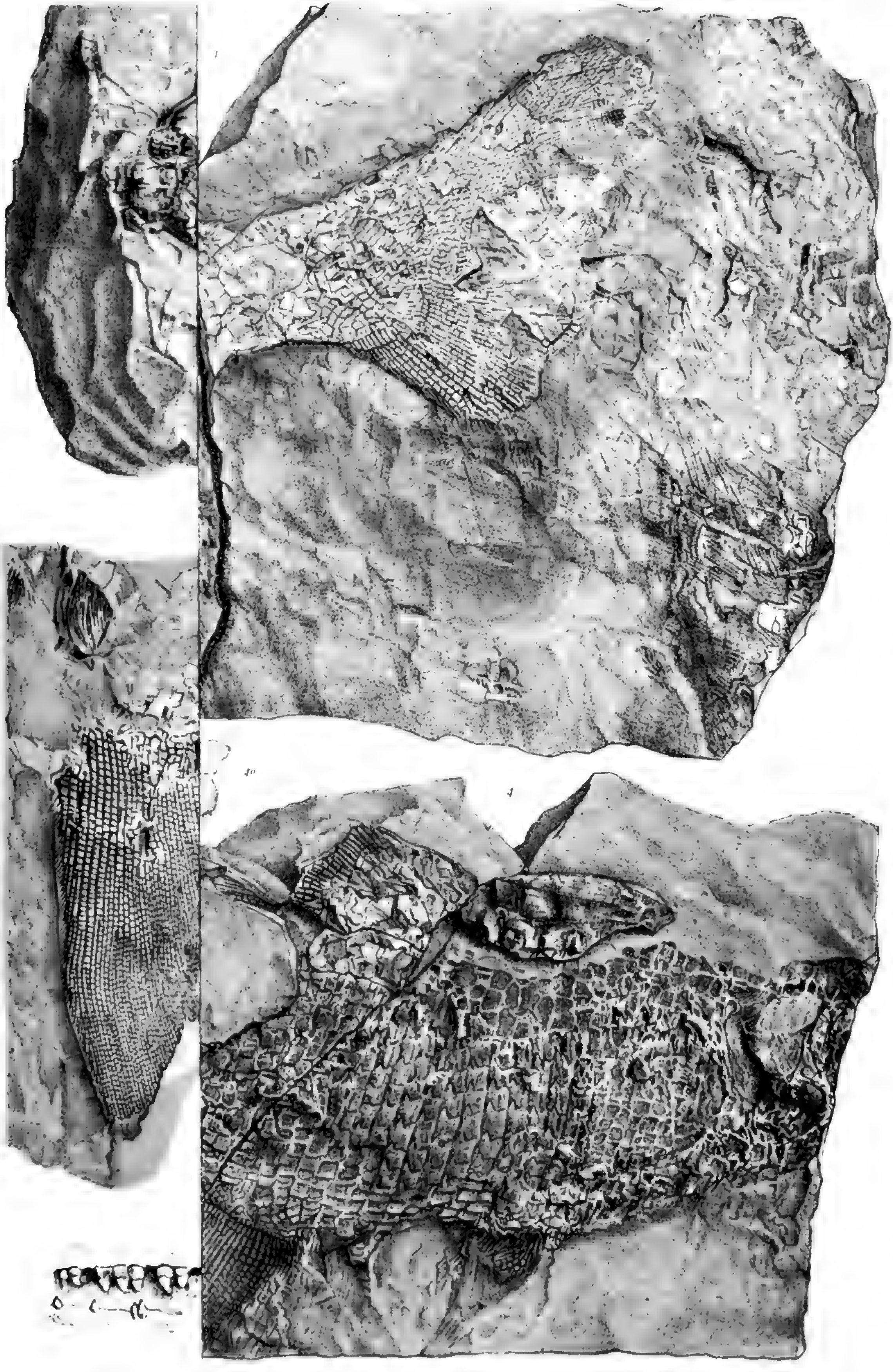


PLATE IX.



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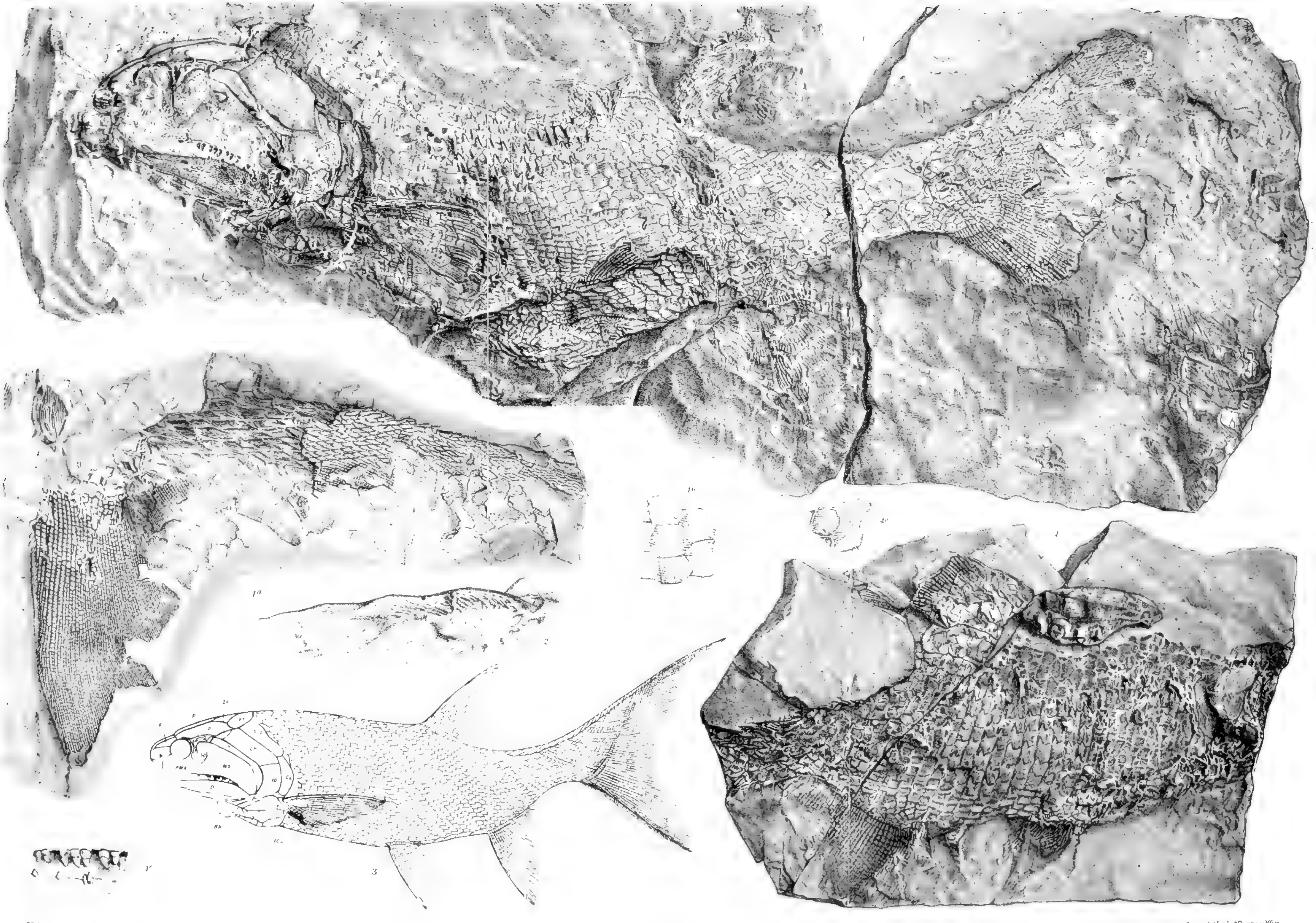

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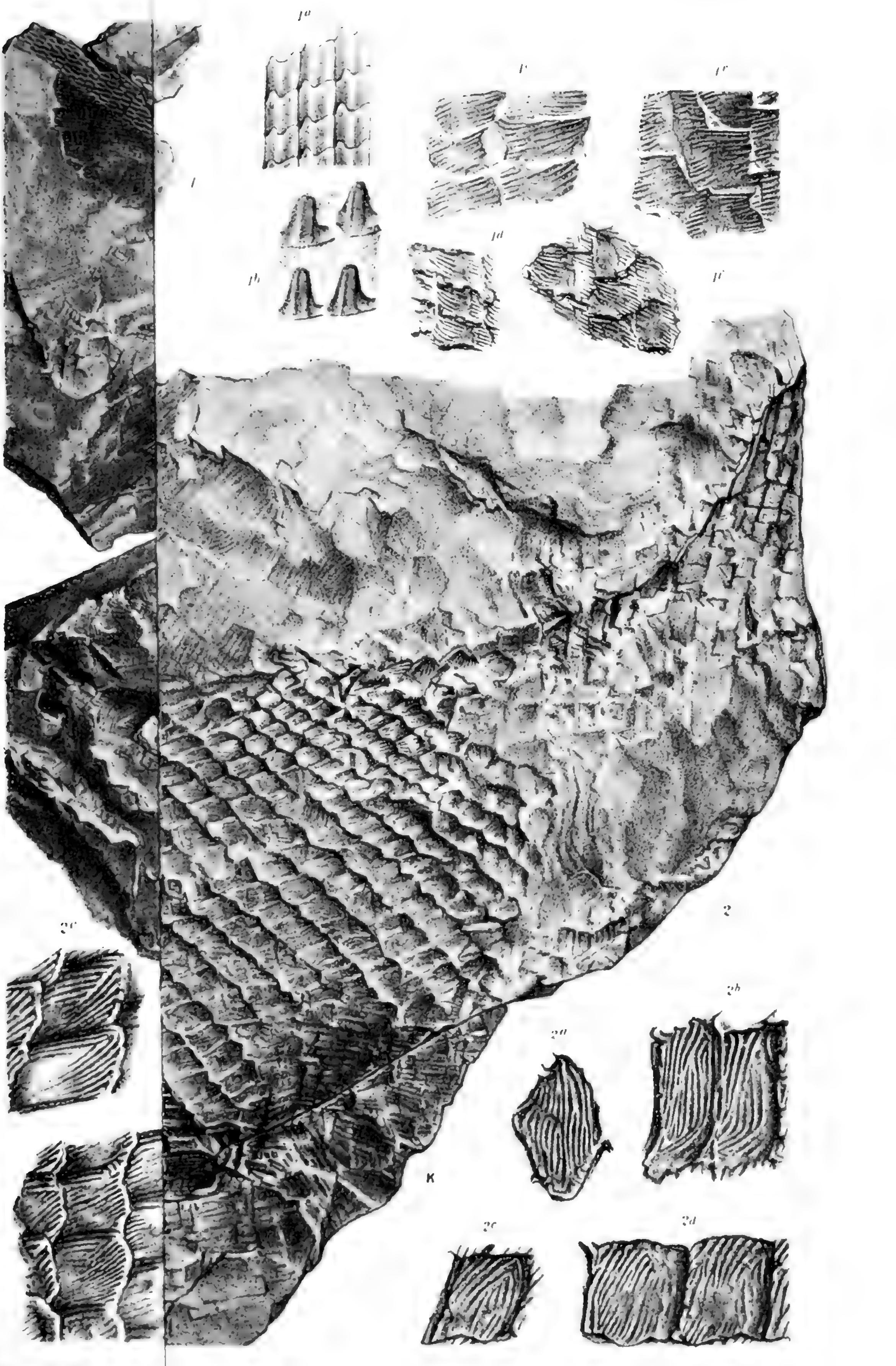

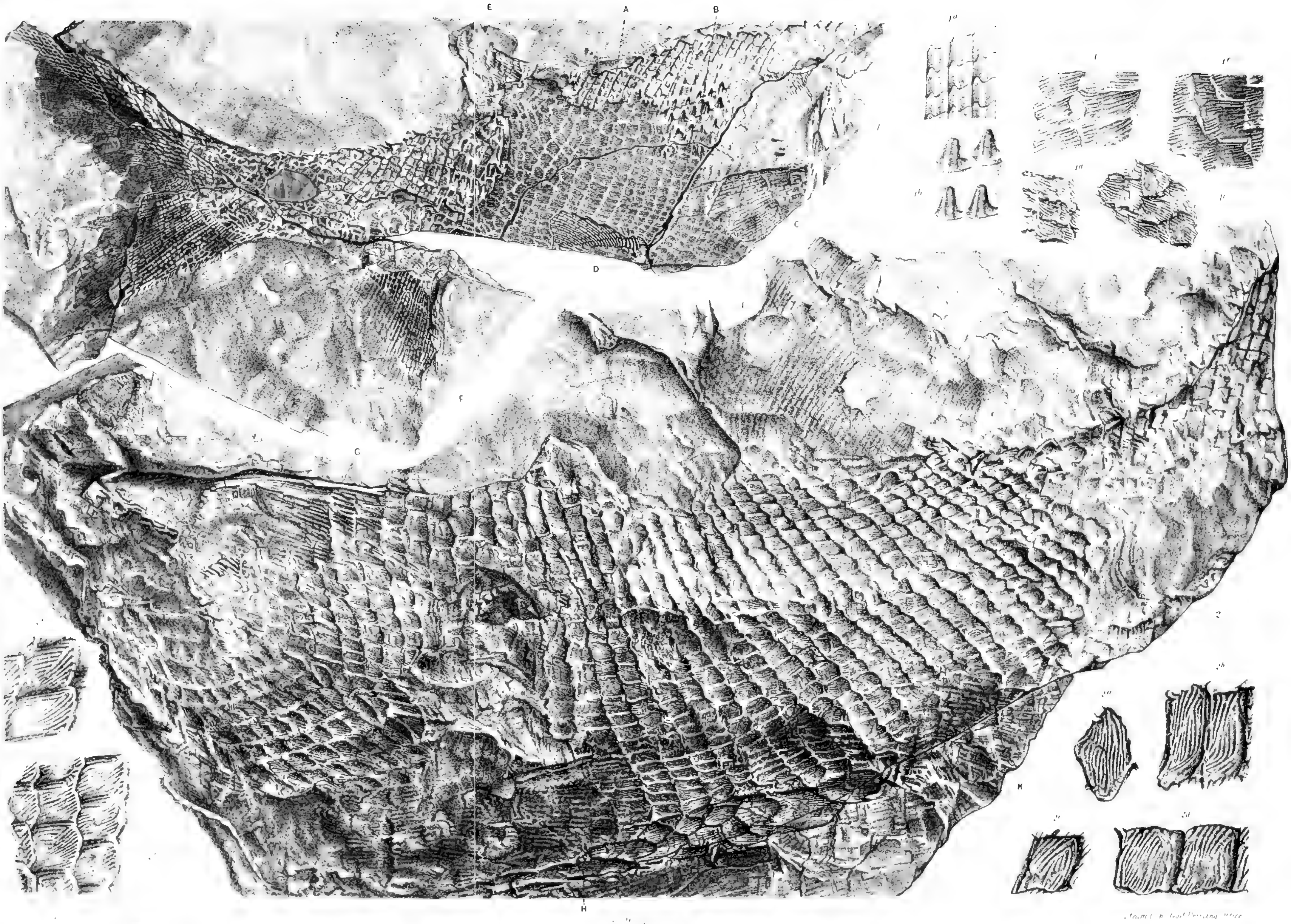

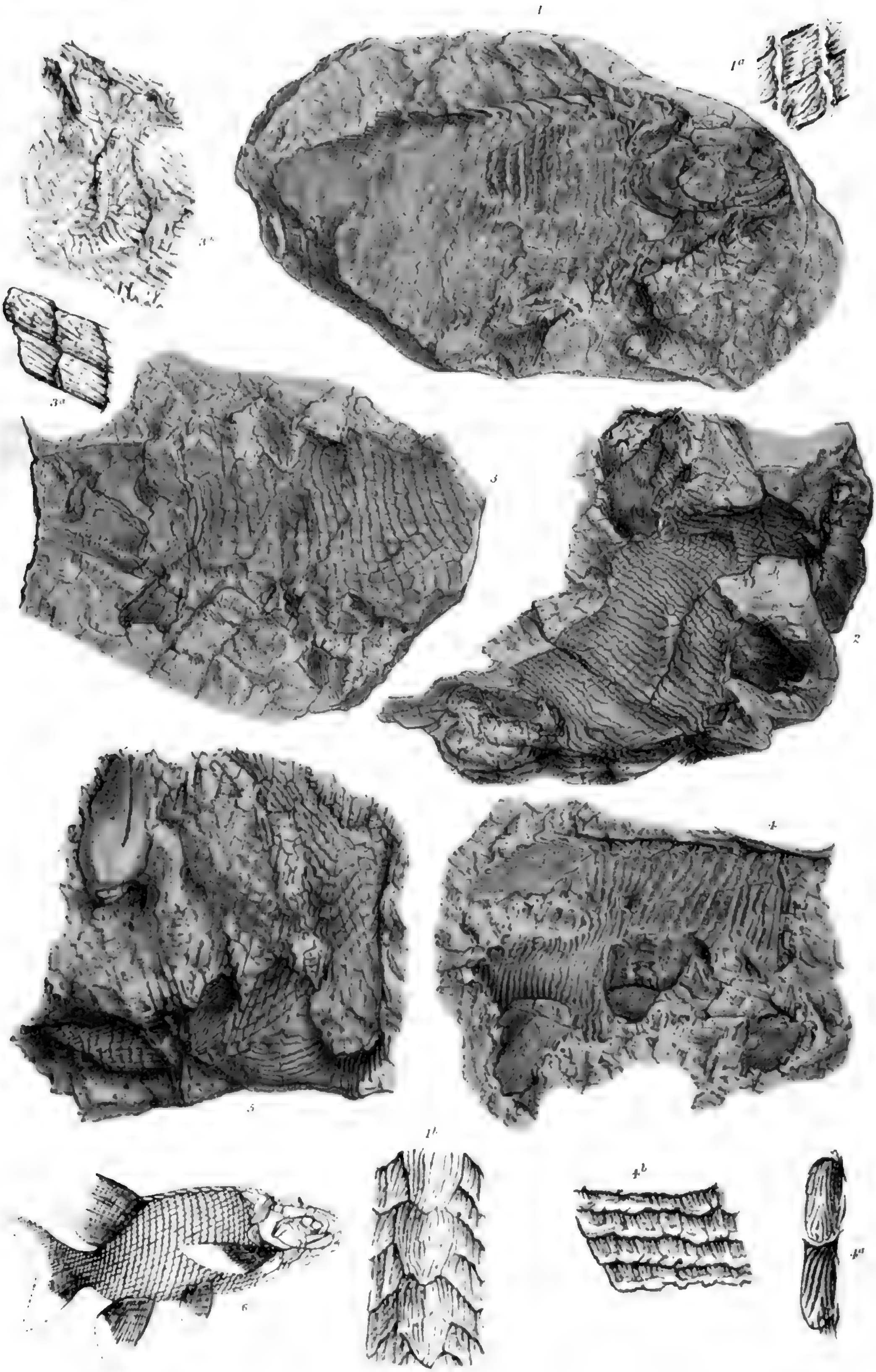

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Sir Frederick McCoy, direxit

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MEMOIRS

OF THE

NATIONAL MUSEUM,

MELBOURNE.

No. 2.—A Monograph of the Silurian Bivalved Mollusca of Victoria.

BY FREDERICK CHAPMAN,

PALÆONTOLOGIST TO THE NATIONAL MUSEUM, MELBOURNE; ASSOC. LINN. SOC. LOND.; F.R.M.S.

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A MONOGRAPH OF THE SILURIAN BIVALVED MOLLUSCA OF VICTORIA, IN THE COLLECTION OF THE NATIONAL MUSEUM, MELBOURNE.

By Frederick Chapman, Palæontologist to the National Museum, Melbourne; Assoc. Linn. Soc. Lond.; F.R.M.S.

INTRODUCTION.

Sources of the Present Collection.

A large proportion of the fossil specimens described herein was collected during the first Geological Survey of Victoria, under the direction of Mr. (afterwards Sir) A. R. C. Selwyn; and was deposited in the National Museum, Melbourne, then under the directorship of Professor (afterwards Sir) Frederick McCoy, who was at the time also palæontologist to the Survey.

Very few of the specimens were identified by McCoy:—a single species described in his Prodromus of the Palæontology of Victoria* under the name of *Cardium gippslandicum* [= *Panenka gippslandica*], and some fossils generically determined for future labelling as *Orthonotus, Anodontopsis, Leptodomus, Arca, Aviculopecten and Avicula,* appear in the Museum collections.

On the ¼ sheet No. 1 N.W. Melbourne, McCoy noted the following bivalved genera from Moonee Ponds Creek ("Royal Park"), viz., *Sanguinolites* (= *Orthonota australis* sp. nov.) and *Cucullella* (= *Nuculites maccoyianus*, sp. nov.).

The fossil referred to under the MS. name of *Orthonotus subrigidus* by McCoy on ¼ sheet No. 4 S.W. Geol. Surv. Vict. is now shown, by the hinge structure, to be identical with *Nucula lamellata*, J. Hall, and not allied, as McCoy supposed, to *Orthonota rigida* Sow. sp. of the Upper Llandovery and Lower Ludlow of Great Britain. On the same geological map a *Leptodomus* allied to *amygdalinus* is noted by McCoy. This is now shown to be a distinct species, here named *Leptodomus maccoyianus*. Certain fossils named in MS. by McCoy as *Arca* spp. are herein described as *Nucula opima*, J. Hall, var.

* Decade VI., 1879, p. 23, Pl. LVI.

australis, nov., and ? *Parallelodon kilmoriensis*, sp. nov. The *Cucullella*, sp., noted on ¼ sheet 3 N.E., by McCoy, I have now referred to *Nuculites coarctatus*, Phillips sp.

The following genera of bivalved shells have been recorded from the Silurian ("Upper Silurian") of Victoria by McCoy, in Progress Report, Geol. Surv. of Victoria, No. 1, 1874, p. 34.

Cucullella, 2 spp. [= *Nuculites*].
Arca, sp. [= *Nucula* and ? *Parallelodon*].
Avicula, 2 spp. [= *Actinopteria*].

The fossil (No. 3368, Mines Dept.) alluded to by McCoy, in Progress Report No. IV., 1877, p. 156, as "a small Aviculoid shell allied to *Ambonychia* (new species)", is here described and figured as probably a young form of a new species—*Lunulicardium antistriatum*.

Three species of Silurian pelecypoda, which had already been described by the Rev. A. W. Cresswell, M.A.,* have been presented by him to our collection. These are *Conocardium bellulum* and *C. costatum*, originally described under the generic name *Pleurorhynchus*; and *Pterinea tatei*, previously described as an *Ambonychia*, but probably identical with *P. lineata*, Goldfuss.

The larger part of the remainder of these Silurian bivalved shells has been obtained from the richly fossiliferous mudstones at South Yarra over the area of the Yarra Improvement Works. They were chiefly collected by Mr. F. P. Spry (now of the National Museum). Other gentlemen who have kindly assisted us in obtaining new material are Messrs. J. T. Jutson, and A. E. Kitson, F.G.S., whilst the opportune donation from Mr. Thos. Warr, of material from a well-boring at Croydon,† has resulted in the addition of several new and remarkable forms of aviculoid and other shells. In addition to the species previously mentioned, we are also indebted to the Rev. A. W. Cresswell, M.A., for a valuable collection of mudstone fossils from near Lilydale,‡ which has furnished us with several additional forms to our list of species.

Some General Aspects of the Silurian Bivalved Fauna.

The collection now described comprises 62 species and varieties, referred to 29 genera. Of the total number, as many as 58 species and varieties are here recorded from the Victorian

* Proc. Roy. Soc. Vict., Vol. V., N.S., 1893, pp. 43, 44.
† For a preliminary description of this collection see Victorian Naturalist. Vol. XXIII., 1906, pp. 237-239.
‡ See Mr. Cresswell's remarks on the fossils and the precise localities in Proc. Roy.—Soc., Vict., Vol. VI., N.S., 1894, p. 156.

Silurian for the first time, whilst 14 genera are new to Australia. These newly recorded genera are—*Palæanatina*, *Cardiola*, *Panenka*, *Paracardium*, *Prælucina*, *Ctenodonta*, *Nuculites*, *Nucula*, *Parallelodon*, *Actinodesma*, *Lunulicardium*, *Mytilarca*, *Glossites* and *Cypricardinia*.

The following notes on the above-named genera are compiled in order to show how interesting is the question of the distribution of the bivalved fauna of the Australian Silurian. When our knowledge of this group and of the remainder of the molluscan classes is more complete, it will be possible to make some valuable deductions as to the general relationship of this widely distributed phylum of the animal kingdom, both from geological and geographical stand-points.

Palæanatina, J. Hall.—Hitherto found only in the Upper Devonian of North America.

Cardiola, Broderip.—This is a Silurian genus in Great Britain; and it also occurs in the Silurian and Devonian in Eastern Europe. It appears to be absent from North America, although the somewhat closely associated genus, *Panenka*, is found there in Devonian strata.

Panenka, Barrande, is both a Silurian and Devonian genus, but attains its maximum development in the latter formation.

Paracardium, Barrande.—This genus occurs in the Silurian (Stage E) in Bohemia, and in the Devonian of North America.

Prælucina, Barrande.—A well-defined generic group in the Silurian and Devonian of Bohemia. Barrande notes the total absence of the genus in the Stage Ee_1, but in the Upper Silurian Ee_2 there occur 25 species, whilst in the lowest zone of the Devonian, Ff_1 there are only two species.

Ctenodonta, Salter, is already known elsewhere from the Silurian, and its range extends to the Carboniferous.

Nuculites, Conrad.—A Silurian and Devonian genus, well-represented in the Devonian of South Africa and South America.

Nucula, Lamarck.—This genus ranges from Silurian to Recent. Probably many of the British Silurian species now referred to *Ctenodonta* may prove eventually to belong to this genus. Although originally described as species of *Nucula*, some of these fossils appear to have been transferred to *Ctenodonta*, on insufficient evidence of the hinge characters.*

Parallelodon, Meek and Worthen.—It is interesting to record this genus from the Silurian of Victoria, since it had an already-known range from the Devonian to Tertiary.

* Compare remarks by J. L. Lobley, on "Palæozoic Arcidæ," Proc. Geol. Assoc., Vol X., No. 8, 1888, p. 402.

Actinodesma, Sandberger.—Although the hitherto-recorded range of this genus is restricted to the Devonian, there is very little doubt that it is represented in the Silurian (Upper Ludlow) of Wales by the so-called "*Avicula*" or "*Pterinea*" *ampliata*, to which our fossil bears a close resemblance.

Lunulicardium, Münster.—This genus is confined to the Silurian and Devonian. In Bohemia it is found throughout both formations; in North America only in the Devonian.

Mytilarca, J. Hall.—Well-represented in the Devonian of North America. It occurs in the Silurian (Wenlock shale) in England, usually referred to as *Mytilus*. The British Silurian fossil recorded as *Mytilus chemungensis* seems to differ from the species originally described by Conrad from the North American Devonian. The genus occurs in the upper division (Yeringian) of the Victorian Silurian.

Glossites, J. Hall.—Fossils of Devonian age in North America (Corniferous Limestone to Waverly Group); and in South Africa (Bokkeveld Beds).

Cypricardinia, J. Hall.—This interesting genus ranges through the Silurian and Devonian, both in Europe and North America. It is here confined to the upper beds of the Silurian.

An inquiry into the number and distribution of the Victorian species which are also found elsewhere in homotaxial or closely-related strata, affords some interesting data. There are no less than eleven species of Silurian bivalves (18 per cent.) in our Victorian rocks which can be identified with fossils found in other, often widely separated areas. Regarding the occurrences of similar fossils in Great Britain, shown by the subjoined table, it will be noticed that, with few exceptions, the distribution ranges through the Wenlock and Ludlow series, whilst in Germany and Bohemia the fossils occur in the Lower and Middle Devonian.* The species of bivalved mollusca which occur in North America are found in the Middle Devonian, but not below it, whilst one of our forms is also found there in Upper Devonian rocks. From this the inference may be drawn, that since both in Western Europe and Australia the species made their first appearance in the Silurian, the point of dispersal would probably be situated mid-way between those places, provided the conditions were equal, and that there were no barriers to their migration. The data given below would also appear to imply that considerable obstacles *did* exist against their dispersal along the radius extending to Eastern Europe (Germany

* Cf. Barrande, Syst. Sil. Bohême, Pt. 1, Vol. VI., Acéphalés, 1881, p. 304. (Stage F, included in the Silurian by Barrande, is now referred to the Lower Devonian.)

and Bohemia); and in the same proportion complex and adverse conditions probably obtained on the migratory path to North America.

Further proof of the general trend of these comparative data as derived from other groups of the Victorian Silurian Mollusca is shown in the Museum collections; one notable example being the occurrence of a gasteropod, *Euomphalus disjunctus*, J. Hall,* in the Victorian Yeringian division of the Silurian, specimens of which are inseparable from the shells described by Hall, from the Lower Helderberg of New York (L. Devonian). The Pteropod, *Coleolus aciculum*, J. Hall† of the Middle Devonian (Genessee Slates) of North America, has a close relation in a form which may eventually prove to be identical, and which is not uncommon in the Melbournian shales of South Yarra.‡

COMPARATIVE TABLE OF VICTORIAN SPECIES OF SILURIAN PELECYPODA, IDENTICAL WITH THOSE FOUND ELSEWHERE.

Genera and Species.	Division.	Foreign Area.	Formation.
Cardiola cornucopiæ, Goldfuss sp. (*C. interrupta*, Sow.)	Melbournian	Europe ...	Silurian
Prælucina ancilla, Barrande	Yeringian ...	Bohemia ...	L. Devonian
Nuculites coarctatus, Phill. sp.	Melbournian	Great Britain ...	Sil. (Ludlow)
Nucula lamellata, J. Hall	,,	North America	Mid. and Up. Devonian
Pterinea lineata, Goldfuss	Yeringian ...	Great Britain ... Germany ...	Silurian (Ludlow) L. Devonian
? *Pterinea tenuistriata*, McCoy	Melbournian	Great Britain ...	Sil. (Wenlock to Up. Ludlow)
? *Ambonychia acuticostata*, McCoy	Yeringian ...	Wales ...	Sil. (Wenlock and L. Ludlow)
Actinopteria textu-rata, Phill. sp.	,,	England (Devonshire)	Mid. Devonian
A. boydi, Conrad sp.	,,	England ... North America	Sil. (Up. Ludlow) M. Devonian
Modiolopsis complanata, Sow. sp.	Melbournian	Great Britain ...	Sil. (Wenlock to passage beds)
Cypricardinia contexta, Barr.	Yeringian ...	Great Britain ... Bohemia ...	Sil. (Wenlock and L. Ludlow) L. Devonian

* Pal. New York, Vol. III., 1859, p. 340, Pl. LXV., Fig. 8; Pl. LXVIII., Fig. 4*a*, *b*.
† Pal. New York, Vol. V., Pt. II., 1879, p. 187; Pl. XXXIIA., Figs. 11-15.
‡ Proc. R. Soc. Vict., Vol. XVI., Pt. II., N.S., 1904, p. 339; Pl. XXXI., Fig. 7.

The large majority of the species of Silurian bivalves herein described are in more or less close relationship with those found elsewhere; at the same time they appear to be sufficiently distinct to warrant their separation as new species. When closely examined, the data afforded by these "paramorphs" or allied forms, are of the greatest interest; for these, as well as the more cosmopolitan species above enumerated, shed considerable light upon the generally obscure questions regarding the relationship of our Australian palæozoic faunas to those of other areas.

The subjoined table is an attempt at giving a synopsis of the species described from other areas, which, apparently, are most closely related to the Victorian Silurian pelecypoda. A glance at this table will suffice to show that, as in the former table of identical species, the general aspect is nearly the same with regard to the several areas known elsewhere.

In Great Britain and Ireland some of our species find their affinities with Upper Ordovician forms (very rarely), with Silurian, Llandovery to Ludlow (commonly), and in the Devonian (very rarely). In Germany related species occur in the Devonian (very rarely).

In Bohemia their relationships are found in typical Silurian and Lower Devonian strata (rarely).

In Canada, a single allied form occurs in the Silurian.

In the United States the many related forms range through the Devonian, from the Hamilton to the Waverley groups; whilst only one species having related characters is found in the Upper Ordovician.

The question as to whether the Lower Helderberg group in North America should be correlated with the Devonian, as maintained by Continental geologists, who recognise in it the equivalent of the Coblenzian; or with the Silurian, as held by American geologists, is a difficult point to determine. The fauna of the uppermost beds of the Silurian in Victoria seems to support the American geologists to some extent; for it includes many types of trilobites, many representatives of the *Capulidæ*, and certain spirifers which, although characteristic of the Hercynian fauna of Europe, are also Helderbergian in aspect. There seems, therefore, as much evidence in support of the one opinion as the other, and it is merely a question of recognising the possibility of the subsequent migration to another area of a distinctive fauna, with a minimum amount of change in its facies.

COMPARATIVE TABLE OF VICTORIAN SPECIES OF SILURIAN PELECYPODA, RELATED TO FORMS FOUND ELSEWHERE.

Australian Species.	Related Species.
Orthonota australis, sp. nov. (Melbournian).	*O. extrasulcata*, Salter. Upper Ludlow, England.
Grammysia cf. *arcuata*, Conrad sp. (Yeringian).	*G. arcuata*, Conrad sp. Hamilton group; North America.
G. aff. *plena*, J. Hall (Melbournian).	*G. plena*, J. Hall. Chemung and Waverley groups; North America.
	Grammysia subarcuata, J. Hall. Chemung group; North America.
Leptodomus maccoyianus, sp. nov. (Melbournian).	
L. heathcotiensis, sp. nov. (Melbournian).	*Leptodomus truncatus*, McCoy. Up. Ludlow; England.
Palæanatina cf. *solenoides*, J. Hall (Melbournian).	*P. solenoides*, J. Hall. Chemung group; North America.
Edmondia perobliqua, sp. nov. (Melbournian).	*E. obliqua* / *E. subovata* J. Hall, Chemung group; N. America.
Panenka planicosta, sp. nov. (Yeringian).	*P. nana*, Barrande. Silurian; Bohemia.
Paracardium filosum, sp. nov. (Yeringian).	*P. filiferum*, Barrande. Silurian; Bohemia.
Ctenodonta portlocki, sp. nov. (Melbournian and Yeringian).	*Arca* [*Ctenodonta*] *dissimilis*. Portlock. Up. Ordovician; Ireland.
Nuculites maccoyianus, sp. nov. (Melbournian).	*N. oblongatus*, Conrad. Hamilton group; North America.
N. subquadratus, sp. nov. (Melbournian).	*N. nyssa*, J. Hall. Hamilton group; North America.
N. jutsoni, sp. nov. (? Yeringian)	*N. oblongatus*, Conrad. Hamilton group; North America.
Nucula melbournensis, sp. nov. Melbournian).	*Nucula bellistriata*, Conrad sp. Hamilton group; North America
N. umbonata, sp. nov. (Melbournian).	*N. varicosa*, J. Hall. Hamilton group; North America.
N. arcæformis, sp. nov. (Melbournian).	*N. subæqualis*, McCoy sp. Up. Llandovery; England.
N. taylori, sp. nov. (Melbournian).	*N. anglica*, d'Orbigny. Up. Ordovician and Silurian; England.
N. opima, J. Hall, var. australis, nov. (Melbournian and Yeringian).	*N. nyssa*, J. Hall. Hamilton group; North America.
N. cf. *lirata*, Conrad sp. (Melbournian).	*N. lirata*, Conrad sp. Hamilton group; North America.
Palæoneilo victoriæ, sp. nov. (Melbournian).	*P. muta*, J. Hall. Hamilton group; North America.
P. raricostæ, sp. nov. (Yeringian).	*P. muta*, J. Hall. Hamilton group; North America.
P. producta, sp. nov. (Melbournian).	*P. elongata*, J. Hall. Chemung group; North America.
P. ? constricta, Conrad sp. (Melbournian).	*P. constricta*, Conrad. Hamilton, Portage, and L. Chemung groups; North America.
P. cf. *brevis*, J. Hall (Melbournian).	*P. brevis*, J. Hall. Chemung group; North America.

Comparative Table of Victorian Species of Silurian Pelecypoda—*continued.*

Australian Species.	Related Species.
P. cf. *tenuistriata*, J. Hall (Melbournian).	*P. tenuistriata*, J. Hall. Hamilton group; North America.
Lunulicardium antistriatum, sp. nov. (Yeringian).	? *Cardium striatum*, Sowerby. Bala to Up. Ludlow; Great Britain.
Mytilarca acutirostris, sp. nov. (Yeringian).	*M. trigona*, Goldfuss sp. Mid. Devonian; Germany. *M. chemungensis*, of Salter *non* Conrad. Wenlock series; Wales.
Conocardium bellulum, Cresswell sp. (Yeringian).	*C. dipterum*, Salter sp. Up. Ordovician; Scotland.
Actinopteria asperula, McCoy, sp. var. *croydonensis*, nov. (Yeringian).	*A. asperula*, McCoy sp. Up. Ordovician; Wales.
A. heathcoticnsis, sp. nov. (Melbournian).	*A. hirundella*, Whidborne. Devonian; England. *A. ventricosa*, Goldfuss sp. Devonian; Germany.
Modiolopsis melbournensis, sp. nov. (Melbournian).	*M. solenoides*, Sowerby sp. Up. Ludlow; England.
M. nasuta, Conrad sp., var. *australis*, nov. (Melbournian).	*M. nasuta*, Conrad sp. Up. Ordovician; North America and Great Britain.
Glossites victoriæ, sp. nov. (Yeringian).	*Glossites depressus*, J. Hall. Chemung group; North America.
Goniophora australis, sp. nov. (Yeringian).	*G. cymbæformis*, Sowerby sp. Silurian; British Islands. *G. consimilis*, Billings. Silurian; Nova Scotia.
G. cf. *glaucus*, J. Hall. sp. (Melbournian).	*G. glaucus*, J. Hall sp. Hamilton group; North America.
Paracyclas siluricus, sp. nov. (Melbournian).	*Paracyclas lineata*, Goldfuss sp. Devonian; Germany. *P. bulla*, McCoy sp. Up. Ludlow; England. Silurian; Ireland. *P. elliptica*, J. Hall. Corniferous limestone and Hamilton group; North America.

No attempt is here made to subdivide the two series of the Victorian Silurian, designated by Prof. J. W. Gregory as Melbournian and Yeringian.* It was evident, during the progress of the present work, nevertheless, that several horizons can eventually be defined, after further detailed work has been done, by conjoining the stratigraphical and palæontological data.

* Proc. Roy. Soc, Vict,, Vol. XV., Pt. II., N.G., 1903, pp. 171, 172.

The life provinces of the various horizons of the Victorian Silurian may then be studied with advantage. As, for instance, that of the sandstone of Moonee Ponds Creek, with their prevailing types of brachiopods and ophiuroids; and the shales and mudstones of South Yarra, with their more abundant bivalve and trilobite faunas. These two areas are apparently on the same stratigraphical horizon, but represent deposits laid down under different lithological conditions.

At present the facilities for examining sections of strata in the various Silurian areas, by means of road and railway cuttings, and by borings, are not so good as in less recently developed countries such as England or the United States, and consequently this renders the work of correlation a difficult task.

DESCRIPTION OF THE SPECIES.

Class **PELECYPODA.**

Family **Solenopsidæ.**

Genus ORTHONOTA, Conrad, 1841.

Orthonota australis, sp. nov. Pl. I., Fig 1.

Description.—Shell large, elongate; dorsal and ventral margins parallel; posterior margin well rounded. From the umbo to the posterior margin slightly more than twice the height of the shell.

Valves rather strongly convex, moderately steep on the ventral margin, and sloping away towards the posterior cardinal area, where they are more compressed.

Beaks situated close to the anterior extremity, rather prominent.

Surface of the valves ornamented with a series of strong concentric sulci, interrupted below the high umbonal ridge by the cincture, which is limited on each side by a furrow.

Measurements.—Approximate (from the specimen figured).

Length, 42 mm.

Greatest height, 18 mm.

Affinities.—A British fossil (found also in Norway and Gotland), which shows some features in common with ours is *Orthonota extrasulcata*, Salter,* occurring in the Upper Ludlow

* Mem. Geol. Surv. G. Brit., Vol. II., Pt. I., 1848, p. 361, Pl. 17, Fig. 3. See also *Grammysia extrasulcata*, Salter sp., McCoy, Brit. Pal. Fossils, 1852, p. 281, Pl. IK. Fig. 29.

beds, near Kendal. In this species the concentric plications are not nearly so pronounced as in the Australian form. Another species which may be compared with ours is *Orthonota undulata*, Conrad.* This fossil occurs in the Hamilton Group in the United States. Although generally resembling our form, it is not so convex, and it has the concentric furrows undulate in the posterior area of the shell; whilst the portion between the umbonal ridge and the post-cardinal slope is more numerously relieved by radiating folds.

Observations.—The *Orthonota* occurring in the Silurian beds at Yass, New South Wales, and recorded by Prof. T. W. E. David† in his geological section of that district as *Orthonota rigida ?* [Sow. sp.] appears to be a new species, judging from a specimen in the National Museum from the Shearsby collection. It is not related in any way to McCoy's Victorian *O. subrigida* (MS.), which is further on shown to be referable to *Nucula lamellata*. Compared with *Orthonota australis*, sp. nov., the Yass specimen is more compressed, and has a more pronounced mesial sinus.

Horizon and Locality.—Silurian (Melbournian), Moonee Ponds Creek, Flemington ("Royal Park"). Two specimens collected by the Geol. Survey of Victoria. [7869 (type), 7870].‡

Family **Grammysiidæ.**

Genus Grammysia, E. de Verneuil, 1847.

Grammysia abbreviata, sp. nov. Pl. I., Fig 2.

Description.—Shell subquadrate, cardinal line arched; ventral margin nearly straight, slightly incurved at the junction with the umbonal depression, the latter meeting the ventral margin a little in front of the median third. Surface of shell rather strongly convex towards the beaks, which are sub-anterior. A sub-umbonal depression in front of the shell makes a slight angularity reaching from the umbones to the antero-ventral margin. In the figured specimen this angularity is emphasized by crushing. From the umbo to the postero-ventral margin

* Conrad, Geol. Survey, N. York,; Ann. Rep., 1841, p. 51, Pl. —., Fig. 6. J. Hall, Pal. N. York, Vol. V., Pt. I., 1885. Lamellibranch., II., p. 478, Pl. LXXVIII., Figs. 37-42.

† Ann. Rep. Dept. Mines, N.S. Wales, 1882 (1883). Notes to Section across Silurian and Igneous Rocks, Yass.

‡ Registered Nos. in Museum.

there is an obtuse shoulder, and from thence the surface slopes rapidly away to the posterior margin. The presence of the posterior shoulder and the moderately prominent beaks preclude this form from being referred to the genus *Cardiomorpha*, to which it otherwise bears some resemblance. The valves are concentrically striated or finely sulcate, and the character of these surface markings is closely comparable with that seen in the smaller species of *Grammysia* described from the Hamilton Group of North America.

Measurements.

Approximate length, 28 mm.
Height, 12 mm.
Thickness (before crushing), probably about 8 mm.

Observations.—The fossil recorded as *? Cypricardia retusa*, Sowerby,* of the Upper Ludlow series of Delbury, near Ludlow, bears a striking resemblance to our species, with the difference, however, that in the latter the beaks are situated farther forward, and the postero-umbonal slope has an accentuated shoulder. Another somewhat allied form is *Grammysia ulrichi*, Clarke,† from the Devonian of Brazil.

Horizon and Locality.—Silurian (Melbournian), Yarra Improvements, S. Yarra. Presented by Mr. F. Spry. [7871.] A somewhat similar form to the above occurs in the Silurian (Yeringian) calcareous shales at Griffith's Kiln, seven miles south of Mansfield. Specimen presented by Mr. E. O. Thiele. [1573.]

Grammysia, cf. *arcuata*, Conrad, sp.

Posidonia? arcuata, Conrad, 1841, Geol. Surv., N. York, Ann. Rep, p. 53.

Grammysia arcuata, Conrad, sp., J. Hall, 1885, Pal. N.Y., Vol. V., Pt. I., Lamell. II., p. 373, Pl. LXI., Figs. 1-9; Pl. LXIII., Fig. 6 (; Pl. XCIII., Fig. 27.

Observations.—This is an imperfect specimen of a *Grammysia* in olive mudstone; only the anterior half of the valve being preserved. The character of the sharp, concentric folds reminds one of *G. arcuata*, Conrad sp., of the Hamilton Group of N. America.

Horizon and Locality.—Silurian (Yeringian). Wilson's, near Lilydale, Victoria. Presented by Mr. J. T. Jutson. [7872.]

* Sowerby in Murchison's Silurian System. Pt. II., 1839, p. 609, Pl. V., Fig. 5. (Now referred by some English palæontologists to *Orthonota*, and included with *C. amygdalina*, Sow. sp.

† See Katzer, Grundzüge der Geologie des Amazonasgebietes, 1903, p. 207, Pl. XIV., Fig. 19.

Grammysia, aff. *plena*, J. Hall.

Grammysia plena, J. Hall, 1885, Pal. N.Y., Vol. V., Pt. I., Lamell. II., p. 382, Pl. LXI., Figs. 31, 32.

Observations.—The antero-median area of this fossil exhibits the confluent character of the interrupted concentric folds, also seen in the N. American species quoted above. The folds, moreover, become more prominent and thinner at the anterior end. There is also a faint, but typically placed, cincture, extending from the beak to the ventral margin, behind the middle of the anterior third. *G. plena* occurs in the Chemung and Waverley groups of Burlington, Iowa.

Horizon and Locality.—Silurian (Melbournian). Ranges east of Heathcote. An imperfect specimen in pinkish sandstone. Coll. Geol. Surv. of Vict., B^b 50. [7873.]

Grammysia cuneiformis, R. Etheridge fil.

Grammysia cuneiformis, R. Etheridge fil., 1899, Prog. Rep., No. XI., Geol. Surv., Vict., p. 35, Pl. B., Fig. 10.

Observation.—This species is represented in the collection of the National Museum by a cast of a left valve in pinkish, friable sandstone.

Horizon and Locality.—Silurian (Melbournian), Heathcote. Coll. by Geol. Surv. of Victoria. [7874.]

Genus Leptodomus, McCoy, 1844.

Leptodomus maccoyianus, sp. nov., Pl. I., Fig. 4.

Description.—Valves sub-trigonal, elongate, with the hinge-line and ventral margin approximately parallel; anterior end narrow and truncated below; ventral border sinuous, posterior rounded and truncated towards the cardinal line. Extremities of valves compressed; beaks prominent, sharp and arcuate, directed forward and situated sub-anteriorly. A mesial sinus extends obliquely from the beak to the middle of the ventral border; umbonal slope well-arched. Surface of valves having a series of closely-set, and somewhat irregular, concentric striæ, which in some specimens are merged into concentric ridges. The shell-surface is also marked with faint radial striæ passing across the ridges from the umbo to the ventral border.

Measurements.—Type specimen: Length, 20 mm.; height, 9 mm.; greatest depth of valve, 4.5 mm. Another specimen has: Length, 15 mm.; height, 7 mm.; greatest depth of valve, 4.5 mm.

Affinities.—This type of shell belongs to the group exemplified by *Grammysia subarcuata*, J. Hall,* from the Chemung Group of N. America, especially in having a forwardly projecting beak with the ventral border narrowing anteriorly. Another form also distinctly related, is the *Myacites striatulus* of Römer,† which notably differs in its more depressed beak.

Observations.—It is interesting to record that McCoy, who established this genus, selected the specimen now figured, as an example of *Leptodomus*; it was, however, not specifically determined. This is probably the same form to which McCoy referred in a note on ¼ sheet, 4 S.W. Geol. Surv. of Victoria, as "*Leptodomus* allied to *amygdalinus*."‡ The species named may be allied to Hall's genus *Pholadella*.

It is appropriate to dedicate this species to one who did such signal work in describing many typical genera and species of British palæozoic mollusca.

Horizon and Locality.—Silurian (Melbournian). Type specimen [976] from Broadhurst's Creek, east of Kilmore, Geol. Surv., Vict., Bb. 18; north-east of Kilmore, Geol. Surv., Vict., Bb. 24. Also west of Mount Disappointment, gully near porphyritic dyke, Geol. Surv. Vict., Bb. 16.

Leptodomus heathcotiensis, sp. nov. Pl. I., Fig. 5.

Description.—Shell subtrigonal, elongate, compressed; rounded in front, subtruncated behind; ventral margin more or less parallel with the cardinal border, but slightly incurved, owing to a feeble sinus extending in a vertical line from the beaks to the ventral margin. Beaks anterior, salient, and nearly terminal. Cardinal line straight. Posterior cardinal area hollowed from the beaks to the postero-ventral margin, resulting in a curved umbonal ridge below. Median area depressed. Surface having numerous parallel concentric ridges (about 18 to 20).

Measurements.—Type specimen: Length, 25 mm.; height, about 13 mm.; depth of left valve, 4 mm.

Affinities.—The nearest allied form with ours is undoubtedly McCoy's "*Leptodomus truncatus*,"§ from the Upper

* Preliminary notice, Lamellibranchiata, 2, 1870, p. 61: *G. (Leptodomus?) subarcuata*, J. Hall, Pal. N.Y., Vol. V., Pt. I., 1885, Lamell., II., p. 375, Pl. LXI., Figs. 10-22; Pl. XCIII., Fig. 26.

† Das Rheinische Uebergangsgebirge, 1844, p. 70, Pl. II., Fig. 5. Also Beushausen, Abhandl. Kon. Preuss. Geol. Landesanst, N.F. Heft, XVII., 1895, p. 265, Pl. XXIV., Figs. 12-14.

‡ See Sowerby, in Murchison's Silurian System, 1839, p. 609, Pl. V., Fig. 2—"*Cypricardia amygdalina.*"

§ British Palæozoic Fossils, Pt. II., 1852, p. 279, Pl. 1K., Figs. 21-24.

Ludlow of Benson Knot, Kendal, Westmoreland. The characters which separate our species from McCoy's are the depressed umbones and the more closely striated surface in the former. In common with the Ludlow species, the specimens from Heathcote also show the same variation in the length of the shell; our figured type being a rather elongate form.

Horizon and Locality.—Silurian (Melbournian). Ranges east of Heathcote. Coll. of the Geol. Surv. Vict., Bb. 50 [987, type]. Also specimens from the same locality presented to the Museum by Mr. J. H. Gatliff.

Genus PALÆANATINA, J. Hall, 1870.

Palæanatina cf. *solenoides*, J. Hall. Pl. I., Fig. 6.

Palæanatina solenoides, J. Hall, 1885, Pal. N.Y., Vol. V., Pt. I., Lamell. II., p. 489, Pl. LXXIX., Figs. 38, 39.

Observations.—The specimen before us is unfortunately incomplete, but there is enough evidence to show that it was thin-shelled, inequivalve, the left valve larger than the right. It bears a fairly close resemblance to the comparatively large, parallel-sided species from the Devonian of N. America, quoted above.

Horizon and Locality.—Silurian (Melbournian). In hard, grey mudstone, S. Yarra. Presented to the National Museum by Mr. A. E. Kitson, F.G.S. [7875.]

Genus EDMONDIA, de Koninck, 1842.

Edmondia perobliqua, sp. nov., Pl. I., Figs. 7, 8; Pl. I., Fig. 9.

Description.—Shell sub-ovate, oblique; thickest in the median and umbonal area. Beaks rather inflated, directed forward, and situated anteriorly. Anterior border short, and truncated towards the ventral margin, curving widely to the posterior extremity, where it turns abruptly upwards to meet the cardinal line. Cardinal border moderately short. In the cast of the shell there is a depression beneath the posterior umbonal slope indicating a ridge or support inside the shell, terminating in a semilunar muscle scar. The posterior area of the shell is compressed, and almost nasute at the postero-ventral margin; and sometimes it is expanded, as in *Ptychodesma*, J. Hall. to which this form shows certain affinities. Surface of shell with fine concentric lines of growth, and obscure radii, especially noticeable on the umbonal slope.

The shell of this species was evidently very thin, since the sculpturing is conspicuous on the casts.

Affinities.—*Edmondia obliqua*, J. Hall* and *E. subovata*, J. Hall,† bear certain close relationship to our species. They both differ, however, in general shape, the former being subquadrate, and the latter lacking the obliquity of the umbonal ridge. Both the above-mentioned species were from the Chemung Group (Upper Devonian) of the State of New York.

Measurements.—Length of type specimen, 22 mm.; greatest height, 15 mm.; thickness of the two valves, about 8 mm.

Horizon and Locality.—Silurian (Melbournian). In pale mudstone, Yarra Improvement Works, S. Yarra, and the dark indurated mudstone of the Domain-road sewerage cuttings, S. Yarra. Not uncommon. The type specimen presented by Mr. F. P. Spry. [7876 (type), 7877, 2239.]

[Genus incertæ sedis.]

Genus SPHENOTUS, J. Hall, 1885.

Sphenotus warburtonensis, sp. nov. Pl. I., Fig. 10.

Description.—[Details from an internal cast.] Elongate-ovate; anterior extremity short, posterior broad and compressed. Beaks prominent, sub-anterior; a well-marked umbonal ridge running from the beaks to the post-ventral border. Cardinal line nearly straight; area having several long, undulose and thin lateral teeth, posteriorly, and two short cardinal teeth beneath the beak. Ventral margin sinuous, incurved towards the middle, where it meets a conspicuous cincture in front of the umbonal ridge. Shell compressed beneath the beaks, and with the margin rounded to the ventral border. A strong adductor impression occurs under the beaks, situated half-way to the ventral angle. Surface of cast marked by strong lines of growth at wide intervals, shown as deep groovings.

Measurements.—Length, 53 mm.; height, 25 mm.; depth of valve, 6 mm.

Observations. The above species is typical of the genus in all essential details. It differs from *Modiolopsis*, to which genus it might otherwise be readily referred, in having the characteristic lateral teeth and anterior cincture.

It is noteworthy of this genus that elsewhere, as in England and N. America, it has hitherto only been recognised in the Devonian; but its occurrence here, in one of the highest beds of the Victorian Silurian, is not surprising, since we already know

* Pal. N.Y., Vol. V., Pt. I., 1885. Lamell. II., p. 388, Pl. LXIV., Figs. 15, 16, 23.
† Ibid., p. 389, Pl. LXIV., Figs. 10, 18-21, 26-28.

that the fauna present in these beds has a strong Devonian aspect, which abnormal feature has led Mr. R. Etheridge, jun., and other Australian palæontologists to refer to such assemblages as Siluro-devonian.

Horizon and Locality.—Silurian (Yeringian). Reefton, Warburton, Upper Yarra, Victoria. From the Mines Dept., Vict., No. 3431. [2240.]*

Family **Cardiolidæ.**

Genus Cardiola, Broderip, 1839.†

Cardiola cornucopiæ, Goldfuss sp., Pl. I., Figs. 11, 12.

Cardium cornucopiæ, Goldfuss 1837, Petrefactiæ Germaniæ, Vol. II., p. 216, Pl. CXLIII., Figs. 1 *a-e.*

Cardiola interrupta, Sowerby, 1839, in Murchison's Silurian System, p. 617, Pl. VIII., Fig. 5.

Observations.—Our Australian specimens present no differential characters by which they can be even varietally separated from the well-known European species. Numerous examples of *C. cornucopiæ* from Bohemia in the National Museum collection help to confirm the opinion of Sowerby and others regarding the identity of that species with *C. interrupta.*

Although Sowerby's specific name (*interrupta*) is almost universally used for this form, it must unfortunately be set aside for the earlier described *C. cornucopiæ* of Goldfuss. The specific name *C. interrupta,* given by Sowerby (not Broderip, as Fischer in his "Manuel de Conchyliologie," gives it) was not published until two years after that of Goldfuss' description. There was no previous reference to, nor description of, *C. interrupta,* as Murchison would lead one to suppose (see his footnote—Silur. Syst., p. 617); for turning to the Proceedings of the Geological Society of London, Vol. II., under date January, 1834, p. 13, the reference given by Sowerby and Murchison, no allusion to *C. interrupta* is found, while in the Table facing p. 13, Div. I., Ludlow Rocks, we read—"Cardiola," Brod., a new genus, 2 spp. My friend Mr. C. Davies Sherborn, F.G.S., who

* In Progress Report No. IV. Geol. Surv., Vict., 1877, p. 156, there occurs a note by McCoy on this and associated fossils, stating them to be of Ludlow age. Even at the present time we cannot speak much more definitely, but judging from the strong Devonian aspect of the fossils they may be even comparable in part to the Dowtonian.

† Recorded as a genus (*nomen nudum*) in 1834, in Murchison, Proc. Geol. Soc., Vol. II., Table, p. 13.

has been good enough to verify these references, thinks that in all probability the original manuscript of Murchison was abbreviated before publication.

Cardiola cornucopiæ (as *C. interrupta*) has a recorded range in Britain from the Llandeilo to the Upper Ludlow beds.*

Horizon and Locality.—Silurian (Melbournian). In brown and blue shale from the Yarra Improvements, S. Yarra, collected by Mr. F. Spry and the author. Also in brown sandstone, Moonee Ponds Creek, Flemington ("Royal Park"). Coll. by Geol. Surv. Vict. [7878, 987.]

Family **Præcardiidæ.**

Genus Panenka, Barrande, 1881.

Panenka gippslandica, McCoy, sp.

Cardium gippslandicum, McCoy, 1879, Prod. Pal., Vict., Decade VI., p. 23., Pl. LVI.

Observations.—In describing this fossil under the generic name of Cardium, McCoy wrote:—"Although not quite satisfied with the generic reference to *Cardium*, still it is congeneric with the previously described Upper Silurian Cardiums." At that time the genus to which we now refer it had not been established, but in 1881 Barrande separated those forms with expanded superior margin and strong radial and concentric ornament from *Cardiola*, Broderip, to which the Upper Silurian "Cardiums" were afterwards referred, and placed them under the above generic name. In Victoria, the genus *Panenka* is found associated with Silurian and occasional Devonian forms, in one of the highest group of the Yeringian beds; it is characteristic of the Silurian and Devonian in Bohemia (stages E to G), and of Devonian beds in Devonshire and N. America.

Horizon and Locality.—Silurian (Yeringian). Mt. Matlock; near Starvation Creek; and Russell's Creek, Gippsland. [7486 (type), 7487-88, 2097.]

Panenka planicosta, sp. nov. Pl. I., Fig. 13.

Description.—Shell minute (for this genus), sub-orbicular, oblique; cardinal alæ conspicuous; hinge line nearly straight; ventral border well-rounded, truncated in front and produced

* R. Etheridge, Foss. Brit. Ids., Palæozoic, Vol. I., 1888, p. 102.

behind. Height nearly equal to the length. Beaks prominent, sub-central, slightly anterior, and directed forward. Surface of shell not much inflated, with the greatest convexity towards the middle; ornamented by about 10 flattened riblets on the median area, each having towards the ventral border a distinct groove, becoming evanescent beyond half the length. Postero-dorsal area bearing a few riblets, disappearing toward the beaks.

Measurements.—Length of the type specimen, 4.25 mm.; height, 4 mm.

Observations.—This form might be regarded as the immature shell of *P. gippslandica*, but for the distinguishing feature of the riblets, which are depressed and grooved, whilst in *P. gippslandica* they are simply and sharply ridged.

Affinities.—The nearest related form to the above appears to be Barrande's *Panenka nana*,* from Stage E in Bohemia. The chief differences shown in the latter are the more numerous riblets, the narrower interspaces, the double striæ on their surfaces, and the general form of the shell, which is not so depressed; neither are the alæ so well developed as in ours.

Horizon and Locality.—Silurian (Yeringian). In the dark shale of Mt. Matlock, associated with *Tentaculites matlockiensis*, Chapman;† presented by Mr. N. Lepoidivil, in 1877. [7879.]

Panenka cingulata, sp. nov. Pl. I., Fig. 14.

Description.—Shell of medium size, obovate, ventral border evenly rounded, abrupt in front, produced behind. Surface evenly convex in the median area and near the umbones; concave anteriorly, depressed posteriorly. Beaks oblique, pointing forward. Surface ornament consisting of about 26 curved ribs radiating from the umbo, well-rounded, closely set and separated by deep furrows. The ribs are transversely crossed at intervals by the rather deep concentric furrows, which apparently represent distinct stages in the growth of the shell, causing interference with the continuous and even growth of the riblets.

Measurements.—Length, 38 mm.; height about 26 mm.; greatest depth of valve, 5 mm.

Observations.—The regular convexity of the valves, and the rounded ribs render this form easily distinguishable from *P. gippslandica*, McCoy.

* Syst. Sil. Bohême, Vol. VI., Pt. I., Acephalés, 1881, Pl. 110, Figs. 1-3; Pl. 266, Figs. 1., 4-7.

† Proc. Roy. Soc., Vict., Vol. XVI. (new series), Pt. II., 1904, p. 338, Pl. XXXI., Figs. 1, 2, 3, 5.

Horizon and Locality.—Silurian (Yeringian). MacMahon's Creek, Upper Yarra. Coll. by Dept. of Mines (3780) [2263]. Another specimen, probably related to the above species, was presented to the National Museum by Mr. R. Jacob in 1867. This was found at the Caledonian Diggings, One Tree Hill, Christmas Hills, in strata apparently of about the same horizon as that of the type specimen. In this example the shell is higher than the figured type, but this difference may be due to compression; the concentric furrows also are not so well marked. [7880.]

Genus Paracardium, Barrande, 1881.

Paracardium filosum, sp. nov. Pl. I., Figs. 15, 16.

Description.—Shell sub-trigonal, the beaks prominent, ventral margin rounded and expanded. Surface contour well arched, especially in the umbonal region and towards the ventral margin. Surface ornament consisting of about 22 fine, flattened riblets, grooved medially. Cardinal line not perfectly preserved, but apparently less extended than in the previous genus.

Affinities.—The small size of the shell, together with the prominent, incurved umbones, and the sub-truncate posterior, show this fossil to belong to the genus *Paracardium*. It closely approaches Barrande's *P. filiferum** in surface ornament, but differs in the more regular proportion of the fine and coarse riblets. The Bohemian examples occurred in the Silurian (Stage E).

Measurements.—Height, 7 mm.; length, 8 mm.

Horizon and Locality.—Silurian (Yeringian). Starvation Creek, Upper Yarra. Coll. Geol. Surv., Victoria (3779). [7881.]

Genus Prælucina, Barrande.

Prælucina ancilla, Barrande. Pl. VI., Figs. 88, 88*a*.

Prælucina ancilla, Barrande, 1881, Syst. Sil. Bohême, Vol. VI., p. 280, Pl. LXVIII.

Observations.—The occurrence of this species in the palæozoic of Victoria is of some stratigraphic importance, since it is apparently a widely-distributed form, having already been described by Barrande from the lowest bed of the Devonian series in Bohemia, a black limestone (FF_1) resting on Silurian

* Syst. Sil. Bohême, Vol. VI., Pt. I., 1881, Acéphalés, Pl. LXXV., Figs. II. 1-4.

(Ee_2). Although we have only a mould from a single specimen to judge by, there can be no hesitation in assigning our example to the above species, for it shows the following characters in common with Barrande's figured specimens: Shell longer than high, sub-oval, truncately rounded in front at the base, boldly curved behind; beaks low, pointed slightly forward, and situated anteriorly. The riblets are numerous (usually about 80), rounded; moderately strong on the basal margin, becoming very fine and almost obsolete towards the umbo. The shell-surface is marked with concentric, inequidistant furrows.

The hinge characters are not shown in any of Barrande's specimens, nor in ours, but in the latter the area on either side of the beaks is marked with several conspicuous short, curved folds or ligamental grooves, more or less parallel with the cardinal border.

Compared with actual Silurian (Stage E in the Bohemian Basin) species of the genus, our specimen differs from the nearest allied form, *P. lustralis** in its more sharply truncated anterior, and higher shell.

Horizon and Locality.—Silurian (Yeringian). Maindample, near Mansfield. Presented by Mr. Hutchinson, per Rev. R. Thom. [7882.]

Family **Ctenodontidæ.**

Genus Ctenodonta, Salter, 1851.

It seems convenient to refer the nuculoid shells without ligament-pit (resilifer) to Salter's genus, whilst the subrostrate forms of the same type find a place in *Palæoneilo* of J. Hall. Some authors, as Beushausen, include both the above-named forms in the one genus.

Ctenodonta portlocki, sp. nov., Pl. II. Figs. 17-20.

Description.—Outline of shell variably elongate-ovate to subquadrate; with moderately high umbones and a prominent cardinal area, the hinge lines sloping away from the umbo. Beaks anterior, the posterior hinge line twice the length of the anterior. Surface of shell concentrically striate, or with shallow concentric grooves.

* Barrande, op. cit., Pl. LXXI., Figs. 1-13.

Measurements—

Ex. 1. Length, 15 mm. Height, 10.5 mm.
Ex. 2. Length, 10 mm. Height, 8 mm.
Ex. 3. Length, 12.5 mm. Height, 10 mm.

Observations.—The Victorian specimens appear to resemble Portlock's *Arca* [*Ctenodonta*] *dissimilis** from the Upper Ordovician of Tyrone, Ireland, in some particulars, but differ in having a sloping or ∧-shaped cardinal line. In *C. dissimilis* the hinge line is straight, and the area conspicuous.

Horizon and Locality.—Silurian (Melbournian); in the mudstone of South Yarra, type presented by Mr. Spry. Silurian (Yeringian); Wilson's Station, Lilydale, presented by Mr. J. T. Jutson; junction of Woori Yallock and Yarra, B 23, Coll. Geol. Surv. Vict. [7883 (type), 7884-6.]

Genus NUCULITES, Conrad, 1841.

[NOTE.—Certain species from Victoria in the National Museum now described for the first time, were labelled as *Cucullella* by McCoy, and this name was used in the notes on the quarter sheets of the Geological Survey of Victoria. Since Conrad's genus *Nuculites* is essentially the same as McCoy's *Cucullella*, and antedates it by some years, it is obviously the correct one for adoption.]

Nuculites maccoyianus, sp. nov., Pl. II., Figs. 21-23.

Description.—Shell elongate-ovate; variable in size, and to some extent in form. Cardinal line sinuously arched, ventral margin gently and evenly curved, rounded off abruptly at the anterior border; posterior extremity rounded, sometimes compressed, narrow and flange-like. Cardinal area having the characteristic taxodont hinge. Surface moderately convex. highest just below the beaks; the latter are usually depressed and situated sub-anteriorly, projecting slightly forward. Each valve carried an anterior buttress or clavicular ridge immediately in front of the umbones, and there is a distinct posterior adductor impression midway between the beaks and the posterior margin. The specimens found are practically in the form of internal casts and moulds, but the latter show indications of a surface ornamentation of concentric rugæ or lines of growth.

* Rep. Geol. Londonderry, 1843, p. 428, Pl. XXXIV., Fig. 5.

Measurements.—Smallest specimens, length, 4.5 mm.; height, 3 mm. A large example, length, 12 mm.; height, 7.5 mm. The largest specimen in the present series has a length of 15 mm.

Affinities.—The *Nuculites oblongatus* of Conrad* from the Hamilton Group in North America is, in general features, closely comparable with our species, but differs in having a relatively greater length and a straight ventral margin. With regard to the posterior adductor impression nearly always present in the Victorian species, comparison may be made with a similarly marked fossil shell, *Nuculites colonicus* Reed† from the Bokkeveld beds of Cape Colony.

Horizon and Locality.—Silurian (Melbournian). Very abundant in the ochreous and blue mudstone at the Yarra Improvement Works, S. Yarra, and the Swanston-street sewer near Collins-street; in brown mudstone N. of Yan Yean, Geol. Surv. Vict., coll. Bb. 11; and in pale grey mudstone, Merri Creek, Kalkallo, Geol. Surv. Vict., coll. Bb. 3; also Silurian (Yeringian), junction of Woori Yallock and Yarra. Geol. Surv. Vict. B 23. [7887 (type), 7888-9, 969-75.]

Nuculites coarctatus, Phillips, sp. Pl. II., Figs. 24, 25.

Nucula coarctata, Phillips, 1848, Mem. Geol. Surv. Gr. Brit., Vol. II., Pt. I., Palæont. Append., p. 366, Pl. XXII., Figs. 1-4.

Cucullella coarctata, Phill. sp., McCoy, 1852, Brit. Pal. Foss., Pt. II., p. 284.

Observations.—This species was originally described from the Ludlow Rocks of Great Britain, and it is therefore interesting to find it also in the Silurian rocks of Victoria. *N. coarctatus* is a somewhat variable species, but is distinguished from the allied form *N. triqueter*, Conrad,‡ from the Hamilton Group of N. America, by the beaks being less pronounced, and the posterior area not so obliquely produced.

Horizon and Locality.—Silurian (Melbournian). In the mudstone of S. Yarra, specimen presented by Mr. F. P. Spry; west of Mount Disappointment; coll. Geol. Surv., Vict., Bb. 17. (See note on ¼ sheet 3 N.E., "*Cucullella* sp.") [7890-1.]

* J. Hall, Pal. N. York, Vol. V., Pt. I., 1885, Lamellibranchiata II., p. 324, Pl. XLVII., Figs. 1-12.

† Annals S. African Museum, Vol. IV., Pt. VI., No. 11, 1904, p. 259, Pl. XXXII., Fig. 1.

‡ Geol. Surv. New York, Ann. Rept., 1841, p. 50. See also J. Hall, Pal. N. York, 1885, Vol. V., Pt. I. Lamell. II., 326, Pl. XLVII., Figs. 17-28, Pl. XCIII., Figs. 8-10.

Nuculites subquadratus, sp. nov. Pl. II., Figs. 26, 27, 27*a*.

Description.—Shell of medium size, subquadrate in outline, narrower anteriorly; the ventral border broadly curved and truncated towards the postero-cardinal angle. Beaks rather prominent, situated sub-anteriorly and directed forward. Anterior buttress impression commencing just in front of the beak, curving slightly, and traversing about two-thirds of the distance to the ventral margin. Posterior adductor impression strong. Surface highly convex; median area near the beaks depressed, curving evenly to the ventral margin, rather steep toward the postero-ventral angle, presenting a decided umbonal slope; depressed immediately below and in front of the beaks. Shell-surface ornamented with closely-set, concentric lines of growth, and crossed by fine striæ, which apparently radiate from the umbo, becoming stronger towards the ventral margin.

Measurements.—(1) Length, 11.5 mm.; height, 9 mm. (2) Length, 6 mm.; height, 5 mm.

Observations.—This species is unusually short, and reminds one of *Arca* in its squareness. The two specimens figured, although differing somewhat in details, are referred to the same species, as they agree in their essential features. In *N. subquadratus* we have a surface ornamentation similar to that seen in some of the better-preserved British specimens of *N. coarctatus*, this feature of the radiating striæ apparently being confined to these two species.

Affinities.—The present species very closely approaches *N. nyssa*, J. Hall,* from the Hamilton Group of N. America, but the latter form is not marked with radiating striæ, nor is it so quadrate in outline.

Horizon and Locality.—Silurian (Melbournian). North of Yan Yean; coll. Geol. Surv., Vict., Bb. 11; west of Mount Disappointment, G.S.V., Bb. 17. [7892 (type), 977.]

Nuculites jutsoni, sp. nov. Pl. II., Fig. 28.

Description.—Valves ovately elongate, length nearly twice the height. Ventral margin evenly curved; cardinal line slightly arched. Beaks sub-anterior, tumid; anterior extremity broadly rounded and compressed beneath the beaks; posterior extremity narrow, produced, curving upward and forward to meet the cardinal line obtusely. Deepest part of the valve just behind the anterior third. Surface somewhat steeply inclined in front

* Pal. N. York, Vol. V., Pt. I., 1885, Lamell. II., p. 328, Pl. XLVII., Figs. 29, 30.

and along the cardinal area, boldly arched in the middle, and thence sloping gently to the back and basal margin. A few faint irregular concentric striæ or growth-lines present. Indications of the anterior buttress just below the umbo; this feature is shown more clearly in another specimen collected from the same locality by Mr. F. P. Spry.

Measurements.—Height, 7.5 mm.; length, 14 mm.; depth of valve, about 3 mm.

Affinities.—The nearest form to the above appears to be *Nuculites oblongatus*, Conrad,* a fossil of the Hamilton Group of N. America, and already compared with our *N. maccoyianus*. The above species differs, however, from the N. American example in being slightly more convex at the umbones, more strongly curved on the ventral margin, and more attenuated posteriorly. It differs from the previously-described *N. maccoyianus* in the more forward position of the beaks and the acuter posterior extremity.

Horizon and Locality.—Silurian (? Yeringian), Wandong,† Victoria. Presented by Mr. J. T. Jutson. Also from the same locality, presented by Mr. F. P. Spry. [7893 (type), 7894.]

Family **Nuculidæ.**

Genus Nucula, Lamarck, 1799.

Nucula melbournensis, sp. nov. Pl. II., Figs. 29, 30, 31, 31*a*, (?)32, (?)32*a*, (?)33, (?)33*a*.

Description.—Shell broadly ovate, ventral margins evenly convex; cardinal line oblique, arcuate; anterior end short, obliquely rounded towards the base; posterior end broad and rounded. Beaks prominent, pointing slightly forward, and closely adpressed. Greatest thickness of valves just below the beaks. Surface sculptured by varices or undulæ at more or less equal intervals. Adductor impressions well-marked on the surface of casts.

Measurements.—Type specimen.—Length, 13.5 mm.; height, 10.5 mm.; width of shell near umbones, 6 mm.

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*J. Hall, Pal. N. York, Vol. V., Pt. I., 1885, Lamell. II., p. 324, Pl. XLVII., Figs. 1-12.

† The rock containing the above fossils is a dark brown irregularly bedded sandstone, probably younger than the dark impure limestone with *Dalmanites* found to the westward of the same locality.

Affinities.—This species resembles in outline *N. bellistriata*, Conrad, sp.,* from the Hamilton Group of N. America, but lacks the fine concentric sculpturing of the surface seen in the latter.

Observations.—*N. melbournensis* is variable in outline, and although agreeing in general form, a series can be readily collected which shows a regular gradation from narrow-oblong to broadly-ovate, or even sub-orbicular forms. It is abundant in some of the localities around Melbourne, especially in the fine argillaceous shales. So far as we know at present, *N. melbournensis* is confined to the neighbourhood of Melbourne.

Horizon and Locality.—Silurian (Melbournian). Yarra Improvement Works, S. Yarra; Sewerage Works, Domain road, S. Yarra; Swanston-street Sewer, Melbourne; also a doubtful specimen from Merri Creek, Kalkallo (Kinlochewe). Coll. Geol. Surv., Vict., Bb. 3. [7895 (type), 7896-8, 985-6.]

Nucula umbonata, sp. nov. Pl. II., Figs. 34, 35.

Description.—Shell sub-trigonal, oblique; strongly convex, especially toward the beaks. Ventral margin gently rounded; anterior border widely curved, sloping steeply and sub-truncated at the junction with the ventral margin; the posterior border is formed by a long curved slope, meeting the ventral margin somewhat abruptly. Beaks not very prominent, incurved, gibbous. Umbonal slope narrowly rounded, extending from the beaks to the postero-ventral margin. Surface of shell marked by several strong concentric varices, between which occur numerous fine growth lines. One specimen shows the ligament-pit (resilifer) very clearly.

Measurements.—Length, 11 mm.; height, 9 mm.; depth of valve, 3.5 mm.

Affinities.—Both in the general form of the shell and its surface ornamentation our species shows some relationship with *N. varicosa*, J. Hall,† a fossil from the Hamilton Group of N. America (N. York State). A marked difference, however, exists between them, in that the Australian species has sub-anterior beaks which are not prominently directed forward.

Horizon and Locality.—Silurian (Melbournian). Type specimen from the Police Paddock, Kilmore; coll. Geol. Surv., Vict., Bb. 22. Also from the south end of the Reservoir, Yan Yean; coll. Geol. Surv., Vict., Bb. 14. [7899 (type), 7900.]

* See J. Hall, Pal. N. York, Vol. V., Pt. I., 1885, Lamellibranchiata II., p. 318, Pl. XLVI., Figs. 1-9.

† Pal. N. York, Vol. V., Pt. I., 1885, Lamell. II., p. 319, Pl. XLVI., Figs. 12-23, Pl. XCIII., Fig. 4.

Nucula arcæformis, sp. nov. Pl. II., Fig. 36.

Description.—Shell sub-rectangular, oblong; strongly convex toward the beaks, sloping away toward the ventral margin, which is depressed and almost flange-like. Beaks prominent, sub-central, directed slightly forward. Both extremities vertically truncate and only slightly rounded; ventral margin straight. Surface marked by irregular and somewhat coarse undulations or lines of growth, especially conspicuous near the ventral border.

Measurements.—Length, **15** mm.; height, **10** mm.; depth of valve, about 2.5 mm.

Affinities.—The shape of the valve in this species is peculiarly rectangular, and not quite comparable with any form hitherto figured, the nearest being *Nucula subæqualis*, McCoy, sp.,* from the Upper Llandovery beds of the Malverns and Wales. The latter species, however, is much more gibbous in the umbonal area. A fragment of another valve is fortunately found underlying the figured specimen of *N. arcæformis*, which shows the form of hingement to belong to the genus *Nucula*.

Horizon and Locality.—Silurian (Melbournian). In the hard black shale of the Domain-road Sewer, and the blue mudstone of the Yarra Impt. Works, S. Yarra (coll. by F. P. Spry). Also from Merri Creek, sect. XXVIII., parish of Merriang, and hills east of Creek; coll. Geol. Surv., Vict., Bb. 6. [7901 (type), **7902-6**.]

Nucula taylori, sp. nov. Pl. II., Figs. 37, 38.

Description.—Shell small, sub-ovate. Beaks prominent, incurved, sub-acuminate, sub-central. Cardinal line strongly arched. Ventral margin gently and evenly rounded, curving boldly anteriorly, and sharply at the posterior extremity, where it is truncated toward the beaks. A well-marked umbonal slope runs from the beak to the postero-ventral margin. Cardinal area on both sides of beak depressed. Surface smooth, or with a few faint lines of growth.

Measurements.—Length, 6.5 mm.; height, 5 mm.

Affinities.—*N. taylori* bears some resemblance to *Nucula anglica*, d'Orbigny,† which ranges from the Caradoc series to the Lower Ludlows in Britain; the chief difference being the greater convexity of our form, especially in the umbonal region.

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* (*Arca subæqualis*) Brit. Pal. Fossils, p. 283, Pl. 1K., Fig. 1. Siluria, 4th ed., Pl. X., Figs. 7, 8.

† Prodr. Pal., p 33, Stage 1, No. 194. *Nucula ovalis*, Sowerby, Sil. Syst., 1839, p. 609, Pl. V., Fig. 8. *Ctenodonta anglica*, d'Orb. sp. Siluria, 4th ed., 1867, Pl. XXXIII., Fig. 10.

Observations.—This species is named after Mr. Norman Taylor, who was attached to the Geological Survey of Victoria, and surveyed the district whence the present specimens came.

Horizon and Locality.—Silurian (Melbournian). Broadhurst's Creek, east of Kilmore; coll. Geol. Surv., Vict., Bh. 18; also Yarra Impt. Extension, Hoyt's Paddock, S. Yarra. Presented by Mr. F. P. Spry. [7907 (type), 7908.]

Nucula opima, J. Hall, sp., var., *australis*, nov. Pl. III., Figs. 39-43.

Cucullæa opima, J. Hall, 1885, Rep. 4th Geol. Distr. N.Y., p. 197, No. 78, Fig. 3 (p. 196).

Nucula randalli, J. Hall, 1885, Palæont. N. York, Vol. V., Pt. I., Lamell. II., p. 315. Pl. XLV., Figs 6, 10, 16, 23, 26, 27; Pl. XCIII., Figs. 1, 3.

Observations.—In the general shape of the valves and their surface ornamentation our Victorian variety agrees fairly closely with the form figured by J. Hall under the names of *Cucullæa opima* and *Nucula randalli*. Hall remarked on the identity of the fossils described under the two above-named species,* but preferred to retain the later name since it had "gone into the literature of the science." The earlier name, however, should undoubtedly be employed, in accordance with accepted rules of nomenclature. The N. American examples were obtained from the Hamilton Group of the State of New York.

The Victorian specimens are much smaller than the N. American, the largest measuring only 13 mm., whilst the average length of J. Hall's examples is about 23 mm. In the Victorian variety there is a greater tendency for the concentric striæ to become fasciculate. Two of our specimens (Pl. III., Figs. 41, 43) show a remarkable gibbosity of the umbonal area.

Horizon and Locality.—Silurian (Melbournian). From the Yarra Improvement works, S. Yarra, presented by Mr. F. P. Spry; also from the coll. Geol. Survey of Victoria, north of Yan Yean, Bh. 11; from a shaft of the tunnel in Reservoir, Yan Yean, Bh. 13; Fraser's, or No. 3, Creek, Springfield, Bh. 25. Silurian (Yeringian). About 1½ miles below Simmons' Bridge Hut, on the Yarra; coll. Geol. Surv., Vict., B16. [7909 (type), 7910-13, 965-6.]

* Op. supra. cit., 1885, p. 315, footnote.

Nucula cf. *lirata*, Conrad sp. Pl. III., Fig. 44.

Nuculites lirata, Conrad, 1842, Journ. Acad. Nat. Sci., Philad., Vol. VIII., p. 250, Pl. 15, Fig. 7.

Nucula lirata, Conrad, sp., J. Hall, 1885, Pal. N. York, Vol. V., Pt. I., Lamell. II., p. 316, Pl. XLV., Figs. 5, 11, 15, 17-22, 24, 25; Pl. XCIII., Fig. 5.

Observations.—Our figured specimen is a crushed valve of a *Nucula*, showing the ligament-pit and denticulate cardinal area. The strong liræ and the general form of the shell, point to an affinity with the above species, which occurs in the Hamilton Group of N. America.

Horizon and Locality.—Silurian (Melbournian). From the coll. of Geol. Surv. of Vict., Yan Yean, Bb. 14. [7914.]

Nucula lamellata, J. Hall. Pl. III., Figs. 45 (var.), 46.

Nucula lamellata, J. Hall, 1885, Pal. N. York, Vol. V., Pt. I., Lamell. II., p. 320, Pl. XLV., Fig. 13; Pl. LI., Figs. 18-21; Pl. XCIII., Fig. 7.

Observations.—This species of *Nucula* is of a somewhat different type to the usual forms, particularly in the sub-quadrate outline, and the sub-central position of the beaks. A connecting link between the sub-ovate forms and this species is exemplified in *N. lirata*, Conrad, sp.*

In nearly all the Victorian specimens before us, represented either as internal impressions or hollow casts, the ligament pit is visible. One of our fossils (Fig. 45) appears to be a short variety of the above species. The specimens referred to by McCoy on quarter sheet 4 S.W., Geol. Surv. Vict. (notes on Bb. 18, 20, and 22), under the MS. name of *Orthonotus subrigidus* are here included under *Nucula lamellata*, J. Hall.

In N. America, *N. lamellata* is found in the Hamilton and Chemung Groups in the State of New York.

Horizon and Locality.—Silurian (Melbournian). Schist Hill, Merri Creek, coll. Geol. Surv. Vict., Bb. 6; south end of Reservoir, Yan Yean, coll. Geol. Surv. Vict., Bb. 14; Broadhurst's Creek, east of Kilmore, coll. Geol. Surv. Vict., Bb. 18 (short variety); Kilmore creek, north of Special Survey, coll. Geol. Surv. Vict., Bb. 20; Police Paddock, Kilmore, coll. Geol. Surv. Vict., Bb. 22. Silurian (Yeringian); about 1½ miles below Simmons' Bridge Hut, on the Yarra, coll. Geol. Surv. Vict., B16. [2252, 2243-49.]

* See above references.

Family **Ledidæ.**

Genus Palæoneilo, J. Hall, 1870.

Palæoneilo victoriæ, sp. nov. Pl. III., Figs. 47-49.

Description.—Shell of variable size, length more than twice the height, rostrate; moderately convex in the umbonal region and the triangular area beneath, the latter bounded by the anterior slope and the posterior umbonal ridge. Cardinal line nearly straight or only slightly arcuate; ventral border sub-parallel and straight, but narrowing the shell posteriorly, widely rounded anteriorly to meet the cardinal line at an obtuse angle; the hind extremity narrow, with the postero-ventral angle bluntly rounded, curving backward and inward to the cardinal line, which posteriorly forms a salient angle. Escutcheon well marked, the depressed area bounded abruptly by the umbonal ridge. Surface of shell gently convex and sloping anteriorly; towards the ventral margin the surface slopes more steeply, whilst the margin itself, in adult shells, is depressed and flange-like. Beaks sub-central or slightly posterior, prominent, somewhat incurved and depressed, or only moderately inflated. Hinge showing an alternating series of curved bars and sockets. On the cardinal border there is a well-marked groove to receive the external ligament. Surface ornamented with numerous concentric lamellar ridges, between which are several parallel thread-like striæ, whilst, in a very few well-preserved examples, traces of fine lineations radiating from the umbo are seen, especially stronger on the salient edges of the concentric lamellæ.

Measurements.—Type specimen (Pl. III., Fig. 47). Length, 27 mm.; height, 12 mm.; number of concentric lamellæ in the space of 4 mm., measured in median area—7.

A medium-sized example.—Length, 17 mm.; height 7.5 mm.; number of concentric lamellæ in the space of 4 mm. in the median area—9.

A small example.—Length, 13 mm.; height, 6 mm.; number of concentric lamellæ in space of 4 mm.—16.

Observations.—The number of the concentric lamellar ridges to a given width is not a factor of any importance in dealing with this group, so far as the Victorian examples show, and the various graduations in ornament do not allow of even a sub-varietal division of the species. A possible explanation of this varying feature in ornamentation, and one partly borne out by the evidence before us is, that in areas of quiet sedimentation

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the molluscs found time and material for forming a broad varix along the pallial border; whereas in sandy areas or under impure conditions of the water, as, for instance, in the presence of decaying crustacea and cephalopoda, seen in the Domain-road examples, the successive laminæ were laid down closer together, and the shell itself would be proportionately thin and depauperated.

This, together with another newly-described ornate species, *P. producta*, are among the commonest forms of the genus in the Victorian rocks.

Affinities.—*P. victoriæ* somewhat resembles the type of shell described under the name of *P. muta* by J. Hall,* from the Hamilton Group of the State of N. York. *P. muta* differs, however, from our species in having the beaks decidedly anterior, in the extremely lamellose condition of the main concentric striæ, and in the absence of the concavely depressed escutcheon in the posterior region.

Horizon and Locality.—Silurian (Melbournian). From the Yarra Improvement Works, S. Yarra, in blue and yellow shale, common; in the hard, dark shale of the Domain-road Sewerage Works at 103 ft. from surface, presented by Mr. F. P. Spry. In the yellowish sandstone with casts of shells, coll. Geol. Surv. Vict., Moonee Ponds Creek, Flemington; in the brown argillaceous rock of Broadhurst's Creek, east of Kilmore, coll. Geol. Surv. Vict., B$^{b.}$ 18. In the brown argillaceous sandstone of Anderson's Creek, near Warrandyte, coll. Geol. Surv. Vict., B22; in the sandstone of Fraser's, or No. 3, Creek, Springfield, coll. Geol. Surv. Vict., B$^{b.}$ 25. [7915 (type), 7916-7.]

Palæoneilo raricostæ, sp. nov. Pl. III., Fig. 50.

Description.—Shell of variable size, length more than twice the height, elongate-ovate, rostrate. Depressed convex. Umbonal ridge not strongly developed. Anteriorly broad and well-rounded, the margin meeting the cardinal line at an obtuse angle; posteriorly produced and sharply rounded. Cardinal line arcuate, straight between the vertical line and the posterior angle. Beaks depressed. Teeth of hinge characteristic, but comparatively large and few. Greatest convexity of shell-surface just behind the anterior umbonal slope. Shell ornamented with well-marked lamelliform concentric varices, comparatively widely spaced, the area between each being relieved by numerous thread-like striæ.

* Palæont. N. York, Vol. V., Pt. I., 1885, Lamell. II. p. 337, Pl. XLIX., Figs. 25-32.

Measurements.—Type specimen: Length, 21.5 mm.; height, 9 mm.; number of concentric lamellar ridges measured over a width of 4 mm.—5.

Observations.—The above species is recognised by its depressed valves, the somewhat acutely rostrate posterior extremity, and the comparatively wide interspace between the concentric ridges.

Affinities.—This species also shows certain affinities with the previously-mentioned *P. muta*, J. Hall, from the Hamilton Group of New York State. The rostrate extremity of *P. raricostæ* and its depressed shape shows it to be specifically distinct.

Horizon and Locality.—Silurian (Yeringian). From the dark mudstone at the junction of the Woori Yallock and the Yarra, coll. Geol. Surv. Vict., B23. In the olive-brown mudstone about 1½ miles below Simmons' Bridge Hut on the Yarra, coll. Geol. Surv. Vict., B16. [7918 (type), 2251.]

Palæoneilo spectabilis, sp. nov. Pl. III., Figs. 51, 52.

Description.—Shell of medium size, elongate ovate, rostrate; strongly convex in the umbonal region. Beaks nearly central, moderately well-inflated and gibbous. Cardinal line arcuate, gently curving to the broad anterior extremity. Ventral border straight, inclining posteriorly towards the cardinal line, and meeting the latter in a somewhat sharp curve. Umbonal slope forming with the median area a sinuous and obtuse ridge. Anterior slope gently convex. Teeth comparatively stout, and not so numerous as usual in this genus; about 10 on the posterior side of the beak. Surface having a series of concentric step-like folds and lamellar ridges, with comparatively fine striæ in the intervals between the ridges.

Measurements.—The type specimen: Length, 28.5 mm.; height, 11.5 mm.; depth of valve, about 4 mm.

Observations.—This species is distinguished from *P. victoriæ* by its umbonal convexity and conspicuously rostrate outline. It is also a much heavier shell, and the groove for the external ligament is more distinctly seen.

Horizon and Locality.—Silurian (Melbournian). In the blue and yellow shale of the Yarra Improvement Works, S. Yarra. Type presented by Mr. F. P. Spry. Also in the fine-grained sandstone at Moonee Ponds Creek, Flemington, coll. Geol. Surv. Vict., B 8. [7919 (type), 7920.]

Palæoneilo producta, sp. nov. Pl. III., Figs. 53, 53*a*.

Description.—Shell small, ovate, very long, length more than twice the height; posteriorly attenuate, almost rostrate. Cardinal line only slightly arched, ventral border gently rounded, and curving upward toward the posterior end, then abruptly forward, meeting the cardinal line at an obtuse angle; well-rounded anteriorly, and curving boldly to the cardinal line. Beaks acuminate and salient, nearly central. Valves depressed-convex below; highest in the middle and at the umbonal region, sloping steeply towards the front, and gently to the posterior extremity, except where interrupted by the umbonal ridge and sulcus; the latter is rather feebly developed, and is parallel with, and in front of, the posterior umbonal ridge. Shell surface marked with very fine, regularly concentric striæ, about 12 to the millimetre, counted on the middle of the shell below the umbonal inflation.

Measurements.—Type specimen: Length, 15 mm.; height, 6.75 mm.; depth of valve, about 2.5 mm.

The average length of the larger number of specimens found is 11 mm.

Affinities.—This species shows a certain relationship to *Palæoneilo elongata*, J. Hall,* from the Chemung Group (Upper Devonian) of the States of New York and Pennsylvania. The points of difference, however, are these:—

The present species has more acuminate beaks.

It is proportionately more elongate.

The cardinal margin is less arcuate.

The surface striæ are finer and more than twice as numerous.

Horizon and Locality.—Silurian (Melbournian). Common in the blue and brown shale at the Yarra Improvement Works, S. Yarra (type specimen presented by Mr. F. P. Spry). Also from the Domain-road sewer, S. Yarra. In the coll. Geol. Surv. Vict. a single specimen from N. of Yan Yean, B$^{b.}$ 11. [7921 (type), 7922, 1563.]

Palæoneilo ? constricta, Conrad sp. Pl. III., Fig. 54.

Nuculites constricta. Conrad. 1842. Journ. Acad. Nat. Sci., Philad., Vol. VIII., p. 249, Pl. XV., Fig. 8.

Palæoneilo constricta, Conrad sp., J. Hall, 1885, Pal. N. York, Vol. V., Pt. I., Lamell. II., p. 333, Pl. XLVIII., Figs. 1-16; Pl. LI., Fig. 17.

* Palæont. N. York, Vol. V., Pt. I., 1885, Lamell. II., p. 345, Pl. XLVIII., Fig. 39; Pl. XCIII., Fig. 11*a*.

Observations.—Our figure is drawn from a cast of a nuculoid shell which, by its depressed umbo, apparent absence of a ligament-pit and constricted posterior angle, falls into the genus *Palæoneilo* as defined by J. Hall. The present specimen is exactly comparable in outline with Conrad's figure of *P. constricta*, and it further shows a characteristically large posterior adductor impression. In the absence of external ornament there is some slight doubt as to its specific identity.

This species ranges through the Devonian of North America.

Horizon and Locality.—Silurian (Melbournian). In the shale of the Yarra Improvement Works, S. Yarra. [7923.]

Palæoneilo cf. *brevis*, J. Hall, Pl. VI., Fig. 55.

Palæoneilo brevis, J. Hall, 1870, Prelim. Notice Lamell. 2, p. 10, Id. 1885, Pal. N. York, Vol. V., Pt. I. Lamell. II. p. 342, Pl. L., Figs. 24-33.

Observations.—Our specimen is comparable with the above form in having a short, ovate valve, ornamented with fine concentric striæ. The posterior margin is not perfect, but the depressed surface in front of the umbonal ridge is sufficient indication of the presence of a constriction on the basal margin of the shell. In the absence of more perfect specimens it will be safer to indicate the species with some reserve. J. Hall's examples were from the Chemung Group (Up. Devonian) of the States of New York and Pennsylvania.

Horizon and Locality.—Silurian (Melbournian). In pale mudstone, Merri Creek, sects. 2 and 3, Kalkallo (Kinlochewe), coll. Geol. Surv. Vict. B^b3. [968.]

Palæoneilo cf. *tenuistriata*, J. Hall, Pl. III., Fig. 56.

Palæoneilo tenuistriata, J. Hall, 1885, Pal. N. York, Vol. V., Pt. I. Lamell. II., p. 336, Pl. XLIX., Figs. 1-12, 14; Pl. XCIII., Fig. 13.

Observations.—Our figure is taken from a wax squeeze of a mould of the external surface of shell. In the regularly and finely striate surface, and the obovate form of the valve it can be closely compared with J. Hall's species cited above. The strongest points of difference are, the obsolescence of the postero-umbonal sulcus in our form, and the central position of the beaks, although one example figured by Hall approaches ours very closely in this respect. The Victorian specimen may also be compared with *P. fecunda*, J. Hall,* although that species has a marked depression in front of the umbonal ridge.

P. tenuistriata occurs in the Hamilton Group in the States of New York and Pennsylvania.

Horizon and Locality.—Silurian (Melbournian). In the whitish mudstone of Merri Creek, Sects. 2 and 3, Kalkallo, coll. Geol. Surv. Vict. B^b 3. [967.]

Family **Parallelodontidæ.**

Genus Parallelodon, Meek and Worthen, 1866.

Parallelodon spryi, sp. nov. Plate I., Fig. 3.

Description.—Shell of medium size, subovate; cardinal line nearly straight, meeting the posterior border almost at right angles, but slightly upturned; ventral border convex, narrower anteriorly, and broadly curved posteriorly. Median area swollen, rising prominently towards the beaks, which are situated sub-anteriorly; posterior region compressed. Cardinal area exposed in the type specimen, showing what appears to be the extremity of a series of about six parallel and slightly oblique hinge-teeth. Surface of valves grooved concentrically, the highest part of the ridges being obliquely striated, the striæ radiating from the beaks. Indications present of a large anterior muscle impression situated close to the cardinal area.

Measurements.—Length, about 26 mm.; height, 17 mm.; thickness of entire shell, 8 mm.

Observations.—The presence of a parallel series of anterior teeth points to relationship with *Parallelodon, sensu stricto*. The genus *Macrodon*, Lycett, 1845 (nom. emend. *Macrodus*, Beushausen, 1895)† is closely allied, and is regarded by Dall‡ as synonymous. The latter genus differs in some slight respects, such as the obliquity of the anterior teeth. Should both types prove to be congeneric, the former name will stand, since the latter had been used by J. Müller for a genus of fishes, whilst Beushausen's name is of much more recent date.

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*Tom. supra cit., p. 336, Pl. XLIX., Figs. 13, 15-24.
† Abhandl. von Preuss. Geol. Landesanst., N. F. Heft. XVII. p. 36.
‡ Text-book of Palæontology, Zittel-Eastman, 1900, p. 364.

Affinities.—Both *Macrodon hamiltoniæ*, J. Hall, of the Hamilton Group of N. America* and *Macrodus villmarensis*, Beushausen, from the upper beds of the Middle Devonian of the Rhine area† bear a general resemblance to our species, but in many points of detail they are quite distinct, lacking the boldly curving ventral margin, and strong compression of the posterior region of the shell seen in the Australian species.

Horizon and Locality.—Silurian (Yeringian), Wandong, Victoria; in yellow sandstone. Type specimen collected and presented by Mr. F. P. Spry, after whom the species is named. [7950.]

Parallelodon æqualis, sp. nov. Plate IV., Fig. 57.

Description.—Shell small, elongate oval, rounded and constricted in front, broader and truncated behind, with a sharp umbonal ridge extending from the umbo to the postero-ventral margin. Beaks sub-anterior, or nearly central, inflated and directed forward. Cardinal line straight; ventral border slightly curved and approximately parallel with the hinge-line. Three posterior, oblique, lateral teeth visible behind the beaks, and close to the cardinal border.

Measurements.—Length, 12 mm.; height, 7.5 mm.; depth of valve, 2.5 mm.

Observations.—The above species belongs to a type of shell of which the "*Arca scitula*" of McCoy‡ is an example. That species differs from ours in the more extended posterior, and in the strong concentric surface ornament; McCoy's species may, however, eventually prove to be more nearly related to the North American Devonian types of this genus.

Horizon and Locality.—Silurian (Melbournian). In brown mudstone, Yarra Improvement Works, S. Yarra. Presented by Mr. F. P. Spry. [7924.]

? Parallelodon kilmoriensis, sp. nov. Pl. IV., Fig. 58, ? fig. 59.

Description.—Shell small, rhomboid, sub-circular; length a little more than the height. Ventral margin boldly rounded; both extremities broad, the anterior short and truncate, the posterior margin curving upward and forward to meet the cardinal line. Beaks prominent, slightly anterior, pointing

* Prelim. Notice, Lamelli., 2, p. 13, 1870. See also J. Hall, Palæont. New York, Vol. V., Pt. I. Lamellibranchiata, II., 1885, p. 349, Pl. LI., Figs. 1, 7, 9, 10.

† Abhandl. von. Preuss. Landesanst., N. F. Heft., XVII., 1895, p. 38, Pl. IV., Fig. 2.

‡ Synopsis of the Silurian Fossils of Ireland, 1846, p. 20, Pl. II., Fig. 6.

forward and inward, umbonal area triangular, with a slight vertical depression from the beak towards the ventral margin. Cardinal line long and straight; cardinal area compressed in front and behind. Surface marked with fine concentric lines of growth, which become lamellose in the cardinal area.

Measurements.—Length, 16 mm.; height, 14 mm.; depth of valve, 3.5 mm.

Observations.—This species is referred to the genus *Parallelodon* with some reservation, since the hinge structure is obscure. The evidence tends, however, in the direction of this genus, for the beaks are not closely adpressed, and the cardinal area is lamellose, as in typical forms of *Parallelodon*, pointing to the former presence of an external and amphidetic ligament.

The specimen figured on Pl. VI., Fig. 4, although at first suggestive of *Tellinopsis*, is apparently referable to this species, possessing the lamellose cardinal area and traces of teeth.

Horizon and Locality.—Silurian (Melbournian). Coll. of the Geol. Surv. Vict. in the Nat. Museum; Police paddock, Kilmore, Bb. 22. Also a doubtful example from Swanston-street sewer, Melbourne. [7925 (type), 7926.]

Family **Pterineidæ.**

Genus Pterinea, Goldfuss, 1832.

Pterinea lineata, Goldfuss. Pl. IV., Fig. 60.

Pterinea lineata, Goldfuss, 1837, Petrefactiæ Germaniæ, Vol. II., p. 135, Pl. CXIX., Figs. 6 *a-c*.

cf. *Ambonychia tatei*, Cresswell, 1893, Proc. Roy. Soc. Vict., Vol. V., N.S., p. 44, Pl. IX., Fig. 8.

Observations.—There is very little doubt that the imperfect valve figured under the name of *Ambonychia tatei* by the Rev. A. W. Cresswell is an example of *Pterinea lineata*, Goldfuss. Fragments of the above form are fairly common at some Yeringian localities east of Melbourne, and it seems to be a characteristic form in the uppermost Silurian beds in Victoria

In Britain, this species was recorded by McCoy from the Ludlow beds; in Germany it is a well-known Devonian fossil.

Horizon and Locality.—Silurian (Yeringian). ? Lilydale (Rev. A. W. Cresswell); north of Lilydale, in mudstone, presented by the Rev. A. W. Cresswell; and Croydon, near Lilydale, in mudstone, presented by Mr. Thos. Warr. [7927, 2269 (type of "A. tatei")].

? Pterinea tenuistriata, McCoy. Pl. IV., Fig 61.

Pterinea tenuistriata, McCoy, 1852, Brit. Pal. Foss., p. 263, Pl. 1 I., Fig. 4.

Observations.—The Victorian example shows very little difference from McCoy's figured specimen; the chief distinction being the acute form of the ears, a character which is not sufficiently important to justify its separation from the British species. Were there other specimens for comparison it is probable that we should find more typical examples amongst them. The general form and surface ornament is similar to the British species. It has been recorded in Britain from the Wenlock and the Lower and Upper Ludlows. This species is doubtfully referred to the genus *Pterinea*, as further examples may show that both McCoy's and our specimens are really referable to *Actinopteria.*

Horizon and Locality.—Silurian (Melbournian). Yarra Improvement Works, S. Yarra. Presented by Mr. F. P. Spry. [7928-29.]

Genus ACTINODESMA, Sandberger, 1850.

Actinodesma cf. *ampliata*, Phillips, sp. Plate VI., Fig. 87.

Avicula ampliata, Phillips, 1848, Mem. Geol. Surv. Gt. Brit., Vol. 2, Pt. 1, p. 367, Pl. XXIII., Fig. 1.

Pterinea ampliata, Phillips, sp., de Koninck, 1876, Foss. Pal. Nouv.-Galles du Sud, Pt. 1, p. 37.

Observations.—A somewhat imperfect valve of a *Pterinea*-like shell which occurs in the present series is, with very little doubt, referable to the above genus. It is most closely allied to Phillips' species above-mentioned, both in form and ornament, which fossil was originally described from the Upper Ludlow of Llangadoc in Wales.

De Koninck has recorded this species from Silurian rocks at Dangelong, Cooma District, New South Wales.

Comparison may also be made with J. Hall's "*Glyptodesma*" *erectum*,* from the Hamilton Group of N. America. This shell, however, is longer on the ventral margin, and the valve is not so strongly convex.

* Pal. N. York, Vol. V., Pt. I., 1884, Lamell., I., p. 153, Pl. XI., Figs. 1-10; Pl. XII., Figs. 1-3, 5-9; Pl. XIII., Figs. 1-4, 12-15; Pl. XXV., Figs. 14-17; Pl. LXXXVI., Figs. 1-8; Pl. LXXXVII., Figs. 1-3.

Our fossil, which is the impression of the interior of a left valve, shows the presence of transverse striæ on the cardinal line.

Horizon and Locality.—Silurian (Yeringian). North of Lilydale; presented by the Rev. A. W. Cresswell, M.A. [2267.]

Family **Lunulicardiidæ.**

Genus Lunulicardium, Münster, 1840.

Lunulicardium antistriatum, sp. nov. Pl. IV., Figs. 62, 63, 63*a*, 64, 65 (juv.).

Description.—Shell vertically sub-elliptical to sub-circular, somewhat oblique; generally highly convex. Beaks prominent, sub-anterior, incurved, with an external ligamental groove situated in front of the beak. Anterior border narrow; posterior broad, gently curved and sub-truncate. Surface marked concentrically with coarse rugæ, and radially striated, bearing numerous fine riblets, sometimes showing a granulose ornamentation when magnified.

Measurements.—A typical left valve. Height, 36 mm.; length, 30 mm.; depth of valve, 7 mm. Right valve of a long variety—height, 18 mm.; length, 21 mm.; depth of valve 6 mm.

Observations.—The above fossils, from the uppermost beds of the Victorian Silurian, at first glance present little difference from those figured under the name of ? *Cardium striatum* by Sowerby.* A minute inspection of a fairly long series of Australian specimens shows, however, that, although closely related to Sowerby's species, their costulæ are less numerous and more distinctly medially grooved, especially towards the ventral margin of the shell, and also that the concentric folds are much more pronounced. Our species is more oblique than that figured by Sowerby, and in this respect they agree more closely with the variety mentioned by that author, from Brindgwood Chace (loc. cit., p. 614). A specimen of the Dudley shell in the National Museum collection shows the multistriate character of the external surface very clearly, and that the riblets or striæ tend to become medially grooved near the ventral margin. The related British species ranges from the Bala beds to the Lower Ludlow.

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* In Murchison's Silurian System, 1839, Pt. II., p. 614, Pl. VI., Fig. 2. *Cardiola striata,* Sow. sp., Etheridge, 1888, Foss. Brit. Ids., Vol. I., Palæozoic, p. 102.

From the Tentaculite slates (G^3) of Bohemia, Barrande has described *Lunulicardium granulosum*, which, although a more depressed shell, is closely related to our species, more especially in the granulose ornament of the shell surface.*

In the shaly mudstone from the mouth of Starvation Creek there also occur numerous small bivalves (Figs. 64, 65), which, on first examination, might reasonably be mistaken for a species of *Vlasta*; in its superficial character and general form, however, it corresponds very closely to the prodissoconch and early dissoconch stages of *Lunulicardium antistriatum*. In connexion with these specimens it is interesting to compare the figure of *? Vlasta*, sp., figured by Mr. F. R. C. Reed from the Upper Silurian beds of Zebingyi, Burma.†

Horizon and Locality.—Silurian (Yeringian). Common in the blue slates and shales of McMahon's Creek, Upper Yarra, Dept. of Mines coll. (3778); Reefton, near Warburton, Dept. of Mines coll. (3432, 3434).‡

The apparently young examples, or micromorphs of the present species occur at Mount Matlock, associated with *Tentaculites matlockiensis*, Chapm., specimens presented to the Museum by N. Lepoidivil, Esq., in 1877; and from the mouth of Starvation Creek, coll. Dept. Mines, Vict. (3368).§ [2257 (type), 2255, 2260-61.]

Family **Ambonychiidæ.**

Genus AMBONYCHIA, J. Hall, 1847.

Ambonychia acuticostata, McCoy, Pl. IV., Fig. 66.

? Ambonychia acuticostata, McCoy, 1852, Brit. Pal. Foss., p. 264, Pl. 1K., Figs. 16, 16*a*.

Observations.—This is a sub-trigonal or sub-ovate shell, which in its general form and ornamentation closely resembles McCoy's species from the Wenlock and Lower Ludlow Beds of Wales. Our specimen shows a less distinct costation on the umbonal part of the shell, but this may be due to imperfect

* Syst. Sil. Bohem., Vol. VI., Pt. I., Pl. 192, Figs. 6-10.

† Palæontologia Indica, N.S., Vol. II., Mem. 3, 1906, p. 119, Pl. VI., f. 37.

‡ See Prog. Rep. No. IV., 1877, Geol. Surv. Vict., pp. 156, 157, where the late Sir F. McCoy indicated their age to be Upper Silurian (Ludlow).

§ See tom. supra cit., p. 156, where McCoy refers to these specimens as "a small *Aviculoid* shell allied to *Ambonychia* (new species)."

preservation, as it seems to have been partly decorticated. The tegulate ornament on the sharp costæ towards the base of the shell appears exactly as shown in McCoy's drawing. There seems to be no reason for doubting the generic affinity of this species, although queried by McCoy. In his Fossils of the British Islands, Robt. Etheridge refers* to the genus without a query, but misquotes the specific name as "acuticosta."

Horizon and Locality.—Silurian (Yeringian). Cave Hill, Lilydale. Collected by the author. [2268.]

Genus Mytilarca, J. Hall, 1873.

Mytilarca acutirostris, sp. nov. Pl. IV., Fig. 67.

Description.—(Cast). Small, ovate, sub-trigonal; length slightly less than the height. Anterior and basal margins curved and meeting almost at right angles; posterior margin truncate and broadly curved. Beaks acuminate, curving sharply forward. Cardinal grooves present on the anterior and posterior ligamental areas. An anterior umbonal ridge passing immediately below the beaks to the ventral margin. Highest part of valve just behind this ridge. Surface of shell gently curving from the beaks to the base and truncated posterior margin, steeply falling to the anterior border, where it is depressed, and continued so along the base. Inner surface markings consisting of numerous, indistinct, concentric growth lines seen as shallow sulci.

Measurements.—Length, 9 mm.; height, 10.5 mm.

Affinities.—The present species differs from *Mytilarca* [" *Cardium* "] *trigona*, Goldfuss sp.† in having the beaks more incurved, and a more rounded basal margin. Another species which seems to bear some relation towards ours is Salter's *Mytilarca* [" *Mytilus* "] *chemungensis* (*non* Conrad), from the Wenlock Shale of Usk, Wales.‡ This is, however, a more generally elongate form.

Horizon and Locality.—Silurian (Yeringian). Coll. Geol. Surv. Vict., from junction of the Woori Yallock and Yarra, B 23. [7930.]

* Vol. 1., 1888, p. 99.
† Petrefactiæ Germaniæ, Vol. II., 1837, p. 215, Pl. CXLII., Figs. 8a-c.
‡ Mem. Geol. Surv. Gr. Brit., Vol. II., Pt. I., 1848, p. 365, Pl. XX., Figs. 10, 11.

Family **Conocardiidæ.**

Genus CONOCARDIUM, Brown, 1835.

Conocardium bellulum, Cresswell, sp.

Pleurorhynchus bellulus, Cresswell, 1893, Proc. Roy. Soc. Vict., Vol. V., N.S. p. 43, Pl. IX., Fig. 6.

Observations.—This species is distinguished from the rarer form which accompanies it, by the more numerous costæ, which are typically lamellated or even squamose, by the greater obliquity of the umbonal ridge, and by its generally smaller size.

Affinities.—The nearest described form to *C. bellulum* is Salter's species *C. dipterum** from the Upper Ordovician (Bala beds) of Ayrshire, Scotland. In this species, however, the umbonal ridge and the costæ are not so oblique nor so strongly curved.

C. bellulum also shows some alliance with *Conocardium cuneus*, Conrad sp. var. *nasuta*, J. Hall,† a fossil which occurs in the Helderberg series of New York State.

Horizon and Locality.—Silurian (Yeringian). The type specimen was found by the Rev. A. W. Cresswell at Cave Hill, Lilydale. It is also an abundant species in the dark-blue limestone of Deep Creek, a tributary of the Thomson River, Gippsland, 7 miles N. of Walhalla. Specimens from the latter locality were presented to the National Museum by Mr. Cresswell. In the Geol. Surv. Coll. from the junction of the Woori Yallock and Yarra, B 23, we have a single specimen in mudstone, which is also referable to the above species. [911 (type), 2343-51, 7932.]

Conocardium costatum, Cresswell sp.

Pleurorhynchus costatus, Cresswell, 1893, Proc. R. Soc., Vic., Vol. V. N.S., p. 43, Pl. IX., Fig. 5.

Horizon and Locality.—Silurian (Melbournian); a slightly crushed and otherwise imperfect specimen from the Domain-road sewer is here doubtfully referred to the above species.—Presented by Mr. F. P. Spry.

Silurian (Yeringian). The type specimen came from Cave Hill, Lilydale, and there is also another specimen from the same locality in the National Museum collection. [910 (type), 1086, 7931.]

* In Murchison's Siluria, 1859, 3rd ed., p. 214, Fossils 36, Fig. 7 (*Pleurorhynchus dipterus*).

† Pal. N. York, Vol. V., Pt. I., 1885, Lamell, II., p. 410, Pl. LXVII., Figs. 12-20.

Family **Pteriidæ.**

Genus Actinopteria, J. Hall, 1883.

Actinopteria texturata, Phillips sp., Plate IV., Figs. 68, 68a.

Avicula texturata, Phillips, 1841, Palæozoic Fossils of Cornwall, W. Devon and Somerset, p. 51, Pl. XXIII., Figs. 87*a*, *b*.

Pterinæa texturata, Phill. sp., R. Etheridge, 1888, Foss. Brit. Islands, Vol. I., p. 159.

Actinopteria texturata, Phill. sp., Whidborne, 1892, Devonian Fauna (Pal. Soc. Mon.), p. 74, Pl. IX., Figs. 2, 2a, 3, 3a, 5-7.

Observations.—This is an oblique shell with an unusually deep left valve. The ornament is very distinct from the usual type in this genus, consisting of a series of rounded radial riblets crossed at varying intervals by moderately thin undulating laminæ, and this gives to the shell-surface a woven appearance. The only difference between our form and already described specimens is the convexity of the posterior wing of the left valve, which, however, seems to be a minor character. An extraordinarily large specimen, which may belong to this species, occurs in the present series; this specimen shows a tendency in the gerontic stage to throw off irregular concentric laminæ on the shell-surface, instead of regular, rounded threads, whilst the radii become almost obsolete towards the ventral margin.

The previously-recorded examples of *Actinopteria texturata* were from the Devonian, of Devonshire, England; the occurrence of Victorian specimens thus extends its range both from a geographical and geological point of view.

This figured specimen is probably that referred to by Mr. Cresswell as "*Pterinæa sub-falcata*, or an allied species."* It differs from Conrad's *sub-falcata* in the character of the ribs, which in that species are not crossed by intermediate threads.

Measurements.—Spec. *a* (figured).—

Height, 23 mm.; length, 19 mm.; depth of valve, 5 mm. Spec. *b* (? *texturata*)—

Height, about 53 mm.; length, about 46 mm.; depth of valve, about 16 mm.

* Proc R. Soc., Vict., Vol. VI., N.S., 1894, p. 156.

Horizon and Locality.—Silurian (Yeringian). The figured specimen is from the mudstone N. of Lilydale; the large example is from the limestone of Cave Hill, Lilydale. Both specimens were collected by the Rev. A. W. Cresswell, M.A. [2264, 2270.]

Actinopteria boydi, Conrad sp., Plate IV., Fig. 69, Pl. V., 70.

Avicula boydii, Conrad, 1842, Journ. Acad. Nat. Sci., Philad., Vol. VIII., p. 237, Pl. XII., Fig. 4.

Pterinea boydi, Conrad sp., McCoy, 1852, Brit. Pal. Foss., p. 259.

Actinopteria boydi, Conrad sp., J. Hall, 1884, Pal., N. York, Vol. V., Pt. I., Lamell. I., p. 113, Pl. XIX., Figs. 2-24; Pl. LXXXIV., Figs. 16, 17.

Observations.—This very handsome species, although variable, is sufficiently distinguished by its characteristic radial and concentric ornament; the concentric laminæ are undulose and concave between the rays, meeting the latter in a more or less sharp point. The edges of the concentric lamellæ are often so pronounced as to give rise to a series of scalloped frills. The areas cut off by the concentric lamellæ are usually much higher than broad.

This species occurs in the Upper Ludlow in Britain, at Kendal, in Westmoreland. In N. America it is abundant in the shales of the Hamilton Group in New York State.

Horizon and Locality.—Silurian (Yeringian). In mudstone from Wilson's, near Lilydale, presented by Mr. J. T. Jutson. Also from a shallow well at Croydon, presented by Mr. Thos. Warr. [7933-35.]

Actinopteria asperula, McCoy sp., var. *croydonensis*, nov., Plate V., Fig. 71.

Observations.—This variety is distinguished from the type species described by McCoy,* by its shorter form and fewer ribs, the latter numbering about 22 on the body of the shell in the Victorian variety. The essential characters of our shell, so far as they can be made out, are, with the above exceptions, the same as those of the specific form. McCoy's species was recorded from the Caradoc series of Radnorshire, Wales.

Horizon and Locality.—Silurian (Yeringian). In the yellow mudstone from a shallow well near Kilsyth Post Office, Croydon, near Lilydale. Presented by Mr. Thos. Warr. [7936.]

* *Pterinea? asperula*, Ann. Mag. Nat. Hist., 2nd ser., Vol. VII., 1851, p. 60. Brit. Pal. Foss., Pt. II., 1852, p. 259. Pl. II., Fig 5.

Actinopteria cf. *sowerbii*, McCoy, sp. Pl. V., Fig. 72.

Avicula reticulata, Sowerby (*non* Hisinger, *non* Goldfuss), 1839, in Murchison's Silurian System, p. 614, Pl. VI., Fig. 3.

Pterinea sowerbii, McCoy, 1852, Brit. Pal. Foss, p. 263.

Observations.—The Victorian specimen is represented by an imperfect mould of the shell, and a wax impression of this shows it to be closely allied to the above-named species. The ornament of lamellated concentric folds, and the interrupted radii, together help to support this identification. Until better specimens have been discovered, however, it is safer merely to point out its relationship with the British fossil, which has been recorded as ranging from the Upper Llandovery to the Aymestry Limestone.

There is another species to which our shell bears some resemblance, namely, "*Pterinea*" *lamellosa*, Goldfuss,* but the radial ornament of the latter is much more strongly pronounced than in our specimen. Goldfuss' species is a typically Devonian shell, and has only been doubtfully recorded from the Wenlock shale and limestone in Britain.†

Horizon and Locality.—Silurian (Yeringian). Reefton, Warburton, Upper Yarra; coll. Geol. Surv. Vict. (spec. 3431). [7937.]

Actinopteria heathcotiensis, sp. nov. Pl. V., Fig. 73.

Description.—Left valve obliquely extended to the posterior angle; umbo sub-anterior, rather prominent. Anterior ala (?) small, posterior triangular, inflated in the central area; the longest side adjoining the posterior slope and extending half-way down the posterior margin. Anterior extremity narrow, the border curving obliquely round the ventral to the posterior margin, which is greatly produced, meeting the border of the posterior slope at a blunt angle. Posterior slope distinctly hollowed. Surface of shell evenly and gently convex from the middle of the umbonal area to the posterior corner, and more strongly convex from the umbo to the ventral margin. The shell is concentrically sulcose and striated, the striæ turning up at an acute angle on the posterior wing. Traces of radial striæ from the umbo to the ventral border. A salient feature of this species is the strongly convex ventral margin.

Measurements.—Height, 46 mm.; length, 65 mm.; depth of valve, 8 mm.

* Petrefactiæ Germaniæ, 1837, p. 136, Pl. CXX., Figs. *1a*, *b*.

† R. Etheridge, Brit. Pal. Foss., Vol. I., 1888, p. 100 [recorded in error as *Pterinea laminosa*, Goldf.].

Affinities.—Our species appears to be closely allied to Whidborne's *Actinopteria hirundella**, from the Devonian of Lummaton, Devonshire. The latter species differs in the more forward position of the beaks, and in the straight posterior slope behind the umbones. Another species having the same type of shell is "*Pterinea*" *ventricosa*, Goldfuss.†

Horizon and Locality.—Silurian (Melbournian). East of Heathcote; coll. Geol. Surv. Vict. [7938.]

Genus Leiopteria, J. Hall, 1883.

Leiopteria cf. *oweni*, J. Hall. Plate V., Figs. 74, 74*a*.

Leiopteria oweni, J. Hall, 1884, Pal. New York, Vol. V., Pt. 1., Lamell. I., p. 170, Pl. XX., Fig. 10.

Observations.—The Victorian specimen is represented as a fairly complete cast in mudstone. So far as can be seen, it resembles the above species in its outline, and details of surface markings, such as the undulose growth lines and faint and comparatively widely-spaced radii. Hall's specimens came from the Hamilton Group of New York State.

Mr. R. Etheridge, jun., has described a species probably referable to this genus under the name of *Leiopteria ? australis*‡, from the Carboniferous, near West Maitland, New South Wales. Our species could scarcely be compared with the former, which has a shorter hinge-line, and consequently smaller posterior wing, whilst in outline it differs considerably, being altogether a higher shell. There are, moreover, no traces of radii in Etheridge's species.

Horizon and Locality.—Silurian (Yeringian). Kilsyth, Croydon; presented by Mr. Thos. Warr. [7939.]

Family **Pectinidæ**.

Genus Aviculopecten, McCoy, 1852.

Aviculopecten spryi, sp. nov. Pl. V., Fig. 75.

Description.—Shell small, sub-orbicular; ventral border almost circular; narrow at cardinal area, hinge-line short, ears well defined. Umbo fairly conspicuous. Surface broken by 20 grooves, the intermediate areas forming depressed convex ribs with a strong median striation and fainter lateral striæ.

* Pal. Soc. Mon., Vol. XLVI., 1892, Devonian Fauna of the S. of England, p. 62, Pl. VI., Figs. 5, 6; Pl. VII., Fig. 4.
† Petrefactiæ Germaniæ, Vol. II., 1837, p. 134, Pl. CXIX., Fig. 2.
‡ Records Geol. Surv. N.S.W., Vol. V., Pt. IV., 1898, p. 178, Pl. XIX., Fig. 19.

The original is an impression of a left valve in blue mudstone, and the drawing has been made from a well-defined cast in wax.

Observations.—The above fossil is a typical *Aviculopecten*, in accordance with the emended definition of the genus given by J. Hall,* since it has a short hinge-line and well-defined ears.

Horizon and Locality.—Silurian (Melbournian). Yarra Improvement Works, S. Yarra; presented by Mr. F. P. Spry. [7940.]

Family **Modiolopsidæ**.

Genus Modiolopsis, J. Hall, 1847.

Modiolopsis melbournensis, sp. nov., Pl. V., Figs. 76, 76*a*.

Description.—Shell small, sub-quadrate, elongate, compressed posteriorly; length rather less than twice the height. Cardinal line nearly straight; ventral margin parallel. Anterior extremity narrowly rounded, and incurved under the prominent sub-anterior beaks. Posterior extremity broadly rounded, and meeting the hinge-line at an obtuse angle. Umbonal ridge extending from the beaks to near the postero-ventral angle. Greatest convexity of surface in the umbonal region; ventral area somewhat depressed. Surface marked by fine, irregularly concentric growth-lines.

Measurements.—Length, 16 mm.; height, 9 mm.

Affinities.—A form nearly allied to the above is *Modiolopsis solenoides*, Sowerby, sp.†, from the Upper Ludlow, near Bridgenorth, England. It differs from our species, however, in its greater compression, less prominent beaks, and in having a broad median depression in the ventral region.

Horizon and Locality.—Silurian (Melbournian). Yarra Improvement Works, S. Yarra. [7941.]

Modiolopsis complanata, Sowerby, sp. Pl. V., Fig. 77.

Pullastra complanata, Sowerby, 1839, in Murchison's Silurian System, p. 609, Pl. V., Fig. 7.

Modiolopsis complanata, Sow. sp., McCoy, 1852, Brit. Pal. Foss., p. 266.

* Pal. N. York, Vol. V., Pt. I., 1884, Lamell. I., p. XII.

† Siluria, 3rd ed., 1859, Pl. 23, Fig. 9 ["*Orthonota* (?*Cypricardia*) *solenoides*"].

Observations.—The Middle Devonian fossil identified by J. Phillips* as ? *Pullastra complanata*, Sowerby, is distinct from the Silurian fossil, and is not related to *Modiolopsis*, since the posterior cardinal area is not compressed nor expanded, whilst the beaks are not situated so far forward. The Victorian specimen agrees in almost every detail with Sowerby's species, which in Great Britain occurs in the Wenlock, the Upper Ludlow, and the Tilestone Series.

Measurements.—The Victorian specimen has a length of 18.5 mm.; height, 11 mm.

Horizon and Locality.—Silurian (Melbournian). This striking species was found by Mr. F. P. Spry in the blue mud stone of the Yarra Improvement Works, S. Yarra, and presented by him to the National Museum. [7942.]

Modiolopsis nasuta, Conrad sp., var. *australis*, nov.
Plate VI., Fig. 78.

References to type form—

Cypricardites nasuta, Conrad, 1841, Ann. Rep., p. 52.

Cypricardites nasuta, Emmons, 1842, Geol. Rep., p. 403, Fig. 4.

Modiolopsis nasuta, Conrad sp., J. Hall, 1847, Pal. N. York, p. 159, Pl. XXV., Fig. 7.

Orthonotus nasutus, Conrad sp., McCoy, 1852, Brit. Pal. Foss., p. 275, Pl. 1 I., Fig. 23.

Orthonota nasuta, Conrad sp., Salter, 1859, in Murchison's Siluria, 3rd ed., p. 74, fossils 12, Fig. 12. Etheridge, 1888, Foss. Brit. Ids., Vol. I., Palæozoic, p. 108.

Observations.—Those elongate and modioliform shells which have no sharp posterior umbonal ridge, and in which the cardinal line is more or less curved, may be justifiably separated from the genus *Orthonota* as now understood, and placed with *Modiolopsis* (as restricted by McCoy).† The above shell is an example of such, which, although not so strongly arched in the umbonal region, yet seems to possess all the essential characters of Hall's genus.

It is interesting to note that the specific form is widely distributed, and there seems no reason to doubt that the Australian example is generally comparable with both the N.

* Pal. Foss. Devon and Cornwall, 1841, p. 35, Pl. 17, Fig. 56.
† Brit. Pal. Foss., p. 265.

American and British specimens. The previously-recorded horizons for the specific form are at the top of the Ordovician (Hudson River Group and the Caradoc series).

The present variety is distinguished from the type species by its shorter and stouter form, and less pronounced nasute anterior extremity.

Horizon and Locality.—Silurian (Melbournian). In the hard black shale, Domain-road, S. Yarra; collected and presented by Mr. F. P. Spry. [7943.]

Genus Glossites, J. Hall, 1885.

Glossites victoriæ, sp. nov. Plate VI., Fig. 79.

Description.—Shell small, compressed, elongate ovate, narrow in front, broad behind. Hinge line slightly curved. Beaks sub-anterior, depressed. Posterior margin strongly curved; ventral margin gently curved and truncately rounded at the anterior extremity. Umbonal convexity gradually becoming more depressed on approaching the postero-ventral margin. Shell texture thin; surface concentrically wrinkled with irregular lines of growth.

Measurements.—Height, 9.5 mm.; length, 16.5 mm.; depth of valve at umbo, 3 mm.

Affinities.—The only form of this genus with which the above species can be at all closely compared is *G. depressus*, J. Hall,* from the Chemung Group of Ithaca and Elmira in the State of New York. That species, however, has a more generally depressed shell, and the beaks are more acute.

Horizon and Locality.—Silurian (Yeringian). Croydon, near Lilydale; presented by Mr. Thos. Warr. [7944.]

Genus Goniophora, Phillips, 1848.

Goniophora australis, sp. nov. Pl. VI., Fig. 80.

Description.—Shell sub-ovate, elongate; length about twice the height. Beaks large and anterior, strongly incurved toward the ventral margin. Anterior extremity of the shell narrow, very broad behind. Umbonal ridge prominent and sharp (in the type-specimen the posterior extremity of the shell is bent forward against the umbonal ridge). Basal edge sinuously curved; rising up to, and terminating just below, the beaks, at a sharp angle. Surface ornamented with numerous bifurcating lines of growth.

* Pal. N. York, 1885, Vol. V., Pt. I., Lamell. II., p. 496, Pl. XL., Figs. 15, 17; Pl. XCVI., Fig. 12.

Measurements.—Length, about 23 mm.; height, 10.5 mm.

Observations.—This form at once reminds one of *G. cymbæformis*, Sow. sp.*, which ranges throughout the Silurian in the British Isles. That species, however, is not so conspicuously marked with the lines of growth, which in our specimen are closely set and strikingly bifurcated. Another form somewhat allied, but having more numerous growth striæ, and a higher shell, is *G. consimilis* of Billings† from the Silurian of Nova Scotia.

Horizon and Locality.—Silurian (Yeringian). In mudstone N. of Lilydale. Presented by the Rev. A. W. Cresswell, M.A. [989.]

Goniophora cf. *glaucus*, J. Hall sp. Pl. VI., Fig. 81.

Sanguinolites glaucus, Hall, 1870, Prelim. Notice, Lamell, 2, p. 38.

Goniophora glaucus, Hall, 1885, Pal. N. York, Vol. V., Pt. I., Lamell. II., p. 299, Pl. XLIII., Fig. 16; Pl. XLIV., Figs. 10-17.

Observations.—Our specimen is imperfect, but the anterior and most characteristic part of the shell is represented.

The habit of the shell is short. The surface is finely striated, and the striæ turn up at a steep angle over the umbonal ridge; this latter feature itself indicates a short form. The beaks are small and strongly incurved, whilst the umbonal ridge is sharp and widely curved. Hall's specimens came from the Hamilton Group of New York State.

Horizon and Locality.—Silurian (Melbournian).—From the mudstone of the Yarra Improvement Works, S. Yarra. Presented by Mr. F. P. Spry. [7945.]

Family **Pleurophoridæ**.

Genus Cypricardinia, J. Hall, 1859.

Cypricardinia contexta, Barrande. Plate VI., 82, 83, 84.

Pterinea ? planulata, Salter *pars*, (*non* Conrad), 1848, in Phillips, Mem. Geol. Surv. Gr. Brit., Vol. II., Pt. I., p. 368, Pl. XXIII., Figs. 2 and 4.

* Cypricardia cymbæformis, Sow., in Murchison's Silurian System, Pt. II., 1839, p. 602, Pl. III., Fig. 10a, p. 609, Pl. V., Fig. 6.

† Pal. Fossils, Geol. Surv. Canada, Vol. II., Pt. I., p. 135, Pl. VIII., Fig. 8

Cypricardinia nitidula, var. *contexta*, Barrande, 1881, Syst. Sil. Bohême, Vol. VI., Pt. I., Pl. 257, Fig. IV., 19-24.

Observations.—Barrande's *Cypricardinia nitidula* is probably the same form as *C. planulata*, and it therefore falls into the synonymy of the latter species. The variety *contexta* of the same author, however, is undoubtedly similar to some of the British fossils described by Salter under Conrad's name of *C. planulata*, but from which they differ in having a secondary interlamellar ornament. The Victorian specimens show the striæ to be often arranged in chevron fashion, and a tendency in this direction is indicated in one of Salter's figures (Fig. 4, loc. cit.), shown by the peculiar twist of the radii. The Bohemian, British and Victorian fossils, having a similar ornamentation, may perhaps be more conveniently referred to as *Cypricardinia contexta*, Barrande. The British examples of *C. contexta* were described by Salter as being pretty generally distributed through the Wenlock and L. Ludlow series, where it appears to be associated, as in Bohemia, with *C. planulata*. The Bohemian examples are recorded from Stage Ff_2, which by Kayser and others is now considered to be Lower Devonian, although formerly placed in the Silurian.

Another striated form of the same type of shell as the above is to be found in Sandberger's *C. crenistria*,* represented by the more highly convex right valve. In this species, however, the striæ are essentially regular and radial.

Horizon and Locality.—Silurian (Yeringian). From the parish of Yering, coll. Geol. Surv. Vict., 1862; north of Lilydale, presented by the Rev. A. W. Cresswell, M.A.; from a shallow well near Croydon, presented by Mr. Thos. Warr. [7946, 2241-2].

Family **Lucinidæ**.

Genus Paracyclas, J. Hall, 1843.

Paracyclas siluricus, sp. nov. Pl. VI., Figs. 85, 85*a*.

Description.—Shell orbicular, length equal to the height; more or less strongly convex, compressed in the cardinal region. Beaks central, prominent, roundly acuminate. Anterior border not so widely rounded as the posterior, and less compressed.

* Die Versteinerungen des rheinischen Schichten Systems in Nassau, 1856, p. 263, Pl. XXVIII., Figs. 5, 5*a*, *b*.

Ornamented with concentric rings of growth, appearing as irregular folds, and most strongly marked near the extremities. All the examples known at present from Victoria are in the form of sandstone casts, so that the finer markings, if any, have perchance been lost. In wax squeezes taken from these casts there seem to be faint traces of a feeble radial, linear sculpturing, such as is seen in *Paracyclas lineata*, Goldfuss sp.*, which, by the way, our species otherwise resembles, with the exception that the latter is more regularly convex over the whole surface.

Measurements.—Figured specimen: Length, 15.5 mm.; height, 15.5 mm.; depth of valve, 3.5 mm.

Observations.—The present species resembles McCoy's *Anodontopsis bulla*† in its general shape, but differs in the coarser sculpturing of the shell-surface. The *A. bulla*, McCoy, does not appear to show any decided affinities with the other species described under the generic name *Anodontopsis* by McCoy, and seems to be a typical example of the earlier described genus *Paracyclas*.

It is of much interest to record that McCoy indicated the actual specimens with which I am now dealing as "a new form of *Anodontopsis* allied to *A. bulla*," by a pencil note written on the tablet of a mounted series in the Museum. The generic name *Anodontopsis*, besides being ante-dated by Paracyclas, appears to embrace three generic types as exemplified by McCoy's published species in his "British Palæozoic Fossils," as follow:—

Anodontopsis bulla, McCoy = *Paracyclas*, J. Hall, 1843.

A. angustifrons, McCoy = *Modiomorpha*, J. Hall, 1870.

A. quadratus, McCoy = *Cypricardella*, J. Hall, 1856 (*Microdon*, Conrad, 1842—pre-occupied by Agassiz's genus).

Another species which may be cited for comparison with ours is *Paracyclas elliptica*, J. Hall,‡ from the Corniferous Limestone and the Hamilton Group of the United States and Canada. It is, however, not so high, and the liræ are more distinct and more closely set.

Horizon and Locality.—Silurian (Melbournian). Coll. Geol. Surv., Moonee Ponds Creek, Flemington. Ranges east of Heathcote, B[b] 50, very common. [7947 (type), 7948.]

* Petrefactiæ Germaniæ, 1834-40, p. 227, Pl. CXLVI., Figs. 8*a*, *b*.

† *Lucina bulla*, McCoy sp., Syn. Silur. Foss., Ireland, 1846, p. 17, Pl. II., Fig. 1. *Anodontopsis bulla*, McCoy, 1852, Brit. Pal. Foss., Pt. II., p. 271, Pl. 1K., Figs. 11-13.

‡ Pal. N. York, Vol. V., Pt. I., 1885, Lamell. II., p. 440, Pl. LXXII., Figs. 23-33; Pl. XCV., Fig. 18.

Paracyclas siluricus, var. *heathcotiensis*, nov. Pl. VI., Figs. 86, 86*a*.

Description.—Suborbicular, rounded in front, subtruncate behind Beaks central, salient and subacuminate. sharper than in the preceding species. Valves strongly convex, especially in the umbonal region, where they become almost ridge-like; superficial markings in the form of fine concentric striæ.

Measurements.—Length, 13.5 mm.; height, 13.5 mm.; depth of valve, 4 mm.

Observations.—This variety presents marked differences from the foregoing species, but in view of the fact that only a single example has occurred up to the present, and in association with the specific form, it will be safer for the present to regard it merely as a variety. In common with the type form, the figured specimen shows obscure indications of a radial lineation of the shell.

Horizon and Locality.—Silurian (Melbournian). Ranges east of Heathcote, coll. Geol. Surv., Vict., B^b 50. [988.]

INDEX TO VICTORIAN SILURIAN PELECYPODA, WITH REFERENCES TO THEIR GEOLOGICAL HORIZONS.

M = Melbournian or older Silurian; Y = Yeringian or younger Silurian.

Index to Victorian Silurian Pelecypoda—*continued.*

EXPLANATION OF PLATES.

I.

Fig.

1. *Orthonota australis*, sp. nov. [Type.] Moonee Ponds Creek. [7869.] Nat. size.
2. *Grammysia abbreviata*, sp. nov. [Type.] S. Yarra. [7871.] × 2
3. *Parallelodon spryi*, sp. nov. [Type.] Wandong. [7950.] Nat. size.
4. *Leptodomus maccoyianus*, sp. nov. [Type.] Broadhurst's Creek. [976.] × 2.
5. *L. heathcotiensis*, sp. nov. [Type.] Heathcote. [987.] × 2.
6. *Palæanatina* cf. *solenoides*, J. Hall. S. Yarra. [7875.] × 2.
7. *Edmondia perobliqua*, sp. nov. [Type.] S. Yarra. [7876.] $\times 1\frac{3}{1}$.
8. *E. perobliqua*, sp. nov. S. Yarra. [7877.] × 2.
9. *E. perobliqua*, sp. nov. Domain Rd., S. Yarra. [2239.] $\times \frac{3}{2}$.
10. *Sphenotus warburtonensis*, sp. nov. [Type.] Right valve, internal cast. Reefton, Warburton. [2240.] Nat. size.
11. *Cardiola cornucopiæ*, Goldfuss sp. S. Yarra. [7878.] Nat. size.
12. *C. cornucopiæ*, Goldfuss sp. Moonee Ponds Creek. [978.] Nat. size.
13. *Panenka planicosta*, sp. nov. [Type]. Mount Matlock. [7879.] × 4
14. *P. cingulata*, sp. nov. [Type.] McMahon's Creek, Upper Yarra. [2263.] Nat. size.
15. *Paracardium filosum*, sp. nov. [Type.] From a wax impression of an external mould. Starvation Creek, Upper Yarra. [7881.] × 2.
16. *P. filosum*, sp. nov. Cardinal aspect of same × 3.

II.

17. *Ctenodonta portlocki*, sp. nov. Wilson's Station, Lilydale. [7884.] × 2.
18. *C. portlocki*, sp. nov. [Type.] S. Yarra. [7883.] × 2.
19. *C. portlocki*, sp. nov. S. Yarra. [7885.] × 2.
20. *C. portlocki*, sp. nov. S. Yarra. [7886.] × 2.
21. *Nuculites maccoyianus*, sp. nov. [Type.] S. Yarra. [7887.] × 2
22. *N. maccoyianus*, sp. nov. Junction of Woori Yallock and Yarra. [7888.] × 2.
23. *N. maccoyianus*, sp. nov. S. Yarra. [7889.] × 2.
24. *N. coarctatus*, Phillips, sp. A short variety. S. Yarra. [7890.] × 2.
25. *N. coarctatus*, Phill., sp. Typical form, from W. of Mt. Disappointment. [7891.] × 2.
26. *N. subquadratus*, sp. nov. W. of Mt. Disappointment. [977.] × 2
27. *N. subquadratus*, sp. nov. [Type.] × 2. 27A, Anterior of valve more highly magnified to show surface ornament. N. of Yan Yean. [7892.] × 4.
28. *N. jutsoni* sp. nov. [Type.] Wandong. [7893.] × 2
29. *Nucula melbournensis*, sp. nov. Internal mould. S. Yarra. [7896.] × 2.

30. *Nucula melbournensis*, sp. nov. A sub-orbicular variety. Domain Rd. sewer, S. Yarra. [985.] × 2.
31. *N. melbournensis*, sp. nov. [Type.] 31A, umbonal aspect of left valve. S. Yarra. [7895.] × 2.
32. *N. ? melbournensis*, sp. nov. 32A, antero-dorsal view. Merri Creek, Kalkallo. [7879.] × 2.
33. *N. ? melbournensis*, sp. nov. Attached valves. 33A antero-dorsal profile of valves. S. Yarra. [7898.] × 2.
34. *N. umbonata*, sp. nov. [Type.] Kilmore. [7899.] × 2
35. *N. umbonata*, sp. nov. Inner surface of valve showing cardinal line and ligament pit. Yan Yean. [7900.] × 2.
36. *N. arcæformis*, sp. nov. [Type.] Domain Rd. sewer, S. Yarra. [7901.] × 2.
37. *N. taylori*, sp. nov. [Type.] S. Yarra. [7907.] × 2.
38. *N. taylori*, sp. nov. Wax impression of an internal mould. Broadhurst's Creek, E. of Kilmore. [7908.] × 2.

III.

39. *Nucula opima*, J. Hall, sp., var. *australis*, var. nov. Yan Yean. [7910.] × 2.
40. *N. opima*, J. Hall, sp., var. *australis*, var. nov. [Type.] Yan Yean. [7909.] × 2.
41. *N. opima*, J. Hall, sp. var. *australis*, var. nov. S. Yarra. [7911.] × 2.
42. *N. opima*, J. Hall, sp., var. *australis*. Internal cast. Fraser's Creek, Springfield. [965.] × 2.
43. *N. opima*, J. Hall sp., var. *australis*, var. nov. Abnormal form, South Yarra. [7912.] × 2.
44. *N.* cf. *lirata*, Conrad sp. Yan Yean. [7914.] × 3.
45. *N. lamellata*, J. Hall. A short variety. Broadhurst's Creek, E. of Kilmore. [2252.] × 2.
46. *N. lamellata*, J. Hall. Schist Hill, Merri Creek. [2243.] × 2.
47. *Palæoneilo victoriæ*, sp. nov. Left valve. [Type.] S. Yarra. [7915.] × 2.
48. *P. victoriæ*, sp. nov. Elongate form; the two valves with the cardinal lines in position. S. Yarra. [7916.] × 2.
49. *P. victoriæ*, sp. nov. Right valve of an elongate and finely costate form. Domain Road sewer, S. Yarra. [7917.] × 2.
50. *P. raricostæ*, sp. nov. [Type.] Left valve. Junction of Woori Yallock and Yarra. [7918.] × 2.
51. *P. spectabilis*, sp. nov. Right valve. [Type.] S. Yarra. [7919.] × 2.
52. *P. spectabilis*, sp. nov. Interior of left valve and cardinal area of right valve. Jolimont, E. Melbourne. [7920.] × 2.
53. *P. producta*, sp. nov. [Type.] 53A, dorsal aspect of right valve. S. Yarra. [7921.] × 2.
54. *P. ? constricta*, Conrad sp. Cast of right valve. S. Yarra. [7923.] × 2.
55. *P.* cf. *brevis*, J. Hall. Merri Creek, Kalkallo. [968.] × 3
56. *P.* cf. *tenuistriata*, J. Hall. Merri Creek, Kalkallo. [967.] × 2.

SILURIAN BIVALVED MOLLUSCA OF VICTORIA.

IV.

57. *Parallelodon æqualis*, sp. nov. [Type.] S. Yarra. [7924.] × 3.
58. ? *Parallelodon kilmoriensis*, sp. nov. [Type.] Kilmore. [7925.] × 2.
59. ? *P.* cf. *kilmoriensis*, sp. nov. Swanston St. sewer. [7926.] × 2.
60. *Pterinea lineata*, Goldfuss. Left valve. Croydon, near Lilydale. [7927.] Nat. size.
61. *P. tenuistriata*, McCoy. S. Yarra. [7928.] × $\frac{3}{2}$
62. *Lunulicardium antistriatum*, sp. nov. [Type.] McMahon's Creek. [2257.] Nat. size.
63. *L. antistriatum*, sp. nov. Reefton, Warburton. [2255.] Nat. size.

63A. *L. antistriatum*, sp. nov. Vental margin of shell. Reefton, Warburton. [2255.] Nat. size.

64, 65. ? *Lunulicardium antistriatum*, sp. nov. Probably young examples. Mouth of Starvation Creek, Upper Yarra. [2260-61.] × 2.

66. *Ambonychia acuticostata*, McCoy. Cave Hill, Lilydale. [2268.] × 2.
67. *Mytilarca acutirostris*, sp. nov. [Type.] Junction of Woori Yallock and Yarra. [7930.] × 2.
68. *Actinopteria texturata*, Phillips, sp. (× 2): 68A, portion of shell-surface more highly magnified (× 4). Near Lilydale. [2264.]
69. *A. boydi*, Conrad, sp. Near Lilydale. [7933.] × 2.

V.

70. *Actinopteria boydi*, Conrad, sp. Another specimen to show variation in surface ornament. Croydon, near Lilydale. [7935.] Nat. size.
71. *A. asperula*, McCoy, sp., var. *croydonensis*, var. nov. Croydon, near Lilydale. [7936.] Nat. size.
72. *A.* cf. *sowerbii*, McCoy, sp. From a wax impression. Reefton, near Warburton, Upper Yarra. [7937.] Nat. size.
73. *A. heathcotiensis*, sp. nov. [Type.] Heathcote. [7838.] Nat. size.
74. *Leiopteria* cf. *oweni*, J. Hall. Left valve. 74A, profile. Croydon, near Lilydale. [7939.] Nat. size.
75. *Aviculopecten spryi*, sp. nov. [Type.] S. Yarra. [7940.] × 3.
76. *Modiolopsis melbournensis*, sp. nov. [Type.] Left valve. 76A, antero-dorsal profile of valve. S. Yarra. [7941.] × 2.
77. *M. complanata*, Sowerby, sp. S. Yarra. [7942.] × 2.

VI.

78. *Modiolopsis nasuta*, Conrad, sp. var. *australis*, var. nov. [Type.] S. Yarra. [7943.] × 2.
79. *Glossites victoriæ*, sp. nov. [Type.] Right valve. Croydon, near Lilydale. [7944.] × 2.
80. *Goniophora australis*, sp. nov. [Type.] N. of Lilydale. [989.] × $\frac{3}{2}$.
81. *G.* cf. *glaucus*, J. Hall, sp. S. Yarra. [7945.] × 2.

82. *Cypricardinia contexta*, Barrande. Right valve. Croydon, near Lilydale. [7946.] × 2.
83. *C. contexta*, Barrande. Surface of right valve on the umbonal slope. Croydon, near Lilydale. [7946.] × 4.
84. *C. contexta*, Barrande. Left valve. Yering, Upper Yarra. [2242.] × 2.
85. *Paracyclas siluricus*, sp. nov. [Type.] 85A, umbonal aspect of left valve. Ranges E. of Heathcote. [7947.] × 2.
86. *P. siluricus*, var. *heathcotiensis*, var. nov. [Type.] 86A, umbonal aspect, left valve. Heathcote. [988.] × 2.
87. *Actinodesma* cf. *ampliata*, Phillips, sp. N. of Lilydale. [2267.] Nat. size.
88. *Prælucina ancilla*, Barrande. From a wax impression of a mould of a right valve in hardened mudstone. 88A, umbonal aspect. Maindample, Gippsland. [7882.] Nat. size.

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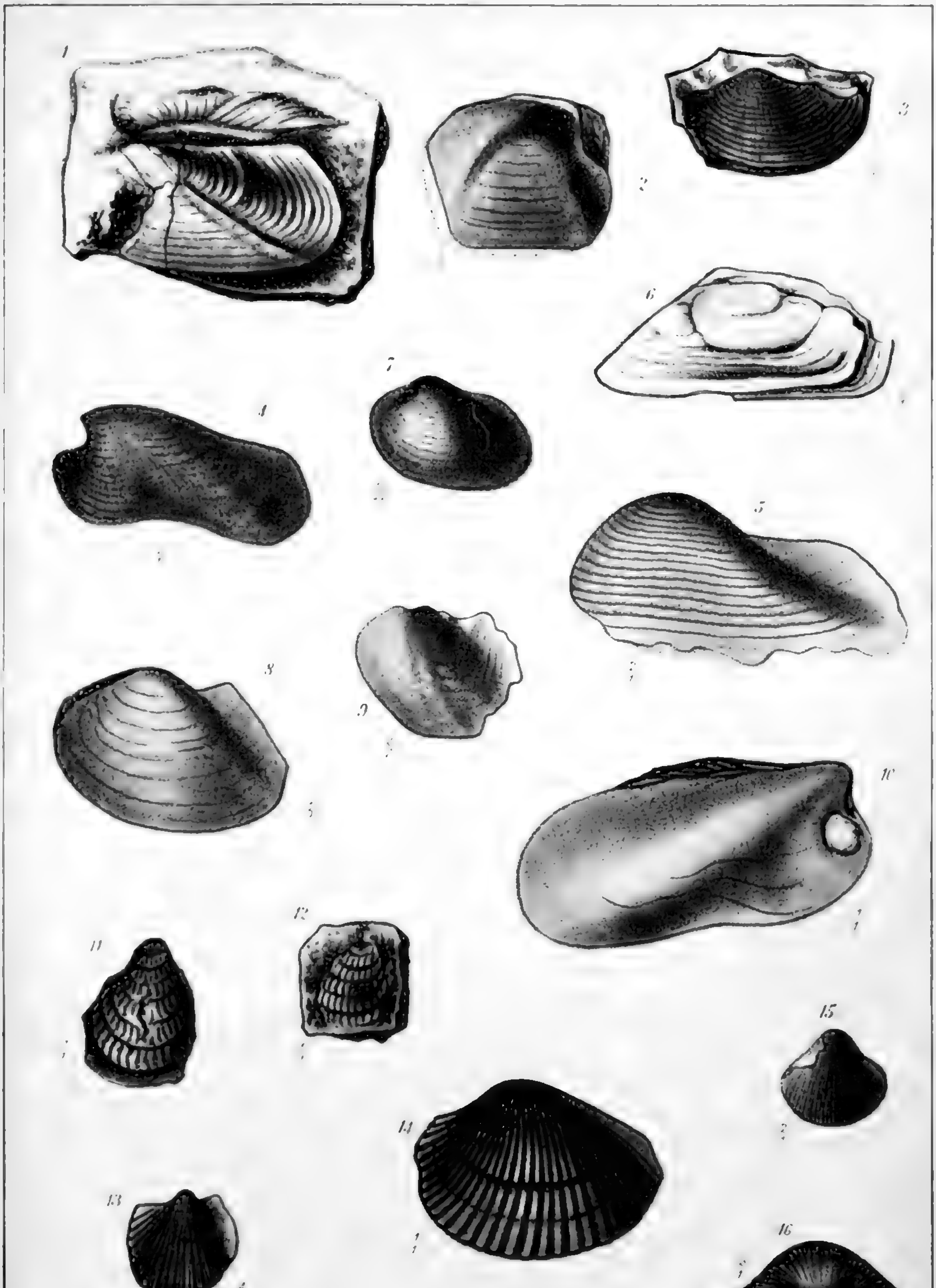

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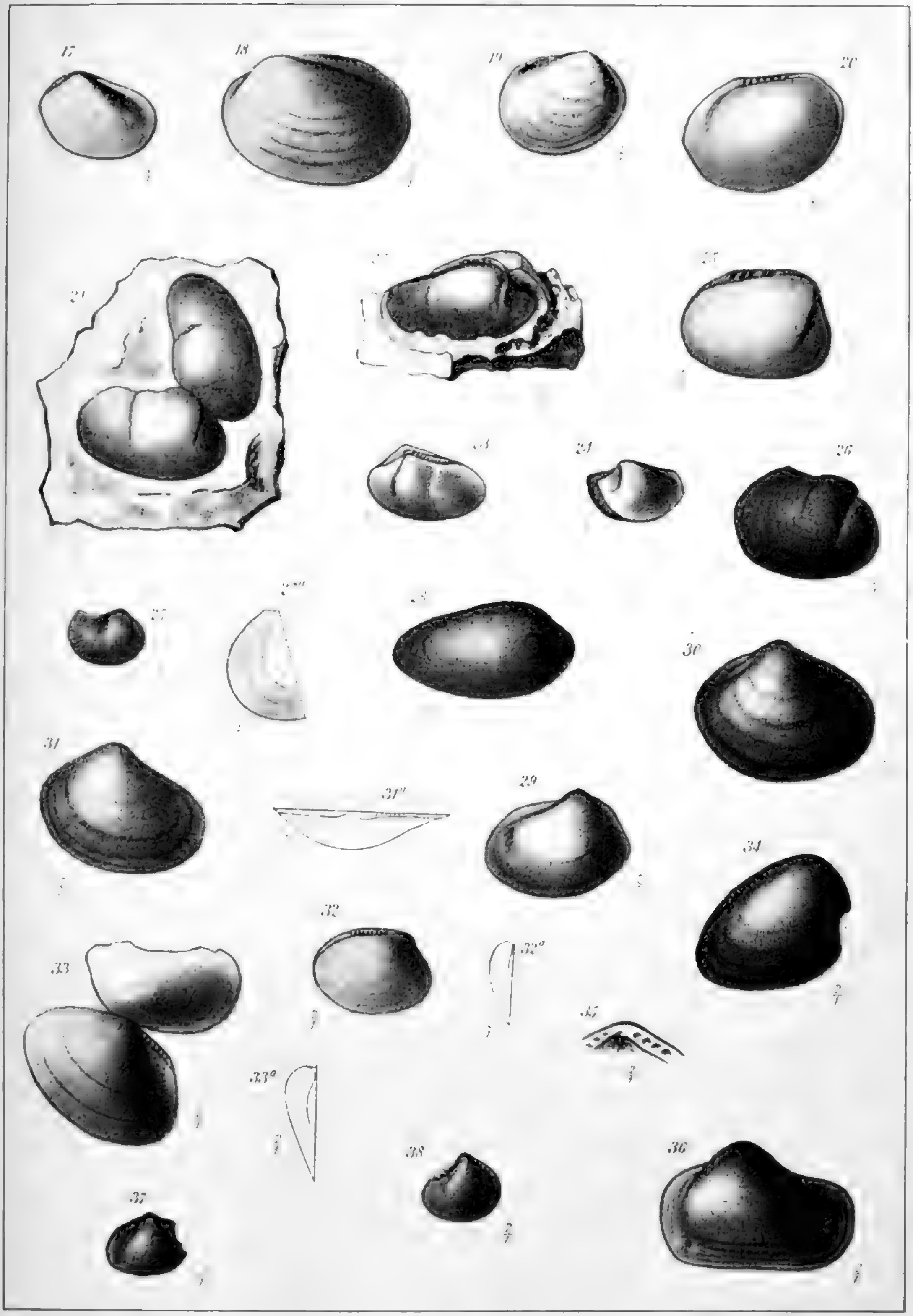

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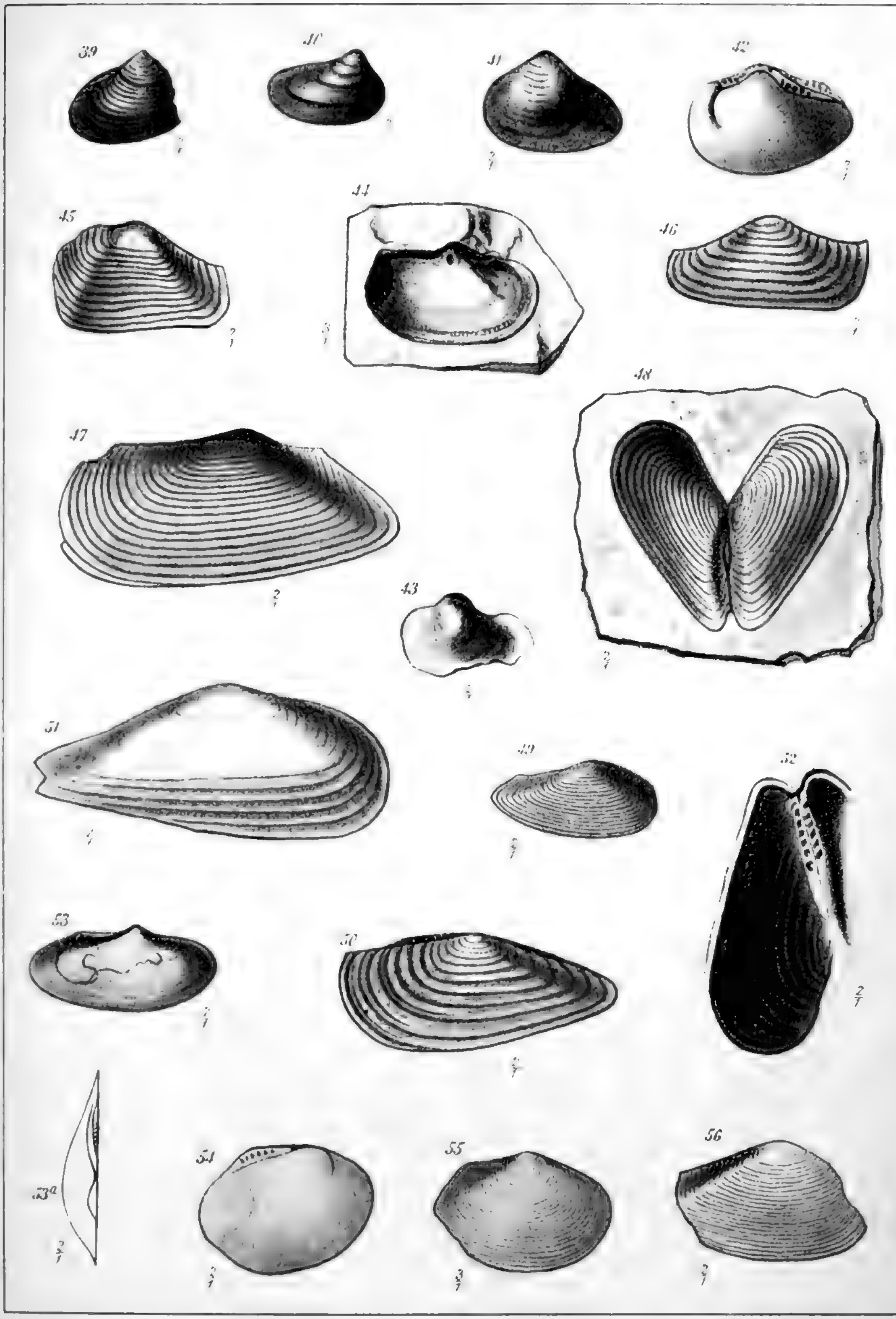

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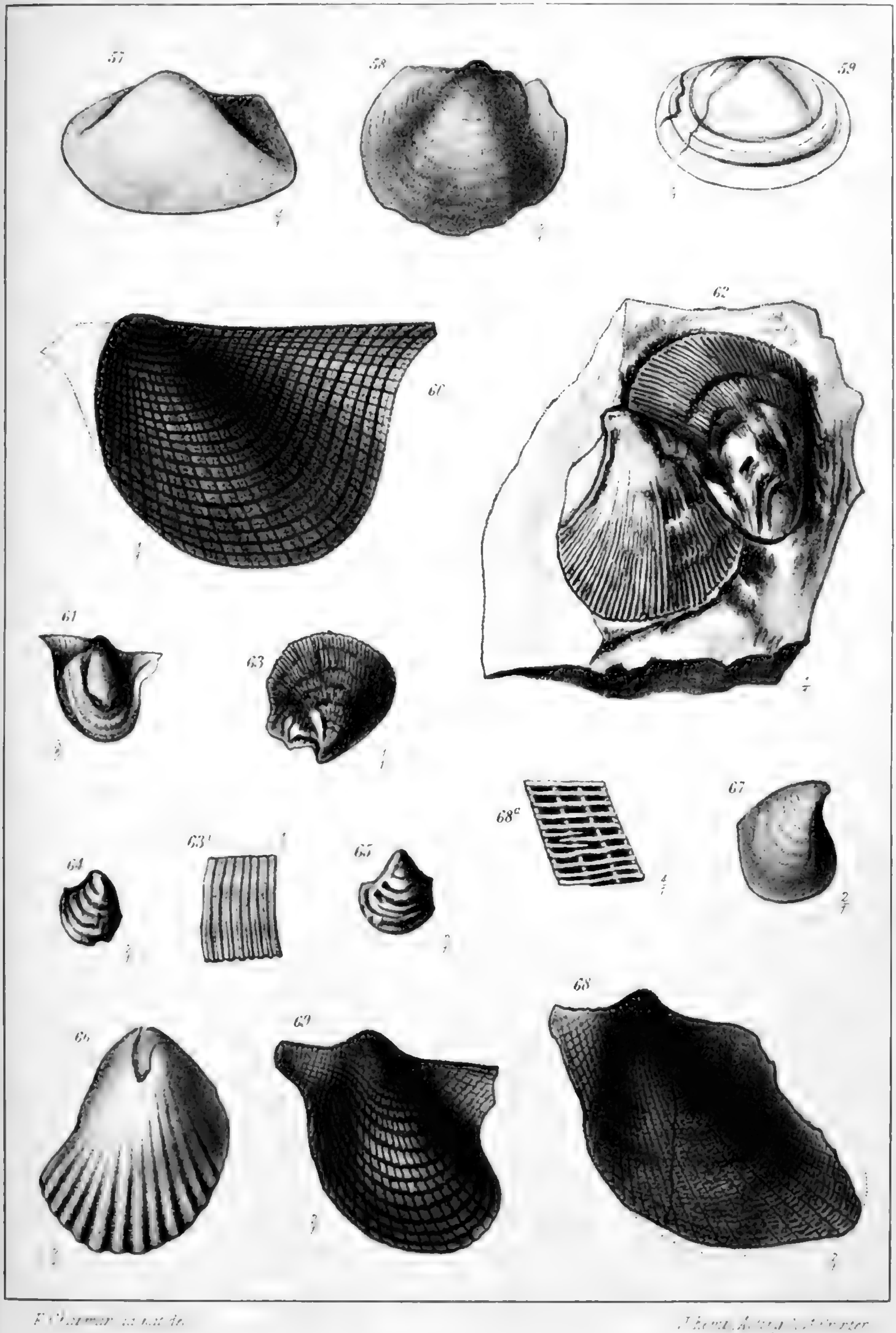

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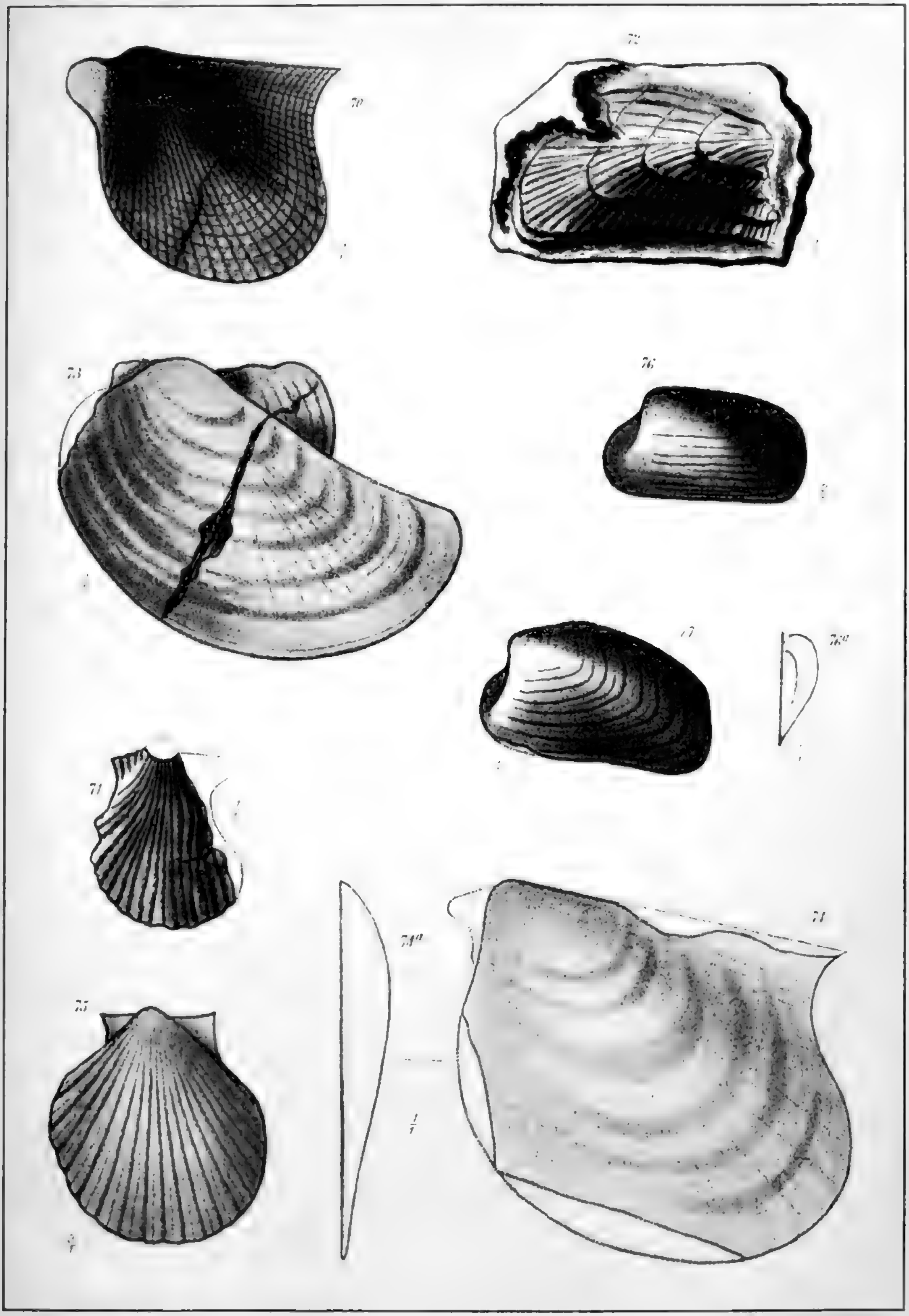
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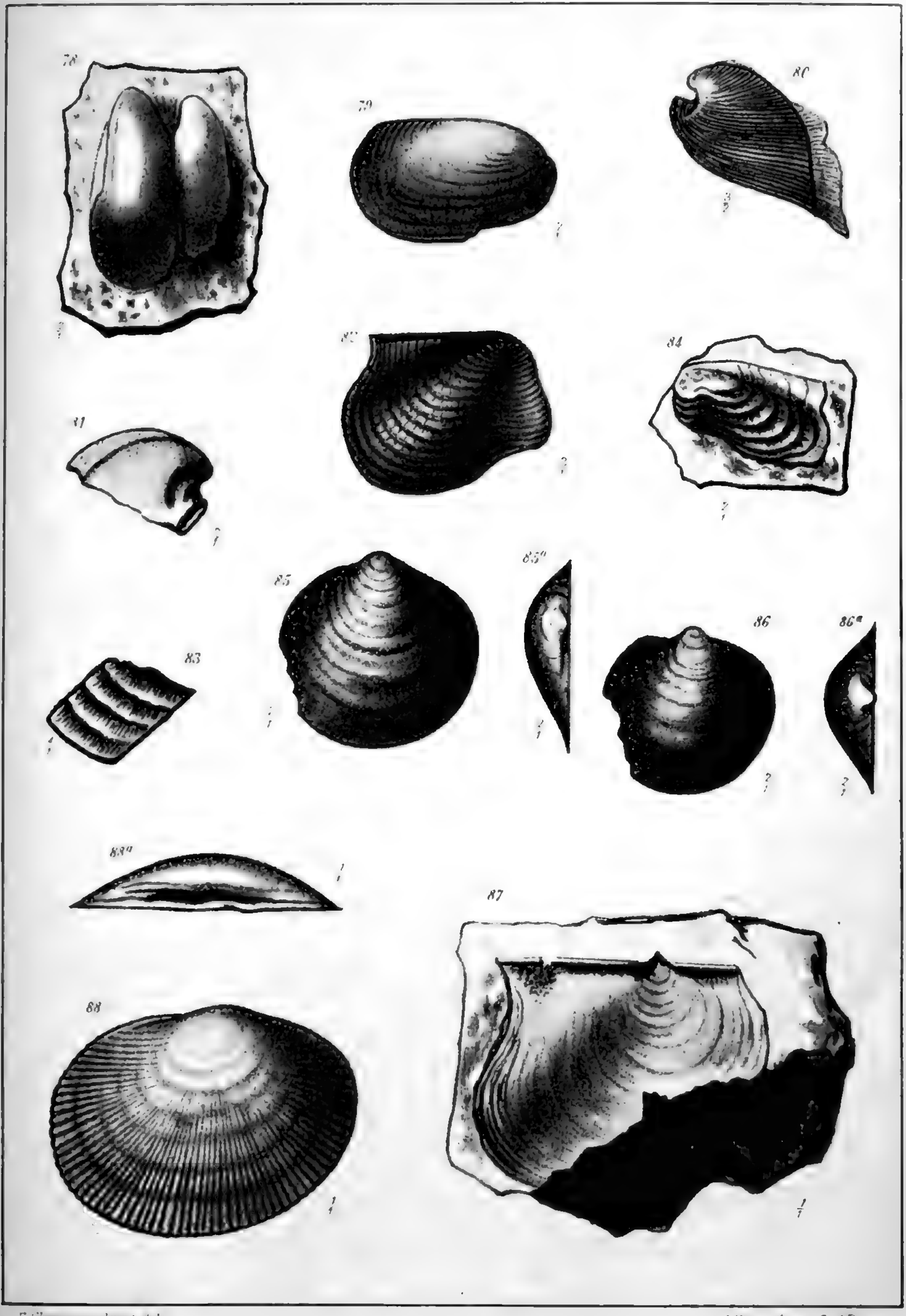

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CONTENTS

A COLLECTION OF SUB-FOSSIL BIRD AND MARSUPIAL REMAINS FROM KING ISLAND, BASS STRAIT.

By Baldwin Spencer, C.M.G., M.A., F.R.S., Hon. Director of the National Museum, and J. A. Kershaw, F.E.S., Curator of the Zoological Collections.

King Island lies at the western entrance to Bass Strait, almost midway between Victoria and Tasmania. A line of sounding, between the island and Tasmania, as laid down in the Admiralty charts, shows an average depth of thirty-two fathoms. The lowest is twenty, the highest forty-four, and the great majority range between thirty and thirty-five fathoms. A line between King Island and Cape Otway, on the Victorian coast, averages nearly forty-eight fathoms. The lowest is thirty-nine, the highest fifty-five.

The date of the formation of Bass Strait is a matter of doubts but it may in all probability be assigned to the Post Pliocene period.*

The fauna of Tasmania differs from that of Victoria partly in the absence of certain animals, such as the Dingo (*Canis dingo*) and the flying phalangers amongst the marsupials, and partly in the presence of others, such as Thylacinus and Sarcophilus, which are now extinct on the mainland of Australia. Such differences as exist between the fauna of Victoria, south of the Dividing Range, and that of Tasmania, may be regarded as due to the formation of Bass Strait, which resulted, during comparatively recent times, in the separation of Tasmania from the south-east part of Australia. Some idea of the nature of the land bridge that once stretched across between Victoria and what is now the island of Tasmania can be gained from a study of its remnants, as revealed to us in the chain of islands that stud both the western and the eastern margins of Bass Strait. The central part of the strait is open water, but on the eastern side a chain of islands, consisting in the north of smaller groups, such as the Curtis and Kent, and in the south the larger Furneaux group, lead across from Wilson's Promontory on the mainland to the north-east corner of Tasmania. On the west there is King Island, and close to the north-west point of

* Howitt, Presidential Address, Anthrop. Sect. Aust. Ass. Adv. Sci., Sydney, 1898, Vol. VII., p. 741.

Tasmania a group of smaller islands—Hunter Islands and the Hummocks. Between King Island and Cape Otway lies open water, with a curious and well-marked dipping invading the fifty fathom line, indicating in all probability the former existence of the estuary of a large stream that once ran southwards from the Victorian ranges. We may therefore safely conclude that the old land bridge was traversed in its north-western part by a river of considerable size, that its central part was comparatively low land.* and that this was bordered on the east by a chain of lofty hills. Across this central part a river probably ran northward to join the one flowing southwards near its estuary. On the western side, to the south of the estuary, was high ground, part of which is now represented by King Island.

In the early days of Australian settlement a few sealers and fishermen frequented King Island, but for long years it was practically deserted until, about thirty or forty years ago, an attempt was made to utilize it as a sheep run, but the existence of the poison weed (*Swainsonia lessertifolia*) proved fatal to the scheme, and once more the island was abandoned. In November, 1887, the Victorian Field Naturalists' Club organized an expedition to the island. Its only inhabitants at that time were the lighthouse-keepers at Cape Wickham and Currie Harbor, and one solitary wallaby hunter. We had considerable difficulty in traversing the island, owing to the fact that its northern half was covered with dense scrub, and its southern part with impenetrable forest. During recent years the island has been occupied again, much of the scrub has been cleared away, and parts previously inaccessible have been opened up. On one occasion a large flock of sheep was placed on what is now known as the "sand patch," near to Stokes Point, the extreme south-western promontory of the island. At that time this particular part of the island was covered with grass, but the sheep eat this down to the roots, and, later on, "numbers of pigs, rooting about, turned up the soil and started a sand-blow, which now extends over some hundreds of acres. There is a dividing ridge running the length of the patch, and the sand shifts from one side of the ridge to the other with every change of wind. . . . . It was during a strong westerly gale that I rode down to Surprise Bay. . . . . Every few yards lay the bone of some animal in a more or less perfect state of preservation, and here and there the ground was covered with the petrified stumps and roots of old scrubs."†

The fact of the existence of these sub-fossil remains became known to Mr. H. H. Scott, the Curator of the Victoria Museum, Launceston, who placed himself in communication with Mr. J.

* Howitt, A.A.A.S., Sydney, 1898, Vol. VII., p. 758.

† Extract from a letter written to one of the authors by Mr. T. Alfred Stephenson, to whom we are indebted for valuable assistance.

McKie Bowling, the proprietor of that part of the island, and was instrumental in securing the first collection that was made. A short time afterwards Miss Dickson, of Hobart, visited the island, and was shown the fossil remains by Mr. Bowling. On her return to Hobart Miss Dickson brought the matter under the notice of the Royal Society of Tasmania, with the result that Mr. R. M. Johnston and the late Mr. Alex. Morton went across from Launceston, and, through the instrumentality of Mr. Bowling, were able to secure a series of specimens, which they kindly placed at our disposal for description. This collection included a considerable number of bones of an Emu, and, after a careful examination of the latter, they were described as the remains of a new species, to which the name *Dromæus minor* was given.*

The collection received from Messrs. Johnston and Morton included also skulls of a Wombat and Dasyurus, and, in view of the importance of the remains as indicating the existence in the islands of Bass Strait of animals, such as an Emu and a Wombat, distinct from those of the mainland and Tasmania, we thought it advisable to make further investigations, and, accordingly, one of us (J. A. Kershaw) went across to King Island, and spent some time there carefully collecting as much material as was available. Most fortunately for us Mr. Bowling was much interested in our work, and afforded us the most generous assistance, without which it would not have been possible for us to secure the large series of specimens that we now possess, and we take this opportunity of thanking Mr. Bowling for his invaluable aid.

The remains were chiefly distributed over the sand dunes on the extreme southern portion of the island.† The area covers some 300 acres in extent, and consists of a series of small ridges, the highest of which is on the south-east point. The sand is constantly being blown from one side or the other of these ridges, and the bones alternately exposed and covered. During the strong winds which prevail these are sifted out in considerable numbers, and lie distributed along the sides and in the trough of the ridges Portions of the skulls, lower jaws, and limb bones of Wallabies were found mixed up with the leg bones of the Emu, skulls of Wombats and Dasyures, and here and there portions of the skeletons of both Seals and Sheep. Wallaby remains were by far the most numerous, and, though extremely fragile, fairly complete skulls could be obtained. Portions of the lower jaws were scattered about in large numbers along the sides of some of the ridges, which had recently been exposed to the action of the wind.

* "Victorian Naturalist," xxiii., p. 140 (1906).
† We are indebted to Mr. C. L. Barrett for the opportunity of illustrating the nature of these dunes.

Emu remains were scarce. Every bone that would bear handling was collected. Very dilligent search was made for any portions of the skull or sternum, but although the whole area was carefully examined several times, but few fragments of skulls or sterna were found. Very incomplete portions of the sternum were occasionally found imbedded in the firmer soil beneath the sand, but every attempt to remove them resulted in their crumbling away. The remains of the eggs were frequently met with either in small fragments in the loose sand, or in patches imbedded in the firmer soil beneath. In one or two instances fully half the shell was found completely flattened out and fractured into small fragments, with the surface more or less removed by the action of the driving sand.

Exposure to the sun and rain had rendered many of the bones extremely fragile, so that when disturbed, however carefully, they broke into small fragments.

Fairly complete skeletons of Wallabies and one or two Emus were found lying in the more compact soil beneath the sand, but the most careful attempt to remove them again resulted in failure.

Although most of the remains were found on the extreme south point of the island, they were also met with on several parts of the west coast wherever a sand blow had started. Bones of Wallabies. Wombats, Emus, and Dasyures were found fairly numerous on an extensive sand blow near the Porky River, some 6 miles north of Currie Harbor. These were, however, less complete and much more fragile than those obtained from the south. That so many bones should be gathered together in one spot is doubtless to be attributed to the fact that in the early days, before the advent of the white man with his sheep, this area was one of the most fertile spots in the island, and was probably a much frequented and favourite feeding ground.

The collection contains remains of the following animals :—

1. Dromæus minor. Spencer.
2. *Tachyglossa aculeata, var. setosa. Shaw.
3. *Macropus billardieri. Desm.
4. *Macropus ruficollis. Desm.
5. *Pseudochirus cooki. Desm.
6. *Potorous sp.
7. Phascolomys ursinus. Shaw.
8. *Phascologale minima. Geoff.
9. Dasyurus bowlingi. Sp. n.
10. Mus sp.

Of these animals the six marked with an asterisk form part of the present fauna of the island, but their bones are intermingled under the sand dunes with those of the other three that are now extinct. We will deal at further length with these three.

Dromæus minor.

The original discovery of an Emu on the islands of Bass Strait was made in 1802. In December of that year Admiral Baudin in his exploring ships *Géographe*, *Naturaliste*, and *Casuarina* visited Kangaroo Island, so named by Flinders, though Baudin, unaware that he had been forestalled by the English navigator, called it île Decrès. Péron described the existence of large troops of Emus there. Three of them were brought back alive to Paris. One went to the Jardin des Plantes and two to the Chateau of Malmaison. The latter evidently found their way eventually to the Museum, as Viellot speaks of several Emus of small size living at his time in the Jardin des Plantes. The Museum now possesses two specimens*, (1) a skeleton labelled "Casoar de la Nouvelle Hollande, mort à la Ménagerie en Mai 1822, de l'île King, par Péron et Lesueur, expédition du Capitaine Baudin," (2) a stuffed specimen labelled "*Dromaius ater* V., Port Jackson, Australie, expédition du Capitaine Baudin," and bearing this further remarkable legend, "Casoar de la Nouvelle Hollande. *Casuarius Australis*, Lath., rapporté vivant de Port Jackson par l'expédition du Capitaine Baudin, mort en avril 1822—Le squelette est à l'anatomie." As Milne Edwards and Oustalet point out, the stuffed specimen certainly contains some bones, and as the skeleton in the gallery is complete the two specimens must represent parts of at least three birds. However this may be, both specimens certainly came from Kangaroo Island, and from neither King Island nor Port Jackson. The mistake with regard to King Island is all the more curious, because during Baudin's expedition the naturalists Leschenault, Bailly, Lesueur, and Péron were left stranded at Sea Elephant Bay, on the east coast of King Island, a strong gale forcing the ships to stand off from the land. Fortunately for them, they came across a few sealers who had settled in this out-of-the-way spot. The chief man amongst them, named Cowper, entertained the French naturalists in his quarters, and in addition to actually seeing two "Casoars" hanging up in his larder they subjected him to a close questioning, the questions and answers being set forth in great detail in a remarkable manuscript recently published by Messrs. Milne Edwards and E. Oustalet.† Cowper described the bird as possessing when young a greyish plumage that became quite black when the bird reached maturity;

* Notice sur quelques espèces d'oiseaux actuellement éteintes qui se trouvent représentées dans les collections du Muséum d'histoire naturelle, par M. A. Milne Edwards et M. E. Oustalet. Paris. 1893. Extrait du volume commémorative du centenaire de la fondation du Muséum d'histoire naturelle, p. 63. For the opportunity of consulting this I am indebted to Professor E. C. Stirling.

† Note sur l'emeu noir (Dromæus ater V.) de l'ile Decrés. Bull. du Muséum d'histoire naturelle. 1899. p. 206. For the opportunity of referring to this I am indebted to R. Etheridge, jun., Esq.

its height was 4½ ft.—that is less than the mainland form—it weighed 40 lbs. to 50 lbs. ; the male was slightly larger than the female, but there was not much difference; and, finally, Cowper informed his catechist that he had himself killed no fewer than 300 birds.

It is rather curious that the naturalists appear to have contented themselves with questioning Cowper, and apparently made no attempt to capture a specimen, which would have been a much more satisfactory manner in which to determine the nature of the bird.

For many years sealers and fishermen frequented King Island, and if many of them followed Cowper's example in regard to his wholesale slaughter of the bird, as doubtless they did, it is not at all surprising that the members of the Field Naturalists' Club, who visited King Island in 1887, found not a trace of the Emu at Sea Elephant Bay on the very spot where, eighty-five years earlier, the French naturalists had questioned Cowper.

In addition to the collection secured by Messrs. Johnston and Morton we have the extensive one made by one of us, and Mr. H. H. Scott, Curator of the Victoria Museum in Launceston, generously placed all of his material at our disposal. We have been in frequent communication with Mr. Scott, who has assisted us in every possible way, and we desire to record our special thanks to him.

The whole collection, upon which the following account is based, contains, apart from many others that evidently belong to decidedly immature birds, the following bones :—

1. Sixty-four femora.
2. Forty-one tibio-tarsi.
3. Seventy tarso-metatarsi.
4. Four pelves of which the total length can be measured, and parts of sixteen others.
5. Parts of six skulls.
6. One pectoral arch.
7. Portions of three sterna.
8. Fourteen fibulæ.
9. Ribs.
10. Vertebral bodies.
11. Toe bones.

1. *Femur*.

(Plate 2.)

The sixty-four femora vary in length from 186–130 mm. A mature *D. novæ-hollandiæ* measures 238 mm., and the length of that of *D. peroni* (= *D. ater*) is given as 180.*

* In his work on "Extinct Birds," (p. 235), the Hon. Walter Rothschild points out that Vieillot applied the specific name *ater* to Latham's *Casuarius novæ-hollandiæ*, and also that the same author makes no mention of Péron or the île Decrès. Mr. Rothschild has, therefore, proposed the specific name *peroni* for the extinct Kangaroo Island bird.

The following table is instructive as affording a good idea of the general size of the femur:—

Length.	180 and over.	170-180.	170-160.	160-150	150-140.	Less 140.
Number of specimens	2	13	20	19	6	4

Of the two longest, one measures 186, the other 180, but as will be seen, the great majority lie between 150-180. The collection evidently includes bones of birds of different ages, as the smallest ones (not included in the table) only measure 110 mm. Almost every one of those included in the table would, however, if found separately, be regarded as the bone of a well-developed bird. How far differences in size are sexual as well as age characteristics it is impossible to say, but when questioned by the French naturalists, Cowper, the fisherman, said that though the male was the larger the difference in size was not considerable. He also said that the bird reached maturity in one year. We may probably regard the two larger ones as decidedly above the average size of a mature bird, the femur of which would be more nearly 170 than 180 mm. So far as the structure of the bone is concerned, there is no difference save size between it and the corresponding bone of *D. novæ-hollandiæ.*

2. *Tibio-tarsus.*

(Plate 3. Figures 1-10.)

The whole collection includes 75 examples of this bone. The 41 that are included in the table of measurements vary greatly in length. In the original description the greatest length was given as 332. Out of the limited number then collected only two exceeded 320. In the large collection now available there are only four of this size, and they measure respectively 363 mm.* (?), 354 mm., 332 mm., and 328 mm. The general results of the measurements is given in the following table:—

Length	Above 350	350-340	340-330	330-320	320-310	310-300	300-290	290-280	280-270	270-260
Number of specimens	2	0	1	1	4	6	3	12	10	2

It will be noted that two out of the series exceed by 23 mm. and 14 mm. respectively the length of the specimen of *D. peroni* in the Paris Museum. The number of specimens of the latter species that have been preserved is unfortunately so small that it is impossible to judge of the amount of variation in the size of the

* This is slightly broken.

bird. That considerable variation did exist is almost certain, judging from the measurements of adult mainland and King Island forms. Out of 42 apparently mature bones of the King Island bird, that is, bones in which the tibial and tarsal elements are firmly ankylosed, it would be rather curious not to find more than two representing those of normal full-sized birds, so that we are probably safe in concluding that these two especially long bones represent birds of abnormal size.*

We are inclined to think that the length of an average-sized mature male is between 300 and 320; that those in the table above this are exceptionally large specimens; that the large number measuring from 270-290 mm. in all probability are fully-grown females and males that are not fully grown. In the case of all those included in the 41 the bones appeared, however, to be mature, with the peroneal ridge well marked.

For the sake of comparison we have illustrated both the tibio-tarsus of *D. novæ-hollandiæ* and that of *D. peroni*.† The former is mature, and measures 446 mm. The latter is not mature, and measures only 276 mm. The Paris specimen measures 342. We have placed the Kangaroo Island tibio-tarsus by the side of a King Island bone of approximately the same length. A comparison of the two indicates the fact that the latter bird was evidently of considerably more robust build than the former. Messrs. Milne Edwards and Oustalet say that the tibia in *D. peroni* is quite straight, in contrast to the slightly curved bone in *D. novæ-hollandiæ*. In all tibio-tarsi from King Island, and in the Kangaroo Island bone, there is a slight but quite distinct curvature.

3. *Tarso-metatarsus.*

(Plate 4. Figures 1–12.)

The 70 specimens measured are not all of them mature bones. The lengths of those that are mature, that is, in which the tarsal element is firmly attached to the end of the metatarsal element, the tubercle for the tibialis anticus well marked, and the foramen completely enclosed, varies from 216 mm. to 292 mm. The largest presumably belonged to old males of exceptional size, the smaller to small females. On the other hand, there are quite immature bones measuring as much as 240 mm. in length. Out of the 70 specimens measured, one reached the length of 292 mm.,‡ and four others the lengths respectively of 278, 278, 277, and 271 mm. As shown in the table, the majority of measurements lie between 220 and 250 mm. There are 23 between 230 and 240, and 12 between 220 and 230, and the same

* *See* p. 17.

† For the opportunity of figuring this we are much indebted to Professor Stirling, Director of the South Australian Museum.

‡ Mr. H. H. Scott informs us that one of his specimens measures 294 mm.

number between 240 and 250. We are probably correct in regarding the length of an average mature tarso-metatarsus as being between 230 and 240 mm.

Above 290	280–290	270–280	260–270	250–260	240–250	230–240	220–230	210–220	200–210	190–200
1	0	4	2	2	12	23	12	11	1	2

In the following table are given the measurements of the femur, tibio-tarsus, and tarso-metatarsus of seven mature specimens of *Dromæus novæ-hollandiæ*, from which it will be seen that there is considerable variation in the size of the bones of the mainland form, though not so great as in the case of the island species:—

Bones of Dromæus novæ-hollandiæ.

	*	*	*	†	†	†	‡
Femur	230	240	227	229	243	217	210
Tibio-tarsus	415	446	429	433	470	450	373
Tarso-metatarsus ...	375	395	388	394	411	335	340

In the following table we give side by side the lengths of the same bones in the three species, taking, in the case of *D. minor* and *D. novæ-hollandiæ*, bones that belong to fair, average-sized, mature specimens.

—	D. minor.	D. novæ-hollandiæ.	D. peroni.
Femur	175	227	180
Tibio-tarsus	325	429	342
Tarso-metatarsus ...	235	388	290

4. *Pelvis.*
(Plate 4.)

There is a most striking difference in size between the pelvis of the mainland and that of the King Island bird, and fortunately, though the bones are very fragile, only one specimen retaining any appreciable part of the pubis and ischium, sufficient measurements can be obtained to warrant the separation of the two species on the evidence of this bone alone.

—	D. minor.						D. novæ-hollandiæ.			*D.* peroni.
Length	276	274	292	...	...	249	440	442	420	340
Width in front	.	64	...	...	...	...	89	105	80	75
Width behind acetabular cavity	80	78	84	84	86	...	105	113	105	92

* Specimens in the National Museum, Melbourne.

† Specimens belonging to the Australian Museum, Sydney. We are indebted to Mr. R. Etheridge for the opportunity of measuring these.

‡ Measurements given by Messrs. Milne Edwards and Oustalet for comparison with those of *D. ater*. This specimen, presumably in the Paris Museum, can scarcely be full grown.

The first portion of a pelvis secured was obtained by Mr. Campbell, and presented by him to the National Museum. This by itself was too fragmentary and imperfectly preserved to base any decided conclusion upon. Indeed, in the absence of other specimens it could not be definitely stated whether it was an adult or a young one, but the structure of the 20 specimens now in our possession is decisive. As the table shows, there is a difference of 150 mm. between the length of the largest pelvis of *D. minor* and *D. novæ-hollandiæ*, and a difference of nearly 50 mm. between the former and *D. peroni*. Indeed, the latter appears to be intermediate in size between the two former.

5. *Skull.*

(Plate 6.)

As might be expected, remains of the skull are difficult to procure, and are of necessity more or less fragmentary, the fragile bones of the jaws being easily detached and broken. The complete fusion of the bones, and entire eradication of all sutural marks, show that the remains are those of quite mature birds; indeed, unless complete fusion of the bones had taken place, there would not be the slightest chance of the preservation of the cranium as a whole. The shifting of the sand, under which the bones lie buried, by strong westerly gales would soon dissociate the skull bones. In a young *D. novæ-hollandiæ*, with a length of 80 mm. between the frontal suture and the occiput—that is, much larger than the largest of the skulls of *D. minor*—the sutures between the occipital, parietal, and frontal bones are widely open, and during maceration the bones separate from one another. Instead of there being any chance that the skulls are those of immature or not fully grown birds, it may be regarded as absolutely certain that only perfectly mature skulls would have any chance of surviving the movements of the shifting sand.

Even more striking than the difference in size is that in the shape of the cranium of the island and the mainland form. The illustrations of the skulls seen in side-view in figures 5, 6 and 9, and the outline drawings representing the curvature of the upper surface of the cranium in two adult specimens of *D. minor* and two adult and one immature specimens of *D. novæ-hollandiæ*, show at a glance the great difference that exists in the cranial formation of the two forms. The outline drawings are life-size and in each case the horizontal line passes through the condyle posteriorly, and the suture of the frontal bone anteriorly.* The contrast

* The drawings were made by means of the Dioptograph, designed by Dr. Rudolph Martin, for the opportunity of using which we are indebted to Professor R. J. A. Berry.

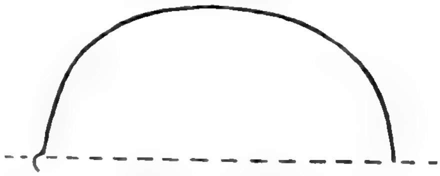


FIG. 1. *D. minor.*

FIG. 2. *D. minor.*

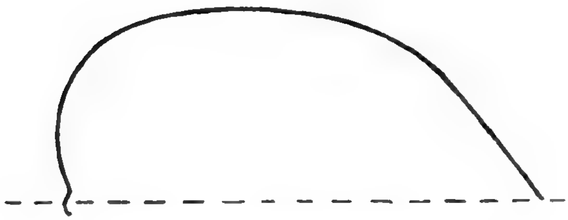


FIG. 3. *D. novæ-hollandiæ, juv.*

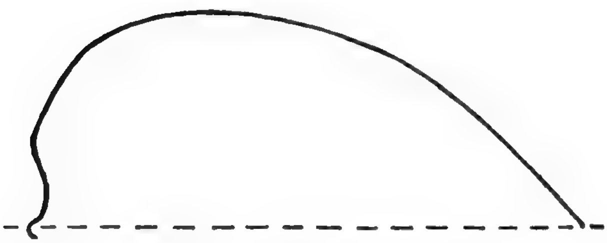


FIG. 4. *D. novæ-hollandiæ.*

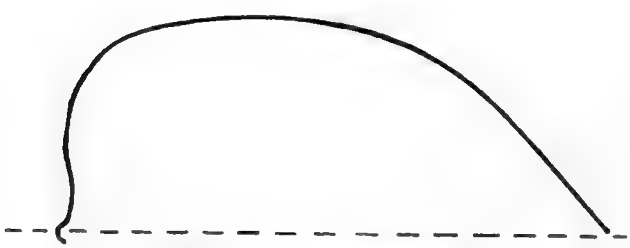


FIG. 5. *D. novæ-hollandiæ.*

between the dome-shaped skull of the island form and the frontally flattened one of the mainland form is strongly marked. It will be noted also that the dome shape of the cranium is indicated to a certain extent in the immature mainland form. The frontal region is certainly flattened, but the proportionate height of the cranium above a basal line running from the condyle to the frontal suture is decidedly greater than in the mature specimens. There is unfortunately no detailed description of the skull of *D. peroni* available, but if the dome shape of the cranium was anything like as well marked in the Kangaroo Island species as it is in that of the King Island bird, it could not have failed to attract attention. This character alone is sufficient to distinguish the King Island species from that of the mainland, and presumably also from that of Kangaroo Island.

In the following table we give (1) certain length measurements of the skulls and (2) the proportionate height of the cranium to the length of a basal line drawn from the condyle to the frontal suture, taking this line as 100:—

—	D. novæ-hollandiæ.			D. peroni.	D. minor.			
	ad.	ad.	juv.					
Occiput to frontal suture ...	90	91	80	80	58	62	58	..
Maximum width	75	76	62	62	66	54	56	...
Interorbital space	29	32	26	26	29	20	...	...
Length of premaxilla ...	84	70+	74	74	...	...	...	20
Proportionate height of skull	39	38	40	...	43	...	42	...

6. *Pectoral Arch.*

(Plate 4. Figures 19 and 20.)

Only one pectoral arch—that of the right side—has been found, and that has the clavicle missing, and about half of the scapular broken off. It is not perfect enough to found any comparisons upon.

7. *Portions of three Sterna.*

(Plate 7.)

It was found very difficult to secure remains of the sterna which broke up into powder as soon as they were touched. The fragment figured represents the greater part of it, but there is nothing apart from size to distinguish it clearly from the sternum of the mainland bird. The concavity on the inner or upper side is less accentuated, but then this is a feature in which the mainland form varies: one of our specimens being decidedly shallower and flatter than the one figured. The difference in size is, however, striking.

8. *Five Fibulæ.*

(Plate 3. Figures 11 and 12.)

These appear to differ only in size.

9. *Ribs.*

(Plate 4. Figures 16, 17, 18.)

Only two ribs were secured, and both of these are broken, The larger one corresponds to the first rib that meets the sternum. and the smaller one to the third. Both belong to the right side. The tuberculum of each is broken, and the capitulum is decidedly longer in proportion than in the corresponding rib of the mainland form.

10. *Vertebral Bodies.*

The collection includes forty-three vertebræ, but, so great has been the action of the wind-driven sand, that not one of them is entire. Apart from size, they do not apparently differ from those of the larger species.

11. *Toe Bones.*

(Plate 4. Figures 13, 14, 15.)

These are such solid parts of the skeleton that it might naturally be expected that they would be well represented, but only two could be found. Each of them is the proximal phalange of the large middle toe, and, apart from size, differs in no way from the same bone in the larger bird.

In the table we give the measurements, and, on the supposition that the first phalange of the median toe has the same relation to the length of the whole toe in the island as in the mainland form, we have calculated the probable total length of the toe, taking as a guide the length of the larger of the two bones, which evidently belonged to a mature bird:—

—	D. novæ-hollandiæ.		D. minor.		D. peroni.
Total length of median toe ...	168	151	115–118	...	110
Length of 1st phalange	64	59	45	40	...

The measurement given of the length of the toe in *D. peroni* is 110, so that in this respect *D. minor* is somewhat larger than the former.

General Remarks on the Species of Dromæus Inhabiting the Islands of Bass Strait.

It is a matter of great regret that in the early days of Australian exploration so few specimens of the fauna of the islands of Bass Strait were preserved. We know now, when it is too late to do more than gather together—and that with difficulty—such remains as we can secure of their skeletons, that these islands were the home of a species of Emu distinct from that of the mainland of Australia, and probably also from that of Tasmania. The early inhabitants of the islands were naturally not in the least interested in natural history, save so far as the animals that they found inhabiting the primeval scrub were good to eat. Their only object was to capture as many seals and sea lions as possible, and whilst doing this they replenished their larder by exterminating as many birds and mammals useful for food as they could secure. Péron records the fact that on King Island Cowper and his associates had actually trained their dogs to go out by themselves and hunt down Emus and Kangaroos.* When they had killed their prey the dogs returned to camp, and, "par signes non équivoque," announced their success, and then led the men to the places where their victims lay dead. On Kangaroo Island, by means of one dog trained by the English sealers, and presented to the French naturalists, the latter were able to capture twenty-seven Kangaroos alive, and numberless others that were killed and eaten. Péron says that Kangaroos are so easily killed by a trained dog that a few of these would not take many years to exterminate all the former on Kangaroo Island.

Péron also relates that the English fishermen had actually domesticated the Wombats, which went out during the day into the forests in search of food, and returned to their shelter huts at night.† We may be permitted to accept this statement with some reserve. Péron and his associates were very hospitably treated by the English sealers when they were in a very uncomfortable plight, owing to their ships having to stand off suddenly from the coast; indeed, if it had not been for Cowper and his friends the French naturalists would have had at least a very unpleasant time, so that naturally everything that they say about their rescuers and their surroundings is not likely to suffer from any lack of friendly and appreciative description.

If Cowper really domesticated the Wombat for the purpose of securing a ready food supply, then this is the first case on record of any such thing in regard to marsupials. How, in what must have been a relatively short space of time, he had trained them to

* "Voyage de découvertes, &c.," vol. ii., p. 18.
† Loc. cit., vol. ii., p. 14.

go out in the day in search of food and return to their huts at night is a mystery. This means not only that he had persuaded the animals to abandon their burrowing habits, but, what is more remarkable still, he had changed a nocturnal into a diurnal animal. The domestication story must, we fear, be regarded as a myth. It is true that Flinders remarks on the fact that on Clarke Island he saw Wombats feeding during the day time. On the mainland the animal is also sometimes seen during the day, but it is essentially nocturnal in its habits, and Sir Everard Home states, in regard to one taken alive from King Island to London, that it was quiet during the day and active at night.

There is no doubt that Emus and Wombats were plentiful at the time of Péron's visit, and that Péron actually saw them. There is a very curious discrepancy between two accounts that are published dealing with their size. Péron makes the following statement* :—" Le puissant Casoar, haut de 16 à 22 décimètres (5 à 7 pieds)," and, in the margin opposite this, reference is made to plate 66. On the other hand, in the publication by Messrs. Milne Edwards and Oustalet, to which we have already referred,† the following question put to, and the answer to it made by, Cowper, are given :—

"6. Quelle est la hauteur la plus grande à laquelle il parvient?

A l'île King, à peu près 4 pieds ½, plus petit qu'à Sydney."

The plate referred to contains the figures of adult and young birds, and bears the following legend: —" Nouvelle-Hollande—ile des kanguroos. Casoar de la N^elle. Hollande (Casuarius Novæ Hollandiæ-Lath.)" It will be noted that in the letterpress the name île Decrès is used, and on the plate the name île des Kanguroos. It is evident that Péron imagined that the island and the mainland forms of Emu were the same, and that he made very little effort to capture them on the islands—indeed, he says, speaking of Kangaroo Island, " Nous mîmes peu de soin à les chasser, nous ne pûmes nous en procurer que trois individus vivans."‡ He makes no remarks whatever about the size of the Kangaroo Island specimens.

It is well known now that there are three authentic specimens of *D. peroni* in existence§—a mounted skin and skeleton in Paris and

* "Voyage de découvertes, &c.," vol. ii., p. 14

† "Note sur l'emeu noir, &c., Bull. du Muséum d'hist. nat.," 1899, p. 206.

‡ Loc. cit., p. 78, vol. ii.

§ Hon. Walter Rothschild. "Extinct Birds." 1907. Also Dr. H. H. Giglioli. "Nature." April 4, 1907, p. 534. A very good account of the various specimens brought to Europe is given by Graham Renshaw in the "Zoologist." No. 741, 1903. p. 81.

a skeleton in Florence.* These three are undoubtedly those taken from Kangaroo Island by Baudin's expedition. In addition there is the doubtful specimen discovered in Liverpool by Dr. H. O. Forbes, in regard to which the Hon. Walter Rothschild says †—"In addition to Decrès or Kangaroo Island, also Flinders, King Island, and Tasmania had Emus living on them at the time of Péron's visit, and I believe, if authentic specimens from these localities were in existence, we should find that each of these islands had had a distinct species or race of Emus. Taking this for granted, and also taking into account that it is slightly different from the type of *D. peroni*, I have come to the conclusion that the Liverpool specimen is an immature, though full grown, individual from one of these other islands; but it is not possible from this one rather poor specimen to separate it from the Kangaroo Island species, especially as there is absolutely no indication of the origin of this specimen." The only other remains of the Kangaroo Island Emu are two bones, one a tibio-tarsus and the other a tarso-metatarsus, of which, through the courtesy of Professor E. C. Stirling, the Director of the South Australian Museum, we are able to give illustrations.

Dr. Giglioli is of opinion that the Liverpool specimen is identical with the Paris and Florence specimens. Most unfortunately, there is no evidence whatever of where it came from or by whom it was collected. A few bones from King Island were also sent to Dr. Giglioli by the late Mr. Alex. Morton, and while pointing out the necessity of securing a larger series of bones from the islands Dr. Giglioli expressed the opinion that the King Island specimens belonged to *D. peroni*.

With the comparatively large series of bones now available it is possible to form a tolerably correct idea of the average size of the King Island bird. Unfortunately, we have only the measurements of the bones of one specimen of *D. peroni*, but we have the advantage of knowing that this was full grown, as it lived for some time after its arrival in France either at the Jardin des Plantes or at the Chateau of Malmaison, and we may therefore regard it as probably an average sized specimen—more especially as there does not appear to be any great discrepancy in size amongst the Paris and the Florence specimens.

* In his "Catalogue of the Fossil Organic Remains, Mammalia, and Birds contained in the Museum of the Royal College of Surgeons," London, 1845, p. 353, Owen makes the following statement in regard to specimen No. 1563:—"A corresponding section of the pelvis of a young Emeu (*Dromæus ater*), showing a smaller proportional expansion of the spinal canal for the enlargement of the chord whence the nerves of the legs originate, and the more marked difference in the form and proportions of the iliac plates, especially behind the acetabulum." In his work on "The Extinct Wingless Birds of New Zealand" he also figures, in Plate xxxv., fig. 7, a sternum to which he applies the name of *Dromaius ater*. No reference to this particular specimen nor any reference to the species is made in the letterpress. It seems clear that Owen is not using *ater* as a synonym for *novæ-hollandiæ*, because the latter specific name is applied to specimens figured in Plates xxxi. and xxxvii.

† "Extinct Birds," p. 235.

In the following table we give the measurements of the bones of six specimens of *Dromæus novæ-hollandiæ*, of the large series of the King Island form, and the measurements of the one specimen of *D. peroni*. In the case of the King Island form we have given three series of measurements—the minimum, the maximum, and those between which lie the great majority of the measurements. Thus, for example, in the case of the femur the minimum of mature bones is 140 and the maximum 186, but whilst only 2 specimens measure more than 180 and 6 less than 150 mm., no fewer than 52 measure between 150–180 mm., and of these 39 measure between 150–170 mm.

Species.	D. novæ-hollandiæ.	King Island Species.	D. peroni.
Skull, length	90–91	58–62	80
,, width	75–76	54–56	66
Femur	217–243	140, 150–180, 186	180
Tibio-tarsus	415–446	265, 270–320, 363	342
Tarso-metatarsus ...	335–411	216, 220–280, 292	290
Pelvis, length	440–442	249–292	340
Pelvis, width in front ...	80–105	64	75
Pelvis, width behind ...	105–113	78–84	92

It will be seen that there is considerable variation, not only in the case of the King Island species, but also in that of the mainland species, and doubtless a corresponding amount of variation would be found to exist amongst the Kangaroo Island birds if only we were fortunate enough to possess as large a series of their bones as we do of those of the King Island Emus. It is, for example, almost certain, or at least quite probable, that amongst the Emus of Kangaroo Island there were many adult birds that exceeded the measurements given in the above table, and many that fell below them unless the three specimens secured happened to belong to birds of either maximum or minimum size.

One very striking fact in regard to the Ratitæ is that on insular areas we find a most remarkable development of distinct species, and that on continental areas there is a widespread distribution of a limited number of species.

Throughout the whole of the South American continent we find only three species of Rhea. Africa has only three species of Struthio.

Throughout the whole of Australia there is only one species of Emu*. Six living species of Apteryx are recognised on the islands of New Zealand, where there also exist the remains of at least twenty species of Dinornis and closely allied genera. In Australia there is only one species of Cassowary ; on the Papuan Islands to the north there are no fewer than ten species, and of these one species may be confined to one island, as in the case of the well known Ceram Cassowary, or several may occur on the same island as in the case of New Guinea.

It is thus apparent that for some reason or another an insular environment is associated with considerable variation amongst Ratite birds. It would not therefore be a matter of surprise, judging by what has taken place in the case of the Ratite birds of New Guinea and the surrounding islands to the north of Australia, if King and Kangaroo Islands and Tasmania each possessed its own species of Emu.

The measurements in the table given above indicate very clearly the fact that the King and Kangaroo Island Emus were quite distinct from those of the mainland. Of this there can be no doubt whatever. There now remains the question of the identity or otherwise of the two former. Despite the fact that in the case of the femur, tibio-tarsus and tarso-metatarsus our collection from King Island includes in each case one or two bones equal in length to the corresponding bones in the Paris specimen from Kangaroo Island, it is clear that these belong to exceptionally large specimens, and that the average size of these bones was considerably less than the maximum given in the table. The two bones from Kangaroo Island also indicate the fact that the species of Emu inhabiting the latter was of decidedly less robust build than that of King Island. Not only is this so, but the measurements of the skull and pelvis are quite sufficient to distinguish the two species.

Both the King Island and the Kangaroo Island species were distinguished by their dark colour from that of the mainland.

We have now to deal with the question of the Tasmanian Emu. At the present time no Emu is extant in the island, but names such as Emu Bay and Emu Plains evidently indicate the fact that when the island was first occupied by white men, and probably for many years afterwards, Emus did exist. The only examples of the Tasmanian Emu of which we can find any record are two skins of adult birds presented to the British Museum by Mr. Ronald Gunn, and recorded by Gray in his List of Birds in the British Museum, iii., p. 54, 1844, and again by Salvadori in the British Museum Catalogue of Birds, xxvii., 1895.

* *D. irroratus* of N.W. Australia is doubtfully distinct from *D. novæ-hollandiæ*.

In 1804, the Rev. R. Knopwood wrote a diary of his visit to Tasmania when H.M. ship *Calcutta* sailed from Port Phillip to the Derwent River in Tasmania.* On Wednesday, 7th March, he has the following record in his diary—"We see Kangaroos, Emews, Pigeons, and Parrotts"; again, on Monday, 26th March, he says—"They caught six young Emews, about the size of a turkey, and shot the old mother;" and, on 9th October, he records the capture by his dogs of an "Emew 60 lbs. weight."†

Bischoff,‡ writing in 1832, and quoting from "An Account of Van Diemen's Land," published by Widowson, in 1829, says—"The birds that may be called game are very numerous, with the exception of the Emu or Native Ostrich, they very much resemble the latter bird, and are very nearly as large." In the "Van Diemen's Land Anniversary and Hobart Town Almanac," for the year 1831, the "Emu or Cassowary Rhea Novæ-Hollandiæ," is included in "A glossary of the most common natural production of Van Diemen's Land," so that evidently the bird was well known at this early date.

The Emu is known to have existed in large numbers in Tasmania up to at least the year 1840. Col. W. V. Legge,§ the distinguished ornithologist of Tasmania, states that during the "forties" the birds inhabited and bred regularly in a locality known as Kearney's Bogs, about 12 miles south of Avoca, amongst the ranges of the east coast. He states that one of the shepherds "used not unfrequently to bring eggs to the house."

Mr. D. Le Souëf, in his notes on the extinct Tasmanian Emu,‖ mentions that Mr. Ransom, of Killymoon, in the Fingal district, remembers Captain Hepburn, of Roy's Hill, finding an Emu's nest with eight or nine eggs. A little later these were hatched under a turkey hen. From these others were bred, and a pair of them were given to the late Baron von Steiglitz, of Killymoon, one of which survived until 1873, when it was drowned while trying to cross a flooded river. With its death, the Tasmanian Emu, Mr. Ransom believed, became extinct.

Gould, in his "Birds of Australia," published in 1848, states that Emus were then almost extirpated in Tasmania; a few still ranging over the western part.

* We are indebted to Mr. J. J. Fletcher for much valuable assistance in regard to the early literature dealing with the Emu and Phascolomys.

† "Journal of the Rev. Robert Knopwood, A.M.," in "Historical Records of Port Phillip," edited by John J. Shillinglaw, p. 65.

‡ Sketch of the History of Van Dieman's Land, &c. James Bischoff, 1832.

§ "Emu," iii., p. 239, 1904.

‖ "Emu," vi., 1907, p. 116.

Mr. Geo. T. Lloyd* writing in 1862, says, "The Emu of Tasmania, as I have before stated, is much smaller and darker in plumage than that of Australia; but, never numerous there, that noble bird is now nearly extinct."

One difficulty in regard to the safe identification of the true Tasmanian Emu lies in the fact that at a comparatively early date specimens were introduced from the mainland. Mr. D. Le Souëf states, on the authority of Mr. Stephens, that one or more were imported from Victoria by Mr. James Cox, of Clarendon, in the early "fifties," and others were introduced somewhat earlier.

Further evidence of this is afforded by Mr. R. Gunn,† who, writing in 1851, says that he obtained two Emus from the Horticultural Gardens in Hobart, and adds "they were originally from a Port Phillip stock, but brought up in Van Dieman's Land." He goes on to say, "a leg of a Tasmanian Emu is now in my possession, and so far as I can judge from it, as a very imperfect specimen, there are differences in the arrangement and size of the scales, which may justify the separation of the Tasmanian Emu from that of New Holland." In a foot-note, Mr. J. Milligan adds that, "Captain Hepburn, of St. Paul's Plains, possesses a breed of Tasmanian Emus, which he succeeded in rearing from eggs found many years since upon the high healthy land in his vicinity."

Two eggs have been recorded as those of the Tasmanian Emu, one of which is in the collection of Mr. J. W. Mellor, of Adelaide, and the other in that of Mr. D. Le Souëf, Director of the Zoological Gardens, Melbourne. Both are said to be considerably smaller than those from the mainland. The measurements given by Mr. Le Souëf are 4·85 x 3·40 inches and 4·80 x 3·50, as compared with 5·56 x 3·63 inches of a typical egg of a mainland form. A bone found by Mr. H. H. Scott in a limestone quarry was sent to Mr. D. Le Souëf, who identified it as the femur of an Emu smaller than those from the mainland, but too damaged to be of any value.

Finally, during a recent visit to England, Mr. D. Le Souëf examined the two skins of the Tasmanian Emu in the collection of the British Museum, and arrived at the conclusion that they were distinct from those of the mainland, a conclusion in which he informs us he was confirmed by the Hon. W. Rothschild, Dr. Bowdler Sharp, and Mr. Hartert, who also examined them.

On the evidence derived from the size of the egg Mr. Le Souëf proposed the name of *Dromæus diemensis* for the Tasmanian bird that laid it, but exactly what this bird was it is now quite impossible to say with absolute certainty. Presumably, however, granting that the eggs are those of the true Tasmanian Emu, and

* "Thirty-three years in Tasmania and Victoria," p. 62, 1862.
† R. Gunn. Proc. R. S. Tas., 1853, p. 170.

not somewhat small ones of introduced mainland birds, the two skins preserved in the British Museum belong to the same species of bird that laid the eggs referred to by Mr. Le Souëf. No adequate description of these skins has yet been published, but in view of the facts that (1) we know of eggs found in Tasmania that are distinct from those of the mainland form, and (2) that there are two authentically recorded skins of Emus from Tasmania that differ from those of the mainland bird, and differ also both in size and colour from those of the Bass Strait Islands, it appears to be certain that Tasmania was inhabited by an Emu distinct both from that of the Australian Continent and that of the Islands, and for this species when it is adequately described the name of *D. diemensis* may appropriately be retained.

In the following tables we give details of the measurements of the Femurs, Tibio-tarsal, and Tarso-metatarsal bones, the general results of which have been summarized in some of the foregoing tables :—

DROMÆUS MINOR.

Femur.

1	2	3	4	5	6	7	8	9	10	11	12
r 186	*l* 180	*r* 179	*r* 179	*l* 179	*r* 179	*r* 178	*r* 178	*l* 177	*l* 176	*l* 174	*l* 172·5
13	14	15	16	17	18	19	20	21	22	23	24
r 172	*r* 171	*l* 171	*l* 169·5	*r* 169	*r* 169	*r** 169	*l* 169	*r* 168	*l* 168	*l* 168	*r* 167·5
25	26	27	28	29	30	31	32	33	34	35	36
r 167	*r* 166	*l* 162	*r* 161·5	*r* 161	*l* 161	*r* 160	*r* 160	*l* 160	*l* 160	*l** 160	*r* 159
37	38	39	40	41	42	43	44	45	46	47	48
*r** 159	*r* 158	*r* 158	*r** 158	*l* 158	*l* 157	*l* 157	*l* 157	*r* 156	*l* 156	*r* 155	*r* 155
49	50	51	52	53	54	55	56	57	58	59	60
*r** 155	*r** 155	*l* 155	*l* 154	*r* 153	*l* 152	*r* 148	*r* 145·5	*r* 145 *juv.?*	*l* 145	*l* 145 *im.*	*r** 142
61	62	63	64								
l 139 *juv.*	*r* 137 *im.*	*r* 132 *imm.*	*l* 130 *juv.*								

* Slightly broken.

Dromæus Minor—*continued.*

Tibio-tarsus.

1	2	3	4	5	6	7	8	9	10	11	12
r* 354	r* 338·5	r 333	l 328	l 318	r 315	l 314	r 311	l 309	r 305	r 303	r 302
13	14	15	16	17	18	9	20	21	22	23	24
r 301	l 300	r 297	r 290·5	r 290	r 288	r 288	r 287	l 287	r 285	l 285	r 284
25	26	27	28	29	30	31	32	33	34	35	36
l 283·5	l 283	l 282·5	r 281	r 280	l 278	r* 277	l 275·5	r 274	l 273	r 273	r 272
37	38	39	40	41	42						
r 272	r 271	r 271	r 268	l 266							

* Slightly broken.

Tarso-metatarsus.

1	2	3	4	5	6	7	8	9	10	11	12
l 292	r 278	l 278	l 277	l 271	r 265	r 264	r 253	r 252	r 249	r 249	r 247
13	14	15	16	17	18	19	20	21	22	23	24
r 247	r 246	r 245	r 245	l 245	l 243·5	r 242·5	r* 242	l 240	r 239	r 238	l* 238
25	26	27	28	29	3 0	31	32	33	34	35	36
l 236·5	l 236	r 235	l 235	r 234	r 233·5	r 233·5	r 233	r 233	l 233	l 232·5	r 232·5
37	38	39	40	41	42	43	44	45	46	47	48
r 232	r 232	r 232	r 232	l 231·5	l 231·5	l 231·5	r 230	r 229	r 228·5	l 228	l 228
49	50	51	52	53	54	55	56	57	58	59	60
l 227	r 225	l 224·5	r 224	r 223	l 222	l* 220	r 220	l 219	r 218·5	r 218	r 218
61	62	63	64	65	66	67	68	69	70		
l 216·5	l 216	r 215	r 214	r 213·5	l 212	r 211	r 199	l 199	r 174·5		

* Slightly broken.

In consequence of the large series of remains secured since the original description was published it is necessary to alter the diagnosis then given :—

DROMÆUS MINOR.

Size varying considerably, but always much smaller than that of *D. novæ-hollandiæ* : not exceeding that of *D. peroni*, but of more robust build. Tibio-tarsus rarely exceeding 330 mm., most usually from 270-320 mm. in greatest length. Tarso-metatarsus rarely exceeding 280 mm., most usually from 220-280 mm. in greatest length. Frontal region of skull decidedly dome-shaped. Length of skull from frontal suture to occiput not or only slightly exceeding 60 mm. Greatest width of skull not or only slightly exceeding 55 mm.

Habitat. King Island. Bass Strait. Now extinct.

PHASCOLOMYS URSINUS, SHAW.

In a separate paper we deal at length with the question of the different species of Phascolomys, popularly known as Wombats, that have been recorded from Australia, Tasmania, and the Islands of Bass Strait. It will suffice to say here that the earliest known Wombat was secured on Clarke Island, in Bass Strait, and taken alive to Sydney in 1797. There is no record of the name of its discoverer.* After lingering in captivity for six weeks it died; and in August of that year Hunter, then Governor of New South Wales, sent the body together with a description of the animal to the Newcastle Philosophical Society. † In 1800 Shaw‡ published a brief description of this animal under the name of *Didelphys ursina.* Up to this year, and indeed until at the earliest 1802, the only Wombat known in England was the one sent home by Hunter. Bass found his specimen on Cape Barren Island in 1799, but no description of this was published until 1802.

There can be no doubt whatever that all the early descriptions of Phascolomys were based upon specimens from the Islands of Bass Strait, and further still that without any adequate investigation it was taken for granted that the Bass Strait Island species was identical with the Tasmanian. Our collection from the Bass Strait Islands includes eight skulls, thirty lower jaws, and two skins, and after a careful comparison of these with fourteen skulls from Tasmania, and a large number from Australia, we have come to the conclusion that the Bass Strait Island form is quite distinct from that of Victoria and Tasmania, and that as already

* It is generally stated that the first Wombat taken to Sydney was captured by Bass, but this is not so.

† In Bewick's "History of Quadrupeds," 4th edit. 1800, p. 225, Hunter's letter is quoted in full, and a quaint figure of the animal, which is called "The Wombach," is given.

‡ "General Zoology" i., pt. 2, p. 504.

described the two latter are also distinct from one another, though at the same time they are more closely allied than is the Bass Strait Island Wombat to either of them.*

It is therefore necessary to distinguish specifically the two forms which up to the present time have been united under the name of of *Phascolomys ursinus*. As this was, without any doubt, applied in the first instance to the particular form secured on Clarke Island, sent to England by Hunter, and named *Didelphys ursina* by Shaw, we retain the specific name *ursinus* for the Bass Strait Island species, and redescribe the distinct Tasmanian species under the name of *Ph. tasmaniensis*.

It is an interesting fact that the first reliable drawings of a Wombat, those in the Atlas to Péron's work represent the King Island species, and further that one of the earliest descriptions of the anatomy of any species of the genus was based upon a specimen taken to London by the distinguished naturalist, R. Brown, who secured it on one of the Bass Strait Islands.† Sir Everard Home, when describing the anatomy of this specimen, says that it lived in captivity with him for two years, and "It appeared to have arrived at its full growth, weighed about twenty pounds, and was about two feet two inches long."

In addition to the sub-fossil specimens from King Island our original collection included a skull from Deal Island, indistinguishable from the King Island skulls. For the purpose of procuring, if possible, material from the Furneaux Group, of which Clarke Island, the habitat of the first found Wombat, forms a part, one of us paid a visit to Flinders Island, the largest of the group, and made the interesting discovery that the small Wombat, though rare, is not yet actually extinct. Further reference to this is made in a separate article. Here it will suffice to say that the Deal, Flinders and King Island skulls are identical. Deal, Flinders, Clarke, and Cape Barren Islands, form parts of a chain of islands stretching across the eastern entrance to Bass Strait, whilst King Island lies far away on its western margin. It would be, at least, a most curious thing if the Deal, Flinders, and King Island wombats were identical, as they are, and at the same time distinct from those of Clarke and Cape Barren Islands.

We have therefore decided to retain Shaw's specific name *ursinus* for the Wombat of the Bass Strait Islands. Though much has been written about it, and it is the oldest known species, it has for many years been confused with the quite distinct Tasmanian form, and it is doubtful if any well authenticated skin of it is in existence, except two recently secured on Flinders Island.

* It is a somewhat remarkable fact that both the King Island Emu and Wombat are more distinct from the mainland and Tasmanian forms than the two latter are from one another.

† Home. Phil. Trans., 1808, p. 304. "An account of some Peculiarities in the anatomical structure of the Wombat, &c."

Unfortunately Hunter in his letter to the Newcastle Philosophical Society, when sending to England the original specimen on which Shaw established the species, gave only a very vague description of it, nor does that specimen appear to have ever been adequately described.

Collins, however, published a more detailed account of the specimen obtained by Bass on Cape Barren Island, though in his account, which undoubtedly refers to this particular species of Wombat,* there is a curious error in regard to the dentition which must have arisen in consequence of a mistake in the transcription of notes. Taking Bass' account of the external form and combining it with the results obtained from the investigation of the skulls from King, Deal, and Flinders Islands, and skins from the latter, the following may be taken as a fairly accurate description of this species :—

PHASCOLOMYS URSINUS. SHAW.

Size, smallest of the genus. Length, from tip of tail to tip of nose, about 775 mm.† Length of head, 175 mm. Weight, from twenty-five to thirty pounds. The female slightly larger than the male. Hair coarse, light sandy brown in colour, darkest along the back. Ears sharp and erect, about 57 mm. long. Eyes about 60 mm. apart. Muzzle naked. The fore legs strong and muscular, their length to the sole about 130 mm. The three middle claws 20 mm. in length, claws of first and fifth digits 15 mm. in length. The three inner claws of the foot about 5 mm. longer than the longest of the fore claws. Skull smaller than that of the Australian or Tasmanian species. Basal length, 120-132 mm. Greatest breadth 99-106 mm. Nasals much expanded posteriorly, their greatest breadth at least three-fourths of their length. Post-orbital processes small. The malar bones strongly bowed downwards and outwards below the orbit. Length of upper molar tooth series not exceeding 45 mm. ; that of the lower tooth series not exceeding 46 mm. Length of humerus 98 mm. Greatest width of humerus at its distal end 42 mm. Length of femur, 125 mm.

Habitat.—King, Deal, Cape Barren, Clarke, and Flinders Islands in Bass Strait.

Type specimen is the one sent to Newcastle by Hunter. It is doubtful whether it is now in existence.

DASYURUS BOWLINGI. SP. N.

When describing the fauna of King Island,‡ Péron says, " Nous y avons recueilli, M. Lesueur et moi, une foule d'espécès inconnes à l'Europe, parmi lesquelles se trouvent deux Dasyures élégans,

* " An account of the English colony of New South Wales." 2nd Edit. 1804, p. 469.

† This may probably be regarded as the maximum. Of two skins from Flinders Island, one, a mature male, measures 715 mm., the other, a female, not quite complete, as the tip of the snout is wanting, measures 675 mm.

‡ Voyage de découvertes, etc., p. 12.

&c." In speaking of Kangaroo Island he says,* " Nous y avons vu que trois espèces de mammifères : l'une appartient au joli genres des Dasyures," and in connexion with the latter refers to a plate on which two Dasyures are drawn, the title of the plate being as follows :—" Nouvelle-Hollande : Nouvelle Galles du Sud. Dasyure à longue queue (*Dasyurus Macrourus*, Geof.)."

It is evident that Péron regarded the Kangaroo Island species as identical with the larger mainland form now known as *Dasyurus maculatus*, but he says nothing with regard to the two King Island species, and does not appear to have collected specimens.

At the present two species of Dasyurus are known from Victoria and Tasmania, a somewhat larger form, *D. maculatus*, and a somewhat smaller one, *D. viverrinus*. Both of these are found in Victoria and Tasmania, the first-named species being more abundant in the island than on the mainland. During the visit of the Field Naturalists' Club in 1887, *D. maculatus* was reported as existing on King Island, but not *D. viverrinus*.

Our collection of bones includes the remnants of twenty-five crania, and sixty lower jaws, one of which came from Deal Island. No trace of any other bone could be found.

The crania and jaws are clearly divisible into two sets, a larger and a smaller, indicating the existence of two species as recorded by Péron, who, unfortunately, gave no indication of their relative size. The question arises as to the relationship of these two species to those now existing in Australia and Tasmania. In our collection, twenty-one of the crania belong to the larger form, and four only to the smaller. Of the lower jaws, thirty-seven appear to belong to the larger, and twenty-nine to the smaller. The difference in size is not due to immaturity, the dentition of both series being the permanent one.

In order to try and decide the relationship of the fossil forms, we have made a considerable number of measurements of skulls and lower jaws of recent specimens, the results of which are given in the following tables.

In the following table the crania of the King Island specimens, and of a series of specimens of *D. maculatus* and *D. viverrinus* are grouped in accordance with their basal lengths :—

Basal length.	MM.							
	60–70.	70–80.	80–90.	90–100.	100–105.	105–110.	110–115.	115 & over.
King Island species ...	...	...	2	1	1	3	6	3
D. maculatus	...	1	3	4	...	...	...	.
D. viverrinus	7	1	...	...	...	...	...	...

* Soc. cit. p. 76. Pl. 63.

The greatest basal length of any of our specimens of *D. maculatus* is 98 mm., and that particular specimen came from Queensland ; a second, measuring 97 mm., from Tasmania ; a third, measuring 96 mm., from Victoria ; are particularly large ones. In the British Museum catalogue the basal length of one is given as 101, but this, as well as the above three, may be regarded as decidedly above the average size. Even if we take 100 mm. as the basal length of *D. macutatus*, the above table still shows very clearly the great relative size of the King Island species.

In the following tables the same species are grouped in accordance with their tooth measurements :—

LENGTH MOLARS $^{1-3}$—UPPER JAW.

	MM.							
	14-15.	15-16.	16-17.	17-18.	18-19.	19-20.	20-21.	21-22.
King Island species ...	...	...	...	...	...	4	17	2
D. maculatus	...	...	...	...	6	6	...	...
D. viverrinus	2	6	...	...	...	...	...	..

LENGTH MOLARS SERIES—LOWER JAW.

	MM.										
	18-19.	19-20.	20-21.	21-22.	22-23.	23-24.	24-25.	25-26.	26-27.	27-28.	28-29.
King Island species ...	...	...	...	...	...	...	8	10	6	13	2
D. maculatus	...	...	...	...	...	6	4	1	...	...	...
D. viverrinus	4	4	..	...	...	..	...	...	...	...	...

LENGTH OF UPPER p^3.

	MM.						
	3-3·5.	3·5-4.	4-4·5.	4·5-5.	5-5·5.	5·5-6.	6 & above.
King Island species ...	...	...	1	7	10	2	3
D. maculatus	...	...	9	3	...	...	...
D. viverrinus	4	4	...	...	...	...	...

LENGTH OF LOWER p^3.

	MM.						
	3-3·5.	3·5-4.	4-4·5.	4·5-5.	5-5·5.	5·5-6.	6 & above.
King Island species ...	...	...	6	11	16	5	2
D. maculatus	...	...	6	5	1	...	...
D. viverrinus	2	5	1	...	...	...	...

The measurements in the first place show unmistakably that *D. viverrinus* is not represented amongst the remains.

They equally clearly indicate the existence of a species decidedly larger than the existing *D. maculatus*, and at the same time prove the existence of animals of a size equal to that of large examples of *D. maculatus*. The question then arises as to whether the smaller King Island specimens are to be regarded as females of the larger form or as representatives of another species, that is *D. maculatus*. We incline to the latter opinion which, moreover, is in accordance with the definite statement made by Péron that two species existed on the island.

A reference to Plate 8, Figs. 2 and 3, representing a larger and smaller specimen will serve to show how distinct the forms are, and though, of course, the smaller amongst the larger forms tend to merge into the larger amongst the smaller, yet an examination of the collection as a whole unmistakably gives the impression that it contains the remains of two distinct forms.

The evidence from the teeth is as decisive as that from the basal length of the skull. In no example of *D. maculatus* does the length of the upper first three molar teeth exceed 19·5 mm.; in the large island specimens it is consistently 20 mm. or more, and the same difference is seen in the length of the lower molar series and of both the upper and lower pre-molar.

But beyond these measurements there is fortunately one structure in the skull which both serves still further to mark the larger form out as a distinct species and at the same time bears evidence in favour of the fact that the smaller island form is *D. maculatus*. Two of the larger and two of the smaller skulls fortunately have the mastoid bullæ sufficiently intact to show clearly what was its size. In *D. viverrinus* this is very largely inflated, the breadth of the bulla being at least three-quarters the length; in *D. maculatus* the expansion of the bulla is not so great, the breadth being slightly more than half the length. When we examine the King Island specimens (Figs. A, B, C,) we find that in

Fig. A.
D. bowlingi.

Fig. B.
D. maculatus.

Fig. C.
D. viverrinus.

the large ones the bulla is decidedly more elongate and much less swollen, whilst in the smaller ones it is similar to that of *D. maculatus*. In a large island form with a basal length of

117 mm. the width of the bulla is 6 mm.; in a small island form with a basal length of 87·5 mm., the width is 6 mm., and in a *D. maculatus*, with a basal length of 91 mm., the width is 6·5 mm.

Taking everything into account we are of opinion—first, that the Dasyurus remains include those of two species; secondly, that the larger of these two is distinct from any yet described; and, thirdly, that the smaller form is identical with *D. maculatus*.

It is of course possible that the larger species may still exist in some of the wilder and more inaccessible parts of the island, but it is much to be feared that, like the small Wombat and the Emu, it is now quite extinct, and will only be known from its sub-fossil remains.

We describe it as follows, and associate with it the name of Mr. J. McKie Bowling, to whose assistance in securing these remains from King Island we are much indebted.

Dasyurus bowlingi. sp. n.

Size, considerably larger than *D. maculatus*. Basal length of skull, 105 mm. or more. Length of upper first three molars, 20 mm., or more; and of lower molar series, 25 mm., or more. Bullæ much less swollen than in *D. maculatus*, and more obliquely elongate, their length decidedly more than twice their width, and their height, measured vertically above the glenoid surface, not or only slightly exceeding 5 mm.

Habitat.—King Island.* Extinct.

Type (skull) in the National Museum, Melbourne.

* A lower jaw from Deal Island, with a measurement of 26 mm. for the molar series, and part of a cranium, probably indicate the former existence there of this larger species of Dasyurus.

DESCRIPTION OF PLATES.

PLATE 1.

View of sand-blow at Seal Bay, King Island, where the majority of the specimens were obtained. Fragments of bones can be seen in the foreground. From a photograph taken by Mr. C. L. Barrett.

PLATE 2.

Fig. 1. Left Femur, *D. novæ-hollandiæ.* 238 mm.
Fig. 2. Left Femur, *D. minor.* 180 mm.
Fig. 3. Femur, *D. minor.* 158 mm.
Fig. 4. Left Femur, *D. minor.* 156 mm.
Fig. 5. Right Femur, *D. minor.* 186 mm.
Fig. 6. Left Femur, *D. minor.* 171 mm.
Fig. 7. Left Femur, *D. minor.* 160.

PLATE 3.

A series of bones showing variations in size of the Tibio-tarsus, and a comparison of this with the same bone in *Dromæus novæ-hollandiæ* and *D. peroni.*

Fig. 1. Right Tibio-tarsus, *D. minor.* 338 mm. (broken, probably 25 mm. longer).
Fig. 2. Right Tibio-tarses, *D. minor.* 333 mm.
Fig. 3. Left Tibio-tarsus, *D. minor.* 328 mm.
Fig. 4. Left Tibio-tarsus, *D. minor.* 314 mm., slightly broken.
Fig. 5. Right Tibio-tarsus, *D. minor.* 315 mm.
Fig. 6. Right Tibio-tarsus, *D. minor.* 301 mm.
Fig. 7. Left Tibio-tarsus, *D. peroni.* 276 mm., broken.
Fig. 8. Left Tibio-tarsus, *D. minor.* 283 mm., slightly broken.
Fig. 9. Right Tibio-tarsus, *D. novæ-hollandiæ.* 447 mm.
Fig. 10. Left Tibio-tarsus, *D. novæ-hollandiæ.* 447 mm.
Fig. 11. Fibula, *D. minor.*
Fig. 12. Fibula, *D. minor.*

PLATE 4.

Figs. 1–12 show the variations in size of the Tarso-metatarsus, and a comparison of this in *Dromæus minor* with the same bone in *D. novæ-hollandiæ* and *D. peroni.*

Fig. 1. Right Tarso-metatarsus, *D. novæ-hollandiæ.* 395 mm.
Fig. 2. Left Tarso-metatarsus, *D. minor.* 292 mm.
Fig. 3. Right Tarso-metatarsus, *D. minor,* 278 mm.
Fig. 4. Left Tarso-metatarsus, *D. minor.* 278 mm.
Fig. 5. Right Tarso-metatarsus, *D. minor.* 265 mm.
Fig. 6. Left Tarso-metatarsus, *D. minor.* 253 mm.
Fig. 7. Right Tarso-metatarsus, *D. minor.* The specimen is immature. 242 mm.
Fig. 8. Left Tarso-metatarsus, *D. minor.* 245 mm.
Fig. 9. Left Tarso-metatarsus, *D. peroni.* 237 mm.
Fig. 10. Left Tarso-metatarsus, *D. minor.* The specimen is immature. 231.5 mm.
Fig. 11. Left Tarso-metatarsus, *D. minor.* 232 mm.
Fig. 12. Left Tarso-metatarsus, *D. minor.* 218 mm.
Fig. 13. Middle Toe Bone, *D. novæ-hollandiæ.*
Fig. 14. Middle Toe Bone, *D. minor.*
Fig. 15. Middle Toe Bone, *D. minor.*
Fig. 16. Rib, *D. novæ-hollandiæ.*
Fig. 17. Rib, *D. minor.*
Fig. 18. Rib, *D. minor.*
Fig. 19. Pectoral Girdle without the Clavicle, *D. novæ-hollandiæ.*
Fig. 20. Pectoral Girdle without the Clavicle, *D. minor.*

PLATE 5.

Fig. 1. Pelvis of *Dromæus novæ-hollandiæ.* Length 423 mm.
Fig. 2. Pelvis of *Dromæus minor.* Broken specimen, showing the proximal parts of the pubis and ischium.
Fig. 3. Pelvis of *Dromæus minor.* Length 285 mm.
Fig. 4. Pelvis of *Dromæus minor,* Length 295 mm.
Fig. 5. Pelvis of *Dromæus minor.* Length 276 mm.

PLATE 6.

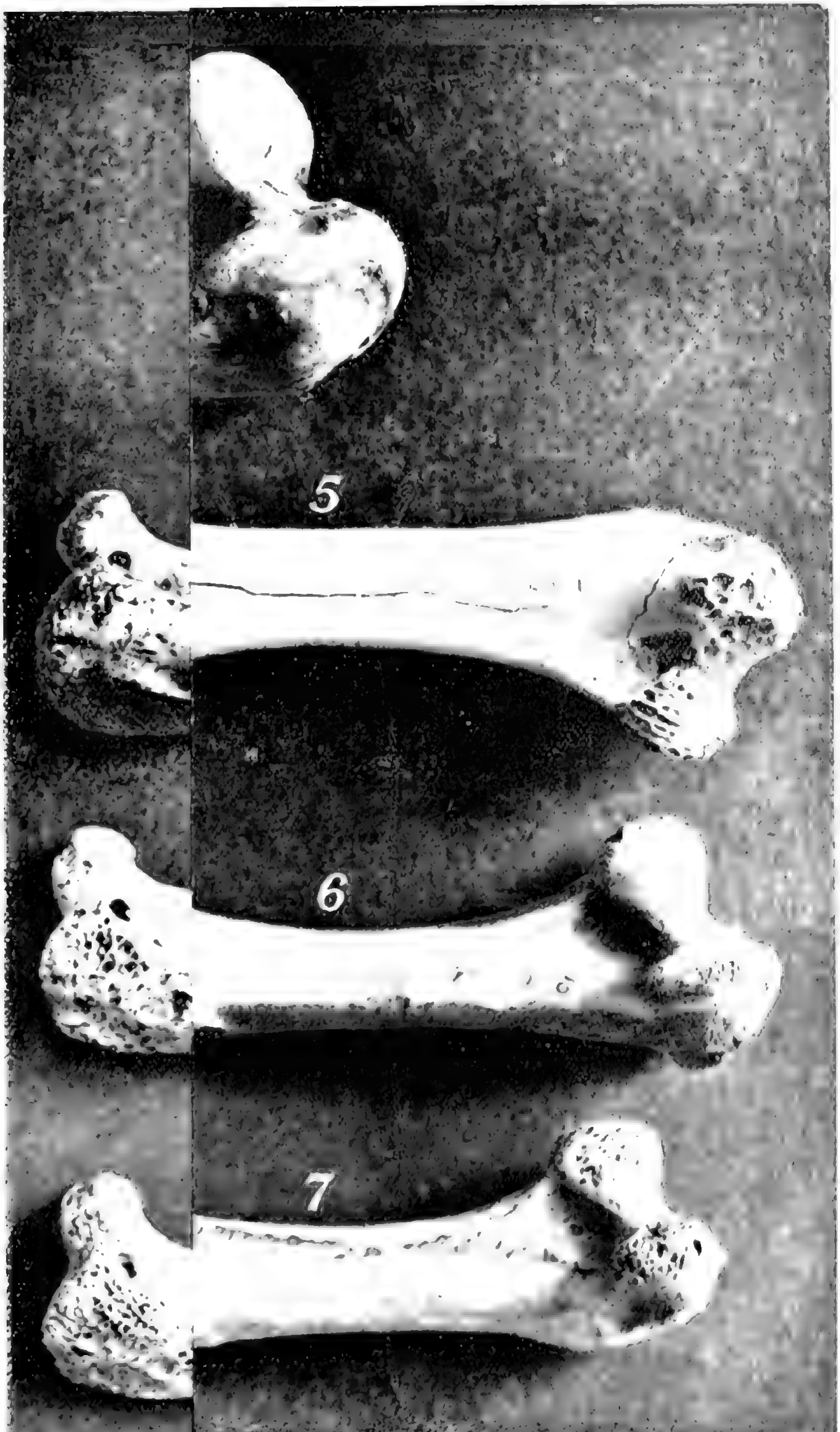
Fig. 1. Upper view of cranial portion of skull of *D. minor*.
Fig. 2. Upper view of cranial portion of another specimen of *D. minor*.
Fig. 3. Hind view of skull shown in Fig. 1.
Fig. 4. Hind view of skull shown in Fig. 2.
Figs. 5 and 6. Side views of skulls of *D. minor*, showing clearly the domed nature of the skull as compared with that of *D. novæ-hollandiæ*.
Fig. 7. Upper view of the cranial portion of the skull of *D. minor* with the pre-maxilla approximately in its proper relative position.
Fig. 8. Upper view of skull of adult *D. novæ-hollandiæ*.
Fig. 9. Side view of skull of immature *D. novæ-hollandiæ*. The frontal bone of the right side is removed.

PLATE 7.

Fig. 1. Ventral view of sternum of *Dromæus novæ-hollandiæ*.
Fig. 2. Ventral view of sternum of *D. minor*.
Fig. 3. Side view of sternum of *D. minor*.
Fig. 4. Dorsal view of sternum of *D. minor*.

PLATE 8.

Fig. 1. Dorsal view of skull of *Dasyurus bowlingi*.
Fig. 2. Dorsal view of skull of *Dasyurus bowlingi*.
Fig. 3. Dorsal view of skull of *Dasyurus maculatus*.
Fig. 4. Side view of lower jaw of *Dasyurus bowlingi*.
Fig. 5. Side view of lower jaw of *Dasyurus bowlingi*.
Fig. 6. Side view of lower jaw of *Dasyurus maculatus*.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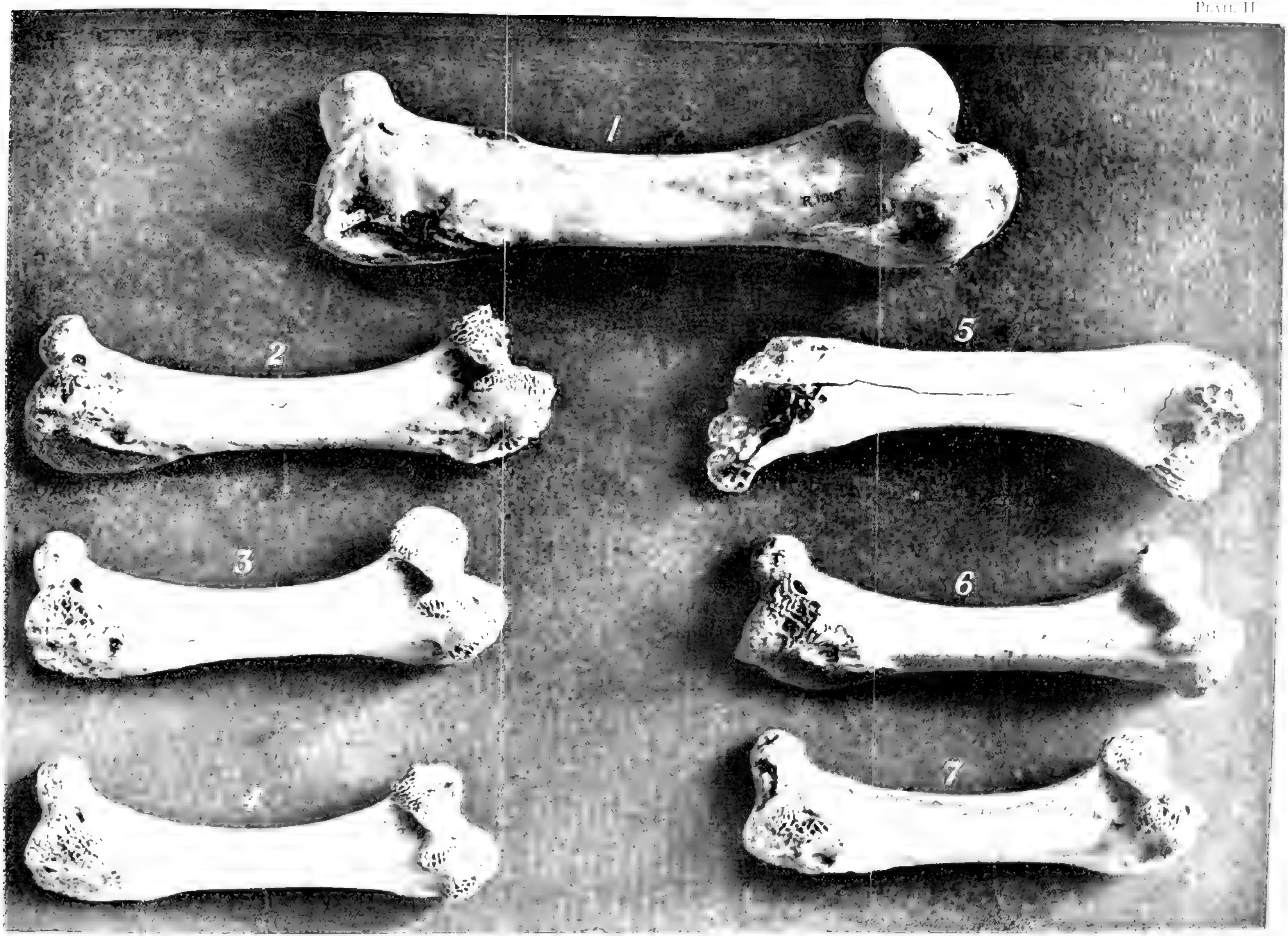
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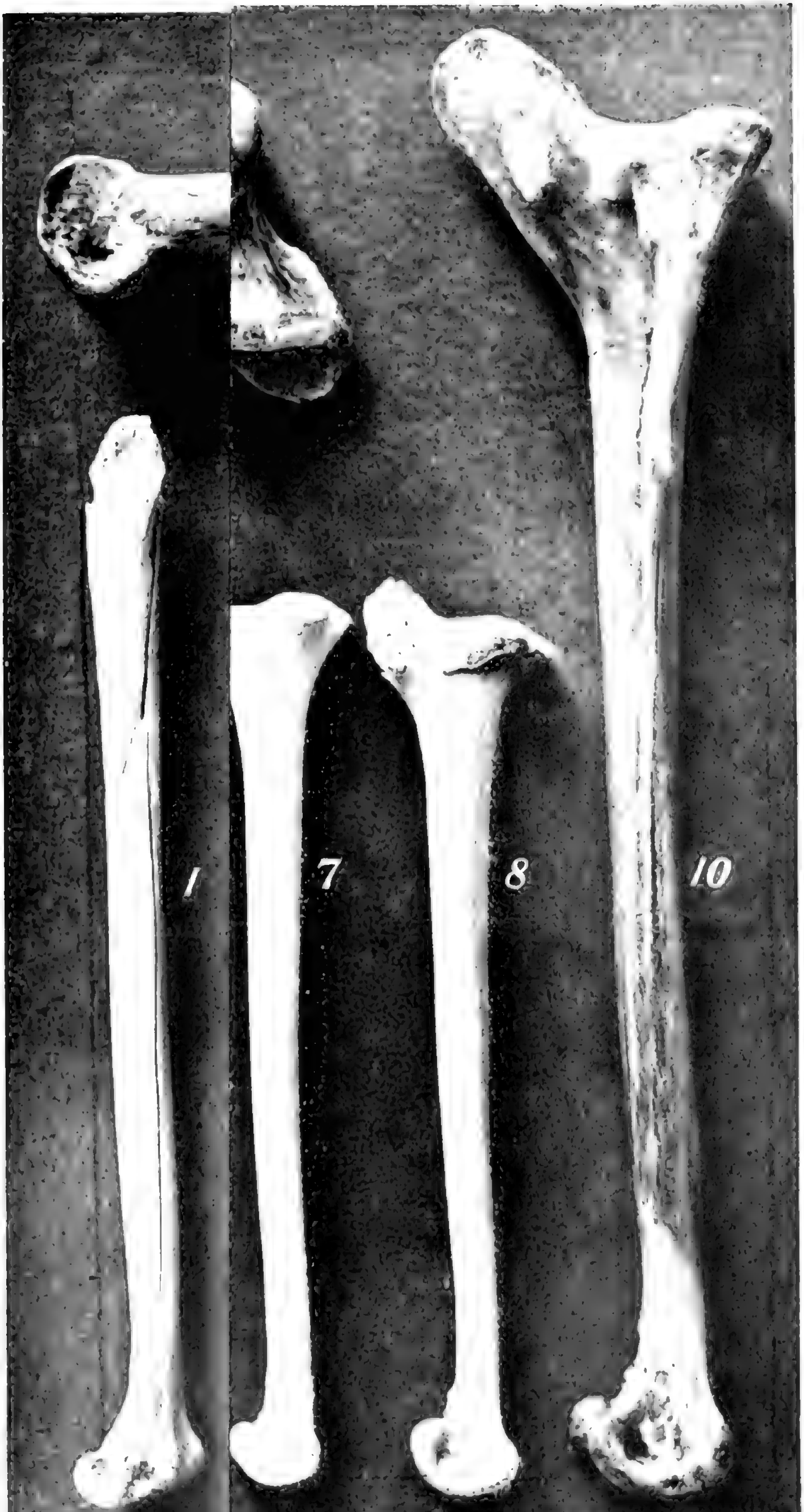
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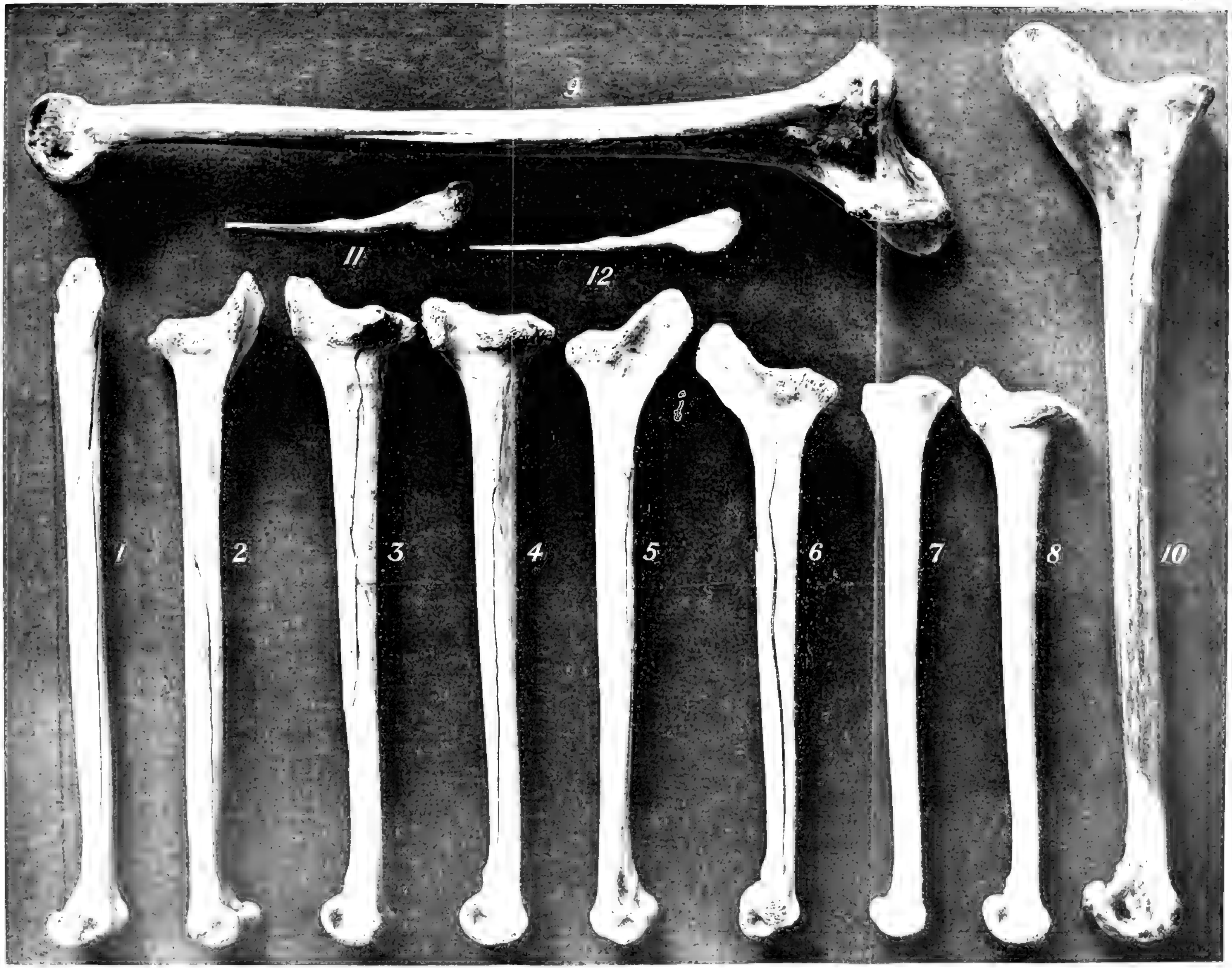
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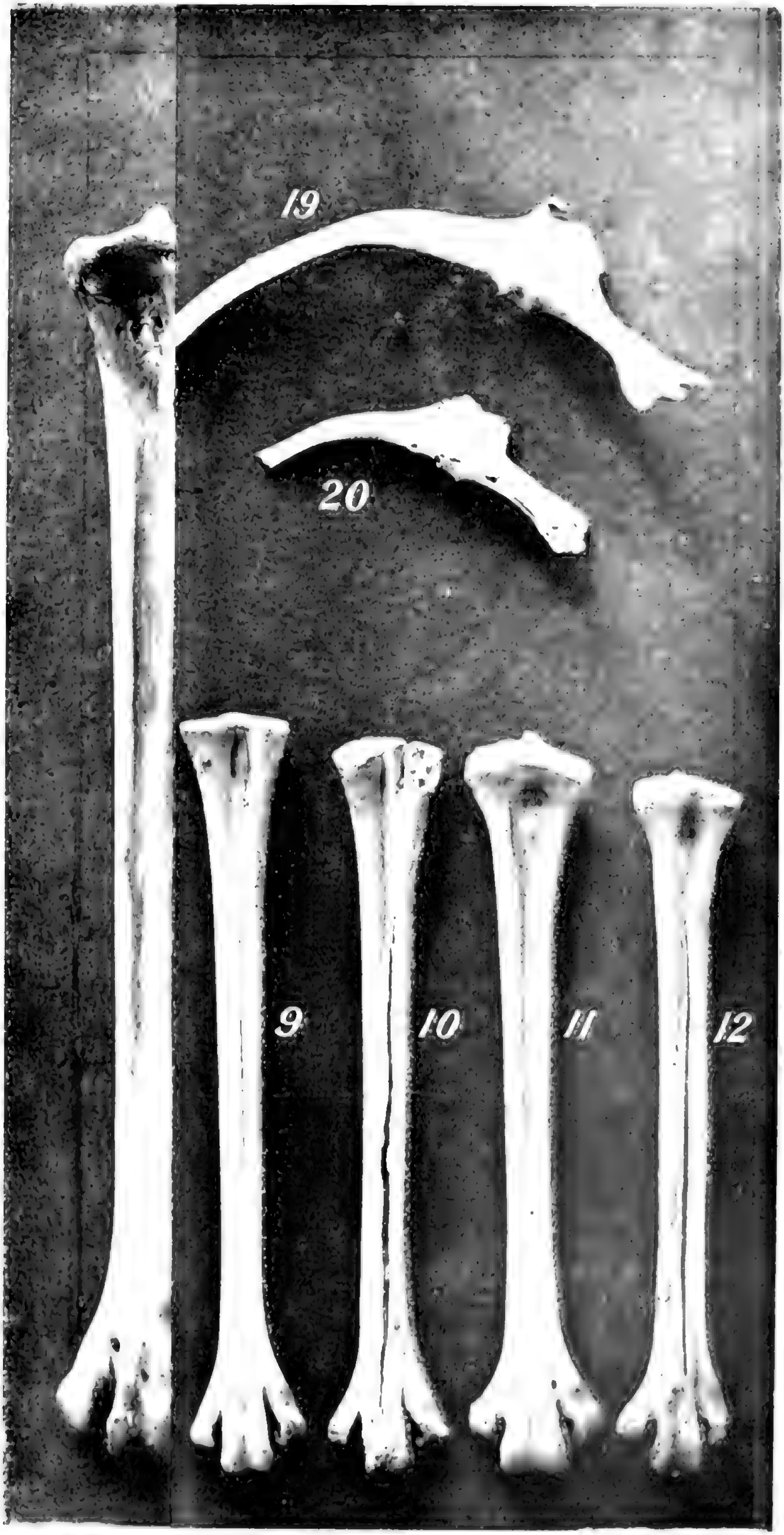
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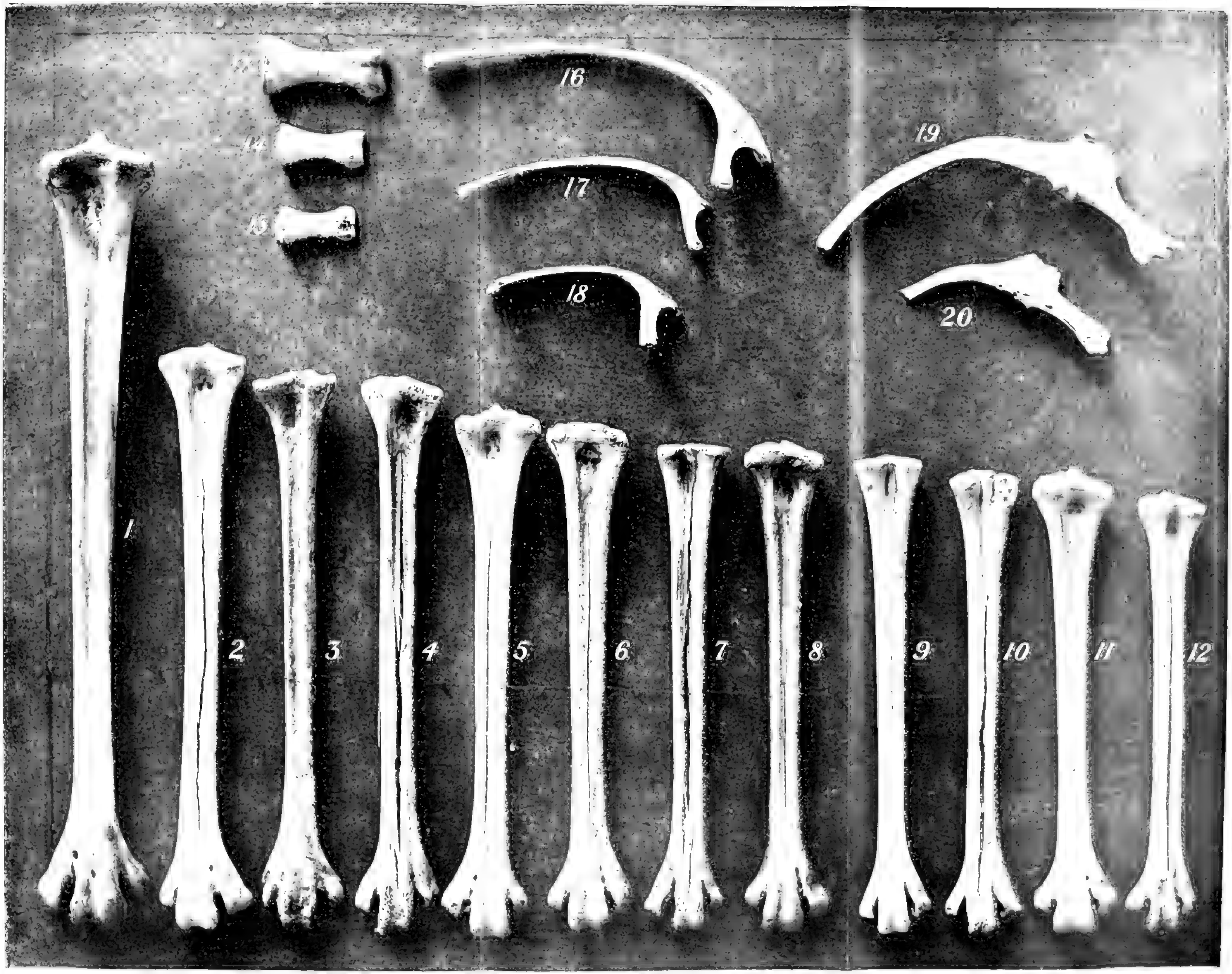
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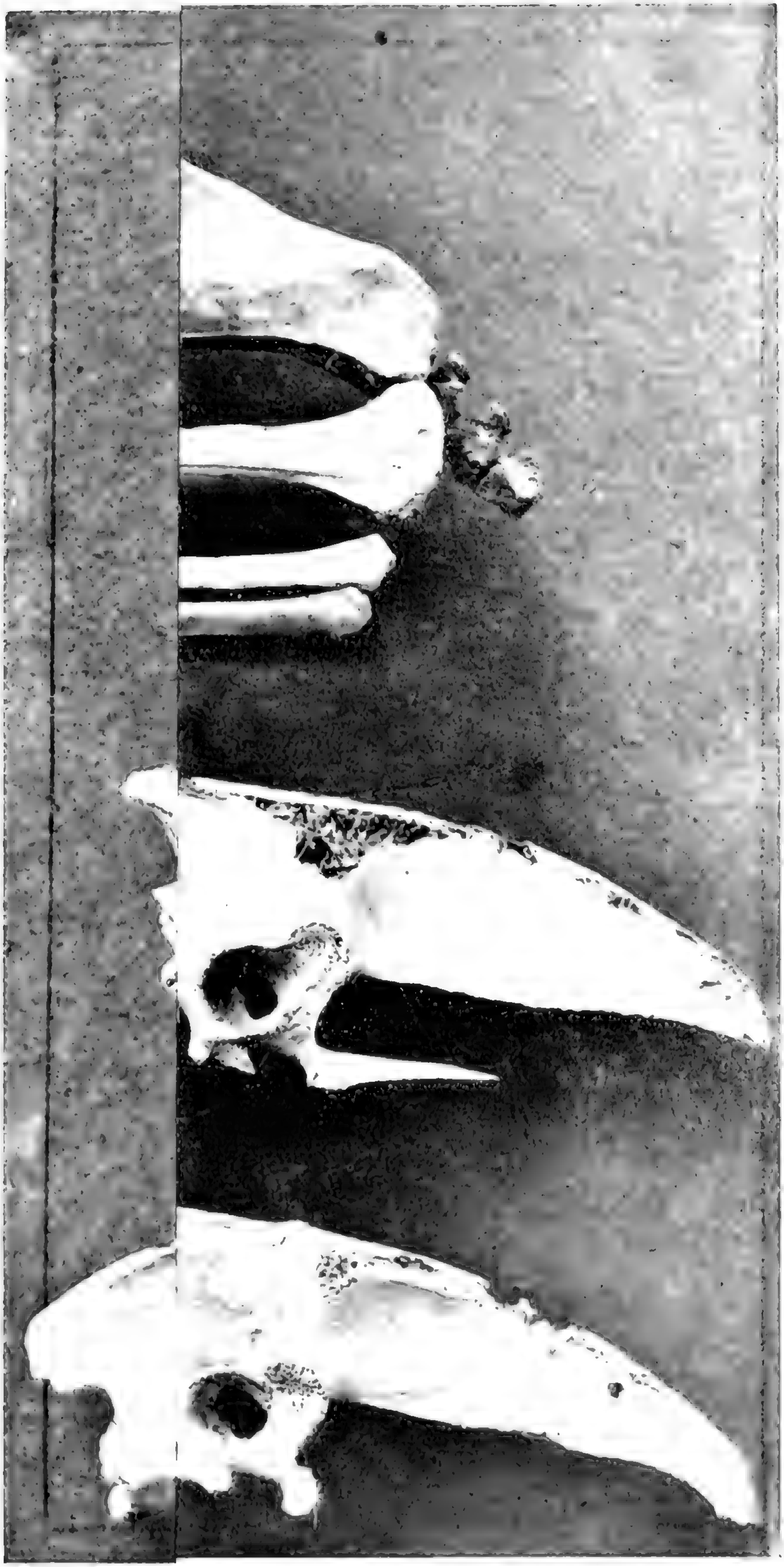

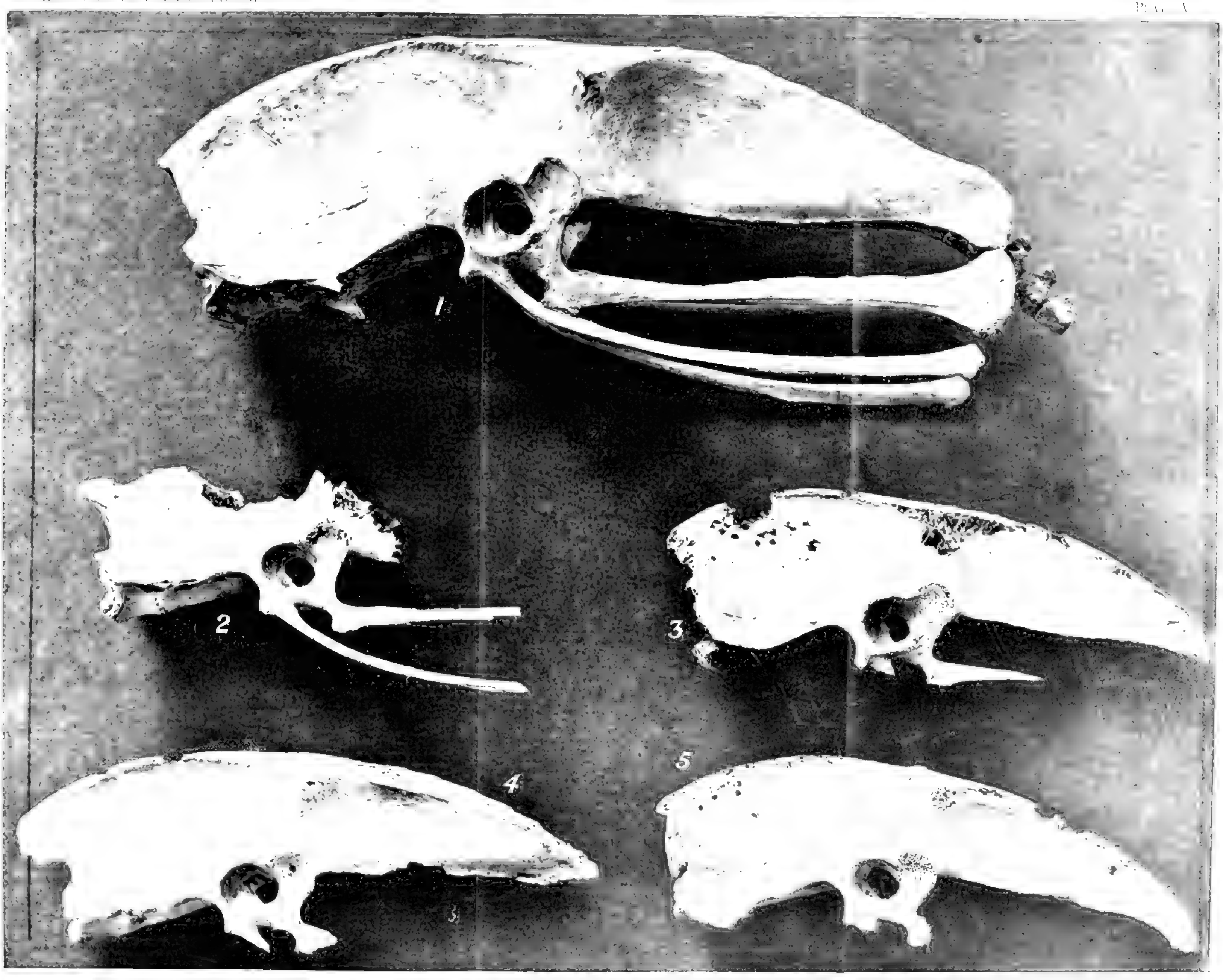
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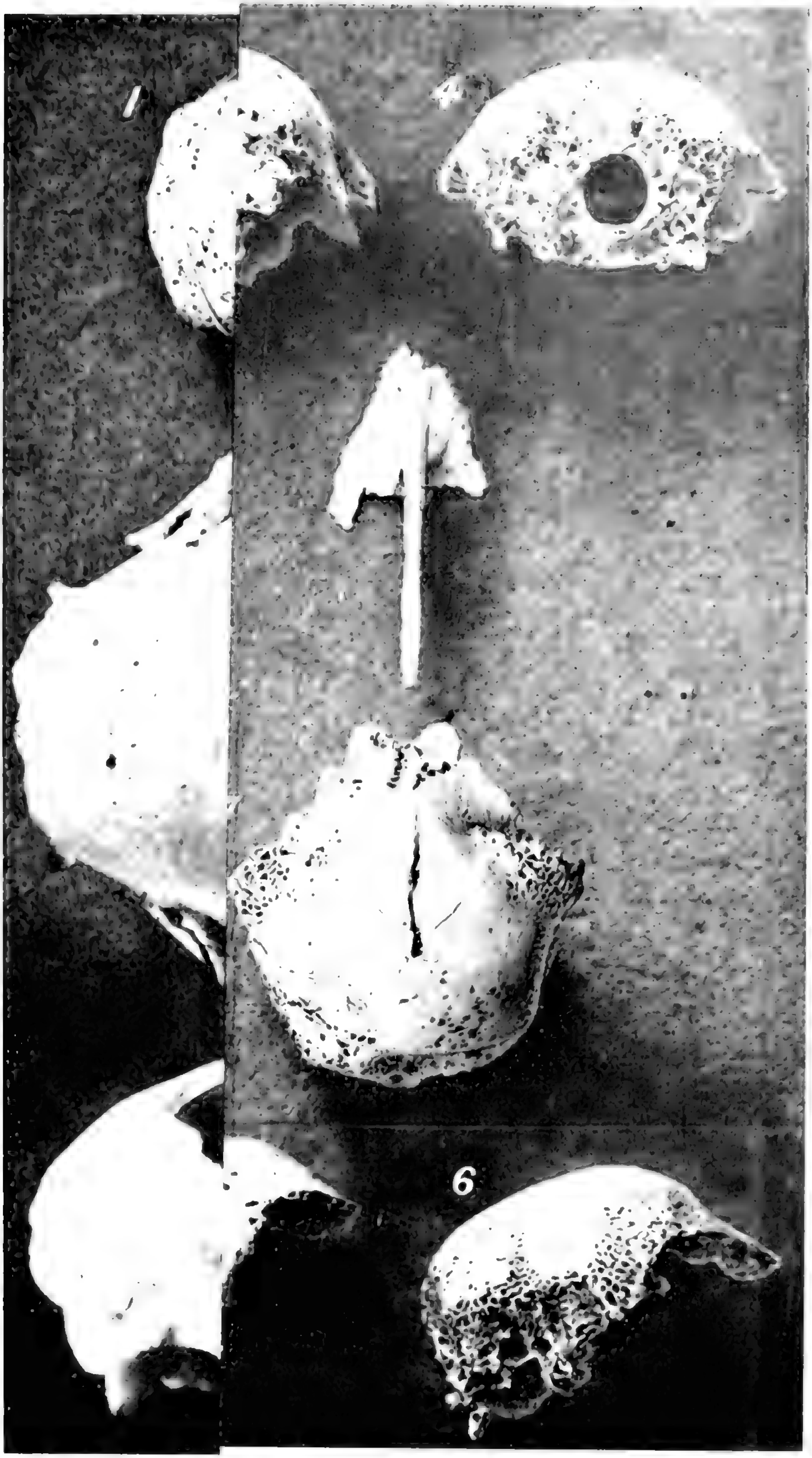
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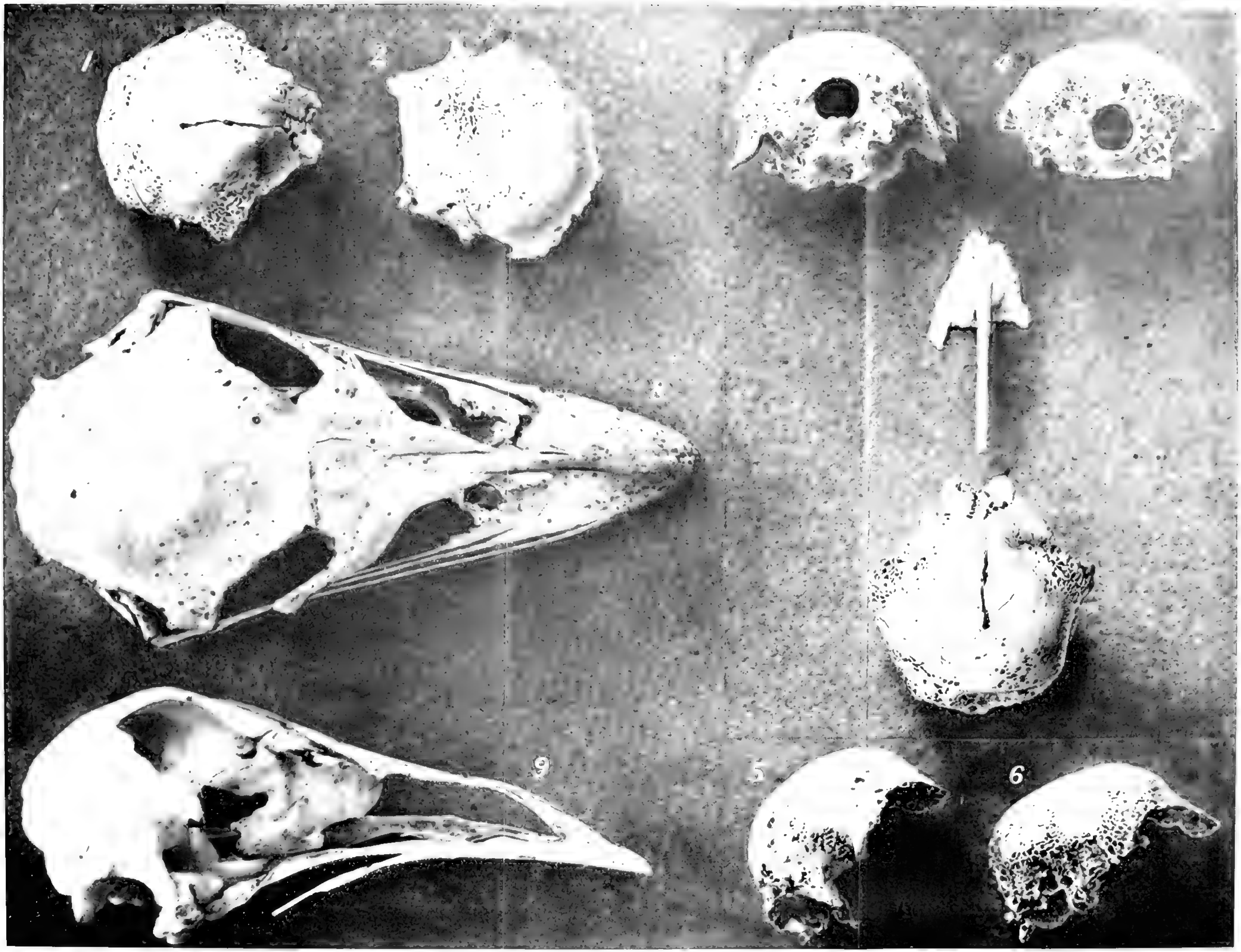
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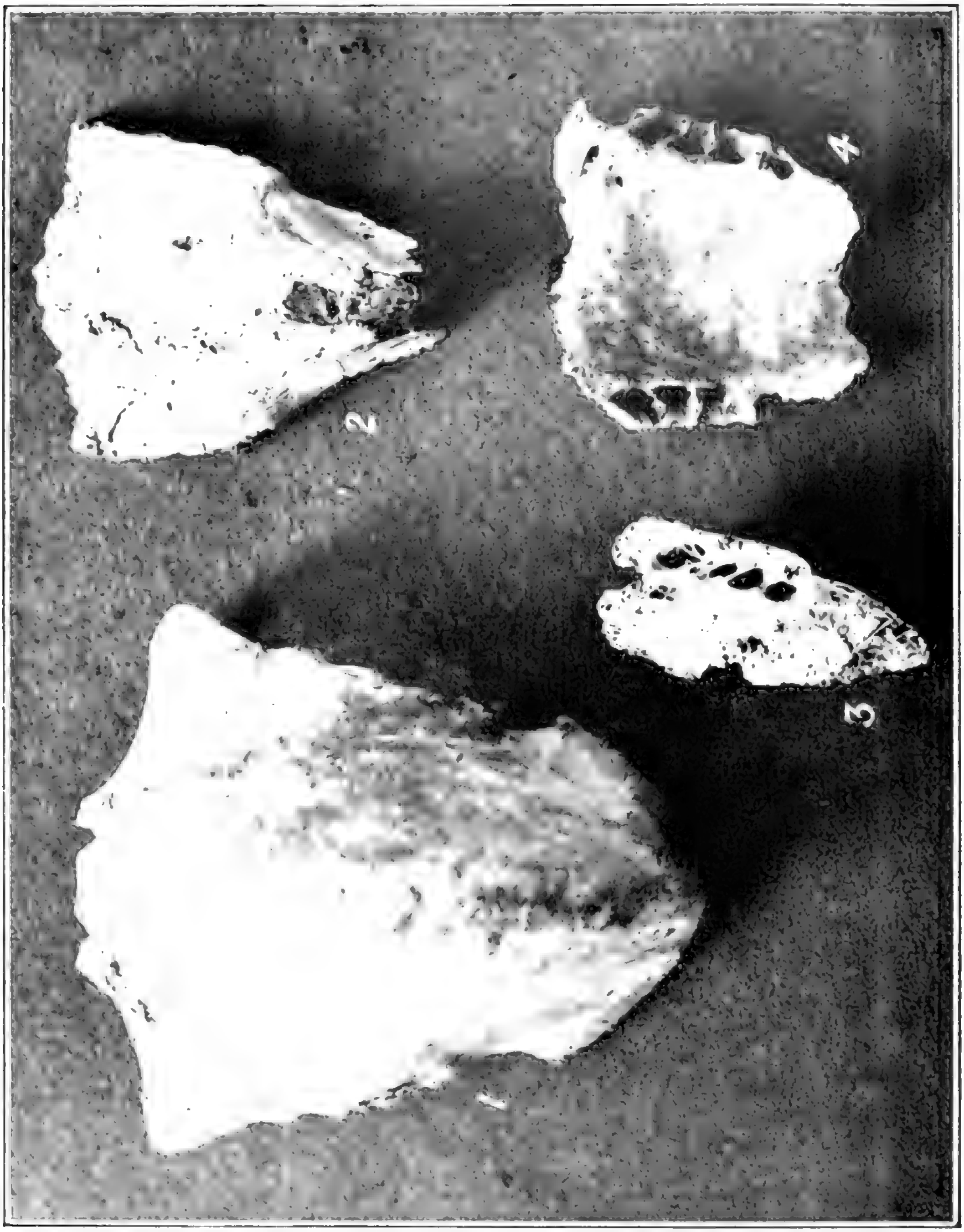
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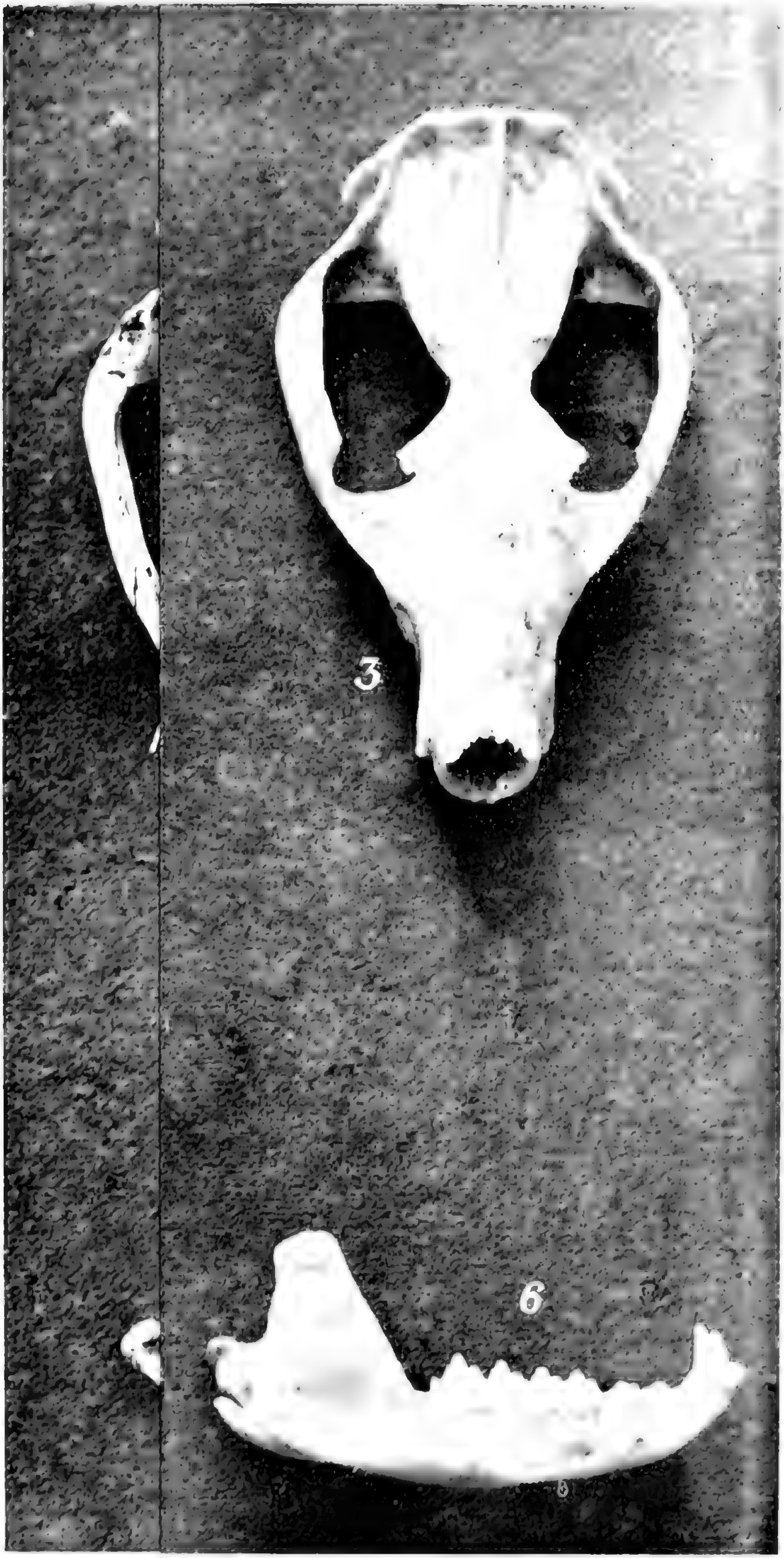
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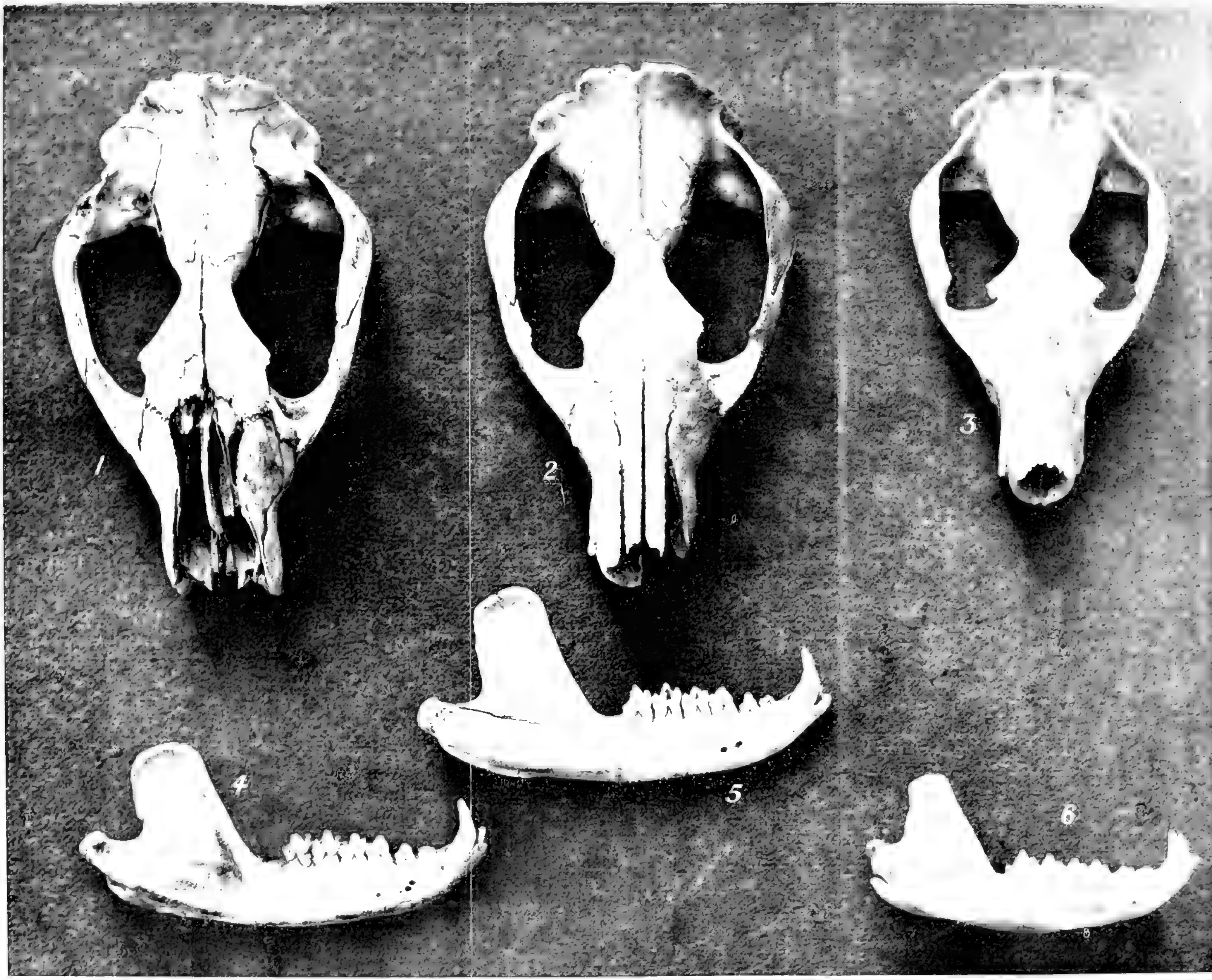
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THE EXISTING SPECIES OF THE GENUS PHASCOLOMYS.

By Baldwin Spencer, C.M.G., M.A., F.R.S., Hon. Director of the National Museum, and J. A. Kershaw, F.E.S., Curator of the Zoological Collections.

(*Plates* 9, 10, 11.)

In this paper we propose to deal principally with the question of the relation to one another of the species of Phascolomys that have been described as inhabiting Victoria, Tasmania, and the Islands of Bass Strait. At the present time, three existing species of the genus are recognised in Australia, viz.:—*Ph. ursinus* of Tasmania and the Islands of Bass Strait, *Ph. mitchelli* of Victoria, New South Wales, and South Australia, and *Ph. latifrons* of South Australia. The latter with its almost silky fur, its hairy nose, and strongly marked post-orbital processes, is a very clearly defined species.

Until quite recently it was supposed that the Bass Island forms were extinct, and *Ph. ursinus* has been known only by specimens from Tasmania. Mr. Oldfield Thomas,* describing the latter animal, says—"This species, the oldest known of the group, presents a remarkable exception to the usual rule of size in Tasmanian animals, these being generally larger instead of smaller than their continental allies. The species seems to be well distinguished from *Ph. mitchelli* by this character of size, but otherwise there appears to be no difference of importance between the two."

The investigation of a collection of sub-fossil bones from King Island has caused us to inquire into the history of this species, an outline of which we propose to give.

During the year 1797, a ship called the *Sydney Cove* ran on shore in Bass Strait, between Preservation and Rum Islands, which form part of the Furneaux group, and lie off the south-west coast of Flinders Island. Hunter, then Governor of New South Wales, sent a boat down from Sydney to rescue the ship-wrecked crew, and this party brought back with it the first found wombat†. It only lived six weeks in captivity, and in August, 1798, Hunter sent its body to England "for the inspection of the learned members of the Literary and Philosophical Society of Newcastle-upon-Tyne."

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* *Brit. Mus. Cat.* 1888, p. 217.

† It is, however, difficult to say positively whether this first wombat was brought back to Sydney by the first expedition sent to rescue the crew of the *Sydney Cove* or by Flinders himself when he went down on a second expedition to the scene of the wreck in the schooner *Francis*, leaving Port Jackson on February 1, 1798, and returning on March 9th.

Early in 1798, Bass had made his celebrated expedition in a whale boat, penetrating the strait that now bears his name, and in October of the same year, accompanied by Flinders, he again set out, this time in a small sloop called the *Norfolk*. During this expedition he found and brought back a wombat from Cape Barren Island.* It is commonly stated that Bass found the first wombat, but this is not so. As a matter of fact, Hunter sent his specimen to Newcastle in August, 1798, and Bass only returned to Sydney with his in January, 1799. It is also evident that Flinders knew of the existence of the animal when, late in 1798, he accompanied the schooner *Francis* on its second visit to the wreck of the *Sydney Cove*. He refers several times to it, calling it by its native name, that is, the name applied to the mainland form by the aborigines of New South Wales. Thus, for example, he says†—" The stations whence angles were taken for a survey of the channel and surrounding lands, were—first, Point Womat, a rocky projection of Cape Barren Island ; " and, again, speaking generally of the Furneaux Islands,‡ he says—" No other quadrupeds than the kangaroo, womat, and duck-billed aculeated ant-eater were found upon the islands ; " and, lastly, he says§—" Clarke's Island afforded the first specimen of the new animal called *Womat*, but I found it more numerous upon that of Cape Barren ; Preservation and the Passage Isles do not possess it. The little bear-like quadruped is known in New South Wales, and called by the natives womat, wombat, or womback . . . . it burrows like a badger, and on the continent does not quit its retreat till dark ; but it feeds at all times on the uninhabited islands, and was commonly seen foraging amongst the sea refuse on the shore, though the coarse grass seemed to be its usual nourishment."

In 1800, Bewick issued the fourth edition of his *History of Quadrupeds*, and in this|| appears in full the letter dated August 5th, 1798, addressed by Hunter to the Philosophical Society of Newcastle, in which he states the position of the island on which the animal was found and describes it.¶ Amongst other things he says—" It is about the size of a badger, a species of which we supposed it to be from its dexterity in burrowing in the earth, by means of its fore paws ; but on watching its general motions, it appeared to have much of the habits and manners of a bear. . . . . . This animal has lately been discovered to be an inhabitant of the interior of the country also. . . . . The natives call it wombach."

This is undoubtedly the earliest notice published of any species of Phascolomys, and was indeed the only description of the animal

* Collins. *An Account of the English Colony of New South Wales*, 2nd Edit., 1804, p. 469.
† Flinders. *Voyage to Terra Australis*, 1814, Vol. i. Introduction, p. cxxviii.
‡ *Loc. cit.*, p. cxxxiv.
§ *Loc. cit.*, p. cxxxv.
|| 4th Ed., 1800, p. 522.
¶ The latitude of the Island is given as 40′ 36″ S., thus proving conclusively that, as Flinders says, the first wombat came from Clarke Island.

sent to Europe up to the year 1800. Bewick gives no scientific name to the animal, but above Hunter's letter appears a quaint figure of the animal, which is entitled "The Wombach." There can be no doubt that this account formed the source of information upon which Shaw founded his very brief description of *Didelphys ursina*.

His description reads as follows:—*

"Ursine opossum."

"Didelphis ursina. *D. flavescens labio superiore bifido.* Yellowish O. with bifid upper lip.

The largest of all the opossums: size of a badger: colour, pale yellow: fur, longish and sub-erect: nose strongly divided by a furrow.

Native of New Holland: a species very lately discovered and not yet fully or satisfactorily known or described."

The letter from Hunter, and Shaw's brief description, seem to have attracted no attention, but when, in 1802, Collins† published his *Account of the English Colony in New South Wales* he included in it Bass' description of the specimen that was captured on Cape Barren Island. It is, at least, a curious fact that in this lengthy account no reference whatever is made to Hunter's specimen; on the contrary Collins speaks of Bass' finding on Cape Barren Island "a new quadruped which was also a grass eater." He goes on to say—"This animal, being a stranger, appears to merit a particular description. The wom-bat (or, as it is called by the natives of Port Jackson, the *Womback*) is a squat, thick, short-legged, and rather inactive quadruped, with great appearance of stumpy strength, and somewhat bigger than a large turn-spit dog." It is difficult to account for this, because certainly Flinders, and without doubt Bass also, were well aware of the previous capture of wombats on Clarke Island; it is indeed, as pointed out previously, quite possible that the first specimen was actually captured by Flinders himself.

In describing the animal from Bass' notes, Collins says that it head measures 7 inches in length, the body 23 $\frac{6}{10}$ inches, and that its weight was from 25 to 30 lbs. The animal was a female, and amongst wombats this sex is heavier than the male. Collins describes how Bass chased one "and with his hands under the belly suddenly lifted him off the ground and laid him upon his back, along his arm, like a child. . . . . He carried the beast upwards of a mile, and often shifted him from arm to arm, sometimes laying him upon his shoulder, all of which he took in good part, until being obliged to secure his legs while he went into the brush to cut a specimen of new wood, the creature's anger arose with the

* General Zoology, 1, Pt. 2, p. 504.

† 1st Ed., Vol. ii., p. 153; 2nd Ed., 1804, p. 466. In this work an account is given of Bass and Flinders' voyage in the *Norfolk*, during which they finally proved Tasmania to be an island.

pinching of the twine; he whizzed with all his might, kicked, and scratched most furiously, and snapped off a piece from the elbow of Mr. Bass' coat." To those who are acquainted with the animals in their living state, the idea of Bass carrying for a mile, apparently with ease, a full-grown female specimen of *Phascolomys ursinus* (as at present recognised) which does not usually weigh much less than 50 lbs., is suggestive of some mistake having been made in this account. It would take a very strong man to hold and carry a full-grown Tasmanian wombat if it behaved as Mr. Bass' specimen did, *i.e.*, "whizzed with all his might, kicked, and scratched most furiously." By some curious error, either Bass or Collins confused the account of the wombat with that of some other animal in regard to the teeth. Towards the close of his description, which is otherwise quite correct, Collins wrote—"The opening of its mouth is small; it contains five long grass-cutting teeth in the front of each jaw, like those of the kangaroo: within them is a vacancy of an inch or more; there appear two small canine teeth of equal height with, and so much similar to, eight molars, situated behind, as scarcely to be distinguishable from them. The whole number in both jaws amounts to twenty-four." The description is accompanied by a drawing of the animal, which is quaint but unmistakable, and bears a strong resemblance to, though it is much larger than, Bewick's figure. The style of drawing and curious pose of the animal, the position of the front and hind legs and of the head—all of these are identical in the two illustrations. We think there is very little doubt that they were drawn by the same hand. There is no evidence that any white man, up to that time, had ever seen the mainland wombat—all that they knew was that a similar creature did exist in New South Wales.

In neither Bewick's nor Collins' account was any scientific name applied to the animal.

During the years 1800–1804, the celebrated French expedition under the command of Baudin was engaged in exploration around the coast of Australia and Tasmania.

One of Baudin's ships, the *Naturaliste*, sailed for Europe in 1802, parting from the other two ships, the *Geographe* and *Casuarina*, at King Island. The *Naturaliste* carried to Europe specimens of the wombat, which presumably came from King Island, though this is not definitely stated. In 1803, E. Geoffroy published a preliminary description* of the animal brought to Europe by the *Naturaliste*, and proposed the generic name of Phascolomys. Evidently he was quite unacquainted with the works of Bewick and Shaw, but had seen Collins' account, because he says that the animal described by Bass, "a le porte de nos nouveaux animaux: mais il en est bien certainement différent, si les observations qui out été publiées sur leurs dents sont exactes." He adds, "Ils out été trouvés à la côte occidentale de la

* *Annales du Museum d'histoire naturelle,* Vol. 2, 1803, p. 364.

Nouvelle-Hollande." In those early days, ideas with regard to Australian geography were naturally rather vague. Geoffroy says that the wombats were 17 inches long, but as they were young, there was reason to think that if the two that remained could be kept alive, they would reach the size of a badger. He also adds that they appear to be endowed with very little energy, they prefer to sleep during the day, and, like burrowing animals, search for their food at night time.

In the same year, Desmarest mentioned the animal under the name of *Wombattus fossor.** It is evident that he had not seen, or at least, carefully investigated a specimen. Sevastianof, writing in February, 1807, describes the skins of two quadrupeds sent to the Museum in St. Petersburg by a correspondent of the Academy, living in London, named Waxel.† One of these was a specimen of *Dasyurus maculatus*, the other was a species of wombat " decouvert " says Sevastianof, " par les navigateurs anglois Bass et Flinders dans la nouvelle Galle du Sud." He goes on to quote Desmarest's description of *Wombatus fossor*, and adds finally, " Desmarest a rangé ce quadrupede dans le même ordre et sous-ordre, que Dasyure tacheté. Il est carnassier par ce qu'il a six incisives et deux canines à chaque machoire." Sevastianof had only a skin, of which he gives a very fair figure, and it is evident that Desmarest's name was applied in the first instance to the specimen secured by Bass.

In 1807 there appeared also the first edition of the first volume of the letterpress of Péron's Voyage; the atlas to this appeared in 1808.‡ In the first edition, there appears a plate,§ drawn by Lesueur, with the following legend—" Nouvelle-Hollande : île King. Le wombat (Phascolomys wombat)." Good drawings are given of a light and dark variety of the animal, together with four young ones. The letterpress describes how four naturalists, including Péron and Lesueur, were left stranded on King Island, when a violent gale forced the exploring vessels to stand out to sea. The naturalists were hospitably entertained by some English sealers, the leader of whom was a man named Cowper, from whom they gathered many particulars concerning especially the emu that then existed in large numbers on the island. Unfortunately, beyond describing how Cowper and his associates had domesticated the wombats, which went out during the day-time to feed in the scrub and returned at night-time to the huts, and describing also the value of the animal as an article of food,

* Desmarest. *N. Dict. d'Hist. Nat.*, xxiv., p. 14. We have unfortunately been unable to refer to this work and give the reference according to Sevastianof.

† Sevastianof. *Mem. de l'Acad. de St. Petersbourg*, i., 1807, p. 443. Plate 17.

‡ Péron et Freycinet. *Voyage de Découvertes aux Terres Australes.* The letterpress and atlases were issued separately. Of the two volumes of letterpress, the first edited by Péron appeared in 1807, the second edited first by Péron, and, after his death, continued by Freycinet, appeared in 1816. The first part of the atlas, with forty-one plates of views and illustrations of Natural History objects by Lesueur and Petit appeared in 1808, the second part, edited by Freycinet, containing fourteen charts, appeared in 1811. A second edition of part i. of the atlas, containing sixty-eight plates, appeared in 1824.

§ Plate 28. In the second edition it is plate 58.

they tell us very little about it. In one part Péron says that later on he intends to deal in greater detail with the animals to which he makes brief reference, but unfortunately, he died before his work was completed, and in regard to the Bass Island wombat, the only really valuable record in Péron's work is this plate. Possibly the figures were drawn from life by Lesueur during his enforced stay on the Island. The legend attached to the plate proves clearly that in 1808, the name *Phascolomys wombat* was applied by Lesueur and Petit to the King Island species.

In the year 1802, also, Charles Grimes,* Acting Surveyor-General of New South Wales, made a voyage of discovery in the *Cumberland* from Sydney to King Island, and in a journal kept by Flemming, it is stated that the party from his ship met the members of the Baudin expedition, and that "the captain (Robbins) hoisted His Majesty's colours behind the French tents." The journal also says that on Thursday, 30th December, 1802, they "caught four emus, three badgers, three porcupines, and a kangaroo"—badger being the popular name then applied to the wombat.

While Baudin with his three boats, the *Geographe*, *Naturaliste*, and *Casuarina*, was exploring the southern coasts of Australia, he met Flinders at Encounter Bay. Flinders, in the *Investigator*, had previously to this visited King Island and there found the wombats† which were well-known to him after his experiences amongst the islands of the Furneaux Group. He says—"On stepping out of the boat, I shot one of those bear-like little quadrupeds, called womat, and another was afterwards killed." Flinders was detained by the French at Mauritius, but material collected by Brown, who accompanied him as a naturalist, evidently reached Europe safely, for in 1808, Everard Home read a paper before the Royal Society in which he embodied an anatomical account of it written by Brodie.‡ Home says that the wombat was a male, that it "was brought from the islands in Basse's Straits by Mr. Brown, the naturalist attached to Captain Flinders' voyage of discovery. It lived in a domesticated state for two years. . . . . . It was quiet during the day, but constantly in motion during the night. . . . . . It appeared to have arrived at its full growth, weighed about 20 lbs., and was about 2 feet 2 inches long."

In 1811, Illiger enumerated two forms under the names respectively of *Phascolomys fusca*, Geoff., and *Amblotis fossor*, the latter genus being founded because Illiger, on account of the wrong description of the teeth given by Collins, naturally imagined that the animal originally described under the name *Vombatus* could not be the same as that to which the generic title *Phascolomys* was afterwards given. The latter animal he distinguished as *Phascolomys fusca*.§

* Historical Records of Port Phillip. Edited by Shillinglaw, 1879.
† *A Voyage to Terra Australis*, 1814, p. 206.
‡ *Trans. R.S.*, 1808, p. 304.
§ *Prodr. Syst. Mamm. et Avium*, 1811, pp. 77–78.

We now come to a description by Leach, published in 1815,* in his *Zoological Miscellany*. In the matter of brevity and inadequateness, it much resembles the original one of Shaw, but it is accompanied by a better figure. The description is as follows :—" Phascolomis Vombatus. P. pallidé fulvescente-brunneus : naso obscuriore ; unguibus elongatis. Wombach. Bewick, Gen. Hist. of Quadrup., Ed. 4, p. 522. Habitat in Australasia." Then he goes on, " Wombat phascolomis. Pale fulvescent-brown : nose darker : claws elongated : inhabits New Holland.

For an account of the anatomical structure of the Wombat Phascolomis, see Philosophical Transactions for 1808. It is named Wombat, or Wombach, by the natives of New South Wales, who kill it for food, its flesh being considered very delicate. The usual length of this animal is about 2 feet, exclusive of the tail." Reading this, one would feel doubtful as to whether the writer had ever seen the animal, but on referring to Gray's *List of the Specimens of Mammalia in the collection of the British Museum*, p. 95, published in 1843, the following entry occurs :—" b. Young : discoloured, having been in spirits. (The one figured in Leach, Z. Misc. t. 69)." Only five specimens of wombat are recorded, the one mentioned above, two from New Holland, one from Mr. Gould's collection, and a young one from Van Diemen's Land. No locality is given for Leach's specimen, nor does he help us in his own description, beyond saying that its habitat is New Holland, and that Home described the anatomy of the species. Home's specimens we know came from King Island. In Thomas' catalogue (1888), apparently the same specimen is described as a young skin, and the locality of Tasmania is ascribed to it. It would be interesting to know the definite authority for this locality, as, up to the time when Leach published, that is, twenty-eight years before Gray's catalogue was issued, there is no record of any true Tasmanian specimen having been sent to Europe.

It is to be presumed that, as neither Gray nor Leach in 1815, nor Gray in 1843, give any definite locality for this particular specimen, none was known when those writers published, more especially since Gray carefully gives the locality of every other specimen. So far as the name is concerned, it does not matter, inasmuch as that of *Phascolomys Wombat* had been applied to the King Island species eight years before Leach published his description. There can, however, be no reasonable doubt that the specimen described by Leach came from the Bass Strait Islands.

Cuvier, writing in 1817,† describes and figures the animal and its skull. He says that only one species is known, which is of the size of a badger and lives on King Island‡ and that this is identical

* Leach, p. 102, Pl. 96.

† Geo. Cuvier. *Regne Animal*, Pl. 51.

‡ He was acquainted with Bass' animal, which was, he says, externally the same as the wombat, but had a different dentition, and refers to Illiger therefor calling it Amblotis.

with Shaw's *Didelphis ursina.* The figure that he gives is one of a brown variety, and was drawn from a stuffed specimen in the Paris Museum—presumably one of those captured during Baudin's expedition. Lesson and Garnot, describing the zoological results of Duperry's voyage in 1826, say*—"Nous ne trouvâmes qu'une seule peau de wombat ou phascolome à Sydney (didelphis ursina, Shaw: phascolomys wombat, Pér. et Les.) animal qu'on n'observe que sur la côte sud et dans les petites îles du détroit de Bass."

In 1831, Owen, when describing the specimens of wombat in the collections of the Royal College of Surgeons,† stated definitely that the distribution of *Phascolomys Wombat* was "King Island and near Port Jackson," and makes no reference at all to Tasmania.

It is, we think, quite certain from the above records that before the year 1831 no wombat had been sent to Europe from Tasmania.‡ With the solitary exception of the skin which Lesson and Garnot mention as found in Sydney in 1826, there is no record of a specimen actually secured on the mainland, and even in this instance there is no proof that the skin was that of a mainland animal. It is quite likely that it had been brought to Sydney from one of the Islands in Bass Strait. It is difficult to believe that no specimens were sent from New South Wales, but, if any were, no record of them appears to have been published, and, apparently, it was taken for granted that the wombats of King, Clarke, Cape Barren, and other islands in Bass Strait were identical with those of New South Wales; indeed, Owen's statement in regard to the distribution of *Phascolomys Wombat*, quoted above, makes this quite clear.

In 1838, Ronald Gunn,§ one of the earliest naturalists in Tasmania, contributed to the *Annals of Natural History* a paper entitled "Notices of some Mammalia and Fish from Van Diemen's Land," and to this, Gray added some notes in which, referring to the wombat, he says—"I have seen Bass' specimen, which is now in the museum of the Natural History Society of Newcastle-on-Tyne; it is the same as the one we now usually receive from Van Diemen's Land, only discoloured by having been kept in spirit." It is evident that this particular specimen must have been the one sent to England by Hunter, and not by Bass.

In 1838, Owen described a mutilated sub-fossil cranium found by Mitchell in the Wellington Valley in New South Wales, under the name of *Phascolomys mitchelli*—this being the first occasion on which a distinct name was given to a mainland form.‖ In his description,

* Duperry. *Voyage Antour du Monde.* Zoologie par Mm. Lesson et Garnot, Tome i., 1826 p. 399.

† *Cat. R.C.S.*, 1831. p. 78.

‡ In 1831, a large wombat reached England, but whether it came from Tasmania or Australia is not known. This particular animal lived in the Zoological Society's gardens for five years; in 1836 it died, and its anatomy was described by Owen.

§ Gunn. Ann. Nat. Hist. 1., p. 103, 1838. Gray's note is on p. 107.

‖ Mitchell's *Three Expeditions into the Interior of Eastern Australia, &c.* Letter from Owen, dated May 8th, 1838, containing, *inter alia*, description of *Phasc. mitchelli.*

Owen remarks that it is a little larger than the largest wombat's cranium in the Hunterian collection. This is not surprising, since the latter specimens were all presented by Home, and came from King Island.

In 1836, Owen described the anatomy of a specimen* under the name of *Phascolomys wombat*, Péron, at the same time making the following remarks :—" The individual lately dissected at the museum of the Zoological Society had lived at the gardens upwards of five years. The one dissected by Sir Everard Home in 1808 was brought from one of the islands in Bass Strait, and lived as a domestic pet in the house of Mr. Clift for two years. This animal measured 2 feet 2 inches in length, and weighed about 20 lbs. It was a male. The society's specimen was a female and weighed, when in full health, in October, 1833, 59½ lbs." Owen does not say where his specimen came from. The first definite notice of the existence of a wombat in Tasmania that we can find is in the paper published by Gunn in 1838, to which we have already referred. The author, Mr. Ronald Gunn, was well known as a naturalist in the early days of Tasmania.† In this he describes the animal under the generic title Phascolomys, but gives no specific name. He states that one large specimen that he secured measured 36 inches from snout to tail, and 34 inches in circumference.

Waterhouse,‡ writing in 1841, accepts the name *Phascolomys wombat*, and says that " the wombat is found in New South Wales, South Australia, and Van Diemen's Land, as well as in some of the Islands in Bass's Straits." Gunn's collection was presented to the British Museum, and possibly it included the young specimen mentioned by Gray in his catalogue,§ with the locality given as Van Diemen's Land. So far as we can ascertain this was the first occasion on which a specific name was applied to a definite example of a Tasmanian wombat, Gray regarding it as an example of *Phascolomys ursinus*.

In 1845, Owen in his article on Marsupialia in *Todd's Cyclopedia*,‖ deals with many points in the anatomy of the wombat and figures a complete skeleton, the name *Phascolomys fusca* appearing under the figure. This is the only mention that he makes of this specific name. In the same year he exhibited at a meeting of the Zoological Society¶ " the skull of a wombat (*Phascolomys vombatus*, Auct.) from Van Dieman's Land, and the skull of a wombat transmitted by Governor Grey from Continental (South) Australia." He pointed out their differences and named the new continental form *P. latifrons*. In 1847** Gray drew attention to certain differences

* *P.Z.S.*, 1836, Pt. 4, p. 49.

† " Notices accompanying a Collection of Quadrupeds and Fish from Van Diemen's Land. *Annals Nat. Hist.*, Vol. i., 1838, p. 101.

‡ Jardine's *Naturalist's Library*, 1841, p. 300.

§ *List of the Specimens of Mammalia in the Collection of the British Museum*, 1843, p. 95.

‖ Vol. iii., 1839–1847, fig. 105.

¶ *P.Z.S.*, 1845, Pt. xiii., p. 82.

** *P.Z.S.*, 1847, Pt. xv., p. 41.

in the teeth of three skulls, two from Van Diemen's Land, and one from New South Wales, and suggested that there might be more than one species confounded under the name *Phascolomys vombatus*. Matters remained in this state until, in 1853, Owen described two skulls in the collection of the Royal College of Surgeons* as distinct from *Phascolomys vombatus*. For these he proposed the name *P. platyrhinus*, that is, under different names as regards two of them, Owen at that time recognised the three recent species that are now accepted, viz., *Phas. vombatus* (= *Phas. ursinus*), *Phas. platyrhinus* (= *Phas. mitchelli*), and *Phas. latifrons*. Apparently, however, he regarded the first of these as distributed on the mainland as well as in Tasmania and the islands. Some confusion arose in regard to the South Australian species, named originally by Owen on the strength of a skull only. When the skin of the hairy-nosed wombat of South Australia was first seen it was not identified as belonging to the same animal to which Owen gave the name *P. latifrons*. Gray accordingly founded a new genus and species for it,† *Lasicrhinus m'coyi*; Gould called it *Phascolomys lasiorhinus*‡ and Krefft described a dark variety under the name of *P. niger*.§ Of the distinctness of *P. latifrons* there is no doubt. There remains the question of the Eastern mainland species, that of Tasmania, and that of the islands.

In 1865, Murie published a paper dealing in detail with the various species.|| He came to the conclusion that *P. mitchelli* and *P. platyrhinus* were identical, but retained the latter name for the recent species, and also, like Owen, recognised two other species—*Phascolomys wombat* and *Phascolomys latifrons*. These results he confirmed in 1867, but curiously says nothing definite with regard to the geographical distribution of the species. McCoy, writing of *Phascolomys wombat* in 1868,¶ said, "This is now known to be confined to Tasmania and other islands south of the Australian continent, and as I have demonstrated from the specimens on the table, it is specifically distinguishable with ease and certainty by the characters of the skull and skin, pointed out by Dr. Murie and others, from the wombats of the mainland, which were at one time supposed to be referable to it." Krefft,** in 1871, says again that *Phascolomys wombat* "is peculiar to Tasmania and the islands of Bass Strait. The New South Wales wombat (*Phascolomys platyrhinus*) is found on the east and south coast, extending even as far as Victoria, where also a brown variety occurs. This eastern wombat differs little from the Tasmanian one, except that it is larger and grows to over 80 lbs. in weight."

* *Descriptive Catalogue Osteological Series, R.C. Surgeons*, Vol. i. 1853 p. 334.
† *A. M. N. H.* 1863, p. 854.
‡ *Mammals*, Pls. 59 and 60. 1863.
§ *Mammals of Australia*, 1871. Text to Pl. v.
|| Murie. *P.Z.S.*, 1865.
¶ *Proc. R. S.*, Victoria, 1868, p. 266.
** *Mammals of Australia.* Text to Pl. v.

In 1888, Thomas published his well-known *Catalogue*, and in this used the names that have been applied ever since to the existing species, viz., *Ph. ursinus* for the Tasmanian and Bass Strait Island species; *Ph. mitchelli* for the common mainland form with naked muzzle; *Ph. latifrons* for the hairy-nosed, South Australian species.

The main points in regard to the history of the various species of wombat up to the present time may be briefly summarized as follows:—

(1) The discovery of a wombat on Clarke Island in Bass Strait, to which the specific name of *ursina* was first given. (1797).

(2) The discovery of a wombat on King Island. (1802).

(3) The discovery of a wombat on the mainland of Australia, first in New South Wales, later in Victoria, supposed to be identical with the Bass Strait Island species. (Exact date uncertain).

(4) The discovery of a wombat in Tasmania, supposed to be identical with the island and mainland species. (Exact date uncertain.)

(5) The discovery of a fossil species (*Ph. mitchelli*) on the mainland. (1838.)

(6) The discovery of *P. latifrons* in South Australia. (1845.)

(7) The determination of *P. platyrhinus* on the mainland, as distinct from *P. ursinus* of Tasmania and the islands of Bass Strait. (1865.)

(8) The discovery of the specific identity of *P. mitchelli*, the fossil form, and *P. platyrhinus*, involving the retention of the former name for the New South Wales and Victorian species. (1865.)

(9) The discovery of sub-fossil remains of the King Island wombat.* (1903.)

(10) The discovery on Flinders Island by Mr. J. A. Kershaw of living specimens of wombats identical with the sub-fossil remains from King Island. (1908.)

A comparison of the skulls from King, Deal, and Flinders Islands shows that the same species of wombat was distributed over all three, and as Clarke and Cape Barren Islands form part of the Furneaux group, separated from Flinders Island and from one another by only shallow, narrow passages, we may safely conclude that the wombat which once existed on these two islands was identical with that on Flinders.

* We have dealt at length with this in a previous paper. Cf. "A Collection of Sub-fossil Bird and Marsupial remains from King Island, Bass Strait." *Memoirs of Nat. Mus.*, Melbourne. No. 3, p. 28.

It is many years ago since the King Island wombat was exterminated. When the island was visited by a party of the Victorian Field Naturalists Club in 1887, no trace of it was discovered nor, during the process of clearing the land that has been vigorously carried on during recent years, has any record of a living wombat been made.

Flinders Island afforded the only prospect of securing a living specimen of the Bass Strait species, and in the hope of finding that the animal had not been completely exterminated there one of us (J. A. Kershaw) took advantage of a trip organized by the Australasian Ornithologists' Union to visit the island in November, 1908. A considerable part of the north, north-east, and north-west coast line was examined, and abundant evidence was obtained to prove that the animal, though very rare and difficult to obtain, was not extinct. In the deserted hut of a half-caste native at Killiecrankie two skins were found. On the extreme north end of the island an incomplete skeleton, including a skull with the skin still attached to it, was secured, and part of another skin on the north-east coast. On the island there are, in addition to a few settlers, a number of half-castes, or rather the much-mixed offspring of whites, Australian, and Tasmanian aborigines. The existence of the wombat is well-known to them, but it is by no means easy to secure. During the three days spent in searching no living animal was seen, and all that could be done was to make arrangements to have one sent to Melbourne when captured. On Cape Barren Island, where most of the half-castes live on the native reserve, the animal was found to be quite extinct, though well-known under the name of "badger," the common term "wombat" not being known there.

Though not successful in obtaining a living specimen, Mr. Kershaw's visit was the means of proving that the animal is still extant, and in addition to the sub-fossil remains from King Island we now possess also recent remains, including skins from Flinders Island.

In January, 1909, Dr. J. W. Barrett organized a trip to the islands, and kindly invited Mr. Kershaw to join the party, with the object of searching again for the animal. Once more, owing to the very limited time available, the search proved fruitless, but we are much indebted to Dr. Barrett for his cordial co-operation.

At the present time the matter stands thus: Evidence of the existence of a wombat is forthcoming in regard to King Island on the west side of Bass Strait, and Deal, Flinders, Barren, and Clarke Islands on the eastern side. Those of King, Deal, and Flinders Islands are specifically identical, and it may be taken for granted, as already said, that the same species inhabited Barren and Clarke Islands. The animal is now extinct everywhere except on Flinders Island.

The specimen sent to Newcastle by Governor Hunter in 1798 belonged to this species, and it was to this that Shaw referred when he described the animal that he calls *Didelphys ursina*. At a later time other writers described the same species under other generic and specific names. In 1803, Geoffroy, ignorant of the fact that a specimen had been sent to England five years earlier, and briefly described by Shaw under the name of *Didelphys ursina*, proposed the generic name Phascolomys. The true designation of the wombat of the Bass Strait Islands is therefore *Phascolomys ursinus*, Shaw; and the following names, all of which have at one time or another been applied to the Island species, are synonyms of the former:—

Wombatus fossor, Desmarest (1803).
Phascolomys wombat, Péron et Lesueur (1808).
Amblotis fossor, Illiger (1811).
Phascolomys fusca, Illiger (1811).
Phascolomys vombatus, Leach (1815).
Phascolomys bassii, Lesson (1827).

The question now arises as to the relationship of *Phascolomys ursinus*, the mainland species, and the Tasmanian species. There is no question as to the specific distinction of the hairy-nosed wombat, *Phascolomys latifrons*, of South Australia. The remaining mainland form, *Phascolomys mitchelli*, is closely allied to the Tasmanian form, which again, up to the present time, has been supposed to be identical with the Bass Strait Island species, that is *Phascolomys ursinus*. In the following tables we give the measurements of the skull, teeth series, &c., of a series of Phascolomys from Bass Strait Islands, Tasmania, and Victoria, as well as a certain number of *Phascolomys latifrons*.

Table 1.—Skull Measurements of Phascolomys from King and Deal Islands.

Number of Specimen ..	1.	2.	3.	4.	5.	6.	7.	8.	Deal Island Specimens. Adult.	Juv.
Basal length ..	130	..	132.5	121	..	..	..	..	..	..
Greatest breadth ..	106	99	107	103	105	105	104	105	102	82
Nasal length ..	55	..	54	46	51	..	..	53	53	..
,, greatest breadth	40	..	44	39.5	41	..	..	39.5	39	30
,, least breadth ..	11	..	15	13	12.5	..	..	14	13	9
Interorbital breadth	40	38	47	42	41	42	43	41	41	..
Breadth between tips of postorbital processes	43	39	48.5	44.5	42	43	46	44	42	..
Constriction ..	33	32	36	33.5	34	33	36.5	30.5	36	..
Palate length ..	84	74	81	..	77	..	..	80	77	59
Diastema length ..	29.5	27	30	26	26.5	..	..	31	25	18
Palatine foramen ..	9	8.5	10	7.5	7.5	..	..	9	5.5	6
Basi-cranial axis ..	42	..	45	41	..	..	40	..	..	..
Basi-facial axis ..	91	81	90	83	82	..	..	83	83	63
Facial index ..	216.5	..	200	202.5	..	..	..	..	..	..
Length of tooth series	45	40	43	42	43	44.5	44.5	41.8	43	35

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Table 2.—Skull Measurements of Phascolomys from Flinders Island.

Number of Specimen ..	1.	2.	3.	4.
Basal length	133.5	..	..	..
Greatest breadth	108(?)	104	..	..
Nasal length	..	..	..	..
„ greatest breadth	..	33	..	..
„ least breadth	..	..	..	..
Interorbital breadth	..	37	..	..
Breadth between tips of postorbital processes	..	40	..	..
Intertemporal constriction	..	..	..	..
Palate length	80	78.5	..	..
Diastema length	31	27	..	..
Palatine foramen	8.5	9.5	..	..
Basi-cranial axis	44	..	..	..
Basi-facial axis	91	88.5	..	..
Facial index	206.7	..	..	..
Length of tooth series—upper jaw ..	41.5	41	..	..
„ „ lower jaw ..	43	..	45	42

Table 3.—Skull Measurements of *Phascolomys mitchelli*.

Number of Specimen ..	1. Adult.	2. Adult.	3. Adult.	4. Juv.	5. Juv.	6. Juv.	7. Aged.	8. Adult.	9. Adult.	10. Aged.	11. Aged.	12. Adult.	13. Adult.	14. Adult.	15. Adult.
Basal length..	170	164	165	116	122	123	170	176	175	166	181	169	170	170	173
Greatest breadth	134	135	127	91	102	101	142	147	141	133	155	138	146	134	135
Nasal length	72	74	70	53.5	52	56	74	76	80	72	75	77	70	75	72
,, greatest breadth ..	52	52.5	52.5	36	41	38	61	60	58	56	63	55	54	48	54
,, least breadth	16	18.5	21	12.5	15	12	19	18	18	22	23	19	19	19	15
Interorbital breadth	52.5	broken	55	39	42	41.5	65	61	59	60	69	61	65	55	57
Breadth between tips of post-orbital processes	52.5	,,	56	41	43	41	71	66	63	66	75	63	67	56	60
Intertemporal constriction ..	45.5	,,	44	37	40	36	51	54	48	55	60	52	46	46	48
Palate length	111	106	106	75	81	79	110	115	116	109	122	111	111	109	112
Diastema length	44	37.5	40	27	28	27	39	45	46	43	51	45	42	41	41
Palatine foramen	14	9	11.5	7.5	9	6	6	9	8	9	8	10	11	10	10
Basi-cranial axis	53	52	53	39	40	40	59	59	53	54	55	53	54	55	54
Basi-facial axis	118	114	116	79	83	85	112	118	122	116	128	119	118	116	120
Facial index	222	219	218	202	207	212	189.8	200	230	214.8	232.7	224.5	218.5	210	222
Length of tooth series ..	51	52	50	38	42	40	53	55	54	51	54	53	52	53	52

Table 4.—Skull Measurements of Phascolomys from Tasmania.

Number of Specimen ..	1.	2.	3.*	4.	5.	6. Old.	7.	8.	9.	10. Juv.	11.	12.	13. Juv
Basal length	163	151	141	142.5	151	148	139	135	148	..	..	150.5	125
Greatest breadth	138	127	116	118	128	119	113	115	123	98	129	128.5	102
Nasal length	69	63	62	59.5	66	59	57	60	62	53.5	65	70.5	58.5
,, greatest breadth	53	47	44	45.5	42	45.5	44	44	45	35	47	50	37
,, least breadth	18.5	13	14	13	17.5	16.5	14	14.5	15	13	13	16	12
Interorbital breadth	60	52	47	48	48	53	44	45	50	38	52	50	41
Breadth between tips of postorbital processes ..	65	51	49	50	50	55	46	43	52	39	51	54.5	42
Constriction	48	39	39	40	40	39	34	36	41	31	39	45.5	33
Palate length	102	96	87	90	97	97	87	84	93	75	97	97	84
Diastema length	40	36.5	32	32.5	38	36	34	32.5	34	28.5	37.5	36	30
Palatine foramen	12.5	13.5	12	10	10	10.5	11.5	11.5	12	9	14	11	10
Basi-cranial axis	53.5	50	46	47	48	48	47	45	49	38	50	49	41
Basi-facial axis	111	104	96	96	104	101	93	92	100	77.5	101	102	86
Facial index	207	208	207.5	204.5	216.6	210	197.9	204	204.8	203	205	208	209
Length of tooth series	51	50	47	47	48	47.5	43	43	46	38	50	47	40

* Type specimen of *Phascolomys tasmaniensis*.

Table 5.—Skull Measurements of *Phascolomus latifrons.*

Number of Specimen ..	1.	2.	3.	4.	5.	6.
Basal length	160	144	152	161	159	162
Greatest breadth	134	116	125	126	130	128
Nasal length	73	55	60	73	73	69
,, greatest breadth	59	58	58	57	61	60
,, least breadth	28.5	27	22	29	27	31
Interorbital breadth	65	56	58	64	65	broken
Breadth between tips of postorbital processes	77	67	66	77	75	80
Intertemporal constriction	42.5	38	42	42	47	..
Palate length	98	89	94	100	105	..
Diastema length	42	37	40	42	38	40
Palatine foramen	6	15	9.5	7	6	6
Basi-cranial axis	49	47	49	54	52	52
Basi-facial axis	112	98	104	117	110	107
Facial index	228	208	212	216.6	211.5	205.7
Length of tooth series	49	47	49	48	52	52

Table 6.—Measurements of Humerus.

—	King Island. Juv.	King Island. Aged.	Flinders Island. Imm.	Flinders Island.	Tasmanian. Adult.	Tasmanian Adult.
Length	71	98	90.5	..	110	110.5
Greatest width distal end	17.5	42	41.5	42	..	..

—	Tasmanian. Adult.	Tasmanian. Imm.	Tasmanian. Imm.	Tasmanian. Imm.	P mitchelli.	P mitchelli.
Length	114	115	115	111	128	126
Greatest width distal end	52	..	..	..	..	..

—	P. mitchelli.	P. mitchelli. Imm.	P. mitchelli. Imm.	P. mitchelli. Aged.	P. mitchelli.	P. latifrons.
Length	125	122	122	117	116.5	111
Greatest width distal end	..	..	..	53.5	..	..

Table 7.—Measurements of Femur.

—	King Island.	King Island.	Flinders Island.	Tasmanian. Adult.	Tasmanian. Adult.	Tasmanian Imm.
Length	125	120	122	146	143	147

Table 7.—Measurements of Femur—*continued.*

—	Tasmanian. Imm.	Tasmanian. Juv.	Tasmanian. Juv.	P. mitchelli.	P. mitchelli.	P. mitchelli.
Length	144	147	141	171	170	161

—	P. mitchelli. Imm.	P. mitchelli. Imm.	P. mitchelli.	P. latifrons.
Length	157	155	150	135

Table 8.—Measurements of Lower Teeth Series of King Island Specimens.

Number of Specimen ..	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Length of series ..	44	45.5	46	45	44.7	45	46	46	45.5	46
Number of Specimen ..	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
Length of series ..	46	42.5	41	44	44	45	42	43	44	44
Number of Specimen ..	21.	22.	23.	24.	25.	26.	27.	28.	29.*	30.*
Length of series ..	44.5	40	43.5	43.5	43.5	44	46	45	30	35.5

Number of Specimen ..	31.*	32.*	33.*	34.*	35.*	36.*	37.*	38.*
Length of series ..	34	29	33.5	31	31	32	33.5	36

* Those marked with an asterisk are immature. In specimens numbered 29, 32, and 34, the fourth moliars not yet in position.

Table 9.—Measurements of Lower Teeth Series of *Phascolomys mitchelli.*

Number of Specimen ..	1.	2.	3. Juv.	4. Juv.	5. Juv.	6. Juv.	7. Adult.	8.	9.	10.
Length, teeth series ..	52	52	44	43	44	44.5	52	52	52	54

Table 10.—Measurements of Lower Teeth Series of Tasmanian Species.

Number of Specimen ..	1. Juv.	2.	3.	4.	5.	6.	7.	8.	9.
Length, teeth series ..	40	48.5	52	52	51	50	48	48.5	42*

* M^4 not in correct position.

Some of the main features in the above Tables may be summarized as follows:—

1.—King, Deal, and Flinders Islands Species.

Basal length	121 – 132.5
Greatest breadth	99 – 107
Teeth—upper series	40 – 45
,, lower series	41 – 46
Length of humerus	90.5 – 98
,, femur	120 – 125
Greatest width of humerus	41.5– 42

2.—Tasmanian Species.

Basal length	135 – 151 (163)
Greatest breadth	116 – 128.5 (138)
Teeth—upper series	47 – 50 (51)
,, lower	48 – 52
Length of humerus	110 – 115
,, femur	143 – 147

3.—*P. mitchelli.*

Basal length	164 – 181
Greatest breadth	127 – 155
Teeth—upper	50 – 52
,, lower	52 – 54
Length of humerus	116 – 128
,, femur	150 – 171

4.—*P. latifrons.*

Basal length	144 – 162
Greatest breadth	116 – 134
Teeth—upper	47 – 52
,, lower	48 – 48.5
Length of humerus	111
,, femur	135

The structural peculiarities of *P. latifrons*, such as the very prominent post-orbital processes and the hairy muzzle, serve to distinguish it at once. In regard to the other three groups, the difference is mainly one of size. It will also be noticed that, so far as the measurements are concerned, the Tasmanian species and *P. latifrons* are very closely similar to one another.

The Island species, the Tasmanian and *P. mitchelli* appear to represent three well-marked forms, so far as size is concerned. The larger Island specimens, of course, approximate in size to the smaller Tasmanian ones, just as the larger Tasmanian ones do to the smaller *P. mitchelli.* In the case of the Tasmanian form, one skull, for which we are indebted to Mr. H. H. Scott, curator of the Launceston Museum, is remarkable for its relatively large size. Its basal length is 163 mm., the next largest being 151 mm., but even this largest Tasmanian skull is slightly smaller in size than the smallest *P. mitchelli*, and it stands out as a giant amongst the Tasmanian specimens. When other bones, such as the humerus and femur of the Island species (Plate 11, Figs. 9–14) are seen side by side with those of the Tasmanian form, the difference in size and in robustness of the bones is very marked, and they clearly indicate two animals of very different form.

The measurements of both the upper and lower tooth series serve also to mark the Island species as distinct. The maximum length of the upper tooth series of the Island species is 45 mm., the minimum of the Tasmanian species being 47 mm., and that of *P. mitchelli* 50 mm. The maximum of the lower tooth series of the Island species is 46 mm.; the minimum of the Tasmanian form is 48 mm., and that of *P. mitchelli* 52 mm.

A reference to Plate 11, Figs. 1 and 2, illustrating respectively side views of the skulls of a King Island and Tasmanian wombat, serve to show not only the difference in size, but one or two features of structural importance in which they differ from one another. In the Tasmanian specimen (and the same is true of *P. mitchelli*) the paroccipital process slants downwards and markedly forwards, in the King Island skulls it always runs nearly straight down, the forward slant being scarcely noticeable. A second point is that in the Island specimens the malar bone is always strongly bowed downwards and outwards beneath the orbit (cf. also Plate 9, Fig. 1, Plate 10, Fig. 1). In regard to the two specimens figured in Plate 11, it will be observed that the snout region in Fig. 1 is distinctly more elongate than the same part in Fig. 2, with the result that, seen from above the nasals, more completely hide the premaxillæ from view in the Island than in the Tasmanian specimen. This feature, though it happens to be rather marked in the two examples figured, is subject to a certain amount of variation, and cannot be relied upon.

The two skins obtained on Flinders Island measure respectively 715 mm. and 675 mm., the latter being slightly incomplete. The hind foot of the first measures 65.5 mm. In the colour and general nature of its fur, the larger specimen, a male, is clearly similar to light-coloured specimens of *P. mitchelli* or the Tasmanian form. In the smaller specimen each hair is light-coloured at the tip, giving a general light greyish-brown colour to the fur, the darker basal part of each hair being hidden from view. This basal part is much more darkly coloured than in the case of the other example. In the smaller one also, the fur has a curious silky appearance, with small curls all over it, but it is coarse to the touch. There is also a light russet-brown line along the back.

In regard to the mainland species (*P. mitchelli*) and the Tasmanian wombat, the difference in size is not so marked as it is in the case of the Island species when the latter is compared with either of the two former. The exceptionally large specimen of a Tasmanian wombat skull sent to us by Mr. Scott (Plate 9, Fig. 7) is so abnormal in size that we feel it would be misleading to take this as the maximum size of Tasmanian specimens without drawing attention to the difference between it and the largest of all the other Tasmanian skulls. A glance at the measurements detailed in Table 4 will serve to show that this one is abnormal so far as Tasmanian wombats are concerned. We have therefore, in the summarized results of measurements, placed in brackets the figures referring to this skull and have taken the largest of the normal series of specimens as indicating what may be fairly regarded as the maximum size of Tasmanian wombats.

In either case it is evident that, so far as size is concerned, the Tasmanian specimens form a group well marked off from those of the mainland, commonly described under the specific name of *Phascolomys mitchelli.* As Mr. Oldfield Thomas* says—"The species seems to be well distinguished from *Ph. mitchelli* by this one character of size, but otherwise there appears to be no difference of importance between the two."

As a result of the evidence now available we have come to the conclusion that four species of existing wombats must be recognised, as follows :—

1. *Phascolomys ursinus*†, Shaw. The oldest known species of the genus confined to the Islands of Bass Strait, and now extinct in all so far as known, except Flinders Island. This is considerably the smallest species.

   Type is the specimen sent to Newcastle by Hunter in 1798.

2. *Phascolomys mitchelli*, Owen. The largest species and the most common one on the Australian mainland. It extends over New South Wales, Victoria, and South Australia. The head and body measure 950–1150 mm. The basal length of the skull measures 160–180 mm.

   Type (fossil) in Museum of the Geological Society, London.

* *Cat. of Marsupialia and Monotremata*, 1888, p. 217.

† For descriptive characters of this cf. "Collection of Sub-fossil Bird and Marsupial Remains from King Isand, Bass Strait," Spencer and Kershaw. *Memoirs Nat. Mus.*, Melbourne, iii., p. 29.

3. *Phascolomys latifrons*, Owen. Characterized by the soft silky fur, hairy rhinarium, and prominent post-orbital processes.
Habitat, South Australia.
Type in the Museum of the Royal College of Surgeons.

4. *Phascolomys tasmaniensis*, sp. n. Size medium, intermediate in this respect between *Ph. mitchelli* and *Ph. ursinus.* Total length of the head and body 910 mm. Except in size it agrees closely in external form with *Ph. mitchelli.* Colour grizzled grey. Underfur fairly abundant, especially on the anterior part of the body.
Hairs within the ear light coloured.
Basal length of skull,* 141 mm.; greatest width, 116 mm.
Type (male) in National Museum, Melbourne.
Specimens vary somewhat in size, the smallest mature female in our possession having a total length of 780 mm., the largest female measuring 910 mm. One male measures 878, and a second (the type) 910 mm., which is probably about the maximum size of the male form, the female reaching a length of 950 mm.
The variation in colour is very considerable, from grizzled grey to black. In melanistic specimens the distal half of the long hairs is black, the proximal half dark-brown; the underfur is also dark-brown, but it is completely, or almost completely, hidden from sight by the black tips of the abundant long hairs. The hairs within the ear are dark-brown in colour. The general colour of the majority of specimens is grizzled-grey, with, at times, brownish or russet tinged areas. The grizzled appearance is due to the fact that the majority of the hairs are tipped with white, and these are interspersed with long, coarse, dark-tipped hairs, varying in number in different parts. They are frequently abundant enough to give a general dark colour to certain areas, such as the middle line of the back.
The underfur appears to be always noticeably thicker on the anterior part of the body, especially in the shoulder region.
In all specimens, excepting melanistic ones, the hairs within the ear are always light-coloured, sometimes almost white. The chin is brown, throat and chest uniformly light-coloured. There is considerable variation in the coarseness of the hair which is not generally so harsh as in *Ph. mitchelli.*

* For skull measurements of the type specimen, see Table 4, specimen No. 3.

In the following list we have enumerated the more important memoirs, &c., dealing with the genus Phascolomys, and have given a brief outline of their contents, so far as they are concerned, with the history of the species included in the genus.

1. *Bewick.—History of Quadrupeds*, 4th edit., p. 522, 1800. Contains in full the letter written by Hunter, accompanying the body of the wombat from Clarke Island sent to Newcastle. Above the letter is a figure of " the Wombach."

2. *Shaw.—General Zoology*, 1, Pt. 2, p. 504, 1800. Gives a short description of, presumably, the animal sent to England by Hunter (as no other was then known) under the name of *Didelphys ursina.*

3. *Collins.—Account of the English Colony in New South Wales*, 1st ed., vol. ii., p. 153, 1802. 2nd ed., 1804, p. 466. Includes a description of a wombat found by Bass on Cape Barren Island. The description of the teeth is wrong. The animal is figured, the drawing being remarkably similar to the one in Bewick.

4. *Geoffroy.—Annales du Museum d'histoire naturelle*, vol. 2, 1803, p. 264. Contains a preliminary description of certain animals collected on Baudin's expedition. The generic name of *Phascolomys* is proposed for the wombat. Reference is made to the animal described by Bass and to the nature of its teeth.

5. *Desmarest.—N. Dict. d'hist. nat.*, xxiv., p. 14, 1803. Refers to the animal described by Bass, and calls it *Wombattus fossor.*

6. *Sevastianof.—Mem. de l'Acad. de St. Petersbourg*, i., 1807, p. 443, Pl. 17. Describes a skin sent to the Museum in St. Petersburg, and says that it is the same species as the one discovered by Bass and Flinders.

7. *Péron et Freycinet.—Voyage de Découvertes aux Terres Australes*, Vol. i., letterpress, 1807; atlas, 1st part, 1808. Gives an account of the finding of wombats on King Island by the naturalists of Baudin's expedition. Plate 28 (1st edit.) represents light and dark varieties of the animals together with young ones, drawn by Lesueur. The animal is called *Phascolomys wombat*, and the locality given is King Island.

8. *Home.—Trans. R. S.*, 1808, p. 304. Contains a description of the anatomy of a male wombat. It was one of those taken to England from King Island by Brown, and lived in a domesticated state for two years.

9. *Illiger.—Prodromus Syst. Mamm. et Avium,* 1811, pp. 77, 78. Refers to what is evidently the species sent to France from the Bass Strait Islands under the name of *Phascolomys fusca*, and proposes the genus *Amblotis* for Bass' animal, in consequence of the wrong description of teeth given by Collins.

10. *Flinders.—A Voyage to Terra Australis,* vol. i, p. 206, 1814. Describes the finding of wombats on King Island in April, 1802. Some were taken to England by Brown.

11. *Leach.—Zoological Miscellany,* p. 102, Pl. 96, 1815. Gives a very brief description of the animal, which he calls *Phascolomis vombatus*, together with a figure. He mentions Bewick's and Home's accounts as referring to the same animal, the usual length of which he says is 2 feet.

12. *Cuvier (G.).—Règne Animal,* Tome i., p. 184, Pl. 51, 1817. Says that only one species is known; it is the size of a badger, lives on King Island, and is identical with Shaw's *Didelphis ursina*. Figures a brown variety from a stuffed specimen in the Paris Museum.

13. *Lesson and Garnot.*—In Duperry *Voyage autour du Monde*, Tome i., p. 399, 1826. The authors say that they could only secure one skin of the wombat in Sydney, and that it is only known from the southern coasts of Australia and the Islands of Bass Strait.

14. *Owen.—Catalogue, Royal College of Surgeons,* 1831. Gives the distribution of *Phascolomys wombat* as "King Island, and near Port Jackson," and makes no reference to Tasmania.

15. *Owen.—P.Z.S.*, p. 49, 1836. Description of the anatomy of *Phascolomys wombat* that had lived in the gardens for five years and weighed $59\frac{1}{2}$ lbs.

16. *Gunn.—Annals Nat. Hist.,* Vol. i., p. 103, 1838. Says that Phascolomys, the wombat, is commonly known as the badger, and is found in various parts. One that he caught measured 36 inches in length and 34 in circumference.

17. *Gray.—Annals Nat. Hist.,* Vol. i., p. 107, 1838. In a note appended to Gunn's paper (15) Gray says that he has seen Bass' specimen at Newcastle, and that it was the same "as the one we now usually receive from Van Diemen's Land" (The specimen was Hunter's, not Bass').

18. *Owen.*—In Mitchell's *Three Expeditions into the Interior of Eastern Australia, &c.* Letter, dated May, 1838. Contains original description of *Phascolomys mitchelli.*

19. *Waterhouse.*—*Jardine's Naturalists' Library*, p. 300, 1841. Describes the animal under the name *Phascolomys wombat*, and gives its distribution as New South Wales, South Australia, and Van Diemen's Land. A short general account of the history of the nomenclature of the animal is also given.

20. *Gray.*—*List of Specimens of Mammalia in Collection of Brit. Mus.*, p. 95, 1843. Includes a young specimen from Van Diemen's Land.

21. *Owen.*—In article *Marsupialia* in Todd's Cyclopedia, p. 208, fig. 105, 1845. Figures a complete skeleton under the name *Phascolomys fusca.*

22. *Owen.*—*P.Z.S.*, p. 82, 1845. Gives the specific name *latifrons* to a South Australian form (skull); also exhibits skull of Phascolomys from Tasmania.

23. *Waterhouse.*—*Nat. Hist. of the Mammalia*, p. 246, 1846. Recognises two species—*Ph. wombat* (distribution as in 19), and *Ph. latifrons* from South Australia, and gives a general account of the knowledge of the genus up to date of publication.

24. *Gray.*—*P.Z.S.*, Pt. xv., p. 41, 1847. Describes and compares skulls from Tasmania and Australia, and suggests possibility of more than one species being confounded under name *Ph. vombatus.*

25. *Owen.*—*Trans. Z. S.*, p. 303, 1849. Describes and compares the skulls of a Tasmanian wombat as *Ph. latifrons.*

26. *Owen.*—*Cat. Ost. Ser. R. C. Surgeons*, Vol. i., 1853, p. 344. Describes two skulls from Australia under the name of *Ph. platyrhinus.*

27. *Angas.*—*P.Z.S.*, p. 268, Pl. 60, 1861. Describes and compares living specimens of the Tasmanian wombat and *Ph. latifrons.*

28. *Gould.*—*Mammals of Australia*, Introduction, p. 29, Plates 59 and 60, 1863. Recognises *Ph. wombat* from Van Diemen's Land and the Islands in Bass Strait; *Ph. latifrons* from Victoria and South Australia; *Ph. lasiorhinus* from Victoria and South Australia; and describes *Ph. niger* from South Australia (?). He figures the first three.

29. *Gray.—A.M.N.H.*, p. 457, Vol. xi., 1863. Describes *Ph. ursinus* from Van Diemen's Land, *Ph. angasii* from South Australia, *Ph. setosus* from Australia. The latter is the specimen figured by Gould as *Ph. latifrons.* Describes the first skin of *Ph. latifrons* that reached England under the name of *Lasiorhinus m'coyi.*

30. *Sclater.—A.M.N.H.*, Vol. xii., p. 78, 1863. States that Gray's *Ph. angasii* is identical with Gould's *Ph. niger.*

31. *Murie.—P.Z.S.*, p. 838, 1865. Contains general discussion with regard to the species of the genus described up to date. Gives figure of *Ph. latifrons* (animal), and of skulls of *Ph. latifrons, Ph. wombat,* and *Ph. platyrhinus.* States that *Ph. platyrhinus* is identical with *Ph. mitchelli.* Recognises *Ph. wombat* and *Ph. platyrhinus,* and Lasiorhinus as a sub-genus with the species *Ph. latifrons.*

32. *Murie.—P.Z.S.*, p. 798, 1867. Describes *Ph. platyrhinus* at length, and again recognises three species. Figures *Ph. platyrhinus.*

33. *McCoy.—P.R.S.*, Victoria, p. 266, 1868. States that the common Victorian species is *Ph. platyrhinus,* of which *Ph. niger* is only a variety, and with which *Ph. angasii* is identical. Recognises *Ph. setosus* as a distinct species.

34. *Krefft.—Mammals of Australia,* Text to Plate v. Says that *Ph. wombat* is peculiar to Tasmania and Islands of Bass Strait. *Ph. platyrhinus* occurs in New South Wales and Victoria.

35. *Grimes.—Voyage of His Majesty's Colonial Schooner "Cumberland" from Sydney to King Island and Port Phillip in* 1802–3. The journal kept by Flemming was published in *Historical Records of Port Phillip,* edited by John J. Shillinglaw, Melbourne, 1879. Grimes met Baudin at Sea Elephant Bay on the east coast of King Island, and on the return voyage to Sydney discovered the River Yarra. Several references are made to the capture of emus and wombats (called badgers) on King Island.

36. *Thomas.—Cat. Marsup. Brit. Mus.* Recognises *Ph. ursinus* of Tasmania and Islands of Bass Strait; *Ph. mitchelli,* the common mainland form; with naked rhinarium and *Ph. latifrons* in South Australia, with hairy rhinarium. The species as recognised by Thomas have been accepted up to the present time.

EXPLANATION OF PLATES.

PLATE 9.

Fig. 1—*Phascolomys ursinus.* Shaw. King Island.
Fig. 2—*Phascolomys tasmaniensis.* Sp. n. Juv. Tasmania.
Fig. 3—*Phascolomys ursinus.* Shaw. King Island.
Fig. 4—*Phascolomys tasmaniensis.* Sp. n. Tasmania.
Fig. 5—*Phascolomys ursinus.* Shaw. King Island.
Fig. 6—*Phascolomys tasmaniensis.* Sp. n. Tasmania.
Fig. 7—*Phascolomys tasmaniensis.* Sp. n. Tasmania.
Fig. 8—*Phascolomys mitchelli.* Owen. Victoria.

PLATE 10.

Fig. 1—*Phascolomys ursinus.* Shaw. King Island.
Fig. 2—*Phascolomys ursinus.* Shaw. King Island.
Fig. 3—*Phascolomys ursinus.* Shaw. King Island.

PLATE 11.

Fig. 1—Side view of skull of *Phascolomys ursinus.* King Island.
Fig. 2—Side view of skull of *Phascolomys tasmaniensis.* Sp. n.
Fig. 3—Lower jaw of *Phascolomys ursinus.* King Island.
Fig. 4—Lower jaw of *Phascolomys ursinus.* King Island.
Fig. 5—Lower jaw of *Phascolomys tasmaniensis.* Sp. n. Juv. Tasmania.
Fig. 6—Lower jaw of *Phascolomys mitchelli.* Owen. Victoria.
Fig. 7—Lower jaw of *Phascolomys tasmaniensis.* Sp. n. Tasmania.
Fig. 8—Lower jaw of *Phascolomys tasmaniensis.* Sp. n. Tasmania.
Fig. 9—Femur of *Phascolomys ursinus.* Shaw. King Island.
Fig. 10—Femur of *Phascolomys tasmaniensis.* Sp. n. Tasmania.
Fig. 11—Femur of *Phascolomys ursinus.* Shaw. King Island.
Fig. 12—Femur of *Phascolomys mitchelli.* Owen. Victoria.
Fig. 13—Humerus of *Phascolomys ursinus.* Shaw. King Island.
Fig. 14—Humerus of *Phascolomys tasmaniensis.* Sp. n. Tasmania.

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Much to our regret we overlooked the description of a new species of hairy-nosed Wombat published by Mr. C. W. de Vis in the Annals of the Queensland Museum, No. 5, p. 14, 1900. Mr. de Vis' description is based upon two entire specimens and a skull secured at St. George, on the Moonie River, in South-eastern Queensland, close to the New South Wales border. Externally it is indistinguishable from the South Australian species, *Phascolomys latifrons*, but Mr. de Vis, as the result of certain cranial peculiarities, regards it as distinct from the latter. In the collection of the National Museum, Melbourne, we have three skins, a stuffed specimen, and skulls of a hairy-nosed Wombat from Deniliquin, in the southern part of New South Wales, close to the Victorian border. One of us,* since this paper has been in print, has recorded these under the name of *P. latifrons*, thus widely extending the distribution of the species. In regard to the proportions of the skull, the shortness of the frontals, the pronounced ramification of the naso-frontal suture, and the backward cuneiform extension of the same, our Deniliquin specimen agrees to a large extent with those of Mr. de Vis, for which he has proposed the name of *Phascolomys gillespiei*, but we feel considerable doubt as to whether either the Queensland or the New South Wales form is specifically distinct from *P. latifrons*.

* J. A. Kershaw. *Victorian Naturalist*, vol. 26, p. 118, 1909

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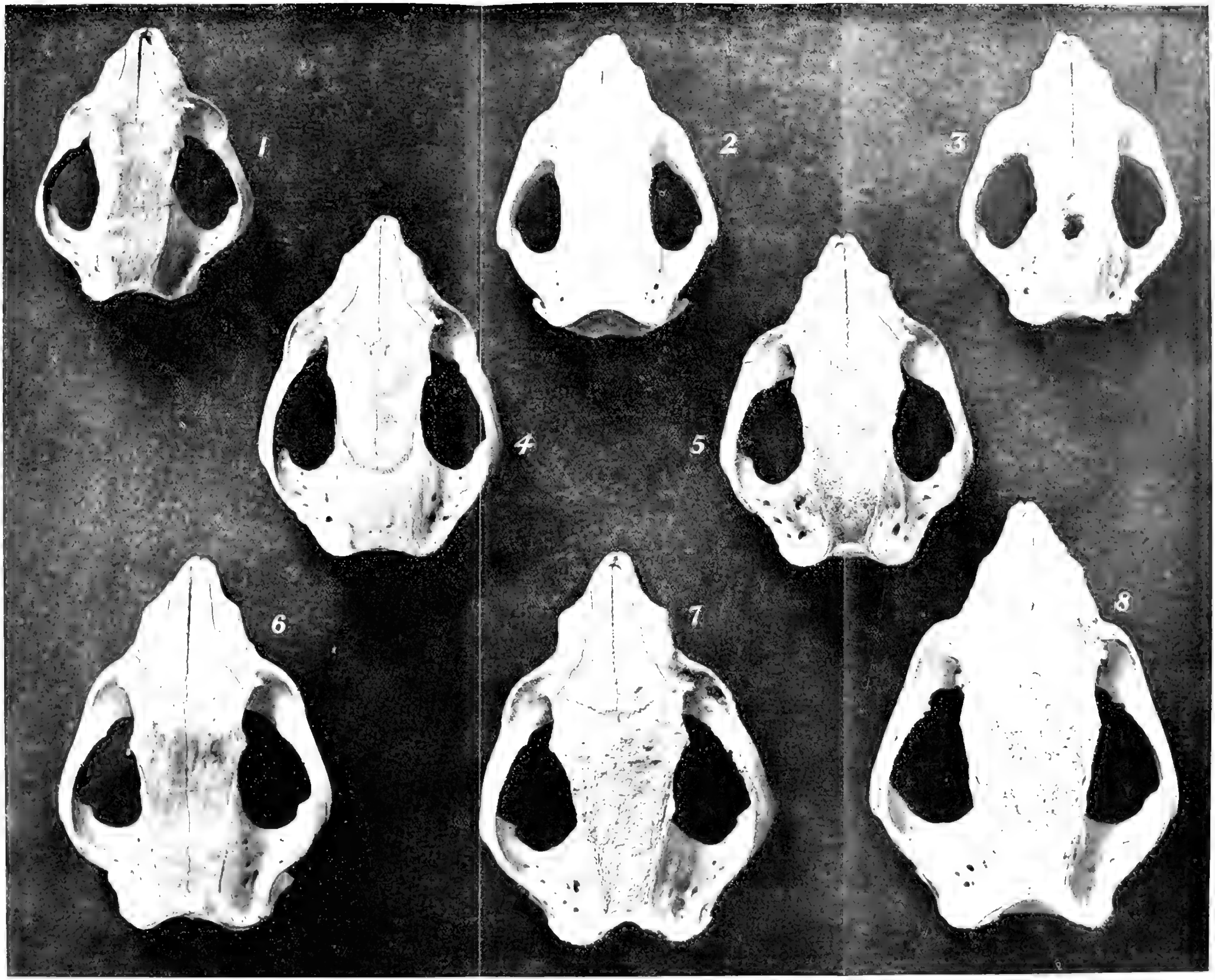
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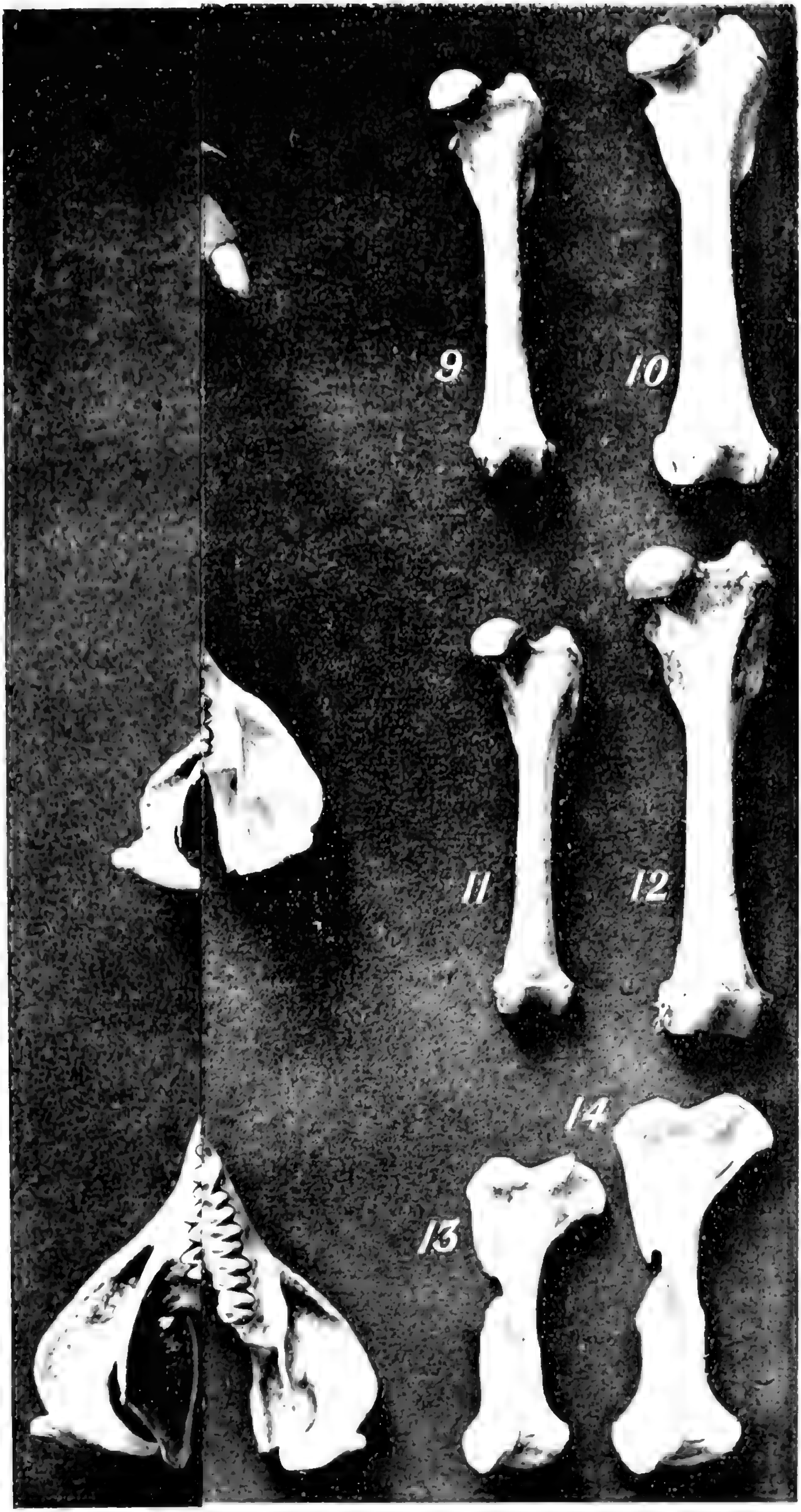
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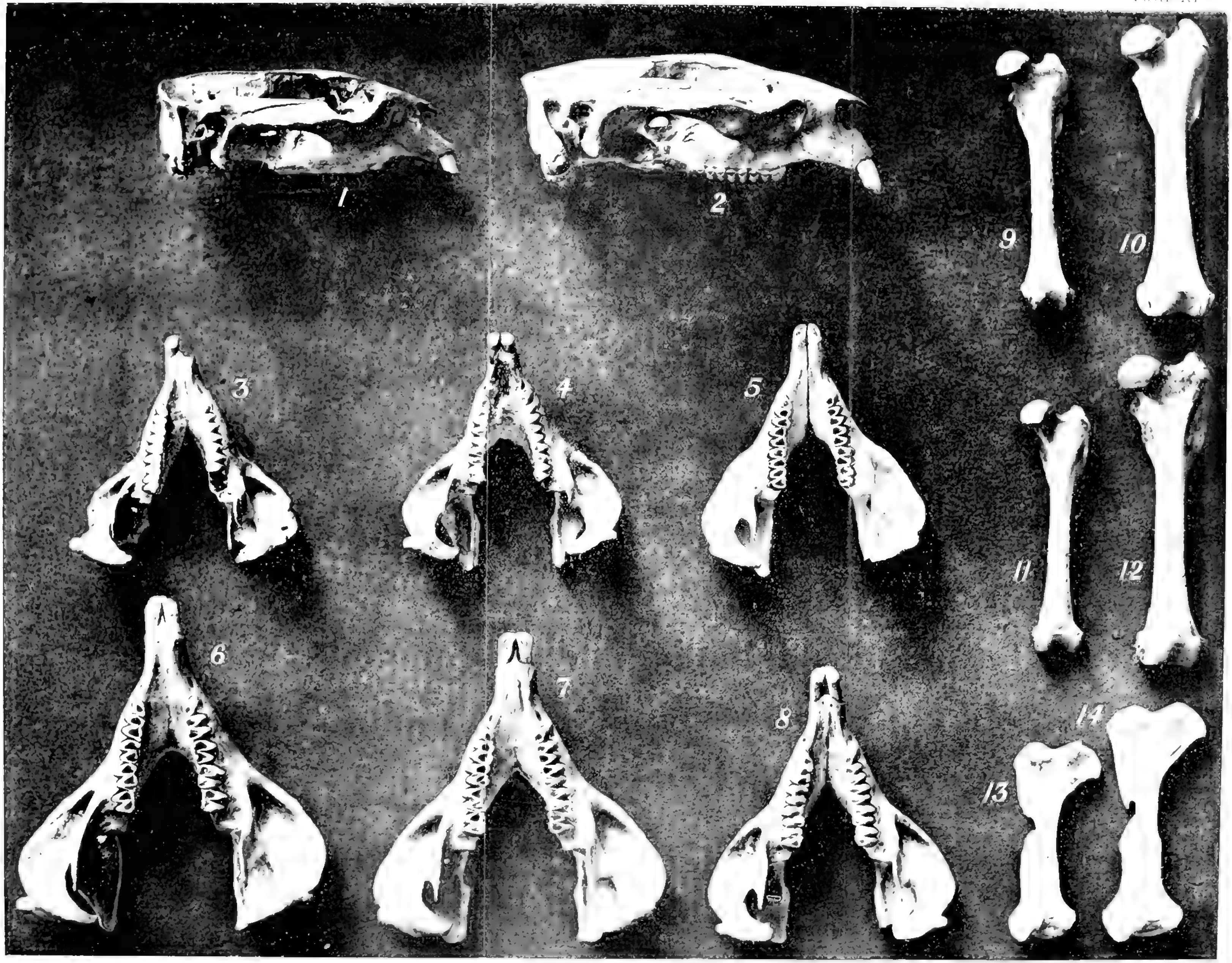
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CONTENTS.

AN INDEX TO THE LAND SHELLS OF VICTORIA.

By J. C. Cox, M.D., and C. Hedley, F.L.S.

(Plates I., II., III.)

At the invitation of the Director of the National Museum, Melbourne, we have undertaken a brief survey of the land shells of Victoria. Material from the National Museum and from the private collection of Mr. J. A. Kershaw has been confided to us. We have also drawn upon the resources of the Cox collection and of the Australian Museum, Sydney. Previous studies on the Tasmanian land shells* by the late Mr. W. F. Petterd and one of us, formed a suitable introduction to the present task.

But little attention has yet been paid to the land molluscan fauna of the State. Recently Dr. T. S. Hall wrote, "As to our land and fresh water mollusca, again, we in Victoria are sadly in the dark. Collecting has been done in the south-west of the State, but the rest is a blank."† Although the search has not been exhaustive and several species doubtless await discovery, sufficient has been done to show that Victoria is poorer in land shells than other parts of Australia. Professor Tate, in discussing this remarkable paucity, suggested that "A deluge of igneous mass must have destroyed terrestrial forms of life over the greater part of the southern region of Victoria."‡

Probably the first conchologists to work in Victoria were the naturalists of the *Astrolabe*, who, in 1826, visited Western Port and found *Helicarion cuvieri* and *Succinea australis.* In 1868, but five species, including two lately collected by Mr. G. Masters, were recorded from Victoria, in Dr. Cox's *Monograph of Australian Land Shells.* A few more species have since been added by desultory collecting. In the earliest paper written exclusively on the molluscs of Victoria, Mr. Maplestone observed the scarcity of land shells around Melbourne.§ In 1884, Professor Tate published a list and general discussion of the land shells. It was his intention to complete this preliminary statement by a more detailed study, but the increasing pressure of an active life gave him no further opportunity of resuming the subject.

An account of the land and freshwater mollusca of Castlemaine was more recently published by Mr. F. L. Billinghurst.||

During the preparation of this report, our friend the veteran conchologist, Mr. W. F. Petterd, passed away. He took a keen interest in the subject, and had generously assisted us with specimens and information.

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* Petterd and Hedley. *Rec. Austr. Mus.*, vii., 1909, pp. 283-304, pls. lxxxii.-lxxxvii.
† Hall. *Victorian Naturalist*, xxvi., 1910, p. 126.
‡ Tate. *Trans. Roy. Soc., S.A.*, iv., 1882, p. 74.
§ Maplestone. *Monthly Microscopical Journal*, viii., 1872, p. 53.
|| Billinghurst. *Victorian Naturalist*, x., 1893, p. 61.

All known Victorian species have now been illustrated, and the present index to the subject will enable students to identify them. But it is to be remembered that smaller and rarer species yet await discovery, and that the structure of some of the small forms also requires investigation.

GROUP HETERURETHRA.

Family Succineidæ.

GENUS SUCCINEA, Draparnaud, 1801.

SUCCINEA AUSTRALIS, Ferussac.

Succinea australis, Ferussac, Tabl. Syst., II., 1821, *p.* 27.

Id., Quoy et Gaimard, voy. Astrolabe, Zool., II., 1832, *p.* 150, *pl. xiii., f.* 19–23.

Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 95.

Id., Billinghurst, Vict. Nat., X., 1893, *p.* 62.

Id., Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 283.

Habitat.—Western Port (Astrolabe), Melbourne (Petterd), Castlemaine and Harcourt (Billinghurst), Stawell (Australian Museum), Frankston and Wimmera District (Kershaw).

GROUP SIGMURETHRA.

SUB-GROUP HOLOPODA.

Family Acavidæ.

GENUS PANDA, Albers, 1860.

PANDA ATOMATA, Gray, var. KERSHAWI, Brazier.

Bulimus kershawi, Brazier, Proc. Zool. Soc., 1871, *p.* 641.

Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

Panda atomata, var. kershawi, Hedley, Rec. Austr. Mus., II., 1892, *p.* 31, *pl. v., f.* 9.

Habitat.—Snowy River, Gippsland (W. Kershaw). The species is unknown between the Hunter and the Snowy rivers. This is the most remarkable instance of discontinuous distribution recorded among Australian land mollusca.

Family Helicidæ.

GENUS CHLORITIS, Beck, 1837.

CHLORITIS VICTORIÆ, Cox.

(Plate I., figs. 1, 2.)

Helix victoriæ, Cox, Monogr. Austr. Land Shells, 1868, *p.* 37, *pl. xii., f.* 5.

Helix brunonia, Johnston, Proc. Roy. Soc., Tasm., 1887, *p.* 75.

Chloritis brunonia, Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 285, *pl. lxxxii., f.* 2, 3, 4.

After *Panda* and *Paryphanta*, this is the largest Victorian snail. When deprived of its characteristic bristly epidermis, it seems transformed into another species. It is obvious that this is what Professor Tate doubtfully recorded* from Fernshaw as *H. mansueta*, Pfr. The latter is a Queensland shell bearing a general resemblance to *C. victoriæ* in size, form, and colour. But *C. mansueta* may be distinguished in all stages of growth by the broader umbilicus and sparser bristles. Professor Tate's record (op. cit.) of *H. brevipila*, Pfr., from Melbourne is evidently again a misquotation for *C. victoriæ*. During the preparation of the *Revised Census of the Terrestrial Mollusca of Tasmania*, Mr. W. F. Petterd was not quite satisfied of the identity of *C. brunonia* with *C. victoriæ*. In the last letter we received from him, he had decided that they were the same. This decision is here adopted. The species seems to be common and widely distributed. We have received specimens from the following places :—Western Port (type locality, Masters and Petterd), Victorian Alps (French), Jan Juc (Kershaw), Forrest (Steel), Lorne (Pritchard), Loutit Bay (Kershaw), and Cape Otway (Petterd). Beyond Victoria it is only known from King Island, and from Mt. Kosciusko.

SUB-GROUP AGNATHOMORPHA.

Family Rhytididæ.

GENUS RHYTIDA, Albers, 1860.

RHYTIDA RUGA, Cox.

Helix ruga, Cox, in Legrand Coll., Monog. Tasm. Land Shells 1871, *sp.* 24, *pl. i., f.* 5.

Id., Tryon, Man. Conch., III., 1887, *p.* 264, *pl.* 37, *f.* 93–95.

Rhytida ruga, Mollendorff and Kobelt, Conch. Cab. Agnatha, 1903, *p.* 29, *pl. v., f.* 10–12.

Id., Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 286.

Helix exoptata, Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

This species is generally distributed throughout the State. It was first recorded from Victoria by Mr. W. F. Petterd, who remarked that "specimens from the Dandenong Range, Victoria, are identical with those from the northern portion of this island"†, *i.e.*, Tasmania.

Professor Tate appears to have considered, on the contrary, that mainland shells should be specifically distinguished from the Tasmanian, and proposed to name the Victorian form, which he recorded from Sale, Cape Otway, and Fernshaw, as *Helix exoptata*, but he never published a formal description or noted differential characters.

The size principally distinguished *R. ruga* from its northern relations, and it may prove a dwarf of a widespread species which, in different parts of Australia, has received different names. We

* Tate. *Trans. Roy. Soc., S.A.*, iv., 1882, p. 75.
† Petterd. *Monogr. Tasm. Land Shells*, 1879, p. 7.

would suggest comparison with *Helix georgiana*, Quoy and Gaimard* from King George's Sound, Western Australia; with *Zonites walkeri*, Gray,† collected 70 miles from Fort Macquarie, New South Wales, in company with *P. atomata;* with *Helix capillacea*, Ferussac,‡ collected by Peron at Port Jackson, New South Wales; with *Nanina fricata*, Gould§, collected by Drayton in Illawarra, New South Wales; and with *Helix gawleri*, Brazier,‖ from the Mount Lofty Range, South Australia.

GENUS PARYPHANTA, Albers, 1850.

PARYPHANTA ATRAMENTARIA, Shuttleworth.

Nanina atramentaria, Shuttleworth. Mittheil. Naturf. Gesell. Bern, 1852, *p.* 194.

Id., Fischer, Notitiae malacol., II., 1877, *p.* 5, *pl. i., f.* 2.

Helix atramentaria, Cox, Monogr. Austr. Land Shells, 1868, *p.* 5, *pl. iii., f.* 2.

Helicarion atramentaria, Ten. Woods, Proc. Linn. Soc., N.S.W., III., 1879, *p.* 124, *pl. xii., f.* 2, 2*a*.

Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

Habitat.—Port Phillip (Shuttleworth), Mount Arnold and Bendigo (Cox), Fernshaw (Tate), and Dandenong Range (Tenison Woods).

PARYPHANTA COMPACTA, SP. NOV.

(Plate I., Figs. 3, 4, 5.)

Shell depressedly globose, narrowly perforate, thin, whorls four. Colour brown, deepening on the last whorl to black and on the second whorl passing into straw yellow. The epidermis, in which the colour resides, is thick and very glossy. Sculpture: On the earlier whorls are oblique wrinkles, on the later a few irregular growth lines occur. Suture deeply impressed. Spire slightly elevated, base well rounded, umbilicus a narrow perforation. Aperture very oblique, slightly descending above, sinuate at the periphery, left insertion a little reflected over the perforation. Margins united by a callus which within the throat is purple and finely granulated. This callous lining does not extend to the very edge of the aperture, but leaves a narrow epidermal margin.

Maj. diam., 24 mm., min. diam., 19 mm.; height, 17 mm.

Type presented to the Australian Museum by Dr. J. C. Cox, collected by Mr. A. D. Hardy in débris and rotten wood at Smithers Creek, Otway Ranges. Three other specimens collected by Mr. Kershaw at the Erskine Falls, Loutit Bay, differ by being smaller, namely:—Maj. diam., 20 mm.; min. diam, 15 mm.; height, 14 mm., and by the spire whorls being almost flat.

* Quoy et Gaimard. *Voy. Astrolabe, Zool.*, ii., 1832, p. 129, pl. x., f. 26–30. *Id.*, Ferussac et Deshayes, *Hist. Nat. Moll. Terr.* (no date), i., p. 88, pl. 84, f. 3-4. *Vitrea georgiana*, Smith, *Proc. Mal. Soc.*, i., 1894, p. 87.

† Gray. *Proc. Zool. Soc.*, 1834, p. 63.

‡ Ferussac. *Tabl. Syst.*, 1821, p. 40, *nom. nud. Id., Hist.*, pl. 82, f. 5 (no date). *Id.*, Pfeiffer, *Conch. Cab. Helix*, 1846, p. 65, pl. 83, f. 7, 9.

§ Gould. *U.S. Expl. Exped.*, xii., 1852, p. 32, pl. v., f. 71 a, b.

‖ Brazier. *Proc. Zool. Soc.*, 1872, p. 618. *Rhytida gawleri*, Kobelt and Moellendorff, *Conch. Cab. Agnatha*, 1903, p. 37, pl. 7, f. 12–14.

The novelty is nearest in the genus to *P. atramentaria,* but with as many whorls in about half the diameter, the whorls increase more slowly, the last whorl is proportionately smaller, the perforation narrower, and the whole shell more globose. In size it resembles the Tasmanian *P. fumosa,* but the whorls of *compacta* are wound more nearly in the same plane and increase less rapidly. It seems confined to the southern part of the State, while *atramentaria* inhabits the centre.

SUB-GROUP AULACOPODA.

Family Endodontidæ.

Genus Endodonta, Albers, 1850.

Endódonta albanensis, Cox.

Helix albanensis, Cox, Proc. Zool. Soc., 1867, *p.* 723.

Id., Mon. Austr. Land Shells, 1868, *p.* 15, *pl. iv., f.* 2.

Endodonta albanensis, Pilsbry, Man. Conch., VIII., 1892, *pl. xxxvii, f.* 43–46 ; *IX.*, 1894, *p.* 34.

Id., Hedley, Proc. Malac. Soc., I., 1895, *p.* 260.

Id., Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 288.

Helix stanleyensis, Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

Habitat.—Fernshaw (Petterd), Wimmera (Australian Museum), Gippsland and Wilson's Promontory (Kershaw).

Endodonta funerea, Cox.

Helix funerea, Cox, Monogr. Austr. Land Shells, 1868, *p.* 16, *pl. iii., f.* 1.

Endodonta funerea, Hedley, Rec. Austr. Mus., II., 1896, *p.* 104.

This species appears to be generally distributed. We now record it from Frankston (Australian Museum), Burrumbeet (Tate), Bairnsdale (Kershaw), and Mount Shadwell (Whan).

Endodonta juloidea, Forbes.

Helix juloidea, Forbes, voy. Rattlesnake, Append., p. 379, *pl. ii., f.* 4.

The type of this species was found at Port Molle, in tropical Queensland, so that the shell is very unlikely to occur also in Tasmania or Victoria. Professor Tate recorded (Trans. Roy. Soc., S.A., IV., 1882, p. 75) *juloidea* from Victoria, but specimens which he so determined prove to be *E. funerea.* The Melbourne shell which Tenison Woods (Proc. Linn. Soc., N.S.W., III., 1879, p. 125) called *juloidea* was probably *E. albanensis.*

Endodonta murrayana, Pfeiffer, var. submurrayana, var. nov.

(Plate I., Figs. 6, 7, 8.)

Helix murrayana, Pfeiffer, Proc. Zool. Soc., 1863, *p.* 527.

Id., Angas, op. cit., p. 521, *and Journ. of Conch., I.*, 1876, *p.* 134.

Id., Cox, Monog. Austr. Land Shells, 1868, *p.* 14, *pl. xix., f.* 10, 10*a*, 10*b*.

E. murrayana is related to *E. funerea*, than which it is larger, flatter, with wider umbilicus, and more distant radial lamellæ. It has not hitherto been recorded from Victoria. Some examples from Geelong, collected by Dr. T. S. Hall, have a narrower umbilicus and weaker closer radial riblets than typical shells from the Murray cliffs. For these we adopt the varietal name of *submurrayana*, which Professor Tate proposed to bestow when he had this form under consideration. A specimen in the Australian Museum here figured is, major diam., 6·5 mm.; minor diam., 5 mm.; and height, 3·5 mm.

Endodonta retipora, Cox, var. melbournensis, Cox.

Helix retipora, Cox, Proc. Zool. Soc., 1867, *p.* 39.

Id., Mon. Austr. Land Shells, 1868, *p.* 21, *pl. vii., f.* 8.

Id., Billinghurst, Vict. Nat., X., 1893, *p.* 62.

Helix melbournensis, Cox, Mon. Austr. Land Shells, 1868, *p.* 22, *pl. xii., f.* 10.

Id., Tate, Trans. Roy. Soc., IV., 1882, *p.* 75.

Endodonta melbournensis, Hedley, Proc. Linn. Soc., N.S.W., XXVII., 1902 (1903), *p.* 604, *pl. xxxi., f.* 16, 17.

The Victorian form is rather more finely sculptured than the South Australian, but the difference is not constant enough for specific distinction.

Habitat.—Melbourne (Masters), Fernshaw (Petterd), Castlemaine (Billinghurst), Gippsland and Wimmera (Australian Museum), Mount Macedon, Dandenong Range, and Western Port (Kershaw).

Endodonta tamarensis, Petterd.

Helix tamarensis, Petterd, Mon. Tasm. Land Shells, 1879, *p.* 30.

Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

Charopa tamarensis, Billinghurst, Vict. Nat., X., 1893, *p.* 62.

Endodonta tamarensis, Hedley, Proc. Linn. Soc., N.S.W., XXVII., 1903, *p.* 605, *pl. xxxi., f.* 18, 19, 20.

Id., Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 291.

Habitat.—Burrumbeet (Tate), Mount Franklin (Billinghurst).

Genus Cystopelta, Tate, 1881.

Cystopelta petterdi, Tate.

Cystopelta petterdi, Tate, Proc. Roy. Soc., Tasm., 1880 (1881), *p.* 17.

Id., Hedley, Proc. Linn. Soc., N.S.W., (2), *V.*, 1890, *pp.* 44–46, *pl. i.*; *and Rec. Austr. Mus., II.*, 1896, *p.* 102.

Id., Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 292.

Habitat.—Ballarat (Musson), Loch (Frost).

Genus Laoma, Gray, 1849.

Laoma morti, Cox.

Helix morti, Cox, Ann. Mag. Nat. Hist. (3), *XIV.*, 1864, *p.* 182.

Id., Monog. Austr. Land Shells, 1868, *p.* 21, *pl. xi., f.* 13.

Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

Laoma morti, Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 294.

Helix hobarti, Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

Flammulina retinodes, Tate, Horn Exp., II., p. 187, *p. xvii., f.* 4.

Habitat.—Mount Eliza (Pritchard), Jan Juc (Kershaw).

Professor Tate has quoted other Victorian localities, but since that of Melbourne (on the authority of Petterd) refers to *L. mucoides*, we regard them as uncertain.

Laoma mucoides, Tenison Woods.

(Plate II., Figs. 9, 10, 11, 12.)

Helix mucoides, Tenison Woods, Proc. Linn. Soc., N.S.W., III., 1879, *p.* 125, *pl. iii., f.* 5, 5*a*.

Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

L. mucoides is closely related to *L. morti*, Cox, in form and sculpture, and has in the past been mistaken for it. *L. mucoides* has an extra whorl, and is larger, darker, and more solid. In *L. morti* the radial lamellæ are better developed. One of Tenison Woods' type specimens here figured is 2·8 mm. maj. diam., 2·35 mm min. diam., and 1·35 mm. in height. The type locality is Melbourne.

Laoma penolensis, Cox.

Helix penolensis, Cox, Proc. Zool. Soc., 1867, *p.* 724.

Id., Monogr. Austr. Land Shells, 1868, *p.* 8., *pl. xi., f.* 12.

Helix pictilis, Tate, Proc. Linn. Soc., N.S.W., II., 1878, *p.* 290.

Laoma pictilis, Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 294, *pl. lxxxvi., f.* 35–37.

Cape Northumberland, the type locality of *H. pictilis*, is but a short distance from Penola, where the type of *H. penolensis* was found. Professor Tate distinguished *H. pictilis* from the Penola shell by "its coarser ribbing, its colouration, and the presence of transverse striæ." The first and second characters are variable, and we find that the type of *H. penolensis* in the Cox collection has microscopic spiral striæ. So that *H. pictilis* may be safely reduced to a synonym of *H. penolensis.*

Found at Port Fairy, by the Rev. W. T. Whan; near Melbourne and at Oberon Bay, Wilson's Promontory, by Mr. J. A. Kershaw; at Lorne, by Dr. G. B. Pritchard.

Genus Flammulina, von Martens, 1873.

Flammulina excelsior, Hedley.

Flammulina excelsior, Hedley, Rec. Austr. Mus., II., 1896, *p.* 103, *pl. xxiii., f.* 2–4.

The type of this species occurred on Mount Kosciusko. It is likely that the unlocalized Victorian specimen obtained by Professor Spencer, and referred to in the original description, came from some neighbouring alpine district.

Flammulina fordei, Brazier, var. m'coyi, Petterd.

(Plate II., Figs. 13, 14, 15.)

Helix fordei, var. m'coyi, Petterd, Monogr. Tasm. Land Shells, 1879, *p.* 14.

Helix m'coyi, Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

? Helix fernshawensis, Petterd, Journ. of Conch., II., 1879, *p.* 355.

Id., Monogr. Tasm. Land Shells, 1879, *p.* 15.

Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.

The type which Mr. Petterd presented to the Australian Museum, and which measures, maj. diam. 7·5 mm., min. diam. 6 mm.. height 5·5 mm., is here figured. The *H. fernshawensis* is regarded by us as a lost species, for Mr. Petterd had retained no specimen of it, neither is an example preserved in the Tate collection, as Dr, Verco kindly informs us. We have taken advantage of Professor Tate's suggestion, that *H. fernshawensis* is an immature *H. m'coyi*, to suppress it as a synonym.

Habitat.—Dandenong Range (Petterd), Fernshaw (Tate), Don River (National Museum), Upper Yarra (Kershaw).

Flammulina elenescens, sp. nov.

(Plate III., Figs. 16, 17, 18.)

Shell subdiscoidal, thin, spire slightly elevated, base flattened and broadly umbilicated. Colour ochraceous-buff, with a few faint radial streaks of brown. Whorls five, slowly increasing, parted by deeply impressed sutures. Sculpture: First whorl and a half smooth, about the ante-penultimate whorl the shell is ornamented with fine close even thread-like radials at the rate of about a hundred to a whorl, this sculpture is also visible within the umbilicus. On the later whorls this sculpture gradually vanishes, so that their smoothness is only broken by fine and rather irregular growth lines. There is no spiral sculpture. Umbilicus about a quarter of the shell's diameter, broad and open, exposing all the earlier whorls. Maj. diam., 6·7 mm.; minor diam., 5·4 mm.; height, 2·9 mm.

Habitat.—Merri Creek (Tenison Woods). Type in the Australian Museum.

In general appearance the novelty is like *F. diemenensis* and *F. marchianæ*, between which it is intermediate in size. The break in sculpture of *F. elenescens* readily distinguishes it.

SUB-GENUS ALLODISCUS, Pilsbry, 1892.

Obs.—The following species are assigned to this sub-genus by reason of their spirally striated nuclear whorls.

FLAMMULINA OTWAYENSIS, Petterd.

Helix otwayensis, Petterd, Mon. Tasm. Land Shells, 1879 (*April*), *p.* 39.

Id., Journ. of Conch., II., 1879 (*December*), *p.* 356.

Endodonta otwayensis, Hedley, Proc. Linn. Soc., N.S.W., XXVII., 1903, *p.* 605, *pl. xxix., f.* 10, 11, 12.

Habitat.—Cape Otway (Petterd), Fern Tree Gully (Hall), Fernshaw (Kershaw).

FLAMMULINA SUBDEPRESSA, Brazier.

Helix subdepressa, Brazier, Proc. Zool. Soc., 1871, *p.* 641.

Endodonta subdepressa, Hedley, Proc. Linn. Soc., N.S.W., XXVII., 1903, *p.* 605, *pl. xxxi., f.* 13, 14, 15.

Helix dandenongensis, Petterd, Journ. of Conch., II., 1879, *p.* 355.

Id., Tate, Proc. Roy. Soc., S.A., IV., 1882, *p.* 75.

Habitat.—Snowy River and Fernshaw (Kershaw), Dandenong Range (Petterd), Oakleigh (French), Gembrook (Coghill), Emerald District (Jarvis).

FLAMMULINA MERACA, SP. NOV.

(Plate III., Figs. 19, 20, 21.)

Shell small, very thin, subdiscoidal spire slightly elevated, base narrowly perforated. Colour pure white. Whorls three and a half, parted by deep sutures and rather rapidly increasing. Sculpture: The protoconch, of one and a half whorls, is finely spirally striated and ends abruptly, the adult shell is perpendicularly traversed by fine evenly spaced radial riblets, amounting on the last whorl to about two hundred, between the riblets are a few very minute radial threads. Aperture lunate-ovate, columella slightly reflected. Inner lip overlaid by a callus spread in advance over the riblets of the preceding whorl. Base rounded, umbilicus narrow, about one-fifteenth of the major diameter. Height, 2 mm.; maj. diam., 4 mm.; minor diam., 3 mm.

Habitat.—Dandenong Range, numerous specimens (Kershaw), and Fernshaw (Petterd). Type from the Dandenongs in the National Museum.

The novelty is nearest related to *F. nivea*, Hedley,* from Kosciusko, which differs in the microscopic details of the sculpture, is more closely coiled, and has a sunken instead of an elevated spire.

It is possible that this may be the species recorded from Fernshaw as *Helix garthii*, Petterd, M.S. by Professor Tate.†

* Hedley. *Rec. Austr. Mus.*, ii., 1896, p. 103, pl. xxiii, f. 2–4.
† Tate. *Trans. Roy. Soc., S.A.*, iv., 1884, p. 75.

Neither the collection of Professor Tate nor of Mr. Petterd now contains this shell, so that the name must be written off as unrecognisable.

Family Zonitidæ.

Genus Helicarion, Ferussac (em.), 1821.

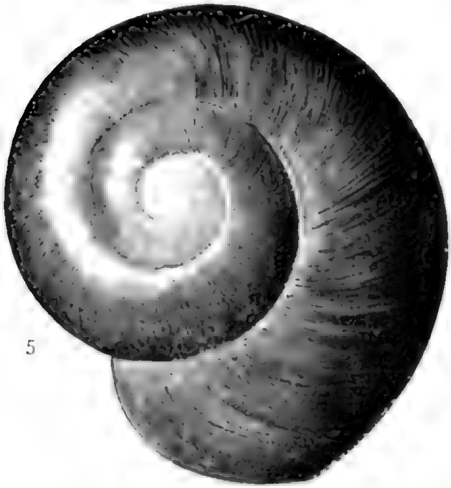
Helicarion cuvieri, Ferussac.

Helicarion cuvieri, Ferussac, Tabl. Syst., 1821, *p.* 20.
Id., Petterd and Hedley, Rec. Austr. Mus., VII., 1909, *p.* 301.
Vitrina nigra, Quoy et Gaim., voy. Astrolabe, Zool., II., 1832, *p.* 135, *pl. xi., f.* 8, 9.
Id., Tate, Trans. Roy. Soc., S.A., IV., 1882, *p.* 75.
Vitrina verreauxii, Pfeiffer, Proc. Zool. Soc., 1849, *p.* 132.
Habitat.—Western Port (Astrolabe), Fernshaw, Sale, and Cape Otway (Petterd), Jumbunna, South Gippsland (Kitson).

The following land mollusca have been introduced into Victoria from Europe :—*

Limax maximus, Linne.
Limax flavus, Linne.
Agriolimax agrestis, Linne.
Agriolimax lævis, Muller.
Milax gagates, Draparnaud.
Vitrea cellaria, Muller.
Zonitoides nitidus, Muller.
Helicella caperata, Montagu.
Helicella barbara, Linne.
Helix aspersa, Muller.
Helix pisana, Muller.

* Musson.—*Proc. Linn. Soc.* (2), v., 1890, pp. 883–896. Woodward.—*Journ. of Conch.*, x., 1903, pp. 352–367.



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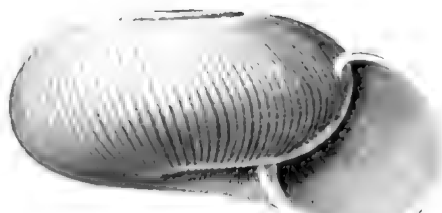

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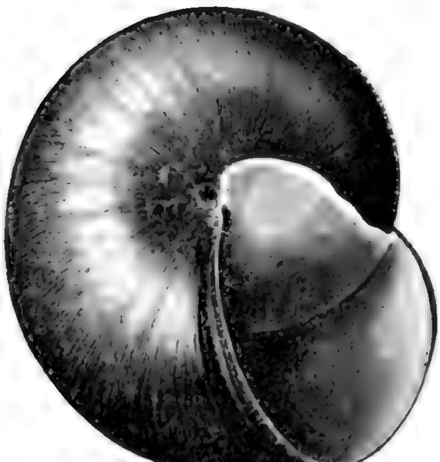

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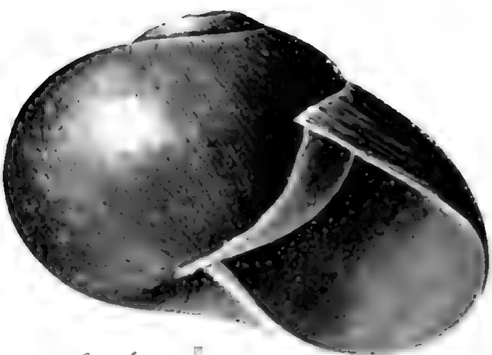

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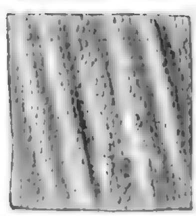

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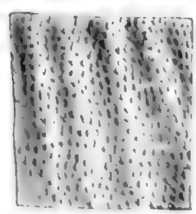

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Winifred Kent

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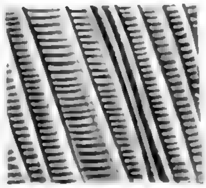

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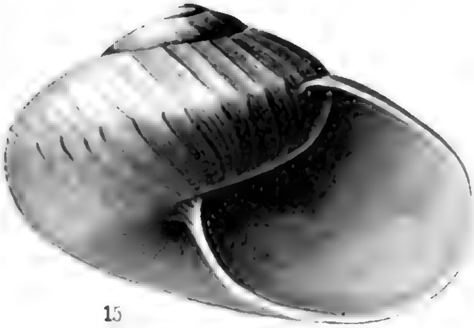

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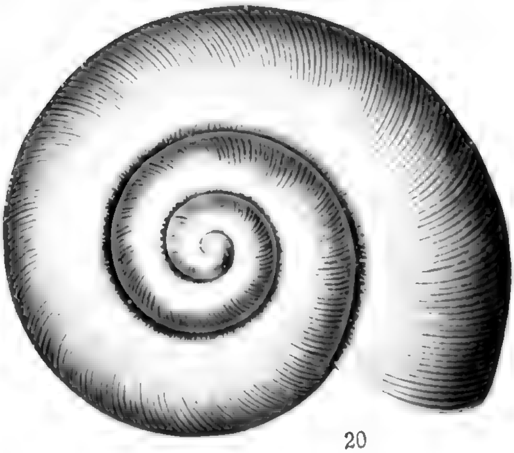

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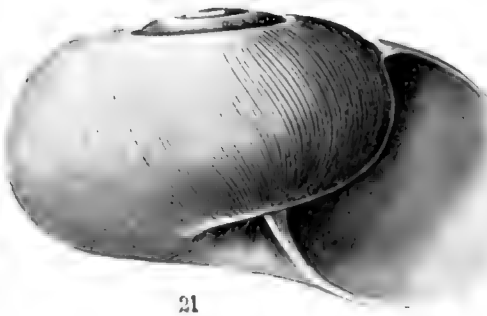

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Winifred Cox del.

EXPLANATION OF PLATES.

Plate I.

Fig. 1.—Bristles and (Fig. 2) hair scars of *Chloritis victoriæ*. Cox. Much magnified.

Figs. 3, 4, 5.—Various aspects of *Paryphanta compacta*. Cox and Hedley. Enlarged.

Figs. 6, 7, 8.—Various aspects of *Endodonta murrayana*. Pfeiffer. Var. *submurrayana*. Cox and Hedley. Enlarged.

Plate II.

Figs. 9, 10, 11.—Various aspects of *Laoma mucoides*. Tenison Woods. Enlarged.

Fig. 12.—Sculpture of *L. mucoides*. Much magnified.

Figs. 13, 14, 15.—Various aspects of *Flammulina fordei*. Brazier. Var. *m'coyi*. Petterd. Enlarged.

Plate III.

Figs. 16, 17, 18.—Various aspects of *Flammulina elenescens*. Cox and Hedley. Enlarged.

Figs. 19, 20, 21.—Various aspects of *Flammulina meraca*. Cox and Hedley. Enlarged.

ON SOME TYPES OF LEPIDOPTERA IN THE NATIONAL MUSEUM, MELBOURNE.

By A. Jefferis Turner, M.D., F.E.S.

In a little work published in 1869 under the title *Characters of Undescribed Lepidoptera Heterocera,* by the late Mr. Francis Walker, F.L.S., are the descriptions of a number of species which it is desirable to identify as far as possible. The work commences with 102 species described as new from the collection of T. Norris, Esq. Of these, eight are stated to have been taken at Moreton Bay, but a large proportion of the species are without locality, so that it is quite possible that there are more Australian types among them. Whether these types are still in existence I do not know, but I believe I have seen some of them in the British Museum. I have made an attempt to identify the Australian forms from the descriptions.

12. *Lithosia remota* is a synonym of *Lexis nitens,* Wlk.
24. *Turriga invasa* is probably a variety of *Olene mendosa,* Hb.
26. *Entometa adusta* is a synonym of *Pinara metaphaea,* Wlk.
32. *Doratifera congrua* is a synonym of *Susica alphaea,* Fab.
33. *Mecytha antiqua* I have not been able to identify.
37. *Antheræa insignis* is a synonym of *Copaxa janetta,* White.
81. *Piana lignificta,* and 88. *Hypopyra fusifascia,* I am not able to identify.

The next instalment is headed " The following fifty-one species inhabit Australia, and are in the National Museum at Melbourne." Through the courtesy of Mr. J. A. Kershaw, the Curator, I have had the opportunity of carefully examining these types. They are kept in a drawer by themselves, and have been well cared for, but bear the traces of previous ill-usage. Mr. Kershaw informs me that they were placed in this drawer from a box, which contained a label saying that they were " received in bad condition," probably from damage in the post. Beneath each type is an M.S. name, probably in Walker's handwriting, and these names correspond to the descriptions in print. Two of the types are missing, but one of these I have identified to my own satisfaction from the description. The remaining forty-nine are all Victorian species, or at least forty-seven of them, which I have determined. Of the two remaining, one is an obscure species of the genus *Anthela,* which will probably be identified some day ; the other is represented by thorax and hind wings only, and all that can be said of it is that it is a species of *Agriophara.* Forty-eight of the species are now accounted for, and of these forty-eight names, thirty-one are synonyms, most of the species having been previously named by Walker himself. There remain seventeen names which must, I think, be adopted. Most of these have been since described by other authors, who had not the opportunity of examining Walker's types. Of the four generic names proposed, none are valid.

I should not have been able to obtain results so complete if it had not been for the generous assistance of Mr. J. A. Kershaw and Mr. Geo. Lyell. The latter went through the types before my arrival, and left me a box of examples from his own collection, which he had compared and identified with them. The former supplemented these with other examples from the Museum collection. Having satisfied myself of the correctness of the identifications, and in some instances this required special care, I was able to study the loaned examples at leisure after my return to Brisbane.

My detailed results are as follow :—

1. *Eterusia auroatra.*—The type is unfortunately missing. The description applies to some species of unusually distinct appearance, and should be recognisable, but at present I cannot identify it with any Australian species known to me.

2. *Eutane partita.*—This is a good species correctly identified by Sir Geo. Hampson, and described as *Thallarcha partita* (Cat. Lep. Phal. II., p. 503). There are several allied and very similar species ; this one is best distinguished by its deep orange-ochreous ground-colour, and by a fuscous spot in cilia of hind wings below middle. It appears to be very rare in collections ; a specimen lent me from the National Museum bears the locality label Spring Vale, Victoria. I have taken a series, which I refer to this species, at Glen Innes, New South Wales, in October.

3. *Castula binotata* = *Castulo doubledayi*, Newm. = *Cluaca rubricosta*, Wlk. The type of *binotata* is a variety occasionally met with in which the termen and cilia of hind wings are ochreous, with a narrow dark-fuscous subterminal line.

4. *Orgyia semifusca* is, I think, a good species, but cannot be referred to this genus. The ♂ agrees structurally with *Porthesia*, but Mr. Kershaw has lent me a ♀ from the National Museum which strikingly resembles a ♀ *Orgyia*. I propose to make this species the type of a new genus *Ocybola*, and both genus and species will be described below.

5. *Teara luctipennis* is a synonym of *Oenosanda boisduvalii*, Newm. ♂. This species is sexually dimorphic.

7965.—B

6. *Entometa despecta.*—The type is a ♂ and should be easily recognised; the hind wings are blackish and much darker than the fore wings, which are brown, densely irrorated with orange-ochreous. I have this species under the name of *Entometa obscura*, Wlk. Walker's types of this genus require to be elucidated, the ♀♀ of many of the species are very similar, and unfortunately some of the types are ♀.
7. *Entometa ignobilis* belongs to the *Psychidae*, and has been correctly identified by Meyrick and Lower (Trans. Roy. Soc. S.A., 1897, p. 197), who redescribe it as *Clania ignobilis*.
8. *Ptilomacra antiqua* is a synonym of *Ptilomacra senex*, Wlk.
9. *Opsirrhina punctilinea* is a synonym of *Pinara divisa*, Wlk. ♀.
10. *Tolype subnotata* is a good species so far as I know. It is closely allied to *trimacula*, Wlk., which Mr. Lyell tells me is the ♀ of *Crexa punctigera*, Wlk. I suspect that my *Crexa hyaloëssa* may be the ♂ of *subnotata*.
11. *Hepialus fasciculatus* is a synonym of *Oncoptera intricata*, Wlk.
12. *Leucania adjuncta* is a synonym of *Cirphis ciliata*, Wlk. It is not the same as the species described by Hampson as *Cirphis adjuncta* (Cat. Lep. Phal. V., p. 489), for which I propose a new name below.
13. *Mamestra confundens* is a synonym of *Dasygaster hollandiæ*, Gn.
14. *Agrotis costalis* is a synonym of *Caradrina tortisigna*, Wlk.
15. *Agrotis transversa* = *Euxoa porphyricollis*, Gn.
16. *Anchoscelis bicolor* = *Agrotis compta*, Wlk.
17. *Orthosia deprivata* is a slightly darker example of *Agrotis compta*, Wlk.
18. *Euplexia mamestroides* has been described by me as *Prometopus poliophracta*. (Trans. Roy. Soc. South Australia, 1908, p. 57.) Hampson identifies this species as *Omphaletis exundans*, Gn. (Cat. Lep. Phal. VIII., p. 377.) It is very similar in markings to *Caradrina instipata*, Wlk.
19. *Xylina saxatilis* = *Ectopatria subrufescens*, Wlk.
20. *Pantydia canescens* = *Pantydia diemeni*, Gn.
21. *Samea distractalis* = *Nacoleia rhoeonalis*, Wlk. The type is mangled, but recognisable.
22. *Ebulea gavisalis* has been since described as *Mecyna rhodochrysa*, Meyr.
23. *Stenopteryx corticalis* = *Nomophila noctuella*, Schiff.
24. *Idiodes inornata* = *Idiodes apicata*, Gn.
25. *Azelina inordinata* = *Mnesampela privata*, Gn.

26. *Azelina biplaga* is a good species, which has been redescribed as *Metrocampa glaucias*, Meyr.
27. *Passa pygaeroides* = *Smyriodes aplectaria*, Gn.
28. *Monoctenia decora* is a pale variety of *Monoctenia vinaria*, Gn.
29. *Arnissa simplex* belongs to the genus *Anthela* (*Lymantriadae*). The type is an obscure ♀, and I was not able to identify the species.
30. *Tephrosia scitiferata* = *Selidosema mundifera*, Wlk.
31. *Tephrosia fulgurigera* = *Selidosema excursaria*, Gn., a variety with thickened dark-fuscous lines on wings.
32. *Asthena vexata* = *Euchoeca rubropunctaria*, Wlk.
33. *Macaria comptata* = *Diastictis australiaria*, Gn.
34. *Larentia approximata* has been since described as *Phrissogonus pyretodes*, Meyr. The type is a ♂ and rather darker than usual.
35. *Larentia gelidata* (Walker's M.S. label reads "*Larentia algidata*") is a ♀ example of *Xanthorhoe subidaria*, Gn.
36. *Oesymna stipataria* is a ♀ example of *Microdes squamulata*, Gn.
37. *Eupithecia destructata* has been since described as *Phrissogonus catastreptes*, Meyr. In this instance only I had no example to compare with the type, but I am confident of my identification.
38. *Acrobasis subcultella* = *Epipaschia nauplialis*, Wlk.
39. *Hypata moderatella* = *Chlenias arietaria*, Gn.
40. *Dichelia vicariana* = *Cacœcia postvittana*, Wlk.
41. *Sperchia intractana* is, I believe, the species described by Meyrick under the name of *Capua obfuscatana*.
42. *Tinea annosella* has been since described as *Xysmatodona saxosa*, Meyr.
43. *Tinea arctiella* has been since described as *Lepidoscia comochora*, Meyr.
44. *Tinea nivibractella* is a good species of the genus *Monopis*, Hb. I give a full description below.
45. *Tinea intritella* has been redescribed as *Phloeopola exarcha*, Meyr.
46. *Hyponomeuta ? viduata* is a good species which may be provisionally referred to the genus *Xylorycta*. Besides the type there are three examples in the National Museum, all imperfect and without palpi. (Localities: Melbourne and Kewell, Vic.)
47. *Chimabacche saxipennella*. This is, I have no doubt, a species of the genus *Agriophara*, but as the type has now no fore wings, palpi, antennæ, nor abdomen, it would be rash to identify it more particularly.

48. *Gelechia improbella* is a species of the genus *Eulechria.* I have not been able to identify it with any of Mr. Meyrick's descriptions, but it is a species difficult to recognise. I describe it below.
49. *Gelechia gemmipunctella* is represented by a single fore wing only, but this is sufficient to identify it with *Glyphipteryx atristiella,* Zel. I consider *G. chrysolithella,* Meyr., to be the same species, the colour of the hind wings being variable in different localities.
50. *Oecophora impletella.* The type is missing, but from the description I have no hesitation in identifying this with *Philobota herodiella,* Feld. As vol. ii. of the *Reise Novara* was published in 1874, Walker's name has the priority.
51. *Cryptolechia scitipunctella* is a synonym of *Hoplitica repandula,* Zel.

In the National Museum is the Curtis collection of British insects. Among them I examined *Arcturus sparshallii,* Curt., which is undoubtedly the same as *Trichetra stibosma,* Butl. Mr. Lyell informs me that he considers this to be a varietal form of *Trichetra melanosoma,* Wlk. How this Australian insect came to be ascribed to Great Britain must remain a mystery.

In the Museum Library I had an opportunity of examining Donovan's *Insects of New Holland.* His *Tinea strigatella* (Plate 40) is the same as *Philobota chrysopotama,* Meyr. The only discrepancy is that the ground-colour is figured purple, but comparison with the description shows that this is an error of the colourist.

Genus Ocybola, nov.

ὠκυβολος, quick-darting.

Head and thorax densely long-haired. Tongue minute. Palpi moderate, porrect, hairy. Antennæ in ♂ with two rows of long pectinations to apex, in ♀ shortly bipectinate. Legs hairy, posterior tibiæ with two pairs of spurs. Abdomen without crests. Fore wings with 2 from middle, 3 from before angle, 4 and 5 from angle, 6 connate with 7, 8, 9, 10, which are stalked, 10 arising beyond 7, no areole. Hind wings with 5 absent, 6 and 7 stalked. Wings in ♀ rudimentary.

Ocybola semifusca, Wlk.

♂, 28 mm. Head, thorax, and palpi dark-fuscous mixed with whitish-ochreous hairs. Antennæ whitish-ochreous, pectinations and inner surface dark-fuscous. Abdomen dark-fuscous, tuft and underside orange-ochreous. Legs ochreous mixed with dark-fuscous. Fore wings triangular, costa gently arched, apex obtusely rounded, termen bowed oblique; orange-ochreous rather densely suffused with dark-fuscous, which forms an ill-defined basal patch, dentate postmedian line, and terminal line, cilia dark-fuscous, apices ochreous interrupted with fuscous. Hind wings with termen rounded; orange-ochreous with scanty dark-fuscous irroration towards termen, cilia concolorous.

♀. Head, thorax, palpi, antennæ, legs, and abdominal tuft whitish; wings represented by narrow linear-lanceolate whitish rudiments, sufficiently long to reach middle of abdomen.

Victoria: Williamstown, near Melbourne; Ocean Grange, near Sale.

CIRPHIS DASYCNEMA, SP. NOV.

δασυκνημος, with hairy shins.

♂ ♀, 36–40 mm. Head, thorax, and palpi grey-whitish, with scanty blackish irroration, external surface of palpi in ♂ purplish tinged. Antennæ grey, towards base grey-whitish; ciliations in ♂ $\frac{1}{2}$, bristles 1. Abdomen grey-whitish. Legs whitish, with sparse blackish irroration; anterior femora in ♂ densely hairy and anterior tibiæ with immense fuscous-purple tufts. Fore wings elongate-triangular, costa nearly straight; apex rounded, termen scarcely oblique, rounded beneath; grey-whitish with sparse blackish irroration, and sometimes some patchy purple-grey suffusion; a white postmedian discal dot immediately preceded by a blackish dot; a row of dark-fuscous dots at $\frac{5}{6}$ parallel to termen; a series of minute terminal dots; cilia grey-whitish, tinged with purplish, with a fuscous subapical line. Hind wings with termen wavy; whitish, towards termen suffused with fuscous; cilia whitish, purplish-tinged except towards tornus, with a fuscous median line.

Very similar to *Cirphis ciliata*, Wlk., from which it may be readily distinguished (1) by the ♂ fore legs, (2) by the postmedian line on fore wings being single, not double.

Type in coll., Turner.

Queensland: Brisbane, in February and May. Three specimens.

MONOPIS NIVIBRACTELLA, Wlk.

♂ ♀, 15–22 mm. Head snow-white. Palpi dark-fuscous, apex of terminal joint white. Antennæ dark-fuscous; in ♂ simple. Thorax fuscous with a large white anterior spot. Abdomen ochreous. Legs fuscous; posterior pair ochreous. Fore wings elongate, slightly dilated posteriorly, costa strongly arched, apex rounded, termen obliquely rounded; dark-fuscous, markings snow-white; a large quadrilateral spot on dorsum near base, rather broadly separate from base and costa; an irregularly triangular spot on costa beyond middle; smaller spots with very irregular outlines on costa before apex, mid-termen, and tornus, the first two tending to confluence; all tending to be broken up by dark-fuscous or ochreous-fuscous irroration; cilia dark-fuscous, on mid-termen and tornus white. Hind wings lanceolate; grey; cilia pale-ochreous, at apex grey.

This species is very similar to *Monopis meliorella*, Wlk., with which it has been confused. For some years I have recognised its distinctness, and am glad to take this opportunity of describing it. The best point of distinction is the broad dark-fuscous band between dorsal white spot and base and costa. Both species are common and widely distributed.

North Queensland: Stannary Hills. Queensland: Brisbane, Toowoomba, Warwick, Bunya Mountains. New South Wales: Glen Innes, Kiama, Jenolan. Victoria: Melbourne.

M. meliorella I have from North Queensland: Cardwell, Mareeba, Kuranda, Stannary Hills, Townsville. Queensland: Brisbane, Rosewood, Stradbroke Island, Dalby, Warwick, Adavale.

EULECRIA IMPROBELLA, Wlk.

♂, 18 mm. Head ochreous-fuscous. Palpi fuscous, inner aspect of second joint mostly ochreous-whitish. Antennæ and thorax fuscous. Abdomen ochreous-fuscous, tuft whitish-ochreous. Legs fuscous; posterior pair whitish-ochreous. Fore wings elongate, not dilated, costa gently arched, apex rounded, termen obliquely rounded; whitish-ochreous densely irrorated with dark-fuscous; a round dark-fuscous discal dot at $\frac{1}{3}$, a second beneath it on fold, and a third in disc at $\frac{2}{3}$; veins towards termen outlined with fuscous; cilia whitish-ochreous, basal half irrorated with fuscous. Hind wings ovate-lanceolate; grey-whitish, slightly darker towards termen; cilia grey-whitish.

Victoria: Melbourne (National Museum collection).

CATALOGUE OF THE VICTORIAN CICADIDÆ IN THE NATIONAL MUSEUM, MELBOURNE.

By Howard Ashton.

(Plate IV., Figs. b, d—h, j, k.)

During my investigations into this group I have been afforded frequent opportunities for examining the collection contained in the National Museum, Melbourne, and, acting on the suggestion of the Curator, I have drawn up the following catalogue embracing all the Victorian species in the Museum. In the collection are a number of specimens determined by Walker; also a number determined by Goding and Froggatt, together with some of their types. Where there is any doubt of a species, I have followed the determinations of Distant, since he has all the material at his disposal, and has recently systematized the family in a thorough and admirable manner. Several of the species in my own collection have been determined by him, and, having these, I have found occasion to differ a little from other workers in the family. I have to thank the Curator of the Zoological Department, Mr. J. A. Kershaw, for facilities afforded me during the examination of the collections, and for the loan of several specimens. In addition to the references given here, may be understood in each case those of Distant's Catalogue of 1906.

Family Cicadidæ.

SUB-FAMILY CICADINÆ.

Division Cyclochilaria.

GENUS CYCLOCHILA, Amy. and Serv.

Type *C. australasiæ*, Donov.

C. AUSTRALASIÆ, Donov.

Tettigonia australasiæ, Don. Ins. N. Holl. Hem., pl. II., f. 1, 1905.

Cicada olivacea, Germ., Thon. Ent. Arch. II., 1830; *id. Silb. Rev. Ent. II., p.* 57, 1834.

Cyclochila australasiæ, Amy. and Serv. Hist. Hem., p. 470, 1843; *McCoy, Prodr. Zool. Vict. decad. V., p.* 57, *f.* 4. *pl.* 1, 1880; *et al.*

Var. spreta, God. and Frogg., Proc. Linn. Soc. N.S.W., p. 570, 1904.

GENUS PSALTODA, Stål.

Type *Psaltoda moerens*, Germ.

P. MOERENS, Germ.

Cicada moerens, Germ., Silb. Rev. Ent. II., p. 67, 1834.

Psaltoda moerens, Stål., Ann. Soc. Ent. Fr., I., *p.* 614, 1861; *God. and Frogg., Proc. Linn. Soc. N.S.W., p.* 590, 1904; *et al.*

Cicada moerens, McCoy, Prodr. Zool. Vict., V., p. 53, *pl. I., fs.* 1, 2, 1880.

P. AURORA, Dist.

Psaltoda aurora, Dist., Trans. Ent. Soc. Lond., p. 664, 1881 ; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 586.

(Note.—Though included in the Victorian collection, the locality must be considered as doubtful. Both Distant and Goding and Froggatt give its habitat as Queensland.)

GENUS HENICOPSALTRIA, Stål.

Type *H. eydouxi*, Guer.

H. NUBIVENA, Walk.

Fidicina nubivena, Walk., List. Hom. Sup., p. 17, 1858.

Henicopsaltria rubivena, Stål., Berl. Ent. Zeit. X., p. 171, 1866 ; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 578.

(Note.—Hitherto not recorded from within Victoria.

SUB-FAMILY TIBICININÆ.

Division Taphuraria.

GENUS ABRICTA, Stål.

Type *A. brunnea, Fabr.*

A. AURATA, Walk.

Cicada aurata, Walk., List. Hom. I., p. 215, 1880 ; *et al.*

Tibicen auratus, God. and Frogg., Proc. Linn. Soc. N.S.W., p. 606, 1904.

(Note.—One specimen determined by Walker in the collection.)

GENUS DIEMENIANA, Dist.

Type *D. coleoptrata,* Walk.

D. COLEOPTRATA, Walk.

Cicada coleoptrata, Walk., List. Hom. I., p. 223, 1850.

Tibicen coleoptrata, Stål., Otv. Vet. Ak. Förh., p. 485, 1862.

Tibicen coleoptratus, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 608.

Diemenia coleoptrata, Dist., Ann. Mag. Nat. Hist. (7), *XVI., p.* 206, 1905 (*Gen. nom. praeocc.*).

Diemeniana coleoptrata, Dist., Syn. Cat. Hom. I., *Cicad., p.* 145, 1906.

(Note.—One specimen determined by Walker in the collection.)

Division Melampsaltraria.

GENUS MELAMPSALTA, Am.

Type *M. musiva,* Germ.

M. DENISONI, Dist.

Melampsalta denisoni, Dist., Ann. Soc. Ent. Belg., XXXVII., p. 78, 1893 ; *God. and Frogg., Proc. Linn. Soc. N.S.W., p.* 636, 1904.

Melampsalta kershawi, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 636.

(Note.—The type specimen of *M. kershawi* is a female of *M. denisoni*, faded in colour, and rather mutilated.)

M. BINOTATA, GOD. AND FROGG., *Proc. Linn. Soc. N.S.W.*, 1904, *p.* 643.

Melampsalta angusta, God. and Frogg. (*nec. Walk.*), *loc. cit.*, *p.* 643.

(Note.—Determined by Walker as *M. angusta*, Walk., in the collection. In the Macleay Museum, Sydney, Goding and Froggatt have determined the male as *M. angusta*, and the female as *M. binotata*, God. and Frogg. *M. angusta* is a synonym for *M. cruentata*, Fabr., a very distinct species, from New Zealand.)

M. CRUENTATA, Fabr.

Tettigonia cruentata, Fabr., Syst. Ent., *p.* 680, 1775.

Melampsalta cruentata, Stal., Hem. Fabr., II., *p.* 116, 1869.

Cicada sericea, Walk., List. Hom., *p.* 169, 1850.

Cicada rosea, Walk., loc. cit., *p.* 220.

Cicada angusta, Walk., loc. cit., *p.* 174.

Cicada bilinea, Walk., List. Hom. Supp., *p.* 34, 1858.

Cicada muta, Kirby, Trans. N.Z. Inst., XXVIII., *p.* 445, 1885.

Melampsalta angusta, Dist., Ann. Mag. Nat. Hist. (6), *IX.*, *p.* 326, 1892 ; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 643.

(Note. One specimen amongst Victorian Cicadidæ, but without locality. In all probability from New Zealand.)

M. ABDOMINALIS, Dist.

Melampsalta abdominalis, Dist., Ann. Mag. Nat. Hist. (6), *IX.*, *p.* 323, 1892 ; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 634.

(Note.—One female specimen determined by Walker as *Cicada melanopygia.*)

M. MURRAYENSIS, Dist.

Melampsalta murrayensis, Dist., Ann. Mag. Nat. Hist. XX., *p.* 421, 1907.

Melampsalta abbreviata, God. and Frogg. (*nec. Walk.*), *Proc. Linn. Soc. N.S.W.*, *p.* 649, 1904.

(Note. Determined by Goding and Froggatt in the Macleay Museum and National Museum, Melbourne, as *M. abbreviata*, Walk. This latter species has been placed, however, in the genus *Quintilia*, and determined by Distant as *Q. infans*, Walk. This genus may be distinguished by having the upper ulnar veins distinctly separate at base.)

M. LANDSBOROUGHI, Dist.

Melampsalta landsboroughi, Dist., Proc. Zool. Soc. Lond., 1882, *p.* 131, *pl.* VII., *fs.* 14*a*, *b*; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 639.

Melampsalta tristrigata, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 638.

(Note.—Determined by God. and Frogg. in the Macleay Museum and also in the National Museum, Melbourne, as *M. tristrigata*, God. and Frogg. Also determined in the female form in the latter collection by God. and Frogg., as *M. incepta*, Walk. The species is very variable, both in colour and size, especially in the female form.)

M. TORRIDA, Erich.

Cicada torrida, Erich., Arch. I., p. 286, 1842.

Cicada basiflamma, Walk., List. Hom., I., p. 170, 1850.

Cicada connexa, Walk., loc. cit., p. 173.

Cicada damater, Walk., loc. cit., p. 178.

Melampsalta torrida, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 631.

(Note.—Two specimens, male and female, in the collection determined correctly by Walker; several determined as *M. interruptus?* Walker has also determined a Western Australian species as *Cicada basiflamma*, and Goding and Froggatt have correctly described this as their type of *M. rubricincta*.)

M. RUBRISTRIGATA, God. and Frogg.

Melampsalta rubristrigata, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 638.

(Note.—These specimens were sent to me by Mr. G. Lyell, from Horsham. Recorded by Goding and Froggatt from South Australia only.)

M. OXLEYI, Dist.

Melampsalta oxleyi, Dist., Proc. Zool. Soc. Lond., p. 131, 1882 *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 655.

(Note.—This species, so far, has only been recorded from Queensland.)

M. LABYRINTHICA, Walk.

Dundubia labyrinthica, Walk., List Hom., p. 75, 1850.

Melampsalta labyrinthica, Stål., Ofv. Vet. Ak. Förh., p. 484, 1862; *God. and Frogg, Proc. Linn. Soc. N.S.W.*, 1904, *p.* 646.

Cicada interstans, Walk., *List Hom. Sup., p.* 32, 1858.

Melampsalta interstans, Stål., Ofv. Vet. Ak. Förh., p. 484, 1862; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 634.

(Note.—One specimen determined as *C. sericea* by Walker. The confusion has arisen through the generally lighter colour of the female. Both sexes are described by Walker under different names.)

GENUS KOBONGA, Dist.

Type *K. umbrimago*, Walk.

K. UMBRIMAGO, Walk.

Cicada umbrimago, Walk., List Hom. Sup., p. 32, 1858.

Melampsalta umbrimago, Stål., Ofv. Vet. Ak. Förh., p. 484, 1862; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 632.

Kobonga umbrimago, Dist., Ann. Mag. Nat. Hist. (7), *XVII., p.* 387, 1906.

(Note.—Sent by Mr. J. A. Leach from Nyah; the only recorded specimen of the species from outside Western Australia.)

GENUS PAUROPSALTA, God. and Frogg.

Type *P. mneme*, Walk.

P. MNEME, Walk.

Cicada mneme, Walk., List Hom. I., p. 181, 1850.

Cicada antica, Walk., loc. cit., p. 182.

Melampsalta mneme, Stål., Ofv. Vet. Ak. Föhr. p. 484, 1862.

Pauropsalta leurensis, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 622.

P. ENCAUSTICA, Germ.

Cicada encaustica, Germ., Silb. Rev. Ent. II., p. 62, 1834.

Cicada arclus, Walk., List Hom. I., p. 184, 1850.

Cicada dolens, Walk., loc. cit., p. 188.

Cicada juvenis, Walk., loc. cit., p. 190.

Pauropsalta encaustica, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 662.

P. ANNULATA, God. and Frogg.

Pauropsalta annulata, God. and Frogg., Proc. Linn. Soc. N.S.W., p. 620, 1904.

Pauropsalta encaustica, Dist., Syn. Cat. Hom. Cicad. I., p. 178, 1906 (*nec God. and Frogg*).

P. DUBIA, God. and Frogg.

Pauropsalta dubia, God. and Frogg., Proc. Linn. Soc. N.S.W., 1904, *p.* 621.

GENUS URABUNANA, Dist.

Type *U. sericeivitta*, Walk.

U. FESTIVA, Dist.

Urabunana festiva, Dist., Ann. Mag. Nat. Hist. (7), *XX. p.* 423, 1907.

(Note.—Determined by Walker as *Melampsalta puer*, Walk. The genus is, however, distinct in the possession of four apical areas to the wings.)

Division Tettigarctaria.

GENUS, TETTIGARCTA, White.

Type, *T. tomentosa*, White.

T. CRINITA, Dist.

Tettigarcta crinita, Dist., Proc. Zool. Soc. Lond., 1883, *p.* 188, *f.* 5*a*, *b*, *c.*, *pl. XXV.*; *God. and Frogg., Proc. Linn. Soc. N.S.W.*, 1904, *p.* 666, *pl. XVIII., figs.* 3, *a*, *b.*

(Note.—Specimens in the collection also determined as *T. tomentosa*, White, from which species, however, *T. crinita* may be readily distinguished by the absence of the spinous projection on the lateral borders of the pronotum.)

EXPLANATION OF PLATE IV.

I have figured eight species which have not so far been illustrated. Several of these have been the subject of some confusion, especially *Tamasa tristigma*, Erich.

Fig. *b.*—*Melampsalta torrida*, Erich. Victoria.

Fig. *d.*—*Diemeniana coleoptrata*, Walk. Victoria.

Fig. *e.*—*Urabunana festiva*, Dist. Victoria.

Fig. *f.*—*Tamasa tristigma*, Germ. Queensland.

Fig. *g.*—*Abricta aurata*, Walk. Victoria.

Fig. *h.*—*Melampsalta binotata*, God. and Frogg. Victoria.

Fig. *j.*—*Melampsalta rubricincta*, God. and Frogg. Western Australia.

Fig. *k.*—*Henicopsaltria nubivena*, Walk. Victoria.

DESCRIPTIONS OF NEW AUSTRALIAN CICADIDÆ IN THE NATIONAL MUSEUM, MELBOURNE.

By Howard Ashton.

(Plate IV., Figs. a, c, i.)

While engaged in the preparation of the Catalogue of Victorian Cicadidæ in the National Museum, the following species were found to be new.

These, with the consent of the Director, Professor Baldwin Spencer, I am now enabled to describe and figure.

Family Cicadidæ.

SUB-FAMILY CICADINÆ.

Division Cicadaria.

GENUS MACROTRISTRIA.

MACROTRISTRIA DORSALIS, SP. NOV. (Fig. *a*, 1, 2.)

Male.—Body above ochraceous, mesonotum tinged with brownish, in fresh specimens probably greenish. Central sulcus to vertex of head, a short longitudinal and anteriorly angulate spot on each side of region of ocelli, and anterior margins to eyes and basal margin of front very narrowly black. Abdomen with a broad central dorsal longitudinal fascia extending from base, where it is very wide, and narrowing sharply to penultimate segment; base of apical segment and spot on anal appendage piceous or black. Face and head beneath, bright ochraceous; sternum, opercula, and legs sordid ochraceous brown; anterior and intermediate tarsi and disc of abdomen beneath warm fuscous. Tegmina and wings hyaline, talc-like; tegmina with costal membrane and area and basal half of venation ochraceous; postcostal area and apical venation fuscous, and claval nervure black; wings to basal two-thirds of venation pale ochraceous, apical veins light fuscous. Head (including eyes) equal in breadth to lateral dilations of posterior pronotal margin. Abdomen much shorter than space between apex of head and base of cruciform elevation; rostrum with tip piceous, barely reaching posterior coxæ. Lateral areas of abdomen much depressed. Long., male 25 mm., female, 23 mm.; exp. teg. 75 mm.

Habitat.—Kuranda, Queensland; several male and female specimens. (Presented by R. W. Armitage, 1908.)

Allied to *M. intersecta*, Walk., and *M. sylvanella*, God. and Frogg., but differing in the shorter abdomen and overlapping opercula. Differing also from *M. extrema*, Dist., by the narrower head and thorax. The dark fascia on the dorsum renders it easily identifiable.

SUB-FAMILY TIBICININÆ.

Division Melampsaltraria.

GENUS MELAMPSALTA.

MELAMPSALTA CYLINDRICA, SP. NOV. (Fig. i.).

Male.—Body above black, anterior and lateral discal areas of pronotum suffused with castaneous, a central short longitudinal fascia to same; spots on mesonotal cruciform elevation, posterior margins of third, fourth, fifth, sixth, and seventh abdominal segments and tip of anal appendage ochraceous. Head beneath, sternum and legs piceous, margins of front, a large spot on each side of prosternum, rostrum (excluding apex) apices of coxæ, trochanters beneath, stripes to anterior femora, stripe beneath and apices of intermediate and posterior femora, bases of intermediate and posterior tarsi, opercula, and posterior margins of third, fourth, fifth, and sixth abdominal segments, ochraceous. Tegmina talc-like, costa and venation brownish-testaceous at base, piceous towards apex; first and second apical anastomoses broadly and darkly suffused with fuscous. Wings similar, with anal streak milky. Head narrower than pronotum, which is equal in width to the mesonotum and abdomen; abdomen longer than space between apex of front and base of cruciform elevation. Breadth of tegmina considerably more than one-third the length. Rostrum reaching intermediate coxæ; opercula large, obliquely reniform, shining piceous at base. Long., male, 25 mm.; exp. teg., 68 mm.

Habitat.—Victoria (Fernshaw).

One male in the collection labelled *M. labeculata*, Dist., by Goding and Froggatt. The species resembles superficially one of the smaller species of *Tibicina*, being similar in general form to *T. septemdecim*, Linn., the well-known U.S.A. species.

MELAMPSALTA CAPISTRATA, SP. NOV. (Fig. c.).

Male.—Body above and below yellow. Head with broad black fascia (embracing area of ocelli) between eyes. Pronotum with central longitudinal fascia and narrow borders to lateral margins black. Mesonotum black, metanotum and abdomen yellow. Tegmina and wings hyaline, immaculate, venation piceous, costa yellow. Body below with sides of face and apex of rostrum (which extends to intermediate coxae), black.

Female.—With the mesonotum also yellow, and four obconical anterior marginal spots (central pair shortest), fine central fascia behind these, and spots before the anterior angle of cruciform elevation black. Abdominal segments finely margined with black.

Long., male, 11 mm.; female, 14 mm.; exp. teg., male, 31 mm.; female, 38 mm.

Habitat.—Queensland (Kuranda). Presented by R. W. Armitage.

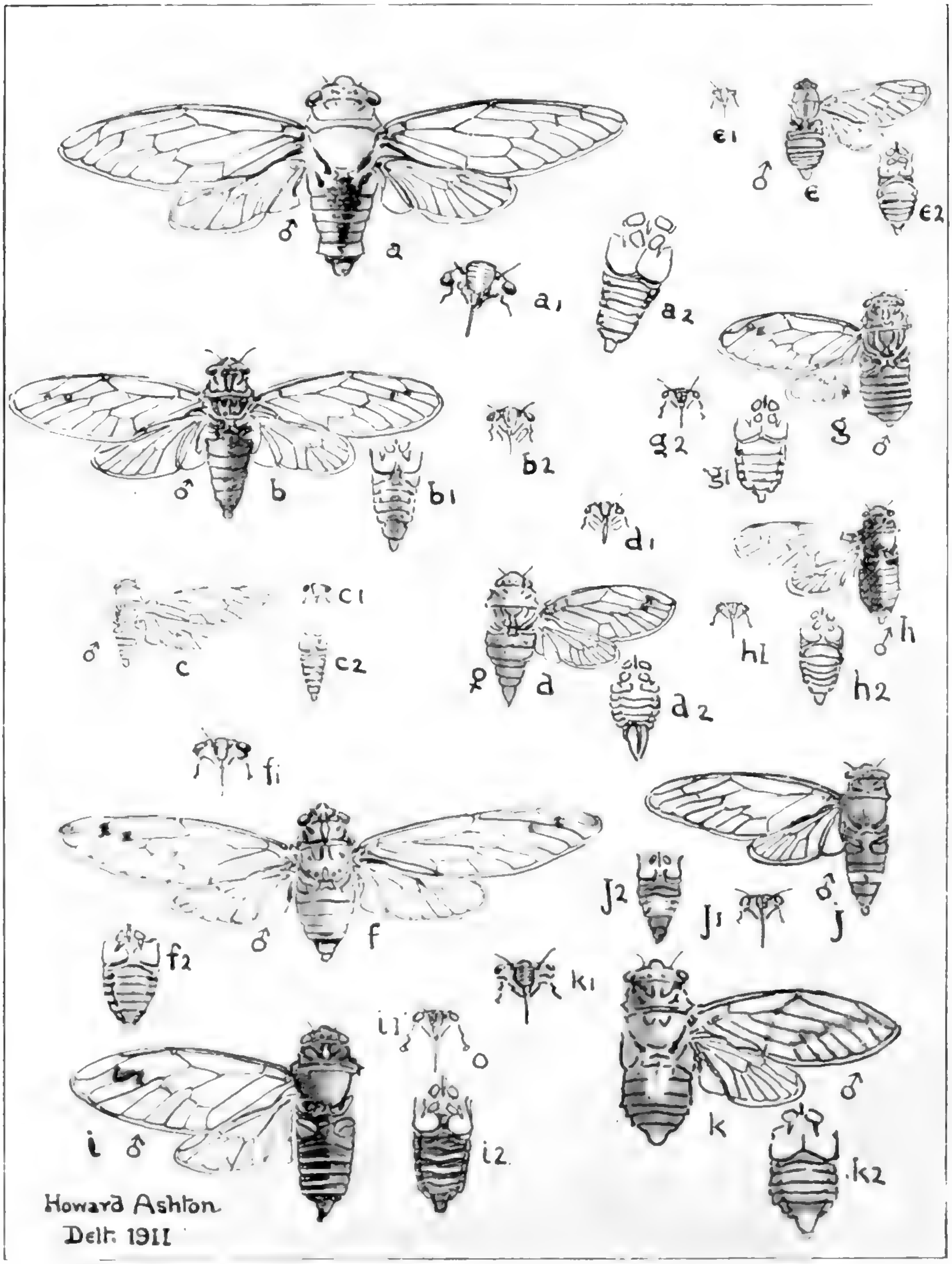
Allied to *M. froggatti*, Dist. I have examined two male and one female specimens; one of the males has five apical areas only in one wing.

EXPLANATION OF PLATE IV.

Fig. *a*, 1, 2.—*Macrotristria dorsalis*, sp. nov. Queensland.

Fig. *c*.—*Melampsalta capistrata*, sp. nov. Queensland.

Fig. *i*.—*Melampsalta cylindrica*, sp. nov. Victoria.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Howard Ashton
Delt. 1911

ON A NEW RHYTIPHORA IN THE NATIONAL MUSEUM, MELBOURNE.

By Arthur M. Lea, F.E.S.

Some time ago, Mr. C. French sent for examination a very large *Rhytiphora*, with the request that I should describe it if new. This it appeared to be, and I would gladly have described it then, but thinking it possible that such a fine insect would not have escaped description if in other entomologists' hands, and that the Zoological Records are usually about two years behind in their records, I deferred describing it till after hearing from Mr. C. J. Gahan, of the British Museum, to whom I wrote. In the interim I returned the specimen to Mr. French, and he gave it to the National Museum, from whence, at my request, I have again received it.

The species is certainly allied to *R. dallasi*, but is even more magnificent than that fine species, from which it differs in being considerably larger, the clothing denser, somewhat differently disposed, and not uniformly silvery. The most noticeable difference is in the elytral costæ; counting the suture as the first, then the third and fourth on each elytron are conjoined close to apex, with the space between densely clothed with ochreous instead of silvery pubescence, and the space equal to or even more than the space between the second and third. In *dallasi*, the third and fourth are not conjoined at apex, and the space between them is much less than that between the second and third. On the prothorax, the dark transverse lines are two in number instead of four, as in *dallasi*.

Mr. Gahan wrote—"I have not described nor do I know any species of *Rhytiphora* answering to the description you have sent me. It appears certainly to be distinct from *dallasi*. In all our four specimens of *dallasi*, the white elytral band between the third and fourth costæ is very narrow, barely more than a line, and in one specimen it is partly broken up into spots. I notice that in the male of *dallasi* there is no pubescent depression at each side behind the posterior margin of the first abdominal segment, as there is in most of the other species of *Rhytiphora*. But this sexual character varies a good deal, being more pronounced in some species, and very feeble in others. Have you noticed the sex of the specimen of the new species ?"

I was under the impression that the type is a female, as although the abdomen is conspicuously variegated, the pubescent depressions common to so many males of the sub-family are entirely absent; and in *Rhytiphora* I know of no other external feature by which the sex of an unique specimen may be determined. Still, if *dallasi* is without such depressions in the male, quite possibly the male of this species is without them.

At Mr. French's request, the species is named after the late Sir William Macleay.

RHYTIPHORA MACLEAYI, SP. NOV.

Black. Densely clothed with white and ochreous pubescence, in places glabrous or with black pubescence; the elytra conspicuously striped.

Head large, with rather coarse but partly concealed punctures, with a narrow continuous median line. Antennæ of moderate length. *Prothorax* about one-fourth wider than long, transversely rugose. *Elytra* widest across shoulders, sides thence regularly diminishing in width to apex, where each is acutely spined; with four almost equidistant feeble but conspicuous elevations on each, the first very close to suture, the second terminated at about the apical fifth, the third commencing just within the shoulder, and the fourth just below it, these two conjoined near apex; all these ridges have small granules towards the base, sometimes rounded, but often acute, and all have coarse punctures gradually decreasing in size posteriorly, but smaller on the subsutural ridge than the others; the margin is narrowly ridged and smooth. Length 43, width 15 mm.

Habitat.—Western Australia: Kookynie.

The clothing on the head is ochreous, but becomes whitish below the eyes and about the mouth; on each side of the base near the middle there is a narrow black patch, straight on its inner, and curved on its outer edge. On the prothorax, the pubescence is whitish, but in places more or less deeply stained with ochreous, and leaving two curved black transverse lines, a median one not interrupted in middle, and a sub-basal one interrupted in middle. The scutellum has ochreous clothing, margined with black. On each elytron the stripes are as follow:—An extremely narrow pale sutural stripe, a narrow black stripe, a wide silvery stripe, a narrow black stripe, terminated at the apical fifth, a wide silvery stripe, a narrow black stripe conjoined near tip with another on the outer edge of a wide ochreous stripe, a wide silvery stripe, and then the narrow black margin; the white stripes about the base are more or less stained with ochreous. Under surface with silvery pubescence marked with ochreous stripes (one at apex of each abdominal segment) and blotches, and black patches (a longitudinal one towards each side of metasternum, and a curved one—very narrow across middle—on each abdominal segment). Antennal joints white tipped with black, but the black increasing till at the seventh it covers half the surface, and the eleventh is white at the extreme base only. The black patches and stripes are due either to the surface being bare or to being clothed with very short black pubescence.

ON AN UNNAMED SPECIES OF PECTEN FROM THE TERTIARY (BARWONIAN) OF SOUTHERN AUSTRALIA.

By Frederick Chapman, A.L.S., F.R.M.S., Palæontologist to the National Museum, Melbourne.

(Plate V.)

A form of *Pecten*, somewhat closely related to Tate's *Pecten consobrinus* has long been known to Australian palæontologists as *P. consobrinus* var. In Professor Tate's "A Revision of the Older Tertiary Mollusca of Australia,"* that author refers to *P. consobrinus*, var., as occurring at Aldinga Bay (Lower beds), Shelford, Maude and Belmont, Waurn Ponds, and Spring Creek. Messrs. Dennant and Kitson, in their "Catalogue of the Described Species of Fossils (except Bryozoa and Foraminifera) in the Cainozoic Fauna of Victoria, South Australia, and Tasmania,"† cite the following localities for *Pecten consobrinus* var. Tate:—Aldinga (Lower beds), Aire Coast, Fishing Point and Guerard Hill, Shelford, Lower Moorabool, Maude, ? Corio Bay, Curlewis-Belmont, ? Mitchell River, Waurn Ponds, and Spring Creek.

It will thus be seen that this particular form is practically restricted to Janjukian beds, and possibly to the horizon immediately below, or the summit of the Balcombian series.

The species *P. consobrinus* was originally described from the Upper beds at Aldinga; whilst the variety occurs in the lower part of the same series, which is shown by its faunal characters, allowing for local lithological differences, to belong to our Victorian Janjukian beds.

The present note is written to establish a name for this variety of *P. consobrinus*, for the convenience of future reference. Since it would appear illogical to refer to an ancestral form of an already described species as a variety thereof, it seems advisable to give it a specific standing, at the same time bearing in mind the fairly close relationship existing between it and the species from the younger beds. Its claims to a specific name are perhaps as great as are those of *P. antiaustralis* and *P. australis*. The affinity with *P. consobrina* is denoted by the denomination *praecursor*.

Description of Type of Pecten praecursor, sp. nov. (= "*P. consobrinus* var." Tate).

The type selected is a left valve of medium size (between the neanic and ephebic stages).

Locality—Spring Creek, Torquay (*ex* Dennant Coll.)

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* Trans. R. Soc. South Australia, vol. xxiii, 1899, p. 269.

† Rec. Geol. Surv., Victoria, vol. i., pt. 2, 1903, p. 119.

Description.—Valve triangularly orbicular, nearly equilateral, the antero-ventral border more sharply curved than the posterior; surface with ten major folds, subacute, with a summit ridge and generally two lateral ridges on either side; interspaces occupied by from 2–6 costulæ, the central usually stronger. All the riblets are closely lamellose or tegulate. Ground surface finely granulate, with shagreen texture, tending to develop into transverse undulate ornament at the extremities of the valves. Ears very unequal; anterior triangular, with outer margin truncated, having five radial costæ; interspaces granular; posterior triangular, truncated; faintly costate and granular.

Measurements of type—Height, 25 mm.; length, 24 mm.

Remarks.—This form differs from *P. consobrinus* in having normally ten folds instead of eight. The folds are subacute, whereas in *P. consobrinus* they are gently convex and equally and numerously costate. In *P. praecursor*, moreover, the transverse ornament of the riblets is, in fresh specimens, more decidedly tegulate, whereas in *P. consobrinus* the ornament is a series of delicate concentric frills.

This species appears to pass upward into *P. consobrinus* (Kalimnan) by loss of major folds, and to pass downward into *P. foulcheri* (Janjukian) and Balcombian by increase of folds and transition of tegulate ornament into the erect squamose.

EXPLANATION OF PLATE V.

Fig. 1.—*Pecten praecursor*, sp. nov. Holotype. Spring Creek, Torquay. (Dennant Coll.) Janjukian.

Fig. 2.—*P. praecursor*, sp. nov. Paratype. Waurn Ponds, near Geelong. (Coll. Geol. Surv., Victoria.) Janjukian.

Fig. 3.—*P. praecursor*, sp. nov. Paratype. Curlewis. (Coll. Geol. Surv., Victoria. Ad. 12.) Barwonian.

The figures are enlarged 7-25ths more than actual size

NOTES ON A COLLECTION OF TERTIARY LIMESTONES AND THEIR FOSSIL CONTENTS, FROM KING ISLAND.

By Frederick Chapman, A.L.S., F.R.M.S., Palæontologist to the National Museum, Melbourne.

(Plates VI., VII.)

Introductory Remarks.

The samples of limestone and limestone-fossils herein described were collected by Mr. J. A. Kershaw, F.E.S., whilst on a recent exploring trip to King Island. Mr. Kershaw informs me that he found this limestone cropping out on the extreme south-east part of the island, and well exposed in the river bed and banks of the Seal River. The outcrop showed a vertical thickness of about 25 feet. The limestone in places was very hard, and the horizontal bedding could be clearly seen on account of the weathering of the softer layers; the more compact limestones projecting as ledges. The polyzoal rock with pectens was found outcropping at the surface of the upper levels. In the absence of any further note as to the relation of the hard limestone to the polyzoal rock, it may be inferred that the latter overlies the hard limestone; and, if this be the case, we have a similar sequence to that of the polyzoal rock of the Grange Burn, which is underlain by the hard pink limestone cropping out at the junction of Grange Burn and Muddy Creek.

The present collection does not comprise many determinable fossils, but, nevertheless, is of great interest, for although several outcrops of tertiary limestone have already been reported from King Island,* no fossils seem to have been collected.†

Prof. Baldwin Spencer, in his report on the general results of the expedition to that locality in 1887,‡ states that the limestone "lies directly upon the granite, and is widely distributed. Thus it was cut through (though the depth of the bed was not recorded) in laying the foundation for the Wickham lighthouse before the grey granite was reached. Again, an outcrop occurs half way from here to Yellow Rock, and on the east coast one a little south of Lavinia Point, and another at the Blow-hole Creek. On the west it is well marked on the coast between the Pass and Ettrick Rivers, inland near Porky Lagoon, and again forms an extensive formation

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* See "Expedition to King Island, November, 1887."—Vict. Nat., vol. iv., Jan., 1888.

† Since writing the above and following account of the fossils (May, 1909), I have seen a paper by Mr. F. Debenham, B.A., entitled "Notes on the Geology of King Island, Bass Straits."—Proc. R. Soc. N. S. Wales, vol. xliv., 1910, pp. 560–576. That author describes therein this same Tertiary limestone of the Seal River, and records *Pecten* aff. *antiaustralis*, Tate; *Lima* cf. *bassi*, T. Woods; *Hipponyx* cf. *australis*; *Turritella* sp., (?) *Hemithyris*, and *Retepora*. These determinations were made by Mr. W. S. Dun, F.G.S., who regards this limestone (and rightly so from the present examination) as belonging to the Table Cape Series.

‡ *Loc. supra cit.*, p. 163.

on the surface inland from Fitzmaurice Bay." Mr. Kershaw's discovery of the same limestone series at the Seal River is therefore additional to the previous records.

During a recent expedition Mr. E. B. Nicholls obtained specimens of a limestone of similar age to the above, and largely composed of polyzoa, which he collected on the east coast, 8 or 9 miles south of Sea Elephant River. This also is a new locality. The specimens have been presented by Mr. Nicholls to the Museum.

General Description.

One variety of the limestone from the Seal River is of a pale ochreous colour, fragmental in structure and of a friable nature. Hand specimens of this rock are seen to consist chiefly of polyzoa with occasional shells of pectens and other mollusca. It bears a strong resemblance to certain beds of polyzoal rock at Waurn Ponds, Batesford, and Torquay.

A harder limestone, associated with the polyzoal rock, is yellow to pink in colour, close textured, and occasionally cavernous, with a tendency to the development of crystalline calcite in the hollows. This rock, like the former, contains much polyzoa and numerous echinoid spines. In its hard texture and pink colour it is closely comparable with the compact limestone of the beds occurring in association with the older basalt on the banks of the Moorabool River, near Maude (W.T.M. 2 and 4 in Nat. Mus. Coll.).

A microscopical examination of thin sections of the friable limestone (Pl. VII., fig. 5) shows the same organic constituents as the compact rock, with the exception that the former has a liberal proportion of clear calcitic cement between the individual grains, whilst the hard limestone has a cement of the nature of a dense pinkish-brown calcareous mud (Pl. VII., fig. 6).

DESCRIPTION OF THE FOSSILS.

THALLOPHYTES.

Boring (?) Fungi.

Palaeachlya tuberosa, sp. nov.

(Plate VII., Fig. 4.)

Some of the shell fragments in the pink limestone were seen to be perforated by a parasitic boring organism. Remains of this kind are frequently met with in both recent and fossil shells and corals, as well as in fish-scales, teeth, and bones. Certain of these are referred to algæ, whilst others are regarded as fungi.† It is probable that the form herein dealt with is of the nature of a fungus, since the thallus is merely constricted and not distinctly septate, and has sporangium-like terminations.

* 30th November, 1908.

† See Seward. Fossil Plants, vol. i., 1898, p. 127.

Description of the borings of P. tuberosa.—Found in shell fragments which are generally more or less water-worn. Perforations (A type), at first slender, entering the shell at right angles to the shell surface or nearly so,* subsequently becoming slightly tortuous, and tending to give off short branches, gradually increasing in width until terminated by a blunt or swollen end; colour, amber yellow. Other perforations in association (B type), commencing as an extremely fine short tube, which suddenly develops a more or less globular termination (? sporangium). Colour, deep reddish brown. Tubes and terminal swellings usually more or less filled with granular material, probably of the nature of spores, some of which are also seen scattered in the neighbourhood of the (?) sporangium. As mentioned above, no distinct septation of the vegetative structure visible, but occasional constrictions occur through the course of the tube. The borings average 13 micra in diameter, and 86 micra in length; sub-globose terminations averaging 18 micra in diameter.

Observations.—The shortness of the perforations and their characteristic clavate terminals serve to distinguish the present form from Duncan's *Palaeachlya perforans*,† which that author found very widely distributed in geological time; one example described having occurred in a foraminifer of Ordovician age.‡

MM. Bornet and Flahault§ have described a boring organism, *Lithopythium*, which they refer to the fungi. Their species, *L. queketti*, bears certain resemblances to the above form; it has a tortuous and filamentous thallus, with globular sporangia at the terminations and outer angles of the sinuses. It differs, however, in the closely interlacing habit of the thallus and the perfectly globular sporangia.

With regard to Australian occurrences of *Palaeachlya*, Mr. R. Etheridge, jun., has described *P. tortuosa* as a parasitic species within a Queensland monticuliporid of Carbo-permian age.|| The chief characters of that species are, a flexuous tube, circular in section, with the terminations irregularly enlarged and with occasional swellings along the course of the tube. Another species instituted by Etheridge is *P. torquis*,¶ found in the coenosteum of a species of *Favosites* from the Devonian limestone of Tamworth, New South Wales. This form consists of slender contorted tubes, filled with yellow granular matter, and having a diameter of ·01 mm. It will be seen that the tube of this species is comparable in size to

* In the case of a prismatic shell, the boring seems to be facilitated by the organism penetrating along the principal axial line or prismatic direction, for easy solution of its base of attack may constitute an important factor in its growth.

† Quart. Journ. Geol. Soc., vol. xxxii., 1876, p. 205, pl. xvi.

‡ *Loc. cit.*, pl. xvi., fig. 5.

§ "Sur les Algues Perforantes," Bull. Soc. Bot., France, vol. xxxvi., 1889, p. clxxii., pl. xii., figs. 5, 6.

|| Rec. Geol. Surv. N.S.W., vol. ii., pt. 3, 1891, p. 95, pl. vii., fig. 1.

¶ Rec. Aust. Mus., vol. iii., No. 5, 1899, p. 121, pl. xxiii., fig. 5.

the above-described form, but which differs, in the very limited length of the tubes, their swollen ends, and occasional bifurcation. It is worthy of notice that Professor Duncan, in his paper previously referred to, figures some very diverse forms under his diagnosis of *Palaeachlya perforans*, and that one of his examples, from a Tasmanian Tertiary coral (*Thamnastraea*) is distinct from our species in that the tubes are excessively slender, long, and tortuous.* *P. tuberosa* also occurs in shell fragments in the limestone of the Moorabool Valley at Maude.

In the pink limestone; Seal River.

Marine Algæ—RHODOPHYCEÆ.

Lithothamnium sp.

Minute fragments of this calcareous alga were seen in thin sections of both limestones, but were too imperfect to compare with any Tertiary examples already described. They belong to a ramose form, since a terminal fragment was observed, showing the characteristic curved and divergent series of cells. The cells from a well-developed branchlet showed a height of ·034 mm. and a width of ·019 mm.

FORAMINIFERA.

Globigerina cf. bulloides, d'Orbigny.

(Plate VI., Fig. 1.)

G. bulloides, d'Orbigny, 1826, Ann. Sci. Nat., vol. VII., p. 277, No. 1.—Modèles, Nos. 17 and 76.

G. bulloides, d'Orb., Brady, 1884, Rep. Chall., vol. IX., p. 593, pl. lxxvii., lxxix., figs. 3–7.

A nearly median section of a *Globigerina* shell occurs in a thin slice of the hard pink limestone. Its test is moderately thick, and from the regular helicoid form, it appears to be referable to *G. bulloides*. This species has been recorded by Mr. Howchin from the Muddy Creek (lower) beds (Balcombian), Waurn Ponds (Janjukian), and Mount Gambier (Barwonian).

Truncatulina lobatula, Walker and Jacob, sp.

Nautilus lobatulus, Walker and Jacob, 1798, Adams' Essays, Kanmacher's Ed., p. 642, pl. xiv., fig. 36.

Truncatulina lobatula, W. and J. sp., d'Orbigny, 1839, Foram. Canaries, p. 134, pl. ii., figs. 22–24.

One example, with unusually well-inflated chambers, was found in washings from the polyzoal limestone.

This species has been recorded by Mr. Howchin from the older beds of Muddy Creek, the Government Well at Murray Flats, the Government Bore at Kent Town, Adelaide, and from the west end of Torrens Lake, Adelaide, the last in comparatively younger strata.

* Q. J. G. S., vol. xxxii., 1876, pl. xvi., fig. 1.

TRUNCATULINA VARIABILIS, d'Orbigny.

(Plate VII., Fig. 6*a*.)

T. variabilis, d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII., p. 279, No. 8; Brady, 1884, Rep. Chall., Vol. IX., p. 661, pl. xciii., figs. 6, 7.

A good example of *T. variabilis* is seen in a thin section of the pink limestone from the Seal River. It is easily recognised by its thin test and numerous chambers arranged in a tortuous and broken-spiral fashion.

From the Australian Tertiaries, Mr. Howchin obtained this species in the older beds of Muddy Creek.

TRUNCATULINA UNGERIANA, d'Orbigny sp.

(Plate VI., Figs. 2*a–c*.)

Rotalina ungeriana, d'Orbigny, 1846, Foram. Foss. Vien., p. 157, pl. viii., figs. 16–18.

Truncatulina ungeriana, d'Orbigny sp., Brady, 1884, Rep. Chall., Vol. IX., p. 664, pl. xciv., figs. 9*a–c*.

A small example with a very deep and conical inferior face was found in the washings of the polyzoal rock.

Mr. Howchin recorded this form as occurring in the Lower and Upper Muddy Creek beds, at Mount Gambier, the Bore on the Murray Flats, and the Kent Town Bore, Adelaide.

ANTHOZOA.

ALCYONARIA.

MOPSEA HAMILTONI, Thomson sp.

(Plate VI., Figs. 3 *a*, *b*; 4.)

Isis hamiltoni, Thomson, 1908, Trans. and Proc. N.Z. Inst., Vol. XI., p. 99, pl. xiv., fig. 1.

In the present series there are two calcareous joints of an alcyonarian which may be referred to the above species. One of them is more or less cylindrical (subquadrate), and longitudinally grooved with comparatively coarse and deep furrows. Ridges often once bifurcated and slightly twisted. A few impressed puncta visible along the surface of the ridges and sometimes in the furrows. A scar on the side of this specimen seems to indicate the position of a branchlet. End of axis dilated and meeting the internodal surface to form a tolerably sharp angle. Terminal face subconical, furrowed, and subdivided into a series of primary septa, and by further division into as many again. These furrows are generally continuous with those on the lateral surface. There is a small conical papilla in the centre of the articular surface. Diameter of axis, 2·5 mm.

The second specimen is much shorter, slightly stouter, and with the lateral furrows crossed by little bars or dissepiments, giving the grooves a distinctly punctate appearance.

There is no doubt of the relationship of the two specimens figured, since all the chief characters are common to both.

Observations.—*Mopsea hamiltoni* has been lately described by Mr. J. A. Thomson, from the greensands accompanying the limestones at Kakanui, New Zealand. Mr. Thomson remarks on the apparent identity of Duncan's New Zealand example, *Isis* sp.*, with the type above referred to, and the writer had come to the same conclusion regarding these, and also the Cape Otway specimens figured by Duncan,† prior to seeing Mr. Hamilton's paper. The fossils, however, belong to the genus *Mopsea* and not to *Isis*, as will be seen on comparing the structure of the joints with those of the species of *Mopsea* still found living round the Australian coast. Duncan's remarks upon the affinities of the fossils did not clear the ground for later students, for, in following Ehrenberg, he says, "It is this branching from the calcareous body which distinguishes the genus *Isis* from *Mopsea,* in which the branching starts from the horny substance (*loc. cit.*, p. 673). In point of fact, the typical *Mopsea encrinula,* to which our species is allied, shows the branching to take place on the calcareous internodes by the formation of a horny node, in some cases, however, so close to the node as to appear to start from it, when in reality it is attached to the calcareous joint (see also Wright and Studer, Chall. Rep. on Alcyonaria, p. 40).

The above species is distinct from Tenison Woods' *Isis dactyla,*‡ in having finer lateral striations and concentrically lineate condyles. *Isis melitensis* of Goldfuss,§ is more nearly related to *I. dactyla* in having fine and numerous lateral furrows; whilst the internodal faces are acutely conoidal and devoid of radial grooves. Goldfuss' species was found in the Pliocene of Sicily and Piedmont.

The above species was found in the polyzoal rock of the Seal River outcrop.

ECHINODERMATA.

CIDARIS (*Leiocidaris*) cf. AUSTRALIAE, Duncan sp.

Leiocidaris australiae, Duncan, 1877, Quart. Journ. Geol. Soc., Vol. XXXIII., p. 45, pl. iii., figs. 1, 2.

There is a somewhat worn fragment of the test of a cidarid in the present series. It shows a portion of the interambulacral area with two primary tubercles and a line of ambulacral pores. Only the one species above mentioned has been recorded from our Tertiaries, and the present specimen, so far as the fragment shows, is probably referable to it. It was first described from the Cape

* Quart. Journ. Geol. Soc., vol. xxxi., 1875, p. 675, pl. xxxviiiB., figs. 1, 1a.

† *Loc. supra cit.*, p. 674, pl. xxxviiiA., figs. 5, 5a.

‡ Palæont. New Zealand, pt. iv., "Corals and Bryozoa of the Neozoic Period in New Zealand," 1880, p. 7, pl. i., fig. 1.

§ Petrefacta Germaniae, 1826–1833, vol. i., p. 20, pl. vii., fig. 17.

Otway beds (Janjukian). It also occurs in the Lower Aldingan beds, and the higher zones of the Balcombian, as at Bairnsdale, and has also been recorded from Beaumaris (Kalimnan).

Found in the polyzoal rock.

SPINES OF ECHINOIDS.

(Plate VII., Fig. 5 *a*.)

Several varieties of echinoid spines are met with in thin sections of the polyzoal rock. In their asperous surface and average dimensions they resemble the smaller secondary spines of the *Cidaris* type.

CHAETOPODA.

SPIRORBIS SP.

Two of the valves of pectens have attached to their external surface some remains of annelid tubes referable to *Spirorbis*. The tubes are not sufficiently well-preserved for description. The superior face is convex and subconical, excavate centrally and the surface of the tube transversely wrinkled, whilst a median ridge runs along the upper surface bordered by two lateral ridges. The tube varies somewhat in diameter, averaging about 1·25 mm.

The genus is mentioned by Tate* as occurring in our older Tertiary beds. The above specimens occur in the polyzoal rock.

POLYZOA—Cyclostomata.

HETEROPORA PISIFORMIS, MacGillivray.

(Plate VI., Figs. 5, 6.)

H. pisiformis, MacGillivray, 1895, Trans. R. Soc., Vict., p. 144, pl. xxi., fig. 15.

The definition of this species, which Dr. T. S. Hall furnished for the late Dr. MacGillivray's report, runs as follows:—"Zooecium nearly spherical, apparently free. Surface closely covered by rounded polygonal apertures of varying size, so that it is not evident in many cases which are zooecia and which are cancelli, as all gradations in size are present. Bounding walls of aperture stout. The apertures of all sizes usually closed by a concave porous plate placed slightly within the mouth."

Three examples were found in crushings from the polyzoal limestone of the Seal River. One was perfectly spherical, and subsequently fell to pieces owing to incipient fracture. The zoarium here figured is spherically topped, but appears to be adherent to a foreign particle at the base, so that it has assumed the shape of a fig. The third specimen was partly damaged, but still shows a clavate outline, and of this a section was made, which exhibits the curvi-radiate arrangement of the zooecia.

This species has hitherto been recorded only from Spring Creek, Torquay (Janjukian).

* Proc. Roy. Soc., N.S.W., vol. xxii., pt. 2, 1888, p. 251.

POLYZOA—Chilostomata.

SELENARIA MARGINATA, T. Woods.

(Plate VII., Fig. 3.)

S. marginata, T. Woods, 1880, Trans. R. Soc., S.A., Vol. III., p. 9, pl. ii., figs. 9*a–d*.

The zoaria are abundant in the hard pink limestone. In thin sections of the rock they are cut in all possible directions, and show the characteristic form of the thyrostome. Where the sections cut through the apex, there is usually seen an adventitious shell or detrital fragment immersed in the apical portion. The zooecial margins are rounded, and there are numerous vibracular cells interspaced at the angles of the zooecia, of about half their size, and with a cribriform wall. A section parallel with and close to the dorsal side shows the radial areolæ to be non-porous, as in MacGillivray's var. *lucens*.*

SELENARIA CONCINNA, T. Woods.

(Plate VI., Fig. 7.)

S. concinna, T. Woods, 1880, Trans. R. Soc., S.A., Vol. III., p. 10, pl. ii., figs. 11*a–e*.

Sections of the entire zoarium occur in the hard pink limestone. They show the characteristic shield-shaped outline of the zooecium, whilst the apical zooecia have in some cases the projecting tongue on the proximal border, which is feebly developed in this species and more strongly shown in the allied *S. otwayensis*, Maplestone.† The elongate vibracularia cells can also be made out, more than one showing the opening with the serrate border typical of this species.

Tenison Woods recorded this form from the Kalimnan of Muddy Creek. It is also distributed in the lower beds, of Barwonian age, in Victoria (Maplestone).

AMPHIBLESTRUM (?) BURSARIUM, MacGillivray.

A. bursarium, MacGillivray, 1887, Trans. and Proc. R. Soc., Vict., Vol. XXIII., p. 66, pl. ii., fig. 2.

Idem, 1895, Trans. R. Soc., Vict., Vol. IV., p. 41, pl. v., fig. 22.

Part of a large zoarium, about 20 mm. square, from which the front walls of nearly all the zooecia have been removed. Zooecia subquadrate to elongate, alternate; more generally quadrate than in MacGillivray's figured specimens. Zooecial margins thick, granular, or furrowed.

Occurs in the polyzoal rock.

* Trans. R. Soc., Victoria, vol. iv., 1895, p. 48, pl. vii., fig. 11 (named *lucens* in text and *lucida* in explanation to plate).

† Proc. R. Soc., Victoria, vol. xvi. (N.S.), pt. ii., 1904, p. 216, pl. xxv., fig. 8.

(?) Lepralia cf. crassatina, MacGillivray.

Lepralia crassatina, MacGillivray, 1895, Trans. R. Soc., Vict., Vol. IV., p. 74, pl. viii., fig. 4.

Our example is represented by a small cluster of encrusting zooecia, somewhat inflated, with sub-hexagonal margins. In its general characters it agrees with the above species, with the exception that many of the zooecia tend to become sub-elliptical by crowding. It has the porous front wall to the zooecium and semicircular thyrostome as in the above form. Mr. Maplestone has pointed out to me that MacGillivray's species appears to belong more properly to *Macropora* than to *Lepralia*. A comparison may be made with *Macropora clarkei*, T. Woods sp.* That species, however, has a generally depressed or even concave zooecial wall, and the zooecia are distinctly broader than in our form. (?) *L. crassatina* occurs throughout our Tertiary series, being found in the lower beds of the Muddy Creek series, at the Moorabool River and Waurn Ponds; and is also found living off New Zealand.

Found attached to a valve of *Placunanomia* in the polyzoal rock of the Seal River.

Adeona sp.

A portion of the branched stem which supports the flabellate zoarium occurs on the surface of one of the slabs of polyzoal limestone. It measures 40 mm. in length and 27 mm. across at the widest part, where there are nine branches.

BRACHIOPODA.

Magellania cf. divaricata, Tate sp.

A cast of a brachiopod shell occurs in the hard pink limestone, which is referable to one or other of the closely related species *M. divaricata*, Tate sp.† or *M. garibaldiana*, Davidson sp.‡ The radial plication seen in the present example is common to both species, but the shell of *M. divaricata* is typically narrower, and shows a marked lateral compression in the region of the beak, also to be seen in our specimen.

PELECYPODA.

Pinna reticosa, sp. nov.

(Plate VI., Fig. 8.)

Description.—Shell triangular, elongate. Valve moderately convex, with a strong umbonal ridge, slightly sinuous throughout its length. Antero-ventral border short and curving backward to meet the postero-ventral edge in a rounded angle. Posterior border

* MacGillivray, *op cit.*, p. 55, pl. viii., figs. 5, 6.

† (?) *Waldheimia divaricata*, Tate. Trans. Phil. Soc., Adelaide, 1880, p. 10, pl. viii., figs. 8, *a*, *b*.

‡ *Waldheimia garibaldiana*, Davidson. Geologist, vol. v., 1862, p. 446, pl. xxiv., fig. 9. *W. macropora*, McCoy. Prod. Pal. Victoria, Dec., v., 1877, pl. xliii., figs. 4, 6. *W. garibaldiana*, Dav., Tate, Trans. Phil. Soc., Adelaide, 1880, p. 7, pl. xi., figs. *a–c*.

transversely truncated, forming a right angle with the dorsal margin. Dorsal line slightly concave. Umbo convex and incurved to the ventral side. Dorsal slope with about nine flat longitudinal ribs crossed at fairly regular intervals by transverse flat ridges. Ventral slope marked by numerous incurved ridge-like growth lines.

Length (approximate, minus the extreme point of the umbo), 15·5 mm.; greatest width, 7 mm.

Observations.—This is a small species of *Pinna* which, in its strong convexity, narrow umbonal area, and the general outline resembles *P. cordata*, Pritchard*, with the exception that our shell is of a more oblong form. *P. reticosa* is distinct in having the dorsal ribs transversely cancellated by flat ridges parallel with the growth lines. The above form differs from *P. semicostata*, Tate,† in the relative narrowness of the proximal part of the shell, and the absence of scales on the ribs. Professor Tate has also recorded a species of *Pinna* (sp. indet.) from the Calciferous sandrock, River Murray cliffs, near Morgan, which agrees generally with the above-named species *P. reticosa*, and he gives the following description‡:— "Apical portions only known. Valves acutely angulated, with faint longitudinal ribs separated by broad interspaces on the ventral slope, crossed by undulose ridges."

From the polyzoal limestone of Seal River, King Island.

Vulsella laevigata, Tate.

V. laevigata, Tate, 1886, Trans. R. Soc., S.A., Vol. VIII., p. 29, pl. iii., figs. 3*a*, *b*.

A right valve, somewhat imperfect, occurs in the polyzoal rock. It is interesting to record this form in the King Island material, since it has only been noted hitherto from the lower beds at Aldinga.

Pecten aldingensis, Tate.

P. aldingensis, Tate, Trans. R. Soc., S.A., Vol. VIII., 1886, p. 16, pl. vii., figs. 1*a*–*c*.

Two typical valves of this species are found in the present series. The larger specimen shows, towards the front margin, some distant, concentric lamellæ traversing the ribs, a character mentioned by Tate in his original description of the species.

It is interesting to find the above species in the present series, since, with the exception of Stansbury, S.A., Tate's original record appears to be the only other locality known, viz., Aldinga Bay, South Australia, in glauconitic limestone (Lower Aldingan).

Found in the polyzoal rock, Seal River.

* Proc. R. Soc., Victoria, vol. vii. (N.S.), 1895, p. 228, pl. xii., figs. 4, 5.
† Trans. R. Soc., South Australia, vol. viii., 1886, p. 29, pl. xii., fig. 9.
‡ *Loc. supra cit.*, p. 30.

PECTEN PRAECURSOR, Chapman.

(Plate VII., Figs. 1, 2.)

P. consobrinus var. Tate, 1899, Trans. R. Soc., S.A., Vol. XXIII., p. 269.

P. praecursor, Chapman, 1912, see present Memoir (No. 4), p. 36, pl. V., figs. 1, 2, 3.

Perhaps the most abundant fossil remains in the Seal River polyzoal rock, with the exception of the polyzoa, are those of *Pecten.* Of this genus the species *P. aldingensis* is readily recognised, but the remaining specimens show a considerable diversity of ornament, partly due to the condition of the shells, so that it was somewhat difficult to settle their points of relationship. There are, however, several fairly well-preserved fragments which show that *P. praecursor* is present, and was an abundant form. One of the more perfect valves represented in the present series is nearly flat, and by the curvature of the ribs is seen to be a left valve. There are about ten or eleven primary folds with a strong median rib, on either side of which are one or two secondary ribs, and between these numerous riblets. Another specimen shows a part of the ventral margin of the valve, in which the surface ornament is particularly well-preserved. The surface of the ribs is concentrically relieved by a series of imbricating lamellæ similar to that seen on well-preserved examples of *P. antiaustralis.** The paucity of the ribs precludes any reference to that species, and, moreover, the intercostal spaces in our specimen are distinctly of a granular shagreen character.

P. praecursor is a characteristic fossil of the lower beds at Aldinga, as well as of many localities, chiefly (or all ?) Janjukian, in Victoria.

Frequent in the polyzoal rock, Seal River.

LIMA BASSI, T. Woods.

(Plate VI., Fig. 9.)

L. bassi, Tenison Woods, 1877, Proc. R. Soc., Tas. (Vol. for 1876), p. 112.

L. bassi, T. Woods, Tate, 1886, Trans. R. Soc., S.A., Vol. VIII., p. 24, pl. v., fig. 8; pl. viii., fig. 1.

An external mould of the shell occurs in the hard pink limestone. The ribs are rounded and transversely lamellated, and the interspaces also show fine and distinct transverse lamellæ. The shell is of the more elongate variety, common at Table Cape, and occasionally found also in the Balcombian.†

* The specimens referred to by Mr. W. S. Dun, in Mr. Debenham's paper on King Island (*op. cit.* p. 567), as a *Pecten* very closely related to *P. antiaustralis*, may possibly be referable to the above-named species, *P. præcursor*, judging from the variation of ornament seen in the present series.

† Mr. W. S. Dun has already recorded *Lima* cf. *bassi* from the King Island Tertiary limestone (*loc. supra cit.*).

PLACUNANOMIA SELLA, Tate.

(Plate VI., Fig. 10.)

P. sella, Tate, 1886, Trans. R. Soc., S.A., Vol. VIII., p. 9, pl. v., figs. 1*a–c*.

Remains of four valves of this species are found exposed on fractured surfaces of the polyzoal limestone. It is somewhat difficult to separate the two forms *P. ione*, Gray, and *P. sella*, Tate. The latter, according to Professor Tate's synopsis of characters, is distinguished by the fine radial threads, as compared with the coarse ornament of *P. ione*, whilst in the latter the radii tend to become subspinose. It is just possible that one of our specimens may belong rather to *P. ione*, since it measures 46 mm. in height; that of Tate's example of the same species being 47 mm.

LIST OF KING ISLAND FOSSILS, WITH NOTES ON THEIR STRATIGRAPHICAL DISTRIBUTION IN THE TERTIARIES OF SOUTHERN AUSTRALIA.

Fossils.	*Remarks.*
Palaeachlya tuberosa, sp. nov. ..	Also found in the limestone of the Moorabool Valley, at Maude.
Lithothamnium, sp.	Common in the polyzoal rock generally.
Globigerina cf. *bulloides*, d'Orbigny	Balcombian to Kalimnan.
Truncatulina lobatula, W. and J. sp.	Distributed throughout the Tertiaries.
Truncatulina variabilis, d'Orb. sp.	Barwonian.
Truncatulina ungeriana, d'Orb. sp.	Balcombian to Kalimnan.
Isis hamiltoni, Thomson ..	Previously recorded from Janjukian beds as *Isis* sp., but not specifically named.
Cidaris (Leiocidaris) cf. *australiae*, Duncan sp.	Chiefly Janjukian and Kalimnan; also from the Gellibrand River (Balcombian).
Spines of echinoids, indet.	
Spirorbis sp.	
Heteropora pisiformis, MacGill. ..	Only recorded locality, Spring Creek.
Selenaria marginata, T. Woods ..	Balcombian to Recent.
Selenaria concinna, T. Woods ..	Balcombian to Recent.
Amphiblestrum (?) *bursarium*, MacGill.	Balcombian to Recent.
(?) *Lepralia* cf. *crassatina*, MacGill.	Balcombian to Recent.
Adeona sp.	
Magellania cf. *divaricata*, Tate sp.	Janjukian.
Pinna reticosa sp. nov.	
Vulsella laevigata, Tate	Lower beds, Aldinga.
Pecten aldingensis, Tate ..	Lower beds, Aldinga.
Pecten praecursor, Chapm. ..	Chiefly Janjukian.
Lima bassi, T. Woods	Barwonian.
Placunanomia sella, Tate ..	Barwonian.

Note on the Age of the Beds.

The palæontological evidence of the foregoing limestone fossils strongly supports the idea of their Janjukian age. Therefore, from a physiographic stand-point, the King Island limestone beds were presumably continuous with those portions of the old sea-bed now represented by the Bird Rock Cliffs, the fossiliferous shell-beds of Table Cape, Tasmania, and the lower beds at Aldinga, South Australia. Not the least interesting fact brought out by the present examination of the King Island fossils is the occurrence in this fauna of two species of mollusca which have hitherto been known almost exclusively from the lower Aldinga beds of South Australia, thus showing a strong affinity in its facies with the fossils of that area. Although the present list of fossils is not so extensive for a complete comparison with other southern Australian horizons as could be desired, yet the evidence before us is fairly conclusive, since the already-known forms recorded here have all—excepting one doubtful polyzoan, which, however, is found living—been previously found in either the Table Cape beds, the Spring Creek series, or the lower Aldingan strata. Further than this, some are peculiar to the Janjukian group.

The correlation of the lower Aldingan beds with normal Janjukian strata is by no means new, since this relationship was long ago pointed out by Messrs. Tate and Dennant* in dealing with the Cape Otway series, also Janjukian. Those authors, however, included both the upper and lower beds at Aldinga which, as Messrs. Hall and Pritchard rightly point out,† belong to distinct stages. The first-named authors, in their second paper on the "Correlation of the Marine Tertiaries of Australia," noted (*loc. cit.*) "the comparatively large proportion of Aldingan species" in the Cape Otway section. "Thus of the forty Aldinga species present at Cape Otway, eighteen are restricted to these two sets of beds," "whilst five of the species indicated are common also to the Spring Creek Fauna."

In my examination of this collection I am under obligations to Dr. G. B. Pritchard, F.G.S., and Mr. C. M. Maplestone for helpful suggestions regarding the mollusca and polyzoa respectively.

Note on the Dune Sand of King Island.‡

In addition to the previously described limestone specimens, Mr. Kershaw also handed me for examination a sample of the dune sand from Surprise Bay, King Island.

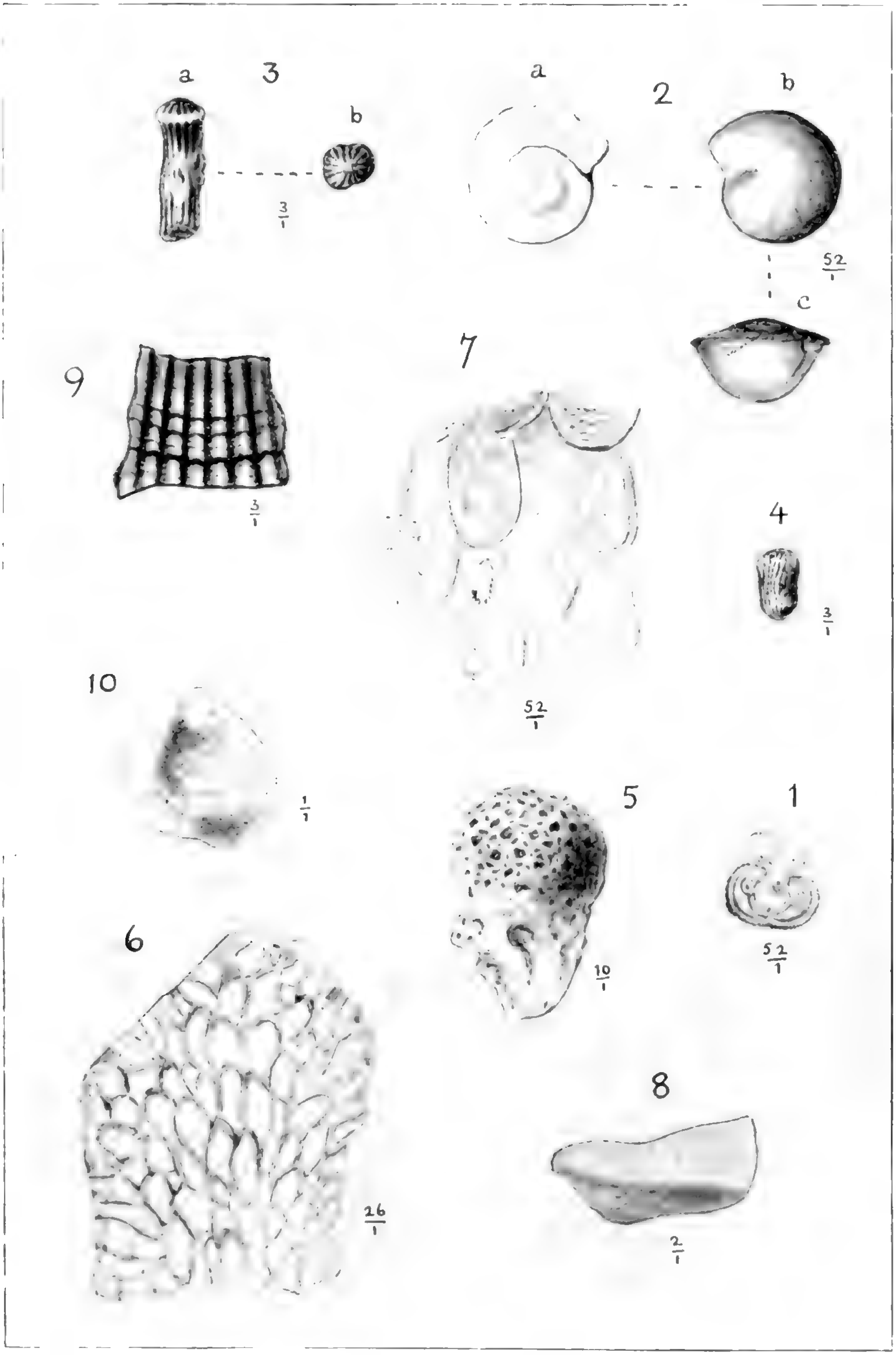
* Trans. R. Soc., South Australia, vol. xix., 1895, p. 110.

† Proc. R. Soc., Victoria, vol. xiv. (N.S.), pt. ii., 1902, p. 79.

‡ Since writing this note (May, 1909), Mr. Debenham (*op. supra cit.* pp. 564, 565) has described the physical and chemical characters of the sand dunes of King Island, and has given a chemical analysis of the sand.

This sand consists chiefly of quartz grains (well-rounded) and rolled shell-fragments in about equal proportions, together with fragmental remains of polyzoa, echinoids, and a few worn tests of foraminifera. Of the last-named group, the following species, all common to the beaches of the southern coast of Australia, were recognised :

Miliolina vulgaris, d'Orb. sp.
Miliolina tricarinata, d'Orb. sp.
Discorbina dimidiata, Jones and Parker.
Pulvinulina repanda, Fichtel and Moll sp.
Polystomella crispa, Linn. sp.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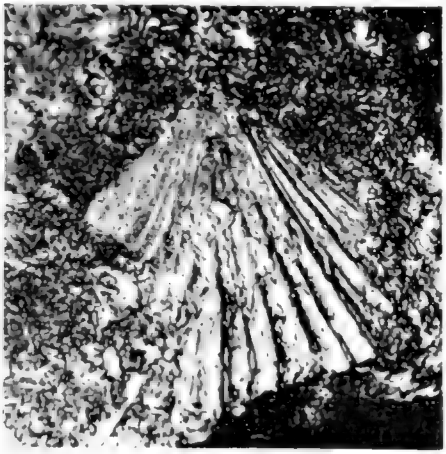

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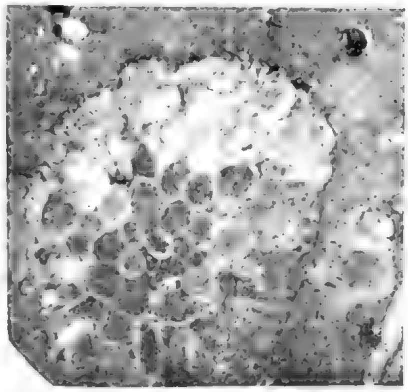

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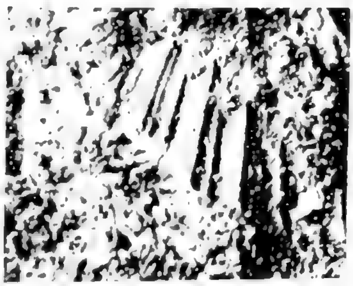

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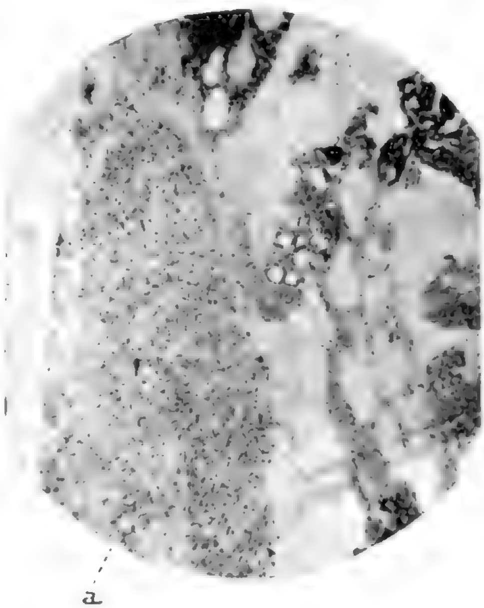

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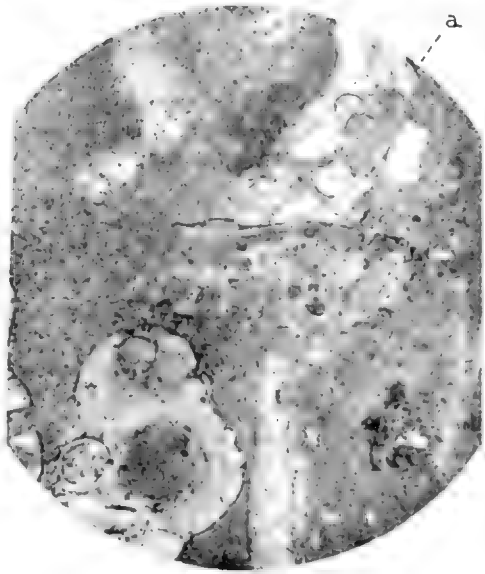

EXPLANATION OF PLATES.

PLATE VI.

Fig. 1.—*Globigerina* cf. *bulloides*, d'Orbigny. A median section of the test. × 52.

Fig. 2.—*Truncatulina ungeriana*, d'Orbigny, sp. (stout var.): (*a*) Superior aspect; (*b*) inferior aspect; (*c*) peripheral aspect. × 52.

Fig. 3.—*Mopsea hamiltoni*, Thomson: (*a*) Lateral aspect; (*b*) articular surface. × 3.

Fig. 4.—*Mopsea hamiltoni*, Thomson. Lateral aspect of another example. × 3.

Fig. 5.—*Heteropora pisiformis*, MacGillivray. × 10.

Fig. 6.—*Heteropora pisiformis*, MacGillivray. Vertical section of a pyriform zoarium. × 26.

Fig. 7.—*Selenaria concinna*, T. Woods. A thin section in limestone, taken tangentially to the zooecial surface; showing vibracular and zooecial cells. × 52.

Fig. 8.—*Pinna reticosa*, sp. nov. × 2.

Fig. 9.—*Lima bassi*, T. Woods. A portion of the shell surface; from a wax squeeze of a mould in limestone. × 3.

Fig. 10.—*Placunanomia sella*, Tate. Nat. size.

Note.—Figures 2–6, 8, and 10 are from the polyzoal limestone of the Seal River; the remainder are from the hard limestone of the same locality.

PLATE VII.

Fig. 1.—*Pecten praecursor*, Chapm. From the polyzoal rock. Nat. size.

Fig. 2.—*P. praecursor*, Ch. Another specimen showing tegulate ornament on the marginal part of the valve. Polyzoal rock. Nat. size.

Fig. 3.—*Selenaria marginata*, T. Woods. A tangential section including apical region. From the pink limestone. × 14.

Fig. 4.—*Palaeachlya tuberosa*, Chapm. The organism perforating a worn shell-fragment. From the pink limestone. × 164.

Fig. 5.—Thin section of the polyzoal rock, showing a cidaroid spine, numerous polyzoa, and the granular calcitic groundmass. × 14.

Fig. 6.—Thin section of the pink limestone, showing polyzoa, shell-fragments, and foraminifera (*a* = *Truncatulina variabilis*), embedded in a fine pasty calcitic groundmass. × 14.

NOTE ON FIJIAN CLUBS ORNAMENTED WITH MAORI PATTERNS.

By R. H. Walcott, F.G.S., Curator of the Geological and Ethnological Collections.

(Plate VIII.)

During a visit to the Museum, Professor R. B. Dixon, of the Anthropological Department of the Harvard University, was particularly interested in a Fijian club bearing an incised design of distinctly Maori origin. Professor Dixon had previously seen elsewhere two other specimens ornamented with a similar type of design, and as, apparently, no record had been made of such an interesting instance of borrowed art, it is well that the Museum should publish a description of the specimen in its collection.

I was fortunate enough, on mentioning the subject to Mr. W. H. Schmidt, of the Australian Metal Company, Melbourne, to find that he had in his private collection another example of a club decorated in a similar manner, which he kindly offered to lend for description.

The Museum specimen, Reg. No. 14,870 (Fig. 1), is, apart from its ornamentation, an ordinary Fijian club of the cylindrical type. Its total length is 3 feet $7\frac{3}{4}$ inches, with an approximate diameter of $1\frac{3}{8}$ inches for 23 inches of its length from the end of the handle. It then gradually increases in diameter to the termination of the head, where it attains a maximum of $1\frac{7}{8}$ inches.

The end of the handle is hollowed out to a depth of a quarter of an inch, a feature not uncommon in Fijian clubs.

The incised design on the handle extends from the extreme end for $11\frac{3}{4}$ inches without a break, and from its termination to the end of the head, seven bands, about three-quarters of an inch wide, of the same incised design are unequally spaced.

The specimen was acquired from Mr. W. Simmonds, of Melbourne, in March, 1908, by whom I have been informed that it was collected by himself some thirty or more years before. Mr. Simmonds, who made a number of visits to Fiji, was unfortunately unable to recollect under what circumstances he obtained the club, or from which island of the group.

The style of ornamentation is common in Maori carvings, and consists, as may be seen from Fig. 2, which is a reproduction of a rubbing, of a series of transverse parallel bands each of four lines, alternating with single lines of diamond-shaped points. The bands of parallel lines do not continue unbroken round the whole

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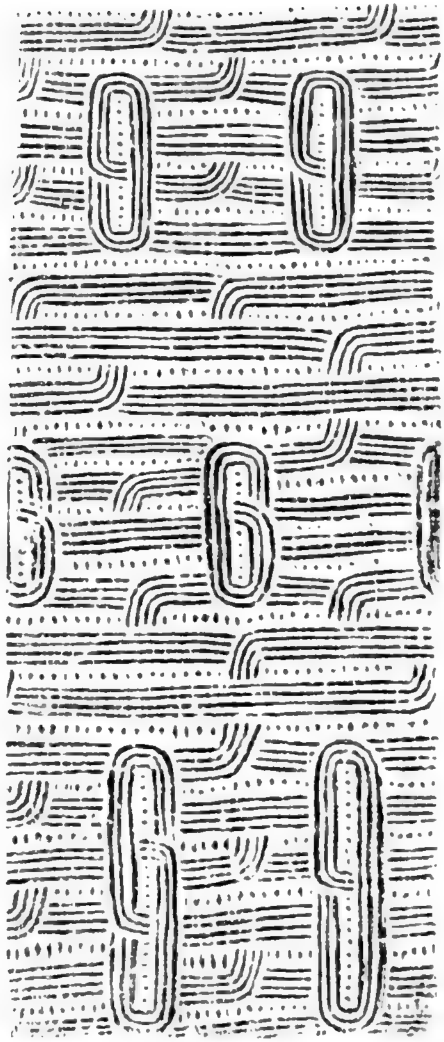

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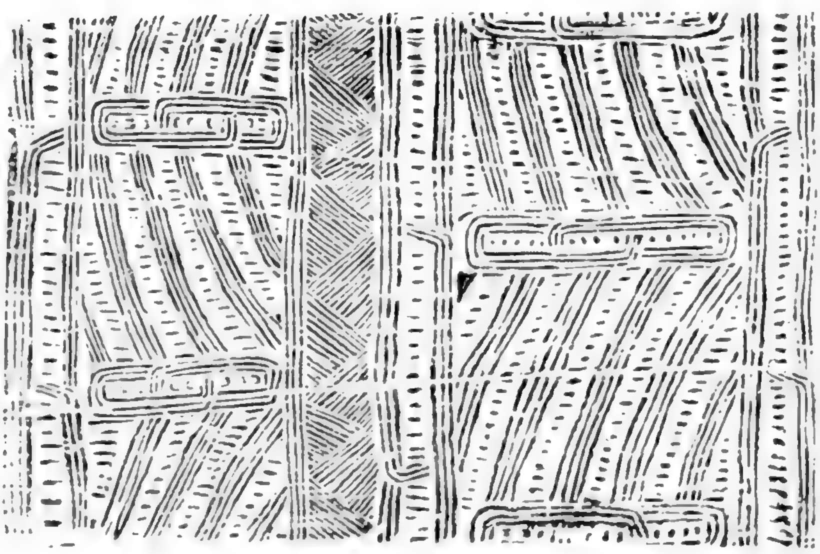

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circumference of the club, but at some place or places in their length bend sharply either upwards or downwards to meet the adjacent band. Interspersed among these are six link-like ornaments, five resembling the stud links of a ship's cable, and the sixth resembling two long plain links. They are arranged longitudinally with reference to the greater axis of the club, or at right angles to the main design, which they resemble in principle, but they are composed of three lines instead of four, as in the transverse bands of the main design.

It seems evident that this type of ornamentation is derived from the spiral, so characteristic of Maori art, and only resembled at all by the scroll pattern prevalent in New Guinea decoration.

Mr. A. Hamilton,* Director of the Dominion Museum, Wellington, N.Z., was informed by an old Maori that the spiral, called *pitau*, represented the young circinate frond of the tree fern, *pitau* being the Maori term applied to the young frond of the tree fern (*Cyathea*).

The small studs between the coils of the spiral in the carvings represent the pinnæ of the frond. The five links in the design on the club are plainly only the elongated first or central coil of the spiral, with one end continued and closed on the central coil, while in the double links both ends are continued and closed.

The transverse bands are simply a further elongation of the same coil, although their origin is not so apparent. The diamond-shaped points forming lines between the bands and in the links take the place of the studs in the spiral.

Mr. Schmidt's specimen (Fig. 3), which has no available history, he having purchased it from a dealer in Prahran, a suburb of Melbourne, is what is commonly known as the pineapple type among Fijian clubs, on account of the head bearing a resemblance to that fruit.

As in the previous specimen, there is also nothing in the form of this club which shows any departure from the type it represents.

The ornamentation (Fig. 4) is restricted to 8½ inches of the handle, the rest being perfectly plain. With the exception of a central transverse band, the ornamentation is in the main similar to that just described.

These minor differences consist in most of the four lined bands being curved, and not bent to meet the adjacent ones. The distance between the bands is also greater, so that the diamond-shaped points of the other club here rather assume the character of short longitudinal ridges, and in the two lower links they are replaced by U-shaped forms. The links, of which there are four, are all double, while in the Museum specimen, as pointed out, there is only one of this kind.

* Maori Art, Part I., p. 11, 1896.

The transverse band near the centre of the design, referred to above (Fig. 4), is about three-quarters of an inch wide, and consists of a triangular pattern of closely placed lines. The style of this decorative band seems to be more characteristic of Fijian than of New Zealand ornamentation.

With regard to the origin of Maori ornamentation on Fijian articles, it is a matter of some difficulty to decide to what circumstances it is due.

Accepting the theory that Maori art is endemic, it having been evolved since the isolation of the Maoris from the rest of the world after the last great migration about the year 1350, and was not brought with them from their original home, it cannot be said that that found in Fiji represents the remnant of a type originally derived from a common source and distributed throughout many islands in the Pacific visited and colonized by the early Polynesians.

No intercourse, then, having taken place between the Maoris and other peoples of the Pacific since the evolution of their art, its introduction into Fiji can best be explained by attributing it to communication between the two places, which commenced with the European whalers and traders at the beginning of last century.

There is, however, a possible explanation which may refer its introduction into Fiji to earlier times, and which was suggested by pieces of a New Guinea canoe in the Museum, said to have been picked up on the coast of New Zealand. It is that, in like manner, a Maori canoe may have been driven out of its course and eventually stranded on one of the islands of the Fijian Group, where either the designs on the canoe were copied by the inhabitants, or the characteristic form of carved decoration was made known to them by some of its Maori survivors.

If by this explanation its origin can be referred to a period antedating the advent of the European, the fact may possibly be ascertained by the type of weapon, or some feature in the carving, differing from that of more modern times. There is nothing in the types represented by the two clubs under consideration, or in their condition, to suggest antiquity; and with reference to their ornamentation, I am not in a position to give an opinion as to any variation in the detail of the work which may offer a clue; but I believe Professor Dixon held the view that some such evidence of antiquity did exist in the Museum specimen. On the other hand, it may only mean that the ornamentation, used originally as a pattern, was of ancient design.

Failing proof of antiquity, it appears to me that the ornamentation most probably originated either by articles brought from New Zealand to Fiji by missionaries, traders, or whalers, or else by some of their Maori sailors decorating the weapons of the Fijians with the New Zealand patterns.

In this way the Maori type of ornamentation may have become known to the Fijians, and, perhaps, adopted by them at times, as offering a pleasing variation on their own well-known designs; but it is not even certain that its introduction can be put back as far as is suggested, and it may only date from about forty or fifty years ago, when a rapid influx into Fiji from the Australasian Colonies took place.

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CONTENTS.

ON THE SUCCESSION AND HOMOTAXIAL RELATIONSHIPS OF THE AUSTRALIAN CAINOZOIC SYSTEM.

By Frederick Chapman, A.L.S., F.R.M.S., Palæontologist to the National Museum, Melbourne.

CONTENTS.

Previous Opinions of Time Equivalents.

In the earlier days of palæontological work in Victoria, the conclusions as to the age of the rich Tertiary faunas of southern Australia* were necessarily founded on limited evidence, derived from an imperfectly-known series of fossils. The palæontology of these beds had then been scarcely touched by systematic workers, so that the small number of species available for purposes of comparison, both in relation to the question of local stratigraphical sequence and the wider one of correlating them with the well-studied Tertiary faunas of Europe, rendered a solution of the problem one of great difficulty.

The first effort at correlation was made by Sir A. R. C. Selwyn in 1854, who, in a "Report on the Geology, Palæontology, and Mineralogy of the Country situated between Melbourne, Western Port Bay, Cape Schanck, and Point Nepean,"† stated, "Both the clay and limestone" [of the Mornington beds = Balcombian] "are very rich in fossil remains, and both in general lithological character,

* By southern Australia it is intended to include the States of South Australia and Victoria, which have a community of facies in Tertiary stratigraphy. This explanation is necessary from the fact that localities in Victoria have often been erroneously referred by European palæontologists to South Australia.

† Parl. Papers, 1854–55, vol. i.

mineral and organic contents, bear a striking resemblance to the clay and associated calcareous nodules of the London and Hampshire Basins." Since no detailed analysis or comparison of the fossil faunas were offered, this conclusion was only tentative. A further opinion was advanced by Selwyn in 1856, when, in his "Report on the Geological Structure of the Colony of Victoria, the Basin of the Yarra, and part of the Northern, North-eastern, and Eastern Drainage of Western Port Bay,"* he relegated the Victorian Tertiaries to Eocene, Miocene, Pliocene, and Pleistocene.

William Blandowski, in 1857 (in a Report written in 1854)† referred to several genera of mollusca and polyzoa as occurring in the Mount Martha beds (= Balcombian), and expressed the opinion that they are co-eval with the uppermost strata of the London, Paris, and various Italian clay basins.

The Mount Gambier Cainozoics (polyzoal limestone) were regarded by the Rev. J. E. Tenison Woods, in 1859,‡ as Eocene; but, later, of the age of the Pliocene Coralline Crag in England.§ The same author finally arrived at a mean in concluding|| that they were older than that series, and younger than the Muddy Creek beds; conclusions which are upheld in the present paper, as far as relate to the lower bed of that series.

Sir F. McCoy, in 1861,¶ regarded the Balcombian beds of Mt. Eliza and Mt. Martha (Balcombe's Bay) as of Upper Eocene age; but this was subsequently altered** to Oligocene, in accordance with the change of nomenclature and subdivision of similar beds in Europe, to which McCoy referred in the following terms:—"These have the general facies, and even specific identity of so many species, so clearly marked that there cannot be the slightest doubt of the great thickness of those beds being Lower Miocene of the date and general character of the Faluns of Touraine, the Bordeaux and the Malta beds; while the base of the series blends imperceptibly with a series of beds having a slightly older facies, and rendering the adoption of the Oligocene formation of Beyrich as convenient for Victoria as for European geologists." In this Essay McCoy draws the inference of a community of strata of Oligocene and Miocene ages exhibited in the Victorian, European, and North American deposits, by noting the occurrence of the teeth of Squalodon†† and typical Middle Tertiary sharks. With his extensive knowledge of European fossil faunas, and a keen eye for resemblances in the facies of widely separated areas, McCoy gave his conclusions, which were at

* Votes and Proceedings, Legislative Council, 1855–56., vol. ii.

† "On an Excursion to Frankston, Balcombe's Creek, Mount Martha, Port Phillip Heads, and Cape Schanck." Phil. Trans. Roy. Soc. Vict., vol. i., p. 24, *et seq.*

‡ Quart. Journ. Geol. Soc., vol. xvi., p. 253 *et seq.*

§ Geol. Obs. in S. Australia, 1862, pp. 85, 86.

|| Q.J.G.S., 1865, vol. xxi., p. 393.

¶ Exhibition Essays, 1861, p. 159.

** Ditto (1866), 1867, p. 322, or sep. paper, p. 16.

†† The Victorian species is now referred to a related genus, *Parasqualodon*. See T. S. Hall. Proc. Roy. Soc. Vict., vol. xxiii. (N.S.), pt. II., 1911, p. 262.

the time almost prophetic, but in reality were based on a knowledge of the guide fossils of both areas. It had yet to be proved whether the Lyellian method of molluscan percentages as a test of the exact age (or as in the case of antipodeal strata, of their homotaxial relationships) could be applied to the Cainozoic beds of this southern continent.

A suggestive contribution bearing on the present subject is found in the Rev. J. E. Tenison Woods' "Palæontological Evidence of Australian Tertiary Formations."* In this paper the author showed that a close relationship exists between the majority of our Tertiary fossils and those of the Miocene of other areas; and although many of the fossil determinations given in that paper require some revision, the conclusions are based on good reasoning. He there says,† "Speaking of the Corals generally, we have more affinities with Miocene forms than any other formation; but a few genera are common to both Eocene and Miocene formations. We have no truly Eocene forms, such as *Turbinolia*, which are found in the Eocene beds both of Europe and America; neither have we among the many Foraminifera such characteristic fossils as Nummulites; but we have certain American genera which have seldom been found, as far as I am aware, above the Eocene." With regard to his remark about the absence of Nummulites in Australia, Tenison Woods was the first to record our commonest nummulinoid form as *Amphistegina*, a determination made for him by Prof. T. Rupert Jones.‡ Subsequently the genus *Nummulites* was recorded from our Cainozoics in error for *Amphistegina*, as will be shown in a separate section, and this has been a factor in the acceptance of the *Eocene* age of the Lower Muddy Creek and other related beds by certain authors.

The corals and echinoids of Victoria were first systematically dealt with by Prof. M. Duncan,§ and yielded that author no very decided evidence as to the age of our Cainozoic fossil series, when compared with the European faunas; although Duncan remarked‖ that the southern Australian fossil deposits with madreporaria, polyzoa, echinodermata, and mollusca have "a facies characteristic of all the European marine tertiary deposits above the Nummulitic." Later on he stated¶ that the aspect of certain genera of the echinoids "gives a Nummulitic-of-Europe-and-India facies to the fauna, whilst the cretaceous aspect is presented by *Catopygus* . . ." also noting other genera the names of which, as well as of the supposed *Catopygus* of Southern Australia (now *Studeria*), have since been changed, redeterminations showing that the forms have a Tertiary

* Journ. Roy. Soc. N.S. Wales, vol. xi. (1877), 1878, pp. 113–128.

† *Loc. cit.*, p. 119.

‡ J. E. T. Woods.—"On Some Tertiary Deposits in the Colony of Victoria, Australia." Quart. Journ. Geol. Soc. Lond., vol. xxi., 1865, p. 391.

§ Quart. Journ. Geol. Soc. Lond., vol. xxvi., 1870, pp. 284–318; and vol. xxxiii., 1877, pp. 42–73.

‖ Q.J.G.S., vol. xxvi., 1870, p. 317.

¶ Q.J.G.S., vol. xxxiii., 1877, p. 69.

relationship. At the same time he admitted that many of the species were almost identical with those of the Miocene of Malta. Duncan was inclined to group the Australian tertiaries in one series as Cainozoic, referring the deposits below the Mt. Gambier beds to the Lower Cainozoic, and all above it to the Upper Cainozoic.*

By the researches of Prof. Ralph Tate, Sir F. McCoy, and others, who have so ably followed in descriptive work, a large number of Tertiary species, particularly in the group of the mollusca, have been carefully diagnosed and figured; although in some cases perhaps scarcely enough attention has been paid to the work of authors who have dealt with fossils from related strata in areas not very far removed, as those of New Zealand. A critical examination of our Victorian lists will in all probability show that in more than one instance the same fossil is credited with two names. On the other hand, this comparative work has been often retarded by insufficient descriptions and inadequate illustrations.

A modification of McCoy's earlier opinion of the age of the Victorian strata was published in the First Progress Report of the Geological Survey of Victoria in 1874 (pp. 35, 36), in which there occurs a list of fossils by that author, correctly placing the Mornington beds at the base of the series, and referring to them as Oligocene. In this list, however, there is an admixture of fossils which are now referred to two different horizons in Victoria.†

In the correlation of the southern Australian Tertiaries by Prof. Ralph Tate and Mr. J. Dennant, in 1893,‡ the clays and polyzoal limestones of the Balcombian and Janjukian Series (giving them the local terms applied by Drs. Hall and Pritchard, *vide seq.*) are there referred to the Eocene. The Cainozoic strata of the Gippsland Lakes and the upper bed at Muddy Creek (= Kalimnan) are there called Miocene. The older and newer mammaliferous drifts are regarded as Pliocene to Pleistocene.

In 1895 Dr. P. H. MacGillivray, fresh from the study of our Cainozoic polyzoa, makes the following statement:—"The age of the deposits has been the subject of a good deal of discussion among geologists. They are now generally referred to the Oligocene or early Miocene, but some are considered by different authorities to belong to the Eocene. It is difficult, however, to believe that any of them can be so old as the Eocene, at least considering it to be comparable to that of Europe. So far as an opinion can be formed from an examination of the Polyzoa, they are not of very different ages."§

Drs. T. S. Hall and G. B. Pritchard, who have worked very assiduously in the study of our Cainozoic faunas and stratigraphy,

* Q.J.G.S., vol. xxvi., 1870, p. 315.

† *Balanophyllia campanulata*, *Trigonia acuticostata*, *Spondylus gaederopoides*, *Volutilithes anticingulatus*, *Voluta macroptera* and *Cypraea platyrhyncha* are found in beds of later age.

‡ Trans. R. Soc. S. Australia, vol. xvii., pt. I., 1893, p. 216.

§ Trans. R. Soc. Vict., vol. iv., 1895, p. 2.

follow Messrs. Tate and Dennant in the same general reference of the older Cainozoics to the Eocene, but consider the Janjukian beds (*vide postea*), in contradistinction to the last-named authors, to underlie the Balcombian clays. This difference of opinion as to sequence is mainly due to the occurrence of fossiliferous clays resting on the polyzoal rock at Belmont* and Curlewis containing a fauna which was compared by Hall and Pritchard with the Balcombian clays of the Mornington and Muddy Creek type. The difficulty is easily explained by the fact that the species in these upper clays are unrestricted; that is, they pass from the underlying Balcombian into the Janjukian, but are, to a great extent, absent from the intermediate polyzoal facies, purely on account of difference of hydrographical conditions.

Until Drs. Hall and Pritchard instituted local names for those beds showing distinct faunal characters,† references to the various strata were very confusing, since no two authorities were actually agreed as to the use of the terms Eocene, Oligocene, Miocene and Pliocene when applied to the southern Australian Cainozoic.‡ The local names referred to are Balcombian, Janjucian (afterwards phonetically spelt Janjukian), Kalimnan, and Werrikooian. To these terms were afterwards added the comprehensive term "Barwonian," which includes both the Balcombian and Janjukian, as having some faunal characters in common, and distinguished from the Kalimnan, between which and the Balcombian there seemed, to the above authors, to be a greater palæontological break. It is here postulated that the Janjukian is the younger series, and therefore nearer in faunal characters to the Kalimnan; and, moreover, the palæontological difference referred to is not so marked as those authors believed. This is borne out by an exhaustive study of the fossils of the Mallee borings, in which there occurs a gradual passage downwards from Kalimnan into Janjukian, without intercalation of beds containing restricted Balcombian fossils.

In Drs. Hall and Pritchard's important paper on "A Suggested Nomenclature for the Marine Tertiary Deposits of Southern Australia,"§ those authors give a convenient summary of the various opinions as to the sequence and age of our Cainozoic strata, together with their local terms for these beds, which has already proved to be of the greatest use in providing a definite terminology for the various outcrops. The use of local terms consequently prevents that confusion which previously occurred when each author ascribed

* Mr. Mulder informs the writer that the shaft at Belmont, after passing through fossiliferous clays, finally reached polyzoal limestone.

† Proc. R. Soc. Vict., vol. xiv., N.S., pt. II., 1902, pp. 75–81.

‡ For an excellent summary of authors' opinions, see G. B. Pritchard's paper, "On the Present State of our Knowledge of the Older Tertiaries of Southern Australia." Rep. Austr. Assoc. Adv. Sci. Brisbane, 1895.

§ Proc. Roy. Soc. Vict., vol. xiv., N.S., pt. 2, 1902, p. 81.

the same stratum to formations of different ages. The summary referred to is given below :—

	McCoy.	*Tate and Dennant.*	*Hall and Pritchard*
WERRIKOOIAN	—	Pleistocene (Tate) Pliocene (Dennant)	Pliocene
KALIMNAN	OLDER PLIOCENE	MIOCENE	MIOCENE
BALCOMBIAN	OLIGOCENE	EOCENE	EOCENE
JANJUCIAN (NOW JANJUKIAN)	MIOCENE TO OLIGOCENE	OLIGOCENE (?) (TATE) EOCENE	EOCENE
ALDINGAN	—	EOCENE (IN PART)	EOCENE (IN PART)

In Drs. Hall and Pritchard's paper above referred to, the sequence given for the Australian Tertiary strata places the Janjukian at the base of the series. There is very strong evidence, however, in favour of the Balcombian being the oldest formation with marine fossils, and of an approximately equivalent age to the Upper Oligocene and Lower Miocene of Europe, North America, the West Indies, and Patagonia. In connexion with the last-named area, Ortmann* lately published an elaborate account of the fossils, and gave his conclusions as to the age of those beds. He also compared them with the Australian Tertiaries, agreeing almost entirely with the early views of McCoy. Dr. Ortmann based his conclusions upon a comparison of the fossil invertebrates with related forms from other localities and horizons in the Tertiaries ; and after giving the percentages of related fossils, goes on to say, " We see a constant increase of the percentages from the Cretaceous to the Miocene, and then again quite a sudden decrease from Miocene to Recent."

As Dall and Ortmann have shown, some of the West Indian faunas used for purposes of comparison have been referred to the Oligocene, and this points to the Patagonian beds having a stronger affinity towards the Older Cainozoic than would otherwise appear from Ortmann's previous calculations ; and accordingly the latter regards them more decidedly as Lower Miocene.†

THE RELATIVE VALUES OF THE PERCENTAGE METHOD; AND THE COMPARISON OF TYPICAL FAUNAS, IN DETERMINING THE AGES OF THE AUSTRALIAN CAINOZOIC STRATA.

When Sir Chas. Lyell formulated the method of judging the age of the various Tertiary beds of the London, Hampshire and Paris Basins by the percentage of the recent species of mollusca contained therein, he was dealing with a set of strata deposited under fairly constant conditions, and dominated by an entirely different geographical distribution of land and water from that which must have prevailed more or less throughout Tertiary times in southern Australia. Since Lyell's time this once generally

* Reports of the Princeton University Expeditions to Patagonia, 1896–1899, vol. iv., pt. 2, 1902. Tertiary Invertebrates, pp. 48–332, pls. xi–xxxix.

† *Op. supra cit.*, p. 297.

accepted rule has been questioned. Kayser remarks*, "Although the principle underlying this classification has in progress of time proved in the main accurate, the percentages of living species originally adopted by Lyell for the various groups have not remained firm. Thus for the Pliocene we must take 40–90 instead of 35–50, and for the Miocene 10–40 instead of 17."

That the percentage method of correlating strata in widely separated areas is attended with serious difficulties has been early recognised, as, for example, by so able an observer of faunal distribution in the past and present as the late Capt. Hutton, of Christchurch, whose words on the subject we cannot do better than quote. After discussing the relative ages of two beds in the Wanganui System of New Zealand, which, on account of the close percentage of living to extinct species, Hutton was inclined to think, overlapped, and advocating the use of this same means of discrimination in determining the relative ages of beds in the same general area, he speaks thus :—†

"But it does not follow that this method can be trusted for correlating with accuracy sets of beds in widely distant areas. On the contrary, different districts have undergone different physical changes, and we have therefore every reason to suppose that alterations in floras and faunas would proceed with unequal rapidity in different parts of the world. At the same time, as the replacement of a whole marine fauna can rarely be sudden, it follows that the percentage system has some value even here. But it must always be used in conjunction with a comparison of the specific forms of the two areas. And here, again, it is only the wide-ranging oceanic, or deep-sea species—such as sharks, cephalopods, and a few bivalves—which should be depended upon for evidence, but these wide-ranging forms are of the very greatest value in correlating strata all over the world."

Another difficulty which confronts us with regard to the computation of the actual percentage of living species is the variable estimation by different authors of the value of minor characters ; as, for example, of shell sculpture in the group of the mollusca, where slight differences are seen only after careful study, or it may be, a trivial variation in form, which, if sufficiently constant would be regarded by some as specific. Hence, critical work on any fauna will always tend to *lower the percentage of living species* in any given fossiliferous series, and consequently to *increase its approximate age.* It seems, therefore, that we, in the southern hemisphere, to use the percentage method, must gradually erect a standard of percentages which will generally accord with the evidence afforded by a study of the strata in this part of the world ; never forgetting, however, to exercise a cautious spirit in regard to species-making in working from this stand-point.

* Text Book of Comparative Geology. English translation by P. Lake, 1895, p. 330.

† Trans. and Proc. New Zealand Inst., vol. xviii., 1886 (for 1885), p. 345.

Although Capt. Hutton mentioned certain groups of animals which, by reason of their comparatively deep sea habitat, furnish species of world-wide distribution, it appears highly probable that even these particular forms would be prone to considerable variation should they survive in an environment differing from that of the open ocean; and this will account for the difficulty of discovering universally distributed species for comparative purposes. To aid in this matter of the comparison of facies of widely separated faunas other than recent, it may be suggested that generic types, no matter of what group of organisms, but which are limited to distinct horizons in the northern hemisphere, should also be regarded as of special value in the correlation of the Tertiary strata in the southern hemisphere. A comparison of selected faunal types, more or less indicative of distinct horizons elsewhere, will be made in drawing up a suggested stratigraphical correlation, and discussed in the notes following in the next section.

In connexion with this subject, it is also necessary to draw attention to the recent work of Dr. A. E. Ortmann* as having an important bearing on the present question. From a study of the mollusca he has brought forward strong evidence in favour of correlating the Patagonian Tertiary beds with at least one of our southern Australian series, as well as with the Pareora formation of New Zealand, all of which he regards as Lower Miocene.

With particular reference to the percentage method, Ortmann remarks† :—" In very many cases the age of the Tertiary deposits is determined by the percentage of living species found in them. In my opinion this line of evidence is entirely inadmissible in our case, and I hardly need to say anything to support this view; this method may be safely used in Europe, but in the southern hemisphere it is out of the question."

Dr. Ortmann further points out that, owing to the changes in the systematic views of the various authors of species, the number of the identifiable living forms fluctuates, and one or two doubtful ones obviously lower the percentage considerably. This difficulty, as I have already mentioned, has frequently arisen in respect to the work of our Australian geologists, causing the same stratum to be referred to under three different age-names by as many authors. As a case in point, the work on the faunas of the Lower Muddy Creek section and the Spring Creek beds by Drs. Hall and Pritchard‡ showed a percentage of living species as low as 2.5 per cent. for the former locality, and only about 1 per cent. for the latter. Since only 3 out of 293 species were identifiable with living forms in the Spring Creek fauna, it is clear that by addition of a few more recent species these beds might be reversed in apparent sequence, by the opinion of the investigator of doubtfully valid living species.

* *Tom. supra cit.*
† *Tom. cit.*, p. 288.
‡ Proc. Roy. Soc. Vict., vol. viii., 1895, p. 190.

It is worthy of note that, in connexion with the subject of the value of the percentage method in its general sense, later research has already proved the survival of many other fossils of the Cainozoics in the seas of the present day. For instance, *Lissarca rubricata*, now living in Western Port Bay and elsewhere, occurs in the Janjukian of the Mallee bores; and the Balcombian to Kalimnan *Trivia avellanoides* is found living off the New South Wales Coast.

SOME COSMOPOLITAN AND WIDELY-DISTRIBUTED FOSSIL TYPES AND THEIR SIGNIFICANCE.

Cetaceans.—In the Nodule or Phosphate Bed which is found at the base of the Kalimnan Series in Victoria, remains of cetacea are very abundant. They include ribs, vertebrae, an occasional scapula, digitals, tympanic bones, &c., evidently belonging to several distinct forms, and representing the Toothed Whales, including the Beaked Whales and the Dolphins. Similar remains are found scattered through the Janjukian Beds of Waurn Ponds and other localities where the strata are of considerable thickness, and marly or purely calcareous; and this, with other data of fossil occurrences, show convincingly that the nodular phosphatic bed of the Grange Burn and that at the base of the cliffs at Beaumaris, which there underlie the Kalimnan, represent a remanié bed of the Janjukian series.

One of the toothed whales (*Odontoceti*) occurring in Victoria is now referred to *Parasqualodon*, and another from South Australia is the type of the genus *Metasqualodon*.* These are closely related to Squalodon, a typically Miocene form extending into the Pliocene. The teeth of the squalodonts form a more numerous and closer series† than those in the Eocene *Zeuglodon*; the former being smaller animals, with a shorter rostrum. The southern hemisphere squalodonts have the roots of the molar teeth united, whilst in the northern forms they are separate and incurved. McCoy described a molar tooth of "*Squalodon*" (= *Parasqualodon*) *wilkinsoni* from the "Miocene Tertiary sands of Castle Cove, Cape Otway Coast,"‡ in beds of Janjukian age; and he subsequently figured another example, a canine tooth from Waurn Pounds, near Geelong. Several specimens both of the molar and canine teeth have since been found in the Waurn Ponds quarries in strata of similar age. In describing the *Parasqualodon* teeth, McCoy compared them with *Squalodon grateloupi*, H. von Meyer, from the Miocene of Bordeaux, from which they differ in the conjunction of the roots. Mr. E. B. Sanger, in 1881, described and figured a molar tooth of a cetacean under the name of *Zeuglodon harwoodi*,§ which has been made the

* T. S. Hall. "On the Systematic Position of the Species of Squalodon and Zeuglodon, described from Australia and New Zealand." Proc. R. Soc. Vict., vol. xxiii., N.S., pt. 2, 1911, pp. 257–265, pl. xxxvi.

† Both *Zeuglodon* and *Prosqualodon* have five molars, whilst there are seven in *Squalodon*

‡ Prod. Pal. Vict., Dec. 2, 1875, p. 7, pl. xi., fig. 1; Dec. 6, 1879, p. 20, pl. lv., fig. 3.

§ Proc. Linn. Soc. N.S. Wales, vol. v., 1881, p. 298, woodcuts A.B.

genotype of *Metasqualodon*, T. S. Hall. The specimens were found in yellow, calcareous clay on the Murray River near Wellington, South Australia. The molariform teeth have shorter roots than in *Parasqualodon*, this constituting the chief difference. In a remarkably well-preserved tooth of *Metasqualodon wilkinsoni*, from Mt. Gambier, in the National Museum collection, the enamel of the crown is of a rich brown colour, and the surface covered with minute prickly tubercles. This example is embedded in the white polyzoal limestone of the locality; the rock being in all probability equivalent to the yellow polyzoal limestone of Waurn Ponds and Jan Juc (Spring Creek). Although new genera have been instituted for these southern types of toothed whales, the conclusion as to their Miocene age is not affected thereby, as they are all members of the Squalodontidæ, belonging to a higher zone than the Eocene Zeuglodonts.

Fishes.—In two papers on the Tertiary fish remains of Australia, published by Dr. G. B. Pritchard and myself,* the general distribution and range in time of each genus and species was fully dealt with; but no inference was then drawn as to the ages of the beds yielding these remains. It is there stated (op. cit. vol. XVII., p. 292) that "These data do not furnish any very clear evidence of our Tertiary succession and relative age of the beds, since the fauna has a general Tertiary aspect, but the occurrence of the few Mesozoic forms gives an aspect of antiquity to the older portion of our Tertiary strata."

The genera discussed in those papers range from Jurassic to Recent, and none have a restricted occurrence in Tertiary times. This at first sight is disappointing to the palæontological inquirer for exact data of chronological value. However, looking more closely into the relative abundance of the genera of sharks and other characteristic fishes of the Tertiary, we find that all the abundant generic forms are especially typical of Miocene strata in the northern hemisphere. Amongst these may be mentioned *Galeocerdo, Odontaspis, Lamna, Oxyrhina, Carcharodon, Labrodon*, and *Diodon*. Evidence of greater antiquity than Miocene is afforded by the occasional occurrence of *Asteracanthus, Edaphodon*, and *Ischyodus*, which appear to be the survivors in Australian seas of types that are elsewhere found in earlier formations. This is a parallel case with the occurrence of *Trigonia* and other forms of archaic life found in the same area at the present day.

With regard to the group of the sharks, the species common to southern Australia and the northern hemisphere are *Carcharias acutus*†, *Sphyrna prisca, Odontaspis contortidens, O. cuspidata, Lamna crassidens, L. compressa, L. bronni, Oxyrhina hastalis, O.*

* Proc. R. Soc. Vict., vol. xvii., N.S., pt. 1, 1904, pp. 267–297, pls. xi., xii. *Ibid*, vol. xx., N.S., pt. 1, 1907, pp. 59–75, pls. v.–viii.

† This determination was formed on the apical portion of a serrated tooth which nwo appears to belong to a recently recorded genus common to the Patagonian and Victorian series, viz., *Carcharoides*.—See Victorian Naturalist, vol. xxx., 1913, pp. 142, 143.

desori, *O. retroflexa*, *O. eocaena*, *O. minuta*, *Carcharodon auriculatus*, and *C. megalodon*. Of these, 2 are northern Cretaceous forms, 11 are Eocene, 1 Oligocene,* 11 Miocene, and 6 Pliocene. A closer scrutiny of these species reveals the fact that, whereas the genus may be recorded from both Eocene and Miocene, yet in regard to abundance and ubiquity the evidence of the species, as before stated, is decidedly in favour of a Miocene age for the majority of the fish remains in the older portion of our Tertiaries.

With reference to the other fish remains in the Australasian Tertiary, it is interesting to note that the Chimaeroids have a more ancient history elsewhere, whilst around Australia they lived in large numbers in the Balcombian and Janjukian seas. Our Tertiary *Labrodon* is comparable with the typical Miocene species of South Carolina, the Vienna Basin, Italy, Sicily, and Brittany. The Australian gymnodont, *Diodon formosus*, is most nearly allied to *D. vetus* from the Miocene phosphate beds of South Carolina. The fossils of this genus are commonest as Miocene forms.

Mollusca.—Of the tetrabranchiate cephalopods, the *Aturia australis* of McCoy is a typical fossil in the Australasian Tertiaries. It had an extraordinarily long existence, being found in the Balcombian, the Janjukian, and the Kalimnan series; although it seems to be more common in the blue clays of the Mornington and Muddy Creek beds (Balcombian), where it often attains a large size. An exceptionally fine specimen from Muddy Creek in the National Museum collection measures 17.5 cm. (nearly 7 inches) in diameter, and about 6 cm. across in the umbilical region. This species is distinct from the Lower Eocene form, *A. ziczac*, to which it was formerly referred, in having more compressed sides. In this respect it is similar to *A. aturi*, Basterot, originally described from the Miocene of Dax, France, and also occurring at Turin and Malta in beds of the same age.

The true Nautili are also well represented in our faunas, but up to the present only one form has been described, viz., *N. geelongensis*, Foord,† which that author compares with *N. regalis*, J. Sow. The London clay species differs, as Foord remarks, in that "it is a more inflated shell, and its sutures much less flexuous." Examples of what appear to be the same form, in the National Museum collection, are from the Moorabool Valley, Victoria, and the cliffs of the Lower Murray River in South Australia (Janjukian).

The dibranchiate cephalopod, *Spirulirostra*, is one of the most remarkable genera of the Australian fauna. The only southern species, *S. curta*, made its appearance suddenly, but after a very short existence as quickly died out. It is strictly confined to

* The low number of records from the Oligocene is probably accounted for by the fact that certain beds of this system were previously regarded as Eocene. A revision of these records would possibly raise the number for the Oligocene.

† Cat. Foss. Cephal. Brit. Mus., pt. 2, 1891, pp. 332, 333, figs. 69*a–c*.

Miocene strata, and in Australia to a very limited horizon of a few feet in thickness in the Janjukian of Spring Creek, near Geelong. Until the Australian species, *S. curta*, Tate,* was described, this genus was represented by two species only, viz., *S. bellardii*, d'Orbigny, from the Miocene of Turin,† and *S. hoernesi*, von Koenen, from the Miocene of Dingden, Berssenbrück.‡

The remaining groups of the mollusc are not especially represented in the Australian Tertiary by genera restricted to any particular horizons elsewhere; but the Australian beds are rich in species of gasteropods, bivalves, and other invertebrates, related to these in the Tertiary faunas of the northern hemisphere, and to which reference will be made.

Echinoidea.—The Australian Tertiary fauna is rich in echinoids; and these furnish some interesting data in regard to closely related forms found in the northern hemisphere. When first authoritatively examined, our fossil sea-urchins were pronounced by Profs. P. M. Duncan and J. W. Gregory and others to have a decided Cretaceous aspect. This opinion has since been abandoned in consequence of the characters of the Australian species having been more clearly defined, showing them to be distinct from apparently related but older forms, as for example, *Holaster* (Cretaceous), and *Duncaniaster* (Miocene). Certain genera, as *Cassidulus*, *Plesiolampas*, and *Prenaster*, are Eocene elsewhere. *Echinoneus* is a genus ranging from Miocene to Recent in other areas. It is represented in our faunas by *E. dennanti*, T. S. Hall, and is found in the Batesford limestone associated with a Miocene foraminifer, *Lepidocyclina*. *Clypeaster*, although unrestricted, attains its maximum development in the Miocene faunas, as at Malta and the south of France. *Linthia* has a range from the Cretaceous to Recent, but is typically a Miocene form. It is represented by several species in our Janjukian series; *L. antiaustralis*, Tate, occurs at Curlewis in beds of that age, whilst *L. mooraboolensis*, Pritchard, is found in the Batesford limestone associated with Miocene foraminifera, as *Lepidocyclina marginata* and *L. tournoueri*. Another unrestricted genus but typically Miocene, is *Schizaster*, and one of its species, *S. sphenoides*, T. S. Hall, from the Barwonian of the Sherbrooke River, is almost identical with *S. scillae*, Desmoulins, a typical Miocene form in Europe.

Foraminifera.—The general facies of the foraminifera from Balcombian strata is that of the Lower Miocene fauna, with a tendency to the Oligocene: but no nummulites are present, as in typical Oligocene strata elsewhere. The Janjukian series, by its included species of *Lepidocyclina*, *Cycloclypeus* and *Amphistegina*,

* Proc. Roy. Soc. N.S. Wales, vol. xxvii., 1894, p. 170, pl. x., figs. 1, 1*a*, *b*.

† Ann. Sci. Nat. 1842, vol. xvii., p. 262, pl. xi. See also Michelotti, Foss. Terr. Miocènes, Ital., 1847, p. 346, pl. xv., fig. 12.

‡ Zeitschr. d. deutsch. geol. Gesellsch., vol. xvii., 1865, p. 428. Palæontographica, vol. xvi., pt. 3, 1867, p. 145, pl. xiv., figs. 6*a*–*h*.

is proved to be of Miocene age, as contrasted with the Eocene. This group of organisms, however, will be discussed in detail in a subsequent section.

Comparative Types.—The following comparative types of European Tertiary fossils have been selected as comprising some of the more striking forms which are isomorphous with the Australian species. It is by no means an exhaustive list, but will serve to illustrate the trend of evidence now brought forward, which proves that the greater part of the southern Australian series is of Miocene age; whilst below are beds of Oligocene to Lower Miocene, and above, of Pliocene, ages :—

B. = BALCOMBIAN ; BW. = BARWONIAN* ; J. = JANJUKIAN ; K. = KALIMNAN.

SOUTHERN AUSTRALIA.	EUROPE.
Bw. — *Ceratotrochus typus*, Seg. sp.	*C. typus*, Seg. sp. (Up. Miocene).
J. — *Deltocyathus aldingensis*, T. W.	*D. italicus*, Ed. and Haime (Upper Miocene).
B.J. — *Balanophyllia australiensis*, Dunc.	*B. praelonga*, Michelotti (Oligocene and Miocene).
J. — *Balanophyllia cylindrica*, Michelin	*B. cylindrica*, Mich. (Upper Miocene).
Bw. — *Balanophyllia selwyni*, Duncan	*B. italica*, Ed. and Haime (Miocene).
J. — *Psammechinus woodsi*, Laube sp.	*P. monolis*, Desmoulins sp. (Miocene).
B.J.K.—*Clypeaster gippslandicus*, McCoy	*C. grandiflorus*, Bronn (Miocene). NOTE.—McCoy refers to *C. subdepressus*, Gray, a W. Indian and W. African living species, as a near ally.
Bw. — *Linthia gigas*, McCoy sp. ..	*L. crucia*, Desor (Miocene).
B.J.K.—*Lovenia forbesi*, Woods and Duncan	*Lovenia hoffmanni*, Goldfuss sp. (Upper Oligocene). This species is usually referred, apparently erroneously, to the genus *Hemipatagus*, for, judging from specimens in the National Museum collection, it has the sub-anal fasciole well developed, and should therefore be transferred to the Prymnodesmia.

* Probably almost all the Barwonian localities will eventually be found to represent an argillaceous phase of the Janjukian.

Comparative Types—*continued.*

Southern Australia.	Europe.
A small depressed variety of *L. forbesi*, more frequent in the Janjukian and Kalimnan	*L. ocellata*, Defr. sp. (Miocene).
B.J.K.—*Cucullæa corioensis*, McCoy	*C. crassatina*, Lam. (Eocene-Miocene).
B. — *Limopsis morningtonensis*, Pritch.	*L. aurita*, Brocchi sp. (Oligocene-Recent). *L. scalaris*, Sow. sp. (Upper Eocene).
J. — *Arca* (*Barbatia*) *limatella*, Tate sp.	*Arca* (*B.*) *appendicula*, Sow. (Upper Eocene and Oligocene).
B.J.K.—*Arca* (*Barbatia*) *consutilis*, Tate sp.	*Arca* (*B.*) *biangula*, Lam. (Middle and Upper Eocene).
B.J.K.—*Glycimeris cainozoicus*, T.W. sp.	*G. pulvinatus*, Lam. The variety described by Brongniart from the Miocene.
B. — *Pteria crassicardia*, Tate sp.	*P. phalaenacea*, Lam. sp. (Miocene).
B.J. — *Pecten peroni*, Tate ..	*Pecten spinulosus*, Münster (Miocene).
B.J. — *Pecten hochstetteri*, Zittel ..	*Pecten burdigalensis*, Lam. (Miocene).
B.J. — *Pecten sturtianus*, Tate ..	*Pecten fistulosus*, Eichw. (= *malvinae*, Dubois) (Miocene).
B.J.K.—*Pecten yahliensis*, T.W. ..	*Pecten hoffmanni*, Goldfuss (Upper Oligocene).
B.J. — *Hinnites corioensis*, McCoy	*H. cortesii*, Defr. (Miocene).
J. — *Spondylus gaederopoides*, McCoy	*S. gaederopus*, Linné (Miocene).
B.J. — *Lima bassi*, T. Woods ..	*L. inflata*, Lam. (Miocene).
K. — *Cardita calva*, Tate ..	*C. orbicularis*, Bronn (= *chamaeformis*, Goldfuss) (Pliocene).
B(?).J.—*Carditamera compta*, Tate sp.	*C. crassicosta*, Lam. sp. (Miocene).
B.J. — *Chama lamellifera*, T. Woods	*C. squamosa*, Sol. (Upper Eocene).
B.J.K.—*Dentalium mantelli*, Zittel	*D. kickxi*, Münster (Oligocene).
B.J.K.—*Crepidula unguiformis*, Lam.	*C. unguiformis*, Lam. (Miocene-Recent).

COMPARATIVE TYPES—*continued.*

SOUTHERN AUSTRALIA.	EUROPE.
B.J. — *Natica hamiltonensis*, Tate B.J. — *Natica wintlei*, T. Woods	*N. helicina*, Brocchi sp. (Miocene).
B.J. — *Natica subnoae*, Tate ..	*N. noae*, d'Orb. (Eocene).
B.J.K.—*Turritella tristira*, Tate ..	*T. vindobonensis*, Partsch (Miocene). *T. triplicata*, Brocchi.
(?)B.J.—*Cypraea archeri*, T.W. ..	*C. sphaericulata*, Lam. (Miocene).
B.J. — *Trivia avellanoides*, McCoy	*T. affinis*, Wood (Miocene and Pliocene).
B.J. — *Lotorium tortirostre*, Tate	*L. argutum*, Nyst sp. (Middle Eocene-Miocene).
J. — *Murex tenuicornis*, Tate ..	*M. spinicosta*, Bronn (Miocene).
J. — *Murex legrandi*, T. Woods	*M. cristatus*, Brocchi (Miocene).
J. — *Typhis tripterus*, Tate ..	*T. fistulosus*, Sow. (Upper Eocene).
B.J. — *Typhis maccoyi*, T. Woods	*T. pungens*, Sol. sp. (Upper Eocene).
J. — *Fasciolaria johnstoni*, T.W. sp.	*F. bilineata*, Partsch sp. (Miocene).
B.J. — *Fasciolaria decipiens*, Tate	*F. tarbelliana*, Grat. (Miocene).
J. — *Volutilithes anticingulatus*, McCoy sp.	*V. cingulatus*, Nyst sp. (Oligocene).
B.J.K.—*Volutilithes antiscalaris*, McCoy sp.	*V. scalaris*, Sow. sp. (Upper Eocene).
B.J.K.—*Voluta strophodon*, McCoy	*V. spinosa*, Lam. (Eocene).
B. — *Olivella angustata*, Tate sp.	*O. clavula*, Lam. sp. (Miocene).
B. — *Ancilla subampliata*, Tate sp.	*A. dubia*, Deshayes sp. (Middle Eocene).
B.J. — *Ancilla hebera*, Hutton sp.	*A. glandiformis*, Lam. sp. (Miocene).
B. — *Ancilla lanceolata*, Tate sp.	*A. obsoleta*, Holl (Miocene).
B. — *Cancellaria exaltata*, Tate	*C. varicosa*, Defr. (Miocene).
K. — *Terebra angulosa*, Tate ..	*T. pertusa*, Bast. (Miocene).
B. — *Terebra platyspira*, Tate	*T. acuminata*, Bors. (Miocene). *T. melaniana*, Grat. (Miocene).
B. — *Pleurotoma murndaliana*, T.W.	*P. planum*, Giebel (Oligocene).
J. — *Apiotoma bassi*, Pritchard	*Pleurotoma ramosum*, Bast. (Miocene).
B.J.K.—*Bathytoma rhomboidalis*, T. Woods sp.	*B. cataphracta*, Brocchi sp. (Miocene).
B. — *Bathytoma decomposita*, Tate	*B. turbida*, Bronn sp. (Oligocene).
B.J.. — *Conus heterospira*, Tate B. — *Conus hamiltonensis*, Tate	*C. dujardini*, Desh. (Miocene).

COMPARATIVE TYPES—*continued.*

SOUTHERN AUSTRALIA.	EUROPE.
B.J.K.—*Conus cuspidatus*, Tate ..	*C. raristriatus*, Bell. and Mich. (Miocene).
B.J.K.—*Conus extenuatus*, Tate ..	*C. procerus*, Beyrich (Oligocene).
B. — *Vaginella eligmostoma*, Tate	*V. strangulata*, Grat. sp. (Miocene).
B.J.K.—*Aturia australis*, McCoy	*A. aturi*, Bast. (Miocene).
J. — *Spirulirostra curta*, Tate	*S. bellardi*, d'Orb. (Miocene). *S. hoernesi*, von Koenen (Miocene).
K. — *Scaldicetus macgeei*, Chapm.	*Scaldicetus carreti*, Du Bus (Lower Pliocene).

ON THE ABSENCE OF NUMMULITES IN THE TERTIARY OF SOUTHERN AUSTRALIA.

One of the chief factors which gave support to the conclusion that the Australian Tertiary beds belong in part to the Eocene or Nummulitic formation, was the erroneous record of the genus *Nummulites* from the lower beds at Muddy Creek, near Hamilton, Victoria. The nummulinoid foraminifer occurring so commonly throughout the main portion of our Tertiaries was, however, correctly assigned to the genus *Amphistegina* as early as 1865 by Tenison Woods*, for whom, as before stated, it was named by Prof. Rupert Jones. In describing the foraminifera from Muddy Creek, Woods writes as follows :—" The foraminifera are large and numerous ; indeed one species, *Amphistegina vulgaris*, d'Orb., is so common that the clay is principally composed of it. Its large lenticular form can be traced in almost every pinch of the *débris*, and what makes the individuals more conspicuous is that they have all received the ferruginous glaze which makes them look like little coins. From their numbers the strata may in truth be called an *Amphistegina*-bed, similar to that in Vienna, and possibly of the same age. Other Foraminifera occur, such as *Discorbina turbo*, *Pulvinulina pulchella*, *Planorbulina Haidingeri*, *Operculina complanata*, *Polymorphina lactea*, *Textularia sagittula*, *Miliolina semiluna*, and *M. trigonula*. Next in frequency to the *Amphistegina vulgaris* is the *Operculina complanata*, Bast., and though equal in size to the species found at Mount Gambier, it is much more common in the latter locality."

The earliest reference to the supposed occurrence of Nummulites in Australia appears to be that given by T. R. Jones in 1882,† when a descriptive note on specimen P.253 in the British Museum

* Quart. Journ. Geol. Soc., vol. xxi., 1865, p. 391.
† Cat. Foss. Foram. Brit. Mus., p. 67.

was published, reading as follows :—" Small Nummulites (near *N. variolaria*) and *Amphistegina?* In the Muddy Creek Tertiaries (Hamilton beds). South Australia.* T. Rupert Jones Coll."

The previous determination made by Prof. Jones in 1865 was the correct one ; and here he was evidently misled by the large size of the *Amphisteginae*, which on casual inspection might be readily assigned to the genus *Nummulites.* In his earlier determination, Rupert Jones had, without doubt, carefully examined these forms and satisfied himself as to their amphistegine nature.

Mr. Walter Howchin, in his valuable and comprehensive account of " The Foraminifera of the Older Tertiary of Australia (No. 1, Muddy Creek, Victoria)."† recorded *Amphistegina lessoni*, d'Orb., and *Nummulites variolaria*, Sow., from the upper and lower beds (Kalimnan and Balcombian), and mentioned in the description of *N. variolaria* the probability of the specimens from the upper bed being derived from the lower bed.

In the course of work on the Tertiary fossils of southern Australia since 1902, I have had occasion to microscopically examine samples of foraminiferal rocks from nearly all Victorian and many South Australian and other localities, and in every case have failed to find a true Nummulite, although many specimens were put aside as doubtful until sections were made from them. Latterly I wrote to my friend, Mr. Howchin, asking him for samples of the supposed Nummulites which he possessed. These he very kindly forwarded, and on my returning to him sliced examples of the shells, Mr. Howchin concurred with me as to their relationship with *Amphistegina.* At the same time he very generously favoured me with a note for publication which will explain how the confusion had arisen in the determination of these difficult forms.

Mr. Howchin writes :—" When working up the foraminifera of the Muddy Creek beds, I was writing to Brady on sundry matters, and enclosed a few of the large nummuline-like forms that are a prominent feature in the Muddy Creek material. Under date, 25th October, 1886, Brady replied as follows :—' Firstly with regard to your specimens. 1. Nummulites in quill. So far as can be made out, this does not materially differ from Num. variolaria—assuming these are fully-grown species and not the young of some larger species. I do not altogether trust my knowledge of the distinctions marking the allied varieties of this group—the subject has become a special one. However, von Hantken, of Pest, to whom I was writing, and enclosed one or two of the specimens, replies to the same effect.' I am afraid that I accepted too readily, and without due examination, the testimony of those two experienced authorities. It is only fair

* For South Australia read Victoria ; a frequent error, made even by some Australian naturalists.

† Trans. R. Soc. S. Austr., vol. xii. (1888), 1889, pp. 1–20, pl. i.

to say that neither Brady nor von Hantken made sections of the specimens, and the very large size of the Amphistegina was no doubt a misleading factor in the determination."

This common little nummulinoid species of the Australian Tertiaries is without doubt referable to *A. lessonii*, d'Orbigny; and the fresh or unworn examples resemble the variety found in the Vienna Basin, known as *A. hauerina*, d'Orb. Some of the larger specimens occurring in the Balcombian marls of Muddy Creek, T. Woods remarked upon as being "glazed with a ferruginous deposit." It appears, however, that abrasion and polishing has occurred in these examples, presumably by aeolian agency, and that they have been subsequently stained by the action of ferruginous water. The large sized tests of the *Amphisteginae* found in the Muddy Creek shell-marl can be matched by those from moderately shallow water of tropical or subtropical areas. At Funafuti the examples of this genus are similarly of large size, and frequently wind-worn or even polished; the latter character appearing on specimens of the tests from various depths in the deep boring. *Amphistegina lessonii* occurs at Funafuti at all depths down to 200 fathoms, and it was at its largest at about 36 fathoms.*

For the convenience of workers in other fossil groups who may not be conversant with the characters separating the genera *Amphistegina* and *Nummulites*, the following table is given.

Common and differential characters of—

	AMPHISTEGINA.	NUMMULITES.
Arrangement of chambers	Spiral, equitant	Spiral, equitant
Peripheral aspect ..	Asymmetrical. Chambers more spacious on the lower side	Symmetrical; therefore chambers equal on both sides
Umbilical axis ..	With unequal-sized cones of finely tubulate shell substance; apices of cones directed inward	Without umbilical cones
Septa	Curved backward, angulately; and either with simple septal wall, or with ill-developed interseptal canals	Roundly arched, not thrown so far backward. Intermediate skeleton and interseptal canal-system highly developed, resulting in double shell-walls.
Alar prolongations, or lateral development of chambers	Forming supplementary lobes on each side; those of the lower surface nearly severed, excepting for a narrow neck, and forming the astral lobes	Alar prolongations completely covering the earlier convolutions, and enclosing either a simple laminar space, or one subdivided into loculi
Aperture ..	A rotaline or crescentic slit on the lower face	A simple V-shaped slit at the junction of the penultimate whorl

* Linn. Soc. Journ. Zool., vol. xxviii., 1902, p. 414.

The Evidence of the Complex-structured Foraminifera in the Australian Tertiary System.

The shells of foraminifera exhibit great diversity of form, as well as a wide range of complexity in shell-structure. It is too often assumed that, because these ubiquitous marine organisms belong to the lowest phylum of the animal kingdom, they cannot therefore be of value in helping to decide the age of the beds in which they occur. This, however, is far from the truth, for, *primâ facie*, no one with a special knowledge of palæontology would dispute the proofs of the restriction of the Nummulites to a limited series of strata (Eocene and Oligocene), or ignore the zonal value of certain species of the genera *Lepidocyclina* and *Miogypsina*.

With regard to the genera of foraminifera which possess simply constructed tests, we may for the present dismiss these from consideration; for, although they have a certain distributional value in affording evidence of geographical facies dominated by local conditions of life, or controlled by sedimentation and hydrographical factors, there is a much more important section to be dealt with in the specialized forms constituting the Family Orbitoididae, and some other more or less related forms with highly specialized shell-structure.

Gypsina howchini, Chapman.—I have already shown* how closely the above species agrees with the Miocene ancestor of *Gypsina*, viz., *Miogypsina*. The chief difference lies in the absence of the vertical pillars as seen in cross-sections of *Miogypsina*; the only differentiation of the chamberlets in the median plane in the test of *G. howchini* being in their more spacious character.†

Amphistegina lessonii, d'Orbigny.—The inequilateral *Amphistegina* took the place of the equilateral *Nummulites* towards the close of the Oligocene, and was the predominant form in many foraminiferal deposits of Miocene age.‡

Cycloclypeus pustulosus, Chapman.—This species is, so far as known elsewhere, confined to the Miocene (Burdigalian), being found in the Island of Santo, New Hebrides, where it is associated with *Miogypsina burdigalensis*, Gümbel sp.; *M. complanata*, Schlumberger; *M. irregularis*, Michelotti sp.; *Amphistegina lessonii*, d'Orbigny; *Heterostegina depressa*, d'Orb.; *H. margaritata*, Schl.; *Lepidocyclina martini*, Schl.; *L. andrewsiana*, Jones and Chapman; and *L. insulae-natalis*, J. and C.

With regard to the Orbitoididae, this group has a range from the Cretaceous to the Miocene. In southern Australia these foraminifera, represented by the Oligocene-Miocene genus *Lepidocyclina*, play the very important part of forming a large proportion of certain limestones such as those of Batesford and Keilor; whilst they are also

* Proc. Roy. Soc. Vict., vol. xxii. (N.S.), pt. 2, 1910, p. 291.
† Proc. Roy. Soc. Vict., *tom. supra cit.*, pl. liii., fig. 5.
‡ See also *loc. supra cit.*, p. 308.

found, often in abundance, in the shallow-water deposits of some of the beds in the Tertiary series, such as those of Clifton Bank, Muddy Creek, and Waurn Ponds, near Geelong.

The earliest reference to the " Orbitoides " group in the southern Australian Tertiaries was made by the Rev. W. Howchin, F.G.S., who, in 1889, recorded *Orbitoides dispansus*, Sowerby, *O. mantelli*, Morton, and *O. stellata*, d'Archiac, from the lower beds at Clifton Bank, Muddy Creek, near Hamilton, Victoria.* An examination of the median layer of the Muddy Creek forms shows them to belong to the genus *Lepidocyclina*, a group that was imperfectly worked out when Mr. Howchin made his determinations. The lepidocycline relationship was suggested by Lemoine and Douvillé in their paper, " Sur le Genre Lepidocyclina, Gumbel,"† where they say, " à Muddy-Creek (Victoria), dans des couches que l'on considère comme d'âge éocène, M. Howchin a signalé *O. mantelli* et *O. stellata* d'Archiac ; cette dernière forme, d'après la description de M. Howchin, possède des loges hexagonal es et doit, par suite, être rangée dans le genre *Lepidocyclina*." This latter form I had already determined to my own satisfaction as belonging to that genus, and have since been able to refer it to *L. martini*, Schlumberger.

In 1891 Messrs. Hall and Pritchard recorded *Orbitoides mantelli* from the Filter Quarries and Upper Quarry at Batesford ; and also at Griffin's and near Madden's in the Moorabool Valley to the south-east of Batesford.‡ These specimens were identified by Mr. Howchin.

Genus *Lepidocyclina*, Gümbel.—Examples of the genus *Lepidocyclina* have been collected by me from four of the known localities in Victoria, and this collection has been further increased by specimens kindly given me by Dr. T. S. Hall. The localities furnishing this interesting group of foraminifera are, in the Balcombian series—Clifton Bank, Muddy Creek ; in the Janjukian series—Waurn Ponds, Batesford, Griffin's, near Madden's, along the Moorabool Valley, all near Geelong; and at Green Gully, Keilor. Quite recently I found a rich horizon for *Lepidocyclina* in Western Victoria, in the Janjukian limestone of the Grange Burn opposite Mr. Henty's farmstead.

It has already been pointed out in another place§ that, whilst the Burdigalian species, *Lepidocyclina tournoueri*, Lemoine and R. Douvillé, occurs in great abundance at Batesford, the Keilor ferruginous limestone contains, besides this form, another species, *L. verbeeki*, Newton and Holland, a species also met with at Clifton Bank (Balcombian). This fact seems to point to the Keilor horizon representing, although Janjukian, a bed slightly older than the Batesford limestone. To illustrate this more clearly we may note

* Trans. Roy. Soc. S. Austr., vol. xii., 1889, p. 17.

† Mem. Soc. Geol. France, vol. xii., fasc. ii., 1904, p. 32.

‡ Proc. Roy. Soc. Vict., vol. iv., pt. 1, 1891, pp. 10, 18, 19.

§ Chapman. " A Study of the Batesford Limestone." Proc. Roy. Soc. Vict., vol. xxii. (N.S.), pt. 2, 1910, p. 311.

that Douvillé has pointed out* that the *Lepidocyclinae* fall into two groups :—1st. The *L. dilatata* group, in which the vertical pillars are small and uniformly distributed over the shell, the test being typically large, as *L. chaperi*, *L. insulae-natalis*, *L. verbeeki*, and *L. elephantina*. 2nd. The *L. marginata* group, in which the pillars are more or less developed, but always more crowded towards the centre of the test, as *L. raulini*, *L. morgani*, *L. tournoueri*, *L. submarginata*, and *L. sumatrensis*.

The beds in Borneo, Italy and Panama (San Juan), characterized by the first group, that of *L. dilatata*, belong to the Aquitanian stage. The beds in Borneo, the south of France and Panama containing those of the second, *L. marginata* group, belong to the Burdigalian stage.†

The distribution of the Victorian forms of *Lepidocyclina* may best be shown by the following schedule :—

Victorian Localities.	Species.	Beds elsewhere.
Batesford	*L. tournoueri*, *L. marginata*, *L. martini*	Burdigalian of southern Europe
Keilor	*L. tournoueri*, *L. verbeeki* ..	Gaj Beds of India ; Upper Aquitanian, S. of Europe ; *L. insulae-natalis* Beds of Christmas Id.
Clifton Bank, Muddy Creek	*L. verbeeki*	Lower Aquitanian

F. Sacco has studied the faunas containing *Lepidocyclina* and *Miogypsina* with especial regard to the Tertiary basin of Piedmont, Italy ; and, although he differs from Douvillé and Prever with reference to the precise horizon of *L. marginata* in that area, yet that question does not affect our present conclusions. M. Sacco fixes the *L. marginata* beds as Aquitanian (but Miocene), whilst Douvillé and Prever place them in the Burdigalian (still Miocene). The succession remains the same, and the periods follow suit. It is thus merely a local adjustment of terms.‡

Prof. A. Silvestri, in his "Distribuzione Geografica e Geologica due Lepidocicline communi nel Terziario Italiano,"§ cites the occurrence of both *L. dilatata* and *L. tournoueri* in the Priabonian (Oligocene) in Italy and Greece, and their recurrence in Italy in the Miocene. In the former instance those species are associated with more archaic forms, as the striated nummulites and *Chapmania*, which, however, are absent from the Australian Tertiaries.

* Bull. Soc. Géol. France, sér. 4, vol. vii., 1907, p. 57.

† H. Douvillé. Bull. Soc. Géol. France, sér. 4, vol. v., 1905, p. 454 (Table), and p. 455.

‡ "Sur la Valeur Stratigraphique des Lepidocyclina et des Miogypsina." Bull. Soc. Géol. France, sér. 4, vol. v., 1906, p. 882.

§ Mem. Pont. Accad. Rom. dei Nuovi Lincei, vol. xxix., 1911, pp. 54, 55.

Stratigraphical Notes bearing on the Sequence of the Strata.

A.—The Port Phillip Area.

A boring at Sorrento close to the Port Phillip Heads has been lately put down by the Mines Department of Victoria to a depth of 1,693 feet.* The results obtained from this, perhaps the most valuable boring from a scientific stand-point which has yet been made in the Cainozoic strata in this State, sets at rest any doubt as to the succession of these beds. In the marls from 1,310–1,426 feet there are bands of *Vaginella eligmostoma*, a pteropod occurring in the fossil beds at and above sea-level at Mornington and Grice's Creek, about 18 and 22 miles to the north-east. This difference in level of the same strata between the two places within so short a distance is explained by the fact that the great Dandenong to Cape Schanck fault cuts between the two areas; Sorrento, being on the down-throw side, and Mornington and Grice's Creek on the upthrow side. These lowest beds of the bore are proved by their fossil contents to be of Balcombian age. In the same boring Janjukian marls are distinguished, at 990 and 758 feet, by containing typical Spring Creek fossils, as *Eutrochus fontinalis* and many others. From 741 to 585 feet *Limopsis beaumariensis* and other typical Kalimnan fossils denote this portion to belong to the upper series. Above this again, the Werrikooian or Upper Pliocene is represented probably between 585 and 489 feet; whilst above this comes a Pleistocene and Holocene succession of estuarine muds and sand-dune rock.

The Cainozoics at Sorrento were not bottomed at 1,693 feet. Judging from the exposure of Mesozoic shales with *Thinnfeldia* on the foreshore south of Grice's Creek, it is highly probable that the Cainozoics at Sorrento may rest on these same Mesozoic rocks.

Following the Port Phillip coast-line in a north-easterly direction beyond Dromana, we find, at the north end of Balcombe's Bay, typical Balcombian blue clays with septaria containing *Vaginella eligmostoma*.

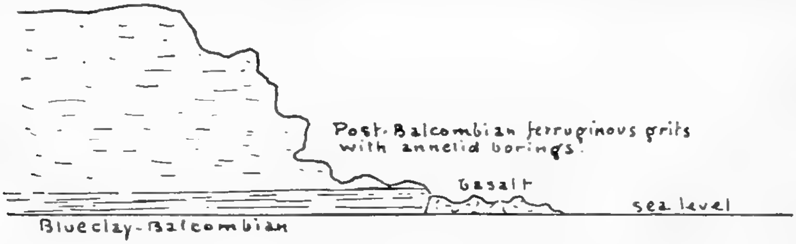


Fig. 1. SECTION AT POINT S. OF CEMENT WORKS, BALCOMBE'S BAY

This bed passes upwards into a grey marl with gypsum crystals. Going southward from the Cement Works past the low point with tumbled ferruginous grits (Fig. 1), a shallow indent in the coast

*See Ann. Report, Dept. Mines, Vict., for 1910 (1911), p. 152.

reveals a thick series, about 80 feet in extent, of a grey clay with gypsum similar to that north of the Cement Works, and which is evidently part of the same Balcombian series. The upper beds are seamed with fracture-lines due to local faulting, and through these minor rifts percolation has taken place through the surrounding strata containing pyritous matter, resulting in the replacement of the fossil shells by gypsum (Fig. 2). The occurrence of the marl-bed

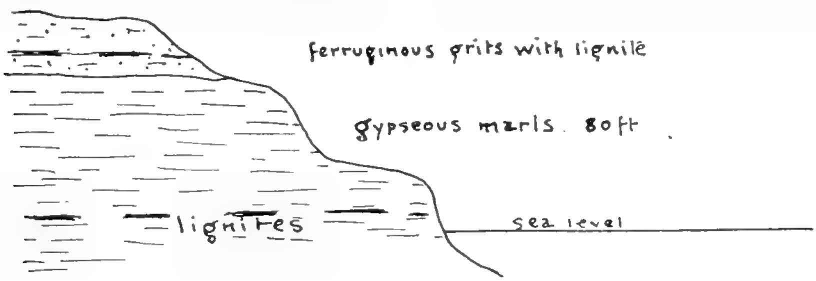


Fig 2. SECTION OF CLIFF NEAR MIDDLE OF BALCOMBE'S BAY.

at this place is compatible with the general character of an Oligocene fluvio-marine series, as typified on the other side of the Bay at Newport and Altona. The relationship between the older basalt and the Balcombian clays is obscure at this part, owing to the masking by landslips and extensive faulting; but near Landslip Point* the basalt is seen to overlie the granite and conglomerate, the latter being referred by Messrs. Hall and Pritchard† to the Balcombian or older, and to underlie the fossiliferous ironstone conglomerate with a typical Janjukian fauna. In a recent visit to Frankston, Mr. R. A. Keble and the writer obtained several restricted Janjukian fossils from the fossiliferous ironstone; thus linking this bed with similar ironstones at Flemington, Keilor, and South Yarra (see postea, p. 29).

Older basalt is met with at various points along the coast, as between Chechingurk Creek and Mornington, between Mornington and Grice's Creek, and between Wallace Bay and Frankston.‡ Leaf-beds also occur, associated " with quartz pebbly drift " . . . " in the base of a high cliff in Balcombe Bay,"§ and Mr. Kitson thinks the leaves resemble those of the Janjukian at Sentinel Rock, Cape Otway. Mr. J. S. Green has lately obtained some leaves from these beds, which show a marked resemblance to the genera described by H. Deane from Berwick, as *Apocynophyllum*, cf. *Tristanites*, *Lomatia*, and cf. *Fagus*. No leaf-beds were met with

* See Section C–D of A. E. Kitson's Report on the Coast Line between Frankston, Mornington, and Dromana. Geol. Surv. Vict., Monthly Prog. Rep. No. 12, 1900.

† Proc. Roy. Soc. Vict., vol. xiv. (N.S.), pt. 1, 1901, p. 43.

‡ See Kitson. Monthly Prog. Rep. Geol. Surv. Vict., No. 12, 1900, p. 8. Also Hall and Pritchard, Proc. Roy. Soc. Vict., vol. xiv., pt. 1, 1901, p. 35, *et seq.*

§ Kitson, *loc. supra cit.*, p. 11.

in the Sorrento Bore, so we may conclude that that area was outside the influence of fluviatile conditions of the continental seaboard of that time. As regards Kitson's reference to these leaf beds as resembling those of the Otway Coast, it is interesting to note that one specimen collected by Mr. J. S. Green is practically identical with branchlets of a *Casuarina* from Sentinel Rock.*

The exact relationship of the basalt to the Balcombian blue clays in the Mornington district appears to be obscured by slipping and faulting; but at Grice's Creek, Drs. Hall and Pritchard mention that these clays are "succeeded by basalt, which occupies the bed of the stream for nearly a chain, and over which the ascent is steep."† In the Table of Rock-Succession, however, the same authors‡ place the basalt below the blue and grey clays, and above the lignitic beds; and in another place§ mention the occurrence of grits and conglomerates (lignitic) as "passing under a small mass of basalt which shows well-developed tabular jointing." This basalt is not seen intercalated between the clays and lignites in the cliff section at Balcombe Bay. Hall and Pritchard offer two possible explanations of this problem. Either a narrow stream of lava flowed down an eroded valley, cutting through the upper sandy beds till the

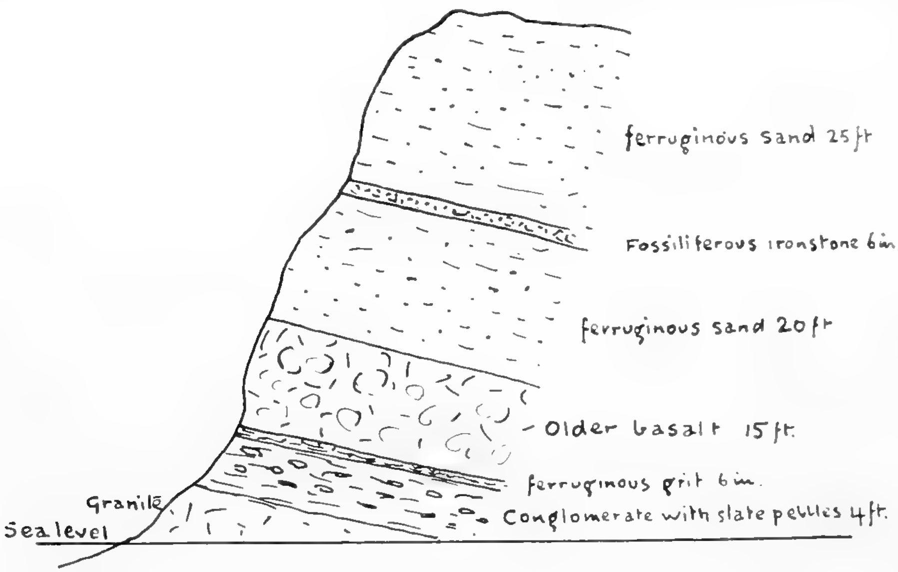


Fig. 3. SECTION AT LANDSLIP POINT, FRANKSTON (S SIDE).

lignitic series was reached, or a sheet of basalt was laid down upon the lignitic series, and subsequently partially removed by denudation before the deposition of the overlying sandy beds.

* Cf. Ettingshausen. *Callitris prisca*, from Vegetable Creek, N.S. Wales, in Mem. Geol Surv. N.S. Wales, Pal. No. 2, 1888, p. 95, pl. viii., figs. 3, 4.

† Proc. Roy. Soc. Vict., vol. xiv., pt. 1, 1901, p. 37.

‡ *Loc. cit.*, p. 41.

§ *Loc. cit.*, p. 40.

The most clearly defined section of this much disturbed and masked coast-line is that given by Mr. Kitson,* from Landslip Point to Narringalling Creek (Kackeroboite Creek of Kitson). At Landslip Point (Fig. 3, a generalized section) the succession is shown to be :—

6. Ferruginous sands.
5. Ferruginous grits with fossils.
4. Basalt.
3. Hard ferruginous grit.
2. Conglomerate (with slate pebbles).
1. Granite.

The discovery of fossils in the ferruginous bed No. 5 mentioned above was made some years ago by Mr. Kitson, F.G.S., who, in his paper, "Report on the Coast-line and adjacent Country between Frankston, Mornington, and Dromana,"† stated that "The [fossil] casts obtained have been examined by Mr. Dennant, who unhesitatingly pronounces them to be of Eocene age."

A fairly extensive series of fossils from this ferruginous band was obtained and recorded by Hall and Pritchard in 1901.‡ Although their list comprises 36 species, none of them seems to be restricted to Balcombian strata. In point of fact, an examination of that list shows that the affinities of the species enumerated lie as closely with a Janjukian as a Balcombian facies, with which latter series Hall and Pritchard state they "show a close agreement."

During the last year I have visited this locality in company with Mr. R. A. Keble, and we have made a fairly comprehensive collection of the ironstone fossils. The impressions, as a rule, are very clean, and in some cases even the shell is preserved. Several of the forms found are noteworthy as being restricted Janjukian species, and as such give strong evidence as to the precise age of this band of ironstone. The fossils amongst the collection made by us which are new to the already published list referred to are :—

Corals—
Placotrochus sp.
Sphenotrochus emarciatus, Duncan.

Vermes—
Ditrupa cornea, L. sp. var. *wormbetiensis*, McCoy.

Brachiopoda—
Terebratula (?) *aldingae*, Tate.
Magellania garibaldiana, Dav. sp.

* Monthly Prog. Rep., Geol. Surv. Vict., No. 12, 1900; section facing p. 4, C–D.
† *Loc. supra. cit.*, p. 10.
‡ Proc. Roy. Soc. Vict., vol. xiv. (N.S.), pt. 1, 1901, pp. 44 and 46–53.

Pelecypoda—
Pecten foulcheri, T. Woods.
Pecten cf. *flindersi*, Tate.
Pecten praecursor, Chapman.
Limatula sp.
Cuspidaria sp.

Scaphopoda—
Dentalium mantelli, Zittel.

Gasteropoda—
Latirus (?)*actinostephes*, Tate sp.
Oliva sp.
Columbarium acanthostephes, Tate sp.

Of the above forms the following are worthy of especial note :— *Sphenotrochus emarciatus* has a remarkably extensive range, being found alike in Balcombian, Janjukian, and Kalimnan strata. *Ditrupa cornea*, var. *wormbetiensis* is especially typical of Janjukian beds; it is a characteristic and abundant fossil in the polyzoal rock of the Mallee Bores and of the upper limestones of the Spring Creek series, and so far as I am aware, only a single specimen has occurred in the Balcombian, at the top of the series, at Muddy Creek. The brachiopod provisionally referred to *Terebratula* (?) *aldingae* is a cast, which, by its compressed shape and outline, is nearest that species, only occurring in Janjukian strata; the squarish anterior is matched very closely by specimens in the Dennant collection; and the only other species with which it could be compared is *T. vitreoides*, T. Woods, also a Janjukian form. *Pecten praecursor* is a specially characteristic Janjukian form. *P. flindersi* is also of similar age, being found at Aldinga.

From Mornington towards Frankston, and over the hinterland, thick deposits of fine and coarse sands, often ferruginous, are largely

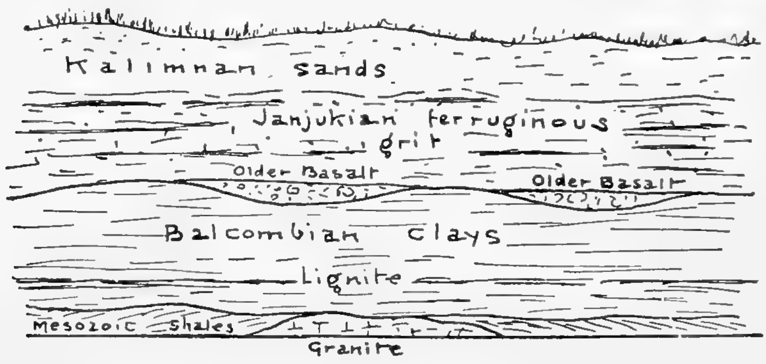


Fig. 4. GENERALIZED SECTION OF STRATA BETWEEN FRANKSTON AND MORNINGTON.

overspread. The age of this series is doubtful, being unfossiliferous, but the lower portion is undoubtedly of Janjukian age, as shown above, and comparable with those beds known elsewhere, as in Western Victoria, as the "older gold-drifts." The general sequence of the strata in Port Phillip between Frankston and Mornington appears to be easily explained by the accompanying diagram (Fig. 4).

Still on the downthrow side of the great fault of Port Phillip and on the opposite (west) side of that great inlet, are situated Altona Bay and Newport, at which places deep shafts have been put down, extending into Balcombian strata, and affording a continuous series from surface level. These bores reveal several seams of lignite or brown coal, one of which is 74 feet in thickness. Unfortunately, no detailed and scientific account of the strata passed through in these bores is available, but the data given by the engineers show that the beds are very variable in character, and a general idea may be gained as to their nature. The bed-rock, probably an Ordovician slate (Fig. 5), was struck in Bore No. 1 at Altona Bay (Sect. VII., parish of Truganina) at 656 ft. 3 in., and penetrated a thickness of 238 ft. 4 in.* Above this bed-rock there is a variable series of gravelly sands and lignitiferous clays, with occasional seams containing broken shells, which amounts to a thickness of 235 ft. 6 in. Above this, again, occurs a brown coal bed 70 ft. 5 in. thick. The succeeding calcareous clays and limestones, as well as those just mentioned, are of Balcombian age, and have yielded an extensive fauna, chiefly of mollusca, which have been listed by Messrs. Thiele and Grant,† and more recently by Messrs. Dennant and Kitson.‡ The latter list

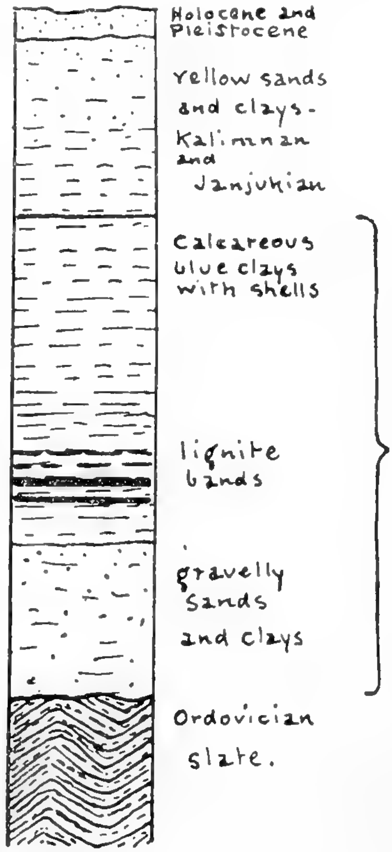


Fig. 5.
DIAGRAM SECTION OF BORES NEAR ALTONA BAY, PORT PHILLIP.

* Ann. Rep. Dept. Mines, Vict., for 1902 (1903), p. 69.
† Proc. Roy. Soc. Vict., vol. xiv., pt. 1, 1901, p. 145.
‡ Rec. Geol. Surv. Vict., vol. 1, pt. 2, 1903.

also include the occurrences from the Newport Bores. Above the calcareous clays there are alternating bands of ferruginous clays and sands, which afford strong evidence of belonging to the Janjukian series of the Corio Bay marly facies ; since from these beds Messrs. J. S. Green and W. J. Parr have obtained many fine examples of the large Magellanias characteristic of the beds at Corio Bay, which crop out to the south-west at the locality named. As collecting on the spoil-heaps from these borings has been done somewhat indiscriminately, it is possible that the published lists of fossils from these localities may include some forms which are not actually from the Balcombian series.

In the report of Messrs. Thiele and Grant it is stated that this "cream-coloured sandy clay, with nodules of yellow limestone . . . . is very full of foraminifera (largely of the genus *Operculina*), and contains a fair number of brachiopods, but few gastropods or lamellibranchs." The brachiopods were not included in their list.* They also noted the uppermost bed as consisting of "a coarse ferruginous grit," in which they "failed to find any traces of fossils." In all probability this bed is the equivalent of the marine Kalimnan series of Brighton and Beaumaris and the subaerial sands of the Melbourne district.

Crossing again to the eastern side of Port Phillip, and on the Melbourne side of Frankston, the cliffs in the neighbourhood of Beaumaris are mainly composed of the Kalimnan beds, consisting of ferruginous clays and sands, which contain typical Kalimnan fossils, as *Limopsis beaumariensis* and *Trigonia margaritacea*, var. *acuticostata*. On the foreshore may be commonly found teeth of sharks, many of which are common also to the nodule bed seen at the Grange Burn and on Muddy Creek ; and which by their position there are seen to form the basal bed at Macdonald's and Forsyth's. Although the beds on the foreshore at Beaumaris are covered by a thick deposit of shingle, it has been proved that, by sinking a shaft for a few feet, the basal nodule bed is exposed *in situ*. By a comparison with the beds of the Hamilton district it is evident that the rolled fossils of the nodule bed constitute a remanié fauna, whilst the surrounding clay contains indigenous Kalimnan fossils.

B.—Flinders.

An interesting little patch of polyzoal limestone is found on the coast at Flinders, resting on the older basalt. The limestone has evidently been deposited in an eroded hollow on the surface of the lava,† and it has a maximum thickness of about 20 feet. The fossils contained in this friable limestone show unmistakeable affinities with the Cainozoics of the Moorabool Valley and Curlewis,

* Proc. Roy. Soc. Vict., vol. xiv., pt. 1, 1901, p. 145.

† See also Kitson. Rec. Geol. Surv. Vict., vol. i., pt. 1, 1902, p. 49.

both of which must be referred to the Janjukian. For instance, the numerous *Amphisteginae** present in the Flinders rock make it comparable to the Filter Quarry stone at Batesford; whilst the occurrence of an abundance of calsisponges shows its time-relationship with Curlewis and the Moorabool section at "Griffin's." At Curlewis I have lately obtained numerous examples of *Tretocalia pezica*, which were only recorded previously from Flinders. Other Janjukian (restricted or post-Balcombian) fossils found at Flinders are—*Arachnoides* (*Monostychia*) *australis*, *Cidaris* (*Leiocidaris*) *australiae*, *Pecten gambierensis*, and *P. subbifrons*.

Besides affording positive evidence for a Janjukian age, it is interesting to note that this limestone rests on the older basalt (Fig. 6), as does the fossiliferous ironstone of the Flemington railway cutting and many other Miocene (Janjukian) occurrences. Whilst far from assuming that the older basalt so-called represents an effusion of one definite period, it is always so closely associated with those beds, which are proving themselves to be merely different lithological phases of the great Janjukian and Mount Gambier series, that we are forced to the conclusion that during this period of maximum sedimentary deposition on the southern Australian coast, an intermittent series of flows were poured out of a generally dense, magmatic basalt, which in some measure represents the relieving outbursts consequent upon the extraordinary strain that was exerted at that period on the continental shelf.

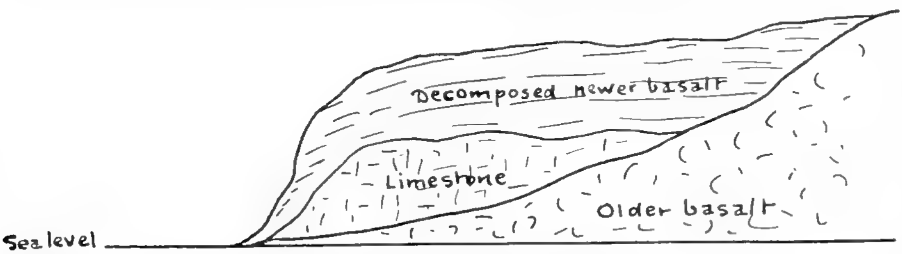


Fig. 6. DIAGRAM SECTION OF JANJUKIAN LIMESTONE AND ASSOCIATED STRATA AT FLINDERS.

The Flinders limestone, by the abundance of its foraminifera, polyzoa, and calcisponges, indicates a fairly deep water and tranquil condition, with little or no solution of the ferruginous constituents of the volcanic sea-bed. At Flemington we have the opposite conditions, of a shore-line with littoral shells, as *Haliotis* and *Patella*, and much alteration of the original shell-conglomerate, resulting, by its absorption of iron probably both from above and below, in a highly ferruginous rock.

An extremely interesting discovery was lately made by Mr. R. A. Keble, of the Mines Department, of a small patch of polyzoal rock resting on older basalt at the back of Cape Schanck. The position of this rock is about 1 mile north-west of the junction of the

* Referred in error to *Nummulites variolaria* by Mr. Kitson.

Lighthouse and Sorrento roads. Besides generally resembling the Flinders limestone, to which horizon it clearly belongs, it proves on examination to contain tests of *Lepidocyclina*, the first recorded east of Port Phillip, the previously known localities being Batesford, Keilor, and Muddy Creek, Hamilton. This occurrence strengthens the view that the beds in the Mornington district also, that overlie the older basalt, belong to the Janjukian and not to the Balcombian, as Hall and Pritchard supposed,* judging from their examination of the fossils at Landslip Point, Frankston. This assemblage, by the way, does not contain any restricted Balcombian species, for even *Vaginella* is found very sparingly as high in the geological series as the younger beds of Muddy Creek (Kalimnan), according to the list of Dennant and Kitson.† Moreover, the Frankston locality contains some restricted Janjukian species, as shown earlier in this paper. The reason one might advance for the absence of *Lepidocyclina* from the Flinders limestone is its deep-water aspect, the foraminifera belonging to that genus appearing to favour shallow to moderately deep-water conditions, but this evidence is not conclusive, since the Filter Quarry deposit is both polyzoal and Lepidocycline in constitution.

C.—The Bairnsdale District.

The Cainozoic rocks of this area were first noticed in detail by Dr. A. W. Howitt, in his paper "Notes on the Geology of Part of the Mitchell River Division of the Gippsland Mining District."‡ In this paper the beds of the Tertiary system are divided into—1st. Middle Tertiaries (Miocene), with a coarse limestone containing marine fossils; marly beds with similar remains. 2nd. Upper Tertiary (Pliocene) ferruginous pebble conglomerate; clayey and sandy beds, stained with iron oxide, and containing marine fossils in concretionary layers of arenaceous ironstone; imperfectly flaggy sandstones.

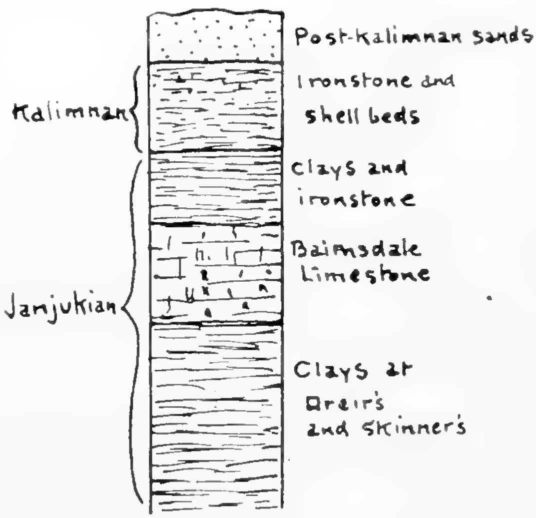


Fig. 7. DIAGRAM SECTION IN THE MITCHELL RIVER DISTRICT.

* Proc. Roy. Soc. Vict., vol. xiv. (N.S.), pt. 1, 1901, p. 36.
† Rec. Geol. Surv. Vict., vol. i., pt. 1, 1902, p. 137.
‡ Prog. Rep. Geol. Surv. Vict., No. 2, 1874, p. 59. Also *ibid.*, No. 4, 1877, p. 122.

The fossil determinations and age of the rocks were reported upon by McCoy*; and their joint conclusions are very nearly the same as advanced in the present work. A similar sequence is given by Mr. Dennant,† who, however, relegates the two beds to the Eocene and Miocene respectively (Fig. 7).

As shown in the previous part of the present paper, the subdivisions of the Cainozoics are regarded by the latter author as of greater age than is justified by the fossil evidence. The Bairnsdale and Mitchell River limestones and calcareous fossil beds contain a facies resembling the polyzoal series of Mount Gambier and the Corio Bay marl beds. The difference in the two series, of the Bairnsdale and Mount Gambier deposits, lies in the fact that in the former the marine conditions during the Miocene were of a shallow-water nature, more akin to that of the Corio Bay series, as shown by the community of fossils, such as *Hinnites corioensis*. At Sale, in similar beds (Dutson's Quarry) the rock is a true *Amphistegina* limestone, like that of the middle series at Grange Burn, and the Flinders limestone. At Bairnsdale a large echinoid, the *Clypeaster gippslandicum*, is fairly common; it is a form which also occurs in the lower (Balcombian) stage at Muddy Creek, but of smaller dimensions, and in the higher (Kalimnan) stage at Beaumaris, where it is also of less size than at Bairnsdale. This is one of many good examples in Victoria of the law of maximum development in the Miocene. Another fossil we may note from Bairnsdale, but which is restricted to beds of Janjukian age, is *Spondylus gaederopoides*, being found in common at Maude, Torquay, the Aire coastal beds, in Victoria, and Table Cape, Tasmania. Of these localities, there can be no doubt regarding their stratigraphic position.

The upper series in the Mitchell River district, as shown by Mr. Dennant,‡ is referable to the beds now classed as Kalimnan (Miocene of Dennant and others, Lower Pliocene of McCoy and the present writer). Many of the fossils found therein are also common to the upper beds at Muddy Creek. A part of the fauna, however, (that of Jemmy's Point), indicates deep-water conditions as compared with that of the last-named locality; and the fauna, as a whole, is perhaps more comparable with the deposits which were laid down in the Kalimnan sea of the Murray Gulf, now found underlying the Mallee district of Victoria and South Australia, and also of Beaumaris. As a case in point, *Turritella pagodula* may be mentioned, which is a common fossil in the Mallee bores, and also found in the Beaumaris cliffs. Evidence as to deep-water conditions in the Kalimnan beds at Jemmy's Point is seen in the aspect of the foraminifera, several

* Proc. Roy. Soc. Vict., vol. iii. (N.S.), 1891, pp. 53-69.

† Op. supra cit. See also Dennant and Clarke, Proc. Roy. Soc. Vict., vol. xvi., pt. 1, 1903, p. 46.

‡ Proc. Roy. Soc. Vict., vol. xvi., pt. 1, 1903, p. 21.

species of which indicate deeper bathymetrical surroundings than the upper beds at Muddy Creek, and clearer water than prevailed in the Beaumaris area.

The view that the Bairnsdale limestone indicates a somewhat low horizon in the extensive and extremely variable Janjukian series is supported by the fact that the two Tertiary groups as revealed in geological sections along the course of the Mitchell River in the Bairnsdale district are unconformable.* Here, as indicated by Dr. Howitt, the Upper Cainozoics rest on an eroded surface of the Bairnsdale limestone. This is also clearly set forth by Messrs. Dennant and Clarke,† who state that at Rose Hill, "Immediately underlying the Miocene [Lower Pliocene] marls there is the typical Eocene [Miocene] limestone of the area, which was here evidently an eroded surface when the later beds were deposited upon it." The same authors also record the Kalimnan series at Belle Vue, represented by a fossiliferous ironstone bed.

D.—The Geelong Area.—Corio Bay.

The strata exposed in the low sea-cliff of Corio Bay consist of yellow and occasionally greyish shelly and earthy marls, in which the large Magellanias, large Pectens, and solitary corals are conspicuous. The beds are evidently an argillaceous phase of the Janjukian stage. An extensive comparison of the fauna with that of some Balcombian marls would at first sight lead one to suppose the ages of the two beds to be identical, so many species of mollusca and other fossils being common to both beds. If, however, we test the faunas from these beds and select the restricted species, we find the following list of nine species of fossils present in the Corio Bay series,‡ which are elsewhere entirely confined to Janjukian localities. They are :—

Bullinella paucilineata, Tate and Cossman.
Ancilla ligata, Tate sp.
Scala echinophora, Tate sp.
Turbonilla liraecostata, T. Woods.
Limopsis insolita, Sow. sp.
Pecten praecursor, Chapman.
P. peroni, Tate.
Nucula semistriata, Tate.
Linthia (?) *gigas*, McCoy sp. (probably referable to *L. moorabolensis*, Pritchard).

Besides these Janjukian restricted forms, another species, *Mysella sericea*, Tate, is recorded which elsewhere only occurs in the overlying Kalimnan series at Beaumaris, the upper beds of Muddy Creek, and in

* Prog. Rep., vol. ii., 1874, p. 62, section No. 4.
† Proc. Roy. Soc. Vict., vol. xvi., pt. 1, 1903, p. 21. The terms in square brackets are inserted by the present writer.
‡ See list of Cainozoic Fossils, by Dennant and Kitson. Rec. Geol. Surv. Vict., vol. i., pt. 2, 1903.

the upper beds of the Murray Cliffs. On the other hand, only one species in the Corio Bay series, *Capulus danieli*, Crosse, is restricted to Balcombian elsewhere.

This particular phase of the earthy limestone of Corio Bay is also found to the east of Geelong, in the outer harbor at Curlewis, and its faunistic and lithological similarity was pointed out by Drs. Hall and Pritchard.*

Curlewis.—The interpretation of the succession of the strata exposed in the cliffs from Clifton Springs to Curlewis is rendered somewhat difficult by the numerous faults which have occurred, and further made more obscure by landslips. By carefully piecing the evidence together the succession appears to be as follows. The lowest bed is a stratum of volcanic ash, almost black,† followed by a 2-ft. bed of blue clay with fossils which passes into a greenish sandy clay with similar forms. The argillaceous fossil beds of this locality have yielded several restricted Janjukian fossils‡ including *Bela woodsi*, Tate, *Cypraea ovulatella*, Tate, and *Pecten praecursor*, Chapman. Above this bed comes a hard polyzoal limestone, altogether about 6 feet thick. This limestone band crops out again a little way beyond the shore at low water, near the point of intersection of the parish boundary with the coast-line, as a curved or slightly undulating reef (Fig. 8).

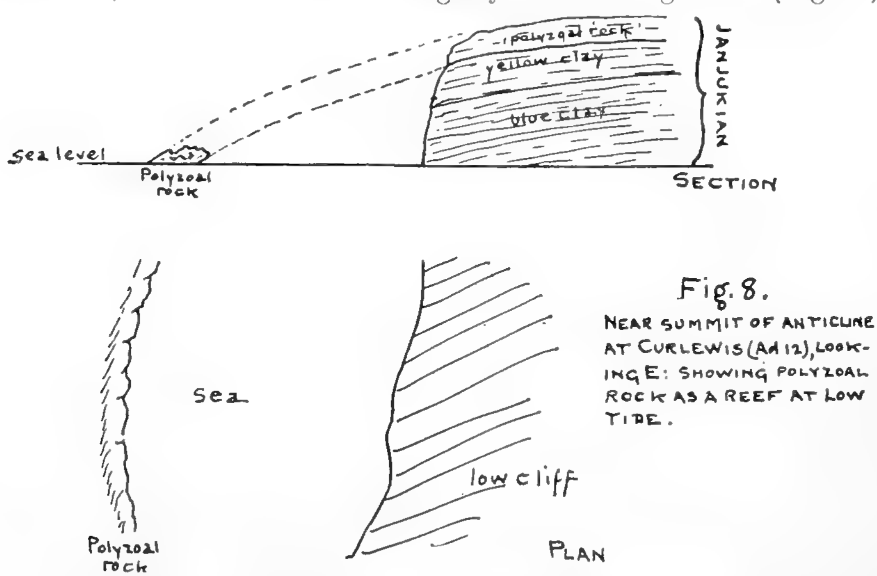


Fig. 8.
NEAR SUMMIT OF ANTICLINE AT CURLEWIS (Ad 12), LOOKING E: SHOWING POLYZOAL ROCK AS A REEF AT LOW TIDE.

This limestone, as pointed out by Messrs. Hall and Pritchard,§ is similar to that of the Moorabool Valley. To the westward, at the Geological Survey locality (Ad 12), I found in this

* Proc. Roy. Soc. Vict., vol. vi. (N.S.), 1894, p. 6.
† *Idem, ibid.*, p. 4.
‡ For some of these fossils the Museum is indebted to Mr. J. Hay Young.
§ Loc. cit., p. 3.

polyzoal rock some calcisponges typical of the Janjukian, as well as a fine specimen of *Thamnastraea sera*, a Table Cape coral. At the locality, Ad 14, the reef of limestone before mentioned is seen to have been once continuous with the limestone band in the middle of the cliff, and thus forms part of an anticline with a steep pitch of 28° to the N. 21° W. These beds dip to the west at about 15°, and are succeeded by yellow and brown clays, in the former of which

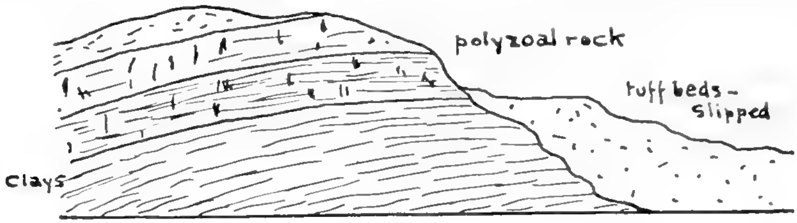
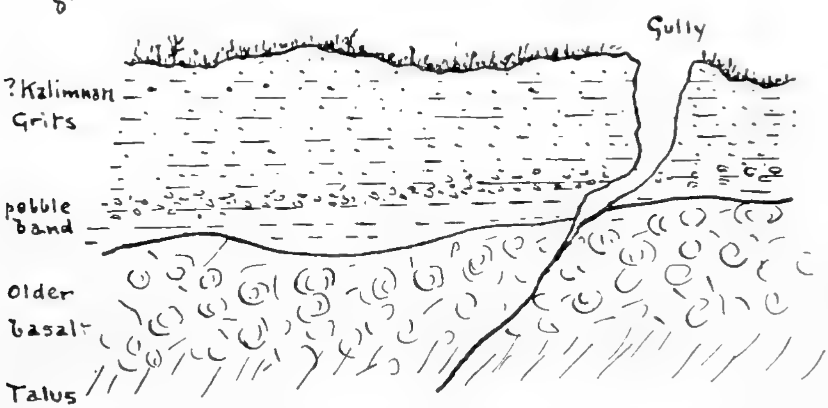


Fig. 9. CLIFF-SECTION 150 YARDS W. OF Ad 12, CURLEWIS: SHOWING OVERLYING TUFF BED BROUGHT DOWN BY LAND-SLIP.

there is a band of earthy limestone nodules. The Janjukian beds are followed by extensive ash and tuff beds of a brown and yellow colour, which are here seen to have slipped *en bloc* from above down to shore level (Fig. 9). To see the relation of the volcanic tuffs and the basalt to the beds immediately succeeding, we have to go eastward to within 1 mile of Clifton Springs Hotel. There we

Fig. 10.



(?) KALIMNAN GRITS RESTING ON ERODED SURFACE OF BASALT.- 300 YARDS W. OF CLIFFE HOUSE, CLIFTON SPRINGS.

have the bedded tuffs, agglomerate and basalt underlying the grit beds (Fig. 10). At the base of the grit beds there is a coarse pebbly deposit of quartz and metamorphosed rocks, but the bulk of the deposit is a coarse white and iron-stained sand, identical in appearance with the Kalimnan sands of the Melbourne district, and like them, in all probability of Kalimnan age. The view here maintained, that the main volcanic series occurs above the yellow limestone and under the Kalimnan grits, is the same as brought forward by Mr. Daintree as early as 1861. A reproduction of Daintree's sketch-section of the cliff at Curlewis (Ad 12) is given in my paper on some Tertiary fossils.* On a recent visit to this place (shown on Quarter-sheet 23 sw) the section of the cliff showed a bed of tenacious blue clay resting on an ash bed, and above this a polyzoal limestone about 5 feet thick. This is surmounted by about 13 feet of basalt, and on this a thin layer of hill wash.

The present occurrence of older basalt as high as the top of the Janjukian is unique in the experience of the writer, for it generally occurs interbedded with or underlying the sedimentaries of that epoch. It further strengthens the view that the Janjukian episode was not only intermittently subject to volcanic disturbance, as already found in the Anglesey district by the occurrence of tuffs interbedded with the sedimentaries,† but that the effusions did not cease until about Kalimnan times.

Fyansford.—The Orphanage Hill section consists of grey clays passing into yellow clays. These beds probably represent an argillaceous phase of the Janjukian. The molluscan fauna has not been completely worked over, but by comparing the list of Hall and Pritchard, it will be seen that five species recorded by them,‡ viz., *Terebratula vitreoides*, T. Woods, *Natica gibbosa*, Hutton, *Pleurotoma haastii*, Hutton, *Limopsis insolita*, Sow. sp., and *Cardita gracilicostata*, T. Woods, are restricted Janjukian fossils. The remainder are persistent types and widely distributed forms. It is probable that by diagnosing the new forms to be found in this locality the proportion of restricted species will be raised. The palæontological evidence, although leaving much to be desired, points to affinity with the Janjukian rather than to the Balcombian, since not one of the species enumerated by Hall and Pritchard is confined to Balcombian.

In my paper on "A Revision of the Species of *Limopsis* in the Tertiary Beds of Southern Australia,"§ in following the general usage I there placed the Orphanage Hill beds as well as the Corio Bay Beds in the Balcombian series. The above evidence, however, is sufficient proof to my mind of their affinities with the younger, Janjukian, series.

Moorabool Valley and Batesford.—There is no doubt as to the position of these beds in the Victorian Cainozoic series, for their

* Proc. Roy. Soc. Vict., vol. xx. (N.S.), pt. 2, 1908, p. 215.
† Hall, T. S., Proc. Roy. Soc. Vict., vol. xxxii. (N.S.), pt. 1, 1911, p. 49.
‡ *Ibid.*, vol. iv. (N.S.), pt. 1, 1892, pp. 19 and 24. Table II.
§ *Ibid.*, vol. xxiii. (N.S.), pt. 2, 1911, p. 419.

faunal relationships are decidedly Janjukian. From Batesford, extending up the Moorabool Valley, the polyzoal rock is greatly in evidence. This deposit at the base is largely composed of *Lepidocyclina* shells, with abundant granite detritus from the adjoining coast. The overlying white polyzoal limestone with *Amphistegina* replacing to a large extent the *Lepidocyclina* indicates fairly deep water conditions, and a general freedom from terrigenous material. During this phase, therefore, the Janjukian sea probably represented a fjord-like aspect in which an arm of the sea extended up a drowned valley. In the neighbourhood of Steiglitz there are certain fault-lines which run in a parallel direction with the general trend of the axis of outcrop of the polyzoal rock, and these may have been developed as a small rift-valley cutting into the Ordovician ranges of the country beyond Maude and Steiglitz. That the conditions were not stable for a long

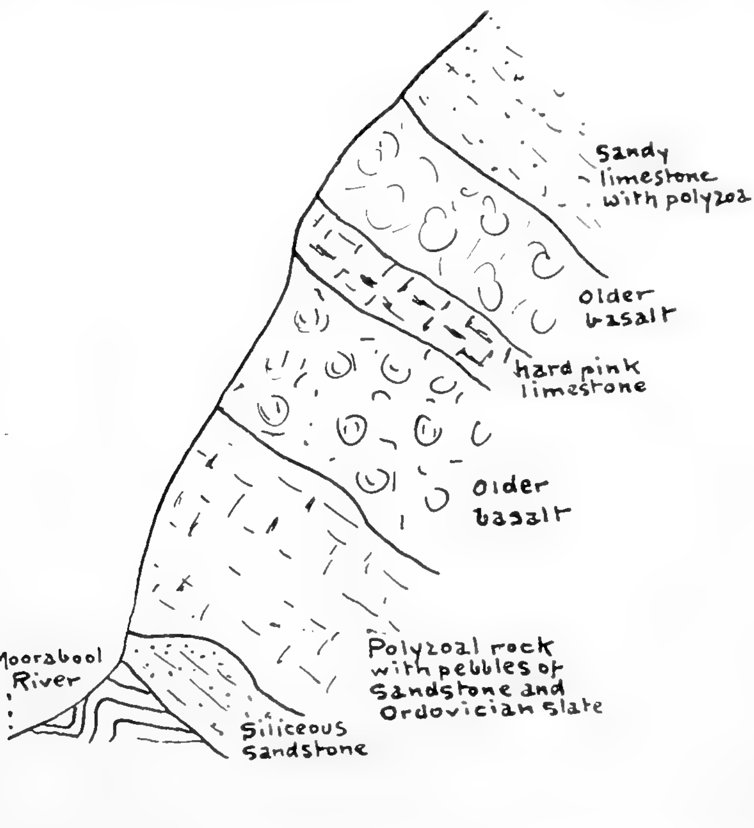


Fig. 11. SECTION IN THE MOORABOOL VALLEY NEAR MAUDE.

period is seen in the presence of argillaceous beds between the polyzoal rock as at Torquay, and above the same at Waurn Ponds and Batesford.

The relationship of the Curlewis polyzoal rock to that of the Moorabool Valley has already been pointed out. The latter locality has yielded a species of Cerithium (*C. pritchardi*, Harris), which is a typical Table Cape fossil. This species also occurs at Mitchell River, Bairnsdale, being additional evidence for the correlation of the latter series with the Janjukian. Further proof of the relationship of the Maude beds to other Janjukian occurrences is furnished by the discovery in this Museum collection of *Lucina planatella*, Tate, and *Modiola pueblensis*, Pritchard, in samples of the hard limestone beds collected by the Geological Survey of Victoria (WTM2). The former shell is a Table Cape fossil and the latter occurs at Torquay.

From an examination of the sections along the river-valley at Maude below Mr. MacDonald's house, I was able to gain a clear idea of the succession of these beds (Fig. 11), which is as follows :—

At the base is a bed of Ordovician slate, covered by a siliceous or quartzose grit, containing impressions of plant stems. This is followed by polyzoal rock containing, in places, pebbles of Ordovician slate and siliceous sandstone derived from the two underlying beds.

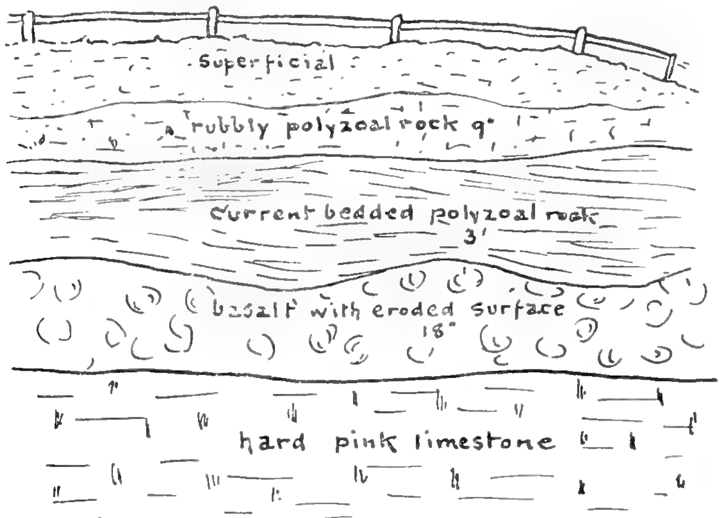


Fig. 12. SECTION AT 100 FEET BELOW MAUDE TOWNSHIP, ON ROAD TO KNIGHT'S BRIDGE.

This polyzoal rock corresponds to the specimens marked TM3 of Wilkinson's survey of this locality, and occurs about 80 feet above the bed of the Moorabool at the spot where I examined it. Lying upon the polyzoal rock is a bed of older basalt, and above this again a bed of pink limestone, thoroughly indurated and containing shells of littoral species, such as the *Cerithium* before-named and *Haliotis*. Upon this lies another bed of basalt, covered by a rubbly polyzoal rock.

At 100 feet below Maude township, on the road to the bridge (Knight's-bridge), the following section was seen (Fig. 12) :—

	Thickness in feet by aneroid.
Surface deposits passing downwards into limestone ..	100
Basalt, near top of which is an intercalated band of hard limestone, followed by (?) polyzoal rock, probably masked by talus	200
Siliceous grit	40
Ordovician slate	40

Close to the basalt an excavation at the side of this same road showed :—

	ft.	in.
Rubbly polyzoal limestone	0	9
Current bedded polyzoal limestone resting on an eroded surface of basalt	3	0

This basalt is only about 18 inches in thickness. Under this basalt occurs the hard pink limestone (WTM4) of the littoral type before mentioned.

The above section supports the survey interpretation of these beds by showing that in some localities there was a second somewhat feeble effusion of the older basalt. It also proves the extremely variable thickness of the basalt and polyzoal limestone. In other sections not far distant the second flow is absent, as shown by the data given by Hall and Pritchard.

E.—The Hamilton District.

Two divisions of the Cainozoic beds in this area have been clearly defined by the work of Messrs. Tate, Dennant, Hall and Pritchard. These beds are revealed by the erosion of the Grange Burn and the Muddy Creek. The lower beds at Muddy Creek are correctly correlated with the Mornington beds (Balcombian); whilst the upper series, seen at Grange Burn and MacDonald's, belong to the same geological horizon as the Beaumaris and Jemmy's Point beds (Kalimnan).

There is, however, a third and intermediate series, which has to be intercalated between these beds, but which up to the present has been entirely overlooked, in relation to its stratigraphical importance and position. In all probability this was a neglected factor on account of its great variability, even in the same district. I have already postulated the middle position of the Janjukian or Spring Creek series in the Cainozoics; a view indeed held by Messrs. Tate and Dennant, the former using the term Post-Eocene for these beds. If such be the case, this series should be either represented between the upper and lower beds in the Hamilton district, or should be negatively represented by an unconformity. That this middle series is present the following data will show :—

During a visit paid to this district six years ago I was struck with the important development of the pink limestone with echinoids (*Eupatagus rotundus* and *Linthia mooraboolensis*), polyzoa, and foraminifera. This rock can be followed from the bed of the Grange

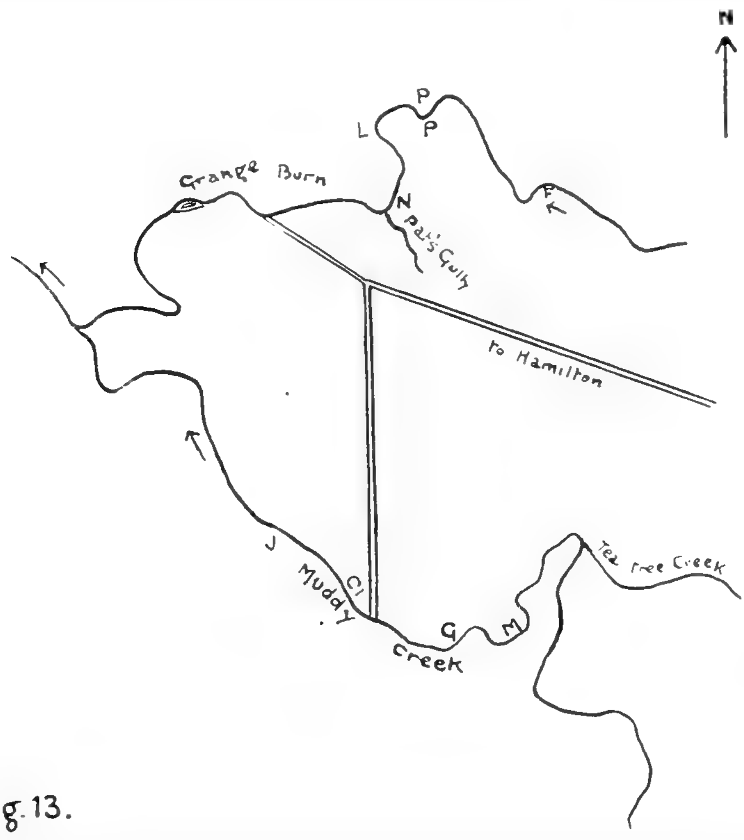


Fig. 13.

SKETCH MAP OF THE GRANGE BURN AND MUDDY CREEK AREA. 2 inches to 1 mile. Cl. = Clifton Bank (Balcombian). G. = Nodule bed (Kalimnan) on Janjukian clays. J. = Junction of Balcombian and Janjukian. L. = Lepidocyclina limestone (Janjukian). M. = MacDonald's (Kalimnan). N. = Nodule bed (base of Kalimnan) P. = Quartz Porphyry, overlain in places by Cainozoic beds.

Burn at Forsyth's, past Henty's, where it is developed on the west in a limestone cliff 60–80 feet high, with caves, and can be traced down the Grange Burn for $1\frac{1}{2}$ miles to its junction with Muddy Creek (Fig. 13). Anent this polyzoal limestone Mr. Dennant remarks* as follows :—" So far as the Muddy Creek itself is concerned, all the beds consist of the clayey and calcareous layers already noticed, but in the Grange Burn, fossiliferous strata of a different character appear, which have not, I think, been referred to by any previous geological writer. They form a rather friable rock, composed mainly of bryozoan remains, with spines of echini, and occasional shells, chiefly pectens, scattered through it. In outward appearance, it resembles almost exactly the strata on the Crawford River, about halfway between Muddy Creek and the south coast of Victoria. Somewhat similar strata are also found at Apsley, on the western boundary of Victoria, and also at Narracoorte, in South Australia. Those at the last-named place are described by Professor Tate under the name of 'polyzoal rock,' which in his classification of the Australian Tertiaries he has placed as antecedent in age to the Muddy Creek shell beds. In one place only

Fig. 14. POLYZOAL ROCK RESTING ON BALCOMBIAN. S. BANK OF MUDDY CREEK, 20 CHAINS N.W. OF CLIFTON BANK. A = BALCOMBIAN BLUE CLAY; B = BALCOMBIAN BROWN SHELL MARL; C = POLYZOAL LIMESTONE (JANJUKIAN), IN SITU.

have I seen the strata in close proximity, and there the polyzoal rock appeared to underlie the shell beds. As, however, I was unable to trace actual contact, I am not prepared to speak definitely on the point. As I said before, this rock is nowhere visible in

* Trans. Roy. Soc. S. Australia, vol xi., 1889, p. 34.

the Muddy Creek, but it abounds in the Grange Burn, not only above but also for a long way below its junction with Muddy Creek."

In a recent visit to the Hamilton district I was able to trace the Cainozoic beds in succession along both creeks, and at one spot, about three-quarters of a mile up the Muddy Creek, from the junction of the Grange Burn, was fortunate enough to find a small landslip revealing the polyzoal rock resting on the Clifton Bank beds (Balcombian), and not underlying them as Mr. Dennant supposed (Fig. 14). This occurrence of the limestone in Muddy Creek is only 20 chains from the well-known Clifton Bank exposure. The section there gives 3 feet of rubble; foraminiferal and polyzoal limestone, 3 feet; brown sand (fossiliferous), 20 feet; and blue clay, 2 feet down to the water line of Muddy Creek. The two last-mentioned beds are comprised in the Balcombian or Clifton Bank series.

The Cainozoic strata in the Hamilton district are not perfectly horizontal, as Mr. Dennant believed (see loc. cit., p. 33), and consequently their irregularity does not "only arise from denudation." In fact, were the strata perfectly horizontal, the great thickness of the polyzoal limestone in the Grange Burn area would present an insurmountable difficulty. The latest data I have collected goes to prove that Clifton Bank itself is on the axis of an anticline, in which the beds dip from 2 to 5 degrees. On the west bank of the Grange Burn, opposite Henty's, there are high cliffs of *Lepidocyclina* limestone surmounted by Kalimnan beds, that is, an oyster bed

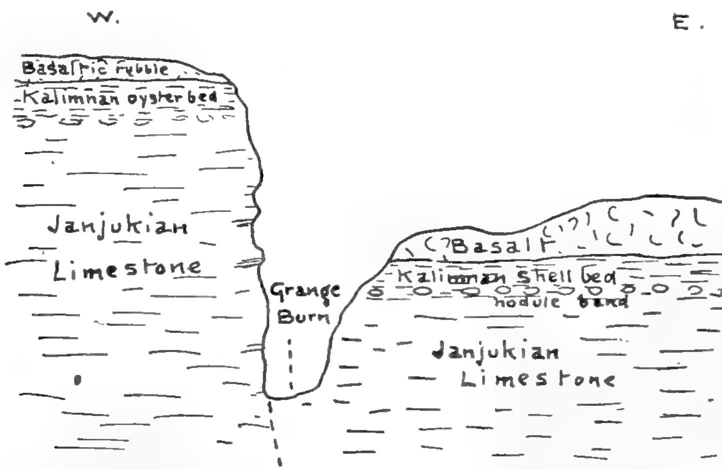


Fig. 15. LIMESTONE SCARP ON GRANGE BURN AT HENTY'S. AREA OF MAXIMUM FAULTING.

with *Natica cunninghamensis*. This elevated position of the middle series shows that the cliff at this spot represents a fault scarp; and further, that the western bank of Grange Burn at Henty's has been uplifted for at least 40 feet (Fig. 15). Moreover, the Grange Burn from this point to the junction bears the aspect of a rejuvenated stream, flowing in a deep, entrenched valley (*see* Fig. 16). The line of fault referred to passes almost due north and south

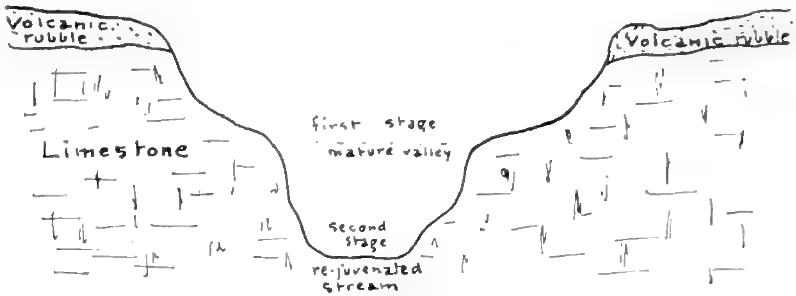


Fig. 16. VALLEY OF THE GRANGE BURN BETWEEN HENTY'S AND THE JUNCTION WITH MUDDY CREEK

cutting the Muddy Creek at MacDonald's, 1 mile south of Forsyth's (*see* sketch map Fig. 13). The effect of this fault is seen on the course of the Grange Burn below Forsyth's, where the mature stream, after coming from Hamilton and flowing over Kalimnan strata (Fig. 17), taking a more northerly turn, cuts through high banks of polyzoal limestone resting on quartz porphyry, thence flows to the west for 20 chains, and then southward for another

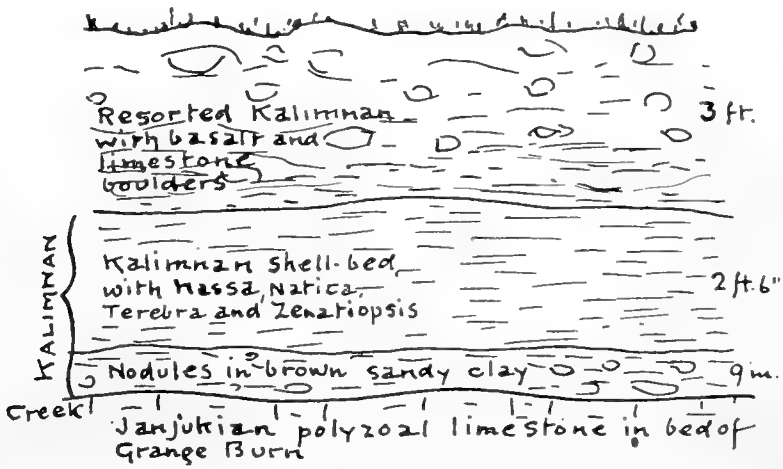


Fig. 17. SECTION IN BANK OF GRANGE BURN OPPOSITE FORSYTH'S.

20 chains, after which it follows its normal westerly course towards the Wannon. On the same area of uplift at Muddy Creek, starting from Clifton Bank, the Balcombian beds gently dip, with some slight undulations, towards MacDonald's, but are still seen at a

slight elevation, about 10 feet, at 40 chains east of Clifton, when the Muddy Creek suddenly turns north-east for 25 chains and as suddenly turns back to the south-east, indicating a small downthrow at this point, which brings the Kalimnan beds almost to creek level.

From the above observations it is clear that the polyzoal rock of the Grange Burn directly succeeds the typical Balcombian of the " Lower beds, Muddy Creek." It is further proved by the occurrence of *Linthia mooraboolensis* and *Lepidocyclina tournoueri* in that limestone, that this polyzoal rock is the precise equivalent of the Batesford limestone. On a previous visit to this locality I had failed to find the tests of *Lepidocyclina*, although that genus, represented by *L. martini* occurs in the older Balcombian beds at Clifton ; but on the last occasion was delighted to find that a large portion of the bluff (60 feet) opposite Henty's was composed of a *Lepidocyclina* rock containing species identical with those occurring at Batesford. At the top of the bluff west of Henty's the beds are somewhat inaccessible, but at one spot, where I was accompanied by Mr. C. J. Gabriel, we found the rock passing into a concretionary bed with Kalimnan oysters and other shells (*O. manubriata* and *Natica cunninghamensis*). This upper bed was 15 feet thick, so that the total height of the cliff from the bed of the Grange Burn is 75 feet ; whilst exactly opposite, the top of the Kalimnan from the creek is only about 45 feet. At about 30 chains up stream the same Kalimnan beds are only a foot or so above the bed of the creek. As to the succession of the beds above the polyzoal rock, the data are very clear along the Grange Burn, for at Pat's Gully* the top of the polyzoal rock is concreted by the leaching out of the phosphoric acid from the bones and coprolites of the nodules immediately overlying it. The nodule bed, I was at one time inclined to think, represented a remanié deposit of the Janjukian series, but my recent visit convinces me that it is the basal bed of the Kalimnan. It consists, as before stated, of cetacean and turtle bones, fish teeth, &c., and lies embedded in a stiff brown clay. The rolled portion of the deposit is probably derived from the underlying Janjukian, since I discovered in a similar bed on the Muddy Creek a scutum of *Lepas pritchardi*, a fossil only found, hitherto, at Waurn Ponds and Torquay in undoubted Janjukian strata. The brown clay of the nodule bed usually contains typical Kalimnan fossils, thus proving the age of the deposit, and making it without doubt a conglomeratic basal bed.

The most complete evidence of the succession of all our Cainozoic series in one locality is therefore to be gathered from the Grange Burn exposures. Let us, however, examine the data afforded on the other side of the Clifton Bank anticline. At about 35 chains

* Named after Mr. Pat. String, a local resident.

up the Muddy Creek past Clifton, at a point marked "G" on the sketch map (Fig. 13) the Balcombian fossiliferous sandy clays appear a few inches above the bed of the creek, and show a dip to the east of 8 degrees. This is surmounted by 4 feet of polyzoal rock with rolled fragments, containing many fossils common alike to either Balcombian, Janjukian, or Kalimnan strata, as *Arca* (*Barbatia*) *consutilis*, *Cucullaea corioensis*, *Chama lamellifera*, *Pecten sturtianus*, *Cardita delicatula*, and *Venus* (*Chione*) *propinqua* (specimens small and approaching the Spring Creek form *V.* (*Ch.*) *halli*, as well as a tooth of *Galeocerdo*, a form which has not occurred lower than the Janjukian. There is no doubt that whilst the Grange Burn area was rapidly subsiding, and given over to clear water conditions, on this, the east side of Clifton, the Janjukian sea was shallow, and subjected to currents, whilst very little deposition took place. Above this 4-ft. bed of polyzoal rock follows the typical Kalimnan strata resting on a nodule bed, the latter containing typical fossils of that stage, as *Glycimeris halli*, and fully developed specimens of *Venus* (*Chione*) *propinqua*.

F.—The Mallee (*Victoria*) *and the Mount Gambier District, the Adelaide Plains, and the Eucla Basin* (*South Australia*).

The first two of the above localities, so far as their underground geology is concerned, are comprised within one area of deposition. In Janjukian times that which is now the Southern Ocean extended for some hundreds of miles inland, forming a great gulf—the Murray Gulf. This gulf was bounded on the west by the great palæozoic axis of which the Mount Lofty Ranges forms a part. Its deposits form the rocks of the Mount Gambier district, and an extension of the area underlies the Adelaide Plains. The fossil fauna of the latter area, as exemplified in the polyzoal limestones of South Australia, is practically identical with the white limestone and marls of the lower portion of the borings in the Mallee of Victoria. The sediments laid down to the north of Gregory's "Primitive Mountain Chain"* formed the foundation of the vast area occupied at the present day by the basins of the Wimmera, Murray, Darling, Murrumbidgee, and Lachlan Rivers; and which form the great subartesian basin of the Murray Gulf. In New South Wales alone this sub-artesian area comprises, according to C. S. Wilkinson, no less than 22,000 square miles.

These older deposits revealed by boring in the Mallee, Victoria, in South Australia and New South Wales, show, by their fossil contents, that they are Janjukian or Miocene in age. The only Cainozoic fossils found in the New South Wales bores occurred at Arumpo,† and one of them is strongly confirmatory of this conclusion

* Gregory, J. W. Geography of Victoria, 2nd ed., 1912, p. 75.
† Rec. Geol. Surv. N.S. Wales, vol. iii., pt. 4, 1893, p. 115.

as to age; for it has been identified by Mr. Robt. Etheridge as *Trigonia semi-undulata,* of the type-form which is only found in the Janjukian series in Victoria, in being ornamented with fimbriated rugæ instead of almost plain sulcations as in the Balcombian variety.* In the last boring in the Mallee which I have examined (No. 11), there are 333 feet of white polyzoal limestone with occasional black cherty bands, and the bottom of the series was not reached. The fauna altogether showed a strong Aldingan and Batesfordian aspect; both Aldinga (lower beds) and the Batesford Limestone being of Janjukian age. To the westward these bores showed a thinning-out of the deep water polyzoal facies, the strata being replaced by terrigenous greensands with a rich fish fauna. The Janjukian polyzoal limestone and greensands pass upwards by gradual sequence into Kalimnan (Lower Pliocene) shell marls and sands of a decided littoral aspect. The maximum thickness of this Kalimnan series is 92 feet. These are followed by estuarine foraminiferal sands, which I regard as Werrikooian (Upper Pliocene), similar in age to the upper beds of the Glenelg River. The maximum of these deposits is 163 feet. Pleistocene beds are indicated by barren quartz sands and grits. The later Pleistocene and Holocene stages are represented by ferruginous sands, and pinkish concretionary limestone, with occasional land-shells; this series attaining a maximum thickness of 148 feet. A full report on the bores of the Mallee district, Victoria, is being prepared at the National Museum, and will be published shortly.

Another but smaller sub-artesian basin, or gulf of the Janjukian sea—really the remanet of a once very extensive area—is seen in the Eucla Basin, north of the Great Bight, and underlying the Nullarbor (= treeless) Plains. The absence of running water in this locality is due to the porous character of the white polyzoal limestone; any moisture falling upon its surface being absorbed as by a sponge, to be carried away by means of underground streams. The average height of the Bunda Plateau, as this country round the Great Bight is called, is from 800 to 1,000 feet.

The limestone country of the southern part of Western Australia is of great thickness, since, according to Mr. H. Deane (in a lecture before the Royal Society of Victoria in 1911), a Government bore passed through 1,370 feet of limestone before reaching bed-rock. From the description it appears to be a similar limestone to that of the Eucla Basin. It is to be hoped that some data will be gleaned in the near future from borings and well-sinkings in this area during the construction of the Transcontinental Railway.

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* *Trigonia semiundulata,* var. *lutosa,* Pritchard, Proc. R. Soc. Vict., vol. xv. (N.S.), pt. 1, 1902, p. 92, pl. xv., figs. 6, 7.

Table of Cainozoic Strata in Australia.

Epochs in Europe.		Equivalent Strata in Australia.
Holocene ..	..	Dunes, beaches, shell-beds, and delta deposits now forming.
Pleistocene ..	..	Raised beaches; river terraces (younger); swamp deposits with *Diprotodon;* cave breccias with extinct marsupials in Victoria, New South Wales, Queensland, South Australia, and Western Australia *Helix* sandstone of Barren and Flinders Islands; older sand-dunes of Warrnambool and Sorrento.
Pliocene	Upper	Estuarine beds of the Murray Basin; (?) hard sandstone with microzoa at 520 feet in Sorrento Bore; shell-beds of Limestone Creek, Glenelg River, Victoria; upper beds of Moorabool Viaduct. (= Werrikooian, Hall and Pritchard).
	Lower	*Terrestrial Series.*—Red Sands of Nillumbik Peneplain, near Melbourne; newer deep leads of Victoria. *Marine Series.*—Shell-beds of Jimmy's Point, Gippsland; sandy shell marl of Beaumaris; *Limopsis beaumariensis* bed of Sorrento Bore; upper beds, Muddy Creek, Hamilton. (= Kalimnan, H. and P.); Upper Aldingan of South Australia.
Miocene ..		*Terrestrial Series.*—Older deep leads, Victoria; leaf-beds of Maddingley, Bacchus Marsh, Victoria, and Dalton and Gunning, New South Wales. *Marine Series.*—Fossiliferous beds of Cape Otway and Spring Creek, Victoria, and Table Cape, Tasmania. Batesford and Grange Burn limestone (*Lepidocyclina tournoueri* and *L. marginata* beds, = Burdigalian). Polyzoal rock, Flinders, Victoria, and Mount Gambier and Nullarbor Plains, South Australia; Older Cainozoic of bores in Murray Basin; Lower Aldingan of South Australia; middle series of Sorrento Bore with *Eutrochus fontinalis.* (= Janjukian, H. and P.). Fossiliferous marls, of Fyansford, Camperdown, Corio Bay and Bairnsdale.
Oligocene ..	..	Shelly clays and leaf-beds of Mornington; lower part of Altona Bay and Newport Bores with sandy shell-marl and brown coal; lower beds of Sorrento bore; lower beds of Muddy Creek. (= Balcombian, H. and P.).

Summary of Conclusions.

1. The oldest fossiliferous beds of the Cainozoics of southern Australia are represented by the Balcombian series (of Hall and Pritchard), as exemplified by the blue clays of Mornington and Altona Bay Coal-shaft, in Port Phillip, and the Clifton Bank series at Muddy Creek, Hamilton.

2. The homotaxial equivalents of the Balcombian in European stratigraphy is the Oligocene (approximately Priabonian to Rupelian), including the fluvio-marine beds of the south of England and the

Isle of Wight, the Septaria Clay of Hermsdorf and Latdorf, in North Germany, and the Tongrian of Belgium. In Patagonia the Magellanian beds probably belong to this series, as well as the Waimangaroa series of New Zealand.

3. The stage above the Balcombian is the Janjukian (of Hall and Pritchard), including the Lower Aldingan (of Tate), in South Australia. During this period enormous subsidence of the coastal plains and adjoining sea-beds took place, which resulted in the accumulation of a great vertical thickness of deposits; consisting of polyzoal limestones, foraminiferal limestones (with *Lepidocyclina* and *Amphistegina*), foraminiferal soapstone, echinoid limestones, shell marls, and deeper water blue muds with gasteropods.

4. The Janjukian marine beds are, in all probability, synchronous with the terrestrial ironstone, sandy, or pipe-clay leaf-beds of Maddingley, Pitfield, Narracan, Berwick, Cobungra, Dargo, and Bogong.

5. The older basalt, in exposures where fossiliferous evidence is available, is either contemporaneous with the Janjukian, that is, interbedded; or underlying, and probably post-Balcombian; or overlying the Janjukian, and pre-Kalimnan.

6. The homotaxial equivalent of the Janjukian in Europe is the Miocene (approximately Aquitanian to Tortonian), and its greatest development approximates to the Burdigalian. In the Miocene of the Vienna Basin a somewhat similar fauna and flora existed, as seen in the accumulated banks of foraminiferal tests of *Amphistegina*, of a variety with sharp keel, found at Batesford, and by the prevalence of the calcareous alga *Lithothamnion ramosissimum*.

7. The Janjukian of southern Australia is the homotaxial equivalent of the Patagonian beds of Santa Cruz in Patagonia; and approximately of the Oamaru series of New Zealand.

8. The Miocene age of the Janjukian receives strong support from the rule of maximum development in certain types of fossil forms of that geological epoch. As for example, in the occurrence of gigantic Clypeasters in the Bairnsdale beds, and the enormous tests of *Linthia* in the Murray River and Batesford beds.

9. The occurrence of the complex-structured foraminifera, as *Lepidocyclina*, of species which are elsewhere Aquitanian and Burdigalian, as in southern Europe, India, Java, Sumatra, Borneo, and New Hebrides, further support a Miocene age for the Janjukian; as well as the extremely prolific growth of myriads of *Amphistegina* which, although found more sparingly in the lower, Balcombian stage, constitute whole beds of limestone, often of great thickness in the Janjukian series. The absence of Nummulites from the Australian Cainozoics is significant of their being younger than Eocene.

10. Although the precise use of the percentage method for testing the relative ages of the beds is here questioned, its value in a general sense is not overlooked. Later researches into our molluscan fauna

and of recent dredged material are continually revealing living species, which are also found in Janjukian or even Balcombian strata.

11. The Kalimnan of southern Australia is seen, from the occurrence of widely distributed fossil types, as *Scaldicetus*, as well as from its associated stratigraphical relationships, to be of Lower Pliocene age.

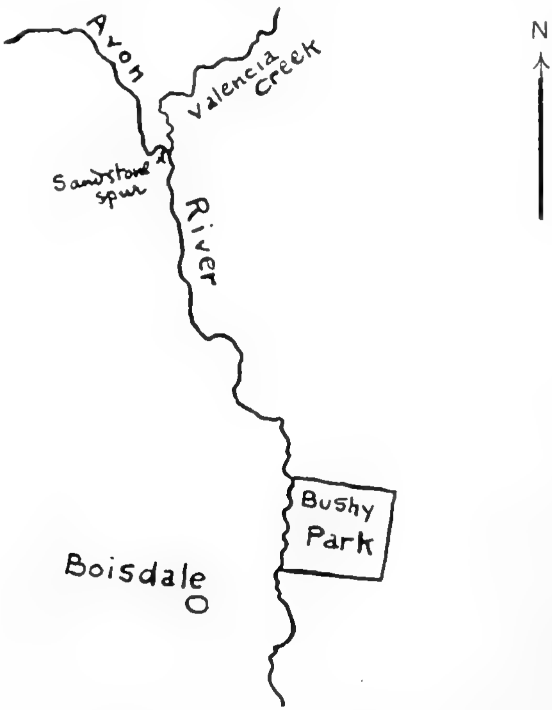
12. The complete sequence of the Cainozoic strata occurring in the following order, Balcombian, Janjukian, and Kalimnan, is seen in the Hamilton District, as first shown in the present paper; and also in the sequence of strata revealed in the deep boring at Sorrento. The Mallee bores demonstrate the gradual transition of the Janjukian into Kalimnan.

NOTE ON THE PRECISE LOCALITY OF THE TYPE SPECIMEN OF LEPIDODENDRON AUSTRALE, McCOY.

By Frederick Chapman, A.L.S., F.R.M.S., Palæontologist to the National Museum.

In the "Prodromus of the Palæontology of Victoria," Decade I., 1874, p. 39, the late Sir Fredk. McCoy recorded the figured specimen (Holotype) of *Lepidodendron australe* as occurring in the "red and yellow micaceous carboniferous sandstone of the Avon River, Gippsland, 5 miles above Bushy Park. Presented by the late Angus McMillan." This present note is written to define the locality more clearly, and to accredit Mr. George Thomas Jones* with the discovery of the specimen.

I am indebted to that gentleman for the following information. About the autumn of 1854 Mr. G. T. Jones was assisting Mr. William Tennant Dawson in surveying the Avon River District. Whilst scrutinizing the sandstone rocks of a spur dividing the Boisdale Plain from the Little Plain, immediately opposite the junction of the Avon River and Valencia Creek, Mr. Jones discovered the specimen on which McCoy founded his species.



* Now Secretary and Engineer, Ballarat Shire.

The locality is on the opposite side (right bank) of the river to Bushy Park, and $3\frac{3}{4}$ miles in a north-westerly direction from that locality, instead of 5 miles, as stated by McCoy.

The specimen was handed over to Mr. W. T. Dawson for transmittal to Melbourne, and presumably was sent later on, with other specimens by Mr. Angus McMillan, of Bushy Park.

Appended is a sketch map showing the exact locality, marked by X, where the specimen was found.

NOTES ON TESTACEA FROM THE PLEISTOCENE MARL OF MOWBRAY SWAMP, NORTH-WEST TASMANIA.

By Frederick Chapman, A.L.S., F.R.M.S., Palæontologist to the National Museum, Melbourne.

(Plates I., II.)

The object of the present note is to record one or two additions to the list of mollusca given by Dr. F. Noetling*, and to describe the occurrence of some Ostracoda new to Tasmania. For the opportunity of examining a sample of this marl from the Mowbray Swamp I am indebted to Dr. T. S. Hall, M.A., and Mr. T. Stephens, M.A. From this deposit the remains of a giant marsupial, the *Nototherium tasmanicum* of Mr. H. H. Scott†, were obtained, whilst Dr. Noetling has dealt generally with the characters of the mud deposit.

Quoting from Dr. Noetling (loc. cit., p. 125), "The Mowbray Swamp is about 12 miles west of Smithton, and, apparently, fills up a shallow depression of the surface. Probably it represents an old river course, which once had an outlet to the sea, but which subsequently became blocked up by sand. At present the 'swamp' is divided from the sea by a narrow strip of sand, on which low dunes are rising towards the coast. There is hardly any natural fall from the swamp to the sea, and the vegetabilic mould, or, better said, peat, which fills up the depression, is completely waterlogged. The thickness of the peat layer is not exactly known yet, but along the edge of the swamp, where drainage work has been extensive, it reaches about 25 feet to 30 feet. To me it seems very probable that the deepest point of the firm bottom on which the peat rests, is below sea level, and this would account in some way for the sluggishness of the fall."

The material here examined, chiefly for ostracoda, of which, by the way, no species have yet been recorded, is a pale yellowish-grey marl, of a loose, pulverulent nature.

The mollusca met with in the present sample are :—

Sphærium tasmanicum, T. Woods sp.
Pisidium tasmanicum, T. Woods.
Bythinella nigra, Quoy and Gaimard sp.
Assiminea tasmanica, T. Woods.
Bulinus tasmanicus, T. Woods sp.
Amphipeplea subaquatilis, Tate sp. var. *neglecta*, Petterd.
Vitrina milligani, Pfeiffer.

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* Proc. R. Soc. Tas., 1911, pp. 124–133. List of mollusca on p. 128.
† Tasmanian Naturalist, vol. ii., No. 4, 1911, p. 64.

Of these, *Assiminea tasmanica* and *Amphipeplea subaquatilis*, var. *neglecta*, are not recorded by Dr. Noetling. The genera *Assiminea* and *Bythinella* are strong indications of the presence of tidal influence in this swamp. This bears out Noetling's conclusions, since he states that " Probably it represents an old river course which once had an outlet to the sea." (loc. supra cit.).

The ostracoda are new to this locality and deposit. They are referable to—

Candona lutea, King, and
Limnicythere mowbrayensis, sp. nov.

NOTES ON THE MOLLUSCA.

PELECYPODA.

Sphærium tasmanicum, T. Woods sp.

Cyclas tasmanica, T. Woods, 1876, Proc. R. Soc., Tasm., for 1875, p. 82. *Sphærium macgillivrayi*, E. A. Smith, 1881, Proc. Linn. Soc., Lond., Zool., vol. XVI., p. 305, pl. VII., fig. 34.

Tenison Woods gives the length of the type shell as 9mm.; whilst the largest of our fossil form is only 4mm. The general colour of the shell, and the silvery bands mentioned by that author, are still visible on the fossil specimens.

As regards the synonymy of the species, there is no doubt of the identity of Mr. Edgar Smith's species with the earlier *S. tasmanicum*. This conclusion is based not only on a comparison of the description of both shells and the figures of *S. macgillivrayi*, but also from an examination of many examples from different localities in Victoria and Tasmania, in the Dennant collection. Moreover, the young of *S. tasmanicum*, from Lake Connewarre, near Geelong (labelled in the Dennant collection as a *Pisidium*, is identical with our Pleistocene fossils from the Mowbray Swamp. Further than this, the *Sphærium tasmanicum* is the only species known from Tasmania, and has been previously identified by Dr. Noetling from that locality.

Pisidium tasmanicum, T. Woods.

Pisidium tasmanicum, T. Woods, 1876, Proc. R. Soc., Tasm., for 1875, p. 81.

The length of the shell in this species, according to T. Woods, is from 2–4mm. The fossil examples are about 1.75mm. in length. In the original description of this species, there is no mention of other surface-ornament than the concentric striæ. The present specimens, however, show numerous very fine radial striæ crossing the concentrics, when viewed under the microscope by oblique incident light. This species has been recorded from the same locality by Dr. Noetling.

GASTEROPODA.

Bythinella nigra, Quoy and Gaimard sp.

Paludina nigra, Quoy and Gaimard, 1834, Voyage Astrolabe, vol. III., p. 174, pl. LVIII., figs. 9–12.

Bythinia legrandi, T. Woods, 1876, ibid for 1875, p. 76.

B. tasmanica, T. Woods, 1876, ibid, p. 77.

Bythinella exigua, T. Woods, 1878, ibid, for 1877, p. 71.

Potamopyrgus nigra, Quoy and Gaimard sp., Petterd, 1889, ibid, for 1888, p. 69, pl. III., figs. 2–8.

Bythinella nigra, Quoy and Gaimard sp., Noetling, 1912, ibid, for 1911, p. 129.

The above species is the commonest mollusc in the Mowbray Swamp deposit. It agrees with the normal form figured by Quoy and Gaimard, and only slightly varies in height of spire and tumidity of whorls. None of the specimens show any variation towards the varieties *legrandiana*, Brazier*, or *unicarinata*, T. Woods†.

This species has been recorded by Dr. Noetling from the same locality as above.

Assiminea tasmanica, T. Woods.

Assiminea tasmanica, T. Woods, 1876, Proc. R. Soc., Tas., for 1875, p. 79.

Rissoa (*Setia*) *siennæ*, T. Woods, 1877, p. 153.

Assiminea tasmanica, T. Woods, Petterd, 1889, Proc. R. Soc., Tas., for 1888, p. 77, pl. II., fig. 2.

A. tasmanica, T. Woods, Gatliff, 1905, Vict. Nat., vol. XXII., p. 15.

The present specimens agree with the original description by Tenison Woods, and, to some extent, with Petterd's figure referred to above. The latter, however, does not do justice to the shell in showing the characteristic acute spire and sub-angularity of the last whorl. Some examples of the species from Port Albert, Victoria, which I have been enabled to examine through the kindness of Mr. C. J. Gabriel, have, however, a decidedly inflated outline. The figure of *A. tasmanica* given by Mr. Hedley‡ is suggestive of *A. brazieri*, T. Woods, in its obtuse spire, sub-globose shell with rounded whorls, and colour bands. These colour bands are absent from typical examples of *A. tasmanica*, as also from our fossil specimens, which, when moistened, show all other colouration originally present.

The present genus and species does not appear in Dr. Noetling's list.

Genus Bulinus, Adamson, 1757.

Note on the genus.—The common Australian sinistral pond-snails have been variously ascribed to *Physa*, *Bulinus*, *Isidora*, and *Aplexa*. Under the genus-name *Bulinus*, Prof. R. Tate has made

* Proc. Zool. Soc. Lond., 1871, p. 698. "*Paludestrina legrandiana*."
† Proc. R. Soc. Tas. (for 1875), 1876, p. 77. "*Bythinia unicarinata*."
‡ Proc. Linn. Soc. N.S. Wales, vol. xxx., 1905, p. 527, pl. xxxii., fig. 27.

the following observations regarding this group* :—" The sinistral spiral pond-snails of Australia have been placed (incorrectly so, I believe) in the genus *Physa*. The thick periostracum of most of them, which in many of them is prolonged into cilia or bristles, is incompatible with a largely reflexed mantle. I have not examined all the Australian so-called *Physæ*, but in no instance have I found those distinctions which characterize *Physa* as separable from *Bulinus*. . . . . . The mantle margin is neither expanded nor digitate, in *B. tenuistriata*, however, it has three small serratures on the columella side."

In looking into this question of the generic position of our sinistral pleistocene fossils the present writer has examined two typical living Victorian species, namely, *Bulinus bullatus*, Sow. sp.†, and *B. crebreciliatus*, T. Woods sp.‡, with the following results :—

The edge of the mantle in both these species is slightly reflected and undulate (Pl. I., figs. 1–3), but is not divided into numerous distinct angular tags, as in *Physa* (see also Pelseneer§). This Australian type of shell would, therefore, naturally fall into the genera *Bulinus* or *Aplexa*, but that the latter has a polished shell.‖ The relationship was then tested by the structure of the radula. *Aplexa* in being placed with *Physa* in the *Physidæ* gives no evidence of relationship with the Australian specimens I have examined. In *Bulinus proteus*, Sow. sp., the radula, on the contrary, shows its relationship to be with the *Planorbidæ* (Pl. I., figs. 4*a–c*), in which family *Bulinus* is placed by Pelseneer. The centrals and laterals of the lingual ribbon in *B. proteus* are only slightly modified from a radula such as *Planorbis corneus*, Linne¶, the three cusps being a constant character of the free edges of the teeth**.

BULINUS TASMANICUS, T. Woods sp.

(Plate I., Figs. 5, 5A.)

Physa tasmanica, T. Woods, 1876, Proc. R. Soc., Tas., for 1875, p. 74.

It was of this species that Tenison Woods remarked (*op. supra cit.*, p. 74) that it " is the common *Physa* of the country, and is found in all the inland streams. It is, however, so closely allied to the *Physa fontinalis* which is diffused over Great Britain and Europe, that we may well doubt if it be distinct††. If not, has it

* Trans. R. Soc. S. Austr., vol. v., 1882, p. 51.

† "*Physa bullata*," Sowerby, in Reeve, 1874, Con. Icon., fig. 97.

‡ "*Physa crebreciliata*," T. Woods, Proc. R. Soc. Vict., vol. xiv., 1878, p. 63.

§ Treatise on Zoology, pt. 5, Mollusca, Oxford, 1906, p. 186.

‖ See Fischer, P., Manuel de Conchyliologie, 1887, p. 511.

¶ Op. supra cit., p. 504.

** Since writing the above, Mr. C. J. Gabriel has kindly drawn my attention to an important paper by the Rev. A. H. Cooke (Proc. Zool. Soc., Lond., for 1889, pp. 136–143), "On the Generic Position of the so-called *Physæ* of Australia," in which the structure of the radula is fully discussed. The conclusions arrived at are in exact agreement with the above investigations, that the Australian *Physæ* are really sinistral Limnæids, but in their radulæ nearer to *Planorbis* than to *Limnæa*.

†† *Physa fontinalis* is a shorter form with a less acuminate spire.

been introduced ? " In discussing the question of the importation of this shell, on the grounds of its determination as *Physa*, Dr. Noetling* points out that the association of the remains of a giant marsupial goes to prove that it is indigenous. The present determination, that it is a distinct type from *Physa*, although outwardly resembling it, affords another instance of convergence of external form in different organisms.

Two minute specimens of *Bulinus* were also found accompanying the shells of *B. tasmanicus* in this deposit; and these were at first thought to represent a new specific type, on account of the few whorls and exceptionally globose protoconch. On comparing the latter characters, however, in a series of *B. tasmanicus* a great range of variability was found in regard to the form of the apex; and the natural conclusion is, that these specimens represent the embryonic shells of *B. tasmanicus*. This species, by the way, appears to connect *B. nitida* and *B. eburnea*, the former having a short shell with a large aperture; the latter a shell with the aperture narrow, ovate, and shorter than the spire.

Dr. Noetling also records this species from the above locality.

AMPHIPEPLEA SUBAQUATILIS, Tate, var. *neglecta*, Petterd.

Limnæa subaquatilis, Tate, var. *neglecta*, Petterd, 1889, Proc. Roy. Soc., Tas., for 1888, p. 66, pl. II., fig. 13.

This interesting little species is here represented by two specimens, typical in all points but that of size, the length of the larger example being 3mm., against 7mm. in Petterd's specimen. It differs from the European *L. peregrer*, Draparnaud, in the less expansive aperture and more slender form of the shell.

VITRINA MILLIGANI, Pfeiffer.

Vitrina milligani, Pfeiffer, 1852, Monographia heliceorum viventium, vol. III., p. 4. Cox, 1868, Mon. Austr. Land Shells, p. 82, pl. XIV., figs. 2, 2*a*.

A bleached and somewhat imperfect shell of the above occurs in the marl. The species has already been recorded by Dr. Noetling from the same locality.

OSTRACODA.

GENUS CANDONA, Baird.

CANDONA LUTEA, King.

(Plate II., Figs. 6 *a*, *b*, 7.)

Candona lutea, King, 1855, Proc. R. Soc., Tas., vol. III., pt. I., p. 67, pl. X., fig. K.

C. lutea, King, Brady, 1886, Proc. Zool. Soc., Lond., p. 92, pl. VIII., figs. 10, 11, pl. X., figs. 7, 8.

Observations.—This species is excessively common in the Mowbray Swamp deposit. There is a fair amount of variation in the carapaces

* Proc. Roy. Soc. Tasmania for 1911, 1912, p. 128.

some having the postero-dorsal angle obtuse, as in a typical *Candona*, although the majority are more evenly rounded than usual in that genus. A young individual is here figured, which goes to show the identity of the specimen from the Tweed River, New South Wales, figured by Dr. Brady as doubtfully belonging to this species (*loc. supra cit.*, pl. VIII., figs. 10, 11); since graduated examples linking both forms may be found here. The living examples previously recorded were all from New South Wales.

The carapaces of some examples in the present series are so well preserved as even to show remains of the dried animal within, though in a powdery condition, whilst the dull yellow colour of the original shell is evident in most of the specimens.

Genus Limnicythere, G. S. Brady.

Limnicythere mowbrayensis, sp. nov.

(Plate II., Figs. 8, *a–c.*)

Description.—Carapace very minute; measuring ·46mm. in length, ·27mm, in greatest height (in the anterior third), and ·17mm. in the thickness of the carapace. Seen from the side, subrectangular; dorsal margin almost straight; ventral edge with a broad median re-entrant angle; anterior border rounded, truncately so on the dorsal region; posterior boldly rounded. There are three rounded tubercles situated a short distance from the dorsal margin in the antero-median area, and one large, prominent tubercle near the middle of the ventral border directed dorsally. Anterior border finally crenulate; post-ventral area with a border of minute aculeations. Anterior margin compressed and flange-like. Surface of carapace finely sculptured with a thread-like reticulated or areolate ornament.

Observations.—This form, although distinct from any species known to me, approaches the type of *Limnicythere inopinata*, Baird sp.; a form common in ditches, lakes, and running streams in Sweden, Holland, and Great Britain; and also occurring as a pleistocene fossil in Scotland and England. It is especially related to that variety of *L. inopinata* known as var. *compressa**, which occurs in Whitefield Loch, Wigtonshire, Scotland. That variety differs in the absence of the quadruple tuberculation and in the general contour of the carapace in edge view.

Limnicythere mowbrayensis is common in the marl deposit of the Mowbray Swamp, Tasmania. This appears to be the first record of the genus *Limnicythere* in Australasia.

In conclusion, my best thanks are due to Mr. C. J. Gabriel for valued assistance in the literature of the mollusca discussed; to Mr. J. Wilson for kindly allowing me to examine his slides of molluscan radulæ; and to Mr. W. L. May, for some valuable notes on the local forms.

* Brady and Norman. Trans. R. Dubl. Soc., ser. 2, vol. iv., 1889, p. 170, pl. xvii., figs. 18, 19.

SUMMARY.

1. The sinistral molluscs generally referred to *Physa*, *Isidora*, and *Aplexa*, are here shown to belong to *Bulinus*, as already held by Prof. Tate, on account of the more or less entire character of the margin of the mantle, and the structure of the lingual teeth which closely approach those of *Planorbis*.
2. Two species of ostracoda are newly recorded from Tasmania. One of these is an entirely new species, and extremely interesting in view of the occurrence of a closely related form in Europe, found similarly in Pleistocene deposits. This opens up a question regarding the transportation of lacustrine or fluviatile organisms within moderately recent geological time.
3. The conclusion as to the age of the Mowbray Swamp deposit is significant, for it shows that the first marsupial associated with these remains cannot date very far back in Pleistocene times, as seen in the comparatively fresh condition of some of the mollusca and the ostracoda, many of which have their original colour markings still preserved. This evidence gives further support to Dr. Noetling's previously recorded conclusions, based on an examination of the mollusca alone.

EXPLANATION OF PLATES.

Plate I.

Fig. 1.—Part of body of *Bulinus crebreciliatus*, T. Woods sp., showing the non-digitate mantle. Living. Sandringham (Nat. Mus. Coll.) × 2.

Figs. 2, 3.—Borders of the mantle in *Bulinus bullatus*, Sow. sp.; showing the sinuate margin. Living. Goulburn Valley, Vict. × 2.

Fig. 4.—Lingual teeth of *Bulinus proteus*, Sow. sp. (*a*) central teeth; (*b*) lateral teeth; (*c*) marginal tooth. Living. Meredith, Vict. × 380.

Fig. 5.—*Bulinus tasmanicus*. An embryonic specimen. Pleistocene. Mowbray Swamp, Tasmania. 5*a*, protoconch. × 26.

Plate II.

Fig. 6.—*Candona lutea*, King. (*a*) side view; (*b*) ventral view. Pleistocene. Mowbray Swamp, Tasmania. × 26.

Fig. 7.—*C. lutea*, King. A young example. Pleistocene. Mowbray Swamp. × 52.

Fig. 8.—*Limnicythere mowbrayensis*, sp. nov. (*a*) side view; (*b*) ventral view; (*c*) end view. Pleistocene. Mowbray Swamp, Tasmania. × 52.

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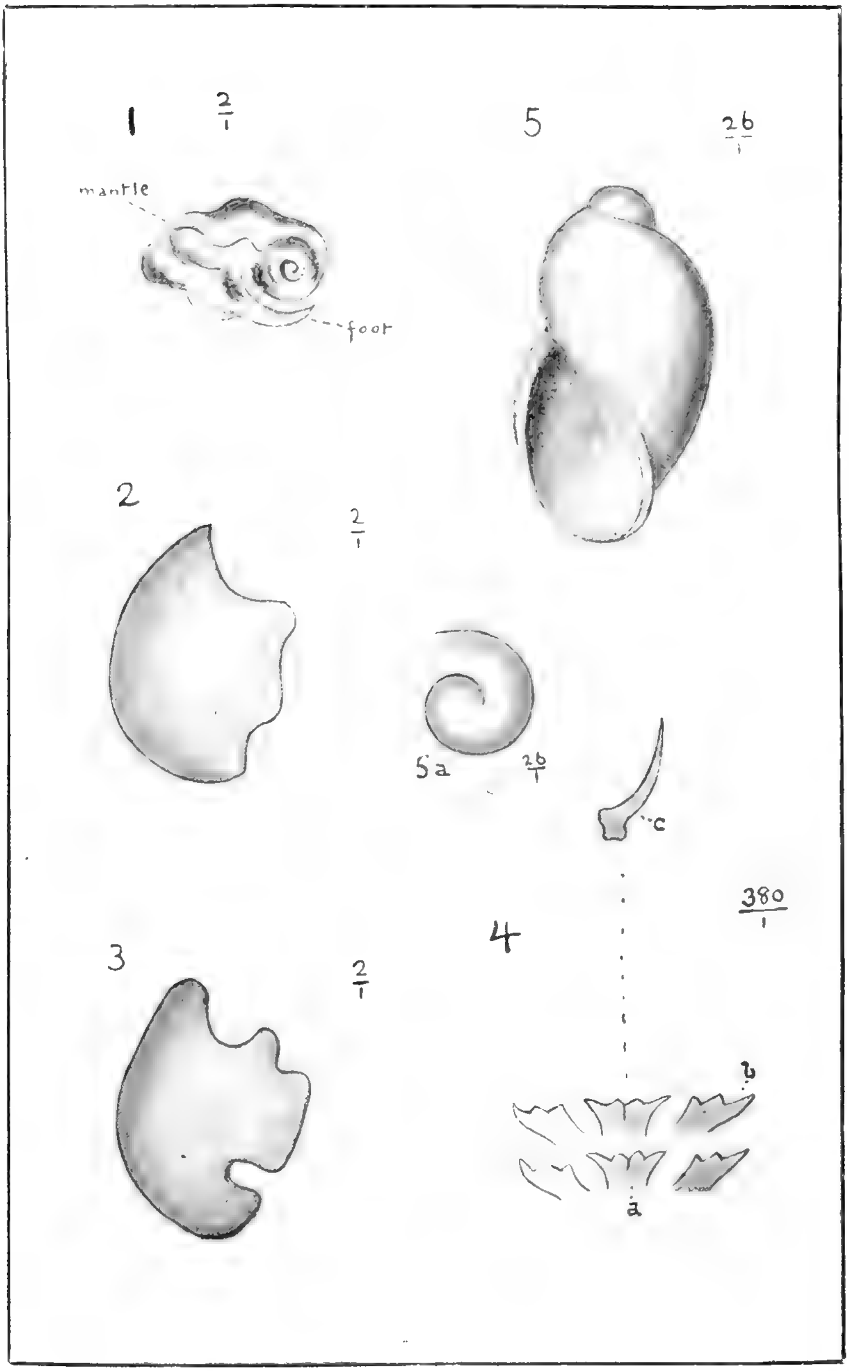

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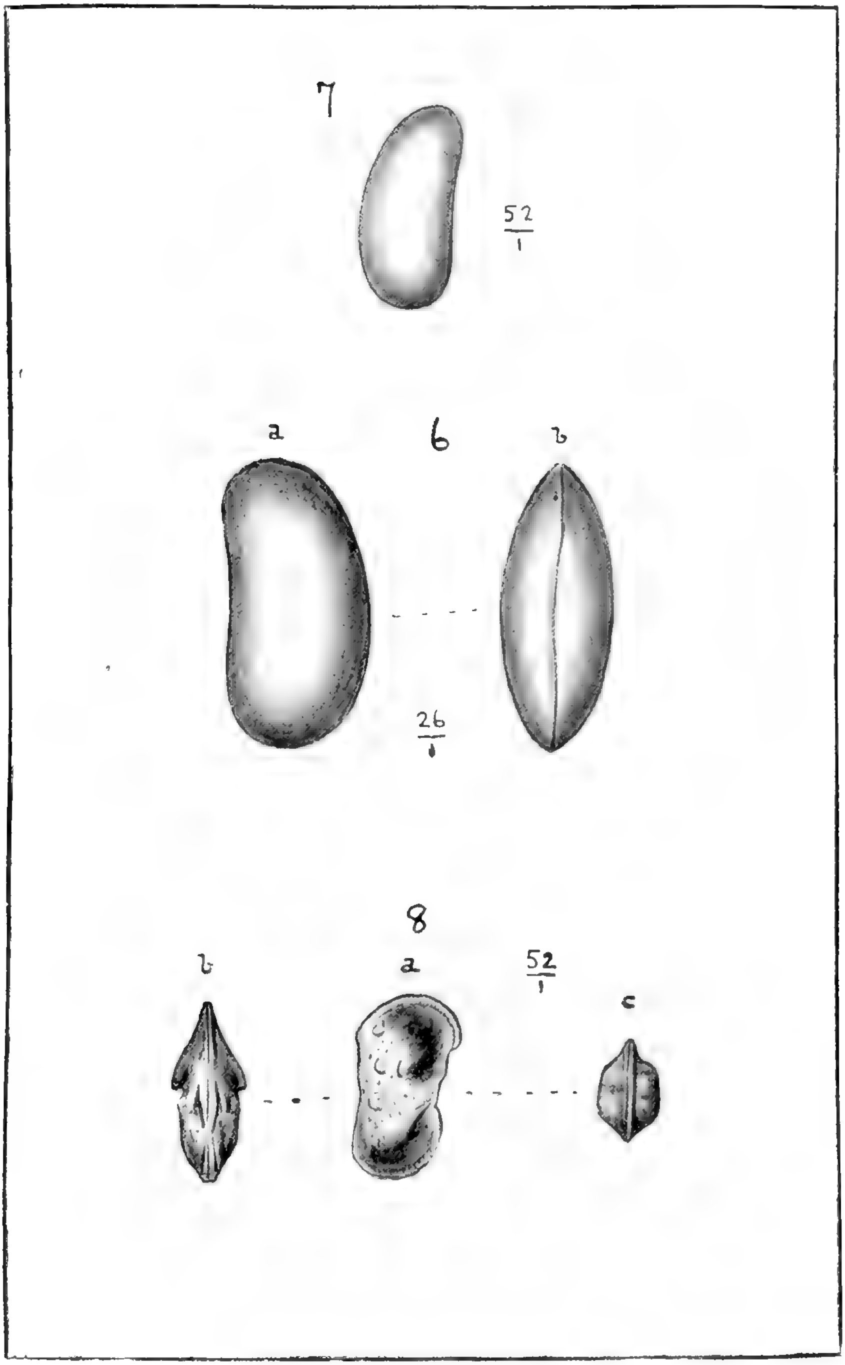
Structure in Bulinus.



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