Geological Survey of Victoria.

PRODROMUS

OF THE

PALÆONTOLOGY OF VICTORIA;

OR,

FIGURES AND DESCRIPTIONS

OF THE

VICTORIAN ORGANIC REMAINS.

DECADE VI.

BY

FREDERICK McCOY,

F.G.S.; HON. F.C.P.S.; C.M.Z.S.L.; HON. F.G.S.E.; HON. M.G.S.M., ETC.
AUTHOR OF "SYNOPSIS OF THE CARBONIFEROUS LIMESTONE FOSSILS OF IRELAND;" "SYNOPSIS OF THE SILURIAN FOSSILS OF IRELAND;" "CONTRIBUTIONS TO BRITISH PALÆONTOLOGY;" ONE OF THE AUTHORS OF "BRITISH PALÆOZOIC ROCKS AND FOSSILS," ETC.
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M DCCC LXXIX.

Presented to
The University of Harvard
On behalf of the Council
of the University of Melbourne
Redmond Barry
Chancellor

6th Nov. 1879

Geological Survey of Victoria.

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MDCCCLXXIX.

Presented by the
Life of
Sir Richard Gregory
President of the Royal Society
Hallowes Library

PREFACE.

As the publications of a Geological Survey cannot properly be limited to the maps and sections, but would be incomplete without figures and descriptions of the fossil organic remains made use of for the determination of the geological ages of the different geological formations of the country,* it has been determined to issue a "Prodromus," or preliminary publication of the Victorian Organic Remains in Decades, or numbers of ten plates each, with corresponding letterpress, on the plan of the Decades of the Geological Survey of England, followed by the Geological Surveys of Canada, India, and several other Governments.

The Decades will contain figures and descriptions in the first place of the more characteristic fossils of each formation, of which good specimens may be in the National Collection; so that observers in the field may make use of them for preliminary or approximate determination of the geological ages of the strata they may meet. A portion of the impression of the plates will be kept back until a complete systematic treatise on the fossils of each formation may be issued when the materials approach completion.

In this sixth Decade, the first plate illustrates the extinct gigantic Kangaroo, *Macropus Titan*, so common in our superficial Pliocene Tertiary deposits; the predecessor of the "Old Man" Kangaroo of the same localities in our own times.

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* "Palæontological researches forming so essential a part of geological investigations, such as those now in progress by the Geological Survey of the United Kingdom, the accompanying plates and descriptions of British fossils have been prepared as part of the Geological Memoirs. They constitute a needful portion of the publications of the Geological Survey."—*Sir Henry T. De la Beche, Director-General of the Geological Survey of the United Kingdom, in notice prefixed to the first of the Decades of the English Geological Survey.*

The two following plates illustrate the curious, extinct Marsupial genus *Procoptodon;* differing from the true Kangaroos in the much more complex teeth; and in having the front molar formed for grinding. The more massive lower jaws being joined by bony union in front, and the tusks inclining upwards, showing a relation to the huge extinct *Diprotodons* of the same Pliocene Tertiary deposits.

The fourth plate shows the extraordinary repetition in Australia of the curious occurrence in the Crag of Suffolk of a multitude of ear-bones of Whales: three species of which are here shown, in beds of nearly the same age, by very similar *Cetotolites*, as these fossils are generally termed.

The fifth plate makes known the teeth of a gigantic fossil extinct species of Spermaceti Whale from the Older Pliocene beds of Mordialloc. It also represents one of the simple, conical, anterior teeth of the Miocene Tertiary extinct genus of Whales, *Squalodon*, from the Miocene Tertiary beds of Waurn Ponds, near Geelong, discovered by Mr. Nelson of that place, who enabled me thus to add to our previous illustration of the lobed, posterior teeth of *Squalodon Wilkinsoni* (McCoy), figured in our second Decade.

The sixth and seventh plates give some further important fossil Mollusca, characteristic of the Upper Silurian formations, from Gippsland.

The eighth plate gives figures of a new and abundant species of *Hinnites*, very characteristic of the Victorian Miocene Tertiary deposits.

And the two last plates represent some of the more interesting and widely distributed of our Tertiary Sea Urchins.

The four remaining Decades required to complete the work will continue the illustration of the fossil collections made in the course of the Geological Survey of the colony.

FREDERICK McCOY.

2nd December 1878.


1
1a

PLATE LI.

MACROPUS TITAN (OW.).

[Genus MACROPUS (SHAW). (Sub-kingd. Vertebrata. Class Mammalia. Order Marsupialia. Fam. Macropodidæ.)

Gen. Char.—Dental formula :—$i.$, $\frac{3-3}{1-1}$; $c.$, $\frac{0-0}{0-0}$; $p.m.$, $\frac{1-1}{1-1}$; $m.$, $\frac{4-4}{4-4} = 28$. Cutting edge of upper incisors in one line; outer one large, grooved by one or two folds of enamel extending from outer side obliquely forwards and inwards. The premolar displaces the 2nd and 3rd deciduous molars, leaving d^4 and m^1 to m^3.

The Kangaroos or "bilophodont" marsupials having two transverse ridges on the molar teeth are distinguishable as a group by that character from the Rat-Kangaroos or Bettongias, in which the molars are quadrituberculate. The premolar, like the anterior deciduous molar, has the crown lengthened antero-posteriorly, with two roots and a subtrenchant margin; the anterior and posterior margins in some species are thickened, and separated from the thinner middle portion by slight vertical side-furrows, especially in the upper jaw.

The bilophodont molars have a "front-lobe" and a "back-lobe;" a "prebasal ridge" in front, and sometimes a "postbasal ridge" behind. There are usually two longitudinal ridges, the "fore-link" uniting the prebasal ridge with the anterior lobe; and the "mid-link" uniting the two lobes; and the "hind-link" often descends from the hind lobe to the postbasal ridge. The upper molars are broader than the lower, and have a narrower prebasal ridge, but the "hind-link," from the hinder and inner angle of the hind-lobe, and the postbasal ridge, are larger.]

DESCRIPTION.—*Upper jaw:* premolar crown of two simple, conical, subcompressed lobes, the hind one broader; outer surface of each lobe convex, smooth, divided by a vertical sulcus. It displaces d^2 and d^3, and is smaller than d^3 (contrasting in this respect with *M.* (*S.*) *Atlas*). It contrasts (when in place) with d^4 by being comparatively fresh and unworn. The bilophodont upper molars have a strong prebasal ridge, and "fore-link" joining it to near the middle of the anterior lobe, inclining rather towards the inner angle. (In *S. Atlas* the "fore-link" is nearly or quite obsolete.) The mid-link is sinuous and tumid in the middle (being more strongly developed than in *S. Atlas*). The oblique posterior ridge is strongly developed, and defines a depression on the inner and under side. The two lobes have broad convex bases in the side view (the crowns longer, in proportion to width, than in the *S. Atlas*). The hind edge of the front pier of the zygoma is in advance of the m^2, in young, but is opposite the vertical of the middle of m^3, in adults. The suborbital canal is nine lines in front of orbit; and three lines behind it is a small canal, not found in the allied living forms. The deciduous molars have four roots and are bilophodont, while the compressed premolar has but two roots. In the adult the three molars, the deciduous molar d^4, and the premolar form a series of five teeth in a line, nearly straight on inner and slightly convex on outer edge, measuring two inches nine lines. In m^3 the prebasal ridge rises into a salient angle near the middle, from which the fore-link goes to the inner side of the middle of the front of the front-lobe; (in *S. Atlas* it does not rise to an angle, and there is no fore-link); the inner end bends up on the front-lobe. The mid-link comes from near the inner end of the fore-lobe. The postbasal ridge extends from the post-internal angle of

the hind-lobe downwards, outwards, and backwards to the base, defining a deep oblique cavity on the back of the hind-lobe; (in *S. Atlas* there is only a slight postbasal ridge and an ill-defined shallow concavity). m^3 is one line longer in *M. Titan* than in *S. Atlas*, with the same breadth. The mid-link of m^3 is more curved than in m^2, the concavity inwards. Length of p^3, 5 lines; of d^4, 5 lines; of m^1, 6 lines; of m^2, 8 lines; of m^3, 8 lines; width of d^4, 5 lines; of m^1, m^2, m^3, 6 lines.

Lower jaw or mandible has the adult series of d^4, and three molars 2 inches $2\frac{1}{2}$ lines long; m^3, 8 lines long and 5 lines wide, stands well in advance of the anterior edge of the coronoid process (more so with advancing age); prebasal ridge large, standing up like a lobe, nearly as wide as the tooth, and to level of hind-lobes of preceding tooth; fore-link strongly developed, joining the anterior lobe on the outer side of the mid-line defining a deep depression on each side (in *S. Atlas* this link is only rudimentary); mid-link also a little on outer side of mid-line, so that the inner hollow is larger than the outer, the middle projecting inwards as a salient angle or projecting lobe; the thickened posterior sides of posterior lobe with a small deep conical pit a little on inner side of the mid-line m^2 like m^3, each about 8 lines long and 5 lines wide; m^1 is 6 lines long and $4\frac{1}{2}$ lines wide, with a strong lobe-like prebasal ridge standing as high as the posterior lobe of d^4; fore-link strongly developed, nearer to the outer than the inner end of the fore-lobe and prebasal ridge, curved, the projecting angle directed inwards; the valley between the prebasal ridge and fore-lobe is divided by the link into two hollows, the inner one larger than the outer one; the inner edge of the prebasal ridge is sharp, the outer edge thicker. The mid-link joins the anterior lobe at a greater depth below the edge than in the prebasal ridge and fore-link; the edge of the fore-lobe is slightly curved with the convexity backwards. The long diastemal edge between the base of the anterior molar and the incisor is sharp, and descends rapidly with a parabolic curve from anterior molar to vertical over dental canal, continuing thence, as a straight sheath, to the incisor. From back of m^3 to tip of incisor 6 inches 2 lines. The long incisor is procumbent or directed forwards with a very slight upward inclination; length of grinding surface 1 inch 1 line, width 4 lines, depth of incisor 5 lines. Depth of jaw behind m^3 1 inch 6 lines, the same at vertical to interval between m^2 and m^1; vertical to front of dental canal, 1 inch. (Professor Owen's figures are more slender, but his measurements of a similarly old jaw are the same.)

Reference.—Owen, in Mitchell's Three Expeditions into the Interior of Eastern Australia, &c., p. 366, t. xlvii., and Catalogue of the Fossil Mammalia, &c., in Museum of College of Surgeons, p. 324; Phil. Trans. Royal Society of London, vol. 164; Extinct Mamm. Aust. p. 435–42, t. lxxvi.–lxxix. p. 400–11, t. lxxxi. fig. 6–9, t. lxxxii. fig. 17, 18.

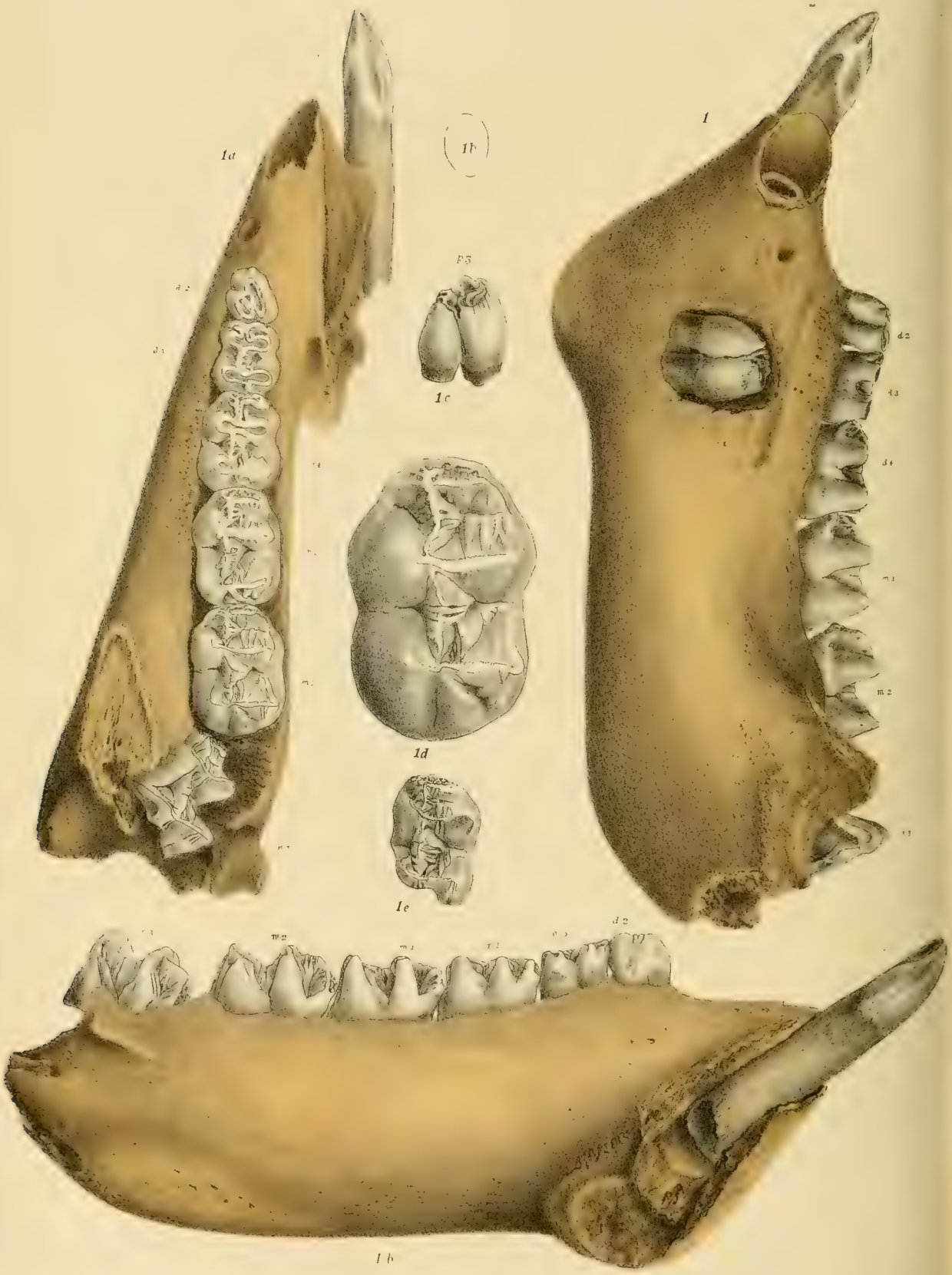
This great extinct Kangaroo was first described by Professor Owen from Sir T. Mitchell's collection of bones from the Wellington ossiferous caves of New South Wales, and seems to be equally common in Victoria, as I have recognized portions of it from Pliocene Tertiary deposits of many localities near Melbourne. It approaches in the character of its teeth more nearly to the common south coast "Old Man" Kangaroo, *Macropus major*, than to any other living form, but is much larger; it also has the palate entire (or without great vacuities), as in it.

Common in the Pliocene Tertiary clays of Colac, and washed out of the same strata, loose on the surface on shores of Lake Timboon, mineralised perfectly.

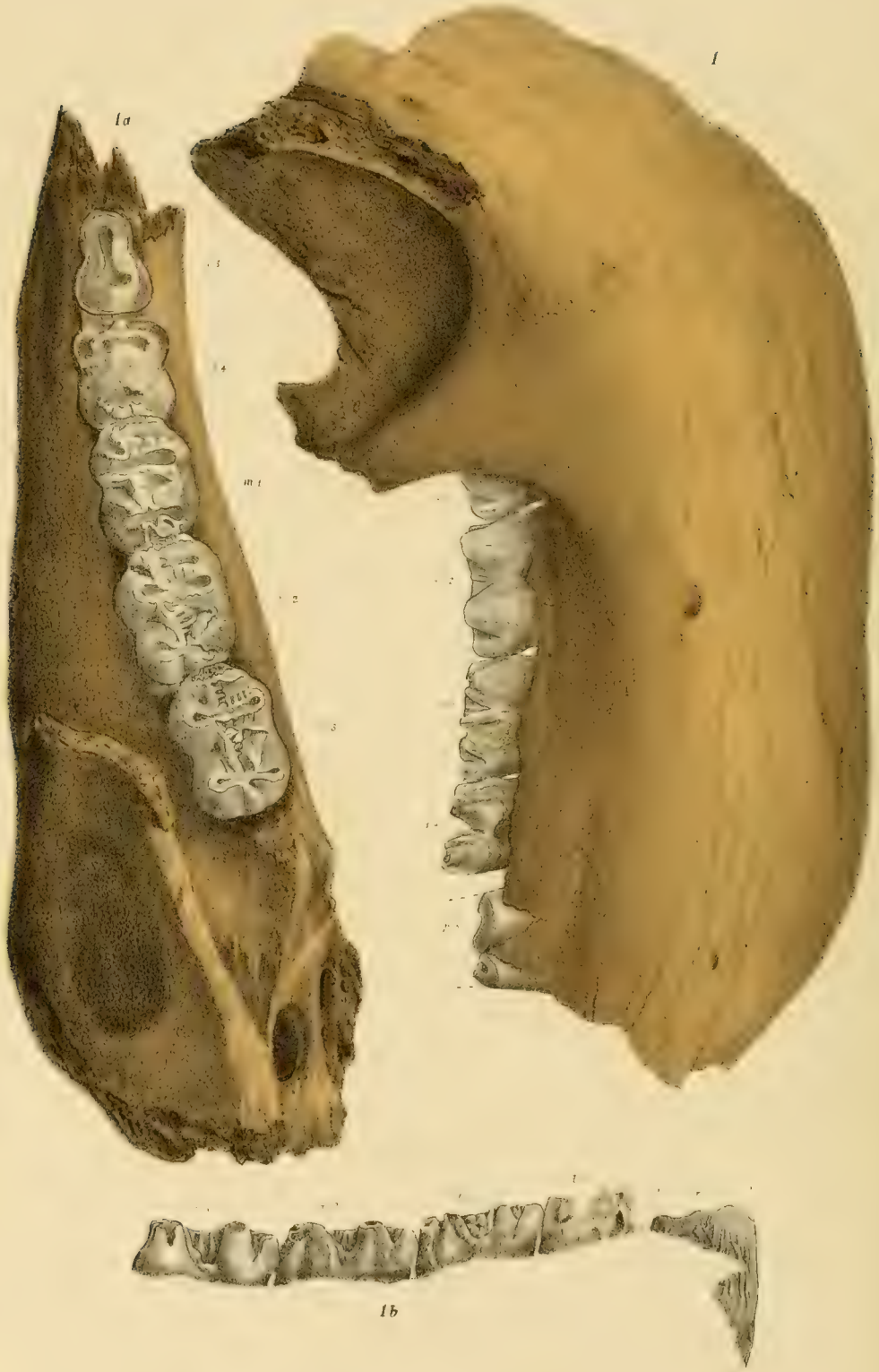
EXPLANATION OF FIGURES.

Plate LI.—Fig. 1, mandibles of adult viewed from above, showing the incisors, deciduous molar and three molars much worn, natural size. Fig. 1*a*, ditto, side view. Fig. 2, portion of upper jaw, showing the three molars and the deciduous molar *in situ*, left side. Fig. 3, ditto, right side of another specimen. Fig. 4, another specimen of m^2 and m^3, younger and less worn than in Fig. 1. Fig. 5, another specimen of the mandibular teeth, intermediate in age and wear of crowns between Figs. 4 and 1, natural size, showing the three molars and bases of the deciduous molar and premolar.

FREDERICK McCOY.



C.J. rosdil & Co. imp.



Prof. Mc Coy del. et lith.

Plates LII. and LIII.

PROCOPTODON GOLIAH (Ow.).

[Genus PROCOPTODON * (Ow.). (Sub-kingd. Vertebrata. Class Mammalia. Order Marsupialia. Fam. Macropodidæ.)

Gen. Char.—Large vacuities in palate† opposite d^4 to m^2; dental formula as in *Macropus.* Molars with a more complex enamel ridging of grinding surface than in *Macropus;* the two lobes separated by a valley, and each with a more elliptical transverse section; prebasal ridge narrow, descending from fore part of outer angle of front-lobe inwards to fore part of base of inner half of front-lobe, disappearing before reaching inner side of that lobe; fore-link indicated by a vertical ridge nearer to outer than inner end of front of front-lobe, numerous smaller vertical grooves and ridges marking rest of fore surface: the hind surface of front-lobe with a concavity bounded by two obtuse ridges going downwards and inwards from the outer and inner ends of the ridge of the front-lobe; in this hollow two sharp ridges of enamel descend into the mid-valley, the outer one or "mid-link" extending with a sinuous curve to the ridge of the hind-lobe; the inner ridge shorter; hind surface of hind-lobe nearly like that of fore-lobe; the inner of the two submedian ridges or hind-link expanding below into the prominent convexity of the base, the outer ridge smaller; a sharp vertical plate of enamel extends inwards from the outer bounding ridge of the middle concavity, on which are some smaller ridges; the base is swollen and smooth. The crown of the premolar p^3 is a little less in length than the next tooth d^4; it is thicker transversely than in *Macropus,* and has a broad working surface with complex enamel transverse ridging between the outer and inner ridges, indicating a tooth for pounding (not dividing as in *Macropus*), as the generic name implies: the height and width of the back part of crown of p^3 are about equal; the outer side having three conical vertical ridges, the apex of first forming anterior prominent end of outer ridge of the crown; the apex of second about middle of same ridge, and the third not reaching up to it; the fore part of the tooth is smaller and separated by a transverse depression from the lower and narrower front end of the inner ridge, which joins the outer one by a transverse ridge at the hinder end, representing the hind-lobe of the other molars, and having its hind surface slightly similarly ridged; the grinding surface between the bounding ridges has sharp transverse enamel ridges and deep hollows.]

Description.—(*Young*).—Lower jaws with three deciduous and only two true molars in place (the last molar m^3 being below the surface, and placed obliquely to the line of the others) afford the following measurements:—Entire molar series from front edge of the anterior deciduous molar d^2 to hind edge of second or last molar in place m^2, 3 inches 3 lines: antero-posterior length of anterior deciduous molar d^2, $4\frac{1}{2}$ lines; greatest width behind, about the same: length of second deciduous molar d^3, $6\frac{1}{2}$ lines; greatest width behind, $5\frac{1}{2}$ lines: length of third deciduous molar d^4, 9 lines; width, $6\frac{1}{2}$ lines: length of fourth molar, or first true molar m^1, $9\frac{1}{2}$ lines; width, 7 lines: length of fifth molar, or second true molar m^2, 11 lines; width, $7\frac{1}{2}$ lines: antero-posterior length of the imbedded premolar p^3, 7 lines. Incisors with an ovate section at base, $5\frac{1}{2}$ lines in vertical diameter and $3\frac{1}{2}$ lines in transverse diameter; greatest width of enamelled crown, $5\frac{1}{2}$ lines; length, 9 lines. Length of diastema from front edge of anterior deciduous molar to base of enamelled crown of incisor, 1 inch 2 lines; dental foramen 3 lines below upper edge of diastema, and 5 lines from front of anterior molar d^2 measured obliquely. The depth of the jaw vertically under the front of anterior molar d^2, 2 inches; depth under first true molar m^1, 1 inch 6 lines; thickness at

* Πρὸ, *before;* κόπτω, *to pound;* ὀδοὺς, *a tooth.*

† Not found in the large Kangaroos of the genera *Macropus* and *Osphranter,* but in some small *Halmaturus* and *Petrogale.*

same point, 1 inch 1 line; lower edge of jaws obtuse, slightly inflected at angle, external side convex, internal face flatter. In this jaw the transverse ridges of the last molar in place m^2 are scarcely worn, and the links not at all; the other molars are successively more and more worn to the front. The front molar d^2 has the grinding surface obliquely triangular, the obtusely rounded apex in front; the outer side divided a little in front of the middle by a deep vertical sulcus separating two convex lobes; the inner side flatter, with three short, subequal, nearly vertical, shallow grooves on the middle third, crenulating the crown, but only extending a short way towards the base; three small oblique tracts of dentine exposed by wear of the enamel. The second molar d^3 has a distinct prebasal ridge, two transversely oblong spaces of dentine exposed by the wearing of the front and back lobes, but the mid-link scarcely divided by a slight line of dentine. The third molar d^4 with the dentine exposed by wearing of the whole transverse length of the ridge of the anterior lobe, but only at the outer extremity of that of the hinder lobe; the links and prebasal ridge unworn. Fourth and fifth molars m^1 and m^2 unworn. (*Adult.*)—Lower jaw with one premolar p^3 and one deciduous molar d^4, and three true molars in place, affords the following measurements:—Length of entire molar series from anterior edge of premolar p^3 to hind edge of last molar m^3, 3 inches 8 lines: antero-posterior length of premolar p^3, 7 lines; greatest width of hind-lobe, 5 lines; of anterior lobe, $3\frac{1}{2}$ lines: length of deciduous molar d^4, 7 lines; width, $6\frac{1}{2}$ lines; length of first true molar m^1, $8\frac{1}{2}$ lines; width of front-lobe 7 lines; width of hind-lobe, $6\frac{1}{2}$ lines: length of second molar m^2, $8\frac{1}{2}$ lines; width of anterior lobe, $7\frac{1}{2}$ lines; of posterior lobe, $6\frac{1}{2}$ lines: length of last molar m^3, 10 lines; width of anterior lobe, 7 lines; of posterior lobe, $6\frac{1}{2}$ lines. The dentine exposed on the transverse ridges of all the teeth.

Reference.—*Macropus Goliah* (Owen), in Waterhouse, Nat. Hist. Mamm., pt. 2, p. 59; Phil. Trans. Lond., vol. 164, p. 791.

In the shortness and depth of the symphysial part of the jaw, the thickness of the premolar especially behind, and in the thickness and depth of the rami, and their firm union in front, and in the upward inclination of the incisor teeth, the *Procoptodons* approach more to the *Nototherium* than any of the other Macropodal genera do. The animal was probably more robust, and with thicker, and shorter, and more equal legs than living kangaroos.

This, the most gigantic species of the extinct genus *Procoptodon*, is not uncommon in the Pliocene deposits of Victoria, generally in company with the much commoner *Macropus Titan.* The specimens figured are from the Pliocene Tertiary clays of Lake Timboon, on the shores of which they are cast up after storms, with various extinct species of *Macropus*, the *Phascolomys pliocenus* (McCoy), and the *Thylacoleo carnifex* (Owen), &c.

Explanation of Figures.

Plate LII.—Fig. 1, side view of exterior side of ramus of lower jaw or mandible, natural size, showing the socket of incisor of same side and inner view of incisor of the opposite side, adhering by the strong bony anchylosis of the jaws in front (contrasting with the loose jaws of *Macropus*);

also showing the 2nd, 3rd, and 4th deciduous molars in place, and the 1st and 2nd true molars; a portion of the 3rd, or last molar, can be seen imbedded in the substance of the bone, not having risen into place or use, while the 2nd and 3rd deciduous molars are in place. A portion of the bone has been cut out to find the premolar p^3, which in such young individuals is imbedded in the bone until after the two teeth above it, the deciduous molars d^2 and d^3, have been shed. The deciduous molars are marked d^2, d^3, d^4; the true molars are marked m^1, m^2, m^3. (By error d^2 is engraved as b^2). Fig. 1*a*, same specimen viewed from above, showing the five molars in place in young individuals, d^2, d^3, d^4, m^1, m^2, with the last molar m^3 not yet come into use, but obliquely set to the line of the others and imbedded in the bone, which exhibits it from a fracture in the specimen. This figure shows the complete pattern of the enamel ridges of the above-named molars when slightly worn on ridges of the deciduous molars, the two molars being unworn by use at the earlier age, also the strong bony union of the two rami of the lower jaw in front; natural size. Fig. 1*b*, same specimen, viewed from inner side, showing the upward inclination of the incisors in *Procoptodon*, characteristically differing from the horizontal or procumbent position of these teeth in *Macropus*. Fig. 1*c*, young premolar p^3 not yet risen to replace the deciduous molars d^2, d^3, viewed from outer side, natural size. Fig. 1*d*, second true molar, magnified to show the precise details of the complex ridging of the crown, so distinctive from *Macropus*. Fig. 1*e*, pattern of enamel ridging of last molar m^3 before coming into place, natural size. Fig. 1*f*, form of section of incisor tooth at base of crown.

Plate LIII.—Fig. 1, outer view of portion of jaw of old individual, with the permanent molars p^3, d^4, m^1, m^2, m^3 in place, natural size (crowns of p^3 and d^4 broken). Fig. 1*b*, same series of teeth of same specimen, viewed from inner side, natural size. Fig. 1*a*, same specimen, natural size, viewed from above, showing the three true molars in place, with the pattern of the ridging, all worn by use. The crowns of the premolar and deciduous molar p^3 and d^4 broken off.

N.B.—The small figures and letters in these plates mark the same teeth as in the text.

FREDERICK McCOY.


1
1a
2b
2
2a
3
3a
3b
4a
4

PLATE LIV.

CETOTOLITES.

[Cetotolites *: Tympanic Ear-bones of Whales.]

In 1843 Prof. Owen recognised as Ear-bones (*Petro-tympanics*) of large whales, and probably indicative of three or four species, a number of hard, rounded, involute, very dense bony bodies, discovered in great abundance by the Rev. Prof. Henslow in the Pliocene Tertiary Red Crag at Felixstow, in Suffolk, but most probably derived from an older underlying Tertiary formation. As these are the only hard parts, capable of withstanding attrition, of the skeletons of most Whales, the disappearance of all the other bones of the skeleton, or their reduction to indeterminable fragments, while the hard Petro-tympanics or Ear-bones alone remained to indicate so many species, was well understood, although the fact still remained amongst the most striking in palæontology that so small a portion of such gigantic animals should have been held sufficient evidence of great numbers of several species being found in this particular spot. I was much interested on finding that a specimen brought to me from a deposit very nearly identical with the older European crag, opened at Waurn Ponds quarries, near Geelong, by the late Rev. Mr. Legge, of Brighton, was an Ear-bone or Tympanic of a Cetacean closely allied to the commonest of those at the English locality; and on requesting that attention might be drawn to the interest attaching to the objects if preserved, I soon had a considerable series apparently indicating at least three species of Whales probably about 40 feet long.

Prof. Owen gave the general name Cetotolites to fossils of this kind in his description of the Suffolk species, but referred them to the genus *Balæna* in his work on British Fossil Mammals, and subsequently to his genus *Balænodon* in his treatise on Palæontology. As, however, I do not think it is possible satisfactorily

* Κῆτος, *a whale*; ὦς, *ear*; λίθος, *stone*.

to refer them to their true genera from such materials, I propose to use provisionally the word *Cetotolites* as a generic term for such fossil Cetacean Ear-bones as I have to describe. These Ear-bones, or Tympanic bones, are always scroll-like, slightly resembling a Bulla or a Cowry shell; very thick and rounded on the lower and seemingly involute inner side, but thin, inarched, and scroll-like on the outer side to the upper edge, which alone forms the junction with the adjacent bones of the head (the *Tegmen tympani* and *pars mastoidea*), accounting for this edge in the fossils being always broken, as the substance of this particular bone is not only excessively dense, but very brittle. The same considerations which were relied upon to distinguish the four English Tertiary species, the *Balæna affinis*, *B. definita*, *B. gibbosa*, and *B. emarginata*, would indicate three or four species in our Waurn Ponds quarry.

All our Victorian Ear-bones are generically distinct from the English ones in the division of the internal cavity into two depressions, a posterior deeper, and an anterior shallower one, by a thick swelling from the involute part, and also by the hinder portion being more bilobed. My own impression is that they belong to *Ziphioid* Whales; and long, flat, dense bones found in the same strata with them I believe to be remains of the dense, long flattened bones of the snout of the same creatures.

PLATE LIV., FIG. 1.

CETOTOLITES LEGGEI (McCOY).

DESCRIPTION.—Depressed, pyriform; posterior end broad, not indented or notched; anterior narrow end obtusely rounded; under side flattened, slightly convex, with a very shallow, wide mesial depression near the posterior end, but not extending to the margin, which is left prominent and unsinuate; upper side with the tympanic cavity small, greatly encroached on from the inner side by the very large tumid, regularly convex, posterior portion of the involute inner side, which in section forms nearly three-fourths of a circle and occupies exactly two-thirds of the greatest transverse diameter of the whole bone at its greatest convexity; the posterior third of the external over-arching wall very thick, obtusely rounded at the edge and only raised enough to define a shallow cavity, which is almost filled by the large broad oblique extension from the middle third of the pyriform involute outer

part; beyond this transverse swelling the cavity is still more shallow than the posterior portion, bounded on the narrow, obtusely rounded front by the thick obtuse continuation of the outer margin slightly stopping the Eustachian canal; a slight flattening of the inner side, forming an obtuse angle with the flattened under surface, slightly interrupts the regular involute curvature of the surface, and there is a slightly concave sinus in this side opposite the internal transverse swelling in the cavity. Length, about 3 inches; greatest width, 2 inches; greatest depth at centre of greatest convexity of involute portion, 1 inch 4 lines to 5 lines; greatest width of involute part, 1 inch 3 lines.

This, which is the rarest of the three species of *Cetotolites*, was the first which I had seen; one of the two specimens in the National Museum collection having been presented to me by the late Rev. Mr. Legge, of Brighton, to whom I have dedicated the species as a slight memorial of his zeal in geological enquiries. It is distinguished from the others by the great size and gibbosity of the involute part, the thick obtuse slightly elevated outer overarching plate, the complete absence of notch or bilobation in the posterior end, and the total absence of projecting process on the upper posterior surface of the involution for attachment to adjacent bone.

Rare in the Miocene Tertiary strata of Waurn Ponds quarries, near Geelong.

Explanation of Figures.

Plate LIV.—Fig. 1, specimen, imperfect at anterior outer edge, viewed from above, natural size. Fig. 1*a*, same specimen viewed from behind, showing the shallow concavity in under surface.

Plate LIV., Fig. 2.

CETOTOLITES PRICEI (McCoy).

Description.—In size and general form resembling *C. Leggei*, but distinguished by a large rugged oblique projection on the upper posterior portion of the involute convexity for articulation with the adjacent skull bones; the more distinct bilobation of the posterior end and deeper mesial concavity on posterior end of under surface leading from the sinus of the slight bilobation; the inner outline is straighter from the posterior portion of the involute part not being so convex, or pyriformly swollen; outer inarching plate very much thinner and extending much higher so as to form a much deeper cavity; the oblique thickened swelling dividing the deeper posterior portion of the cavity from the anterior is less prominent, and the anterior cavity at the Eustachian semicircularly rounded anterior end is larger and deeper, the raised bounding margin continued from the outer wall being much thinner. Length, 2 inches 8 lines; greatest width, 1 inch 11 lines; greatest depth, 1 inch 1 line; greatest width of involute part, 1 inch 1 line.

This species is much more abundant than the *C. Leggei*, and I dedicate it to the Rev. Mr. Price, of Geelong, who first discovered it and brought to me several specimens, and to whom I am much indebted for preserving and forwarding to the Museum many of the fossils of the Tertiary strata of that neighborhood.

The smaller and less pyriform involution of the inner side, the distinct though small posterior bilobation, and the much thinner and higher outer wall enclosing an obviously larger cavity, render it easy of recognition. The usual oblique articular projection on the upper side of the posterior part of the thick involution being distinctly marked, is another character separating it easily from the *C. Leggei*, which is curiously peculiar in completely wanting any trace of it.

Not uncommon in the Miocene Tertiary strata of Waurn Ponds, near Geelong.

Explanation of Figures.

Plate LIV.—Fig. 2, average specimen, natural size, viewed from above. Fig. 2*a*, same specimen viewed from below. Fig. 2*b*, same specimen viewed from behind.

Plate LIV., Figs. 3, 4, and 5.

CETOTOLITES NELSONI (McCoy).

Description.—Oblong, broad and distinctly bilobed behind, rather suddenly tapering to the depressed nearly rectangular wedge-shaped anterior end, on the inner and lower sides of the Eustachian outlet; under side divided longitudinally into two convex portions by a distinct narrow concavity, deepest where it strongly bilobes the posterior end, gradually becoming obsolete at the flattened wedge-shaped anterior end; involute inner side small, club-shaped, swollen above posteriorly, suddenly narrowed at about the middle of the length, the narrow anterior convexity subsiding into the flattened anterior wedge-like truncated end; a strong oblique articular projection on posterior part of upper convexity, in front of which is an oblique depression extending forwards and downwards, and distinctly notching the exterior of the inner side of the bone; all the inner edge of the involute part marked with irregular plicæ extending forwards and downwards; posterior half of tympanic cavity very large and deep, suddenly defined by a raised thickening, extending from the involute inner part to the outer wall, leaving a rugged surface for the much shallower anterior portion of cavity; over-arching outer wall very thin, much elevated behind. Length, 2 inches 5 lines; greatest width, 1 inch 7 lines; greatest width and depth of involute part, 11 lines; width of truncated anterior end, 8 lines.

This is by far the most abundant of all the Victorian *Cetotolites*, there being fourteen specimens in the Museum, collected by the Rev. Mr. Legge, the Rev. Mr. Price, and Mr. Nelson, a young and promising geologist, who has put his residence near the quarries at Waurn Ponds to excellent use by preserving the more important fossils, with many of which he has enriched the public collection. I have great pleasure in dedicating this species to Mr. Nelson, and hope he may add still further to our knowledge of the Tertiary remains of Whales from the Geelong strata.

This is so totally unlike the two previously described species that there is no difficulty in identifying it by the flattened wedge-like anterior truncation, by the smaller and more rugged or plicated inner involute part, and by the very deep bilobation of the hinder end. This latter character is so pronounced that I dare say it would be found to be generically distinct from the two previously described, and much more nearly allied to the *Ziphioid* Whales. As these latter Cetaceans have a long solid beak of dense flattened bones, I fancy that the numerous Cetacean bones of this character found in the Waurn Ponds quarries may be found to have belonged to a form of this group, and possibly the present species of *Cetotolites* may be the ear-bone of the same.

Not uncommon in the Miocene Tertiary strata of Waurn Ponds, Geelong.

EXPLANATION OF FIGURES.

Plate LIV.—Fig. 3, average specimen, natural size, viewed from above. Fig. 3*a*, same specimen viewed from below, showing the posterior bilobation. Fig. 3*b*, same specimen viewed from behind. Fig. 4, another specimen (*var. Rugosa*), viewed from above, natural size, showing the rugged shallow anterior part of cavity near the flattened wedge-shaped anterior truncation. Fig. 4*a*, same specimen viewed from below. Fig. 5, another specimen viewed from behind.

FREDERICK McCOY.


1
3a
5
1a
3b
1b
2
1c

PLATE LV., FIGS. 1 AND 2.

PHYSETODON BAILEYI (McCOY).

[Genus PHYSETODON (McCoy). (Sub-kingd. Vertebrata. Class Mammalia. Order Cetacea.)

Gen. Char.—Teeth very large, fusiform, slightly arched, circular in section; at about middle of length the thickness of the cement is about one-fourth of the diameter, and the dentine about one-half the diameter. The osteodentine of the pulp-cavity ceases at about half the length from the base, beyond which the dentine shows conical layers of growth coinciding with the form of the apex, the thick cement becoming thinner towards the point; base of the tooth tapering conically, more rapidly than the apex, to a narrow conical small pulp-cavity coinciding with the diameter of the osteodentine. External surface of cement finely sulcated with longitudinal vermicular irregular minute wrinkles and pits.]

DESCRIPTION.—Tooth about 10 inches long and 2 inches wide at middle, tapering gradually, and slightly arched towards the obtusely rounded conical apex of the crown. Base tapering more rapidly than the crown to a small conical pulp-cavity 4 lines in diameter and 3 lines deep. Thickness of cement at middle of tooth, $5\frac{1}{2}$ lines. Both the dentine and cement have their outer surface marked with minute, wavy, rounded vermicular ridges with pits in the intervening grooves, and fewer and much larger faintly marked rounded irregular ridges.

In the general form, size, and in the proportion which the cement and dentine bear respectively to the entire diameter at about the middle of the tooth, this fossil agrees with the gigantic living Cachalot or Sperm-Whale, the largest of which our fossil equals in size. Instead of the base, however, terminating in a wide conical pulp-cavity, with a narrow margin of tooth-tissue as in the living *Physeter*, the base of the fossil tapers to a narrow point, which might be mistaken for the apex of the tooth but for having a small conical cavity. The section of the tooth shows the osteodentine of the pulp-cavity with the same curious spheroidal structure as in *Physeter*, produced by the tendency of the calcigerous cells to form concentric layers round detached vascular irregularly scattered centres; and the dentine presents the same lines converging to the apex as in the living form, from layers of calcigerous cells (as usual in cetaceous dentine). Prof. Halford has kindly measured for me the corpuscles as $\frac{1}{1,600}$th of an inch long and $\frac{1}{2,000}$th of an inch wide on the average, and the tubuli about $\frac{1}{20,000}$th of an inch in diameter, but almost unmeasurable. The corpuscules and tubuli being therefore smaller than in the English crag fossil *Balænodon*.

As in the Cachalot, the osteodentine of the pulp-cavity blends imperceptibly with the dentine. The radiated bone corpuscles of the cement agree almost completely with those of the living *Physeter* and fossil *Balænodon ;* and there is, as in the latter, a clear colorless basis of the cement forming a conspicuous narrow band, where it fills the undulations formed by transverse sections of the longitudinal flutings of the dentine. The *Balænodon*, from beds of the same geological age as those affording our fossils (Older Pliocene), differs entirely in the greater proportion of the diameter occupied by the dentine.

The magnificent specimen represented by our Figure 1 was discovered by Mr. J. F. Bailey, of Melbourne, in one of his many successful explorations of the strata at Mordialloc, and was by him presented to the National Museum, where it now bears his name as a well-merited compliment to his intelligent zeal and liberality.

Rare in the ferruginous layers of the older Pliocene Tertiary strata of Mordialloc.

Explanation of Figures.

Plate LV.—Fig. 1, view of tooth, imperfect at upper end, natural size, showing the external surface, and base, and the small conical pulp-cavity. Fig. 1*a*, longitudinal and transverse sections of other side of same specimen, showing the spheroidal nodular structure of the osteodentine towards the middle below, the more solid dentine, with lines marking the form of the apex of the crown, and the coarse radiating fibrous external layer of cement. Fig. 1*b*, surface ridging, magnified. Fig. 1*c*, cement tubes, magnified. Fig. 2, longitudinal section of another specimen, polished in one part and roughly fractured in the others, natural size.

Plate LV., Fig. 3.

SQUALODON WILKINSONI (McCoy).

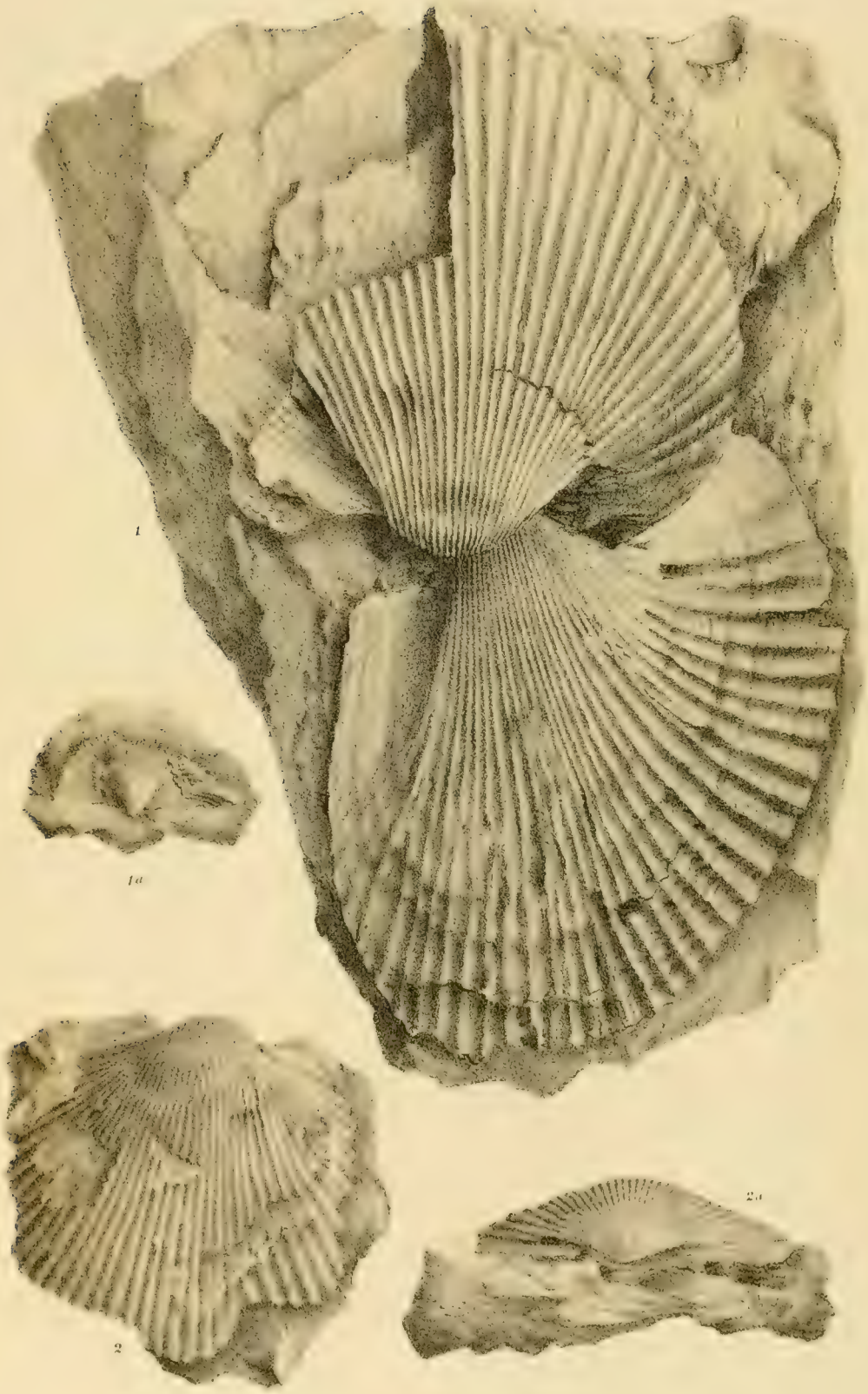
Description.—(For hind, lobed teeth see Decade II., plate xi.) Anterior teeth with a long single cylindrical fang, and a short, conical, arched, moderately compressed crown having an oval section. Surface of crown highly polished, and marked with narrow, irregular, prominent, simple or branching, angular rugged longitudinal ridges, more numerous towards the base. Length of crown and root, about 1 inch 10 lines; length of crown, about 9 lines; longer diameter at base of crown, 5 lines; shorter or transverse diameter, 4⅓ lines.

I am here enabled to figure one of the simple conical arched anterior teeth of this curious carnivorous extinct genus of Whales, so unlike the lobed posterior molars figured in our second Decade, but showing in this another approximation to the larger extinct Cetacean genus of Tertiary Whales, the *Zeuglodonts* of America. This is one of the many interesting discoveries of Mr. W. Nelson in the Waurn Ponds quarries of the Miocene Tertiary deposits near Geelong, from which place also I should mention that the Rev. Mr. Price has sent me a portion of the lobed posterior tooth, like that in our first figures from a different locality.

EXPLANATION OF FIGURES.

Plate LV.—Fig. 3, side view of fang and crown, natural size. Fig. 3*a*, surface of crown, magnified to show the character of the ridging, agreeing with that of the lobed teeth. Fig. 3*b*, form of section of base of crown.

FREDERICK McCOY.



(M. Goydzier.)

J. Sudds.

PLATE LVI.

CARDIUM GIPPSLANDICUM (McCoy).

[Genus CARDIUM (LIN.). (Sub-kingd. Mollusca. Class Lamellibranchiata. Order Ishedrolotila. Fam. Cardiadæ.)

Gen. Char.—Shell sub-cordate; margins close or gaping anteriorly and posteriorly; cardinal teeth, 2, 1, or absent; lateral teeth, one anterior and one posterior, or absent. Marine. Range in time from Palæozoic to Recent.

The surface is usually costate, radiatingly, but in the section *Protocardium* the radiating ridges are only distinct on the posterior slope, and there is a slight sinus in the pallial scar.]

DESCRIPTION.—Rotundato-quadrate, slightly oblique, ventral margin very convex, gradually curving to the obtusely rounded cardinal angles; moderately convex, greatest depth about the middle; beaks large, tumid, slightly oblique; about 36 subequal, rounded, large radiating ridges, separated by narrow sulci, about as wide as the ridges; the anterior and posterior sides close to the hinge-line flattened and smooth; whole surface slightly marked with fine close concentric striæ of growth. Greatest length and depth nearly equal, $3\frac{1}{4}$ inches in large specimens; the depth cannot be accurately given owing to the irregular compression of the specimens.

This striking fossil was first made known to me by the discovery of the large specimen, figured in the upper part of our plate, in the Mount Matlock flags by Mr. N. Lepoidivil, who presented it to the public collection. I have cleared several specimens carefully in search of hinge-teeth, and believe them to be absent. Although not quite satisfied with the generic reference to *Cardium*, still it is congeneric with the previously described Upper Silurian *Cardiums*, and is not more allied to any other genus, nor does it show any character incompatible with a generic affinity with the living edentulous species of *Cardium*.

In the black Upper Silurian flags of Mount Matlock; common in the yellowish and pinkish earthy beds of Upper Silurian, 4 miles above Starvation Creek; common in the blackish soft Upper Silurian flags of Russell's Creek, Gippsland.

EXPLANATION OF FIGURES.

Plate LVI.—Fig. 1, large specimen, natural size, from Mount Matlock. Fig. 1*a*, apex of beak and hinge-line of same. Fig. 2, another specimen from near Starvation Creek. Fig. 2*a*, beak and hinge-line of same specimen seen from the back.

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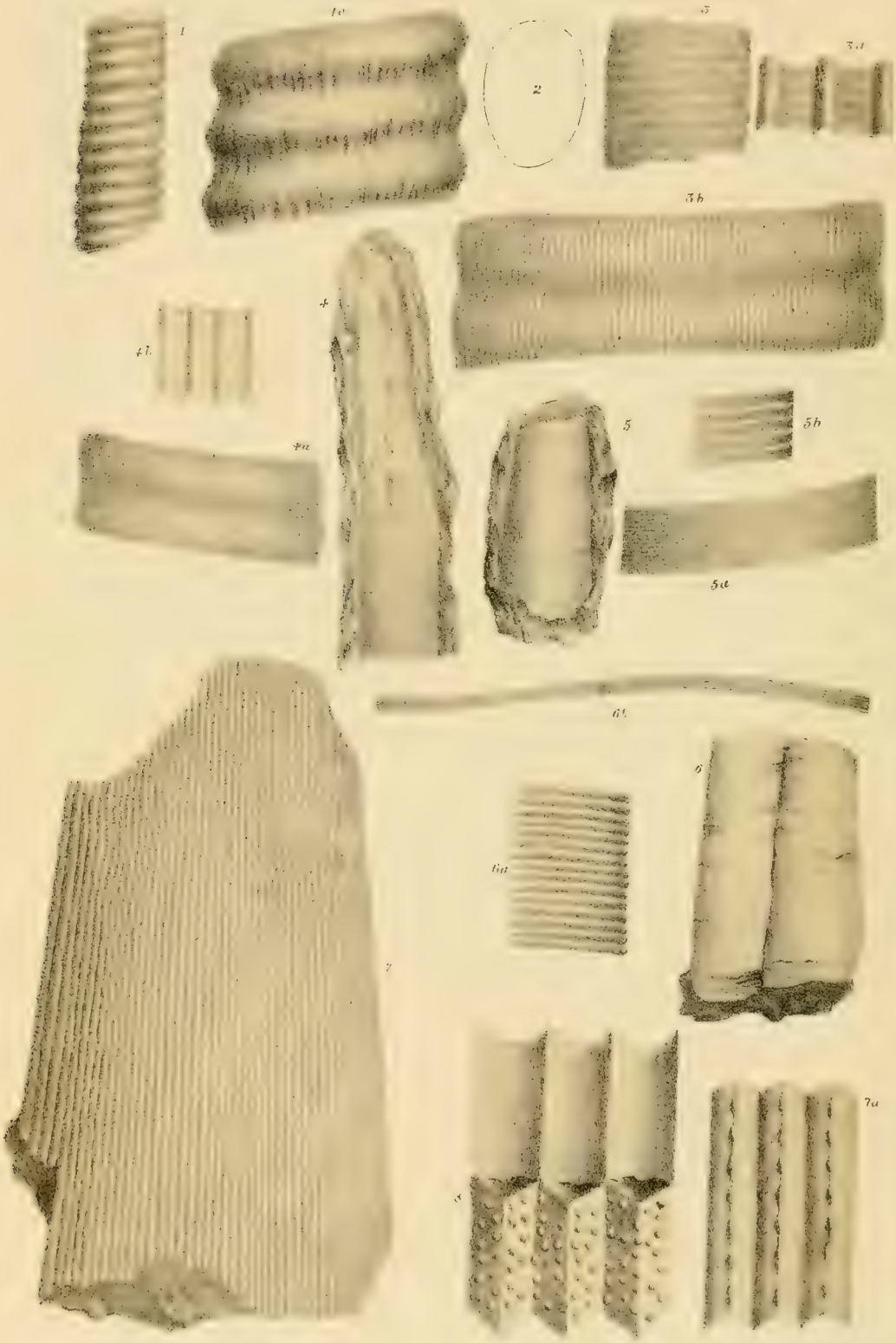

1
1a
2
3
3a
3b
4
4b
4a
5
5b
5a
6b
6
6a
7
7a

PLATE LVII., FIGS. 1 AND 2.

ORTHOCERAS (CYCLOCERAS) IBEX (SOW.).

[Genus ORTHOCERAS (BREYN.) restricted. (Sub-kingd. Mollusca. Class Cephalopoda. Order Tetrabranchiata. Fam. Nautilidæ.)

Gen. Char.—Shell conical, straight or nearly so, having the greater part of the posterior end traversed by convex, transverse septa, with simple edges, at right angles to the long axis of the shell; siphon calcareous, central or slightly excentric, cylindrical or dilated between the chambers; external surface even.

Sub-genus Lococeras (McCoy). General form of *Orthoceras* proper, but the septa are oblique to the long axis, and have a deep wave in their edges on each side, and the siphon is either marginal or submarginal, varying, however, as in *Orthoceras*, in thickness or inflation between the septa.

Sub-genus Cycloceras (McCoy). Shell straight, or slightly curved at the tip, tapering; section circular or slightly oval; girt with prominent transverse rings; siphon varying from sub-central to marginal; septa at right angles to the axis of the shell, with even edges; surface often sculptured with scaly laminæ, or decussated.

The external characters of this ringed and often sculptured group is so strongly marked that it forms a useful, easily recognised sub-genus, provisionally, apart from the true *Orthoceras*.]

DESCRIPTION.—Shell long, slightly compressed, nearly cylindrical (tapering at the rate of about half a line in 3 inches at the diameter of 6 inches), with occasional abrupt diminutions of diameter; girt with prominent, narrow, rounded, slightly oblique, and very slightly flexuous rings, about $\frac{2}{3}$ of a line thick, separated by rather wider concave spaces; about five rings in a space of 6 lines at 6 lines in diameter; septa, one between each pair of rings; section broad oval; siphon slightly excentric towards one of the broad sides. Surface with very fine longitudinal furrows and close transverse striæ.

REFERENCE.=*O. Ibex* (Sow.) + *O. articulatum* (Sow.); Murch. Sil. Syst., t. 5, fig. 30, 31.

On the most careful comparison with English and Swedish Upper Silurian specimens I cannot find any difference in the Australian examples. As in the English specimens when preserved like ours in sandstone it is extremely difficult to detect traces of the striation, but they may be seen by those who know what to look for. Although Mr. Sowerby does not mention the transverse striation, Mr. Salter (who is understood to have engraved the figure) distinctly states that it is present in the original specimen of the above quoted, t. 5, fig. 31, in his remarks at page 354 of the pt. 1, vol. ii., of the Memoirs of the Geological Survey of the United Kingdom, and I have mentioned observing the same character in other specimens from the Upper Ludlow rocks of West-

moreland (British Palæozoic Fossils, page 320). All observers are now agreed that the two supposed species of Sowerby, as above quoted in the Reference, should be united under the present name, as I originally suggested.

Common in the Upper Silurian Sandstone (Mayhill Sandstone) of Wenlock age, at road section, sect. 44, parish of Wallan (B^{15}); also in similar sandstone at (A1); also in sandstones of same age in Royal Park, near Melbourne; rarer in (B^{b} 20), Wenlock shale, near Kilmore.

EXPLANATION OF FIGURES.

Plate LVII.—Fig. 1, fragment, natural size. Fig. 1*a*, portion magnified, showing traces of striation. Fig. 2, section of larger specimen.

PLATE LVII., FIGS. 3 AND 4.

ORTHOCERAS BULLATUM (Sow.).

DESCRIPTION.—Section broad oval, tapering gradually (at about the rate of 3 lines in 2 inches from a diameter of 1½ inches); septa about 1 line apart, at about 1 inch or less in diameter; very slightly oblique; [siphon subcylindrical, moderate, nearly central]; surface covered with fine, rigid, nearly equal longitudinal striæ, nearly twice their thickness apart, separated by flat spaces, about 8 in the space of one line.

REFERENCE.—Sow., Sil. Syst., t. 5, fig. 29.

There cannot be any doubt of the identity of this Australian species with the English one, of which I have formerly published (Brit. Pal. Foss.) a more minute description than that originally furnished by Sowerby, although the character above enclosed in brackets cannot be seen in our Australian fragments. When viewed with a longitudinal incidence of light, very faint, slightly convex, transverse undulations may be seen in parts which are not visible when the light is transverse.

The *O. Neptunianus* (Bar.) from the Upper Silurian limestone of Bohemia is very nearly allied, but has the septa much wider apart and the striæ closer, and less regular as I find on comparison.

Rare in olive mudstones of Upper Silurian (Upper Ludlow) age in cutting at Johnston street, Collingwood, Melbourne. In fine sandy Upper Silurian beds (B^{12}) of hills in township of Whittlesea, parish of Toorourrong.

EXPLANATION OF FIGURES.

Plate LVII.—Fig. 3, fragment from Whittlesea, natural size; (transverse undulations coinciding with position of septa slightly too strongly marked for the direction of the light in the figure). Fig. 2*a*, portion of striæ highly magnified, showing the rarely seen transverse striæ of growth crossing the flat spaces between the longitudinal lines. Fig. 3*b*, entire width of specimen less highly magnified to show the number of the striæ. Fig. 4, specimen, natural size, from Johnston street. Fig. 4*a*, portion magnified to show number of striæ. Fig. 4*b*, portion more highly magnified to show the normal character of the striæ and the flat interspaces.

PLATE LVII., FIG. 5.

ORTHOCERAS CAPILLOSUM (BAR.).

DESCRIPTION.—Slightly compressed, section broad oval; very gradually tapering at the rate of 1 line in 1 inch from a diameter of 10 lines; surface girt with very slightly oblique, very fine, equal, rigid, thread-like transverse striæ, 19 in the space of 2 lines at 6 lines in diameter, separated by flat spaces nearly twice the width of the ridges.

A careful comparison of our fossil with specimens from the Upper Silurian limestone of Barrande's Bohemian locality, Butowitz, near Prague, leaves no doubt of the perfect identity of our species, giving another proof of the correctness of the original reference I ventured to make of the Kilmore strata to the Wenlock period. The finer striæ, or their greater number in a given space, readily distinguish the species from Portlock's *O. tenuicinctum.*

Not uncommon in the Wenlock shale of Broadhurst's Creek (B^b 18), E. of Kilmore.

EXPLANATION OF FIGURES.

Plate LVII.—Fig. 5, fragment, natural size. Fig. 5*a*, entire width magnified to show the slight obliquity of the striation. Fig. 5*b*, portion of striation more highly magnified to show the proportion of the narrow elevated striæ to the wider flat interspaces.

PLATE LVII., FIG. 6.

ORTHOCERAS LINEARE (MÜNST.).

DESCRIPTION.—Very gradually tapering, at the rate of $1\frac{1}{2}$ lines in 1 inch from a diameter of 10 lines, at which size the septa are 2 lines apart; surface girt with excessively fine, close, equal, very slightly oblique, transverse striæ, 29 in a space of 2 lines, without distinct interspaces.

REFERENCE.=Orthoceratites linearis (Münster), Beiträge zur Petrefactenkunde, Heft 3, t. 19, f. 1.

The excessive fineness and regularity of the microscopic transverse close thread-like lineation renders this species easy of recognition. Count Münster originally described it from the Upper Silurian of Elbersreuth, and M. Barrande subsequently found it in limestone of the same age in Bohemia. I do not think it has been found elsewhere until I now find it in Victoria in strata of the same age.

Not uncommon in the olive mudstones of the junction of Woori Yallock and the Yarra.

EXPLANATION OF FIGURES.

Plate LVII.—Fig. 6, fragment, natural size. Fig. 6*a*, striation highly magnified to show the closeness of the rounded striæ without defined interspaces. Fig. 6*b*, a few striæ across the whole width of the shell, magnified three diameters to show their slightly oblique wave.

PLATE LVII., FIGS. 7 AND 8.

ORTHOCERAS STRIATO-PUNCTATUM (MÜNST.).

DESCRIPTION.—Short conical, rapidly tapering, at the rate of 5 lines in 2 inches from a diameter of about 2 inches; surface covered with strong, slightly unequal, longitudinal ridges, about 4 or 5 in a space of 2 lines at 2 inches in diameter; between each pair is a longitudinal row of strong oval puncta, about two in a length, equalling the transverse distance of the rows; slightly oblique, sigmoid, transverse fine lines of growth.

REFERENCE.=Orthoceratites striato-punctatus (Münster), Beiträge zur Petrefactenkunde, Heft 3, t. 20, f. 1 to 3.

This very large, rapidly tapering, handsome, species at first sight recalls the English *O. filosum* of the Lower Ludlow rocks, but is at once distinguished by the rows of ovate tubercles between the lines. Count Münster originally described it as common in the Upper Silurian rocks of Elbersreuth, and M. Barrande has since found it in the Bohemian Upper Silurian limestones of Kozorz and Lockhow, near Prague; but I have never heard of it elsewhere until recognising it in the strata of the same age in the colony of Victoria.

Very common in the Upper Silurian olive mudstones of the age of the Wenlock shale at McMahon's Creek, Upper Yarra; in similar beds at Reefton, Warburton.

EXPLANATION OF FIGURES.

Plate LVII.—Fig. 7, fragment, natural size, from Reefton. Fig. 7*a*, portion magnified to show the row of tubercles as appearing on a cast. Fig. 8, portion of another specimen magnified to show the granulation seen on the ridges on some impressions of inner layers.

FREDERICK McCOY.


1
1a
1b
5
5a
2
3
4

PLATE LVIII.

HINNITES CORIOENSIS (McCOY).

[Genus HINNITES (DE FRANC.). (Sub-kingd. Mollusca. Class Lamellibranchiata. Order Pleuroconcha. Fam. Pectinidæ.)

Gen. Char.—Shell irregular, inequivalve, moderately oblique and inequilateral; in the young state regular, pectiniform, nearly equilateral, ovate, both valves regularly ridged radiatingly, with small pointed beaks, and a straight hinge-line extended into quadrate ears, the anterior ear of the right valve with a small sinus for the passage of a byssus; with age the growth suddenly becomes irregular, undulated, distorted, and fixed by the substance of the right valve, which develops irregular prominent concentric scaly projecting growths; left or upper valve usually flatter, and radiatingly ridged without squamæ or marks of attachment; no hinge-teeth; cartilage-pit triangular, agreeing with Pecten.]

DESCRIPTION.—*Young* stage from ½ to 1½ inch in length, regular, ovate, very slightly oblique, with nearly equal subquadrate ears, valves nearly equally and moderately convex; surface closely radiated with narrow subangular ridges, nearly equal near the beaks, but each pair receiving between them irregularly from one to five smaller ridges towards the margin (in some specimens the original ridges remain so much more prominent than the intercalated ones that angular bundles are formed); each ridge is roughened by hollow semiconical spines formed of projecting angularly arched scales a little further apart than the thickness of the ridge, interspaces varying from the width of the ridge to four or five times the width of the ridges, and closely covered with a perfectly regular pattern of oblique intersecting lines of equal rounded granules, less than their diameter apart, about twelve in two lines; usually about eight ridges in two lines at an inch from beak, but varying from three to ten. *Adult* growth beyond the young regular stage—valves suddenly becoming irregular in growth, often obliquely extended posteriorly, the upper or left valve irregularly undulated and flatter than the right valve, but varying from concave to convex; the ridges nearly equal, very irregularly undulating, the spinose scales less regular, and becoming obsolete at margin of old specimens; flat intervening spaces about twice the width of the ridges, crossed by concentric lines of growth; right valve with a scar of attachment, and with large irregular projecting concentric scaly fringes. The muscular impression large. Length of large specimen, 3½ inches; depth from beak to opposite margin about the same; width varying from 1 to 2 inches.

This extremely common fossil in our Miocene Tertiary strata is a representative of the European *Hinnites Cortesii* (de Franc.) of the Coralline Crag of England and corresponding Tertiary strata on the European continent. The characters of the extinct genus *Hinnites* are well seen in this species, appearing to connect the genera *Pecten* and *Ostrea*. The young regular Pecten-like stage of growth being seen for about an inch from the beaks corresponding with the time it was attached by a byssus; the older stage of growth, when it became fixed by the shelly substance of the lower

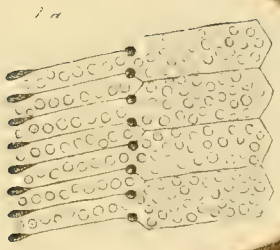
or right valve, being marked by sudden irregularity of general growth and change of the character of the ridging, and by the development on the lower or right valve of the large concentric irregular shelly fringes like those of *Spondylus.*

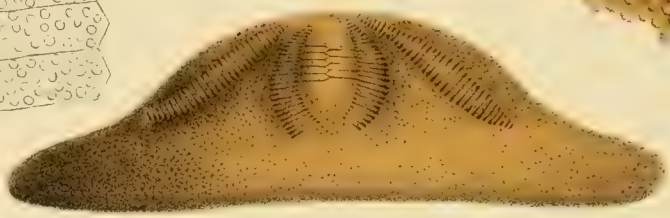
Extremely common in Miocene Tertiary of Corio Bay ; and in similar beds near Bairnsdale, on the Nicholson River.

Explanation of Figures.

Plate LVIII.—Fig. 1, average specimen of left valve, natural size. Fig. 1*a*, magnified view of striation, showing the proportions of the interspaces and the character of the vaulted scales forming the tuberculation about the middle of the shell on the older stage of growth. Fig. 1*b*, magnified view, showing character of more uniform ridges with blunt tubercles becoming obsolete near margin of old specimen. Fig. 2, magnified view of another specimen, showing the ridging of the ears. Fig. 3, view of right valve, natural size, showing the regular character of the byssiferous early stage of growth near the beak and the distorted transversely squamous older stage of growth nearer to the margin. Fig. 4, another specimen of right valve, natural size, viewed in profile, showing the great depth sometimes attained, the regular Pecten-like early growth near beak, beyond which is the large scar produced by the subsequent calcareous attachment, beyond which the concentric scale-like shelly fringes as in *Spondylus* are seen and the nearly equal ridges.

Frederick McCoy.





J. Barthol. ipsor. del. et lith.

Prof. McCoy Direx.

Sp. Lyon.

PLATE LIX.

CLYPEASTER GIPPSLANDICUS (McCoy).

[Genus CLYPEASTER (LAM. restricted). (Sub-kingd. Radiata. Class Echinodermata. Order Echinida. Fam. Clypeasteridæ.)

Gen. Char.—Testa of single walls; subpentagonal, depressed; ambulacra petalloid; actinal, or lower, surface flat, with the mouth depressed in a narrow circumscribed hollow; well-developed straight ambulacral grooves extend from mouth. Tubercles small, perforated and crenulated. Supports between upper and lower walls formed of very numerous, needle-like (in size and shape) calcareous styles and fewer, thicker, irregular pillars. A row of pores in the sutures connecting the long sides of the two rows of ambulacral plates beyond the petals in some species.]

DESCRIPTION.—Subpentagonal, longer than broad, greatest width opposite end of anterior pair of petals of ambulacra; outline at interambulacral edges slightly concave; lower, or actinal, surface flat, with a small central depression for mouth; marginal edge obtusely rounded; surface above rather flat from edge to distal ends of ambulacral petals, from whence the back rises with a rather sudden moderate convexity to abactinal apex. The sulcated poriferous part of petals and the median ambulacral spaces nearly equal, the latter more prominent but less convex than the interambulacra; twenty-five to twenty-six pairs of pores in each half ambulacral petal. Genital openings small, close to the madreporiform plate. Tubercles nearly equal on upper and under surfaces, close set, with usually one or two rows of intervening miliary granules; anal opening its own diameter within the lower edge. Length of average specimen, $3\frac{1}{2}$ inches; in proportion to length (taken as 100), width, $\frac{88}{100}$; height, $\frac{27}{100}$; length of two hinder ambulacral petals measured from genital pore, $\frac{32}{100}$; anterior lateral pair of petals, $\frac{30}{100}$; anterior odd petal, $\frac{35}{100}$; diameter of anus, $\frac{7}{100}$; diameter of madreporiform apex from one genital pore to opposite, $\frac{5}{100}$; greatest width of petals, $\frac{19}{100}$; width of ambulacral space between the rows of pores, $\frac{10}{100}$ (anterior lateral pair slightly less). Seven tubercles in a space of 2 lines on middle of side of upper surface, four in same space on lower surface.

This fossil has been referred to by Prof. Duncan, the Rev. J. Tenison Woods, and other authorities as identical with the recent *Echinanthus testudinarius* (Gray), found commonly on the warmer N. E. coasts of New South Wales and Queensland, though not on our cooler southern shores. The under surface of the fossil is, however, much flatter, and the depression for the mouth much smaller and more abruptly defined or suddenly bent inwards. The tubercles on the upper surface are also more numerous, and the granular spaces between them narrower, and with fewer miliary granules between them than in the living species, in which also the tubercles are smaller and with much more numerous granules between them than on the under side, departing widely from the fossil, in which

the tuberculation of the upper and lower surfaces is more nearly alike; the diameter of the tubercles, in the fossil, is usually greater than the intervening flat space, but much less in the living form, in which the comparatively wide flat granular spaces between the tubercles are conspicuously different. The number of pores in the rows of ambulacral petals is also a marked and obvious difference between the living *E. testudinarius* and the present fossil species; there being thirty-six in the anterior petals, and forty in the posterior petals of the recent form, but only twenty-five in the anterior, and twenty-nine in the posterior petals in the fossil. The greatest difference is, however, to be found by making a horizontal section of the margin, where, in specimens of the same size and thickness of margin, the fossil has five to eight concentric rows of vertical calcareous pillars extending from the lower to the upper walls, exactly as in the recent *Clypeaster subdepressus* (Gray) (Ag. Rev. Echin., t. 13, f. 17; and t. 11[b], figs. 3 and 4; and t. 11[c], figs. 1 and 2; and t. 12[d], fig. 4), while the recent *Echinanthus testudinarius* has only one row round most of the margin, and no more than two imperfect rows on the posterior edge. The interior, except where the intestine winds, is crowded with the very slender needle-like calcareous filamentary vertical extensions from the upper and lower walls of the testa, so common in the typical living species of *Clypeaster*.

Vertical section showing marginal and more central pillars and the fine "needles" from upper and lower walls.

I very much doubt the wisdom of maintaining *Clypeaster* and *Echinanthus* as distinct genera, when the characters are so completely united as we find them in the recent Australian *Echinanthus testudinarius* of Gray. The genus *Clypeaster* is supposed to be distinguished from *Echinanthus* by the flatter lower surface, smaller depressed space in which the mouth is sunk, by the better defined ambulacral grooves on the under side, by the walls being thinner, single and not double as in *Echinanthus*, and by the many slender needle-like styles rising from the lower floor, contrasting with the more massive columns of *Echinanthus*. The pores on the edges of the ambulacral plates beyond the petals, supposed to be another distinctive character, do not seem to exist in the Malta *Clypeaster*

Tarbellianus and allied forms, which I have cautiously ground down for the purpose of making a careful examination, and find they are as completely absent as in our present Gippsland species.

The nearest analogue for our fossil is, I think, the recent American (Florida and West Indies) and West African *Clypeaster subdepressus*, which is, however, clearly distinguished by its longer anterior petal, and it also has the ambulacral pores beyond the petals well marked. The walls of the testa vary in thickness very much, but are, as far as I have seen, always single.

Very common in Miocene Tertiary strata of Bairnsdale and other localities in Gippsland; rarer and of smaller size in the Miocene strata of Corio Bay; rare and small in the Miocene beds of Muddy Creek, near Grangeburn, 5 miles from Hamilton; rare in Miocene Tertiary limestone at the locality marked $F^{s}M$; rare in the Lower Pliocene beds of Mordialloc.

Explanation of Figures.

Plate LIX.—Fig. 1, average specimen, natural size, viewed from above. Fig. 1*a*, same specimen viewed in profile. Fig. 1*b*, same specimen viewed from below, showing the flat under side, small mouth, and strong ambulacral grooves. Fig. 1*c*, tubercles and granules, magnified. Fig. 1*d*, portion of ambulacral petal, magnified, showing half of the interporiferous portions and more numerous poriferous plates of one side of petal, magnified.

Frederick McCoy.

Echinodermata.

PLATE LX., FIGS. 1–4.

LOVENIA FORBESI (McCOY).

[Genus LOVENIA (DESOR. EMEND.) = HEMIPATAGUS (DESOR.) = MARETIA (GRAY). (Sub-kingd. Radiata. Class Echinodermata. Order Echinida. Fam. Spatangidæ.)

Gen. Char.—Testa thin, cordiform, narrow, and truncated behind; large primary tubercles perforated, in deep pits, those of upper surface on the two anterior pairs of interambulacra, absent on the posterior interambulacrum; ambulacral petals moderate, the anterior half of the apical portion of the anterior lateral petals obsolete; anal opening on the narrow truncated posterior end; anterior ambulacrum sunk in a broad shallow groove; genital pores four, the anterior pair smaller and closer together than the posterior pair. Under side with a nearly smooth central plastron, with the transversely lunate mouth excentric towards the anterior side; lateral portions flatter, with large primary perforated tubercles in deep pits. Fascioles, one internal on upper surface, and one spectacle-shaped subanal one, with a group of primary tubercles in dilated lateral portions; miliary tuberculation, small (but much larger than that of the fascioles), covering the whole upper surface, and between the primary tubercles below.]

DESCRIPTION.—Cordate, subpentagonal, greatest width about middle of posterior lateral interambulacra, variable; profile moderately arched from apex to front, less arched to overhanging posterior margin; greatest depth a little behind the apex; posterior truncated end narrow, with an obtuse ridge extending to the apex, from which the sides slope with slight convexity to the obtuse lateral margins; anterior sulcus and notch in front margin varying in depth, the obtuse bounding ridges covered with a band of rather coarse miliary tubercles; anterior pair of lateral ambulacra diverge obliquely with a slight forward and outward curve from the apex; posterior pair of ambulacra shorter and straighter than the anterior lateral pair; forming less than a right angle with each other; ocular pores very minute; whole upper surface granulated with close fine miliary tubercles; a band of larger ones, with finer between, on the ridge on each side of anterior sulcus; primary tubercles large, perforated, not crenulated, in very deep pits, 4 to 11 in one to three rows on anterior lateral pair of interambulacra, and 4 to 11 in two to five rows on anterior part of posterior lateral pair of interambulacral spaces; under side with numerous primary perforated tubercles on the sides, in very deep pits, to the anterior outer portion of which they are excentrically confluent; plastron, or prominent middle portion, comparatively smooth, with fine miliary granules forming a large radiating semicircular group just in front of the subanal fasciole, and a few more scattered on the more anterior plates; spectacle-shaped subanal fasciole of very minute granules with a circular group of small primary perforated tubercles within each of the lateral dilated ends, which also include three or four pores of the posterior ambulacra. Internal fasciole narrow, of very minute granules, forming an acute angle just behind the madreporiform tubercle, extending straight outwards and forwards to apex of posterior lateral interambulacra, thence with an obtuse angle extending forwards, with a slight outward concavity, along outside of granulated bounding ridges of anterior sulcus, extending about half-way from apex to margin. Usually about fourteen pairs of pores in each perfect ambulacral band, but varying from ten to sixteen.

Var. A.—With 3 to 5 tubercles in 2 or 3 rows on posterior lateral interambulacra. Length, 1 inch 4 lines; proportional greatest width, $\frac{95}{100}$; from posterior end to apex, $\frac{55}{100}$; depth, $\frac{45}{100}$.

Var. B.—With 6 to 15 tubercles on posterior lateral interambulacra in 3 or 4 rows. Length, 1 inch 2 lines; proportional greatest width, $\frac{90}{100}$; from posterior end to apex, $\frac{55}{100}$ to $\frac{59}{100}$; depth, $\frac{45}{100}$; posterior ambulacra, length $\frac{40}{100}$, width $\frac{12}{100}$ to $\frac{15}{100}$.

REFERENCE.—*Spatangus* (Forbes), Lectures on Gold, p. 50, 1852; *Spatangus Forbesi* and *Hemipatagus Forbesi* (McCoy MSS.); *Lovenia Forbesi* (Duncan), Geol. Jour. 1877, t. 4, figs. 5 to 8.

I find that it is impossible to divide this species into two, as suggested by Mr. Etheridge, jun. (*L. Woodsi* and *L. Forbesi*), from the number of primary tubercles in the posterior lateral interambulacra, although I notice that those with the more numerous tubercles are more common in the Murray cliffs and more rare near Melbourne, and that they are less pentagonal from a slightly greater proportional length and less protuberant sides, and have the apex usually farther from the posterior end, and the posterior ridge stronger. After noting hundreds of specimens I find with Prof. Duncan that the variations in any one of these points and in the slope of the anterior profile exceed the difference, and there is no connection between them; the same may be said of his var. *minor*.

I first named this species after Prof. Forbes in MSS. labels of the fossils collected by the Geological Survey of Victoria shortly after arriving in the colony nearly 20 years ago, and the specimens so labelled were from that day to this publicly exhibited in the National Museum at Melbourne. Specimens with this specific name, and my own as authority, were then sent home with Victorian collections to the different International Exhibitions held in London and Paris, and distributed thereafter to various European public museums. So, lest it might be thought that I had taken credit to myself in those early days for a discovery and specific name of any other observer, I think it best to continue to use my own name as the original authority for the species, to which I gave the name of my old colleague Prof. Forbes, because he was the first to figure it, from Melbourne specimens, in his "Lectures on our Knowledge of Australian Rocks as derived from their Organic Remains," p. 50, published in 1852,* but which no other subsequent writer seems to have noted. Prof. Forbes only named it "*Spatangus*," without giving any description or specific name. Since then numerous

* "Lectures on Gold," &c., delivered at the Museum of Practical Geology. London: D. Bogue. 1852.

better figures and more or less perfect descriptive notices have been published by the Rev. J. E. Tenison Woods, Prof. Duncan, Dr. Laube, and Mr. Etheridge. The Rev. Mr. Tenison Woods took my name for this species on looking over the Melbourne Museum, and figured it as *Spatangus Forbesi* in his "Geological Observations in South Australia," in 1862, without giving any authority, and mentioning that Capt. Sturt was in error in identifying it with the *Spatangus Hoffmanni* (Gold.). Prof. Duncan and Dr. Laube next dealing with the species, gave to the Rev. Mr. Tenison Woods the correction of Sturt's error, and also gave his name as the authority for the species; this was soon corrected by that author, who in his next published notice * gave me the credit of distinguishing the species, and in writing to me said he must have copied the name from my specimens in the Museum and forgotten where he had obtained it. Prof. Duncan has since added his own name (Woods and Duncan) as the authority for the species, but under the circumstances he also will probably prefer to leave it now under the old authority.

To Prof. Duncan belongs the credit of first showing the identity of *Hemipatagus* and the older genus *Lovenia*, and of clearly showing the fascioles of the present fossil. I have figured the details as carefully as I can make them out, but fail to see in my specimens any transverse connection between the anterior ends of the internal fasciole, which do not go beyond half-way from the apex to the front margins, and do not seem to interrupt the inner bands of coarser tubercles on the bounding ridges of the anterior sulcus.

Extremely abundant, filling one particular ironstone layer in the older Pliocene strata of Mordialloc and Frankston, on the east side of Port Phillip Bay; very abundant in cream-color, calcareous Upper Miocene beds of the Murray banks; very abundant in yellow Miocene beds of the locality marked (F^s m.); common, beautifully preserved, in the creamy Miocene beds of Portland Bay; common,

* "I must here note that Dr. Duncan inadvertently gives me credit for a discovery which does not belong to me. Sturt's mistake was corrected by Prof. McCoy as palæontologist of the Geological Survey. The . . . Professor did not publish any diagnosis, and I really forget now how his determination reached me." Paper by the Rev. J. E. Tenison Woods. Read December 19, 1865, to and published by Adelaide Philosophical Society.

but of small size in similar beds, Upper Miocene limestone beds from mouth of Curdie's Inlet (A^w 11); also in similar beds at Bird Rock Point, $\frac{3}{4}$ mile west from mouth of Spring or Tait's Creek, parish of Jan Juc, 15 miles S. from Geelong; lower beds of Miocene (A^d 23); and S. of mouth of Spring Creek (A^d 20); and at Bird Rock Point, middle beds of Miocene (A^d 24), A^d 28; Waurn Ponds quarries, near Geelong, and also from Miocene beds of beach at outer Geelong Harbor (A^d 12).

Explanation of Figures.

Plate LX.—Fig. 1, specimen, viewed from below, to show the peculiar arrangement of the tuberculation; natural size. Fig. 1^a, same view magnified, to show the details of the tuberculation and the sub-anal fasciole. Fig. 1^b, same specimen, viewed in profile. Fig. 1^c, same specimen, viewed from posterior end, natural size. Fig. 2, average specimen of typical variety, natural size, viewed from above. Fig. 2^a, same view magnified, to show the details of the tuberculation, the ambulacra, the four genital pores, the posterior madreporiform tubercle, and the internal fasciole. Fig. 3, primary tubercles of under side, to show the eccentric junction with the margin, magnified. Fig. 3^a, primary tubercles of upper side, magnified. Fig. 4, elongate variety with more numerous primary tubercles on posterior lateral interambulacra, natural size. Fig. 4^a, same specimen, viewed from above.

Plate LX., Figs. 5–7.

MONOSTYCHIA AUSTRALIS (Laube).

[Genus MONOSTYCHIA (Laube). (Sub-kingd. Radiata. Class Echinodermata. Order Echinida. Fam. Scutellidæ.)

Gen. Char.—Testa flat or slightly concave below, subpentagonal, rounded, slightly longer than wide; edge thin, deeply indented at the ends of the ambulacral furrows, and slightly indented in middle of posterior margin; apex a little in front of the centre, slightly raised conoidally; profile nearly straight to hinder edge, slightly convex to the front; genital pores four, the hinder larger and farther apart than the anterior pair; ocular pores very minute; ambulacral petals wide open at ends, the pores of each pair widely separated in the middle, connected by oblique sharp sulci; the pores of the inner row of each ambulacral zone smaller and rounder than the slit-shaped outer ones; the outer line of pores of each half ambulacrum more arched than the straighter inner row, the acutely angular interporiferous space nearly twice as wide as the poriferous zone; mouth rounded or subpentagonal, central; five deep narrow ambulacral furrows extend from the mouth to the margin, the three anterior nearly straight, the posterior lateral pair slightly arched outwards and forwards, extending with similar directions on the upper side through the centre of the ambulacra nearly to the apex; anal opening on under side, near the sinus in posterior margin, a slight prominence extending from it to the mouth; internal supports from mouth to margin, except in place of intestine, very numerous, and variable in size and shape; whole surface covered with minute close rounded tubercles, the narrow ridges between which are simple above and granular below. Differs from *Scutella* in its simple unbranched ambulacral furrows from mouth; differs from *Arachnoides* in being longer than wide and having the anal opening on the under side.]

Description.—Subpentagonal or nearly round. 13 to 15 tubercles near margin above of several large and moderate sized specimens in a space of 2 lines; 9 to 10 in same space below; very large specimens, 12 above, 6 below: 32 to 36 pores in each row of the ambulacral petals. Proportions:—

Large specimen—Length, 2 inches 3 lines; in proportion thereto, greatest width, $\frac{93}{100}$; length of ambulacral petals, $\frac{24}{100}$; depth, $\frac{20}{100}$.

Small specimen—Length, 1 inch 4 lines; in proportion thereto, greatest width, $\frac{90}{100}$; length of ambulacral petals, $\frac{30}{100}$; depth, $\frac{25}{100}$.

Small specimen—Length, 1 inch $1\frac{1}{2}$ lines; in proportion thereto, greatest width, $\frac{90}{100}$; length of ambulacral petals, $\frac{24}{100}$; depth, $\frac{18}{100}$.

Small specimen—Length, 1 inch $9\frac{1}{2}$ lines; in proportion thereto, greatest width, $\frac{90}{100}$; length of ambulacral petals, $\frac{27}{100}$; depth, $\frac{19}{100}$.

Round variety—Length, 1 inch $3\frac{1}{2}$ lines; in proportion thereto, greatest width, $\frac{95}{100}$; length of ambulacral petals, $\frac{26}{100}$; depth, $\frac{16}{100}$.

Reference.—Laube Sitzungsberichte d. Kaiserlichen Akademie d. Wissenschaften zu Wien, 1869, p. 190, t. ?, fig. 3.

This is a very variable species in form, in the strength of the ambulacral furrows, in the depth or distinctness of the notches in the margin where they pass over, and the degree of curvature or straightness of the posterior pair of ambulacral furrows, and the prominence of the posterior interambulacrum at the margin, and I do not find any coincidence between the variations; nor do I think Dr. Laube's observation, "Die jüngsten Exemplare sind fast kreisrund, mit kaum angedeutetem Rostrum und unmerklichen Randkerben, auch du Ambulacralfurchen sind kaum wahrnehmbar, erst im mittleren Alter werden letztere deutlicher und das Rostrum tritt mehr und mehr hervor, bis es sich scharf und deutlich abhebt," borne out by the very numerous specimens I have examined, as some very small ones are of the longest proportions, and have the most projecting posterior interambulacrum (Rostrum of Laube) of any I have seen, and the largest specimens have the least indentation of the margin at the passage of the ambulacral furrows and least projection of the hinder part. Most of the nearly circular examples are, however, small, while small and large show the slight elongation of the more pentagonal forms. Towards the margin of large specimens the ridges between the granules on the under side show a tendency to diverge in oblique, feather-like lines from the ambulacral furrows; but this also is very variable and often not recognizable, although occasionally seen in all the above noted varieties.

Common in the cream-color Miocene Tertiary beds of the Murray cliffs ; also at Bird Rock Point, S. of Geelong, lower beds of Miocene (A^d 24).

Var. LOVENI (Dunc.).

Description.—Length and width equal or nearly so. Length, 1 inch 10½ lines; width, $\frac{98}{100}$; length of ambulacra, $\frac{25}{100}$; depth, $\frac{16}{100}$. Tubercles in space of 2 lines, 12 below, 17 to 20 above.

Reference.—*Arachnoides Loveni* (Duncan), Q. J. G. S. L., February 1877, p. 47, t. 3, figs. 6 and 7.

Very common at Mordialloc, usually broken and worn into puzzling triangular ferruginous pieces, dividing along the ambulacral furrows.

One large specimen from this locality is 2 inches 9 lines long, and has the proportional width only $\frac{86}{100}$.

As Dr. Laube has included the circular and elongate forms under his single species *M. Australis*, and as I have stated above that I can find no constant difference in these specimens, I cannot but think that Prof. Duncan's two proposed species should be only looked on as varieties of Dr. Laube's, until other characters can be pointed out to favor specific distinction.

Explanation of Figures.

Plate LX.—Fig. 5, large specimen of the elongated typical variety, from the Murray cliffs, natural size. The obscure obtuse radiated ridging is very rarely seen, even with carefully adjusted oblique light. Fig. 6, shorter, rounder form [var. *Loveni* (Duncan)], from Mordialloc, viewed from below, showing the two openings of the alimentary canal. Fig. 6^a, same specimen, viewed from above, natural size. Fig. 6^b, profile view of same specimen. Fig. 7, section showing the internal support between the upper and under walls, with the smooth, nearly circular bed of the intestine.

Frederick McCoy.

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N.B.—The originals of all the Figures are in the National Museum, Melbourne.

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