Geological Survey of Victoria.

PRODROMUS

OF THE

PALÆONTOLOGY OF VICTORIA;

OR,

FIGURES AND DESCRIPTIONS

OF

VICTORIAN ORGANIC REMAINS.

DECADE I.

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.
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MELBOURNE:
PRINTED AND PUBLISHED BY JOHN FERRES, GOVERNMENT PRINTER.
LONDON:
TRÜBNER AND CO., 57 AND 59 LUDGATE HILL.
MDCCCLXXIV.

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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.

This first Decade contains two plates of species of *Graptolites*, from which I was enabled to determine the Lower Silurian geological age of the slates containing our gold reefs.

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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.*

Then follow three plates illustrative of the extinct fossil Wombats from the gold cement of Dunolly, &c., which first enabled me to show that our gold drifts, like those of Russia, were of the age of the mammaliferous crag of the English Pliocene Tertiary period.

Then follow two plates of the singular *Volutes*, representing the *Volutilites* of the Barton clay formation of Hampshire, which, amongst others, enabled me to fix the place of the Tertiary formations, extending from the shores of Hobson's Bay to the Murray, in that debatable *étage* newer than the Eocene Tertiary and older, by Lyell's percentage test, than the Miocene, for which modern geologists have proposed the new intermediate geological period, the Oligocene.

Then comes a plate of the *Cycadeous* Plants, not found in the Palæozoic coalfields, but so abundant in, and characteristic of, the rich Oolitic or Mesozoic coalfields of India, China, Richmond in Virginia, &c., as well as in the less rich coal seams of the same age in the Great Oolite of Yorkshire and other parts of Europe, and from which, amongst others, I ventured to class the known Australian coal deposits in the Mesozoic age.

Next a plate is given illustrating one of the most highly characteristic genera of fossil plants of the Palæozoic Coal Formations, never found in the Mesozoic deposits, and figured here from the Avon sandstones in Gippsland, which I have accordingly identified as Upper Palæozoic or Carboniferous.

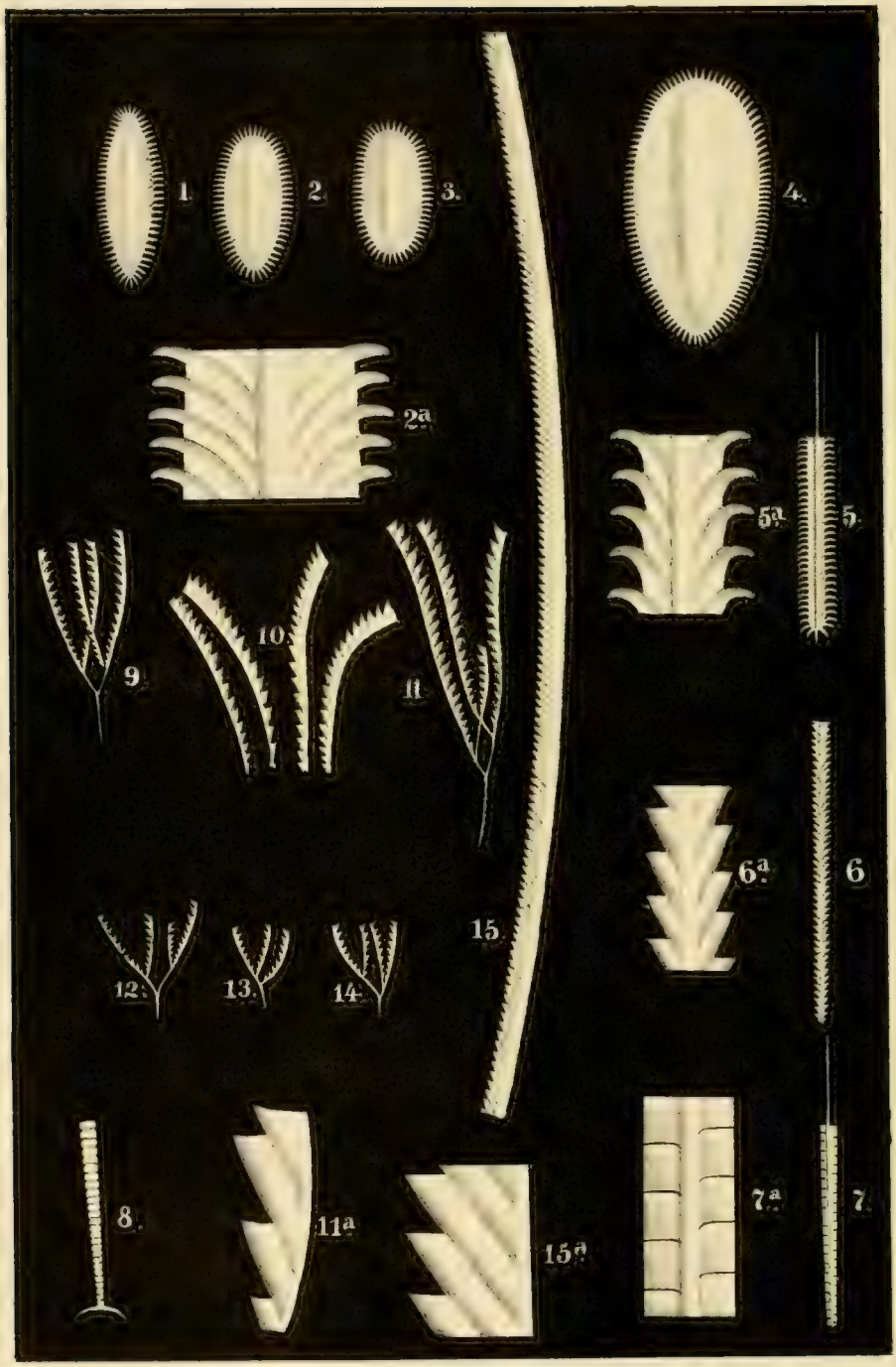
And lastly, a plate illustrating two new species of Fossil Starfishes from the Upper Silurian rocks.

The future Decades will continue the illustration of the fossil collections made in the course of the Geological Survey of the Colony, which has been now resumed under the care of the Secretary for Mines, Mr. R. Brough Smyth, the permanent head of the Mining Department.

FREDERICK McCOY.

25th May 1874.

Pl. I.



L. Schmeichel, Lith. Melb. Mus. Lith. Hamer Imp.

PLATE I.

FAM. GRAPTOLITIDÆ.

THE Graptolites are the most characteristic fossils of the Silurian rocks; and the first determination of the geological age of the Victorian auriferous reef-bearing slates was from my recognising as *Graptolites* a series of specimens which had been collected from the Bird Reef, at Bendigo, by Mr. J. A. Panton, then Warden of that goldfield. To this gentleman is due the merit of having first collected these fossils from the gold rocks, and he kindly gave me the first specimens seen for the National Museum, about sixteen years ago, when I visited him in company with Mr. Selwyn, then Director of the Geological Survey. Since that period I have identified 12 or 14 species from rocks of the same age, in different parts of the colony, collected during the progress of the survey.

Geologists may imagine the astonishment with which I recognised, in all of these, species well known to me as occuring in the Lower Silurian or Cambrian rocks of Sweden, Bohemia, Wales, Ireland, Scotland, and the United States of America, showing a world-wide distribution of these species in the old geological time. A still more curious coincidence was the fact of my having, shortly before coming to Victoria, knocked out with my hammer, from the slate rocks of the Welsh old Roman gold mines, at Gogofau, near Llanpümp-saint, exactly the same species of Graptolites which I found to be the most common in our goldfield slates in this colony; showing that the Romans had obtained their gold from quartz veins in slates in Wales of exactly the same geological age as our Australian formations.

When restricting the generic name *Graptolites* to those species having only one row of cells, in my work published in conjunction with Professor Sedgwick, "The British Palæozoic Rocks and Fossils," I suggested the sub-generic name *Didymograpsus*, or twin-Graptolites, for those species having two simple stems (such as singly would be referred to *Graptolites* proper) united by the simple

slender non-celluliferous base ; and I think the term might be advantageously extended to the more complex species, not then known, in which four, eight, or a greater number of precisely similar stems are similarly united at the base. The number of the branches could not possibly be accepted as a generic character on any analogy with the living Hydrozoa, such as *Sertularia*, *Plumularia*, &c., which are the nearest known allies of the *Graptolites;* and yet the genera *Tetragraptus*, *Loganograptus*, &c., have been mainly proposed on this ground, and I do not therefore adopt them—the portions of the stems, if found singly, being undistinguishable. In some individuals of some of these other species a horny disc has been observed connecting the bases of the stems, but it is more often absent, and its nature is not known.

The following descriptions and figures on our second plate illustrate four of those very compound species so exceedingly rare in Europe and the United States, but abounding, as shown by Professor Hall, in Canada, and, as I find, just as common in Victoria.

In the above-mentioned work I proposed the separation of the simple stems with the two rows of cells as a distinct genus under the name *Diplograpsus*, universally adopted since by Palæontologists. And, as these are confined to rocks of the Lower Silurian or Cambrian age, while those with a single row of cells are common to those rocks and the Upper Silurian, the generic discrimination of these two types of structure is of great importance to the geologist, who has thus a means put in his hands of recognising the older age of any formation in which he might find the smallest fragment of one of these double-celled Graptolites.

I have adopted here Professor Hall's view of the generic separation of those leaf-shaped forms, apparently composed of four semi-elliptical parts, joined at right angles by the straight back of the common canal at the base of each row of the cells. These forming the genus *Phyllograptus* are also confined to the Lower Silurian or Cambrian rocks.

PLATE I., FIGS. 1–4.

PHYLLOGRAPTUS FOLIUM (HIS. SP.). VAR. TYPUS (HALL).

[Genus PHYLLOGRAPTUS (HALL). (Class Zoophyta. Order Hydroida. Fam. Graptolitidæ.)

Gen. Char.—Polypidom composed of 4 semi-elliptical flat laminæ, united by the straight edge at right angles to each other; each lamina composed of tubular cells extending upwards and outwards from the straight inner edge to open on the convex outer edge. Confined to Lower Silurian or Cambrian rocks.]

DESCRIPTION.—Polypidom petaloid, either broad oval or broad ovate, with the basal end often broader or rarely narrower than the apex, or very elongate elliptical, tapering to both ends, or with straight parallel sides and obtusely rounded ends; ordinary length about 10 lines, with a width varying from $\frac{1}{3}$ to $\frac{2}{3}$ of the length. Midrib or axis varying from narrow and linear to excessively thick, about 1 line wide in specimens of ordinary size, $\frac{1}{2}$ line wide in young individuals of 3 lines long, and from $1\frac{1}{2}$ to 2 lines wide in large specimens of $1\frac{1}{2}$ inches long, according to the direction of compression. Cells gently arched outwards and downwards towards the distal end, the chord of the arc forming an angle of about 70° with the axis in the greater part of the length, but gradually becoming more erect at an angle of 40° towards the apex of the polypidom, and exceeding a right angle in the downward inclination towards the base. Mouth of each cell with a concave outline slightly extended obliquely towards the lower point, but nearly at right angles with the upper and lower boundaries, which are produced into slender, straight, or downward curved points, about equalling or slightly exceeding their distance apart in length, their width scarcely $\frac{1}{4}$ of their length; about 5 cell points in 2 lines of the margin of ordinary sized specimens of all shapes, but 7 in the same space close to the base, or in young specimens 3 lines long.

REFERENCES AND SYNONYMS.—*Prionotus folium* (Hisinger), Lethæa Suecica., pl. 34, fig. 8; *D. ovatus* (Barrande), Graptolites de Bohême, pl. 3, figs. 8 and 9; *Phyllograptus typus* (Hall), Geol. Surv. Can., dec. 2, t. 15, figs. 1–12.

I have little doubt, from careful comparative measurements of Bohemian and Swedish specimens, that both this form and the *D. ovatus* of Barrande, from the Bohemian basin, may ultimately be proved to form only varieties of the Swedish *D. folium* of Hisinger. The gigantic size of the Australian type is the first distinction which strikes the eye (the length and width commonly 3 or 4 times that of the European examples); but the most important distinctive character seems to be the extraordinary width and thickness of the midrib or axis. This, in the Bohemian and Swedish

types, is always distinctly *figured* and described as capillary, like that of *D. pristis*, but here, in the smallest young specimens, 3 lines long, it is often $\frac{1}{2}$ line wide; and in specimens preserved in the soft "pipeclay," or decomposed flags of Bendigo, where the sides of the polypidom with the cells are perfectly flat, the axis is fully $\frac{1}{4}$ of an inch thick, either depressed or projecting in relief, the width being about 1 line in ordinary sized specimens. I find both Swedish and Bohemian specimens to vary, however, just as the Canadian and Australian ones do; and on the new supposition of these Graptolites being composed of four rectangularly united pieces, the broad axis would represent one of the leaves broken through, but the slender linear appearance would follow from two adjacent leaves being flattened in one plane, leaving the linear suture in the middle as the central line. In all the varieties above noted of shape and size, the number of cell spines in the given space of the sides seems nearly constant between 5 and 7, according to position. When ill preserved, the cell teeth or spines seem slightly wider in proportion to their length than the proportion indicated above from the finest examples. The most usual form is ovate, broad, and semi-elliptical at the basal half, and narrowing, and with straighter sides, towards the upper end, which is obtusely rounded. The next most common form is a nearly regular ellipse, varying greatly in proportional width, but widest about the middle, and tapering almost equally to each end. The rarer forms have parallel sides and nearly equal rounded ends, and these seem to pass occasionally into a very long linear form bearing the same puzzling relation to the short forms that *D. foliaceus* does to *D. folium* or *D. ovatus*. I give a few measurements of different varieties (perfectly connected by intermediate specimens) to show the nature of the variation:—

1 oval: length, 1 inch 4 lines; width at middle, 9 lines; width of axis, 2 lines; not quite 5 cell points in 2 lines.

1 ovate: length, 1 inch 1 line; width at middle, 4 lines; width of axis, 1 line; 5 cell points in 2 lines of side margin.

1 oval: length, 8 lines; width at middle, 6 lines; width of axis, $1\frac{1}{2}$ lines; 5 cell points in 2 lines of side margin.

1 parallel-sided: length, 10 lines; width at middle, $3\frac{1}{2}$ lines; width of axis, 1 line; 5 cell points in 2 lines of side margin.

1 young, oval: length, $3\frac{1}{2}$ lines; width at middle, 3 lines; width of axis, $\frac{1}{2}$ line; 7 cell points in 2 lines of side margin.

In most specimens the axis becomes undefined on approaching the ends, but in some it slightly projects as a blunt angular point below. Mr. Salter's figure of *D. folium* (Quart. Jour. Geo. Soc. L., v. viii., t. 1, fig. 12), which I quite agree with him in believing identical with Hisinger's type, makes a nearer approach, on a small scale, to our form than any other.

Since the above was written I received Mr. Hall's paper, which he was kind enough to send me, establishing on this form his genus *Phyllograptus*, and making known from the "Hudson River" formation of Canada a perfectly identical series of varieties, which he unites under the name *P. typus*, which I adopt for the large variety. Several of the specimens in the soft Bendigo slates show, I think, evidence of the laminæ of connected cells imbedded at different levels, though united to one midrib, favoring his view of four semi-elliptical leaflets being joined by their straight inner edge, diverging rectangularly, instead of a simple ovate flat frond with midrib. One of the specimens from B^d 5 also favors the same view.

Very abundant, of great size (often $1\frac{1}{2}$ inches long and $\frac{3}{4}$ of an inch wide), and every variety of form in the black Llandeilo flags, or Bala rock of the ranges N. of Camp Lancefield (B^b 29); also in the similar rock, section 20, Newham (B^b 29); an ovate specimen, 1 inch long, much wider in the lower than the upper half in the altered slates on the east bank of the River Loddon, half way between the junction of the Boundary Creek and Middleton's Creek (B^a 76); very common in the soft white altered Llandeilo flags at Bendigo, between the gold reefs. Abundant and well preserved in the Llandeilo flags (B^b 27) of the camp near Lancefield. Not uncommon in the black glazed slates (B^d 5) on branch creek W. side of Lerderberg, $2\frac{1}{2}$ miles N.W. do. do. One of the specimens showing the four semi-elliptical leaflets on laminæ of the shale, accidentally broken at the different levels, but still in contact at the extremities. In the black slates (B^d 4) of the River Lerderberg, 3 miles N.W. of McLeod's station; in flags of B^b 41; in black flags of B^b 39, with *Siphonotreta micula* (McCoy); in flags B^b 27 and 28; flags of E. bank of Saltwater

River, 1 mile from Bacchus Marsh road (B^a 71); flags of Kangaroo Creek, S. of Kangaroo township (B^a 80); in slates of W.L.S. 2.

EXPLANATION OF FIGURES.

Plate I.—Fig. 1, elliptical narrow variety, natural size. Fig. 2, slightly ovate form, natural size. Fig. 2*a*, portion magnified, showing the thick axis and direction of the middle cells; the cell points are usually rather more slender than in this figure, and the mouth of each cell should be slightly more extended along the lower margin outward, so as to be very slightly oblique and concave. Fig. 3, more parallel-sided variety, with equal ends, natural size. Fig. 4, large ovate variety, natural size.

PLATE I., FIG. 5.

DIPLOGRAPSUS MUCRONATUS (HALL SP.).

[Genus DIPLOGRAPSUS (McCOY). (Sub-kingd. Radiata. Class Zoophyta. Order Hydroida. Fam. Graptolitidæ.)

Gen. Char.—Stem simple, straight, with a slender central axis, and two oblique rows of cells in one plane, one row on each side of the axis. Tip of axis sometimes developing an ovarian vesicle.]

DESCRIPTION.—Polypidom simple; about 1½ inches long, and 1 line wide (in slate), tapering rather abruptly towards the base; denticular cells 5 in the space of 2 lines, outer and lower margin oblique, upper margin nearly horizontal, the angle produced into a long, slender, flexible filament; central axis excessively fine hair like.

REFERENCE.—*Graptolites mucronatus* (Hall), Pal. N. Y., t. 73, fig. 1.

A beautiful and distinct species, easily recognised by the little mucronate film terminating each denticle, and which films, from their flexibility, extend in every direction, upwards and downwards, or horizontally. Professor Hall describes the species from the partially altered slates of the Hudson River group, near the upper limit of the New York Cambrian system (probably not far from the parallel of the British Caradoc shale).

Very abundant and beautifully preserved in the white decomposed (Llandeilo flags) soft shale (B^a 67) of section 24, parish of Bulla.

EXPLANATION OF FIGURES.

Plate I.—Fig. 5, specimen, natural size, with an unusual prolongation of the axis above, without cells. Fig. 5*a*, portion magnified.

PLATE I., FIG. 6.

DIPLOGRAPSUS PRISTIS (HIS. SP.).

DESCRIPTION.—Straight, simple, about 1 to 2 inches long, and 1 line wide, gradually tapering to the base; central axis capillary; the dissepiments diverging from it at an acute angle, their upper and lower margins parallel, forming narrow cylindrical tubes, when uncompressed, with the opening simply truncate at the outer end; when compressed the walls of the cells form parallel lines, very oblique to the axis, producing denticles at the edge, with a long straight lower, and a very short concave upper, margin, 5 in the space of 2 lines.

REFERENCE.—*Prionotus pristis* (His.), Leth. Suec., t. 35, fig. 5. *Var. B.* (Hall), Pal. N. Y., t. 72, fig. 1, r, s.

The probably distinct species *var. B.* accompanies the above in the Utica slate of New York, and I have found it also rarely at Lockerby and in Victoria; it seems distinct from the true *pristis* by its broader triangular teeth, slightly mucronate at the tip, and cells much less oblique to the axis; it is more strongly and broadly toothed than the *D. mucronatus.*

Very common in the whitish decomposing flags of (B^a 67) section 24, parish of Bulla; B^a 66; B^a 62; black flags of ranges N. of Camp Lancefield (B^b 29); in slates (W.L.S. 1) of section 16, parish of Darriwill, Sutherland's Creek.

EXPLANATION OF FIGURES.

Plate I.—Fig. 6, specimen, natural size (the ink has encroached on the figure, reducing it too narrow). Fig. 6*a*, portion magnified.

PLATE I., FIG. 7.

DIPLOGRAPSUS RECTANGULARIS (MCCOY).

DESCRIPTION.—Straight, simple, usually from 1 to $1\frac{1}{2}$ inches long, about 1 line wide, gradually tapering to the base, which is a fine simple point; axis fine, capillary; cells perfectly at right angles to the axis, forming square denticles to the margin, distinctly separated by rather wide parallel-sided notches, reaching $\frac{2}{3}$ of the way to the axis; 5 in the space of 2 lines.

REFERENCES.—(McCoy), Annals Nat. His., 2nd s., vol. vi., p. 271; Brit. Pal. Fos., pl. 1 B, fig. 8.

This species is more distinct and constant in its characters than most of the allied forms. In general appearance it approaches the

D. pristis (His. sp.), but is easily distinguished by the short, square cells, set *at right angles to the axis*, instead of the narrow, very oblique ones of that species. The only Graptolite making any approach in the form and direction of the denticles is the *bicornis* of Hall, which, however, is distinguished by the strong lunate process to the base, from which it derives its name—the base of the present species being a simple point, as in the *D. pristis*. There is also in most of Mrs. Hall's figures a perceptible obliquity in the denticles, which so admirable an artist could not have designed for this species; the bicornute base (so commonly preserved in the *D. bicornis*) certainly does not appear in ours. Both this and the *D. pristis*, being of considerable thickness, are occasionally liable to be compressed in a plane at right angles to that usually seen, the two rows of cells being pressed flat against each other, and so producing a form like that figured and described by Hisinger, Portlock, Hall, &c., under the name of *Graptolites scalaris*. As the numerous specimens under my examination show every stage of the accident, I do not hesitate to recommend the suppression of that species.

In the white, soft Llandeilo flags of (B^a 67) section 24, parish of Bulla; B^b 66; black slates, Didic River, Gippsland.

Explanation of Figures.

Plate I.—Fig. 7, ordinary specimen, natural size, showing the square notches of the rectangular cells, with an unusual prolongation of the axis. Fig. 7*a*, magnified view of a portion of a curious specimen, in which, apparently by an oblique upward compression of the cells, the lateral notches appear closed.

Plate I., Fig. 8.

DIPLOGRAPSUS (CLIMACOGRAPTUS) BICORNIS (Hall).

Description.—General characters of *D. rectangularis* (McCoy), but the base extended into two oblique horn-like spines.

Reference.—(Hall), Pal. N. Y., vol. i, t. 73, figs. 2*a* and *b*.

Professor Hall proposes a new genus *Climacograptus* for species like this and the last, having two rows of cells and general character of my *Diplograpsus*, but the cells not oblique, seeming

to be squarely notched out of the side margins. The only specimen of *D. bicornis* I have seen in Australia is 1 inch long, $1\frac{1}{3}$ lines wide, 5 cells in a space of 3 lines, and a distinctly bicornute base, but being compressed at right angles to the usual plane, I cannot describe it fully.

In the black flags of B^a 62.

EXPLANATION OF FIGURE.

Plate I.—Fig. 8, specimen, natural size.

PLATE I., FIGS. 9–14.

GRAPTOLITES (DIDYMOGRAPSUS) FRUTICOSUS (HALL SP.).

[Genus GRAPTOLITES (LIN.). (Class Zoophyta. Order Hydrozoa. Fam. Graptolitidæ.)
Gen. Char.—Polypidom horny, elongate, compressed, with a slender solid axis along one edge, followed by a parallel common longitudinal canal, from which one close row of cells extends, each inclined upwards and outwards, and all terminating in separate apertures on the serrated edge opposite the solid axis.]

[*Sub-genera.*—1. *Graptolites* (proper). Stem single and simple; Upper and Lower Silurian.—2. *Didymograpsus* (McCoy). Stems simple, but united in groups of two or more by the pointed uncelled lower end. Some of these have a round horny disc, connecting the non-celluliferous bases of the grouped stems; Lower Silurian. Some writers divide the species into sub-genera *Tetragraptus*, *Loganograptus*, &c., according to the number of stems conjoined, a character certainly not of generic value.]

DESCRIPTION.—Polypidom composed of 4 sigmoidally curved stipes, usually about 1 inch long, diverging in pairs, with elegant bell-shaped outlines from 2 short branches which diverge at an angle of about 40° from the summit of a straight non-celluliferous slender radicle about 6 lines long. Each stipe gradually increases in width from its slender base nearly to the upper extremity, to which the last 2 or 3 cells diminish so much in length as to form an abrupt rounding towards the outward curved apex. Cells on the inner edge of each pair of branches very large, aperture very wide, forming a large moderately acute angular denticle, the angle of which diminishes gradually from the base to the apex, being about 35° in middle (about 4 to 5 in 3 lines near middle of stem), nearly half of the length uncovered by next lower cell. Surface smooth, substance very thin and delicate.

REFERENCE.—(Hall), Geol. Sur. C. D., 2, t. 5, figs. 6–8; t. 6, figs. 1–3.

This is the first Victorian Graptolite I ever saw, and, as it was then a new species, I had named it in my MSS. after Mr. J. A. Panton, who had found it in the soft shales of Bendigo, of which goldfield he was then Warden, and in whose hospitable camp I was

then able to recognise the true geological age of the gold-bearing slates of the colony for the first time. The same species was subsequently discovered by Professor Hall in Canada; and as he kindly sent me an early proof of his illustration before publication, I of course adopted his name as above.

The extraordinary symmetrical grace of the regular form in which this most beautiful species is developed renders it very easy of recognition, and even fragments are clearly marked by the great size of the broad triangular denticles.

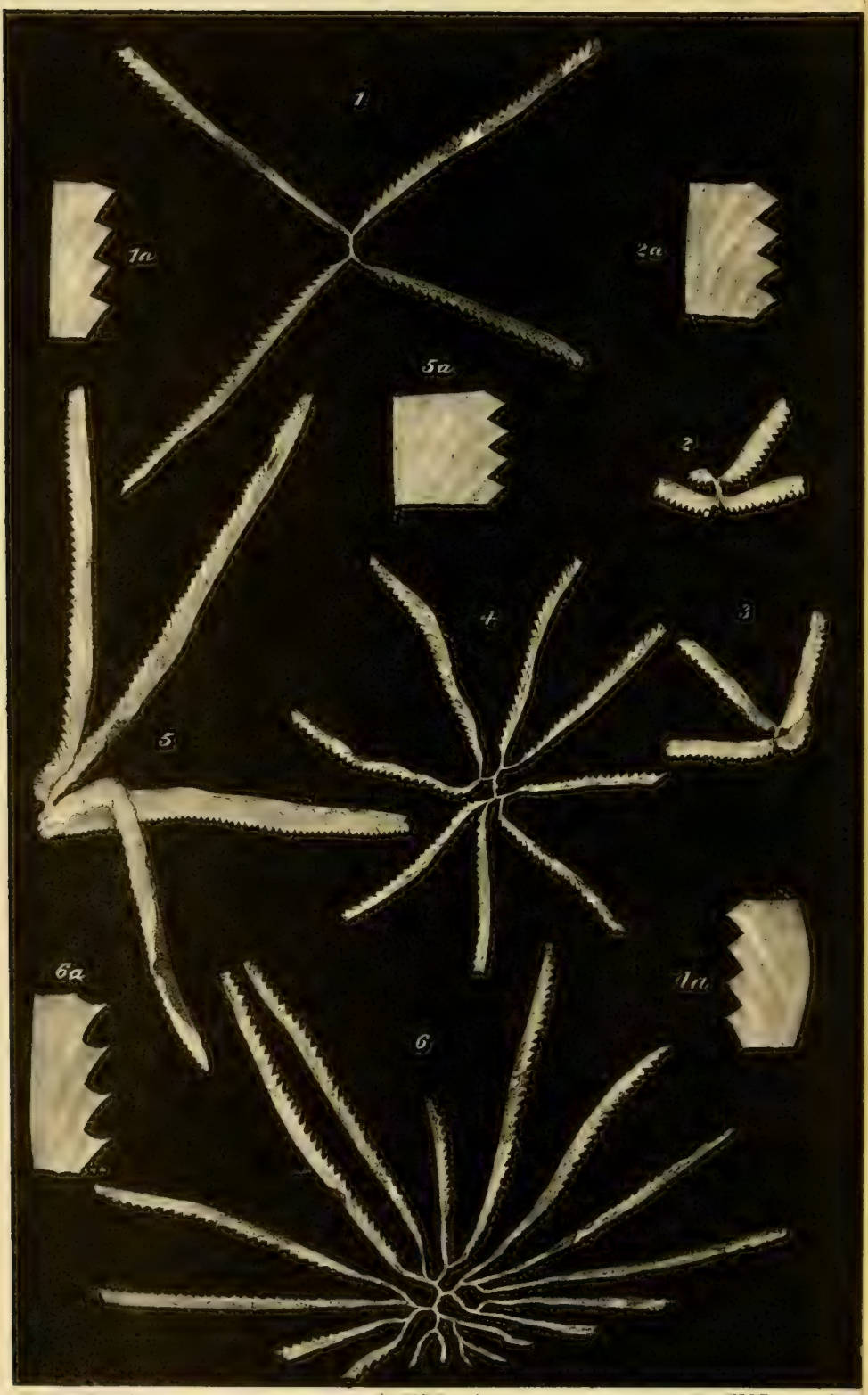
The Victorian specimens are perfectly identical in all respects with the N. American ones.

Common in the Lower Silurian slates (Llandeilo flags) of Bird Reef, Bendigo; in the smooth, red shales of (B^b 46) section 29, Spring Plains; in Black flags of B^b 45; (B^b 76) altered slates on bank of River Loddon, half way between junction of Boundary Creek and Middleton's Creek; in flags on E. bank of Saltwater River, 1 mile from Bacchus Marsh road.

EXPLANATION OF FIGURES.

Plate I.—Fig. 9, small, perfect specimen, natural size, with the 4 branches in their normal position, but defective at the upper ends. Fig. 10, portion of larger specimen, defective above and below, natural size. Fig. 11, moderate-sized specimen, one branch broken, natural size. Fig. 11*a*, portion magnified, but the angle of the denticles not sufficiently extended outwards or acute. Figs. 12, 13, and 14, smaller specimens, natural size, one of the branches broken from fig. 13.

FREDERICK McCOY.



Pl. V. Gr. direx. *J.M. Ferguson imp.*

PLATE II., FIG. 1.

GRAPTOLITES (DIDYMOGRAPSUS) QUADRIBRACHIATUS (HALL SP.).

[Genus GRAPTOLITES (LIN.). (Class Zoophyta. Order Hydrozoa. Fam. Graptolitidæ.)
Gen. Char.—Polypidom horny, elongate, compressed, with a slender solid axis along one edge, followed by a parallel common longitudinal canal, from which one close row of cells extends, each inclined upwards and outwards, and all terminating in separate apertures on the serrated edge opposite the solid axis.]

[*Sub-genera.*—1. *Graptolites* (proper). Stem single and simple; Upper and Lower Silurian.—2. *Didymograpsus* (McCoy). Stems simple, but united in groups of two or more by the pointed uncelled lower end. Some of these have a round horny disc, connecting the non-celluliferous bases of the grouped stems; Lower Silurian. Some writers divide the species into sub-genera *Tetragraptus*, *Loganograptus*, &c., according to the number of stems conjoined, a character certainly not of generic value.]

DESCRIPTION.—Central stipe straight, rather less than 2 lines long and about $\frac{1}{4}$ of a line wide, bifurcating at each end into 2 equal linear branches (4 in all), diverging at about 95°, branches usually upwards of $1\frac{1}{2}$ inches long (broken at ends), and after $\frac{1}{2}$ inch from the base, about 1 line wide to tip of denticles, for the remainder of their length; denticles varying in the same branch from 5 to 6 in 3 lines, indented rather more than $\frac{1}{3}$ the width of the branch near the base, and slightly less at a distance from it; points moderately acute, and very slightly recurved at the apex (the lower edge filiformly produced in a few instances), the lower boundary line of each cell reaching the inner edge of the tubular canal of the back at a point coinciding with a line at right angles to the back, passing through the point of the second lower cell; the upper edge of the cell denticles is sometimes convex, and sometimes concave in the same branch, and is about $\frac{2}{3}$ the length of the lower edge.
REFERENCE.—(Hall), Can. Org. Rem., dec. 2, t. 5, figs. 1–5, p. 91.

One specimen from (B^b 29) Newham shows clearly one of the 4 connected branches bent back, exhibiting a length (imperfect at the end) of $3\frac{1}{2}$ inches; the denticles 5 in 3 lines, and the width very slightly exceeding 1 line ($1\frac{1}{3}$); the character of this part of the branch so exactly resembles some straight fragments in the same flags, broken at each end, but 8 inches long, that I feel inclined to refer the latter to the present species. The branches in all the specimens are nearly straight, but slightly curved with the concavity usually on the denticulate side; and this character is seen in the large fragments mentioned, and separates them from all the varieties of *G. Ludensis* and *G. sagittarius*, as well as the greater width of the branches and the more simple form of the denticles, which are never thickened and abruptly hooked as in these latter species.

The specimen figured seems perfectly identical in all respects with the Canadian ones determined by Professor Hall.

I have not seen any trace of the central disc in the Victorian specimens.

Finely developed in the greenish soft slates of Bird Reef, Bendigo; well developed and very distinctly defined in the black flags of section 20, Newham (B^b 29); in Llandeilo flags of B^b 39; black flags N. of Lancefield (B^b 27); and shales of section 20, Spring Plains (B^b 46).

EXPLANATION OF FIGURES.

Plate II.—Fig. 1, specimen, natural size, from Llandeilo flags, Bird Reef, Bendigo. Fig. 1*a*, portion magnified, showing form of cells.

PLATE II., FIGS. 2, 3, AND 5.

GRAPTOLITES (DIDYMOGRAPSUS) BRYONOIDES (HALL SP.).

DESCRIPTION.—Polypidom of four equal simple stems arising from a very slender cylindrical transverse funicle with a short conical radicle in its middle; each stem is slightly curved at base, and rapidly enlarges in the space of 3 or 4 cells to a broad, flat, parallel-sided, nearly straight stem, upwards of 3 inches long and varying from $1\frac{1}{2}$ to 2 lines wide from back to tip of denticles. Cells extending from a narrow common canal upwards and outwards at an angle of about 45° with a slight curve, about 4 to 5 times longer than wide; 10 to 12 in a space of 6 lines; about $\frac{1}{4}$ of the lower edge free, leaving the denticles nearly equilateral and acutely pointed usually without conspicuous mucronation or extension; the end concave.

REFERENCES.—*G. bryonoides* (Hall), Can. Org. Rem., dec. 2, t. 4, figs. 1 to 11; ? *G. latus* (McCoy), Brit. Pal. Fos., p. 4, 1 B., fig. 7.

Although it is quite possible Brongniart may have had this Graptolite before him when figuring and describing his *Fucoides serra*, still no good could follow from adopting his name, as the figure and description are not sufficiently accurate to give any certainty to the reference, which is chiefly supported by the fact that the rock and locality he cites are not known to contain Fuci, but abound in Graptolites, with several species of which his

Fucoides serra might be said to approximately agree. I have little doubt that the *Graptolites latus* (McCoy) which I described in 1852, from the Lower Silurian or Cambrian slates of Builth and the Skiddaw slates of Scawgill, is one of the stems, imperfect at each end, of the same species as was subsequently described by Prof. Hall from nearly perfect specimens from the similar slates of Quebec under the name *G. bryonoides*. The great size of the stems, both in length and width, and the comparatively small, nearly equilateral denticles, render the species easy of recognition.

Common in the black flags of B^d 1, branch of Barwon Creek, 4 miles N. of Griffith and Green's station; and B^d 2; B^b 39, B^b 44; B^b 45; Watchbox Range, Glenhope, and Piper's Creek, B^b 43; B^b 27; B^b 46, section 29, Spring Plains; B^a 80, Kangaroo Creek, S. of township; in chiastolite slate of S^d 5; black slate of W.L.S. 5; W.L.S. 1, section 16, parish of Darriwill, Sutherland's Creek; W.L. S. 2, section 84, parish of Coole Barghurk; black glossy slates of creek W. side of Lerderberg, $2\frac{1}{2}$ miles N.W. of Lancefield camp.

Explanation of Figures.

Plate II.—Fig. 2, base of young specimen, natural size, showing the origin of the four short abruptly recurved branches from the short funicle. Fig. 2*a*, portion of specimen fig. 2 magnified, showing the form of the denticles and shape of cells. Fig. 3, another specimen with longer branches, natural size. Fig. 5, specimen with the usual width of the adult branches broken short at the ends. Fig. 5*a*, portion of ditto magnified.

Plate II., Fig. 4.

GRAPTOLITES (DIDYMOGRAPSUS) OCTOBRACHIATUS (Hall sp.).

Description.—Central stipe or vinculum straight, about $1\frac{1}{2}$ lines long, bifurcating equally at each end at an angle of 80°, with two branches, each about $\frac{2}{3}$ of a line long, and these bifurcating each into 2 equal simple branches (8 in all), several inches in length; the stipe and branches as far as a little beyond the last furcation are about $\frac{1}{8}$ of a line wide, seem formed of a definite capillary tube, which extends along the plain edge of the branches; the branches at about 1 inch from the base are commonly $\frac{3}{4}$ of a line wide, but in some specimens from B^b 43 they are $1\frac{1}{2}$ lines wide, the denticles (5 to nearly 6 in 3 lines), very coarse, triangular,

indenting the branch $\frac{2}{3}$ of (or rarely only $\frac{1}{2}$) its width, the lower boundary line of each cell reaching the back at a point opposite the next lower cell point in the deeply indented examples, but reaches nearly to the next further one in others; lower margin straight, upper margin slightly convex, points in most specimens only slightly acute and not mucronate, and not recurved in any examples seen.

REFERENCE.—(Hall), Can. Org. Rem., dec. 2, p. 96, t. 7–8.

None of our specimens are so broad as many of the Canadian ones, but the number of denticles in a given space is usually the same at an inch or more from the base, and some of the Canadian specimens of this species are as narrow as the Australian ones, and the greater proportionate indentation and less obliquity of the cells agrees with the narrower American specimens, though seeming to differ from the broader ones; it is probable that the diversity is due only to a difference in the direction of the pressure the individuals were subjected to. Some of the specimens have 8 denticles in 3 lines close to the base, though only 6 or the normal American number of 5 on more distal parts of the branch.

Some specimens seem to have only 7 branches, from 1 of the 4 primaries apparently not dividing.

Common in the whitish slates, B^a 78, Barker street, Castlemaine; common in the black Llandeilo flags of B^b 43, Watchbox Range, Glenhope, and Piper's Creek, sheet 51 S.W.; in the olive slates of B^a 71, on the east bank of the Saltwater River, 1 mile from the Bacchus Marsh road; B^b 39; B^b 27; B^b 28; B^a 2.

EXPLANATION OF FIGURES.

Plate II.—Fig. 4, specimen, natural size. Fig. 4*a*, portion of polypidom magnified to show form of cells.

PLATE II., FIG. 6.

GRAPTOLITES (DIDYMOGRAPSUS) LOGANI (HALL). VAR. AUSTRALIS (McCOY).

DESCRIPTION.—Vinculum rather more than 1 line long with a short radicle or mucro in the middle. At each end of the vinculum 2 branches extend diverging at about 100° from each other, and rather shorter than the vinculum, each

branching into 2 nearly straight branches, a little more or less than 1 line long, each of these dividing into 2 (or occasionally 3 by a 4th furcation, about a line distant from the preceding one) nearly straight branches; the vinculum branches as far as a little beyond the 3rd or 4th bifurcation, about $\frac{1}{3}$ of a line wide; beyond this the simple branches are several inches in length [and when compressed are slightly more than a line wide, including the point of the cell denticles which are about 18 in the space of an inch]; other specimens have as many as 28 in an inch, and are only $\frac{2}{3}$ of a line wide: the cell denticles are sometimes on one side, sometimes on the other, only indenting the edge after the 3rd bifurcation from the centre; they project rather less than half the width of the branch, are acute, the upper edge moderately concave and the lower margin moderately oblique, arched and reaching the back margin opposite the point of the next but one lower denticle; the width of the branch from back to point of denticle about equal to $1\frac{1}{2}$ of the spaces between the denticles. The middle portion, before the 3rd or 4th or final branching, marked with an impressed central line representing the back tube of the branches.

REFERENCE.—(Hall), Can. Org. Rem., dec. 2, p. 100, t. 9 and 11.

I have enclosed in brackets [ ] the only characters in which the *var. Australis* differs from the ordinary Canadian types as made known by Hall, namely, a greater width (in one compressed specimen, B^a 78) of the branches, and a smaller number of denticles in an inch by 10, according to Hall's description, but only of one according to his figures. The large specimen figured B^a 78 has 8 branches on one side of the vinculum and 10 on the other, as in many of the Canadian specimens. As Professor Hall considers the disposition of the branches the chief diagnostic character of his species, *G. Logani*, I refer the Australian form which is perfectly identical in this respect to it, indicating the two differences in measurement of some of the specimens, and affixing a geographical name to the variety for separate reference; in the same slates, however, at Castlemaine, are other specimens in which the branches are only $\frac{2}{3}$ of a line wide, and the denticles reach 27 or 28 in an inch, agreeing thus in all respects with the Canadian ones. Many specimens show only what Hall terms the outer side or non-celluliferous edge, so that the vinculum and branches, to an inch or more, show only as equal filiform rugged lines of the width of the tubular marginal canal which then occupies the middle, but which appears on the entire edge of denticulate specimens.

Both the *var. Australis* and the typical forms finely developed in the black and whitish slate, B^a 78, Barker street, Castlemaine; in the black flags of B^b 29, Newham, section 20; B^b 27; B^a 80, gully running from E. into Kangaroo Creek, S. of township;

W.L.S. 1, section 16, Darriwill, Sutherland's Creek; slates of F^c 17, Leigh River, three-quarters of a mile below junction of Cargarie Creek.

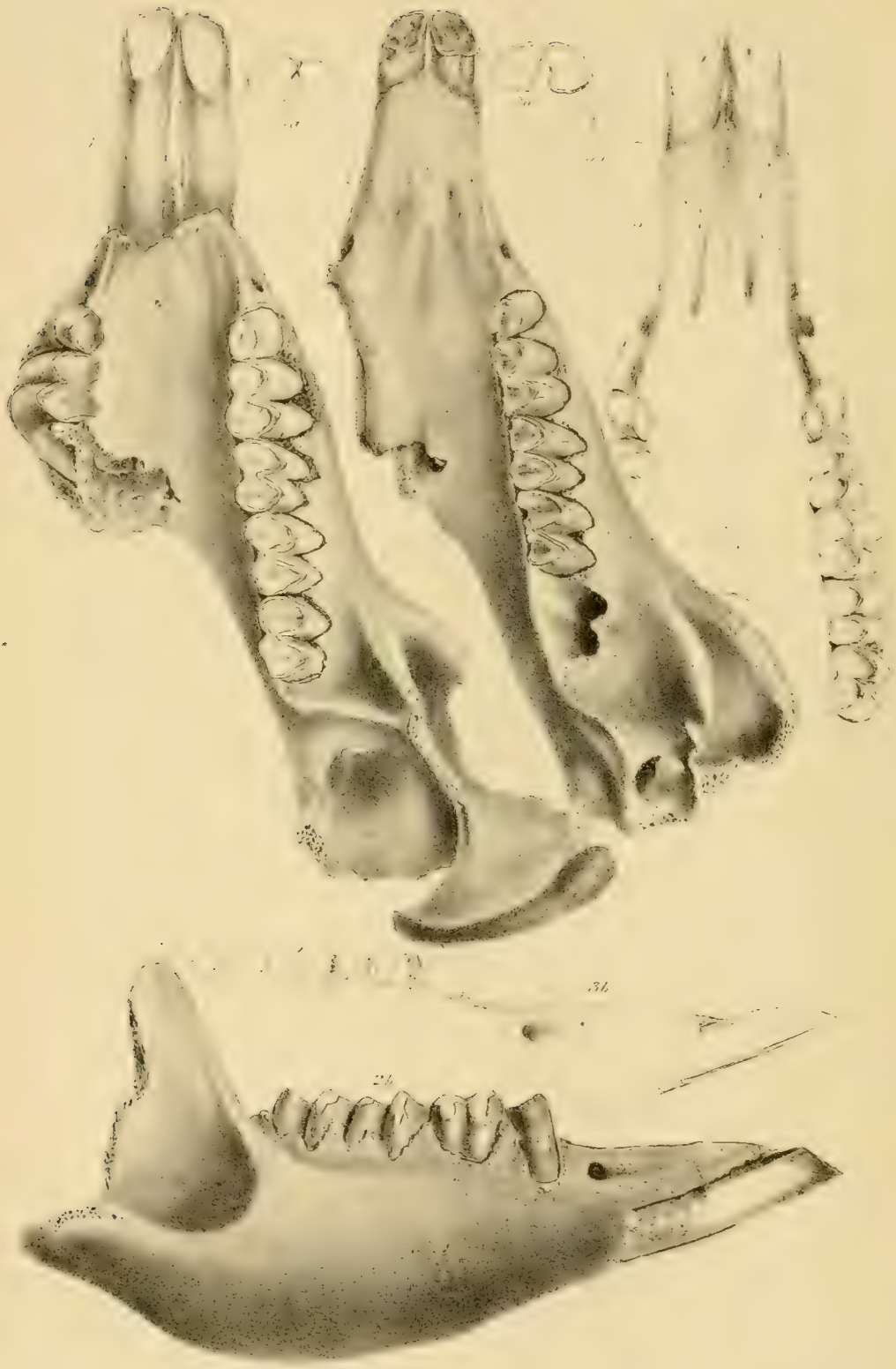
EXPLANATION OF FIGURES.

Plate II.—Fig. 6, specimen, natural size, from Llandeilo flags of Barker street, Castlemaine. Fig. 6*a*, portion of polypidom magnified to show form of cells.

FREDERICK McCOY.

Ludwig Becker del & lith Prof. M'Coy direxit. Hamel & Co. imp.

Pl. I.



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PLATES III., IV., AND V.

PHASCOLOMYS PLIOCENUS (McCOY).

[Genus PHASCOLOMYS. (Sub-kingd. Vertebrata. Class Mammalia. Order Marsupiata. Fam. Phascolomidæ.)

Gen. Char.—All the teeth with long curved hollow bases, destitute of solid fangs; incisors $\frac{2}{2}$, canines $\frac{0}{0}$, premolars $\frac{2}{2}$, molars $\frac{3}{3}$. The incisors are scalpriform; the molars, except the first, are divided each into two nearly equal parts by a very deep inflection of the enamel on the outer side, and a shallow inflection on the inner side in the lower jaw, and the deeper inflection on the inner side in the upper series. Body short, thick; tail rudimentary; head large, depressed; eyes and ears small; legs short, nearly equal; anterior feet, with five short stout toes, each with broad solid little-curved claws; hind feet with five toes, of which the inner one is very small, without claw, and placed at right angles to the others, which have curved claws, hollow below; the three middle toes joined. Confined to Australia in the recent and fossil state.]

DESCRIPTION.—Mandible. Symphysis terminating on a line with the middle of the anterior lobe of the 4th molar (M^2); from anterior edge of incisors to hind edge of alveolus of last molar, 4 inches; length of molar series, 2 inches $2\frac{1}{2}$ lines; from anterior edge of alveolus of first molar (D^3) to edge of incisor, 1 inch $8\frac{1}{2}$ lines; width of diastema between hinder lobe of second molars, $9\frac{1}{2}$ lines, deeply concave; anterior molar (D^2) obliquely ellipsoid in section. Width of anterior transverse diameter of the two incisors together, 7 lines; thickness in opposite direction, 3 lines; so that the width of each does not exceed the length. Ectacrotaphyte cavity deep. The coronoid is large, wide, and high, its anterior root arising from the alveolar wall of the last molar (M^3), and not of the penultimate (M^2), as in *P. Mitchelli.*

In size, in the backward extension of the symphysis, and in the whole length of the dental series from edge of incisor to hind alveolus of last molar, this species agrees with the living naked-nosed Wombat, *Phascolomys platyrhinus* (Ow.), of the same localities; but it is easily distinguished by the great size of the molar series, these teeth being not only larger transversely, occupying a longer fore and aft space, but extending so very much nearer to the edge of the incisors as to afford an easy mode of discriminating the species. The figures on our Plate V. illustrate this clearly. If a horizontal line be taken across the upper part of the plate touching the edge of the incisors of the shaded figures 1 and 2, which belong to the *P. pliocenus*, and those of the outline figure 3, which is taken from the living *P. platyrhinus*, and if another line parallel to the first be taken so far down as will touch the anterior edge of the first molars of the shaded figures of our fossil species, it will be seen how far behind this line the first molars of the living species represented in outline are. If the whole length of the dental series from hind edge of last molar alveolus to front edge of incisor be taken as unity, the ratio to it of the molar series in the *P. pliocenus* is $\frac{55}{100}$, but only $\frac{45}{100}$ in the most nearly allied recent species, the

P. platyrhinus. The diastema is narrower between the molars in this fossil than in the recent species ; and the portion in front of the anterior molar (D^3) is so much shorter in the fossil that it seems thicker or deeper, and the lower outline of the mandible rounded with a more uniform curve, than in the recent species, although the depth below the molar series is nearly alike in both. The anterior outlet of the dental canal is closer to the anterior molar than in *P. platyrhinus*, and the incisors are more compressed, or not nearly so wide in proportion to the thickness as in the living species, their vertical and transverse diameters being almost equal.

Of fossil species it is only closely related to the *P. Mitchelli* (Ow.), from the Wellington caves in New South Wales, but it differs in its much larger molars, and in the symphysis extending behind the third molar instead of only behind the second, as in *P. Mitchelli.*

This is the first fossil ever found, as far as I know, in our Victorian gold drifts, the specimen figured on Plates III. and IV. having been cut out of the hard ferruginous gold cement of Dunolly. It is one of the important specimens we owe to my friend, Mr. J. A. Panton, Warden of Bendigo at the time of its discovery, and is of great interest as thus showing that our gold drifts are not "alluvial," but of the more ancient Pliocene Tertiary period, at least as old as the Mammaliferous Crag ; thus corresponding in age with the gold drifts of the Ural. The species occurs also commonly in various superficial localities in clays, with the *Macropus Titan*, and *M. Atlas* and other extinct forms.

Explanation of Figures.

Plate III.—Figure of mandible embedded in the hard gold cement of Dunolly viewed from above, natural size.

Plate IV.—Fig. 1, same specimen viewed from the side. Fig. 1*a*, view of condyle.

Plate V.—Fig. 1, portion of lower jaw viewed from above, natural size, showing symphysis complete at the back, but imperfect in front, and the whole of the molar series complete. From the shores of Lake Bullen-merri, near Camperdown. Fig. 1*a*, transverse section of incisors showing the compression. Fig. 2, same view of another specimen, showing the symphysis complete from the posterior to the anterior margin, but wanting the last molar and condyle, natural size. Fig. 2*a*, transverse section of incisors showing the compression or great vertical diameter of each. Fig. 2*b*, side view of same specimen, showing the form of the under contour of the jaw, and the position of the ectacrotaphite cavity. Fig. 3, outline of corresponding part of the living *Phascolomys platyrhinus*, showing the more backward place of the anterior molars, natural size. Fig. 3*a*, transverse section of incisors, showing their greater comparative lateral extension. Fig. 3*b*, outline lateral view of same specimen to contrast with fig. 2*b* in the more backward position of the anterior commencement of the molar series, and the more slender form of the jaw between them and the incisors.

Frederick McCoy.

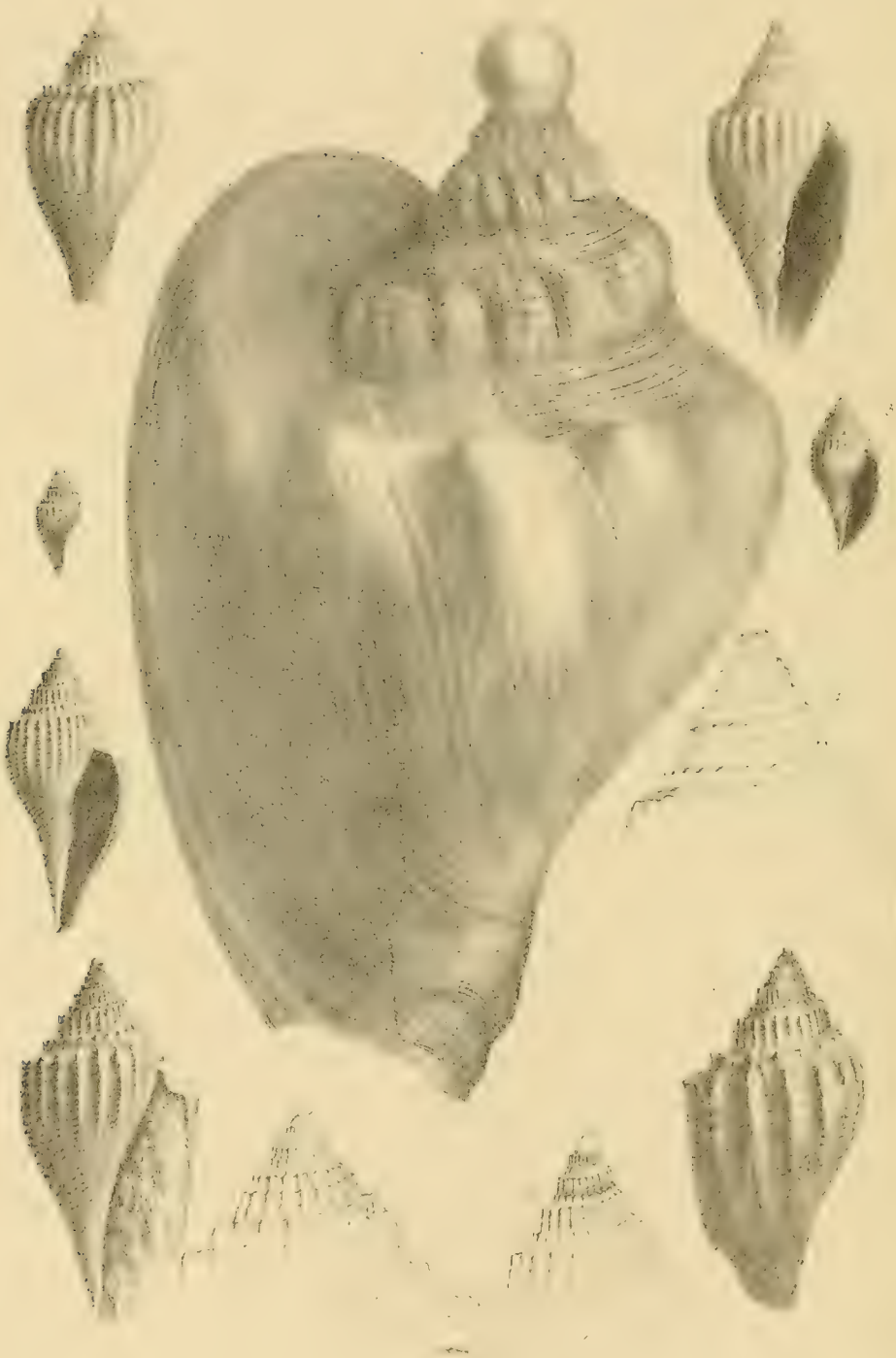


PLATE VI., FIG. 1.

VOLUTA HANNAFORDI (McCOY.)

[Genus VOLUTA (LAM.). (Sub-kingd. Mollusca. Class Gasteropoda. Order Pectinibranchiata. Fam. Volutidæ.)

Gen. Char.—Shell ovate or fusiform; apex of spire obtuse, mammillated, and oblique; aperture large, with a wide notch in front, not produced into a canal; columella or inner lip with several large oblique prominent plaits, of which the anterior ones are largest.]

DESCRIPTION.—Broad fusiform; pullus at apex of spire, very large smooth spheroidal, of little more than $1\frac{1}{4}$ turns; spire conical, apical angle 70°, of 4 whorls (besides the pullus), each obtusely angulated in the middle, and having on the angle from 14 to 17 large nodose tubercles, obtuse and conoidal on the body whorl, on which the smaller number is found, more elongate on those of the spire, on the upper of which the greater number occur; the oblique space between the tubercles and the suture marked with narrow slightly undulating thread-like spiral ridges, irregularly alternating in thickness; below the tubercles the body whorl is smooth or marked with obtuse lines of growth until the anterior extremity, which is marked by thick obtuse spiral striæ crossing the lines of growth; but the young whorls, or vertical portion of the smaller turns of the spire, are marked with spiral striæ slightly larger and less distinct than those of the posterior portion; and, finally, in very large, old specimens, the spiral striæ on the space above the tubercles are reduced to a few near the suture. Outer lip in adults greatly dilated into an oblong wing, with a broadly rounded, auriculate posterior margin rising nearly up to the suture of the penultimate whorl for attachment; outer margin nearly straight, thin and slightly inflected, ending at the narrowed anterior end in a moderately deep sigmoid respiratory notch, which does not form a crest; inner lip excessively thin, spreading as a slight glaze over a part of the body whorl; columella slightly sigmoid and flattened towards the anterior end, with 3 large, equal, very prominent, compressed, widely separated oblique plaits, behind which, in some examples, are 1 or 2 closer and smaller ones, usually absent; aperture moderately large, oblong. Length of small perfect specimen, 6 inches; proportional length of body whorl, $\frac{75}{100}$; of penultimate whorl, $\frac{13}{100}$; antepenultmiate, $\frac{9}{100}$; preceding whorl, $\frac{4}{100}$; length of pullus, $\frac{8}{100}$; diameter of pullus, $\frac{10}{100}$; diameter of succeeding whorl at suture, $\frac{8}{100}$; length of wing, $\frac{90}{100}$; greatest width of body whorl and wing, $\frac{65}{100}$; of penultimate whorl, $\frac{32}{100}$; ordinary length of pullus, 6 lines; diameter, 7 lines.

So disproportionably large and smooth does the pullus or young nucleus on the top of the spire appear, that it looks like a comparatively large *Natica* or *Helix* artificially stuck on the comparatively slender, rugosely nodulated and striated spire; its disproportion far exceeding the greatest living instance of such an incongruity, the recent *Voluta mammilla*. The first very large specimen seen was presented to the National Museum by Mr. Hannaford, of Warrnambool, an enthusiastic naturalist, after whom I have great

pleasure in naming the species. This specimen having the apex absent, and the outer lip and the anterior end of the columella broken off, as well as possessing two unusual small extra plaits behind the others, looked so much more like a *Fasciolaria* than a *Voluta*, that in my manuscript I used the former generic name until I saw other specimens showing the true character of the notched anterior end, mammillary spire, &c.

There is no known recent or fossil species at all approaching it in general characters.

Rare in Oligocene Tertiary clays of Muddy Creek, near junction with Grange Burn, 5 miles from Hamilton. One very large imperfect specimen, presented by Mr. Hannaford, from the clays of Port Fairy, Warrnambool, where it occurs with several other species of the Mount Eliza beds. Rather rare in the clays near the foot of Mount Eliza, in Hobson's Bay, from whence the perfect figured specimen was obtained, as well as a few fragments of the spire, with the large nucleus attached. Rare in the clays of Orphan Asylum reserve, Fyans Ford, A^{d} 28. Rare in the Oligocene Tertiary clays near Mount Martha.

Explanation of Figure.

Plate VI.—Fig. 1, back view of specimen, natural size.

Plate VI., Figs. 2–4.

VOLUTA ANTI-CINGULATA (McCoy).

Description.—Ovate; spire moderately acute (apical angle varying from 55° to 65°, usually 60°), of 5 slightly convex sculptured gradually increasing whorls, and a rounded smooth small swollen nucleus of 1½ turns; sutures turreted or sub-canaliculate by a narrow, flattened, or hollow space, separating the sutural line of conoidal tubercles, which are on the other side separated from the obtuse tubercular ends of a nearly straight longitudinal rib, by a deep spiral constriction or channel, seeming to cut the ribs to the depth of the spaces between them; body whorl obtusely rounded at the shoulder, rounding abruptly to the sub-sutural channel, and conoidally attenuated, tapering to a narrow slightly emarginate front; ribs thick, obtusely rounded (usually 19, to 15 rarely, and in one case 24, in last whorl), usually

becoming obsolete at about half the length of the body whorl (sometimes shorter and often somewhat longer), but becoming very prominent, and separated by rather wider deep concave spaces on the shoulder, where each terminates in an obtusely rounded end at the constriction or sub-sutural groove, above which each rib seems continued as a blunt conoidal tubercle, above which moniliform rows of tubercles, a narrow step-like undulated flattened or slightly concave space extends to the suture, perpendicular to the axis. Lower or anterior half of body whorl strongly marked with transverse or obliquely spiral deep narrow sulci, having broader flattened spaces between them, occasionally extending, more faintly marked, a further variable distance towards the suture. Mouth, with a slight posterior channel, oblong, narrowed in front; outer lip smooth within (edge sometimes very faintly crenulated in old individuals); inner lip slightly curved, with 4 slender oblique nearly equal plaits about the middle, the anterior slightly larger than the posterior; occasionally traces of a very small 5th plait occur. Usual length, 1 inch 9 lines; proportional length of body whorl, $\frac{72}{100}$ to $\frac{82}{100}$; penultimate whorl, $\frac{14}{100}$ to $\frac{13}{100}$; width, $\frac{50}{100}$ to $\frac{43}{100}$. Young, 5 lines long; body whorl, $\frac{75}{100}$; penultimate whorl, $\frac{14}{100}$; width, $\frac{50}{100}$; at this size only 3 sculptured whorls and the pullus; 22 ribs on body whorl. Some specimens show that the mouth was dark-violet within.

From the examination of a great number of specimens from the Lower Miocene or "Tongrien" beds of Lattorf, near Bernberg, I long ago satisfied myself that the *V. suturalis* and *V. cingulata* of Nyst were only extreme varieties of one species, and Beyrich seems somewhat inclined to the same opinion, from examination of a larger number of specimens from other localities, of one of the varieties at least, than Nyst seems to have had of either, as he marks them both as rare in his "Coquilles et Polypiers Fossiles de Belgique;" and the latter name would be the best to retain, as it indicates the remarkable girding of the whorls by the deep sulcus or constriction which seems to cut off a sub-sutural row of tubercles from the ends of the longitudinal ribs in the most common variety; still, as in the *V. bulbula* (Lam.), to which Nyst likens his *V. suturalis*, specimens may be found showing all the passages between the most strongly marked sub-sutural sulcus and its entire absence; the latter variety I mark *β indivisa*, and in it the ribs are often fewer and more sigmoid, and the shell narrower, than in the ordinary forms, though none of these characters are constant; in this variety the spiral striæ are often confined to the anterior base of the shell, leaving the body whorl and ribs smooth and polished. Var. *α persulcata* has the ribs rather more numerous and straighter than the ordinary type, and the spiral striæ very strongly marked over the whole body whorl and spire, so as to be in this respect intermediate between the Hampshire Barton clay *V. ambigua* and

V. digitalina; in this variety the teeth sometimes reach 6 or 7. A similar range of variety is to be found in the present Australian species, which, in this respect, as in almost all others, is such an exact representative of the European *V. cingulata* of the same age that I have named it *V. anti-cingulata* as a representative of it. The obtuse swollen papillary "pullus" to the top of the spire readily separates it generically on comparison of specimens, and the sutural space of the Australian species is never so deep or concave as in its European prototype, in which also the plaits on the columella are very much less conspicuous and more oblique, the anterior one alone approaching the size of the four on the *V. anti-cingulata.* The spire has one sculptured whorl fewer than in *V. cingulata* of Germany. There is no living species like it.

Very abundant, with occasionally the *β var.*, and more rarely the *α var. persulcata*, in the Tertiary sands of the Bird Rock, beds A^d 22 and 21, less so in A^d 23; both varieties common in the sandy beds A^d 24.

EXPLANATION OF FIGURES.

Plate VI.—Fig. 2, front view of average specimen, natural size. Fig. 2*a*, do., back view. Fig. 3, young specimen, natural size. Fig. 4, outline of spire magnified 2 diameters.

NOTE.—In the larger specimen figured, the ribs are straighter or less sigmoid than usual, and the striæ rather more distinct than in many specimens on the posterior or sutural half of the body whorl.

PLATE VI., FIG. 5.

VOLUTA ANTI-SCALARIS (McCOY).

DESCRIPTION.—Ovate, moderately ventricose, rather abruptly attenuated towards the front; spire moderately acute, apical angle 65° to 70°, of 4 to 5 whorls and a rounded, swollen, smooth, oblique nucleus at the tip of $1\frac{1}{2}$ turns; body whorl with about 16 to 24 angular slightly sigmoid longitudinal ribs extending rather less than half way to the front, narrow and sharp in the young, wider and more obtusely angular in adults, becoming gradually obsolete in front, each ending in a sharp conical tubercle crowning the obtusely angulated shoulder; a second row of smaller conical pointed tubercles surmounts the larger on each whorl; the space between the two rows is deeply concave and rather wider than the interval between the corresponding larger tubercles; the space between the upper row and the suture is flattened,

nearly horizontal, and about half as wide as the space between the two rows; both spaces marked only by the coarse lines of growth. Whorls anterior to the tubercles crossed by deep narrow spiral sulci, having flat spaces between them about equal to half the distance of the longitudinal ribs from each other, usually about 3 of these spiral striæ visible on each of the whorls of the spire, crossing the longitudinal ridges. Pillar folds slender, widely separated oblique, 3 or 4; the 3rd or 4th when it exists, posterior, abruptly smaller than the 2 anterior plaits. Outer lip thin, smooth. Length of large specimen, 2 inches; proportional length of body whorl, $\frac{73}{100}$; penultimate whorl, $\frac{15}{100}$; greatest width, $\frac{50}{100}$ to $\frac{45}{100}$. Specimen 8 lines long gives all the same proportional measurements.

A careful comparison of specimens of the true *Volutilites scalaris* (Sow. sp.), from the middle Eocene beds of the Isle of Wight and Barton, will show (what none of the existing figures or descriptions would) that our species, which I have named *Voluta anti-scalaris*, is not identical, but a most remarkable instance of a representative form, distinguished with apparent doubt perhaps by a slightly longer spire, less ventricose body, and the ribs less twisted at their anterior end, but with perfect certainty, by the spire, which in the European species is sharply pointed (in accordance with the genus *Volutilites*, Swain.), and of 8 or 9 gradually and regularly tapering whorls, the apical 2 or 3 smooth, while in the Victorian species it terminates in an obtusely rounded smooth swollen nucleus or "pullus" of $1\frac{1}{2}$ turns, below which are only 5 sculptured whorls in adult individuals.

In accordance with the slightly more slender form, the pillar is less curved than in the English species, and the plaits slightly thinner and more oblique; the number of ribs in a whorl is greater, being about 14 or 15 in the English species, but in all other characters the coincidence or representation of characters is so complete that, if the tip of the spire were in each case absent, the nicest eye could scarce separate them; yet the distinguishing character is one of such importance, and so invariable, that there can be no doubt of its marking a perfectly distinct species.

This species is also closely allied to the *V. nodosa* (Sow.) of the Hampshire Eocene Tertiary, Barton clay, and Bracklesham beds, but may be distinguished by the upper row of tubercles of the spiral whorls being distinctly separated from the suture by a space equalling about half the width of the space between the upper and lower rows of tubercles on each whorl as *V. scalaris* is.

One or two very old thick specimens show a spreading inner lip, and a very faint indication in some lights of a crenulation on the edge of the outer lip; and the plaits are thicker, and in one case an intermediate 5th plait appears.

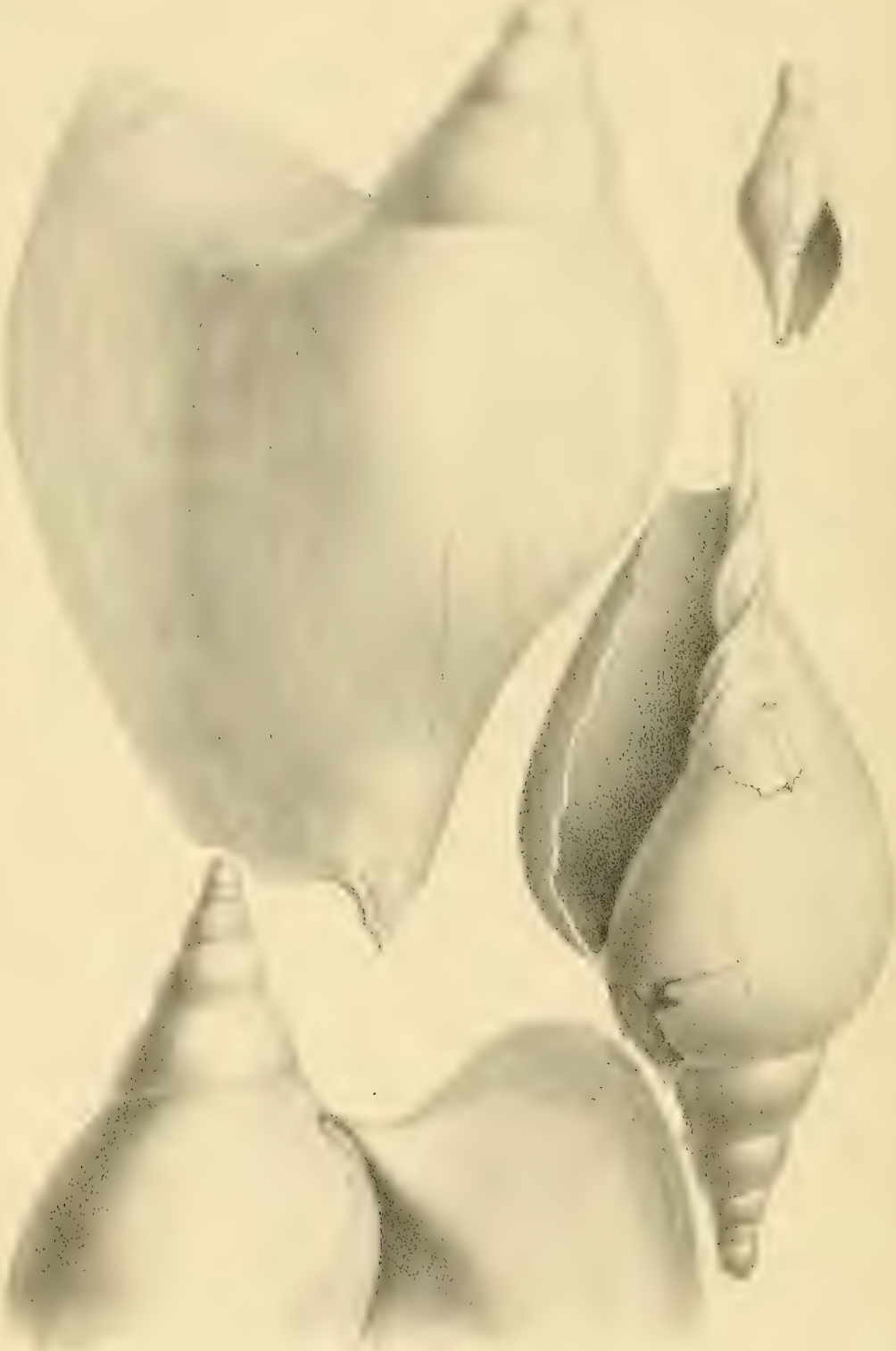
Common in the Tertiary clays of A^d 14, parish of Moolap; a variety not uncommon in Oligocene Tertiary clays of Orphan Asylum reserve, Fyans Ford, A^d 28. Not uncommon in blue Tertiary clays and limestone, near Mount Martha.

Var. α levior has the apical angle 65° to 70°, often a 4th small columellar plait, and the spiral, transverse sulci become nearly or quite obsolete near the spinous shoulder, and sometimes on more than half of the body whorl, as well as on the whorls of the spire; it is also a little stronger, but is certainly only a variety. In clays and limestone, Mount Martha.

EXPLANATION OF FIGURES.

Plate VI.—Fig. 5, front view of average specimen, natural size. Fig. 5*a*, do., back view. Fig. 5*b*, outline of spire magnified. Fig. 6, outline of spire of V. cingulata (Sow.) from the Barton clay of Hampshire, showing the regular acute spire for comparison with the Australian species. The two un-numbered figures are front and back views of younger specimens of the *V. anti-scalaris.*

FREDERICK McCOY.



A. Bartholomew, del.
F. Schönfeld, lith.

[illegible]

PLATE VII., FIGS. 1–4.

VOLUTA MACROPTERA (McCOY).

DESCRIPTION.—Shell fusiform, until nearly adult, when the outer lip becomes dilated into a very large thin-edged, triangular flattened wing, the outer margin of which is slightly convex, the posterior margin slightly concave, running up half way to the suture of the penultimate whorl in a slight channel; the approximately rectangular junction of the outer and posterior margins broadly rounded. Apical angle about 55° in middle-aged specimens, and 35° in young ones $1\frac{1}{2}$ inches long. Spire with a concave outline of 4 rapidly enlarging whorls and a mammillary cap-shaped pullus of $1\frac{1}{2}$ half-turns, the basal half-turn of the pullus less than half the width of the next succeeding turn of the spire, the remaining turn nipple-shaped with a small excentric projecting apex; the length of the pullus equalling once and a half the width of the next following turn of the spire; turns of the spire embracing the preceding one at the suture, near which they are concave, then forming a convex shoulder and nearly parallel with the axis of the shell below; body whorl fusiformly narrowed in front and marked with a broad sigmoid siphonal notch, without anterior crest or ridge. Inner lip excessively thin, moderately spreading; plaits of the columella, 4, widely separated, very prominent, narrow, moderately oblique, the 3 anterior nearly equal, the posterior one smaller. Aperture moderately wide, oblong, narrowed above and below, becoming effuse with age. Pullus smooth; the next two turns of the spire, with excessively fine spiral striæ, only visible with the lens (about 10 or 11 in the space of 1 line); rest of the spire and body whorl smooth or marked with fine lines of growth. Length of pullus, 4 lines; width of ditto, 3 lines; length of adult (including the pullus, which is 3 lines), 6 inches; proportional length of body whorl, $\frac{75}{100}$; length of wing, $\frac{92}{100}$; width of body and wing, $\frac{70}{100}$; width of body on inside of base of aperture, $\frac{38}{100}$.

There is no living or fossil species at all like the present, in the large thin angular wing-shaped outer lip and fusiform body.

Young specimens $1\frac{1}{2}$ inches long are irregularly fusiform, of two whorls in addition to the pullus of nearly two.

The layer of shell bearing the microscopic spiral striæ seems very liable to fall off, leaving the whorls only marked by the lines of growth.

Not uncommon in the passage beds of the Tertiary sands (A^d 22) at Bird Rock, near Geelong.

EXPLANATION OF FIGURES.

Plate VII.—Fig. 1, back view of specimen, natural size, the tip broken. Fig. 2, front view of portion of specimen, natural size, showing mammillated apex of spire and adult form of outer lip. Fig 3, front view, natural size, of specimen, showing the apex of spire and form of plaits on the columella. Fig. 4, front view of very young specimen, natural size, showing undilated outer lip, the folds on the pillar, and the mammillated apex of the spire as large as in the adult.

FREDERICK McCOY.

PLATE VIII.

Note.—The Gymnospermous plants represented on this plate present some special points of interest in connection with the well-known popular impression amongst geologists that the recent Fauna and Flora of Australia have a far closer relation to the Fauna and Flora of the Oolitic period than is to be found between the fossils of that epoch and the living denizens of any other part of the earth, and also in a botanical point of view as tending to diminish still farther the assumed differences between the two sections of Gymnosperma, the *Cycadeæ* and the Pines. The difficulty for the palæontologist who has not the more perishable parts of the fructification to guide him, and can only deal with the foliage and the cones, is now greater than ever. I quite agree with Mr. Carruthers in his reference of many of the species of so-called *Zamites* found in the Oolitic and more recent formations to the *Pinites;* and a special difficulty which has not hitherto occurred is presented by the plants on the present plate. Until recently the simple pinnation of the foliage of the Cycadeous plants, such as *Zamia*, was without exception ; but the discovery in Queensland of the bipinnate *Zamiæ*, constituting the genus *Bowenia* (named after Sir G. Bowen, the present Governor of Victoria), gives us a compound foliage otherwise unknown amongst the *Cycadeæ*, but which I think it possible may ultimately be found in the *Zamites Barklyi* here figured, in which I suspect the two parallel portions on the piece of stone represented in our plate are really lateral divisions of a great bipinnate growth. If this fossil should ultimately prove to be bipinnate, and truly distichous, I would propose the subgeneric name *Bowenites* for such compound fossil *Cycadeæ* as in this respect resemble the recent *Bowenia*, the only known species of which, like our fossils, has the leaflets also narrowed at the base, approaching in shape, ridging, and striation, &c., to our *Z. ellipticus.* On the other hand, I have lately found in these same Bellarine rocks a

plant so closely related to the *Z. ellipticus* that I cannot help suspecting an affinity, in which the rachis or stalk is bipinnate, and the leaflets resemble those of *Podozamia* or *Bowenia* among the Cycads, but are apparently here and there in four rows, just as completely resembling the bipinnate branches and leaves of the Australian form of *Araucaria*, the *A. Bidwilli*, or bunya-bunya, in which the leaves differ from those of the American *Araucariæ* in being contracted at base to a narrow petiole, and, in greater part of the branches, being in two rows, and having the shape, texture, ridging, and striation of the *Bowenia* and other Cycads, but here and there (like the fossils I allude to) showing by occasional four rows of leaflets (or at least one leaflet appearing in some irregular intervals between the ordinary two rows lying in one plane, as in the foliage of the Cycads) that the distichous appearance is due to a spiral arrangement, the successive leaves of which appear just on opposite sides of a branch at intervals generally of 180°, but occasionally separated by only 90° ; and as in the fossil which I shall shortly figure the rachis is so thick and clumsy as to more resemble a branch, I propose the subgeneric term *Bunyalites* (from the native name of the recent type) for these forms, which could not be placed under the genus *Araucarites*, used by geologists for fossils (allied to, if not identical with, the *Lycopodites*) having, like the American living *Araucariæ*, the leaves thick, short, fleshy, widest at base of attachment, carniated, and in several rows. It is quite possible the *Z. ellipticus* may prove, on more perfect specimens occurring, to have a similar structure as the thickness of the rachis, or branch in that case, would lead us to suspect. The fruit found with these remains are not sufficiently perfectly preserved to determine their affinity with certainty, but they are much more like in appearance the fruit of the fossil *Zamiæ* of the Yorkshire Oolites than the Araucarian type. Under any circumstance of the ultimate affinity of these Australian fossil plants proving to be with one section or the other of the *Gymnosperma*, they are equally unlike any Palæozoic types, and in one case as in the other are entirely indicative rather of the more recent geological periods, although impressed with so strong a local peculiarity as to have no great resemblance to any species known elsewhere.

PLATE VIII., FIGS. 1, 2, AND 5.

ZAMITES (PODOZAMITES) BARKLYI (McCOY).

[Genus ZAMITES (BRONG.). (Class Exogena; sub-class Monochlamydea; § 2 Gymnospermæ. Order Cycadacea.)

Gen. Char.—Leaves pinnate; pinnæ or leaflets distichous, entire, or denticulate, approximate subimbricate pointed; base sub-constricted and attached by its whole width, or dilated, or auriculate, or cordate, and adhering only by the midrib, occasionally thickened. Veins fine, equal, all parallel, or rarely slightly divergent, and doubtfully dichotomous in some.

The species, with very approximate imbricating leaflets, with cordate base attached by the middle, form Morris' genus *Ptilophyllum* and *Otozamites* of Braun. The remaining species, with only slightly contracted base, attached by its whole width, are *Podozamites* of Braun. The slight longitudinal thickening, like a midrib or plication, seen in some species is quite distinct from the true veining or neuration which overlies it. The fruit is strobiliform, oval, pendunculated, with large, spirally-arranged, imbricating scales. Stem cylindrical, sometimes as broad as long; no distinct axis; cicatrices rhomboidal.

Sub-gen.—Podozamites.—Base of pinnæ constricted; nerves sub-parallel, converging at apex; not conspicuously branched.]

DESCRIPTION.—Fronds from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches wide; rachis thick (about $1\frac{1}{3}$ lines wide); pinnules close set, narrow linear, elliptically pointed at the distal end (about 1 inch 5 lines long, and 1 line wide in *var. gracilis*, and 1 inch 3 lines long, and $1\frac{1}{2}$ lines wide in *var. latior*), abruptly contracted to the base, the narrowed lowest portion of which is obliquely inserted in two very slightly alternate or nearly opposite rows; basal portion, with about 10 or 12 narrow, equal, rounded, longitudinal ridges, which usually become obsolete towards the distal half, on which often only 3 large ridges or undulations can be seen; the surface has about 50 to 70 longitudinal striæ in the width of a pinnule. The bases of the pinnules are nearly opposite, and, from their narrowness, seem rather widely separated, though only far enough apart to allow the edges of the broader portion to nearly touch the adjoining edges of the next ones.

Dedicated to Sir Henry Barkly, formerly Governor of Victoria, in commemoration of the lively interest he has taken for some years in one of the nicest and most difficult questions of critical Palæontology with which Australian geologists have had to deal, and which continues to excite the doubts and frequent discussions of European, Indian, and American geologists—namely, whether the fossil flora associated with the coal of Newcastle, N. S. Wales, Tasmania, and the neighborhood of Melbourne, be Mesozoic or Palæozoic—a question which I believe to be now set at rest by the continued discovery of Mesozoic forms, and the continued absence of the characteristic Palæozoic genera. The three species of Zamia-like plants now made known were among the specimens sent to me by Mr. Daintree (formerly of the Geological Survey of Victoria, now Agent-General for Queensland), from one of the shafts sunk by his party at Bellarine, between Queenscliff and

Geelong, in search of coal, which he found in small quantity. As far as the specimens go, they present the characters of *Podozamites;* but I think in them we have an additional link between the Cycads and Firs. Lindley points out that the cones of *Dion* amongst the Cycads, and *Araucaria* amongst the Firs, can scarcely be distinguished; and I would point out that the peculiar foliage of an Australian *Araucaria*, the *A. Bidwilli*, if fossilised, could not be distinguished in fragments as large as our fossils from *Zamites.* As our present specimens are unbranched, and with two rows of pinnæ, I am bound to refer them to *Zamites;* but I have another plant from the same beds, with nearly identical pinnæ in four rows, and branched, which I shall shortly figure under the generic name *Bunyalites*, showing an insensible blending between the two great sections of Gymnosperms as far as foliage is concerned.

In these Bellarine beds the *Pecopteris Australis* also occurs, a species which is to be seen with the *Glossopteris Browniana* of the Newcastle coal beds, on one bit of stone in the survey collections from Tasmania, thus carrying our Gymnospermous plants of Bellarine to the Palæontological account of both the Tasmanian and N. S. Wales coal seams.

There is some slight variation in the amount of alternation or oppositness of the pinnules in different specimens; but I attach no specific importance to this, as I observe in the recent *Zamia Preissi* the pinnules occasionally opposite near the tip of the frond, but perfectly alternate towards the base. Also, as in the recent examples, the upper surface is more nearly smooth, and the lower surface of the pinnules more distinctly ridged.

At first sight, in size and shape, this nearly resembles the common *Zamia hastula* of the Yorkshire Oolitic coal beds, but is easily distinguished by its smoother surface and the contracted base of the pinnæ or leaflets.

EXPLANATION OF FIGURES.

Plate VIII.—Fig. 1, specimen, natural size of the *var. gracilis.* Fig. 2, portion of rather larger frond, natural size, with somewhat broader pinnules. Fig. 2*a*, magnified section, showing the thickness of the pinnules. Fig. 2*b*, portion of surface, with many ridges magnified, showing the superficial striæ. Fig. 2*c*, one of the pinnules less magnified, showing only two or three ridges. Fig. 5, portion, natural size of the *var. latior.* Fig. 5*a*, portion of pinnule beyond the middle, showing the superficial striæ and only three ridges. Fig. 5*b*, base of same pinnule, showing twelve ridges.

PLATE VIII., FIG. 4.

ZAMITES (PODOZAMITES) ELLIPTICUS (McCOY).

DESCRIPTION.—Fronds about 2¼ inches wide; rachis very thick, about 2 lines wide; pinnules elliptical, scarcely touching; varying in width, from 1¼ inches long and 3½ lines wide, to 1 inch 1 line long and 2 lines wide; substance thick, usually showing only 3 obtuse ridges, but sometimes 11 smaller, the whole covered with a very fine longitudinal striation; base of pinnules contracted and inserted obliquely on the rachis, in a slightly alternate order, or nearly opposite.

This is easily distinguished from the *Z. Barklyi* by the much thicker rachis, the broader oval form of the pinnules, and their thicker substance. I have just received some specimens nearly like this plant in foliage, but having indications of the leaflets or leaves being in four instead of in two rows, and having a branching stem, recalling the *Lycopodites Williamsoni* of the Scarborough Oolites, but with the leaves flat and elliptical, instead of thick, carinate, and falcated. I should propose the name *Bunyalites* for these fossil forms which approach *Araucarites* in many respects and have branching stems, but with the leaves contracted at the base, as in the *Podozamites* and *Araucaria Bidwilli*, or bunya-bunya. Along with these plants are also fruit cones, resembling the Oolitic *Zamiostrobus*, as far as their character can be seen.

EXPLANATION OF FIGURES.

Plate VIII.—Fig. 4, specimen of part of frond, natural size.

PLATE VIII., FIG. 3.

ZAMITES LONGIFOLIUS (McCOY).

DESCRIPTION.—Fronds about 10 lines wide; rachis about ½ a line thick; pinnæ slightly contracted and obliquely inserted at base, closely arranged in two rows, standing nearly at right angles to the rachis, except at the curved base; pinnæ

linear, narrow, elliptically pointed at apex, about 5 lines long, and $\frac{1}{2}$ a line wide; midrib distinct, with fine parallel longitudinal striæ.

At first sight this resembles the *Zamites taxinea* of the Yorkshire Oolites, but is still smaller and even more like a yew from the distinctness of the midrib; it differs more essentially in the contracted base and oblique insertion of the leaflets. The strong midrib approximates the species to *Cycadites*, but it varies in some pinnæ, and the contracted oblique base of the pinnæ prevents a reference to that genus.

This plant is not so common as the other Gymnosperms in the coal shale at Bellarine, where I have seen about half a dozen specimens.

EXPLANATION OF FIGURES.

Plate VIII.—Fig. 3, specimen, natural size. Fig. 3*a*, portion highly magnified to show the striation. Fig. 3*b*, one of the pinnules magnified four diameters.

FREDERICK McCOY.

1 a

1 b

1

PLATE IX.

LEPIDODENDRON (BERGERIA) AUSTRALE (McCOY).

[Genus LEPIDODENDRON (STERNBERG). (Class Acotyledones. Sub-class Acrogenæ. Order Lycopodiaceæ).

Gen. Char.—Large trees with dichotomous branches; surface closely covered with alternately arranged, rhombic scars, having a vascular cicatrix near the middle or upper angle. Leaves linear or peltate; fruit, a cone at the extremity of certain branches.]

[*Sub-genus.—Bergeria* (Presl.). Scars nearly flat, obovate, rhombic, or quadrate, with a very small oval vascular cicatrix near upper angle.]

DESCRIPTION.—Stem at 2 inches in diameter having rhombic scars with straight thick boundaries, about 4 lines long and 3½ lines wide, with a very small, oval, rounded, vascular cicatrix rarely near the middle or more usually excentric towards the upper angle, and often connected with the appearance of a vertical shallow rounded sulcus; branches 1 inch in diameter, having similar scars 3 lines long and 2½ lines wide; upper and lower angles of the scars usually slightly more acute than the lateral ones, very rarely the lateral ones more acute.

These most characteristic plants, the Lepidodendra, occurring in the utmost profusion everywhere in the Palæozoic coal measures of every part of Europe, and equally abundant in the coal measures of the same geological age in America, have roots which constitute the genus *Stigmaria;* cone-like fruit constituting the genus *Lepidostrobus:* casts of variously preserved internal parts constituting the genera *Knorria*, *Sternbergia*, &c.; and great fluted trunks in some kinds constituting the genus *Sigillaria;* and foliage constituting the genus *Cyperites*, &c.; all which various appearances of different parts or conditions of these plants abound in, and form the most characteristic palæontological marks of, the Palæozoic coal measures, and not one of which has ever yet been found, up to the present date, in the coal strata of New South Wales or Victoria, as far as my enquiries, under most favourable circumstances, have gone. I have, many years ago, however, published the occurrence of the genus both in the northern part of New South Wales and in Victoria, but in both cases entirely unconnected with the beds yielding the coal, which I have long maintained to be of the Mesozoic age, from the absence of *Calamites* and the above-named Palæozoic coal plants, and from the presence of *Tæniopteris.*

Phyllotheca, and various Gymnosperms and Ferns of forms intimately related to those of the Mesozoic coal beds of the Oolitic formations of Yorkshire and many places on the continent of Europe, and the thick coal deposits of Richmond in Virginia, India, &c., equally distinguished palæontologically from the Palæozoic coal measures.

The species here figured is scarcely distinguishable from the *Lepidodendron tetragonum* (Sternberg) [= *Aspidaria quadrangulata* (Presl.)] of the European Palæozoic carboniferous deposits by any definable character, so that my inclination was to indicate it as a *var. Australe* of that species, and I do not see any reason for supposing it referrible to the little Devonian *Lepidodendron nothum* (Unger), nor the probably identical *Lepidodendron Gaspianum* (Dawson), nor the *Lepidodendron Chemungense* of Hall, from the Devonian sandstones of New York. Hall's figure of the latter plant is not much less than the narrow part of the right hand branch of our figure, but it shows the scars nearly five times more numerous and scarcely $\frac{1}{5}$ of the size; and all the figures of the Devonian species mentioned, indicate the much smaller, more numerous, and much more acute, longitudinally elongate, leaf-scars as constant characters; together with a central vascular cicatrix.

The sandstone containing the present species in Victoria has been found by Mr. Howitt, over a large extent of Gippsland, to lie always unconformably on the upturned edges of the true Devonian rocks. These latter containing *Spirifera lævicosta*, Placodermatous fish, and various other Devonian fossils. Mr. Carruthers refers a plant from Queensland, which probably is identical with ours, to the Devonian *L. nothum;* but I know of no reason for considering the Gimpie beds Devonian; the great balance of the palæontological evidence, in my opinion, indicating rather the Lower Carboniferous age, and as I have said of our Victorian plant I think of the Gimpie one, that the scars are so much larger and fewer on approximately the same sized branches, that it is not desirable to make such a reference. The small vascular scar is sometimes indistinct, and is usually about half way between the upper angle and the middle; the occasional longitudinal furrow from it is no doubt due, as Mr. Carruthers suggests, to the greater

resistance of the bundle of vascular tissue originally extending upwards and outwards from the interior of the plant, as compared with the softer cellular tissue through which it passed, giving the occasional furrowed appearance from the accidents of pressure of the rocky bed in which it was petrified. Any one comparing Mr. Carruthers' or my figures with that of Sternberg's *Lepidodendron tetragonum* (*L. quadrangulare*, Unger) in t. 59, fig. 2, of his "Versuch einer Geognostisch-Botanischen Darstellung der Flora der Vorwelt," will find that the identity is so close, that for what I have figured as a variety or species under the special name *L. Australe*, I can only suggest the general slightly longer form of the scars as possibly distinctive; the elongation never approaches that of the American true Devonian species with the smaller elongate scars and central vascular cicatrix. I do not see, by the way, why Geinitz's figure of the *L. tetragonum* in t. 3, f. 1, of his "Darstellung der Flora des Hainichen-Ebersdorfer und des Flœhaer Kohlenbassins" should be supposed to be different from Sternberg's species; it shows the vascular cicatrix at the upper end.

Common in the red and yellow micaceous carboniferous sandstone of the Avon River, Gippsland, 5 miles above Bushy Park. Presented by the late Mr. Angus McMillan.

EXPLANATION OF FIGURES.

Plate IX.—Fig. 1, branched specimen, natural size; the left hand branch showing on the sides the thickness of the outer cylinder, and its inner markings. Fig. 1*a*, inner markings of outer cylinder magnified. Fig. 1*b*, outer surface showing scars, vascular bundle, thick boundaries, and longitudinal sulcus magnified.

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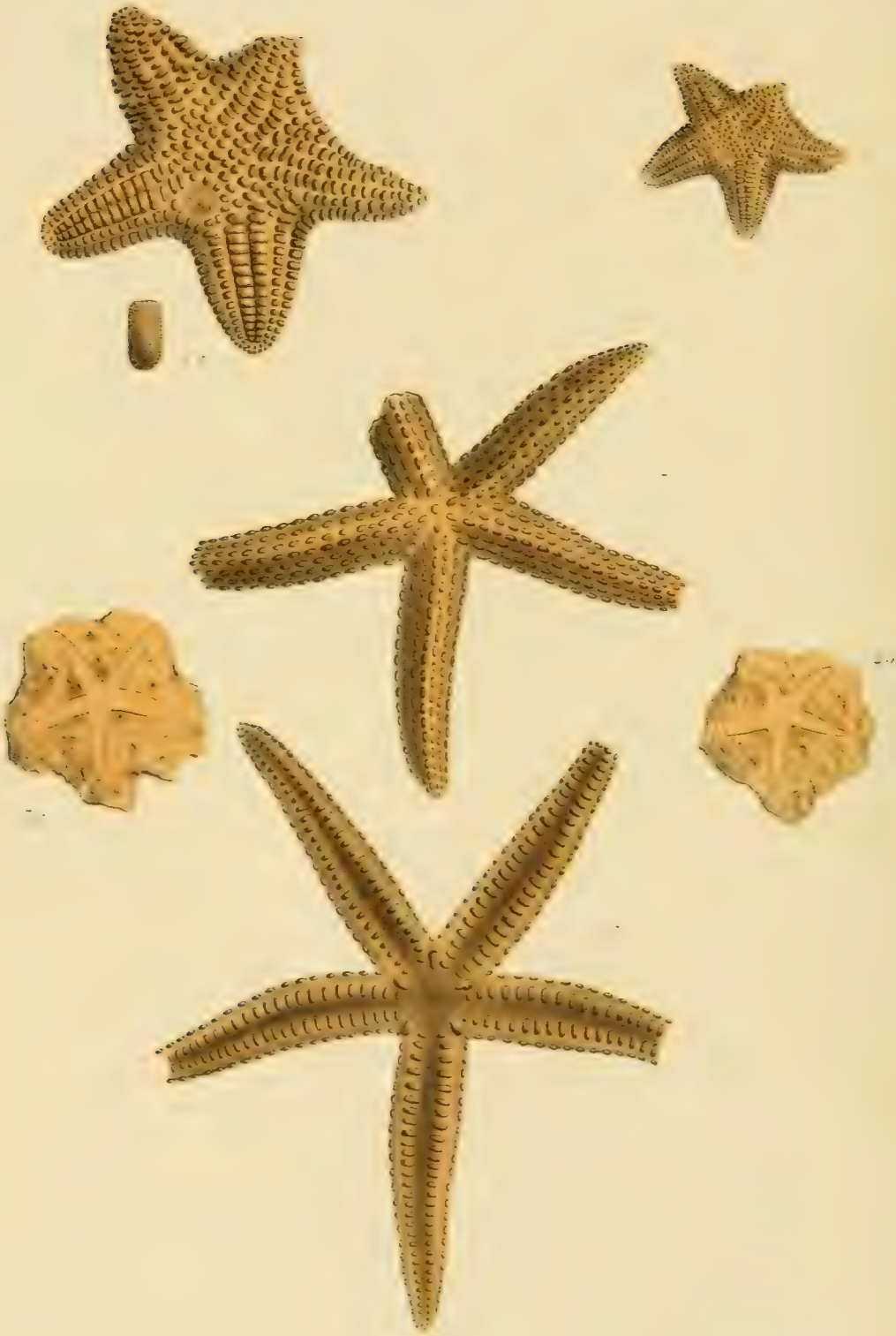

PLATE X., FIG. 1.

PETRASTER SMYTHI (McCOY).

[Genus PETRASTER (BILLINGS). (Class Echinodermata. Order Asteriæ. Fam. Urasteridæ.)

Gen. Char.—Stellate of 5 rays, moderately tapering, having on each side of the ambulacral groove 1 row of adambulacral plates, 1 row of marginal plates, and a few smaller disc plates, extending a variable distance along the rays.]

DESCRIPTION.—Five broad semi-elliptical lobes meeting at slightly rounded re-entering angles, leaving the length and the width at base of the rays nearly equal and less than the width of the disc. The upper surface is covered with crowded irregularly polygonal tumid plates. Madreporiform tubercle very large ($1\frac{1}{3}$ lines in diameter), irregularly porous, and rugged with branching vermicular ridges, excentric towards base of the two posterior rays. Ambulacral groove very narrow, bordered with a row of large transversely oblong adambulacral plates, wider than long, about 6 in 2 lines at middle of ray; margin of the rays bordered with a rather smaller row of similar marginal plates; between the row of adambulacral and marginal plates an intercallary row of small irregular plates. Width of disc between the rays, 7 lines; from tip to tip of rays, about 1 inch 2 lines; length of ray, about $5\frac{1}{2}$ lines.

This very remarkable starfish has clearly the intercallary row of plates between the marginal and adambulacral rows of plates distinguishing *Petraster* from *Palæaster*. I dedicate the species to Mr. R. Brough Smyth, who discovered it, and kindly gave me the specimen figured several years ago for the Public Museum collection. From some accident of decomposition, one part of the specimen figured shows the skin of the dorsal surface with its irregular plates and madreporiform tubercle, while two of the rays show the plates of the lower surface.

Very rare in the fine sandy Upper Silurian rocks of Moonee Ponds, Flemington, a little north of Melbourne.

A smaller specimen found since the above figures and description were made, having the rays scarcely 3 lines long from the re-entering angle at base to the apex, has nearly 9 adambulacral plates in the space of 2 lines. This specimen shows the elliptically pointed end of the rays, with the rows of adambulacral, marginal, and intercallary, plates distinctly.

EXPLANATION OF FIGURES.

Plate X.—Fig. 1, partly dorsal and partly ventral view, natural size. Fig. 1*a*, do., magnified. Fig. 1*b*, one of the plates magnified to show the granular surface.

PLATE X., FIGS. 2, 3.

URASTERELLA SELWYNI (McCOY).

[Genus URASTERELLA (McCOY) = STENASTER (BILLINGS). (Class Echinodermata. Order Asteriæ. Fam. Urasteridæ.)

Gen. Char.—Small starfishes, with five moderate rays, narrowed at the base, and without disc. Ambulacral grooves narrow, bordered on the under side, with only one row of large (adambulacral) plates; no marginal plates. Upper surface with numerous rows of small tubercular plates. Confined to Silurian rocks.]

DESCRIPTION.—Rays 5 elongate gradually tapering from a little beyond the base, which is slightly contracted, angulated on the upper side by a prominent ridge along the middle of each ray, having a row of conical tubercular plates (about 8 in 2 lines), each side sloping on the dorsal aspect from the middle with about 3 rows of conical tubercular plates rather smaller than the middle row. The 5 axil plates small, ovate, triangular, very tumid. Adambulacral plates large, extending to the tubercular margin, transversely oblong, about twice as wide as long (about 9 in 2 lines). Ambulacral plates small, in a deep ambulacral groove. Length of ray from mouth to tip, 6 lines; greatest width near base, $1\frac{1}{4}$ lines. Surface of plates granular.

The late Mr. Salter and Mr. Billings refer the starfishes of this type to the subsequently published genus *Palæaster* of Hall; but, as Professor Hall objects that his genus *Palæaster* has ambulacral, adambulacral, and marginal plates, and the types of my genus *U. Ruthveni* and *U. hirudo* of the English Ludlow rock, like our Australian species and the American *Palæaster* or *Stenaster pulchella*, have only one row of plates on each side of the ambulacral groove, I return to the use of my old generic name, of which *Stenaster* of Billings seems a synonym.

This beautiful species is easily known by its strongly angulated rays on the dorsal side. The traces of oral plates are so very minute and indistinct that I cannot give their character.

This is the first fossil starfish seen in Australia, and I dedicated it to my old friend Mr. Selwyn, formerly Director of the Geological Survey of Victoria, and now Director of the Geological Survey of Canada, who collected it.

Common in the fine sandy Silurian beds of range on E. side of commonage reserve, Kilmore.

This species is most nearly related to the *Uraster Ruthveni* of Forbes from the Upper Silurian grits of Kendal in Westmoreland.

EXPLANATION OF FIGURES.

Plate X.—Fig. 2, dorsal view magnified (the tubercles should have appeared more acute). Fig. 2*a*, do., natural size. Fig. 3, another specimen showing the lower side magnified. (In lithographing, the two rows of adambulacral plates have been too much reduced in size, leaving too much marginal space, and leaving the 5 axil plates apparently too large in proportion and too narrow at the outer end.) Fig. 3*a*, do., natural size.

FREDERICK McCOY.

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CONTENTS OF DECADE I.

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