Geological Survey of Victoria.

PRODROMUS

OF THE

PALÆONTOLOGY OF VICTORIA;

OR,

FIGURES AND DESCRIPTIONS

OF

VICTORIAN ORGANIC REMAINS.

DECADE II.

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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PRINTED AND PUBLISHED BY GEORGE SKINNER, ACTING GOVERNMENT PRINTER.

LONDON:
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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.

In this second Decade, the first plate illustrates a new species of the curious genus of carnivorous Whales, *Phocodon* or *Squalodon*,

* "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.*

hitherto only found in the Miocene Tertiary formations of Malta and of Bordeaux; and as this mammalian genus is unknown in beds of more recent date than Miocene the new species now made known from the Victorian Tertiary sands near Cape Otway is an interesting evidence in favor of my suggestion from other fossils of the Miocene age of those beds. On the same plate are illustrations of the astonishing gigantic extinct fossil Shark of the Eocene Tertiary London clay form, the *Carcharodon megalodon*, from the Miocene Tertiary beds near Geelong. As the species is found, in Europe, also in the clearly Miocene Tertiary beds of Malta and the French Miocene Faluns of Dax, the evidence is in favor of my suggestion that these beds were Miocene. The same conclusion is borne out by the third fossil represented on this plate, the *Carcharodon angustidens* (Ag.), from the same beds near Geelong, which is identical with examples from the Miocene Tertiary beds of Bünde, in Westphalia.

Then follow two plates illustrative of the curious, netted-veined, fossil Ferns from the Bacchus Marsh sandstones, the *Gangamopteris*, also found, though rarely, with the *Glossopteris* in the Mesozoic coal beds of New South Wales.

The fourth plate illustrates the characteristic Mesozoic coal Fern-genus *Tæniopteris*, from the coal strata near Cape Patterson; also a fine specimen of another characteristic Mesozoic coal Fern, the *Pecopteris Australis*, from the coal borings at Bellerine, near Queenscliff, identical with examples from the Tasmanian Mesozoic coal beds, and I think, on careful comparison of specimens, not separable by any definite characters from a species in the Oolitic coal shales of Yorkshire to which the late Mr. Bean gave the MSS. name *Neuropteris Scarburgensis;* strengthening the evidence of the Mesozoic age of the known Australian coal workings.

The next four plates illustrate species of *Cypræa* so remote in character from any living, Pliocene, or Miocene forms as to coun-

tenance my suggestion as to the Oligocene Tertiary age of the Schnapper Point and Muddy Creek beds in which they are found.

Then follows a plate of great interest as illustrating two Tertiary species of *Trigonia*, a genus hitherto only known as abounding in the Mesozoic rocks of many parts of the world, and at the present time in Australian seas; but the complete absence of which, in the intermediate Tertiary periods, in all localities examined, was looked upon by geologists as a most curious exception to the general palæontological law of the distribution of genera in time—an exception which we can now remove. The remaining figures on this plate illustrate three of the very few still living or recent species found in our Miocene and Oligocene Tertiary rocks; one of these is the most common bivalve in the Geelong and Schnapper Point beds, and lives now, not in our seas, but in those of the northern part of New Zealand. The second is a *Limopsis*, long known as a common Miocene Tertiary species in many European localities, and of special interest from having been dredged up alive in the Arctic Ocean. Its recognition as one of the most abundant of our Miocene bivalves was inexplicable until lately Prof. Wyville Thompson dredged it alive from extreme depths continuously along the ice-cold bottom extending from the Arctic Ocean, under the Tropics, into the Southern Ocean farther south than Melbourne. The third species is a *Limopsis* hitherto only known from a few living specimens, dredged from 120 fathoms off the Cape of Good Hope by Admiral Belcher, but which I have been able to certainly identify by direct comparison as one of our commonest fossils in several Victorian Miocene and Oligocene strata.

The last plate is devoted to further illustrations of additional species of *Graptolites** from our goldfield slates, identical with

* On receipt of the 1st Decade, Mr. Selwyn writes to remind me that in June 1856 he brought me a specimen of a Graptolite, six months before those of Mr. Panton were received; so to him, and not to the latter, must be awarded the merit of finding the first Graptolite which

examples of the same species occurring in rocks of the same age in Scotland, North Wales, Bohemia, and North America.

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

FREDERICK McCOY.

26th April 1875.

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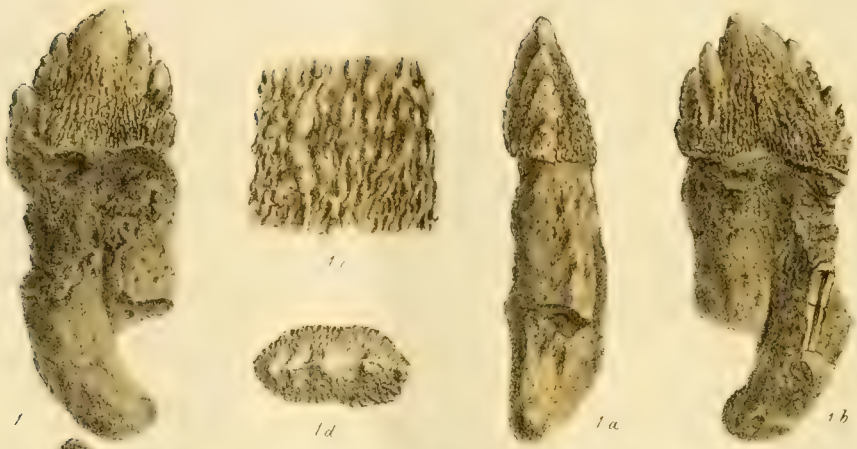
determined the age of the gold reef-bearing slates of Victoria. I greatly regret that my memory should have carried the impression that the *G. fruticosus* shown me by our friend Mr. Panton was the first Graptolite I had seen; but the difference of date is small, and I may have counted on Mr. Panton having had his specimens before I had an opportunity of determining them.

(Tertiary Mammalia.)



(Tertiary Fishes.)

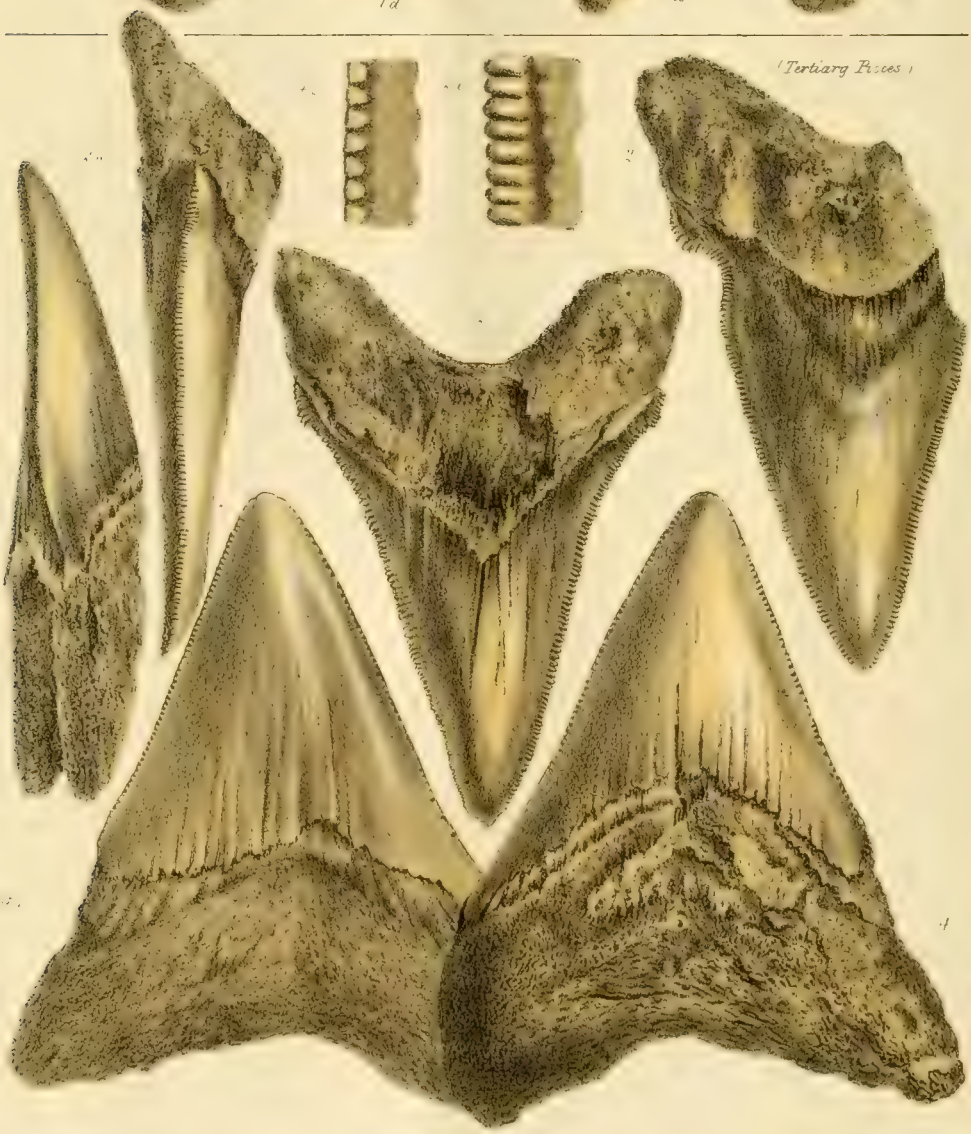


PLATE XI., FIG. 1.

SQUALODON WILKINSONI (McCOY).

[Genus SQUALODON (GRAT.) = PHOCODON (AG.). (Sub-kingd. Vertebrata. Class Mammalia. Order Cetacea. Fam. Zeuglodontidæ.)

Gen. Char.—Molar teeth, with a semi-elliptical crown, strongly compressed laterally, the cutting edge divided into semi-elliptical lobes in one plane, the middle one largest, the lateral gradually diminishing to the anterior and posterior ends; enamel longitudinally marked with small irregular ridges; root with two or three fangs.]

DESCRIPTION.—This species is founded on one of the hindmost molars, having a compressed semi-elliptical crown 9 lines high, base 11 lines long and $5\frac{1}{2}$ lines thick; middle cusp bent moderately backwards; anterior convex edge irregularly serrated and divided into unequal cusps, the smaller about one-third from the top, and the larger one-third from the bottom of that edge; posterior shorter edge divided almost equally into three larger cusps, the lowest smallest, the two upper nearly equal and much larger, being about half the width of the middle cusp. Surface longitudinally marked with coarse rough very irregular sulci, and small granular angular ridges and striæ. Root bilobed below the upper half-inch, with incurved end; length of bilobed root, 1 inch 9 lines.

The American Eocene Zeuglodonts, as well as the Malta Miocene *Squalodon* or *Phocodon* molars, constituting the New and Old World types of those extraordinary extinct carnivorous whales forming the family *Zeuglodontidæ*, are larger than the present species. The Zeuglodonts differ remarkably in the roots of the molars forming two widely separated fangs divided from each other nearly from the crown, and but little exceeding the crown in depth; each face of the crown is indented by an extension of the depression corresponding with the separation of the fangs. While in this fossil the root is very long, single, or only marked with a shallow sulcus on each side for the greater part of its length, only slightly extended to the crown. In these respects the *S. Wilkinsoni* most nearly resembles the hind molar of the *Squalodon Grateloupi* (Gervais) of the French Miocene beds near Bordeaux; from which the Australian species is distinguished by its rather smaller size and peculiar proportions. The great proportional length of the roots indicates a greater proportional depth and strength of jaw than in the European species. The sole species of *Squalodon* previously known is found in the Miocene Tertiary beds of Léognan

(Gironde), in beds of the same age at Saint Jean de Videy (Herault), and in Austria near Linz. The recognition of a second species of the genus is therefore of special interest.

As the genus is unknown in strata above the Miocene, the discovery of this mammalian tooth in the Tertiary sands of the Victorian coasts is confirmatory of the Miocene age, which I had suggested for those beds from other orders of fossils.

The specimen was found by Mr. Wilkinson, a successful young geologist formerly attached to the Field Geological Survey, and to whom I have much pleasure in dedicating this important fossil.

Rare in the Miocene Tertiary sands of Castle Cove, Cape Otway coast.

EXPLANATION OF FIGURES.

PLATE XI.—Figs. 1, 1*a*, 1*b*, and 1*d*, different views, natural size, of the only specimen known. Fig. 1*c*, portion of surface of crown magnified to show the sculpturing.

PLATE XI., FIGS. 2, 3.

CARCHARODON ANGUSTIDENS (AG.).

[Genus CARCHARODON (Ag.). (Sub-kingd. Vertebrata. Class Pisces. Order Plagiostomata. Fam. Squalidæ. Sub-fam. Lamninæ.)

Gen. Char.—Teeth very large, compressed, triangular, without basal cavity, composed of massive dentine, with reticulated canals, edges serrated.]

DESCRIPTION.—Teeth having the middle cusp acutely angular, with a broad short lateral cusp on each side; outer face nearly flat, inner face strongly convex; cutting edges serrated, the serratures much larger on the lateral cusps than on the central one. Ganoine of surface smooth and highly lustrous. Length of middle cusp, 2 inches 2 lines; width at base, 1 inch 6 lines; thickness, 8 lines; width of base of crown, including lateral cusps, 2 inches. Nine serratures in 3 lines at middle of cutting edge; depth of root, 9 lines.

REFERENCE.—(Agassiz), Pois. Foss., vol. 3 = C. angustidens (Ag.) + C. lanceolatus + C. heterodon + C. megalotis + C. auriculatus + C. turgidus + C. semiserratus + C. Toliapicus. (Dr. Gibbes, Mon. Sq., says Agassiz agrees now to unite these species.)

The gigantic sharks constituting the genus *Carcharodon* are extremely abundant in the Miocene Tertiary, but are almost extinct, only one species living at present. They are easily

distinguished from the *Carcharias* of the present seas, even when only the teeth can be examined, by the absence of the conical cavity in the base. The present species, even as originally restricted by Agassiz, is one of the most abundant and characteristic Miocene Tertiary fossils of every part of Europe and America in which strata of this age exist, and I recognized it amongst the Australian beds to which I assigned Miocene and Oligocene ages with great astonishment, from this evidence of its world-wide distribution in the Tertiary period.

The most minute comparison fails to indicate the slightest difference between our Victorian specimens and those from the well known Miocene Tertiary beds of Bünde, in Westphalia ; they also agree perfectly with those from the supposed Eocene strata of South Carolina. On the convex inner face a small triangular space at the base is not covered by the thick polished ganoine which extends to the root on the outer face, as is common in the genus. The species is easily distinguished from the *C. megalodon* (Ag.) by the centre cusp being much narrower in proportion to its length, and by there always being a distinct pair of short, obtuse, strongly serrated, lateral cusps, one on each side of its base.

Not uncommon in Miocene Tertiary sands of Bird Rock, near Geelong.

Explanation of Figures.

Plate XI.—Fig. 2, specimen presented by Mr. Butler from the Miocene Tertiary of Bird Rock, near Geelong, natural size, viewed on the inner side, showing space bare of ganoine at base of crown. 2*a*, side view of same specimen. 2*b*, portion of lateral serration magnified. Fig. 3, inside view of another specimen having the lateral cusps smaller.

Plate XI., Fig. 4.

CARCHARODON MEGALODON (Ag.).

Description.—Teeth very large, of one broad triangular cusp, without lateral cusps ; cutting edges finely serrated ; flat outer surface, with a few irregular longitudinal sulci on basal half ; inner face smoother, convex ; root of moderate depth, not deeply bilobed. Dimensions of figured specimen—height of crown, 2 inches 2 lines ; width of base, 2 inches 6 lines ; thickness, 8 lines ; seven serratures in 3 lines on middle of cutting edge ; depth of root, 11 lines.

Reference.—C. megalodon + C. rectidens (Ag.), Pois. Foss., vol. 3, t. 29.

This, which is the most gigantic of all fishes (the teeth indicating a length of 40 feet), is also one of the most characteristic of the Miocene Tertiary of Europe and Virginia. I am glad, therefore, to figure it as portion of the evidence in favor of my reference of the Victorian Tertiary deposits near Geelong to the Miocene period, as the specimens from them are perfectly identical with those from Malta and the Miocene Faluns of Dax on the most careful comparison.

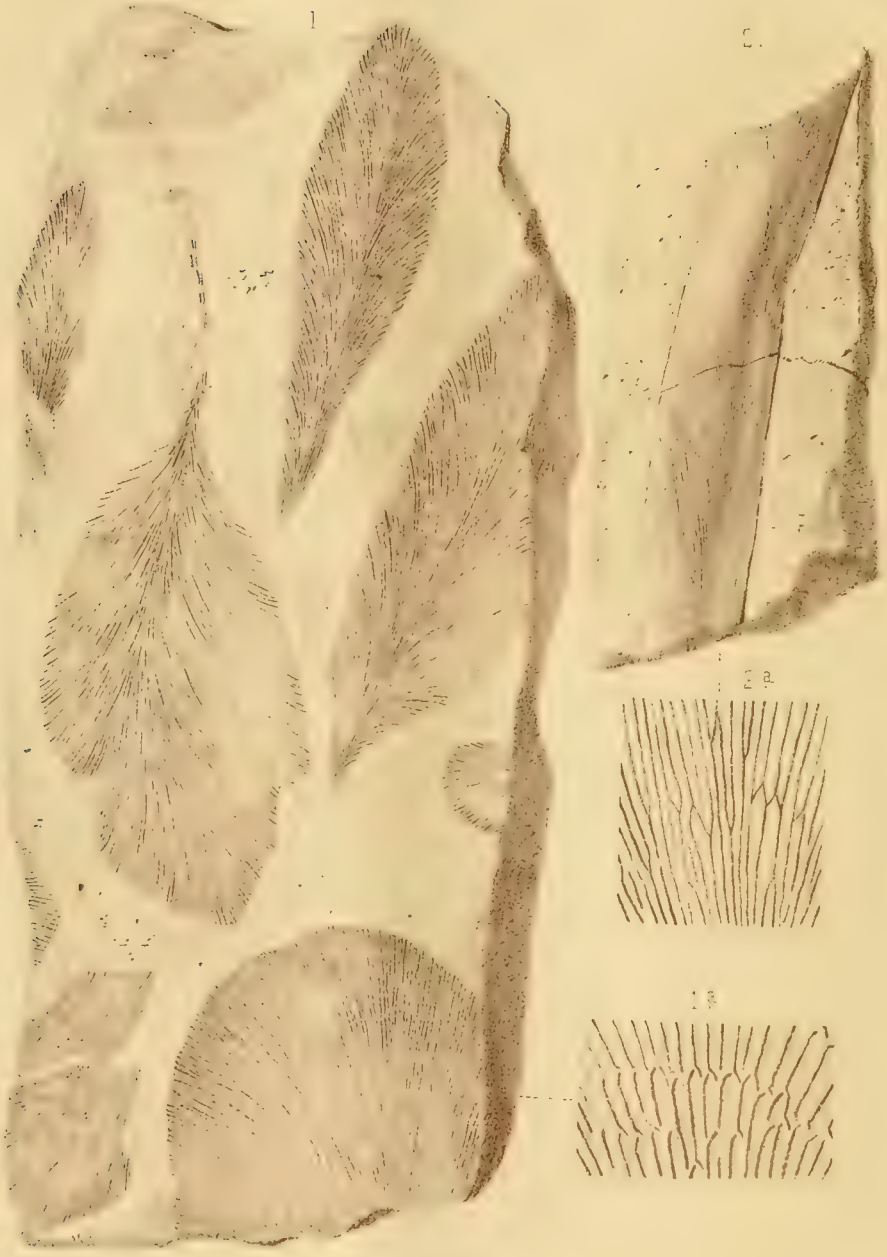
It is easily distinguished from the *C. angustidens* (Ag.) by its greater size, and the wider, triangular, single cusp, the lateral cusps being wanting. It is usually less thick, with finer serration and proportionally smaller root; the glossy ganoine of the surface is also thinner and less lustrous.

Rare in the Miocene Tertiary of Bird Rock, near Geelong.

EXPLANATION OF FIGURES.

Plate XI.—Fig. 4, view of convex inner face, natural size. Fig. 4*a*, view of flat outer face, same specimen. Fig. 4*b*, edge view of same specimen. Fig. 4*c*, serration magnified.

FREDERICK McCOY.



Ludwig Becker del. & lith. *Prof. M'Coy, direx!* *Hamel & Co imp.*

PLATES XII. AND XIII.

PLATE XII., FIG. 1; PLATE XIII., FIG. 2.

GANGAMOPTERIS ANGUSTIFOLIA (McCOY).

[Genus GANGAMOPTERIS* (McCOY). (Class Acotyledones. Sub-class Acrogenæ. Order Filices. Fam. Neuropteridæ.)

Gen. Char.—Frond simple or impari-pinnate; middle pinna spatulate, symmetrical, semi-elliptically pointed above, gradually tapering towards the base; lateral pinnæ variable, very acute, tapering from base, or obliquely ovate, to trigonal or flabelliform, broad above, gradually narrowed towards the oblique adherent base, which is never auriculate, but moderately wide and embracing; no midrib; veins coarsely reticulate, many arising from the base, branching as they diverge towards the margin, and frequently anastomosing to form an irregular polygonal network.]

DESCRIPTION.—Very long, narrow, unequal sided, slightly oblique, very gradually tapering towards the apex from the widest portion near the base; base slightly contracted, embracing, and obliquely truncated. Length, often 9 or 10 inches; width, rarely exceeding 1 inch.

REFERENCE.— = *Cyclopteris? angustifolia* (McCoy), An. & Mag. Nat. Hist., v. 20, t. 19, f. 3 and 3*a*.

The gigantic ferns constituting the genus *Gangamopteris* were originally described by me in a paper in the Annals of Natural History for 1847, from a single terminal leaflet having the form and netted neuration of the narrow varieties of *Glossopteris Browniana*, but which I pointed out as generically distinct from wanting the midrib. I there referred the plant doubtfully to *Cyclopteris* (as *Cyclopteris? angustifolia*), pointing out, however, the apparently generic difference of the anastomosing of the veins. This latter character I think I have observed in some of the typical *Cyclopteri*, but in the present plants it is a marked and constant character. The great numbers of specimens I have lately examined from the Victorian locality of Bacchus Marsh suggest, by their varied obliquity, that the plant was in all probability impari-pinnate; the symmetrical spatulate examples being either a simple frond or the central terminal division of an impari-pinnate frond, of which the unequal-sided, oblique examples with broad oblique base of attach-

* Etymology Γαγγαμον, *a small round drawnet*, and Πτερις, *a fern*.

ment would in that case be the lateral pinnæ ; the wider examples being probably more nearly basal than the narrower ones. As there is at present no direct evidence of this connection of the three types of form commonly occurring, it is necessary to describe them for the present under three distinct names for reference until evidence of their relation may be obtained. The netted neuration and want of midrib would indicate the nearest affinity in these respects to be with Gutbier's Carboniferous genus *Dictyopteris*, which differs altogether in its more complex form and the auriculated base of the pinnules, a character never found in *Gangamopteris*. These *Gangamopteri* are the only fossils found as yet in the Bacchus Marsh sandstone, so that their association as originally observed by me with *Glossopteris Browniana* of the N. S. Wales coalfields is of value as indicating a Mesozoic age for this Victorian rock, the stratigraphical relations of which are not clear.

This *G. angustifolia* is the form I first observed and described from the coal beds of New South Wales ; it is sometimes a foot in length and scarcely 1 inch wide.

EXPLANATION OF FIGURES.

Plate XII.—Fig. 1, moderate sized specimen, nearly perfect, natural size, showing the obliquely truncated broad sessile clasping base. Plate XIII.—Fig. 2, portion of smaller specimen, natural size. Fig. 2*a*, portion magnified to show anastomosis of neuration.

PLATE XIII., FIGS. 1–1*a*.

GANGAMOPTERIS SPATULATA (McCOY).

DESCRIPTION.—Spatulate, symmetrical, equal sided, semi-elliptically pointed above, tapering towards base to a slender petiole. Length, $4\frac{1}{2}$ inches ; width, about $1\frac{1}{2}$ to 2 inches.

This is by far the rarest of the three forms in the Bacchus Marsh beds.

EXPLANATION OF FIGURES.

Plate XIII.—Fig. 1, several rather small specimens on slab of stone, natural size, showing the regular ovate form and slender attenuated base. Fig. 1*a*, portion of surface magnified to show netted neuration.

PLATE XII., FIGS. 2–4.

GANGAMOPTERIS OBLIQUA (McCOY).

DESCRIPTION.—Very wide, unequal sided, very oblique, sub-trigonal, widest near the broadly rounded distal end, gradually tapering to the base, which is not petiolate, but obliquely truncated with a moderately wide sessile base of attachment. Length, commonly about 4 or 5 inches; width near apex, about $3\frac{1}{2}$ inches; width near base, commonly about 9 lines.

This is the most variable and common of the three forms. Abundant in the sandstone quarries of Bacchus Marsh.

EXPLANATION OF FIGURES.

Plate XII.—Fig. 2, average shorter and broader specimen, natural size, showing usual form of distal end, and obliquely truncated sessile base. Fig. 3, rather elongate specimen, the apex of which is turned over, but would have probably conformed to the dotted outline, natural size, showing the oblique truncated sessile clasping base. Fig. 3*a*, portion of neuration in middle near base magnified. Fig. 4, very small and narrow specimen, natural size.

FREDERICK McCOY.

PLATE XIV., FIGS. 1–2.

TÆNIOPTERIS DAINTREEI (McCOY).

[Genus TÆNIOPTERIS (BRONG.). (? Class Acotyledones; sub-class Acrogenæ. Order Filices. Fam. Danæaceæ.)

Gen. Char.—Frond simple or pinnate, long, narrow, with a thick strong midrib, from which the veins extend nearly at right angles to the lateral edges, either once or twice forked or simple. (Possibly Cycads allied to *Stangeria*.)]

DESCRIPTION.—Frond very long, linear, parallel-sided; substance thick; edges straight; midrib thick, very strong; veins extending at right angles from the midrib to the lateral margins, a few straight and simple, the greater number once forked at a variable distance between the midrib and lateral margin. Usual width of frond, 4 lines; about 10 or 11 lateral veins in the space of 2 lines at the margin (both of ordinary specimens 4 lines wide, and one young fragment nearly 2 inches long, but only 1½ lines wide throughout).

The fossil plants of this genus abound in Mesozoic rocks, and the only few doubtful fragments from older rocks that have ever been assigned to this generic type were too imperfect to admit of satisfactory determination. The presence of a species of this genus in the coal rocks of Victoria is of great importance in the determination of the Mesozoic age of these deposits coupled with the absence in them of all of the characteristic abundant forms of the old or Palæozoic coal.

The first specimens seen of this species I recognized in a small collection of vegetable fragments in the rocks associated with the coal seams at Cape Patterson forwarded to me by Mr. Daintree, then of the Geological Survey, to whom I dedicated it. I subsequently identified it in abundance at the sinkings for coal at the Barrabool Hills. As at the former locality I found in the rock with it fragments of the equally Mesozoic *Phyllotheca* of the N. S. Wales coal beds, and in the rocks at the latter place found it with the *Pecopteris Australis* (Mor.) of the Tasmanian coal basin, which itself has been noticed in one of the Tasmanian specimens in the Survey collection in the same mass of stone with the *Glossopteris Browniana* so common in the N. S. Wales coal seams, we are enabled by its means to connect the palæontological characters of the three principal Australian coal regions, and increase for each the evidence of their being more recent than the Palæozoic.

I have never seen this species more than about 4 lines wide, and as numerous fragments before me about 4 inches long are of this width throughout, the form must have been of a singularly narrow, long, linear shape ; and as the veins seem always to come off at right angles from the midrib, the Queensland specimen, figured by Mr. Carruthers in the *Quarterly Journal of the Geological Society* as of this species, is probably different.

The great thickness of the substance of the blade and midrib makes this *Tæniopteris* more like the Cycadeous *Stangerites* than any other I know. It is smaller and very much narrower in proportion and thicker than the specimens of the English Oolitic *Tæniopteris vittata* (Phil.), with which I have carefully compared it, and which otherwise it most resembles. The *T. vittata* has about 14 veins in the space of 2 lines at the margin, and they branch rather more frequently and irregularly than in our species.

Very common in the olive Mesozoic carbonaceous strata of the Barrabool Hills. Common in the Mesozoic coal beds of Cape Patterson (C^1 1) ; also (but broken into short fragments) in the dark ferruginous strata at Murundal, on the River Wannon, from whence our specimens were presented by Mr. E. Dacomb of Portland.

EXPLANATION OF FIGURES.

Plate XIV.—Fig. 1, portion of young frond, imperfect at each end, natural size, showing the narrow linear proportion. Fig. 1*a*, portion ditto magnified. Fig. 2, portion of another specimen of usual width, natural size.

PLATE XIV., FIG. 3.

PECOPTERIS AUSTRALIS (MOR.) = PECOPTERIS SCARBURGENSIS (BEAN MSS.).

[Genus PECOPTERIS (BRONG. PARS). (Class Acotyledones ; sub-class Acrogenæ. Order Filices. Fam. Sphænopteridæ).

Gen. Char.—Frond bi- or tri-pinnatifid ; pinnæ long, pinnatifid ; pinnules oblong obtuse, sub-equal, attached to the rachis by the entire width and usually more or less united at base ; midrib strong, veins oblique or at right angles, simple or once or twice (rarely thrice) forked.]

DESCRIPTION.—Frond bipinnate ; pinnæ invariably oblique, alternate, usually about 3 or 4 inches long, about 1 inch apart, and about $1\frac{1}{2}$ inches wide, so that the tips of the pinnules of adjacent pinnæ overlap. Pinnules oblique, slightly subfalcate, subalternate (nearly opposite), so close that they nearly or quite touch, lanceolate-ovate, semi-elliptically pointed at apex, nearly parallel-sided in the middle, and slightly

Pl 14

dilated at base, so as to adhere by the whole width to the rachis, and slightly to each other; edges usually simple, or slightly undulated, rarely slightly serrated minutely at apex; midrib thin, slightly flexuous, nearly obsolete at tip; secondary veins oblique, forking once near base, and occasionally a second time near the margin; the ordinary length of pinnules is about 9 lines; and width at base, 3 lines.

Reference.—Mor. in Strzl. N.S.W., p. 248, t. 7, figs. 1–2.

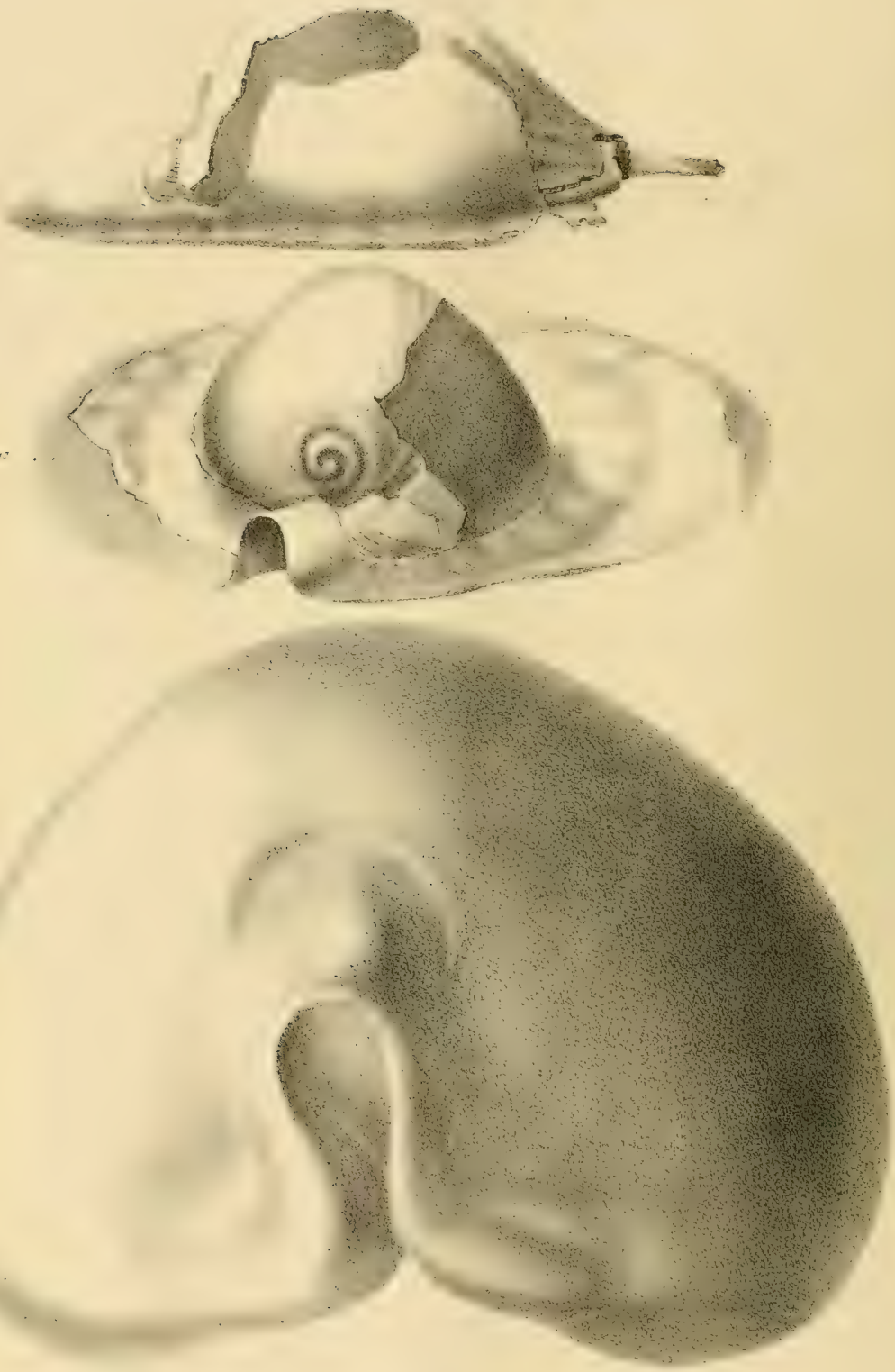
I can in no way distinguish by any satisfactory character this species from one in the Oolitic coal shales of Scarborough to which the late Mr. Bean of that place gave the manuscript name of *Neuropteris Scarburgensis*, and which Mr. Leckenby, the most experienced living authority on the Yorkshire Oolitic Ferns, considers intermediate between the *Pecopteris insignis* and the *P. ligata* of the same beds. The slightly more distinct serration or jagging of the apex of the pinnules in the English than in the Australian (as represented in our magnified figure) is the only difference I see on careful comparison of specimens from both rocks. The *hastata*, *ligata*, *recentior*, and *Whitbiensis* of the Yorkshire beds, to some of which this and the allied *Pecopteris Indica* (Old. and Mor.) have been compared by various authors, have shorter, broader, more falcate, and more pointed pinnules; but any one even comparing our plate with Lindley and Hutton's one of *Pecopteris insignis*, and taking Mr. Leckenby's view of *Scarburgensis* being intermediate between it and *Pecopteris ligata*, and our Australian plant having actually the same length and proportion of pinnules as this intermediate smaller form (*Scarburgensis*), will see the difficulty of separating the Australian plant from it, particularly when I state that the veins are much more commonly forked only once in the Australian plant, as I figure it, than with the second marginal branching as given by Morris, and which I have occasionally seen in the English Oolitic plant also.

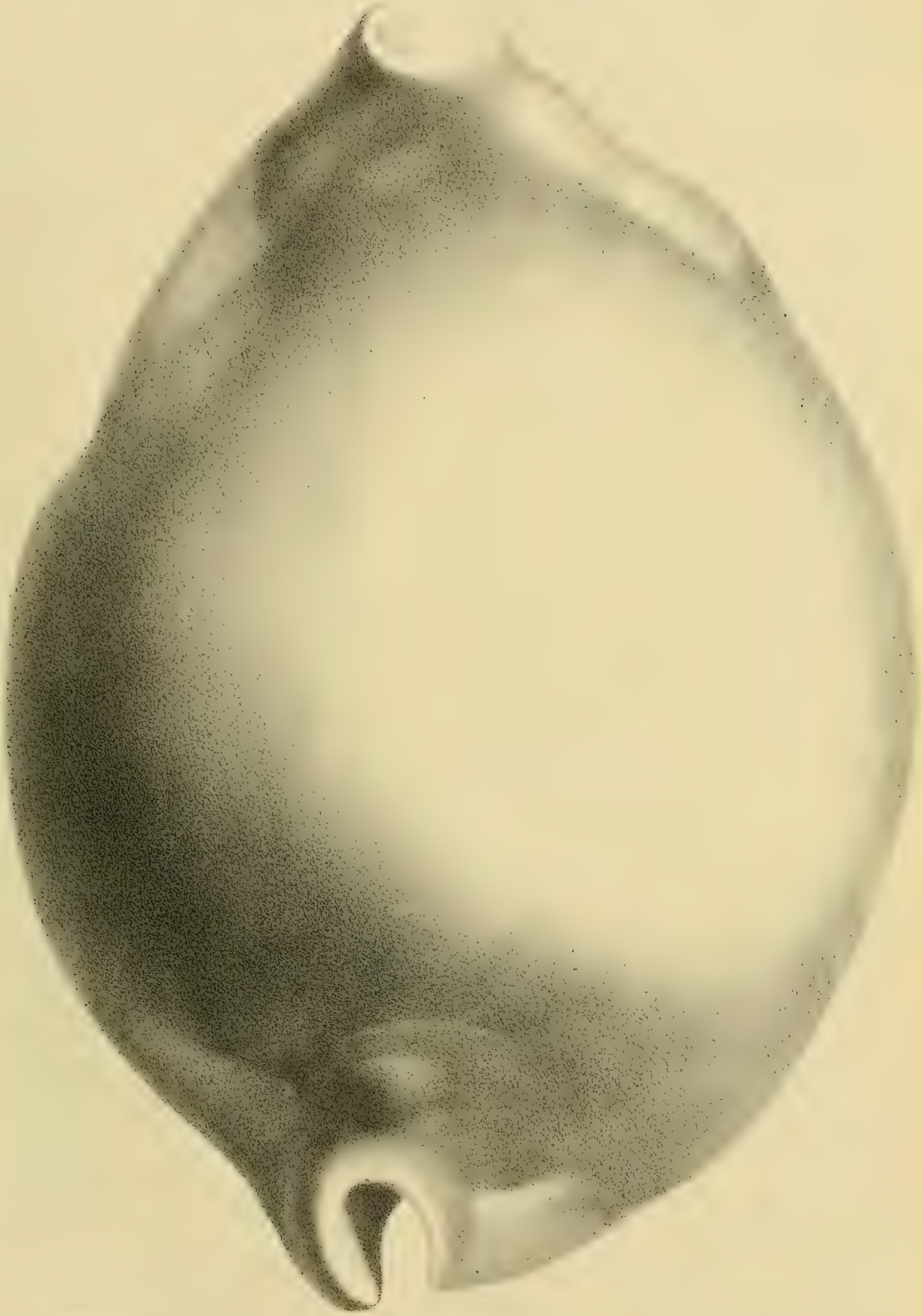
This species, which is common in the Jerusalem Basin of Tasmania, is here figured from the light-grey fine clays associated with thin coal seams at Bellerine, near Geelong, the beautiful specimen figured having been presented to the Museum by Dr. King of that place.

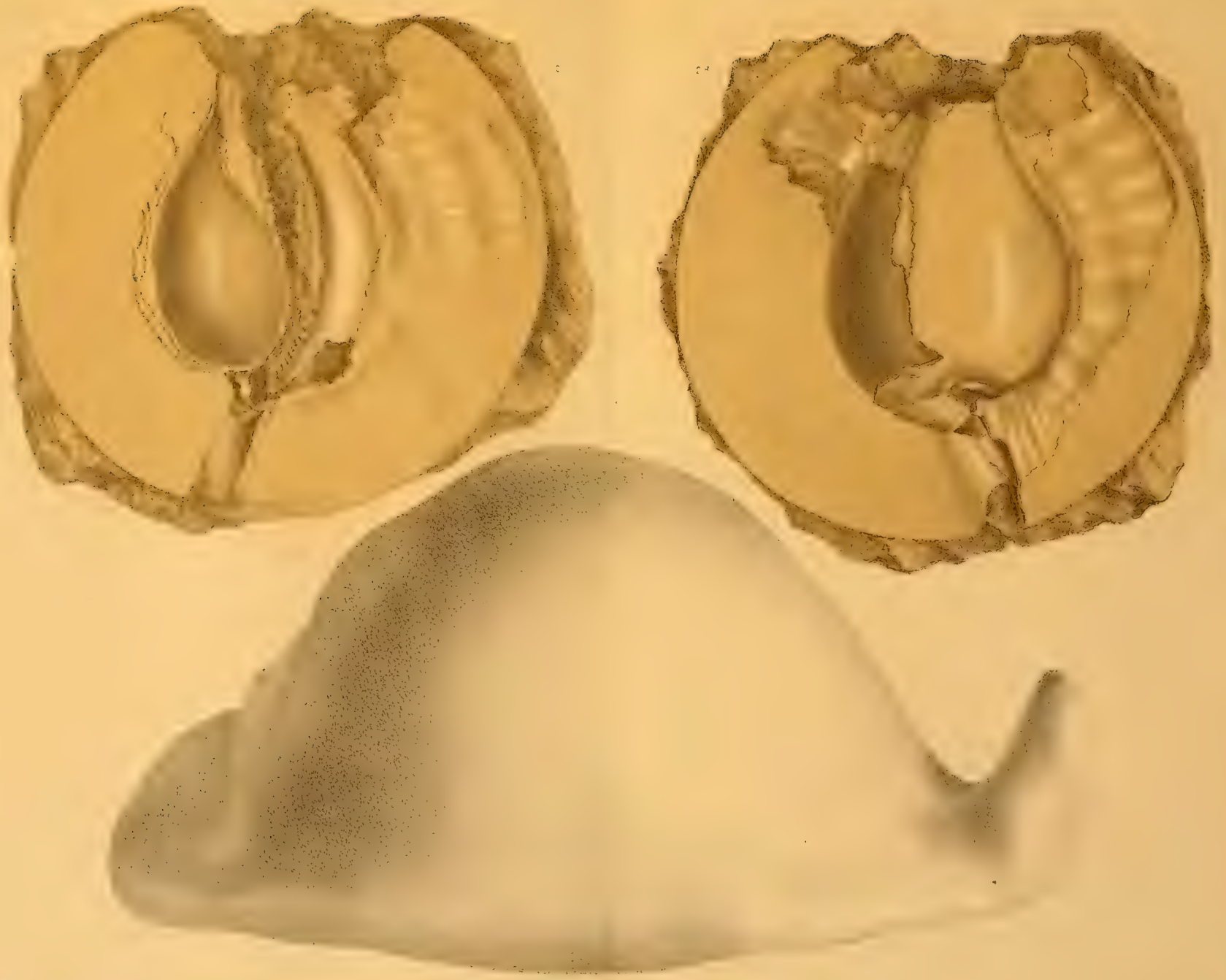
Explanation of Figures.

Plate XIV.—Fig. 3, pinnate frond, natural size. Fig. 3*a*, three pinnules magnified, showing form, attachment, venation, and slight serration sometimes seen near tip.

Frederick McCoy.







J.M. Ferguson Imp.

PLATES XV., XVI., XVII., AND XVIII.

PLATE XV.; PLATE XVI., FIG. 2; PLATES XVII. AND XVIII., FIG. 1.

CYPRÆA (ARICIA) GIGAS (McCOY).

[Genus CYPRÆA (LIN.). (Sub-kingd. Mollusca. Class Gasteropoda. Order Pectinibranchiata. Fam. Cypræidæ.)

Gen. Char.—Shell ovato-oblong; spire very short, or entirely covered by the body whorl; back rounded; inner and outer lips inrolled; aperture narrow, as long as the shell, reflected at both ends, transversely toothed and ridged on each side.

Sub-genus.—Aricia (Gray). Surface highly polished; gibbous above; flattened, thickened, and dilated at the sides below; spire covered; aperture straight, narrow, outer and inner lips callous, thickened, wide, dentated.]

DESCRIPTION.—Shell very large, thick; form ovate; back very gibbous, somewhat spheroidally irregularly rounded; base flattened, oval, much thickened, extending slightly in thick obtusely rounded margins on each side of the anterior and posterior ends of the shell (not in the middle); inner lip rounded, smooth within, flattened near the anterior channel, slightly concave before joining the tumid outer margin; outer lip inflected, tumid, broad, the edge smooth in the middle, with 9 or 10 nearly obsolete obtuse teeth near the anterior end, and a few still fainter near the posterior end. Aperture narrow, moderately curved, widest towards the anterior end, terminating in deep narrow channels at each end, the anterior one reflected at an angle of about 70° from the base, projecting upwards, forming a re-entering angle of 65° with the back; the posterior channel reflexed at upwards of 140°, obliquely subtruncate, inclining forward, and adherent to the spire. Spire exposed, of two whorls; apex obtuse, large; surface smooth. Length of large specimens, 8 inches; proportional width, $\frac{6.7}{100}$; height, $\frac{5.5}{100}$; height of anterior channnel, $\frac{3.2}{100}$; of posterior one, $\frac{2.5}{100}$; diameter of spiral suture at base of spire, $\frac{1.5}{100}$; width of middle of mouth, $\frac{7}{100}$.

REFERENCE.—(McCoy), Ann. Mag. Nat. Hist., Dec. 1867, p. 438.

This gigantic species far exceeds any known cowry in size; and, like the large Upper Eocene or Oligocene Tertiary *C. tuberosa* and *C. Coombi* of the Paris Basin and the English Bracklesham beds, is so completely destitute of teeth on the inner lip as almost to belong to the genus *Ovula*. With the very oblique light of a candle, or by a delicate sense of touch, faint indications of teeth may be detected, but scarcely more than, under similar circumstances, may be found in the recent *Ovula ovum*. I, however, agree with Gray and Sowerby in referring the European species to *Cypræa* instead of to *Ovula*, as proposed by Deshayes, and therefore refer the present species also, which is congeneric with them, to the same genus. The flattened base and thickened inner lip forming an obtuse lateral

projection at each end of the shell, as well as the strong reflexion of the channels, also induce me to place the present fossil in *Cypræa.* The fine specimen figured was found by a shepherd of Angus Cameron, Esq., and was presented by Lindsay Clarke, Esq.

In blue Oligocene clay of Muddy Creek, ten miles south of Hamilton. Rare in Oligocene clay of Mornington, near Mount Eliza.

Explanation of Figures.

Plate XV.—Dorsal view, natural size. Plate XVI.—Fig. 2, end view of same specimen, natural size. Plates XVII. and XVIII.—Fig. 1, side view, natural size.

Plate XVI., Fig. 1; Plates XVII. and XVIII., Fig. 2.

CYPRÆA (ARICIA) GASTROPLAX (McCoy).

Description.—Ovate; back very gibbous, moderately attenuated in front, rounded posteriorly. Spire small, blunt, of two volutions; aperture narrow, arched, set with large prominent teeth on each side. Base flattened and dilated from each side into a very large flat thin circular disc, with a semi-cylindrical channel in front and behind, not extending beyond the circular outline of the ventral disc. Whole surface highly polished; one or two faint concentric undulations, and more numerous faint radiating ones on the gastric disc. Length and width of the ventral disc, 4 inches 3 lines; greatest width of body whorl (without disc), 2 inches; length of body whorl, $2\frac{1}{2}$ inches; height, 1 inch 6 lines; diameter of spiral suture, 5 lines; thickness of flange, about $1\frac{1}{2}$ to 2 lines.

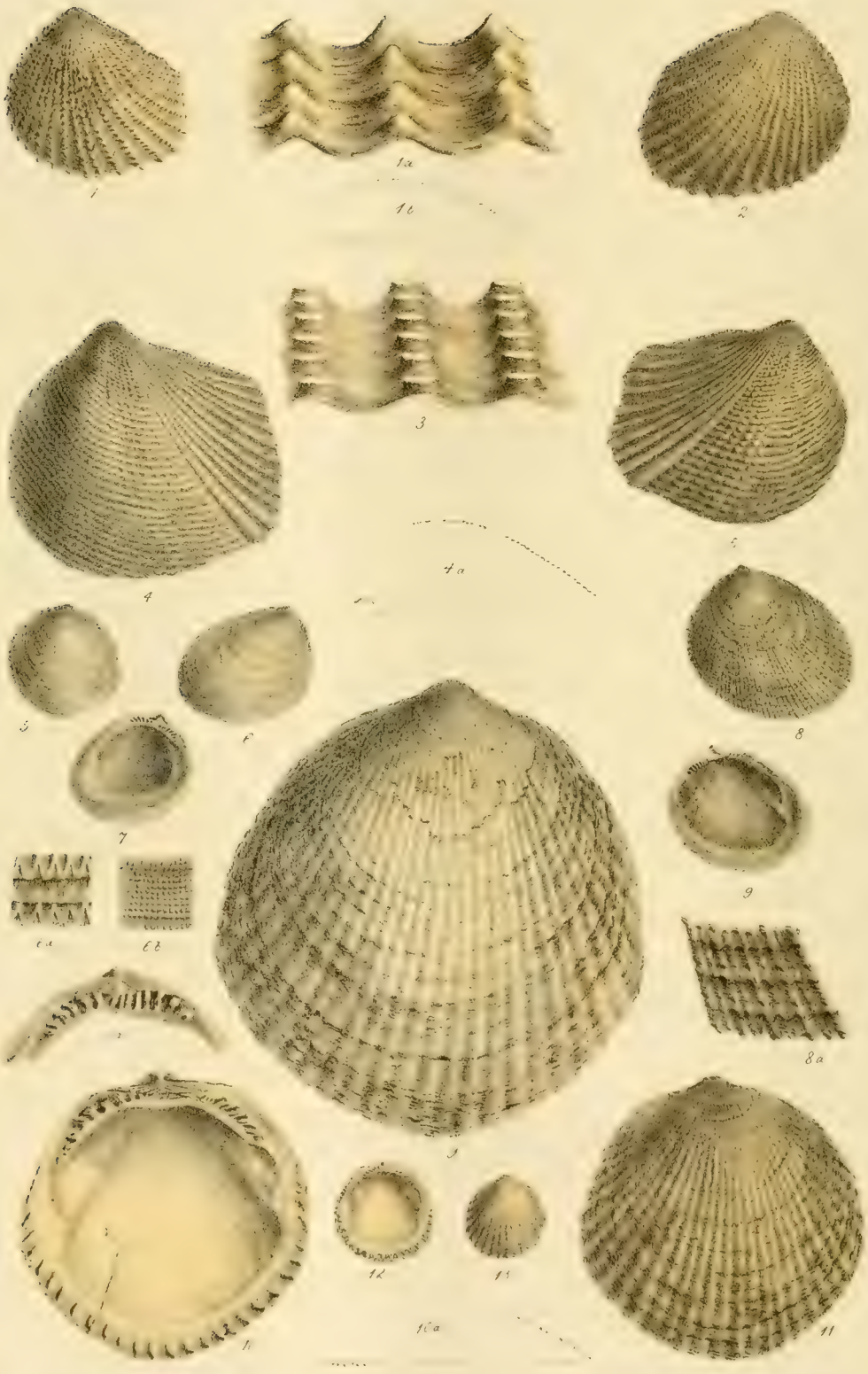
The enormously extended circular thin flange into which the base is extended renders this cowry totally unlike any previously known living or fossil species.

Rather rare in the Oligocene Tertiary limestone of the tract between Mount Eliza and Mount Martha, on the shores of Hobson's Bay.

Explanation of Figures.

Plate XVI.—Fig. 1, profile view, natural size, showing the elevation of the back and form of the anterior and posterior canals. Fig. 1*a*, oblique end view, showing the spire, posterior canal, and extension of gastric plate. Plates XVII. and XVIII.—Fig. 2, view of under side, showing circular outline of gastric disc, posterior canal, with the form of the aperture and outer and inner teeth. Fig. 2*a*, dorsal view of same specimen. All the figures natural size.

Frederick McCoy.


1
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12

PLATE XIX., FIGS. 1, 2.

TRIGONIA ACUTICOSTATA (McCOY).

[Genus TRIGONIA (BRUG.). (Sub-kingd. Mollusca. Class Dithyra. Order Pectinacea. Fam. Trigoniidæ).

Gen. Char.—Shell equivalve, inequilateral, subtrigonal; outside ridged, inside pearly; right valve, with a V-shaped pair of large diverging teeth, transversely sulcated on each side, received between 4 teeth, similarly sulcated on one side, in the left valve.]

DESCRIPTION.—Rotundato-rhombic, moderately convex; posterior slope flattened; anterior and ventral margins rounded, posterior margin obliquely sub-truncate, nearly straight, respiratory angle obtusely rounded, anal angle about 130°; surface radiated with about 32 acutely angular ribs, about 13 of which are on the posterior slope; the intervening spaces seem wider than the ribs, from the sides of each rib gradually converging to an acutely angular line, closely set with numerous small thorny tubercles (about 7 in 3 lines at 6 lines from the beak); intervening spaces coarsely striated and wrinkled at right angles to the ribbing. Length from anterior to posterior end of average specimens, 1 inch 3 lines; proportionate width from beak to opposite point of ventral margin, $\frac{90}{100}$; depth of one valve, $\frac{30}{100}$; length of anterior side, $\frac{20}{100}$; length of hinge-line, $\frac{52}{100}$; of truncated posterior margin, $\frac{55}{100}$.

REFERENCE.—*T. Lamarcki* (Jenkins), Geol. Mag., v. iii., p. 201, t. x., f. 3–7 (Not Math.). (McCoy), Geol. Mag., v. 3, p. 482.

The genus *Trigonia* has hitherto been looked upon as an extraordinary and strongly marked exception to the usual geological law, almost universally observed, of the distribution of genera and species in Time, viz., that when a genus or species ceased to exist, by efflux of geologic time, it was never re-created, or never reappeared at a more recent time than that of the formation in which it was absent. Now *Trigonia* is a very abundant genus in the Oolitic and Cretaceous formations, but was unknown in the whole of the Tertiary periods in any part of the world, while it was well known to occur in the living state in the Australian seas of our time. Being enabled to announce the discovery of three distinct species of *Trigonia* from the Pliocene and Miocene Tertiaries near Melbourne clears away this supposed exception to a general Palæontological law, and cannot fail to be welcome, not only to geologists generally, but to the biologists engaged with the large question of the succession of life on our globe.

The present species is easily distinguished even in fragments from the *T. Lamarcki*, *T. pectinata*, and other recent species by

the character indicated in the specific name, *i. e.*, the remarkable compression of the ribs into acute angular ridges; and from the same cause the spinous tubercles do not form the broad, blunt, transverse tubercles which they do in the recent species, in which latter the ridges form broad, obtusely flattened, almost square ribs when viewed from the margin in a position in which those of the present species form a series of acute angles.

Not uncommon in the Older Pliocene beds of Mordialloc, in Hobson's Bay. Rare in the Upper Miocene beds of Muddy Creek.

EXPLANATION OF FIGURES.

Plate XIX.—Fig. 1, left valve, natural size. Fig. 1*a*, portion of surface magnified to show the acute ribs and tubercles. Fig. 1*b*, dotted outline of profile to show the depth. Fig. 2, right valve. Fig. 3, portion of surface of the most nearly allied recent species, the *T. Lamarcki*, to show the broad, blunt, flattened tubercles and ridges, contrasting with fig. 1*a*.

PLATE XIX., FIGS. 4, 5.

TRIGONIA SEMI-UNDULATA (McCOY).

DESCRIPTION.—Rotundato-oblong, little longer than deep, moderately convex; anterior and ventral margins broadly rounded; posterior margin nearly straight, abruptly truncated, forming an angle of 120° with the hinge-line; posterior slope flattened and radiated with about 10 or 11 strong obtusely rounded ridges, separated by rather wider flatter spaces, and crossed by lines of growth near the margin, closer and spinulose near the beak, and followed on the lunule close to the hinge-line by 6 or 7 much smaller spinulose ridges; middle and anterior portion of the valve covered with narrow rounded slightly undulating ridges, nearly parallel with the ventral margin, crossed, except on the anterior portion, by rather faint impressed sulci radiating from the beak to the ventral margin, nearly the same distance apart as the ridges of the posterior slope. Length of largest specimen, 2 inches 4 lines; proportional width from beak to ventral margin, $\frac{80}{100}$; length of anterior side, $\frac{25}{100}$; length of hinge-line, $\frac{60}{100}$; of truncated posterior margin, $\frac{50}{100}$; depth of one valve, $\frac{25}{100}$; average length, $1\frac{1}{4}$ inches.

REFERENCE.—*T. semi-undulata* (McCoy), Geol. Mag., v. 3, p. 481.

I sent labelled specimens of this species to the second Great Exhibition in London. Mr. Jenkins gives a figure of it in the *Quarterly Journal of Science*, in which the transverse ridges are not sufficiently thin, numerous, or undulated.

Easily distinguished from any known recent or Tertiary species by the rippled appearance produced by the undulated concentric ridging of the anterior two-thirds of the valves; the posterior slope

is abruptly marked by the ridges being only radiating. The transverse ridging, though common in the Mesozoic Trigoniæ, is not found in the recent species.

Very abundant in the sandy beds of Bird-Rock Bluff (A^d 22 and A^d 24).

EXPLANATION OF FIGURES.

Plate XIX.—Fig. 4, average sized specimen of left valve, natural size. Fig. 4*a*, profile of ditto. Fig. 5, smaller specimen of right valve, natural size.

PLATE XIX., FIGS. 5, 6, 7.

LIMOPSIS AURITA (BROCCHI SP.).

[Genus LIMOPSIS (SASSI). (Sub-kingd. Mollusca. Class Dithyra. Order Pectinacea. Fam. Arcidæ.)

Gen. Char.—Shell suborbicular, slightly oblique, moderately convex, margins closed. Hinge in each valve composed of 2 equal curved rows of transverse small numerous teeth; beaks small, separated by a flat, triangular, ligamental area, with a triangular cartilage pit in the middle under the beak.]

DESCRIPTION.—Obliquely ovate when old, more orbicular when young; beaks small, moderately tumid, rounded, slightly projecting beyond the hinge-line; valves moderately convex, most so at about the middle of the length; cartilage pit large, an equilateral triangle with 4 or 5 teeth much smaller than the lateral ones under it in large specimens, but few or no teeth under it in small specimens, 5 (or sometimes 6) larger ones on each side of the cartilage pit; ligamental area flattened, slightly concave, faintly striated transversely, increasing in width with age, and forming obtuse-angled, undefined, very short ears on each side; anterior muscular impression, with a prominent posterior edge; inner margin of the valves with a broad, flat, smooth, bevel-like space round the thin sharp edge. External surface with numerous close irregular imbricating concentric laminar ridges (4 or 5 in one line at 3 lines from the beak). Well-preserved specimens show under the lens close, obtuse, radiating striæ, about twice their thickness apart on the flat portion of the concentric laminæ, each seeming to widen and dichotomise towards the edge, which it does not pass (about 10 in one line at 3 lines from the beak). Ordinary length from beak, in the direction of the obliquity, to opposite margin, 7 lines (one specimen 10 lines long); proportional greatest width at right angles to length, $\frac{90}{100}$; length of hinge-line, $\frac{40}{100}$; depth of the two valves together, $\frac{55}{100}$. Smaller specimens are flatter, and larger ones are proportionately deeper.

REFERENCE.—*Arca aurita* (Brocchi), Conchiologia Fossile Subapenninæ, t. xi., f. 9.

To the naked eye most specimens seem to be only concentrically marked, and in some even the lens fails to show the interrupted longitudinal striæ, except on the sides; they are generally, however, more distinct in the Australian specimens than in those from

the Coralline Crag of Suffolk ; the Australian ones agreeing perfectly in this as in every other character with the specimens from the Miocene Faluns of Flonheim near Alzey, Rheinhessen. The number and proportion of the teeth and other internal characters of the hinge, broad, smooth, bevelled margin, &c., are identical in the English Crag, the German Miocene, and the Australian examples. I think it right to remark that I assert the identity of the Australian and European Miocene species only after a minute comparison of specimens from the different localities, and that I have no doubt of the identification. I have placed English and German specimens in the Melbourne Museum for comparison. This identification is the more remarkable from Mr. Jeffries having lately (Ann. & Mag. N. H. Nov. 1862) dredged a shell which he identifies with this species from a depth of 85 fathoms in Shetland, and there is no parallel example known of a North Sea shell in Australian rocks ; I can only vouch myself for the identity of the Australian and European Tertiary fossils.*

The concentric ridges being stronger than the longitudinal ones, and interrupting them, as well as the greater convexity and differences of proportional measurements, easily distinguish this species from the *L. Belcheri*, the only other species of the genus hitherto found in Victorian rocks.

Abundant in the bed of blue marl with *Septaria* (marked E in Geol. Survey Section) at Bird-Rock Point, near mouth of Spring Creek, 15 miles S. of Geelong (part of A^d 24 and A^d 21). Very rare and of small size in the clays of A^d 16. Not uncommon, of small size, in the sandy marls of A^d 8. Very common in junction beds at Bird Rock (A^d 22). Very common in brown sandstone beds at Bird Rock (A^d 23). Not uncommon in Oligocene sandy clays between Mount Eliza and Mount Martha, at Mornington.

Explanation of Figures.

Plate XIX.—Fig. 5, natural size of average specimen, left valve. Fig. 5*a*, portion of hinge magnified to show the triangular cartilage pit. Fig. 6, more oblique larger specimen of right valve, natural size. Figs. 6*a* and 6*b*, portions of surface in different states magnified. Fig. 7, inside view of average specimen.

* Since the above was written, H.M.S. *Challenger* has visited Melbourne, and Professor Thompson informed me that he also had dredged this species in a living state from a great depth, finding it to extend, like many others in the hitherto unexplored depths investigated by him, continuously from the Arctic into the Southern Ocean.

PLATE XIX., FIGS. 8, 9.

LIMOPSIS BELCHERI (AD. & REEVE SP.).

DESCRIPTION. — Obliquely ovate, subtrigonal, moderately convex; surface radiated with very numerous narrow, rough, longitudinal ridges, varying from sometimes nearly equal and their own thickness apart, to having from 1 to 3 smaller ridges between each pair, which usually increase quickly to the size of the main ones, but sometimes continue subordinate as far as the margin; longitudinal ridges, crossed by less prominent, less regular, concentric ridges, varying from sometimes closer than the radiating ones to three or four times more distant, but usually about the same. Triangular cartilage pit large, deep; flat ligamental area small; anterior side slightly smaller than the posterior; teeth varying from 5 to 11 on each side, usually some intermediate number; inner margin of valves bevelled flat and smooth. Greatest length from anterior to posterior side of large typical specimen, 1 inch 1 line; taking this as unity, the ratio of depth from beak to ventral margin is $\frac{90}{100}$; convexity of middle of one valve, $\frac{20}{100}$; hinge-line, $\frac{30}{100}$. At about six lines from the beak there are about 7 ridges in the space of 2 lines of the regular size, with, in some spaces, a smaller one between the pairs.

REFERENCE. — *Pectunculus Belcheri* (Adams and Reeve), Voyage of the *Samarang*, t. 22, fig. 5.

The *Pectunculus Belcheri* was dredged up alive from a depth of 120 fathoms off the Cape of Good Hope by Admiral Belcher's *Samarang* expedition, and was figured and described briefly by Messrs. A. Adams and L. Reeve in the zoology of the voyage. As no other specimens, I believe, have been obtained, and so few people know the shell, it would have scarcely been possible for any geologist to have recognized the fact that it is one of the most abundant fossil shells in the Oligocene and Miocene Tertiary rocks of Victoria from any comparison with the brief and insufficient description, or from the figure above quoted; the latter representing the shell with the surface covered with the concentric fringes or scaly laminæ of the very abundant horny periostraca, which quite conceals the characteristic sculpturing. Having, however, fortunately obtained a recent specimen (which is now in the National Museum at Melbourne), I can with certainty announce the curious fact of one of the few living species in our Tertiary strata being an inhabitant, not of our own Bay, but of South African deep water. On clearing the periostraca from part of the living specimen, I find the sculpturing perfectly identical with that of our fossil

ones, many specimens of which are perfectly identical in all other respects. Some specimens are less oblique, and many specimens are more convex than the typical ones, which agree precisely with the recent shell in these respects.

Very abundant in the Oligocene Tertiary clays of between Mount Martha and Mount Eliza, in Hobson's Bay. Very common in similar clays of Muddy Creek. Abundant in a whitish clay at Moorabbin. Abundant in fine sandy beds at Corio Bay (A^d 15); in similar beds (A^3_w), 3 miles W. of mouth of Gellibrand River.

EXPLANATION OF FIGURES.

Plate XIX.—Fig. 8, specimen of ordinary character, outer surface, natural size. Fig. 8*a*, portion of surface of ditto magnified. Fig. 9, inside view of another specimen, natural size.

PLATE XIX., FIGS. 10–14.

PECTUNCULUS LATICOSTATUS (QUOY AND GAIMARD).

[Genus PECTUNCULUS (LAM.). Sub-kingd. Mollusca. Class Dithyra. Order Pectinacea. Fam. Arcidæ.)

Gen. Char.—Shell suborbicular; beaks small, nearly central; equivalve, nearly equilateral, closed all round; substance very thick; hinge-teeth forming a curved line of very numerous teeth, small and transverse under the beak, larger and oblique at the ends, more numerous on the posterior than on the anterior side; ligament and cartilage on V-shaped lines diverging from beneath the beaks, on a flat triangular cardinal area in each valve.]

DESCRIPTION.—Orbicular when young, slightly subtrigonal, and the length from anterior to posterior side rather greater than the depth from beak to opposite margin; with age becoming ovate, and depth from beak to ventral margin the greatest measure. Surface regularly radiated with about 39 ribs from the beak, subangular, sharply defined, and separated by transversely striated channels in the young; becoming gradually broader, less convex, and only separated by narrow impressed lines towards the margin in old specimens; whole surface with close, sharp, concentric striæ of growth; inside of margin strongly denticulated; hinge-teeth vary from 5 to 14 on each side (usually 2 more on posterior than on the anterior side of the beak); cardinal area small in the young, forming very large flat triangular area with very numerous close V-shaped ligamental striæ in the old. Old, depth about 3 inches from beak to ventral margin; proportional to this the greatest length from anterior to posterior side is $\frac{96}{100}$; depth of one valve, $\frac{34}{100}$. Young, length from anterior to posterior edge, 6 lines; proportional to this greatest measurement, depth from beak to ventral edge, $\frac{93}{100}$; thickness of one valve, $\frac{20}{100}$. At 3 lines from the beak there are about 10 ribs in 2 lines; but at 3 inches from the beak 2 ribs occupy 4 lines.

REFERENCE.—P. *laticostatus* + P. *ovatus* (Quoy and Gaimard), Voy. de *l'Astrolabe*, t. 77, figs. 1 to 6.

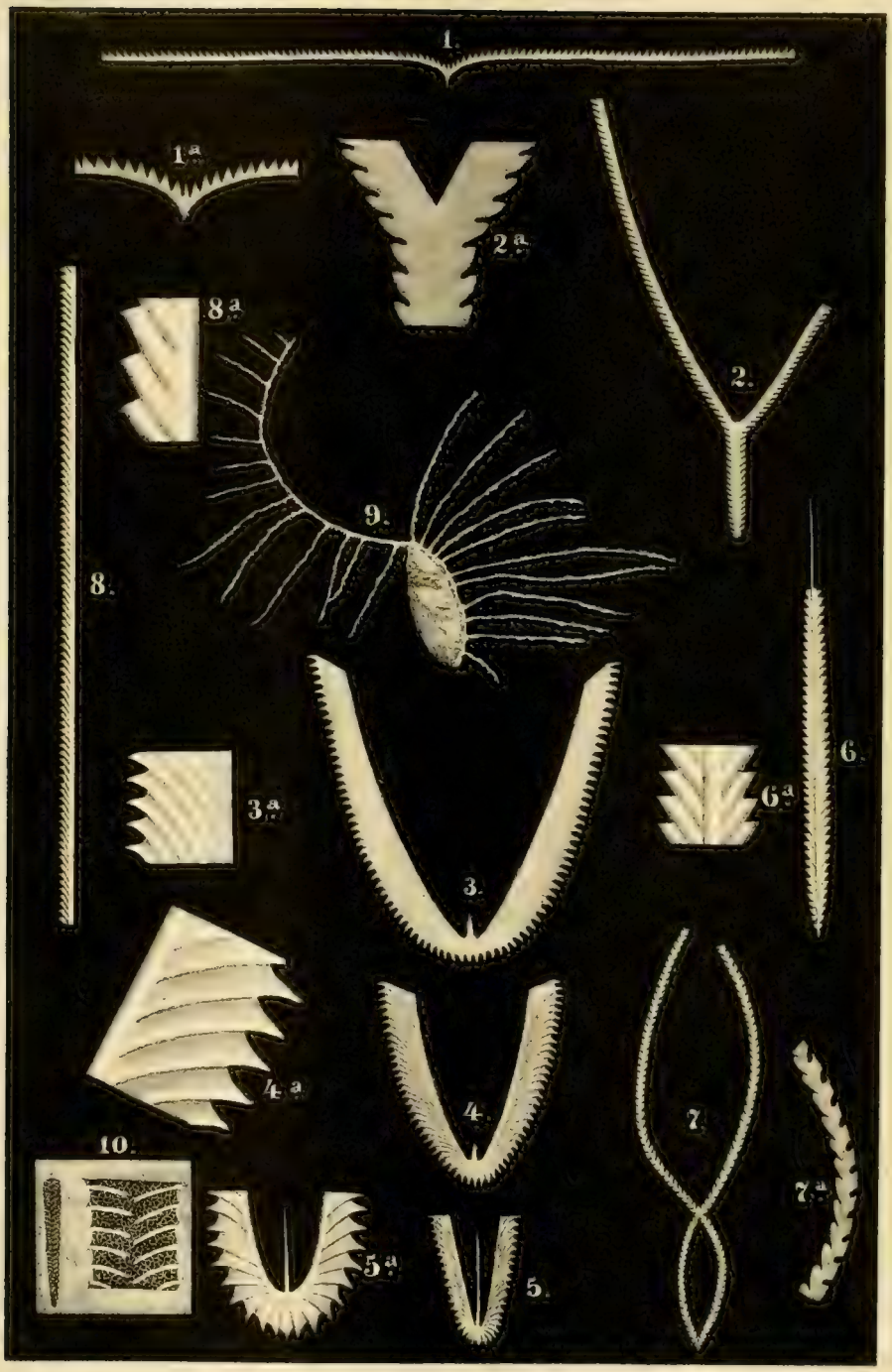
The depth and thickness increase greatly with age, the form becomes more elongated in the direction of the depth from the beak to opposite margin, slightly angulated on the posterior side; the ribs become less prominent and ultimately almost obsolete at the margin, the cardinal ligamental area increases, and the teeth diminish in number from the middle ones becoming obsolete. In all respects, and in the variations, there is the most complete identity between our fossil and the living species to which I have no hesitation whatever in referring it; although it must be a matter of astonishment to find that one of the few living species of shells in our Oligocene and Lower Miocene Tertiary beds should be an inhabitant, not of our seas, but of the North-Eastern portion of New Zealand and the Chatham Islands, between which coasts and the Victorian there are scarcely any recent mollusca in common, and between us being water of the deepest soundings.

This species occurs of large size, often with the valves still in contact, showing they have not been moved from the spot on which they lived, and in the utmost profusion, in the Tertiary sands and muds of the cliffs at Bird Rock, Geelong. Nearly as abundant, but smaller, in the clays between Mount Eliza and Mount Martha, at Schnapper Point.

EXPLANATION OF FIGURES.

Plate XIX.—Fig. 10, interior of moderate sized specimen, natural size. Fig. 10*a*, profile showing depth or convexity of valve. Fig. 11, exterior view, natural size, of moderately grown specimen, showing the angulated character of ribs and distinct interspaces. Fig. 12, interior of young specimen, natural size. Fig. 13, still younger specimen, outer surface, natural size. Fig. 14 (9 by error on plate), adult, natural size, showing obtuse nearly obsolete character of ribs towards margin, with comparatively narrow interspaces.

FREDERICK MCCOY.



F. Schonfeld, Lith *Prof. M^c Coy, Direct^r* *Hamel & C^o Imp*

PLATE XX., FIG. 1.

GRAPTOLITES (DIDYMOGRAPSUS) EXTENSUS (HALL).

[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.—Radicle forming a very small acute point, scarcely a line long, from which the two stems extend nearly at right angles and nearly in one straight line, and in the same plane right and left to a length usually of upwards of 3 inches, and a width of about $\frac{3}{4}$ of a line at 2 inches from the radicle; the cells are on the upper side, acutely angular, the space of three cell points about equalling the width of the stem from cell points to back; and the breadth of the top of the cell or indentation equals about $\frac{1}{3}$ of the width of the stem, the outer line of each cell making an angle of about 42° with the back, about seven cells in 3 lines.
REFERENCE.—(Hall), *Grap. Can.*, t. 2., f. 11 to 16.

The closer cell-teeth, when compared with the width of the stem, seem to separate this from the New York *Graptolites serratulus*. None of our stems are quite so wide as the Canadian examples of the *G. extensus*, but I do not think there can be any reasonable doubt of their specific identity.

Occurs in great abundance in the black Llandeilo flags of B^4 1, branch of Parman Creek, 4 miles N. of Griffiths and Green's Station.

EXPLANATION OF FIGURES.

Plate XX.—Fig. 1, rather small specimen, natural size, the branches imperfect at each end. Fig. 1*a*, portion of ditto magnified, but with the cell-teeth slightly too erect and a little too deeply indented.

PLATE XX., FIGS. 3–5.

GRAPTOLITES (DIDYMOGRAPSUS) CADUCEUS (SALTER).

DESCRIPTION.—Radicle filiform, extremely slender, straight, and often 9 lines long, arising from a triangular mucro about 1 line long (which is always present, though the hair-like extension may not be visible). Frond composed of 2 reflexed branches, commonly about 9 lines long and 1 line wide to the tips of the denticles, the denticles at this size being 7 or 8 in 3 lines, but occasionally 1 in. 9 lines long, and then 3 lines wide, and with only 5 to 6 denticles in 3 lines; the branches are continuously rounded semi-elliptically at their junction, and nearly as wide there as at any other part, slightly wider a little beyond the junction, and thence slightly narrowing to the extremities, the outer edge forming tangents to the basal curve; inner edges almost straight, and diverging at an angle varying (without relation to size) from 50° to sub-parallel, and 3 lines apart, owing to the small abrupt rounding of the inner edge at the junction with the short angular mucronate base of the radicle. The denticles form a continuously uniform row along the outside of the branches and connecting curve; they are small, triangular, slender, gradually pointed, and slightly arched downwards; their lengths slightly more or less than the space between their points; the contiguous upper and lower edges of the denticles forming an oblique elliptical notch, not angulated; the thickened lines from the denticles forming the lower boundary of each cell are arched near the outer end, and nearly straight and very oblique as they extend downwards and towards the inner edge of the branch opposite the third lower denticle, but becoming much more oblique (opposite 5th denticle) near the ends of the branches, and much less oblique towards the rounded junction of the arms when they are almost direct and nearly at right angles to the margin. The denticles indent the branch rather less than half a line when they are nearly 3 lines wide, and are very slightly less when the branches are only 1 line wide, so there is no relation between these proportions. The ends of the branches when perfect are obliquely rounded parrallel to the cell lines. Very young specimens resemble an expanded fan between 2 and 3 lines in diameter, with about 14 radiating cell lines, divaricating through nearly three-fourths of a circle and terminating in denticles of the size and shape of those of adults; the central mucro resembles the handle of the fan.

REFERENCE.—(Salter), Quarterly Journl. Geol. Soc. Lond., vol. ix., p. 87.

The figures given as above by Mr. Salter, more than ½ an inch long, show the branches little less than a line wide excluding the points of the cells, and scarcely exceeding a line wide including them; the central spine is about ¾ of an inch long, and the denticles are represented as almost 7 in 3 lines, and the lateral branches are figured and described as sub-parallel or only diverging at about 20°. Such specimens occur occasionally in Victoria, but they are poorly developed and unusual; the more common specimens being intermediate between the small state and the large

broad widely diverging forms figured in our plate. In most specimens the very long slender stipe observed by Mr. Salter seems absent, indicated by a short thicker one about 1 or 2 lines long. By the strong oblique light of a shaded Argand lamp, and using a lens of low power, it may be detected as fine as a hair and nearly an inch long in many specimens. I do not think this can be the edge of a fourth plate like *Phyllograptus*, as Professor Hall suggests, from the removal of a small thickness of rock causing it to disappear as it would if a radicle, but which would only give the same appearance at a different depth if it were a celluliferous plate. The greater number of specimens have the same number of denticles in given spaces as in Salter's figure (6 or 7 in 3 lines), but as described there is some variation in this according with the extremes of size now described. I at first sight conceived the large wide divergent forms distinguishable as at least a marked variety from the narrow sub-parallel forms first noted by Salter from Lauzan Precipice, Point Lévis, Quebec, but the very great number of specimens I have now examined convince me that no concurrence of characters can be got to separate specifically the extremes of form here figured and described and that from small specimens perfectly identical with the original type in everything to the largest forms here made known there is the most gradual and irregular transition of characters.

Common and exquisitely preserved in the fine whitish soft slates of Barker street, Castlemaine (B^a 78).

Abundant with *G. extensus* in the black flags of B^a 1, on a branch of the Barwon Creek, 4 miles N. of Griffiths and Green's Station.

Common in the black slates (B^b 32) $\frac{1}{2}$ mile N.W. of cleared hills on Baynton's Range.

Abundant in the black flags of B^b 43, Watchbox Range, north of granite boundary, between the parish of Glenhope and Piper's Creek, sheet 51 S.W., all the specimens here being remarkable for the strong development of the long filamentary radicle. Narrow, very slightly diverging variety in the black flags of B^b 29, 20 Newham.

Rare in black slates of B^b 34.

All these are Lower Silurian, or Cambrian rocks, I think of the age of the Llandeilo flags.

EXPLANATION OF FIGURES.

Plate XX.—Fig. 3, large specimen, natural size, with wide angle of divergence and short thick radicle. Fig. 3*a*, portion of cells of ditto magnified. Fig. 4, another specimen with smaller angle of divergence, natural size, with smaller radicle. Fig. 4*a*, portion of cells of ditto magnified. Fig. 5, smaller specimen with most acute angle of divergence and very long radicle. Fig. 5*a*, portion of ditto magnified.

PLATE XX., FIG. 6.

DIPLOGRAPSUS PALMEUS (BARR. 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.—Elongate, linear, ovato-lanceolate, from $1\frac{1}{2}$ to nearly 3 inches in length; upper portion linear, with straight sides, gradually tapering to the truncated upper end, which is usually about $\frac{1}{10}$ of an inch wide; the width often slightly increases nearer the base, which is then slightly ovate from the rapid tapering to the base. The midrib is distinctly continued beyond the upper end, a variable length often terminating in a wide cordate or pyriform (? ovarian) vesicle about $\frac{1}{3}$ wider (when flattened) than the celluliferous stem, and varying from complete continuity to separation by $\frac{1}{2}$ an inch of midrib. Cells narrow, tubular, diverging in straight lines, or nearly so, 7 in 2 lines; the outer oblique end slightly concave, simple; the lower edge rather more than twice the terminal edge in length; cell tubes forming an angle of about 35° with the midrib.

REFERENCE.—*Grapt. palmeus* (Barrande), Grap. de Bohême, t. 3, f. 1 to 7 (excl. 5 and 6).

I believe the curious smooth dilatation so frequently found at the upper end of this species to be an ovarian vesicle, and I think it is probably pear-shaped, because it presents a similar cordiform outline whether compressed in the plane of the cells or at right angles thereto. It varies in position, sometimes being separated from the cells by a length of $\frac{1}{2}$ an inch of naked midrib, and sometimes being united at base to the cellular tip by its whole width. There can be no doubt of the perfect identity of the Australian and Bohemian specimens, on one of which latter (placed for comparison in the Melbourne Museum) I have detected the

pyriform or cordate vesicle exactly as in the Victorian ones. The widest ovate part in large compressed specimens sometimes nearly 2 lines wide. Fragments of this species are easily distinguished from *D. pristis* by the much closer and narrower cell tubes ; the oval wider portion near the base is never found in that species ; it is not invariably in this.

Extremely abundant of large size in the black Llandeilo flags of B^b 29. Common of large size in the slates of (W. L. S. 1).

EXPLANATION OF FIGURES.

Plate XX.—Fig. 6, average specimen, natural size, showing the stem slightly wider a little above the base than at distal end, with the axis extending beyond the cells above, natural size. Fig. 6*a*, portion of ditto magnified.

PLATE XX., FIG. 2.

CLADOGRAPSUS RAMOSUS (HALL SP.).

[Genus CLADOGRAPSUS (GEINITZ PARS). Stem simple below, with two rows of cells and midrib as in *Diplograpsus;* dividing above into branches with one row of cells only ; cells excavated in the margin as in *Climacograptus;* without distinct tubes.]

DESCRIPTION.—Simple, double-celled, basal portion of stem about 7 lines long and 1 line wide, above which is a dichotomous division at about 35° into 2 equal branches upwards of 2 inches in length and $\frac{2}{3}$ of a line wide, with 1 row of cells on outer edge; from upper angle of one cell to upper angle of the next is about $\frac{3}{4}$ the width of the branch, and about $\frac{1}{2}$ the width of the basal stem, or scarcely 5 in 2 lines; the wide spaces between the cells, with a straight edge parallel to the axis ; inner edge of branch straight, smooth, thickened.

REFERENCE.—*Graptolites ramosus* (Hall), Pal. N. Y., v. I., p. 27, t. 73, fig. 3. *Climacograptus* (*Dicranograptus*) *ramosus,* id. Grap. Can. t. A, figs. 18–21.

I think, in justice to Professor Geinitz, that the genus *Cladograpsus* should be adopted for this species and others agreeing with it in having a simple basal stem with two rows of cells, dividing subsequently into branches, because, in his work "Die Graptolithen," p. 29, he defines the genus *Cladograpsus*, dividing it into two well distinguished groups. The first of these, his group (*a*), I think should bear the name *Cladograpsus*, and of this he names *C. ramosus* as the first species. His second group (*b*) is identical

with my previously defined genus *Didymograpsus*. The following remarks quoted from his work will show, I think, that this is so definitely made clear, that the genus *Dicranograptus* of Salter, adopted by Professor Hall, is unnecessary, and the more recent uses by other writers of the generic name *Cladograpsus* in different senses are not desirable—

"Die Arten dieser Gattung vertheilen sich in zwei natürliche Gruppen, je nachdem die Basis ihres Polypenstockes, bevor die Theilung in Arme oder Zweige beginnt, mit Zellen versehen ist, oder nur als glatter, einfacher oder zweiwurzeliger Stiel erscheint, mit welchem der Körper sich einst im Schlamme einsenken Konnte.

(*a*) "Der Polypenstock entwickelt sich anfänglich wie *Diplograpsus*, und trägt demnach an beiden Seiten eines durch die solide Axe gestützten Kanales Reihen von Zellen; später thielt er sich entweder in 2 oder in 3 Arme, und im letzteren Falle kann sich die Theilung des mittleren Armes wiederholen. Bis jetzt sind bei der zweiten Theilung nur wieder 2 Arme beobachtet worden, was jedoch nicht die Möglichkeit einer mehrfach wiederholten Theilung ausschliessen kann."

Our Australian specimens seem perfectly identical in all respects with the American ones; the slightly narrower cell-indentations and less broadly truncated outer margin between the cells in our figures being only the result of a slightly oblique compression in the portions represented, other parts agreeing in these respects completely with the New York Utica Slate examples, and with those recognized by me in the North of England.

Not uncommon in the white Llandeilo flags of B^a 64 and in the black flags of B^a 62, N.W. of Bulla.

EXPLANATION OF FIGURES.

Plate XX.—Fig. 2, specimen with the basal portion perfect and the branches imperfect, natural size. Fig. 2*a*, portion of ditto magnified.

PLATE XX., FIG. 7.

CLADOGRAPSUS FURCATUS (HALL SP.).

DESCRIPTION.—Base very short, of only 1 or 2 pairs of cells; branches about $2\frac{1}{2}$ inches long, sigmoidally curved so as to overlap or cross each other at about $\frac{1}{3}$ of the length, near the change of direction of the curves, which are in symmetrically opposite directions in the opposite branches, converging again towards the apex;

square straight-edged interspaces between the cell notches nearly as wide as the branches; inner edge of branches thickened and obliquely undulated, with an indentation opposite each cell; width of branches, $\frac{1}{2}$ line; about 4 cells in 2 lines.

REFERENCE.—*Graptolites furcatus* (Hall), Pal. N. Y., v. I., t. 74, f. 4.

This is a rare species in Victoria, but is unmistakably identical with the North American examples.

In the reddish and whitish Llandeilo flags of B^a 64.

EXPLANATION OF FIGURES.

Plate XX.—Fig. 7, average specimen, natural size. Fig. 7*a*, portion of branch magnified. (The oblique indentations on the left hand or inner edge are rather too strong in the lower part of the figure, the indented angle being too acute and entering the substance of the branch too far; the slight obliquity of the cell notches towards the top of the figure is due to compression.)

PLATE XX., FIG. 9.

GRAPTOLITES (DIDYMOGRAPSUS) GRACILIS.

DESCRIPTION.—Basal non-celluliferous stipe excessively slender (about $\frac{1}{8}$ of a line wide), thread-like, upwards of 2 inches long and gently curved sigmoidally; from this the celluliferous stems arise at regular intervals from one side, the bases being about 1 line apart, and as slender as the basal common tube from which they arise, the common canal along the back continuing of this size; cell-teeth slightly obtuse, distant from each other about twice the width of the branch, the upper edge of each about $\frac{1}{3}$ the length of the outer oblique side; length of each celluliferous stem rarely exceeding 1 inch, greatest width about $\frac{1}{4}$ of a line; cell-teeth about 3 in 1 line.

REFERENCE.—*Graptolites gracilis* (Hall), Pal. N. Y., v. I., t. 74, fig. 6.

So small and inconspicuous are the cells in this strange species, that the common canal running along their back can alone be seen, and as this is about the size of the creeping root-like stipe, the appearance is so like that of a *Rastrites* that one would almost suspect Mr. Harkness' *Rastrites Barrandi* to be of this nature; a slight roughness of the apparent branches, as in our figure, alone indicating the place of the cells, and a difference from the true *Rastrites* tubular cells. In a good light, however, the cells may be seen in our Australian specimens exactly as in the New York examples, with which they are quite identical. Although I have

doubtfully referred this species to *Didymograpsus* as having single-round celluliferous simple stems arising from a common non-celluliferous stipe, yet the unusual form of the growth would warrant another sub-genus being established for it.

Rare in the black flags of the Bala rock (B^a 62), N.W. of Bulla

Explanation of Figure.

Plate XX.—Fig. 9, large specimen, natural size; the ruggedness of the branches indicates slightly the place of the cells, but they are so minute and the rock so rough that a satisfactory magnified view could not be drawn.

Plate XX., Fig. 10.

RETIOLITES AUSTRALIS (McCoy).

[Genus RETIOLITES, formerly GLADIOLITES (Barrande). (Class Zoophyta. Order Hydroida. Fam. Graptolitidæ.)

Gen. Char.—Polypidom flat, parallel-sided above, tapering to the base, with two rows of cells in one plane alternating with each other, extending obliquely upwards and outwards to the margin on which they open; no central axis; surface covered with a prominent calcareous network. The reticulated surface and want of central axis separate this genus from *Diplograpsus*.]

Description.—Stem nearly parallel-sided, semi-elliptically tapering at base, about $1\frac{1}{3}$ lines wide and upwards of 7 lines long; strong boundary lines between the cells, nearly straight, making an angle of 55° with the lateral margin, the length of each cell being about double its width; the lower boundary of each cell is extended in a short slender spine at right-angles a little beyond the margin. Whole surface reticulated with slender flexuous anastomosing prominent thread-like ridges, and a small square slightly elevated granulation; about 7 cell-points in a space of 2 lines at the margin.

This species is most nearly allied to the *Gladiolites* or *Retiolites Geinitzianus* of Barrande from the base of the Upper Silurian strata of Bohemia, but is very much smaller, and has nearly double the number of cells in the space of 2 lines at the margin that that species has.

The occurence of this extraordinary genus of Upper Silurian Graptolites in the Australian beds of the same age is very interesting, considering the rarity of species of the genus elsewhere.

Not very uncommon in the olive mudstone (Wenlock shale) of B^a 56 and B^a 57, north-west of Keilor.

EXPLANATION OF FIGURE.

Plate XX.—Fig. 10, left-hand figure, specimen natural size (the lithographer has altered the drawing so as to render it too gradually and regularly tapering). The right-hand figure portion magnified (but the cell boundary lines should diverge at a rather more acute angle and be straighter).

FREDERICK McCOY.

NOTE.—Fig. 8 has been rendered inaccurate in the lithographing and must be refigured before the description can be given.

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

DECADE I.

DECADE II.