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GEOLOGICAL SURVEY OF CANADA.

SIR W. E. LOGAN, F. R. S., DIRECTOR.

FIGURES AND DESCRIPTIONS

OF

CANADIAN ORGANIC REMAINS.

DECADE I.



Montreal:
PRINTED BY JOHN LOVELL, ST. NICHOLAS STREET.

1859.

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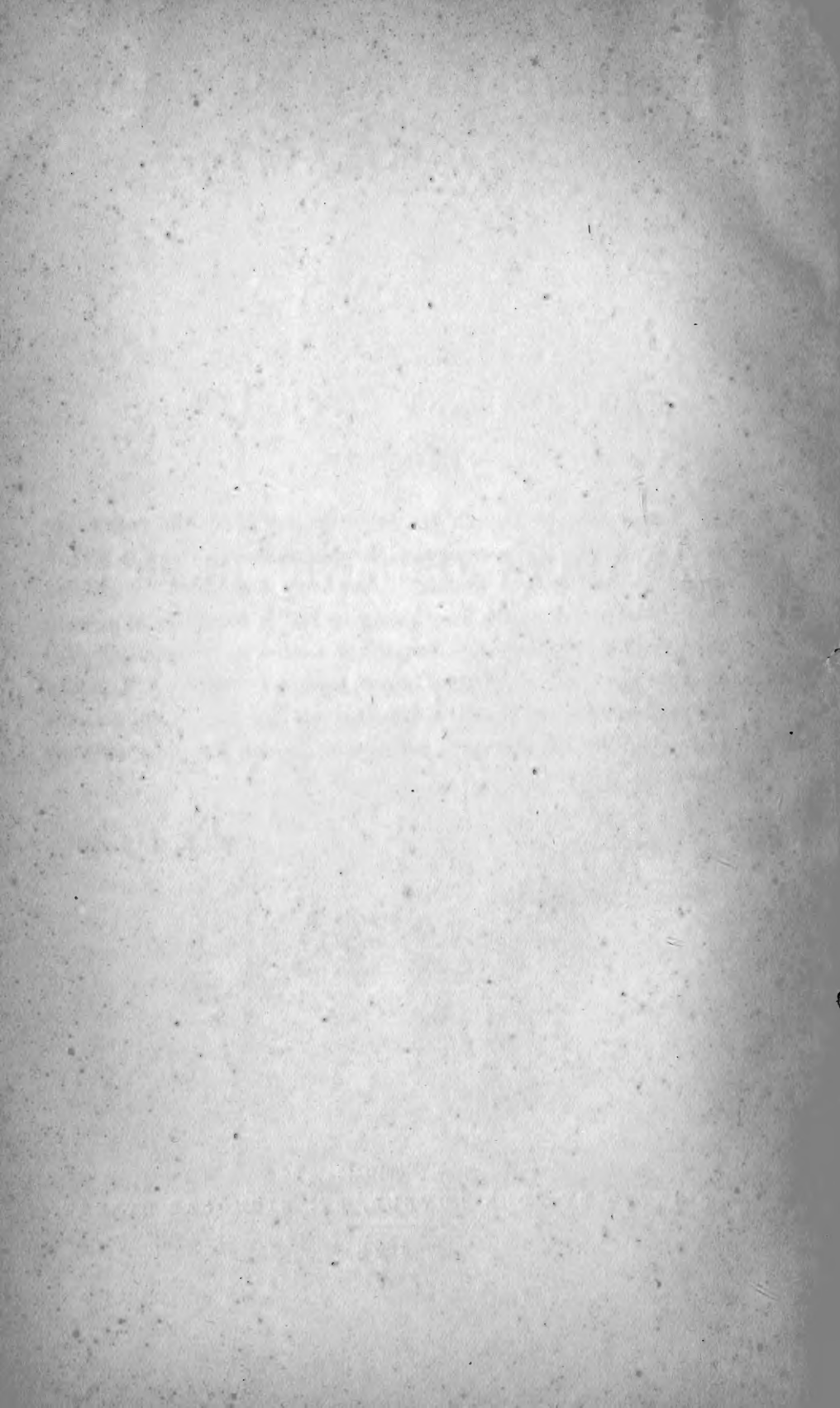


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NOTICE.

IN the preface to Decade III., already published, the reason has been given why the present one, though second in time, is first in number. In the same preface it has been stated that the present Decade, confided for the descriptions to Mr. J. W. SALTER, palæontologist to the Geological Survey of the United Kingdom, is intended to illustrate a commingling of forms heretofore supposed to belong to distinct epochs; that the drawings are by Mr. BONE, and the engravings by Mr. SOWERBY, artists well known for their accuracy and skill.

W. E. LOGAN.

MONTREAL, 11th April, 1859.

BRITISH

1850

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P R E F A C E .

IN describing the few generic types given in these pages, I am acting as pioneer for my friend Mr. E. Billings, who wishes me to share this portion of his task, and I very willingly join with him, and with Professor James Hall, in commencing this series of Decades. The drawings and plates have been executed for some time past.

In a short memoir on the fossils collected in the limestone at Pauquette's Rapids, on the Ottawa River, which was presented to the British Association in the year 1851, and appended to Sir William Logan's paper on the Rocks of Canada, it was stated, that the limestone included fossils characteristic of all the lower divisions of the New York system, from the Calciferous sandrock to the Trenton limestone inclusive. With regard to the lowest of these strata, a correction may be made, for, when more closely examined, the *Euomphalus uniangulatus* of that rock appears to be somewhat different from the Ottawa shell referred to it. The other limestones are certainly represented;—the Chazy by the peculiar genus *Maclurea*, and the Birdseye and Black-river limestones by some identical corals and shells. With the Trenton formation, as might be expected, the affinity is greatest; and the beautifully preserved fossils, silicified in a pure calcareous matrix, and weathered extensively, permit of accurate comparison with the figures and descriptions of those from the United States.

In this collection from a single calcareous band, we meet with the *Bellerophon sulcatus* and *B. rotundatus* of the Chazy limestone; *Murchisonia ventricosa* and the *Stromatocerium* from the Birdseye.

There are Black-river limestone species, viz., *Columnaria alveolata*, and the remarkable cephalopod, *Goniceras anceps*, of Hall. Of Trenton species, we have in abundance the *Strophomena filitexta*, *Pentamerus (atrypa) hemiplicatus* and *Atrypa increbescens*, *Murchisonia gracilis* and *M. bicincta*, *Cyrtoceras annulatum* and *C. lamellosum* of Hall (*C. Billingsii* of this Decade), *Orthoceras arcuoliratum*, *bilineatum* and *laqueatum* of Hall, together with *Ormoceras tenuifilum*, a fossil common to both the Trenton and Black-river limestones. *Schizocrinus nodosus* is the common Crinoid, and species of *Petraia (Streptelasma)*, with *Favosites lycoperdon*, go to swell the list of Trenton species. Lastly, there is the characteristic *Asaphus gigas*, so that the parallel is complete.

J. W. SALTER.

CANADIAN ORGANIC REMAINS.

MACLUREA LOGANI, Salter.

Decade I. Plate I.

Generic character.—*Maclurea*, Lesueur. Mollusca Nucleobranchiata. Family Atlantidæ? “Shell discoidal, few whorled, reversed* (the apical whorls being brought down to the base and the umbilicus flattened out); upper surface convex, deeply perforate instead of raised into a spire; outer side spirally grooved; operculum sinistrally sub-spiral, solid, with two internal projections for the attachment of muscles—one of them beneath the nucleus, and very thick and rugose.”—WOODWARD.

Synonyms.—*M. Logani*, Salter, in Rep. Brit. Assoc., 1851, Trans. Sections, page 63; in Murchison’s “Siluria,” 3rd edit., 1859, page 215, figure 1 (?) and 1a, operculum.

Diagnosis.—*M. 3½ uncias lata, paucispirata; anfractibus 4-5 (ultimo in latitudine præcedentem ter superante), subtus planissimis lævigatis, et ad latera multistriatis insuper, valde convexis, umbilico parvo.*

This fine species, detected in great plenty by the officers of the Survey in exploring the Ottawa river, was first noticed in Sir R. I. Murchison’s paper on the Silurian Rocks of the South-west of Scotland, in the Quarterly Journal of the Geological Society, vol. vii., 1851, page 176, and its name proposed in the British Association Reports for the same year.

* The reader will please to bear in mind, that though drawn uppermost on the plate (a position which shews the characters best), the flat spiral side of the whorls is really to be considered the base, and the umbilicus the upper side. See Woodward’s Manual of Shells, p. 202, where the shell is represented (fig. 106) in its normal position.

It is clearly distinct from, though closely allied to, the great *Maclurea magna* of the Chazy limestone, which may be seen so often in the paving-slabs and door-ways of New York, and which has been well figured by James Hall.

The genus is by no means rare in the old deposits of the Silurian seas, and apparently there were several very distinct species, some of which are yet unpublished, and one, *M. Peachii* (Salter), which has the operculum extravagantly elongated and curved, occurs in plenty in a rock very like the Canadian limestone, and full of similar types, in the north-west angle of Scotland. It has been figured, and its locality described, by Sir R. I. Murchison, in the Quarterly Journal Geological Society for 1858. Another is plentiful in the Llandeilo limestones of the south of Scotland.

Description.—*M. Logani*, when perfect, is fully three and a half inches wide, and is conspicuous for the great flatness of its lower or whorled side, and the fewness of its whorls, for, if we except one or two minute inner ones, there are but two or three distinct whorls, which diminish so rapidly in breadth that the outer is at least thrice the width of the preceding ones in succession, and greater than that of all the inner whorls taken collectively: in *M. magna* it is greatly less than these. The whorls are very gently convex between the sutures, which are sharply marked though not deep, and are closely striated by regular sharp-arched lines of growth. The sides of the whorl are steep, pyramidal, the depth exceeding the width of the whorl, and are furrowed by a number of deep grooves, sometimes 16 or 17, a few of which are interlined with smaller ones. Occasionally seven or eight only are present, or a deep one (figure 3) occurs at a short interval; but this may be the result of injury.

The base itself is smooth, or with faint concentric striæ only, and the umbilicus* rather abrupt and very narrow, not above one third the width of the whorl, and with a rounded edge. The shell is solid, nearly a line thick.

The most singular part of the shell is its operculum, sometimes fixed, as in figure 3, in its normal position, at other times drawn within the shell. It is exceedingly solid, the successive layers are subspirally arranged, tiling over one another, and are antiquated in growth. The nucleus is near the inner and lower angle of the mouth; in old shells it is pushed further out, and becomes the apex of a very solid short cone, one face of which lies close upon the inner flat

* Used in a false sense, since it is the perforate spire.

surface of the whorl. Two curved furrows radiating from the nucleus divide the surface into three areas, less distinct in the mature shell. Inside, a thick compressed process (*a*) takes its rise beneath the nucleus, retaining its place near the inner angle of the mouth, even in the adult shell, when the nucleus itself has removed further out (figure 6). The process is as broad as long, and on its oblique free margin it is roughened and grooved for the attachment of muscles. Another attachment, similar but much less prominent, exists at the inner and upper angle (*b*), and a line of minute prominences partially connects the two.

These processes have their analogues in the internal ridges of the operculum in *Nerita* and some other genera, and in that of the small Pteropod shell, *McGillivrayia* (Forbes), but no recent shells are known in which they are equally produced.

The view above expressed of the shell being a reversed one in which the spire is deeply sunk, in the so-called umbilicus, and the latter expanded and flattened so as to appear like the upper side in ordinary shells, will not appear unlikely, if comparison be made with *Ophileta* (plate 3), in which there is a similar condition of the spire.

Moreover, this view has the advantage of rendering it unnecessary to suppose an operculum arranged on a different plan to that of ordinary univalves, since no case is known in which the nucleus is placed at the upper angle of the mouth, though some few have it external. The genus *Atalanta* however, says M. Woodward, has the spire and the operculum both sinistral; hence it is possible that *Maclurea* might be an opposite case, in which it is dextral in both.

The alliance of this heavy shell with the lighter and fragile Nucleobranchs would seem much more unlikely, had we not such solid forms as *Bellerophon* to compare it with. But there are no other genera with which it can be better associated, since *Euomphalus* has quite a different operculum (multispiral), and no opercula are known in *Ophileta* or *Raphistoma*, depressed forms resembling *Maclurea*, but which are probably, with *Murchisonia*, members of the families Ianthinidæ or Trochidæ (see plates 2, 3). Prof. Forbes believed there was some affinity between *Maclurea* and *McGillivrayia*, above mentioned, a minute spiral Pteropod with the nucleus of the operculum external, and with a process beneath it. But this affinity is not so close as that suggested by *Bellerophon* with the Nucleobranchs, and we must therefore leave it for the present where the judgment of Mr. Woodward has placed it, and regard *Maclurea* as a Heteropod with a heavy shell, and probably stationary or nearly so on the bottom, seeing that its

upper or convex side is constantly overgrown with sponge (*Stromatocerium rugosum**), while the flat or lower side preserves the sharp lines of growth, which would have been abraded had the animal been endowed with much locomotion.

RAPHISTOMA, HELICOTOMA, AND OPHILETA.

Decade I. Plates II. and III.

Genus *Scalites*, Conrad. Mollusca Gasteropoda. Family Ianthinidæ.

Shell thin, turbinate or depressed, with angular whorls, flat above; aperture deeply notched, but without a band.

Sub-genus *Scalites*. Turbinate; whorls flat above, turrited, produced below; umbilicus none. Form elongate.

Sub-genus *Raphistoma*, Hall. Depressed, often discoid; spire flat, or only gently convex, with close sutures; whorls acute angular externally, and often with an angular edge to the moderate umbilicus. Form lenticular.

Sub-genus *Helicotoma*, Salter. Depressed, discoid; spire nearly flat; whorls obtusely angular externally, rounded below; umbilicus broad. Form cirrhoid or helicoid.

Sub-genus *Ophileta*, Vanuxem. Discoidal; spire sunk above; umbilicus below perfectly open, and exposing the whorls all on one plane; whorls numerous, truncate and biangular exteriorly; mouth trigonal. Forms with deeply concave spires.

On mature consideration I cannot find any reason for separating the above series of forms, except as sub-genera. They pass into each other by almost insensible degrees, some species of *Raphistoma*, for instance, being merely depressed *Scalites*, while others need but a little more angularity below to become species of *Ophileta*. *Helicotoma* is a new sub-generic form, which I have been obliged to institute in order to express a middle term of the series, one in which the true discoid form of *Raphistoma* is maintained, without the extreme angularity of that genus, yet with a spire almost as much sunk and an

* A fossil of the Chazy and Birdseye limestones of New York. The *Maclurea* may thus be regarded as representing in this rich locality the Chazy limestone, which is still further illustrated by such species as *Bellerophon sulcatus* and *B. rotundatus*. See Preface.

umbilicus as greatly exposed as in *Ophileta*. All are Lower Silurian forms, and from near the base of the system, and all, with the exception of *Scalites* proper, which does not occur in the Ottawa limestone, are illustrated in plates 2 and 3.

The genus must be regarded, in the present state of our knowledge, as allied to *Pleurotomaria* and *Murchisonia* (which, with *Scissurella*, is now considered* to belong to the Trochidæ), but differing from them importantly in the want of the spiral band. It is probably nearer to *Ianthina*, some of the typical species of which are strongly striate in the direction of the lines of growth, and deeply notched in the middle of the mouth. These thin floating shells certainly seem to offer the best affinity with *Scalites* and its various sub-genera; and inasmuch as *Ianthina* is arranged as a family close to the Trochidæ and Haliotidæ, the association of *Scalites* with the former would not call in question its relationship to the latter. Both *Ianthina* and *Scalites* have but few whorls and a short spire (in the fossils with a much greater tendency to a depressed shape); while the Trochidæ and *Murchisonia* are on the contrary elongate and many-whorled.

The total absence of opercula, while it rather strengthens this view of the affinities of *Scalites*, throws some doubt on the propriety of keeping *Murchisonia* among the Trochidæ. Professor E. Forbes would have arranged all these thin-notched shells, with *Platyschisma* (McCoy), and some other palæozoic genera, alongside of *Ianthina*.

RAPHISTOMA.

I have altered but little the essential parts of Prof. Hall's description of the genus. The main characters by which the sub-genus is distinguished are pointed out by him, viz.: the close-fitting sutures between the whorls, and the subtrigonal, not rounded, form of the mouth, caused by the production of the outer angle.

There are two sections even of this sub-genus, one with flat spire and the whorls convex below (*R. striata*, Hall), the other with spire and base about equally convex, and a general lenticular form (*R. staminea*, Hall, *R. lenticularis*, Sowerby, &c.). The two species here described belong to the second sub-division.

* By Mr. Woodward, the author of the "Rudimentary Treatise on Recent and Fossil Shells." John Weale, London, 1854. This excellent work contains in a condensed form the fruits of much research, and is highly prized by European naturalists.

R. LAPICIDA, N. sp.

Plate II. Figures 1-3.

R. uncialis, discoidea, lenticularis, margine acutissimo: anfractibus 4 levigatis, supra planis, atque suturis inconspicuis, subtus convexis; umbilico angusto rotundato; ore ovato acutissimo. Diameter, 10 lines; alt., $5\frac{1}{2}$ lines.

This elegant shell a good deal resembles the *R. staminea* of Hall's work (Pal. New York, vol. i., pl. 6, fig. 4, 5), from which it is readily distinguished by the less raised spire, flatter base, and larger umbilicus. It is altogether a flatter and smoother shell, the lines of growth not sharp and regular, and on the upper surface there is no concentric ridge to interrupt the backward course of the striæ. And comparing it with other American species, the *R. (Maclurea) labiata*, Emmons, and the very similar *R. (Pleurotomaria) lenticularis* of the same author (not of Sowerby), have both more convex bases, the outer face of the whorl below being almost vertical in the former, and at least convex in the latter, instead of first concave and then prominent. The umbilicus in both is too large for ours.

The whorls of the spire slope regularly to the apex without interruption at the sutures, the last whorl excepted, which descends a little beneath the margin of the preceding. The edge is very acute. The under-side, only a little more prominent than the spire, is first concave beneath the keel, then convex towards the deep narrow umbilicus with its incurved sides. The striæ of growth are more conspicuous below than above. The rounded sides of the umbilicus easily distinguish *R. lapicida* from the next described species. The inner lip is prominent and a little reflexed. The angle of the ovate mouth very acute, and the notch deep, but the lower margin does not project greatly forward.

A general resemblance to *Helix lapicida* suggests the name.

Locality.—Allumette Island.

R. APERTA, N. sp.

Plate II. Figure 4.

R. semiuncialis, anfractibus 4 insuper depressis, subtus perangulatis: umbilico latissimo infundibulato; ore rhomboideo. Diameter, 6 lines; alt., 3 lines.

The whorls are of about the same proportionate width as in the

last species, four of them in the diameter of half an inch; they are not quite flat above, but gently convex between the sutures. Below they are strongly angular at about the middle of the volution, the outer face being plane, and the umbilicus broad and conical, with slightly curved sides; its width is fully half the entire diameter of the shell.

The mouth is rhomboidal, as high as wide, the outer angle about 80° , its lower and inner margin defined by the angle and sloping wall of the umbilicus; the margin not reflexed.

This has a more convex base than the *R. (Pleurotomaria) subtilistriata* (Hall*), which nevertheless appears to be of the same genus. *P. lenticularis*, Emmons,† also resembles ours, but it is a larger shell, and less angular below.

R. aperta is however so like *R. (Euomphalus) qualteriata* of Schlotheim from the Lower Silurian limestones of St. Petersburg, that but for the greater size and less elevated spire, it might be taken for the young of it. *R. qualteriata* however seems constantly to be more depressed above, and the outer angle therefore of the mouth not so equal-sided as ours; nor is the umbilicus quite so broad or so decidedly angulated.

There are several other species of *Raphistoma* in the Canadian limestone, one an inch and a half in diameter, slightly concave at the sutures, and with large angular umbilicus.

Locality.—Allumette Island.

HELICOTOMA.

The characters are given above, and only four species are yet known—one the *H. (Euomphalus) uniangulata* of Hall, from the Calciferous sandrock of New York, and the three species here given. *H. planulata* should stand for the type of the sub-genus, which is less regularly depressed than *Raphistoma*, and without the reversed umbilicus of *Ophileta*, though with a much larger one than the other sub-genera.

* Palæontology of New York, vol. i., plate 37, figure 5.

† Geology Second District, New York, page 393 (not of Sowerby).

H. PLANULATA, N. sp.

Plate II. Figure 5-7, and Variety, figure 8.

H. unciam lata, anfractibus 4 gradatis, concentricè sulcatis, supra planis; carinâ ad angulum externum elevatâ; basi tumido latè umbilicato.

Synonym.—[*Euomphalus uniangularatus*, Hall, Palæontology of New York, vol. i., plate 3, figure 1?] *Scalites uniangularatus*, Salter, in British Association Reports for 1851, Trans. Sect., p. 63.

Prof. Hall's specimens of the very nearly allied *Euomphalus uniangularatus* are so depressed, that "the spire scarcely rises so high as the angular ridge on the upper and outer edge of the last whorl." Ours are generally more elevated. His specimen too shews the umbilicus entirely open, and the shell therefore truly discoidal, while in ours at least half the whorl on the lower side is covered by the preceding one. They are probably therefore distinct species.

The general form is depressed, the whorls being nearly flat above, and rising a little above each other in a step-like manner, each whorl nearly twice the breadth of the preceding. They are bluntly carinate on their outer upper angle, and the carina is elevated (but is not a true band), the distinct lines of growth being curved backwards to it, and beneath it bent abruptly forwards. The whorl is concave for a short space beneath the keel, and then tumid over the sides and base. Concentric furrows occur on the margin to the number of four or five, and are often duplicate, three of the intervening ridges being more conspicuous than the rest.

The base is smooth, except the prominent lines of growth; the umbilicus steep, nearly half of each whorl exposed in it, and its edge is not angular, except in the young whorls.

The mouth is rounded, about as high as wide, and has the upper margin retreating towards the deep notch, and the lower edge brought forward. No reflection of the inner lip takes place in this species, and the general aspect is that of *Euomphalus*.

Variety *Muricata*. Figure 8.

Instead of the plain ridges round the outer border of the whorl, there are three spinose or tuberculate ridges (like those of *H. spinosa*, figs. 9, 10), but the tubercles are not strictly regular in position on the ridges, though they occur all round the shell. They may be extraneous, and so may those of the following species.

The upper surface of this variety is concave, not flat.

Locality.—Allumette Island, in siliciferous limestone.

H. SPINOSA, N. sp.

Plate II. Figures 9, 10.

H. vix semiuncialis, anfractibus 4-5, paullo elevatis, extus carinatis, supra planis seu sub-concavis tuberculisque cristatis sparsis, subtilus convexis; umbilico angusto verticali; ore sub-rotundo.

Whether the spinose ornament be considered structural or extraneous, this is certainly very distinct from all the varieties of the last species, and more elegant in outline. The shape of the deep umbilicus, with its vertical sides, is a good deal like that of *H. larvata* next described, but the form of the shell is much more depressed.

The upper surface is rather thickly studded over with tubercles, which are disposed in sub-concentric rows, one row of large compressed crest-like tubercles along the outer carina, an imperfect row within this on the upper concave surface, and several incomplete rows of smaller size on the outer convex edge. All have an irregular appearance, and it is more than probable are only the relics of a papillate sponge, converted into silex, and having its projecting portions determined in position by the ridges of the shell.

H. LARVATA, N. sp.

Plate II. Figure 11-14.

H. semiuncialis, levigata, spirâ lenté elevatâ; anfractibus 5, suprâ sub-concavis, subtilus convexissimis; umbilico verticali angusto: ore rotundato margineque acuto valde sinuato.

This shell is covered so frequently with a coat of the sponge, *Stromatocerium rugosum*, as to suggest the specific name. The upper side or spire only is covered, just as the *Halichondria panicea* invests the *Buccinum* and other common univalves of the British coasts. (See Johnston's "British Zoophytes," 1st edition.)

Some specimens however, which are free from the parasite, shew the spire to be composed of five gradually increasing whorls, each about one and a-half times the width of the preceding. The whorls are slightly concave on the upper side, which is divided by an angular ridge from the convex outer border. The base is regularly

convex, the umbilicus deep and rather narrow, bounded by a sharp edge which cuts the lower angle of the mouth about its middle.

The mouth itself is rounded, very deeply notched at the upper angle, and the edge then curves strongly forward and forms a projecting outer lip. The inner margin again retreats very considerably, and has a sharp, almost cutting edge. The lines of growth in the umbilicus follow the curve of the edge of the inner lip, which is somewhat excavated, as in species of *Natica*, *Littorina littorea*, etc., by the reflection of the mantle's edge.

The entire form is very compact, and the smooth lower surface being convex, with small, deep, regular umbilicus, the shell has a good deal the aspect of a land-snail, a resemblance at once contradicted by the angular umbilicus, the sharp retreating inner lip, and the notched and projecting outer one.

The last two species violate in some respects the character of the sub-genus, having the small umbilicus of *Raphistoma*, with an angular edge. In truth they might be included with the former sub-genus, and are retained here on account of the rounded, not triangular mouth. *Raphistoma* is better typified by such species as have a flat or regularly conical spire, a triangular mouth, and a small umbilicus. It is always difficult to define the limits of sub-genera, for they are mostly convenient, rather than absolute, groups.

OPHILETA, Vanuxem.

The characters given by the author of the genus merely describe its general appearance, and do not indicate its relations to *Raphistoma* or the other allied sub-genera. It appears to be strictly confined to the lowermost of the calcareous strata which lie upon the Potsdam sandstone, and holds the same place in Scotland as it does on the American continent.

O. COMPACTA, Salter.

Plate III.

O. magna, sesquiuncialis, anfractibus 5-6, utraq̄ue perangulatis, supra profunde excavatis, infra planissimis; ore trapezoidali fere trigono, faciei internâ angustissima externa biangulata,—verticali.

So few species are known of this genus, that it is not necessary to be minute in the specific character. This is by far the largest known.

Prof. Emmons' *O. complanata*, as figured by Hall (Palæontology of New York, vol. i., p. 11), is nearest in size, but is still greatly smaller, and has even more whorls in a shell of half the diameter. *O. levata* is a minute species.

At first sight this shell, like the *Maclurca* (plate 1), appears to be reversed or left-handed, the flatter side apparently being the spire, as in many *Euomphali*, and the concave one the wide umbilicus (*Euomphalus calyx*, of the mountain limestone, in form greatly resembles fig. 3). But when comparison is made with such forms as that last described—*Helicotoma* (*H. uniangularata*, for instance)—the real affinity is manifest; although the evolution of the whorls is extreme in the present case, the direction of the lines of growth is decidedly similar in the two genera.

Diameter, about one inch and a half, and height of outer whorl about six lines.

General form thick-discoidal, the upper side shewing five or six whorls, rather slowly increasing in size, steeply concave from the outer margin, so as to form a hemispheric cup. The whorls have each a sharp keel outside, which rises prominently above the general concave surface (in the cast making deep impressed furrows, fig. 1), and the lines of growth are turned considerably backward, from the suture to the prominent upper keel, *a*. On the outer vertical face they make a bold curve forwards, retreating again, fig. 4, to the lower angle, *b*.

The umbilical face, fig. 2, makes nearly a right angle with the vertical outer margin. We are unacquainted with the course of the lines of growth over this. The mouth, fig. 1 *ab*, is trapezoidal, the inner side, *c*, vertical like the outer, and parallel to it, but not above half the length. Fig. 1 being reversed, the lower or square angle of the mouth is indicated at *c*. The upper side, fig. 3 *ad*, takes of course the same slope as the spire generally, and forms with the outer face an angle of less than 45°.

The species has been quoted by me from the Lower Silurian rocks of N. W. Sutherlandshire, where it occurs in a thick cherty limestone overlying quartz rock.* A fresh comparison shews only very trifling differences. The English fossil is not quite so large, and has rather more whorls in a given space; but these proportions vary, and the form is exact. The *O. (Maclurca) sordida* appears to accompany it in Sutherlandshire as it does in Canada and New York.

* See Sir R. I. Murchison's Memoir on the Rocks of the N. W. of Scotland. Quarterly Geological Journal, vol. 14, ined.

Locality.—Found in a hard, brownish, calcareous sandstone (Calcareous Sandrock) at Beauharnois, near Montreal, associated with the *Ophileta (Maclurea) sordida* of Hall. The latter species has much fewer and more rounded whorls, but it is probably of the same sub-genus, as there are intermediate forms connecting this sub-genus with *Raphistoma*.

MURCHISONIA, D'Archiac and DeVerneuil.

Generic characters.—*Murchisonia*, DeVerneuil and D'Archiac. Mollusca Gasteropoda. Family, Trochidæ (see Woodward, 1858). Shell elongated, many-whorled; whorls variously sculptured, and zoned like *Pleurotomaria* by a spiral band; outer lip deeply notched; aperture slightly channeled in front.

Section 1.—*Murchisonia*, proper. Turbinate shells, with angulated and variously ornamented whorls, the band generally most prominent; mouth ovate, produced below.

Section 2.—*Hormotoma*. Elongate, beaded, with round whorls having a distinct band and notch, as in the other *Murchisonia*; mouth rounded, not effuse.

The shells which the above distinguished authors separated under this name, were long classed with *Pleurotomaria*, with which they are closely allied. They bear the same relation to the *Pleurotomariæ* of the Palæozoic rocks that *Pleurotoma* does to *Conus*; indeed there seems to be an almost perfect gradation between them. If the spire of a *Pleurotomaria* be lengthened, it becomes a *Murchisonia*; and, in like manner, if the produced mouth and spire of *Murchisonia* be shortened, the Trochoid forms so common in the Carboniferous limestone are again produced.

Probably both these genera are allied to *Scissurella*, which is not a pearly shell, rather than to the true *Pleurotomariæ* of the Oolitic rocks, which are nacreous, and clearly allied to *Trochus*. But we have not the means, in the absence of the operculum, to establish this point.

Prof. E. Forbes thought the whole group of these thin palæozoic shells with notched apertures were related to the Ianthinidæ. And it is probable this is a correct view, though these could scarcely be pelagic forms, associated as they are with numerous other types of molluscs, annelides, crustacea, etc., and frequently found gregarious

in sandstones and conglomerates which must have been formed in a shallow sea. They appear to have inhabited however every kind of sea-bed (though more abundant in those of a sandy character), and are common throughout the limestones of the New York and Canadian series.

It is probable that the angular-whorled and strongly-striated species belong to a different genus from the elongate, beaded forms. But they are at present kept together under one name, as sub-genera.

M. BICINCTA, Hall.

Plate IV. Figures 5, 6 (and 7 junior).

Specific characters.—*M. pyramidata*, *biuncialis*, *anfractibus* 6-7, *acutiangulatis* (*valde distinctis*), *lævigata*—*carinâ* *primariâ* *crassâ* *trilineatâ* *suprà* *medium* *anfractûs*—*secundiâ* *obtusâ* *ad* *suturam* *positis*; *umbilico* *parvo*; *ore* *ovato* *effuso*.

Synonym.—*M. bicincta*, Hall, Palæontology of New York, vol. i., plate 38, fig. 5. [*M. perangulata*, *ib.*, plate 10, fig. 4, junior.]

The shape of this common and fine species is rather abruptly but regularly pyramidal, the spire composed of six or seven whorls, each sharply angulated in the middle, or rather beneath the middle in the whorls of the spire, but considerably above it on the body-whorl. The keel is thick and prominent, ornamented with three faint-raised threads, one along the middle.

Beneath the principal carina a second, much less prominent and obtuse, abuts against the suture (in the spire), and occupies a position rather below the middle of the body-whorl. The slope of the whorl above the principal keel is nearly straight, not concave; between the principal keel and the lower one a little concave, and beneath the last the whorl is convex as far as the small umbilicus. The mouth is ovate, gently effuse at base, and the columellar lip straight and reflected, but apparently not closing the umbilicus.

The surface, unlike that of most of the accompanying species, is smooth; the lines of growth obscure, but a good deal bent back. The triple keel is not serrated or even decussated by them, but quite even-edged.

M. perangulata, Hall, has a more elongate spire, but does not appear to differ specifically from young specimens of *M. bicincta*. Those from Canada are more like what Prof. Hall has figured from

the Birdseye limestone; that in the Trenton limestone (pl. 38, fig. 7) seems a more elongate species. Our specimens may however be distinct, as the author does not mention the small carina round the sutural edge of the whorl, conspicuous in *M. bicincta* when young, but much fainter when full-grown. The base too is less convex and the umbilicus more distinct. But these are minute differences, and from examination of a series, I am much disposed to unite the two species.

Locality.—Allumette Island. There is another species associated with these, and differing chiefly by having strong upper and lower keels; and there are several new *Pleurotomariæ*, distinguished by their shortened form from the present genus.

M. SERRATA, N. sp.

Fig. 1.

M. latè conica, spirà brevi; anfractibus 4 acuticarinatis, carinis 4 serratis, spatiiis intermediis concavis et striis conspicuis; basi convexo, ore rotundato.

The spire is less produced than in the preceding, forming an angle of fully 55° or 60° , and composed of four acutely carinate whorls, deeply separated at the sutures. The body-whorl is furnished with four keels—the principal one *very prominent* about the middle of the body-whorl; one keel above it, near the suture; another at an equal distance below; on the convex base there is a fourth, which surrounds at some distance a rather large umbilicus, the sides of which are very convex. The keels are all more or less serrate, the principal one especially so (and not so much undulated as our figure shews); and the spaces between them are deeply concave—that between the upper keel and the suture nearly horizontal, but still hollowed out. The lines of growth are sharp and equidistant, decussating the keels to produce the serrate edges, and bending back considerably to the central prominent one, which is so narrow as not to shew a distinct band.

This beautiful species is more sharply keeled than any other Silurian species known to me, and reminds one of some of the Carboniferous forms.

Locality.—Allumette Islands.

M. HELICTERES, N. sp.

Plate IV. Fig. 2-4.

M. turrita, biuncialis, anfractibus 5 sub-rotundatis, tricarinatis antiquatis, ultimo vago: carinis omnibus obtusis, medianâ (cingulo) latâ; striis crebris asperis.

This shewy species is not more remarkable for the irregular uncoiling of the last whorl (resembling in this respect certain varieties of the common snail, *Helix aspersa**), than for the rough striation and antiquated appearance of the whorls.

The band or principal keel is broad and flat, the upper and lower edges being prominent, and the middle only a little convex; the rounded notch is rather deep. The upper and lower keels are obtuse, and equally distant from the band, the upper placed about half-way towards the suture, which is not at all channeled; its edge on the free whorl shews as an obtuse ridge. See figure 3s.

The spire is pyramidal, but the separate whorls are rounded; the upper ones have the inferior carina covered by the suture, but it is exposed in the lower one by the divergence of the last whorl figure 2, which afterwards becomes quite free, figures 3, 4.

The striation is very rough and coarse; the lines of growth crossing the ridges, give these an antiquated appearance. The mouth is round; the shell thickened, especially on its inner side.

In the thick, obtuse whorls, coarse striation, and broad band, this species a good deal resembles *M. semirotundata*, McCoy, from the Caradoc formation of N. Ireland, but that species is destitute of the upper keel, besides having much rounder and more ventricose whorls.

M. tricarinata, Hall, (Pal. New York, vol. i., plate 38, fig. 6,) is a Trenton species much more resembling our shell; but his specimens are too imperfect to identify with, particularly as he mentions nothing of the tendency to uncoil, and distinctly says there is no umbilicus; the carinæ, too, are represented as sharper than those of our species. Moreover, the mouth is said to be "acutely" produced below. It has, however, similar sharp prominent striæ, and is probably very nearly allied.

Locality.—Common at Allumette Islands.

* See Gray's edition of "Turton's Manual of British Shells." (Vignette.)

Section HORMOTOMA.

Elongate, beaded forms, like *Holopella*, but with a distinct band and notch, as in the other *Murchisonia*. Mouth rounded, not effuse.

M. GRACILIS, Hall.

Plate V. Figure 1.

M. elongata, biuncialis, anfractibus 10–13, *ventricosis, rotundatis (supra vix planulatis), cingulo centrali lato, etiam quartam partem anfractibus æquante.*

Synonym.—Hall, Palæontology of New York, volume i., plate 39 figure 4; page 181.

This gracefully-formed species belongs to a group of *Murchisonia*, which doubtless ought to be separated generically from the more typical angulated forms. They resemble *Holopella*, McCoy (the so-called *Turritella* of the Silurian rocks), in the elongate, beaded form, and round, instead of oblong and effuse, aperture. The band however effectually distinguishes them. The inner lip, too, is reflected on the columella, which is probably not the case with *Holopella*.

M. gracilis is a fine species, full two inches long, and very gradually tapering; of about twelve or thirteen round whorls, which are only very slightly flattened on the upper side, above the band. The latter is broad, equal to about one-fourth the whole width of the whorl, and placed centrally or a very little below the centre. ("On the centre," Hall.) The striæ, which are close but not prominent, curve sharply backward to this band, and forward again beneath it.

The slight angularity of the whorls is alluded to by Prof. Hall, who compares it in this respect with the larger species, *M. bellicincta*, of the same limestone. This slight angle does not however detract from the general roundness of the volutions, as represented in the figures above referred to. It is an exceedingly plentiful species.

Our figured specimen has the outer portion of the last whorl broken away so much that the inner lip (*a*) looks far more conspicuous than it is in reality. It is slightly reflected over the columella.

Locality.—Abundant in the slabs of limestone at Pauquette's rapids, etc.

M. VENTRICOSA, Hall.

Plate V. Figures 2, 3.

M. turrita, anfractibus rotundatis ventricosis lævigatis, supernè subangulatis, et cingulo lato marginato prope suturam posito; ore rotundato.

Synonym.—*M. ventricosa*, Hall, Palæontology of New York, vol. i., plate 10, figure 3.

The position of the band easily distinguishes this fine species from the *M. bellicincta*, Hall, with which its size and general shape would lead us at first sight to identify it. It has the same proportions of spire, and convexity of the whorls, and the pillar-lip is straight, as described by Hall, though his figures do not clearly shew this character.* But the band, instead of being nearly central and rather narrow, is broad, flat, and placed so high up as to be less than its own breadth from the suture; while the lower margin forms the prominent angle seen above the middle of the whorl. The lines of growth curve back much in the way figured in the *M. bellicincta*, and far less sharply than in *M. gracilis*, tending back to the broad band, in which they are much curved, and then forward again, leaving an open angle of about 100°.

Any comparison with other allied species seems unnecessary, as, except *M. bellicincta*, there is no American species likely to be confounded with it. *Pleurotomaria inflata*, McCoy, Silurian fossils, Ireland, is a kindred species, but quite distinct.

It is found in tolerable plenty associated in the same slabs with the *M. bicincta*, *Orthoceras arcuoliratum*, *Cyrtoceras Billingsii*, and *Strophomena planumbona*, at Allumette Islands. Hall's specimens were found at the junction of the Birdseye and Trenton limestones in the Mohawk valley.

CYCLONEMA, TROCHONEMA, EUNEMA.

Decade I. Plate VI.

CYCLONEMA, Hall.

Cyclonema, Hall. Mollusca Gasteropoda. Family Litorinidæ.
Turbinate, thin, of few ventricose whorls, with concentric striæ

* It is with some doubt this is referred to Hall's very imperfect figured specimen. His description however agrees accurately, and it is useless to multiply names.

or ridges, crossed by oblique, straight (or very slightly sinuous) lines of growth. No umbilicus. The mouth rounded, and with an imperfect peritreme. Inner lip thin, closely reflected, and a little concave.

TROCHONEMA, Salter.

Trochonema.—Mollusca Gasteropoda. Family Litorinidæ. Turbinate, thin, of few angular whorls, marked by strong concentric ridges, and crossed by very oblique lines of growth. Umbilicus wide, open. Inner lip thin, scarcely reflected; peritreme complete.

EUNEMA, Salter.

Eunema.—Mollusca Gasteropoda. Family Litorinidæ. Turbinate thin, of few angular whorls, marked by strong concentric ridges, and crossed by strongly sinuate, prominent, and thread-like lines of growth. Inner lip not reflected; peritreme simple; mouth rather effuse below; no umbilicus.

LOXONEMA, Phillips.

Loxonema.—Mollusca Gasteropoda. Family Pyramidellidæ. Elongated, many-whorled; aperture simple, attenuated above, effuse below; lines of growth (marking the form of the outer lip) sigmoidal; no umbilicus.

The characters of these four genera which have been figured together are here given in order to shew in what points they differ, and what analogy and gradation of form subsists between them.

Taking *Trochonema* as the most depressed and widely umbilicate form, or with simple and very oblique lines of growth, the next step would appear to be *Cyclonema* or *Holopea*, in which the umbilicus is closed, and the lines of growth a little sigmoid, or at least sinuate, below. *Eunema* is still more elongate, and the lines of growth decidedly sigmoid; while it is difficult to say if *E. pagoda* more properly belongs to this genus or to *Loxonema*, in which the edge of the outer lip, indicated by the lines of growth, is sigmoid, and the entire form elongated.

Yet notwithstanding this apparent passage established by such forms as *Eunema*, it is probable that *Loxonema* belongs to an entirely different family (the *Pyramidellidæ*), and that the rest are thin-shelled forms of *Litorinidæ*, with an evident tendency towards the fragile *Ianthina*, with which the rudimentary sinus in the outer lip also helps to connect them.

Professor Forbes thought *Holopea* (and therefore *Cyclonema*, which is closely allied,) much like *Litiopa*, a pelagic form of the *Litorinidæ*, and they both have the concave inner lip of *Litorina*. There is some difficulty in determining the nearest recent analogue of *Trochonema*. It may be compared with *Skenea* (*Litorinidæ*) or with *Adeorbis* (i. e., *Cyclostrema*), which differs from the other Trochidæ in its non-nacreous shell. *Eunema*, it is true, has the sinus of the outer lip so much increased as to separate it from any recent forms of *Litorinidæ*, while it much resembles *Ianthina* or the allied genera *Recluzia*, which has an extremely simple, paludiform shell. It has a much thicker shell, however, than these, and its affinities are with the fossil genera above described, from which the elongate form and sinuous outer lip effectually distinguish it.

The fossil shells under consideration appear to be all too solid for comparison with floating shells, and the tendency they exhibit to form projecting and irregular apertures in old age indicates rather a *ground-feeding* and ultimately *sedentary* habit.

CYCLONEMA.

With regard to the limits between *Holopea* and *Cyclonema*, not much that is satisfactory can be said. The form is similar, and the striæ or ribs are not always present in the one or absent in the other. The possession of a concave reflected inner lip, if it could be established for *Cyclonema*, would be a good character, yet certain species in the Canadian collection which are quite smooth, and have the general character of *Holopea*, resemble *Cyclonema* in this, though they want the characteristic sculpture. *Holopea* seems to be sometimes (*H. obliqua*, Hall,) umbilicate, and sometimes not so. *Cyclonema* is never umbilicate, and the inner lip is concave in the type species.

If accepted as a genus, *Cyclonema* should include all those Silurian species hitherto referred to *Turbo*, *Euomphalus*, etc., which have concentric ridges and oblique lines of growth. Although this is only a superficial character, it is found in so many species, that, combined with the thin shell, it may be taken into account.

Euomphalus granulatus and *E. lineatus*, Portlock, *Turbo crebristria*, McCoy*, and *T. sulcifer* of Eichwald, in addition to those described by Hall, will certainly fall into it. These, with numerous concentric ribs, none of which are specially prominent, lead the way easily to such forms as *T. rupestris*, Eichwald, in which most of the ridges are suppressed, and a few large ones only remain. The bands of color follow the direction of the ridges in the last named elegant species.

T. trimarginatus, Eichwald, is another similar form. It is difficult, if not impossible, to draw the line between such species as these and the several gradations which lead back to *C. bilix* or the fossil here figured. The group appears to range into the Devonian rocks, as we learn from the figures of the MM. Sandberger of Nassau.

C. HALLIANA, N. sp.

Plate VI. Figure 1.

C. turbinata, ventricosa, anfractibus 5 rotundatis, supra paullulum planatis,—ultimo ad basin gibboso, striis que concentricis undulatis cincto; basi subangulatâ lævi; ore rotundo.

It is not difficult to distinguish this from the *C. bilix* (*Pleurotomaria bilix*, Conrad), for the whorls are much rounder and the spire consequently not nearly so conical; the striæ only cover a part of the whorl, and the pillar-lip is not so straight or so much reflected. The species are however very closely allied.

The whorls are rounded, and even rather gibbous toward the lower part, but there is a decided flattening above, and the base too is a little flattened (not nearly so much as in *C. bilix*). The lines of growth are oblique backwards, as far as the basal angle, if it may be so termed, and thence turn forward, making a slight sinus. [This character is even more decided in the *C. bilix*, and is greatly exaggerated in the genus *Eunema*.]

The suture is well pronounced, the upper part of the whorl free from concentric striæ, which occur only on the sides; the base also is smooth. The mouth is roundish, a little prominent only beneath the columellar lip, which is not quite vertical, nor is the inner lip much reflected or more than slightly concave.

Locality.—Pauquette's Rapids.

* Palæozoic Fossils, Woodwardian Museum, Cambridge, Plate 1 L, figure 22.

C. SEMICARINATA, N. sp.

Figure 2.

C. semiuncialis, spirâ regulariter conicâ, nisi suturis horizontalibus insectâ; striis obscuris; anfractibus 4-5 supra biangulatis, infra 6-carinatis, carinâ secundâ maximâ medianâ, quartâ prominulâ; ore rotundo.

Of this well-marked form there are only two or three specimens, the largest not above half an inch in height. They were first taken for *Pleurotomaria percarinata*, Hall, which, as it shews nothing of the characteristic band or notch, may very probably belong to *Cyclonema*. But in that species the sutural space is not horizontal, and the conical spire seems therefore blunt instead of deeply incised, while the keels below the chief ridge are mostly equal.

There are two or three other species in the Ottawa limestone, one beautifully ornamented, and like a *Pleurotomaria* in everything except the notch.

Locality.—Allumette Islands. *Holopea obliqua*, Hall, accompanies it.

TROCHONEMA.

Under this proposed name will fall several Upper and Lower Silurian species, such as the *Turbo trochleatus* of McCoy, and *Euomphalus tricinctus* of the same author; only those however with the strong concentric ridges possess a wide umbilicus. *Inachus angulatus*, Hisinger, is probably an extreme form of the group, with a greatly depressed spire. *Pleurotomaria umbilicata*, Hall, is the one here described, and the type of the genus.

T. UMBILICATA, Hall.

Plate VI. Figure 3.

Troch. unciam lata, depressa; anfractibus perangulatis, facie externâ latâ verticali; umbilico latissimo, tumido, carinâ obtusâ permarginato.

Prof. Hall, Palæontology of New York, vol. i., plate 10, fig. 9, and pl. 38, fig. 1; p. 43-175.

Turbinata, depressed, the last whorl often free; the spire short, truly conical, interrupted only by the vertical faces of the whorls and the hollow sutural edge. Volutions, 4 or 5, with 4 carinæ, of which two

on the middle of the whorl are strong, prominent angles, enclosing a broad, vertical, slightly concave space (the upper angle rather the more prominent); one close to the deeply canaliculated suture; the fourth only visible on the base, margining a very broad umbilicus.

The space between the upper and second carina is more concave than that below the latter, while between the third and fourth the space is a little convex, not quite flat. The umbilicus is first concave and then tumid; it exposes the second and part of the third whorl. The mouth is round-ovate—the obliquity from above outwards—and thickened at the basal angle formed by the lowest keel.

Hall's specimens are all more or less distorted and compressed; hence his description, though accurate, does not fully agree in all points. The character of the angular volutions, with the concave spaces between short depressed spire and wide umbilicus, enables us to recognize the species; and I am further assured by Mr. E. Billings that there is no doubt of their identity. But the species must be more variable than the Canadian specimens shew, since Hall figures and describes forms (plate 38, figure 1 *g*) more elevated, and others (plate 38, figure 1 *e*, and plate 10, figure 9 *b*) more depressed than any of ours. The base of none of his specimens is ventricose, and I think that must be due to oblique pressure in his specimens or to their being mostly internal casts.

The description, by Prof. McCoy, of his *Turbo trochleatus** agrees well with ours, except in the rounded base and small umbilicus; it has a less deep suture, as his figure shews, and the space between the two bands on the whorl is decidedly narrower. These differences are here noted particularly, as I had provisionally referred the Canadian shell (see Reports British Association, preface) to the *T. trochleatus*, McCoy. Now that we know the position of the Galway rocks as Middle Silurian, it is the less likely that any species should be in common with those of the lowest formations of Canada.

Pleurotomaria latifusciata, of the same author, is another species so like ours, that it seems hardly distinguishable, except by the longer spire.

Locality.—*T. umbilicata* is a common species occurring in nearly all the slabs from Pauquette's Rapids. It ranges from the Birdseye to the Trenton limestones, in New York.

* Silurian Fossils, Ireland, plate i., figure 9.

EUNEMA.

The typical species may be considered *E. strigillata*, which has an elongate form, and the striæ bent forwards below the sinus; while there are others with the lines of growth vertical below, or scarcely at all brought forward. These latter connect it with the *Cyclonema*, but have still the produced mouth and more turritid form, which gives them the aspect of *Murchisonia*.

E. STRIGILLATA, N. sp.

Plate VI. Figure 4.

E. turbinata, elongata, anfractibus 6 obliquis, sæpe vagis: carinis tribus æquidistantibus, superiori ad suturam, secunda supra medium positis; cunctis à striis asperis dichotomisque decussatis; ore ovato.

This beautiful shell is quite abundant at Pauquette's Rapids, and many finely-weathered specimens shew the characters well. It is a thin shell, and the striations of the surface are remarkably sharp, prominent, and regular.

Shell elongate, turbinate, of about six rather oblique whorls, the last sometimes free. There are three prominent ridges on each whorl, the principal one placed much above the middle of the body-whorl, the upper one near the suture, the lower at an equal distance below the median keel. All are crossed by equal, sharp, close, thread-like ridges of growth, which tend about 60° backward to the principal keel, where they are sharply bent, and proceed a little forwards over the sides and base; the open angle of the notch so formed is about 130°. They bifurcate regularly between the upper and middle keel, and re-unite in pairs upon the base, which is produced. The mouth is oval, a little pointed above, and below somewhat effuse. There is no umbilicus, and the inner lip is not reflected or pressed closely against the columellar base, which has a slight angle upon it.

Locality.—Pauquette's Rapids.

E? PAGODA, N. sp.

Plate VI. Figure 5.

E. turrita, elongatissima, anfractibus 10-11 depressis tricarinatis; carinâ superiori remotâ minimâ, suturam profundam approximâtâ; medianâ inferiorique fere æqualibus, eminentibus: cunctis crenulatis, striis obscuris (retrorsis?).

A much elongated, turritid shell, of about ten or eleven very convex beaded whorls, very gradually increasing in size, and furnished each with two prominent keels, besides a smaller one along the sutural edge. Of the principal keels the upper is rather the more prominent, and placed about the middle of the whorls in the spire, but above it on the body-whorl. The space above it is a regular slope, between it and the third keel concave, and below the third also concave for a somewhat greater space as far as a fourth, which only shews on the base of the body-whorl, being covered by the suture in the spire. Mouth, unknown.

The keels are all more or less crenulated, evidently by the lines of growth, but these are so obscure that it is impossible to say whether they are oblique backwards, as in *Eunema*, or arched forward, as in true *Loxonema*. The species might be referred to either of the two genera, but as yet we know of no *Loxonema* with strong spiral keels, while they are characteristic of *Eunema*; it is therefore safest to leave it in the present genus, especially as there are other smaller species not described here, of quite as elongate a form, in which the course of the lines of growth is not doubtful.

Locality.—Frequent on slabs of limestone, in company with many of the foregoing species, at Pauquette's Rapids. Another new species resembles a small *Cerithium*, and might be termed *E. cerithioides*.

LOXONEMA, Phillips.

The species of this genus are but rare in Lower Silurian rocks. One is introduced here to compare with the most extreme forms of *Eunema*. The inner lip is still more incomplete, and the curve of the striæ more sigmoidal.

L. MURRAYANA, N. sp.

Plate VI. Figure 6.

L. $2\frac{1}{2}$ uncias longa, anfractibus regulariter convexis etiam inflatis, ne supra planulatis, (ad suturam vallo angusto notatis,) striis concentricis obscuris, striis incrementi conspicuis, antrorsum arcuatis: umbilico nullo; ore obovato.

The length of this species must have been full two and a half inches, and the diameter of the lower whorl not less than three quarters of an inch. The whorls are very convex, almost inflated, and have no special prominence in any part; their base is a little produced. The sutural edge is a fine raised thread, and beneath it occurs a narrow flattened space (with a raised border on the lowest whorl). There are a few faint concentric striæ, but the lines of growth are the only prominent ones; they are strong, sigmoid, the backward curve short, the lower forward one a broad arch, reaching further forward than their origin at the suture. There is only a minute umbilical depression, with no bounding ridge, and the inner lip is incomplete, its edge simple, not reflected.

A single specimen only has occurred of this fine shell, and I have pleasure in naming it after Mr. Alexander Murray, who has labored so long in the Canadian Survey.

Locality.—Pauquette's Rapids. *Murchisonia* (*Loxonema*?) *subfusiformis*, Hall, appears also to occur in this limestone.

CYRTOCERAS, Goldfuss.

Generic characters.—*Cyrtoceras*, Goldfuss. Shell curved or partially involute, sometimes with the transverse, at others the longitudinal, diameter the greater. Aperture often contracted (in the smooth forms). Siphuncle subinternal, central, or external. (Barrande.)

Section *Cyrtoceras*.—Curved; siphuncle variable in position, simple,
 ——— *Gyroceras*.—Involute; siphon internal or subcentral, solid, radiated.

It is not easy, in the absence of a perfect structure in the siphuncle, to separate *Cyrtoceras* from *Gyroceras*, the principal difference being the more regularly involute form and ornamented surface in the latter (just as in the case of *Toxoceras* and *Crioceras* among the genera with foliated septa).

Indeed it is much to be wished that a name so ill applied as *Gyroceras* should be abolished altogether. Originally given by Meyer to the *Spirula compressa* of Von Buch, which has since proved to be a *Goniatites*, M. d'Orbigny had no warrant for applying the name to a totally different form. And as the *position* of the siphon will not distinguish the two genera, there remains but the somewhat obscure character of its more solid *radiated structure* to separate the two genera. It would be better to reunite them, and when the value of this character is better known, to complete the classification.

We are fortunately able to present two extreme forms of the genus in one plate: the one smooth on the surface and much laterally compressed, as in the several Silurian forms; the other ornamented with large, frill-like varices of growth, and with a wide section, like those of the Devonian species. Some of these latter (referred to *Cyrtoceras* by Goldfuss and Phillips,) are as much involute as a *Lituities*, and are wide in section, the fore and aft diameter, so to speak, being less than the tranverse measure.

CYRTOCERAS FALX.

Decade I. Plate VII. Figure 1-4.

Synonym.—*C. falx*, Billings. Report of Progress, Geological Survey of Canada, 1857, p. 314.

A smooth shell, or with very faint and nearly direct lines of growth. It is strongly curved, and somewhat compressed, about two inches long, rapidly tapering from ten lines broad to two and a half, and in some specimens more quickly. Aperture oval, ten lines broad by eight thick. Siphon nearly close to the peripheral margin. Septa close, concave from back to front.

I have Mr. Billings' own authority for identifying this shell with the species described by him, else I should have regarded it as rather belonging to the other allied species (from the same locality) which he has termed *C. simplex*. As the specimen figured—and others still more perfect—are in the Canadian Museum—I beg to refer to his description in the Report of Progress of the Geological Survey, published 1857, pp. 313, 314,) for the specific characters. It might be compared with *C. macrostomum*, *C. arcuatum*, and *C. camurum*, Hall, but all have more distant septa.

Locality.—Pauquette's Rapids.

C. BILLINGSII.

Plate VII. Figures 5, 6.

C. 2-3 unciale, in juventute subcylindricum involutum, in ætate depresso-ovale, rectius; annulis remotioribus elevatis undulatis in dorso sinuatis; septis approximatis planis, siphunculo externo; suum diametrum a margine remoto.

Synonym.—*C. lamellosum*, Hall, Palæontology of New York, vol. i., plate 41, figure 2 (not of DeVerneuil and D'Archiac).

Prof. Hall's description, taken from a young and very imperfect specimen, is clearly applicable; but this species must receive a new name, since the *C. lamellosum*, a nearly allied species from the Eifel limestone, differs both in the less rate of increase in the whorl, and the lamellæ are much closer. The curve of the tube is also more gentle. But for these proportional characters, which however are quite sufficient in this genus, it would be difficult to separate the Devonian species, which the Professor seems to have overlooked, as he describes his fossil as new. I adopt such parts of his description as are applicable to the adult form.

Subcylindrical when young, at a diameter of seven lines (and regularly involute?), but soon attaining a more open curve and becoming laterally expanded, the dorso-ventral diameter being to the lateral as nine lines to thirteen, when this diameter is attained. The tapering is more rapid in the young than in the adult portions.

The lamellæ are rather coarse and somewhat irregular in distance. (*C. lamellosum* has them very close and regular.) In figure 6 they are not more than a third of a line apart in the young portion (*a*), and less than a line distant in the older portion (*b*), while in figure 5 they are fully two lines apart in the same diameter, and become closer again in the adult portion (*b*), where the distance is again not more than a line or a line and a half.* Their course is direct over the sides and inner margin, but on the outer (ventral) surface they turn rapidly backward, forming a distinct sinus. They are rudely fimbriated, with "transverse, undulating, squamose lamellæ, abruptly bent backwards on the dorsal line," and several obscure, longitudinal furrows cross them. "The spaces between the lamellæ are marked

* Such a change in the ornament is not unfrequent in the *Cephalopoda*, and indicates probably a more vigorous growth in middle age.

by fine transverse striæ." Septa close (Hall), very flat. Siphunculus small, its own diameter distant from the outer or ventral* border.

Of this elegant species only two examples have as yet occurred, both of which are figured.

Locality.—Allumette Islands. *C. annulatum*, Hall, is more rare. *Orthoceras arcuoliratum*, *O. bilineatum*, and *O. laqueatum*, are also found, the first very common indeed; and the *Gonioceras anceps* of the Black-river limestone occurs with these. (See Preface.)

CTENODONTA, Salter.

Ctenodonta, Salter, 1851. Mollusca Lamellibranchiata. Family, Arcacidæ. Nearly equilateral, generally transverse, anterior side largest; beaks, approximate, not prominent; hinge-line with a double series of bent teeth, connected by smaller ones beneath the beak; ligament posterior, external, on a fulcrum: no striated area or cartilage pit; muscular impressions strong (with supplementary scars), not bounded by elevated ridges; pallial line simple.

I was not aware, when I proposed the above generic term for a group of palæozoic Nuculæ†, that the principal species had been previously published under the name of *Tellinomya* by Prof. Hall. His recent descriptions‡ shew this to have been the case, and if the name did not convey an entirely erroneous view of the affinities, I should have been glad to restore it. But the chief characters of the genus reside in the hinge and teeth, which are neither figured nor described by him, casts only of the interior and the external surface having been given in the plates of his excellent work, nor was the external ligament observed.

Mr. S. P. Woodward, in his most able treatise on the Mollusca, has included my proposed genus under *Isoarca* of Munster, a group of nuculoid shells which have the peculiarity of *Ctenodonta* so far as the external ligament is concerned. But in *Isoarca* there is a ligamental area, as in *Arca* and *Cucullæa*, and the tumid beaks are remote,

* The outer margin is often called dorsal, but there is an objection to using terms in direct contradiction to the anatomical structure.

† Reports British Association, 1851. Trans. Sect., p. 63.

‡ Descriptions of New Palæozoic Fossils; extracted from the Reports of the Regents of the University, Albany, 1856, p. 142.

subspiral, and in the typical species (*I. cordiformis*, Schübler, and *I. subspirata*, Munster,) quite toward one side. It may be doubtful if such species as *I. lineata* of Munster and *Nucula elliptica* of Goldfuss, which have subcentral beaks, do not belong to *Ctenodonta*; they are smooth, or with a concentric lineation only, while *Isoarca* is often cancellate.

Solenella, Sowerby, has an external ligament like *Ctenodonta*, but a notched pallial line.

The genus has been referred to in the third edition of "Siluria," p. 213, 859. It will include, as I believe, *all* the Silurian *Nuculæ*, and a considerable number of the other Palæozoic species. It probably extends, as above stated, into the *Trias*.

C. NASUTA.

Plate VIII. Figures 1, 2.

C. biuncialis et ultra, transverso-ovata, lævis, nisi anticè rugis concentricis; latere antico rotundato, postico subcontracto elongato, haud carinato; umbonibus depressis.

Synonym.—*Tellinomya nasuta*, Hall, Palæontology New York, vol. i., plate 34, figure 3. *Ctenodonta Logani*, Salter, in British Association Reports, 1851. Trans. Sect., page 63. *Isoarca Logani*, Woodward, Manual Shells, page 269. *Tellinomya nasuta*, Hall, Report of the Regents of the University, Albany, 1857, p. 143, fig. 1-3.

A beautiful species, not unlike in shape to some species of *Anatina* or *Thracia*, and, from the subcentral position of the beaks, very unlike the usual appearance of *Nucula*.

It is the largest known species of the genus, full two and a half inches wide, by one inch and a quarter long, measuring from the slightly prominent beaks, which are much nearer the anterior than the siphonal end. The depth of the valves, united, comprises three fourths of an inch.

The general contour is transversely ovate. The anterior side perfectly rounded and marked with concentric rugæ, which are strongest on the upper portion. The posterior side narrows considerably, and is a little contracted at the posterior third; its surface is smooth and gradually less convex towards the subtruncated end;

the posterior slope or ridge only excepted, which is convex, but not at all carinate. There is a slight groove below the straight cardinal border.

The ligament fulcrum extends to full half an inch from the beak, and the ligament itself (often perfectly preserved in the silex) is convex, and rather conspicuous. The teeth are straight, vertical, and set on a moderately broad edge; there are about eleven or twelve on each side, arranged nearly in a direct line; the hinge-plate which bears them is narrowest on the anterior side, and beneath the beak much contracted in depth. (In the next species it is considerably broader.

Locality.—Allumette Islands. A new species of *Lyrodesma* occurs with it, distinct from *L. plana* of the Trenton limestone.

C. LOGANI.

Plate VIII. Figure 3.

C. uncialis, convexa, anticé rotundata fere gibba, posticé subtruncata obtusicarinata; umbone subcentrali eminente; dentibus anticis 7, posticis 9 curvatis.

Synonym.—*Tellinomya dubia*, Hall, Report Regents University, pl. c, figures 4, 5 (not of Pal. New York, plate 34, vol. i.).

An elegant species, which might, till closely examined, pass for a variety of the last. It is much more convex, and almost gibbous anteriorly: the posterior side more decidedly contracted and subcarinate above. The beak is rounded, but elevated and placed centrally, or rather nearer to the subtruncate posterior end than the other. There is no lunette.

The teeth are placed on a gently curved hinge-plate, which is not indented by so prominent a ligament fulcrum as in the other species. Those on the anterior side are straight, prominent, and simple; the posterior ones are bent towards the centre, and those beneath the beak crowded, no space being left between the anterior and posterior sets.

The anterior shews that the adductor impressions were not so deep as in the next described and smaller species.

As the larger fossil above described cannot bear the name I had originally proposed, and as the name *Ctenodonta Logani* has appeared

in print, I wish to apply it to this fine species. Professor Hall has figured it under the name *dubia*, but the figures given in his Palæontology of New York, plate 34, shew that species to have been smaller and wider, the "length almost twice the height." It is much more gibbous too, according to his figures, the edge being turned quite abruptly inward. Mr. Billings, who has seen specimens of the *C. dubia*, assures me they are distinct.

Locality.—With the last. Rare.

C. CONTRACTA.

Plate VIII. Figures 4, 5.

C. parvula, tres partes unciæ lata, trigonula, subæquilatera, anticé rotundata, posticé cuneata carinata contracta, umbonibus elevatis præ medium positis; lunulâ distinctâ; cardine dentibus majoribus.

Synonym.—*Tellinomya cuneata*, Hall, Report, l. c., figures 6, 7.

A common but pretty little species, which well illustrates the character of the genus as distinct from *Nucula* or *Leda*, to either of which it bears a strong resemblance. Instead of two rows of teeth separated by a spoon-shaped process to carry the ligament, the two rows run into each other, with only a slight angular notch to separate them, and the ligament is clearly seen outside, set on its prominent fulcrum.

The form is that of a wide triangle, with the gently elevated beak rather nearer the anterior end. This is rounded into the ventral border, which has its greatest convexity in advance of the line of the beak. The shell too is most convex here, and a depressed line separates the elevated and carinate siphonal ridge. The posterior cardinal slope is flat in some specimens, and nearly so in all; the ligament fulcra marked out on it as a long oval lunette extending half-way along it. A similar lunette, more deeply sunken, marks the anterior side. The ligament itself is but small.

Teeth about six or seven on each side; beneath the beak a few crowded ones occur; they are straight, or nearly so, and set obliquely inwards on both sides of the broad, bent hinge-plate. The beak considerably overhangs the hinge (fig. 5a).

The shell is thick, the impressions of the adductor muscles deep, and close under the hinge-line. A small accessory scar occurs above

each impression. A thickened ridge lies on the inner side of each, strongest behind the straight-edged anterior impression.

Fig. 4 shews the variety with the flat or vertical posterior slope; fig. 5 has it slightly convex.

Locality.—Plentiful in the Allumette limestones.

C. GIBBERULA, N. sp.

Plate VIII. Figure 6.

C. subtrigona, rudis, 9 lineas lata, margine antico cardinali gibbo; latere antico magno, convexo, lunulâ nullâ; postico brevi subcarinato; cardine dentibus modicis.

Differs from the last by characters not very obvious at first sight, but these grow more evident by study, and it seems to bear the same relation to *C. contracta* that the *C. obtusa* does to *C. Logani*. The form is trapezoidal rather than triangular, and of unequal sides; the posterior bluntly pointed and small; the anterior large, gibbous and rounded; the ventral margin almost straight. The beak is considerably nearer the posterior side. It is not very prominent, the valves being most convex all along the anterior slope which overhangs the hinge-margin all along; the sinus which separates the somewhat pointed posterior side falls under the beak, and consequently near to that margin; and the posterior slope is bluntly carinate, and so short as to be not far from vertical. The ligament fulcra are marked out by a narrow lunette, which the beak overhangs.

The hinge-plate is bent at an obtuse angle, and bears about ten teeth on each side, which are set obliquely, as in the last species. The shell is thick, but the muscular impressions are scarcely visible in our specimens. A few antiquated lines of growth near the margin shew that our specimen is full-grown.

Notwithstanding the above important differences, there is much similarity to the last species in habit, the distinction being chiefly due to the exaggerated development of the anterior side.

Locality.—Not uncommon in the Allumette limestone.

C. ASTARTÆFORMIS, N. sp.

Plate VIII. Figure 7.

C. crassa, vix semipollicaris, trigona, nate curvo, excelso: margine postico lente concavo, reliquis convexis; superficie lineis creberrimis rugisque concentricis ornatá: dentibus pluribus, fractis.

A small, thick shell, higher than wide, triangular, with a greatly elevated and somewhat curved beak, and the surface covered with fine equal concentric striæ, besides four or five rugæ or varices of growth. The posterior side (at least we must suppose this to be the posterior side from analogy with other species of *Nucula*,—the beak is however extravagantly raised;) is gently concave without a distinct lunette, the posterior and ventral margins arched; the whole figure is triangular.

The interior shews a flat hinge-plate, broadest beneath the beak, but with no cavity for a ligament, which must therefore have been external, though no fulcra are visible. The teeth are numerous and V-shaped, extending far down the posterior hinge-plate, and half-way down the anterior side. They are either absent or very small immediately under the beak.

This beautiful species exactly resembles at first sight one common in the Lower Silurian rocks of Wales, the *C. (Nuc.) varicosa*, Salter, and it is difficult to say how they differ. But while the Canadian fossil is a solid shell, the British species is a very thin one, and it is the interior cast of the one that resembles the outside of the other.

Locality.—Allumette Islands.

ORTHIS TRICENARIA, Conrad.

Decade I. Plate 9.

Genus *Orthis*, Dalman. Mollusca Brachiopoda. Family Orthidæ.

Shell punctate, squarish, rounded, or transversely oblong (the hinge-line generally narrower than the shell), radiately striated or plaited, convex in one or both valves; hinge-line with a fissure open in both valves*; dorsal valve with divergent short teeth, and a simple cardinal process between them; muscular impressions roundish, and circumscribed in the dorsal valve.

* In *Orthisina* and *Streptorhynchus* the fissures are closed. These are regarded as subgenera of *Orthis* by some authors.

Specific character.—*O. rotundata pollicaris*, valvâ dorsali planâ, ventrali gibbâ cardine, in latitudine testam æquante; arcâ magnâ subcurvâ; foramine angustissimo. Costæ radiantes convexæ, circiter 30, interstitiis angustissimis in valvâ dorsali sæpe filiferis; striis transversis inconspicuis.

Synonym.—*O. tricenaria*, Conrad, 1843. Proc. Acad. Nat. Hist. Soc., vol. i., p. 333. Hall's Pal. New York, vol. i., p. 121, plate 32, figure 8.

There could scarcely be better examples of specific character, as distinguished from mere variability, than are exhibited by four shells, two American and two British, among the large plaited Orthides of the Lower Silurian rocks. Of these, *Orthis tricenaria*, the subject of our plate, is precisely analogous to the English form, *O. actonia*, Sowerby, while *O. pectinella*, of Conrad, another American species, with numerous varieties, equally well represents the *O. flabellulum* of Snowdon.

Yet while all these species so much resemble one another that they might easily be confounded, each is distinguished by characters as neat as they are constant. *O. Actonia*, Siluria, 3d edition, p. 209, fig. 32, has few strong angular plaits, frequently bi- or tri-furcate at their ends, and the ventral or receiving valve is the convex one, the dorsal being concave. In *O. flabellulum* the reverse takes place, or the larger ventral valve, although prominent at the beak, being much flattened and actually concave, while the convex valve is the dorsal one. This difference is constant, while the fewness of the ribs in both distinguish them from the variable *O. calligramma* of Dalman, which has both valves gently and equally convex.

The same relative differences are observable in the two American species above quoted. *O. tricenaria* has the ventral valve the large one, and the other flat or even concave, while *O. pectinella* possesses a well-defined convex dorsal valve and a concave ventral valve, the beak of which is nevertheless prominent, as it is in *O. flabellulum*. Both again are distinct from the *O. plicatella*, which represents in America the *O. calligramma* of Europe, and, like it, has both valves convex.

O. tricenaria is of a semi-oval or even subtrigonal form when young, and in age is subquadrate, from the greater extension of the front than the sides, with length and breadth very nearly equal. Dorsal valve (fig 1), flat, concave at the beak, its hinge-line straight, produced into very short ears; ventral valve (fig. 2), strongly convex, even gibbous, its beak much elevated, but not at all incurved;

area oblique, broad-triangular (about 140°); foramen almost linear, continued quite to the apex.

Surface of both valves closely radiated by about thirty convex, rod-like ribs, with narrower interstices, the ribs quite simple in the ventral valve, but interlined in the upper or dorsal valve by fine regular threads. All are crossed by delicate, inconspicuous striæ of growth. Old specimens are antiquated near the margin. The shell is thin; the interior is deeply scored, for some distance from the margin, by conspicuous furrows between the ribs; each rib is impressed by a median groove.

The space for the muscular impressions in the ventral valve (fig. 3a), is moderately large, rhomboidal, bilobed at the base, circumscribed by external blunt ridges, and divided by a very slight median one. The hinge-plates are very short, and diverge at about 80° . The ovarian spaces (b) are well marked.

The interior of the dorsal valve (fig. 4), with the muscular impressions very strongly marked (b, c), shews them divided by a broad, rounded ridge. The brachial processes or hinge-teeth (a) are very short, diverging at 50° , and with a linear central tooth (cardinal process), which bisects the narrow foramen, and bends backward with the area. The ribs shew very strongly in the interior, fully half-way up the shell.

The area in the dorsal valve is flat, and forms an angle of 50° with the valve itself: that of the ventral valve is inclined at about 70° ; it is very little curved. The two areae meet at about 120° in the young shell, and about 90° to 100° in the adult.

A great advance was made in the classification of the Brachiopoda by Dalman, when he established the genera *Orthis* and *Leptæna* for the numerous Silurian species he was acquainted with. And little has since been done for the family of the *Orthidæ*, except the subdivision of the former genus, and the separation from both of the flat, semicircular forms now known under the name of *Strophomena*. The three genera are clearly separable, if account be taken of the general habit, as well as of the characters of the hinge and muscular impressions, for while *Leptæna* has the valves involute, and the muscular impressions of the entering valve greatly elongated, *Strophomena* and *Orthis* have these four impressions subquadrate and arranged in a circumscribed group, *Strophomena* being further distinguished from *Orthis* no less by its expanded flat form, than by the large bilobed cardinal process between the teeth in the dorsal valve. In *Orthis* the process is simple, often linear, and the two teeth

divergent at a much less angle. The hinge-line of *Orthis* is variable in width, often considerably less than that of the shell. In *Strophomena* it is always as wide as the widest part of it. *Orthis* has generally one, sometimes both valves convex. *Strophomena* has both valves flattened, and generally one bent over the other. And while the impressions of the blood-vessels in the mantle of *Orthis* are radiating and but little curved upwards on the sides, those of *Strophomena* take a wide upward bend, and quite encircle the ovarian spaces.

The range of the three genera, thus defined, is somewhat different. *Orthis* is the earliest, beginning in the period of the Lingula flags, and reaching upwards by one or other of its subgenera to the Permian rocks. *Leptaena* began not quite so early, in the Llandeilo flags, but maintained its position till the Oolitic period; while *Strophomena*, more restricted than either, commenced apparently at the same period with *Leptaena*, but is not known later than the Devonian epoch. Some authors of repute (M'Coy, Woodward, etc.) regard *Strophomena* and *Leptaena* as mere subgenera, but I prefer, as Mr. Thomas Davidson has done, to give them each generic rank.

The separation of the four subgenera,—*Orthis* (Dalman), *Orthisina* (D'Orbigny), *Streptorhynchus* and *Platystrophia* of King, is quite convenient, and of geological value. The range of the true *Orthis* is the most extensive, and the possession of an open triangular foramen in one or both valves, distinguishes it from *Orthisina*, a Lower Silurian form. In this both valves have a closed deltidium, a small circular hole only being left in the apex of the larger valve. *Platystrophia*, which has the form of a *Spirifer*, and an open foramen in both valves, is Silurian only, while *Streptorhynchus*, (which, in the form of the teeth and hinge-plates) is most like *Orthisina*, has a wide area, and is attached by the twisted beak. It is an irregular form, characteristic of the Carboniferous and Permian strata.

Locality.—Pauquette's Rapids, in tolerable plenty, with *Strophomena planumbona* and *S. filitexta* (*S. alternata* seems to be absent). *Rhynchonella increbescens* and *Pentamerus (atrypa) hemiplicatus* of Hall are here. They are both Trenton fossils, and there are one or two other species of *Rhynchonella* and of *Orthis*, of smaller size.

RECEPTACULITES.

Decade I. Plate 10.

Generic character.—*Receptaculites*, DeFrance. Sub-kingdom Protozoa. Order Foraminifera. Family Orbitolitidæ. An infundibuliform disk, composed of vertical cells in a single series, having rhomboidal thickened apices at each extremity: the casts of these cells within are thick cylindrical columns (of sarcode) connected by transverse stolons at their upper and lower ends; and by smaller ones in the middle of the columns.

The clearing up of the affinities of a single doubtful fossil is never barren of good results, since it may tend to throw light on other forms as little understood, as well as upon the conditions under which the organisms lived and were imbedded. And if, as in the present instance, it should be rendered probable that an extinct form was of much greater size and importance than its living congeners, the excessive development in earlier times of a type now existing, is a fact quite as significant in its bearing on the history of organic life on the globe as the absolute replacement of one group by another in geological time.

The genus *Receptaculites* has long been known, having been described and figured by DeFrance so early as 1827, and quoted by De Blainville from the Devonian rocks of Belgium. It is known in the Silurian strata of Australia and in the northern parts of the American continent, but has not yet been detected in strata of that age in Britain.

It has been referred to plants, and doubtfully to corals, but still remains where it was first placed, among the group of "Incertæ Sedis." It does not seem to have occurred to naturalists* that a form frequently five inches in diameter and not less than an inch in thickness could be referable to the group of Foraminifera, and be allied not very distantly to the genus *Orbitolites*. But the excellent figures and elaborate descriptions by Dr. Carpenter of this group of the Foraminifera, and especially of some large species from Australia and the

* Except my friend Mr. T. R. Jones, who, some years back, perceived the analogy in form, but neither he nor myself at that time took any further notice of it. I had forgotten his observation when Dr. Carpenter's memoir appeared. It is due to him to recall it.

South Sea Islands, shew a great resemblance to our fossils, which on closer study becomes more striking; and I am induced, notwithstanding slight differences of structure, to regard *Receptaculites* as belonging to the same family, and as having a greater resemblance to the complex than to the more simple forms of the Orbitolitidæ.

It will be desirable first to shew what is the structure of Orbitolites, as given by Dr. Carpenter in his memoir, "Trans. Phil. Soc.," volume for 1856. If the enlarged figure with vertical and horizontal sections in his plate 5, fig. 6, be taken, as he intends them, to shew the general structure of a compound Orbitolite, it will be seen that the greater part of a vertical section through a disk is occupied by the simple columnar cells which form the basis of the whole structure, and which are produced in successive rings around the globular central chamber. The cells of one ring alternate with those of the next, and form, when the superficial layer is removed, or as seen in horizontal section, a quincunx arrangement of circular cavities. Each ring of cells is connected with the next by small perforations giving passage to the minute stolons of sarcode, and of these there is only one to each cell in the simple forms, but they are numerous in the more complex varieties. Besides these small connecting stolons which link together the cells of one circle with those of the next, there are others, concentric ones of large size, which connect the cells laterally, there being in the complex form an upper and a lower great concentric stolon running along the top and the bottom of all the columns. It is from these stolons that the superficial segments take their rise, and not directly from the crown of the large cell itself. In the simpler type there is no distinction into superficial and median cells, nor any great concentric stolons above or below, the connecting pores being placed about the middle of the large cells, which are often bent in shape. (See figures 4, 5, 7, in plate 5 of Dr. Carpenter's paper.)

In the Orbitolites of the Paris basin there is not that clear separation of the superficial from the columnar cells which exists in the other form;—the upper or outer cells being in fact the upward or downward continuation of the columns themselves, and only separated from them by the large stolons before described. (See his plate 6, figs. 10, 11.)

Receptaculites.—In the possession of great columnar cells, with large connecting stolons above and below, and with several smaller ones on the sides of the columnar cells, our fossil agrees with the complex forms described by Dr. Carpenter, but (as in the Parisian

Orbitolites), there are no superficial cells proper, although the cavity has swelled out and been extended at the terminations of the columns above and below, so as to give the appearance of a superficial stratum. It will be seen by the description that this form most nearly illustrates our fossil.

R. OCCIDENTALIS, N. sp.

Plate X. Figs. 1-7.

Synonym.—*R. Neptunii?* Hall, Palæontology of New York, vol. i., page 68, plate 24, figure 3.

Specific character.—*R. magnus*, 5-6, *pollicaris*, *vix infundibulatus*, *crassus*, *cellulis verticalibus rectis cylindricis, apicibus supra rotundatis convexis, subter planis, rhomboideis granulatis.*

Discoid, from four to six inches broad, and from half an inch to an inch in thickness; the limb gently convex above, but rather suddenly indented and cup-shaped in the middle, from which the rows of cells radiate in curved lines, crossing like the engine-turned ornament of a watch. The thickness of the disk near the centre is but little, but this increases rapidly towards the margin, becoming in some cases half an inch thick at twice that distance from the centre. The cavities of the cells themselves (in the fossil filled up with silex) are not above a line and a half broad in the largest specimens. They are rhomboidal on the lower surface (figure 5); on the upper (figure 3) they terminate in a convex boss and have wide openings between, but are connected by four lateral processes with the adjoining cells.

A cross section, as in the right-hand portion of fig. 1 (fig. 6c) shews the columns round (*a*) and with interstices nearly equal to their own diameter, and a lateral view (figure 6) shews the columns with their bases (*a*) expanded, so as to leave but narrow linear interstices on the lower surface*. At a short distance above this they give birth to four connecting processes or stolons (*c*), as above described. The columns are thence cylindrical, and nearly their own diameter apart. In one of the specimens there are several intermediate small connecting stolons along the columns (figure 4a), and this is important in comparing the fossil with the recent *Orbitolites*.

* Figures 1, 4, 5, 6, 7, are reversed, being placed upside down on the plate. Figures 2, 3, shew the upper surface of the cup.

The upper termination of the cells (fig. 6c) again expands, so as to form broad and closely placed tesserae, with only small cavities between them. These were of course, if the fossil be a Foraminifer, filled up with solid calcareous matter, now removed.

One character in particular which serves to connect the fossil with its living analogue is the very considerable space occupied by the animal matter—now solid spaces filled with silex—both on the upper and lower surfaces.

It forms, as above noted, rhomboidal plates on the *lower* surfaces, which plates are somewhat imbricated; and the concavities within them (not distinct cells, as in compound Orbitolites,) communicate with each other at one or more of the angles (figure 7) very much in the way shewn by a section of Orbitolites (see Carpenter, l. c., plate 6, figs. 1, 2), while the intervening calcareous walls are linear and thin. (Sometimes, as in *R. australis*, figs. 8, 9, these basal plates are lobed.)

If, instead of comparing Receptaculites with the Orbitolites, we should suppose it related to any of the millepore corals, or still more probably to such a form as that of the purple organ-coral (*Tubipora musica*), the reverse of all this would be the case. There should be a calcareous plate or epitheca on the lower surface, from which the tubular corallites would spring, and the walls of these latter, however thin, ought to be visible in the transverse section, which we do not find to be the case in slices of the columns viewed by transmitted light. Again, the upper extremity of the tubes should be open, not closed by convex plates as in the fossil, since such could only be the case when the walls of the coral-cells were so greatly thickened as nearly to close the mouth, while we have seen that in the fossil the corresponding part expands, and is covered over by a definite and often lobed plate, to all appearance continuous with the walls of the cells.

If any analogy be suspected between Receptaculites and such Palæozoic corals as Halysites (the chain-coral), or with Syringopora, there should, besides the characters above mentioned, be indications of transverse plates which have never yet appeared.

I believe all this applies equally to the *Receptaculites Neptuni* of the Devonian rocks of Belgium, but there is some appearance of a thin investment of the columns in transverse sections of that species which requires further investigation. And as it is of a deeply infundibuliform shape, there is of course a possibility that it and the other Receptaculites may be very regularly formed sponges; but I

have the greater satisfaction in the above view of the affinity, because, on explaining the specimens to Dr. Carpenter, I found that he entirely agreed in it. After pointing out several objections that might be made, he shewed me that there was in nearly every point a close coincidence in essential structure between Receptaculites and Orbitolites, the difference being only in the giant size of the cells in this the most ancient of Foraminifera.

Locality.—Plentiful in the limestone of Pauquette's rapids. The Corals and Crinoidea which accompany it are: *Petraia* (2 species), *Favosites lycopodites* (?) or *lycoperdon*, with the Crinoid *Schizocrinus nodosus*, and a species of *Glyptocystites*, the latter more rarely.

R. AUSTRALIS, N. sp.

Plate X. Figure 8-10.

Specific character.—*R. magnus*, *expansus*, *cellulis verticalibus subcylindricis incrassatis, apicibus subter convexis, lobulatis*.

Under this name a curious species of the genus is figured, for the sake of comparison, from the Silurian limestones of New South Wales. Communicated by the Rev. W. B. Clarke.

It is remarkable as having the expanded apices of the columns on the lower surface lobulated in larger or smaller divisions, which all seem to radiate from a central boss. And this arrangement is quite different from the merely granulated surface observable in the *R. occidentalis* (figure 6).

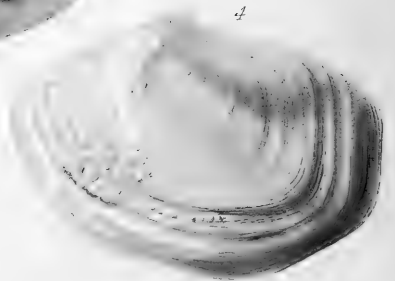
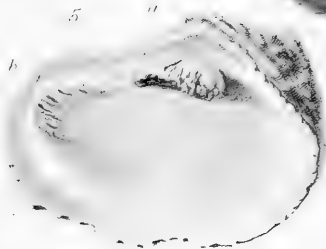
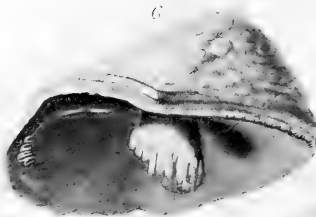
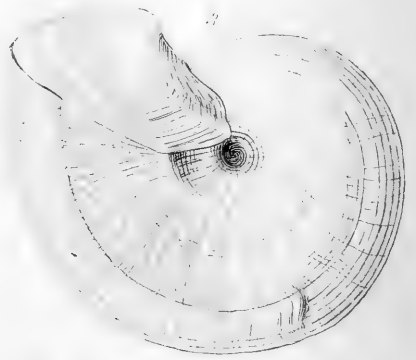
The upper surface too (figured as the lower in the plate, figure 8), is curiously lobed beneath the surface. Figure 10 represents a portion of two columns, broken off near the base, and viewed from within.

Locality.—Upper Silurian limestone of Yarradong, between the Yass plains and the Murrumbidgee river, New South Wales, a locality rich in Upper Silurian forms, Tentaculites, Favosites, Pentamerus, Ormoceras, Trochonema, Rhynchonella, &c.

J. W. SALTER.







Maclurea locant. Saller

N. Sowerby del.

PLATE I.

MACLUREA LOGANI (page 7).

- Figure 1. *Maclurea Logani*. Natural size. Lower or umbilical surface.
- “ 2. A younger specimen, with the operculum in place.
- “ 3. Upper view of same specimen, shewing the false umbilicus or concealed spire. This specimen has suffered some injury, and has a deep concentric furrow.
- “ 4, 5, 6. Exterior, inside and lateral views of an old operculum, with the apophyses for muscular attachments, *a*, *b*.





Fig 1-3. <i>Raphistoma lapicida</i> . Salter	Fig. 8. <i>H. planulata</i> var <i>muricata</i> .
4. ————— <i>aperta</i> . id	9. 10. <i>H. ? spinosa</i> . Salter
5-7. <i>Helicotoma planulata</i> . id	11-14. <i>H. laevigata</i> .

PLATE II.

RAPHISTOMA LAPICIDA (page 12).

- Figure 1. *Raphistoma lapicida*. Side view, with mouth.
" 2. ——— ———. Spire of ditto.
" 3. ——— ———. Base of ditto.

RAPHISTOMA APERTA (page 12).

- " 4. *Raphistoma aperta*. Upper, lower and side view.

HELICOTOMA PLANULATA (page 14).

- " 5. *Helicotoma planulata*. View of the spire.
" 6. ——— ———. Same specimen; under view.
" 7. ——— ———. Do. side view.
" 8. ——— ———. Var. *muricata*.

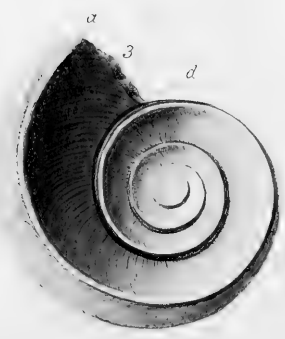
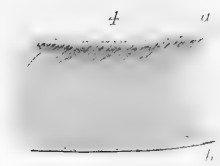
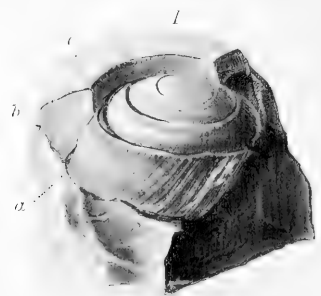
HELICOTOMA ? SPINOSA (page 15).

- " 9. *Helicotoma ? spinosa*. Slightly magnified; the natural size is indicated by the cross lines.
" 10. Under view of the same, also magnified.

HELICOTOMA LARVATA (page 15).

- " 11-13. *Helicotoma ? larvata*. Upper, under and side views.
" 14. ——— ———. The same species, encrusted by a sponge (*Stromatocerium rugosum*).





Ophileta compacta, Saltor

PLATE III.

OPHILETA COMPACTA (page 16).

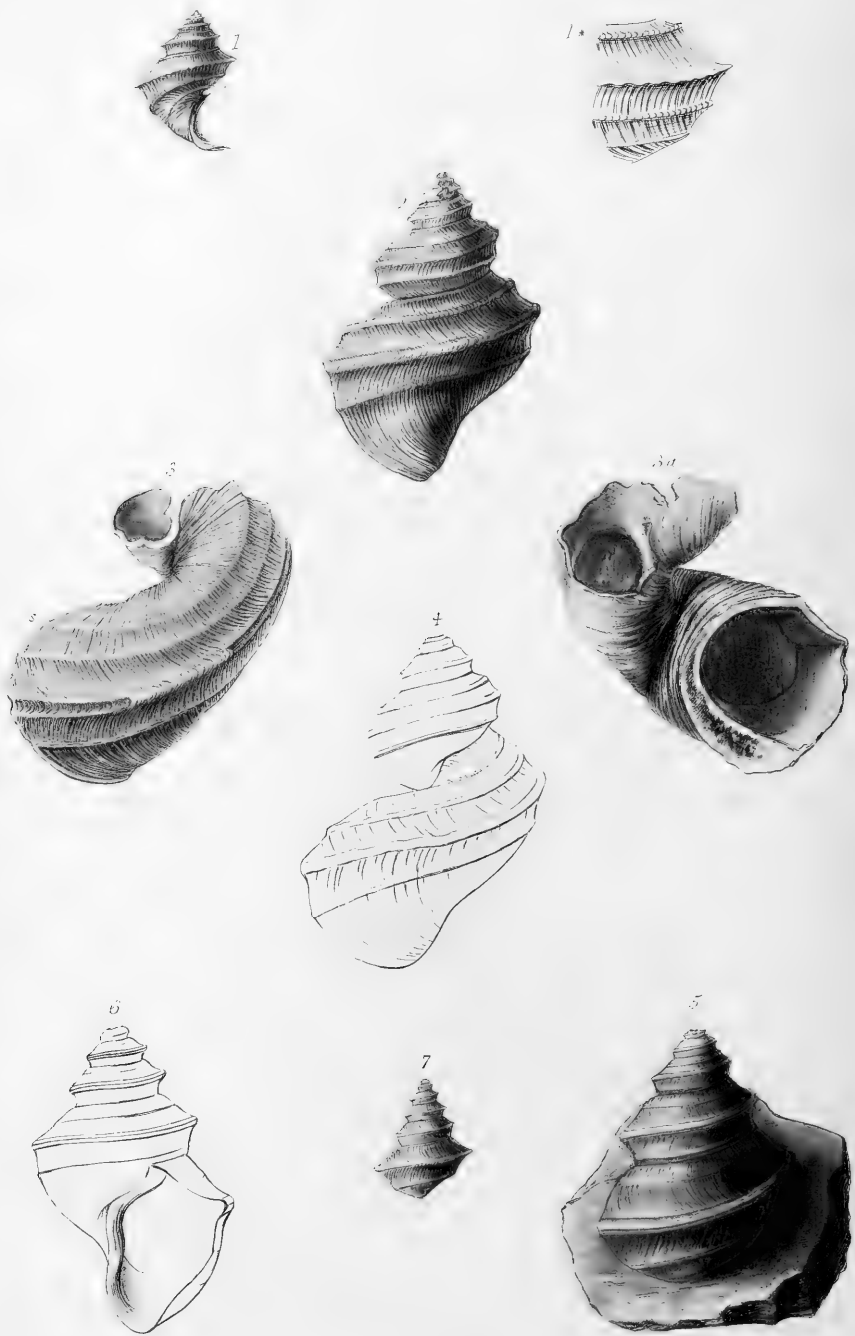
Figure 1. *Ophileta compacta*. Internal sandstone cast; only a portion of one whorl is left. Internal cast, sandstone, reversed, and shewing the flat or umbilical surface. *c*, the inner basal angle; *b*, the outer basal angle; *a*, the upper angle or keel. The convex dome-like cast of the deep cup-shaped spire shews distinctly, as the whorls are broken away.

“ 2. Cast of lower or umbilical surface.

“ 3. Exterior of upper or concave side. *a*, the outer angle or keel; *d*, the inner upper angle. A gutta-percha mould, taken from a cast of the upper surface, representing therefore the true shell.







1. *Murchisonia serrulata*. Salter.
2-4 *M. helicteres*. id.
5. 6. *M. bicincta*. Hall.
7. *M.* ———. var. *perangulata*. id.

PLATE IV.

MURCHISONIA SERRULATA (page 20).

(Not *serrata*, as in page 20.)

Figure 1. *Murchisonia serrulata*. Natural size; 1*, a portion magnified.

MURCHISONIA HELICTERES (page 21).

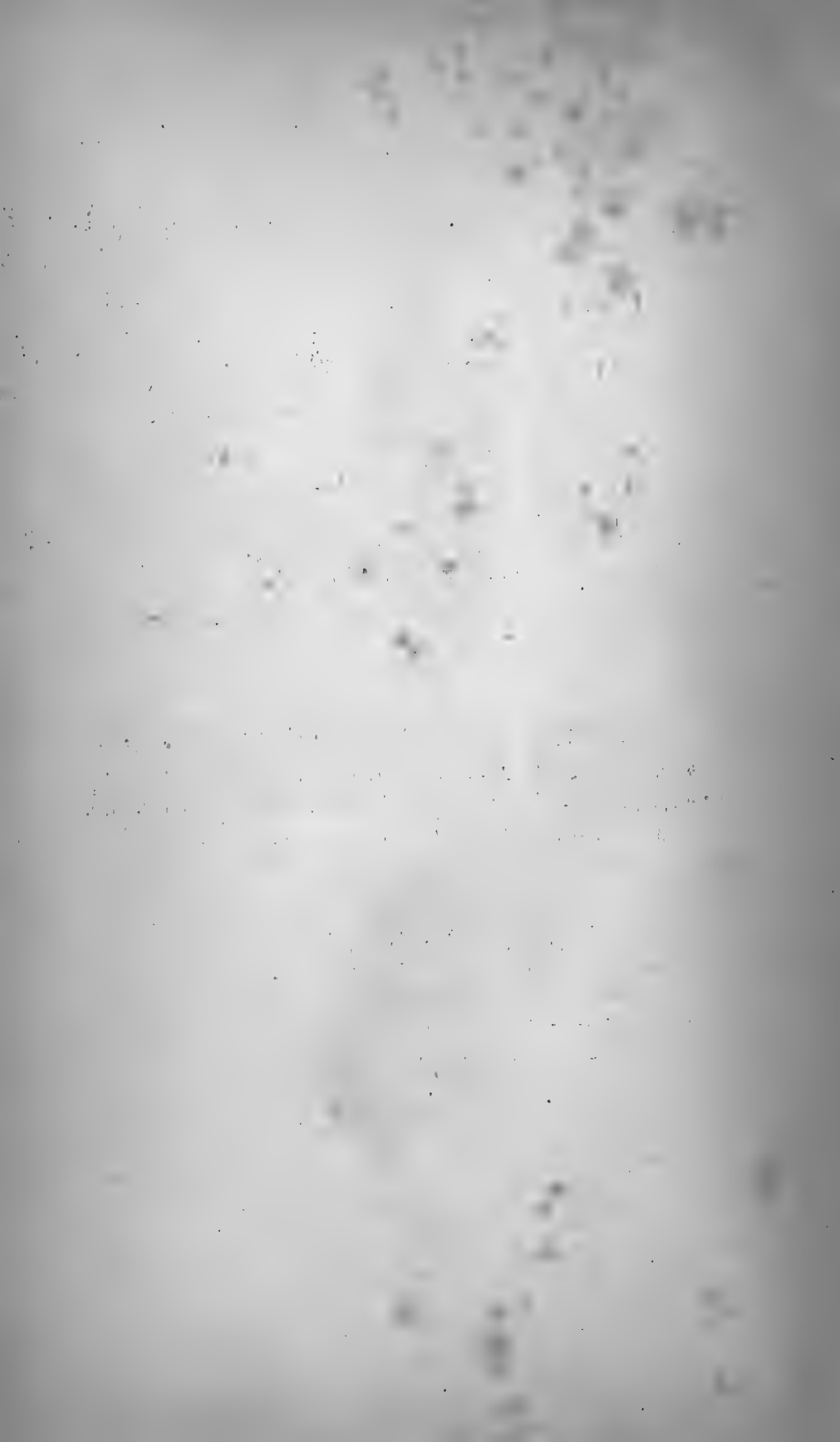
" 2. *Murchisonia helicteres*. A normal specimen.

" 3, 3a, 4. — — —. The same species, irregularly uncoiled. The sutural edge on the uncoiled whorl is indicated at s.

MURCHISONIA BICINCTA (page 19).

" 5, 6. *Murchisonia bicincta*, Hall. Ordinary large variety.

" 7. — — —. Variety with more angular whorls, and without the upper keel. (Var. *perangulata*, Hall.)





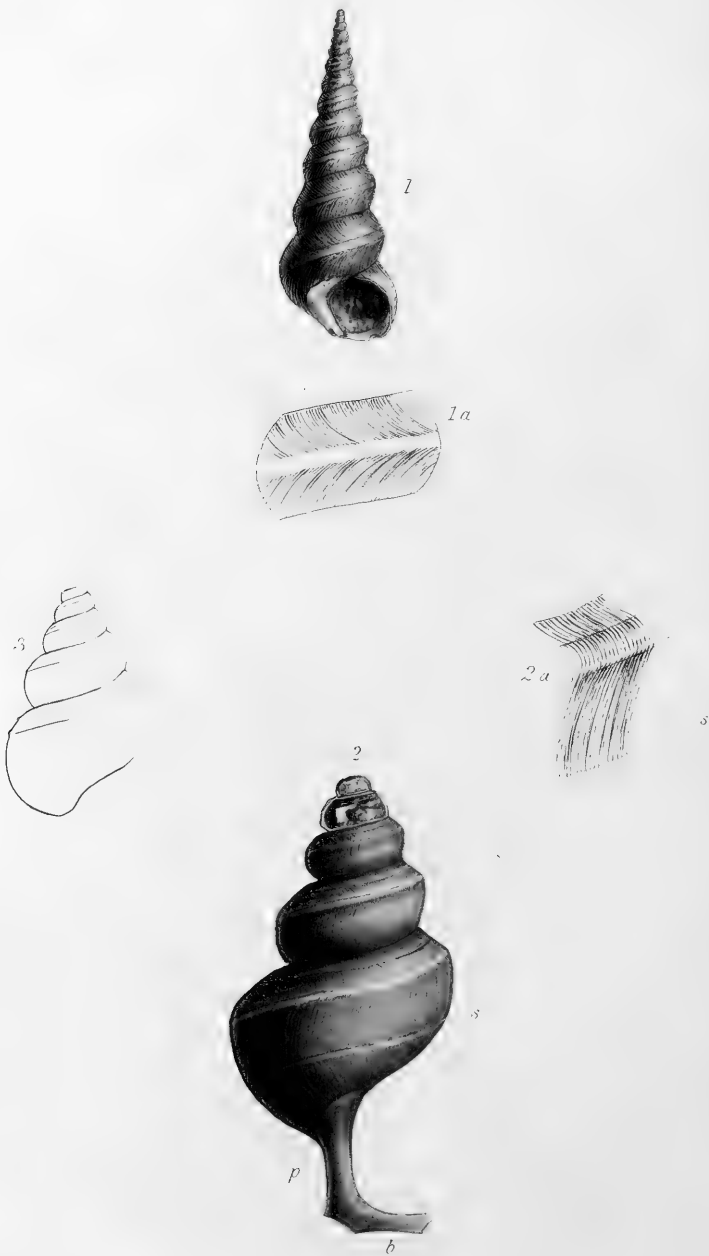


Fig. 1. *Murchisonia gracilis*. Hall.
2, 3 ----- *ventricosa*. id

PLATE V.

MURCHISONIA GRACILIS (page 22).

Figure 1. *Murchisonia gracilis*, Hall. The cast or body-whorl a good deal broken away, and shewing the inner reflected lip.

“ 1a. An enlarged whorl, to shew the lines of growth and the smooth band.

MURCHISONIA VENTRICOSA (page 23).

“ 2. *M. ventricosa*, Hall. Of large size. The body-whorl here is also broken away; hence the pillar-lip, *p*, and the base of the whorl, *b*, are more prominent and curved than they should be. At *s* a slight ridge, just above the suture, is sometimes visible.

“ 2a. Shews the moderately arched lines of growth.

“ 3. A smaller specimen, less elongate than usual. The position of the band high up, near the sutures, is contrasted in this species with that of *M. gracilis*, figure 1.



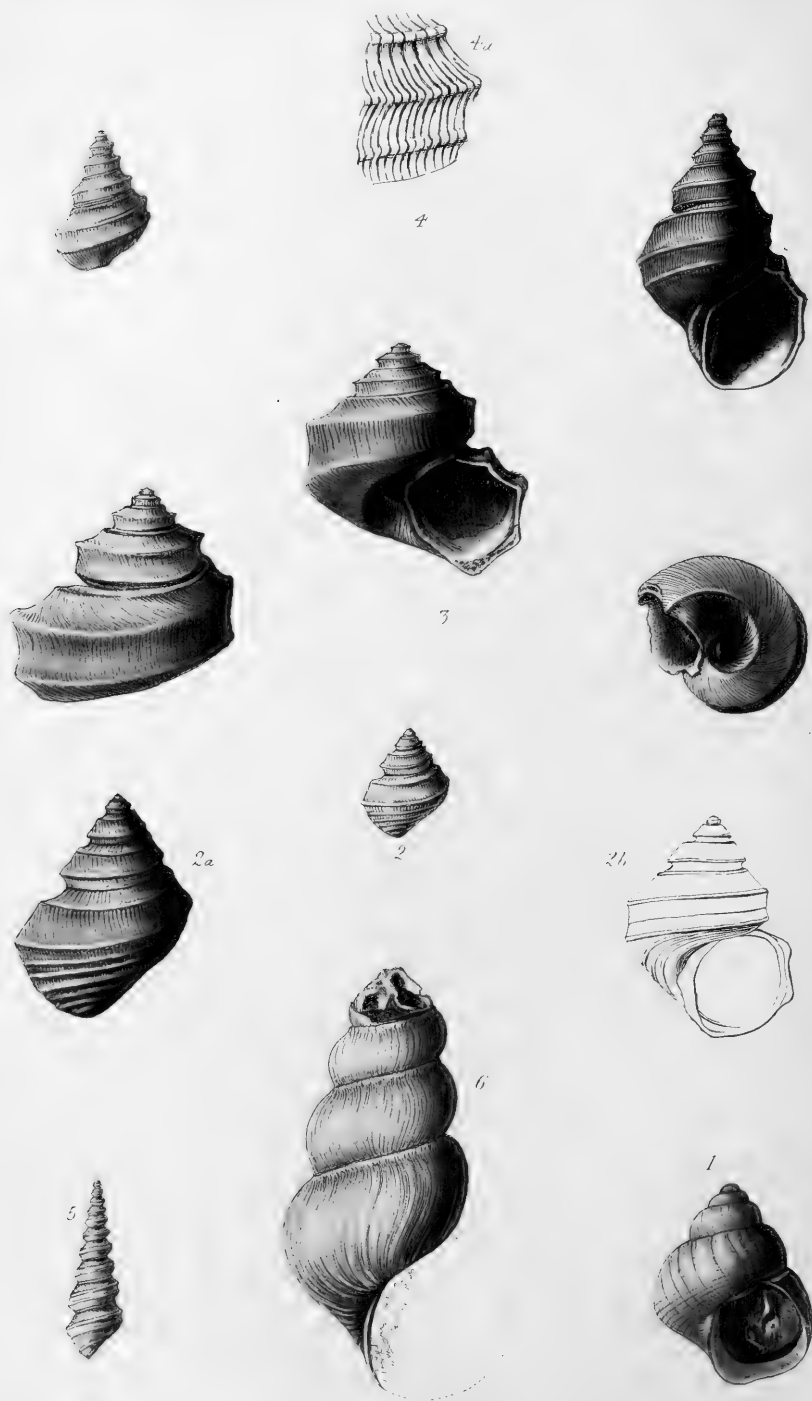


Fig. 1. <i>Cyclonema Halliana</i> . Salter.	Fig. 4. <i>Eunema strigillata</i> . Salter.
2. ——— <i>semicaninata</i> . id.	5. ——— ? <i>Pagoda</i> . id.
3. <i>Trochcnema umbilicata</i> . Hall	6. <i>Iaconema Murrayana</i> . id.

PLATE VI.

CYCLONEMA HALLIANA (page 26).

Figure 1. *Cyclonema Halliana*. Natural size.

CYCLONEMA SEMICARINATA (page 27).

" 2. *Cyclonema semicarinata*. Natural size; 2a, 2b, front and back views, more enlarged.

TROCHONEMA UMBILICATA (page 27).

" 3. *Trochonema (Pleurotomaria) umbilicata*, Hall. Three views of one specimen.

EUNEMA STRIGILLATA (page 29).

" 4. *Eunema strigillata*. Two specimens, natural size; 4a, upper part of whorl, magnified to shew the dichotomous striæ.

EUNEMA? PAGODA (page 30).

" 5. *E? Pagoda*. Natural size.

LOXONEMA MURRAYANA (page 31).

" 6. *Loxonema Murrayana*. An unique specimen, imbedded in limestone.

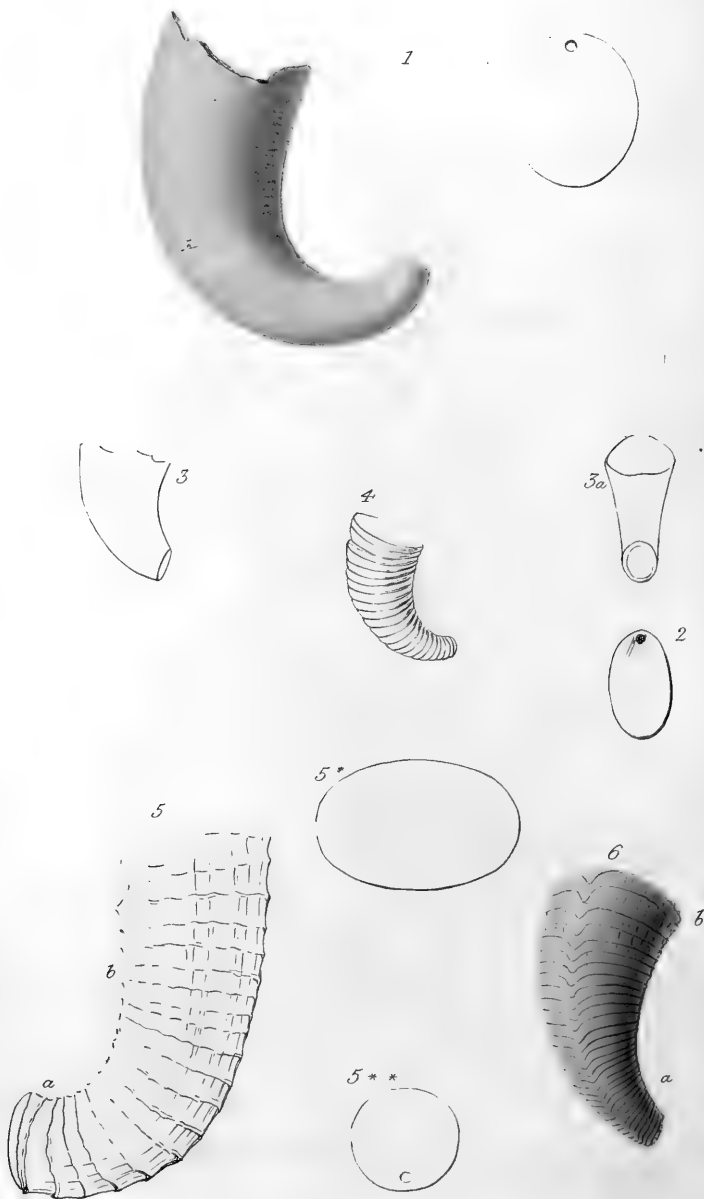


Fig. 1-4. *Cyrtoceras falx*. - *Billings*
 5. 6. _____ *Billingsii*. *Salter*.

PLATE VII.

CYRTOCERAS FALX (page 32).

- Figure 1. *Cyrtoceras falx*, Billings. Side view and section of the larger end, the siphon on the outer (ventral) side of the curve.
- " 2. Section (with siphuncle) of a more compressed form, the compression partly due to pressure. The tube becomes more and more cylindrical in age.
- " 3, 3a. A younger specimen, from the Ottawa limestone.
- " 4. A worn specimen, shewing the close septa.

CYRTOCERAS BILLINGSII (page 33).

- " 5. *Cyrtoceras Billingsii* (*C. lamellosum*, Hall). Side view. 5* is the section at the larger end; 5** of the smaller cylindrical end—the siphon external.
- " 6. A younger specimen; with closer lamellæ of growth.

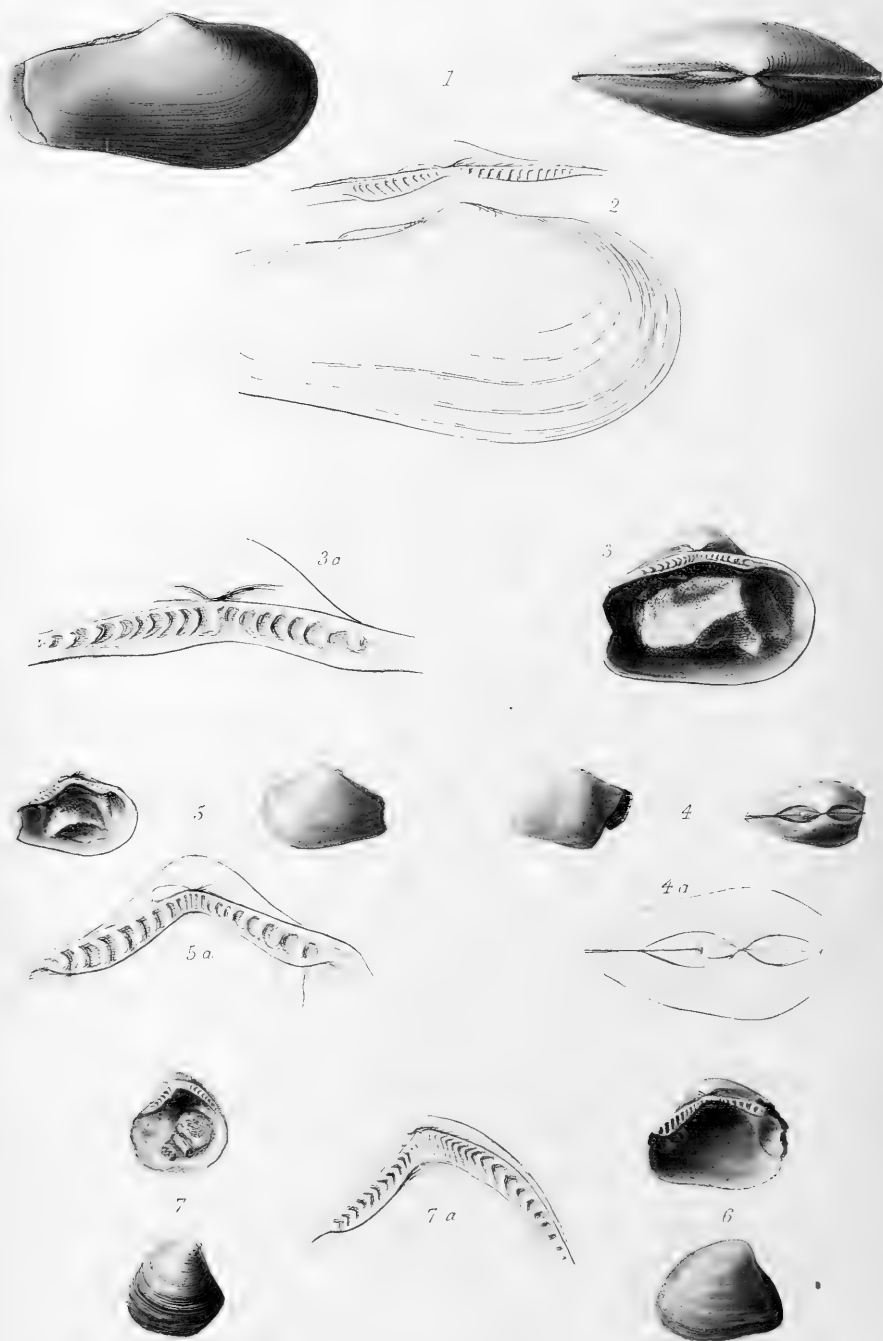


Fig. 1. 2. *Ctenodonta nasuta*. Hall. sp. | Fig. 4. 5. *C. contracta*. Salter.
3. ——— *Logani*. Salter. | 6. *gibberula*. id.
7. *C. astartiformis* id.

PLATE VIII.

CTENODONTA NASUTA (page 35).

Figure 1. *Ctenodonta nasuta*, Hall. Natural size.

" 2. — — —, —. Large specimen, with external ligament and hinge-teeth.

CTENODONTA LOGANI (page 36).

" 3. *Ctenodonta Logani*. Interior of left valve. 3a, the hinge enlarged.

CTENODONTA CONTRACTA (page 37).

" 4. *Ctenodonta contracta*. Var. with posterior sinus well marked. 4a, enlarged, to shew ligament.

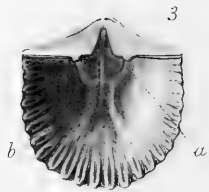
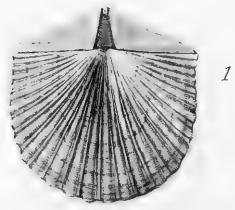
" 5. — The same, with the sinus obsolete. 5a, the hinge enlarged, the muscular impressions deep.

CTENODONTA GIBBERULA (page 38).

" 6. *Ctenodonta gibberula*. Interior and exterior of the left valve.

CTENODONTA ASTARTÆFORMIS (page 39).

" 7. *Ctenodonta? astartæformis*. Left valve, outside and interior. 7a, the hinge-line magnified.



C. P. Bone del.

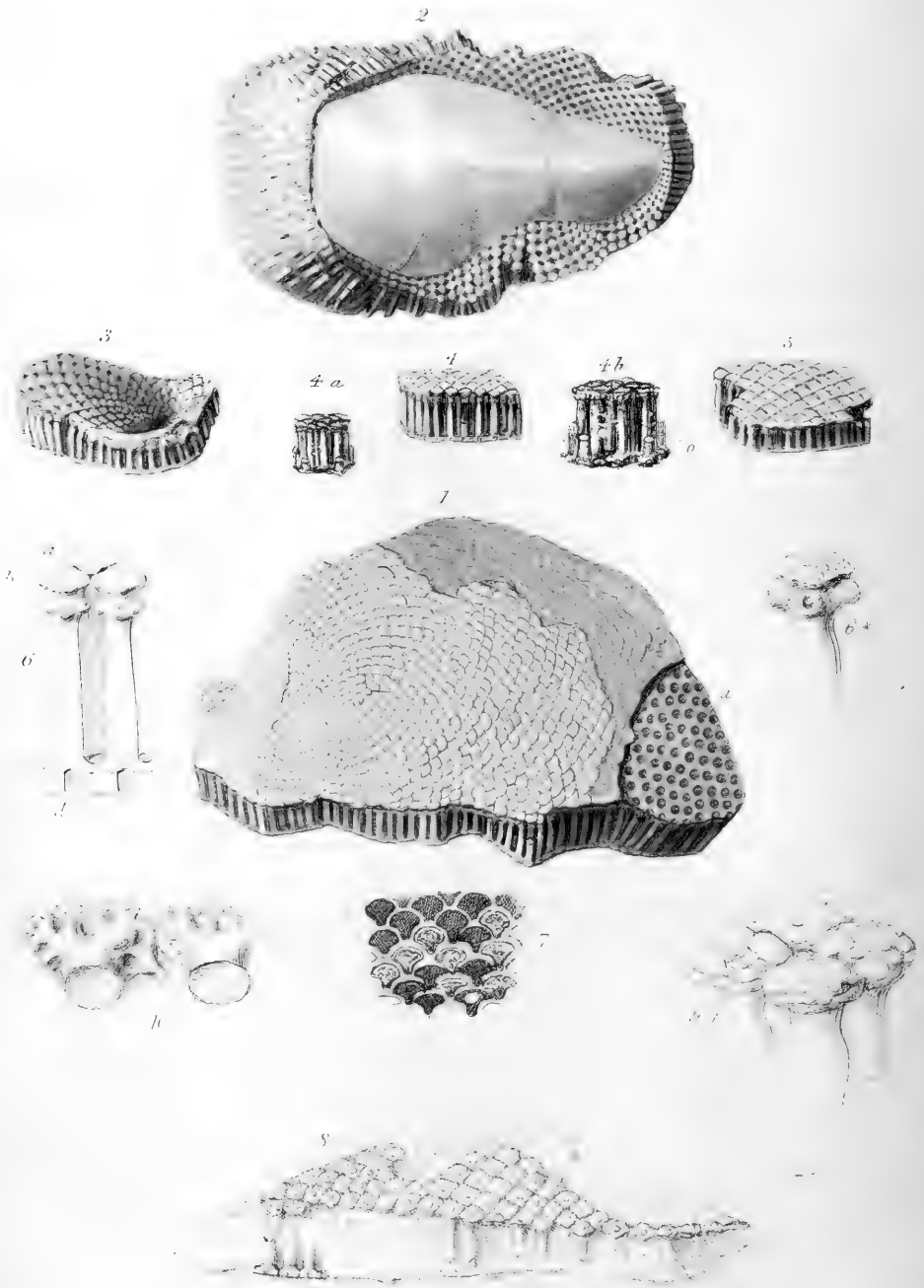
W. Sowerby sc^t

Orthis tricenaria. Conrad

PLATE IX.

ORTHIS TRICENARIA (page 39).

- Figure 1. *Orthis tricenaria*, Conrad. Both valves closed. Dorsal view.
- “ 2. The same specimen; ventral view.
- “ 3. Interior of the ventral valve, shewing the muscular impressions (*a*), and the ovarian spaces (*b*).
- “ 4. Interior of the dorsal valve. *a*, the teeth or brachial processes—the small linear cardinal process is seen between them. *b, c*, the quadruple muscular impressions



1-7. *Receptaculites occidentalis.*
 8-10. *R. _____ australis.*

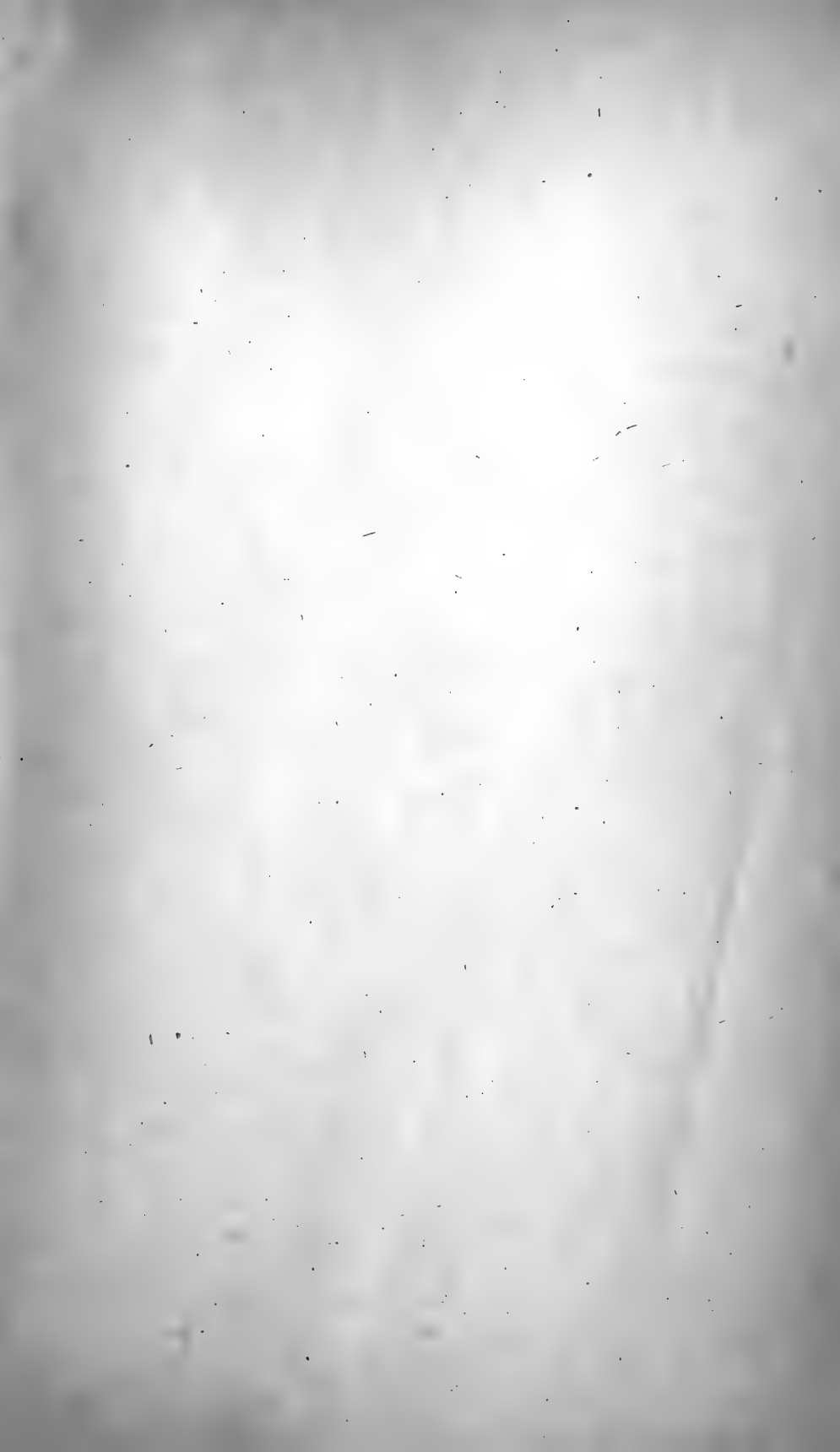
PLATE X.

RECEPTACULITES OCCIDENTALIS (page 45).

- Figure 1. *Receptaculites occidentalis*. Upper view of a fragment of a large specimen. At *a*, a rubbed portion exposes sections of the cylindrical columns.
2. A more weathered specimen, upper side shewing the convex ends of the columns.
 - “ 3. Cupped central part of a specimen.
 - “ 4, 5. Detached fragments reversed, the upper side downwards, shewing the rhomboidal bases to the columns. *4a* ditto., shewing the connecting stolons. *4b*, the same magnified.
 - “ 6. One or two columns magnified, reversed. *a*, the rhomboidal granulated space; *b*, the connecting basal stolons; *c*, the apices of the columns; *d*, the interstices between them; *6** is the base of one of the columns, more highly magnified.
 - “ 7. Shews a portion of the lower surface polished. Some of the rhomboidal spaces are connected by the stolons with each other.

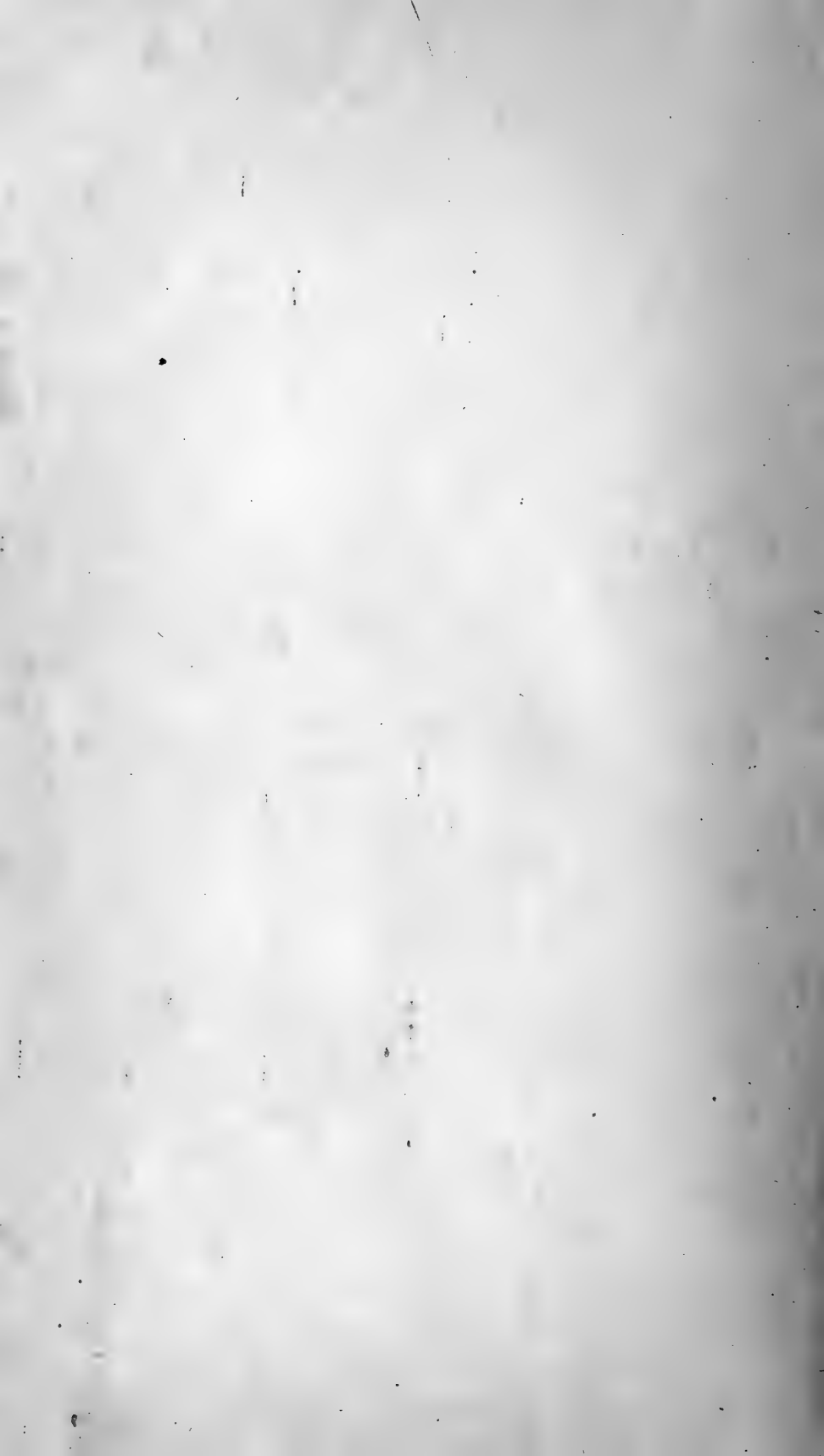
RECEPTACULITES AUSTRALIS (page 47).

- “ 8. *Receptaculites australis*, Salter. A new Australian species, introduced for comparison. Lower surface, with the lobed bases of the columns.
- “ 9. Some of the columns magnified. The stolons are not clearly seen in this specimen.
- “ 10. View from the inner surface of these lobed bases, shewing the ramifications of the sarcode highly magnified.













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