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PALÆONTOLOGY

OF

NEW-YORK.

VOLUME II.

CONTAINING DESCRIPTIONS OF THE ORGANIC REMAINS OF THE LOWER MIDDLE DIVISION OF THE NEW-YORK SYSTEM,

(EQUIVALENT IN PART TO THE MIDDLE SILURIAN ROCKS OF EUROPE.)

BY JAMES HALL.

ALBANY:
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1852.

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TO HIS EXCELLENCY WASHINGTON HUNT,

Governor of the State of New-York.

SIR,

I HEREWITH submit to Your Excellency that part of my Report on the Palæontology of New-York, containing descriptions of the organic remains from the lower part of the middle division of the System, embracing those of the Medina sandstone, Clinton group, Niagara group, Coralline limestone, and Onondaga-salt group. All the species described are illustrated by figures drawn and engraved from original specimens, the geological positions of which are well authenticated.

I have the honor to be,

With great respect,

Your obedient servant,

JAMES HALL.

ALBANY, September 1, 1852.

CONTENTS OF VOL. II.

PREFACE TO THE SECOND VOLUME.

This volume contains descriptions and figures of all the fossils yet observed by me, whether collected by myself or others, in the Medina sandstone, Clinton group, Niagara group, Coralline limestone and Onondaga-salt group; the entire number of species being 344. As announced in the first volume, I intended to include in this volume the descriptions and illustrations of the fossils of the Lower Helderberg; but it soon became apparent that the number of plates would be too much increased, and it was therefore necessary to terminate the volume with the Onondaga-salt group.

The numbering of the plates in this volume extends to 85; while the actual number, from intercalation, amounts to 101.

The engraving for this volume was commenced in 1847; and during the year 1848, nearly all the plates were given in hand to the engravers. In February, 1849, there remained to be given out the drawings of plates 35, 36, 37, 38, 60, 70 and 73 A; and the printing of the volume was then in progress. After having proceeded as far as the 120th page, and finding that the engraving was likely to be much delayed, I suspended the further printing at that time, for the purpose of making a re-examination of the corals and bryozoa, which resulted in the ascertaining of nearly as many additional species as possessed before. These additions to this class of fossils have increased the number of plates between 34 and 41, by an amount equal to those indicated by letters.

With the exception of the last fifteen pages, the printing of this volume was completed in the early part of 1850; but the engraving has not been finished to permit its appearance till 1852. In the mean time several works have appeared, in which species, identical or allied with those here described, have been published. To those authors, therefore, whose publications bear date anterior to this volume, but which are not referred to, this

explanation is due. The works of more especial interest, which have come to hand in the interval, are :

Graptolites de Bohême. By J. Barrande.
A paper on Stephanocrinus. By Dr. F. Rœmer.
A paper on Brachiopoda. By M. de Verneuil and Mr. Davidson.
Monographie des Polipiers fossiles des Terrains palæozoiques. By Milne-Edwards and Jules Haime.
British Palæozoic Rocks and Fossils : Part ii. By Sedgwick and M'Coy.
Die Versteinerungen der Grauwacken Formation in Sachsen, &c. Von Hans Bruno Geinitz. Heft 1 : Graptolithen.

In the progress of this volume, I have been indebted to numerous friends for specimens of fossils, communicated to me for illustrating the work. In all such cases, suitable credit has been given at the close of the description of the fossil. I am, however, more especially under obligation to Col. E. Jewett, formerly of Lockport, now of Utica, for many unique specimens, particularly among the crinoids. I am likewise indebted to Dr. Worcester, of Lockport, for several specimens in the Clinton and Niagara groups, and to Mr. Gebhard for a large proportion of those from the Coralline limestone.

I would also express my obligations to Mr. John Paterson, under whose supervision the volume has passed through the press.

PALÆONTOLOGY OF NEW-YORK.

ONEIDA CONGLOMERATE.

The Oneida conglomerate marks, in a most decided and unequivocal manner, the limit between the lower and middle portions of our system. Its wide extent, and, in many places, its extraordinary development entitle it to rank as a formation of great importance. It is true that in Western New-York, and in the Western States, it is comparatively unimportant; but when we pass to the southeast and to the south by the shores of the Hudson, and thence into New-Jersey, Pennsylvania and Virginia, this formation becomes very powerful, forming distinct topographical features. As examples of this we may instance the Shawangunk mountain in the southern part of New-York, and the extension of the same range in New-Jersey in the Blue or Kittatiny mountain range, which, in its southern extension, crosses the Delaware river at the Delaware water-gap, and thence through Pennsylvania and the western part of Maryland into Virginia. There are also numerous minor points, in Pennsylvania and Virginia, where this rock forms distinct and prominent features in the topography of the country.

In the regular ascending order, the Oneida conglomerate succeeds the Hudson-river group. It sometimes rests directly upon the shales of that group, as in Herkimer county; or succeeds a fine-grained gray sandstone, which may be regarded as terminating the Hudson-river group, and forming a more natural passage into the conglomerate*.

I have not been able to recognize any fossils in this rock: indeed its materials are of such character that fossils could scarcely be preserved, and the conditions under which it was formed were not favorable to the development of organic existence.

A few fragments of what appear to be marine plants have been seen in this rock, but in all too imperfect to be of any importance.

* In Herkimer and Oneida counties, this conglomerate is closely associated with the beds of the Clinton group which immediately succeed it; and being there of coarse materials, it would readily be confounded in one group with the conglomerate. In the southern part of Herkimer county, the shales of the Hudson-river group are separated from the sandstones and ore beds of the Clinton group only by the Oneida conglomerate, which has but a very inconsiderable thickness. Still farther east, along the base of the Helderberg, where the Clinton, Niagara and Onondaga-salt groups are very thin, the Oneida conglomerate is absent, and the shales and sandstones of the Hudson-river group rise to within a few feet of the Tentaculite limestone or Water-lime group.

MEDINA SANDSTONE, CLINTON AND NIAGARA GROUPS.

These rocks have been described in the Geological Reports of the State as three distinct groups, which distinction they are in truth entitled to throughout the State. When, however, we come to investigate minutely the physical conditions under which they were formed, the line of demarcation is not always so readily defined. The Medina sandstone, throughout the greater part of its thickness, is almost wholly devoid of fossils; presenting the character of a nearly homogeneous argillaceous sandstone, which, from its easy destructibility by atmospheric agencies, usually presents a broad sloping plateau. In the banks of ravines, streams or rivers only, the edges of the strata are seen, and here always in a state of decomposition.

Towards the upper termination of the mass, its composition becomes more purely arenaceous, and it forms a distinct feature in the exposed edges of the harder strata. Here, also, in several localities, it contains fossils in large numbers, though of few species. Between this point in the Medina sandstone where marine shells appear, and the point we have left in the Hudson-river group where similar fossils are found, there is a thickness, in some parts, of about one thousand feet, in which no well defined forms are known to exist. Thus, the gray sandstone terminating the Hudson-river group, the Oneida conglomerate and lower part of the Medina sandstone separate the fossiliferous portions of the Hudson-river group from the point where we now take up the subject, by the great amount of thickness named. It is true that in the eastern part of the State these groups approach each other within one hundred feet, but the distinction between them is much more strongly marked here than at the west.

The upper fossiliferous portion of the Medina sandstone is generally of no great thickness, though in the extreme western limit of the State it reaches a maximum of more than one hundred feet. In the western portion of the State, the limit between the Medina sandstone and Clinton group is well defined, and the materials very distinct; but in the central part of the State, we find the same conditions which operated during the deposition of the Medina sandstone to have been continued into the Clinton group. The latter commences by a shaly deposit, which is soon succeeded by alternations of sandstone in character precisely like the Medina sandstone. I have shown (*Geological Report 4th District*, p. 52) the existence of sea beaches, with wave lines, drifted shells, etc. upon the surface of the sand. The same features are continued into the Clinton group; and where the alternations of sand occur in the shaly deposits of the latter, similar wave lines, drifted shells, and other evidences of beaches or shallow water, such as the trails of shells or other animals, are found.

The general character of the marine vegetation of the two periods is similar; and a peculiar type of plants commences its existence in the Medina sandstone, and terminates in the Clinton group. These facts will be shown by the illustrations and descriptions in the successive plates. Still it is convenient, and even necessary, to treat these two as separate and successive groups, since in the main they are each so well defined.

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When we examine the Clinton group in the central part of the State, its analogies are chiefly with the Medina sandstone ; and it is there a powerful and important formation, presenting, however, great variation in its successive beds, and characters in every respect truly protean.

In its western extension, the Clinton group assimilates in character to the Niagara group, and, in the Western district, has nearly lost the character which it presents in Oneida county. At the same time that the group assumes a more calcareous character in its western extension, it loses the fossils which were typical of it, and becomes charged with fossils peculiar to calcareous strata. Thus while we find its lower beds, from Wayne county westward to the Niagara river, characterized by peculiar fossils, we find the upper beds containing many species which pass upwards into the Niagara group. Indeed there is no line which can be designated between these two groups, which shall mark the limits of the organic products. It is true, nevertheless, that by far the greater part of the fossils of the two groups are distinct ; and the small number in the lower group, of those which we regard as proper to the Niagara group, are for the most part inconspicuous, and not so well developed as they are in the Niagara.

To ascertain the value of these characters, and to decide the relations of these groups, has cost much time and labor ; and the localities, with their productions, have not yet been fully explored. In these investigations some new facts have been brought to light, facts which all the previous examinations had not shown. Among these I may mention as pertinent to the present object, the discovery of several species of fossils heretofore known only in the lower rocks. In the western part of the State, the lower beds of this group have furnished very dilapidated specimens of *Bellerophon bilobatus*, with *Delthyris lynx*, and one or two imperfect specimens of a *Leptæna* undistinguishable from *L. alternata*. A few other fragments and imperfect specimens have also been found, which appear to be of forms belonging to lower silurian strata. These facts are extremely important and interesting ; and I take the first occasion of recording them, from the circumstance that all our investigations previously had only strengthened the opinion that no fossils of the lower rocks had passed the Oneida conglomerate. Neither should it be forgotten at the present time that all the specimens found are in a very dilapidated condition, and the number altogether so few, that we might even yet be disposed to doubt whether the same lived at this period, or whether their appearance here is merely accidental.

In its western extension, the upper limit of the Clinton group is marked by a thick bed of limestone, which contains several species of fossils common to this bed and the group above, as well as several which are peculiar to the Clinton group, and do not pass above this limestone.

The Niagara group, which is so well marked and powerful in the neighborhood of Niagara Falls, Lockport, Rochester and even in Wayne county, becomes diminished in thickness in its extension eastward, and appears quite subordinate to the Clinton group. The fossils peculiar to the Niagara group farther west are scarcely recognized ; and in Oneida county, this group is in some places represented by a thin mass of shale, with some beds of concretionary limestone. In this condition it appears scarcely separable from the Clinton group which it succeeds, and, in the early part of the Geological Survey, was included with it under the name of the Protean group. Diminished and inconspicuous as the Niagara group has thus become, even in the central

part of the State, its place is still marked by a thin band of limestone even as far east as the base of the Helderberg at Schoharie, and upon the Hudson river near Rondout.

It will be seen, therefore, that these three groups, though in some parts so intimately connected that no well marked line of separation is perceptible, have nevertheless an independent existence. The Medina sandstone proper thins out, so as not to be recognized east of the central part of the State. The Clinton group proper has its greatest development in the central part of the State, extends eastward to the Helderberg in a thin bed of shale, and westward beyond the Niagara river in alternating beds of shale and limestone. The Niagara group preserves its independent character, though greatly diminished, eastward to the Hudson river, and, in its western extension, becomes more prominent than either of the others. The Medina sandstone and Clinton group gradually recede in character from each other in their western extension; and finally the former is altogether lost, while the latter becomes assimilated in character to the Niagara group, so far that they are regarded as the same.

MEDINA SANDSTONE.

This rock has not been recognized east of Oneida county. It is traced from thence towards Oswego, and extends thence along the southern shore of Lake Ontario to its western extremity, whence it takes a northwesterly direction. It is fossiliferous at few points only; those of Oswego, Rochester, Medina and Lockport being the principal ones. The fossils are almost entirely confined to its upper portions, rarely appearing one hundred feet below its surface. The occurrence of peculiar marine plants is its most interesting feature.

FOSSIL PLANTS OF THE MEDINA SANDSTONE.

Genus ARTHROPHYCUS.

[Gr. αρθρον, *articulus*, and φυκυς, *fucus*.]

Character. Stems simple or branching, rounded or subangular, flexuous, ascending, transversely marked by ridges or articulations.

The species of this genus yet known consist either of simple elongated stems of nearly equal dimensions throughout, or those which divide near the root into several branches, and afterwards remain simple. The species of the Medina sandstone may be regarded as the typical form.

382. 1. ARTHROPHYCUS HARLANI.

PLATE I. Fig. 1.—PL. II. Figs. 1 a, 1 b, 1 c.

Fucoides alleghaniensis & *brongniartii.* HARLAN, Med. and Phys. Researches, p. 393 & 398.
F. harlani. CONRAD, Annual Report on Palæontology, 1838, p. 113.

Plant composed of strong rounded and articulated stems, which divide near the base into numerous elongated branches; branches simple, flexible, articulated and diminishing very gradually, usually appearing of the same dimensions throughout, and more or less curved; diameter of the branches $\frac{1}{4} - \frac{1}{2}$ inch.

The specimens of this plant, always in fragments, often cover large surfaces of the thin slabs of the Medina sandstone. The more common diameter of the branches is from one-fourth to half an inch, but some of the larger stems often reach an inch in diameter. Fragments are frequently seen of one to two feet in length, and broken at either extremity. Fragments are sometimes found where a strong stem, apparently near the root, divides into several branches near the same point, but these branches are not again found to subdivide. From the condition of the rock, and the few specimens which have been found showing this character, its mode of growth cannot be clearly determined. It must have been exceedingly prolific, since great surfaces are crowded with its fragments; and these layers are covered only by a deposition of a few inches, when another growth equally abundant is found upon the succeeding layer. This succession of deposits has gone on through a thickness of many feet; the surface of each successive layer, at intervals of a few inches, being covered in a similar manner. In many situations the transverse ridges or articulations are mostly or entirely removed, leaving the surface nearly smooth. The branches are often compressed, and present a longitudinal furrow, which, however, is only accidental.

PLATE I.

Fig. 1. This specimen is a portion of a slab covered with fragments of the branches of this species. Some of them are worn nearly smooth, and others have a longitudinal depressed line.

PLATE II.

Fig. 1 *a*. A fragment, showing the base of a large stem which diverges into numerous branches.

Fig. 1 *b*. A similar fragment, showing a second bifurcation above the first.
Specimens like the above are of rare occurrence.

Fig. 1 *c*. A fragment of a branch somewhat spirally twisted and flattened. This specimen gives evidence that the plant grew in an erect or suberect position, and that the pressure from above caused it to assume its present form. The fragment shows also two broken stems with bifurcating branches.

Position and locality. This species occurs abundantly at the falls on the Oswego river, somewhat rarely and imperfectly at Rochester and Brockport, and very abundantly and in fine condition at Medina in Orleans county. It is likewise found at Lockport, and in an imperfect condition near Lewiston. Fine specimens have been obtained along the Welland Canal (in Canada West), where it cuts through the Medina sandstone. Fine specimens are likewise obtained near Lewistown, Mifflin county, Va. *(State Collection.)*

See note at the end of the volume.

383. 2. ARTHROPHYCUS —— ?

Pl. II. Fig. 2.

This species presents large rugose expansions, which are curved into irregular shapes. The substance appears as if composed of a number of flattened stems, coalescing at their edges.

From the position in which this form is usually found, it appears not unlikely to have been the root of the preceding species. Its entire characters, however, have not been fully determined.

Position and locality. This form occurs usually in the thicker layers, associated with the preceding species at Medina, Orleans county, and at Lockport, Niagara county.

(*State Collection.*)

384. 2. SCOLITHUS VERTICALIS (*n. sp.*).

Pl. III. Fig. 3.

Plant composed of smooth round stems, which penetrate the strata vertically.

This species is smaller than the one in the Potsdam sandstone, though resembling it in its general characters. It penetrates the more firm and arenaceous strata, and has not been found associated with the preceding species.

Position and locality. In the thick-bedded sandstone of Monroe county. (*State Collection.*)

385. 6. PALÆOPHYCUS TORTUOSUS (*n. sp.*).

Pl. III. Figs. 2 a, b.

Stems or branches rounded, tortuous, frequently bifurcating ; surface smooth and glossy.

This species is a branching one, though it has been impossible to procure it in a condition to give a full representation of its form. The branches are often twisted or bent in zigzag forms, probably from pressure. It usually occurs in the thickbedded portions of the rock ; and being replaced by soft argillaceous matter, it has a slightly different and more brilliant color.

Position and locality. This species occurs in the central or lower part of the rock, about the mouth of the Genesee river, and at the Irondequoit bay. It likewise occurs in other parts of the rock, but is never abundant at any locality. (*State Collection.*)

386. 1. DICTUOLITES BECKII.

Pl. II. Fig. 1.

Lithodictuon beckii. Conrad, Annual Geol. Reports of 1837, p. 167, note.
Dictuolites beckii. Annual Report on Palæontology, 1838, p. 113.
— — Hall, Geol. Report of the Fourth District, pag. 48, pl. 1, fig. 1.

A body composed of numerous strong stems or branches joined in an irregularly reticulated manner ; branches furnished on each side with lateral rootlets, which extend from the elevated branches into the surrounding stone.

The whole substance and arrangement is angular, and there is some reason to hesitate in assenting to its organic character. It covers large surfaces of the stone; and there is no evidence, on the largest slabs obtained, of any thing like a commencement or termination of the structure. Every branch or reticulation is connected with the stone by the small rootlike fibres, as in the figure; and surfaces several feet in extent present no deviation from the general character given in this figure. The surfaces thus covered present a most singular and beautiful appearance; and when in some cases covered by ripplemarks, the interesting character is greatly enhanced.

Position and locality. This peculiar form is known only in the terminal gray portion of the rock (gray band) at Medina in Orleans county. (*State Collection.*)

PL. III. Figs. 3 & 4.

Fucoides auriformis, and *F. heterophyllus*. Report of the Fourth Geological District of New-York, 1843, p. 47.

Fig. 4. Surface covered with irregular auriform elevations, single or overlapping each other. These appear like casts of soft material, made in cavities in the rock below.

Fig. 3 has a still more artificial character, presenting irregularly rugose or striated elevations which have no prevailing or definite shape.

These forms were described in the Report of the Fourth District as different species of FUCOIDES; but I have not, up to this time, been able to satisfy myself that they are organic. They appear among the many curious and remarkable markings which cover large surfaces in the Medina sandstone and Clinton group, but which can scarcely be referred to organic remains. A shallow sea, with the proximity of beaches and sudden transitions in the nature of the deposits, have produced many appearances upon the surface that at first view might be attributed to organic influences, but which are doubtless due to the influence of waves, currents, and perhaps to other dynamical causes.

The kind of markings in question are found abundantly at Rochester, and also at Medina and other places in Western New-York. (*State Collection.*)

387. CHÆTETES ——?

PL. IV. Fig. 1.

This species is undistinguishable from the branching forms in the Trenton limestone, and is represented here from the interesting circumstance of occurring in the Medina sandstone at Lockport.

BRACHIOPODA OF THE MEDINA SANDSTONE.

This rock contains comparatively few species of fossil shells. At the time the Report of the Fourth District was published, scarcely more than half a dozen species were known in the rock. The most diligent search has little more than doubled that number to the present time ; and it is scarcely possible that many more will ever be discovered, unless some peculiarly favorable locality should be found. The almost entire absence of calcareous matter, and more particularly the abundance of ferruginous coloring matter, has been unfavorable to the development of testaceous organic forms.

388. 12. LINGULA CUNEATA.

Pl. IV. Fig. 2 a, b, c, e.

Lingula cuneata. Conrad, Annual Report of 1838, p. 113 (name without description); of 1839, p. 64.

Shell cuneiform, very acute at the beaks ; margins nearly rectilinear, and converging uniformly from near the base to the beak ; base lightly curved ; the valves convex on the upper half, but flattened or compressed towards the base ; surface longitudinally striated.

This species of Lingula is readily distinguished from any of the other species, by its acutely cuneate form. It occurs in great numbers in some gray layers about fifty feet below the upper surface of the rock ; but the shell is usually more or less exfoliated, and the striæ partially or wholly destroyed. The shell is translucent and usually of a light color, particularly in the light gray sandstone. It is so abundant that some layers at Medina are almost entirely composed of it, the laminæ of sand separating each layer of shells being scarcely a quarter of an inch thick.

In another situation near Lockport, this species occurs scattered over large surfaces of the sandstone layers, still remaining in the position they were deposited by the advancing and retiring waves upon the beach. In this position they are scattered over wide surfaces, and on successive layers often scarce half an inch in thickness. The surfaces of these layers are marked by wave lines, indicating the limit of the advancing waves.

Fig. 2 *a.* A specimen of large size, nearly destitute of a shell.

Fig. 2 *b.* A small fragment of sandstone, showing upon its surface three individuals of different size.

Fig. 2 *c.* A small individual, preserving the shell nearly entire. The two last are associated with a small species of Cytherina, fig. 8.

Fig. 2 *e.* A small fragment from a slab of sandstone, where the Lingulæ have been drifted by the waves. From the beak of each one extends a small ridge of stone which accumulated here, protected by the shell during the receding of the wave*.

* For a full description of the phenomena connected with these shells, wave-lines, etc., see Report on the Geology of the Fourth District, 1843, p. 52 et seq.

Position and locality. This species is very abundant at Medina, Orleans county. It is found at Lockport, a little to the north of the village; and again two miles farther to the north, in the extensive sandstone quarries of that town. I have found imperfect specimens at Rochester, and thin laminæ in the sandstone are often made up of the comminuted fragments of these shells. It is likewise of rare occurrence on the Niagara river, and at other localities along the south shore of Lake Ontario. (*State Collection.*)

This shell, together with the *Arthrophycus harlani*, are unerring characteristics of the Medina sandstone.

389. 22. ATRYPA OBLATA (*n. sp.*)

Pl. IV. Figs. 4 a, b, c, and 5.

Shell oblate, nearly as broad as high, broader at the upper part and sloping abruptly to the beak, which is small, neat, and well defined; valves nearly equally convex, the larger one with a distinct groove down the centre; the smaller valve presents a corresponding elevation, with a slight groove on each side; surface marked by fine concentric lines.

This species is of a type distinct from any in the Lower Silurian, and one eminently characteristic of the Middle and Upper Silurian period: it is, therefore, of much interest, as occurring at the very base of the upper division. There are several similar species in the Clinton and Niagara groups, and in the Delthyris shaly limestone; but this species is unknown in either of these positions, though in form closely allied to some of them. Its distinguishing feature is in the narrow longitudinal groove in the larger valve, which reaches nearly to the beak, and is of nearly equal width throughout; the corresponding elevation being narrow, and unlike the broad mesial elevations and depressions of many species of this genus in a higher position. (The specimen figured is a cast.)

Fig. 4 *a*. View of the ventral valve.

Fig. 4 *b*. View of base.

Fig. 4 *c*. Profile view.

Fig. 5. The dorsal or larger valve imbedded in sandstone, which covers the lower part of the shell. It is impossible to say positively that this is identical with the preceding; but the partially imbedded specimen affords no positive characters to distinguish it.

Position and locality. This species occurs in the upper gray portion of the formation at Lockport; and I am indebted to Col. Jewett, of that place, for the specimen figured.

390. 23. ATRYPA PLICATA (*n. sp.*)

PL. IV. Fig. 6.

Smaller valve suborbicular, wider than long; surface marked by 12 sharp plications, without any perceptible mesial elevation; plications marked, in the shell, by fine concentric lines; beak small, incurved.

The specimen is the cast of a single smaller valve, but it presents characters unlike any of the preceding species. In its form and plications it resembles the *A. increbescens*, but differs in having no mesial elevation, and the form of the cast at the beak (which is not well represented in the figure) differs essentially from that shell.

Position and locality. This shell occurs with the following species, in the higher red portions of the rock at Lockport. (*Collection of* Col. JEWETT.)

391. 17. MODIOLOPSIS ORTHONOTA.

PL. IV. A. Figs. 1 a, b, c.

Unio orthonotus. CONRAD, Annual Report of 1839, p. 66.
Cypricardia orthonota. HALL, Geol. Report 4th Dist. New-York, 1843, pag. 48, figs. 8 & 9.

Subelliptical or rhomboidal, obliquely truncated before; hinge-line straight; posterior extremity rounded or obliquely truncated; sides nearly parallel; umbones elevated, thin, sharp, with a defined ridge extending to the posterior basal margin; anterior to the ridge is a flattened space widening from the umbones towards the base, anterior to which the shell is a little more ventricose; muscular impression at the anterior extremity distinct, no other visible; surface marked by fine concentric lines.

The specimens of this species are usually casts, preserving some faint concentric lines, the markings of the shell. There is little difficulty in identifying this species by its general form. The characters are not always so clearly defined as in the larger specimen figured; but in all the variety of smaller forms, there is not a sufficient departure from those figured as to mislead. Some of the smaller specimens bear a close resemblance to *M. faba* (*Palæontology*, Vol. i. pag. 158, pl. xxxv. fig. 6 *a*, *b*, *c*); but the hinge-line is much more straight, and the posterior extremity usually less rounded; and the sinus, which is so conspicuous in *M. faba*, is only represented by a flattened or slightly depressed space.

This species is quite abundant in some of the higher layers of the rock.

Fig. 1 *a*. Right valve of a small specimen, with the posterior extremity rounded and the anterior one extended.
Fig. 1 *b*. Right valve of a larger specimen, having the anterior extremity less prolonged.
Fig. 1 *c*. View of the hinge-line and cardinal area of the last.

Position and locality. This shell is usually found about fifty or sixty feet below the top of the sandstone at Medina, and in the higher part of the rock at Lockport. (*State Collection.*)

392. 18. MODIOLOPSIS? PRIMIGENIUS.

Unio primigenius. CONRAD, Annual Report 1838, p. 113; 1839, p. 66.
Cypricardia alata. HALL, Geological Report 4th District, pag. 48, fig. 3.

Subrhomboidal, rounded anteriorly, expanded and alate posteriorly; hinge-line straight, longer than the length of the shell; anterior extremity short; ventral margin rounded; surface marked by strong concentric imbricating lines, which are crossed by fine radiating striæ on the posterior half of the shell.

The casts of this shell usually preserve only some remains of the concentric lines, and these are sometimes obliterated. In the casts the hinge-line is shorter than the length of the shell, and presents on the anterior slope a fold with a depression on either side, like the impressions produced by the teeth of the shell. In addition to this, there is a single fold running nearly the whole length of the hinge-line, exhibiting in the left valve a well marked depression. The surface markings present various degrees of perfection; and the differences between the entire cast and the specimens in different conditions is so great, as to induce a belief that more than one species exists; still I have been unable to distinguish characters in the specimens I have, which warrant a separation.

Fig. 2 *a.* A small specimen, with the beak very prominent, and almost vertically truncated at the posterior extremity.
Fig. 2 *b.* A cast having the markings almost entirely obliterated, and showing a fold or depression along the hinge-line.
Fig. 2 *c.* A specimen partially preserving the shell, which is alated on the posterior dorsal margin, and slightly acute in front.
Fig. 2 *d.* A fragment preserving an impression of the shell, showing the concentric and radiating lines.
Fig. 2 *e.* A portion of the same enlarged.

Position and locality. This species occurs at Medina, in a thin stratum charged with univalves, about sixty feet from the surface of the rock. It occurs likewise at Lockport, in the same position, or at a less distance below the surface. (*State Collection.*)

*** I am unable to determine the true relations of this shell. It is allied to *Modiolopsis*, but its absolute generic relations may be somewhat different.

393. 19. PLEUROTOMARIA? PERVETUSTA.

PL. IV. (bis). Figs. 3 a, b, c, d.

Cyclostoma pervetusta. CONRAD, Annual Report 1838, p. 113; 1839, p. 65.
Pleurotomaria pervetusta. HALL, Geol. Report 4th District, 1843, pag. 48, figs. 1 & 2.

Shell suborbicular or depressed-conical; volutions about four, gradually enlarging; umbilicus large, extending to the apex; surface of the cast smooth.

This little shell is found in immense numbers, as if it had been drifted together by waves or currents; but I have never been able to find one in which the markings of the surface are preserved. It is either in the condition of casts in the weathered portion of the rock, or in the solid portions having the shell crystalline, so that all surface characters are obliterated. Under these circumstances, I have referred it to the Genus PLEUROTOMARIA. In its character and habits it is much like LITTORINA, but it is associated in great numbers with the *Lingula cuneata*. Its almost uniform size is that of the specimens figured, and many thousands often occur in the space of a few feet.

Fig. 3 *a*. Profile view of a specimen.
Fig. 3 *b*. View of the base.
Fig. 3 *c*. View of the apex.
Fig. 3 *d*. A fragment of the sandstone containing numerous individuals of this species, with *Bucania trilobata*.

Position and locality, This species is exceedingly abundant at Medina, constituting by itself, and with the *Lingula cuneata*, some thin beds about sixty feet below the surface of the rock. It occurs more rarely at Lockport. (*State Collection.*)

394. 20. PLEUROTOMARIA LITOREA (*n. sp.*).

PL. IV. (bis). Fig. 4 a, b.

Subconical volutions about 3 or 4, somewhat obtusely angular, rapidly enlarging; umbilicus small; surface markings unknown.

Two specimens, both casts, of this species have been found. It differs from the last in its greater size and more rapidly ascending spire. The umbilicus is also much smaller, and it will not readily be confounded with that species. The specimen figured seems somewhat depressed from pressure, and its height is less than another specimen.

Fig. 4 *a*. Profile view of specimen. Fig. 4 *b*. View of the apex.

Position and locality. This species occurs at Lockport, in the upper part of the rock. I am indebted to Col. JEWETT for the specimen figured.

395. 15. MURCHISONIA? CONOIDEA (*n. sp.*).

Pl. IV. Fig. 7.

Shell extremely conical; volutions about four or five, flattened, showing (in the cast) a slight elevation a little below the middle; character of the surface unknown.

The individual figured is the only one of the species known. It differs from the species of this genus in the lower rocks, and, in its flattened volutions, approaches some of the forms in a higher position.

Position and locality. This species occurs in the upper gray portions of the sandstone at Lockport. (*Collection of* Col. Jewett.)

396. 7. BUCANIA TRILOBATUS.

Pl. IV (bis). Fig. 5 a, b, and part of 3 d.

Planorbis trilobatus. Conrad, Annual Report 1838. p. 113; 1839, p. 65.
Bellerophon trilobatus. Hall, Report of the 4th Geol. District, 1843, pag. 48, figs. 6 & 7.
Not *B. trilobatus*, Murchison, Silurian System pag. 604, pl. 3, fig. 16.

Shell suborbicular, convoluted, three-lobed; volutions all visible, the last one greatly expanded; aperture much wider than long.

This shell bears a close resemblance to *Bellerophon trilobatus* of Murchison; but the difference of geological position is very great, and our shell is usually less expanded at the aperture than the figure of Murchison. The middle lobe is broader than the lateral ones, but the apparent proportions are often changed by distortion of the shell from pressure. No perfect specimens have been seen.

Fig. 5 *a.* Side view of a specimen. Fig. 5 *b.* Dorsal view of the same.
Fig. 3 *d.* The upper figure in this specimen, and the lower lefthand figure, are of this species.

Position and locality. It is associated with *Pleurotomaria pervetusta* in the sandstone at Medina. It occurs likewise in the Clinton group (See Plate 28, fig. 9). (*State Collection.*)

397. 2. ONCOCERAS GIBBOSUM (*n. sp.*).

Pl. IV (bis). Fig. 6 a, b, c.

Fragment subcylindrical or fusiform, slightly curved; section broadly elliptical, the largest diameter of the specimen being at the commencement of the septa; outer chamber gradually diminishing towards the aperture, slightly curving, and gradually contracting from the same point towards the apex; siphuncle dorsal; septa distant about one-eighth the diameter.

This specimen has all the general characters of the Oncoceras of the Trenton limestone, though it is an entirely distinct species. It diminishes much less abruptly in either direction from the last or outer septum, and is otherwise dissimilar. The outer chamber appears to be nearly entire, and has a depth of scarcely three-fourths of an inch. From pressure, the siphuncle appears less perfectly dorsal in the figure than is really true, but this is due to accident.

Fig. 6 *a*. Ventral view of the specimen. Fig. 6 *b*. Lateral view. Fig. 6 *c*. Section of same.

Position and locality. The specimen was found at Lockport, near the upper part of the sandstone.

398. 26. ORTHOCERAS —— (*n. sp.*).

Pl. IV (bis). Fig. 7 a, b.

Subcylindrical, straight; section elliptical; siphuncle subdorsal; septa closely arranged and highly arched.

This species is known only in a single fragment, but it is clearly distinct from any heretofore described. The septa are distant about one-eighth the narrowest diameter of the shell.

Fig. 7 *a*. Lateral view of the fragment. Fig. 7 *b*. Section showing position of siphuncle.

Position and locality. In the upper fossiliferous portions of the rock at Lockport.
(Collection of Col. Jewett.)

399. 27. ORTHOCERAS MULTISEPTUM (*n. sp.*).

Pl. IV (bis). Fig. 8 a, b.

Cylindrical, gradually tapering; septa distant one-sixth to one-seventh the diameter.

The septa are slightly more distant than in the preceding species. I have not been able to ascertain the position of the siphuncle, or convexity of the septa. It is possible that this and the preceding are the same species, and the oval form in that one may be due to pressure.

Fig. 8 *a*. A fragment of a small specimen, showing a part of the outer chamber.
Fig. 8 *b*. A fragment of a larger specimen, showing the commencement of the outer chamber, with a narrow one at the termination of the others.

Position and locality. In the upper fossiliferous part of the rock at Lockport, and associated with *Pleurotomaria* at Medina. (*State Collection.*)

These cephalopods are extremely rare, and few specimens have ever been found.

400. 2. CYTHERINA CYLINDRICA (*n. sp.*).

Pl. IV. Fig. 8 a, b.

Elliptical, elongated, very convex.

This species being preserved in sandstone, presents no characters beyond its general form. It is readily identified by its oval rather elongated form and great convexity, which, when both valves are joined, would give an almost cylindrical form to the shell.

Position and locality. Associated with *Lingulæ* and other fossils at Medina, Orleans county.

CLINTON GROUP.

This group presents a very variable assemblage of organic remains; resulting, as before stated, from the varying conditions under which the strata were deposited, and from the sudden transitions in the nature of the sedimentary deposits of which it is composed. The totality of its organic contents in its eastern and central portions, when compared with those of its western extension, offer but little similarity. Marine plants are the predominating fossils of its eastern and central exposures, while scarcely more than a single species of these extends westward beyond the eastern part of Wayne county. The Brachiopoda, so characteristic of its western extension, are rare to the east of Wayne county. The *Pentamerus oblongus* associated with the iron ore beds is almost the only fossil which continues constant from its eastern development as far as the western part of Monroe county. These ore beds which are so distinguishing a feature of the group in its eastern localities, form one of its characteristic features as far west as the Genesee river.

The following sections show the order of succession, and the nature of the materials of which the group is composed, at different localities, from its more easterly exposures, to the Niagara river :

The most easterly section I have been able to observe, is one in the town of Canajoharie, Montgomery county; though the succession is there very obscure, and the whole thickness less than fifty feet.

1. Drab-colored layers of Onondaga-salt group.
2. A red coarse sandstone (forming a terrace) with pebbles, and containing much iron ore. } CLINTON GROUP.
3. A space occupied by shales. }
4. Greyish sandstone, conglomeritic below, and darker colored and laminated above. }
5. Oneida conglomerate.
6. Shales of Hudson-river group.

At Vanhornsville in the town of Stark, Herkimer county, the following section is exposed, though somewhat obscurely.

1. Onondaga-salt group.
2. Red, coarsely laminated, friable sandstone, containing much iron ore, but no distinct beds. } CLINTON GR.
3. Green shale with fossils. }
4. Red, diagonally laminated sandstone. }
5. Greyish sandstone and conglomerate, with thin layers of green shale. }
6. Oneida conglomerate.
7. Shales and sandstones of the Hudson-river group.

SECTION *above* WICKS'S STORE, *in the town of Stark, Montgomery county.*

1. Onondaga-salt group.
2. Quartzose sandstone & conglomerate, forming the terminating mass of the Clinton group. } CLINTON GR.
3. Thinbedded sandstone with fucoids, alternating with green shale. }
4. Red sandstone, diagonally laminated. }
5. White sandstone with pebbles, and green shale. }
6. Oneida conglomerate.
7. Shales of Hudson-river group.

SECTION *at* TISDALE'S MILL, *in the town of Warren, Herkimer county.*

1. Gray sandstone, forming the upper termination of the group : 60 feet thick.
2. Shale : thickness?
3. Sandstone, and shale with iron ore : 20 feet.
4. Green shale, with arenaceous matter, pebbles, etc. : 25 feet.
5. Coarse sandstone, with much shaly matter : 10 to 15 feet.
6. Green shale with fucoids.

The Oneida conglomerate and Hudson-river group were not observed at this locality.

The terminal mass of sandstone attains its maximum thickness of about 70 feet in the vicinity of Steele's creek, south of Mohawk village.

SECTION *of the strata of the Clinton group, about three miles south of Utica, in the town of New-Hartford.*

The section commences below the quartzose sandstone (which is not seen at this place), and consequently is between 60 and 100 feet below the top of the group, as nearly as can be ascertained.

1. Hard siliceous and silico-calcareous layers alternating with shale, the whole abounding in remains of marine vegetation : about 15 feet. These beds form the quarries of GAYLORD & NORTON.
2. A slope with no rock visible, probably shaly : about 20 feet.
3. Shales and shaly sandstones, with *Buthotrephis*, *Agnostis*, &c. and iron ore beds.
4. Upper portion shaly, and the lower part of thinbedded sandstones with wavelines and ripplemarks. The fossils are *Agnostis*, *Nucula*, aud some marine plants : about 15 feet.

   WADSWORTH'S quarries are in these layers.
5. A slope, probably over shaly layers of 20 or 30 feet, to Blackstone's quarries.
6. Alternating layers of shaly sandstone, sandstone and conglomerate with shale : about 25 to 30 feet.

   BLACKSTONE'S quarries are in these beds.
7. Oneida conglomerate.

*** The absolute contact of the upper beds with the Oneida conglomerate is not seen at this place.

It will be observed that in all these beds there is no evidence of the existence of the Medina sandstone, unless it be in the diagonally laminated red sandstone, and the grey sandstone with pebbles near the base of the group.

From the point last noticed, it is difficult to obtain good sections of the group till we go westward to Wayne county, where its characters are greatly changed, and where the Medina sandstone is in great force.

The greater part of the group is well developed on a small stream near the former Shaker settlement at Sodus bay, and, more perfectly, just above the lower falls of the Genesee. At this place the mass admits of the following subdivisions in the ascending order :

1. Green shale resting on the Grey band, destitute of fossils, very fissile and unctuous.
2. Oolitic iron ore with concretions, fragments of shells, corals, etc. A few thin layers of impure limestone or shaly sandstone sometimes intervene between the shale and iron ore.
3. Pentamerus limestone, a siliceous or calcareous mass with thin sandy layers, often having the character of shaly sandstone : it also contains bands of hornstone or chert, consisting mostly of silicified fragments of fossils. This part of the mass is distinctly marked by the presence of large numbers of the *Pentamerus oblongus*, sometimes crowded together, forming a band a foot or more in thickness, or distributed through the whole rock.
4. A green shale similar to that below, though of a less deep color. It also exhibits one or two bands of limestone, composed mostly of shells of *Atrypa hemispherica*, which preserves its beautiful pearly lustre. It contains graptolites ; and in some localities where these abound, the mass is black.

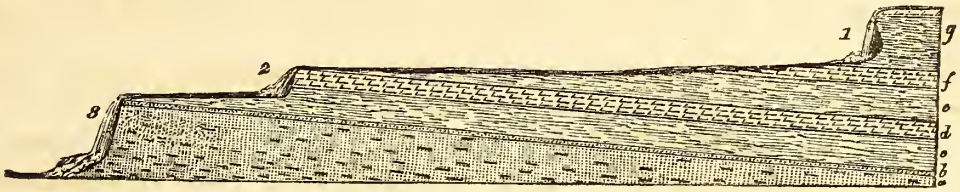
   In this relative situation in Wayne county, the second bed of iron ore occurs. The ore is more perfectly

oolitic than that below, and with fewer concretions, and usually has less carbonate of lime intermixed. It appears at Wolcott furnace, and is apparently the bed wrought six miles further east.

5. A limestone similar to the more calcareous portions of No. 3; and, at Rochester, containing few fossils except crinoidal joints : it is usually thinbedded, the layers separated by shale. It contains numerous cavities filled or partially filled with sulphate of lime, sulphate of baryta, iron pyrites, etc. From its situation as the separating mass, it partakes also of the character of the next succeeding group. The Niagara, however, being so well characterized, and the Clinton group an acknowledged variable one, it is thought better to place it with the latter.

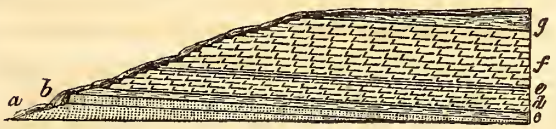
The same essential order in the parts of the group appertains to it in several localities in Wayne county, but west of the Genesee river two or more of its members are wanting. The shale and calcareous matter seem equally persistent, but both gradually diminish westward.

SECTION *on the Genesee river, from the upper to the lower fall at Rochester.*



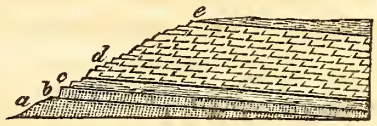
1, 2, 3. Upper, Middle, and Lower falls.
g. Shale of Niagara group.
f. Upper limestone of Clinton group.
e. Upper green shale.
d. Pentamerus limestone.
c. Lower green shale.
} CLINTON GROUP.
b. Grey band, upper part of Medina sandstone.
a. Medina sandstone.

1. SECTION *of the strata one mile south of Medina.*



g. Niagara shale.
f. Upper limestone of Clinton group.
e. Place of the upper green shale : no rock seen.
d. Pentamerus or lower limestone of Clinton group.
c. Lower green shale of Clinton group.
b. Terminal gray mass of the Medina sandstone.
a. Medina sandstone.

2. SECTION *showing the Clinton group and associated strata at Lewiston, on the Niagara river.*



e. Niagara shale.
d. Limestone, formed by the junction of the lower and upper limestones of the group.
c. Lower green shale of Clinton group.
b. Terminating gray portion of the Medina sandstone.
a. Medina sandstone.

*** **The three last preceding sections are taken from the Report for 1843, pp. 59, 78 & 79.**

FOSSIL PLANTS OF THE CLINTON GROUP.

It has been the practice to refer to vegetable origin all those fossil bodies of the older strata, which have, in their general aspect, their habit or mode of growth, some similarity to plants; and in which no organic structure can be detected, beyond, sometimes, the external markings. These have been regarded as belonging to marine vegetation like the Fuci of the modern ocean, and which from their nature could leave only impressions of their external form, or the outline of this form replaced by stony matter. In this mode of treating the subject, it is not improbable that some bodies wholly inorganic have been included under plants; while others, likewise included, may have been the polypidoms of some of the lower orders of zoophytes, such as *Alcyonidia*, sponges or the like, which, requiring a small amount of calcareous matter, may have lived in conditions where the calcareous zoophytes could not have existed. In the present state of our knowledge and means of determination, it is in fact impossible to decide to which of these classes some of these bodies belong. We are not yet fully aware of the nature and character of the fauna and flora of the period, nor of the impressions they were capable of leaving in the soft mud and sands forming the bed of the ocean in which they lived. In the mean time, to neglect them altogether would be manifestly wrong; since many of them are conspicuous, and already well known; and since it is only by attracting attention to the obscure and unknown, that we can hope to learn its true nature. I have accordingly given figures of such of these bodies as possessed peculiar characters, though not having positively determined whether they belong to plants or zoophytes, and some even perhaps of inorganic origin.

401. 6. BUTHOTREPHIS GRACILIS.

Pl. V. Fig. 1 *a, b, c, d.*

Fucoides gracilis. Report 4th Geol. Dist. New-York, 1843, pag. 69, fig.

Not *B. gracilis*, Pal. N. York, Vol. i, pag. 62, pl. 21, fig. 1. The species of the Clinton group will retain this name by precedence, and that of the Trenton limestone may be changed to *B. tenuis.*

Plant slender, branching; branches numerous, often crowded, irregularly diverging, sometimes with acute terminations; entire plant slender and fragile.

The specimens of this plant, which may be fragments only of a larger one, present a main or principal stipe, with numerous radiating and bifurcating branches which are often a second time branched. Scarcely any two specimens are alike, and it is difficult to fix upon characters which shall be decisive of specific distinction. This and the following species occur in the thin fine-grained layers of shaly sandstone spread out on the surface of the thin laminæ.

Fig. 1 *a.* A small delicate specimen of this species. The engraving represents the branches rather too slender and acute.

Fig. 1 *b.* An elongated stipe with numerous branches.

Fig. 1 *c.* A fragment with several branches which are again subdivided.

Fig. 1 *d.* A large individual having fewer branches in proportion to its size, than the preceding, and approximating in character to the succeeding forms.

Position and locality. In the central and lower part of the group at Blackstone's quarries in New-Hartford, Oneida county*. (*State Collection.*)

402. 7. BUTHOTREPHIS GRACILIS, *var.* INTERMEDIA.

Pl. V. Fig. 2 *a*, *b*.

Fucoides gracilis. Report of 4th Geol. District of New-York, 1843, p. 69.

Slender, flexible; branches diverging, often simple and much elongated, of the same width as the main stipe.

It is difficult to draw any line of distinction between this and the preceding or the following forms. Many specimens are slender and graceful, with few branches which often appear nodulose: other specimens are more rigid, and the branches numerous.

Fig. 2 *a*. A slender specimen with few branches.
Fig. 2 *b*. A more rigid specimen with numerous branches.

Position and locality. Same with the last.

403. 8. BUTHOTREPHIS GRACILIS, *var.* CRASSA.

Pl. V. Fig. 3 *a*, *b*, *c*.

Plant flexuous, branching; branches simple or bifurcating, more or less diverging from the central stipe, obtuse at the extremities, often nodulose.

In the absence of definite characters, we are compelled to unite the three varieties of form, which are most conspicuous, in one species.

There seems to be a regular gradation of character through 1 *c*, 1 *d*, 2 *a*, 2 *b*, to 3 *a* and 3 *b*, making it impossible to characterize distinct species. The smaller varieties are found in the thinly laminated sandy shales which alternate with the coarse irregular layers of sandstone and conglomerate: the coarse varieties occur generally in other beds of sandstone, less thinly laminated, but composed of fine siliceous mud. This species is extremely abundant in the shaly sandstones from Oneida county to the Genesee river, though it varies in form so much that scarcely two specimens are precisely alike.

In its general characters, this species resembles the *B. subnodosa* of the Hudson-river group; but it is usually more delicate in form, and, in its mode of branching, differs from that one, which is always somewhat nodulose.

Fig. 3 *a*, *b*, *c*, are common forms of this species in its stronger and coarser varieties.
Fig. 3 *d*. A large specimen, with the branches extremely diverging and mostly simple.
(*State Collection.*)

* This fossil reappears again in a western direction, far beyond the limits of New-York; but the lithological character of the group has there entirely changed.

404. 9. BUTHOTREPHIS GRACILIS?

PL. V (bis). Fig. 1.

This is a specimen in sandstone, where the material of the fossil has been removed, leaving an impression in the stone.

405. 10. BUTHOTREPHIS PALMATA (*n. sp.*).

PL. VI. Fig. 1.— PL. VII. Fig. 1 *a*, *b*.

Stipe strong, thick, rounded, branching in a more or less palmate or digitate form; branches round, thick and strong, terminating abruptly.

This plant presents a strong rounded stem, sometimes with several branches, often with two or three only; the branches are usually little divergent. Sometimes the branching takes place altogether from near one point, while in others there is a succession of bifurcations at different distances from the base. Detached branches are frequently found, having the character of simple round stems, which are not especially interesting.

This species is less abundant than several of the others, and but few specimens have been seen as perfect as those figured.

In its thick and strong stems and branches, this fossil more resembles a zoophyte than a true marine plant; and it is not improbable that this, among other species, will prove such, belonging to the Alcyonidia or to the Sponges. The almost entire absence of calcareous matter has precluded the existence of the calcareous skeletons of the ordinary corals in all the deposits of this group in its eastern extension.

PLATE VI.

Fig. 1. A specimen showing numerous branches diverging from nearly the same point.

PLATE VII.

Fig. 1 *a*. A specimen where the branches separate at different distances from the base.

Fig. 1 *b*. Another specimen, apparently of the same species, showing successive branches from a single stem. This is a very unusual form, though I am not able to find characters to separate it from the preceding one.

The rugose surface represented in the engraving is due to weathering, and is not a character of the species. (*State Collection.*)

406. 11. BUTHOTREPHIS IMPUDICA (*n. sp.*).

PL. VI. Fig. 2.

Stems smooth, strong, round, of nearly uniform size, terminated above by a kind of spongiform stigma or swelling, which expands at its base beyond the diameter of the stem.

This is a rare species, not more than three or four individuals having been seen. It is associated with the preceding species in the shaly sandstones. The specimens are probably the branches of a ramose stem.

Position and locality. Blackstone's and Wadsworth's quarries, New-Hartford, below the lower ore bed. (*State Collection.*)

407. 12. BUTHOTREPHIS RAMOSA (*n. sp.*).

PL. VI. Fig. 3.

Stem rigid, divaricately branching, branches numerous, opposite or alternate; root or terminations unknown.

This species is clearly distinct from any other one, in its rigid form; and numerous branches which are not flexuous.

Position and locality. In the shaly sandstone of Blackstone's quarries, New-Hartford, Oneida county. (*State Collection.*)

Roots of Buthotrephis?

PL. VII. Fig. 2 *a, b, c.*

Specimens such as are here represented in the figures, are frequently found upon the surface, and penetrating the strata. In the figures 2 *a* and 2 *b*, there has been clearly a round stem broken off in removing the superincumbent layer, for there is a fresh fracture in the centre. From this stem radiate something resembling rootlets, which form a compact mass, and penetrate the stratum in which it lies imbedded. The surface of this stratum has evidently, for a considerable time, remained the undisturbed bed of the sea; for over its surface, sometimes for many yards, are spread fragments of several species of marine plants, around which have accumulated thin laminæ of extremely comminuted materials like the last sediment of turbid waters. Upon such a surface these marine plants affixed themselves, growing upwards to a greater or less height. At the time of the deposition of the succeeding bed, many of them are thrown down, and it is those only which give us the form of the plant. Those which remain upright during the next deposition of mud, penetrate the now stony bed, and we are able to see only the transverse sections of the stems.

The figures 2 *a*, *b*, represent the common appearances of these roots upon the lower surface of the stone.

Fig. 2 *c* is a specimen where the successive layers of a subsequent deposition gathered around the stem. It is represented in its vertical position; the lower part being the root which was fixed in the lower bed, and above this the edges of the successive layers are clearly seen: penetrating the centre of these from the base to the top, is the stem as represented in 2 *b*.

PL. X. Figs. 9 *a, b,* and 10.

Fig. 9 *a*. The lower part of this figure presents precisely the same appearances as the lower part of fig. 2 *c*, pl. 7. The upper part presents a thin layer of rock with a depression upon the upper side, in the centre of which appears the stem of one of these plants broken off. The form of the cavity and the size of the stem are shown in fig. 9 *b*. The sides of this cavity present shallow grooves or depressions, extending down to the point where the stem is broken off. These depressions appear very much as if made by the stem of the plant as it swayed from side

to side by the action of waves or currents. We may see similar depressions around the roots of marine plants growing in the mud, where blown by the wind when the tide is out; with this difference only, that in these cases the stem does not leave distinct impressions of its pressure upon the sides, but simply a smooth or irregular funnel-shaped depression.

Fig. 10 is a cast from an impression similar to 9 *a*, *b*.

408. 7. PALÆOPHYCUS? STRIATUS (*n. sp.*).

Pl. X. Fig. 1 *a, b, c, d.*

Stems simple, cylindrical, flexuous, striated longitudinally, terminated above by a swelling or expansion of the stem; plant affixed at base by numerous small rootlets.

This species is readily distinguished by its striated stem, which is also more slender and flexible than most of the smooth species. It is of rare occurrence in all the exposures of this group which I have examined, and no entire specimens have been found. The stem is evidently simple, since both the lower and upper portions, as well as the intermediate parts which have been found, show no evidence of branches.

Fig. 1 *a*. A fragment of a stem having the striated surface well preserved, with a more elevated line along the centre of the portion exposed.

Fig. 1 *b*. A fragment from near the base, with the rootlets preserved.

Fig. 1 *c*. A similar fragment, giving indications that the stem was hollow.

Fig. 1 *d*. A fragment of a small specimen, showing the upper termination.

Fig. 2 is perhaps the expanded termination of one of these stems, which has been much flattened: it is represented of the natural size.

Position and locality. In the central or lower part of the group, in thin shaly sandstone, near Clinton village, Oneida county. (*State Collection.*)

409. 8. PALÆOPHYCUS ——?

Pl. 10. Fig. 3.

This specimen presents a stem divided below, which may be due to accident, and above it is separated into three branches.

Position and locality. Case's quarry near New-Hartford, Oneida county.

410. 9. PALÆOPHYCUS ——?

Pl. VIII. Fig. 3.

This is a fragment of a soft flexuous species, presenting few characteristic features. It is much compressed, and evidently hollow.

Position and locality. Blackstone's quarry.

Genus RUSOPHYCUS.

[Gr. ρυσσος, or ρυσος, *rugose;* and φυκος, *fucus*, a sea-plant.]

Character. Plant consisting of simple or branched stems, which are transversely rugose or wrinkled.

The genus includes also the bilobate forms which are not much elongated, and which may be attached by stems or pedicels of different character (ex. *R. bilobatus*). It differs from Arthrophycus, in being irregularly wrinkled transversely, while that is distinctly annulated.

411. 1. RUSOPHYCUS CLAVATUS (*n. sp.*).

Pl. VIII. Fig. 1 *a*, *b*.

Plant short; stems thick, subangular, enlarging from the root upwards; surface transversely ridged, or rugose with one or more longitudinal grooves on one side.

This species has, in some degree, the characteristic marks of Arthrophycus in its transverse rugæ or articulations, but is short, thick, and scarcely flexuous. Sometimes apparently two stems grow from a single root. Specimens of this form never attain a length of more than three or four inches.

Fig. 1 *a*. A specimen with two stems, apparently proceeding from a single root.
Fig. 1 *b*. A smaller single specimen.

Position and locality. Blackstone's quarry, New-Hartford, Oneida county.

412. 2. RUSOPHYCUS SUBANGULATUS (*n. sp.*).

Pl. VIII. Fig. 2 *a*, *b*.

Stems subquadrangular, elongated, simple, transversely rugose, longitudinally grooved on one side.

Fragments of this species are abundant in the shaly layers of the central part of the group: they are all characterized by having a subquadrangular stem with a longitudinal groove, which, in some specimens, gives them a bilobate appearance. It differs from the last principally in the stem being of equal dimensions throughout, and usually more elongated.

Fig. 2 *a*. A specimen of large size, and greater than the ordinary length.
Fig. 2 *b*. Two fragments of smaller size.

Position and locality. Blackstone's quarry.

413. 3. RUSOPHYCUS PUDICUS (*n. sp.*).

PL. VIII. Fig. 6 *a*, *b*.

General form elliptical, transversely rugose or nearly smooth; a deep longitudinal groove along the centre reaching nearly to each extremity.

This species is evidently closely allied to the preceding ones in its generic characters, though it presents no elongated stem. The smaller and younger specimen is nearly smooth, while the larger is distinctly rugose. There appears to be a regular gradation from *P. clavatus*, through the present species, into the succeeding one, which is very strongly characterized.

Position and locality. Blackstone's quarries.

414. 4. RUSOPHYCUS BILOBATUS.

PL. IX. Fig. 1 *a*, *b*, *c*.

Fucoides bilobata. VANUXEM, Geol. Report, 1842, pag. 79, fig. 1.

Distinctly bilobate, with the lobes often separating at one extremity; form broadly oval or subquadrangular, very rugose transversely, with a deep longitudinal groove running the entire length.

This species is readily recognized by its distinctly bilobate form, appearing as if composed of two separate bodies joined along a central line. It is always strongly and irregularly wrinkled transversely; the two extremities being depressed, while the centre is elevated. In several specimens, there arises from between the two lobes a round slender stem, which extends to the length of several inches. It is impossible to say whether this stem is supported by the portion described, which is the root; or whether the stem originally supported the larger bilobate portion as a floating appendage. In most cases very little evidence of the existence of this stem is preserved; while in others, it appears to have been an actual portion of the plant.

This species is always found on the under side of the strata, attached on one side only; so that the side presented in the view is the lower side in its position in the stratum. They are extremely abundant in some thin layers, but appear to have existed, like most of the other species, only during a limited interval, and never to have extended through any considerable thickness of the strata. The preceding species, which are allied to this one, are found in a lower position, and never associated in the same strata with it.

Fig. 1 *a*. A well marked specimen with a stipe attached.
Fig. 1 *b*. A flattened specimen, showing the point where a stem was broken off.
Fig. 1 *c*. A large and well preserved specimen, showing no marks for the attachment of a stem.

Position and locality. Gaylord and Norton's quarry near New-Hartford, Oneida county, about one hundred feet above Blackstone's quarries, which is the position of the two preceding species. (*State Collection.*)

PLATE IX. Fig. 2.

Large surfaces covered with what appear to be fragments of stems of some marine plant, are common in the same position with the species last described. They appear like fragments of plants that have been broken by the action of winds and waves, and then floated in an even layer upon the surface of the water, and thus deposited. These fragments are sometimes very uniform in size, but generally they are composed of those of various size and length. Slabs of the stone, often two or three feet in diameter, are covered as uniformly as the fragment in the engraving.

Position and locality. Gaylord and Norton's quarry near New-Hartford, Oneida county. (*State Collection.*)

ROOTS OF DIFFERENT SPECIES OF MARINE PLANTS, &c.

PL. X. Fig. 4, 5, 6 & 8.

Fig. 4 is a rootlike expansion similar to figs. 9 *a*, *b*, & 10, which are referred to *Buthotrephis palmata*. This specimen, however, differs in some particulars, and it was found in a situation where *B. palmata* has not been seen.

Position and locality. Ruddock's quarry near Clinton village.

Fig. 5 presents two specimens, evidently roots of some species not yet distinguished.

Fig. 8 has the root with a small portion of the stem attached, but in such a condition as to present no reliable characters.

Locality same as the last.

Fig. 6. Two fragments upon the surface of a stone, which appear like stems of some marine plant with abrupt swellings at the extremities, although they have a nearer resemblance to bones with large apophyses at their extremities. These, however, have nothing bone-like in their structure, and are probably concretionary, either originally, or of matter around some organic body.

Position and locality. Blackstone's quarry.

PL. VIII. Figs. 4 *a*, *b*, & 5.

These specimens are fragments evidently of the roots of some marine plants, but their connection with stems has not been traced.

Position and locality. Blackstone's quarry.

ICHNOPHYCUS.

Among the numerous curious impressions and remains of plants and other bodies in the shaly sandstones of this group, these are interesting from their similarity in form to the ORNITHICNITES of the New Red Sandstone; but since we have no evidence of the existence of such animals at this period, I have proposed a name significant of their form, and more for the purpose of attracting attention to the fact of their occurrence, than for the purpose of deciding their true relations, which cannot be done with the meagre materials we possess.

415. 1. ICHNOPHYCUS TRIDACTYLUS (*n. sp.*).

PL. X. Fig. 7 *a*, *b*.

Impressions tridactyle, apparently in series one before the other; substance of the fossil resembling that of other species of marine plants.

The only specimens seen are those represented on Plate X, fig. 7 *a*, *b*. The specimen 7 *a* represents the surface of a slab, with two tridactyle impressions arranged as in the figure. The impressions are indented, and the laminæ depressed around them: the extremities are pointed, the central one being longest. They resemble very closely the tracks of birds in the sandstone of the Connecticut valley, but we have no evidence of the existence of birds at the period of the Clinton group.

The specimen 7 *b* is in relief upon the under surface of a slab of shaly sandstone, and appears like a substance itself rather than a cast of an impression of this form.

It will be observed that both the impressions on 7 *a*, and the one in relief 7 *b*, present an emargination behind, in which they differ from most of the ORNITHICNITES of the Connecticut river valley.

Whatever these curious impressions may be proved to be, they are subjects of interest; and further investigation may throw light upon them, to enable us to decide their true relations.

Position and locality. Blackstone's quarries, associated with numerous species of marine plants.

TRACKS OF GASTEROPODA, CRUSTACEA, OR OTHER MARINE ANIMALS.

Among the evidences of the existence of organic beings, and of the condition of the ocean bed during the deposition of the strata composing this group, may be mentioned the occurrence of the tracks of various animals, some of which, as they passed over or just beneath the surface of the sand, have left a continuous furrow or trail, while others present the character of distinct and separate footprints. These trails, though not organic in themselves, are nevertheless so interesting that I present them in connexion with the other evidences of organic life at this period. From the character of the surfaces of the arenaceous beds in which they occur, I am inclined to the belief that many of them were made while the bed was exposed above water, and most

of the others in very shallow water. In many instances, the marks of what appear to be *wave-lines* are still preserved upon the surface of the layers. These markings have been regarded as evidences of a line of beach at the period of the Medina sandstone, and the strata under consideration follow in immediate succession to that period : they are, moreover, associated with pebbly beds which were probably littoral.

Some of these continuous tracks or trails I have been disposed to refer to the gasteropodous mollusca ; but on comparison with such trails made upon recent beaches, they do not all appear to have had such an origin, and there are likewise other animals which produce somewhat similar tracks. Many of these markings resemble, in their tortuous direction, and in the manner of crossing and recrossing the same line, the trails produced by the little *Idotea* upon the beaches of our present coasts. Some of them, however, must have been made by animals of different character. It is perhaps impossible to ascertain satisfactorily, at the present time, the origin of all these singular and interesting markings ; but by calling attention to their existence in these ancient strata, we may perhaps be able to find analogous markings upon our recent beaches.

It should be noticed that all these markings are preserved in the arenaceous beds ; and though they may have originally existed in the softer shaly beds, they would not now be visible. That they have been sometimes made in the shaly layers, we have good evidence in the casts that are often preserved on the lower side of the harder layers. The tracks or trails in question are always seen upon the upper surface of the layers, and are not to be confounded with those curious and variable markings so often found in relief upon the under sides of the harder layers, where they rest upon shale.

These markings occur in greater or less number and perfection throughout the entire extent of the group, so far as I have been able to make examinations, but they are more perfect and abundant in Herkimer and Oneida counties. The three characteristic varieties figured in the plates have been found in a single locality. The condition of the strata is very variable, and frequent alternations of shaly and arenaceous deposits are the characteristic features of this part of the group. The mass here consists in its lower part of a coarse conglomerate with green shaly matter intermixed, together with a bed of iron ore : still higher is a thick mass of shale, and above this commence alternations of shale and thinbedded sandstones. It is in the latter that the trails are most abundant and best preserved.

PLATE XI. Figs. 1 *a b*, 2 *a b*, 3 & 4.

Fig. 1 *a*, is a continuous trail, made by a single individual moving along a slightly elevated ridge upon the surface of the sandstone. The trail continues along this ridge, often descending slightly from the higher part, but always returning again, and recrossing itself many times in succession. Beyond that portion of the stone figured, the trail leaves the ridge, crosses a slight depression, which must have been more moist, or where water was still standing (as the trail is very faintly perceptible), and again ascends to another elevated portion of the slab, where it continues meandering about over a considerable space.

The trail consists of a slightly elevated ridge in the centre, with a depression on each side which limits it. This may have been produced either by the moving body having two depressed edges, with an arch between; or it may have been made by some small object crawling beneath the sand, elevating it in the centre, and thus causing a continuous depression on each side. This trail, although presenting a general resemblance to that of *Idotea*, is nevertheless distinct, so far as I have been able to observe the trails of that crustacean.

Not only this, but numerous others of these tracks prove that the present inequalities of the surface of the layers existed at the time the tracks were made. In more than one instance the track is nearly obliterated in the depression, while, on the more elevated parts, it is perfectly preserved.

Fig. 1 *b* is a similar trail, but smaller than the last. The small fragment figured is only a portion of the surface of a large slab, which is similarly marked. In some instances the crossings and recrossings upon the same trail, in a small space and apparently by the same individual, are so numerous that it seems natural to suppose that the animal moved rapidly.

The *Idotea* before alluded to moves with considerable rapidity; but the mollusca move slowly, and it is not probable, therefore, that this trail is due to a gasteropod. The trails of *Melania*, made on muddy and sandy bottoms beneath shallow water, are more similar in their meandering direction and recrossings than the trails of *Natica*, which are usually of no great extent. The *Melania*, on the contrary, often leaves a trail of several feet long, winding about in this manner; but the trail in this case is a simple depression margined by a slight ridge, produced by the animal pushing away the material from before it, and piling it up on each side. The tracks of *Littorina* on a sandy beach resemble these in some degree; but they are usually more direct, and show fewer recrossings in the same space.

Figs. 2 *a* and 2 *b*. These are evidently trails of different character, presenting a simple depressed channel without elevation along the centre as in the preceding forms; and though exhibiting different features from the ordinary wave-lines, are perhaps due to inorganic causes.

Fig. 3 is a trail formed after the same manner as the preceding, in figures 1 *a* and 1 *b*, but larger and stronger in its character. The continuation of the same trail occupies twice as much space as represented in the figure. There is a slight imperfection in the centre of the specimen, which has rendered the figure a little obscure: the whole is, however, a part of the same trail, which is continous in its windings throughout.

Position and locality. This and the preceding specimens were found in Herkimer county, in the ravine below Tisdale's sawmill.

Fig. 4 is a large and very perfect specimen of this kind of track. It has essentially the same characters as the preceding; but being so much stronger, and the depressions deeper, the effects of the weight of the animal are quite distinct. The central ridge, with a depression on each side, are not only very clearly preserved; but on the outside of this, and beyond the depressed line, the sand is piled up in a narrow ridge, as if in the progress of the animal the loose material had been thrown out on either side. This is one of the most perfect specimens, and offers conclusive

evidence of the nature of these markings. The stratum on which it is made is a level sandy surface, with a slight coating and intermixture of shaly matter.

Position and locality. Quarries near New-Hartford.

PLATE XII. Figs. 1, 2, 3, 4.

Fig. 2. A specimen similar to fig. 4 upon the preceding plate, but the trail is stronger and deeper, and the ridges of sand thrown up on the sides much higher than in any other one. The windings of the trail are much more extensive than either of the others, and correspond in this respect to the size of the animal. Both in this and the preceding specimen, there is a slight bending of the older or first made track visible where it is crossed by the newer track, showing that the progress of the animal across a previous track produced a motion in the wet sand beyond the extension of its body. These appearances are not so clearly represented in the figures as they appear in the stone.

Position and locality. Blackstone's quarries, New-Hartford.

Fig. 3 is a small portion from a specimen covered with trails of this character, where the margin of the track is marked by coarser particles of sand which have evidently been pushed out laterally during the progress of the animal. This is, to some extent, visible in the other large tracks, and depends in part on the consistence of the material. Many of these tracks are partially filled up by the moist sand and mud which flowed back into the trail after the passage of the animal. This will be readily understood by any one who has witnessed the action going on in a wet sea beach or elsewhere, where wet sand is disturbed and afterwards left at rest.

In the same specimen, at the right of the principal track, are some remains of very minute tracks which are found meandering among the coarser ones.

Position and locality. Quarries near New-Hartford, Oneida county.

The tracks thus far noticed appear to belong to a single class of animals, and of species varying in size. Some of them may, indeed, be due to animals of the same species in different stages of growth; and from the impossibility of finding means of proper distinction, I have not attempted to distinguish species, since nothing could be gained at this time by such an attempt. The preservation of such minute markings upon surfaces which must afterwards have been subjected to the influx of water (or which were at the time beneath water), and the subsequent deposition of other materials upon them, is truly wonderful, and might reasonably be doubted, but that we have the most unquestionable proof of their origin, connected at the same time with other evidences of the existence of beaches at the same period.

Fig. 1 (pl. 12) appears to be a cast of one of these trails, upon the lower side of a thin layer of sandstone. This cast presents a narrow depressed line along the centre, and a broader elevation at each side. This specimen is interesting, as showing, that in some instances, the nature of the subsequent deposition has been such as to preserve the form of these tracks.

Position and locality. Ruddock's quarry near the village of Clinton, Oneida county.

PLATE XII. Fig. 4.

This figure is from the surface of a large slab, marked by these meandering tracks. These, in their general aspect, are similar to those preceding; but they present, in addition, fimbriated or ciliated margins, which, although not very distinct in these specimens, are nevertheless absolute and important features. In some portions of the same track, this character is scarcely or not at all visible, while in other parts they are sharp and well defined markings.

Tracks of this character are not so abundant as the preceding kinds, but they are nevertheless frequently found intermingled with them upon the same slab.

Position and locality. Blackstone's quarry, New-Hartford.

PLATE XIII. Figs. 1 *a*, *b*, *c*, *d*; and fig. 2.

All the figures upon this plate are of one type, though differing to some extent among themselves. The peculiar feature of the preceding ones on Plate xi, of having a depression at each side, with an elevated ridge in the centre, is not here so characteristic. Most of them, indeed, appear to be only a single continuous fimbriated depression, gradually rising from the centre towards the margin, where a slight ridge is formed, elevated above the surface of the surrounding stone.

The central ridge which exists in some of these trails appears not to have been an original feature, but to have been caused by a partial filling up of the fimbriated trail. The trails of this character show a deeper depression along the central line than the marginal depressions in the other species, as if the bodies making them were heavier, or rested upon a less extent of surface.

Fig. 1 *a* represents a part of the surface of a slab, marked by these fimbriated tracks. The trail from *e* to *e'* is clearly the oldest or first made trail, since it is crossed by the two others at *m* and *p*. The trail *o' o* was subsequently made, crossing the one *e e'* at *p*; and again the third line was made from *e''* to *e'''*, which crosses both the preceding ones. Between *e* and *e''*, the meeting of the two trails is very obscure, and they appear like one continuous trail: they are distinct, however, though perhaps made by the same animal.

The crossing of these trails affords a clue to the direction in which the animal moved; and it appears to have been from *e* to *e'*, and from *e''* to *e'''*. The crossing at *m* shows that the animal moved from *e''* to *e'''*, since the marginal ridge of the trail crossed is pressed onward in the same direction. Again, in the crossing at *n*, the margins of the trail *o o'* are pushed forward in the direction of *e'''*.

The trail from *e* to *e'*, first made, was probably continued beyond *e'*; and, after turning to the right beyond the margin of the specimen, comes again upon the same slab at *e''*, re-crossing the same trail twice before leaving the slab. During this interval, another similar animal had crossed from *o'* to *o*. These trails throughout present no elevation in the centre.

Fig. 1 *b*. A trail similar to the last, but which appears to have been partially filled by the flowing in of mud.

Fig. 1 *c*. A similar trail, with the central depression partially filled with shaly matter. At *ff* the sides are nearly closed, evidently from the material being soft and moist at the time the impression was made.

Fig. 1 *d*, is a part of a similar trail, larger than the others, and with the fimbriated impressions very deep and strong.

Fig. 2. This trail is similar to the preceding; but the fimbriæ are broader, more distinct and regular, giving it the appearance of a plant or the impression of one.

Position and locality. These specimens were all, with the exception of 1 *c*, obtained in the banks of the deep ravine below Tisdale's sawmill in the town of Warren, Herkimer county. These impressions range through a considerable thickness near the centre of the group.

Fig. 1 *c* is from Blackstone's quarry, New-Hartford, Oneida county.

PLATE XIV. Figs. 1, 2, 3.

Fig. 1 is a specimen like the preceding : it becomes narrower towards one extremity, from the sides of the impression having been partially closed after the animal passed along.

Figs. 2 & 3 present some peculiar features. At intervals along the trail, the stone is elevated into vesicular knobs with a small opening in the centre. These appear almost like a continuation of the central ridge, which is conspicuous in these specimens. In their form, these knobs appear as if they had been portions of wet arenaceous mud inflated, by air or water, into this form.

The trail on fig. 2 was apparently made in the direction from *c* to *c'*. Other peculiar markings are also visible on the same specimen : one of these, *g*, is similar to the fimbriated trails just noticed ; and the others, *f*, *h*, *i*, are of different character.

On the specimen fig. 3, there are portions of two trails very conspicuous, and some remains of others. In portions of these two, the fimbriated character is distinctly visible ; and in the continuation of the same trail, the vesicular knobs are also very distinctly preserved. Some portions of the trail are smooth and continuous like those first described.

These elevated knobs were evidently made after the animal had passed over that part of the trail, as if, by means of a posterior organ, it had the power of inflating a portion of the wet sand.

Position and locality. At Blackstone's quarry near New-Hartford, Oneida county.

PLATE XIV. Fig. 4.

This specimen is a fragment of a large slab, showing the small trails first noticed. These are even more minute than those previously figured ; and from the fact that large surfaces are marked in this way, it would seem that the animls making them were numerous.

Position and locality. In the red sandstone in the bank of the creek below Tisdale's sawmill.

The preservation of these trails in arenaceous and semi-arenaceous deposits of the Clinton group, in such condition that we recognize them at once, deciding without hesitation as to their general character and origin, suggests a question, whether similar markings, preserved under other circumstances, and where the primitive character of the deposit has been metamorphosed or obscured from other causes, may not have been differently interpreted. The fimbriated tracks on Plate xiii are not very different in their general character from the *Nereites;* and this similarity very forcibly impressed me on their first discovery, in the specimen fig. 2, pl. 13. If we compare, for example, the *Nereites loomisi* of Emmons (*Taconic System in Agr. Report*, Vol. i, pl. 15), there is not a great dissimilarity between it and the fig. 1 *a*, pl. 13 of this volume. Compare also *Nereites gracilis*, Emmons, Plate xvi, fig. 3, with fig. 2, pl. 13 of this volume. Going still farther in the figures 1 *b*, 1 *c*, 1 *d*, and fig. 2, and including those on Plate xiv, we shall be ready to conclude that these individual specimens, under other circumstances, might have been mistaken for species of *Nereites*. Again the *Myrianites*, *Nemerites*, &c. find not very dissimilar representations in the smooth trails on Plates xi and xii. It should be observed, also, that these specimens of trails form but an imperfect exhibition of the great number and variety of character which may be obtained at the localities named.

I have not, it is true, had an opportunity of examining the specimens from which the original species of these genera were described by Mr. Murchison; but those from which Professor Emmons has described species are, many of them, not very unlike the trails of some marine animal upon the surface*. It is true that in the metamorphosis which the slaty rocks of Maine have undergone, it may not be easy to decide that such markings have been originally trails upon the surface preserved by subsequent depositions.

In comparing the actual specimens of *Nereites*, *Myrianites*, &c. from the State of Maine, with the specimens from the Clinton group, there is a great similarity in general character, though not in the material of the rock. There are also upon the Maine specimens markings very similar to those on Plates xi and xii of this volume, which show no evidence of fimbriæ or other appendages like the *Nereites*. Many of the *Nereites* also have not the regular coiled or folded character of most of the specimens figured, but are seen meandering over a considerable extent of surface. Upon the same slabs, too, may be seen those of various character and different species crossing each other. On the one side these markings present a continuous groove or channel with the fimbria attached; and on the opposite side, or portion separated, a continuous elevation corresponding to the groove, and neither presenting any evidence of articulations. Moreover there is not, in any of the specimens examined, any apparent remains of organic structure; not even a film of matter differing from the surrounding rock, or a discoloration of the surface†.

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* As a fact in proof of the similarity of the trails of other animals to these supposed remains of Annelida, I may mention that the *Nemapodia tenuissima* of Emmons has been proved to be the trail of some existing animal over the outer surface of the rock, removing the minute lichen which covers it, and discoloring the rock beneath.

† For further details and illustrations, see note at the end of this volume.

Besides the regular continuous trails described, and which are clearly due to different species of animals creeping or drawing themselves over the surface of a wet sandy beach, or beneath shallow water, there are numerous other markings which do not furnish characters sufficient to entitle them to a notice in the present state of our knowledge of their origin. Many of these may be due to accidental causes, and such as we see in operation upon our recent sandy beaches, and in the shallow bays and estuaries of our coasts, but which can scarcely be described or understood without reference to specimens, or even to the actual recent and fossil localities.

There are, however, some peculiar markings often associated with those previously described, and which, from having a pretty uniform character, and being extremely numerous and widely extended, are worthy of our attention. These are so clearly and neatly defined as to furnish convincing evidence that they were made by organic bodies, but of what character, we have no very satisfactory means of proving. I have heretofore been disposed to refer these tracks to crustaceans; but I learn from my friend Mr. J. D. Dana, that he has examined existing beaches in the southern latitudes, where crustaceans are numerous, and that the tracks they make in travelling over the surface are entirely different from the markings in question, and that their mode of progression also gives a different general character in the group of tracks produced.

Prof. Agassiz has suggested that they may be the impressions of the horny hooks of the arms of Cephalopoda which have been left upon the beach by the retiring water, and, while all the soft parts perished, these harder portions produced the impressions still preserved in the stone. The impression in the lithographic slate of Solenhofen, of the arms of *Kelæno speciosa* of Munster, with their clasps or hooks, resembles in some degree these impressions; but they are nevertheless quite different. In the specimens before us, there is no evidence of a central stipe or arm to which these clasps or hooks were attached, nor any evidence of a body with which the whole was connected.

Some of the impressions are made by a pointed body like a spine or claw, and they are for the most part sharp, distinct and decided; and the motion has been made somewhat obliquely, drawing up a slightly elevated ridge of sand behind it. In others the marking is clearly tridactyle; and we are able even to distinguish impressions with the marks of four and five toes or claws. These are likewise so often connected with others showing single impressions, that they all appear to have been made by the same animal.

The single hook or claw-like impressions might perhaps have been made by crustaceans with sharp, pointed feet; but we cannot well see how impressions with three, four, and five small claw-like markings in the same imprint, could have been made by any crustacean. Moreover when we examine a single series of these, there does not appear to have been as many appendages as are usual in crustaceans. We are not aware of the existence of lizard-like animals at this period; and even admitting their existence, they were not, probably, furnished with five toes or nails; neither do the tracks appear like impressions made by the foot of an animal like a lizard. Again, on careful scrutiny it does not appear that the palm or foot has been impressed behind the toes, but that in its stead there is a little elevation of sand. There is but one other class, whose existence is known at this period, to which they can be referred, and these are the

fishes. The question remains, then, whether fishes are capable of producing impressions upon the bed of the ocean; and, if so produced, whether they can be preserved in the bed after the accumulation of successive depositions? In answer to the first question, I can only state that I have seen fishes driven into shallow water, and, in their attempts to swim, produce confused marks and scratches with their fins and tail, but presenting little regularity or definite form. That such markings could be preserved, we have no doubt, from the fact of the preservation of equally destructible markings made upon the ocean bed, and which are frequently found in a very perfect state. There may be some doubt whether fishes, in their undisturbed element, would swim so close to the bottom; but still, in the search for food, they are compelled to do so. The only explanation I can offer, therefore, is that these markings were made by the pectoral, and perhaps the anal or other fins of the fishes, as they propelled themselves along the bottom of the sea. I do not doubt, from other evidence, also, that the water was exceedingly shallow, and probably disturbed by currents. The associated tracks and trails with other markings, indicate very shallow water, or even exposed lines of beach, which may, however, have been very limited in extent, and not existing for any prolonged period of time. In expanding the fins and throwing them forward, no marked impression would be left; but as they were drawn backward and downward, the body of the fish resting on or near the bottom, the expanded fin would produce the dactyloid impression, which has three, four or five marks, as three or more rays reached the sand. In this we see an explanation for the little elevation of sand at the base of these impressions, which would naturally take place as the rays were drawn backward and constantly converging. In those impressions which present a simple imprint, it is probably due to a single spiny ray of the fin touching the sandy bed, and which, having the backward converging motion, produced the marks to be described. The mode of progression of fishes seems the only one by which we can explain this peculiar feature connected with the tracks. In this way, also, we can see why, in some places, the surface appears as if pressed by the body of the animal, and the tracks are confused as if he had floundered about, being unable to make rapid progress (See fig. 2, pl. 16).

The difference in size and appearance of these tracks indicates that they were made by animals of different weight or size; and we have, in some instances, seen that in the same series the track varies from a single to a tridactyle impression. It should be recollected that the different consistence of the sand would be sufficient to produce different impressions, even if made by the same animal. This is often clearly seen in the tracks of mice and other small animals over snow, which in some parts is more compact than in others, and likewise in the tracks of similar animals upon sand.

In attempting to decide what kind of animals have made these markings, we naturally recur to the fauna of the period. We find the Brachiopoda most abundant, Acephala and Gasteropoda comparatively few, while the Cephalopoda are extremely rare. The crustaceans are not numerous, being far less so than in the following period. The remains of fishes, though extremely rare, are sufficient to prove that they existed at this period, and perhaps in greater numbers than we are at present aware. It is not necessary, however, that the animals making

them should have been numerous, but only that the conditions should have been favorable for their preservation. Therefore in looking at these and the other trails, we are not to regard the paucity or abundance of any particular class in order to account for their having been made. Throughout all the other strata, there are probably few situations where the conditions have been such as to preserve similar markings if made. It required not only the yielding material, but that it should be so exposed as to become partially hardened previous to the deposition of another layer upon it. We have in this group all these conditions; and therefore such markings as, under other conditions, would have been obliterated, are here preserved.

PLATE XV. Figs. 1, 2, 3, 4, 5, 6.

Several of the tracks represented upon this plate are distinctly tridactyle, or even present four and five distinct radiating impressions as of toes or claws. The sand seems, not as if pressed by a foot, but as if drawn backwards, and the impression thus produced leaves a small elevation or knob of sand behind it. Others present only a simple pit with an elevated point of stone behind, leaving no marks like toes.

Fig. 1. The small fragment of stone figured presents a surface marked by about six distinct tracks, each one showing the radiating impressions like toes very clearly. Parallel to these are three deep single tracks, having no marks of toes. Almost in the same line is a row of shallow oblique cuts, also without marks of toes, but which unfortunately are not represented in the figure. The exact parallelism of the two ranges, though of different character, induces a belief that they were made by the same animal. The range of tracks at the right hand, which escaped the observation of the artist in the figure, may have been partially obliterated after being made, as they now lie in a kind of depression or channel in which water flowed; while those on the left hand, preserving the impression of toes, are on a slightly more elevated surface.

The same specimen is marked in other parts by tracks less distinct than those given, but nevertheless clearly due to impressions made in the soft sand.

Fig. 2. This figure is from a specimen marked by parallel ranges of tracks, which are more or less distinctly preserved throughout. A row of tracks on the left hand is preserved nearly entire, with the marks of toes or appendages in almost every one. The righthand range is less perfectly preserved, but still distinctly marked. Towards the lower side are some deep sharp pits, as if made by a single spine or claw. Near the base of the figure are three or four ranges of tracks, crossing the others obliquely. These tracks are slightly different in their character from the others, but still appearing as if made by sharp spines or claws impressed into the mud and withdrawn, leaving sharply elevated ridges on both sides.

Near the centre of the specimen, the tracks are partially obliterated by another range of shallow pits or tracks made in a double parallel series.

Fig. 3, is a part of a specimen which shows a double parallel series of tracks, all of which are marked by toe-like appendages, and appear as if made by two animals travelling in parallel lines.

Fig. 4 is a part of the same slab; and the two double ranges of tracks commencing at *a*, proceed with varying distinctness to *b*: here they are obliterated by a depression in the stone, evidently a kind of water-course; after which they are again visible some four or five inches beyond, as represented in fig. 3, commencing at *c*.

The whole extent of these lines of tracks is more than twelve inches; and they are of uniform size and character throughout, except from abrasion due to subsequent action. This fact appears to me to be an argument against their having been appendages of a cephalopod, which, in so great a length, would have presented some variation in size.

Fig. 5 is a portion of another slab of similar character with the last. The tracks are here also partially obliterated by a shallow water channel. This specimen, like the last one, exhibits some impressions with no distinct trace of appendages; showing that such absence, in other cases, depends upon subsequent abrasion, or upon the power of the animal to make impressions with the appendages closed.

Fig. 6 represents a portion of a specimen with small pitted tracks on one side, and on the other are the meandering continuous trails previously noticed. In the small pitted tracks a few of them are distinctly digitate, while others are apparently simple impressions. This circumstance renders it difficult to distinguish between species.

PLATE XVI. Figs. 1, 2, 3, 4.

Fig. 1 presents several series of tracks differing to some extent from each other. The lefthand double series are confluent in the lower part, though a careful examination shows them to have been made by two limbs or other appendages. In the upper part they become separated, showing two distinct ranges, the impressions being individually tridactyle. The middle range, in its commencement near the base of the specimen, seems to have been made by a sharp claw planted at the upper righthand extremity of the track, and then drawn obliquely downwards, and again more transversely. They are distinct sharp impressions, and have been made with force, as the surface is depressed towards them on both sides. Toward the upper part of the specimen, these tracks assume the character which the first range have near the lower part, and seem as if made by two limbs impressed together upon the sand. The righthand partially double range presents a somewhat different appearance. These, like the others, appear to have been made by a sharp claw planted at the upper angle and drawn obliquely downwards, accumulating a distinct sharp knob or ridge of sand below it as shown in the figure. The evidence that the impressions were made in this manner is very clear: no other cause, than a body in motion, could have produced such sharp pits with the accumulation of sand behind. An inspection of the specimen convinces one that they must have been made on wet sand; and to be assured of this, we have only to strike a sharp point or hook into moist mud or sand, draw it a short distance, and then withdraw it without obliterating the little pile of mud or sand which has accumulated before it.

Fig. 2. This specimen presents all the characters of the last combined. There appears to be two double ranges of tracks. The lower parts of both are partially obliterated, not by water,

but apparently by some body being drawn over the surface after they were made. The upper portion of the righthand series is preserved in its integrity, or without subsequent pressure or abrasion.

Figs. 3 & 4, are parts of two different slabs, covered by numerous small tracks, scarcely one of which presents the dactyloid character of the first ones. They are sharp, distinctly marked pits, with elevated ridges of sand behind them or obliquely upon one side. Some of them have a triangular form, as in the lower part of fig. 3. In the upper part of the same figure, the impressions are nearly obliterated, but were originally small and very numerous.

These figures present nearly all the variety which has been observed in the specimens collected. A more thorough examination would doubtless bring to light a greater variety. I have been unable to visit the locality since my discovery of it in 1847 ; and at that time, owing to the difficulty of access, was able to bring away only some of the better specimens of these and other tracks, leaving behind a large number of others.

Position and locality. The tracks of this character have been found most abundant in the ravine below Tisdale's sawmill in Warren, Herkimer county. Their position is near the centre of the group at this place. The rock in which they occur is a coarse sandstone, sometimes with considerable intermixture of shaly matter. Similar markings, though less distinct, have been observed at intervals in a western direction as far as Flamborough Head, Canada West.

(*State Collection.*)

NOTE.

Wishing to present the opinions of other naturalists regarding these peculiar markings upon the surface of the strata, I wrote to Sir Charles Lyell, enclosing several of the plates then complete. These plates were submitted to Professor Forbes : his remarks on them are as follow:

Plate 10 : "*Plants.*" The conclusion that these bodies are plants, seems to me very questionable.

Plate 11 : "*Tracks of Gasteropoda.*" Fig. 4 has to me the aspect of a gasteropodous track, and so has fig. 3. Figs. 1 *a* & *b* seem rather to be the trails of a planarian worm allied to *Nemerta.* 2 *a* & *b* do not seem organic.

Plate 15. The markings on these slabs look remarkably like those made by many crustaceans : so do some of those on pl. 16. In fig. 1, the tracks to the right hand are remarkably like those made by certain fishes. I have seen similar markings in the tilestones in Wales.

Prof. Forbes is probably better acquainted with the character and origin of such markings, than any other person. The inspection of the actual specimens would doubtless enable him to give a more decided opinion, and perhaps to modify to some extent the views expressed regarding those on Plates 15 and 16, which are clearly all due to a similar cause.

CORALS OF THE CLINTON GROUP.

The corals peculiar to this period are comparatively few in number, though in some localities the individuals are extremely numerous. The general character of these corals is similar to those of the Niagara group; and several species pass from one group into the other, or, in other words, are common to the two groups. I have endeavored to give here only those species which are limited to the Clinton group; or if one or two species, common to the two groups, are noticed, it is because they present some peculiarity not observed in specimens from the Niagara group.

The condition of the sediment in this group has not been favorable to the preservation of these fossils in the best condition for examination. In nearly all localities the calcareous rocks are more or less silicified; and though this kind of material preserves the mass, it often obliterates the finer characters. In the green shales the material is too soft to preserve well the fossil corals, and therefore we have not the means of defining them so perfectly as in some of the other formations.

From the great number of individuals which are crowded into some beds of this formation, extending from Wayne county westward as far as the head of Lake Ontario, we may infer that the condition was favorable for their growth, and that there was no great variation in the depth of the water over this area. This evidence from the corals, contrasted with their almost entire absence in the eastern portions of the group, together with the coarse and uneven nature of the sediment in the same parts of the series, shows conclusively that the eastern part of the group was deposited in situations subjected to great agitation, and probably near to land, or in the direction of conflicting currents. Taking this view of the deposition, it is easy to see how the shaly and calcareous strata of the western portion, quietly deposited in an ocean of moderate depth, assimilate both in organic and physical characters with the succeeding Niagara group, also deposited throughout in quiet water; while in the eastern portions, the contrast is so extreme that they bear little similarity.

Nearly all the preceding species of plants, the trails and tracks upon the surface, are confined to the eastern portion of the group; while the fossils yet to be described, belonging to the same, are mostly from its western part, or from points west of Oneida county. The fact should also be remembered, that the eastern character of the group is maintained, to a great degree, in its southern extension beyond the limits of New-York; while to the west and southwest, it constantly approximates in character to the succeeding group.

Among the corals which continue their existence into the Niagara group, the CATENIPORA is the most conspicuous and interesting. It first appears associated with the ore beds in Wayne county, and has been found in other localities. This coral becomes abundant in the Niagara limestone, and its existence has not been traced beyond that period.

GRAPTOLITES.

I have detected two species of Graptolites in this group : One of them was known and published in the Report of the Fourth Geological District, 1843 ; the other is new. Thus far all our examinations have not sufficed to bring out a single species of GRAPTOLITHUS from any more recent period than the Clinton group. This genus must therefore be ranked among those families which, though living in great profusion in early geological periods, never prolong their existence into the modern periods even of the palæozoic era. In all our more recent formations of Silurian and Devonian age, we have nothing which represents the Graptolite : we bid a farewell to the genus.

416. 15. GRAPTOLITHUS CLINTONENSIS.

PL. A. XVII. Fig. 1 *a* – *i*.

Graptolithus clintonensis. Geol. Rep. 4th Dist. N. York, 1843, p. 74; fig. 12, p. 72.

Stipe slender, simple, linear, straight or curving, serrated on one side, the opposite side (or back) marked by a fine longitudinal groove ; serræ long, deeply cut into the stipe, with the points recurved ; surface slightly granulated ?

This species is readily distinguished from any in the lower strata, by its long recurved teeth, which are very peculiar. When the points of these are imperfect, its distinctive characters rest on the depth to which they are cut into the stipe, and their close arrangement, which likewise distinguishes this one from those in the lower rocks. In specimens where the back of the stipe is shown, it presents a longitudinal groove ; and at the base of the teeth it becomes much thicker, and again diminishes towards the points.

Fig. 1 *a*. A lamina of slate, with fragments of this species upon the surface. Where imbedded in the soft green shale, the depth of the serratures and the pointed extremities are not so clearly preserved.

Fig. 1 *b*. A fragment of a stipe, showing the depth of the serratures and the curved extremities.

Fig. 1 *c*. A similar fragment, showing the opposite side.

Fig. 1 *d*. A small fragment which is less flattened, the axis more solid, and the teeth appearing shorter.

Fig. 1 *e* & 1 *f*. Enlargements from the previous figure.

Fig. 1 *g*. A small fragment of the same species, showing some small nodes at the base of the teeth.

Fig. 1 *h*. A portion of 1 g enlarged.

Fig. 1 *i*. The back of the stipe enlarged, showing a slight groove.

Position and locality. This species is very abundant in the upper green shale of the group at Sodus, Wayne county ; also in the eastern part of Williamson, and in the banks of the Genesee river at Rochester. (*State Collection.*)

417. 16. GRAPTOLITHUS VENOSUS (*n. sp.*).

PL. A. XVII. Fig. 2 *a, b, c.*

Stipe rather broad, linear, rigid, serrated on both sides; serræ short, acute, distant, the spaces between curving into the substance of the stem; substance composed of reticulated or venose threads.

This very peculiar species differs from all the others in a sufficient degree to be readily identified. The substance is very thin and fragile, and scarcely recognizable without a glass; but when once the peculiar venose structure is discovered, it is readily detected afterwards. The peculiar serræ, or emarginations of the two margins, is also a very peculiar and distinctive feature. By these characters the smallest fragment is readily distinguished, and its difference from all known species is at once clearly observable.

Fig. 2 *a.* A piece of slate, with numerous fragments of *G. clintonensis* and *G. venosus.* The latter are much more indistinct than the former, and can scarcely be brought out without a magnifier.

Fig. 2 *b.* A fragment of *G. venosus* enlarged.

Fig. 2 *c.* A fragment (enlarged), which appears to be the upper extremity of the stipe of this species. With the exception of this figure, no terminations of either species have been seen. They occur in fragments of various lengths, having a pretty uniform character throughout.

Position and locality. This species occurs with the preceding one in the same thin black layers in the green shale below Rochester. (*State Collection.*)

101. 2. CHÆTETES LYCOPERDON.

PL. XVII. Figs. 1 *a–l.*

A species, which I am unable to distinguish from the one in the Trenton limestone and Hudson-river group, occurs in considerable numbers in the Clinton group. In this position, however, it never attains those massive hemispherical forms which are so abundant in the Trenton limestone. It is almost always found in the branching form; and the others, though sometimes seen, are thin, and never attain any considerable bulk.

Fig. 1 *a.* The upper surface of a flat massive form.

Fig. 1 *b.* Figure showing the height of the same specimen.

Fig. 1 *c.* The lower surface of the same specimen.

Fig. 1 *d.* Section of a small hemispheric mass.

Fig. 1 *e.* Several columns enlarged.

Fig. 1 *f.* Openings of cells enlarged.

Fig. 1 *g.* A ramose specimen on limestone.

Figs. 1 *h, i, k.* Sections of the branches of several ramose specimens through the centre, and on one side of the centre, showing the arrangement of the cells.

Fig. 1 *l.* Several of the cells enlarged.

Position and locality. This coral is found in the lower part of the group at Sodus in Wayne county, at Rochester on the Genesee river, at Reynale's Basin and Lockport in Niagara county, and at Flamborough Head in Canada West, always in the lower part of the group, and very rarely in the higher part. (*State Collection.*)

418. 2. FAVISTELLA FAVOSIDEA (*n. sp.*).

PL. XVII. Figs. 2 *a* - *f*.

Corallum spheroidal, hemispheric or flattened, increasing by lateral and interstitial additions of new cells; cells sometimes radiating from a centre, in others they are nearly parallel, and rise from a broad base, increasing on all sides by the addition of new cells; cells opening upon the surface by four, five or six-sided mouths, the margins elevated, and the separating walls apparently double; rays often obsolete or broken away, so that they are only presented as projections from the walls of the cells.

This species has the general appearance of a FAVOSITES, with cells a little larger than *F. gothlandica;* and would readily be confounded with that on cursory examination, as it has always been heretofore. A careful examination always shows the remains of rays projecting from the walls of the cells; and by grinding down good specimens, the true character can be readily ascertained. The cells are smaller than *F. stellata* of the Hudson-river group, though it much resembles that fossil in its general characters.

Fig. 2 *a*. A fragment of a large mass: cells natural size.
Fig. 2 *b*. Three of the cells enlarged, showing the double walls which coalesce at intervals.
Fig. 2 *c*. A small spheroidal mass of the same species.
Fig. 2 *d*. A section of a spherical mass of this species, showing the radiating cells.
Fig. 2 *e*. A small fragment showing the rays within the cells.
Fig. 2 *f*. Several of these cells enlarged, showing the rays, etc.

Position and locality. This coral occurs associated with *Pentamerus oblongus* at Rochester, and in the same situation in the towns of Ontario and Sodus in Wayne county. It is also found in the same position at Reynale's basin, Niagara county. (*State Collection.*)

419. 1. CANINIA BILATERALIS (*n. sp.*).

PL. XVII. Figs. 3 *a* - *h*.

Obliquely turbinate or obconical, anterior side increasing much more rapidly than the other, very slightly curved; cup opening obliquely with the axis of the coral, margin considerably elevated above the centre; rays (lamellæ) from 20 to 50 (depending on the age of the coral), curving towards the centre where they are irregularly contorted or coalescing, often running into and uniting with a lamella on each side of a central longitudinal space, scarcely visible externally, and increasing on one or two sides by the addition of new rays. Transverse dissepiments highest in the centre, and curving abruptly downwards near the margin; on the an-

terior side, the dissepiment abruptly and deeply bent downwards, and a single ray at this point is obsolete.

This species has the ordinary external appearance of STREPTELASMA, for which it may be mistaken from its external characters, the cup being usually filled with stony matter. In perfect specimens the lamellæ are scarcely distinct on the outside, but most of the specimens seen are worn or dissolved so much as to show them very conspicuously. Within the cup the rays are usually curved, and often uniting two or more in one before reaching the centre. The dissepiments bend abruptly downwards near the margin, presenting a deep cavity between the rays. On the anterior side the dissepiment is bent downwards more deeply, and one ray is carried with it or partially obliterated. This peculiar feature is very conspicuous and characteristic. From each side of this depression the lamellæ are often almost continuous to the posterior side; and all the other lamellæ from each side join these, leaving a narrow groove or space through the centre of the cup.

This species possesses the peculiar characters of CANINIA, as represented in some of the figures of MICHELIN and DE KONINCK, though other species united under the genus have a different structure in addition to this curvature in the dissepiments.

Fig. 3 *a*. Posterior view, showing the shorter posterior side and oblique cup, which has about 48 rays.
Fig. 3 *b*. Anterior side of another specimen, showing the mode of increase by the addition of new rays or lamellæ.
Fig. 3 *c*. An enlarged view of the cup of another specimen.
Fig. 3 *d*. A longitudinal section, showing the internal characters.
Fig. 3 *e*. A young specimen, lateral view.
Fig. 3 *f*. Enlarged view of the cup, showing the irregular union of the lamellæ in the centre.
Fig. 3 *g*. A large individual : view a little on one side of the anterior face. Rays 50 or more.
Fig. 3 *h*. An irregular form, apparently of this species.

Position and locality. This species is most abundant at Reynale's basin, and occurs also at Lockport, Niagara county. It is also found at Rochester, associated with *Pentamerus oblongus*, and at the iron ore beds in Wayne county. (*State Collection.*)

420. 1. CYCLOLITES ROTULOIDES (*n. sp.*).

PL. XVII. Figs. 4 *a*, *b*, *c*, *d*, *e*.

Compare *Madrepora radiis dentatis*, FOUGT. 1745; LINNE, Amœn. Acad. t. i, p. 194, f. 5, 1749.
Madrepora porpita. LINNE : GMELIN, pag. 3756, no. 3. GUETTARD, Mm. iii, tab. 23, figs. 4 & 5.
Fungia nummismalis. GOLDFUSS, Petrefacta Germania, pag. 48, pl. 14, fig. 4 *a*, *b*.
Cyclolites numismalis & *C. orbiculata*. LAMARCK, System, t. ii, p. 233.
Cyclolites numismalis. BLAINVILLE, Actinologie, pag. 335, pl. 51, figs. 1, 1 *a* & 1 *b*.
Cyclolites nummismalis, HISINGER, Lethæa Suecica, pag. 100, pl. 28, fig. 5 *a*, *b*, *c*.

Coral circular, the upper surface convex with a circularly depressed centre, marked by about 20 original rays which proceed from the centre, and an equal number of smaller secondary or

interstitial rays which are less prominent; rays crenulated; lower surface flat, showing the origin and base of the rays.

This little fossil is easily recognized by its regular circular face and strong crenulated rays. It has at first view the appearance of the cup of some species of CYATHOPHYLLIDÆ; but the rays curve outward and downwards towards the margin, and there is no rim or border.

Our species, though smaller, is closely allied, if not identical with the one figured by HISINGER; but if the figures of GOLDFUSS, which he cites, or those of DE BLAINVILLE, be any thing like correct representations of the fossil described by LINNE, then the species of HISINGER and our own are very distinct from that one. The rays are much more numerous and finer than in ours, and the entire coral much larger, with a smaller proportional depression in the centre.

This fossil occurs in an impure limestone, associated with other small corals and Bryozoa, and is apparently confined to a single thin layer.

Fig. 4 *a*, *b*. The upper surface of two individuals of different size.
Fig. 4 *c*. Lateral view of same.
Fig. 4 *d*. Base of another individual.
Fig. 4 *e*. Several rays enlarged.

Position and locality. In the lower part of the Clinton group at Ruddock's quarry near Clinton village, Oneida county. (*State Collection.*)

GENUS CANNAPORA (*nov. gen.*).

[Gr. καννα, *canna*, and πορος, *porus*.]

Coral calcareous, massive, tubular, internally radiate or cellular; tubes united externally at regular intervals by transverse septa.

This coral has the general aspect of TUBIPORA, from which it differs in the stellate and cellular interior of the tubes. It likewise resembles SYRINGOPORA, from which it is distinguished externally by the transverse septa, which are continuous, and occurring at regular intervals; and internally by the tube being stellate, or indistinctly cellular.

421. 1. CANNAPORA JUNCIFORMIS (*n. sp.*).

PL. XVIII. Fig. 1 *a–f*.

Massive, hemispheric, isolated (or incrusting other bodies); tubes slender, parallel or diverging, united by septa crossing rectangularly to the direction of the tubes; interior of the tubes showing six or more rays forming a star, sometimes cellular without distinct rays, and often entirely hollow. Increasing by the addition of lateral or interstitial cells, 18 to 20 in an inch; connecting septa, 10 in an inch.

The species under consideration resembles *Tubipora purpurea*, a very common recent coral; but the tubes are smaller, and there are twice as many in the same space.

This fossil occurs in the calcareous shales of the Clinton group, usually replaced by silex; the best specimens, however, being those which are weathered from the rock. In consequence of the silicified condition of the mass, the internal characters are not so clearly preserved as they would otherwise be. This is the earliest known form of this type, evidently representing the SYRINGOPORA which occurs in a higher position. It is associated with CATENIPORA in the same strata, and is apparently a closely allied genus.

Fig. 1 *a*. A portion of a hemispheric mass, showing the mode of growth.
Fig. 1 *b*. A small fragment where the tubes are parallel.
Fig. 1 *c*. Showing the tubes surrounding and radiating from some foreign cylindrical body, upon which the polyps have grown.
Fig. 1 *d*. Several tubes enlarged.
Fig. 1 *e*. Transverse section, showing the stellate orifices of the tubes.
Fig. 1 *f*. A similar section, where the cells are hollow.

Position and locality. Shales of the Clinton group, Ontario, Wayne county, and in the debris about Rochester and other places. (*State Collection.*)

422. 1. CATENIPORA ESCHAROIDES.

PL. XVIII. Fig. 2.

For reference and synonyms, see CATENIPORA under Niagara group.

This figure is given here to show the existence of CATENIPORA at the period of the Clinton group. It occurs in the iron ore beds and in the calcareous strata, though somewhat rarely, and usually in an obscure condition. The earliest appearance of the Genus CATENIPORA is therefore almost coincident with that of PENTAMERUS; the *P. oblongus* occurring in great numbers only a few feet below the *Catenipora*, though the latter, in its higher positions, is widely separated from the *P. oblongus* in the western part of New-York.

GENUS HELOPORA (*nov. gen.*).

[Gr. Ηλος, *clavus*, and πορος, *porus*.]

Simple or branching cylindrical stems, often swelling at the upper extremity, poriferous on all sides; pores oval or subangular, arranged between longitudinal elevated lines.

This genus is constituted to receive, more especially, a species of coral very common in the calcareous layers of the Clinton group. It usually occurs in fragments, appearing like small spines or tentacles: more perfect specimens are clearly celluliferous.

423. 1. HELOPORA FRAGILIS (*n. sp.*).

PL. XVIII. Fig. 3 *a* – *f*.

Corallum minute, cylindrical or clavate; pores oval or subangular, having a spiral direction

around the stipe, and arranged between longitudinal elevated lines; cellules apparently reaching to the centre, and diverging and radiating from a central imaginary axis.

This little coral is extremely abundant in the thin calcareous layers in the lower part of the Clinton group. The entire surface, often for several inches square, is covered with these minute fragments, of the length of from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch, and rarely longer. The least worn of these will be found, on examination with a microscope, to be poriferous, while others are nearly or entirely smooth. Whenever the termination is distinctly visible, it appears thickened or swollen; but this character is only of specific importance. In worn specimens, where the pores are visible, they are distinctly oval; the angular form being apparent in more perfect individuals, from the longitudinal lamellæ separating the pores. Some of the specimens are branched, but this is a rare feature.

Fig. 3 *a*. Fragment of the ordinary character.
Fig. 3 *b*. A fragment showing the thickened termination.
Fig. 3 *c*. A specimen having a single branch, the stipe and branch both having enlarged extremities.
Fig. 3 *d*. The specimen 3 *b* enlarged.
Fig. 3 *e*. A portion of another specimen enlarged.
Fig. 3 *f*. A small specimen of limestone with fragments of this coral upon its surface.

Position and locality. This coral is abundant in the thin semi-calcareous layers above the *Pentamerus oblongus* at Rochester; it is less abundant in Wayne county, and at Reynale's basin and Lockport in Niagara county; and is again abundant at Flamborough head, Canada West.

424. 7. STICTOPORA CRASSA (*n. sp.*).

PL. XVIII. Fig. 4 *a*, *b*, *c*.

Frond branching; branches numerous, somewhat thick; openings of the cellules oval, about ten in the width of the stipe or branches; each opening margined by a shallow groove, which gives the surface a striated appearance. The non-celluliferous margins of the branches narrow and smooth?

This species is more robust than any heretofore described. The number of rows of cells on the stipe and branches is ten or upwards, and the openings are well defined. In worn specimens the striated surface of the intercellular spaces is not obvious, but in more perfect specimens is quite conspicuous.

This species differs sufficiently from any heretofore described, to be readily recognized. The margins may perhaps, in better specimens, prove to be striated.

Fig. 4 *a* & *b*. Two fragments, natural size.
Fig. 4 *c*. A portion enlarged, showing the striated surface of the intercellular spaces.

Position and locality. In the lower part of Clinton group, Wayne county; and at Flamborough head, Canada West: also, more rarely, at Rochester and Reynale's basin.

425. 8. STICTOPORA RARIPORA (*n. sp.*).

PL. XVIII. Fig. 5 *a, b, c.*

Stipe slender, divaricately bifurcating or alternately branching; surface of stipe and branches marked by about three rows of oval cells; cells distant, with an elevated margin; surface of stipe apparently striated.

This slender species is readily recognized by the few and widely separated cellules. The stipe is also more nearly cylindrical, and has apparently no extended non-celluliferous margins.

Fig. 5 *a, b.* Two specimens of this species.
Fig. 5 *c.* A portion enlarged.

Position and locality. In the thin calcareous layers of this group at Flamborough head, Canada West. The same species occurs in the shale of the Niagara group at Rochester, N. Y.

GENUS PHÆNOPORA (*nov. gen.*).

[Gr. φαινω, *fenestro;* and πορος, *porus.*]

Corallum consisting of a thin broad calcareous or semi-calcareous expansion, which is celluliferous on both sides; cellules oval, arranged between direct longitudinal and obliquely transverse lamellæ, and opening upward and outwards from the base.

The specimens of this genus have a near resemblance to the species of FENESTELLA, with small fenestrules; but this resemblance is only apparent, and more especially observable in worn specimens. The cells have not always the ascending or spiral arrangement noticed in STICTOPORA; and there is no smooth or striated margin destitute of cells, as in that genus.

426. 1. PHÆNOPORA EXPLANATA (*n. sp.*).

PL. XVIII. Fig. 6 *a – e.*

Corallum consisting of a thin, even, expanded crust with no apparent tendency to branching, both sides equally celluliferous; cellules minute, oval, arranged between thin longitudinal lamellæ; transverse arrangement of cellules obliquely ascending and separated by a sharp elevated line, sometimes somewhat irregularly arching or undulating.

Cellules in the transverse direction, 8 in the space of one line; in the longitudinal direction, 10 to 11 in the same space.

This species, particularly when a little worn, bears a close resemblance to the non-poriferous side of a FENESTELLA with minute openings, and the true form of the little cellules is not perceptible to the naked eye. The bases of the cells, from the two sides, are separated by a thin calcareous membrane. The longitudinal laminæ, separating the rows of cells, are coincident on the two sides.

Worn specimens of STICTOPORA present a near resemblance to this and other species; but the laminæ separating the cells are never so directly longitudinal, but more or less undulating, corresponding to the alternating arrangement of the cellules. By a careful examination, even small worn fragments of the two genera, often met with in the same fragment of stone, may be easily distinguished. In unworn specimens of this species, the longitudinal lamellæ are distinctly crossed by a sharp elevated line, dividing the surface into rhomboidal spaces corresponding with the cellules.

Fig. 6 *a*. A small unworn fragment, of the natural size.
Fig. 6 *b*. A similar fragment with the surface somewhat abraded.
Fig. 6 *c*, *d*. The two last, respectively, enlarged, showing the difference between the worn and unworn surface.
Fig 6 *e*. A portion still farther enlarged, showing the form of the openings of the cellules.

Position and locality. In the thin layers of limestone alternating with shale at Flamborough head, Canada West. Probably also at Lockport and other places in New-York, but not collected at these localities.

427. 2. PHÆNOPORA CONSTELLATA (*n. sp.*).

PL. XVIII. Fig. 7 *a*, *b*, *c*, *d*, *e*.

Corallum broadly expanded and elongated, with the two edges parallel; both sides celluliferous; cellules minute, oval, arranged between thin longitudinal lamellæ which separate the rows, transversely arranged in nearly a direct or slightly undulating line; surface of the crust marked at regular intervals by circular depressions, in the centre of which is a point more elevated than the general surface.

This species resembles the last in some degree; and being preserved in the iron ore, it is difficult to point out the differences in the more minute details. The most obvious distinction exists in the circular impressions, which are regularly arranged in obliquely transverse lines over the surface. The space between the bases of the cells is much wider than in the last species.

Fig. 7 *a*. A portion of a large specimen, showing the entire width of the stipe. The specimen shows only the bases of the cellules, the upper portion with the centre having been broken away.
Fig. 7 *b*. A fragment presenting casts of the cellules, the calcareous matter being removed.
Fig. 7 *c*. A surface showing the bases of the cellules at their origin.
Fig. 7 *d*. A portion of 7 *a* enlarged.
Fig. 7 *e*. A portion of surface of 7 *b* enlarged.

Position and locality. In the iron ore of Wayne county, central part of the group; also at Reynale's basin, Niagara county.

428. 3. PHÆNOPORA ENSIFORMIS (*n. sp.*).

PL. XVIII. Fig. 8 *a, b, c.*

Stipe ensiform, narrowing and curved towards the base; surface at the larger extremity marked by eight or nine rows of rhomboidal reticulations, within which the oval openings of the cellules are scarcely discernable: three of the central rows are continued to the smaller extremity of the stipe.

This species is quite abundant, and, when nearly perfect, is readily distinguished by its form. The openings of the cellule vary little in size from those of the first species described, though they are always rather more conspicuous, and appear more nearly rectangular. The longitudinal and transverse decussating lines are very prominent.

This species is rarely found more than an inch in length, though great numbers often appear upon the same specimen of stone. When the curved portion is broken off, the slightly larger openings, the sharper edges of the decussating lamellæ, and the narrow form, will suffice to distinguish it from *P. explanata.*

Fig. 8 *a.* A single individual of the natural size.
Fig. 8 *b.* A portion of the same enlarged.
Fig. 8 *c.* A fragment of stone having several specimens upon the surface.

Position and locality. In the thin layers of siliceous limestone in the lower part of this group, at Flamborough head, Canada West.

GENUS RHINOPORA (*nov. gen.*).

[Gr. ρινη, *lima*, and πορος, *porus.*]

Corallum consisting of an expanded calcareous crust, either subcylindrical and hollow or explanate, poriferous on the two sides; cells arranged somewhat in quincunx order, roundish or oval, and strongly raised in little papillæ or pustules above the surface.

429. 1. RHINOPORA VERRUCOSA (*n. sp.*).

PL. XIX. Fig. 1 *a, b, c.*

A somewhat thin expanded calcareous crust of irregular form; surface covered with roundish elevated cells, a little more than their own diameter distant from each other; openings round or round-oval, directed upwards; surface between the cells granular.

Cellules 64 in the length of an inch.

This species is very abundant, occurring in fragments of greater or less magnitude. It is clearly celluliferous on both sides, the callicles rising so much above the surface as to make it rough like a grater. All the specimens seen are fragments, the original having probably been

of a palmate form. Many specimens are marked by a ramose elevated ridge upon the surface, which, however, scarcely disturbs the regular arrangement of the cellules.

Fig. 1 *a*. Fragment of the natural size.
Fig. 1 *b*. A fragment of the natural size, showing a ramose elevated ridge running over the surface.
Fig. 1 *c*. A portion enlarged, showing the form and arrangement of the cells.

Position and locality. In the thin calcareous and semi-calcareous layers at Flamborough Head, Canada West. (*State Collection.*)

430. 2. RHINOPORA TUBULOSA (*n. sp.*).

PL. XIX. Fig. 2 *a, b, c.*

Corallum somewhat flattened, semi-cylindrical, hollow, celluliferous over the entire surface; pores small, round and elevated above the surface, distant from each other a little more than their diameter; openings round.

Cellules 80 to 85 in the length of an inch.

This species is readily distinguished from the preceding, by its smaller and more closely arranged pores. In fragments it occurs as a thin expanded crust; but the only specimen seen, which approximates to a perfect form, is the one described, where the poriferous faces are separated by a flattened semi-cylindrical hollow space, instead of having the bases of the cells in contact, and forming a thin explanate frond, as in the preceding and other known species. Fragments of this, and perhaps other species of similar character, may be frequently found having only one side celluliferous.

Fig. 2 *a*. A fragment of this species, of the natural size.
Fig. 2 *b*. A section of 2 *a*, showing the form, the interior being filled with shaly matter.
Fig. 2 *c*. A portion of the surface enlarged, showing the form and arrangement of the cellules.

Position and locality. In the green shale of this group at Sodus in Wayne county, also at Reynale's basin, Niagara county.

431. 4. RETEPORA ANGULATA (*n. sp.*).

PL. XIX. Fig. 3 *a–h.*

Frond much expanded (perhaps cyathiform originally); branches anastomosing; fenestrules large, very oblong-oval or irregularly subrhomboidal, varying in size; non-poriferous face striated; poriferous face with two or three rows of pores on each branch; pores small, round, salient, papilliform.

The larger and best preserved specimens of this coral are in shale, and, to the eye, and even to an ordinary magnifier, both faces are smooth. In some smaller fragments in calcareous layers, the pores are very prominent. In some of the specimens in shale, the pores appear

even with the surface, but this may be due to removal of the incrusting shaly matter with a brush, in cleaning, which has also broken off the projecting papillæ; for in other specimens in shale, the pores are quite prominent. The non-poriferous face is distinctly striate longitudinally, though often appearing smooth or granular. The size and form of the fenestrules in different specimens is variable; but after examining a large number of specimens, I am unable to find any specific distinction.

Fig. 3 *a*. The poriferous face of a portion of a frond (the specimen preserved in shale).
Fig. 3 *b*. The non-poriferous face of another individual.
Fig. 3 *c*. A portion of 3 *a* enlarged, the pores still scarcely visible.
Fig. 3 *d*. A portion of the non-poriferous face of 3 *b* enlarged.
Figs. 3 *e*, *f*, *g*, *h*. The poriferous face of two small fragments from calcareous strata, natural size and enlarged. In these the pores are very prominent, and the fenestrules differing in size and form in the two specimens.

Position and locality. In the green shale at Sodus and Rochester, New-York; and in the thin calcareous layers at Flamborough Head, Canada West. (*State Collection.*)

432. 1. FENESTELLA PRISCA?

Pl. XIX. Fig. 4 *a* – *m*.

Fenestella prisca. [?] Lonsdale, Sil. System, pag. 178, pl. 15, fig. 18 *a*, *b*, *c*.

Compare *Retepora prisca*, Goldfuss, Petrefacta Germania, pag. 103, taf. xxxvi, fig. 19 *a*, *b*, *c*

Frond cyathiform, much expanded; externally the branches are irregularly dichotomous, with the edges thin and sharp; transverse or connecting bars very indistinct; a row of round pores on each side of the branch; fenestrules oval, varying in size and shape to oblong and quadrangular; non-poriferous surface of branches striated.

This species resembles very nearly that of Mr. Lonsdale, though we cannot compare accurately. I have not been able to count the number of pores in each fenestrule, since the poriferous face is somewhat obscure, and the transverse bars are very thin, and do not rise from the inner face so high as the pores.

This species is very abundant in the soft shales, and in the arenaceous shales of the Clinton group. The calcareous matter of the coral has often been removed, and the impressions only are left. In this condition we find the little elevated portions of stone filling the non-poriferous face to be oval or quadrangular, but not often much elongated. The impression of the poriferous side usually presents only the marks of the thin-edged branches, with a row of projecting points on each side of the solid space between, which were the filling of the pores. In such specimens, sometimes we see slight impressions of the transverse bars upon the interspaces, but so slight as scarcely to attract attention. In the coral itself the quadrangular spaces arise from a partial wearing down of the non-poriferous face, so that the bars, which are thickened on their internal face at their junction with the branches, giving the oval fenestrule, are worn down to a line

where they are but a thin straight bar. This also gives the fenestrule a larger or longer space, and conduces in part to the variable form. Lateral pressure, however, seems often to have narrowed these spaces, and they are also of variable size in their perfect condition.

Fig. 4 *a*. The base of a frond, showing the external poriferous face.
Fig. 4 *b*. A portion of the same enlarged.
Fig. 4 *c*. The non-poriferous face of a portion of a frond.
Fig. 4 *d*. Several of the fenestrules near the base enlarged, showing distinctly the oval form.
Fig. 4 *e*. Several of the fenestrules enlarged (from a portion of the surface which has been worn down), showing a quadrangular form.
Fig. 4 *f*. A surface of stone, preserving the impression of the poriferous and non-poriferous faces of this coral.
Fig. 4 *g*. A portion enlarged, showing the thin sharp lines of impression of the branches of the poriferous face.
Fig 4 *h*. Enlargement of the spaces filling the fenestrules on the non-poriferous face.
Figs. 4 *i*, *k*, *l*, *m*. Similar enlarged portions of the impressions of the two faces of the coral.

Position and locality. This species is very abundant in the green shale above the ore bed at Wolcott furnace; also in the semi-calcareous portions of the rock, associated with the ore bed below the shale. It is abundant likewise at Ontario in Wayne county, and it occurs at Rochester, Reynale's basin, and Lockport, New-York; and at Flamborough Head, Canada West. (*State Collection.*)

433. 2. FENESTELLA TENUIS.

PL. XIX. Fig. 5 *a*, *b*, *c*.

Frond much expanded, thin and slender; branches small, roundish, dividing at irregular intervals; bars small, thin, not curved or enlarging; fenestrules oblong, quadrangular or subrhomboidal; length and breadth about as five to three; poriferous face of branches carinate, with a row of small round prominent pores on each side of the thin carina, and distant from the margins of the branch; about four pores to each fenestrule; sometimes a pore upon the transverse bar distant from the branch. Fenestrules about 6 in three lines longitudinally, and 12 in the same space transversely.

This species differs from the last in the more slender branches, the size and form of the openings, and other more minute details. There is little tendency to the oval form in the fenestrules. The bars are scarcely enlarged as they join the branches; and their direction is usually a little oblique, giving a sort of rhomboidal form to the fenestrule. The poriferous side of the branches differs equally from the last in the thin carinate edge being much lower, and the transverse bars more prominent; the pores are likewise smaller and more distant, and open more directly outward. The upper or younger parts of the frond of *F. prisca* bear a more close resemblance to this species on their non-poriferous face, than any other part of the coral.

Fig. 5 *a*. A portion of the frond of this species, natural size.

Fig. 5 *b*. A portion of the poriferous face magnified.

Fig. 5 *c*. A portion of the non-poriferous face magnified, showing distinctly the form of the fenestrules.

Position and locality. In the impure calcareous layers associated with the ore bed at Wolcott furnace, and at Whiting's mill, Wayne county. (*State Collection.*)

CRINOIDEA OF THE CLINTON GROUP.

The Crinoidea peculiar to this group are few and rare; and though the joints of a single species are very abundant in some localities, the remains of this class of animals do not in general form any distinguishing feature of the strata.

In the lower part of the group, and particularly in the eastern and central localities, these remains are rarely seen, with the exception of some peculiar rings in the ore beds of Herkimer county. After passing west of the Genesee river, the upper limestone is often composed in great measure of the fragments of crinoidal columns; and at Lockport, numerous fragments of columns and some of the bodies have been found, but even here they are obscure and unsatisfactory. At this locality, however, I have found, in the upper limestone of the group, fragments of HYPANTHOCRINUS and CARYOCRINUS, which we regard as typical of the Niagara group. In the same limestone, Col. JEWETT has found the body of a CARYOCRINUS, exhibiting a curious anomaly in the development of the plates.

*** The description of the crinoidea of this group will be deferred in this place, and given altogether with those of the Niagara group.

BRACHIOPODA OF THE CLINTON GROUP.

The very considerable number of species of Brachiopoda which occur in this group, and which are not found elsewhere, make it desirable to study and illustrate them separately. The species which are known to ascend into the Niagara group are generally inconspicuous in this group, being few in number, while the typical forms are abundant. The most conspicuous species is the *Pentamerus oblongus*, and the most numerous the little *Atrypa hemispherica*, and almost equally so the *A. congesta*, all of which seem remarkably restricted in their vertical range.

Regarding the limited thickness of the group, and the circumscribed area which is accessible along its line of outcrop, the Brachiopoda are really very numerous, showing in fact a group of species not to be mistaken or confounded with those of any other group. With the exception of an inconsiderable number, the species are strongly contrasted with those of the lower period; and this fact will become more apparent as we study them more carefully. On the other hand, we at once perceive the introduction of types which assimilate the species of this group with the succeeding ones, and which are eminently typical of the Middle Silurian period.

We observe at this period a great diminution in the number of species of Orthis, while the individuals are likewise rare : the forms known are, with one exception, nearly equivalved, and we have few of those with coarse striæ.

In the leptænoid type we find at this period, for the first time, the introduction of those forms with a crenulated hinge-line (the Genus Stropheodonta). The remarkable form Chonetes, is also first introduced at this period, and, with the preceding genus, continues throughout the system.

The species of Atrypa are comparatively more numerous than Leptæna or Orthis, when compared with the preceding period. In this genus we perceive the introduction of the smooth, rounded or subcylindrical forms, which can scarcely be said to occur in the lower period of the system. We also recognize, in several species, characters which are observed in a single species in the lower period, and which proves the necessity of a separation among the forms now grouped under this genus, into several genera.

Lastly we have the introduction of the Genus Pentamerus, which is wholly unknown in the preceding period, and which eminently typifies the middle portion of the series in this country. Already we know about seven or eight species, all of them occurring between the Clinton group and the Onondaga limestone inclusive, while not a single one is yet known in any higher or lower position.

434. 13. LINGULA OBLONGA.

PL. XX. Fig. 1 *a, b, c, d.*

Lingula oblonga. CONRAD; Annual Geol. Report of 1839, p. 65.
Lingula clintonii. VANUXEM, Geol. Report Third Dist. N. Y., 1842, p. 79, fig. 4.
Lingula oblonga. Geol. Rep. Fourth District, 1843, p. 77.

Shell oblong, the sides nearly straight and parallel; abruptly rounded or sub-acute above; truncate, with scarcely rounded angles at the base; flat below, and very convex towards the beak, the shell extending thence in a ridge; surface marked by concentric lines of growth and fine longitudinal or sub-radiating striæ.

The general aspect of the surface is smooth, but the longitudinal lines are often more distinct than the concentric lines. The shell is very flat at the base, but is elevated into a ridge towards the beak. The general proportions of the shell are somewhat variable, owing, partially, to pressure; but it is readily distinguished by its straight nearly parallel sides, and nearly equal width throughout.

Fig. 1 *a.* A young individual of this species.
Fig. 1 *b.* A specimen of the ordinary size of this shell.
Fig. 1 *c.* Specimen longer than the usual form.
Fig. 1 *d.* A portion of the surface enlarged, showing the longitudinal striæ and concentric lines of growth.

Position and locality. This species occurs in the sandstone of the lower part of the group, at a quarry near Martville, Cayuga county. (*State Collection.*)

435. 14. LINGULA OBLATA.

PL. XX. Fig. 2 *a, b, c.*

Lingula oblata. HALL, Geol. Rep. 4th Dist. N. York, 1843, p. 77; fig. 8, p. 76.

Shell very wide in proportion to its length (length and width usually as 8 to 6 or 9 to 7); base truncated; surface marked by exceedingly fine concentric striæ, which appear under a magnifier as if crenulated; interior of the valve marked by a longitudinal depressed line. Some apparent longitudinal folds or striæ in a single specimen.

This shell differs from the preceding one very essentially, and is readily distinguished by its close fine striæ, which are evenly distributed over the surface: in addition to these, there are concentric undulations or folds sometimes very distinctly preserved towards the margin. The interior of the shell is nearly smooth, with the exception of the longitudinal impressed line, and a few partial concentric folds near the beak.

Fig. 2 *a.* A figure of an individual of the ordinary size of this species.
Fig. 2 *b.* A portion of the surface enlarged.
Fig. 2 *c.* The inner surface of a specimen, showing the longitudinal depressed line.

Position and locality. In the green shales of the group at Sodus, and particularly in the dark greenish shales associated with the iron ore bed at Wolcott. (*State Collection.*)

436. 15. LINGULA PEROVATA.

PL. XX. Fig. 3 *a, b.*

Shell abruptly obovate, as wide as long, the base regularly rounded and the sides much expanded; beak abruptly acute; surface marked by fine, rather distant, elevated concentric lines; intermediate spaces smooth to the naked eye, but exhibiting under the magnifier fine scarcely elevated concentric lines.

This shell is readily distinguished by its form (being as wide as long), by its distant concentric striæ, and absence of longitudinal striæ.

Fig. 3 *a.* Specimen natural size.
Fig. 3 *b.* The specimen enlarged.

Position and locality. In the upper green shale of the group at Rochester.

437. 16. LINGULA LAMELLATA.

PL. XX. Fig. 4 *a, b, c.*

Shell subelliptical, acute at the beak and broad below; surface regularly convex, and the sides curving downwards and apparently inwards, surface marked by strong transverse curved and elevated lamellose lines not parallel to the lines of growth; fine concentric lines of growth visible near the beak on either side; beak acute, and neatly defined.

This species is the most remarkable of all the forms of LINGULA observed; the sides below are nearly straight and parallel; the outline of the upper part and beak is very peculiar. The prominent features, however, are the transverse lamellose lines, which, instead of curving round and tending upwards towards the beak, terminate in the margin, the finer concentric lines of growth being visible only for a little space on each side below the beak. These strong lamellæ are equally visible on the inner side of the shell.

Fig. 4 *a.* A single valve, preserving the form and character of the shell very perfectly.
Fig. 4 *b.* A portion of the surface enlarged.
Fig. 4 *c.* The inside of a fragment of the shell of the same species.

Position and locality. The only perfect specimen of this species which I have seen, is from the late Mr. VANUXEM'S cabinet, and was obtained at a quarry near Clinton village, Oneida county. I have obtained fragments of the same species in Ruddock's quarry, east of Clinton village.

438. 17. LINGULA ACUTIROSTRA*.

Pl. XX. Fig. 5.

Lingula acutirostra. Hall, Geol. Rep. 4th Dist. N. York, 1843, p. 77 ; fig. 9, p. 76.

Shell broad below, tending abruptly to an acute point at the apex ; surface marked with a single series of rather coarse striæ.

This species is larger than *L. acuminata*, and the surface more strongly marked by the concentric striæ, as well as being more abruptly acute in form.

439. 21. ORTHIS CIRCULUS.

Pl. XX. Fig. 6 *a* – *g*.

Orthis circulus. Hall, Geol. Rep. 4th District, 1843, pag. 71, fig. 1.

Shell nearly circular, wider than high, nearly equivalved ; surface finely radiated ; rays arcuate, dichotomous, curving upward and running out on the hinge-line ; hinge area narrow and short, being little more than one-third the width of the shell ; dorsal valve somewhat depressed near the base, and the opposite valve with a corresponding elevation ; beak of dorsal valve small and neat, slightly curving over the area ; beak of ventral valve scarcely rising above the area line.

Fine concentric lines are barely visible in some parts of the shell, crossing the radiating striæ. These lines are probably conspicuous in other specimens : in the one before us, the surface has been partially injured by the decomposition of iron pyrites. The depression noticed in the dorsal valve is broad and undefined, as likewise the elevation on the corresponding valve.

In many respects this shell resembles the *O. hybrida* of the Niagara group, but differs from that species in its larger size, narrower area, and in the beak of the ventral valve being less elevated above the area line. In the interior, the figures of the casts of the two species show a decided difference. The *O. circulus* is similar in size and form to, and would readily be mistaken for, the species of the Delthyris shaly limestone ; but in the latter the beaks are more nearly equal, the area almost equal on the two valves, the striæ are less sharp and less arcuate, and the interior muscular impression and other characters differ still more widely. From the allied species of the Hamilton group, it differs still more widely than from either of those named.

The several species of Orthis, of which *O. circulus* is the earliest type known in our strata, approach each other in external characters so nearly that it requires careful observation to discriminate between them. They should not, however, on account of their similarity, be confounded with each other, nor regarded as a single species, which gives rise to much confusion and difficulty in geological investigations.

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* The specimen from which the description was made, and the only one known to me, has been lost or mislaid since the Geological Report was published. The species *L. elliptica*, described in my Geological Report of 1843, I do not include here ; having some suspicion that it does not belong to the Clinton group, and being unable to assign its true position.

Fig. 6 *a*. View of ventral valve, showing the beak of the dorsal valve.
Fig. 6 *b*. View of the dorsal valve.
Fig. 6 *c*. Profile view of the shell.
Fig. 6 *d*. Front view of the same.
Fig. 6 *e*. Cardinal view of the same.
Fig. 6 *f*. Cast of the dorsal valve of this species.
Fig. 6 *g*. The striæ enlarged, showing their mode of bifurcation and increase.

Position and locality. This species occurs in the lower shaly calcareous beds at Reynale's basin, Niagara county.

440. 22. ORTHIS ELEGANTULA ? Var.

PL. XX. Fig. 7 *a* – *k*.

Compare *Orthis elegantula*, DALMAN.
For references and synonyms, see *O. elegantula* under Niagara group in this volume.

Dorsal valve circular, being as wide as long, very convex and much elevated towards the beak; striæ not much elevated, of equal size and evenly bifurcating; cast of the muscular impression oblong, pointed above, and having a distinct impressed line towards the lower part.

Several of the specimens figured have many features unlike the ordinary forms of *O. elegantula*, but a careful examination has shown no reliable characters for specific distinction. Many of the specimens are larger than any individuals of that species in the Niagara group, where it reaches its maximum of development in regard to numbers. The dorsal valve is more often round, and it is usually circular or nearly so, having a proportionately greater width than specimens in the Niagara group. This greater width, however, may arise in part from pressure, as the specimens are less elevated than those of the Niagara group which have not suffered pressure.

Fig. 7 *a*. Dorsal valve of a specimen of medium size, somewhat distorted by pressure.
Fig. 7 *b*. Hinge-line and beak of dorsal valve. The hinge-line of the ventral valve is not quite so straight as usual in *O. elegantula*.
Fig. 7 *c*. Dorsal valve of a large individual.
Fig. 7 *d*. Profile view of 7 *c*.
Fig. 7 *e*. The cast of a dorsal valve of a small individual.
Fig. 7 *f*. Cast of the dorsal valve somewhat compressed.
Fig. 7 *g*. Dorsal valve with the shell partially removed.
Fig. 7 *h*. Dorsal area of 7 *g*.
Fig. 7 *i*. Showing the flattened striæ.
Fig. 7 *k*. Several of the striæ enlarged.

The forms here figured, which are some of the best defined, would not be readily recognized by the unaided student as belonging to the species, and it therefore seems desirable to illustrate it under these phases.

Position and locality. Nearly all the specimens were found in the lower green shale at Sodus, Wayne county. A few individuals of the smaller forms have been found at Rochester; but in the western extension of the group, none have been observed. (*State Collection.*)

441. 23. ORTHIS TRINUCLEUS (*n. sp.*).

PL. XX. Fig. 8 *a, b, c.*

Suboval, longer than wide; interior of ventral valve concave, presenting a strong longitudinal ridge and three strong obtuse teeth at the hinge.

The only specimens (except very imperfect ones) which I have seen, are the interior of the ventral valve and a cast of the same. The interior is smooth, with the prominent ridge noticed, and three conspicuous teeth in the hinge, which, with its rather elongated form, distinguish it from any other species.

Fig. 8 *a.* Interior of ventral valve.
Fig. 8 *b.* Cast of ventral valve.
Fig. 8 *c.* The same magnified.

Position and locality. In the impure iron ore bed at Cental's mill, Wayne county.

442. 24. ORTHIS TENUIDENS (*n. sp.*).

PL. XX. Fig. 9 *a – e.*

Ventral valve nearly flat, with a depression along the centre, and becoming slightly convex above the centre; hinge-line nearly or quite as long as the width of the shell; surface finely striated; striæ somewhat in fascicles; hinge showing three small thin teeth, which are closely approximate, middle one very short; muscular impression obovate or obcordate.

This valve resembles the ventral valve of *O. elegantula;* but the hinge-line is proportionally longer, the teeth smaller and closer together, and the muscular impression of different form.

The form of this shell, and its general appearance, are much like LEPTÆNA; but it appears, however, to be a true ORTHIS.

Associated with the ventral valves, which are preserved mostly as casts, are impressions of a very convex dorsal valve, which, probably, is of the same species.

Fig. 9 *a.* Ventral valve with the shell partially removed.
Fig. 9 *b.* A more perfect cast, showing the form of the muscular impression.
Fig. 9 *c.* The last enlarged.
Fig. 9 *d.* The impression of a dorsal valve.
Fig. 9 *e.* The last enlarged.

Position and locality. This species occurs in considerable numbers in an iron-stained shaly sandstone, and also in semi-calcareous layers, on the road from New-Hartford to Clinton village, Oneida county. (*State Collection.*)

146. 9. LEPTÆNA SERICEA.

Pl. XXI. Fig. 1 *a, b, c, d, e.*

For synonymy and references, see Pal. N. York, Vol. i, p. 110.

Strophomena elegantula. Hall, Rep. 4th Geol. Dist. N. York, 1843, pag. 73; fig. 1, p. 72.

Semicircular or semioval; hinge-line extending beyond the length of the shell, into acute points; surface marked by strong elevated striæ, and finer ones between; dorsal valve very convex.

M. de Verneuil has suggested that the *S. elegantula* cited, is identical with the *L. sericea* of the lower strata; and on a careful comparison, I am unable to find constant characters, by which to distinguish the one from the other. The specimens in the Trenton limestone and Hudson-river group rarely show the great difference in the size of the striæ, which are so conspicuous in the Clinton specimens. The dorsal valve in the latter specimens is always very convex, and much more so than in specimens from the lower rocks. The Clinton specimens often show a depression, commencing at the beak of the convex valve, expanding towards the centre of the valve, and becoming obsolete below. This feature is not conspicuous in specimens from a lower position. Still I am unable to show constant and reliable characters to distinguish this as a species.

Fig. 1 *a.* A large individual, preserving the shell nearly entire.

Fig. 1 *b.* A specimen preserving a portion of the shell, and showing in the cast the puncta which are so characteristic in this species.

Fig. 1 *c.* A cast of the same, showing the strong puncta produced by the small spines of the interior of the shell.

Fig. 1 *d.* A portion of the shell enlarged, showing the larger and smaller striæ.

Fig. 1 *e.* A similar portion of the cast, showing the puncta.

Position and locality. This species is found in the green shale at Rochester; also at Sodus in Wayne county, associated with *Graptolithus clintonensis*, and with *Atrypa reticularis.*

(*State Collection.*)

443. 18. LEPTÆNA CORRUGATA.

Pl. XXI. Fig. 2 *a, b, c, d, e, f.*

Strophomena corrugata. Conrad, Jour. Acad. Nat. Sci. Philadelphia, Vol. viii, pag. 256, pl. 14, fig. 8.
— — Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 73, fig. 2, p. 72.

Semioval, nearly flat; hinge-line extending into small acute ears; surface marked by fine prominent striæ, which alternate with finer ones; striæ usually unequal, but often equal in size and regularly bifurcating, crossed by fine concentric lines; the hinge-margin marked by oblique folds, which are sometimes obsolete: cast striated, except on each side of the beak and below, where it is punctate.

This is a very beautiful species, found in the upper green shale at Rochester, more commonly than elsewhere. The striæ are usually unequal in size, increasing not by regular bifurcation, but by the appearance of a small one between the larger, which, if followed, becomes in turn large, while a smaller one takes rise between it and the next : in some instances, the increase is by regular bifurcation. The fine concentric striæ are often obsolete. The shell is usually marked by several oblique plications along the hinge-line on each side of the beak, but these marks are not always visible in compressed specimens. In these oblique folds the shell resembles a species of the Trenton limestone (*L. subtenta*), but it is entirely distinct. The interior of the dorsal valve is striated nearly to the beak, and the striæ appear to be regularly bifurcating.

Fig. 2 *a*. A young individual, with the striæ very unequal, and the folds on the hinge-line scarcely conspicuous.
Fig. 2 *b*. A larger individual, with the shell partially removed from near the beak.
Fig. 2 *c*. The interior of a dorsal valve, showing the striæ equally bifurcating.
Fig. 2 *d*. An old individual, with the shell entirely removed about the beak, and partially removed from other portions; the concentric striæ being still partially preserved.
Fig. 2 *e*. An obscure cast in sandstone, where the striæ appear to be nearly equal.
Fig. 2 *f*. A portion of the surface of the shell enlarged.

Position and locality. This species is found in the upper green shale of the group, more abundantly than in any other position. It is likewise found in the Pentamerus limestone at Rochester, Sodus, Wolcott, &c.

444. 19. LEPTÆNA PATENTA.

Pl. XXI. Fig. 3 *a, b, c.*

Shell resupinate, wider than high (about as ten to twelve, and varying as eleven to fourteen); hinge-line apparently not extended beyond the width of the shell; surface marked by fine unequal striæ, which are crossed by fine concentric lines; concave (dorsal) valve with the muscular impression foliated; inner surface thickly covered with sharp points, which extend into the muscular impression; rays scarcely visible on the inside of the shell.

This species closely resembles the *L. subplana* of the Niagara group, with which species I had been inclined to unite it; but it differs in the finer and more numerous rays, which are less sharply elevated, and in the interior, which is nearly free from rays and very papillose, while the interior of the Niagara species is strongly rayed and scarcely papillose at all. The proportions of length and breadth are not greatly different in the two shells.

Fig. 3 *a*. The interior of the concave valve, showing the muscular impression.
Fig. 3 *b*. The exterior of the concave valve of another individual.
Fig. 3 *c*. A portion of the surface enlarged.

Position and locality. This species occurs in the calcareous layers above the lower green shale at Reynale's basin, at Medina, and other places. It has not been recognized in the upper part of the group.

445. 20. LEPTÆNA PROFUNDA (*n. sp.*).

Pl. XXI. Fig. 4 *a, b.*

Shell large, semioval, much wider than high; hinge-line extended beyond the width of the shell; ventral valve profoundly concave (the depth being $\frac{3}{4}$ of an inch), bending very abruptly upwards; surface marked by fine unequal striæ; interior surface papillose or punctate, depending on the degree of weathering.

This shell differs greatly from the last, as also from any other species of the group, by the great concavity of the ventral and convexity of the dorsal valve. The specimens are usually very imperfect, and the external characters obscure. The one figured is the interior of the ventral valve, which preserves the hinge-line, showing the projecting, grooved and bidentate process through which the pedicel passed. The interior surface is finely striato-punctate; but the specimens being mostly weathered, it varies in the appearance of the markings.

Fig. 4 *a.* The interior of the ventral valve, which is worn on the upper part, and striato-punctate below.

Fig. 4 *b.* A portion of the surface enlarged.

Position and locality. This species is known only in the upper limestone of the group at Lockport, Niagara county. (*State Collection. Collection of* Col. Jewett.)

445. 20. LEPTÆNA PROFUNDA? (young shell?).

Pl. XXI. Fig. 5 *a, b, c.*

Dorsal valve very convex, flat near the hinge, and bending abruptly downward and inward towards the margin; surface marked by large striæ alternating with four or five smaller ones, which are all crossed by fine concentric lines.

The shape of this young shell resembles the preceding so nearly, that I am inclined to unite them, though I have had no good opportunity of examining the surface of individuals in the intermediate stages of growth. The shell (the dorsal valve) is extremely convex, corresponding in this respect to the deep concavity of the large ventral valve fig. 4.

Fig. 5 *a.* Outer surface of specimen. 5 *b.* Profile view of same. 5 *c.* The striæ enlarged.

Position and locality. In the lower limestone of the group, corresponding in position to the *Pentamerus oblongus*, Reynale's basin, Niagara county. (*Collection of* Col. Jewett.)

446. 21. LEPTÆNA OBSCURA.

Pl. XXI. Figs. 6 *a*, 6 *b*.

Shell semioval, width and height in proportion of five to four; hinge-line extending slightly beyond the width of the shell; dorsal valve nearly flat; surface marked by fine sharp striæ, which bifurcate near the beak, and towards the margin increase by other smaller ones coming in between; concentric markings not visible in our specimens.

This species is nearly flat, and somewhat resembles *L. corrugata;* but is destitute of the folds along the hinge margin, and the striæ are likewise sharper.

The specimen fig. 6 *b* is a cast in shaly sandstone; and the striæ, though preserved, are less sharp, and apparently more numerous than in the shell 6 *a:* still there appears no specific difference between them.

Position and locality. The specimen 6 *a* was found on the Saquoit creek south of Utica, in the position near the upper ore bed. The specimen 6 *b* is a cast from the shaly sandstone associated with the ore beds in the town of Kirkland, Oneida county. (*State Collection.*)

447. 22. LEPTÆNA ORTHIDIDEA.

Pl. XXI. Fig. 7.

Shell semioval, somewhat wider than high; hinge-line rather less than the width of the shell below; dorsal valve slightly convex, finely striated; striæ somewhat in fascicles; dental lamina thick at the foramen, and extending downwards into the shell with a gentle curve; muscular space oval, scarcely wider below than above.

The specimens which I have of this species, are all casts in shaly sandstone; but the characters preserved are sufficient to distinguish it from any of the preceding. It has a peculiar Orthis-like aspect; and the striæ being apparently sometimes in fascicles, contributes to this impression. The peculiar curving of the dental lamella is the distinguishing feature of the cast.

Fig. 7. Cast of the dorsal valve of this species, from a fragment containing several others.

Position and locality. In the shaly iron-stained sandstone associated with the ore beds in Kirkland, Oneida county.

448. 23. LEPTÆNA DEPRESSA.

Pl. XXI. Fig. 8.

This species is of somewhat frequent occurrence in this group, though it is usually somewhat imperfectly developed, being often of small size and obscurely marked. I have given this cast of the dorsal valve, as indicating its occurrence simply at this period.

This species, which may be identical with *L. tenuistriata* of the lower silurian strata, is not abundant in the Clinton group, but becomes abundant and well defined in the Niagara

group, and finally reaches its maximum development at the period of the Delthyris shaly limestone. In the Onondaga and Corniferous limestones it is still quite frequent, but has assumed in some degree other characters.

The figure in the Geological Report of the Third District, page 79, was drawn from a Niagara specimen, and I have never seen specimens in the Clinton group so perfect and well developed.

Position and localities. This species occurs in the lower calcareous beds of the group; in the shaly sandstones associated with the ore beds in Kirkland; in the fucoidal beds near Clinton and other places; in the Pentamerus limestone at Rochester, and in the higher shale and limestone of the group at numerous localities farther west. (*State Collection.*)

New Genus STROPHEODONTA.

[Gr. στροφευς, *cardo*, and οδους, *dens.*]

Shell with the general form and characters of Leptæna (viz. one valve convex and the other concave, the concave one following the same curve, and nearly parallel to the convex one); cardinal area continuous, nearly linear, mostly occupied by the dorsal valve, striated transversely; foramen decidedly closed; ventral valve with the hinge-line uninterrupted; margins of the hinge-line crenulated; area striated very strongly in the transverse, and more slightly in the longitudinal direction*. Muscular impressions somewhat bilateral.

The crenulated hinge-line is a very strong distinctive character, since in Leptæna this margin is smooth. In true Leptæna, also, the area is striated only longitudinally (that is in the direction of the hinge-line), and the foramen is in part occupied by a projection of the ventral valve which fills it; while in Strophedonta, the foramen, if it ever existed, is entirely closed by the growth of the dorsal valve, and the hinge-line of the ventral valve is straight and continuous.

The striæ of the shell in many species of Strophedonta differ from those of Leptæna, and some of the species are readily distinguished by this character alone.

449. 1. STROPHEODONTA PRISCA (*n. sp.*).

Pl. XXI. Fig. 9 *a, b.*

Shell semioval, wider than long, apparently contracted at the extremity of the hinge-line; hinge-margin crenulated; striæ fine, closely arranged.

The specimen is an imperfect valve, nearly flat, with the hinge-line distinctly crenulated; but it is interesting as being the earliest known species of this type, appearing at the same period with Chonetes. The specimen figured is a cast, or rather impression of the inner side of the concave ventral valve, and the impression left in the stone is consequently concave. It is

* The *Leptæna demissa* of Conrad (Hamilton group), may be regarded as the type of this genus.

impossible, therefore, to know precisely what the external characters of the shell are, until we have more perfect specimens.

Fig. 9 *a*. The specimen, natural size.
Fig. 9 *b*. The crenulated hinge-line, enlarged.

Position and locality. This shell, with *Leptæna orthididea* and *L. depressa*, occurs in shaly laminated sandstone highly charged with oxide of iron, associated with the iron ore beds in the town of Kirkland, Oneida county. (*State Collection.*)

Genus CHONETES (Fischer).

This genus has the same form as *Leptæna*, and is distinguished principally by a row of tubular spines on the margin of the dorsal valve bordering the area.

450. 1. CHONETES CORNUTA.

Pl. XXI. Fig. 10 *a* – *f*.

Strophomena cornuta. Hall, Geol. Rep. 4th Dist. N. York, 1843.
Chonetes cornuta. De Koninck, Recherches sur les animaux fossiles, 1847, Part 1, pag. 200, pl. xx, fig. 3 *a*, *b*.

Shell semicircular; surface covered with fine equal striæ, which are equal to the spaces between them; striæ round, straight, bifurcating; upper margin of the dorsal area with three tubes or spines on each side of the beak; spines oblique or divergent below, curving inwards at the middle and upper parts, outer ones largest; area extremely narrow; interior surface striato-punctate as in Leptæna.

This shell bears some resemblance to *Chonetes lata* (*Leptæna lata*), Sil. System, pl. 5, fig. 13; but a comparison of specimens has shown them decidedly distinct species.

This species is more flat than the small one in the Corniferous limestone and Hamilton group, which it resembles. It is evidently very limited in its geological as well as geographical range. It is commonly seen in the form of casts, the shell being extremely thin and usually separated; and the spines are often removed with the shell, so that it becomes necessary to rely on the form of the shell, striæ, etc., to distinguish the species.

Fig. 10 *a*, *b*. Two specimens of the natural size (ventral and dorsal views), having the spiniform tubes attached.
Fig. 10 *c*. A small fragment of green slate, with several valves upon the surface, some of them destitute of spines.
Fig. 10 *d*. The dorsal valve enlarged, showing its appearance when magnified to double the natural size.
Fig. 10 *e*, *f*. Enlarged portions of casts of the hinge and dental processes of the dorsal and ventral valves, as seen under a magnifier.

Position and locality. In the upper green shale of the group, associated with *Graptolithus clintonensis*, at Sodus bay, Wayne county. This shell is unknown beyond this locality.

(*State Collection.*)

172. 1. SPIRIFER* BIFORATUS, *var.* LYNX.

Pl. XXII. Fig. 1 *a - e.*

For synonymy and references, see Pal. N. York, Vol. i, p. 132.

Delthyris brachynota. Rep. 4th Geol. Dist. N. York, 1843, p. 71 ; fig. 6, p. 70.

This shell is evidently identical with the *D. lynx* of the lower strata. M. de Verneuil has suggested the analogy in his paper on the parallelism of American and European rocks, page 655 ; and he mentions having found fragments of the same shell in the Clinton group in Ohio. All the specimens I have seen in this position are single valves, and so much worn as to present no indication of the concentric undulating lamellæ. There is no difficulty, however, in identifying the shell, after being acquainted with *D. lynx* as it appears in the lower rocks. In 1843 I had seen no figure or description of *D. lynx*, and had then had no opportunity of studying the species of the lower rocks which have since engaged my attention.

The figures on Plate 22 give the usual appearance of this fossil, as it is found in the Clinton group.

Fig. 1 *a.* Ventral valve, with a very short hinge-line. There are four mesial plates, and twelve or thirteen on each side. The great number of ribs on each side the mesial lobe is remarkable, being greater than in any specimen I have ever seen.

Fig. 1 *b.* The ventral valve of another specimen, having the mesial lobe worn smooth, and ten ribs on each side. The hinge-line is somewhat more extended than in the preceding specimen.

Fig. 1 *c.* The dorsal valve of a large specimen, having four ribs in the mesial sinus, and ten on each side.

Fig. 1 *d.* The interior of the dorsal valve, showing the form of the muscular impression, and the papillose surface on each side.

Fig. 1 *e.* Cardinal view of the ventral valve, showing the projecting dental processes.

Position and localities. This species occurs, associated with *Pentamerus oblongus*, at Rochester ; and at Reynale's basin, Niagara county, associated with *Atrypa congesta* in the calcareous layers. M. de Verneuil mentions the occurrence of this species in the magnesian limestone at Springfield, Ohio. (*State Collection.*)

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*There seems no good reason for adopting the term *Delthyris* instead of *Spirifer*, since the latter name has precedence in point of time, and since the typical species of *Spirifer* given by Sowerby are generically identical with those given by Dalman as species of *Delthyris*. The latter name has besn adopted in this country to distinguish the true types of the original genus *Spirifer* from the apparently heterogeneous assemblage of species included under that genus by European authors. Hereafter in this work the name of *Spirifer* will be adopted in place of *Delthyris*.

451. 2. SPIRIFER —— (*n. sp.*).

Pl. XXII. Fig. 2.

Dorsal valve three-fourths as high as wide (compressed in the specimen described), rounded at the extremities; hinge-line short; mesial sinus broad and shallow, not well defined, marked by four ribs; surface of the shell on each side the mesial sinus marked by twelve or more ribs; ribs rounded or flattened, smooth or with slight indications of longitudinal striæ.

The specimen is a single dorsal valve, which has been somewhat distorted by pressure; but the characters remaining seem to be sufficient to distinguish it from any known species in this part of the series. The extremities of the hinge-line are remarkably contracted. There appear to be some remains of longitudinal striæ upon the surface of the ribs, as in *D. niagarensis;* but that species is readily distinguished by having fewer ribs on the sides, and none in the mesial sinus.

Position and locality. In the thin calcareous layers associated with the lower shale near Sodus, Wayne county.

452. 3. SPIRIFER RADIATUS.

Pl. XXII. Fig. 3 *a – t.*

Spirifer lineatus. Sowerby (not Martin), Min. Conchology, pag. 151, tab. 493, fig. 1 & 2.
S. radiatus. Sowerby, Sil. System, pag. 637, pl. 12, fig. 6; and pag. 638, pl. 21, fig. 5.
Delthyris radiatus. Geol. Rep. 4th Dist. N. York, 1843, p. 105, fig. 2 *a, b.*

Shell variable in form, subtriangular, rotund or subglobose; valves almost equally convex, the beak of the dorsal valve more or less extended, and curving over the ventral valve; hinge-line often less than the width of the shell, the extremities being rounded; surface marked by fine close radiating striæ; mesial elevation and depression moderate, marked by the striæ as other parts of the shell; dorsal area more or less exposed, and giving a very variable appearance to the shell; foramen narrow and long, often partially or entirely closed by a callosity; interior plates of the dorsal valve near together, and extending downwards within the limits of the mesial depression.

This shell has occasioned so much doubt and perplexity among several amateurs, that I have given in this place figures of its principal forms, and the variations to which they are subject. The beaks of the two valves are often so closely approximated that no area is visible; and at the same time the extremities are rounded and contracted, so that the shell has more the appearance of an Atrypa than a Spirifer. In others the extremely wide dorsal area gives one the impression that there is a species having this constant character, and quite distinct from those with the moderate area and rounded extremities. After examining numerous specimens, I am able to see no distinction, and the numerous intermediate forms unite the whole as a single species.

Fig. 3 *a*. Ventral view of a specimen having the cardinal extremities somewhat contracted, and the dorsal area very wide and fully exposed.

Fig. 3 *b*. Profile view of the same.

Fig. 3 *c*. A specimen with the dorsal extremities more extended, and the area broad.

Fig. 3 *d*. An individual much extended in width, having the cardinal extremities rounded and the area almost closed.

Fig. 3 *e*. A similar specimen, larger than the last.

Fig. 3 *f*. A specimen with the hinge-line very much contracted and the angles rounded, with the area nearly closed.

Fig. 3 *g*. A specimen which has apparently suffered no pressure. The beaks are approximate, the dorsal one much curved, and the area nearly closed. The cardinal extremities are rounded, and the whole contour of the shell very rotund.

Fig. 3 *h*. Profile view of the last.

Fig. 3 *i*. Front view of the same, showing the elevation of the mesial lobe.

Fig. 3 *j*. A portion of the surface enlarged, showing the character of the striæ.

Fig. 3 *k*. Ventral view of a larger specimen with the cardinal extremities rounded, the beak much elevated and incurved, and the area very small.

Fig. 3 *l*. Profile view of the last.

Fig. 3 *m*. Dorsal view of the same.

Fig. 3 *n*. Front view of the same.

Fig. 3 *o*. Dorsal view of a larger specimen, having the extremities rounded, and the beak much elevated and incurved.

Fig. 3 *p*. Ventral view of the same, showing the area nearly closed.

Fig. 3 *r*. Cardinal view of the same shell.

Fig. 3 *s*. Dorsal view of a specimen with the shell partially exfoliated, showing the direction of the dental plates.

Fig. 3 *t*. Dorsal area of a single valve, showing the narrow foramen.

Position and localities. This shell appears in the iron ore beds and associated with strata in Wayne county, and likewise in the upper green shale of the group at Sodus in the same county. It is more abundant, however, in the upper limestone of the group at Lockport, Lewiston, and other places in Niagara county. It is less abundant in the same position at Rochester, and other eastern localities. It extends upwards into the Niagara shale (See Plate 54 and description). (*State Collection.*)

453. 24. ATRYPA CONGESTA.

Pl. XXIII. Fig. 1 *a* – *n*.

Atrypa congesta. Conrad, Jour. Acad. Nat. Sci. Philadelphia, 1842, Vol. viii, pag. 265, pl. 16, fig. 18.

— — Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 71, fig. 2.

Suborbicular, gibbous, often more or less ovate ; dorsal valve, much larger and more elevated at the beak than the ventral valve, with a deep mesial furrow which commences at the beak,

and gradually deepens and widens to the base of the valve, which is much elevated into a linguiform process filling a sinus in the ventral valve; mesial furrow of the dorsal valve margined by a more or less obtusely carinated fold, produced by a depression in the shell on each side of the sinus; ventral valve with a strong elevated mesial fold and a depression on each side, beyond which is sometimes an obscure fold; beak of the dorsal valve very closely curving over the beak of the ventral valve; entire surface marked by concentric striæ, with a few imbricating folds near the base.

This species is readily recognized in its usual appearance by its rotund and gibbous form. The variations are mainly due to the greater development of the carinæ on either side of the mesial fold and depression, which sometimes give the shell a different character, having three prominent folds on the ventral and four on the dorsal valve. This change usually takes place in the older individuals, while the younger ones present only the mesial fold and depression. The specimens usually found are smooth, the striæ having been worn or dissolved away; but in perfect specimens, they appear as fine raised threadlike lines.

Fig. 1 *a*. A young specimen.

Fig. 1 *b*, *c*. Dorsal and front view of a young specimen.

Fig. 1 *d*, *e*, *f*. Ventral view of three different specimens, showing the progressive development in the lateral folds of the ventral valve.

Fig. 1 *g*, *h*. Front view of *e* & *f*, showing the deep sinus in the ventral valve, and the linguiform process of the dorsal valve.

Fig. 1 *i*. Profile view of a full grown specimen.

Fig. 1 *k*, *l*. Dorsal valve and cardinal view of a specimen, where the lateral folds are more than usually developed.

Fig. 1 *m*. Interior of the dorsal valve, showing the simple dental processes on each side of the foramen.

Fig. 1 *n*. A portion of the surface enlarged, showing the striæ.

Position and localities. In the lower part of the Clinton group at Rochester, rarely; abundant at Reynale's basin, and Medina; and less abundant at Lockport. Also rarely at Flamborough head, Canada West.

454. 25. ATRYPA QUADRICOSTATA (*n. sp.*).

PL. XXIII. Fig. 2 *a*, *b*, *c*.

Shell gibbous, suborbicular; valves sub-equal; dorsal valve somewhat longer and higher towards the beak, with a deep mesial furrow corresponding to a prominent mesial fold on the ventral valve (this fold, in older shells, has a slight depression along the centre), each valve with two prominent plications on each side of the mesial fold, which reach to the margin or base of the shell; cardinal area extended on each side of the beak; surface marked by fine concentric striæ, which undulate on crossing the plications.

This species very much resembles those specimens of *A. congesta* where the lateral folds

have become prominent; but in that species these folds never reach the base of the shell, while they do so even in young individuals of the present species. In older individuals of *A. congesta*, the front of the ventral valve is more elevated and the sinus deeper than in this shell; while in the single young individual of this species known, the sinus is developed more than in the young of *A. congesta*. The cardinal line in *A. quadricostata* is much more extended than in *A. congesta*, and has more the appearance of a *Spirifer*. The species are therefore unquestionably quite distinct, as will be seen on comparing individuals.

Fig. 2 *a*, *b*. Ventral and front view of a young shell of this species.
Fig. 2 *c*, *d*. Ventral and front view of an older individual.
Fig. 2 *e*. Profile view of the same.
Fig. 2 *f*. A portion of the surface enlarged, showing the striæ.

Position and locality. In the lower part of the Clinton group at Lockport.

(*Collection of* Col. JEWETT.)

455. 26. ATRYPA BIDENS (*n. sp.*).

PL. XXIII. Fig. 3 *a*, *b*, *c*, *d*.

Compare *Terebratula bidentata*, DALMAN, HISINGER, &c.
Also *Terebratula decemplicata*, MURCHISON, Silurian System, pag. 641, pl. xxi, fig. 17.

Subpyramidal, oblate, the width greater than the height; valves subequal, the dorsal valve slightly more convex and extended at and near the beak; cardinal line not extended; margins abruptly sloping from the beak downwards; dorsal valve with a profound mesial depression, in the centre of which is a single small plication; front much elevated, and filling a sinus in the ventral valve; ventral valve with two plications on the mesial elevation; each valve with about five angular plications on each side of the mesial fold (rarely six on the dorsal valve); surface marked by fine concentric filiform undulating striæ; beak of dorsal valve small, closely incurved, and apparently perforate (from accident?).

This species closely resembles the *A. dentata** of the Trenton limestone, but differs in having the mesial depression less profound and not so much elevated in front. This species has likewise five or more plications on each side the mesial fold; while in that one there are but four on each side, though the specimen described is larger than those here figured. In the Trenton species the sinus is wider at the base, and the extension of the dorsal valve higher in front. Notwithstanding these differences, as well as a general difference in the aspect of the shells, they may readily be confounded on cursory examination.

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* This species has been regarded by several palæontologists as identical with *A. bidentata* of DALMAN. I have not been able to discover the identity of the two, on comparing our species with Swedish specimens. The resemblance is the same as between those and the one now described, or between either of them and the *A. duplicata* of the Chemung group.

Fig. 3 *a*, *b*. Ventral valve of two specimens of different age.
Fig. 3 *c*. Front or base of the larger specimen, showing the elevation of the sinus.
Fig. 3 *d*. Profile view of the same.

Position and locality. In the lower part of the Clinton group at Lockport.
(*Collection of* Col. JEWETT.)

456. 27. ATRYPA NEGLECTA.

PL. XXIII. Fig. 4 *a*–*f*.

Subpyramidal or subglobose, the beaks more or less elevated; valves very gibbous below, and tapering very abruptly to the beaks; mesial depression and elevation moderate, marked in the dorsal valve by three, and in the ventral valve by four plications; valves on each side of the mesial fold marked by from five to nine plications, which are angular and undivided to the beak; surface marked by undulating or zigzag striæ, which are usually obsolete; cardinal line not extended; beak of dorsal valve sometimes closely incurved, and in other specimens elevated and slit beneath the apex.

This species is also common to the Niagara group; and though more abundant, it is never so gibbous or rotund, but has a more triangular outline.

Fig. 4 *a*. A specimen with seven plications on each side of the mesial fold.
Fig. 4 *b*, *c*. Profile and front views of the same specimen.
Fig. 4 *d*, *e*, *f*. Ventral, dorsal, and profile view of a specimen with only five plications on each side of the mesial fold.

Position and locality. This species occurs in the lower part of the Clinton group at Reynale's basin, Niagara county, associated with *A. congesta*. (*State Collection.*)

457. 28. ATRYPA EQUIRADIATA.

PL. XXIII. Fig. 5 *a*–*e*.

Ovate; base rounded; sides long, tapering to the beak, which is small and narrow; valves nearly equally convex; beak of the dorsal valve projecting beyond the ventral valve, and slightly incurved; cardinal line not extended; valves without any apparent mesial depression or elevation, marked by from twenty-four to thirty-two rounded plications, which are undivided, and extend to the beak.

This is a pretty, symmetrical species, which is known to me as occurring only in the arenaceous beds of the group; the shell is usually destroyed, leaving partial or entire casts. It is distinct from any other known species in this group, but resembles one in the Niagara group, from which it will be distinguished by a less proportional width, a longer beak, and larger number of plications in comparison to the size.

Fig. 5 *a*, *b*. Ventral and profile view of a small specimen.
Fig. 5 *c*, *d*, *e*. Dorsal valves of three individuals of different size.

Position and locality. In the arenaceous layers near the base of the group in Oneida county, Blackstone's quarries. (*State Collection.*)

458. 29. ATRYPA EMACERATA.

Pl. XXIII. Fig. 6 *a*, *b*, *c*, *d*.

Flabelliform, subrhomboidal, trilobate; surface plicated; plications about eighteen, six of them raised in front on the mesial lobe, usually bifurcating equally, those on the mesial lobe often having a smaller one intercalated; concentrically marked by undulating imbricating lamellæ.

This species is known only in the green shales of Sodus and Rochester. All the specimens seen are flattened, and the shell partially or entirely destroyed. In the specimens figured, although the ribs are distinctly preserved over the entire surface, the outline and extent of the muscular impression are clearly perceptible. On the sides of the shell, the ribs are distinctly and equally bifurcating above the centre, and often near the beak; on the mesial lobe, in addition to this, there are other smaller ribs intercalated.

Fig. 6 *a*, *b*. Two individuals of this species in green shale.
Fig. 6 *c*. The surface enlarged, showing the concentric striæ.
Fig. 6 *d*. A cast of the beak of the same.

Position and locality. In the upper green shale at Sodus, associated with *Leptæna corrugata* and *Spirifer radiatus;* and in the same position at Rochester and intermediate localities.

459. 30. ATRYPA ROBUSTA.

Pl. XXIII. Fig. 7 *a*, *b*, *c*, *d*.

Subrhomboidal, trilobate; surface marked by eleven or twelve strong angular plications on each valve, four of which are raised on the mesial fold, and three in the depression of the opposite valve; plications crossed by abruptly undulating striæ; cardinal line not extended, and the sides sloping abruptly from the beak.

The specimen figured is somewhat compressed, the perfect form being more rotund. The species is readily distinguished by the small number of strong angular plications, which are undivided from the beak. In the specimen figured, the beak of the dorsal valve is broken off at the termination of the beak of the ventral valve; beyond which it extended some distance, as usual in species of this form. The concentric striæ in the specimen figured are nearly obliterated by exfoliation of the shell.

Fig. 7 *a*, *b*. Dorsal and ventral valve of a full grown specimen.

Fig. 7 *c*. Profile view of the same.

Fig. 7 *d*. Front view of the same, showing the three plications in the mesial sinus, and four on the elevation.

Position and locality. In the upper limestone of this group at Lockport.

(*Collection of* Col. JEWETT.)

460. 31. ATRYPA RETICULARIS.

PL. XXIII. Fig. 8 *a* – *e*.

Anomia reticularis. LINNÉ, 1767, Syst. Naturæ, 12th ed., Vol. i, p. 1152; 1798, Encyclop. Methodique, pl. 242, fig. 4 *a*, *b*, *c*.

Terebratulithus priscus. SCHLOTHEIM, Petrefactæ, 1820 : Nachtrage, pl. 17, fig. 2; pl. 20, fig. 4.

— *explanatus.* ID. Ibid. p. 263; Nachtrage, pl. 18, fig. 2.

Anomites reticularis. WAHLENBERG, 1821, Act. Soc. Sci. Upsalensis, Vol. viii, p. 65, no. 6.

Terebratula affinis. SOWERBY, 1823, Min. Conchology, Vol. iv, pag. 24, pl. 324, fig. 2.

Atrypa reticularis. DALMAN, 1827, Vet. Acad. Handlingar, pag. 127, pl. 4, fig. 2.

Terebratula cancellata. EICHWALD, 1829, Zool. sp., Vol. i, pag. 276, pl. 4, fig. 11.

Porambonites maxima. PANDER, 1830, Beitr. zur Geogn. Russland, pl. 16 B, fig. 7.

Terebratula prisca. LAMARCK, 1836, Anim. sans Vertebres, 2d edit., Vol. vii, p. 365.

— *reticularis.* BRONN, 1837, Leth. Geognostica, page 72, pl. 2, fig. 10.

— *prisca.* PUSCH, 1838, Polen's Palæontologie, p. 26.

— — VON BUCH, 1838, Mem. Soc. Geol. de France, Vol. iii, pl. 16, fig. 19.

Atrypa affinis. J. SOWERBY, 1839, in Murchison's Sil. System, pl. 6, fig. 5.

— *aspera.* ID. 1839, in Sil. System, pl. 12, fig. 5.

— *reticularis.* HISINGER, 1839, Leth. Suecica, pag. 75, pl. 21, fig. 11 *a*, *b*, *c*, *d*, e

Terebratula prisca. VON BUCH, 1840, Beitr. zur Geog. Russland.

— — J. SOWERBY, 1840, Geol. Transactions, 2d series, Vol. v, p. 703.

Atrypa aspera. ID. Ibid. pl. 56, fig. 23.

Terebratula prisca. EICHWALD, 1840, Sil. Syst. in Esthl., p. 141.

— *armiger.* ID. apud VON BUCH, 1840, Beitr. zur geog. Russland, p. 108.

Atrypa prisca. PHILLIPS, 1841, Pal. Fossils, pl. 33, fig. 145.

— *affinis.* VANUXEM, Geol. Rep. 3d Dist. N. York, 1842, p. 88.

— — HALL, Geol. Rep. 4th District, 1843, p. 108.

Terebratula reticularis. DE VERNEUIL, Geol. Russia and the Ural Mts., 1845, p. 9, pl. x, fig. 12 *a*, *b*, *c*.

Shell subrotund, more or less compressed, subtruncated above or on the hinge-line; valves more or less equal, the beak of the dorsal valve extending beyond the ventral valve, and the latter being deeper and more convex in older specimens; surface marked by dichotomous rounded striæ, which are crossed by concentric elevated lamellæ, giving a reticulated or decussated character to the surface.

It is impossible to give a definite description of this very protean species, which commences its existence in the Clinton group, and continues under various modifications through the succeeding strata as far as the Chemung group. In each of its geological positions, however, it presents peculiar characters, and we are able to decide at once the geological position of specimens, by these peculiarities.

On its first appearance in the Clinton group, it shows its variable character in a remarkable degree, and it is scarcely possible to avoid referring the individuals to distinct species. In many of the young specimens, the ventral valve is nearly flat, or slightly convex, with a depression along the centre from beak to base. In specimens of medium size the valves are nearly equal, and in older ones the ventral valve is the more convex. Again there are others where, in the young shell the ventral valve has no depression in the centre, and is equally convex with the dorsal valve. In the radiating striæ or plications it is equally variable; many specimens having them very distinctly dichotomous, while others are nearly undivided from the beak. In many young shells the concentric striæ leave the plications nodulose at their crossing; while there are specimens having the plications quite free from such characters, and entirely smooth.

Notwithstanding all these differences, however, there seems no possibility of drawing a line of separation between species, and I have therefore given the principal varieties of form under the same name. It never reaches the maximum size in this geological position; and though appearing in the Niagara group under one of its many variable forms, and again in the Pentamerus and Delthyris shaly limestones, it only reaches its greatest of size in the Onondaga limestone and Hamilton group, where it occurs in great numbers. Specimens of the form peculiar to these different geological positions will be given in the succeeding plates.

Fig. 8 *a*. A specimen of the ordinary size of this species in the Clinton group.

Fig. 8 *b*, *c*. Ventral and front view of a young specimen, in which the valves are equally convex, and the concentric laminæ very rugose.

Fig. 8 *d*, *e*. Dorsal valve and profile view of an older specimen, with the valves almost equally convex. The concentric laminæ are less prominent than in the preceding specimen.

Fig. 8 *f*, *g*. Ventral valve and cardinal view of a specimen slightly larger than the preceding, in which the dorsal valve is more convex, with a slight depression in the ventral valve, reaching from the beak halfway to the base.

Fig. 8 *h*. The dorsal valve of a specimen where the shell is partially exfoliated. The plications are flat, broad and scarcely dichotomous, extending to the beak undivided.

Fig. 8 *i*. The cast of the dorsal valve of a similar form, where the plications are flat and undivided.

Fig. 8 *k*, *l*. The ventral and dorsal valves of a young specimen, where the ventral valve is flatter than the dorsal, and has a distinct mesial depression.

Fig. 8 *m*, *n*. Front and profile view of a similar form, showing the inequality of the valves and the mesial depression. The striæ in these forms are all dichotomous.

Position and locality. This species occurs in the lower green shale at Sodus, in the Pentamerus limestone of the group, and in the upper shale and limestone, presenting much variety of form and appearance. (*State Collection.*)

461. 32. ATRYPA PLICATULA.

Pl. XXIII. Fig. 9 *a* – *h*.

Atrypa plicatula. Hall, Geol. Rep. 4th District, 1843, pag. 71, fig. 4.

Shell roundish ovate, plicated, sub-trilobate; valves nearly equal in old shells; dorsal valve, in young specimens carinate from the beak and depressed towards the base, in older shells with a mesial sinus or depression extending nearly to the beak; ventral valve in young shells almost flat, very slightly raised in front, in older shells slightly depressed along the centre near the beak, and elevated in a mesial fold towards the base; plications two in the mesial depression and three on the mesial elevation, and from six to eight on each side; foramen extending to the beak; concentric striæ not obvious.

This shell, in its young state, resembles the *Atrypa modesta* of the lower strata, but in its older condition is very easily distinguished. It differs in the young shell in having the ventral valve more flat, and is without the larger plication in the centre which distinguishes the *A. modesta*. The dorsal valve of the latter is also distinguished by having a wider space between two stronger plications from the beak to base, while in *A. plicatula* there is no distinction in the plications or spaces between them. Near the base of the dorsal valve, also, there is a depression or sinus, which, though inconspicuous in young specimens of *A. plicatula*, never occurs at all in *A. modesta*. The beak of the dorsal valve in the latter species is also more extended beyond the ventral valve, and has the appearance of a narrow cardinal area.

Fig. 9 *a*, *b*. Ventral valve and profile view of a young specimen.
Fig. 9 *c*. Profile view of another specimen, in which the valves are still quite unequal.
Fig. 9 *d*, *e*. Front view of a young shell and a full grown individual.
Fig. 9 *f*, *g*. Dorsal and ventral valves of a specimen having the ordinary characters of full grown individuals.
Fig. 9 *h*. A larger individual.

Position and locality. This species occurs in the calcareous shale at Reynale's basin, associated with *A. congesta;* and is rarely found in any other locality.

462. 33. ATRYPA HEMISPHERICA.

Pl. XXIII. Fig. 10 *a* – *g*.

Atrypa hemispherica. Sil. System, 1839, pag. 639, pl. 20, fig. 7.

Shell hemispheric or semiorbicular, plicated; ventral valve flat, nearly orbicular; dorsal valve convex; hinge line extended and nearly straight; surface marked by from eight to twelve rounded or subangular simple plications, which are crossed by strong undulating and imbricating lamellæ.

This beautiful little species is very abundant in this group, occurring principally in the upper green shale, where it often forms thin calcareous layers in which the shells preserve a beautiful

silvery lustre. It is easily recognized by its convex, nearly orbicular dorsal and flat ventral valve, differing very widely from every species in the group except the following one, from which it differs in the smaller number and simpler character of its plications.

Fig. 10 *a*, *b*. Dorsal and ventral valve of young specimens. The dorsal valve in shale shows the concentric striæ less conspicuously than the smaller ventral valve preserved in iron ore, where more of the calcareous matter of the shell remains.
Fig. 10 *c*. A large dorsal valve, showing the concentric striæ near the base.
Fig. 10 *d*. A group of individuals on a fragment of stone.
Fig. 10 *e*. A cast of the ventral valve.
Fig. 10 *f*. Several plications enlarged.
Fig. 10 *g*. Profile of the elevation of the plications.

Position and locality. In the upper green shale at Rochester, very abundant; also less common near the Ridge road in Ontario; in the iron ore beds at the same place; at Cental's mill, and Sodus and Wolcott in Wayne county. It likewise occurs more rarely in localities west of Rochester. (*State Collection.*)

463. 34. ATRYPA PLANOCONVEXA (*n. sp.*).

PL. XXIII. Fig. 11 *a* – *h*.

Shell semiorbicular, plano-convex, longer than wide, plicated; ventral valve nearly flat, and often slightly concave; dorsal valve convex, subcarinate near the beak; beak small, prominent, and closely incurved over the ventral valve; surface marked by rounded dichotomous plications and concentric imbricating lamellose striæ; plications sixteen to twenty-four on each valve.

This species at first view resembles the *A. hemispherica*, but it differs very essentially on closer comparison: it is proportionally less wide; and the plications, instead of being simple, are dichotomous, more numerous, and rounded. The concentric striæ give the plications a rugose character, not noticed in *A. hemispherica*. The shell is also often marked by lines of growth near the base, which give it a rough and thickened appearance; which character has not been noticed in *A. hemispherica*.

Fig. 11 *a*. A young individual.
Fig. 11 *b*. Ventral valve, with the plications nearly all simple. The small neat beak is distinctly shown, projecting above the ventral valve, with the foramen open to the extremity.
Fig. 11 *c*. Dorsal valve of the same specimen, showing the plications more dichotomous.
Fig. 11 *d*. The dorsal valve, having a few of the plications in the middle larger than the others, and a small interstitial one in the centre.
Fig. 11 *e*. The dorsal valve of another specimen, in which all the plications are dichotomous, numbering twenty-six below the centre.
Fig. 11 *f*. Profile view of a specimen of ordinary size.
Fig. 11 *g*. A cast of the ventral valve.
Fig. 11 *h*. The interior of the hinge of a ventral valve.

Position and locality. This species occurs in the lower part of the group at Flamborough head, Canada West. (*State Collection.*)

464. 35. ATRYPA NAVIFORMIS.

PL. XXIV. Fig. 1 *a* - *k*.

Atrypa naviformis. HALL, Geol. Rep. 4th Dist. N. York, 1843, pag. 71, fig. 3.

Shell ovoid, gibbous, both valves very convex; dorsal valve much elevated, and angulated or subcarinated towards the beak; beak very strongly incurved; base extremely elevated, and extended into a linguiform process filling a deep sinus in the ventral valve; ventral valve very convex, and angulated towards the beak; surface marked by fine concentric lines and more distant elevated imbricating lines of growth, longitudinally marked by radiating striæ, which, on old shells, become quite conspicuous towards the margin; young shells with the fine concentric and radiating striæ rather inconspicuous, and the lines of growth very prominent.

This species, though in general form approaching several others in the group, is nevertheless very distinct. In old shells the valves are very gibbous, and subangulated towards the beak. The beak of the dorsal valve is more extremely incurved, and the front very perfectly continued into a linguiform process, which does not occur in the following species, nor in those of similar forms in the Niagara group. It is further distinguished by longitudinal striæ, which are quite conspicuous towards the margins of the valves in old shells. Its greater proportional width distinguishes it from the succeeding species, while its great depth and elevated front at once distinguish it from *A. intermedia*. It should not be forgotten, however, that in young shells the elevated front is not a characteristic feature, a slight indentation or sinus only being observable.

Fig. 1 *a*. View showing the ventral valve, with the elevated beak of the dorsal valve.
Fig. 1 *b*. View of the dorsal valve of a full grown shell.
Fig. 1 *c*, *d*. Front and cardinal view of the same shell.
Fig. 1 *e*. Profile view of the same.
Fig. 1 *f*. A portion of the surface enlarged.
Fig. 1 *g*, *h*, *i*, *k*. Several views of a young shell, the front 1 *i*, showing a scarcely formed sinus, contrasting in this respect very strongly with fig. 1 *c*.

Position and locality. In the upper limestone of the group at Sodus point, and in the same position at Rochester; it has been rarely seen in other localities. (*State Collection.*)

465. 36. ATRYPA CYLINDRICA (*n. sp.*).

PL. XXIV. Fig. 2 *a* - *h*.

Shell elongated, cylindrical, gibbous, width and depth equal; valves nearly equally convex, beak of the dorsal one much extended beyond and incurved over the beak of the ventral valve; dorsal valve moderately elevated in front, centre flat, or with a slight undefined de-

pression extending from the base nearly to the curve of the beak; lateral margins of the two valves uniting in nearly a direct line; surface marked by fine concentric lines, and stronger lines of growth; towards the margin, some fine radiating striæ are visible.

The peculiar form of this species distinguishes it from all the others of the group. It is nearly cylindrical, the depth of both valves, where the shell is closed, being equal to the width. The beak of the dorsal valve is much elevated above the ventral valve, but is not angulated as in the preceding species. There is a slight sinuosity in the front of the ventral valve, filled by a corresponding projection of the dorsal valve; but in ordinary specimens, this feature is scarcely observable. All the specimens seen are more or less exfoliated, so that the entire character of the surface can not be distinctly seen. The longitudinal striæ are quite effaced on some specimens, while in others they are very distinct towards the margin.

Fig. 2 *a*. View of the ventral valve, showing the beak of the dorsal valve elevated above it.
Fig. 2 *b*. Dorsal valve of the same.
Fig. 2 *c*. Profile view of the same.
Fig. 2 *d*, *e*, *f*. Ventral, dorsal and profile views of a smaller shell.
Fig. 2 *g* Cardinal view of the last.
Fig. 2 *h*. Front view of the same.

Position and locality. In the upper limestone of the group at Lockport, Niagara county. Probably also in other places in the same position. (*Collection of* Col. JEWETT.)

466. 37. ATRYPA INTERMEDIA.

PL. XXIV. Fig. 3 *a* – *f*, and 4 *a* – *d*.

Shell obovate, rapidly expanding in width from the beak nearly to the base, which is abruptly rounded; length and width nearly equal; valves almost equally convex, gibbous near the beaks, but becoming flattened below; front margin slightly sinuous; surface marked by concentric striæ and a few lines of growth.

This species, at first view, appears like one of the preceding ones flattened by pressure; but after examining a large number, I am satisfied of its specific distinction. It occurs likewise with *A. cylindrica*, and has been subjected to the same conditions. It is readily known by being much compressed towards the base, the beak less incurved than in the preceding forms, and its great width, which is nearly or quite equal to the length. The cast of this species is likewise peculiar, and serves to show that it is quite distinct from either of the preceding.

Fig. 3 *a*. View of the ventral valve.
Fig. 3 *b*. Profile view of the same.
Fig. 3 *c*. Cardinal view.
Fig. 3 *d*. Front view, showing the scarcely sinuous margins.
Fig. 3 *e*. A specimen with the shell partially removed, showing three strong elevated lines in the cast. These elevated lines are laminæ, marking the centre and margins of the muscular impression, but in entire casts they are not conspicuous.

Fig. 3 *f*. A cast of this species. The stone being granular, the mark *a* of the muscular impression is not well defined.

Fig. 4 *a*, *b*, *c*, *d*. Ventral, profile, cardinal, and front views of a young shell, apparently of the same species. The width and length are nearly equal, and the surface is marked by conspicuous lines of growth with intermediate finer concentric lines. It differs from the young of *A. naviformis* in being wider, less convex, and having the beak of the dorsal valve smaller and less strongly incurved.

Position and locality. This species is quite common in the upper limestone at Lockport, and probably elsewhere. The young specimen is from the same limestone at Sodus point, Wayne county. (*Collection of* Col. JEWETT.)

467. 38. ATRYPA —— (CAST).

PL. XXIV. Fig. 5 *a*, *b*.

The figures represent a cast of a species of ATRYPA, common in the ferruginous sandstone of the group. The cast of the rostral cavity is remarkably prominent and extended, and slightly incurved. The cast of the muscular impression on either side is marked by three distinct ridges, and in the portion below the beak are several other similar folds or ridges.

The rock in which it occurs is usually so friable that the more minute characters are not preserved. The cast is the only remaining evidence we have of the existence of this species, which, during a limited period, was quite abundant.

Fig. 5 *a*. Cast of dorsal valve.
Fig. 5 *b*. Profile of the same.

Position and locality. In the friable ferruginous beds associated with the ore beds of the group in Kirkland, Oneida county. (*State Collection.*)

468. 39. ATRYPA CYLINDRICA ? (CAST).

PL. XXIV. Fig. 6 *a*, *b*.

This cast is of a crushed and imperfect specimen, which is apparently the *A. cylindrica*. That portion extending into the beak is remarkably straight, flat, and thin : below this is a prominent triangular elevation, filling the muscular cavity. This elevated portion is margined on each side by a thin elevated ridge, having a stronger but less elevated one in the middle, and a smaller one on each side of the central one, halfway between it and the marginal ridge. On each side of the muscular impression, the cast is marked by prominent points for the attachment of muscular fibres.

Fig. 6 *a*. Dorsal view of cast.
Fig. 6 *b*. Profile view of the same.

Position and locality. Upper part of Clinton group at Lockport.

469. 40. ATRYPA GIBBOSA (*n. sp.*).

PL. XX. Fig. 10 *a, b, c, d.*

Shell subglobose; valves almost equally convex; muscular impression, as marked in the cast, shallow; cast of dorsal valve showing the foliated muscular impression, and thin abruptly acute beak; cast of ventral valve with a slit extending from the beak one third the length of the shell, and the surface marked by faint longitudinal elevations and depressions.

The casts of this species are not very unlike those of *A. reticularis*, but the muscular impression is less strong, and the depression on each side of the beak more marked, leaving the latter more prominent, and the general outline of the cast is more rounded.

Position and locality. In a hard siliceous layer in the central part of the group, near Clinton village, Oneida county. (*State Collection.*)

470. 1. PENTAMERUS OBLONGUS.

PL. XXV. Fig. 1 *a – m*; and PL. XXVI. Fig. 1 *a, b, c, d.*

Pentamerus oblongus. MURCHISON, Sil. System, 1839, pag. 641, pl. 19, fig. 10.
P. *lævis.* IBID. Idem, pl. 19, fig. 9.
P. *oblongus.* HALL, Geol. Rep. 4th Dist. N. York, 1843, pag. 7, fig. 1 – 5.

Shell oblong oval or ovate, sometimes oblate or suborbicular, often depressed, becoming ovoid in advanced stages of growth, also becoming sub-trilobate; young shells smooth, or marked only by fine scarcely elevated concentric lines; older shells more or less strongly marked by concentric ridges indicating stages of growth; younger shells often exhibiting two or three obscure longitudinal plications on eaeh valve, in addition to the trilobate character; beak of the dorsal valve much extended, and closely incurved over the ventral valve; slope from the beaks more or less abrupt; base rounded or subtrilobate. Cast of the dorsal valve with the division made by the central longitudinal plate reaching about one third the length of the shell; cast of the ventral valve with the central chamber narrow and almost linear, having a groove along the centre which reaches below the base of the separating plates, the latter extending a little more than one third the length of the shell.

It is impossible to give a description which shall be applicable to every form of a shell so variable as this species. In the smaller and medium sized forms, in the Pentamerus limestone of the Clinton group at Rochester and elsewhere, the shell has a general oval or ovate form, sometimes slightly trilobate at base; it is so much depressed that the thickness or depth of both valves is only about half the width. This proportion sometimes continues even in very old shells, the trilobate character of the base being often very conspicuous. In the majority of specimens, however, the valves become gradually more gibbous as the shell increases in size, and the trilobate character may be either preserved or entirely lost. In young shells, usually, the surface is marked only by concentric striæ; though in some instances distinct lines of

growth give a more uneven surface, and this character becomes more prominent with increasing age.

Although the general and prevailing form is oval or ovate, yet we not unfrequently meet with forms that are roundish, and the ventral valve wider than long. Increasing the variety of form and appearance, we may add, that the shells are often much broken, and appear to have been long macerated in water before becoming imbedded, so that perfect specimens are rare.

In localities west of New-York, this fossil occurs mostly in the form of casts, and presents a still greater variety of form than in the localities in this State. At Springfield and Dayton, Ohio, it occurs in yellowish gray limestone, the prevailing forms being apparently the trilobate and gibbous. I am indebted to I. A. Lapham, Esq., of Milwaukie, for some very fine casts from that locality, exhibiting in the greatest extreme the large gibbous and depressed trilobate forms.

I have collected this fossil, in the form of silicified casts, on the west side of the Mississippi river, having the same general characters as those from New-York localities; and I have a single specimen in translucent quartz, collected by the late Mr. Nicollet still farther to the northwest*. When to these localities we add its occurrence in Europe, we find this species one of the most persistent and widely distributed. So far as we know, also, it is the earliest created type of the genus; and though under its ordinary phases it has little of the form or aspect of the more recent species of the genus, nevertheless, in its various modifications it typifies many of those found in strata of succeeding groups.

The following figures illustrate, to some extent, the principal varieties of form that have fallen under my observation. Those not otherwise indicated are from New-York.

Plate XXV.

Fig. 1 *a*. Ventral view of a perfect specimen, the form being somewhat depressed, and slightly indicating the trilobate character of the base. This is an extremely neat and beautiful specimen of the species.

Fig. 1 *b*. The dorsal valve of a larger specimen, somewhat trilobate in form.

Fig. 1 *c*. The dorsal valve of a smaller specimen, more distinctly trilobate.

Fig. 1 *d*. The ventral valve less elongated and proportionally wider than the prevailing forms.

Fig. 1 *e*. The dorsal valve of a small specimen, having the trilobate form, with an unusually thick and prominent beak.

Fig. 1 *f*. A ventral valve nearly circular in form, being somewhat wider than long.

Fig. 1 *g*. A small dorsal valve of nearly circular form, excepting the prominence of the beak.

Fig. 1 *h*. A small ventral valve of circular form.

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* This specimen presents an interesting feature, not noticed in any other of this species in my collection, viz. a mesial depression in the ventral valve, which produces an extension or elevation in front, filling a sinus in the dorsal valve; this feature being the reverse of what it is observed in similar forms of Atrypa and other Brachiopoda, but characteristic of Pentamerus, as is distinctly seen in species of younger geological age.

We perceive here a regular gradation of form in the ventral valves, from 1 *a* through 1 *d*, 1 *f* and 1 *h*; and in the dorsal valve, through 1 *b*, 1 *c*, 1 *e* and 1 *g*, giving the principal varieties observed.

Fig. 1 *i*. A profile view of a small perfect specimen.

Fig. 1 *k*. The interior of two fragments of dorsal valves, showing that the single plate is in effect composed of double laminæ, produced by the folding inwards of the inner lamina of the shell.

Fig. 1 *l*, *m*. Dorsal and ventral view of a silicified cast of this species, showing in a very satisfactory manner the internal structure. The specimen is from Iowa, but resembles in form those of New-York, and is not more gibbous than the majority of specimens from this State.

PLATE XXVI.

Fig. 1 *a*, *b*. A cast : views of the dorsal and ventral valves of a very large and gibbous specimen.

Fig. 1 *c*. Cardinal view of the same, showing casts of the interlaminar spaces.

Fig. 1 *d*. Profile view of the same, showing strong concentric ridges of growth.

Position and localities. This species is very abundant in the Clinton group of New-York, appearing as casts or fragments of shells in the eastern and central part of the State, but becoming more numerous and perfect in Wayne county, where it is distributed through several feet in thickness of an impure limestone. At Rochester it occupies a thin layer of limestone which is almost entirely composed of this shell, packed together as if drifted upon a beach, the greater portion consisting of separated valves lying one within another. Westward of this point it is scarcely known within the State of New-York, but appears again in Ohio at several places, and is abundant at Milwaukie and the neighborhood of that place in Wisconsin, probably occurring along the northern outcrop of these formations entirely across the country from Lake Michigan to the Mississippi river. It occurs in Iowa and farther to the northwest on the tributaries of the Mississippi. (*State Collection.*)

471. 2. PENTAMERUS FORNICATUS (*n. sp.*).

PL. XXIV. Fig. 7 *a*, *b*, *c*, *d*.

Helmet-shaped; length and breadth nearly equal; dorsal valve extremely convex, arched and incurved over the ventral valve; beak very prominent, and abruptly incurved; ventral valve nearly circular, moderately convex; surface, particularly of the dorsal valve, marked by obsolete longitudinal plications and fine concentric striæ.

All the specimens of this species which have been obtained are more or less imperfect; and the one figured has the ventral valve crushed, and the shell removed from the beak of the dorsal valve. The dorsal valve usually presents about five or six plications, which are sometimes

quite distinct; in other cases they are less so, and sometimes there appears only a single mesial fold with a depression on each side.

Fig. 7 *a*. Ventral valve, with the large elevated beak of the dorsal valve incurved over it.
Fig. 7 *b*. Dorsal view of the same specimen.
Fig. 7 *c*. Cardinal view, showing the great convexity of the dorsal valve.
Fig. 7 *d*. Profile view of the same.

Position and locality. In the upper limestone of the group at Lockport, Niagara county.
(*Collection of* Col. JEWETT. *State Collection.*)

ACEPHALA OF THE CLINTON GROUP.

The species of Acephala of this group are comparatively few, and they form no very conspicuous palæozoic feature of the strata. With the exception of a few localities, they are extremely rare, and I have not yet seen a single species west of Rochester. The shales below the iron ore bed in the eastern part of Wolcott have furnished more than all the other localities; while one or two species are quite common farther eastward, in the non-calcareous portions of the group. It is probable that other localities (were they accessible), between the eastern part of Oneida county and Wayne county, would furnish a greater number of species and individuals; but this portion of the formation lies in a low, level tract of country, scarcely accessible at all from natural exposures, and there are few artificial ones. We are warranted in this inference from the fact that in New-Hartford and Kirkland we find several species in considerable numbers, which are unknown in the localities in Wayne county, while these localities furnish other species unknown in Oneida county. We infer, therefore, not only from these facts, but from similar ones in relation to most of the Brachiopoda, that the species existing at the period of this deposition were limited in their geographical extent, and consequently every locality discovered will disclose new species. Those which we now present, therefore, can not be regarded as a full exposition of these forms in the group; and in the Acephala this period is less perfectly represented than in the Brachiopoda, which have been collected from a greater number of localities extending over a wider space.

472. 6. AVICULA EMACERATA.

Pl. XXVII. Fig. 1 *a*, *b*.

Avicula emacerata. Conrad, Jour. Acad. Nat. Sci. Philadelphia, 1842, pag. 241, pl. 12, fig. 15.
Avicula leptonota. Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 76, fig. 5.
For description, see *A. emacerata,* Niagara group.

The specimens examined thus far present no real difference from the Niagara species, and I have thought proper to unite the two. The specimen figured in the Geological Report (Fourth District), has the form there represented; but on a more careful examination, I am inclined to believe that it is distorted by pressure. Other specimens in the same soft shale are evidently distorted in a greater or less degree, scarcely any two individuals preserving precisely the same form. Those now figured from the Clinton group are scarcely at all distorted, and present so many features in common with the species in the Niagara shale, that I have referred them to the same.

Position and localities. This species occurs in the ferruginous layers associated with the ore beds in Kirkland, Oneida county; also in the shaly layers at Blackstone's quarries, and in the soft shales below the ore bed in Wolcott, Wayne county. (*State Collection.*)

473. 7. AVICULA RHOMBOIDEA (*n. sp.*).

PL. XXVII. Fig. 2 *a, b, c, d.*

Shell rhomboidal, higher than long; hinge-line nearly straight, or slightly deflected; base rounded; sides nearly parallel, and slightly sinuous; beak prominent, and a little elevated above the cardinal margin; umbo prominent, becoming gradually depressed towards the margin; anterior wing short, rounded, and separated from the central part of the shell by a sinus; anterior wing triangular, not extending so far as the posterior margin of the shell; surface marked by concentric striæ, which become, at intervals, prominent folds indicating stages of growth.

In young specimens the beak is usually more sharply defined, the umbo more prominent, and sometimes the posterior wing is very acute. The specimens known occur mostly in sandstone, so that little more than a cast is preserved. In these casts there is no evidence of longitudinal striæ, and in a single specimen in shale there is likewise no evidence of such striæ. In sandstone the specimens are very convex, and even gibbous, while the one in shale is extremely compressed, giving a slightly different aspect.

Fig. 2 *a*. A large individual, in which the anterior wing is less prominent than usual.
Fig. 2 *b*. A smaller specimen.
Fig. 2 *c*. A young specimen, having the length nearly equal to the height.
Fig. 2 *d*. The posterior portion of another specimen, having the striæ more perfectly preserved and the angle of the wing more extended.

Position and localities. In the fine-grained sandstones near the base of the group at Blackstone's quarries, New-Hartford; and in the upper green shale of the group, associated with CHONETES, at Sodus, Wayne county.

474. 19. MODIOLOPSIS SUBALATUS (*n. sp.*).

PL. XXVII. Fig. 5, and 6 *a, b.*

General form ovate or sub-rhomboidal; posterior side expanded and sub-alate; umbo prominent, and the beak slightly elevated above the cardinal line; anterior side narrow, rounded or sub-acute; surface marked by fine equal concentric striæ.

This shell is usually of the size of those in fig. 5, of which considerable numbers occur at Rochester in the upper green shale, and particularly in a thin band of purple shale included in the former. It is associated with *Atrypa hemispherica;* but from its small size and compressed condition it scarcely attracts attention.

Fig 5. A fragment of slate, with figures of the right and left valve.
Fig. 6 *a, b*. Figures of the right valve of two specimens of large size. The specimen fig. 6 *a* is somewhat crushed, and the figure gives an incorrect representation of its true character.

Position and locality. In the upper green shale of the group at Rochester, and in the same position at Sodus; also in the shale beneath the ore bed in Wolcott. (*State Collection.*)

475. 6. TELLINOMYA LATA.

Pl. XXVII. Fig. 7.

Ovate; anterior extremity broadest, short and rounded, narrowing somewhat abruptly from the beak to the posterior extremity, which is acutely rounded; beak scarcely elevated above the cardinal line; surface marked with fine, scarcely elevated concentric striæ.

This shell has the general appearance of the succeeding species, but it is proportionally much broader, and more abruptly narrowed towards the posterior extremity.

Position and locality. This species has been found only in the shale beneath the ore bed in Wolcott, Wayne county.

476. 7. TELLINOMYA MACHÆRIFORMIS.

Pl. XXVII. Fig. 8 *a*, *b*, *c*, *d*, and 9.

Nucula machæriformis. Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 76, fig. 2.

Shell oval-ovate, much elongated; anterior side short, rounded; posterior side very much extended, and gradually narrowed towards the extremity; beak scarcely prominent; cardinal line extending about two-thirds the length of the shell; length nearly twice and a half the height; surface marked by fine equal concentric striæ, which are scarcely visible to the naked eye.

Fig. 8 *a*. The left valve of an individual of ordinary size.
Fig. 8 *b*. The right valve of a large individual.
Fig. 8 *c*. The right valve of a smaller individual.
Fig. 8 *d*. A small portion of the surface much enlarged, showing the concentric striæ.

These specimens are all of entire individuals, having the valves closely compressed.

Fig. 9 (*Cypricardia angusta*, Geol. Rep. 4th District, pag. 76, fig. 6). This fossil appears to be identical in its surface markings and general character with the preceding. The extreme narrowness of the valves appears to have been produced by pressure, which has otherwise left the shell uninjured.

This is the most abundant species of bivalve shell in the group; and it will be readily recognized by its elongated form, and proportionally short anterior extremity. It is extremely thin and delicate, having suffered more from pressure than any other species. The shell is rarely preserved in a perfect condition; and the specimens figured, though having both valves united, scarcely retain any marks of the striæ, though the substance of the shell still remains.

Position and locality. In the shale below the ore bed at Wolcott, Wayne county. (*State Collection.*)

477. 8. TELLINOMYA CURTA (*n. sp.*).

Pl. XXVII. Figs. 10 and 13.

Shell ovate-rhomboidal, length once and a half the height; anterior extremity short, abruptly rounded; beak elevated above the cardinal margin; posterior extremity obliquely truncated; posterior umbonal slope angular or sub-carinated, with a sinus between it and the margin of the shell; surface marked by concentric undulations.

This shell is readily distinguished from any of those preceding, by the obliquely truncated posterior extremity, and stronger folds upon the surface. The beak is also more elevated, standing prominently out from the cardinal line. In the drawing of fig. 10, the beak is incorrectly blended with the cardinal margin.

Position and locality. In the shales beneath the ore bed at Wolcott, Wayne county.

478. 4. ORTHONOTA CURTA.

Pl. XXVII. Fig. 11 *a*, *b*.

Orthonota curta. Hall, Geol. Rep. 4th District, 1843, pag. 76, fig. 1

Shell sub-quadrangular, oblong, length from twice and a half to three times the height; posterior umbonal slope sub-carinated; hinge-line straight; anterior extremity short, contracted in front of the beak, and rounded or sub-acute; posterior extremity obliquely truncated; surface marked by prominent concentric folds, which are more conspicuous on the anterior and central portions of the shell.

The proportions of this, as well as the other species, are much altered by pressure, as shown in the two specimens figured, which give the extremes noticed. The specimen fig. 11 *a*, however, retains more nearly its original form and proportions, judging from other specimens. It is readily recognized by the straight hinge-line and strong concentric folds.

This species possesses the true characters of the genus Orthonota, as established by Mr. Conrad.

Fig. 11 *a*. The right valve of a specimen of natural size and proportions.
Fig. 11 *b*. A specimen of the left valve, narrowed by pressure.

Position and locality. In the shale below the ore bed at Wolcott, and in the upper green shale at Rochester. (*State Collection.*)

479. 1. POSIDONIA? ALATA.

Pl. XXVII. Fig. 4.

Posidonia ? alata. Hall, Geol. Rep. 4th Dist. N. York, pag. 72, fig. 7.

Shell suborbicular, compressed, inequilateral, alate posteriorly, rounded before and on the base; hinge-line direct; beak slightly elevated above the cardinal line; surface marked with concentric undulations and finer striæ.

This shell can not with propriety be referred to Posidonia, and it seems equally inappropriate to refer it to any other established genus. The shell is distinctly alate posteriorly, though there is no sinus at the junction of the wing with the body of the shell, as in Avicula. The surface is smoother than in most species of Posidonia, though the external form is not sufficient to distinguish it.

The specimen figured is the only one found in this group, but a similar or identical species occurs in the Niagara group.

Position and locality. In the upper green shale of the Clinton group at Rochester.

Genus PYRENOMŒUS (*nov. gen.*).

[Gr. πυρηος, *nucula*, and ομοιως, *similis.*]

Shell equivalved, inequilatural; umbones prominent, beak elevated; a strong muscular impresssion near the anterior extremity; posterior musculer impression unknown; characters of the hinge not fully ascertained; surface concentrically striated.

This genus is constituted to receive those shells having the general form of Nucula, but which are destittte of the teeth or crenulations so characteristic of that genus. The shells included under this genus have not the transverse fold or clavicle which marks the Genus Cleidophorus; and although resembling in some degree the Modiolopsis in the anterior muscular impressions, they are contracted towards the posterior extremity.

Many shells are referred to the Genus Nucula, simply from external form, and which are entirely destitute of teeth or crenulations on the hinge-line. The present genus, with Cleidophorus, will include the greater proportion of those at present known to me.

480. 1. PYRENOMŒUS CUNEATTS (*n. sp.*).

Pl. XXVII. Fig. 3, and 12 *a*, *b*, *c*.

Shell robust, sub-cuneate; beak strongly elevated, and the umbo very convex or even gibbous; anterior extremity very abruptly rounded; posterior side elevated, rapidly narrowing from the beak to an acute extremity; surface marked by equal concentric striæ, and in older shells some stronger folds; cast marked by a prominent anterior muscular impression.

This shell has the form of NUCULA, but the hinge-line shows no teeth or crenulations. In the cast the cardinal line is smooth, and the surface presents only the mark of a single strong muscular impression at the anterior extremity, which is not prominent enough in the figures. In some specimens there is the appearance of a muscular fold near the posterior extremity, but it is not sufficiently defined to be reliable.

Fig. 3. This specimen, though differing to some extent in form, I have referred to the same species. It retains the shell, which is faintly striated, the beak remarkably elevated, and the anterior extremity abruptly rounded.

Fig. 12 *a*, *b*. The casts of opposite valves of specimens nearly of the same size.

Fig. 12 *c*. The cast of a large individual, showing several prominent folds parallel to the lines of growth.

Position and locality. The specimen fig. 3 was found in the shale below the ore bed in Wolcott. The casts 12 *a*, *b*, *c*, occur in a shaly sandstone near the base of the group, associated with (*Agnostis*) BEYRICHIA, in New-Hartford, Oneida county. (*State Collection.*)

Several other species of acephalous mollusks occur in the shales and sandstones of this group; but the specimens which I have collected are not sufficiently perfect, or well marked, to enable me to draw specific distinctions which would be useful in identifying them hereafter.

GASTEROPODA OF THE CLINTON GROUP.

The Gasteropoda are about equally conspicuous with the Acephala, individuals of a few species occurring in all the eastern localities of the group, while they are more rarely seen on the west of the Genesee river. Since many of these occur only as casts in a ferruginous shaly sandstone, they present no reliable characters, and consequently in this condition are of less interest. Like the Acephala, the Gasteropoda appear to be restricted in their geographical range, and indeed few of the species occur in more than one locality. The same remark therefore will apply to them, viz: that those species now presented can not be regarded as so complete a representation of this class in the group, as we have of the Brachiopoda.

Referring again to what has been said regarding the variable lithological character of this group, we shall at once trace this influence upon the fauna. Thus nearly all the Gasteropoda, as well as Acephala, are restricted to that part of the group east of the Genesee river; while the Brachiopoda peculiar to this portion are few in number, and of far less importance than those which occur in the group from Wayne county westward. The inference, therefore, that the physical conditions of the surface have had much influence upon the organic existences, is sustained in this instance.

Genus CYCLONEMA (*nov. gen.*).

[Gr. κυκλος, *ambitus*, and νεμα, *filum*, in allusion to the elevated threadlike striæ marking the surface of several species.]

Shells turbinate, thin; spire short, consisting of few volutions which increase rapidly from the apex; aperture large, rounded anteriorly, and somewhat flattened on the columellar side; umbilicus none; surface strongly marked by spiral threadlike striæ, which are cancellated by finer striæ.

The shells of this genus include forms which have been referred to Pleurotomaria, Littorina, &c., but which have no slit or indentation in the outer lip, or band upon the volution. The surface is marked by elevated striæ parallel to the direction of the volutions, and the spaces between these are marked by finer striæ crossing the others obliquely; the latter, however, are often obsolete.

The *Pleurotomaria bilix* of Conrad*, may be regarded as the type of this genus. The following species have the volutions a little more gibbous than in *P. bilix*; but the general characters, such as form of aperture, striæ, etc. are similar.

* See Palæontology of N. York, Vol. i, pag. 305, pl. 83, fig. 4.

481. 1. CYCLONEMA CANCELLATA.

Pl. XXVIII. Fig. 1 *a* – *g*.

Littorina cancellata. Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 72 and 73, figs. 5 and 6.

Obliquely sub-conical or globose, with a short spire; volutions about four, rounded, rapidly increasing from the apex so that the last one occupies almost the whole bulk of the shell; aperture scarcely expanded; surface marked by prominent threadlike lines, coincident with the spire, which are decussated by finer elevated striæ in a slightly oblique direction.

The size of this shell varies from the most minute form, as in 1 *a*, to the largest figure represented. In young shells the decussating striæ are usually well preserved, while they gradually become obsolete in older specimens, which are likewise frequently distorted by pressure.

Fig. 1 *a*, *b*, *c*, *d*. Views of several specimens, showing an increasing size and slight variation in form.

Fig. 1 *e*. View of the aperture, the shell being slightly compressed in a vertical direction.

Fig. 1 *f*, *g*. View of the front of the shell, and aperture of the same.

Position and localities. This species is quite abundant in the lower green shale at Sodus, Wayne county, and occurs in other localities between that place and Rochester, where it is found in the upper green shale. (*State Collection.*)

482. 2. CYCLONEMA VENTRICOSA (*n. sp.*).

Pl. XXVIII. Fig. 2 *a*, *b*, *c*.

Shell ventricose, sub-conical; volutions about three, rapidly enlarging from the apex; mouth of the size of the last volution; surface marked by strong elevated sub-imbricating striæ parallel to the direction of the volutions.

This shell resembles the last, but it is more elongated and the striæ parallel to the volutions are very sharp and distinct, with obsolete decussating striæ. The shell is also larger than is usual for the preceding species, and has one volution less.

Fig. 2 *a*. Front view of the shell.

Fig. 2 *b*. View of the mouth.

Fig. 2 *c*. A portion of the surface enlarged, showing the character of the striæ.

Position and locality. In the lower green shale, Sodus, Wayne county.

483. 3. CYCLONEMA? OBSOLETA (*n. sp.*).

Pl. XXVIII. Fig. 3 *a*, *b*.

Sub-globose or ovoid; volutions scarcely three, the last one occupying almost the entire bulk of the shell; spire scarcely elevated, consisting of less than two minute whorls; mouth oval oblong; surface finely striated transversely to the direction of the volutions.

This species has the general appearance of other species of the genus, but the spire scarcely rises above the first volution. The oblong form of the last volution, and form of the mouth, distinguish it from the preceding species, even when both appear as casts.

Position and locality. In the lower cherty layers of the group at Medina and Lockport, N. Y.

484. 4. CYCLONEMA CANCELLATA ?

Pl. XXVIII. Fig. 5.

This specimen is a cast in limestone, preserving only a small fragment of the shell upon its base.

The form and general character of this individual does not differ sufficiently from *Cyclonema cancellata* to enable me to separate it. The marking of the small portion of shell preserved is somewhat different, but this character is subject to variation from age and abrasion. The last volution is much compressed, giving it an apparently greater extension beyond the axis than would appear in the natural form of the shell.

Fig. 5 *a*. The cast of the shell, which is smooth.
Fig. 5 *b*. A portion of the shell from the base, enlarged.

Position and locality. In the upper limestone of the group at Lockport, N. Y.

485. 1. PLATYOSTOMA.

Pl. XXVIII. Fig. 4 *a b*.

Orbicular, depressed; volutions about three, the first scarcely rising above the level of the outer one; aperture transversely oval or sub-angular.

The cast exhibits evidence of transverse striæ, which were slightly waved upon the back of the shell.

Fig. 4 *a*. View looking upon the top of the spire.
Fig. 4 *b*. Profile view showing the slight elevation of the spire.
Fig. 4 *c*. Another specimen, view looking upon the spire.
Fig. 4 *d*. View of the aperture, which is angular at the outer margin, probably from pressure.

These two specimens are casts, with smooth rounded outlines; but it is impossible to determine from them what may have been the character of the shell.

Position and locality. This species occurs in the ferruginous shaly sandstones of the group in Kirkland and New-Hartford, Oneida county.

486. 16. MURCHISONIA SUBULATA.

Pl. XXVIII. Fig. 7 *a, b, c, d.*

Loxonema subulata. Conrad, Jour. Acad. Nat. Sciences, 1842, Vol. viii, pag. 273, pl. 16, fig. 14.

Shell subulate; spire much elongated, and very gradually tapering; volutions seven or more in full grown shells; height and width of volutions very nearly the same; surface ?

All the specimens of this species which have fallen under my observation are casts, and these have often been much compressed ; and, as they are usually replaced by siliceous material, they are rough and irregular. I have referred the species to MURCHISONIA, to which genus it more probably belongs than to LOXONEMA. In the specimen figured by Mr. CONRAD, there are a few folds on the last volution, but these are not the remains of striæ ; and since we do not yet know of the existence of a true LOXONEMA in the middle silurian period, we should require unequivocal proofs of its character before referring a specimen from this geological position to that genus.

Fig. 7 *a*. A young specimen of this species.
Fig. 7 *b*. An older specimen of the same.
Fig. 7 *c*, *d*. Two specimens of the largest size observed ; the last one wanting one or more of the upper volutions.

Position and localities. The smaller individuals of this species occur in the shale below the ore bed in Wolcott ; and the larger specimens have been found at Medina, Orleans county, and at Reynale's basin in Niagara county. (*State Collection.*)

487. 8. BUCANIA STIGMOSA (*n. sp.*).

PL. XXVIII. Fig. 8 *a* - *e*.

Compare *Bucania punctifrons*, Pal. N. York, Vol. i, pag. 187, pl. 40, fig. 1 *a*, *b*, *c*, *d*.

Convolute, suborbicular ; volutions – ?, somewhat rapidly enlarging towards the aperture, which is abruptly expanded with a sinus on the dorsal margin ; back of the shell rounded, with a sharp carina along the centre ; sides of the volutions somewhat rounded, and abruptly depressed into a deep umbilicus ; surface marked transversly by elevated lines, diverging and ascending from the carina, and arching over the side into the umbilicus ; longitudinally marked by elevated lines parallel to the carina ; intermediate spaces rhomboidal or oval.

This shell resembles in its general character *B. punctifrons* of the Trenton limestone, and possesses characters intermediate between that species and *B. sulcatina*.

The surface of this species is regularly decussated by arching transverse and longitudinal striæ, leaving rhomboidal spaces between them. Where these elevated lines are somewhat worn, the spaces appear like oval depressions or scars, with the separating lines not strongly defined. In this condition the surface resembles *B. punctifrons ;* but in all the specimens of that shell examined, there are no direct longitudinal striæ visible, and the arching transverse ones are very inconspicuous ; the puncta, moreover, are proportionally smaller than in the present species.

The casts of this species, where the last volution is incomplete, are scarcely distinguishable from *B. punctifrons*. The species is quite rare, and all those observed are more or less imperfect.

Fig. 8 *a*. Dorsal view of an imperfect specimen.

Fig. 8 *b*. A portion of the same enlarged, showing the elevated decussating striæ, and another portion where these are obliterated by abrasion or exfoliation.

Fig. 8 *c*. Dorsal view of a cast of this species, with the aperture and a part of the last volution broken off.

Fig. 8 *d*. Lateral view of the same specimen.

Fig. 8 *e*. Transverse section of the last volution, where broken off.

Position and locality. This fossil has been found only at Lockport in the chert of the lower limestone bed, and but a few feet above the Medina sandstone.

(*Collection of* Col. JEWETT.)

488. 9. BUCANIA ? BELLA-PUNCTA (*n. sp.*).

PL. XXVIII. Fig. 9.

Last volution rapidly expanding from a small spire; apex or inner volutions unknown; surface marked by small punctures arranged in longitudinal series; form of aperture not ascertained.

In two specimens examined, the back of the outer volution only is visible, the apex or smaller extremity is incurved, but the number or extent of the volutions is uncertain. The marking on the surface is very peculiar; but there is no carina, which usually marks species of this genus.

Position and locality. In the dark shale below the iron ore bed in Wolcott, Wayne county.

396. 7. BUCANIA TRILOBATA.

PL. XXVIII. Fig. 10 *a*, *b*.

Reference, *B. trilobatus*, page 13 this volume.

This species, which occurs in the Medina sandstone at Medina, appears again in the ferruginous shaly sandstones between the ore beds, and also in a lower position, associated with *Avicula rhomboidea*. A single specimen shows that it attains a large size, though the smaller figure is of the usual size of this species, both as it occurs here and in the Medina sandstone. It is impossible to ascertain what were the original surface markings, since all the specimens seen, either in the Medina sandstone or Clinton group, are casts preserving no remains of the original shell.

Fig. 9 *a*. A specimen, natural size.

Fig. 9 *b*. A large individual, much compressed in a longitudinal direction.

Position and localities. This species occurs in the central and lower part of the group in the several exposures in the neighborhood of Blackstone's and Wadsworth's quarries, New-Hartford, Oneida county.

CEPHALOPODA OF THE CLINTON GROUP.

The fossils of this family are so rare as scarcely to attract attention, though there are a few interesting forms which are almost entirely restricted to the lower part of the group. The most remarkable genus is the ORMOCERAS, of which a single species occurs in great numbers in the Black-river limestone; while it is extremely rare in the Trenton limestone, and appears again in the Hudson-river group, and there only as a single species. Until within a short period, this genus has been unknown above the Lower Silurian period in our country; but, from fragments occurring in the strata under consideration, and in a higher position, it is probable that this genus extends throughout the silurian strata.

489. 3. ONCOCERAS SUBRECTUM (*n. sp.*).

PL. XXVIII. Fig. 11 *a, b.*

Fragment subfusiform or conical, abruptly enlarging from the smaller extremity, and contracted towards the aperture, slightly curved; surface marked by fine, slightly uneven, transverse striæ.

This specimen, at first view, appears like GOMPHOCERAS; but it still retains a slight curve, increasing towards the smaller extremity, but which, from the specimen having been compressed, is not so obvious in the figure. The transverse section is oval, but owing to pressure towards the aperture that portion is quite flattened, so that the contracted aperture of ONCOCERAS is not characteristic in the specimen. The surface is plainly striated, except on the inner side of the curve for a short distance there is a suture, producing an abrupt arching in the striæ.

Fig. 11 *a.* Lateral view of the fragment,
Fig. 11 *b.* A portion of the surface enlarged, showing a suture on one side.

Position and locality. In the lower cherty layers of the group at Lockport.

490. 4. ORMOCERAS VERTEBRATUM.

PL. XXIX. Fig. 1 *a - g.*

Shell elongated, gradually tapering, section circular; siphuncle nearly central; surface unknown; septa four to five in the space of an inch; edges of the septa slightly projecting in the cast, and the spaces between them contracted or concave; siphuncle presenting the usual appearance of ORMOCERAS, the longitudinal diameter of the expanded portions being about one half as great as the transverse diameter.

This species, which occurs in casts or fragments, bears considerable resemblance to *Ormoceras tenuifilum* of the Black-river limestone; but the septa are more convex and somewhat

closer together, and the margins are extended or projecting in the cast, which is not observable in that species. Many of the specimens are weathered, exhibiting the structure in a very beautiful manner, and showing also the variable aspects under which the same species may be presented.

Fig. 1 *a*. A fragment of the cast of a specimen, having the edges of the septa slightly projecting.

Fig. 1 *b*. Longitudinal section, showing the arching of the septa and form of the siphuncle.

Fig. 1 *c*. A fragment where the laminæ of the shell have become silicified and separated, so that the septa and siphuncle appear to be composed of double laminæ. The interior of the siphuncle is hollow in this specimen.

Fig. 1 *d*. A fragment of the siphuncle, and several of the septa attached. The siphuncle is worn down in part, exhibiting a section having the laminæ thickened, while other portions retain their entire character.

Fig. 1 *e*. A fragment of the siphuncle, with parts of the septa attached. At the lower part the shell is removed, showing a cast of the interior of the siphuncle, having the contractions and expansions corresponding to those of the outer covering.

Fig 1 *f*. A fragment having the walls of the siphuncle broken down, and the cast of the interior standing out very prominently.

Fig. 1 *g*. A portion of the cast of the siphuncle enlarged, showing the rugæ impressed upon it by the interior rugose surface of the siphuncle.

The specimen fig. 1 *f*, exhibits in a very satisfactory manner the character of those specimens where the shell is entirely removed, and casts of the cavities only are left. In such specimens the characters of the Genus Ormoceras may be overlooked, and the true relations of the species misunderstood, or referred to the Genus Actinoceras.

I have termed the interior filling of these siphuncles *casts*, because I do not see any organic character upon their surfaces or in the substance, neither is there any evidence that they were originally connected with the walls of the siphuncle. They present upon their surface the rugæ corresponding to the rugæ shown in the siphuncle of Ormoceras (Pal. N. York, Vol. i, pl. 17, fig. 1 *a*), and there are no rays uniting with the walls of the siphuncle. It is true that in some specimens where the expanded portion of the interior does not reach the walls of the siphon, there are verticillations of crystalline or semi-crystalline matter extending to the interior wall of the siphon. In good specimens, it is readily seen that there is no organic connexion; for the expansion is equal on all sides, except that where perfect, the thin edge of the cast is crenulated from the rugæ as shown in fig. 1 *g*, pl. 29.

In order to exhibit this "tube" or cast of the interior, a peculiar condition of the fossil is required, as is shown in a comparison of the specimens here represented; since in fig. 1 *b* there is no evidence of its existence, and scarcely at all in 1 *c* and 1 *d*. In the specimen 1 *e*, the continuation of the upper extremity shows this cast in a very different state from what it is in the lower part of the same. In all the specimens from the Black-river limestone, where the rock is calcareous, there is no interior tube or cast, though the siphuncles are preserved in every possible condition. In the present species, which in other respects is very similar to that

one, this interior cast often becomes the most conspicuous feature, owing to the nature of the material in which it is enclosed, and the conditions attending its conservation. It is evident, therefore, that the Genera ACTINOCERAS and ORMOCERAS can not both be retained, unless ACTINOCERAS can be shown to relate to some other fossil than that to which it was originally applied. It is true this name has priority over ORMOCERAS, but being founded in an erroneous opinion of a fossil drawn from a figure, I have preferred to retain the latter name; since it is founded on a character belonging to the fossil, and not to a peculiarity exhibited in the cast*.

Position and locality. All the specimens of this species known to me have been collected near Reynale's basin, Niagara county, from the lower part of the group. (*State Collection.*)

491. 28. ORTHOCERAS VIRGULATUM (*n. sp.*).

PL. XXIX. Fig. 2 *a, b, c.*

Slender, cylindrical, gradually tapering; siphuncle sub-central; surface marked by small round pits or punctures.

The subtance of the fossil is converted into a kind of chalcedony, and the shell is silicified. The punctures on the surface are probably not original markings of the shell, but due to weathering and the peculiar arrangement of the siliceous particles. In another specimen, these puncta are not preserved.

Fig. 2 *a.* A small fragment preserving the shell.

Fig. 2 *b.* A section of the last.

Fig. 2 *c.* A silicified fragment broken through the centre longitudinally, except the lower part. The greater convexity of the septum shown in this figure, over that in fig. 2 *a*, is owing to lateral pressure.

Position and locality. In the lower siliceous limestone of the group, associated with the preceding species, at Reynale's basin, and also at Lockport, Niagara county.

492. 29. ORTHOCERAS ANNULATUM?

PL. XXIX. Fig. 3.

Reference, *Orthoceras annulatum*, SOWERBY, Min. Conchology, t. 133. See description, etc. under Orthocerata of the Niagara group.

The fragment figured does not appear separable, by any specific distinction, from the species in the Niagara group which is illustrated on Plate 64. It is much compressed, so that the

*I should not omit to state here that I have this moment had an opportunity of seeing Mr. M'COY's observations on the same subject, in his Synopsis of the Carboniferous Fossils of Ireland, which work was unknown to me except by name when I published my previous volume.

annulations are scarcely distinguishable, while the thin shell is so closely pressed upon the siphuncle that its divisions are distinctly visible.

Position and locality. In the shale below the ore beds at Wolcott, Wayne county.

493. 30. ORTHOCERAS ABRUPTUM.

PL. XXIX. Fig. 4 *a, b.*

Shell conical, tapering somewhat abruptly; section oval; siphuncle marginal; septa distant about one fourth the narrowest diameter; surface?

The specimen is a fragment of about two inches in length, which tapers abruptly towards the apex. The section is oval, though there is no evidence of compression. The position of the siphuncle, combined with the conical form, is very characteristic.

Position and locality. This specimen was sent to me by Col. JEWETT of Lockport, as coming from the upper limestone of the group at that place. There are some peculiarities about it, which incline me to refer it to a higher position; but at this time I have no means of ascertaining positively. (*Collection of* Col. JEWETT.)

INCERTÆ SEDES.

494. 1. CORNULITES FLEXUOSUS (*n. sp.*).

PL. XXVIII. Fig. 12 *a* – *c*.

Body an extremely elongated hollow cone, flexuous or arcuated, composed of a series of rings with the edges placed one within the other; each ring smaller at the base and expanding above, the upper margin rounded and incurved so that the edge closely embraces the base of the next succeeding ring; the shell or crust at the base of each ring is thinnest, and gradually becomes thicker at the same time that the diameter becomes greater; surface of the external crust cancellated by strong undulating striæ, the longitudinal ones often obsolete.

This very peculiar body, in the present state of our knowledge, is not referable to any known type or family. The specimens which usually come under observation are imperfect; and the shell commonly remaining is evidently an internal shell, which has been encased within another. This internal shell or crust is usually smooth, but there are sometimes single longitudinal elevated lines at wide and unequal distances from each other; these, where occurring, scarcely interrupt the general smoothness of the surface, and more frequently they are absent altogether. In several specimens there are portions of an exterior shell remaining upon the inner one; and in a single specimen, the entire exterior shell is preserved, somewhat worn, but presenting an entirely different character from the usual aspect of this fossil. In this state it likewise appears to be composed of a series of rings, but which are largest in the centre and becoming thinner at either edge, the lower or larger enclosing within its upper edge the base of the next succeeding one. The surface of these rings is strongly striated in a transverse direction; and in the less worn parts, longitudinal striæ are distinctly visible. It is evident, from the condition of these specimens, that these rings were so joined as to admit of lateral motion, since all the specimens are curved or tortuous, and this without having suffered any great degree of pressure. The existence of an inner and an outer shell may perhaps be explained, by supposing it to be a simple exfoliation of the outer portion; but this seems scarcely adequate to produce the effect, since the separation of the parts always leaves the same form beneath, and the surface thus remaining has no marks of exfoliation. In the original form the rings are not larger above; but the portion separating is always thinner at the upper edge, and thicker at the lower or smaller diameter of the ring, so that its exfoliation leaves the form represented in figures 12 *c*, *d*, *e*. On the other hand, the shell remaining is thinner below and thicker above, as already described.

Fig. 12 *a*. A specimen, somewhat tortuous in form and partially compressed, covered with the external striated shell.

Fig. 12 *b*. A portion of the surface enlarged.

Fig. 12 *c*. A specimen, nearly entire, exhibiting the usual form and surface characters of this fossil.

Fig. 12 *d*. A fragment of a specimen more curved than usual.

Fig. 12 *e*. A longitudinal section of the last, showing the tube filled with fragments of crinoids and shells*.

Position and locality. In the upper limestone of the group at Lockport, Niagara county.

Genus DISCOSORUS (*nov. gen.*).

[Gr. δισκος, *discus*, and σωρος, *cumulus*.]

A body composed of discs or rings piled one above another, and gradually diminishing in size; outer edges rounded, joining surfaces broad and flat; internally fibrous or solid.

I propose this name for a peculiar fossil body whose relations are at present unknown to me; and having but a single species, it is scarcely possible to give the generic characters that degree of comprehensiveness that may be required.

495. 1. DISCOSORUS CONOIDEUS (*n. sp.*).

Pl. XXVIII. Fig. 13 *a, b, c.*

Body conical, composed of a series of rings which are flattened above and below, each succeeding ring or disc increasing in size from the apex to the base; exposed edges of the discs rounded; joining faces flat and smooth, without apparent marks of articulation of any kind; open or hollow in the centre; substance of the discs fibrous, radiating towards the outer margin.

This peculiar fossil body differs from the Cornulites in the mode of articulation or joining of the discs, and also in the structure of the substance composing it. It does not, indeed, appear in the least degree allied to the preceding genus. Two specimens have been examined, both presenting the same essential characters; and though they do not appear to be entire, yet their structure furnishes no clue to their affinities. In the cavity of one of these specimens there is a mass of crushed crystalline plates of some crinoidean, which has led me to infer that they may belong to a cystidean. The substance of the discs, however, does not present the usual characters of crinoidean or cystidean columns; though one can not fail to perceive some analogy between these and the peculiar crinoidal joints from the ore beds of this group, and which are described with the Crinoidea in the same connexion with those of the Niagara group.

Fig. 13 *a*. One of these bodies of the natural size, preserving eight or nine rings from the apex to the base.

Fig. 13 *b*. The base of one of these discs from another individual.

Fig. 13 *c*. A section of one of these discs exposed by fracture, showing the radiating and fibrous structure of the body.

Position and localities. A single specimen has been found in the green shale near the Ridge road in the town of Ontario, Wayne county; and another specimen in the lower part of the group at Lockport, Niagara county.

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*It seems scarcely possible that these bodies can be the columns of Cystideans, as suggested by Prof. Forbes; since they are hollow tubes filled with extraneous drifted materials, and do not present the usual structure as to arrangement and character of plates or rings, which are seen in the fragments of cystidean columns examined. There is at least little analogy with those from the Niagara and Helderberg rocks, though it is possible that they may belong to some similar bodies.

FOSSILS OF THE UPPER GRAY SANDSTONE OF THE CLINTON GROUP.

The Clinton group proper is in many places terminated by a thick mass of heavy bedded sandstone. This sandstone is for the most part destitute of fossils; but in a few localities it is fossiliferous, and these fossils are so peculiar that I have preferred to give them by themselves.

In the more eastern localities of this group, and as far west as Oneida county, this mass of sandstone forms a conspicuous feature in the group. There are several localities south of Mohawk village, where this rock is in great force, forming a terrace above the more destructible layers of the group, and below the soft marls of the Onondaga-salt group, the Niagara group having little or no importance in that neighborhood. At Tisdale's mill, this mass of sandstone is very conspicuous (See section page 16 of this volume); and in localities east of this point, it is more or less conspicuous and important.

This mass of sandstone in some of its localities was described by Prof. EATON as the *Grey band*, which, becoming confounded with the gray mass terminating the Medina sandstone, has produced some confusion heretofore in the identification of strata associated with these two very distinct formations.

It should be remarked that this mass is not known to be fossiliferous in its more eastern localities; the first place at which fossils were noticed being at Remington's quarry, south of Mohawk, and again at another locality a mile or two west of this one. In the southwestern part of Oneida county, I have been unable to find this mass in place, though fragments containing fossils are frequently seen.

496. 1. MYALINA MYTILIFORMIS (*n. sp.*).

PL. XXX. Fig. 1 *a, b, c, d.*

Shell ovate, elongated; beak acute, anterior margin sub-alate; cardinal line straight; surface of cast marked by concentric undulations indicating stages of growth.

The specimens seen are all in the condition of casts, as are the other fossils of this sandstone. In some of the casts the concentric lines are not perceptible, while in others they are quite conspicuous. The cardinal margin is often arched from pressure, and from the same cause the anterior margin often appears more alate; at the same time pressure in the direction of the two margins renders the anterior fold inconspicuous.

This shell appears to be allied to AMBONYCHIA, but is wanting in the posterior alation, and in other characters of the hinge and beak possessed by that genus. The present species is the earliest form of this type known to me, though it appears in all the succeeding groups as high as the Chemung.

I have referred this shell to the Genus MYALINA of DE KONINCK, from its external form alone, having had no opportunity of examining the entire shell or its internal characters. In

its form it resembles the Genus MYTILUS ; and DE KONINCK regards the Genus MYALINA as possessing characters intermediate between the MYTILUS and PTERINEA, and establishing a natural passage from one to the other.

Fig. 1 *a*. The right valve of this species somewhat compressed, and having the anterior expansion broken off in part.

Fig. 1 *b*. The right valve of another specimen, less compressed than the preceding.

Fig. 1 *c*. A specimen preserving both valves, which are partially open along the cardinal line. The lower portion of both valves is broken off.

Fig. 1 *d*. The left valve of the preceding specimen, compressed so that it appears much narrower than its natural form.

Position and locality. In the upper gray sandstone south of Mohawk village, Herkimer county.

497. 20. MODIOLOPSIS OVATUS (*n. sp.*).

PL. XXX. Fig. 2 *a*, *b*.

Shell oblong ovate, greatly extended, and gradually narrowing towards the posterior extremity, which is rounded ; anterior extremity short, with a sinus before the beak ; cardinal line arched ; umbones prominent ; surface evenly rounded and concentrically striated.

The surface markings are obscure in the casts, only a few stronger lines of growth being usually visible. The sinus before the beak is variable, being in some specimens much deeper than in others. There is, however, little difficulty in distinguishing the species by the form alone.

Fig. 2 *a*. The left valve of a specimen of ordinary size.

Fig. 2 *b*. The right valve (imperfect) of a large individual. The sinus before the beak is deeper, and the extremity more produced than is usual in this species.

Position and locality. In the gray sandstone south of Mohawk village, Herkimer county.

498. 21. MODIOLOPSIS SUBCARINATUS (*n. sp.*).

PL. XXX. Fig. 3 *a*, *b*, *c*, *d*, and 4 *a*.

Shell elongated, somewhat rhomboid-oval ; young specimens with an obtuse carina along the posterior umbonal slope, reaching to the posterior basal margin ; anterior extremity rounded ; posterior extremity obliquely truncated or rounded ; base slightly arcuate ; surface marked by strong concentric folds, which are scarcely conspicuous on the posterior part of the shell. In older shells the carina and concentric folds become obsolete.

The individuals figured present the prevailing characters observable in this species, which appear to have been quite numerous at this epoch. It resembles the *M. anodontoides* of the Hudson-river group, but a comparison of the two shows them to be quite distinct. The

younger specimens are neat and well defined, preserving the carina and concentric folds which become obsolete in older specimens. The shell originally has been very convex, but, from pressure, it is often flattened, and the form of the outline altered.

The only shell in the Clinton group resembling this species is the *Orthonota curta*, from which it differs in its greater proportional height, and from the hinge-line being less straight.

Fig. 3 *a*. A young individual of this species.
Fig. 3 *b*, *c*. The right valves of two individuals of medium size.
Fig. 3 *d*. The left valve of an older individual.
Fig 4 *a*. This individual has nearly the same form as figs. 3 *b* and 3 *c*, but is more compressed, and the concentric folds are not at all conspicuous. I am unable to find any characters, however, indicating a specific distinction.

Position and locality. In the upper gray sandstone of the Clinton group, south of Mohawk village, Herkimer county.

499. 9. TELLINOMYA ELLIPTICA (*n. sp.*).

PL. XXX. Fig. 4 *b*.

Elliptical; extremities nearly equal; beak scarcely prominent; surface convex, without any distinctive elevations, marked by fine concentric striæ.

This species approaches *Tellinomya curta* of the preceding plate 27; but the extremities are more nearly equal, and the beak more nearly central than in that species. The surface is similarly marked by fine concentric striæ, though of these the species under consideration scarcely preserves any remains.

Position and locality. In the upper gray sandstone of the group south of Mohawk village, Herkimer county.

PL. XXX. Fig. 5 *a*, *b*.

Shell with both valves closed, elongate, sub-cordate; umbones very prominent and somewhat gibbous below, becoming narrow and thin towards the posterior extremity; anterior extremity very short; surface of the cast preserving very slight traces of concentric striæ.

This species is readily recognized by its gibbous anterior below the beaks, and by its elongate-cordate form when both valves are closed. The specimen figured is somewhat crushed, so that its entire characters are not preserved.

Fig. 5 *a*. View looking upon the cardinal line.
Fig. 5 *b*. Lateral view of left valve, which is crushed, showing the outline of the right valve beyond.

Position and locality. In the upper gray sandstone of the group, south of Mohawk village, Herkimer county.

The three following species were found in a loose mass of gray sandstone evidently belonging to the Clinton group, but whether to the upper gray sandstone, can not well be determined at the present time.

500. 3. PENTAMERUS OVALIS.

PL. XXXI. Fig. 1, 1 *a*.

Dorsal valve more or less elongated, varying from nearly circular to elliptical; larger individuals becoming sub-trilobate; the specimens which are casts, preserving some remains of concentric striæ.

This species approaches in character to the *P. oblongus* of the lower limestone of this group, but it is evidently a much smaller shell, and differs in other essential features from that species. The *P. oblongus* likewise occurs in the same neighborhood, but in a much lower position, corresponding to its horizon in Wayne and Monroe counties; while the upper sandstone holds a much higher position, corresponding probably to the upper limestone of the group on the Genesee river, where the whole is much diminished from its thickness in Oneida county. This species seems to be restricted to its lower position in all the localities known.

Fig. 1. A small valve, having a width slightly greater than the length.

Fig. 1 *a*. A larger valve, having a length nearly once and a half the width. The shell is removed, though the cast still preserves some slight markings of striæ or lines of growth.

Position and locality. In a loose mass of gray sandstone of the group, New-Hartford, Oneida county.

446. 21. LEPTÆNA OBSCURA?

PL. XXXI. Fig. 2.

Reference pag. 62, pl. 21, fig. 6 *a*, *b*.

The specimen figured is a cast in sandstone, which presents no reliable characters to distinguish it from the species before figured under this name. The striæ are represented too strong and coarse in the present figure, which has arisen in part from the character of the sandstone preserving the surface of the cast.

Position and locality. In a loose mass of gray sandstone of the Clinton group, New-Hartford, Oneida county.

501. 1. PLATYOSTOMA*.

PL. XXXI. Fig. 3 *a*, *b*.

Sub-globose, depressed; volutions about three, rapidly increasing towards the aperture, which is much expanded; surface marked by simple uninterrupted striæ.

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*PLATYOSTOMA, *Conrad;* NATICOPSIS, *M'Coy*. I am unable, from the descriptions and figures given by Mr. CONRAD, and those given by Mr. M'COY, to find any sufficient characters to distinguish PLATYOSTOMA from NATICOPSIS. I have therefore preferred to adopt the former genus, since it has precedence in point of time, and was applied originally to fossils well known to us in the rocks of New-York.

This species is apparently identical with one in the Pentamerus limestone in the lower part of the group at Rochester.

Fig. 3 *a*. A large specimen of this species, having a portion of the last volution broken off.
Fig. 3 *b*. A smaller specimen, with the expanded portion of the last volution broken off.

Position and locality. In a loose mass of gray sandstone of the Clinton group, New-Hartford, Oneida county.

502. 28. ORTHOCERAS CLAVATUM (*n. sp.*).

PL. XXXI. Fig. 4 *a*, *b*.

Cylindrical, rapidly tapering; septa numerous, strongly arched; siphuncle eccentric.

Fig. 4 *a*. A fragment near the smaller extremity of the shell.
Fig. 4 *b*. A smaller fragment preserving a portion of the outer chamber.

The larger fragment has been much compressed, and in consequence the septa have an apparently oblique direction. The siphuncle is slightly excentric. Several other fragments of the same species have been observed in the gray sandstone, but they are always denuded of the shell, and preserve no reliable features except the numerous and closely arranged septa.

Position and locality. In the upper gray sandstone of the Clinton group, south of Mohawk village, Herkimer county.

503. 1. HOMALONOTUS DELPHINOCEPHALUS.

PL. XXXI. Fig. 5 *a*, *b*.

For description, see Trilobites of the Niagara Group.

The buckler and caudal extremity of this species are found in considerable numbers in this sandstone, though no perfect individuals have been seen.

At the time these fragments were figured, I had not found this trilobite in a lower position; but have since then obtained numerous fragments from the lower strata of the group, showing the existence of this species as early as the deposition of the ore beds, and probably from the commencement of this period.

Position and locality. In the upper gray sandstone of the group, south of Mohawk village, Herkimer county.

504. FRAGMENT OF ICHTHYODORULITE.

PL. XXXI. Fig. 6.

This fragment of the defensive fin bone of some species of fish occurs in the sandstone with *Pentamerus*, *Leptæna* and *Platyostoma*, figured on the same plate. It is the earliest

unequivocal evidence of the existence of vertebrata which we have yet discovered in this country.

There have been found some fragments imbedded in a coarse conglomeritic mass in this group, which resemble bones in their structure; but all these which I have examined prove to be inorganic, and to have only a fibrous or porous mineral structure.

The small fragment now figured has the form as well as the structure of these defensive bones; and though in such a condition that no definite markings appear by which to characterise it, it is nevertheless of sufficient importance to be represented.

Since this fragment was figured, I have obtained another more perfectly preserved from the sandstone in the lower part of the group. This specimen will be represented, with one from the Niagara group, on Plate 71.

PL. XXXI. Fig. 7.

The specimen figured has the form and proportions of the rib of some vertebrate animal, but it preserves no bony structure, being entirely replaced by siliceous matter.

This specimen was found in the upper gray sandstone, associated with the preceding fossils of Plates 30 and 31.

NIAGARA GROUP.

The rocks of this group, where best developed in western New-York, consist of a mass of shale succeeded by one of limestone, the passage from the former to the latter taking place by the gradual increase of calcareous matter. The upper or terminating limestone of the Clinton group is succeeded by a soft argillo-calcareous shale, which maintains its character unchanged for a thickness of eighty to one hundred feet. Throughout the greater part of this it abounds in fossils, nearly all of which are quite distinct from those in the beds of the Clinton group. The limestone is of equal or greater thickness than the shale; its lower part thin-bedded and argillaceous, becoming gradually more calcareous. A thick bed near the lower part is almost entirely composed of crinoidal joints, and comminuted fragments of corals, shells and crinoids. This portion of the mass contains, in a more or less perfect state of preservation, the remains of many species which are more entire in the shale below. In the central and higher portions of this limestone there are few fossils besides corals, and these are often partially dissolved and their places filled by crystalline matter. This limestone is remarkable for the numerous cavities lined with various forms of calcareous spar, and others filled with sulphate of strontian, anhydrite or selenite. Fluor spar, and sulphurets of zinc and iron, are occasionally found in the same connexion. These cavities vary in size from the smallest dimensions to the extent of two or three feet; and in a great number of instances, and probably in all, they were originally occupied by some fossil body, which has been partially or entirely removed by solution. In many instances the masses of selenite or anhydrite still retain portions of some coral, included within the mass; while in others a small portion of the fossil is preserved in connection with the surrounding stone, and envelopes the crystalline mass in such a manner as to show that the whole space has once been occupied by the same. In many of the masses of coral, still preserved, there are cavities occupied by crystals of sulphate of strontian, and others divided by plates of selenite; and many more where these crystals have been removed, leaving the cavities. It is evident, therefore, that in a rock where so many species of fossils have been partially or entirely obliterated, we can not present its entire palæozoic characters; and if we were able to trace this rock where its condition is such as to preserve all the imbedded remains, we should make large accessions to the species already known.

This group of rocks is better developed, and the exposures more favorable, in the vicinity of Niagara Falls and Lockport, than in any other part of the State. At Rochester, also, the two masses are well developed, and the exposure of the shale very complete. Farther to the east, the group has much diminished; and though the limestone and shale are both visible at Wolcott and other points in Wayne county, the former has much diminished in thickness, and the latter is less fossiliferous. Farther eastward there are several points where the group may

be recognized ; but it contains few fossils, and has so far thinned out as to be quite unimportant. Still, however, when we come to the base of the Helderberg mountains, we find a mass of limestone about four feet in thickness, holding the place of the Niagara limestone, and containing many similar fossils*.

In the town of Verona, there are two or three localities where the limestone, with a concretionary shale below, may be seen resting upon the rocks of the Clinton group. Still farther east, in the vicinity of Clinton village, and between this place and New-Hartford, there are many loose masses of concretionary and fragmentary limestone lying along the road ; these belong to a thin band of limestone of the same character, which is the only representative of the group.

At one point on Steele's creek in Herkimer county, may be seen this thin band of limestone, representing the Niagara group ; but to the eastward of this point, for many miles, we have thus far been unable to find any evidences of its existence.

In localities west of New-York, this group becomes almost entirely calcareous, and forms a distinct thick mass of limestone bearing the lead ores of Wisconsin, Illinois, Iowa, &c. In this part of the country it often produces a distinct topographical feature, and on the Mississippi river is equally conspicuous with the great Carboniferous limestone. In this western extension of the limestone, we already know many fossils which have not been seen in the same rock in New-York.

In the western part of New-York, the lithological characters of the Clinton and Niagara groups are so similar that they could well be united. The fossils also of the two groups, though generally distinct, are nevertheless generically similar, and several species pass from the lower to the higher group. The upper limestone of the Clinton group, which forms a strong line of demarcation between the two, contains in its western extension several fossils usually regarded as peculiar to the Niagara group. Among these may be noticed the *Caryocrinus ornatus* and the *Hypanthocrinus decorus*. It can not be denied, therefore, that there is a gradual approximation in the two groups, both in lithological and palæozoic characters, as we trace them westward within the limits of the State of New-York. Still farther west, the assimilation becomes more perfect, and there appears to be no line of separation between the two groups. At the same time the fossils appear to be commingled ; for, in several collections sent me from Wisconsin and other places, fossils, which in New-York are restricted to their respective groups, are here collected from, and referred to, a single rock. This fact is not at all surprising, if we consider the gradual change which takes place in western New-York, and which has been described in the Report on the Fourth Geological District.

On the other hand, when we examine the Clinton group as it is developed in central New-York, it seems impossible to assimilate in any degree its discordant and protean masses, with

* I have not united the fossils of this limestone with those of the Niagara limestone, though satisfied as to its position, but have described them under the head of "CORALLINE LIMESTONE," the name by which this mass has long been distinguished in the neighborhood of Schoharie. In this manner these fossils follow those of the Niagara limestone in the descriptions, but it is not intended to be understood that they belong to a higher position.

a group so uniform and well characterised as that of Niagara. As I have already shown, the almost total absence of calcareous matter has precluded the existence of nearly all those forms of fossils peculiar to the Niagara group ; and the shales, sandstones, and conglomeritic layers, are marked by the presence of an infinite number and variety of marine plants, with few molluscs, and here and there a fragment of a trilobite of the same species as those in the Niagara group. Even here we perceive, notwithstanding the discordant nature of the materials of the two groups, that they belong to a period during which the same fauna to some extent existed. Although the HOMALONOTUS, PHACOPS and BUMASTIS occur in the shaly sandstones of the lower part of the group in Oneida county, they could not exist in any considerable numbers, or degree of development, on account of the nature and the conditions of the sediment.

In addition to the influences of the prevailing siliceous and argillaceous character of the strata of this group in the eastern and central portions of this State, we have that of the ores of iron, which, in all situations, appear to be prejudicial to most forms of animal life ; and though these ore beds are apparently made up of organic exuviæ, yet fossils are comparatively rare in their immediate neighborhood, or where the hydrate of iron enters into the composition of the surrounding strata.

I have presented all these facts, that they may be considered in reference to the period from which the fossils are described. Notwithstanding the dissimilar character of the groups in some places, yet regarding their entire extent and character, I am inclined to unite them as one group ; but since they have heretofore been separated and thus published in the Geological Reports, I have preferred to leave the determination of the question to a future time, giving the fossils of each group by themselves, indicating those which are common to both. In order, however, not too widely to separate some of the families, I have carried forward the Crinoidea and Trilobites to be described with those of the Niagara group ; and I should have done the same with the Corals, had they not been already included in the numbering of the preceding plates.

Regarding the very great advantages to be derived from a minute subdivision among the groups, I am unwilling to describe in conjunction, or as from the same group, fossils that are in a great degree restricted to individual rocks or beds of such group, where it is composed of several members. It is far more easy for the student to unite these, than it would be to separate them ; and to those who look at their entire character for the purpose of generalizing these subdivisions, it can offer no objection that they are presented in the order of their occurrence, the true order of their appearance or coming into existence upon our planet. This must be my only apology with those who think that the science is retarded by numerous subdivisions, but which appear to me, on the other hand, to facilitate progress, by giving us more exact knowledge for the basis of our generalizations.

CORALS OF THE NIAGARA GROUP.

This group of strata, though of very moderate thickness, contains nearly or quite as many species of corals as all the preceding groups together, excluding the graptolites. This increased number of species has not been procured either by the exploration of larger tracts, or of more numerous localities, than in the lower strata; but, on the contrary a smaller area has been examined, and a fewer number of localities. Indeed nearly all the species described under this group have been found at Lockport and vicinity, while many other localities afford a large proportion of the whole number, and perhaps diligent search would discover still more. The excavations for the enlarged Erie canal at Lockport have brought to light several species in shale, which, by ordinary excavation and the process of weathering, would not have been discovered. The rapid disintegration of the shale on exposure soon destroys all except the more solid calcareous corals; and the Bryozoa, which are more prolific in these shales than elsewhere, are usualy obliterated, or so much injured as to render their recognition difficult. In the lower part of the limestone, however, myriads of the smaller branching corals are preserved, and likewise some of the more solid or hemispheric forms. Still higher, those massive forms occur which leave on their destruction large cavities, or become changed to crystalline matter by the action of sulphuric acid waters.

It is not only the great number of species here displayed which renders the period exceedingly interesting, but, also, in a higher degree, the great number of new types which, for the first time in our knowledge, came into existence at this epoch. Another fact, also, of importance in its geological bearing, will be made manifest in our progress in the study of these corals; and that is, that they are really as typical of the strata in which they occur, as are the fossils of a higher organization. In all these forms we do not yet recognize a single species of the Lower Silurian formations; while, on the other hand, scarcely one of these prolongs its existence into the succeeding period. Even the smaller Bryozoa of this and the higher strata are quite distinct.

In the family of Cyathophyllidea, which in the lower rocks of our State is represented only by the genus STREPTELASMA, we have at least four new generic types introduced at this period. In the Favositidea, the genus FAVISTELLA of the lower rocks is apparently represented by another generic form, and the true FAVISTELLA is unknown. Thus far, I am not able to decide positively that the Genus FAVOSITES occurs at this period; and all the corals heretofore referred to that genus evidently belong to a different one. The smaller forms, like CHÆTETES, have in some examples stellate cells, showing a different relation to those from the lower rocks.

The genus HELIOLITES, in one or more species, characterizes the strata of this period, not only in New-York, but far to the westward; while the *Catenipora escharoides* is preëminently characteristic of the group. This genus appears for the first time in the Clinton group, but only becomes developed in a high degree in the Niagara limestone, which in New-York con-

tains two species; while the one above cited occurs everywhere in this limestone, as far west as Iowa on the west of the Mississippi. Probably nowhere in the world are there so many beautiful and really splendid specimens of this coral to be found, as in the western United States. It is not a little interesting that this coral, though occurring in such immense numbers at this period, has never been found in any stratum of more recent date.

The Genus STROMATOPORA, in a species allied to or identical with *S. concentrica*, occurs at this period, and is found in masses of one to two feet in diameter. Numerous branching corals, allied to CHÆTETES or FAVOSITES, occur in the lower part of the limestone, but they really belong to other genera. In the Genus LIMARIA, or allied genera, we have several species; while in the true Bryozoa, we have the genera RETEPORA, POLYPORA, FENESTELLA, &c., developed in great numbers of individuals, though of comparatively few species.

Finding it impossible to refer to established genera many species occurring in this group, I have constituted new genera to receive them. The practice of referring species of ancient corals to existing genera, or to those of modern geological periods, is often or always attended with uncertainty, unless the comparison of species be made directly. When we find, for example, that a large part of the corals of the Upper Silurian are of distinct genera from those of the Lower Silurian strata; and that again many new generic types are introduced at the Devonian period, while nearly all the older types have disappeared, we can form some idea of the impropriety of referring silurian corals to genera typical of the Oolite or Chalk periods, or of modern seas. Still it is to some extent almost impracticable to depart entirely and at once from this custom, particularly as we have as yet no systematic description of fossil corals, or any authoritative limitation of the application of generic names. The comparison of specimens with figures is often not satisfactory; and since we have no accessible authentic collections, it is not always easy to decide upon questions of generic and specific identity and difference.

In the following species, the figures have all been made from actual specimens; and no figure elsewhere represented, although sometimes regarded as identical, has been copied, or made the basis of any of those here given. The geological position of these specimens is well established; and therefore the great point of their order in time will always be reliable, whatever changes may be made in other respects.

With the exception of some of the smaller corals, all these species have been collected with my own hands; and the isolation of this group in the western part of New-York, where it is separated from the upper limestones by one thousand feet of thickness and twelve miles in width of the Onondaga-salt group, which is there almost entirely non-fossiliferous, sufficiently proves that no intermixture of corals from succeeding formations have found their way into the collection.

FAMILY CYATHOPHYLLIDEA.

505. 7. STREPTELASMA CALICULA

Pl. XXXII. Fig. 1 *a* - *k*.

Turbinate, oblique or curved, more or less rapidly expanding by the addition of interstitial rays; cup moderately deep; rays or vertical lamellæ about half the thickness of the space between them, from 20 to 50, ordinarily about half this number, more or less curved towards the centre; external surface with the lamellæ very distinct and marked by transverse striæ; surface rarely corrugated; rays alternating with short dentations on the inner margin of the cup.

This species, which is very abundant in the shale of the Niagara group, differs but little in its external characters from some of the species in a higher position. A more careful comparison, however, shows it to be clearly distinct. From the small Trenton limestone species it differs in having a more shallow cup and stronger lamellæ.

This species presents a striking feature in having the rays mostly increasing on two sides, leaving two central or anterior rays continuous from the base: the increase, if taking place in other parts, does so by interstitial rays on one side only of a ray continuous from the base.

Fig. 1 *a*. Anterior view, showing the interstitial or additional rays on each side of two continuous rays.

Fig. 1 *b*. Lateral view, showing interstitial rays on one side of a continuous ray.

Fig. 1 *c*. The opposite side of the same individual, showing the same character as fig. 1 *b*.

Fig. 1 *d*. View showing the interior of the cup, and posterior or shorter side of the coral.

It will be seen that there is no increase on this side by interstitial rays, and consequently the cup does not increase so fast as on the other side, which is not only expanded by this addition of new rays, but is built upwards more rapidly, producing the form which we see prevailing not only in this but in many other species. This increase of the Cyathophyllidea on one side always takes place equally on each side of the larger or anterior ray; though in many specimens, and perhaps in all of the Genus Streptelasma, there are no means of distinguishing the larger ray, except from the mode of increase. The feature presented in fig. 1 *a* is, however, of equal interest and importance, and corresponds to the larger ray in other examples.

Fig. 1 *e*. Transverse section, showing the number of rays with the alternating dentate processes.

Fig. 1 *f*. A vertical section, showing the depth of the cup. The margin above is broken off.

Fig. 1 *g*. An unusually large individual of this species: lateral view.

Fig. 1 *h*. An individual more straight than usual.

Fig. 1 *i*. A small individual with the enveloping membrane or cup entirely destroyed, leaving only the rays.

Fig. 1 *k*. An enlarged portion of the margin of the cup, showing that the dentate process between the rays appears externally, and extends downwards equally with the full ray. The number of rays usually seen in the cup (except when the dentate process in the margin is visible), is only half the number which will be counted in the outer circumference of the cup.

In cases where few and imperfect specimens only are accessible, it is important to bear in mind this circumstance, since in this species the rays can be so readily counted on the exterior surface.

Position and locality. In the shale of this group at Lockport, Rochester, Marshall's mill, Wolcott, and almost every other locality where the shale is exposed. (*State Collection.*)

Genus POLYDILASMA (*nov. gen.*).

[Gr. πολυς, *multus*, δις, *duplex*, and ελασμα, *lamella;* in allusion to the numerous double lamellæ.]

Corallum turbinate; lamellæ numerous, thin, apparently rising in pairs, and one often much stronger than the other; cell broad, margin thick and strong, with a deep central pit; half the lamellæ reaching to the centre of the cell, where they are complicated or contorted; transverse septa in the centre below the base of the central part of the cup, obsolete or irregular.

This coral is allied to Calophyllum, but does not show the transverse septa characteristic of that genus. The cell is very peculiar in its character, one half only of the rays extending into the deeper portion, giving it a peculiar aspect which is preserved in solid crystalline specimens, even when no rays are visible or when they are very indistinct.

506. 1. POLYDILASMA TURBINATUM.

Pl. XXXII. Fig. 2 *a* – *h*.

Turbinate or clavato-turbinate, usually short; outer surface nearly smooth, or transversely somewhat rugose; cell deep, gradually descending from the margin halfway to the centre, and then deepening almost vertically; rays numerous, thin, becoming complicated before reaching the centre, often apparently crenulate on the weathered exterior; transverse septa irregular, and sometimes nearly or quite obsolete.

This species is of variable form, though usually short, turbinate, and rapidly expanding. The cup presents a peculiar feature of being suddenly depressed about halfway from the outer margin to the centre; and this is likewise accompanied by the termination of one half of the rays at the same point, so that only half the rays of the margin reach the centre. The rays are also variously curved, complicated, or coalescing before reaching the centre. There is no evidence of transverse dissepiments in the cup, and indeed the great depth of the cell in the centre almost precludes their existence in many specimens. The worn exterior surface shows the lamellæ in pairs; and these, on ascending, become again regularly duplicated, so that the increase of size is pretty uniform on all sides, and the corallum is usually nearly straight. The

surface presents a variable character according to the degree of wearing which it has suffered; and in the unweathered specimens the lamellæ are not visible on the exterior; and whenever the lamellæ become visible from weathering, they have a crenulate appearance.

Fig. 2 *a*. An individual (larger than the prevailing size), somewhat weathered on the surface, and showing, slightly, the lamellæ.

Fig. 2 *b*. A specimen of ordinary size, much weathered, and showing the lamellæ in pairs and bifurcating above.

Fig. 2 *c*. A specimen showing two bases or points of attachment.

Fig. 2 *d*. A specimen of ordinary size divided vertically, showing the depth of the cell, which is filled with fragments of corals.

Fig. 2 *e*. The cell of another individual, having the margin somewhat worn.

Fig. 2 *f*. Several of the lamellæ enlarged, showing the termination of the alternate ones at the point where the cup deepens.

Fig. 2 *g*. A transverse section near the base of a small specimen, showing the arrangement of the lamellæ and the absence of transverse dissepiments.

Fig. 2 *h*. An individual of more elongated form than usual. The upper portion is a bud from one side of the centre of the lower cup, which the partial wearing down has made to appear as a continuation of the same.

Fig. 2 *i*. A longitudinal section showing a confused cellular structure below the centre of the cell.

Position and locality. In the limestone of the group, a few feet above the shale, associated with numerous species of corals, at Lockport. (*State Collection.*)

419. 1. CANINIA BILATERALIS.

Pl. XXXII. Fig. 3 *a, b, c.* See Pl. 17, fig. 3.

This specimen was figured in this place before its true geological position was known.

This individual presents a better development of the characters of the species than those from Reynale's basin, in which the cup is always more or less filled with extraneous matter, and consequently the characters obscured.

Fig. 3 *a*. View of the specimen, showing the cup with the depression in the dissepiment on the anterior side.

Fig. 3 *b* & 3 *c*, showing the arrangement and coalescing of the lamellæ in the cup.

Position and locality. From the siliceous portions of the limestone of the Clinton group at Lockport. (*Collection of* Col. Jewett.)

Genus CONOPHYLLUM (*nov. gen.*).

[Gr. κωνος, *conus*, and φυλλον, *folium;* in allusion to the inverted conical septa.]

Corallum turbinate or subcylindrical, having transverse septa in the form of inverted cones set one within the other; rays or lamellæ very thin, numerous and denticulate.

In weathered specimens the transverse septa often project beyond the sides of the coral above, and the whole appears somewhat like a series of inverted cones. The weathered surfaces have sometimes the appearance of Cystiphyllum, from the irregular meeting of the upper and under surfaces of the successive transverse septa.

507. 1. CONOPHYLLUM NIAGARENSE.

Pl. XXXII. Fig. 4 *a* - *n*.

Irregularly cylindrical, elongated or subturbinate, more or less expanding above, externally rugose at intervals (when weathered often very rough); cup regularly concave, deep; lamellæ thin, distance from each other equal to their thickness, denticulated on their upper and inner edges; transverse dissepiments corresponding to the concavity, and forming the cell or cup, and extending upwards to the margin.

In this fossil, the rays become in fact subordinate to the dissepiments; and the character would be more correctly defined, by describing the coral to consist of a series of concave discs or inverted cones setting one within the other, having their upper surface marked by radiating rows of denticles. The form is very irregular, varying from small, short, turbinate forms, to elongated cylindrical ones in which the diameter scarcely varies throughout. The weathered surfaces present the arrangement of the dissepiments more or less perfectly in numerous specimens. In one or two instances, I have seen specimens where the weathering developed the rays more prominently than the dissepiments, and in such instances the surface is beautifully denticulated (fig. 4 *b*).

Fig. 4 *a*. A specimen of the turbinate form, showing the rays externally. The denticulate rays within the cup are also well shown, and the denticles between the dissepiments near and below the upper margin of the cup on the outside.

Fig. 4 *b*. A turbinate specimen, showing the denticulate lamellæ on the external surface. In the interior of the cup, the lamellæ are less perfectly denticulate than in 4 *a*.

Fig. 4 *c*. A small turbinate specimen with the surface worn, showing the successive dissepiments and the denticulate lamellæ within the cup.

Fig. 4 *d*. The external surface of an unweathered specimen, where the edges of the transverse dissepiments project at intervals.

Fig. 4 *e*, *f*, *g*. Portions of the interior of the cup enlarged, showing the condition of preservation of the denticulated lamellæ.

Fig. 4 *h*, *i*, *k*, *l*. The exterior of specimens of various sizes, more or less worn, showing in 4 *h* particularly the arrangement of the dissepiments where partially worn down.

Fig. 4 *m*. A small specimen, showing a section through the centre, with deep transverse cup-form septa.

Fig. 4 *n*. This individual shows apparently lateral budding, but the appearance is probably due to the cessation of growth at the point *o*, where the animal had contracted the cup; and from this cell originated three young polyps, the stronger growing more uprightly and pushing out the others to one side.

Position and locality. In the lower part of the Niagara limestone, associated with the preceding and following species. (*State Collection. Collection of* Col. JEWETT, &c.)

GENUS DIPLOPHYLLUM (*nov. gen.*).

[Gr. διπλοος, *duplex*, and φυλλον, *folium;* in allusion to the duplex character of the cell.]

Simple, ramose or aggregate cylindrical stems; corallum composed of two distinct portions, the inner transversely septate, the outer with fine transverse dissepiments uniting the lamellæ which are continuous to the centre; cell deeply concave in the centre, and separated from the outer portion by a distinct rim; both the inner and outer portions stellate with the same number of rays.

The distinguishing features of the genus are the difference in the characters of the central and marginal areas of the cell, which are distinctly separated from each other, as shown in longitudinal sections.

This genus is apparently related very nearly to the DIPHYPHYLLUM of LONSDALE (Geology of Russia and the Ural Mountains, Appendix), preserving also more intimate relations to CYATHOPHYLLUM, COLUMNARIA and allied genera, but requiring separations upon sufficient grounds, if we are to give to the numerous forms of this family names of any definite signification. The generic names proposed for the species here described sufficiently indicate their difference from the Cyathophyllæ; and instead of applying that generic term to all the Silurian corals having any general resemblance to the genus, we have the means of giving geological value to the type.

I may remark in this place, that thus far we have not found a single species of the Genus CYATHOPHYLLUM, as limited by recent authors, in any rock below the Onondaga limestone. It seems, therefore, that notwithstanding the representatives of this type came into existence at very early geological periods, still no species having the structure of *Cyathophyllum ceratites* of GOLDFUSS is known throughout the Silurian rocks of America, if we limit the application of that term to those rocks below the Oriskany sandstone.

The rocks of the Niagara period, from which these fossils are described, is regarded as equivalent to the Dudley or Wenlock formation of England; and although we have the family Cyathophyllidea represented by STREPTELASMA, CANINIA, and the three new genera here introduced, we have no true CYATHOPHYLLUM; nor have we CYSTIPHYLLUM, or HELIOPHYLLUM at the same period. These are all typical of certain geological periods; and by attending more minutely to their structure, they become valuable evidences of the age of the rock in which they occur.

508. 1. DIPLOPHYLLUM CÆSPITOSUM (*n. sp.*).

PL. XXXIII. Fig. 1 *a - r*.

Corallum cylindrical or subturbinate in its young state; stems coalescing at intervals and increasing by lateral budding, cæspitose or aggregated in large groups, which often grow from a single base; rays or lamellæ numerous (about 50), thin; centre of the cell with rays and transverse septa; external portion with fine rays and thin transverse dissepiments uniting the lamellæ, giving a kind of cellular structure to the outer portion of the coral.

This species assumes a somewhat variable character, occuring in small groups, or rarely in single stems with one or two buds on the sides; but the more common form is that of numerous individuals aggregated in large masses, the ends of the stems appearing on the surface of the stone as in fig. 1 *i*. The manner of growth and aggregation is well shown in fig. 1 *l*, which represents a small portion of a larger group exposed in the longitudinal direction, the whole length of which is three times as great as the figure. Single individuals often grow for some time independently, and then throw out numerous buds which become the base of a large group as in fig. 1 *m*. Usually the specimens present only the radiating lamellæ; these are stronger in the outer portion of the cell, which is very distinctly separated from the inner portion as it were by a cylindrical tube within the outer one. The interior is very frequently crystallized, so that all structure is lost, while the external portion preserves the rays and the fine transverse dissepiments uniting them. When weathered calcareous specimens are examined, the cellular character of the external portion of the cup is distinctly visible; but if the specimen is much crystallized or silicified, then only the rays are visible. In good specimens, the rays in the external portion of the cup appear denticulated on either side from the partial destruction of the dissepiments.

The interior structure varies to some degree, and the condition of preservation of the coral has apparently an influence in this respect.

In some instances the outer cellular portion is quite solid, and no rays or dissepiments can be seen, and in such cases usually the centre presents only transverse septa. In others the lamellæ are all preserved, and the transverse septa are less conspicuous in the centre, and frequently bent downwards or otherwise departing from their directly transverse character. In many cases the lamellæ are equally strong with the septa, and a lamellar structure only is visible. In such examples the structure approaches that of COLUMNARIA; but there is no central axis, and the cells are not in contact. This variable appearance, even in individuals of the same group, proves that much care is necessary in the determination of the interior characters of a coral in a fossil state, where one portion of the structure may be entirely absent, or appear to play a very subordinate part, while in other instances some other part seems of undue importance.

The usual character observed in a longitudinal section is that of transverse septa in the inner portion of the cell, with the radiating lamellæ rarely preserved. In the exterior portion, the rays are always preserved with closely arranged transverse septa more rarely. But there are

departures from these characters, due perhaps to accidental causes, which present almost specific differences.

Fig. 1 *a*. A single cell with a lateral bud on one side. The weathered portion near the top of the specimen shows very distinctly the transverse dissepiments.

Fig. 1 *b*. A specimen cut obliquely, showing the transverse dissepiments in the inner circle of the cell.

Fig. 1 *c*. A group formed by budding from a single stock below. One of the buds is broken off near the base. The exterior surface is well preserved in this specimen, showing the fine transverse striæ. The outer circle is distinctly cellular from above, while the centre is solid. The base of this specimen is covered by an incrusting coral.

Fig. 1 *d*. A small group, showing one mode of budding. The continuation of the righthand portion of the figure has been broken off.

Fig. 1 *e*. A cylindrical specimen, contracted at intervals from intermitted growth, and showing a tendency to budding at these points. On the lefthand side, at *a*, *a*, are two buds broken off; and on the righthand side, at *b*, *b*, *b*, are the germs of three other buds which have not expanded.

Fig. 1 *f*. A portion of fig. 1 *a* enlarged, showing the transverse dissepiments uniting the lamellæ.

Fig. 1 *g*, *h*. The cell natural size and enlarged, showing the denticulated appearance of the lamellæ, arising from the dissepiments being partially preserved at the junction with the lamellæ. The inner and outer portions of the cell are distinctly shown.

Fig. 1 *i*. A vertical section of the cell.

Fig. 1 *k*. A fragment showing the ends of several stems standing out above the weathered surface, having the exterior portion still cellular, while in many of them the centre is solid.

Fig. 1 *l*. A polished section of a less crystalline specimen, showing the ends of several stems.

Fig. 1 *m*. A part of a larger group, showing the manner of budding and increase.

Fig. 1 *n*. A single stem with two buds in the lower part, which are broken off near the stock; while near the upper part the buds are numerous, and thrown out on all sides. The surface of the specimen is somewhat worn, showing the lamellar structure of the outer circle, while the transverse septa are obliterated.

Fig. 1 *o*. A longitudinal section of several stems, showing the transverse dissepiments, which, near the base of one stem are bent downwards in the middle, and are otherwise irregular in other parts of the stem.

Fig. 1 *p*, *r*. Longitudinal sections from two different groups, showing irregularity in the transverse septa of the centre of the cell.

Position and locality. This coral is quite abundant in weathered specimens of the lower part of the limestone of the Niagara group at Lockport, but is rare in other places in New-York. (*State Collection.*)

509. 2. DIPLOPHYLLUM CÆSPITOSUM?

PL. XXXIII. Fig. 2.

Compare *Columnaria*, *Syringopora*, *Sarcinula*, etc.

The figure is drawn from a longitudinal section, and is remarkable for having the septa in the middle portion of the cell bent downwards in the centre, like a series of inverted cones, and presents to some extent the character of SYRINGOPORA, while the outer portion shows the fine dissepiments uniting the lamellæ. Notwithstanding this wide departure from the prevailing character of the species, there are numerous instances of individuals approximating to this one in structure, and the external appearance presents nothing to distinguish it from those already described.

There is another fact also shown in the same specimen; the bud on the right side of the figure shows several strong transverse septa, crossing the inner division of the cell, while the outer portion is distinctly separated, and of the same structure as the corresponding parts in other specimens.

It seems scarcely possible, therefore, to regard this peculiar interior structure of the main stem as anything more than an abnormal development, which is to some slight extent shown in the preceding sections, and which is clearly a variation in character of the same species. This is the only individual, out of several hundred polished specimens, which shows this peculiar structure.

Position and locality. In the lower part of the Niagara limestone, associated with the preceding specimens figured.

GENUS SYRINGOPORA (GOLDFUSS).

I have referred the following species to the Genus SYRINGOPORA, though its internal structure does not correspond with that given by GOLDFUSS. I am induced thus to refer the species, from the fact that no corals have fallen under my observation, having the structure given by this author, and all those in our rocks, usually referred to SYRINGOPORA, have a lamelliferous or radiate structure more or less perfect, with transverse septa or dissepiments either extending across the tube or uniting the lamellæ. The species from the Wenlock limestone, referred by LONSDALE to *S. reticulata* of GOLDFUSS, has certainly a stellate structure more or less developed, and the same is probably true of other species. The unequal development of the radiate and septate characters, or their unequal preservation, has given a very variable appearance to the interior structure; and it is often altogether obliterated, and we have only external form and mode of growth to rely upon.

Should it be found necessary, on further investigation, to separate under another generic name the following and allied species, the name SYRINGOPHYLLUM may be very properly applied, indicating their relation with the Cyathophyllidea.

510. 1. SYRINGOPORA? MULTICAULIS.

PL. XXXIII. Fig. 3 *a* – *h*.

Tubes simple or aggregate, cæspitose, increasing by lateral budding, connected among themselves by lateral processes, at unequal intervals, externally transversely striate, internally radiate with about fourteen or sixteen distinct rays; transverse septa often nearly direct or ascending towards the centre, and complicated with the lamellæ. The entire interior of the tube sometimes filled with the oblique ascending septa.

This coral consists of an aggregation of tubes, which, beginning from a small base or root, have increased by lateral budding to a large mass. The processes uniting the tubes laterally are not numerous or distinct, and they often appear as if parallel and disconnected. In many instances there appears to be regular intervals of budding, where a single tube throws out two or three buds at about the same elevation. From this mode of increase, the mass spreads rapidly from the base, and becomes hemispherical. Sometimes, however, a large number of tubes grow up together nearly parallel to each other, and the mass has a less hemispheric form. When the coral is calcareous, the stellate tubes are very easily discerned on the weathered surfaces; but in other cases they are solid, or irregularly cellular in the interior. The external surface rarely or never shows any longitudinal striæ; but the surface, in calcareous specimens, is distinctly striated and wrinkled transversely, and in siliceous specimens a sort of granular surface is often preserved. In such instances, there is often a longitudinal arrangement of the granules corresponding to the lamellæ.

Fig. 3 *a*. A small part of a larger group of these tubes from a siliceous specimen.
Fig. 3 *b*. A transverse section, showing the ends of the tubes.
Fig. 3 *c*, *d*. The end of a tube, natural size and magnified.
Fig. 3 *e*. A separated tube, showing contraction at intervals, with a shorter one at the base, and a bud proceeding apparently from between them.
Fig. 3 *f*. A longitudinal section from the top of the cup downwards, showing in the upper part the simple rays, and below the complicated oblique septa.
Fig. 3 *g*. A longitudinal section of a tube, the middle of the figure reaching to the centre of the tube, and showing oblique septa, while at the two ends only the lamellæ are seen.
Fig. 3 *h*. A longitudinal section of several tubes, showing the interior structure.

In all the specimens which have been polished down to the centre, there is an appearance of transverse septa ascending towards the centre and crossing the lamellæ, or uniting them. Sometimes these specimens present the appearance of having a central axis, which arises apparently from a partial involution of the lamellæ at their junction.

Position and locality. In the lower part of the Niagara limestone at Lockport, and in the central part of the same limestone in Barre, Orleans county.

Genus ASTROCERIUM (*nov. gen.*).

[Gr. αστηρ, *stella*, and κηριον, *favus;* in allusion to its similarity to Favosites with stellate cells.]

Coral massive (or ramose?); interior prismatic or basaltiform; cells contiguous, openings upon the surface more or less angular, and often very variable in size; rays twelve or more, consisting of slender elongated and ascending points; transverse septa direct.

In some species, the columns or cells are contracted at intervals during the process of growth.

The corals of this genus resemble Favistella; but I have separated them, on account of the spiniform rays which constitute a marked distinction, those of the latter genus having continuous lamelliform rays. Making this distinction, we shall find the genus Favistella, if not confined to lower silurian strata, at least more decidedly typical of that period*.

The form and general character of the species of this genus is like that of Favosites; and in many specimens the absence of the slender spiniform rays leaves the transverse septa alone, making it nearly impossible to distinguish them from Favosites.

511. 1. ASTROCERIUM VENUSTUM (*n. sp.*).

Pl. XXXIV. Fig. 1 *a – i.*

Porites? Rep. 4th Geol. District, pag. 86 and 91, figs. 25 and 27.

Corallum hemispheric or spheroidal, massive, commencing growth upon other bodies; composed of small angular tubes or cells, which increase by lateral and interstitial additions; interior of cells stellate, with twelve ascending spiniform rays; septate transversly; openings on the surface stellate, or solid and columnar.

This species occurs in masses of greater or less dimensions, often reaching two or three feet in diameter, and sometimes even larger. In its general aspect, it is composed of stellate tubes of from $\frac{1}{28}$ to $\frac{1}{24}$ of an inch in diameter. The rays are composed of slender spines rising from the side of the tubes, and pointing upward; and between each series of these there is a transverse septum. Specimens, however, are usually so imperfect that a longitudinal section presents a confused septate and radiate character. In some specimens the transverse septa alone are preserved, with the bases of the spines upon the sides of the tube. In other cases the rays alone are preserved with few of the septa, so that the strict application of characters is liable to difficulty. The solid specimens present the columnar character of Favosites, from which they are not readily distinguished, but the ends of the tubes are still stellate in many of the solid masses.

One peculiarity of this species is that of being marked at intervals by strong laminæ parallel to the surface, and indicating periods of growth. The entire substance of the coral is some-

* The species of Favistella described under the Clinton group may perhaps belong to the genus now constituted, or form a connecting link between the true Favistella of the lower silurian period and those now described. In many instances where the ends of the tubes appear stellate in solid specimens, it is not easy to discover whether they are spiniform or lamelliform rays; sections of such specimens do not always reveal the true structure.

times destroyed, leaving only these thin laminæ, as in the figure below. In other instances these laminæ are of a different color, and give a very pretty aspect to a polished surface.

It is often entirely replaced by anhydrous gypsum, or by selenite, and the structure is sometimes traceable in the crystallized mass of the former mineral. The large masses of anhydrite at Lockport usually, if not always, fill spaces previously occupied by this coral.

Fig. 1 *a*. A vertical section of a solid spheroidal mass, showing its columnar character, and the lines indicating stages of growth.

Fig. 1 *b*. The base of a smaller solid specimen, showing the coral surrounding, and the columns diverging from a stem of the *Syringopora multicaulis*.

Fig. 1 *c*. A vertical section, with the cells open, showing the internal character.

Fig. 1 *d*. A portion enlarged, showing the arrangement of the spiniform rays between the septa.

Fig. 1 *e*. A similar section where the rays are nearly obsolete.

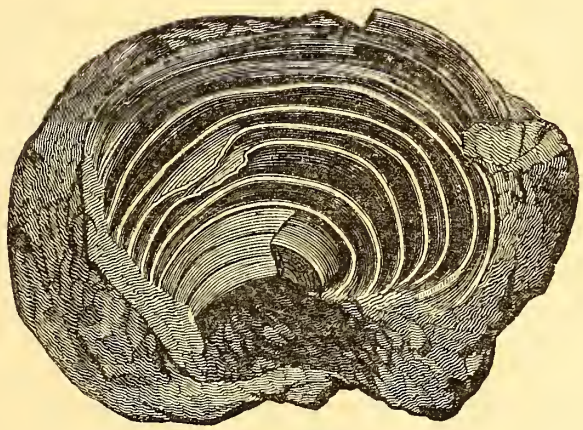
Fig. 1 *f*. A section enlarged, showing the surface of the walls of the cell, where the rays are broken off.

Fig. 1 *g*. A single space between two septa, greatly enlarged.

Fig. 1 *h*. A transverse section of the cells parallel to the surface.

Fig. 1 *i*. The same enlarged.

Position and locality. Throughout the Niagara limestone : abundant at Lockport, and less common at Rochester and other places. (*State Collection.*)



Astrocerium venustum.

The concentric laminæ, indicating stages of growth, are alone preserved.

512. 2. ASTROCERIUM PARASITICUM.

PL. XXXIV. Fig. 2 *a - i.*

Corallum hemispheric, spheroidal, growing independently, or attaching itself and growing upon, or enveloping other bodies; composed of angular tubes or cells; openings of cells upon the surface unequal in size, stellate, with twelve to twenty-four spiniform rays; tubes transversely septate.

This species has the general appearance of FAVOSITES, from which it is often almost impossible to distinguish it. The coral increases by lateral and interstitial addition of cells, the younger ones being more angular and smaller than the older ones. In many specimens the mass is solid, and separable into columns as in FAVOSITES; while the stellate character is still preserved in the ends of the tubes. In other specimens, where the cells are open, the spiniform rays have often been destroyed, and the specimen has all the appearance of a true Favosite. The utmost care is required, therefore, in discriminating the species. It should be observed, that in tubes destitute of the rays, the sides are marked by little processes which are the bases of the rays, giving the whole interior surface a papillose appearance. Where the coral is silicified, however, this character fails, and the walls of the cell present only an aggregation of small siliceous concretions.

This species, in the young state, attaches itself to shells, to stems of living crinoids, and to other corals, being eminently parasitic in its habit.

Fig. 2 *a*. A small spheroidal form, attached to a coral which projects beyond the base.

Fig. 2 *b*. A small spheroidal specimen.

Fig. 2 *c*. A spheroidal mass with the cells open on a part of the surface, showing the unequal size of the openings; the interspaces are also very wide.

Fig. 2 *d*. A smaller mass enclosing a piece of a crinoidal column, which projects on both sides of the coral; and it is probable, from the habit of this species, that it commenced growth on the crinoid while the latter was in a living state. See Plate 49 *a*, fig. 1, *e* and *e*+, where the stem of a Caryocrinus is enveloped in a similar manner by a coral of this species.

In this and the preceding specimen the cells are open on the surface, and distinctly stellate.

Fig. 2 *e*. Section of a spherical mass, which enclosed a fragment of an ichthyodorulite.

Fig. 2 *f*. A portion of the surface from a large specimen, where the cells are filled, and the whole mass is columnar. The ends of the columns present a confused stellate character.

Fig. 2 *g*. A small portion from the base of the last, showing the weathered surface of the columns.

Fig. 2 *h*. The ends of the tubes enlarged, showing the stellate character.

Fig. 2 *i*. Figure showing the papillose surface of the interior of the tube when the rays are broken away, leaving the bases projecting.

Position and locality. In the lower part of the limestone near Lockport.

513. 3. ASTROCERIUM PYRIFORME (*n. sp.*).

PL. XXXIV A. Fig. 1 *a* – *e*.

Irregularly subturbinate, pyriform or spheroidal; cells angular, radiating from a more or less extended base, often from a narrow area, spreading out above and rapidly increasing by the addition of interstitial tubes; tubes opening upon the surface by well defined angular mouths, which are seen of all sizes and forms, from triangular to hexagonal, in their different stages of development; cells within divided by transverse septa, and one or more rows of fine spiniform rays between each pair of septa.

This species presents but slight differences from the last, and may perhaps be only a variety of the same. The most obvious difference appears in the openings of the cells upon the surface, which are usually smaller than in the preceding species, more uniformly angular, and do not present the larger nearly round openings which occur at intervals in the last species. It is often difficult, from any external character, to discover any distinction between this fossil and some species of FAVOSITES; but a careful examination of the internal structure has shown, in nearly all instances, the peculiar stellate structure and spiniform rays.

Fig. 1 *a*. A spheroidal form of this species.

Fig. 1 *b*. A turbinate form, the cells increasing rapidly from a narrow base.

Fig. 1 *c*. An irregular turbinate form of larger size.

Fig. 1 *d*. A portion enlarged, showing the internal structure of the cells.
In this individual both the septa and rays are nearly obliterated, but enough remains to decide the generic characters of the species.

Fig. 1 *e*. An enlarged portion from the inner walls of the cells, showing the granulated or papillose surface from the bases of the spiniform rays.

The specimens figured above are nearly solid throughout, the cells being filled to the openings, so that the stellate structure is very obscure, though evidently existing in all the specimens figured.

Position and locality. This species occurs in the shale of the group at Rochester, Wolcott and Lockport, and more rarely in the limestone at Rochester and Lockport. (*State Collection.*)

514. 4. ASTROCERIUM CONSTRICTUM (*n. sp.*).

PL. XXXIV A. Figs. 2 *a* – *c*, and 3 *a* – *e*.

Massive, hemispheric; cells minutely stellate; coral dividing into columns, which appear as if constricted at intervals.

This species has the columns a little larger than *Chætetes lycoperdon*, and more strongly constricted at intervals. These characters alone are sufficient to distinguish it on careful comparison, though from a cursory examination it would easily be mistaken for that one. When the ends of the cells are visible, however, there is no difficulty in distinguishing the true cha-

racter, but in its solid state this feature can not often be observed. In the specimen described, it is impossible to decide whether the rays are spiniform or lamelliform; and therefore it is still possible that it may have the character of FAVISTELLA, though its constricted growth presents a different feature from any thing yet observed in that genus.

Fig. 2 *a*. A fragment of a hemispheric mass, natural size.
Fig. 2 *b*. A portion of the same enlarged, showing the constricted growth at intervals.
Fig. 2 *c*. A transverse section of the same enlarged, showing the stellate character of the ends of the columns.

The following figures are from small hemispheric forms, apparently of the same species as the preceding.

In the open cells there is a confused stellate structure visible, but so minute that it is scarcely possible to decide more than that the rays appear to be spiniform, and like those in the preceding species. In the solid specimens of this form I have found no rays. Although having the character of growth and form of the *Chætetes* before described, this is clearly distinct in the size of the cells and columns, and is probably identical with fig. 2 *a* – *c*.

Fig. 3 *a*. A small hemispheric form of this species.
Fig. 3 *b*. The base of the same, showing its mode of growth upon the valve of an ATRYPA.
Fig. 3 *c*. Profile view, showing the form and elevation.
Fig. 3 *d*. The base of a larger specimen, which commenced its growth upon a small shell.
Fig. 3 *e*. A portion of the surface enlarged, showing the form and apparent stellate character of the cells.

Position and locality. In the shale of the Niagara group at Lockport and elsewhere.

(*State Collection.*)

GENUS FAVOSITES.

When the introductory remarks to the corals of this group were printed, I had not detected in any specimens examined the unequivocal evidence of pores in the walls of the cells; and in all but a single specimen of this family, I had found evidences of rays or lamellæ. I have, however, been able to prove the existence of the genus at this period, though in New-York it holds a very subordinate place, so far as number of individuals or dimensions of the masses is concerned: indeed it would be almost overlooked among the great number, and more conspicuous character, of the corals of the genera ASTROCERIUM and HELIOLITES. On a farther examination of the specimens sent to me from Milwaukie by Mr. LAPHAM, I have found a species apparently identical with the one from Niagara; and likewise, in the same association, another species of very distinct character, so that we may regard the genus as being represented in two species at this epoch. It now becomes a matter of some interest to ascertain the characteristic differences between this species, the one in the *Pentamerus galeatus* limestone, and the one in the Onondaga limestone, all of which approach in character the *F. gothlandica*, but which are, in their habit and mode of growth, distinct species.

515. 1. FAVOSITES NIAGARENSIS.

PL. XXXIV A. Fig. 4 *a* – *h*.

Spheroidal or irregular in form, rapidly increasing by interstitial cells ; walls of cells usually thin, pierced by two rows of minute pores ; transverse septa thin, often oblique or bent downwards.

The first specimens in which I have detected pores in the walls of the cells, and at the same time the entire absence of rays, were from the limestone at the top of Niagara Falls, or even a few feet higher, being at the southeastern side of Goat island. In these specimens the walls of the cells are very thin, and likewise the septa, which are frequently bent or oblique to the axis of the tube. The pores are often very distinctly visible in the sides of the cells. In a spherical specimen from near Rochester, the walls of the cells appear stronger and thicker ; but this is probably due to their being replaced with silex, and thus thickened. The pores are likewise larger than in the specimens from Niagara Falls.

I have included with this species, one from Milwaukie, in which I am unable to distinguish any specific difference.

Fig. 4 *a*. A fragment from the limestone at Goat island, showing the ends of the cells which are open.

Fig. 4 *b*. A portion enlarged, showing the transverse septa and pores in the walls of the cells.

Fig. 4 *c*. A small spherical form, having the cells open, and the walls replaced by siliceous matter.

Fig. 4 *d*. A small portion enlarged, looking into the cells and showing the perforated walls.

Fig. 4 *e*. A worn specimen from the lower part of the limestone at Lockport. The cells are open, but there are no pores visible.

Fig. 4 *f*. A section of a small mass of apparently the same species, showing the septa bent downwards.

Fig. 4 *g*. A longitudinal section of another specimen, in which the septa appear at irregular intervals, some of them at great distances, probably from a part of the original number having been obliterated ; and others in close proximity, showing that this feature can not be relied upon to characterize specific distinctions.

Fig. 4 *h*. Transverse section, showing the ends of the cells and the separation of the walls, forming distinct and separate tubes.

The three last figures are taken from specimens in which a partial or entire substitution of the original has taken place by a kind of semicrystalline calcareous matter, which has apparently obscured or filled up the pores in the sides of the cells, as none are visible.

This species differs from the *F. gothlandica*, in forming more usually small spheroidal masses, and in the rapid increase of cells almost entirely by interstitial growth, the base continuing small. The size of the cells is always less than in that species, and from this character alone it may be distinguished.

Position and locality. In the Niagara limestone at Niagara Falls, Lockport, Rochester and elsewhere; and has been sent to me by Mr. I. A. LAPHAM, from the same geological position, from Milwaukie, Wisconsin. (*State Collection.*)

516. 2. FAVOSITES FAVOSA?

PL. XXXIV A. Fig. 5 *a–e.*

Reference *Calamopora favosa*, GOLDFUSS, Petrefacta, p. 77, pl. xxvi, fig. 2 *a*, *b*, *c*.
Compare *Favosites striata*, SAY, Silliman's Am. Journal of Science, Vol. i, p. 381, 1818.

Massive, hemispheric; tubes large, strong, prismatic, sometimes striated transversely; transverse septa numerous, sometimes convex above; base and sides of the mass covered by a thick calcareous membrane, which is strongly striated concentrically, and corrugated.

This species is remarkable for its large strong columns, which diverge rapidly from the base, and admit numerous interstitial ones. The septa are closely arranged, very strong, and sometimes present the convexity in the centre noticed by GOLDFUSS, though this is far from being a uniform character in the specimens we possess.

I have preferred to refer this species to the *F. favosa*, more particularly since the species described by GOLDFUSS is from Drummond island, which is of the same geological formation as the rocks at Milwaukie. The specimens which I have examined are not in a favorable condition for preserving the more minute markings; and therefore it is not easy to decide with regard to its identity with other species.

It seems probable that the *F. striata* of SAY includes several species, as the specimens cited are from different localities and geological positions.

Fig. 5 *a*. A longitudinal section of a small hemispherical mass.
Fig. 5 *b*. Section of another specimen, where the septa are more distant and irregular.
Fig. 5 *c*. The solid columns of the same species. The nature of the semicrystalline calcareous matter replacing these is such that the pores are very indistinctly preserved.
Fig. 5 *d*. Transverse section of the cells.
Fig. 5 *e*. An impression left by the exterior surface of one of these masses.

Position and locality. In the Niagara limestone at Milwaukie, and (as I am informed) in Canada West. I have not, thus far, found this species in the State of New-York.

(*State Collection.*)

517. 1. CATENIPORA ESCHAROIDES.

PL. XXXV. Fig. 1 *a*, *b*, *c*.

Millepora. FOUGT, 1745.
Millepora tubis ovatis longitudinaliter reticulatim concatenatis. LINNE, Amœn. Academicæ, t. i, p. 208, f. 20, 1749.
Tubipora catenulata. GMELIN : LINNE, p. 3753.
Tubularia catenulata. KNORR, Recueil, t. 2, pp. 16, 57, 58 ; tab. F. ix, F. ix*, f. 4, t. 3, p. 158; supp. tab. vi *a*, f. 1, 1775.
Tubularia catenulata. WALLERIUS, Min. Uebersetz, p 439.
T. gothlandica. BROMEL, Nr. 10, 11.
Millepora catenularia. ESPER, Petrefacta, tab. v, f. 1, 1795.
Chain Coral (*Tubipora catenulata*, Linn.), PARKINSON, Organic Remains, Vol. ii, pag. 20, pl. iii, fig. 4, 5, 6, 1808 ; 2d edition, 1833, pl. iii (18) of Vol. i, figs. 4, 5, 6.
Catenipora escharoides. LAMARCK, Anim. sans vertebres, 1st edition, t. 2, p. 207, 1816.
— — LAMOROUX, Expos. methodique, p. 65, 1821 ; *C. tubulosa*, ib. id. note.
— — SCHWEIGGER, Beobachtungen, tab. vii, 1819.
— — SAY, Am. Jour. Science, Vol. ii, p. 34, 1819.
— — GOLDFUSS, Petrefacta, p. 74, t. xxv, f. 4 *a* – *c*, 1826.
— — STEININGER, Mem. Geol. de France, t. 1, p. 341, 1831.
— — EHRENBERG, Abhandlungen, 1831.
— — KONIG, Akad. Berlin, p. 344, 1832.
— — DE BLAINVILLE, Man. d'Actinologie, pag. 352, pl. 62, f. 1, 1834.
— — MILNE EDWARDS, 2d edition of Lamarck, t. 2, p. 322, 1836.
— — HISINGER, Lethea Suecica, p. 94, t. xxvi, f. 9, 1837.
— — LONSDALE : MURCHISON, Sil. System, pag. 685, pl. 15 bis, fig. 14, 14 *a*, 14 *b*.
— — HALL, Geol. Rep. 4th Dist. N. York : Tables of organic remains, no. 22, fig. 1, 1843.
Tubiporites catenarius. SCHLOTHEIM, Petrefacta, p. 366, 1820.
Halysites. FISHER, Oryct. de Moscou, 1830.
Halysites escharoides. BRONN, Lethea geognostica, p. 52, 1835.

Coral in hemispheric masses, composed of oval tubes placed laterally in juxtaposition in a single series, or separated by a cellular interspace ; lines of tubes arranged in reticulated form, with unequal interspaces. Tubes within, septate transversely and striated longitudinally, externally transversely striated, and sometimes with more elevated ridges at equal intervals.

This coral is so well known by its peculiar net-like structure, that a description seems scarcely necessary. It presents considerable variety, however, in the mode of its reticulation and the size of the spaces. The openings of the tubes upon the surface are oval, though often varying in size ; and the whole expansion is frequently very thin and slender, and in other cases thick and strong.

The greater number of specimens found in New-York are siliceous, the interior structure is not well preserved ; and the transverse septa seen only at irregular intervals. The striæ noticed in the interior of the tube are distinct crenulated ridges like the bases of lamellæ, and give to the well preserved tubes a very characteristic feature.

Fig. 1 *a*. A portion of a hemispheric specimen, giving the usual characters of the species as it occurs in New-York.

Fig. 1 *b*. The base of the same specimen, showing its mode of growth from below, and the increase by interstitial cells, which appears like a bifurcation of a single tube.

Fig. 1 *c*. A fragment from a strong growing mass, preserving the transverse striæ, and showing tubes somewhat larger than the preceding figure.

Fig. 1 *d*. An individual where the growth is more slender, and the reticulate spaces are smaller.

Eig. 1 *e*. A vertical section of the same, contrasting with fig. 1 *c*.

Fig. 1 *f*. A vertical section of fig. 1 *c*, showing the transverse septa of the tubes, and also a confused cellular structure, which is probably due to crystallization, from the infiltration of siliceous matter into the interior.

Fig. 1 *g*. A vertical section of a well preserved specimen, showing the external striated character of the tubes, when magnified.

Fig. 1 *h*. A longitudinal section of the interior of several tubes magnified, showing the striæ.

Fig. 1 *i*. A figure showing the vertical section of a mass of this coral, where the spaces are filled, and the whole intimately combined with the surrounding stone. It is impossible, in such specimens, to distinguish any characters of structure.

The specimens 1 *a*, *b*, *c*, are from New-York, and show a stronger and more vigorous growth than the specimens *d* and *e*, which are from western localities. Indeed the variation sometimes appears sufficient for the establishment of a distinct species; but as the specimens present among themselves considerable variety, it is difficult to find constant characters. In all the New-York specimens examined, the cells are round-oval, rather closely united, and the coral of strong growth. In the western specimens, the openings of the cells are smaller, more elongated, and not so closely united, and the coral more slender and delicate. The space of one fourth of an inch covers the openings of two to three cells of the New-York specimens, while there are three to four in the same space in western specimens, although the latter are less closely united. In other respects there appears no important difference, though, from the silicified condition of most of the specimens, the minute structure is rarely preserved in perfection.

Position and localities. This coral has been already noticed under the Clinton group, in which position it makes its earliest appearance. In the Niagara group, it occurs in almost every locality in the upper part of the limestone; but the condition of the rock is such that it is frequently nearly obliterated, and it often requires careful examination to detect its remains even where it has been abundant. Nearly all the well preserved specimens are silicified, and these remain while the surrounding rock is destroyed. In this condition the coral is more abundant in the vicinity of Rochester and Brighton, Monroe county, than in any other localities. It is less abundant in Wayne and Orleans counties; and at Lockport are occasionally found fragments of large masses, the principal portion entirely obliterated, and replaced by gypsum, strontian, or other crystalline matter.

This coral occurs in the neighborhood of Schoharie, in the coralline limestone*, and in the same band of limestone in Ulster county.

Near Louisville, Kentucky, this coral is one of the most abundant fossils in the Cliff limestone; and as the Niagara limestone there comes in contact with the upper Helderberg, or the Onondaga and Corniferous limestones of New-York, the true position of the fossil is not always appreciated.

I have collected fine specimens of this coral, and in great abundance, in Iowa; and have likewise received it from Wisconsin and Michigan, always holding the same geological position. It is represented as abundant on Drummond island, Lake Huron, and is cited by Goldfuss from that locality.

The wide geographical distribution of the species on this continent is very interesting; and it becomes more so, when we learn that in Europe it is also very extensively distributed, being cited from Dudley, Wenlock, and other localities in England; from the shores of the Baltic, Gothland; near Moscow, Russia; and the Eifel, Germany†. (*State Collection.*)

518. 2. CATENIPORA AGGLOMERATA.

Pl. XXXV. Fig. 2 *a* - *g*.

Catenipora agglomerata. Hall, Geol. Rep. of 4th Dist. N. York, 1843 : Tables of fossils, no. 22, fig. 2.

Coral consisting of cylindrical tubes, arranged laterally in a continuous series forming broad explanate expansions, which are closely arranged in parallel, straight, or more or less curving lines; openings of the cells circular, tubes cylindric; septa numerous, concave from above; spaces between the tubes cellular; exterior surface somewhat transversely striated.

This species contrasts with the preceding in the circular openings and cylindrical form of the tubes, while it shows no tendency to assume the reticulated arrangement so characteristic of that one. It appears as if made up of expansions of a single series of tubes, which are then folded one against the other, sometimes in close parallel lines more or less curved and frequently irregular, as if a regular series of foldings had been crushed laterally. In rare instances, a single tube may be detected intercalated between two series or lines of tubes, uniting them. The septa are very numerous, and sometimes scarcely more than their thickness asunder, always bent downwards or concave. Transverse sections of the mass often present, upon the lower side, the prominent convex surface of these septa.

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* See note page 107.

† Its geological position in Europe appears not to be as constant as in this country, though it is easy to see how in England it may be referred to the upper part of the Caradoc formation, when the *Pentamerus oblongus* is placed in the same position, while both these fossils are remarkably typical of the Clinton group of New-York, which is unquestionably upper Silurian.

Fig. 2 *a*. A weathered surface of a mass of this species, showing some irregularities in the arrangement of the series of cells.

Fig. 2 *b*. A transverse section of an upper weathered surface, showing the form of the openings, and the arrangement in parallel lines with slight interruptions.

Fig. 2 *c*. A vertical section, showing the transverse septa within the tubes.

Fig. 2 *d*. A vertical section magnified, showing the concave septa and the cellular interspaces between the tubes.

Fig. 2 *e*. The external surface of several tubes enlarged, showing an obscurely striated surface.

Fig. 2 *f*. A fragment showing the lower or convex surface of the septa.

Fig. 2 *g*. The openings of several tubes enlarged, contrasting with similar figures from the varieties of the preceding species.

Position and locality. This species, so far as known, is confined to the upper part of the Niagara limestone in Sweden and Ogden, Monroe county. It occurs also at Milwaukie, Wisconsin, in the same geological position, associated with *C. escharoides*, *Favosites* and *Heliolites*, as in the Niagara group of New-York. (*State Collection.*)

Genus HELIOLITES (Guettard).

Millepora subrotundata poris minimis confertis majoribusque crenatis remotis. Fougt : Linne, Amœn. Acad. i, 203, fig. 24.

Heliolithe pyriforme. Guettard, Mem. iii, 454, pl. 22, fig. 13, 14.

Heliopora pyriformis. Blainville, Man. d'Actinol. p. 392.

Porites pyriformis. Lonsdale : Murchison's Sil. System, p. 686, pl. 16, fig. 2.

Astrea porosa. Goldfuss, Petrefacta, Vol. i, p. 64, pl. 21, fig. 7.

Mr. Dana (Zoophytes, U. S. Exp. Expedition) proposes to unite under Guettard's name of *Heliolites*, certain fossil corals which have been referred to the various genera cited above. It is very clear that these corals are neither Porites, Astrea or Heliopora, as the latter genus is limited. It is therefore very appropriate to refer them to this genus, which, in its restricted signification, includes several interesting silurian corals that have hitherto scarcely attracted attention in this country.

519. 1. HELIOLITES ELEGANS (*n. sp.*).

Pl. XXXVI. Fig. 1 *a* – *g*.

Coral massive or hemispheric, increasing by the lateral addition of cells more than by interstitial additions; cells small, 16 to 18 in an inch; openings upon the surface marked by twelve or more short rays; transverse septa numerous; interspaces apparently lamelliferous.

This species has much smaller cells than any described species known to me; the openings upon the surface are much expanded, and the rays are apparently confluent, but on careful examination there appear to be intermediate vertical lamellæ; a vertical section shows the rays and transverse septa of the tube, but the thick interspaces are often apparently solid. In

some of them, however, I have been able to detect several vertical lamellæ, but without any transverse septa. The whole is so minute that these lamellæ may prove to be tubular and not celluliferous.

The coral presents a variable surface appearance, from the different influences of weathering; when it has suffered little or nothing from such causes, the entire surface presents a series of stars having a depression in the centre, and apparently confluent at the margins; where it has been slightly weathered or worn, the stars are limited, and in many cases there is a solid crystalline centre with surrounding rays. A polished transverse section presents the cells with a space between them equal to the diameter of the cell. A vertical section gives the same general appearance.

This species has not the cells as well defined with the tubular or cellular interstices as the following, and in this respect does not precisely meet the requirements of the generic character as given by Mr. Dana. It seems, however, to differ too little to require reference to any other genus.

Fig. 1 *a*. A portion of the surface, showing the openings of the cells.
Fig. 1 *b*. A vertical section produced by weathering.
Fig. 1 *c*. Enlargement of 1 *a*, showing the variable appearance of the cells.
Fig. 1 *d*. Enlargement of 1 *b*, showing the cells as they appear when weathered.
Fig. 1 *e*. A magnified view of a polished transverse section.
Fig. 1 *f*. A magnified view of a polished vertical section.
Fig. 1 *g*. A magnified view from the lower side of the coral.

Position and locality. In the lower part of the Niagara limestone at Lockport.

(*State Collection*)

520. 2. HELIOLITES SPINIPORA (*n. sp.*).

Pl. XXXVI. Fig. 2 *a* – *n*.

Compare *Porites tubulata*, Lonsdale : Murchison, Sil. System, p. 687, pl. 16, fig. 3. Also fig. 2 *a*, *b*, of *Porites pyriformis*, id. ib.

Turbinate, pyriform, hemispheric and spheroidal masses, formed of diverging cylindrical tubes with cellular interspaces, often rapidly increasing by interstitial additions of new tubes, and thus becoming spheroidal; openings of the cells upon the surface circular, with twelve short rays, not confluent; spaces between the openings cellular; tubes transversely septate, and externally marked by strong longitudinal striæ. A longitudinal section shows cellular interspaces, and the interior of the tubes often crowded by spiniform rays nearly meeting in the centre.

This coral presents such a variety of appearance and character, that it is impossible to give an adequate description in a few words. It occurs mostly in small hemispheric or spheroidal masses, and its great variety of aspect is mainly due to weathering and the effects of different conditions of crystallization of the mass. In many specimens the exterior limits of the cells are not conspicuous, and the stellate openings appear to be confluent or nearly so. In such

specimens the central portion, or that included within the cup and rays, is crystalline, and weathers less rapidly than the lamellæ and walls of the cell, which are consequently worn down; and the rays which appear upon the surface are the crystallized spaces between the lamellæ, which, from the margin of the cup having been obliterated, often extend indefinitely outwards, and become nearly or quite confluent with those of the adjoining cells. This is a very common character, and one at the same time liable to mislead an inexperienced observer.

In the same specimen, it often happens that the openings of the cells present a very different appearance; the centre of the cell being depressed, and the rays reaching to it, still without defined outer margins. In others, and often in connexion with the first described characters, we find the open cells with twelve short rays, the margin or walls of the cell elevated, and each one standing separate and distinct. These, with other varieties of character, are due to the state of preservation of the coral, and the influence of weathering upon crystalline and uncrystalline, siliceous or calcareous masses of the coral. In some of the more solid specimens, the intercellular spaces present oval or irregular points like minute tubular openings, which lie parallel to the principal tubes.

In specimens that are siliceous, and sometimes in calcareous specimens, the tubes stand out separately and disconnected except by a few transverse dissepiments at irregular intervals, while in others the interspaces seem filled with parallel minute cylindrical tubes.

Aside from the varieties of character presented from the causes here mentioned, there is sometimes that resulting from the difference in size of the tubes, and the different distances from each other, owing to an increase of the intercellular spaces. I am unable, however, to discover any positive characters by which species may be separated, and I have therefore introduced the principal varieties of form and appearance under one specific name.

Fig. 2 *a*. A calcareous mass where the interstices between the rays are crystallized and prominent, the entire surface presenting a confused stellate appearance.

Fig 2 *b*. A portion of the same enlarged, showing more definitely the limits of the stellate cells and the intercellular lamellar or granular surface.

Fig. 2 *c*. Several of the cells near the base of the same specimen enlarged, showing a different appearance from 2 *b*. In these cells the centre is depressed.

Fig. 2 *d*. A vertical section of the small specimen fig. 2 *a*.

Fig. 2 *e*. A portion of the same enlarged, showing the spiniform ascending rays in the cell and the transverse septa in the interspaces. In this and numerous other specimens, there is no appearance of transverse septa in the longitudinal sections of the cells.

Fig. 2 *f*. A figure from a polished piece of crinoidal limestone, showing a nearly transverse section of a spheroidal mass of this coral, with a vertical section of another individual which apparently commenced growth upon the preceding one. On the right hand is a vertical section of a smaller species, also growing on the first. This surface presents beautiful stellate cells, with twelve rays, and interspaces with dark oval spots like tubular openings.

Fig. 2 *g*. This figure is enlarged from the surface of the polished specimen, showing the characters very distinctly.

Fig. 2 *h*. A portion of the vertical section in the same figure enlarged, showing the lamellæ in the interior of the cells with interrupted transverse septa ?

Fig. 2 *i*. An enlarged figure of a vertical section, showing the transverse septa crossing the cell directly and interruptedly; also in other cells having the appearance of spiniform ascending rays, as in fig. 2 *e*. The openings of the cells upon the surface of this specimen are somewhat larger than in fig. 2 *a*, and show a gradation in size to those of the figures on the next plate.

Fig. 2 *k*. A portion of the surface of a weathered specimen, presenting the principal varieties of appearance assumed by this coral.

Fig. 2 *l*, *m*, *n*. Enlargements showing the different aspects of the surface in fig. 2 *k*.

Position and locality. In the lower part of the Niagara limestone at Lockport, New-York.

521. 3. HELIOLITES PYRIFORMIS?

Pl. XXXVI A. Fig. 1 *a* - *m*.

Compare *Porites pyriformis* (Ehrenberg), Lonsdale : Murchison, Sil. System, pag. 686, pl. 16, fig. 2, 2 *a* – 2 *e*, 1839.

SYNONYMES AND REFERENCES.

Millipora subrotundata. Fougt, 1745. Linne, Amœn. Acad. t. 1, p. 203, f. 24, 1749.
Heliolithe pyriforme. Guettard, Mem. t. 3, p. 454, pl. 22, fig. 13, 14, 1770.
Madreporites stellatus. Schlotheim, Petref. p. 362, 1820.
Madreporites interstinctus. Wahlenberg, Nova Actæ Upsalæ, p. 98, 1821.
Astrea porosa. Goldfuss, Petrefacta, p. 64, I. xxi, fig. 7, 1826.
— — Hisinger, Lethea Suecica, p. 98, tab. xxviii, fig. 2, 1837.
Astrea interstincta. Hisinger, Esquisse Petref. Suède, 2d Edition, p. 36, 1831.
Madrepora porites. Ehrenberg, Abhandl. König. Akad. Berlin, p. 344, 1832.
Heliopora pyriformis. De Blainville, Man. d'Actinologie, p. 392, 1834.
— — Steininger, Mem. Soc. Geol. France, t. 1. p. 346, 1834.
— — Milne Edwards, 2d Edition Lamarck, t. 2, p. 437 note, 1836.
Heliopora interstructa. Bronn, Lethea Geognostica, Vol. 1, p. 48, tab. v, f. 4, 1835.

Cells tubular; rays short, transversely septate, septa more or less interrupted; interstices with tubular openings upon the surface; vertical sections cellular or tubular.

This coral scarcely differs from the preceding, except in the size of the tubular cells, which are larger and often more widely separated from each other. The internal structure of the cells, as shown in vertical sections, is usually transversely septate; and the crowded spiniform rays are not often visible, though the two kinds of structure have been seen in a single specimen.

I am strongly inclined to believe that this coral is not identical with *Astrea porosa* of Goldfuss, if specimens from Gothland sent me under this name are authentic; but it is perhaps identical with a smaller species from the same locality, which has come to me without a name. These two European species are evidently quite distinct from each other, presenting more reliable characters for separation than the species in the Niagara limestone.

The preceding species approaches in character the *Porites tubulata* of LONSDALE; though the cells are more closely arranged than in his figures, except in fig. 3 *f*. I have separated the preceding species from this one, principally on account of the structure shown in the vertical sections of the cells, which are also smaller and more closely arranged. The different aspects produced by weathering do not offer reliable characters, since the same specimen often presents a great variety of appearance.

The following specimens are found in a somewhat different condition from those of the preceding plate. The cells also are for the most part larger, and the walls better preserved; sometimes standing out in relief, while the interstitial portions are worn away. The size of the cells, although variable, is not more so than in the CATENIPORA; and the difference of aspect is often caused more by the greater distance between the cells, from the expansion of the intercellular spaces, than by the increased size of the tubes.

Fig. 1 *a*. A weathered vertical section of a hemispheric mass, showing the tubes partially in relief upon the surface, with the interspaces more abraded.

Fig. 1 *b*. An enlargement of several tubes, showing the structure of the interior.

Fig. 1 *c*. An enlargement from another part of the same specimen, where the cylindrical tubes stand out in relief.

Fig. 1 *d*. A portion of the surface of the same specimen, showing the openings of the cells upon the surface, and the intercellular spaces.

Fig. 1 *e*. An enlargement from fig. 1 *d*, showing the structure of the surface and the openings of the cells.

Fig. 1 *f*. The base of a weathered calcareous specimen, where the lamellæ and septa are nearly all obliterated, showing the striated interior and exterior of the tubes. This specimen contrasts very strongly with fig. 2 *a* of the preceding plate.

Fig. 1 *g*. An enlargement of a portion of the preceding figure.

Fig. 1 *h*. A fragment where the walls of the tubes are preserved, the elevated edges appearing to be produced by twelve points or granules, with here and there slight evidences of rays.

Fig. 1 *i*. The same enlarged, showing more distinctly the characters mentioned, and also the unequal distances of these tubes from each other; in some cases the walls being nearly or quite in contact, while in others they are widely separated.

Fig. 1 *k*. A weathered surface, showing the exterior and interior surface of these cells.

Fig. 1 *l*. A weathered surface of a specimen preserving the cylindrical tubes, where the intercellular spaces have been filled with crystalline matter, which has assumed a minutely tubular or cylindrical form. Each little cylinder is rugose or crenulated, perhaps indicating the spaces between the transverse septa.

Fig. 1 *m*. Transverse section of the same, showing the ends of the minute tubes.

Position and locality. This species is common at Lockport, in the lower part of the Niagara limestone. It likewise occurs at Milwaukie, Wisconsin, in the same geological position (fig. 1 *l*).

(*State Collection.*)

522. 4. HELIOLITES MACROSTYLUS (*n. sp.*).

PL. XXXVI A. Fig. 2 *a, b, c.*

Tubes large, closely arranged; rays strong; interspaces apparently tubular.

The single specimen of this species examined, differs from the preceding mainly in the size of the tubes, which are comparatively closely arranged, and much stronger than in any specimens of the preceding species. Externally the tubes, like those of the other species, are striated or fluted, the striæ corresponding to the number of rays or lamellæ.

Fig. 2 *a.* A transverse section, natural size; the rays for the most part obliterated.
Fig. 2 *b.* A part of the same enlarged.
Fig. 2 *c.* A vertical section, showing the striated surfaces and close arrangment of the tubes.

Position and locality. In the Niagara limestone at Milwaukie, associated with the preceding species. (*Collection of* I. A. LAPHAM.)

GENUS STROMATOPORA (GOLDFUSS).

The characters of this genus, as given by GOLDFUSS, are not entirely satisfactory; and BLAINVILLE, after an examination of the specimen described by that author, expresses doubts whether it be a true coral, while EHRENBERG supposes it may be a species of PORITES allied to one which he has named *P. stromatopora.*

In the specimens here referred to this genus, there is so much general similarity to those figured by GOLDFUSS and LONSDALE, and also an apparent identity with a specimen from Dudley marked *S. concentrica*, that I cannot hesitate to refer this coral to the genus. Having a similar species from the Delthyris shaly limestone, where the characters of the genus are better developed, it appears that the coral is composed of minute cylindrical tubes with considerable space between; and that the laminated structure arises from thin layers of calcareous matter deposited and filling the spaces between, and enclosing the tubes. In no examples have I found the openings of the cells disposed in concentric lines or furrows. This tubular structure is not so clearly visible, though still perceptible, in the Niagara species. Admitting the reference to the genus, it appears from this structure to be more nearly related to TUBIPORA than to any other genus, and differs from it in this, that the parallel connecting laminæ are contiguous and produce a solid coral*.

* For further illustration, see Corals of the Delthyris shaly limestone.

523. 1. STROMATOPORA CONCENTRICA.

PL. XXXVII. Figs. 1 *a* -*f*.

Compare *S. concentrica*, GOLDFUSS, Petrefacta, pag. 22, pl. viii, fig. 5, 1826.
— — DE BLAINVILLE, Man. d'Actinologie, pag. 413, pl. 70, fig. 1, 1834.
— — LONSDALE : MURCHISON, Silurian System, pag. 680, pl. 15, fig. 31, 1839.

Coral hemispheric, spheroidal or irregular in form, composed of thin concentric laminæ which are visible in weathered specimens ; an apparent fibrous structure often visible in a direction vertical to the laminæ ; surface of the laminæ marked by minute pores not contiguous.

The structure above indicated is all that can be seen by the naked eye, or even with a good magnifier ; but in specimens favorably weathered, the fibrous structure, when much magnified, is seen to be composed of cylindrical tubes penetrating the laminæ. These laminæ are scarcely so thick as writing paper, and sometimes the ends of the tubes may be seen penetrating them, and showing the spaces between which appear to be quite solid.

This coral is extremely abundant, but attracts little attention from its apparently amorphous character ; but it is nevertheless very interesting, and although composed of such minute cells, and increasing by such exceedingly thin layers, it forms masses of one and two feet in diameter, larger even than any individuals of CATENIPORA, HELIOLITES or FAVOSITES in the same rock. The extremely minute structure renders it impossible to point out specific distinctions, if any exist, between this coral and a similar one in the coralline limestone ; though it is possible that specimens more favorably weathered than any I have yet seen, may indicate some slight difference of character. In the general aspect, mode of weathering, and color of the mass, there is a very striking similarity between those just noticed and the species in the Delthyris shaly limestone, which proves, however, quite distinct. It cannot for one moment be doubted, that the numerous large and small masses of this coral seen at Lockport are organic in their structure.

Fig. 1 *a*. The surface of a small hemispheric mass, showing the edges of the thin laminæ which are unequally weathered.

Fig. 1 *b*. A magnified portion of the same surface, showing the circular ends of the cylindrical tubes.

Fig. 1 *c*. A magnified portion, showing the weathered edges of successive laminæ which are indented by the cells, giving them the appearance of being arranged in concentric lines.

Fig. 1 *d*. A transverse section of a small mass.

Fig. 1 *e*. A magnified portion of the same.

Fig. 1 *f*. A larger mass, showing the effects of weathering upon the thin concentric laminæ.

Fig. 1 *g*. The base of the same specimen, showing several centres of growth.

Position and locality. In the lower part of the Niagara limestone : very abundant at Lockport, and less common in Orleans county and at Rochester.

Genus CLADOPORA (*nov. gen.*).

[Gr. κλαδος, *surculus*, and πορος, *pora*.]

Ramose or reticulate; branches cylindrical or slightly compressed, terminations terete; coral composed of a series of tubes or cells radiating equally on all sides from the axis, and opening upon the surface in rounded or subangular expanded mouths; cells more or less closely arranged, but not always contiguous, and apparently destitute of septa or rays.

The corals of this genus form a very distinct and well characterized group, sometimes in masses of closely arranged, slender, parallel or branching stems, and in other species of beautiful reticulated forms. Where the cells are empty and well preserved, the openings on the surface are margined by a thin projecting lip or calicle on the lower side, having a nearly semicircular outline, and gradually sloping below into the substance of the branch. In worn specimens the surface has no prominences, and the apertures of the cells are subangular or rounded, being a little more expanded than the cavity below. Where the cells are filled with calcareous matter, they frequently separate in prismatic forms like Favosites, but there is no evidence of transverse septa. The cells are not always contiguous, and there is often a space between the walls, which appears to be solid in one or more species.

These corals belong apparently to a group, some species of which have been referred to Alveolites by different authors, but which do not possess the essential characters of that genus; neither do they belong to the Genus Chætetes or Favosites. All the species yet known are branching, the reticulated forms being produced by coalescing of the branches, which, at the extremities, are often free or ramose. Probably some of the smaller reticulated species have been referred to Retepora, from which they are readily distinguished by the branches being poriferous on all sides, as well also as in the form of the cell.

The following species, and several of its congeners, have the habit and mode of growth of the Seriatopora, while others approach in this respect to Pocillopora.

524. 1. CLADOPORA SERIATA (*n. sp.*).

Pl. XXXVIII. Fig. 1 *a* – *m*.

Coral composed of a series of nearly vertical stems, more or less closely arranged in nearly parallel series, forming glomerate masses; stems sometimes bifurcating, internally composed of a series of tubes radiating from an axis, and gradually enlarging $\frac{m}{1}$ towards the mouth; openings somewhat transverse, closely arranged in alternating series, and margined on the lower side by a projecting semicircular lip; stems sometimes quite solid.

This is a very beautiful and characteristic species, and one of the most abundant corals in the Niagara group. It is often seen in the compact limestone, where the characters of the cells are not so readily examined; but it is known from any other coral by the numerous cylindrical

stems penetrating the rock, arranged in close proximity and parallel to each other. The ends of the tubes are thus presented in polished specimens, where no structure is visible. In the softer limestone the rock often weathers away, leaving the coral well preserved, and exhibiting in a beautiful manner its peculiar structure. In worn specimens the projecting lip on the lower side of the mouth is worn away, and the openings present scarcely any difference from CHÆTETES and FAVOSITES. A vertical section shows the radiating and diverging angular tubes; but in those which are very perfectly preserved, there are no traces of septa.

Sometimes upon the margin of one of these masses of parallel stems, there are some individuals having a more widely bifurcating character, while the stems have a stronger aspect, and present a considerable variety of appearance; but in general the stems are not only parallel, but nearly of the same diameter throughout.

Fig. 1 *a*. A small group of the parallel stems of this coral, closely arranged.
Fig. 1 *b*. A similar group in limestone, where the stems are less closely arranged. In this specimen one or two of the stems are bifurcating.
Fig. 1 *c*. An enlarged stem, showing the form and character of the cells.
Fig, 1 *d*. A portion of the surface, showing the apertures where the stem is worn.
Fig. 1 *e*. A vertical section of several stems, where the cells are open.
Fig. 1 *f*. A single one enlarged.
Fig. 1 *g*. The ends of several cells where the tubes are open.
Fig. 1 *h*. A single one enlarged, showing a transverse section of the tubes, the inner or nearest the axis being smaller than the outer ones, indicating the increase in size towards the surface.
Fig. 1 *i*. A polished specimen of limestone, showing the solid ends of the stems of this coral.
Fig. 1 *k*. A figure of a branch, upon the outer margin of a group of parallel stems.
Fig. 1 *l*, *m*. Small separate stems showing modes of branching.

Position and locality. This species occurs in the limestone in nearly all localities examined in the State, but it is more abundant and better preserved at Lockport than elsewhere. It appears to be more particularly limited to the lower part of the limestone, and is very rarely seen in the shale. (*State Collection.*)

525. 2. CLADOPORA CESPITOSA (*n. sp.*).

PL. XXXVIII. Fig. 2 *a*, *b*, *c*.

Stems glomerate or cæspitose, closely aggregated about the root, frequently branching and rapidly diverging above; stems cylindrical, composed of subangular tubes radiating from the centre, and opening upon the surface in roundish oval mouths.

I have been unable to see this species, except in a somewhat worn condition; and therefore the form of the cell apertures upon the surface, in their natural state, can not be determined. It is clearly allied to the preceding species; but the branches are larger, the form of the worn opening is different, and the mode of growth and habit of the coral are entirely unlike the last.

Fig. 2 *a*. A view of this species from the base: the upper part of the branches are imbedded in limestone.

Fig. 2 *b*. A part of a stem enlarged, showing the openings on the surface.

Fig. 2 *c*. A longitudinal section, showing the arrangement of the cells.

Position and locality. This species occurs in the lower part of the limestone at Lockport.

526. 3. CLADOPORA CERVICORNIS (*n. sp.*).

PL. XXXVIII. Fig. 3 *a*, *b*.

Ramose, branches ascending, branchlets growing more on one side of the principal branches; cellular; cells scarcely angular; openings upon the worn surface roundish or longitudinally oval.

This species is widely different from the preceding, though the specimens examined are not in good condition; the direction of the cells is more ascending, or more nearly in the direction of the axis of the stem. The form of the mouths in perfect specimens is unknown, but in the worn surfaces it is quite different from any other species in the same condition.

Fig. 3 *a*. A fragment of a branch of the natural size.

Fig. 3 *b*. A portion enlarged, showing more distinctly the form of the apertures.

Position and locality. In the lower part of the Niagara limestone at Lockport.

527. 4. CLADOPORA FIBROSA (*n. sp.*).

PL. XXXVIII. Figs. 4 *a*, *b*, and 5 *a*, *b*.

Coral branching; branches numerous, bifurcating; cells numerous, small, closely arranged and ascending; openings upon the surface roundish, or subangular in worn specimens.

This species has more the character of CHÆTETES or FAVOSITES than any other noticed, though there is no evidence that it possesses transverse septa or pores in the walls of the cells. From its habit, and the form of the mouths in weathered specimens, it is referred to the genus under consideration. In the two specimens figured, and which possess some characters inducing a belief that they are distinct species, the cells are filled, and separate in prismatic forms, which are closely arranged, and have a direction more nearly parallel to the axis than the last one, and differ widely in this respect from the preceding and following species.

This species has the general aspect of *Favosites fibrosa*, and it is probably one among several species that are often thus referred.

Fig. 4 *a*. A small branch, showing a tendency to regular bifurcation in its mode of growth.

Fig. 4 *b*. An enlarged portion, showing the weathered openings and the fibrous or prismatic structure of the longitudinal section.

Fig. 5 *a*. A large branch, which is solid, and worn so as to show the prismatic structure.

Fig. 5 *b*. A portion enlarged, showing a structure and arrangement analogous to the preceding figure 4 *b*.

Position and locality. In the lower crinoidal and coral-bearing part of the Niagara limestone at Lockport. (*State Collection.*)

528. 5. CLADOPORA MULTIPORA (*n. sp.*).

PL. XXXIX. Fig. 1 *a* – *g*.

Frond ramose or reticulate; branches short, terete, in the reticulations cylindrical; cells numerous, closely arranged, penetrating to the axis in a slightly oblique direction; openings upon the surface subangular or circular, sometimes apparently transverse; reticulations irregular, and the dichotomous branches often extending beyond and terminating in terete forms. Cells 48 to 60 in the space of an inch longitudinally.

This species is readily distinguished, even in small fragments, by its numerous closely arranged cells, which have the general appearance of being circular, but which are often slightly irregular or transversely oval. The openings, where perfect, are like others of the genus, and appear like a series of loops or reticulations alternating with each other in a longitudinal direction, but often arranged in parallel series. The effects of wearing and weathering often produce changes in the form of the openings and the appearance of the surface; but the characters of the species are so well marked that little difficulty can usually attend its identification.

Fig. 1 *a*. A part of a broken and macerated specimen, showing its irregularly reticulated character.

Fig. 1 *b*. A fragment showing the terminations of several small branches.

Fig. 1 *c*. A fragment enlarged, showing the forms of the mouths of the cells where little worn.

Fig. 1 *d*. A similar portion enlarged, from a surface somewhat more worn than the preceding specimen.

Fig. 1 *e*. A fragment where the surface is much worn, presenting simple circular pores on a smooth surface.

Fig. 1 *f*. A longitudinal section, showing the interior structure of the coral.

Fig. 1 *g*. A transverse section of a single stem, showing radiating tubular cells.

Position and locality. In the lower part of the Niagara limestone at Lockport.
(*State Collection.*)

529. 6. CLADOPORA MACROPHORA (*n. sp.*).

PL. XXXIX. Fig. 2 *a*, *b*.

Branches slender, lax, uniting in wide meshes of irregular form and size; direction of cells but slightly oblique to the axis; pores (in a much worn specimen) somewhat longitudinally oval, or approaching to circular; character of the cells as in other species of the genus.

In a small portion where the weathered openings of the cells are visible, they have much the appearance of *C. cervicornis;* but the branches are more slender than in that one, and have the additional character of a reticulated form. Unfortunately no well preserved specimens of this species have been obtained, but it differs so entirely in character from either the preceding or following reticulate species, that it will be readily distinguished.

Fig. 2 *a*. A fragment of a frond having the cells filled and solid, separating in prismatic forms.
Fig. 2 *b*. A portion enlarged, showing the structure.

Position and locality. In the lower part of the Niagara limestone at Lockport.

530. 7. CLADOPORA RETICULATA (*n. sp.*).

Pl. XXXIX. Fig. 3 *a* – *e*.

Coral expanded into a broad reticulate frond; branches roundish or slightly flattened, coalescing at frequent intervals, and forming meshes of various form and size, poriferous on all sides; openings of the cells upon the surface roundish or oval, distant from each other rather more than their diameter, often arranged in parallel longitudinal lines; interior showing the cells reaching to the centre from all sides, and, in solid specimens, becoming prismatic. Cells distant from each other $\frac{1}{64}$ of an inch.

This species has the general aspect of a Retepora, but a slight examination proves it poriferous on all sides, having round tubular cells, which, in perfect specimens, open upon the surface by nearly circular mouths, having a projecting lip on the lower side. In slightly worn branches, the openings are quite circular; and in those more worn, they become somewhat angular. From unequal wearing, the openings sometimes appear oval; and from other causes, specimens often present a variety of appearance. The spaces between the mouths of the cells are slightly greater than the width of the openings themselves, and, in longitudinal sections, this is distinctly seen penetrating to the axis, while the cell appears like a gradually enlarging tube from the centre to the surface of the branch. In specimens wholly crystalline, it is impossible to distinguish any thing beyond a general prismatic or fibrous structure.

Fig. 3 *a*. A part of a large frond, showing the branches and reticulations of the natural size. The branches, in their circumference, have seven distinct rows of pores, arranged in nearly regular longitudinal rows.
Fig. 3 *b*. An enlarged portion, showing the form and arrangement of the cells upon the surface.
Fig. 3 *c*. A similar enlargement where the surface is worn.
Fig. 3 *d*. A longitudinal section enlarged, showing the interior arrangement of the tubular cells.
Fig 3 *e*. A fragment of another frond having only six longitudinal rows of pores on the branches, which gives a greater lateral distance between the openings on the surface, though presenting no appreciable difference in the longitudinal distance. In other respects this specimen preserves all the characters of the preceding one, and of others of the same species.

Position and locality. The specimens figured were found, associated with *Catenipora escharoides*, near Louisville, Kentucky. I have found small fragments of the same or a very similar species at Lockport; but the evidence of the geological position of the specimens figured rests chiefly on their association with Catenipora, and that the limestone containing both is below the limestone containing the fossils identical with those of the Onondaga and Corniferous limestones of New-York.

Genus LIMARIA (Steininger).

Small, ramose; coralla quite solid, cells with a subtriangular aperture; calicles none.

I have included under this genus a single species which is not ramose; this one has the internal structure and form of aperture which characterizes the ramose species. The cells in different species open by a subtriangular or transversely extended sinuate aperture; the tubular cell is flattened near the aperture, and angular below as shown in transverse sections of the stems. With the exception of the form of cell and aperture, their structure and mode of growth differ scarcely at all from species of the preceding genus. It differs from the two following genera, in having no intercellular septate spaces. Worn specimens of Limaria are scarcely distinguishable from Chætetes or Favosites.

Two species of this genus are recognized by Mr. Lonsdale in the Wenlock limestone of England, and we have three species in the Niagara group.

531. 1. LIMARIA RAMULOSA (*n. sp.*).

Pl. XXXIX. Fig. 4 *a – d.*

Compare *Limaria clathrata*, Steininger, Mem. Soc. Geol. France, i, 339, t. 20, f. 6, 1834.
— — Lonsdale, Sil. System, pag. 692, pl. 16 bis, fig. 7, 7 *b*, 1839.

Coral ramose; branches cylindrical or compressed, equally bifurcating or sometimes irregularly trichotomous; apertures of the cells sinuous, or subtriangular from wearing, closely arranged; internal structure of stems prismatic.

I have separated this species from *L. clathrata*, which it greatly resembles from the uniform close arrangement of the apertures of the cells, which are likewise less transversely elongated than in specimens from Dudley. A single fragment among several specimens from Dudley has the characters possessed by the Niagara species, but it is at the same time very different from the larger number of specimens from the same locality. Until we know to what degree these variations may extend, it seems more satisfactory to place the Niagara specimens under another designation.

Fig. 4 *a*. A single bifurcating branch of this species, somewhat worn.
Fig. 4 *b*. A fragment which is trichotomous.
Fig. 4 *c*. The surface enlarged.
Fig. 4 *d*. The end of a stem enlarged, showing the structure.

Worn specimens of this species may be readily mistaken for some of the preceding or following forms; but by a careful examination, the apertures of the cells will always be found characteristic.

Position and locality. In the lower part of the limestone at Lockport, Niagara county.

532. 2. LIMARIA FRUTICOSA?

Pl. XXXIX. Fig. 5 *a, b.*

Compare *Limaria fruticosa*, Steininger, Mem. Soc. Geol. France, 1, p. 339.
— — Lonsdale : Murchison, Sil. System, pag. 692, pl. 16 bis, fig. 8.

Coral branching, subpalmate; stems compressed; cells opening by a triangular aperture, interiorly subquadrangular, often solid and giving a prismatic structure to the stems.

Fig. 5 *a*. A fragment of the natural size, showing a disposition to branch in a palmate form, the section above showing five distinct centres, from which the cells radiate.
Fig. 5 *b*. A portion of the surface of the same enlarged.

Position and locality. In the lower part of the limestone at Lockport.

533. 3. LIMARIA LAMINATA (*n. sp.*).

Pl. XXXIX. Fig. 6 *a - d.*

Coral massive or lamelliferous, composed of angular tubes; apertures of cells sinuate or angular, separated only by the walls of the cells; base of the cells triangular.

This specimen is a small fragment of a massive species: it is composed of interrupted laminæ, presenting an irregular surface covered with angular openings of the cells. The enveloping laminæ are often interrupted at intervals, and enclose between them depositions of inorganic matter.

This species is referred to the Genus Limaria, from the form of the apertures of the cells and of the flattened angular tubes shown in a vertical section, which are precisely similar to those of *L. ramulosa.*

Fig. 6 *a*. The uneven upper surface, showing the apertures of the cells.
Fig. 6 *b*. A vertical section, showing the interruption in the growth of the enveloping laminæ.
Fig. 6 *c*. The apertures of the cells enlarged, when little worn.
Fig. 6 *d*. The apertures of the cells as they appear when much worn.

Position and locality. In the lower part of the Niagara limestone at Lockport.

Genus CALLOPORA (*nov. gen.*).

[Gr. καλλος, *pulcher*, and πορος, *pora.*]

Ramose or encrusting species of corals, having a columnar structure; cells tubular, with the apertures circular or petaloid, not contiguous, and having the intermediate spaces occupied by angular cell-like openings which are transversely septate; tubular cells rarely septate.

The species of this genus are all beautiful corals in their structure and surface appearance. The first species under the genus often grows in large groups or cespitose masses, though it is sometimes seen incrusting other corals and attaching itself to some other substances. The terminations of the stems are sometimes hollow, and it has the aspect of a Bryozoa, but it is evidently a true coral.

This genus includes species in many respects allied to Ceriopora of Goldfuss, and more nearly to those separated by de Blainville under the name of Heteropora. They possess to some extent the characters of Heliopora and Millepora, but are essentially distinct. The *Heteropora crassa* of Lonsdale (Murchison's Sil. System, pag. 680, pl. 15, fig. 14), is probably referable to this genus. Our specimens differ from Heteropora in the septate character of the cells and intercellular spaces, and in the columnar structure; and, although sometimes approaching that genus in their mode of growth, are nevertheless more often solid, prismatic or columnar in structure, and more or less ramose or lobato-ramose in form. The true Heteropora from the chalk have round tubular cells, with minutely tubular interspaces; but in no case have I been able to discover septa crossing the cells or interspaces, nor in this character mentioned by de Blainville.

534. 1. CALLOPORA ELEGANTULA (*n. sp.*).

Pl. XL. Fig. 1 *a - m.*

Coral consisting of cespitose or fruticulose groups, composed of small stems, frequently branching; branches bifurcating or variously diverging from the stems, solid, extremities often hollow, or having a cup-like termination; apertures of cells circular, with intermediate angular cellular spaces; the circular apertures often having a smaller central point, or circle with rays extending to the outer walls. Intercellular spaces variable in extent, often irregular; circular openings of cells usually destitute of rays; cells tubular, extending to the axis in solid specimens, often filled and separating in prismatic forms.

This is a very beautiful coral, and readily recognized by its small circular openings, which are usually separated from each other by cellular interspaces which open on the surface in angular apertures. In some specimens the cells are absolutely contiguous, as far as they can be without compressing the circular walls, leaving triangular interspaces where three cells meet. In other cases there is a narrow row of meshes between the circular openings, separating them very slightly; and again these are expanded and become two rows, or cover an irregular space.

Where the surface is worn, the intercellular spaces often appear to be solid, and a vertical section shows no cellular character : transverse sections of the stems sometimes show the continuance of the intercellular spaces to the centre of the stem.

In well preserved specimens the cells are transversely septate, though the septa are rarely preserved in the open tubes, and are best shown in partially weathered crystalline specimens. In the greater number of specimens the apertures of the cells are quite open ; while a small number of specimens (and in others a few of the apertures), have a smaller circle or point in the centre, with six or seven rays diverging therefrom. This character, however, cannot be relied upon, as these rays appear to be deciduous, and are preserved only in the most perfect specimens.

Fig. 1 *a*. The base of a specimen, showing numerous diverging stems which are irregularly branched.

Fig. 1 *b*. A continuation of some of the branches of the last specimen, showing an individual of *Cladopora multipora*, attached and growing from the stems of this coral.

Fig. 1 *c*. A fragment showing the circular openings unequally distributed over the surface.

Fig. 1 *d*. A smaller bifurcating branch, having the cells more evenly distributed.

Fig. 1 *e*. A fragment showing the hollow terminations of the branches.

Fig. 1 *f*. A fragment enlarged where there are no circular apertures on one side, a striated or minutely cellular surface alone existing. The transverse section of the stem in the annexed figure shows that the increase of growth was made mostly on one side, and this side is the one on which the tubular cells exist, while that side represented in 1 *f* has increased very little.

Fig. 1 *g*. A fragment having a tortuous or irregular form, caused by contraction from the obliteration or cicatrizing of the cell apertures, and consequent cessation of growth at these points.

Fig. *h*. An enlargement at one of those points where growth has ceased, and the intercellular space appears to be solid or simply striated upon the surface.

Fig. 1 *i*. An enlargement of 1 *c*, showing the irregular distribution of the apertures of the cells.

Fig. 1 *k*. A similar enlargement where the cells are in contact.

Fig. 1 *l*. An enlargement showing the stellate apertures, with another figure somewhat more highly magnified than the preceding.

Fig. 1 *m*. An oblique section of a stem enlarged.

Fig. 1 *n*. An enlarged portion of the section of another stem, showing the transverse septa crossing the intercellular spaces, with a single tubular cell crossed by several septa in the lower part.

Position and locality. This species is very common in the shale at Lockport, and occurs likewise in the lower part of the limestone at the same place. It can be found at the base of the terrace, or in any other situation where the shale has decomposed, leaving the small calcareous fossils washed out by the rains. (*State Collection.*)

535. 2. CALLOPORA FLORIDA (*n. sp.*).

PL. XL. Fig. 2 *a-f.*

Coral explanate or incrusting, scarcely ramose, often fixing itself upon or incrusting other corals; cells tubular, opening upon the surface by floriform apertures, the margins of which appear as if formed by segments of six or seven smaller curves; in perfect specimens, each angle of the aperture is furnished with an elevated papillose point. Intercellular spaces with one or more rows of angular openings upon the surface; vertical section showing the cells tubular, with the intermediate spaces septate.

This species differs from the preceding, both in the form of the apertures of the cells, and in its habit of growth: the general aspect of the surface in other respects is not much unlike. It rarely grows in extended branching forms, but the branches are flattened or palmate, and end in thickened terminations, in which character it differs widely from the preceding species. Its more common habit is that of growing upon or enveloping some other coral, and in this condition takes on somewhat the form of the body on which it grows, and rarely attains to large dimensions. The surface has a coarser aspect than the preceding or following species, and there is no difficulty in distinguishing it from those.

Fig. 2 *a*. An enveloping mass, consisting of several distinct layers, which, at the commencement of growth, attached itself to a branch of *C. elegantula*. During a cessation of growth in one part, another species of the same genus commenced growth upon the surface of this species, which is again partly overgrown by it at a subsequent period, and thus we have the three species in one specimen.

Fig. 2 *b*. A portion of the surface enlarged, showing the form of the apertures and of the intercellular spaces.

Fig. 2 *c*. A portion of a more perfect specimen, showing the elevated points at the angles of the cells.

Fig. 2 *d*. A section enlarged, showing the tubular structure, its connexion with *C. elegantula*, and the surface of *C. aspera* in its connexion with the other two.

Fig. 2 *e*. A fragment giving some appearance of branching in a palmate form.

Fig. 2 *f*. A section showing the septate character of the intercellular spaces.

Position and locality. In the decomposing calcareous shale at Lockport.

536. 3. CALLOPORA LAMINATA (*n. sp.*).

PL. XL. Fig. 3 *a-e.*

Coral massive, irregular in form, composed of thin solid concentric laminæ penetrated by minute tubular cells, which open upon the surface by floriform mouths; spaces between the tubes appparently solid, equal to or greater than their diameter; lower surface covered by a concentrically striated membranous expansion.

I have referred this species to CALLOPORA, from its possessing the essential characteristics of the preceding, differing perhaps in the character of the intercellular spaces, which appear to be solid upon the upper surface. The apertures of the cells are smaller, and often only tripetaloid or formed by segments of three or four curves. The coral is, to the naked eye, apparently quite solid, but the minute cylindrical tubes penetrating the mass are very distinct under a magnifier. The spaces between the tubes, though appearing to be of uniform texture, still show, when highly magnified, the lines of the transverse septa, giving a kind of cellular appearance to the mass. The structure and mode of growth do not, therefore, differ in any degree from the preceding species.

There is no appearance of the minute spinulose or papillose points around the aperture which occur in the preceding and following species, but it is possible that these have been removed by abrasion, which has likewise obliterated the marks of intercellular tubes; still the surface gives no evidence of having been worn. This coral, from its apparent structure, could be referred to STROMATOPORA, without doing violence to the essential characters of that genus.

Fig. 3 *a*. The surface showing the openings of the natural size.
Fig. 3 *b*. A section showing its mode of growth in concentric laminæ.
Fig. 3 *c*. The lower surface, showing the concentric striated membranous covering.
Fig. 3 *d*. A portion of the surface enlarged, showing the form of the mouths of the cells.
Fig. 3 *e*. A section enlarged, showing the vertical tubular cells and transverse septa.

Position and locality. In the shale of the Niagara group at Lockport.

537. 4. CALLOPORA ASPERA (*n. sp.*).

PL. XL. Fig. 4 *a* – *i*.

Coral growing in solid or hollow cylindrical stems, often incrusting other bodies in broad explanate or foliate expansions; stems usually thickened or clavate at their extremities; cells tubular, openings circular or slightly oval, with finely reticulate interspaces; margins of the aperture surrounded by minute points, which give the entire surface an asperato-granular appearance; vertical section tubular or columnar; intercellular spaces septate; the form of apertures and intermediate spaces often very irregular towards the margin of an incrusting mass.

In unworn specimens, the minute points surrounding the apertures of the cells give a very peculiar and characteristic appearance to the surface. The apertures are smaller and of different form, and the intermediate spaces more finely reticulate than in the two first species; and in worn specimens the appearance and texture is more delicate, though it assumes a greater variety of appearance than either of the preceding species. In its growth it often surrounds the stems of crinoids, probably while the latter are in a living state; in other instances the centre of the stem is filled with amorphous mineral matter, while the coral forms an enveloping hollow cylinder. This feature may arise from the mode of growth, the coral first enveloping the stem of a crinoid, and afterwards growing on beyond its extremity while the

interior still remains open. This is shown to some extent in fig. 4 *a*, where the base is cylindrical, enclosing a fragment of a crinoidal column ; while at the upper extremity it is hollow, showing a tendency to spread into a palmate form. One of the most constant characters of this coral is that the branches at their termination are swollen, having two or three times their diameter below. In transverse sections of the stems giving a vertical section of the coral, it is often impossible to decide whether the cells and interspaces are not both septate.

Fig. 4 *a*. A fragment of this species, enclosing in its lower part a crinoidal column, and in the upper part being hollow and expanding laterally.

Fig. 4 *b*, *c*. Sections of the two extremities.

Fig. 4 *d*, *e*. The upper extremities of two stems of this coral.

Fig. 4 *f*. A lateral view of the termination of a stem which is apparently solid throughout, but consisting of enveloping laminæ which ceased to extend in some parts while they were added to parts of the stem adjoining.

Fig. 4 *g*. An enlarged portion, showing the apertures of the cells and the intercellular spaces where the surface is partially worn.

Fig. 4 *h*. An enlarged portion where the minute points surrounding the cell are very conspicuous, leaving the cells scarcely visible to the naked eye.

Fig. 4 *i*. A transverse section of a stem enlarged, showing the columnar character and septate interspaces with open tubular cells.

Position and locality. In the shale of this group at Lockport. (*State Collection.*)

538. 5. CALLOPORA NUMMIFORMIS (*n. sp.*).

Pl. XL. Fig. 5 *a*, *b*.

Depressed hemispherical ; cells opening upon the surface in round-oval apertures, which are often contiguous, and sometimes separated by minute intercellular spaces.

The specimen described is a small segment of a spheroid, differing little in appearance from the common Chætetes ; but a more careful examination shows the apertures to be distinctly roundish oval, and not compressed on the sides. The intercellular spaces are unequal, and the margins of the apertures sometimes in contact, while in others they are separated.

The species seems more nearly allied to *C. elegantula* in structure, and an examination of other specimens will probably prove more clearly its generic affinities.

Fig. 5 *a*. The upper surface of the specimen, natural size.

Fig. 5 *b*. A portion magnified.

Position and locality. In the shale of the group at Lockport.

Genus TREMATOPORA (*nov. gen.*).

[Gr. τρηματος, *foramen*, and πορος, *pora*.]

Ramose or incrusting corals, composed of tubular cells more or less closely arranged; intermediate spaces solid on the surface, but in the interior transversely septate; cells not septate; apertures oval or circular, often contiguous, margined by a thin elevated border or calicle, which, on the lower side, is often prominent or labellate.

The corals of this genus bear a close resemblance to the preceding, and indeed it is difficult to indicate to which of the two genera some of the species belong. The prominent surface characters by which Trematopora differs from Callopora are the more conspicuous calicle or elevated rim around the aperture, and the solid interspaces on the surface, where the cells are not contiguous. Like Callopora, the cells are often separated from each other and contiguous in the same species; and in transverse sections of the stems there is no means of distinguishing the two, the mode of growth in each being similar.

These corals have often a close resemblance to Chætetes or Favosites; but the tubular cells with the walls rarely contiguous, and the circular or oval openings margined by a distinct calicle, sufficiently show that they are different.

Corals of this character have been referred to Ceriopora of Goldfuss, to Millepora and Verticillipora, to neither of which genera do they strictly belong. They are for the most part ramose, with the branches generally solid, and the tubular cells reaching to the centre; in others the stems are hollow, and in rare instances, and particularly at the commencement of their growth, they are incrusting. It seems necessary, in order to insure definiteness, to separate several species possessing the essential characters noticed, rather than to place them under genera which have been established for the reception of recent corals, or for those of modern geological epochs, and which do not strictly correspond in character.

539. 1. TREMATOPORA TUBERCULOSA (*n. sp.*).

Pl. XL A. Fig. 1 *a* - *g*.

Corallum irregularly ramose; branches stout, often more or less flattened; surface tuberculous; cells tubular, usually solid; apertures distinctly oval, more or less closely arranged, often contiguous, though preserving a distinct oval form; calicles spinulose; section of the stem showing a solid prismatic or fibrous structure; intercellular spaces septate.

This species is readily recognized by the strong nodose branches, closely and often irregularly arranged openings of the cells upon the surface, and a close fibrous structure radiating from the centre in transverse sections of the stems. The apertures are not always closely arranged, nor are the longest diameters always placed in the longitudinal direction of the stem or branches; but these variations are usually inconsiderable, the general aspect being that given above. In the smaller terminating branches the nodose character is not always developed,

and the apertures in some specimens are nearly circular. Where well preserved, the calicle or margin of the aperture bears three, four or five minute spinules which under the magnifier appear like dark points. In the greater proportion of specimens, however, these spinules are worn off without changing the form or appearance of the aperture.

Fig. 1 *a*. A fragment with parts of several branches, showing the tuberculous character very distinctly.
Fig. 1 *b*. A smaller bifurcating branch of the same species.
Fig. 1 *c*. A small branch scarcely showing the tuberculous character.
Fig. 1 *d*. The surface magnified, where the apertures are close together, and irregular in their arrangement.
Fig. 1 *e*. A surface somewhat worn, where the openings are less closely arranged.
Fig. 1 *f*. The apertures of several cells, showing minute points or spinules around the aperture.
Fig. 1 *g*. A transverse section of a stem enlarged, showing the internal structure.

Position and locality. In the shale at Lockport, particularly in the thin calcareous layers, and occurring where the softer portions have been decomposed and carried away by rains.

(*State Collection.*)

540. 2. TREMATOPORA COALESCENS (*n. sp.*).

Pl. XL A. Fig. 2 *a, b.*

Corallum consisting of coalescing branches, somewhat flattened; surface smooth; apertures of cells round-oval, not contiguous; intercellular spaces solid; transverse section indistinctly fibrous.

This species can be distinguished by its peculiar mode of growth, in specimens where this character is preserved; and in fragments of branches, the more nearly circular form and wider separation of the apertures are sufficient to distinguish it. The wider interspaces between cells probably gives a more solid structure and appearance to the ends of the stems. In some examples, this species appears to increase by successive laminæ overspreading portions which have ceased to increase by extension of the cells. The calicle is thin and fragile, being often worn away entirely, leaving a perforated surface.

Fig. 2 *a*. A fragment showing several branches coalescing.
Fig. 2 *b*. A portion of the surface enlarged, showing the apertures where worn and unworn. The cells are to some extent unequally distributed over a part of the coral.

Position and locality. In the soft calcareous shale of the group at Lockport.

541. 3. TREMATOPORA TUBULOSA (*n. sp.*).

PL. XL A. Fig. 3 *a, b, c.*

Corallum consisting of cylindrical or flattened stems, solid or having the interior filled with mineral matter; cells closely arranged, opening upon the surface by minute oval apertures, and margined by elevated borders which are more projecting on the lower side; transverse section showing a fibrous structure.

This coral differs from the preceding, in having more closely arranged apertures opening obliquely upward, with the border on the lower side more projecting. The coral is a hollow cylinder, the interior being filled with stony matter; but this condition occurs in many species of this genus.

Fig. 3 *a.* A fragment of a stem of the natural size.
Fig. 3 *b.* A section of the end of the stem.
Fig. 3 *c.* A portion of the surface enlarged, showing the form and arrangement of cells.

Position and locality. Green shale of the Clinton group, Wayne county.

This species is arranged with its congeners in this place, in preference to giving it by itself with the corals of the Clinton group. It is the only one of the genus known below the Niagara shale.

542. 4. TREMATOPORA PUNCTATA (*n. sp.*).

PL. XL A. Fig. 4 *a, b, c.*

Coral incrusting, composed of cylindrical tubular cells which open upon the surface in circular apertures; apertures closely arranged; internal structure showing the cylindrical tubes and septate interspaces.

This coral is only known as incrusting crinoidal stems, several specimens having been found in this condition. It differs from either of the preceding species in the circular apertures, which are usually closely arranged, giving the surface a punctate character. In worn specimens the little marginal elevations around the aperture are often obliterated, and the stem is smooth with the small round pores penetrating its surface. The apertures are sometimes slightly separated from each other, and the arrangement, though apparently uniform, is nevertheless, under a magnifier, shown to be variable.

Fig. 4 *a.* A coral of this species enveloping a fragment of a crinoidal stem.
Fig. 4 *b.* A portion of the surface enlarged, showing the form and arrangement of the apertures, which are sometimes close together and in other parts separated.
Fig. 4 *c.* A section of the stem enlarged, showing the structure of the coral.

Position and locality. In the soft shale of the Niagara group at Lockport.

543. 5. TREMATOPORA OSTIOLATA (*n. sp.*).

PL. XL A. Fig. 5 *a–n.*

Coral irregularly branching; branches numerous, cylindrical, gradually tapering towards the extremities which are obtuse; apertures of cells round-oval, distant from each other nearly their diameter, arranged in spiral ascending lines or irregularly distributed over the surface; intermediate spaces smooth; stems solid, or incrusting other bodies; internal structure showing tubular or prismatic cells extending to the centre, with the interspaces transversely septate.

This coral often commences growth by affixing itself to the stems of crinoids, and to other corals; but becoming thus attached, it throws out branches quite independently of any such support. It is a very abundant species, and the branches are scattered profusely over the thin calcareous layers in the Niagara shale, as well as in the shale itself. The apertures are sometimes unequally distributed, or the spaces between them unequal; though the principal variety of aspect arises from abrasion of the surface, which has obliterated the little elevated borders around the apertures. The stems are sometimes slightly nodose, but for the most part smooth. The species is easily recognized by its roundish-oval pores, which are generally evenly distributed over the surface, at about the distance of their diameter asunder. Where the branches are hollow and flattened, it has the appearance of a BRYOZOA, but the structure shown in the solid stems and branches proves its distinction.

Fig. 5 *a*. A specimen showing the coral surrounding the stem of a crinoid, and throwing out branches in several directions.

Fig. 5 *b*. A fragment of a bifurcating branch.

Fig. 5 *c*. An enlargement of the surface from the same specimen.

Fig. 5 *d*. A fragment slightly nodose, and having the apertures of the cells somewhat irregularly distributed over the surface, and the oval form rather more elongated than in the preceding figure.

Fig. 5 *e*. A portion of the surface of the same enlarged.

Fig. 5 *f*, *g*. Fragments showing the irregular mode of branching.

Fig. 5 *h*. An enlarged portion of fig. 5 *g*, where the elevated border of the aperture is more perfectly preserved.

Fig. 5 *i*. The end of a stem enlarged, showing arrangement of cells and interspaces.

Fig. 5 *k*. A portion of the last still further magnified, showing the structure of the intercellular spaces, and the empty or solid cells without visible septa.

Fig. 5 *l*. A longitudinal section of a hollow stem enlarged, showing the direction of cells.

Fig. 5 *m*, *n*. A small bifurcating stem, and an enlargement of the same, showing some slight variation in the character of the apertures of the cell.

Position and locality. In the Niagara shale at Lockport, Rochester and other localities. (*State Collection.*)

544. 6. TREMATOPORA SOLIDA (*n. sp.*).

Pl. XL A. Fig. 6 *a, b, c.*

Stems bifurcating or irregularly ramose; coralla solid, tubular cells closely arranged; apertures oval or subangular from compression, margined by an even calicle.

This species in its surface aspect has the character of a membranaceous coral of the Flustra tribe, spread over a solid substance. It is only by very careful examination that tubular cells can be traced to the centre of the stems, so completely solid are all the specimens examined. The character of the intercellular spaces, if any exist, has not been ascertained.

Fig. 6 *a.* A fragment of a solid stem, spreading and slightly flattened above.
Fig. 6 *b.* A fragment of a bifurcating stem.
Fig. 6 *c.* An enlargement of the surface, showing form and arrangement of the cells.

Position and locality. In the Niagara shale at Lockport : extremely rare.
(*Collection of* Col. Jewett.)

545. 7. TREMATOPORA STRIATA (*n. sp.*).

Pl. XL A. Fig. 7 *a - d,* and 8 *a, b.*

Compare *Ceriopora granulosa,* Goldfuss, Petrefacta, pag. 217, tab. lxiv, fig. 13.
— — Lonsdale : Murchison, Sil. System, pag. 680, pl. 15, fig. 29.

Coral expanded at the base, strongly striated; branches slender, cylindrical, scarcely tapering; openings of the cells oblong oval, distant from each other about the width of the aperture; space between the aperture with a continuous groove.

This coral is a very slender species, occuring usually in small fragments. It is readily distinguished from all the preceding species by its oblong elliptical apertures, which are not closely arranged. The spaces between the openings appear sometimes striated in a longitudinal direction, and, in more perfect specimens, sometimes slightly crenulated in the transverse direction.

This species has considerable resemblance to *Ceriopora granulosa* cited above, and may perhaps prove to be identical with it.

Fig. 7 *a.* The base or attached portion of an individual of this species, having two diverging branches.
Fig. 7 *b.* The same enlarged, showing the form of the apertures of the cells and the strongly striated base.
Fig. 7 *c.* A small fragment of the same species.
Fig. 7 *d.* The surface of 7 *c* enlarged.

A transverse section of the stem of this species shows nothing peculiar; the cells extend to the centre, and the intermediate spaces appear to be solid.

In the specimen fig. 7 *a, b,* the apertures of the cells below the branches open downward or towards the base of the specimen, as shown in some degree upon the

right hand of the enlarged figure. In another individual, (8 *a*, *b*), which can scarcely be separated by any reliable characters from this species, the pores open downward or in the direction of the base of the root, and the stem above is broken off. The cells apparently open in the bottom of continuous striæ or grooves, and the same character in some degree often prevails in the branches of the preceding specimens.

Fig. 8 *a*, *b*. The fragment natural size and enlarged.

Position and locality. In the shale of the group at Lockport.

546. 8. TREMATOPORA GRANULIFERA (*n. sp.*).

PL. XL A. Fig. 9 *a* - *e*.

Compare as in the preceding species.

Stems bifurcating or variously branched; openings of cells oval; margins of calicle granulate, sometimes confluent, and presenting a single crenulated edge between the cells; internal structure fibrous, and too minute to be fully illustrated.

This species has the openings of cells much more closely arranged than in the preceding species; and the interstices, instead of being striated longitudinally, are very distinctly granulated, and, where the space is widest, have the appearance of intermediate cellular structure as in CALLOPORA. It usually occurs in small slender bifurcating branches, and the original form and mode of growth has not been ascertained. Stems always solid throughout.

Fig. 9 *a*. A bifurcating branch of this species, where the surface is beautifully granulated.

Fig. 9 *b*. An enlarged portion of the same specimen.

Fig. 9 *c*, *d*. A small cylindrical stem, and an enlargement, showing the fibrous structure in a longitudinal direction.

Fig. 9 *e*. A stem having several branches.

Position and locality. In the shale of this group at Lockport.

547. 9. TREMATOPORA ASPERA (*n. sp.*).

PL. XL A. Fig. 10 *a*, *b*, *c*.

Coral consisting of small, solid, cylindrical, and bifurcating stems; openings of cells oval, with a crenulate or denticulate margin on the inner side; intercellular spaces wide, papillose-asperate.

This species has the cells comparatively distant from each other, the intermediate space covered with very minute spinules or papillose points, and the inner margin of the aperture crenulate. The minute spinules are usually obliterated by abrasion, while the crenulations of the apertures still remain; where neither of these characters are preserved, the greater distance of the apertures from each other is a reliable character. In several specimens examined the mode of branching is peculiar, and differs from any other species (fig. 10 *c*). This is a much more slender species than *T. striata*, to which smooth specimens bear some resemblance.

Fig. 10 *a*. A fragment of a stem of the natural size.
Fig. 10 *b*. A portion magnified, showing the spinulose surface and crenulated margins of the apertures.
Fig. 10 *c*. Two small fragments showing a peculiar mode of branching.

Position and locality. Same as the preceding.

548. 10. TREMATOPORA SPINULOSA (*n. sp.*).

Pl. XL A. Fig. 11 *a, b, c.*

Stems cylindrical; apertures of cells oval, more or less closely arranged, except at intervals where the base of the calicle is expanded and extended into a short strong spinule; internal structure fibrous.

This species is easily recognized by the comparatively strong spinules, arranged at nearly regular intervals.

This is probably a rare species, since few individuals have been observed, and these with a single exception are simple stems, showing scarcely a perceptible diminution towards the upper extremities. A single minute fragment is bifurcated, and the cells somewhat widely separated from each other.

Fig. 11 *a*. Fragment of a small cylindrical stem without branches.
Fig. 11 *b*. A bifurcating branch.
Fig. 11 *c*. An enlargement of the surface, showing the spinules.

Position and locality. On the surface of the calcareous layers in the shale, and in the soft shale at Lockport.

549. 11. TREMATOPORA SPARSA (*n. sp.*).

Pl. XL A. Fig. 12 *a – d.*

Stems cylindrical, slender, bifurcating; cells distant from each other, opening obliquely upwards, calicle nasiform, elongated.

This coral usually occurs in minute fragments scattered upon the surface of the calcareous layers, and shows two or three rows of cells on the exposed surface, giving about five in the circumference. The calicles are much more prominent than in any other of the small species, and stand out upon the surface like minute buds. In worn specimens, however, there is little prominence about the apertures.

Fig. 12 *a*. A bifurcating branch of this coral, scarcely worn.
Fig. 12 *b*. A simple slender branch of the same species, having the surface worn.
Fig. 12 *c, d*. Enlargements from the surfaces of the same.

Position and locality. With the preceding species very abundant in the calcareous layers in the shale at Lockport. (*State Collection.*)

Genus STRIATOPORA (*nov. gen.*).

Ramose, coralla solid; stems composed of angular cells; apertures of the cells opening upon the surface into expanded angular cup-like depressions; interior of the cell rayed or striated, striæ extending beyond the aperture of the cell.

The corals composing this genus are very peculiar in their characters, and establish a distinct genus. Two species are already known to me; one occuring in the Niagara, and the other in the Hamilton group. Both are found in soft calcareous shale, associated chiefly with Bryozoa and Brachiopoda. In the Hamilton group species, the aperture is surrounded by a thin expanded calicle, and worn specimens only have the appearance of the Niagara species. The character of the cells, and the extension of the striæ beyond the cells are very characteristic and distinctive features in the two species.

550. 1. STRIATOPORA FLEXUOSA (*n. sp.*).

Pl. XL B. Fig. 1 *a* – *e*.

Coral composed of bifurcating or irregularly ramose stems; branches terete; cells large, angular below, and opening in a circular striated aperture; striæ extending beyond the cell, particularly in an upward direction; cells arranged in an irregularly alternating series; calicles labellate or expanded on the lower side, and uniting above in angular ridges separating the cells; apertures very unequal in size.

This species is readily distinguished by the form and arrangement of its cells, which are of much larger proportional size than any of the ramose corals of the group. The apertures are round, but open into an angular depression, which is limited on the lower side by the calicle, but extends upwards to unequal distances depending upon the arrangement of the cells. The striæ which are visible in the circular cell extend beyond into this angular space, and are very distinct in well preserved specimens. The influence of wearing, combined with some slight original differences, has sometimes produced great changes in the character of the coral, though I have been unable to recognize any specific distinction. It usually occurs in small fragments, and is a very fragile species.

Fig. 1 *a*. A bifurcating stem, showing the spreading branches to be lax or flexuous.
Fig. 1 *b*. A fragment showing some differences in form of apertures and enclosing spaces.
Fig. 1 *c*. A fragment showing irregular branching.
Fig. 1 *d*. Several apertures with the enclosing angular spaces enlarged.
Fig. 1 *e*. A transverse section enlarged, showing the form of cells internally.

Position and locality. In the shale of this group at Lockport. (*State Collection.*)

The following species (including Plate XL B in part, and all of Plates XL C, D, E & F), probably belong to the Bryozoa group; though it is not possible, in the present state of our knowledge, to decide positively in regard to some of them. The CERAMOPORA, in its depressed hemispheric forms, has a very close resemblance to the true corals; while in the expanded incrusting forms, they seem unequivocally of the Bryozoa type. The other genera have not, either in the form of cells or mode of growth, the character of true corals.

551. 9. STICTOPORA PUNCTIPORA (*n. sp.*).

PL. XL B. Fig. 2 *a*, *b*, *c*.

Axis flattened, bifurcating; edges striated; surface marked by minute rounded (sometimes scarcely oval) or punctiform cells; border of the cells more elevated on the upper side; cells arranged in ascending rows, having about fourteen in each row and ten in the width of the stipe.

This species is remarkable for the minute rounded apertures of the cells, differing in this respect from all the species described; a single species only, in the Chazy limestone, approaches to this one in the form of the cell apertures, while it differs very essentially in all other respects. The present species, though not abundant, is common in the calcareous layers in the shale of the Niagara group. The form of the apertures is so nearly like those of *Trematopora ostiolata*, that the surface may be mistaken for that coral, and it often requires careful attention to discriminate between the two. In the STICTOPORA, however, the apertures are more nearly round, and in a small degree more closely arranged, and may be followed in oblique ascending lines across the stipe. Where the edges of the stipe are visible, there is no difficulty in distinguishing between the genera and species, even where specimens of TREMATOPORA are flattened as they sometimes are.

A single fragment of this species presents a peculiar feature, as shown in fig. 2 *c*. The substance of the flattened stipe rises in two rounded elevations, which become cylindrical and celluliferous on all sides, the apertures in the flattened stipe continuing into and along the sides of the cylindrical stem without any diversion or interruption. These bases of cylindrical stems present a close approximation to those of TREMATOPORA, and the phenomenon is very remarkable, inasmuch as the structure of the latter genus differs in a considerable degree from STICTOPORA.

Fig. 2 *a*. A fragment of a bifurcating stipe of this species, natural size.

Fig. 2 *b*. A portion of the surface enlarged, showing form and arrangement of cells.

Fig. 2 *c*. An enlargement of the fragment referred to above, showing the bases of two cylindrical stems connected with the flattened stipe, and the rows of cells continuous from one to the other.

Position and locality. Upon the surface of calcareous layers in the Niagara shale at Lockport.

552. 1. DIAMESOPORA* DICHOTOMA (*n. sp.*).

PL. XL B. Fig. 3 *a* – *d*.

Coral occurring in regularly bifurcating cylindrical stems, which usually consist of a thin envelope or membranous crust enclosing inorganic matter; interior surface of hollow stems striated transversely; cells opening upward, and arranged in regular ascending or spiral lines; calicles prominent, nariform.

This species sometimes approaches *Trematopora ostiolata* in its appearances; but the very conspicuous nariform calicle, where not worn off, at once distinguishes it. The stems are usually flattened, and its regular bifurcation likewise distinguishes it from TREMATOPORA. In some instances where the stem is flattened and worn, elevated lines or ridges are visible between the rows of cells, and it approaches in appearance to the surface of ESCHAROPORA, and, in its totality of characters, it appears to form a link between that genus and STICTOPORA.

This species is usually associated with STICTOPORA and TREMATOPORA; and in small fragments the stems retain their cylindrical form, and are rarely solid throughout, though there is no evidence that the cells reach to the centre of the stem. In the strong stems just below the point of bifurcation, thirty-five or forty cells may be counted in the circumference, and about twenty in the circumference of each branch above.

Fig. 3 *a*. A fragment of a stem bifurcating above and longitudinally divided below, showing the striated interior.

Fig. 3 *b*. The surface enlarged, showing the form and arrangement of apertures.

Fig. 3 *c*. An enlarged portion where the ridges between rows of cells are conspicuous.

Fig. 3 *d*. A fragment of a stem preserving a cylindrical form, and commencing to bifurcate above. In the transverse sections of the two branches, one is solid while the other is hollow.

Position and locality. On the surface of calcareous layers in the shale at Lockport.

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* This generic name is introduced in this place as indicative of the character of this coral; but since no other species have fallen under observation, the generic description is reserved for the result of further investigations.

Genus CLATHROPORA (*nov. gen.*).

[Latin, *clathrum*, a lattice, and *pora*, a pore.]

Ramose or reticulate corals; uniformly poriferous on both sides of the reticulate fronds, and on all sides of the stems and branches of ramose forms; apertures of cells more or less quadrangular, regularly arranged in series parallel to the direction of stems, or obliquely in quincunx order.

The habit and general characters of the corals of this genus are similar to Retepora; but the two sides are poriferous, and the form and arrangement of the cells differ from those of Retepora. The branching species differs from Stictopora in being celluliferous on all sides, and having the cells arranged between linear ridges or lamellæ; while in that genus the branches are flattened, with non-poriferous edges, and the cells are not thus arranged between laminæ. From Phænopora, as described under the Clinton group (page 46), it differs in the form of the cells, and the thickening of the stems and branches, a character which has not been observed in any species of that genus.

A more critical examination of *P. ensiformis*, which likewise occurs rarely in the Niagara group, shows that it differs in some respects from the other species of Phænopora, and is more nearly allied to the following species of this genus.

553. 1. CLATHROPORA ALCICORNIS.

Pl. XL B. Fig. 4 *a*, *b*, *c*.

Stems cylindrical below and flattened above, bifurcating and variously branched, branches frequently bifurcating; entire surface celluliferous; apertures of cells quadrangular, rhomboidal or oblong, and variable in form at the divisions of the stem; cells consisting apparently of simple tubes reaching to the axis of the stem and branches.

This species is readily distinguished from Stictopora and Retepora, by the characters given under the generic description. In its mode of branching it is very peculiar, differing from any species described: the stem makes an abrupt bending at the point where each branch is given off, and the branches scarcely differ in size from the stem above and below. At the point *o* in fig. 4 *a*, one of the branches appear to have reunited to the stem, and a young shoot has commenced growing from the junction. This reuniting or anastomosing of the branches does not, however, seem to be characteristic of the species.

Fig. 4 *a*. A portion of the stipe and branches of an individual of this species, natural size.
Fig. 4 *b*. A portion enlarged, showing the oblong quadrangular apertures.
Fig. 4 *c*. An enlargement of another portion of the surface, showing a difference in the form of the apertures.

Position and locality. In the shale of the group at Lockport.

554. 2. CLATHROPORA FRONDOSA (*n. sp.*).

Pl. XL B. Fig. 5 *a - e.*

Frond reticulate, expanded, flabellate, or funnel-shaped; the two surfaces regularly and equally celluliferous; cells with rhomboidal or oblong quadrangular apertures opening obliquely upward; tubular cells reaching to the centre, and gradually enlarging towards the aperture.

This species consists of a thin expanded frond, produced by the anastomosing of broad flattened branches. It appears more like a perforated flabellate frond, than a reticulate structure. It has the general appearance of Retepora, from which it is not readily distinguished unless both sides are examined. The form of the apertures of the cells, however, is more quadrangular than in any species of Retepora I have seen, and this character may be of service in deciding the reference of specimens. It usually occurs in the soft shale, one side adhering to the stone, from which it is necessary to remove some portions of the coral before its real character can be ascertained. Portions of fronds, six inches or more in diameter in every direction, have been obtained, and which are imperfect on all sides, showing that the coral attained a large size.

From the mode of divergence of the frond from a centre, it appears that the perforations are arranged in concentric circles, each row or circle having successively been at the outer margin of the frond.

Fig. 5 *a*. A fragment from a much larger frond.

Fig. 5 *b*. A small fragment where the perforations are smaller, though the coral does not apparently differ in other respects from the preceding.

Fig. 5 *c*. An enlarged portion of the surface, showing the arrangement of cells in reference to the perforations.

Fig. 5 *d*. An enlargement where the cells are arranged in series parallel to the axis of the branch.

Fig. 5 *e*. A section of a branch enlarged, showing arrangement and upward divergence of the cells.

Position and locality. In the shale of the group at Lockport, and very rarely in the lower part of the limestone. Macerated fragments sometimes occur associated with Callopora and Trematopora. (*Collection of* Col. Jewett.)

555. 5. RETEPORA DIFFUSA.

Pl. XL C. Fig. 1 *a - f.*

Fruticulose; several stems originating from a common base; stems frequently bifurcating and spreading laterally, forming a broad frond; stems and branches celluliferous on one side only, the other side deeply striated longitudinally; apertures of cells quadrangular or subrhomboidal, with the angles in the direction of the longitudinal and transverse axes of the stems and branches, and sometimes much extended longitudinally; branches often crowded and tortuous; terminations often thickened or clavate, and always obtuse.

This beautiful little coral, occurs in fragments of the size of those figured, and rarely larger. It appears from the best preserved specimens that several stems originated from a common base, bifurcating frequently and spreading on every side, forming a broad expanded or flabellate frond. All the specimens observed present the striated surface to view, the other side always adhering to the rock; and it is only by detaching fragments, that the character of the celluliferous face can be ascertained.

Fig. 1 *a*. A part of a frond of this species, natural size.
Fig. 1 *b*. A strong branch with numerous bifurcating branchlets, which are thickened at their extremities. This specimen is much stronger than the prevailing forms of this species, but it offers no other essential difference of character.
Fig. 1 *c*. A portion of the striated surface enlarged.
Fig. 1 *d*. A similar enlargement of the celluliferous surface.
Fig. 1 *e*, *f*. Parts of figs. 1 *c* and 1 *d* still farther enlarged.

Position and locality. In the shale of the group at Lockport, and rarely in the lower part of the limestone at the same place. (*State Collection.*)

556. 6. RETEPORA ASPERATO-STRIATA.

Pl. XL C. Fig. 2 *a* - *h*.

Frond composed of a thick network formed by the anastomosing branches; interstices oval, somewhat unequal, the shortest diameter being usually equal to the width of the branches; outer face asperate or echinulate-striate; inner face poriferous, with three, four or more rows of oval or subangular cells arranged somewhat in oblique parallel lines, or in quincunx order; apertures of cells in perfect specimens probably with an elevated border or calicle.

This species is somewhat variable in the size of the branches and interstices, but there is not sufficient difference to constitute a distinct species. In the stronger growing individuals the interstices are larger, and the diminution in size corresponds in both branches and interstices. To the naked eye, and to an ordinary magnifier, the outer surface appears simply striate, but a farther enlargement shows the striæ to be echinulate or denticulate. The striæ are less strong and sharp than in the preceding species. The cells vary from round-oval to elongated and angular forms, and are sometimes closely crowded; while in other examples they are separated from each other a distance equal to the narrowest diameter, and the apertures are more nearly round.

Notwithstanding these differences of appearance in several fragments examined, it is impossible to find reliable characters for a separation of the species. Farther examinations may discover specimens showing more decisive differences than those yet observed.

Fig. 2 *a*. A fragment of the base with the point of attachment, showing the exterior surface of an expanded funnel-shaped frond.

Fig. 2 *b*. A portion of a similar frond, showing the external or striated surface.

Fig. 2 *c*. A smaller fragment, showing the root with a part of the frond, where the interstices are smaller than in the preceding.

Fig. 2 *d*. An enlargement of the striated surface, showing the asperate character of the striæ.

Fig. 2 *e*, *f*. The celluliferous side of two fragments of this species.

Fig. 2 *g*, *h*. Enlargements from the two preceding fragments, showing the difference in form and arrangement of cells.

Position and locality. In the shale at Lockport, associated with the preceding and with FENESTELLA and POLYPORA. Small fragments occur on the surfaces of the calcareous layers in the shale, and more rarely it is found in the lower part of the limestone above the shale.

(*State Collection.*)

Genus HORNERA (Lamouroux).

This genus was established by Lamoroux, for some species of Zoophytes, which by Lamarck were left united with Retepora, and which differ from them in being arborescent, and do not form a network, while their ramifications are sometimes large and also slightly anastomosed; above all, however, they differ in having the cellules salient, almost tubulous or alveolar, and united in fascicles.

The following species is placed under Hornera, simply from having the round tubulous cells. The description of the genus would include all arborescent or ramose forms like Retepora that do not form a network; and therefore the *R. diffusa*, described above, would fall under this genus. I have preferred to leave this under Retepora, chiefly from the form of the cells. Further investigation will probably render it necessary to separate the ramose non-reticulate forms with angular cells, from true Retepora; and those with round or tubular cells may fall under Hornera, or more probably constitute a distinct genus.

557. 1. HORNERA? DICHOTOMA (*n. sp.*).

Pl. XL C. Fig. 3 *a* – *d*.

Stems minute, semicylindrical, rigidly branching or bifurcating; one surface striated longitudinally, the other celluliferous; cells with round or oval apertures, which open from the summit of a pustuliform elevation.

This species is extremely minute, its characters being scarcely distinguishable with the naked eye. In its striated and poriferous surface it resembles in general characters Retepora; but the mode of branching is different, and the cells are round or oval, with the openings elevated above the surface of the branch, which does not occur in Retepora.

Fig. 3 *a*, *b*. A bifurcating fragment, natural size, and a part of the surface enlarged, showing the form and arrangement of cells.

Fig. 3 *c*, *d*. The striated or non-celluliferous surface, natural size and enlarged.

Position and locality. This coral occurs on the surface of thin calcareous layers in the shale at Lockport and Rochester.

558. 3. FENESTELLA ELEGANS (*n. sp.*).

PL. XL D. Fig. 1 *a - g.*

Frond expanded or cup-shaped (often quite large); branches slender, frequently bifurcating; dissepiments thin and slender, scarcely enlarging at the junction with the branches. Fenestrules on the non-celluliferous side oblong quadrangular, rarely oval; branches striated by two or three fine grooves which are scarcely visible; celluliferous side of branches with a thin low edge margined on each side by a row of small oval cells, about four or five to each fenestrule; cells with the longitudinal diameter oblique to the direction of the branches: sometimes the edge of the branch is grooved longitudinally between the rows of pores.

Fenestrules about seven in the space of three lines longitudinally, and twelve in the same space transversely.

This beautiful and delicate species is readily distinguished by its slender branches, which, on the non-celluliferous side, are scarcely distinctly striate; and on the celluliferous side, the oval, obliquely arranged pores, which are very conspicuous, opening more directly upward than in the preceding species. The cells are more or less prominent, depending on the degree of wearing they have suffered, and from this cause also the form may slightly vary. In some specimens, the elevated margins of the pores have the appearance of extending beyond the edge of the branch.

Fig. 1 *a*. A portion of a frond, showing the non-celluliferous side. The specimen is on shale, and, being partially removed, shows, in the upper lefthand side, the impression of the celluliferous face.

Fig. 1 *b*. A portion enlarged, showing the form of fenestrule, striated surface of branches, etc.

Fig. 1 *c*. The impressions of the celluliferous side in the shale.

As these fossils occur in shale, from which the coral is often separated without presenting its peculiar features, the species may often be detected by the impression. This differs from the following species in being less deep, and the transverse bars almost as strongly marked as the branches.

Fig. 1 *d*. A fragment showing the celluliferous side of the coral.

Fig. 1 *e*. The same enlarged, showing the form and arrangement of the cells.

Fig. 1 *f*. Another specimen of the celluliferous side.

Fig. 1 *g*. The same enlarged, showing the form and appearance of the cells where the surface is somewhat worn.

This species approaches very closely to the *F. tenuis* of the Clinton group; but in that species the pores are round and prominent, and I have not been able to see them of the oval form.

Position and locality. In the shale of the Niagara group, and also in the thin calcareous layers in the same rock at Lockport, Rochester and other places. (*State Collection.*)

559. 4. FENESTELLA TENUICEPS (*n. sp.*).

Pl. XL D. Fig. 2 *a - h*.

Fenestella prisca? Lonsdale, page 50 of this volume.
Compare *F. prisca*, Lonsdale : Murchison, Sil. System, pag. 678, pl. 15, figs. 15, 15 *a*, *b*, *c*, and 18, 18 *a*, *b*, *c*.

Frond cyathiform, much expanded, attached by a short cylindrical process to the spreading radicles below; external face presenting sharp thin-edged branches; transverse bars not reaching so high as the edges of the branches; cells round, rather large, opening laterally, being scarcely visible in looking upon the face of the frond (particularly near the base); cells four rarely five in each fenestrule; non-celluliferous side with oval fenestrules and striated surface.

Fenestrules about seven in the space of three lines longitudinally, and nine or ten in the same space transversely.

I am unable to find any reliable characters for separating this species from the one in the Clinton group, but a more perfect specimen in the Niagara shale proves that it can not be the *F. prisca* of Lonsdale. The spreading form of the cup is very different from those figured by this author (pl. 15, figs. 15, 15 *a b c*), and the cells are proportionally larger and more prominent.

In perfect specimens, the distinguishing features of this species are the sharp thin-edged branches on the celluliferous side, and which scarcely show any signs of connecting bars. Where they can be examined, the cells are round short tubes, the elevated edges projecting almost laterally from the side of the branch. The upper or non-celluliferous face is marked by short oval fenestrules, caused by the thickening of the dissepiments at their junction with the branches. In perfect specimens, the branches are striated longitudinally on this side, but, from weathering, they often appear granular. A partial abrasion of the celluliferous face often wears away the thin edges of the branches, and they not only appear thicker than in their natural state, but the cells lie close to the upper edge of the branches. The fenestrules in such specimens are quadrangular, the dissepiments not expanding at their junction with the branches.

The specimens found in the Clinton group are usually in such condition that the characters are obscure, and the celluliferous face rarely if ever well preserved; the specimen figured on pl. 19, fig. 4 *a*, being the only one in which the cells have been observed at all.

Fig. 2 *a*. The exterior surface of a large cyathiform frond which has been crushed. The point of attachment to the root is well preserved. The surface is somewhat worn, so that the pores are more distinctly visible in some parts than is usual in this species.

Fig. 2 *b*. A portion of the last enlarged, showing the cells where the edges of the branches are worn.

Fig. 2 *c*. An enlarged view, looking into the cells from a direction oblique to the surface of the frond.

Fig. 2 *d*, *e*. Lateral and basal view of a fragment of the cup broken off just above the root: the thin sharp prominent edges of the branches are very distinctly seen.

Fig. 2 *f*. A specimen showing a fragment of the non-poriferous face of *Polypora incepta* and of *Fenestella tenuiceps*.

Fig. 2 *g*. A portion of the latter enlarged, showing the form of fenestrules and the granular worn surface.

Fig. 2 *h*. A portion of another fragment enlarged, showing the striated surface of the branches.

Position and locality. In the shale of the Niagara group, particularly in the thin calcareous layers at Lockport: more rarely at Rochester and elsewhere.

(*State Collection. Collection of* Col. JEWETT.)

560. 5. FENESTELLA CRIBROSA (*n. sp.*).

PL. XL D. Fig. 3 *a*, *b*.

Frond expanded or cyathiform; branches strong, irregularly bifurcating; surface striated; transverse bars or dissepiments thin, scarcely enlarging at their junction with the branches; fenestrules small, quadrangular, sometimes oval; poriferous side unknown.

Fenestrules eleven in the space of three lines longitudinally, and eighteen in the same space transversely.

This species is readily distinguished by the small angular fenestrules, which are much more numerous than in the same space in any other species in this group; the branches are quite as strong, or even stronger than in *F. elegans*. It is easily distinguished, therefore, by the non-celluliferous side alone.

Fig. 3 *a*. A fragment natural size.

Fig. 3 *b*. A portion of the same magnified.

Position and locality. In the lower part of the Niagara limestone at Lockport.

561. 6. FENESTELLA —— (*n. sp.*).

PL. XL D. Fig. 4.

The base of the cup of two specimens have been found, showing much stronger branches than either of the preceding. The arrangement of the fenestrules or bells has not been observed.

Position and locality. Shale of the Niagara group, Lockport.

Genus POLYPORA (M'Coy).

This genus includes Bryozoa having the characters of Fenestella in every respect, except that they have more than two rows of cells on the branches. The carinate branches of Fenestella, with a single row of cells on each side, are shown at the origin of the branches in the following species of Polypora; but the number increases from two rows to four rows of cells on each branch, and there is a slight striation or carina between each row of cells. In the same example, also, the transverse dissepiments have in many cases a single cell at each extremity as in some species of Fenestella. The character and habit of the animal, mode of growth, structure, and form of its habitation are precisely similar in both.

The following is the only species that has fallen under my observation in this geological period, and its characters are probably more analogous to those of Fenestella than are those of the Carboniferous period. The one before us probably shows the first departure from the characters of true Fenestellæ.

562. 1. POLYPORA INCEPTA.

Pl. XL D. Fig. 5 *a-f*.

Frond expanded, flabellate, originally cyathiform or funnel-shaped; branches dividing somewhat regularly, sometimes anastomosing; transverse bars arranged at regular intervals, slender, scarcely thickened at their junction with the branches; fenestrules oblong quadrangular, scarcely oval; non-poriferous face with the branches regularly striated longitudinally, the striæ extending into and running in the same direction as the transverse bars; celluliferous side with the branches rounded, and marked by three or four rows of cells; cells oval, alternating; transverse bars thinner than on the non-poriferous side, sometimes expanded at the junction with the branch, and bearing a single cell at each extremity.

Fenestrules 4 to 4½ in the space of three lines longitudinally, and 7 to 10 transversely in the same space.

The inner or non-celluliferous face of this coral is undistinguishable from Fenestella; but the branches on the celluliferous side are not strongly carinated, and the surface is marked by three rows of cells. One of the specimens is flat and fan-shaped, but another has been clearly cup-form or funnel-shaped in its original condition. The branches are broader on the non-celluliferous face than any species of Fenestella in this group, except the *F. tenuiceps*, which has decidedly oval fenestrules.

Fig. 5 *a*. The inner surface of a part of a large frond.

Fig. 5 *b*. A portion of the same enlarged, showing the striated surface of the branches and the transverse bars.

Fig. 5 *c*. A cup-form specimen, showing the inner or non-celluliferous surface; and on the lower lefthand side a portion of the cup broken and pressed inwards, showing the celluliferous face.

Fig. 5 *d*. The celluliferous face enlarged.

Fig. 5 *e*. The non-celluliferous face enlarged. In this one, the transverse bars appear somewhat more slender than in 1 *b*.

Fig. 5 *f*. Several branches from the celluliferous face greatly enlarged, showing the bifurcation of the branches, and the increasing rows of pores from the point of bifurcation upwards.

Position and locality. In the shale of the Niagara group at Lockport, Rochester and other places. The celluliferous face is rarely observable, though fine specimens of the opposite face of the coral are not uncommon. (*State Collection.*)

Genus CERAMOPORA (*nov. gen.*).

[Gr. κεραμις, *imbrex*, and πορος, *pora*.]

Coral incrusting, or in flattened hemispheric forms; cells arranged in alternating or imbricating series; apertures arching or triangular, with the apex above.

The two first species placed under this genus present peculiarities sufficient to distinguish them from any described genus of fossil corals. They are probably Bryozoa, though the flattened hemispheric forms do not appear to be attached, and the general character is not unlike some of the true corals.

The characters of the Genus Berenicia are applicable to a considerable extent to some species, where the cells are more or less regularly disposed from a centre. The *Berenicia irregularis* of Lonsdale, and *B. megastoma* of M'Coy, are similar in general character to the first species of the present genus. There are too many objections to the adoption of the name *Berenicia* for fossil corals, since it was originally applied to a living type; and even among existing species, there appears to be much doubt and confusion in its application.

563. 1. CERAMOPORA IMBRICATA (*n. sp.*).

PL. XL E. Fig. 1 *a* – *i*.

Coral depressed hemispheric, flattened or concave on the lower side, composed of cylindrical or subcylindrical tubes slightly diverging from the centre, and extending upwards in a direction rectangular to the plane of the upper surface ; apertures arched or triangular, opening on all sides towards the outer margin, arranged in alternating and imbricating series.

In form and general appearance, these little corals are much like some of the small Chætetes, but a slight examination of the cells suffices to distinguish them. The mass appears to be composed of cylindrical tubes, which, on reaching the surface, bend abruptly outwards and downwards, presenting the openings of the cells in an obliquely vertical plane facing the outer margin ; giving upon the surface the appearance as of cells radiating on all sides from a centre, and, unless broken through in a vertical direction, or a view of the base be obtained, it is impossible to decide otherwise. In some specimens the divergence of the tubes at the crown of the specimen is very great, while in others the surface at this point scarcely differs from other parts.

Fig. 1 *a*, *b*. Upper surface of two specimens of different size.
Fig. 1 *c*. Profile outline, natural size.
Fig. 1 *d*. Vertical section magnified, showing structure and arrangement of the tubular cells.
Fig. 1 *e*. The centre of fig. 1 *a* magnified, showing the upper extremities of the tubes bending outward, and the form of the apertures.
Fig. 1 *f*. A portion of the surface enlarged, looking into the cells, and showing the alternating and imbricating arrangement.
Fig. 1 *g*. A portion of the base of a specimen, showing the circular bases of the cells.
Fig. 1 *h*. An individual of the same species, somewhat compressed, and the surface worn.
Fig. 1 *i*. An enlarged portion of the surface of 1 *h*.

Position and locality. In the shale at Lockport. (*Collection of* Col. JEWETT.)

564. 2. CERAMOPORA INCRUSTANS (*n. sp.*).

PL. XL E. Fig. 2 *a* – *d*.

Coral incrusting ; surface nodulose ; cells increasing unequally from a centre or point of growth, short, minute, opening obliquely outward and arranged in quincunx order.

The specimen described covers one valve of an Atrypa ; the central or originating point of growth being near the beak, from which the cells diverge in all directions, spreading more extensively towards the base of the shell, and extending over the edge of the shell in the other direction. The apertures are smaller, and the expanded tube or calicle on the upper side shorter than in the preceding species ; the mode of growth and increase are precisely the same in both.

Fig. 2 *a*. The surface of this coral, natural size.

Fig. 2 *b*. The interior of the shell, showing the extension of the coral over the edge of the valve.

Fig. 2 *c*. Profile showing the nodulose surface.

Fig. 2 *d*. An enlargement of the surface, showing form and arrangement of cells.

Position and locality. In the shale of the group at Lockport.

565. 3. CERAMOPORA FOLIACEA (*n. sp.*).

PL. XL E. Fig. 3 *a, b, c.*

Frond thin, expanding, foliate or subpalmate; openings of the cellules (where worn) oblong oval, or (where not worn) acutely angular at the upper extremity, slightly raised above the surface, distant from each other less than the longest diameter of the aperture, often unequally distant. Surface marked by ramulose or foliate impressions, giving an ornamented appearance to the frond.

This species is more slender and delicate than either of the preceding, consisting of a thin expanded crust marked by rather distant oblong cells. The thin calicle is usually worn down so that the apertures appear oval, or nearly so, and its affinity with the preceding species is not always so readily perceived. These foliated impressions appear to be produced by the cicatrizing of a small elongated space, from which the cells radiate on two sides and one extremity, giving an ornate appearance to the whole frond, but at the same time producing irregularity in the arrangement of the cells. The cells penetrate the crust obliquely.

Fig. 3 *a*. A portion of a frond, natural size.

Fig. 3 *b*. The surface enlarged, showing form and arrangement of cells.

Fig. 3 *c*. A portion of the surface enlarged, showing the foliate impressions and arrangement of cells around them.

Position and locality. In the calcareous layers in the lower part of the Niagara shale at Lockport.

566. 3. RHINOPORA TUBERCULOSA.

PL. XL E. Fig. 4 *a, b, c.*

Coral lamellose, subpalmate; surface asperate and tuberculous; tubercles mostly destitute of cells at the summits; cells rising in pustules upon the surface, and opening by roundish oval or tripetalous apertures.

This coral grows in lamellose or explanate fronds, which are celluliferous on both sides. The outer edges are thickened and celluliferous, and the entire surface on both sides is uniformly tuberculous. The tubercles are usually smooth and solid at their summits, rarely celluliferous. The cells rise to the surface in minute, irregular pustules; and the aperture, where entire,

appears to be oval, and surrounded by a thin calicle. Where worn down, the form of the aperture changes, and is more or less tripetalous or irregular. Under an ordinary magnifier the cells appear like minute papillose points, with an oval or roundish aperture, and the variety of form is scarcely perceptible.

Fig. 4 *a*. A fragment of a larger frond.

Fig. 4 *b*. A portion of the surface enlarged, showing the papillose cells, and tubercles with smooth summits.

Fig. 4 *c*. A small portion still further enlarged, showing some variety in the form of the apertures.

Position and locality. In the shale of the Niagara group at Lockport.

Genus LICHENALIA (*nov. gen.*).

[Gr. λιχενος, *lichen*, and αλιος, *marine*.]

Membranous or subcalcareous bryozoa, growing in circular or flabellate forms, concentrically or radiately striate, celluliferous on one surface only; frond usually a thin membrane, though often unequally thickened and contorted or wrinkled.

This genus includes several species of Bryozoa, which usually occur in circular or expanded forms presenting a striated surface. It is only in rare instances that distinct cells are visible, though in most cases the surface appears marked as if by stigmata, or the commencement of cells, which sometimes rise in low nodes without presenting any defined apertures. Although many specimens have been examined, it is still difficult to point out the true relations of these forms. The genus is perhaps more nearly like Diastopora or Udotea than any others, but it possesses characters entirely peculiar, and is probably a true palæozoic type.

567. 1. LICHENALIA CONCENTRICA (*n. sp.*).

Pl. XL E. Fig. 5 *a* – *g*.

Frond circular, slightly cup-form in the young state, flattened at maturity, and often variously contorted from irregular growth or accident, and thickened at intervals; surface concentrically marked by fine striæ and prominent concentric folds or ridges; celluliferous side less strongly striated, cells arranged in concentric lines, almost coincident with the striæ; apertures of cells narrow, opening upon the summit of an elevated pustule; non-celluliferous side of the frond showing oval stigmata, produced by the bases of cells on the opposite side.

This fossil, in its young state, is often found in a tolerably perfect condition; but in more advanced stages, as the size increases, its fragile structure has suffered injury and distortion in various ways. The young specimens differ little from the membranous envelope of the base of a Chætetes or Favosites, but they are never found with the structure of these genera. The older and larger specimens are usually broken, and in some instances they are folded together

in great confusion, as if they had grown abundantly in limited spaces, and that the action of water had drifted them together where they now form masses like drifted seaweeds and kelps.

Fig. 5 *a*. The concave side of a young specimen.
Fig. 5 *b*. The convex side of another larger individual.
Fig. 5 *c*. A larger imperfect frond, one half of which only remains.
Fig. 5 *d*. A fragment showing the condition of these fronds when drifted together.
Fig. 5 *e*. An enlargement of the celluliferous side, where the cells are strongly developed.
Fig. 5 *f*. Another fragment where the cells scarcely rise above the surface.
Fig. 5 *g*. An enlargement of the non-celluliferous side, showing the form and arrangement of the stigmata.

Position and locality. This species occurs in the soft shale at Rochester and Lockport; more rarely it is found associated with the lower part of the limestone in broken masses enclosing mud, and enveloped in the same material. (*State Collection.*)

Genus SAGENELLA (*nov. gen.*).

[Gr. σαγηνη, *verriculum.*]

A fragile membranous net or web-like bryozoum, incrusting other bodies; cells arranged in regular parallel or diverging series, more or less oblong quadrangular when in juxtaposition, and separated from each other by a thin lamina of calcareous matter.

Several species of Bryozoa of this character are known in different groups, usually occuring as incrustations upon the Orthocerata. The general appearance is much like Flustra or Membranipora, and they were doubtless among the earliest forms of that family of fossils. Nothing remains of the structure, except the thin laminæ constituting the lateral walls, with transverse septa separating the cells.

568. 1. SAGENELLA MEMBRANACEA (*n. sp.*).

Pl. XL E. Fig. 6 *a*, *b*.

A thin membranaceous incrustation, consisting of elongated quadrangular cells, which are slightly narrowed toward each extremity; cells arranged laterally in parallel series, with an interstitial range intercalated at intervals; cells in contiguous rows alternating, the distal extremity often concave; length about six times the width.

This species often covers surfaces of several inches upon the Orthocerata of this group, not confining itself to a single species. The specimen figured is the larger extremity of an Orthoceras more than two inches in diameter, and nearly all the exposed surface is covered. In some instances this coral appears to line the inner side of the shell, where it probably affixed itself after the death of the original occupant. In parts of these incrustations there is sometimes a

solid space where no cells appear ; and it often happens that some other species of coral has commenced growth upon this species, as in the example figured.

Fig. 6 *a*. A fragment of an Orthoceras covered by this coral, showing at two points *a'*, *a''*, the growth of other corals upon this one.

Fig. 6 *b*. An enlarged portion of the surface, showing the form and arrangement of the cells in this species, and in a species of CALLOPORA which covers it in parts.

Position and locality. This coral occurs attached to Orthocerata in the shale at Rochester, Marshall's mill, and Lockport.

PLATE XL E. Fig. 7 *a*, *b*.

An incrusting coral enveloping a Stephanocrinus. The form of the shallow cells is different from any mature species yet observed in this rock ; and probably it is only the commencement of growth of a coral or bryozoa, which, in a perfect or mature condition, presents a different character. Should it prove to be a mature form, it will find its analogues in the Flustra or Eschara type.

Fig. 7 *a*. The coral enveloping a broken crinoid.

Fig. 7 *b*. An enlargement of a portion of the surface.

Position and locality. In the shale at Lockport

PLATE XL E. Fig. 8 *a*, *b*.

An incrusting membrano-calcareous coral, growing upon Lichenalia and other bodies. Coral composed of tubular cells, which increase by regular dichotomizing, transversely striate or rugose ; a nearly circular aperture of each simple tube, opening upward, at the point where bifurcation takes place.

This species is very peculiar and characteristic, probably forming the type of a distinct genus. Its mode of growth is somewhat like AULOPORA, but the tubes are more minute, closely adhering to the body to which it is attached, and placed laterally in juxtaposition. The frequent bifurcation of these tubes causes a rapid expansion of the coral, and it spreads in nearly circular or flabellate blotches.

Fig. 8 *a*. A portion of Lichenalia, on which this coral is growing.

Fig. 8 *b*. An enlargement showing mode of growth and character of tubes.

Position and locality. In the shale at Lockport, growing upon Lichenalia and other corals.

The following species present no positive characters by which they can be identified either as bryozoa or true corals, except in their mode of growth and general appearance. They have usually been referred to GORGONIA, but there are really no characters visible by which such reference can be made.

GENUS DICTYONEMA (*nov. gen.*).

[Gr. δικτυον, *rete*, and νεμα, *filum.*]

Frond circular or flabelliform, composed of slender radiating branches which frequently bifurcate as they extend towards the margin; branches and subdivisions united laterally by fine transverse dissepiments; branches impressed with deep striæ or grooves, producing indentations that sometimes have an elongated rhomboidal form; axis subcalcareous with a corneous exterior.

The general structure of this coral is very similar to FENESTELLA, in its diverging bifurcating branches with transverse dissepiments. The branches appear like flattened black threads united laterally by finer ones, leaving quadrangular interstices. One species forms large circular fronds sometimes a foot in diameter, while the other has been seen only in flabellate forms. The branches of these corals consist of a black film enveloping a semi-calcareous or corneous interior, and they have the appearance and texture of Graptolites, to which they are doubtless closely allied. A single branch, where the lateral connexion with others is broken off, can scarcely be distinguished from some species of Graptolites.

569. 1. DICTYONEMA RETIFORMIS (*n. sp.*).

PL. XL F. Fig. 1 *a, b.*

Gorgonia? retiformis. Geol. Rep. 4th District, p. 115, fig. 1, 1843.

Frond circular, or expanded cyathiform in its growing state (flattened in its fossil condition); branches thin, flat, frequently bifurcating, united laterally by obliquely transverse filaments, leaving oblong quadrangular interstices; surfaces of branches indented, or intermittingly striated in an oblique direction.

This species is readily recognized in its more perfect condition by the circular form, comparatively broad and flattened branches, which radiate on every side from a centre. The branches do not strictly reticulate, although a cursory examination gives this impression, particularly in fragments where the circular character of the frond and radiating branches are not observable. It is a common species in the shale at Lockport, and fragments are found at nearly all localities of the same rock, though perfect fronds are extremely rare.

The species can have very little if any true relations with GORGONIA, to which it was previously referred, with doubt, upon the authority of LONSDALE's figures in MURCHISON's Silurian System. The specimens are preserved in calcareous shale, where the most minute and delicate forms of FENESTELLA and RETEPORA retain their texture in the most perfect manner.

It is not probable, therefore, that these fossils could have lost all indication of their original structure, had they been Gorgoniæ.

Fig. 1 *a*. A large nearly circular frond of this species.
Fig. 1 *b*. An enlargement from a similar frond.

Position and locality. In the shale at Lockport, Rochester, Marshall's mill, Wolcott, and at nearly all the exposures of the shale along the range from Rochester westward to the Niagara river. (*State Collection.*)

570. 2. DICTYONEMA GRACILIS (*n. sp.*).

Pl. XL G. Fig. 1 *a* – *d*.

Gorgonia? Rep. 4th Geol. District, p. 115, fig. 2, 1843.

Frond circular or flabelliform (probably cyathiform in its growing state), composed of slender bifurcating and slightly diverging branches, which are united laterally, and at long intervals, by very slender filaments; branches irregularly striated or indented, sometimes having uneven or subserrate margins; texture like the preceding, with an outer black film and interior subcalcareous stipe.

This species is readily distinguished from the preceding, by its more slender and neatly defined branches, with more distant connecting dissepiments, which are likewise extremely slender. It bears a close resemblance in structure and mode of growth to Fenestella, with the difference in texture and absence of cells on one side.

This species has not been observed in circular fronds like the preceding, but, judging from some crushed specimens, of which one side and a portion near the base is visible, it grew in expanded funnel-shaped or cyathiform fronds. There is no apparent difference in the texture of the branches on the inner or outer side, though the lateral margins may have been celluliferous as in the Graptolites.

Fragments of this species have been observed, of a size which show that had the frond been circular, it would have had a diameter of ten inches or more.

Fig. 1 *a*. A portion of a frond, showing the branches neatly defined, and spreading only in a moderate degree.
Fig. 1 *b*. A part of another frond, where the branches appear to spread more rapidly, but have otherwise the essential characters of the preceding.
Fig. 1 *c*. An enlargement, showing the indented or corrugated surface of the branches.
Fig. 1 *d*. An enlargement of several branches, where the margins appear indented or subserrate.

Position and locality. This species has been observed only in the shale at Lockport.
(*State Collection*)

Genus INOCAULIS (*nov. gen.*).

[Gr. ινος, *fibra*, and καυλος, *caulis*.]

A plant-like, corneous coral, with numerous bifurcating branches; structure fibrous or plumose.

The texture of this coral is similar to the Graptolites, a black scaly crust or film being all that remains of the substance. From the specimens examined, it appears to have grown in groups, with rounded or flattened stems, which are dichotomous above, and more or less spreading. The structure is too peculiar to be mistaken, or to be referred to any established genus.

571. 1. INOCAULIS PLUMULOSA (*n. sp.*).

Pl. XL G. Fig. 2 *a*, *b*.

Stems flattened, dichotomous; structure fibrous or plumulose, apparently composed of imbricating elongated scales or fibres, which spread equally on all sides.

This coral is not abundant, though small fragments are frequently seen in the shale. It is very often replaced by iron pyrites, and where the surface is exposed to weathering, the fossil soon disappears, so that it is only on freshly fractured surfaces that the structure is preserved.

Fig. 2 *a*. A part of several stems upon the surface of the shale.
Fig. 2 *b*. An enlarged portion, showing the structure.

Position and locality. In the Niagara shale at Lockport, Rochester and other places.

(*State Collection.*)

The corals of this group, described in the preceding pages, constitute the greater number and most conspicuous forms among the numerous species of this period. Further examinations, however, will doubtless much increase the number now known, since many imperfect and unsatisfactory specimens have fallen under observation, possessing characters distinguishing them from those described, but insufficient to furnish conclusive evidence of their affinities.

CRINOIDEA OF THE MIDDLE SILURIAN PERIOD.

The Crinoidea of this period are confined to a very moderate thickness of strata, being limited to the Clinton and Niagara groups, and not a single species being known either in the Medina sandstone or Onondaga-salt group. Notwithstanding this limited range, the number of species already known as having existed at this period is twice as great as from all the lower silurian strata. This proportion, moreover, is greatly increased, when we survey the entire extent of the rocks of this period, if we may judge from the great number of species occurring in some western localities. It should not be forgotten, also, that the whole number described in the succeeding pages, with two or three exceptions, have been found at a single locality of very limited extent. Other exposures of the same rock, equally extensive, have afforded not more than two or three species; and in many localities, scarcely any thing more than fragments of columns have been seen. These facts show very conclusively the habits of this class of animals, which always congregate in great numbers within very limited areas; while other portions of the same strata, though presenting no essential variation of character, are almost entirely destitute of them. In this instance, notwithstanding the whole line of exposure of the shale of the Niagara group, west of the Niagara river, and eastward to Wolcott in Wayne county, presents no essential difference in its geological features or mineral composition, we still find the animals of this class, mostly restricted within a small area, in the vicinity of Lockport. At this point, and the vicinity, the shale is covered by a heavy bedded encrinal limestone, composed almost entirely of the broken columns of these animals, with an admixture of small corals, and rarely a few other fossils. In the natural exposures, as well as the artificial excavations, this rock is far better developed in this neighborhood than at any other place along the entire escarpment.

This period is not only more prolific in these animals than the lower silurian period, but even much more than any portion of the succeeding strata, whether silurian or devonian, within the State of New-York. At the present time we do not know half as many species, in the entire series from the Onondaga-salt group to the Chemung group inclusive, as are known in the Niagara group alone. This condition and degree of development in this family of fossils, and probably also to a greater or less extent in the corals, corresponds with formations of the same age in Europe.

Mr. Murchison, in his introductory remarks to the Crinoidea of the Silurian System, says, "In the mean time I may state that the Crinoidea are more abundant in the Wenlock formation than any other member of the Silurian System, by far the greater number of the forms described having been formed in the limestone of that age near Dudley."

The variety of form, appendage and ornament of these fossils, is proportionally much greater than in the species of the lower strata. The normal or pentapetalous base is still the prevailing

form, though connected with a great variety of structure in the upper part of the calyx. The first deviation from this structure in the true crinoids, appears in a tripetalous impression on the base of the calyx, and a canal of the same form in the column. Thence proceeds the tripetalous base or pelvis, which characterizes a small group of these fossils mostly of very simple structure and few appendages.

In the Genus HYPANTHOCRINUS, we first perceive a remarkable deviation from the true crinoid type. The arms, which are usually expanded or expansible, are contracted, and with the tentacula or other appendages folded closely together; each pair being separated by a solid vertical plate reaching nearly to the centre, and converging, as do the enfolded arms, towards the apex, which is surmounted by a few small plates forming a kind of proboscis over the cavity of the stomach. This appears to be the first type developed in the direction of the Pentremites; the pairs of arms representing the ambulacral areas, while the solid plates represent the interambulacral spaces. In fact the Hypanthocrinus appears to be nothing more than a monstrous Pentremite.

In another direction, and still bearing some analogy with PENTREMITES and also perhaps more with the Genus EUGENIACRINITES, we have the STEPHANOCRINUS, presenting peculiarities not observed in any species of this class of animals from the succeeding strata.

The CARYOCRINUS, which is regarded by VON BUCH as forming the passage from the true Crinoidea to Cystidea, is the most abundant species of the group, and is one of the most interesting forms. The true Cystidea, of which a single species was noticed in the Trenton limestone, appears in several beautiful forms at this period.

It was not until within the past two or three years that these fossils were added to the list of our species, by the persevering researches of Col. E. JEWETT of Lockport, who has not only contributed these beautiful forms to our knowledge, but has by his collections increased the number of species among the Crinoidea previously known to us, by one third of all the species here given.

Notwithstanding the great variety of forms among animals of this class, at this period, there appear to be no true Carboniferous or Devonian types. The genera PLATYCRINUS and ACTINOCRINUS are not represented, and the species sometimes thus referred have not the true structure of these genera.

CRINOIDEA OF THE CLINTON GROUP.

There are a few species of this family of fossils, peculiar to the Clinton group, or which do not appear in the Niagara group. These species, with a single exception, are of types quite distinct from those of the lower silurian period, and show a greater affinity with those of the succeeding period. In the upper limestone of this group, several species have been observed, which are identical with those of the Niagara group; while those species in the beds beneath this limestone, are quite distinct. In all the localities examined, the crinoids in this group are found in a broken and dilapidated condition; and the short intervals of quiet alternating with periods of disturbance, or a change in the nature of the sediment, has operated unfavorably to the growth and preservation of these animals.

Genus CLOSTEROCRINUS (*nov. gen.*).

[Gr. κλωστηρ, *fusus*, and κρινον, *lilium*.]

The structure, as given under specific decription below, characterizes the genus. It is the earliest form known, having only three plates in the first series, as this one appears to have, judging from the side exposed to view.

572. 1. CLOSTEROCRINUS ELONGATUS (*n. sp.*).

Pl. A XLI. Fig. 2 *a-f*.

Body subfusiform, elongated, gradually tapering below and above, with ten pairs? of arms which are narrow and closely arranged; surface nearly plain, or with fine ornament; pelvic plates three? which are surmounted by five in the second series; third series of plates irregular, or with intercalated plates; arms and fingers composed of quadrangular joints, with jointed tentacula; column round, enlarging above where it joins the pelvis, composed of alternating thicker and thinner joints, except in the upper part, where there are two or three thin ones to one thick one.

The only specimen known, and from which the figure and description are taken, is imperfect on the exposed side, while the stone adheres to the opposite side. The structure shown in the righthand figure can be clearly made out, but the subdivisions beyond this are too obscure to be defined. This form is remarkable for the narrow deep cup, which enlarges very gradually from the pelvis to the base of the arms, where it seems contracted. The column is much enlarged at its junction with the pelvis.

Fig. 2 *a*. The specimen, natural size.

Fig. 2 *b*. The structure of the calyx enlarged, showing one side with column below.

Figs. 2 *c*, *d*, *e*, *f*. Portions of the columns and sections, natural size and magnified.

Position and locality. In the upper limestone of the Clinton group, Lockport, Niagara county. (*Collection of* Col. Jewett.)

573. 2. GLYPTOCRINUS PLUMOSUS.

PL. A XLI. Fig. 3 *a* - *g*.

Actinocrinus? plumosus. Geol. Rep. 4th Dist. N. York, 1843, p. 72.

Body unknown; fingers long, slender, and furnished with long, numerously jointed tentacula; joints of the tentacula slightly longer than the joints of the fingers (the former being from $\frac{1}{16}$ to $\frac{1}{10}$, and the latter $\frac{1}{12}$ to $\frac{1}{18}$ parts of an inch); column long, slender, obtusely five-angled, consisting of alternating thicker and thinner joints; sections of the column, or ends of the larger joints roseate, and distinctly divided into five parts, each one bearing an impression.

I have united the fragments of fingers and tentacula with the columns under the same species, though having no positive evidence that they are identical. The joints of the fingers bear a close resemblance to those of the column, and are evidently closely related, if not of one species. The joints of the fingers and tentacula are very numerous. In the latter, I have counted twenty-seven in an imperfect one. The columns are easily identified by the obtusely pentangular form and the pentapetalous section. The joints are extremely numerous, and often entirely cover the surface of some thin layers. The column is always longitudinally marked by a fine line or slit, indicating the line of separation between the five parts of each plate.

The character of the column and joints induces me to unite this species to the GLYPTOCRINUS, since it is very clear that it is not an ACTINOCRINUS, that genus being as yet unknown in the silurian or devonian periods of our country.

Fig. 3 *a*. A portion of a single finger, with the tentacula attached.
Fig. 3 *b*. Two joints of the finger enlarged, with several of the tentacular joints attached.
Fig. 3 *c*. A fragment of the column, probably of the same species.
Fig. 3 *d*. A few joints of the same enlarged, showing the longitudinal line of separation between the five parts of the plate. The same line is seen also in 3 *c*.
Fig. 3 *e*. The end of the same column enlarged.
Fig. 3 *f*. A small fragment of the rock, with the surface nearly covered with the joints of this crinoid.
Fig. 3 *g*. Several of these joints enlarged, showing their variable character.

Position and locality. This species is but rarely seen in the group east of the Genesee river, but becomes more abundant in the western part of the State. On the Oak-orchard creek south of Medina village, the columns and joints are very abundant; and also at Reynale's basin in Niagara county, where the fingers and tentacula are also found associated. It likewise occurs at Lockport. In all these localities, it is found in the lower part of the group. On the Niagara river, and at other localities in Canada West, it is of extremely rare occurrence: its horizontal range, therefore, appears to be quite limited. (*State Collection. Collection of* Col. JEWETT.)

574. 3. GLYPTOCRINUS ——?

PL. A XLI. Fig. 4.

Several large joints have been found, apparently belonging to a new species of this genus. The character is more like the species of the Hudson-river group.

Position and locality. Reynale's basin, lower part of the group.

575. 1. ICHTHYOCRINUS? CLINTONENSIS (*n. sp.*).

PL. A XLI. Fig. 5.

The specimen consists of the arms and fingers, which are not tentaculated : the arms divide at irregular distances from the base, and are each composed of a single quadrangular series of plates, except the joint at the bifurcation, which is pentagonal.

I have placed this provisionally in the Genus ICHTHYOCRINUS, from the similarity in the arrangement and mode of bifurcating of the arms and fingers, to the one in the Niagara group. It is, however, an entirely distinct species, as clearly seen in the form of the plates in the fragment.

Position and locality. In the lower shaly calcareous portion of the group at Reynale's basin, Niagara county. (*Collection of* Col. JEWETT.)

PL. A XLI. Fig. 6 *a, b, c.*

Body? Arms simple, undivided, semicylindrical, furnished with long slender linear tentacula which are attached to the two inner sides or angles, the convex side being outwards ; joints of the tentacula long, angulated at the margins, and the centre depressed or grooved. Column?

All we know of this species is the specimen figured, which presents the characters given above. The tentacula are very much obscured by shaly matter, and they appear like single, slender, rather rigid branches; but in one or two points, the true jointed character appears. From the character of these arms with spreading tentacula, I infer that they are simple from their origin. By the side of the arms is a small rounded column, which may perhaps belong to this species.

Fig. 6 *a.* The specimen of the natural size.
Fig. 6 *b.* The tentacula enlarged.
Fig. 6 *c.* Section of the same.

Position and locality. In the lower green shale near the Pentamerus limestone, Ontario, Wayne county.

JOINTS OF UNDETERMINED CRINOIDEA.

PL. A XLI. Figs. 7 *a* – *e*.

These bodies, from their structure, are apparently the joints of crinoidal columns, which have been worn smooth, and the marginal angles worn down to a rounded edge : the canal is also rounded and enlarged, and the whole presents a flattened globular appearance with a depression in the centre. When these bodies are separated from the stone, the two sides are precisely similar. They vary in thickness from half an inch to the fiftieth part of an inch. The thicker ones are mostly found in the iron ore, and appear not so much worn as macerated and dissolved. They present in fact the same peculiar oolitic aspect with the materials of the iron ore, where all the little fragments of fossils, of whatever kind, have lost their angular character. In the shale at Sodus and other places there are many thin joints of this kind, which are clearly worn or dissolved away on the prominent edges and angles, and they all present the smooth uniform character peculiar to the thicker ones in the iron ore. Some of these appear to be composed of more than one joint or articulation, but so closely united that there is no line of separation except upon the edge. All these are crystalline in structure, and those in ore are replaced by crystallized carbonate of iron.

In their external aspect the rings have lost all the characteristic features of the Crinoidea, but their crystalline structure is a clearly distinctive character on which we can rely.

Fig. 7 *a*. One of these rings, presenting a smooth globular surface, with a smooth opening in the centre. The thickness of this one is nearly a quarter of an inch.

Fig. 7 *b*. The impression left in the iron ore by a larger individual, the thickness of which was more than a quarter of an inch.

Fig. 7 *c*. A very thick one, with a small opening in the centre.

Fig. 7 *d*. A small specimen of the same character.

Fig. 7 *e*. View of the edge of a very thin specimen.

Position and locality. All the specimens figured are from the iron ores south of Mohawk village, on Steele's creek. Similar specimens, but smaller and thinner, occur in the shales of the lower part of the group in Wayne county. (*State Collection.*)

576. 1. CARYOCRINUS ORNATUS.

PL. A XLI. Fig. 1.

For description, see this species under Niagara group.

The only specimen known in the Clinton group, presents the anomalous structure shown in the figure referred to. The difference between this structure and the structure usually found in this species is clearly shown by a comparison with the figure on Plate 49. The difference in this one appears to result from the modification or imperfect development of the second series of plates, and the absence in part of the third series or scapular plates, allowing the arms to

rest, on one side, upon the costal plates. The costal plates are, with one exception, all modified in form; and just beneath the ovarian aperture, a supernumerary plate is intercalated. Or the plate *a* may perhaps be regarded as a scapular plate, or a plate of the third series, developed between two plates of the second series, and supporting as do the adjoining third plate on one side and second plate on the other side, the arms as shown in the figure.

This is doubtless an abnormal development, and can not constitute any specific distinction. A less important deviation has been observed in another specimen, but it is clearly due to a similar cause, or to some accident at one period of the animal's growth.

Position and locality. In the upper limestone of the Clinton group at Lockport.

(*Collection of* Col. JEWETT.)

577. 2. TENTACULITES MINUTUS.

PL. A XLI. Figs. 8 *a* – *e*.

Tentaculites minutus. HALL, Geol. Rep. 4th Dist. N. York, 1843, p. 72.

Tubes single, straight, rigid, minute, annulated; annulations extending to the apex, obtuse or rounded, distant three or four times their thickness; intermediate spaces smooth. Length $\frac{1}{8}$ of an inch.

This little tentaculite is found in the green shale; and from being extremely minute, its characters are not always well preserved. In length it is from one-eighth to three-sixteenths of an inch, and is marked by from fifteen to twenty annulations. I am unable to distinguish either longitudinal or transverse striæ between or on the annulations. In two specimens measured, there are seventeen annulations in the eighth of an inch. The annulations are usually sharp rings, rising abruptly from the tube, and comparatively distant from each other.

Fig. 8 *a*. A small fragment of the green shale, preserving several specimens of this fossil.
Fig. 8 *b*. Two specimens drawn separate from the shale, of the natural size.
Fig. 8 *c*. An individual enlarged.
Figs. 8 *d*, *e*. Portions of two individuals still further magnified, showing in one an apparent crenulation of the rings.

This feature is observable in two or three specimens, but it is difficult to make it out clearly; while in others the rings are decidedly plain. This difference may be due to the presence or absence of the outer crust or shell.

Position and locality. In the upper green shale at Rochester, associated with *Atrypa hemispherica*. (*State Collection.*)

578. 3. TENTACULITES DISTANS (*n. sp.*).

PL. A XLI. Fig. 9 *a, b, c.*

Tubes strong, rather rapidly enlarging from the apex, annulated by sharp elevated rings; annulations distant, apparently extending to the apex, four to five in the eighth of an inch; intermediate spaces striated longitudinally; striæ sharp, with spaces between equal to their width.

This species is readily distinguished from the last, and indeed from any of the others, by the great distance of its annulations, which are sharp, while the spaces between are marked by longitudinal striæ: the tube is likewise stronger, and more rapidly enlarging from the apex than the species in the lower silurian strata.

Position and locality. This species has thus far been found only in the thin layers of limestone in the lower part of the group at Flamborough Head, Canada West, near the head of Lake Ontario. It probably occurs at Lockport and Reynale's Basin, since the associated fossils are precisely similar.

The following are, in a few words, some distinctive characters of the species as they have fallen under my observation:

T. flexuosus. Annulations sharp, nine in $\frac{1}{8}$ of an inch, with intermediate spaces striated longitudinally.

T. minutus. Annulations obtuse or rounded, seventeen in $\frac{1}{8}$ of an inch; intermediate spaces smooth or transversely striated.

T. distans. Annulations sharp, distant, four to five in $\frac{1}{8}$ of an inch; intermediate spaces striated longitudinally.

T. —— of Niagara group. Annulations rounded, eight or nine in $\frac{1}{8}$ of an inch; intermediate spaces marked by transverse rounded striæ.

T. —— of Tentaculite limestone. Annulations rounded, unequally distant, from six to twelve in the space of $\frac{1}{8}$ of an inch; intermediate spaces transversely striated with rounded striæ. The tube is very long and slender, and the annulations frequently do not extend to the apex, leaving that portion smooth for the distance of an eighth of an inch: this feature, however, is variable.

These characters constitute reliable means of distinction, and, if properly observed, will enable any one to distinguish them. I am the more solicitous to show these in conjunction, since some persons have been disposed to doubt the distinctions between these small bodies in the successive groups. I need not here, perhaps, point out the very marked distinction between these and the other species known in a higher position.

CRINOIDEA OF THE NIAGARA GROUP.

In the description of the fossils of this family from the Niagara group, it has been necessary to establish eight new genera among the true Crinoidea : these have been founded upon important parts of the structure, or the relations of one part to another, showing the necessity of such a course. In nearly every one a full detail of the structure is given, so that a comparison with others may be made in all its parts not depending on a simple figure of the fossil. The details of structure in the Genus ICHTHYOCRINUS of CONRAD show some interesting relations to the crinoids with three pelvic plates.

Two species related to CARYOCRINUS have been added to that type, which, when more fully known, may perhaps show a transition to the CYSTIDEA of this group.

The number of species of Crinoidea, Cystidea, and one asteroid form now known in this group, are twenty-seven, which have been studied from important parts of their structure; while several others are known from fragments of columns, and other parts of the animal.

GENUS HOMOCRINUS (*nov. gen.*).

[Gr. ὁμος, *similis*, and κρινον, *lilium*.]

Crinoidea having the calyces composed of three series of simple plates, each series consisting of five plates; sometimes one or more irregular plates intercalated between the scapular or third series of plates on one side; arms proceeding from the summit of the third series of plates, simple or bifurcating, composed of a single series of plates, without tentacula.

The crinoids constituting this genus have been referred to POTERIOCRINUS or CYATHOCRINUS, the structure of which genera are somewhat different. An examination of specimens belonging to these genera shows the necessity of separating those silurian species having the characters given above. The two species given as POTERIOCRINUS in Vol. I. Palæontology of New-York, should be placed under this genus, having the same simple structure and arrangement of plates, arms, etc.

579. 1. HOMOCRINUS PARVUS (*n. sp.*).

PL. XLI. Fig. 1 *a-f*.

Minute, slender, structure microscopic; composed of five elongated pelvic plates, which are surmounted by an equal number of elongated costal plates; scapular plates short, minute, and surmounted by minutely slender elongated arms; arms composed of very elongated joints, which are thickened at their extremities; column composed of joints, of which the thickness nearly equals the width of the column.

This is an extremely minute species, of which two individuals occur on a small fragment of stone. It is probably in a mature state, since the form and proportion of the plates is very different from any other species observed in the group.

Fig. 1 *a*. An individual, natural size, with a portion of the column attached.
Fig. 1 *b*. The head and arms of another individual.
Fig. 1 *c*. The specimen fig. 1 *b* enlarged : the small plate supporting the arms is not present in this specimen, and one of the plates of the second series is divided transversely.
Fig. 1 *d*. A figure showing the structure and form of plates.
Fig. 1 *e*. A part of one of the arms enlarged.
Fig. 1 *f*. A portion of the column of 1 *a* enlarged.

Position and locality. In the higher part of the Niagara shale at Lockport.

(*Collection of* Col. JEWETT.)

580. 2. HOMOCRINUS CYLINDRICUS (*n. sp.*).

PL. XLI. Fig. 2 *a, b, c ; 3 a, b, c.*

Body subcylindrical, and gradually enlarging above ; first and second ranges of plates nearly equal in size ; an intermediate plate inserted on the upper oblique edges of two of the costal plates, which divides the succeeding scapular plate, giving six in the third series ; arms ? ; column comparatively very strong, composed of alternating thicker and thinner joints, the thicker ones projecting and rounded on the edges.

The specimen figured is very imperfect, the body and a small portion of the column alone remaining ; the arms are also broken off. All that remains, however, shows the simple structure of the genus, with the plain unornamented surface of the plates.

Fig. 2 *a*. The body and part of the column, natural size.
Fig. 2 *b*. An enlarged portion of the column.
Fig. 2 *c*. The structure, showing the single intercalated plate, and the division of the succeeding scapular plate.
Fig. 3 *a*. The body of an individual somewhat more rotund than the preceding, showing the same general structure.
Fig. 3 *b*. The base of the specimen which has one of the larger joints adhering, showing the central articulating portion, while the outer portion of the face is smooth.
Fig. 3 *c*. A figure showing the structure of the specimen.

Position and locality. In the central and lower part of the shale at Lockport.

(*Collection of* Col. JEWETT.)

Genus GLYPTASTER (*nov. gen.*).

[Gr. γλυπτος, *sculptilis*, and αστερ, *stella*.]

Pelvic plates five, marked by strong diverging ridges which unite on the plates of the second series, forming five strong ridges, which again bifurcate, sending one division to the base of each arm. Structure of upper part of cup unknown; arms ten, composed of a double series of plates.

This species is closely allied to Glyptocrinus in the structure of the calyx, which can not be fully determined.

581. 1. GLYPTASTER BRACHIATUS (*n. sp.*).

Pl. XLI. Fig. 4 *a, b*.

Structure of the calyx not ascertained; surface granulate or tuberculated, in addition to the strong ridges; arms ten, nearly cylindrical and much elongated.

The specimen figured is the only one which has fallen under observation, and the shaly matter adheres so strongly to the plates as to render it impossible to ascertain the true structure. The arms are spread out on the surface of the stone, and the base of the specimen turned upward so that the junction of the arms with the plates below can not be seen.

Fig. 4 *a*. The specimen as it appears on the surface of a slab of shale.

Fig. 4 *b*. A part of one of the arms enlarged, showing more distinctly the arrangement of the plates of the arms.

Position and locality. In the shale at Lockport.

In the Lower Silurian period, there is a single species in the Chazy limestone, marked by strong ridges diverging from the centre to the margins of the plate; and another in the Hudson-river group, and the Blue limestone of the same age at the west. There is probably a third species, and possibly a fourth, in the Clinton group; judging from the fragments of arms and columns found in that position, and figured on Plate A 41. These three, with the one figured above, are the only ones presenting these external characters at present known to me in the whole range of the New-York strata. Were it not that similar characters are shown (according to figures) in species of Actinocrinus from the Carboniferous period, I should be inclined to regard this marking as characteristic of silurian crinoids.

Genus THYSANOCRINUS (*nov. gen.*).

[Gr. θυσανος, *fimbria*, and κρινον, *lilium;* from the fimbriated arms or fingers of the species included under this genus.]

Column round; pelvis composed of five pentagonal plates; costal plates five, hexagonal; scapular plates alternating with the costal plates, bearing a second scapular plate, and an arm-joint on which the subdivisions of the arms take place; a single interscapular and two second interscapulars; arm divisions composed of a single series of plates in the lower part, and a double alternating series in the upper part. Or, the arm-joint succeeded by a hand of one or more joints in direct succession, succeeded by fingers composed of a double alternating series of joints.

The essential characters here presented, it is believed, will be found in a number of species, all having the arms composed, particularly in the upper portions, of a double series of joints with jointed tentacula. The interscapular plates will probably not be found constant in all species, but they are clearly present as described in the specimen fig. 1 *a*, pl. 42, and also in fig. 4 *b* of the same plate. The fragments of arms of other species with tentacula having similar characters, show the group to be a natural one, and containing several species.

582. 1. THYSANOCRINUS LILIIFORMIS (*n. sp.*).

Pl. XLII. Fig. 1 *a–f*.

Body cup-form, subangular; surface of plates ornamented by vertical or radiating, interrupted or crenulated, sharp, elevated striæ; pelvic plates small; costals larger, and succeeded by five still larger scapular plates, from which in direct series originate the arms and fingers; arm-joints succeeded by three simple hand-joints; fingers composed of a double series of joints, fimbriated; column round, composed of alternating thicker and thinner joints, which are more irregular near the base of the cup.

The surface ornament of this species is quite peculiar and distinctive: on the plates near the base it is radiating, and sometimes granular; on the higher plates, interrupted, nearly vertical striæ; and on the plates of the fingers the striæ extend quite across the plate somewhat obliquely, and are sometimes granulated. The structure and arrangement of the plates, to the commencement of the arms, are only of generic importance, though the forms are slightly different from another species. The joints of the fingers are wide, and the tentacula are quite distinctive when compared with others, as shown on the same plate. The first joint is narrow and long, very gradually tapering; the succeeding joints are somewhat longer than the first, distinctly angular, with the angles crenulate or asperate.

Where the fingers are crushed, and one side only shown, they appear to be composed of a single series of plates only, since the line of joining of the two rows of the plates on the back is so nearly vertical.

Fig. 1 *a*. An imperfect specimen of the head of this species, with a portion of the column attached.

Fig. 1 *b*. The structure of this species; the upper portion of the figure including to the base of three of the arms, and the continuation of two of them being made out from the exposed side of the specimen fig. 1 *a*.

Fig. 1 *c*. A portion of one of the fingers enlarged, showing only one side with the tentacula attached.

Fig. 1 *d*. The base of one of the fingers enlarged, showing the commencement of the double series of plates. The upper part of the figure connected by the dotted lines, shows the union of the plates in the middle and upper part of the fingers, where they are less deeply interlocked with each other.

Fig. 1 *e*. A single scapular plate enlarged.

Fig. 1 *f*. A portion of the column enlarged, showing the alternation of one thick plate with two thinner ones, and, below this, of one thick and one thin one.

Position and locality. In the shale of the Niagara group at Lockport.

(*Collection of* Col. JEWETT.)

583. 2. THYSANOCRINUS CANALICULATUS (*n. sp.*).

PL. XLII. Fig. 2 *a* – *d*.

Joints of the fingers alternating, and but slightly interlocking with each other on the back; tentacula adhering to the entire inner margin or face of the finger-joints; first joint of tentacula somewhat abruptly tapering from the finger-joints; second and succeeding joints slender, with prominent angles and a strong groove along the centre, slightly thickened at the joints; surface of the finger-joints simply granular, without any peculiar ornament.

This species is only known from the fragments of several fingers with the tentacula attached, one of which is shown in fig. 2 *a*. The character and proportion of the joints of the tentacula furnish good characters for specific distinction. The first tentacular joints adhere to the entire face of the finger-joints, and do not at all alternate with them. These joints, in the position in which the fragments lie, are two-thirds as long as the exposed width of the finger-joints, and nearly twice their length. The deep groove and prominent smooth angles of the succeeding tentacular joints contrast very strongly with the preceding and following species.

Fig. 2 *a*. A fragment of one of the fingers, showing the tentacula on one side.

Fig. 2 *b*. Two joints of the same enlarged, showing attachment of tentacula, form and proportion of joints, etc.

Fig. 2 *c*. The exterior of the finger enlarged, showing the union of the two series of joints.

Fig. 2 *d*. Vertical section enlarged, showing the position of the contracted tentacles.

Position and locality. In the shale at Lockport.

(*Collection of* Col. JEWETT.)

584. 3. THYSANOCRINUS ACULEATUS (*n. sp.*).

Pl. XLII. Fig. 3 *a* – *d*.

Fingers composed of a double series of alternating joints, slightly interlocking upon the back; first joints of the tentacula alternating with the joints of the fingers, short, pentagonal, not diminishing towards the outer extremity; second joints of tentacula elongated, twice as long as the first joints, and gradually narrowing to their junction with the third joints. The first two or three joints rounded, smooth or finely granulated; third or fourth and succeeding joints grooved longitudinally; number of joints in each tentacle not ascertained.

This species presents a striking contrast to either of the preceding, in the first short joints of the tentacula, which partially alternate with the joints of the fingers; the two sides, thus in contact with the finger joints, being about equal to one-third on the upper and two-thirds on the lower of the two joints in contact. When closed, the back of each finger presents a depression along the suture, which is quite conspicuous, and differs from the preceding species. The first two or three joints are smooth or granulated, without ornament. On the third, or sometimes only on the fourth joint, commences a shallow groove, on each side of which the surface is rounded.

The degree of alternation of the tentacular joints with those of the fingers is slightly variable; and in some positions of the fingers, this character may be overlooked.

When once understood, the characters of the finger and tentacular joints of the three preceding species are as clearly defined and reliable as the characters derived from any other part of the crinoid. The single joints of the tentaculum, though scarcely visible to the naked eye, become, under the magnifier, marked by distinct and reliable characters.

From the similarity in general features and arrangement of parts, the two preceding species are referred to the same genus with figure 1, though no other parts of the animal have been seen. The name of this species is given from the aculeate second, or second and third joints together, of the tentacula (see fig. 3 *c*).

Fig. 3 *a*. The upper part of a crinoid, showing the contracted fingers and tentacula, five of which are seen in the figure.

Fig. 3 *b*. An enlargement of the back of a part of one of the fingers, showing the joining of the plates.

Fig. 3 *c*. Several joints of the finger enlarged, showing the tentacula attached, the form, etc. of the joints.

Fig. 3 *d*. Several joints from another individual enlarged, showing the first joints of the tentacula to be less extremely alternating than in fig. 3 *c*.

Position and locality. In the shale at Lockport.

585. 4. THYSANOCRINUS IMMATURUS (*n. sp.*).

PL. XLII. Fig. 4 *a–f.*

Calyx cup-form or depressed subturbinate; pelvic plates minute, enclosed within the extended plates of the second series which envelop the upper joints of the column; second series of plates hexagonal, with a single exception, which is truncated on the upper extremity; the second series, or costal plates, support on their oblique edges five scapular plates, which alternate with the same number of interscapular plates; arms dividing upon the second joint above the scapulars.

This species is known to me only in a single fragment, which, so far as preserved, has all the characteristics of the genus. The first series of plates appear not to be fully developed, and the second series cover them so entirely that they are not visible in a lateral view of the specimen. It is evident, however, from the form of the second series of plates, that they can not properly form the base, or part attached to the column, since they only enclose it. The second series of plates now unite with the first series on their inner edges only, leaving the outer edges projecting. It is possible that this is only an immature state of the species, which, in its fully developed condition, will present five minute triangular or pentagonal pelvic plates, on the oblique upper edges of which the second series of plates will rest. This structure is better shown in fig. 4 *f*, where the outer circle shows the present extent of the column, while the inner shows the character it would have if developed as just described.

Fig. 4 *a*, *b*. Lateral view of the specimen, natural size and enlarged.
Fig. 4 *c*. The upper margin of the broken cup.
Fig. 4 *d*. The base of the cup, natural size.
Fig. 4 *e*. Figure showing the structure of the cup, and form of the plates as far as the divisions of the arms.
Fig. 4 *f*. The base enlarged, showing the relations of the first and second series of plates, leaving out of view the overlapping edges of the latter.

Position and locality. In the lower part of the limestone at Lockport.

GENUS MYELODACTYLUS (*nov. gen.*).

[Gr. μυελος, *medulla*, and δακτυλος, *digitus.*]

This generic name is proposed for characterizing the arms or fingers described below, the remarkable feature of which is the foramen or medullary canal penetrating the column of joints, a character not existing in the species where the fingers are composed of a double series of joints, and which is not conspicuous in the simple jointed fingers without tentacula.

586. 1. MYELODACTYLUS CONVOLUTUS (*n. sp.*).

PL. XLII. Fig. 5 *a*, *b*; and 6 *a* – *h*.

Fingers? Composed of a single series of thin joints, which are slightly nodulose or tubercular on the back; ends of the joints somewhat semicircular or crescent-form, with the extremities truncated; tentacula composed of numerous rounded or slightly nodulose joints, which are attached to the truncated extremities of the finger-joint by a tendon inserted into a perforation in the joint; fingers usually incurved or convolute; plates penetrated vertically by an oblong quadrangular canal, through which probably passed a strong tendon connecting the whole together; surface of each plate marked by a pentagonal depression, within which are elevated ridges, the whole intended for the strong attachment of muscular fibres connecting the plates; outer edge of the plate, upon the back, marked by two, or sometimes three minute grooves or perforations communicating with the muscular impression upon the upper surface.

Numerous fragments of this species (like fig. 6 *a*, *b*) have been found, composed of a single series of wide flat joints with a semicircular groove on the inner side, showing on the face of the truncated inner angles a minute perforation for the attachment of the tentaculum. These fragments are always curved, however slightly, in the same direction, and the specimen fig. 5 *a* forms more than a single convolution. In a lateral view, there is no visible character to separate it from THYSANOCRINUS; but believing that the other characters mentioned are of generic importance, it has been separated.

Fig. 5 *a*. A fragment rolled together, forming more than a single convolution; the tentacula apparently contracted gradually during the infolding of the arm, and those of the outer extremity spread evenly over, enclosing the others.

Fig. 5 *b*. Three joints of the finger enlarged, showing the tentacula to the fifth joint.

Fig. 6 *a*. A fragment of a similar finger, showing the broad groove on the inner side, and the minute perforations on the truncated inner angles of the plate.

Fig. 6 *b*. The outer side or back of the same fragment, showing a nodulose surface.

Fig. 6 *c*. Several joints enlarged, showing the character of the inner side.

Fig. 6 *d*, *e*. The back enlarged, showing in *e* the minute groove for the passage of a tendon to the external surface.

Fig. 6 *f*, *g*. Articulating surface of the plates, natural size, from two different specimens; the upper one less distinctly defined than the lower one.

Fig. 6 *h*. The same enlarged, showing the form of canal, the pentagonal muscular impression with ridges for the attachment of muscles, and the minute grooves extending to the back of the column.

Position and locality. In the shale at Lockport. The fragments are washed out from the decomposing rock by rains. (*Collection of* Col. JEWETT.)

Genus DENDROCRINUS (*nov. gen.*).

[Gr. δενδρον, *arbor*, and κρινον, *lilium*.]

Calyx obconical, large; pelvic plates five, minute; second and third series of plates large; scapular or arm-bearing plates five, resting upon the upper oblique edges of the third series of plates; the truncated second costal plate supports the interscapular plates, the upper of which sustain a series of plates forming an elongated proboscis; arms and fingers composed of single series of joints without tentacula.

The specimen figured presents peculiarities quite sufficient for the establishment of a new genus. It is the only crinoid yet observed in this geological period possessing an elongated proboscis, and having the arms originating below the summit of the cup.

587. 1. DENDROCRINUS LONGIDACTYLUS (*n. sp.*).

Pl. XLIII. Fig. 1 *a* – *k*; and Pl. XLII. Fig. 7 *a*, *b*.

Cup large, obconical; pelvic plates scarcely visible; second series of plates nearly straight across the base; third series of plates having one or more truncated on the upper side, and supporting an interscapular plate, which again supports a second interscapular plate; the latter, together with the oblique upper edges of the upper scapular plates, support four plates which form the base of the long proboscis; arms slender, composed of a single series of joints resting on the depressed upper edge of the large second scapular plate, bifurcating on every fifth, sixth or seventh plate; proboscis composed of several series of hexagonal plates, placed one above another in a direct line, and alternating with a similar series on either side; plates of the proboscis strengthened by a strong vertical ridge connecting them throughout, and smaller ridges diverging from the centre to each side, meeting similar ones from the adjoining plate.

The structure of this very singular crinoid was not fully understood from an investigation of the specimen figured on Plate 43, fig. 1 *a*. The long slender fingers only were at first visible, and it was after much labor that their connexion with the body was ascertained. In working away the stone still farther, the interscapular plates were found to be connected with another series, as shown in that figure, and finally the base of a proboscis was clearly traced. The full extent of this portion was not suspected until the fortunate discovery of another specimen by Col. Jewett, figured on Plate 42, where a large part of the proboscis is preserved, while the arms are broken off near the base.

The same side, apparently, is presented to view in both specimens. The second costal plate, directly in front, is truncated above, while those on each side are angular. The structure, so far as ascertained, is shown in the upper part of fig. 1 *b*, pl. 43; while the form of the two second costals not seen, is conjectural. The plates are obtusely angular, as if bent, the ridges running towards the angles. The surface of the calyx is marked by no peculiar ornament, but appears to be simply granular. It is difficult to distinguish the true form and arrangement

of the plates near the base of the proboscis, though it is evident they are variable; but they soon become hexagonal, as described and represented in the figures. There will be little difficulty in recognizing any detached fragments of this species, when the figures have once been studied: even the joints of the arms and fingers possess a peculiar character, and the undulating or subangular surface of the plates above the second series is alone sufficient for recognition.

PLATE XLIII.

Fig. 1 *a*. An individual, natural size, partially imbedded in shale. The base of the proboscis is shown between the arms. The portion of an arm or fingers, seen in the centre of the figure, has no connexion with the plates directly below it, which belong to the proboscis.

Fig. 1 *b*. Figure showing the structure of the cup, the commencement of the proboscis, and the arms.

Figs. 1 *c*, *d*, *e*. Detached plates from the upper part of the cup of other individuals.

Fig. 1 *f*. A portion of a branch near the lower part.

Fig. 1 *g*. A similar fragment near the extremity of the branches of the fingers.

Fig. 1 *i*. A fragment of an arm somewhat unequally bifurcating, but having surface aspect and structure like this species.

Fig. 1 *h*. The end of the joint enlarged, showing the articulating rays extending only a short distance from the centre.

Fig. 1 *k*. Several joints of the preceding enlarged.

PLATE XLII.

Fig. 7 *a*. A specimen of this species, with the arms broken off, but preserving a large portion of the long proboscis which is flattened.

Fig. 7 *b*. A portion of the proboscis enlarged, showing the form and arrangement of the plates of which it is composed.

Position and locality. In the shale at Lockport.

Genus ICHTHYOCRINUS (Conrad).

This genus is characterized by Mr. Conrad (Jour. Acad. Nat. Sci. Philadelphia, Vol. viii, p. 279), as follows:

"Column round, smooth; canal small and round; scapulæ with the margins of the articutions parallel, and somewhat imbricated."

These characters are not sufficiently decisive, and alone do not enable one to distinguish the fossil.

The column is round, smooth and slender, having the articulating rays on the outer circumference. The base of the cup shows five small triangular pelvic plates, succeeded by scapular plates resting on the oblique upper edges of the pelvic plates: a second and third scapular plate succeed in direct series, when subdivision takes place, which is repeated two or three times at irregular intervals. The base of the cup, when the column is separated, presents a tripetalous impression, which is probably of generic importance.

This genus is known only in a single species; but it possesses peculiarities of high interest, showing its relations to crinoids with three pelvic plates; while the arms proceeding in direct line from the second series of plates, is characteristic of the lower forms with pentapetalous calyx.

588. 1. ICHTHYOCRINUS LÆVIS.

Pl. XLIII. Fig. 2 *a – p.*

Ichthyocrinus lævis. Conrad, Jour. Acad. Nat. Science, Vol. viii, pag. 279, pl. 15, fig. 16.

Column slender, round and smooth, gradually enlarging towards the base of the cup, and composed of alternating thicker and thinner joints; base of the cup showing a tripetalous impression (or three undeveloped pelvic plates surrounding the centre); pelvic plates five, triangular, with wide bases; on one side an interval between the pelvic plates, allowing one of the second series to rest upon the column (see figs. 2 *f*, *g*) for a narrow space; second series having the form and position of scapular plates; lower side resting on the sloping sides of the pelvic plates; upper edge nearly parallel to the lower, giving the succeeding plates the same form on the lower side, each series alternating with that laterally in juxtaposition; first subdivisions taking place in the fourth or fifth plate from the pelvis; second subdivisions occurring on the sixth or ninth plate from the first one, and beyond this at irregular intervals; plates obtusely angulated on the exterior surface from the centre of the base to the sinus on the upper edge, articulated on their upper and lower surface by marginal crenulations. On the side where the plate of the second series rests on the column, there are two supernumerary plates intercalated on the lefthand side and above its upper lefthand angle. The subdivisions, though apparently commencing by the division of a single plate, still show one edge elevated a little higher than the other, so that the series are in their lateral relations alternate with one another,

taken at any point from the commencement of the scapular plates. The subdivisions of the arms from the scapular plates can be traced to the number of sixty, and many of these again subdivide, and perhaps all, so that the entire number in the living and perfect animal may have been one hundred and twenty.

This is probably the same species figured by MURCHISON (Sil. System, pag. 672, pl. 17, fig. 6) as *Cyathocrinus pyriformis*, and is perhaps identical with fig. 2 of MILLER's *Cyathocrinus tuberculatus*. The structure, however, shows conclusively that it should constitute a distinct genus. The remarkable character of an undeveloped tripetaloid base assimilates it with the crinoids having this structure, or three pelvic plates succeeded by five in the second series (See, for example, the description and illustration of *Lecanocrinus*, pl. 45).

The form of this species, with its neatly tapering base and slender column, are sufficient to distinguish it from all the other species, without having particular reference to the details of the structure. The arms are usually infolded at the summit, giving a well defined outline.

Fig. 2 *a*. An individual of medium size, slightly compressed: a portion of the column still remains attached.

Fig. 2 *b*. A smaller individual, having the arms extended upon the stone in which it is partially imbedded.

Fig. 2 *c*. A young individual of the same species.

Fig. 2 *c+*. The base of the same.

Fig. 2 *d*. The crown of another individual, where the arms are regularly incurved and enfolded, leaving in the centre a cavity filled with stone.

Fig. 2 *e*. A figure showing the structure as far as the third or fourth subdivisions: this structure is made out from an individual not otherwise figured on the plate.

Fig. 2 *f*. The base enlarged, showing the three undeveloped plates, the five pelvic plates resting on the column, and the small space occupied by the scapular plate resting on the column.

Fig. 2 *g*. The same, showing the relative position of the pelvic and secondary plates.

This structure and arrangement of plates has been observed in several specimens and is not the result of accident affecting a single individual.

Fig. 2 *h*, *i*, *k*; *l*. Successive joints from the arms and subdivisions, showing the form of the plate, looking upon its upper or lower surface: the margins are crenulated, and the projecting inner angle of the plate is longer on one side than the other.

Fig. 2 *m*. Lateral view of a fragment of one of the fingers, showing the union of the plates.

Fig. 2 *n*, *o*. Fragments of columns of this species.

Fig. 2 *p*. The end of a column enlarged, showing the crenulations on the outer margin, and the small, circular or obscurely pentagonal canal.

Position and locality. In the shale at Lockport.

(*State Collection. Collection of* Col. JEWETT.)

Genus LYRIOCRINUS (*nov. gen.*).

[Gr. λυριον, *lyra parva*, and κρινον, *lilium.*]

Column round; pelvic plates five, pentagonal; costal plates five, resting on the oblique upper edges of the pelvic plates, and succeeded by five scapulars, which support an arm-plate, upon the oblique upper edges of which rest the hand-joints supporting a pair of fingers; a single interscapular plate between each pair of scapulars, with the two second interscapular plates resting upon its oblique upper edges and the edges of the adjoining costal plates.

The arrangement of the plates in this genus commences upon the simplest plan known, that of the continuation of the plates in the second series in a direct line to the base of the arms. The number of plates interposed, however, between the pelvis and the subdivisions at the base of the arms, shows a higher type, which is further indicated in the arms, the fingers of which are composed of a double series of plates.

589. 1. LYRIOCRINUS DACTYLUS.

Pl. XLIV. Fig. 1 *a – g.*

Marsupiocrinites? dactylus. Hall, Geol. Rep. 4th Dist. N. York, pag. 114; fig. 4, p. 113, 1843.

Column round, composed near the head of alternating larger and smaller joints, the larger projecting much beyond the smaller ones; canal apparently round; surface of plates finely ornamented; pelvic plates small, pentagonal; costal plates heptagonal, scapulars hexagonal (in one of the five there is a double scapular, and the succeeding plate is somewhat smaller than in the others); arm-plates of the form of the pelvic plates; hand-joints two, one above the other, the lower somewhat cuneate, resting on each of the sloping upper sides of the arm-plate; fingers ten, composed of a double series of joints interlocking with each other, gradually tapering to the extremity. The intermediate plates are uniform, with one exception: a quadrangular plate is interposed between the two second interscapular plates; this point is on the opposite side from the supernumerary scapular, and both may be seen in fig. 1 *d*. Between each pair of fingers there are two small plates interposed at the base, directly above the interscapulars; and between the fingers of the same pair there is a single pentagonal plate interposed, similar to the larger of the two plates between the pairs of fingers.

This species is readily distinguished by the great number of plates below the subdivisions of the arms, which take place in a direct line from the divisions between the

pelvic plates. The plates in the fingers of LYRIOCRINUS interlock somewhat more deeply, and have a greater lateral extension and smoother surface than those of GLYPTASTER, while the fingers themselves diminish more rapidly towards the extremities. From all the other species of this period, this is readily distinguished on careful comparison. I am the more particular in calling attention to the less conspicuous parts, since, in the larger number of specimens seen, the structure of the cup is obscure, and it may not be readily compared with the figures given on the plate. Many specimens have no portion of the column remaining, and they appear like a globular sac with the simple terete arms spreading above. The column is more like the column of EUCALYPTOCRINUS than any other species; but the proportional thickness of the joints is less, and the projecting edges of the alternate joints are much thinner.

Fig. 1 *a*. An individual of medium size, preserving the cup and the arms nearly to their extremities. The structure is more clearly shown in this specimen, than in any other examined. Several of the arms remain imbedded in shale, and partly broken off.

Fig. 1 *b*. A smaller specimen, preserving a portion of the column, and leaving four of the arms only visible : the specimen is imbedded in shale.

Fig. 1 *c*. A larger specimen, showing the arms and column well preserved.

Fig. 1 *d*. The structure as made out from the specimen fig. 1 *a*. The commencement of three pairs of fingers is shown, and the simple joints at the base of the other pairs in the same relative position.

Fig. 1 *e*. A single plate enlarged, showing the character of the surface, and the increased ornament at the margins or junction with adjoining plates.

Fig. 1 *f*. A fragment of a column enlarged, showing more distinctly the alternating larger and smaller joints.

Fig. 1 *g*. The end of the column enlarged.

Position and locality. In the shale at Lockport.

Genus LECANOCRINUS (*nov. gen.*).

[Gr. λεκανη, *pelvis*, and κρινον, *lilium;* from the bowlshaped form of the calyx in the typical species.]

Pelvis composed of three plates; second series consisting of five, with an intercalated plate; third series, or scapular plates broad, with an interscapular plate in the same range; arms with two joints, above which are several subdivisions closely arranged, the plates uniting laterally without interlocking.

There are several species possessing characters sufficiently similar to admit of their union under a single genus; regarding minutely only the more important parts of the structure, and recognizing a general similarity in habit and character of other portions of the animal.

590. 1. LECANOCRINUS MACROPETALUS (*n. sp.*).

Pl. XLV. Fig. 1 *a - h.*

Body sub-globose; pelvis composed of three small plates, succeeded by five costal plates of very large dimensions, two of these are pentagonal, one regularly hexagonal, and two heptagonal; a single sub-quadrangular intercostal plate; scapular plates five, two of them pentagonal, and three with a short sixth side; a single interscapular plate; arm-plates two, above which the plates subdivide, a second subdivision occurring above the third or fourth plate from the first division; extremities of the fingers folded inward, leaving an open cavity at the summit; column round, composed of smooth, alternately thicker and thinner joints which articulate strongly upon their outer margins; canal rounded, with sometimes indications of a tripetalous form.

This species is easily recognized by its general form, and particularly by the structure of the calyx, which is constant in all the specimens examined. The plates, to the subdivisions of the arms, are remarkably large, and the wide scapular plates give great width to this part of the body. The column is comparatively slender, and composed of smooth thick joints, alternating at irregular intervals with thinner ones. The edges of the joints of the column appear slightly rounded, giving it a characteristic appearance.

There is a very interesting analogy between this species and the *Ichthyocrinus lævis;* which is the more remarkable, since the latter belongs to the division with five pelvic plates. The Lecanocrinus seems, as it were, to be a farther development of the type first appearing in the Ichthyocrinus. It has been shown, that at the base of the latter, and entirely covered by the upper extremity of the column, are three minute plates, which nowhere reach the margin. The five small pelvic plates do not entirely surround the margin, but allow a narrow portion of one of the second series to rest upon the edge of the column. If we suppose for one moment these three minute plates to be more fully developed, we have the pelvis of the Lecanocrinus. Regarding still farther those portions of the triangular pelvic plates of the Ichthyocrinus, intervening between the outer margin of those plates and the three minute plates of the centre, to

be developed in the same plane with the upper portion of these plates, we have the precise form of the costal plates of LECANOCRINUS.

The narrow margin of a plate of the second series resting on the stem in ICHTHYOCRINUS, has its perfect analogy in the intercostal plate of LECANOCRINUS. This will be made more apparent by inspecting the figure 2, plate 45, which is a representation of the base of ICHTHYOCRINUS, showing the relative position of all the plates to the fourth series somewhat enlarged. By comparing the base of this, or that portion occupied by the summit of the column, with that part of the structure of LECANOCRINUS (fig 1 *e*) inscribed within the circle, the analogy will be seen at once. Beyond the circle are left the five triangular plates of ICHTHYOCRINUS, with the intercalated plate occupying a narrow space between them at one point, and succeeded by the other plates as in that genus.

This analogy is the more interesting, as showing that the tripetaloid pelvis in the crinoids is a higher stage in the development, than the pentapetalous forms, and coincides with the knowledge furnished by geology upon the same point. It has been elsewhere remarked, that in the lower silurian strata, all the true crinoids have five plates in the first series, and it is only in the second period that we have recognized any with three pelvic plates. Thus far we do not know any species with three pelvic plates, so simple in the organization of its other parts, as are some of those with five plates in the pelvis. By this is meant that no species of this type has been seen, where the brachial or arm-bearing plates continue in direct line from the plates of the second series, and have simple arms and fingers, or fingers composed of a single series of plates placed in direct line one above another.

Fig. 1 *a*. An individual preserving a portion of the column. The upper part of the arms being crushed, gives it a different appearance from entire specimens.

Fig. 1 *b*. A larger specimen, showing the intercalated plates between the costal and scapular series.

Fig. 1 *c*. The opposite side of the same specimen, showing the simple structure. The specimen is slighty distorted at the base, showing the point of attachment of the column.

Fig. 1 *d*. A smaller specimen, showing the side with the intercalated plates as in fig. 1 *b*.

Fig. 1 *e*. The crown of this specimen, showing the infolded arms.

Fig. 1 *f*. The base of the same.

Fig. 1 *g*. The structure of this species, as shown in the preceding figures. The subdivisions of the arms are carried out in direct lines over the large scapular plate.

Fig. 1 *h*. A fragment of the column enlarged, with a section of the same size, showing the crenulations near the outer margin of the joints, the form of the canal, etc.

Position and locality. In the shale of the group at Lockport.

*** For description of remaining figures on Plate 45, see end of the article on Crinoidea.

591. 2. LECANOCRINUS ORNATUS (*n. sp.*).

PL. XLIV. Fig. 2 *a* – *m*.

Calyx cup-form, spreading to the commencement of the arms, above this point the sides are nearly straight; pelvis composed of three minute anchylosed plates; second range, or costal plates, having two pentagonal, one regularly hexagonal, and two unequally heptagonal; scapular plates heptagonal, succeeded by two arm-joints, upon the upper of which, or the hand-joint, commence the subdivisions which are once or twice repeated; a single quadrangular intercostal plate on one side, and above it two interscapular plates, succeeded by two others, beyond which they have not been traced; surface ornamented by minute points or tubercles, which, towards the margins of the plates, extend into striæ or ridges, meeting similar ones from the edge of the adjoining plate; column round; joints thin, unequal, alternating more or less regularly, articulating surfaces crenulated near the margin; canal at base of cup pentangular.

This neat little species is very readily distinguished from the preceding by its proportionally smaller plates, and in the wide separation of the first divisions of the arms, showing a tendency to free branching, and never having the close arrangement so constant in the other species. The arms and fingers can readily be traced to the third division, beyond which they are closely incurved, thus making at least forty divisions at the extremities of the fingers.

The upper joints of the column are thin and somewhat irregular, crenulated near the margin, and nearly smooth towards the centre; canal at this point, minute, pentangular. The inside of the pelvis is marked by a triangular impression with raised margins, the angles alternating with the divisions of the plates (figs. 2 *d*, *e*). The edges of the pelvic plates are slightly crenulated at the inner and outer margins, the intermediate space being granulated. A single fragment of a column, having some characters in common with the few joints attached to fig. 2 *b*, is shown in fig. 2 *f*; but the canal is round, though the crenulations are marginal.

Fig. 2 *a*. A small specimen of this species.

Fig. 2 *b*. A larger individual, showing same form as the preceding.

Fig. 2 *c*. Base of the anchylosed pelvic plates, with a single joint attached.

Fig. 2 *d*. The interior of the same.

Fig. 2 *e*. The same enlarged, showing more distinctly the triangular cup and the sutures of the plates.

Fig. 2 *f*. Lateral view of the same specimen.

Fig. 2 *g*. The plates separated, showing the structure of the crinoid as far as the first divisions of the arms.

Fig. 2 *h*, *i*. A costal and arm-joint enlarged, showing the character of the surface markings.

Fig. 2 *k*. A fragment of a column, composed of irregularly alternating thicker and thinner plates, which are also interrupted, or not continuous laterally, each joint being often composed of several pieces overlapping each other. The surface is ornamented in the same manner as the plates of the cup; the crenulations upon the articulating sur-

faces are near the outer edge, not quite reaching to it nor extending to the centre; canal round. The several joints attached to the specimen fig. 2 *b*, except in the form of the canal, have the same character with this fragment, which is referred to that species.

Fig. 2 *l*, *m*. The end view of this fragment, and the same enlarged, showing form of canal and crenulations of the surface.

Position and locality. This species has been found in the shale at Lockport and vicinity. Perfect specimens are extremely rare*. (*Collection of* Col. JEWETT.)

*** The fragments of crinoidal columns figured on Plate 44, will be noticed at the end of the article on Crinoidea.

592. 3. LECANOCRINUS SIMPLEX (*n. sp.*).

PL. XLVI. Fig. 2 *a* – *e*.

Body ovoid, the smaller extremity at the base; calyx composed of three minute anchylosed plates; pelvic plates elongated, three of them hexagonal and two pentagonal; four of the scapular plates equal, the fifth divided, resting lower down upon the costals, and producing an alternation in the joining at the lateral margins; arms dividing on the second joint above the scapular plate, no farther subdivisions being observable; no intercostal or interscapular plates apparent; surface marked with minute ornament; column small, the joint attached showing a faint pentagonal impression.

I have referred this species to the Genus LECANOCRINUS, from its general similarity to the other species, except in the intercalated plates, which are not visible. The only irregularity noticed is that in one of the divisions the costal plate is smaller, and is succeeded by two scapular plates, producing an alternation in the lateral union of the plates. The form of the calyx plates, the scapular and arm-joints, and the subdivisions of the arms, are all similar to the type first appearing in ICHTHYOCRINUS. The specimen figured is probably a young individual, and it is not impossible but in its more advanced stages it may present the detailed characters of the genus in the interstitial plates.

Fig. 2 *a*, *b*. The specimen, natural size and enlarged.

Fig. 2 *c*. The crown, showing the ten subdivisions of the arms closely infolded.

Fig. 2 *d*. An enlargement showing the ornamented surface of the plates.

Fig. 2 *e*. The structure of the cup, carried to the third plate beyond the divisions of the arms. The minute joint of the column attached to the base of the specimen is too obscure to afford any positive evidence in the identification of the species.

Position and locality. In the shale at Lockport.

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*An imperfect specimen was figured in the Geol. Report of the Third District, 1843, under name of CYATHOCRINUS, which was the only individual I had then seen. The two perfect specimens now figured have been obtained by Col. JEWETT.

593. 4. LECANOCRINUS CALICULUS (*n. sp.*).

PL. XLVI. Fig. 3 *a, b.*

Calyx cup-form, base concave for the insertion of the column ; pelvic plates comparatively large, not closely anchylosed ; costal plates as in the first two species, two of them heptagonal from the insertion of the intercostal plate ; scapular plates broad and spreading, with a hexagonal interscapular plate. Arms unknown ; column round.

This species is sufficiently distinguishable from any of the preceding. The cup is more spreading than in either species described, and the pelvic plates proportionally larger. The small intercostal plate is quadrangular, as in the two first described ; but the costal plates, on either side of the intercostal plate, are more regular and angular in form than in the first described species, and differ in other respects from the second. The surface of the specimen figured is too much worn to preserve any traces of marking. On the base of the pelvis, the impression of the stem shows that the joints were crenulated towards the margin, but not near the centre. The canal is pentangular, three of the angles corresponding to the divisions of the three plates, and one in the inner margin of each of the broader plates of the pelvis.

Fig. 3 *a*. The fragment described, showing intercostal and interscapular plates.
Fig. 3 *b*. Shows the structure of the specimen and arrangement of plates.

Position and locality. In the shale at Lockport.

GENUS MACROSTYLOCRINUS. (*nov. gen.*).

[Gr. μακρος, *longus*, στυλος, *stylus*, and κρινον, *lilium.*]

Pelvic plates three, costals five, large ; scapular plate, resting on the truncated upper edge of the costal, and supporting an arm-plate from which proceed a pair of arms ; a single interscapular plate between two or more of the arms, succeeded by two interbrachial plates.

This genus is more simple in the structure of the cup than LECANOCRINUS ; the costal plates supporting, in direct line, the scapular and arm-plates, making but a single alternation in the principal plates of the calyx. Since a single species only has been seen, it is impossible to know positively whether the characters of interscapular and interbrachial plates, as well as the structure of the arms, are of generic importance.

In its inception, the structure of this crinoid is similar to that of PLATYCRINUS ; but there is a prominent scapular plate interposed above the broad costal plates, which does not exist in that genus, where the arm-plates rest on the summit of the plates of the second series, which are regarded as the scapular plates, and correspond in position to the costals of this one. In the intermediate plates between the arms this crinoid is likewise similar to PLATYCRINUS, as also are the succession and subdivision of the plates of the hands and fingers, to some species of that genus.

594. 1. MACROSTYLOCRINUS ORNATUS (*n. sp.*).

PL. XLVI. Fig. 4 *a* - *g*.

Body small, composed of three pelvic plates of moderate size, succeeded by five large costal plates, three of which are heptagonal and two are hexagonal, having all truncated upper margins on which rest the scapular plates, and to which succeeds in each series a single arm-plate; a single hexagonal or heptagonal interscapular plate is interposed between the scapular plates, its lower oblique edges resting on the short oblique upper edges of the costal plates; the interscapular plate supports two small plates above it, which are succeeded by other small plates; each arm-plate supports upon its oblique upper edges a pair of arms, which diverge from each other; each arm in its lower part is formed of a single series of eight or nine plates, above which it is composed of a double series slightly interlocking with each other; surface of plates of the body tuberculo-striate, the lower ones being marked with interrupted ridges or striæ with few tubercles, while the upper ones, or the scapular, interscapular and arm-plates, are covered with minute tubercles, sometimes elongated in a direction from the centre to the upper and lateral margins; two or three of the lower simple joints of the arms are tuberculate or crenulate on the upper margins, while the upper or double series of plates of the arms are marked by distinct round or subangular tubercles along the centre.

The body of this species is very prettily ornamented by elevated striæ and tubercles, somewhat similar to the body of *Thysanocrinus liliiformis*, but more strongly, particularly in its upper portion. The arms are very long and much diverging, destitute of fimbriæ. The distinguishing feature of the arms is the simple series of plates in the lower part, with a double series above; which portion, in fragments, may be distinguished by the prominent node or tubercle upon the back of each joint, with less prominent ones upon the sides. The column of this species is entirely unknown, but it is probably round, with alternating thicker and thinner joints, the margins in some parts probably nodulose.

Fig. 4 *a*. The specimen described, showing the body and four of the arms, all broken off before reaching their termination.

Fig. 4 *b*. The structure as ascertained from the specimen 4 *a*.

Fig. 4 *c*, *d*. Two costal plates enlarged, showing their striate and tuberculo-striate character.

Fig. 4 *e*. A pelvic plate enlarged, showing a striate surface only.

Fig. 4 *f*. A plate from near the base of the arms, showing the tuberculo-crenate upper edge.

Fig. 4 *g*. Several joints from the upper part of the arms enlarged, showing the strong tubercle on the back of each plate, with smaller ones on each side.

Position and locality. In the shale at Lockport. (*Collection of* Col. JEWETT.)

Genus SACCOCRINUS (*nov. gen.*).

[Gr. σακκος, *saccus*, and κρινον, *lilium*.]

Pelvic plates three ; costal plates five, very large, succeeded by a second, third and fourth series of costal and intercostal plates ; scapular plates double or in conjunction, and the pairs separated by a wide interscapular plate ; arm-joints of each pair succeeding the scapular plates, and separated by a single small plate ; arms composed of a double series of plates, originating in pairs, from distinct arm-joints, each arm bifurcating, two, three or more times.

595. 1. SACCOCRINUS SPECIOSUS (*n. sp.*).

Pl. XLVI. Fig. 1 *a–n* ; and Fig. 2.

Body large, elongated, sac-form, gradually enlarging from the base ; pelvic plates not well ascertained ; first costals large, pentagonal or hexagonal, one or two probably heptagonal ; a second, third and fourth series of costal plates with intercostals in the two higher series, making respectively ten and fifteen plates in each one? ; second series of costal plates apparently with one or two large supernumerary plates, making six or seven plates ; scapular plates double or in pairs, placed directly over the summits of each first costal plate, and supporting a pair of arms, which, above the second or third joint, are composed of a double series of joints slightly interlocking with each other ; column round, composed of alternating larger and smaller joints, the larger ones sometimes nodulose on the margins ; surface of the body finely granulate.

It is with some difficulty that the characters of this species have been made out. Several of the plates in the centre of figure 1 *a* are much broken and mutilated : the pelvic plates are broken off. When first discovered, this individual was nearly entire, with five or six inches of the column attached, but was subsequently broken before its characters were studied. The specimen fig. 2 is certainly of the same genus, if not specifically identical, and from this one we are able to establish the fact of three pelvic plates. The two specimens, apparently, present opposite sides to view, and both are much injured in the plates of the third and fourth series, which have been restored as far as possible from the fragments remaining. There are clearly five series of plates from the base to the commencement of the scapular plates, which are arranged in pairs, giving origin to ten arm-plates ; the arm-plates of the same pair are separated by a small intercalated plate, which supports two other smaller plates, and these a second series of the same number, beyond which the structure has not been traced. These plates are between the arms of one pair ; and between the arms of different pairs there is a wider separation, produced in the first place by a wide interscapular plate, which sustains several other plates in successive series, which have not been fully traced. A large arm-joint rests on each of the scapulars, succeeded by one or two simple joints, above which the arms are composed of a double series of joints. The arms of this species divide in a very peculiar manner, necessarily quite different from the bifurcation of arms composed of a single series of plates, which divide

upon a larger pentagonal plate. In this one there is usually the introduction of a third plate between the two, then of two interstitial plates in the next series, and again two other plates in the third series, before the separation is complete. Sometimes the separation takes place at the first introduction of interstitial plates; and sometimes, instead of a single plate introduced, one of the other plates is extended laterally, to give width to the arm below the separation.

It will be observed, therefore, that the structure and mode of bifurcation of the arms and fingers are peculiar in this species, and sufficient to distinguish it from any known species of this period. The large elongated body is likewise quite characteristic, when destitute of the arms.

The column of this species is round, long and slender; consisting in its upper portion of joints of unequal thickness and diameter, those of the largest diameter being nodulose on the edges.

Fig. 1 *a*. A specimen preserving the greater part of the body, with several arms attached, which are nearly entire: the angle of bifurcation, and curving of the branches beyond, is very characteristic. The fragment of a column below is composed of parts originally belonging to the specimen, though perhaps not occupying this position in relation to the body.

Fig. 1 *b*, *c*. The bifurcation of two of the arms, showing a slight difference in the arrangement of the plates at these points.

Fig 1 *d*, *e*. Fragment and section of the column.

Fig. 1 *f*, *g*. Enlargements of the same, showing the slightly nodulose margins of the alternating joints, the crenulations towards the margin of the section, and the round canal.

Fig. 1 *h*. Another fragment of a column, showing the nodulose joints more distant from each other.

Fig. 1 *i*. Section of the same.

Fig. 1 *k*, *l*. Enlargements of the two preceding figures.

Fig. 1 *h* shows the canal to be much larger than in 1 *e*, and the striated surfaces extending to it; while in *e*, *g*, there is shown a smooth space between the margin of the canal and the commencement of the striæ.

Fig. 1 *m*, *n*. A fragment from the same column, farther from the summit, where the joints are equal and smooth; the canal is large, and the striæ extending from its margin to the circumference ptoduce a crenulated suture.

Fig. 2. The body of another specimen, probably of the same species. Several of the plates in the centre of the figure are in part restored, in accordance to what appears to have been their original form and size. The opposite side of the specimen is entirely destroyed, so that it can not be compared with fig. 1 *a*, to which it is closely allied if not identical. It is not improbable, however, that this one may be a distinct species; more particularly since it occurs in the limestone, while the other occurs in the shale below.

Position and locality. Fig. 1 was found in the central or lower part of the shale, and fig. 2 in the limestone above the shale at Lockport. (*Collection of* Col. JEWETT.)

Genus EUCALYPTOCRINUS.

Eucalyptocrinites, Goldfuss, 1826.
Hypanthocrinites, Phillips, 1839.

The Genus Eucalyptocrinites is described by Goldfuss as having no column, although in his figures the arrangement of the plates clearly indicates the existence of this part of the structure. In other respects there is no sufficient character to separate it from the Genus Hypanthocrinites, established by Prof. Phillips.

The structure of this crinoid is too peculiar to be mistaken for one moment; and it can not be supposed, from the evidence before us, that there is any ground for the foundation of a distinct genus.

596. 1. EUCALYPTOCRINUS DECORUS.

Pl. XLVII. Figs. 1, 2 *a* – *h*, 3 *a* – *d*.

Hypanthocrinites decorus. Phillips : Murchison, Sil. System, 1839, pag. 672, pl. 17, fig. 3.
— — Hall, Geol. Rep. 4th Dist. New-York, 1843, pag. 113, figs. 2 and 3.
Compare *H. cælatus*. Id. pag. 113, fig. 1; and pl. 47 *ut sup.* fig. 4 *a*.

Column round, composed of alternating thicker and thinner joints, the thicker joints wider than the thinner, with rounded edges; two or three thin joints between each two of the thick ones; articulating surfaces of the joints marked by short, simple, and deeply impressed striæ reaching from the margin nearly to the canal; canal distinctly pentapetalous, usually filled with crystalline matter; body subcylindrical or ovoid, gradually enlarging from the base upward to the commencement of the arms, from which it gradually contracts to the summit, to which the parts all converge, and are surmounted by a short proboscis. Pelvis composed of five hexagonal plates, succeeded in a direct line by the same number of quadrangular costal plates and pentagonal scapular plates; each scapular plate supporting upon its oblique upper sides, a pair of arm-joints; arm-joints ten, pentagonal or hexagonal, each supporting a quadrangular hand-joint, which again supports a pair of fingers; fingers in the lower part composed of a single series of plates, but becoming divided above the fifth or sixth plate, and consisting of a double series of alternating joints; fingers tentaculated; tentacula usually anchylosed with the joints of the fingers and among themselves, forming altogether a solid thin cuneiform plate reaching to the alimentary canal in the centre.

In addition to this structure, there are five large intercostal plates having a cuneate base, and resting upon the oblique upper edges of each two adjoining pelvic plates, separating the costal and scapular plates, and having a short side of one arm-plate of each pair resting on its sloping upper edges; its two upper short sides support a pair of narrow elongated pentagonal plates, which are placed in conjunction on their longest sides, separating the pairs of arms and fingers at their base; the union of these plates leaves, at their upper extremity, an angular depression, from which proceeds an elongated solid plate or rib reaching to the summit, separating the

fingers throughout. In like manner the arms of each pair are separated at their base by an elongated subconical plate, having usually two short sloping sides below, resting upon the upper sloping sides of the two arm-plates of each pair (sometimes, or perhaps in each individual, one or two of these plates are truncated at base, and rest upon a short truncated upper edge of the scapular plate, separating entirely, the arm-plates (see fig. 2 *a*)), and separating the hands and fingers of the same pair; these plates support, on their upper side, an elongated rib similar to that between the pairs of arms, which likewise reaches to the summit, and, together with the five other similar ribs, supporting the ten plates or tubercles at the base of the proboscis; proboscis short, depressed conical, composed near the base of ten rows of hexagonal plates; surface of the plates of the body, and sometimes of the arms and fingers, ornamented by oval or elongated tubercles, of unequal size, and, in the larger plates, frequently radiating from the centre.

This beautiful and interesting species presents considerable variety of appearance, from some of which perhaps distinct species may be constituted. After examining a larger number of specimens, however, I have doubted the propriety of making such a separation, for all the varieties, at present. The principal forms observed are represented on Plate 47; fig. 1 presenting the upper part much contracted and conical, while in fig. 2 it is proportionally shorter and broader : the plates in these two are but slightly ornamented. In the specimens fig. 3, the upper part is much elongated, but continues very full and round nearly to the summit, where it contracts more abruptly. In fig. 4 the surface is highly ornate, and the markings continuing on the surface of the fingers and the intervening ribs; while fig. 5 presents an equally ornamented surface, but of less conspicuous and somewhat different character. The two last are most conspicuously different, and will follow the descriptions of the preceding figures.

Regarding, according to the description, the direct series of plates from the base upward as constituting the pelvic, costal and scapular plates, the last supporting a pair of arm-plates, we have a structure differing in a very prominent feature from any crinoid of a pentapetalous base known to me. This difference consists in having the basal plates supporting, in direct line, the succeeding plates to the base of the arms. I have examined numerous specimens, without being able to find any evidence of a series of plates lower than those termed *pelvic;* and the form of these being straight across the base, and curving around to the form of the column, to which they distinctly adhere, seems to preclude the possibility of finding other plates below these. To avoid admitting this anomaly, we are compelled to consider as costal plates those termed in the description of Prof. PHILLIPS, as *intercostal;* and the plates there termed *costal*, as intercostal plates; regarding the scapulars as alternating with the costal plates, and resting upon their sloping edges. This gives to the most conspicuous plates of the second series the place of costals, while the smaller are regarded as intercostals; and this view is in accordance with the structure of the greater number of species, so far as regards the first two series of plates. Should we ever be able to discover a series of plates below those given, even if not extending to the outer margin, we may regard the series as described, with the exception that what are now termed *pelvic* will be regarded as costal plates.

In the description of the fingers and tentacula, it was remarked that they appear to be anchylosed together, and the same is often true of the joints of the fingers themselves. In a single weathered fragment, I have been able to discover more fully the articulation of the tentacula to the joints of the fingers, and even the joints of the tentacula themselves. The latter are quadrangular, oblong, their length being twice or thrice their vertical extent or thickness; there are about twenty joints in each tentaculum near the base, and six or seven near the summit; they are closely arranged, and, in freshly broken specimens, anchylosed so firmly that the surface presents the appearance of a solid striated plate as in fig. 3 *d*, the striæ indicating the direction of the tentacula.

It has been remarked that the elongated subconical plate between the arms of each pair is sometimes truncated below, by resting on the scapular plate : this character is variable, and sometimes it occurs in one, two, or three plates of an individual; it can not, therefore, be relied upon for indicating a specific distinction.

Fig. 1. An individual with lower portion of the cup broken off; the upper part, from the commencement of the arms, having a conical form surmounted by the short proboscis.

Fig. 2 *a*. An individual retaining a portion of the column, and having the summit somewhat spreading, probably from compression. One or two of the lower ranges of plates of the proboscis are still preserved; the upper part being broken off, shows the opening into the alimentary canal. The entire specimen is somewhat compressed, and adheres to a slab of shale. The exposed face shows two of the subconical plates, between the arms of the same pair, truncated at base.

Fig. 2 *b*. A young specimen having the same characters as the preceding.

Fig. 2 *c*. The structure of the species as shown in the preceding and other specimens. The large ten-sided plate is marked F, as a costal plate; while the smaller plate, directly above the pelvic plate, is marked G, as an intercostal plate* (see description and remarks).

Fig. 2 *d*. A fragment of one of the fingers, showing the articulation of the tentacula, and their direction inward and upward.

Fig. 2 *e*. A fragment of a column, showing the alternating larger and smaller joints.

Fig. 2 *f*. Transverse section, showing the pentapetalous canal. The fragment figured is worn, and does not show the deep striæ.

Fig. 2 *g*. A fragment from the column of 2 *b* enlarged.

Fig. 2 *h*. A fragment of a very minute column.

Fig. 3. *Those with ovoid forms, or rounded summits.*

Fig. 3 *a*. Vertical view of a fragment, looking upon the summit, showing the convergence of the fingers, and the union of the interstitial ribs around the canal, which penetrates thence to the cavity below. The proboscis is broken off.

* There are some errors in the arrangement of the letters in the higher plates, which may be corrected thus: The letters K and M are affixed to the two pairs of arm-plates, each of which should be marked K. The plates marked N should be marked M, and N affixed to the succeeding portion, implying the fingers which at the summit are indicated by the letters *c*, *c*.

Fig. 3 *b*. Lateral view of the preceding specimen, which is broken off near the base of the arms.

Fig. 3 *c*. View from below, showing a portion of the cavity; the sides arching over, and contracting to the angular canal which extends to the summit. The interior of this cavity is formed by the expansion of the solid ribs between the fingers, which unite, lining the entire upper part of the cavity; beyond which, their inner edges, uniting just before reaching the centre, produce the angular canal which reaches from the cavity to the summit. By this union of the interior edges of these ribs, it will be perceived that the tentacula are confined within solid walls, and become (as before remarked) anchylosed, forming, with the ribs, essentially a solid mass penetrated only by the narrow canal.

It should be observed that this specimen is somewhat compressed, and in consequence the form of the canal is distorted.

Fig. 3 *d*. Another specimen, showing a longitudinal section of the upper part, and a portion of the cavity below. The centre is marked by the angular canal formed by the junction of the ribs, as just described. On the outer margins are the joints of the fingers, with the tentacula attached, all converging inward and upward to the walls of the central canal.

This specimen, with the preceding, when taken in connexion with the other figures where the base is preserved, give a very clear idea of the structure of this peculiar crinoid.

Position and locality. In the shale of the Niagara group at Lockport, Rochester and Marshall's mill in Sweden, Monroe county, New-York; and in several localities in Kentucky and Tennessee. (*State Collection.*)

597. 2. EUCALYPTOCRINUS CÆLATUS.

Pl. XLVII. Fig. 4 *a* – *e*.

Hypanthocrinites cælatus. Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 113, fig. 1.

This species was separated from the preceding, on account of the sculptured surface of the hand and finger-joints, as well as the surface of the interstitial ribs. The plates below are also much more strongly tuberculated than any other specimen observed. This character is the principal external one, by which it differs from the specimens before described. In measuring the extension of the finger-joints towards the centre, they are found to be proportionally much longer than in either of the specimens fig. 2 *d* and 3*d*, which furnishes an additional character on which to found a separation. For these reasons, I have allowed the species to remain as published, until an opportunity offers for a comparison with other specimens.

Fig. 4 *a*. The specimen, somewhat broken in the upper part.

Fig. 4 *b*. The surface of one of the interstitial ribs, enlarged.

Fig. 4 *c*. Several joints of the fingers enlarged and separated, showing their deep interlocking with each other near the base, and the character of their surface marking.

Fig. 4 *d*. A scapular plate enlarged, showing the elongated tubercular ornament.

Fig. 4 *e*. The large costal or intercostal plate enlarged, and showing the peculiar arrangement of the tubercles upon its surface.

Position and locality. This specimen was found in the same position, and associated with the preceding species at Lockport.

598. 2. EUCALYPTOCRINUS PAPULOSUS (*n. sp.*).

PL. XLVII. Fig. 5 *a, b*.

Compare *Eucalyptocrinus decorus*, ut supra.

The structure of the fragment figured shows no deviation from *E. decorus*, and is probably only a variety of that species, having some peculiarity in its external characters or surface ornament.

Fig. 5 *a*. A fragment of the cup, having the base and arms broken off. It presents some peculiarities in its surface markings; many of the plates having rows of granules or minute tubercles arranged along their margins, and parallel to the same. There are also round or oval depressions with raised margins, many of them penetrating the plates. These depressions, or pore-like orifices, are indiscriminately scattered over the surface, sometimes near the junction of the plates, or in the line of separation, and sometimes at a distance from the margins. The irregularity of their arrangement induces hesitation in regarding them as pores communicating with the interior.

Fig. 5 *b*. Several of these plates enlarged, showing more distinctly the arrangement of tubercles and pore-like openings mentioned above. The form of this cup is more spreading from the base upwards, than any specimen that has fallen under my observation.

Position and locality. This fragment was found in the Niagara shale at Marshall's mill, in the town of Sweden, Monroe county.

In a paper recently read before the American Association for the Advancement of Science, giving a list of the FOSSIL CRINOIDS of Tennessee, by Prof. TROOST of Nashville, ten species are given under the Genus EUCALYPTOCRINITES, viz. *E. splendidus*, *ovalis*, *extensus*, *lævis*, *phillippsii*, *goldfussii*, *nashvillæ*, *conicus*, *tennessseæ*, and *gibbosus*. It seems to me very probable, from the names of some of these, that specimens which I have regarded only as varieties are given the rank of species. It is certainly very remarkable that so large a number of species of a genus having the singular structure of EUCALYPTOCRINUS should be found in one region. The entire list, however, shows a most remarkable development of this family within the limits of Tennessee. Unfortunately the geological position of these fossils is not given, and we can only infer that they are from the strata embraced between the base of the Silurian and the upper part of the Carboniferous systems inclusive.

Genus STEPHANOCRINUS (Conrad).

The following is Mr. Conrad's description of this genus:

"This singular fossil may be described as having five sides, each of which is depressed and "angulated, the angles profoundly carinated; three of the sides with an oblique carina; three "longitudinal articulations only visible; ambulacra on the upper surface, and five in number; "from the margin proceed five elevated, angular, spiniform processes; pelvis or base trian- "gular, with a cavity where the column unites with it; canal probably pentangular, and very "small."

This description alone does not convey a very accurate idea of the structure of this very remarkable crinoid, which may be characterized as follows:

Column round, with a round canal; base triangular, composed of three pelvic plates, succeeded by five costal plates, on the upper sloping edges of which rest in alternation five scapular plates, which are extended above into angular spiniform processes; the upper margins of the costal plates are excavated in the middle, and on their inner margin support a small semicircular plate; each of these little plates supports two narrow elongated plates or ribs, all converging towards the centre, and sustaining in part the five pentagonal plates of the proboscis or aperture; these five pentagonal plates have their bases resting, in the centre, upon the inner narrow side of the spiniform terminating plate of the outer series, while the sloping basal margins rest upon the elongated ribs before mentioned; on one side of the centre, and on the inner face of one of the spiniform plates, is an ovarian(?) aperture, protected by five elevated triangular plates.

This structure, in all its essential particulars, exists in two very distinct species which have been examined. A structure not very dissimilar exists in some of the so called Pentremites from the Carboniferous limestone*.

599. 1. STEPHANOCRINUS ANGULATUS.

Pl. XLVIII. Fig. 1 *a* – *m*.

Stephanocrinus angulatus. Conrad, Jour. Acad. Nat. Science, Vol. viii, pag. 279, pl. 15, fig. 18.

Column round, composed of thick equal joints which are rounded on the exterior margins, articulating surfaces crenulated near the outer margin; canal minute, round; form of the body reverse-pyramidal, spreading more or less gradually from the base upwards; sutures between the plates scarcely visible; base triangular, depressed towards the centre, which is occupied by the minute round column; pelvic plates three, equal at the base, one of them pentagonal the other two heptagonal, the vertical sides being equal, the pentagonal plate two-sided, and the other two each four-sided above; the width of the hepatagonal plates on the upper margin

* The Genus Pentremites, in its usual signification, includes fossils of at least three distinct genera.

nearly twice as great as the pentagonal plate, and having the form as of two anchylosed pentagonal plates; costal plates five, hexagonal, with a short excavated upper side. On the oblique upper edges of the costal plates, and alternating with them, rest five plates having two short sides below, and, contracting above this point, are extended into elongated, diverging, spine-like processes, giving the coronated appearance to the fossil. The summit, when perfect, shows a semicircular plate resting upon the upper and inner edge of each costal plate, and supporting on its indented inner face two linear elongated plates, which support the short sloping sides of two adjoining plates of the proboscis, the centre of each resting on the extension of the coronal plate; proboscis composed of five pentagonal plates, supported as just described, and forming by their lateral junction a minute conical elevation. On the inner sloping face of one of the coronal plates, near the centre, is a similar smaller elevation produced by five small plates, surrounding and protecting a circular aperture communicating with the cavity below. The surface is often finely tuberculated, or more frequently marked by elevated tuberculated striæ, which are transverse, vertical, or oblique in their direction on different parts of the same fossil, as shown in several figures.

In addition to the surface marking which is indicated above, the ridges or carinæ are peculiar and characteristic. The base is distinctly triangular as shown in fig. 1 *g*; the bases of the three plates being equal, the angle in the centre of each. On the pentagonal plate, two carinæ diverge from the base, extending upwards to the two short sides; and on the other two plates, three carinæ diverge in like manner, two going to the outer upper margins, and the central stronger one to the angular depression in the centre of the upper side of the plate. These two stronger carinæ continue in direct line to the summits of the succeeding costal plates; the six smaller carinæ, being two on each plate, converge on the adjacent pelvic plates, and, continuing in the same direction, meet at the summits of the costal plates succeeding. This gives two of the costal plates marked by a strong vertical carina, and three marked by slightly smaller carinæ converging from the two basal margins to the centre of the upper margin.

This very singular crinoid is readily recognized, even by small fragments, from the peculiar form and surface character. Although preserved in the same dark shale, it is always of a lighter color than the other crinoids, and usually crystalline throughout. The peculiar angular character of the body, with strongly carinated plates surmounted by the coronal processes, renders the species very conspicuous. They are rarely found with any portion of the column attached, and ordinarily the sutures of the plates are so closely united that it is difficult to ascertain the structure. Still more difficult is it to ascertain the structure and arrangement of the plates in the crown, since they are very frequently concealed, or more or less broken and absent.

After an examination of more than fifty specimens, I have given the structure and arrangement of parts as far as they have been actually seen. There may be a suture down the centre of the heptagonal pelvic plates, which would make five in that series; but it will be perceived that if such a character do exist, we ought not to find the central carinæ on these plates coalesced in one. It is possible that the plates of the third series, forming the coronal processes, may be formed of two plates closely anchylosed; but of this I have no positive

evidence. It is also possible that what appears to be a minute single semicircular plate, on the upper excavated edge of the costal plate, may be composed of three smaller plates. These parts are very minute, and almost always much obscured or dilapidated, and I have given therefore only what has been actually seen. Until recently, this fossil has been one of the most rare species; but some fortunate discoveries have shown, that in certain thin layers, it is quite numerous, having no great vertical range, and probably restricted in its geographical extent. It is extremely rare to find specimens with the coronal processes still attached entire; and it is only by carefully separating those found imbedded in shale, that they are obtained in perfection.

Fig. 1 *a*. A specimen of the ordinary form and proportions, having a part of the column attached.

Fig. 1 *b*. A specimen more elongated, and somewhat flattened.

Fig. 1 *c*. A small specimen with very prominent carinæ.

Fig. 1 *d*. A similar larger specimen, with the body somewhat rotund and the carinæ very strong. The coronal processes are broken off, in this and the preceding specimen.

Fig. 1 *e*. Three of the costal plates arranged laterally, showing the single and two converging carinæ, and the succeeding coronal plates.

Fig. 1 *f*. The lefthand side of one of the heptagonal pelvic plates, above which the costal plates divide, showing one of the carinæ extending from the base obliquely to the summit.

Fig. 1 *g*. The base of a specimen, showing the three divisions, and the depression for the attachment of the column.

Fig. 1 *h*. Figure showing the form and arrangement of plates of the body.

Fig. 1 *i*. The crown, as it usually appears when destitute of the plates, diverging from and supporting the central proboscis.

Fig. 1 *k*. The crown, preserving the plates as described above.

Fig. 1 *l*. An enlarged figure, showing the structure and arrangement of the plates forming the summit. F is the summit of the costal plates, slightly bent inward, and sustaining the succeeding small plate, from which two narrow elongated plates proceed to the central proboscis. H, the plates holding the place of scapulars, and forming the elongated coronal plates, which, on their inner truncated angles, support the five plates of the proboscis. On the lower plate of this series, as the figure is arranged, and near its inner angle, is the small elevation composed of five minute plates, and surrounding an aperture opening into the cavity below.

Fig. 1 *m*. A transverse section at the base of the costal plates, showing the subdivisions of the plates, and the projecting angles of the carinæ.

Position and locality. In the Niagara shale at Lockport. The specimens, usually destitute of a column and of the coronal processes, are often found at the base of the cliff, washed out by rains from the decomposing shale. (*State Collection.*)

600. 2. STEPHANOCRINUS GEMMIFORMIS (*n. sp.*).

PL. XLVIII. Fig. 2 *a-i.*

Column round, composed of joints of equal thickness; canal round, minute, articulating surfaces of joints minutely crenulated or denticulated near the outer margin; body triangular at base, rapidly enlarging above, and becoming rotund in the middle and slightly contracted near the summit; structure as in the preceding; pelvic plates three, short, angular below, and becoming curved above; costal plates five, succeeded by an equal number of plates forming the spiniform processes around the summit; upper margins of the costal plates scarcely depressed or excavated; structure of the summit precisely as in the preceding species; surface granular.

This species is usually minute, the largest entire specimen seen being figured in 2 *a*, *b*. It is clearly distinct from the preceding, not only in size and form, but in surface markings. The plates have no carinæ upon their surfaces; and though the form is more sharply triangular at the base, it nevertheless expands rapidly, and becomes rotund above. At the base of the third range of plates, the fossil is slightly contracted; which contrasts strongly with the preceding species, which has its greatest breadth at this point. The coronal processes are slightly converging, while in the other they are diverging. There is otherwise no appreciable difference in the structure. In one or two specimens, the structure of the crown has been distinctly observed. In all its parts there is the most perfect similarity of structure, with slight differences in the proportions.

A single fragment has been found, where the base indicates that the entire individual was twice or thrice as large as the largest one figured.

Fig. 2 *a*. An individual somewhat larger than the ordinary size. The position in which it is figured, shows the pentagonal pelvic plate, and the short sloping sides of the adjoining plates.

Fig. 2 *b*. A specimen with a few joints of the column attached.

Fig. 2 *c*. The crown of an individual, as it is usually seen.

Fig. 2 *d*, *e*. The base of one of these, and the same enlarged, showing the rapidly expanding form which becomes nearly round or very obtusely pentagonal at the centre.

Fig. 2 *f*. The structure of this species as shown from fig. 2 *a*.

Fig. 2 *g*. A small specimen, where the base is much drawn out, and quite triangular.

Fig. 2 *h*. The same enlarged, showing more distinctly the form and proportions.

Fig. 2 *i*. A portion of the surface enlarged, showing the character of the ornament.

Position and locality. In the shale at Lockport. Usually found at the base of the cliff, washed out by the rains. (*State Collection.*)

Genus CARYOCRINUS (Say).

"*Column* cylindrical, perforated by a tubular alimentary canal : *pelvis* formed of four plates ; "costals six, supporting the scapulæ, from which the arms proceed.

"In Miller's arrangement, this genus will occupy a station in the division *Inarticulata*, "between the Genera Cyathocrinites and Actinocrinites. It may be indicated by the fol- "lowing formula :

A. Pelvis of four plates.
A. Costal plates six.
a. Column not diladed.
o. Alimentary canal.
§. Articulating surface of the columnar joints, radiated.
†. Auxiliary side-arms cylindrical, and placed irregularly. *Genus* Caryocrinites.

1. Two of the costals hexagonal. 1*st Sp. ornatus.*
2. One of the costals hexagonal. 2*nd Sp. loricatus.*"

601. 1. CARYOCRINUS ORNATUS.

Pl. XLIX. Fig. 1 *a* – *z* ; and Pl. XLIX A. Fig. 1 *a* – *d*.

Caryocrinites ornatus. Say, Jour. Acad Nat. Science, Vol. iv, p. 289, 1825.
C. *loricatus*. Id.
C. *ornatus*. London Zoological Journal, October 1825, p. 291.
— — Blainville, Man. d'Actinologie, pag. 263, pl. 29, fig. 5, 1843.
— — Castelnau, Essai sur le Systeme Silurien de l'Amerique septentrionale, pl. 25, fig. 2, 1843.
— — Hall, Rep. 4th Geol. Dist. N. York, pag. 111, fig. 1 & 2, & p. 112, 1843.

Column round, composed near the body of larger and smaller joints alternating with each other ; edges of the joints thin and sharp, sometimes slightly crenulated or denticulated ; articulating surfaces having the striæ extending from the margin half way to the centre ; canal round. Body ovoid or more or less subglobose, the greatest diameter being usually below the middle ; summit slightly convex, and surrounded by a corona of arms and fingers, varying in number, and extending to the length of several inches ; body composed of three series of plates ; pelvic or basal plates four, two of them pentagonal and two hexagonal ; costal plates six, large, forming more than half the height of the body, two of these are pentagonal, two are hexagonal, and the other two heptagonal ; scapular plates six, alternating with the costal plates ; interscapular plates two, resting on the truncated upper sides of the heptagonal costal plates ; the upper edges of the scapular and interscapular plates are interrupted and made irregular upon their upper margins by the arms, the lower joints of which rest on their indented edges. The summit presents the appearance of a depressed arch or dome, composed of numerous plates

resting partly upon the upper edges of the scapulars and partly upon the base of the arms, having on one side a mouth composed of six small triangular plates forming a little conical elevation; arms thirteen (the number sometimes variable), composed, from near the base upwards, of a double series of slightly interlocking joints, which are sharply tuberculated on their surface and intermediately granular, a kind of foliaceous tentaculum attached to their inner margins; tentacula with numerous oblique joints, which are narrow at their bases, and gradually expand on each side of a central line or midrib; surface of the plates of the body marked by striæ or rows of granules parallel to their edges, sometimes by tubercles irregularly arranged and more or less abundant; all the plates to the centre of the scapular plates marked by single or double rows of pores, which proceed from the base of the pelvic plates to the prominent upper angles, and from the basal angles of the costal plates to their centre, whence they radiate to each of the upper angles of the same plate, meeting corresponding rows from the centre of the scapular and interscapular plates. These pores communicate with the interior, and, though not always conspicuous, are present in some degree of development in every individual. The plates of the summit partake of the same variable character in their surface markings, as those of the body below.

This very interesting crinoid combines within itself, in its numerous phases, the elements of many interesting developments, which become important characteristics in other forms of this class of animals.

M. Von Buch has given a very elaborate account of this species; and it is quite evident that he has examined numerous specimens, to have seen all the phases which he describes: nevertheless there are some points in which our specimens present characters either not observed by him, or not described as we understand them*.

It will be seen from the date of Say's description, that this species has been a long time known, and for many years it was almost the only crinoid well ascertained in this country. The immense numbers which were found at Lockport, about the time Mr. Say described this species, placed it within the reach of every one, and they were to be seen in every collection†.

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*M. Von Buch gives the author credit for having given (Geol. Rep. 4th District) the best figures of this fossil yet published, though without a description; and yet he says that many parts have been misunderstood, or inaccurately represented! It will be perceived that the present description does not, in some particulars, correspond with that of M. Von Buch, though it does with numerous specimens in the author's collection. By comparing the two, it will be observed that some points have escaped the attention of this very careful observer himself; and if the specimens figured in the Geological Report are compared with the figures there given, no great inaccuracies will be found in any parts represented. The smaller specimen there given is remarkable for the irregularity in the pores of the costal plates, and the occurrence of interrupted double rows from the centre obliquely to the basal angles. At the time when the figures of the interior of the costal plates were given (Tables of Organic Remains No. 19, figs. 5, 6 and 7 at the end of volume cited), showing the distribution of these pores, and their connexion with the internal structure of the animal, as now described, the author supposed they could be understood without the aid of a description.

† This period was at the time of the excavation for the Erie Canal, when these crinoids were found in immense numbers at Lockport, from which place Mr. Say's specimens were obtained. Many hundreds, and probably thousands of individuals, were obtained at that time; and one gentleman informed me, that at one time, he had half a bushel of them. In all the specimens which I have seen, collected at that period, not one possesses the fragment of a

It is only in a comparatively small number of specimens, that the details of the beautiful structure are clearly shown.

The pelvic plates are four as described, two of them pentagonal and the other two hexagonal, the vertical sides being equal in all. The upper side of the hexagonal plates is nearly straight, or slightly concave; and they have the form and surface characters of two plates, like the pentagonal ones, joined together at their lateral margins. The upper margin between the prominent angles, instead of presenting sloping sides, to a central retiring angle, is extended in a nearly straight or slightly concave line.

This feature is more conspicuous when we examine the pores, which extend in double rows from the base of the pelvic plates to the prominent angles of each one, the larger plates having two of these double rows of pores. The six costal plates consist of three pairs of similar form; two of these pairs alternating, and one having their bases opposite, giving, with the basal plates, a beautiful symmetry of form to this part of the body. Rarely, there is some deviation in the form of one or more of the costal plates; but this is usually at the summit of the plate, scarcely affecting the form below that point. The scapular plates, with rare exceptions, are triangular below, having two sloping sides resting on the upper sloping edges of the costal plates: their lateral margins are nearly vertical, which is likewise true of the interscapular plates, which have a straight base. The upper margins of all these are more or less irregular, from the insertion of the plates around the base of the arms; they are usually, however, two-sided on the upper margin, sometimes three-sided, and sometimes truncated. The summit is composed of an unequal number of plates, the central one being largest, heptagonal, and surrounded on six of its longer sides by the same number of large plates; while the short seventh side adjoins a smaller plate, which sustains, in part, the plates of the mouth, which organ is always near the margin of the summit.

If a line be traced from the base through the division between the larger pelvic plates, passing through the centre of one of the hexagonal costal plates, and thence to the summit, it leaves the mouth a little to the right, as regards the observer, or, in reference to the animal, a little on the left side of this line*.

There is a wider separation of the arms at the point where the mouth occurs, and in consequence a slight depression producing a flattening upon that side; while on the side directly opposite, the bases of the arms are more prominent. This gives a kind of triangular form to the summit, the mouth being placed in the centre of the base; and a line drawn, as before mentioned, through or near the mouth and the apex of this triangle, will divide the fossil in two equal portions, the component parts of each having the same form and relative position. This bilateral arrangement of the parts is very conspicuous in many well preserved specimens.

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column or an arm. The recent excavations for the enlargement of the Erie Canal, though much less in extent, have enabled us to procure more perfect specimens of this crinoid, and greatly to extend the list of genera and species of this family.

* M. Von Buch says the mouth is directly in this line; but in more than one hundred specimens examined, it is not so, but more nearly over the centre of the next scapular plate. The difference, however, is of small importance, but shows conclusively that this organ is always nearly in the line dividing the animal into two equal parts.

The greatest diameter is in the direction of the two parts, and the shortest diameter is in the direction of the line separating the two halves. This is shown not only by measuring across the summit of the fossil, but through the centre of the costal plates. In specimens which are compressed or distorted, these proportions may not be preserved; but in all well preserved specimens it is a prominent feature.

The arms vary in number, but in full grown specimens there are thirteen: in several smaller specimens, I have counted only nine; and in a very young specimen, there are not more than three or four; while in several somewhat larger, there are six. It is evident that the number depends in some degree upon the age of the individual; and in two or three very large specimens, there remain the bases of fourteen arms. These arms appear to be composed, from their base upwards, of a double series of joints; at the base, semicircular, and scarcely interlocking; while in the middle and upper part, the plates are more extended laterally, and there appears to be a thin extension or lamina from the middle of the uniting face on each side, penetrating between every two of the adjoining plates, and strongly interlacing the whole series throughout. The surface is finely granulated with stronger sharp tubercles. The tentacula are sharply grooved along the centre, or apparently composed of a double series of joints alternating with each other.

The most conspicuous and interesting feature of the surface, exists in the ambulacral pores which penetrate the plates. In the very young specimens, these pores are sparsely scattered over the surface of the costal plates, scarcely taking any definite direction, and are barely visible on the lower plates: in the farther advanced stage, they have assumed the direction so conspicuous in the full grown individual*. Beginning at the base, we find there are six conspicuous double rows of pores, extending from the base to the highest angles of the pelvic plates; being a single row on each of the pentagonal, and two on each of the hexagonal plates. In looking at the structure, it will be perceived that these angles meet the intersection of each two of the costal plates; and these double rows of pores are continued, as it were diverging one into each of two adjoining costals at their outer basal angles, and extending in single rows to the centre of the plate. In addition to these, there is usually an interrupted row of pores on one or both margins of the pelvic plates, along their line of junction; and these are continued, sometimes as a single and sometimes as a double row, from the angle at the base of the hexagonal and heptagonal costal plates, to the centre. Sometimes there is a scattered row of pores from the centre of the base of the pentagonal costal, extending to the centre; and sometimes there is an interrupted double row of pores, instead of the usual single row, extending from the centre to the outer basal angles of the other costal plates. In many instances these pores are obsolete in part; and where a double row exists in place of what is usually a single one, a portion of the whole are obsolete. On the upper part of the costal plates, these pores become more numerously and perfectly developed. To each of the higher angles of these costal plates, which meet the

* The appearance of being scattered arises in part from the small number present, there being often only one and sometimes none, in a line from the centre to the angles of the costal plate. At this period of growth, also, there are pores between the centre and lateral margins of these plates, which become obsolete in the more advanced stages.

junction of the plates above them, there extends from the centre a double row of pores; and to each of the lower angles, meeting the lower angles of the scapular plates, there is a single row of pores directed. The double rows of pores on the costals diverge, as it were, into two single rows, extending from the lower lateral angles of the scapular plates to the centre; while the single rows of two adjoining costal plates unite in a double row upon the angle at the base of the scapular plate, and extend to the centre. This very symmetrical marking gives a beautiful appearance to the surface of this crinoid, the ornament appearing as if arranged in fanciful festoons from the centre of the scapular plates to the angles and the centres of all the plates below.

In addition to the regularly arranged rows of pores, there are usually a few others near the lateral margins of the costal plates, either arranged in lines parallel to the edges, or irregularly scattered near that part of the plate. The uses of these in this place will be seen when we trace the communication of the pores to the interior.

These pores are, as described, usually minute, circular openings, being either simple perforations through the plates, or having a raised border, which sometimes forms a little papulous elevation, having the pore at the summit. In addition to this character of the pores, there is another very remarkable structure observable in some of them: instead of a simple pore, we observe two, three, four, five, six or more, decreasing in size as the number increases; sometimes there is a single one in the centre and others arranged around it, the whole penetrating what appears like a porous or spongy tubercle upon the surface of the plate. In many well preserved specimens these pores appear like minute vesicles, scarcely perforated at their summits, and having about the same size as the granules covering the surface of the plates between the rows of pores. This character is more conspicuous in the scapular plates, where it almost always exists to some extent. In the pelvic plates it is likewise very frequently present, and is not unfrequently observed on the costal plates*. This characteristic is more fully developed in older specimens; but in very young specimens, I have found the pores on the scapular and pelvic plates with double and triple perforations; and in one specimen not larger than a small pea, the pores of the scapular plates, though only three or four in each one, are some of them elongated, and others with a double perforation. In the larger and older specimens, the rows of vesicular tubercles marking the single rows of pores have continued to enlarge till they have coalesced, forming a vesicular ridge; and the double rows down the middle of the plate, form a broad flattened ridge with a slight depression along the centre.

Connected with the rows of pores, particularly on the costal plates, and often on the other plates also, there is another characteristic feature which has been described by M. Von Buch, who, after speaking of the arrangement of the rows of pores, and other surface ornament, says: "Such is the decoration of the external surface of the Caryocrinus in the young and mature "state; but with age, it exhibits a remarkable change. Along each row of pores there arise

* I am aware that M. Von Buch says that these vesicles do not exist on the lateral or costal plates; but I have in my possession many specimens in different stages of growth, where this characteristic is conspicuous, more particularly in the isolated lines or irregularly scattered pores near the lateral margins, and also in the rows diverging from the centre.

" small oblong vesicles resembling the pores, but never piercing through and reaching the " inner surface of the plate. These vesicles gradually lengthen, and at last unite into an elevated " ridge, occurring between the rows of pores where they are double; but, where the row is " single, below it on the upper half of the plate, and above it on the lower half — another " very singular instance of symmetry of arrangement in this part."

I believe I shall be able to show that this symmetry in the arrangement of these ridges with reference to the rows of pores on the exterior surface, has likewise some connection with the internal arrangement of the pores, and the organs connected therewith. I should first observe, however, that it is not always with age that this change takes place; for some of the specimens exhibiting these radiating ridges most strongly, are below the medium size; while the largest specimens I have seen, though exhibiting in other respects every mark of age, are quite free from such ridges. It has been already remarked, that these pores communicate with the internal organization of the animal; which is shown on the examination of the inner surface of the plates, individually or collectively. The rows of pores are found penetrating the plate, from the openings on the inside of which proceed minute but very distinct grooves, extending to the edge of the plate : these grooves are margined by a thin elevated border, giving sometimes almost the appearance of a semicylindrical tube, proceeding from the pores to the margin of the plate, in relation to which they are always vertical. At the junction of the plates, these little grooves meet others coming from the opposite plate, which, being likewise vertical to the margin of the same, meet the adjoining ones in a continuous line, and we have a fascicle of grooves with parallel interspaces. In the living animal, the pores undoubtedly offered the means of protruding some organ necessary to the vitality and growth of its body. These filaments, or organs, of whatever nature, passed along the little groove extending to the margin of the plate, there meeting similar organs from the pores and grooves of the adjoining plate. As one plate became extended, the adjoining one was necessarily extended in a corresponding degree; a new pore was added on each plate exterior to those already existing, and another filament or fleshy tentaculum protruded from each. In this way nearly the whole interior of the animal, from the base to the centre of the pelvic plates, was covered with fascicles of filaments extending across the joining edges of the plates, connecting them together, and undoubtedly acting an important part in their formation and extension. Now when we examine the ridges which exist between the double rows of pores on the exterior, and those above the single rows on the lower half of the plate, and below the single rows on the upper half of the plate, we find this symmetrical arrangement having relation to the direction of the little grooves proceeding from the pores on the inner side of the plate. In all cases the external ridge has a corresponding one on the interior; and there is *always* an internal one, though none be visible externally. On the inner side of the plate, it will be found that where there is a double row of pores, that one row is directed, in the little groove, to the margin of the plate on the right; while the other goes to the left, leaving the ridge in the centre. Then, again, all the tentacular filaments from the single rows of pores on the upper half of the plate are directed to the upper margins of the plate, leaving a ridge below their inner opening, as well as one below

the apertures on the exterior surface ; and again on the lower half of the plate, the tentacular grooves are directed to the lower margins of the plate, leaving the ridge above them corresponding to the external ridge above the rows of pores on the lower half of the plate. This arrangement of the pores often leaves a large portion of the interior of the plate, across the centre, free from these tentacular grooves ; and it becomes much thickened, sometimes in distinct ridges, and in other instances the ridges uniting form a thick callosity across the middle of the plate. This character is very well shown in the plates, figs. 1 *s*, 1 *t*, and 1 *t*+.

It should not be forgotten, however, that there are in most instances interrupted rows of pores, or a few scattered ones, along the lateral margins of the costal plates, which, like the others, penetrate to the interior. The tentacular grooves extending from these pores reach to the lateral edges of the plate, meeting other similar grooves from the opposite side. In all the examples of the interior surface of plates, the spaces not occupied by pores, or the grooves extending therefrom, are filled by thickened ridges or callosities, which may or may not have corresponding ridges or tubercles upon the exterior surface. The arrangement of these pores, and the tentacular grooves, is well shown in the figures before referred to, and in fig. 1 *u*, which represents the interior of one of these crinoids.

The beautiful symmetry of all these parts, their constant presence and relations to each other, show that they are intimately connected with the vital functions of the animal economy. By the arrangement of these pores, and their relation to the parts of the plate, it is evident that the organs occupying them, and the interior structure communicating with them, performed an important office in the increase of the plates, and the consequent enlargement of the entire animal. Mr. Miller supposes that there was a membrane protruding between the joining edges of the plates, enveloping their external surface, and producing the striæ or ridges marking the plates in all the Crinoidea. If such a membrane existed in the Caryocrinus, it was probably subordinate in its functions to the organs occupying the pores. The striæ, or granulated lines parallel to the margins of the plates, are usually the only evidences we have of the mode of increase in the plates of the Crinoidea ; but in the Caryocrinus, we have these radiating rows of pores, beginning in the younger specimens with one, two, or three pores in each row, and, as the body increases in size, showing constantly that they increase by the addition of new pores on the distal or marginal extremity of the rows, till they reach the number of fifteen or twenty, and this shows most clearly the mode of extension by increments upon the margins of all and every one of the plates individually. There is certainly no species of this family, within the range of our knowledge, which furnishes so much instruction relative to the structure of parts, and mode of growth of the Crinoidea, as the Genus Caryocrinus. The extravagance of some parts, the modification of some, with the occasional absence of others, furnishes an instructive study, and enables one to understand more readily those variations and modifications, which, though occurring in other species, are rarely or never presented in such perfection, or in a manner so readily to be understood and explained, as in this species.

M. Von Buch has shown how this remarkable crinoid differs from the true *Crinoidea*, where the number of plates is five, or, in the pelvis, three, two of which are divisible, making five of

the same form ; while in CARYOCRINUS the number is six, two of the four pelvic plates having the form of double plates, above which are six costal plates succeeded by six scapulars, and the mouth is composed of six plates. I have previously shown that the tripetaloid pelvis is a secondary or derivative type from the pentapetalous base, or at least that it follows the latter in point of time. Those crinoids with tripetalous bases, besides showing two of their plates to be double, have always in their higher structure the number five, or some multiple of that number, in the plates of the body and number of arms.

In a single species of Crinoid known to me in the Hamilton group, the base is composed of six distinct plates, showing that this feature is not alone confined to CARYOCRINUS. This structure is, however, unquestionably very rare ; probably commencing in the CARYOCRINUS, and appearing in other forms of this structure modified, in later geological periods. The Cystidea of VON BUCH, properly so called, though having four pelvic plates, do not possess this easy subdivision into six ; neither do the succeeding series of plates present characters analogous to those of CARYOCRINUS.

Fig. 1 *a*. An individual of this species, of medium size, showing a portion of the column below. The actual position of the mouth is clearly shown.

Fig. 1 *b*. A larger individual, destitute of a column.

Fig. 1 *c*. The base of the same or a similar specimen, showing the form and arrangement of the pelvic plates, and succeeding costal plates.

Fig. 1 *d*. A specimen of large size, having a portion of the column still attached. This individual shows the anomalous feature of having one of the pentagonal costal plates truncated above, by which it becomes hexagonal. This is shown in the left-hand costal plate in view, which is contiguous to the heptagonal plate on the right, as seen in the same figure, and to the left of the hexagonal costal below the mouth. This peculiar feature introduces a supernumerary scapular or interscapular, making nine in the higher series ; thus increasing the breadth at this point, and giving space for the attachment of another pair of arms. The one double row of pores that usually extends to the higher angle in this plate, has become two double rows from their origin at the centre of the plate ; but below this point, the whole crinoid has the same character in every respect as other specimens.

Fig. 1 *e*. A small specimen, slightly more elongated than usual, where the pores are less strongly developed than in many other specimens, and the marking of the surface very minutely granulate in regular concentric lines, without tubercles or ridges of any kind.

Fig. 1 *f*. A specimen of about the same size, having a character precisely the reverse of the preceding. The surfaces of the plates are covered with strong tubercles, and ridges diverging from the centre to the angles, at the bases of which the pores are nearly buried.

These opposite characters, therefore, do not appear to depend upon the age of the individual, but upon other circumstances. I have another specimen, of no greater length than the preceding, but proportionally wider, where the ridges and tubercles are even stronger than upon this one.

Fig. 1 *g*. A young specimen with a part of the column attached.

Fig. 1 *h*. A small specimen with several of the arms still remaining attached.

Fig. 1 *i*. A fragment of slate enclosing the arms of a large individual, several of which are shown in the figure, in a broken and distorted condition.

Fig. 1 *k*. A portion of a single arm or finger, natural size, showing it to be composed of a double series of joints; a thin lamina of each penetrating deeply between the two adjacent ones, and interlocking them strongly together. Each joint is marked by an elongated tubercle in the middle, and a shorter one at each side as shown in fig. 1 *l*.

Fig. 1 *m*. A fragment showing the inner margin with the tentacula attached, in alternation with the joints of the fingers. The tentacula are apparently composed of a double series of joints alternating with each other, or of joints having a peculiar shape, and longitudinally marked by a deep groove. These are so minute in the original, that it is difficult to decide positively in relation to this character.

Fig. 1 *n*. A large separate plate, showing the arrangement of rows of pores, and surface marking of the ordinary character.

Fig. 1 *o*. A plate where the radiating ridges are developed between and by the side of the rows of pores, with scattered tubercles over the remainder of the surface.

Fig. 1 *p*. A similar plate where the ridges and tubercles are more strongly developed.

Fig. 1 *r*. An enlargement of several of the little pustular elevations, terminated above by the opening of the pore.

Fig. 1 *n*+. A portion of a pelvic plate highly magnified, showing the vesicular tubercles in place of the pores.

Fig. 1 *o*+. A portion of a scapular plate highly magnified, showing the pores with two, three, and more apertures, opening like little vesicles upon the surface of a tubercle scarcely raised above the surface of the plate. The number of vesicles increases from the base of the plate, to the termination of the rows in the centre.

Fig. 1 *o**. The interior of a scapular plate, showing that the apertures of the pores are simple, as in the other plates, though opening in numerous minute perforations at the centre.

Fig. 1 *p*+. Parts of other scapular plates, showing the vesicular tubercles, and the same where they have increased in size and coalesced, forming a continuous ridge, as in many of the larger or full grown individuals.

Fig. 1 *s*. The inside of one of the hexagonal plates, showing the openings of the pores on the inner side, and the grooves extending from them to the margins of the plates. In this plate there are no pores sending tentacula to the lateral margins; the double row from the centre to the upper and lower angles, sending grooves to the basal and upper margins. The centre of the plate, including all the space between the rows of pores, has become thickened, forming a broad callosity.

Fig. 1 *t*. An enlargement of the preceding figure, showing more distinctly the character of these little grooves, margined by a thin border, and a space between these and the border of the next groove.

Fig. 1 *t*+. The inner side of one of the heptagonal plates, showing the arrangement and divergence of the grooves from the pores. A few pores occur near the lateral margins of this plate, sending out grooves as described in the detailed description given of their arrangement.

Fig. 1 *u*. The interior of a specimen, preserving thin sharp ridges, marking the direction of the grooves to the margin of the plates. The specimen preserves a part of three costal and three pelvic plates, with the larger part of two scapular plates. The costal plate is a hexagonal one, and its lateral joining edges are marked by fascicles of grooves *n*, *n*, which proceed from pores in this and the adjoining plates on either side. The basal edges of this costal plate, and the two adjoining ones, unite with the basal plates along the line marking the greatest width of the fascicles of grooves *o*, *o*, which are almost continuous; and the same is likewise true of the junction of the scapular plates with the costals, as marked in the line *p*, *p*.

This fragment shows, in a very satisfactory manner, the arrangement of the grooves proceeding from the pores; proving the intimate connexion between the organs protruding from these pores, if not their continuation from one plate to the other in the interior.

The arrangement of the pores and the little grooves proceeding from them, upon the inner side of the plate of HEMICOSMITES, has been shown by M. VOLBORTH (Trans. Imp. Min. Soc. St. Petersburgh, 1845 – 6). The analogy between this genus and CARYOCRINUS, even in these minute details, is very remarkable; and yet the former is destitute of arms, has a lateral ovarian aperture, and a central proboscis. These characters show more clearly how near is the CARYOCRINUS to Cystideans, and suggests whether it should not be included in this family.

Fig. 1 *v*. This figure represents the structure of this species from the base to the summit of the scapular plates, showing one or two of the succeeding plates, and the relative position of the arms and the mouth. The latter organ, it will be perceived, is not directly over the centre of the hexagonal plate, but a little on one side, and, if the plates were brought together, would rest over the centre of the scapular plate on the right side of the vertical line*.

Fig. 1 *x*. A view of the summit of a specimen, where the plates are well preserved, but the form has suffered a little distortion. See similar figure on Pl. 49 *a*, where the form of the summit is distinctly triangular.

Fig. 1 *y*. The structure of the summit or crown of another specimen, showing the arrangement of the plates, arms and mouth, in reference to each other, and to the scapular plates.

Fig. 1 *z*. An enlargement of a portion of the column of fig. 1 *d*, showing the crenulated edges of the joints.

PLATE XLIX A.

Fig. 1 *a*. An individual of this species, preserving a portion of the column more than seven inches in length. The body is compressed, and has been a long time macerated, so that the tubercles and apertures of the pores are not prominent. This specimen is interesting, not only as showing the long portion of the column connected with the

* The mouth has been described as composed of six plates or valves, and this number is all that usually appear. In very perfect specimens, however, there will be found an inner series, of three or four plates, protruding beyond the others, and alternating with them. One of the six outer ones is usually less conspicuous than the other five, giving the appearance of a pentapetalous proboscis. In one example there are three plates in the inner series, and one of the six outer ones is elongated to equal and oppose them.

body above, but from having that column enclosed at three points by corals of different species, which could only have grown about it during its upright position, and during the lifetime of the animal. The upper coral upon this column, *e* (*e*+ the enlargement of some of its cells), is the *Astrocerium parasiticum;* and this example furnishes an explanation of the manner in which many larger specimens of this species of coral are found, enclosing the stems of crinoids. It is probable that in many instances the growth of those corals to a large size aided in the destruction of the crinoid, by the increased size and ponderous nature of the mass enclosing the slender column.

At the points *f* and *g* (enlargements of the same in *f*+ and *g*+*), are two other corals of the Genus TREMATOPORA, which, from their more minute structure, were probably of slower growth than the ASTROOERIUM. These are often found enclosing fragments of crinoidal columns, as shown in Plate 40 A.

Fig. 1 *b*. A portion of the column enlarged, showing the edges of the joints quite smooth and flat. This character prevails throughout the whole length of this specimen; but it is not the prevailing feature in this species, though not uncommon.

Fig. 1 *c*. View of the end of the column, showing the articulating striæ reaching to the canal. This feature of the articulating surface has not been seen in any other individual; though all those examined, with this exception, have been from near the upper extremity.

Fig. 1 *d*. A specimen having a small univalve shell attached, with its aperture setting closely down upon the summit, and covering the mouth of the crinoid. The shell could scarcely have assumed this position by accident; and it was probably thus enclosed within the arms of the crinoid while the animal was in a living condition, and the accidents which have subsequently removed the column and arms have left the shell adhering.

Fig. 1 *e*. The summit of a specimen of medium size, showing the triangular form, the arrangement of the arms, and position of the mouth. Connected with this figure, are some enlargements of the plates at the base of the arms.

Fig. 1 *f*. An individual of medium size, nearly globular in form, marked by strong ridges parallel to and between the rows of pores, with intermediate strong tubercles. The ridges are so strong, and so intimately continuing into those of the adjoining plates, that the line of separation is not conspicuous. The pores either open in elevated pustules, or are imbedded in the sides of the strong ridges. I have not seen, in any other specimen, the ridges and tubercles so strongly developed.

Fig. 1 *g*. The structure of CARYOCRINUS when spread out, showing the bilateral arrangement of its parts as before described. The arrangement of the rows of pores dividing the surface, particularly in its upper part, into rhomboidal areas, is likewise more clearly shown in this figure. The plates are copied in detail from a specimen in the author's possession, and the relative position of every part is preserved, as well as the arrangement of the pores upon the plates, their openings in vesicular tubercles upon the scapular and pelvic plates, and, in some examples, upon the costal plates.

* The determination of these individuals is very difficult, from the surface being covered by a kind of pyritous shale which can not be removed by any process.

This very interesting species is found in all stages of growth, and in all varieties of aspect and surface marking. I have in my collection specimens from the size of a pea, to one of two inches in length and an inch and three-fourths in its greatest diameter; the intermediate ones present much variety in form, from elongated ovoid, to globose, and sometimes almost oblate spheroidal forms. This variety of form is sometimes caused by the presence or absence of some plates at the base of the arms, above the scapulars, and sometimes by the development of the plates progressing more rapidly in a lateral than in a longitudinal direction.

Prof. Troost has enumerated five species as occurring in Tennessee: these are the *Caryocrinus meconideus*, *C. hexagonus*, *C. granulatus*, *C. insculptus*, *C. globosus;* while the *C. ornatus* is not mentioned. It seems scarcely possible that this species, so common and abundant in New-York, should not occur in Tennessee; since the association of the genera named is similar to that in New-York, and, as cited previously, ten species of Eucalyptocrinus are found in the same strata. The study of the five distinct species of this genus offers a most delightful task.

Position and locality. This species is very abundant at Lockport and vicinity, and is not uncommon at Rochester and Sweden in Monroe county, and has been found as far east as Wolcott in Wayne county. Its greatest development, however, was in the vicinity of Lockport; and from other evidence, this was a favorable position for the growth of many species of this family. (*State Collection.*)

Genus MELOCRINITES (Goldfuss).

Columna teres, canali tereti vel quinquelobo perforata, brachiis auxiliaribus.... ; pelvis articulis quatuor; costales primarii et secundarii quini, hexagoni, sibi invicem impositi; intercostales quinque, hexagoni costalibus impositæ, hexagonæ; interscapulares quaterni, in oris regione quinque; brachiæ quinque; os in latere verticis.

The characters of the fragment described below, so far as can be ascertained, correspond to those of this genus of Goldfuss. The anomalous feature of four pelvic plates succeeded by five costals, is met with in no other crinoid; and having only the plates of these two series remaining, they furnish sufficient evidence for the reference to this genus.

Of the two species described by Goldfuss, one is cited from the Mountain limestone, and the other from the Transition limestone.

Melocrinites hieroglyphicus, and *M. lævis*, Goldfuss, Petrefacta Germania, Vol. i, pag. 197, pl. lx, figs. 1 and 2.

602. 1. MELOCRINITES SCULPTUS.

Pl. XLIX A. Fig. 2 *a* – *d*.

Compare *Melocrinites lævis*, Goldfuss, ut supra, pl. 60, fig. 2.

Base concave; column round; articulating surfaces of joints strongly striated; striæ reaching nearly or quite to the canal; pelvic plates spreading outward and downward, enclosing the column, and having their surfaces marked by a few concentric lines; costal plates five, bending slightly downwards to their centre, from which point they are suddenly bent upwards; surface of costal plates marked only by concentric lines or ridges; costal plates, at the point of bending upwards, marked by a strong angular node on each side, and below this an equally prominent one in the centre of the plate; near their upper margins these plates are each marked by three prominent sharply angular ridges, which probably corresponded to similar ones on the succeeding plates.

This crinoid, when held in a reversed position, has a coronate appearance, from the prominent angular nodes on the margins of the costal plates. The base of the pelvic plates is depressed below these angles to the depth of three eighths of an inch. This feature contrasts very strongly with the narrow protruding base of *M. hieroglyphicus;* and there is in the figure of *M. lævis* no appearance of a depression at the base, though the upper margins of the first costal plates of our specimen are marked in a manner very similar to that species.

Fig. 2 *a*. View of the base of this species, showing the plates slightly separated.

Fig. 2 *b*. A figure showing the structure and relative position of the plates. It will be seen by this figure, that if the pelvic plate on the upper side were divided, it would make two of the same form as the other three. This structure of the base clearly arises from a development of a single plate in place of two, accompanied also by a slight modification of the adjoining pelvic plates in the extension of their sloping sides.

Fig. 2 *c*. The interior of a cup which is much elevated in the centre, showing an exterior depression corresponding to the specimen described. In this fragment the divisions of the plates are not conspicuous, and it may possibly prove a distinct species.

Fig. 2 *d*. The articulating surface of a joint of the column, attached to the specimen fig. 2 *a*.

Position and locality. This species, of which only the fragments figured are known, was found in the lower part of the Niagara limestone at Lockport. (*Collection of* Col. Jewett.)

Genus HETEROCYSTITES (*nov. gen.*).

[Gr. ἕτερος, *varius*, and κυστις, *vesica.*]

Pelvic plates four, unequal, succeeded by ten costal plates, which alternate with cuneiform intercostals reaching only half way to the base of the former; the body above this composed of numerous small plates, the arrangement of which has not been ascertained.

This is perhaps a true cystidean, but the structure of the higher portions has not yet been ascertained. The pelvic plates present a singular inequality in their form, and the costal plates are likewise equally irregular

603. 1. HETEROCYSTITES ARMATUS (*n. sp.*).

Pl. XLIX A. Fig. 3 *a, b, c.*

Column?; pelvis composed of four unequal plates, one being much smaller than the other three; costal plates ten, nine of them of nearly equal size, and clustered about the summits of three of the pelvic plates; between each two of the costal plates, except on the side nearly opposite the small pelvic plate, there is a cuneiform intercostal inserted, reaching about half way to their base; these and the costals are succeeded by numerous small scapular and interscapular plates, the entire structure not being ascertained. On the side nearly opposite the smaller pelvic plate, there is a circular projection, like a proboscis, from between two of the costal plates near their summits. Each costal plate is marked near its centre by a prominent angular node projecting downwards; the intercostals are similarly marked by less prominent nodes, as are the succeeding scapulars; surface of plates granulated, and, near their junction with the adjoining ones, marked with strong striæ, meeting similar ones from the opposite plate.

This crinoid is a fragment having the base imperfect, so that its actual connexion with the column, or the base of the pelvic plates, has not been seen. The summit is likewise extremely imperfect, a few fragments of plates only remaining. The base, as presented in the specimen, has the appearance of a terminal proboscis; but the large plates connecting, as they are shown to do, with others, have all the characteristic features of pelvic and costal plates, and are so represented. The angular nodes, projecting downwards, present another character indicative of the relative position of these plates. At the summit of fig. 3 *a*, there are some remains of semicircular plates indicating the place of the arms. On one side there is a projecting process, the structure of which can not be determined; but it appears to be connected with the body, and was probably the mouth or ovarian aperture.

Fig. 3 *a*. Profile view of the specimen, showing the form of plates, the angular nodes, and the projection on one side indicating an aperture, marked *o*.

Fig. 3 *b*. Several plates enlarged, showing the granular surface, with the strong striæ at the junction of the plates.

Fig. 3 *c*. The structure as far as can be ascertained from the specimen, showing position of aperture at *o*.

Position and locality. This specimen was found at Lockport, in the lower part of the limestone. (*Collection of* Col. JEWETT.)

PLATES OF UNDETERMINED CRINOIDEA.

PLATE XLIX A. Figs. 4, 5, 6, 7 and 8.

Fig. 4. This specimen has much the form of a pelvic plate of the preceding species, but the base is very narrow. It is very abruptly bent through the middle in a longitudinal direction, and slightly depressed on the upper edge.

Fig. 5 and 6. These plates are apparently of the *Lecanocrinus macropetalus*, or a closely allied species, though they present characters on their interior surface indicative of a different origin. The surfaces are smooth, partly, perhaps, from long maceration; but the angles are still preserved, showing that they have suffered little abrasion.

The preceding specimens were found in the shale at Lockport.

Fig. 7. A plate of an unknown crinoid, the exposed surface of which is finely granulated, and the margins apparently thickened: there is also a slight ridge or elevation extending through the plate in a longitudinal direction. This specimen was found at Marshall's mill in Sweden, Monroe county.

Fig. 8. Plate of an unknown crinoid, but probably of *Dendrocrinus*, found at Rochester, on the weathered surface of the shale.

These specimens, with others not figured, as well as the fragments of columns to be noticed, sufficiently indicate that there are still other species of Crinoidea to be discovered in the shale of this period.

COLUMNS OF UNDETERMINED CRINOIDEA.

PLATE XLIV. Figs. 3, 4, 5, 6, 7, 8 and 9.

Fig. 3 *a*, *b*. A fragment of a column, of the natural size, with section of the same.

Fig. 3 *c*, *d*. Enlargements of the same.

This fragment of a column resembles, to a considerable degree, the column of SACCOCRINUS; but the joints are thicker, and the nodes stronger. The joints consist of a single smooth one alternating with a somewhat thicker one, which is nodose: the striæ on the articulating surfaces are numerous, slender, and often bifurcating, and reach to the small circular canal. If belonging to this genus, it is of a species different from the one described.

Fig. 4 *a*. A fragment coiled upon the surface of a piece of shale.

Fig. 4 *b*. A small portion of the same enlarged.

The coiled specimen fig. 4 *a* has characters somewhat similar to the preceding, but there are two or three thin joints between the thicker nodose ones. The nodes also are not quite as prominent as those on the other fragment.

Fig. 5 *a*, *b*. A fragment of a column where the joints are thin, the edges of the wider ones being slightly crenulated, having two or more thin joints between. The enlargement fig. 5 *b* shows a point where there is an intermediate joint not so wide as the widest, but wider than the intervening ones.

Fig. 6 *a*, *b*, *c*. Columns composed of smooth equal joints, having lateral branches or side arms. The articulating surfaces are marked by numerous fine dichotomous striæ, reaching to the round central canal. These columns are remarkable for their external smoothness and equality of the joints, and for having been furnished with lateral appendages at irregular intervals.

Fig. 7 *a*. A fragment of the base of a column where it diverges into the radicles : it is remarkable for the strong striæ upon the articulating surfaces.

Fig. 7 *b*, *c*. The articulating surface, natural size and enlarged, showing the strong somewhat dichotomous striæ.

Fig. 8. A fragment of a column with the radicles attached : at this point the column is composed of three or four thin joints articulating with a single thicker one, all of equal diameter, and the column having a smooth exterior.

Fig. 9 *a*, *b*, *c*. The base of another species, with the radicles attached. The few joints remaining are thin ; the striæ of the articulating surface are numerous and undulating, sometimes partially dichotomous, and appearing as if granulated. The characters of this fragment are very similar to those of *Lecanocrinus ornatus*, and it is probably the radix of one of that species.

Position and locality. These fragments, with the exception of fig. 8, are from the shale at Lockport. The specimen fig. 8 is from the lower part of the limestone at the same place.

PLATE XLV. Figs. 3, 4, 5, 6, 10 and 11.

Fig. 3 *a*, *b*. A fragment of a small column, composed of unequal joints with rounded edges, having scattered spines upon the edges of the thicker joints. The articulating surfaces are strongly striated, the striæ reaching to the small canal in the centre.

Fig. 3 *c*, *d*. Enlargements of the same, showing the form of joints, and the striæ upon the articulating surface.

Fig. 4 *a*, *b*, *c*, *d*. A fragment similar to the preceding, having the spines more numerous and proportionally longer, while the articulating surfaces are concave at one end and convex at the other.

Fig. 5 *a*, *b*, *c*. A fragment of a column, having the joints composed in part of thin irregular plates not continuous on the margins.

Fig. 6 *a*, *b*, *c*. A fragment of a compressed column, having two distinct centres, though appearing as one externally. It is composed of alternating joints of equal thickness, but of unequal width. The articulating surfaces are finely striated, the striæ reaching to a large solid oval space which may have been a canal.

Fig 10 *a*, *b*. A fragment of a root, with numerous radicles, of an undetermined species ; with a section of the same, showing a large irregularly triangular canal.

Fig 11 *a* *b* A fragment of a root, with few radicles ; and a section of the same, showing a hexagonal canal.

604. 2. MYELODACTYLUS BRACHIATUS (*n. sp.*).

PL. XLV. Fig. 7 *a* – *e*.

Fragment of an arm, somewhat semicylindrical or unequally pentagonal; lateral appendages cylindrical, strongly articulated; canal transversely oval, with marks of muscular impressions towards the circular margin very strongly impressed.

Fig. 7 *a*. A small fragment enlarged, showing two lateral appendages.
Fig. 7 *b*. Transverse section of the same.
Fig. 7 *c*. Section of one of the cylindrical appendages.
Fig. 7 *d*. A larger convolute fragment, with several appendages near the lower part.
Fig. 7 *e*. The convex or outer side of this specimen, which has a depression along the centre, from the upper part, nearly to the base, where it gradually becomes obsolete. The depression is marked by two finer grooves along the centre. There are three appendages on each side near the lower extremity, composed of elongated cylindrical joints gradually tapering upwards.

605. 3. MYELODACTYLUS —— ?

PL. XLV. Fig. 8 *a*, *b*; and 9 *a*, *b*, *c*.

The fragments figured are similar to the preceding in many respects, but the section is trapezoidal, the canal more extended transversely, and there are no appearances of lateral appendages or tentacula.

Fig. 8 *a*, *b*. A fragment, which is compressed either naturally or by accident. The section 8 *b* shows the form of section.
Fig. 9 *a*, *b*, *c*. Another fragment, and the section, showing the difference of form in the two. The canal and character of muscular marking are precisely the same in each.

Position and locality. All these fragments of columns and roots have been found in the decomposing shale at Lockport. Many other fragments, showing distinct features, have been found with these; but the examinations I have been able to give them, have not been sufficient to settle definitely their analogies with known species.

CYSTIDEÆ.

There are certain peculiar fossil bodies, which, from their general structure and habit, have usually been arranged with the Crinoideæ; but to which the name of Cystideæ has been given by M. Von Buch*, who regards them as forming a distinct order of Echinoderms, inferior to the Crinoids. They approach the Crinoideæ in some of the genera, and depart widely from that family in others. Among the obvious characteristic distinctions we may mention that the genera of cystideans have the entire body more or less spherical, and entirely covered with polygonal plates, except at several points where there exist apertures connected with important functions of the animal. One of these apertures near the summit is the mouth, and near it is an anal aperture or pore; but the most conspicuous one is the ovarian aperture, which is situated below the summit, on the posterior side of the animal. The arms are either absent altogether, or very much modified in their character, when compared with those of the Crinoidea proper. Instead of originating from the higher plates of the cup, which are gradually changed in form, or the interstices filled with smaller plates, the cystideans are entirely enclosed; and the appendages representing arms are spread over the summit, originating from near the mouth, and extending down the sides to a greater or less distance; or represented only by a few oral tentacula. These arms in many species consist of a double series of joints, separated from each other by a groove, and the whole resting in a depression upon the surface of the plates or along their joining edges. These representations of arms appear like a surface ornament, but they are readily separated from the plates, and are shown to be composed of joints of unequal size. At certain points upon these arms there arise jointed tentacula, not very dissimilar to those of some Crinoidea; so that the surface is ornamented with several rows of tentacula, diverging or radiating from the summit.

These arms and tentacula are not present in all species: indeed they were at first supposed, by Von Buch, to be destitute of arms altogether; and some of the species possessing these appendages may have them entirely removed, leaving no positive evidence of their having existed, beyond the shallow groove in which they are imbedded, and even this is sometimes obliterated†.

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* Uber Cystideen, &c., by Leopold Von Buch: Transactions of the Royal Academy of Sciences of Berlin. Translated and published in the Quarterly Journal of the Geological Society of London, Vol. ii, part 2, page 20, with two plates. This memoir should have been cited under *Caryocrinus ornatus*.

† The Cystideæ were described by Von Buch as being entirely destitute of arms, and in this respect they would show an important deviation from the Crinoideæ. M. Volborth, on the other hand, maintains that the Cystideæ all have arms, and that they are true Crinoideæ. His argument is as follows:

"All the Cystideæ, like Crinoideæ, were provided with articulated arms; and this statement is not mere hypothesis, "but the result of philosophical induction from distinct well grounded facts, determined by observation, from the "presence of arms in some species, and the presence of tentacle furrows in others. The Cystideæ are likewise *true* "*Crinoids*. Either in the young state, or throughout life, they were attached by an articulated stalk, or by a pedicle, "either to the bottom or to foreign bodies. They had articulated arms, which, as in Crinoideæ, proceeded from the

In addition to these peculiar and characteristic organs, there are, in several genera at least, others, which have sometimes been termed "*ambulacral openings*," but which Prof. FORBES terms "*pectinated rhombs*." These organs are arranged in pairs (each pair forming a rhomb[?]) on contiguous plates, and have a general similarity to each other, but they are by no means precisely alike. They consist of a more or less elevated border or rim, which is quite thick and strong, evidently intended for the protection of the enclosed part, and the centre is depressed below the surface of the plate. In the bottom, these spaces are marked transversely (which is usually in a line nearly vertical to the body) by slender bars, with interspaces equal to the bars, from which they are termed *pectinated*. It is certain that these organs offered a means of communication between the interior and the exterior, perhaps not unlike that afforded by the pores of CARYOCRINUS and HEMICOSMITES; but the dissimilarity of the individuals of each pair, on adjoining plates, and their distribution in three parts of the body only, indicates that their office was not so universal, and probably more specific than that of the pores. Nevertheless these apertures open upon the interior precisely as upon the exterior; and from the base of each, to the margin of the plate between these pairs of organs, there extend little grooves. In the other direction, the grooves are marked for a short distance at least; but the specimens examined do not furnish positive evidence that they extended to the margin of the plate*.

In their external form, these pectinated apertures, as just remarked, are similar, but not

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" dorsal pole of the cuticular skeleton. Diametrically opposite to the orifice for the pedicle is placed the buccal orifice, " and generally close to it is the subcentral anal orifice. The cup differs, however, from that of the crinoids, by " such a predominance of the dorsal side over the ventral, that the latter is often reduced to a minimum, consisting " only of the orifice of the mouth, so that the arms appear to be much nearer to the mouth than is the case with " crinoids" (VOLBORTH on the Arms of Cystideæ: Trans. Min. Soc. of St. Petersburgh, 1845–6, p. 167).

There is certainly reason to regard this argument in reference to the structure of these bodies, and the origin of the arms, as compared with the true Crinoideæ. In the CARYOCRINUS, we observe in a remarkable degree the development of the dorsal side, with a diminution of the ventral, particularly in young specimens, where the summit is proportionally narrower than in older ones. This body is provided with true arms and tentacula, while HEMICOSMITES, which is so nearly related in structure, ambulacral pores, etc., has the summit protruded, and a lateral or posteal ovarian aperture. The examples of CARYOCRINUS where the mouth is forced downwards by the absence of the scapular plates, or the modification of the costal plates leaves that organ much in the position, and having the appearance of an ovarian aperture. In the absence of arms, therefore, the CARYOCRINUS would become a true Cystidean, with the exception of the mouth. Among the analogies of CARYOCRINUS to the Cystideans, may be noticed the tentacula, which are composed of a double series of joints, alternating with each other precisely like the arms of Cystideans, and unlike the tentacula of any other crinoid which has fallen under my observation. It is not probable that CARYOCRINUS is the only form where intermediate characters will be found; and we shall probably find a necessity of restraining subdivisions within narrower limits.

* Prof. FORBES will pardon me for differing from his opinion in reference to these organs being media of communication with the interior. I am quite sure he could not withhold his assent to this opinion, were he to examine the specimens I have before me. Moreover I can not conceive it possible that such conspicuous organs, and so peculiarly arranged with reference to the animal, and the exsert parts to the protection of the interior, should be only modifications of a plate, or a metamorphosis of any part, except to serve some very important function in the animal economy.

It is not impossible but these narrow spaces may become obsolete by coalescing of the bars, as do the pores in CARYOCRINUS; or that in the process of mineralization of the specimen, the spaces may have been filled with crystalline matter, taking the same character as the adjoining, originally solid, parts.

alike in form, in each pair. In the higher or lateral pairs, although the individuals are sometimes placed nearly in a line parallel to each other, one is always a little higher, and sometimes nearly, or directly, above the other. The higher one has a nearly straight base, usually not much elevated, and sometimes coincident with the margins of the plate : on its upper side it is arched or angular, with an elevated border, making the entire outline triangular or sub-reniform. The bars crossing this aperture are consequently longer in the centre, and gradually diminish towards each extremity. The lower aperture is often quite oval, sometimes elongated or almost crescent-form, but always bounded on all sides by an equally elevated rim. When we examine the basal pair, the relative position of the two apertures is reversed, and the triangular or sub-reniform one, which in the higher pairs is above, is here placed below the oval one. Thus whatever may be the form, or the relative position of the two forms in the upper pairs, it is always reversed in the lower pair, or the relative position of the two in the lower pair is reversed in the upper pairs. Nor is this all : the pectinated space in the oval aperture, or the lower one of the upper pairs and the higher one of the lower pair, is always deeper below the surface of the plate ; and the protecting rim or margin is stronger, than in the angular or higher aperture of the upper pairs, where the bars reach nearly or quite as high as the surface of the plate, and the rim on the upper side is thin. From this cause, the upper ones have often suffered from abrasion, and are frequently obliterated, while the lower or oval ones still remain nearly perfect. In many such instances they may be overlooked, since they appear much like cystalline striæ ; or like the striæ upon the interior of plates of CARYOCRINUS when worn down from the external surface.

Such is the character of these organs, as existing in several very distinct species which have been examined. They have doubtless a greater variety of form and mode of development than here described, but it is believed that the important characteristics are given.

Many, if not all the cystideans, were attached, like the crinoids, by a column or pedicle, which is usually very short, rapidly diminishing to the base, and the joints growing thicker or becoming anchylosed as they recede from the animal. These columns or pedicles present considerable variety in their external appearance, the joints being often expanded on their lower margin, and overlapping the upper part of the one below, giving a reverse cup form, as if the lower were inserted into the next succeeding joints, very much like the internal casts of CORNULITES when placed with its larger extremity upwards.

The Cystideæ, both in this country and in Europe, are known to have commenced their existence in the Lower Silurian period (as shown in Pal. N. Y., Vol. 1, p. 87), where we have but a single American species yet known. In the Upper Silurian period we have several (at least four) well ascertained species* ; while in the Devonian period we have no well

* One of these has been for a long time well known through the indefatigable zeal of Mr. GEBHARD of Schoharie, who had thoroughly studied its structure previous to 1840, when it was published by Mr. CONRAD as *Lepocrinus* [*Lepadocrinus*] *gebhardii*, in the Annual Report on the Palæontology of New-York for that year, without any detailed description. This species is so closely allied to *Pseudocrinites*, PEARCE, that it may be necessary to cancel one of the names. The name has allusion to the short pedicle and form, altogether like ANATIFA. This one will be published in the succeeding volume.

defined species, unless the AGELACRINITES of VANUXEM be found to belong to this group, but it appears rather to be a free echinoderm*.

Such are in brief some of the principal characteristics of this family, as at present defined. Several of the lower silurian genera are described as being destiute of arms, and the same is true of a less number of the upper silurian genera. The appearance of arms has been regarded as a stage of progress in the development of the type ; and, that in this, the Cystideans make a gradual approach to the true Crinoideæ, the family finally disappearing before the commencement of the Carboniferous period, where true Crinoids are most fully developed. If we admit this explanation, there seems to be no very natural relation between Cystideæ and Echinidæ proper ; since, if the farther development of the former assumes the crinoid type, we should go behind the Cystideæ for Echinidæ, which in truth do not appear till the Crinoideæ have passed their fullest development. We know also that crinoids with pentapetalous bases existed in considerable numbers, at least coeval with the earliest cystidean ; and we have at about the same time the asteriad type, so that it is not easy to reconcile these different views, if we have any regard to the order of time in the appearance of types.

In a treatise, like the present, intended as a record of species and genera in their order in time, there is not space to introduce much disquisition in relation to the history and affinities of the different families of which species are described, more particularly since there is no opportunity of bringing all the species of any family together.

Prof. FORBES, in his investigation of the British Cystideæ, has presented a very interesting essay upon the position of this family in the animal series, in which he has shown so many remarkable analogies from his extended comparisons, and from which he has drawn such purely philosophical deductions, that we might rest satisfied with the conclusion. In these deductions he has given the credit due to geology for having brought to light the means of supplying the links in this chain. If, however, we go to geology, which we shall find always necessary, then we should take into consideration the occurrence of these, or other connecting links, in the order of time ; and we have no right to neglect that part of the proposition, by taking such fossil forms as may suit our views, without reference to the vast periods of time that have elapsed. The following diagram is given by Prof. FORBES, as showing the affinities of the Cystideæ with the higher Echinoderms†.

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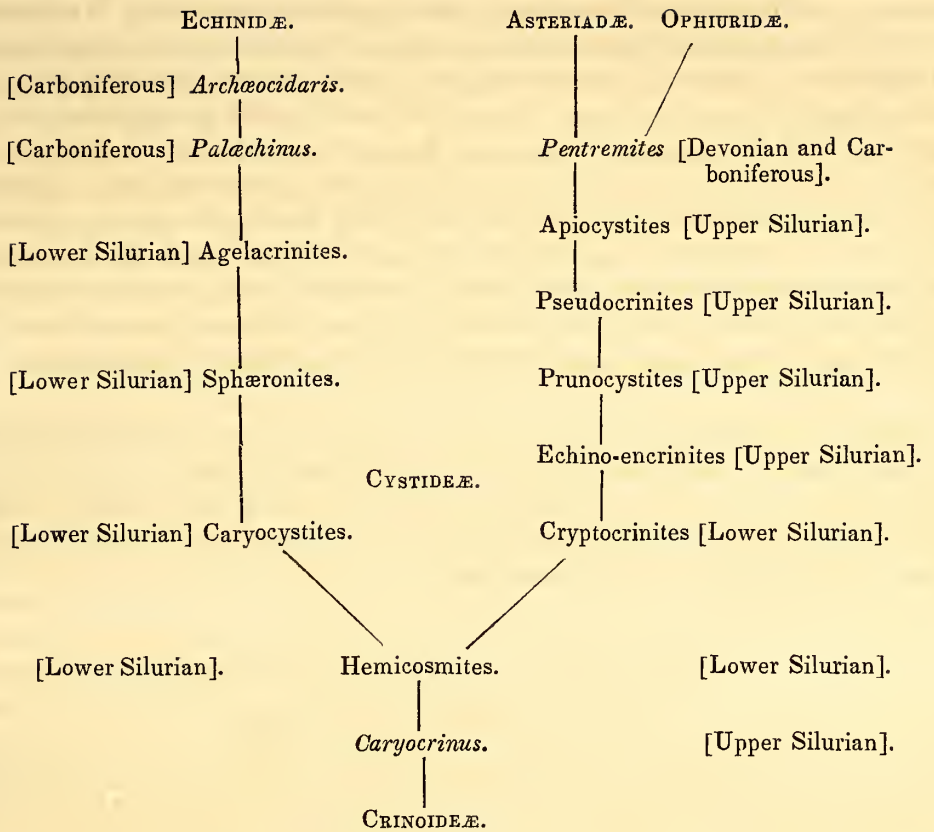
* Prof. FORBES has cited the AGELACRINITES of VANUXEM, but applies the name to a very different fossil, and places it in Lower Silurian, regarding it as congeneric with a species found in Lower Canada by Dr. BIGSBY. It seems quite doubtful if the characters of VANUXEM's fossil have been fully understood; and if so, we have the very remarkable fact of a genus of Cystideans common to the Lower Silurian and Devonian systems, which, in these singular and comparatively rare fossils, we can scarcely expect to be true.

† This diagram is copied as it stands in the memoirs of the Geol. Survey of Great Britain, Vol. ii, part ii, with the exception of the geological position of genera, which has been added.



In this diagram we begin at the base with Crinoideæ, and through *Caryocrinus* very naturally pass to *Hemicosmites*, a true cystidean. The word Cystideæ occupies the centre, around which are arranged the genera of true Cystideans. On the one hand we pass from *Hemicosmites*, through *Caryocystites*, *Sphæronites*, *Agelacrinites*, all true Cystideans, by the genera *Palæchinus* and *Archæocidaris*, which link the former with the other great sections of Echinodermata. On the other hand, we pass from *Hemicosmites*, by *Cryptocrinites*, *Echino-encrinites*, *Prunocystites*, *Pseudocrinites*, *Apiocystites*, all true Cystideans, by the genus *Pentremites*, to the Asteriadæ, and by divergence to Ophiuridæ.

Let us examine for one moment the direction of these lines of progressive development in the geological series, and see whether there are not some objections to this view, or at least some important links wanting in the chronological order. *Caryocrinus* is an upper or middle silurian fossil : *Hemicosmites* is lower silurian ; and, in point of time, we go backward from the former to the latter. Starting with *Hemicosmites*, we pass, on the one hand, through the three genera of Cystideans, all of which are of lower silurian age, and link them with Echinidæ by

the two carboniferous genera *Palæchinus* and *Archæocidaris*. Here are at least some links wanting, or the Cystideæ in lower silurian times approached very rapidly to the echinidean character, if the apparent analogies be real ones. On the other hand, we pass from *Hemicosmites* to *Cryptocrinites*, which is a lower silurian genus, through the four succeeding genera, all of which are upper silurian; and thence through *Pentremites*, which is both devonian and carboniferous, to the ASTERIADÆ and OPHIURIDÆ. However close, therefore, the links may appear from structural affinities, there is a vast space of time between the occurrence of *Agelacrinites** and the allied carboniferous genera; and we might justly question the authority of Geology in such a case, if no intermediate types should be found. On the other hand, the links connecting these genera with ASTERIADÆ are more numerous, and more closely connected in the order of time, and the direction may be true; still there are a great number of forms yet to be known, which will perhaps modify any view at present given of the affinities of these genera.

The following species of cystideans have been found in the shale of the Niagara group at Lockport; and I am indebted to the zeal of Col. E. JEWETT of that place, for being able to present figures of well preserved specimens†. They offer very close analogies with those described by Prof. FORBES from Dudley in England; but one of them, at least, is generically distinct, and the species are all quite dissimilar.

GENUS CALLOCYSTITES (*nov. gen.*).

[Gr. καλος, *pulcher*, and κυστις, *vesica.*]

Body ovoid or sub-spheroidal, composed of four series of plates, three of which are conspicuous, the fourth scarcely exposed; basal plates four, unequal; costal plates or second series eight, third series probably of the same number, with a fourth series of small plates forming the apex. Ovarian orifice conspicuous, closed by a pyramid of triangular plates; pectinated apertures in pairs on three parts of the body; arms five or more, radiating from the apex and folded back upon the sides, resting in a broad shallow groove and distinctly projecting above the surface, composed of a double series of joints separated by a narrow groove; articulated fingers attached to the arms in a double row, separated by the groove. Oral orifice below the apex, with an anal pore near it, and a porous tubercle above and a little on one side. Column short, composed of thin joints which diminish rapidly from the body.

This cystidean, in its general characters and habit, is closely related to PSEUDOCRINITES, and also to APIOCYSTITES; but it will be perceived at once that there are important differences in the structure of the body. It commences with four basal plates, as the genera mentioned; but

* This genus is used as defined by Prof. FORBES, and is not the *Agelacrinites* of VANUXEM.

† Among the specimens of CARYOCRINUS collected at Lockport several years since, I discovered some specimens of these curious fossils; but they were so completely coated with pyritous shale, that I was unable to ascertain their structure, till the more fortunate discoveries which have brought to light the beautiful forms illustrated in Plates 50 and 51.

the second series is more numerous, and upon the upper angles of two of these the ovarian orifice rests, its upper half occupying a depression in the base of a plate of the third series. The upper pairs of pectinated apertures are likewise in part borne by two plates of the second series; while the five arms, which may be simple or subdivided, radiate from the apex, covering much of the third and nearly all of the fourth series of plates.

606. 1. CALLOCYSTITES JEWETTII (*n. sp.*).

PL. L. Figs. 1 – 11; and 12 – 16 var.?

General form of body oblong ovoid, nearly symmetrical; base composed of four plates, one of which, bearing the pectinated aperture, is pentagonal, the second and fourth hexagonal, and the third heptagonal. These plates support on their upper edges eight plates in the second series, Nos. 5 and 6 of which are similar, and also 11 and 12, the others being of dissimilar form. Of the basal plates, No. 1 is not directly opposite to the ovarian aperture; but the position of No. 6, bearing the second one of the lower pair of pectinated apertures, is almost directly opposite; and a line drawn from this aperture, through the centre of the base, to the lower angle of plate No. 6, will divide the body into two parts of equal dimensions, though not composed of similar parts. In the third series of plates, a single one is excavated on its lower side, to form the upper margin of the ovarian aperture; and two other plates bear the upper member of the higher pairs of pectinated apertures. Above the apex of the pentagonal basal plate, and resting upon the sloping edges of plates five and six in the second series, is a quadrangular plate marked 14 (fig. 11), its two higher sloping sides flanked by 13 and 15. This is probably a supernumerary plate, not present in all individuals of the species. Every one of these plates is more or less covered by the arms, which spread over the surface. The pectinated apertures of the upper pairs are situated on each side of the ovarian aperture, and equidistant from it, but not on opposite sides of the body. The individuals of the pair on the right side are nearly horizontal in regard to each other, while those of the other pair are one above the other, and the basal or anteal pair are nearly opposite the ovarian aperture. Arms double, or composed of two parallel series of plates separated by a sinuated groove; plates of the arms of two forms, alternating ones similar, and opposite ones in the two series of different forms; fingers or tentacles composed of minute plates, articulating with the arms at the higher junction of the larger and smaller joints and at the bottom of each sinus. Surface of the entire body ornamented by polygonal depressions, having a more or less perfectly defined border and a granulated surface.

This is a most beautiful species, and, when furnished with tentacula and pedicel, was a magnificent form. The base is large, giving room for the strong attachment of a broad column; and the lower series of plates are expanded, with the exception of the pentagonal one, which narrows this side, and gives to the whole body a more nearly straight anteal side, while the posteal or ovarian side is swollen or pressed outward. The plates forming the ovarian pyramid have not been observed; but from the character of the aperture remaining, we may fairly infer

that the plates covering it were similar to those in the following species. The anteal or basal pectinated apertures present the characters noticed in the general review of these parts, having the lower one of the pair sub-triangular, with apex placed towards the base, while the higher one is nearly oval or sub-reniform. In the higher pairs, this relative position is reversed ; and in the pair placed nearly horizontal, the one slightly higher than the other is the triangular one. The triangular apertures have a thinner border, and are larger and less deep than the oval ones, which gradually expand outwards, and the border is labiate. The transverse bars which can be counted in the higher, or triangular ones of the left and right sides, and the base or anteal side, are respectively 9, 13 and 16 ; while in the lower or oval ones there are a less number, apparently having the same gradation, but not distinctly ascertained. If a line be drawn through the specimen in a direction from the anteal to the posteal side, the mouth and associated organs are on the left side ; the bases of two of the arms arch over these organs, including between them the pair of pectinated apertures on the left side : one of these arms is dichotomous below, or near the extremity. On the right side diverge three arms, two of which, arching over the right pectinated apertures, are dichotomous near their extremities ; while one of the simple arms goes to the right of the anteal pectinated apertures, and to the left of the ovarian aperture. The bifurcation of the arms may not be of specific importance, but following or coincident with some other modifications. The arms are, as described, composed of a double series of plates laterally in contact, and resting in a shallow groove in the plates of the body. Each series of joints is similar, and composed of a large and small joint alternating with each other : the large joint has its inner margin convex, and longer than the outer margin ; the smaller plate has a long external margin, while the inner margin is extremely narrow, and not projecting as far as the margins of the adjoining plates. The groove between the rows of the plates of the arms is excavated from the plates of both series, but not entirely through them, as they still join by their margins below. The sinus is made by the narrow margin or angle of the smaller plate, which is intercalated between each two of the larger ones, but does not project as far into the centre as those. At the bottom of this sinus, the tentacula take their origin. This groove, in the living condition of the animal, was undoubtedly occupied by some organ diverging from the centre, extending to the extremity of the arms, and finally diverging into the bottom of each sinus. From some remaining evidences, it seems that this organ was composed of minute articulating joints, probably covered by a fleshy envelope, and possessed the power of keeping up a communication from the centre along the line of the arms, and to each individual tentaculum ; so that from the most remote points of these, sensation was communicated at once to the centre. The similarity of this groove to the canal or avenue on the under side of starfishes, is too obvious to escape attention. The little porous tubercle near the mouth also strongly reminds one of the madreporiform tubercle in Asterias and other Echinoderms.

Fig. 1. The posterior side, showing the ovarian aperture destitute of plates closing it, the arms on each side arching over it, and the pectinated apertures on the right side, with the margin of those on the left, between which and the aperture is a dichotomous arm.

Fig. 2. The right side, showing the pectinated apertures.

Fig. 3. The anterior side, showing the pectinated apertures near the base, and the position of the intercalated quadrangular plate.

Fig. 4. View of the base, showing the large foramen opening from the column.

Fig. 5. A portion of the base of the arm-plates on the left side, showing an aperture marked *a*, which may be the mouth, and another pore-like orifice which is perhaps the anal pore. The little oblong body marked *t* is the porous tubercle, which is very distinct, and of a texture different from the plates to which it is attached. The bases of tentacula are marked *b b*.

Fig. 6. Two plates from the right side of the body, enlarged, showing the relative form and proportions of the pectinated apertures.

Fig. 7. One of these pectinated apertures still farther enlarged, and defining more clearly the transverse bars and the spaces between.

Fig. 8. A portion of the surface enlarged, showing the polygonal spaces, which are separated by scarcely elevated ridges.

Fig. 9. The structure and arrangement of the arms and plates composing them, with the relative position of the simple and dichotomous ones ; the originating points of the tentacula, with the relation of the whole to the ovarian and pectinated apertures, the oral orifice, etc.

Fig. 10. The bases of the arms enlarged, showing more distinctly the oral orifice and tubercle on the lower one, which is larger than the others ; and also that from right to left there is a continuous line, marking the direction of the anterior and posterior sides.

Fig. 11. The structure of the body, including the first and second series of plates, and a part of the third series.

Fig. 12. An individual having a slightly different form, being more contracted towards the apex, but in other respects having the same arrangement of parts, surface marking and other details, with the exception of the arms, which are simple throughout their whole extent. The anal orifice holds the same position, but the part immediately above this is mutilated. A portion of the column still remains attached, the joints of which are compressed, carinated, and somewhat reflexed.

Fig. 13. The arms spread out in a plane, and showing their relation to the ovarian and pectinated apertures.

Fig. 14. Section of the column, showing the large canal.

Fig. 15. A portion of one of the arms enlarged, showing the sinuated groove, with the bases of tentacula marked *b b*.

Fig. 16. The granulated surface of the plates of the arm magnified.

Fig. 17. A fragment of a column very similar to that attached to the body fig. 12.

Fig. 18. An enlargement of the same, showing the crenulated edges of the joints.

FRAGMENTS OF COLUMNS OF CYSTIDEÆ.

PLATE L. Figs. 19 – 29.

Fig. 19. Several joints of a column, near the base, having the joints connected and reflexed, with the margins strongly crenulate.

Fig. 20. An enlargement of two joints from the preceding figure.

Fig. 21. A fragment of a column where the joints are composed of interrupted plates, which extend only a short distance, gradually thinning away, and being overlaid by the thin edge of another one. The plates are reflexed towards the outer margin.

Fig. 22. An enlargement of the same.

Fig. 23 and 24. A fragment of a column with the joints carinated and reflexed on their outer margins, and finely crenulate.

The separate plates figs. 25 and 26, 27 and 28, belong to the same or a similar species. The exterior surface of 27 is covered with a minute coral like AULOPORA, and the ornament has been obliterated. Fig. 28 is the inside of the same plate, showing concentric lines of growth.

Fig. 29. An enlargement of the small branching coral on fig. 27.

Position and locality. The specimens figured are from the shale in the vicinity of Lockport.

(*Collection of* Col. JEWETT.)

GENUS APIOCYSTITES (FORBES).

" Corpus oblongum, tetragonum, rhombiferum, angulis truncatis, excavatis ; brachia quatuor " plana, in sulcis angulorum inclusa ; sulci brachiales obliqui-lobulati. Os transversum, apicale ; " anus lateralis, subapicalis ; ossicula ovariales laterales sex. Assulæ basalis 4 ; infra-ovariales " 5 ; centro-laterales 5 ; supra-ovariales 5 ; apicalis ? Basis plana. Columna ?"

The essential characters of this genus appear to me to be so nearly represented in our specimens, that I am unwilling to give another name at present ; though a strict interpretation may render it necessary, if the discovery of other species shows the same differences. The form and arrangement of the plates of the base and second series are precisely as in APIOCYSTITES. The plates bearing the higher pectinated apertures are also of the third and fourth series. In our species, however, the plates of the ovarian pyramid are distinctly five, as counted in two well preserved specimens ; and the plates surrounding them (circa-ovarian plates) are ten. The plate arching over this aperture is sometimes simple, and sometimes divided into three, in the same species ; but the apex of this plate does not reach the summit, and should be considered as belonging to the third series entirely. The only point which can be regarded as the mouth, is a subtriangular elevation with a spreading border, situated on the left side a little below the apex, and rising from one of the plates at the base of the arms. The arms are almost similar to those of the preceding genus, except that they consist of two distinct pairs, composed of a double row of joints, each row consisting of unequal plates ; the alternate ones being similar,

and those laterally in contact dissimilar. The longitudinal groove is sinuated or lobed in the same manner. A range of minute joints, or ossicula, partially fill this groove, diverging to the bottom of each sinus or lobe, where the tentacula originate. These grooves from the four arms do not meet at the apex of the body ; but the two from the anterior pair meet on the anterior side of the summit, and those from the posterior pair meet on the posterior margin of the summit, and are thence connected together by a single straight groove in the direction of the back and front of the body. When these grooves are occupied by the little ossicula, which do not fill them entirely, they give a very beautiful appearance to the surface, diverging into the lobes of the grooves and reaching the bases of the tentacula, of which a few of the lower joints still remain, proving them to have been calcareous.

I am unable to observe the reniform groove or pore on the right side near the apex, or any orifice beyond the one noticed on the left side, except a minute elevation of a slightly darker color just below that which I have termed the *oral orifice*. This point, much magnified, presents scarcely a visible peculiarity ; but a farther enlargement shows it to be composed of minute triangular plates, and that it is a miniature form of the ovarian orifice. In another specimen, which is weathered, these minute plates are wanting ; and there is a small cavity visible, which probably communicates with the interior : this therefore may be regarded as the anal orifice. It will be seen from the arrangement of the arms, that the groove with ossicula communicating between the pairs and across the apex, precludes the existence of a mouth in that position, unless it be very minute ; and even then, there is no arrangement of parts to admit of its existence. It should be noticed that the base of the tentaculum, in the angle at the divergence of the arms of each pair, is larger than the others, and this may be of generic importance.

The slight deviations in structure from the intercalation of a small plate between the first and second series as shown in the diagram of structure, or the subdivision of one plate into three, does not in any other respect affect the form or important characteristics of the animal, and can not even be regarded as of specific importance.

607. 1. APIOCYSTITES ELEGANS (*n. sp.*).

Pl. LI. Figs. 1 – 17.

Compare *Apiocystites pentremitoides*, Forbes, Mem. Geol. Survey of Great Britain, 1848, Vol. ii, part ii, pag. 502, pl. xv.

Body oblong oval, slightly compressed at the sides, composed of four series of plates, the basal series consisting of four, the second five and the third six, while the fourth is not fully ascertained ; arms four, consisting of an anterior and posterior pair, which are placed in shallow grooves at the rounded angles of the body, and rise above the plates on either side, extending downward to the junction of the basal and second series of plates ; surface of the body and plates of the arms ornamented by minute granules and larger tubercles, the latter often coalescing and forming irregular ridges ; rows of granules often parallel to the margins of the

plates, and the larger tubercles sometimes forming straight ridges from the centre to the angles of the plates.

This exquisitely beautiful little fossil is from the collection of Col. JEWETT of Lockport, and was found associated with the preceding species, and with *Caryocrinus ornatus*. This is much smaller than Callocystites, and is very conspicuously different in the form of the plates and the number of those in the second series, as well as in the position of the higher pectinated apertures. The arms are but four, and very obviously consist of an anterior and posterior pair, which are united at their bases. The character of the shallow groove in which these arms rest, and the groove or avenue in the arms themselves, is precisely similar to the preceding genus. The little ossicula partially filling this groove are not perfectly preserved in that one, though there remains sufficient to prove their existence originally. In the present form there is an oral orifice near the summit, and a minute anal pore below; while in CALLOCYSTITES the mouth is smaller, and the anal orifice proportionally larger, and there is a distinct tubercle on one side of the mouth, which does not appear in this one.

The body, in a well preserved specimen, appears to be slightly compressed laterally; though in another specimen, apparently in its natural condition, there is no perceptible difference in the two diameters. The groove in which the arms lie is more deeply impressed near the summit than in the lower part, and distinctly divides the body into four lobes. Modifications of the form, to some extent, take place from the introduction of supernumerary plates as in the crinoids proper. This also modifies the form of the adjoining plates, as in the example fig. 5, where the introduction of a quadrangular plate between the first and second series has truncated an angle of one of the pentagonal basal plates, and changed the form of one, and altered the relative position of the other adjoining plate, of the two succeeding ones of the second series. Modifications in the form, and subdivision of plates in the third and fourth series, appear not to be uncommon in this species.

The largest specimens seen reach the size of the figures on Plate 51, though others are smaller.

Fig. 1. The posterior side, showing the ovarian aperture, the shallow groove in which the arms are lodged, and the base of the larger tentaculum.

Fig. 2. The left side, showing the pectinated apertures and arrangement of plates on that side.

Fig. 3. The right side, showing the pectinated apertures and the protruding plates of the ovarian pyramid. The plates of one of the arms remain, retaining the minute ossicula, which are shown diverging into the lobes of the groove to the base of the tentacula.

Fig. 4. The anterior side, showing the pectinated apertures at the base, the grooves for the anterior pair of arms, and the base of the large tentaculum at the summit.

Fig. 5. Diagram showing the structure of one specimen having an intercalated quadrangular plate between the first and second series of plates.

Fig. 6. Diagram of the structure of another specimen, where there are only the usual number of plates in the first and second series. One plate of the third series, over the ovarian aperture, is divided into three distinct plates. Between the plates bearing the pec-

tinated apertures on the right, and the supra-ovarian plate, there is a small plate intercalated in both specimens, as shown in the figures; and in the upper figure, there are two small plates above the higher pectinated one.

Fig. 7. A diagram of the structure of the upper part of a specimen where the arms are preserved, showing their arrangement in two pairs as described. The filaments of ossicula are shown, extending along the groove to the little points which represent the bases of the tentacula.

Fig. 8. A part of the preceding diagram enlarged, showing the plates at the base of the arms, the position of the mouth, and anal pore in reference to the other parts. The ovarian pyramid is in the centre below : on the left side is the oral aperture *a*, and below it the minute anal pore *d*, *b b* representing the bases of the tentacula.

Fig. 9. The brachial plates on the left side enlarged, showing the oral and anal orifices, with the bases of the two nearest tentacula.

Fig. 10. A part of one of the arms enlarged, showing the filament of ossicula running along the groove, and the bases of the tentacula *b b*.

Fig. 11. A still farther enlargement, showing the first joints of the tentacula.

Fig. 12. A lateral view of the same.

Fig. 13. An enlargement of the ovarian pyramid and the surrounding plates.

Fig. 14. Profile of the same, showing the elevation of the pyramid.

Fig. 15. One of the pentagonal ovarian plates, with the three adjoining ones at the base, much enlarged.

Fig. 16. The pectinated plates of one of the higher pairs, showing the form and proportions of the two apertures.

Fig. 17. Another plate enlarged, to show the tuberculous character of the surface.

Position and locality. This species was found with the preceding at Lockport, and has not been observed elsewhere. (*Collection of* Col. JEWETT.)

GENUS HEMICYSTITES (*nov. gen.*).

[Gr. ἥμι, *semi*, and κυστις, *vesica*.]

Body circular, depressed at the margins, centre elevated, composed of an unequal number of imbricating plates; arms five, adhering, radiating from the centre, and composed of a double series of alternating joints; an ovarian orifice closed by triangular plates; an oral and an anal orifice, with a porous tubercle near the apex.

This body was at first supposed to be an immature stage of some crinoid; but after examining several specimens of this very singular fossil, I have felt compelled to constitute a new genus for its reception. It is parasitic upon shells, and being composed of a large number of unequal plates, with the peculiar arrangement of the arms and the other more vital organs, it seems sufficiently unlike any known form to be regarded as distinct. It has, in its present condition, all the characteristic organs of a cystidean, wanting the form and arrangement of plates; and therefore if we regard these bodies as higher in the scale than crinoids, the fossil under consideration, if immature, must be regarded as exhibiting the embryonic condition of a still higher organization.

608. 1. HEMICYSTITES PARASITICA.

Pl. LI. Figs. 18, 19, 20 and 20+.

Body more or less circular, composed of plates of unequal sizes, the outer ones overlapping the edges of the inner, central plates large, a border of smaller ones surrounding them and forming the margin; arms five, radiating from the centre and reaching more than half way to the margin, appressed and coalescing with the plates of the body, composed of a double series of plates which interlock with each other at their joining edges; ovarian aperture closed by a double series of plates, five outer ones, and an equal number within these; a porous tubercle near the apex on the side opposite the ovarian orifice, and near this the minute oral orifice, with an obscure pore below and near it; surface of plates granulated; base closely adhering to the shell on which it grows.

This peculiar body is parasitic on the shells of *Spirifer niagarensis* and *S. radiatus*, adhering so closely that it is scarcely possible to separate them. In the more perfect specimens, the characters mentioned in the description are readily recognized. The plates never join by their edges directly, but overlap and lie against each other. The plates within the radius of the arms are larger, and sometimes nearly equal in size, those of the margin beyond the radius of the arms are smaller, gradually decreasing to the margin, and form a close slightly thickened border. The space between the arms, enclosing the ovarian aperture, is wider than between any two other arms of the body. The arms appear to consist of two pairs extending right and left, and of one anterior one: those of each pair meet together before reaching the centre, and are united by a stronger ridge of plates, from which the anterior one proceeds. There is not sufficient evidence to decide that there were tentacula attached to these arms, except perhaps near the summit. The outer limit of the ovarian aperture is on a line with the radius of the arms, so that its apex is a little nearer the outer margin than the centre. The oral orifice is so minute and obscure that little can be said of it, more than that near the porous tubercle, on the side opposite the conspicuous ovarian pyramid, there is a triangular orifice, and near it a circular depression or pore. The existence of this porous tubercle is very curious and interesting, since it has been shown to occur on the very distinct globose body of Callocystites.

Fig. 18. An individual of the natural size.

Fig. 19. The plates of the ovarian pyramid enlarged, showing a double series, one a little within and alternating with the other.

Fig. 20. The specimen No. 18 enlarged, showing more distinctly the arrangement of the plates, arms, etc.

Fig. 20+. A still farther enlargement of a part of a specimen, showing the arrangement of the arms, the position of the ovarian aperture, the oral and anal orifices, with the comparatively large porous tubercle near the apex, on the side opposite the ovarian aperture.

Position and locality. In the shale of the Niagara group at Lockport.

(*Collection of* Col. Jewett.)

ASTERIADÆ.

FOSSIL STARFISHES.

We now know that species of this family have existed in every geological period, from the Lower Silurian upwards to the Tertiary period, as well as in the present seas. Prof. FORBES has published (in the Memoirs of the Geological Survey of Great Britain) descriptions of all the known British Fossil Asteriadæ, which amount to the number of thirty-five species. He has referred the palæozoic species to the existing genus URASTER, regarding them as differing in no essential feature from the living forms. It might appear unnecessary, therefore, to propose another name for our palæozoic species. Prof. AGASSIZ, however, holds a different opinion; and, after a careful examination of a very fine specimen from the Hamilton group, informed me that he had discovered an important characteristic, by which not only that one, but other palæozoic species could be distinguished from recent forms. This feature consists principally in the plates being *perforated* by pores; while in existing genera, the pores penetrate the joints, or pass between the plates. He also regards the several fossil species known to us here as constituting a genus quite distinct from any established one. Contenting myself with this authority, I shall, with the consent of Prof. A., propose the name of PALÆASTER for our silurian species; since his investigations have not yet been put in form for publication.

GENUS PALÆASTER (*nov. gen.*).

Body stellate; rays five, rounded, spinous, composed of five or more series of plates; avenues deep, and bordered by strong spines; pores penetrating the plates of the upper surface.

609. 1. PALÆASTER NIAGARENSIS (*n. sp.*).

PL. LI. Figs. 21–23.

Body stellate; disc small; arms short, terete with a deep avenue on the lower side, which is margined by strong short spines; centre of plates (in the fossil) nearly smooth, margins strongly granulate; lower side of arms showing two ranges of plates on each side of the avenue, the outer range composed of strong hexagonal plates, with an inner range of smaller ones alternating, the latter usually covered by tufts of spines; a large pentagonal plate inserted at the base of the arms, on the lower side.

In this species, the arms are about twice as long as the width of the disc. There are about fifteen or sixteen plates in each range from the base to the apex of the arms. The range of plates margining the avenue are usually not visible, the whole being covered by the short spines, which also partially fill the avenue. A single specimen only has been discovered; but it is quite distinct from the species in the Lower Silurian strata, or from those known in a higher position.

Fig. 21. The lower side of the specimen, of the natural size.
Fig. 22. One of the arms enlarged.
Fig. 23. Several of the ossicula, with the short spines as they appear bordering the avenue.

Position and locality. In the shale at Lockport. (*Collection of* Col. JEWETT.)

The principal genera of Cystideæ, which have been described, are given in the table on a preceding page. Two other genera are added in the preceding descriptions, and one which is not positively ascertained, under Crinoideæ. To these we have to add another form in the *Pentamerus galeatus* limestone; above which, we have, yet, no well ascertained species of this family. It is not improbable, however, that we shall meet with species when more complete examinations are made in the higher rocks. It is not a little interesting to observe that the development of species in this family corresponds to the Crinoideæ; both being more numerous in the Niagara period, than in any preceding or succeeding period of the New-York strata.

Since the preceding pages were in type, a farther examination of a specimen of the CALLOCYSTITES, which was coated with hard shaly matter, has revealed the fingers or tentacula attached to the fragment of an arm still remaining. This has been figured on Plate 50, and completes the characters of this beautiful fossil. In the same figure, is shown more distinctly the longitudinal division between the bases of the arms upon the summit.

Further examinations among specimens of CARYOCRINUS have served to convince me that the orifice termed the *mouth* is not the only one existing upon the summit; and I am more inclined to regard the so called mouth as an ovarian aperture, corresponding to the organ of similar structure in the Cystideæ. In the description of this fossil, the mouth was regarded as being in the centre of the base of the triangle formed by the summit. No sufficient reason has been shown why this part assumes a triangular form, which is almost always apparent in well preserved specimens; but we have an explanation of the reason why the side on which the mouth is placed assumes a more direct line, from the wider space between the arms at that point. Now if we regard the mouth as posterior, we shall find on the left side, near the middle of one side of the triangle, an aperture or pore, which in some instances appears to be closed by small plates. In no instance where it has been sought for, in this position, have we failed to find some evidence of its existence. It has been impossible to pursue the examinations far enough to decide the nature of this organ, or whether it be simple or two organs.

I was led to search for an aperture in this position from the fact that the mouth and anal pore in the CALLOCYSTITES and APIOCYSTITES are always on the left side of the summit, regarding the ovarian aperture as posteal; and this aperture in CARYOCRINUS, bears the same relation to the mouth or ovarian aperture.

On the opposite or right side of the body of CARYOCRINUS, there is, in several specimens, some appearance of an aperture or tuberculous plate, which has not been sufficiently examined. These facts induce me to believe that there is a very close affinity between this genus and some of the cystidean genera.

BRACHIOPODA OF THE NIAGARA GROUP.

We find at this period large numbers of individuals of this family of fossils, though of comparatively few species. There is a manifest diminution in the number of species of *Lingula*, *Orthis* and *Leptæna ;* while we observe an increase among those of *Spirifer* and *Atrypa* over similar forms in the Lower Silurian period. This change, which was noticed in the Clinton group, becomes more conspicuous in the Niagara period ; showing not only a continuannce, but an increased intensity, of those causes which operated through successive periods of time, as manifested throughout the palæozoic era.

We have comparatively few new species among those which have fallen under observation, most of them having been published in this country or in Europe. We find in this family, as well as in others, that the fossils of the Niagara group correspond so closely (many species being identical) with those of the Wenlock limestone of Great Britain, that we can not hesitate to regard the two formations as synchronous. This geological parallel is in fact almost the only one that we can regard as fully established, except for the great groups below this, when taken together ; for we are not able to identify them individually. Neither are we able to identify the succeeding formations, except in a very general way. From some facts developed in relation to the succession of groups in this country, it would seem that we have, in a succeeding limestone and shale, another representation of the Wenlock formation, as these rocks are almost a repetition of the Niagara group. This formation, consisting of the limestone bearing *Pentamerus galeatus*, and of the " Delthyris shaly limestone," though separated from the Niagara group by many hundreds of feet, and in fact containing scarcely one fossil found in that group, seems to be, in Great Britain and elsewhere in Europe, merged in one formation with the Wenlock. Therefore it may appear that the fossils of the Niagara group will but imperfectly represent those of the same period in Europe ; and it will only be when we have brought together, in a succeeding volume, those of the higher rocks, that a full comparison can be made.

437. 16. LINGULA LAMELLATA.

Pl. LIII. Figs. 1 and 2.

Lingula lamellata. Hall, Geol. Rep. 4th District, 1843, pag. 108, fig. 2 ; descr. p. 109.

Oval, somewhat broader at the base ; surface marked by concentric elevated lamellæ ; lamellæ slightly undulating ; shell sometimes wrinkled at the margins ; base rounded.

Fig. 1. A specimen preserving the shell, and having the beak acute.

Fig. 2. A specimen where the shell is removed, leaving the surface with faint concentric lines and a few longitudinal striæ.

In the specimen fig. 1, there are a few longitudinal striæ visible beneath the shell. The specimen fig. 2 is proportionally broader and shorter than fig. 1, but there does not appear to be sufficient difference to constitute a distinct species.

Position and locality. In the shale of the Niagara group at Lockport, and at Rochester and Sweden in Monroe county.

610. 8. ORBICULA TENUILAMELLATA (*n. sp.*).

Pl. LIII. Fig. 3.

Circular; shell thin; surface marked by prominent thin concentric laminæ.

Imperfect specimens only have been seen, and the shell is extremely fragile. The thin elevated laminæ are particularly characteristic of the species.

Position and locality In the lower part of the limestone at Lockport.

611. 9. ORBICULA? SQUAMIFORMIS.

Pl. LIII. Fig. 4 *a*, *b*.

Orbicula squamiformis. Hall, Geol. Report, 1843, pag. 108, fig. 1.

Oval, very depressed, apex excentric; surface marked by strong concentric lamellæ, which are close together on the anterior, but diverging on the posterior part of the shell. Shell thin, translucent.

This shell has a different appearance from the *Orbiculæ* generally; and it is probably identical with *Patella? implicata* of Murchison's Silurian System, pag. 62, pl. 12, fig. 14 *a*.

Fig. 4 *a*. An individual of the natural size.

Fig. 4 *b*. The same enlarged, to show more distinctly the characters of the surface.

Position and locality. In the shale, and upon the thin calcareous layers in the same, at Lockport, and at Rochester and Sweden in Monroe county.

612. 25. ORTHIS PISUM.

Pl. LII. Fig. 1 *a* – *e*.

Reference *Spirifer? pisum*, Murchison, Sil. System, pag. 63, pl. xiii, fig. 9.

Lenticular, globulose; surface marked by fine concentric striæ; valves nearly equal, each valve with a slight depression down the centre; dorsal valve somewhat more convex, and the beak more elevated than the ventral valve; area narrow, small, scarcely extending beyond the width of the beaks at their base.

This fossil so closely resembles *Spirifer pisum* cited above, that I can scarcely doubt the identity of the two. I have referred it to Orthis from its general form, from one valve being smaller and somewhat flatter than the other, and from the narrow area which has so slight an

extension laterally. The depression on the dorsal valve, which is indicative of SPIRIFER, is also shown in the ventral valve, and there is usually a slight indentation in front.

This species is exceedingly like one in the Delthyris shaly limestone, though the latter is a stronger shell, and has usually a deeper indentation in front.

Fig. 1 *a*, *b*. Young specimens of this species.
Fig. 1 *c*. The ventral valve of a full grown individual, showing the beak of the dorsal valve.
Fig. 1 *d*. Profile view of the same, the shell slightly compressed.
Fig. 1 *e*. View of the beaks of the same.

Position and locality. In the shale at Wolcott, the only locality at which it has been observed.

613. 26. ORTHIS PYRAMIDALIS (*n. sp.*).

PL. LII. Fig. 2 *a* – *i*.

Subpyramidal, usually minute ; vertical valve flat, semicircular, with a depression along the centre ; dorsal valve extremely elevated at the beak ; area large, triangular, extending to the extreme angles of the cardinal line ; plane of the area vertical to the plane of the ventral valve ; surface of shell marked by strong diverging straight striæ, which, on the cardinal margins, scarcely reach the beak ; striæ sometimes dichotomous, and crossed by concentric lamellose striæ.

This peculiar little species is readily recognized by the pyramidal form and large triangular area of the dorsal valve. The species bears considerable similarity to the *O. disparilis* of the lower silurian strata, but it is less extended laterally, is proportionally longer, and the beak of the dorsal valve much more elevated. The number of plications in old shells of this species is about the same as in *O. disparilis*, but they are crossed by more elevated striæ. In the young shells the plications are often dichotomous, though not uniformly so.

Fig. 2 *a*, *b*, *c*, *d*. Dorsal, ventral, cardinal and profile views of a specimen of the ordinary size.
Fig. 2 *e*, *f*, *g*, *h*. Similar views of a much larger shell. The usual size is that of the preceding figures of which many specimens have been found, while but the single large one figured has been found.
Fig. 2 *i*. An enlargement of the surface, showing the sharp plications crossed by concentric striæ.

Position and locality. In the decomposing shale at Lockport.

440. 22. ORTHIS ELEGANTULA.

Pl. LII. Fig. 3 *a* – *r*.

Orthis elegantula. Dalman (not Von Buch), K. Vet. Acad. Handl. 1827, pag. 117, tab. 2, fig. 6 *a* – *e*.

— — Hisinger, Pet. Suecica, pag. 71, tab. xx, fig. 13 *a*, *b*, *c*.

O. canalis. Sowerby : Murchison, Sil. System, 1839, pag. 631, pl. 13, fig. 12.

O. canalis. Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 107 ; fig. 6, p. 105.

Compare *O. elegantula*? var., page 57, pl. 20, fig. 7, of this volume.

Shell semioval ; ventral valve nearly or quite flat, sometimes with a depression along the centre ; dorsal valve very convex, extremely elevated towards the beak, which is much extended and incurved over the area ; hinge-line shorter than the width of the shell ; area narrow, not extending to the extremities of the hinge-line ; surface covered with fine striæ, which are dichotomous towards the margin and arched towards the hinge-line. In the more perfect specimens, the diverging striæ are crossed by extremely fine concentric striæ.

This species is closely allied to *O. testudinaria*, and perhaps more nearly to *O. parva*, both of which are lower silurian species. In our specimens, however, the shell is usually more elongated and the beak more extended, while the surface is more finely striated, so that there is usually little difficulty in distinguishing it. It occurs in the Clinton group, though usually not in well preserved specimens, and in such a condition that it is not always easy to distinguish it from *O. testudinaria*.

M. de Verneuil cites this species from Perry county, Tennessee, which is in the same geological position. In the Delthyris shaly limestone of New-York there is a very similar species, but it is proportionally broader, more robust, and the dorsal valve more nearly carinated, while the beak is not so much extended ; the striæ are likewise stronger, and the ventral valve is usually convex. This species attains to a larger size than *O. elegantula ;* though at the time I first made the comparison in 1843, I had seen only specimens of about the same size.

Fig. 3 *a*, *b*. The dorsal valves of young individuals.

Fig. 3 *c*. The dorsal valve of a full grown individual, having the beak somewhat more extended than in other specimens, though by no means an unusual form.

Fig. 3 *d*. Ventral view of the same specimen.

Fig. 3 *e*. Profile view of the same specimen.

Fig. 3 *f*. Cardinal view of the same, showing the elevation of the dorsal valve.

Fig. 3 *g*. Ventral view of a shorter specimen.

Fig. 3 *h*. Cardinal view of the same.

Fig. 3 *i*. Cast of a dorsal valve of an elongated specimen.

Fig. 3 *k*. Cardinal view of the same.

Fig. 3 *l*, *m*. The interior of the dorsal valves of a young and full grown individual.

Fig. 3 *n*. The interior of a ventral valve, showing the muscular impression, lamellæ, etc.

Fig. 3 *o*. The same enlarged.

Fig. 3 *p*. The interior of a similar shell, showing a slight variation in character.

Fig. 3 *r*. Cardinal view of the same, showing the dental lamellæ, and the callosity at the apex of the foramen.

Position and locality. This species is found in all localities of the Niagara shale, from Wolcott in Wayne county, to the Niagara river. The species is eminently characteristic of the Upper Silurian period, occurring in the same position in Europe as it does over wide areas in the U. States.

614. 27. ORTHIS HYBRIDA.

Pl. LII. Fig. 4 *a - o*.

Orthis hybrida. Sowerby : Murchison, Sil. System, 1839, pag. 630, pl. 13, fig. 11.
— — Hall, Geol. Rep. 4th District, 1843, pag. 107 ; fig. 7, p. 105.

Lenticular or depressed spheroidal, wider than long ; valves nearly equal, the dorsal one depressed from the centre to the base, while the ventral valve is regularly convex, sometimes with a slight depression in the centre near the beak ; beaks almost precisely equally elevated, the dorsal one being scarcely incurved ; hinge-line much shorter than the width of the shell ; surface marked by thin sharp dichotomous striæ, which are arched upwards upon the sides and hinge-margin ; radiating striæ crossed by extremely fine concentric striæ, which are visible under a magnifier.

This species is readily distinguished by the near equality of the valves, one of which has a broad undefined depression along the centre. The surface characters are very similar to the preceding, but the form of the shell, or of the separated valves, is quite sufficient to distinguish it. The shell is rarely larger than the specimens figured, the prevailing size being about the same as those figured by Murchison.

Fig. 4 *a*, *b*, *c*. Figures of specimens showing three gradations of size.

Fig. 4 *d*, *e*. Cardinal and profile views of fig. 4 *c*, which is compressed, but still exhibits the usual proportions of specimens.

Fig. 4 *f*. A specimen having the valves more convex than usual.

Fig. 4 *g*. Profile view of the same specimen, showing the nearly equal convexity of the valves.

Fig. 4 *h*. A cardinal view of a specimen, showing the convexity of the dorsal valve, while the ventral valve is depressed in the centre. The dorsal valve is represented too extremely convex in this figure.

Fig. 4 *i*, *k*. The interior of the dorsal valve of this species, showing the muscular impression divided by a longitudinal ridge. On each side of this ridge there are two lobes or depressions, which are marked in the outline of the impression. Two strong diverging teeth project from the inner angles of the foramen.

Fig. 4 *l*. An enlargement of the muscular impression of the preceding specimen.

Fig. 4 *m*. The interior of the ventral valve, with a scarcely defined muscular impression having a strong ridge, proceeding from the central process, down the centre. The lateral teeth were originally strong, but have been broken off in the specimen figured.

Fig. 4 *n*. A cast of the ventral valve of this species, showing the bilobate character of the muscular impression, the cavities of the teeth, etc.

Fig. 4 *o*. An enlargement of the surface, showing the longitudinal diverging and fine concentric striæ.

Position and locality. This species occurs at all the localities of the shale from Wolcott to the Niagara river, but the best specimens have been found in the vicinity of the former place.

615. 28. ORTHIS PUNCTO-STRIATA (*n. sp.*).

Pl. LII. Fig. 5 *a-f*.

Sub-globose; valves nearly equal, extremely convex or inflated in the middle; beaks extended, that of the dorsal valve somewhat longer and incurved; hinge-line shorter than the width of the shell; area shorter than the hinge-line, comparatively rather broad, and occupying both valves; surface marked by fine equal striæ, which bifurcate at intervals on the upper part of the shell; depressions between the striæ, particularly in slightly worn specimens, punctate.

This species is readily distinguished from the preceding, or any other species of this period, by the extremely convex valves and strong prominent beaks, with a proportionally short hinge-line. The striæ are flattened, and the bifurcations take place mostly above the centre of the shell. The concentric striæ are extremely fine, and rarely preserved in the specimens examined. The puncta between the striæ give the surface a very peculiar and characteristic aspect.

Fig. 5 *a*. View of the ventral valve of a small specimen, showing the beak of the dorsal valve, and a part of the area above it.

Fig. 5 *b*. A profile view of the same specimen.

Fig. 5 *c*. A cardinal view of a larger specimen, showing the great convexity of the valves.

Fig. 5 *d*. A large dorsal valve which has been flattened by pressure.

Fig. 5 *e*. The interior of the same. The form of the muscular impression can not be ascertained, the shell being filled with calcareous matter.

Fig. 5 *f*. Several of the striæ enlarged, showing the puncta between.

Position and locality. This species was found in the lower part of the limestone at Lockport. (*Collection of* Col. Jewett.)

616. 29. ORTHIS FLABELLULUM, Var.?

Pl. LII. Fig. 6 *a-g*.

Orthis flabellulum (*a*)? Rep. 4th Geol. Dist. N. York, 1843, pag. 105, fig. 5, and p. 107.
Compare *Orthis flabellulum* (*a*), Sowerby in Murchison's Silurian System, pag. 639, pl. 21, fig. 8.

Shell semioval; hinge-line equal to the width of the shell; surface marked by twenty-four to thirty simple rounded plications, which are equal to the space between them; plications usually smooth, with the remains of concentric striæ crossing the depressions between, and

rarely appearing on the elevations; a few strong imbricating lines of growth near the base; cardinal area usually narrow, and extending to the extremity of the hinge-line.

This shell is usually much compressed, and both valves are flattened so as to appear equal. In more perfect specimens, the dorsal valve is more convex than the ventral. The foramen is broadly triangular, with a thin sharp tooth in the centre, and a stronger one on each side projecting into the centre; the muscular impression has a strong rounded ridge down the centre, with a depression on each side, but the margins are not well defined. The interplications, on the inside, appear to be duplicate, or have a groove along the centre. In some specimens, the plications on the interior extend but halfway to the beak; while in others, that are apparently of the same species, they extend to the muscular impression.

Fig. 6 *a*, *b*, *c*. Dorsal, profile and ventral view of a compressed specimen.
Fig. 6 *d*. The interior of a ventral valve, showing the characters described above.
Fig. 6 *e*. A cast of a ventral valve, having similar characters with the preceding, except that the marks of plications extend nearly to the beak.
Fig. 6 *f*. Cardinal view of a specimen, which is partially a cast, having external characters similar to fig. 6 *e*.
Fig. 6 *g*. Cardinal view of the specimen fig. 6 *a*.

Position and locality. In the shale of this group at Lockport, Rochester, Sweden, Wolcott and other places.

616. 29. ORTHIS FLABELLULUM? Var.?

Pl. LII. Fig. 7 *a* – *d*.

Specimen robust, both valves nearly equally convex; plications simple, strong, rounded, crossed by concentric striæ, and near the base by stronger lines of growth; area large, partly occupied by the ventral valve; beak of the dorsal valve much elevated.

I can find no essential characters in the single specimen I possess, to separate it from the preceding, if the cast fig. 6 *e* and the specimen fig. 6 *f* are admitted under this species. For the present, therefore, I shall unite the two.

Fig. 7 *a*, *b*. Dorsal and ventral views of the specimen.
Fig. 7 *c*. Profile view of the same.
Fig. 7 *d*. Cardinal view of the same.

Position and locality. In the shale of the Niagara group at Rochester.

617. 30. ORTHIS FASCIATA (*n. sp.*).

Pl. LII. Fig. 8 *a*, *b*.

Shell semioval; hinge-line sometimes extended beyond the width of the shell; surface striated; striæ in fascicles, which are almost simple at their origin, and divide into two prin-

cipal ones towards the margin, in each of which are four or five striæ ; a slight depression along the centre of the ventral valve.

The specimens figured are casts of the two valves, the one showing the hinge-line to be much more extended than the other. The striæ are evidently in distinct fascicles like *O. fissicosta* of the lower silurian strata, but it is a very different shell.

In a fragment of shale from Lockport, the surface of this shell is preserved, showing the concentric striæ crossing the diverging ones.

Fig. 8 *a*. A cast of the ventral valve, showing an extended hinge-line.
Fig. 8 *b*. A cast of the dorsal valve.

Position and locality. In the shale at Rochester and Lockport.

618. 24. LEPTÆNA TRANSVERSALIS.

Pl. LIII. Fig. 5 *a* – *l*.

Anomites transversalis. Wahlenberg, Act. Soc. Upsaliensis, 1821, Vol. iii, p. 64, n. 4.
Leptæna transversalis. Dalman, Vet. Acad. Handl. 1828, pag. 109, pl. 1, fig. 4.
— — Hisinger, Pet. Suecica, 1837, pag. 69, pl. 20, fig. 5.
— — Murchison, Silurian System, 1839, pag. 629, pl. 13, f. 2.
Strophomena transversalis. Hall, Geol. Report, 1843, p. 105, and fig. 4, p. 104.

Semicircular ; dorsal valve very convex ; ventral valve extremely concave, conforming to the dorsal valve ; hinge-line inflected, equal to or longer than the width of the shell below. Surface marked by distant elevated striæ or ribs, with the interstices more finely striated : a few strong concentric lines of growth sometimes occur near the base.

This shell resembles *L. sericea* in the characters of the surface ; but it is usually less extended laterally, proportionally longer, and much more convex. The cast of the shell likewise presents a very different character, being striate or puncto-striate instead of punctate only. It is one of the most common shells of the shale, but it is nevertheless difficult to obtain good specimens.

Fig. 5 *a*, *b*, *c*. Dorsal and ventral views of two small individuals, where the hinge-line is much extended into acute points.
Fig. 5 *d*. A larger specimen, where the hinge-line is slightly extended on one side, while the other is less extended.
Fig. 5 *e*, *f*. Dorsal and ventral views of a large individual, having the hinge-line slightly extended. Individuals so large as this one are rarely found.
Fig. 5 *g*. Cardinal view, showing the extreme convexity of the dorsal valve, and the inflection of the cardinal margin.
Fig. 5 *h*. An enlargement of the surface, showing the coarser striæ with intermediate finer ones.
Fig. 5 *i*. The interior, showing a striato-punctate character, with reticulations like the lines of bloodvessels.
Fig. 5 *k*. The interior of the ventral valve, showing the strong parallel laminæ, and prominent points on either side for the muscular attachment.

Fig. 5 *l*. A profile or cardinal view of the preceding specimen, showing the strong elevated laminæ for muscular attachment.

This feature of the interior is quite peculiar, and is alone sufficient to distinguish the species.

Position and locality. This species is more abundant in the vicinity of Rochester, than at any other locality examined. It is also common at Marshall's mill in Sweden, and at Wolcott in Wayne county, and less abundant at Lockport and other western localities. In England, it occurs in the Wenlock Limestone, and in the same position in the Island of Gothland.

448. 23. LEPTÆNA DEPRESSA.

Pl. LIII. Fig. 6 *a* – *l*.

Dritte Anomiten art mit breiter schlosskante. Hupsch, Naturg. des Neiderdeutschland, 1781, Vol. 1, pag. 15, pl. 1, fig. 7 & 8.
Anomites rhomboidalis. Wahlenberg, Acta Soc. S. Upsaliensis, 1821, Vol. viii, pag. 65, no. 7.
Producta depressa. Sowerby, Genera of Shells.
— — Id. Min. Conchology, 1825, Vol. v, pag. 86, pl. 459, fig. 3.
Producta rugosa. Hisinger, Vet. Acad. Handlingar, 1826, p. 33.
Productus depressus. Defranc, Dict. des Sciences naturelles, 1826, Vol. xlvii, 353.
Leptæna rugosa. Dalman, Vet. Acad. Handlingar, 1827, pag. 106, pl. 1, fig. 1.
Leptæna depressa. Id. Ibid. pag. 107, pl. 1, fig. 2.
Strophomena rugosa. Bronn, Leth. geognostica, 1825, Vol. i, pag. 87, pl. 2, fig. 8.
Producta depressa. Phillips, Geol. Yorkshire, 1846, Vol. ii, pag. 215, pl. 8, fig. 18.
Productus depressus. Deshayes, 2d Edit. Lamarck An. sans vertebres, Vol. viii, p. 380.
Leptæna rugosa and *L. depressa.* Hisinger, Leth. suecica, 1837, pag. 69, pl. 20, fig. 2 & 3.
Orthis rugosa. Von Buch, Ueber Delthyris, 1837, p. 70.
Leptæna. Fischer, Oryct. du Gouv. du Moscou, 1837, p. 143.
Leptæna depressa. J. Sowerby in Murchison's Sil. System, 1839, pag. 623 & 636, pl. 12, fig. 2.
L. tenuistriata[?]. Id. Ibid. pag. 636, pl. 22, fig. 2 *a*.
L. rugosa. Id. Trans. Geol. Soc. London, 1840, 2d series, Vol. v, pl. 56, fig. 4.
Orthis rugosa. Eichwald, Sil. Syst. in Esthland, p. 162.
Leptæna rugosa. Phillips, Pal. Fossils, 1841, pag. 57, pl. 24. fig. 95.
L. depressa. De Koninck, Desc. An. Foss. de Belgique, 1842, pag. 215, pl. 12, fig. 3, 4, 5, 6; pl. 13, fig. 6.
L. — G. B. Sowerby, Conch. Manual, 1842, pag. 71, and pag. 300, fig. 206.
Orthis rugosa. D'Archiac and De Verneuil, Trans. Geol. Soc. London, 1842, 2d series, Vol. vi, part 2, p. 396.
Strophomena depressa. Vanuxem, Geol. Rep. 3d Dist. New-York, 1842, pag. 79, fig. 5.
S. undulata. Id. Ibid. pag. 139, fig. 3.
S. depressa. Hall, Geol. Rep. 4th Dist. New-York, 1843, pag. 77, fig. 5; pag. 104, fig. 2.
Orthis rugosa. C. F. Rœmer, Rhein. Uebersgangsgebirge, 1844, pp. 85 & 90.
Leptæna depressa. De Verneuil, Geol. Russia and the Urals, 1845, Vol. ii, pag. 234, pl. 15, fig. 7.

Shell semioval or semicircular; hinge-line equal to, or extending beyond the width of the shell; dorsal valve having the upper part nearly flat, slightly convex or even concave, with

strong concentric undulations, towards the margin abruptly inflected ; ventral valve parallel to the dorsal valve, presenting a deep concavity. Surface marked by prominent radiating striæ.

The cardinal area is narrow, and extended to the extremities of the hinge-line ; the foramen is broad and spreading, but filled by a callosity of the ventral valve, which has a narrow groove at its summit for the protrusion of the pedicle ; the apex of the dorsal valve is often, and perhaps always, perforated.

The flatter portions of both valves are strongly marked by concentric undulations, which are crossed by finer striæ. On the deflected portion there are no undulations, the striæ alone marking the surface. Sometimes the shell is nearly flat, the deflected portion being either very narrow, or not at all conspicuous. The undulations are variable in number, even in shells of the same size, and are not to be relied upon as characteristic ; and in very old shells they are not so strong as in younger ones, or those of medium size. The striæ crossing the undulations are likewise variously prominent in different individuals, frequently bifurcating, and in well preserved surfaces are crossed by fine concentric striæ. The interior structure is always peculiar and sufficiently characteristic, though the exterior characters are very closely simulated by a different shell in the Shaly limestone of the Helderberg.

This species has a wide range, occurring in the Clinton group, and ranging to the Upper Helderberg limestones ; and if we include the similar or identical species *L. tenuistriata* as the same, we have the example of a species ranging from Lower Silurian to Devonian, and traversing three systems of strata. M. de Verneuil, after examining this species on both sides of the Atlantic, and from all the various positions, has concluded that it is identical in all, and must be regarded as one species. The specimens from the lower rocks are always smaller, the undulations fewer, and the valves less extremely inflected than those of the middle or upper silurian, but I have had no opportunity of seeing their internal structure.

Fig. 6 *a*, *b*, *c*. Dorsal and ventral views of young specimens, where only a narrow portion of the margin is deflected.

Fig. 6 *d*. A larger individual.

Fig. 6 *e*. An individual of the ordinary full grown size, regarded as a mature form.

Fig. 6 *f*. A very large individual, having the undulations more numerous, but less conspicuous than in fig. 6 *e*. The extremities of the hinge-line are much extended into acute points.

Fig. 6 *g*, *h*. Dorsal view of two small individuals, showing a slight difference in the character of the foramen, etc.

Fig. 6 *i*. The interior of a ventral valve, showing the muscular impression and dental laminæ. The specimen is imperfect, but is the only one from this group in which I have been able to see the internal structure.

Fig. 6 *k*. The interior of the shell, showing the punctate surface.

Fig. 6 *l*. The exterior striated surface, with fine concentric striæ crossing them.

Position and locality. In the shale at Lockport, Rochester, Sweden, Wolcott and other places : rarely in the limestone of the group. It is extremely common in Europe in the same

geological position, as well as in the succeeding strata. (See the same in fossils of Lower Helderberg rocks.) (*State Collection.*)

619. 25. LEPTÆNA STRIATA.

Pl. LIII. Fig. 7.

Strophomena striata. Hall, Geol. Rep. 4th District, 1843, pag. 104, fig. 3.
Compare *L. corrugata*, page 59 of this volume.

Shell semielliptical; hinge-line equal, or a little longer than the width of the shell; dorsal valve slightly convex, ventral valve flat. Surface finely striated; striæ crossed by concentric striæ, which are not always conspicuous.

I have been unable to obtain specimens of this shell in a condition to examine the interior, and I have some doubts regarding its specific distinction. The striæ are apparently more round than in *L. subplana;* but in a few specimens I have detected some slight plications near the hinge-line, which, with the round concentric striæ, give it the appearance of *L. corrugata* of the Clinton group.

All the specimens examined are extremely compressed, and closely adhering to the shaly laminæ.

620. 26. LEPTÆNA SUBPLANA.

Pl. LIII. Figs. 8 – 10.

Strophomena subplana. Conrad, 1842, Jour. Acad. Nat. Science, Vol. viii, p. 258.
— — Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 104, fig. 1.

Shell resupinate, semielliptical, length and width often nearly equal; hinge-line extending beyond the width of the shell. Surface marked by prominent sharp striæ, which frequently bifurcate before reaching the margin; radiating striæ crossed by strong concentric striæ. Cardinal area extending to the extremities of the hinge-line, narrow, partially formed by both valves.

In a few well preserved specimens the sharp dichotomous striæ are well preserved, having the character described by Mr. Conrad; while in other specimens, apparently of the same species, the radiating striæ are less prominent, and less conspicuously crossed by concentric striæ. The specimen fig. 10 *a* has precisely the characters of the one described by Mr. Conrad, as I have ascertained by comparison; but those of figs. 8 and 9 have more rounded striæ, and are somewhat proportionally shorter. I have not, however, been able to find decisive characters for the separation of species.

Fig. 8 *a*. The interior of the convex valve of a young individual, where the width is greater than the length, the extremities of the hinge-line being extended beyond the width of the shell below.

Fig. 8 *b*. A specimen from which the shell is partially removed, showing, near the beak, the form of the muscular impression, etc.

Fig. 8 *c*. The striæ enlarged.

Fig. 9 *a*. Cast of the ventral valve, apparently identical with the preceding, showing the muscular impression and the remains of the dental laminæ.

Fig. 9 *b*. The interior of the valve of another specimen, showing the dental laminæ of the same form as in the preceding figure.

Fig. 10 *a*. A large individual having sharp prominent striæ which are dichotomous, and crossed by finer striæ, which remain in the depressions only.

Fig. 10 *c*. Several of the striæ enlarged, showing the concentric striæ.

Fig. 10 *b*. Cardinal view of another similar specimen, showing the narrow extended area and foramen.

This shell has the character of an ORTHIS in many respects. The valves are almost equally convex, one being usually quite flat, except near the beak; while the other is plano-convex at the beak, and slightly convex below. I have united the forms given above, believing them to belong to the same variable species, the different appearances being often caused by partial exfoliation of the shell.

Position and locality. This species occurs in the shale at Lockport, the most perfect specimens being found adhering to the thin calcareous layers. In other localities this shell is less conspicuous, though occurring at Rochester and Wolcott, and probably at intermediate places.

621. 4. SPIRIFER BILOBUS (LINNE).

PL. LIV. Fig. 1 *a* – *k*.

Anomia. LINNE, Syst. p. 1154.
Terebratula sinuata. SOWERBY in Linn. Transactions, Vol. xii, p. 516, t. 28, f. 5 and 6.
Terebratula cardiospermiformis. HISINGER, Acta. Soc. Holmiensis, Vol. iv, p. 18, pl. 7, f. 6.
Delthyris? — DALMAN, Vet Acad. Handl. 1827, pag. 124, tab. iii, fig. 7.
— — HISINGER, Petref. Suecica, 1837, p. 74, t. 21, f. 9.
Spirifer cardiospermiformis. VON BUCH, Sur les Spirifer et Orthis, T. 1, f. 7.
— *sinuatus.* SOWERBY in MURCHISON's Sil. System, 1839, pag. 630, pl. 13, fig. 10.
Delthyris sinuatus. HALL, Geol. Rep. 4th Dist. N. York, 1843, pag. 105, fig. 8.

Shell bilobate, obcordate, sinuate in front; extremities of the cardinal line auriculate; dorsal valve very convex, arcuate; ventral valve flat or slightly concave (rarely a little convex); area comparatively large, triangular, with a distinct triangular foramen; surface striated; striæ dichotomous or in fascicles, radiating from the apex to each lobe of the shell; concentrically marked by fine striæ, which are deeply arched or sinuate in the sinus of each valve; hinge-line of ventral valve marked on its inner margin by three simple teeth.

This peculiar little species is readily distinguished from any other known, except a closely allied form in the Delthyris shaly limestone. Our species is evidently identical with the European one, as proved by a comparison with Swedish specimens, and the figures in the Silurian System cited above. The species of the shaly limestone of New-York attains a larger

size than that of the Niagara group; the cardinal area is proportionally smaller, and the hinge-line less extended; likewise the ventral valve is always more or less convex, particularly in the upper part, while in very rare instances the Niagara species has the ventral valve a little convex. The dorsal valve also of the Niagara species is much more arcuate than the other species, and the surface is marked by fewer striæ.

The Niagara species is extremely rare, so far as we at present know; while the species of the shaly limestone is extremely abundant, not less than fifty thousand specimens having been collected in a single locality within a few years.

Fig. 1 *a*, *b*. Ventral and dorsal view, where the extremities of the hinge-line are scarcely extended.
Fig. 1 *c*, *d*. Another specimen, where the extremities of the hinge-line are auriculate.
Fig. 1 *e*. Front view of a specimen, showing the bilobate character.
Fig. 1 *f*, *g*. Profile views of two specimens, one of which is much more convex than the other.
Fig. 1 *h*, *i*. Enlarged figures of a specimen, representing the prevailing form.
Fig. 1 *k*. Interior of the ventral valve.

Position and locality. In the shale of the Niagara group at Wolcott, and rarely at Lockport.

622. 5. SPIRIFER SULCATUS.

Pl. LIV. Fig. 2 *a* - *k*.

Delthyris sulcatus. Hisinger, Petref. Suecica, 1837, pag. 73, pl. xxi, fig. 6.
Terebratula. Hisinger, Anteckn. v, tab. iii, fig. 2.
Spirifer octoplicatus?. Sowerby : Murchison, Sil. System, 1839, pag. 624, pl. 12, fig. 7.
Delthyris rugatina. Conrad, Jour. Acad. Nat. Sciences, 1842, Vol. viii, p. 261.
Delthyris decemplicatus. Hall, Geol. Rep. Third District, 1843, pag. 105, fig. 4.
Not *Spirifer plicatus**, Sharpe (*Orthis plicatus*, Vanuxem; *Delthyris plicatus*, Hall), Quart. Jour. Geol. Soc. London, no. 15, p. 177.

Shell subtriangular, gibbous; valves subequal; cardinal line more or less extended, often mucronate at the extremities; surface plicated; plications four to seven on each side of the mesial fold and sinus, crossed by strong imbricating lamellæ, and longitudinally marked by fine striæ which are interrupted by the edges of the lamellæ; mesial fold of the dorsal valve very deeply impressed towards the base of the shell.

This species is readily distinguished by its roughly lamellate or rugose surface, which is usually preserved in a tolerable degree of perfection. The only species of the same period which approaches it in character is the *S. crispus*, which has an evenly striated surface, and less prominent plications. There is a species in the shaly limestone of the Helderberg which possesses the characters of this species even in a higher degree, but the shell is much larger, and very robust. A comparison of the Niagara species with Swedish specimens of *S. sulcatus*

* This species is quite distinct from the *S. sulcatus*, and is restricted to the tentaculite limestone or water-lime, and the lower part of the *Pentamerus galeatus* limestone, in New-York, being separated from the Niagara group by the entire thickness of the Onondaga-salt group.

proves the identity of the two, while the *S. octoplicatus* can only be considered as a representative form in the Carboniferous period.

This species is one of the most common forms in the Niagara group, always associated with the following species, which is far less abundant.

Fig. 2 *a*. A small specimen, having the cardinal extremities scarcely extended.
Fig. 2 *b*, *c*. Views of specimens where the cardinal line is extended into mucronate points.
Fig. 2 *d*. An unusually large specimen, having the hinge-line less extended than the preceding.
Fig. 2 *e*. A specimen where the length and breadth are nearly equal, though the specimen appears to retain its natural proportions.
Fig. 2 *f*. Front view of fig. 2 *b*.
Fig. 2 *g*. Front view of 2 *e*.
Fig. 2 *h*, *i*. Profile views of different specimens.
Fig. 2 *k*. An enlargement of the surface, showing the longitudinal striæ crossing the lamellæ.

Position and locality. In the shale of the Niagara group at Lewiston, Lockport, Rochester, Wolcott, and other places.

623. 6. SPIRIFER CRISPUS.

Pl. LIV. Fig. 3 *a* – *k*.

Terebratula crispa. Hisinger, Act. R. Acad. Sc. Holmiensis, 1826, tab. vii, fig. 4.
— — Id. Anteckn. iv, t. vii, fig. 4.
Delthyris crispus. Dalman, Vet. Acad. Handl. 1827, pag. 122, tab. iii, fig. 6.
— — Hisinger, Petref. Suecica, 1839, p. 73, t. xxi, f. 5 *a*, *b*.
Spirifer crispus. Sow. in Murchison's Sil. System, 1839, pag. 624, pl. 12, fig. 8.
Delthyris staminea. Hall, Geol. Rep. 4th Dist. N. York, 1843, pag. 105, fig. 3, and p. 106.

Shell subrhomboidal (ventral valve semicircular), gibbous; valves very unequal, the dorsal one extremely convex, and the beak extended and incurved; surface marked by five or six, rarely eight, plications on each valve, which are sometimes obsolete, concentrically marked by fine elevated thread-like striæ; area broad, with the cardinal extremities short; foramen long, narrow.

This shell is readily distinguished from the last, by the slightly elevated and often obsolete plications, which are crossed by fine, closely arranged simple striæ. A careful examination of these striæ under a magnifier shows that, between and upon the striæ, the surface is thickly set with minute setose points, giving a semistriated appearance to the surface. This feature is not ordinarily visible, and it appears to have been abraded by very slight attrition. In the more perfect condition of the shell, the beaks of the two valves are widely separated, presenting a broad cardinal area; but in many specimens, either from pressure or other causes, the beaks approach each other, and the proportions of the shell differ little from the preceding species.

A comparison with Swedish specimens shows no difference of character; and it is there, as here, associated with *S. sulcatus* in the same rock, and in the same locality. The same is likewise true of these species in the Wenlock formation of England. This one, like the pre-

ceding, has its representative in the shaly limestone of the Helderberg, where a larger species presents the same characters of surface in all its details.

Fig. 3 *a*, *b*, *c*. Ventral views, presenting the ordinary characters of well preserved specimens.
Fig. 3 *d*. An individual, still preserving its natural proportions, where the beaks are widely separated, with a broad cardinal area and little extension of the cardinal extremities.
Fig. 3 *e*, *f*, *g*. Profile views of three specimens, showing the variable elevation of the beak of the dorsal valve, and width of the area.
Fig. 3 *h*, *i*. Front views of specimens, showing a different proportional convexity.
Fig. 3 *k*. A portion of the surface enlarged.

Position and locality. In the shale at Lockport, Lewiston, and rarely in other places.

624. 7. SPIRIFER BICOSTATUS.

Pl. LIV. Fig. 4 *a* - *e*.

*Orthis bicostatus**. Vanuxem, Geol. Rep. 3d Dist. N. York, 1842, pag. 91 and 94.

Somewhat obovate-triangular, the dorsal valve gibbous, with the beak extended and incurved over a short triangular area; ventral valve convex; surface marked by conspicuous concentric subimbricating striæ; dorsal valve with a distinct plication on each side of the sinus, and towards the base are two other obscure plications on each side, presenting three and sometimes four gentle undulations on the margin on each side of the centre; cardinal line shorter than the width of the shell, and the area scarcely extending so far as the cardinal line; extremities distinctly rounded.

This species is intermediate in its characters between *S. crispus* and *S. ptychodes*. The concentric striæ are slightly dissimilar from those of *S. crispus*, in appearing to imbricate more distinctly. The plications, except one on each side of the sinus of the dorsal valve, rarely reach the beak, and usually appear only near the base or on the margin. It may be readily confounded with *S. crispus;* but the shorter hinge-line, and abrupt curving of the striæ at the extremities, are sufficient to distinguish it from that species, even where the plications are insufficient.

The specimen figured has the ventral valve compressed, and I have not been able to see one with this valve perfect, though the dorsal valve is not uncommon.

Fig. 4 *a*. Dorsal valve of an individual of this species.
Fig. 4 *b*. Ventral view of the same, showing the area and foramen, the beak of the ventral valve being broken off.
Fig. 4 *c*. Profile view, showing the form of the dorsal valve.
Fig. 4 *d*. Front view, in which the elevation of the ventral valve is given as it appears to have been in its perfect state.
Fig. 4 *e*. An enlarged portion of the surface, showing the character of the striæ.

* This species was labelled by Mr. Conrad, in Mr. Vanuxem's collection, *Orthis bicostatus;* but the name has been published, so far as I know, only in the report of Mr. Vanuxem cited above.

Position and locality. This species occurs in the limestone of the Niagara group, in its eastern extension into Oneida county. The only place I have been able to find it, is at the locality cited by Mr. VANUXEM, on the banks of the creek a short distance west of Vernon centre. At this place the shells appear upon the surface of the thin layers of limestone, and I have been unable to obtain any perfect specimens.

625. 8. SPIRIFER NIAGARENSIS.

PL. LIV. Fig. 5 *a* – *t*.

Delthyris niagarensis. CONRAD, Jour. Acad. Nat. Science, 1842, Vol. viii, p. 261.
— — HALL, Geol. Rep. 4th District, 1843, pag. 105, fig. 1.

Semioval or semicircular, convex or moderately gibbous in the centre, and compressed towards the sides; valves nearly equally convex; dorsal valve having the beak elevated and incurved over the area; area medium width; hinge-line usually shorter than (rarely extended beyond) the width of the shell, with the extremities rounded. Surface marked by twenty to thirty rounded, depressed plications (in young shells not more than ten or twelve), longitudinally striated by fine equal striæ, which are equally conspicuous on the mesial sinus and elevation.

This shell is typical of the Niagara group, and is always readily recognized by its rounded plications, which are evenly striated in a longitudinal direction. There is usually a stronger line in the depression between the plications. The surface is similarly striated to the margins, but the plications gradually die out towards the cardinal extremities. The area in perfect shells is of medium width, but usually appears as if very narrow, and the valves nearly closed, from compression. From its large size, it is rarely found in a good state of preservation, and the valves are often distorted and compressed, giving an outline very different from the natural form. Although having a wide horizontal range, its vertical range is extremely limited, occurring in considerable numbers only through a very limited thickness of the shale, and rarely in the limestone above.

Fig. 5 *a*, *b*. Ventral and dorsal views of a young specimen, which has only about five or six defined plications on each side of the mesial fold and sinus.

Fig. 5 *c*. Front view of the same.

Fig. 5 *d*. Profile view of another more gibbous specimen.

Fig. 5 *e*, *f*, *g*. Ventral, front and profile views of a well preserved specimen, which has about eight defined plications on each side of the mesial sinus and fold.

Fig. 5 *h*, *i*. Ventral and profile views of a well preserved specimen, of the ordinary size of this species.

Fig. 5 *k*. A flattened dorsal valve of about the same size as the preceding specimen, showing the change in form produced by compression.

Fig. 5 *l*. A flattened ventral valve of a specimen somewhat larger than the preceding. This condition of specimens is a very common one in the shale: indeed the perfect form is the exception.

Fig. 5 *m*. A large specimen, having the form well preserved, but the angles at the extremities of the hinge-line worn off and rounded.

Fig. 5 *n*. Front view of the specimen fig. 5 *h*.

Fig. 5 *o*. Cardinal view of a small specimen, where the area is nearly closed.

Fig. 5 *p*. Cardinal view of a specimen where the lower part of the shell is compressed, leaving the area exposed to a greater extent than in ordinary specimens. This specimen shows also that the ventral valve has a narrow area and a partial foramen.

Fig. 5 *r*. The interior of a dorsal valve, showing the strong lamellæ on each side of the triangular foramen, extending down to the centre of the valve, with a central stronger one.

Fig. 5 *s*. An enlargement of the striæ.

Fig. 5 *t*. Section of the plications, showing their form and the number of striæ upon the surface.

Position and locality. In the shale of the Niagara group at Wolcott, Rochester, Sweden, Lockport, and near Lewiston on the Niagara river.

452. 3. SPIRIFER RADIATUS.

PL. LIV. Fig. 6 *a* -*f*.

For references and synonymes, see page 66 of this volume.

Delthyris cyrtæna. DALMAN, Vet. Acad. Handl. 1827, t. iii, f 4.

Delthyris bialveatus. CONRAD, Jour. Acad. Nat. Sciences, Vol. viii, p. 261.

I am unable to distinguish any difference between the *S. radiatus* and the specimen figured by Mr. CONRAD, which is broken and otherwise mutilated. This shell does not always present the same appearance in the soft shale of the Niagara group as in the limestone of the Clinton group, but there is no evidence of the existence of a distinct species. The width of the area is variable, and so also the form of the foramen, which is often triangular, and sometimes long and nearly linear, varying with the proportions of the area. The striæ are flat, bifurcating, and rarely interrupted by lines of growth.

M. DE VERNEUIL cites* the *S. cyrtæna* of DALMAN as occurring at Lockport with *S. niagarensis*, and occupying the same position as in Europe. A careful comparison of our specimens with specimens of *S. cyrtæna* from Gothland, and specimens of *S. radiatus* of SOWERBY from Dudley, has convinced me that there is but a single species; and our specimens show, in a still greater degree, the variable character mentioned by DALMAN. In the Swedish specimens the margin is usually plicated, the rounded plications sometimes extending halfway to the beak; while in others they are only visible in the undulating outline, and sometimes are quite free from such characters. This plication of the margin appears not to be unfrequent in the Dudley specimens, judging from those I have seen, and we may therefore regard the specimens from these localities as identical. In all the American specimens I have seen, there is no evidence of this plication of the margin or surface, though in other respects they are almost identical with the specimens from Dudley, and it is not easy to point out any important characters by

* Note sur le parallelisme des depôts palæozoiques de l'Amérique Septentrionale avec ceux de l'Europe, &c.

which they may be separated from the Swedish specimens. In well preserved specimens from Gothland, the striæ are sharp, or round and prominent, and crossed by conspicuous elevated concentric striæ, which, towards the margin, are undulated upon the elevations and depressions of the plications. All the New-York specimens I have seen are destitute of the concentric striæ, and the longitudinal striæ are often flattened. This character, however, may arise from abrasion or partial exfoliation; and, in the shale, the presence of iron pyrites, producing solution of the surface by sulphuric acid, is a probable cause of the absence of the more minute surface markings.

It is not a little interesting to the palæontologist and zoologist to consider the fact, that while we have no evidence of a plicated surface in this species from the New-York (and probably all American) strata, we yet have another species of similar form, and a similarly striated surface, which is distinctly plicated from beak to base, and never deviates even in the youngest specimens seen. This species (the *S. niagarensis*) appears to be unknown in Europe, where the other species is common. We can not avoid the thought that the manifestation of a peculiar feature in the *S. radiatus* of Europe was more strongly developed in a distinct, but allied form, in the western ocean, and which now appears as a characteristic species of the Niagara period.

Fig. 6 *a*, *b*. Ventral and front view of a small specimen.

Fig. 6 *c*. A large specimen entirely flattened, which causes the beak to project as shown in the figure.

Fig. 6 *d*. A specimen from which the shell is partially exfoliated, showing the form of the muscular impression.

Fig. 6 *e*. Cardinal view of the same, showing the entire extent of the dorsal area and foramen, which is partially closed above, and broadly triangular. This feature is in remarkable contrast to many specimens in the Clinton group as shown on plate 22.

Fig. 6 *f*. The interior of a dorsal valve, showing the extension of the plates or laminæ on each side of the foramen, with a central one commencing below the beak.

This character corresponds precisely with the *S. niagarensis* (see fig. 4 *r*), where the interior of a small dorsal valve is shown. This coincidence increases the interest in the similar external characters of the two species.

Position and locality. This species is not common in the shale of the Niagara group, though occurring in many localities in the lower part of the same, associated with the preceding species.

626. 9. SPIRIFER PYRAMIDALIS (*n. sp.*).

Pl. LIV. Fig. 7 *a* – *e*.

Compare *Delthyris elevata*, Dalman, Vet. Acad. Handl. 1827, pag. 120, t. iii, f. 3.

Shell pyramidal; dorsal valve extremely elevated; beak acute; area vertical or slightly bent forwards; foramen linear, filled by a projecting callosity; ventral valve semicircular, nearly flat, or convex only along the mesial fold; surface plicated; plications subangular, about five on each side of the mesial fold and sinus, crossed by fine threadlike striæ.

This species is evidently closely allied to *D. elevata* of DALMAN; but the apex is not incurved, and in two specimens examined the foramen is narrow and linear, and filled by a projecting callosity, unlike the representations in DALMAN's figures. It is possible that a comparison of specimens, which I have had no opportunity of making, will show a more close alliance than appears from the figure.

This is an extremely rare species, two only having been seen. It is allied in form to a species in the shaly limestone of the Helderberg, and to another in the Hamilton group, but is distinct from either.

Fig. 7 *a*. The ventral valve of this species.
Fig. 7 *b*. Dorsal valve of the same.
Fig. 7 *c*. Cardinal view, showing the area and long linear foramen which is closed.
Fig. 7 *d*. Profile view of the same.
Fig. 7 *e*. Several of the plications enlarged, showing the concentric striæ.

Position and locality. The only two specimens seen were collected in 1837, from near the top and just below the edge of the cliff on the Niagara river above Lewiston. It has not been seen in any other locality, and is doubtless a very rare species.

NOTE.

TEREBRATULA, ATRYPA, HYPOTHYRIS, &c.

In the present state of our knowledge, and in the divided or unsettled opinion of authors upon this subject, I have preferred to allow the fossils of this family of the Brachiopoda to remain under the Genus ATRYPA, to which, strictly, many of them do not belong. I am averse to using the name *Terebratula* indiscriminately, according to most of the European continental authors: neither does it appear well established that all the subdivisions proposed are tenable, or founded upon structural characters of sufficient importance. That the whole group requires a reorganization, is but too apparent; but we have, in attempting to introduce DELTHYRIS, STROPHOMENA, and other genera of Brachiopoda, occasioned, to beginners, more confusion and uncertainty than advantage. These reasons, therefore, must be my apology for leaving, for the present, these species under the Genus ATRYPA.

627. 41. ATRYPA NITIDA.

PL. LV. Fig. 1 *a* – *o*.

Atrypa nitida. HALL, Geol. Rep. 4th Dist. N. York, 1843 : Tables of Organic Remains of Niagara Group, No. 14, fig. 5.

Shell ovoid, with the beaks more or less extended ; surface smooth, or with fine concentric striæ and a few conspicuous lines of growth towards the base, and sometimes on the middle of the shell ; valves nearly equally convex, the beak of the dorsal valve being much elevated above, and incurving over the ventral valve ; the dorsal valve sometimes marked, near the base, by a longitudinal depression.

This is a very abundant species in the shale at Lockport, where it presents considerable variety of form and proportions. It is usually remarkable for its smooth surface, interrupted only by a few lines of growth on the middle or towards the base, the finer concentric striæ being obsolete or invisible to the naked eye. In some individuals the shell becomes thickened near the base, and marked by very strong lines of growth.

We find no difficulty in tracing the characters of the species from the most minute specimen figured to the largest (fig. 1 *l*) ; beyond which it is difficult to find specimens showing a gradation to the larger individuals of fig. 2 and 3, which are closely allied forms, and perhaps only varieties of the same species.

Fig. 1 *a*, *b*, *c*. Ventral views of three individuals of small size.
Fig. 1 *d*. Profile view of fig. 1 *c*.
Fig. 1 *e*. A gibbous specimen, where the outline is narrow in proportion to the length.
Fig. 1 *f*. Profile view of the same specimen.
Fig. 1 *g*. Front view of the same.
Fig. 1 *h*, *i*, *k*. Ventral, profile and front views of a specimen, where the valves are very much thickened towards the bases.
Fig. 1 *l*. A large individual of the same species.
Fig. 1 *m*, *n*. Profile and cardinal views of other specimens.
Fig. 1 *o*. Ventral view of a large specimen, which is inequilateral from pressure. This feature is very common ; and the specimens being usually compressed, and often elongated, give the impression that there is a distinct species presenting these characters. It will be found, however, that this is only an accidental character, and often occurs in the shorter and more gibbous specimens.

Position and locality. This species occurs in every part of the shale of the Niagara group, and in some localities is quite abundant. The most prolific locality is at Lockport, but it is of common occurrence at all the exposures of the shale as far eastward as Rochester, and is found at Wolcott in Wayne county.

628. 42. ATRYPA NITIDA, Var. OBLATA.

Pl. LV. Fig. 2 *a, b.*

Shell subglobose, oblate, wider than long; surface marked by fine concentric striæ; a broad and undefined mesial depression towards the base of the dorsal valve.

This species possesses many features in common with the preceding, though its greater size, and want of connexion by specimens of intermediate size, induces a belief that it may be a distinct species.

Fig. 2 *a.* Ventral view of a specimen of this variety.
Fig. 2 *b.* Dorsal view of a large specimen.

Position and locality. In the shale at Lockport, and at Marshall's mill, Sweden, Monroe county.

629. 43. ATRYPA —— (*Species undetermined*).

Pl. LV. Fig. 3 *a - e.*

Shell subglobose; length a little greater than the width; dorsal valve very gibbous, with a depression from the centre to the base; surface marked by concentric striæ and stronger lines of growth; beak of dorsal valve small, acute, and strongly incurved.

This species is allied to the preceding variety of *A. nitida*, but presents a slightly different form, a more defined and conspicuous sinus on the dorsal valve, which is more gibbous and has a more acute and incurved beak. The cast presents some peculiarities which I have not been able to see in casts of *A. nitida.*

Fig. 3 *a.* Dorsal view of this species.
Fig. 3 *b.* Front view of the same.
Fig. 3 *c.* Cast of the dorsal valve of a specimen having the general external features of this species.
Fig. 3 *d.* Cardinal view of the same.
Fig. 3 *e.* Lateral view of the same.

Position and locality. In the shale of the Niagara group at Lockport.

630. 44. ATRYPA CRASSIROSTRA (*n. sp.*).

Pl. LV. Fig. 4 *a, b, c.*

Shell elongated, subcylindrical, gibbous in the middle; valves nearly equally convex; beak of the dorsal valve much elevated above the ventral valve, and abruptly incurved; base of dorsal valve extended into a linguiform process, filling a sinus in the base of the ventral valve; ventral valve having a broad, partially defined mesial elevation on the lower half of the shell; surface concentrically striated, with several stronger lines of growth.

This species is intermediate in form and characters between *A. naviformis* and *A. cylindrica* of the Clinton group, but it is quite distinct from either. It differs from the preceding species of this group, in its more elongated form, and the extension of the dorsal valve at the base, which character is scarcely conspicuous, or undefined, in the others. Numerous specimens having these characters have been observed, all of which are so uniform as to leave no doubt of the specific differences between them.

This species is far less abundant than the others, but has been found usually in isolated groups in the calcareous layers of the shale, and not indiscriminately scattered through the rock.

Fig. 4 *a*. Ventral view of a full grown specimen.
Fig. 4 *b*. Profile view of the same.
Fig. 4 *c*. Front or basal view, showing the extension of the dorsal valve.

Position and locality. In the Niagara shale at Lockport, usually confined to the thin calcareous layers.

460. 31. ATRYPA RETICULARIS.

PL. LV. Fig. 5 *a* – *t*.

For references and synonymes, see page 72 of this volume.

Shell depressed-globose, or more or less circular, being slightly truncated by the hinge-line; valves nearly equal in size, the ventral valve much more convex than the dorsal valve; dorsal valve often with an undefined depression or sinus at the base, and a corresponding elevation on the ventral valve; extremities of the cardinal line sometimes extended a little beyond the width of the shell; beak of the dorsal valve small and slightly elevated above the ventral valve, or above the hinge-line. Surface marked by from 24 to 30 small rounded plications, which bifurcate about one-third of the distance from the beak to the margin; plications crossed by prominent imbricating laminæ. This description is applicable to the variety occurring in the Niagara group, but not for the species in all its phases.

This species commences its existence in the Clinton group; and if we include in one species all shells having these general characters, it extends through all the succeeding groups to the Chemung group inclusive. In each of these positions, however, it possesses some peculiarity by which it may be distinguished; and the variety from the Niagara group can never be mistaken for that from the lower Helderberg limestones, nor the one from the lower for the one from the upper Helderberg limestones; nor will either of these be confounded with the specimens from the Hamilton and Chemung groups. It is in fact much less difficult to discriminate between specimens of this fossil from the different geological positions, than between others which are recognized as distinct species. On this account, I have been inclined to recognize them as distinct varieties at least, and there is much foundation for specific distinction.

Taking the view that these are all of a single species, we must regard it as having possessed a remarkable capacity of endurance, and of adaptation to change, to have existed during so long a period. Its power of adapting itself to the changed condition is clearly shown in the

different aspects which it presents in the different rocks, and in rocks of different age, though similar or alike in their lithological and mineral character. This is fully exemplified in the contrast between specimens from the shale of the Niagara group and the shale of the Hamilton group, which are very similar rocks.

In the present instance I have presented the principal varieties of aspect under which this fossil appears in the shale of the Niagara group, from the young to the full grown individuals. The imbricating lamellæ of the shell in this geological position are not so prominent as in some of those in a higher position, while they are nevertheless quite conspicuous.

Fig. 5 *a*. A young individual of this species.
Fig. 5 *b*. Cardinal view, showing the compressed form.
Fig. 5 *c*. A larger individual.
Fig. 5 *d*, *e*. Cardinal and profile views of the same.
Fig. 5 *f*, *g*, *h*. Ventral, profile and front view of a specimen, showing, in the last figure, the slight sinus in the dorsal valve, and the elevation of the margin of the ventral valve.
Fig. 5 *i* Profile view of a flattened specimen.
Fig. 5 *k*, *l*, *m*. Ventral, profile, and cardinal view of a globose specimen of medium size.
Fig. 5 *n*, *o*. Dorsal and front view, showing the sinus more conspicuously than the preceding figure.
Fig. 5 *p*. A large individual : view of the ventral valve.
Fig. 5 *r*. Profile view of the same specimen, which is compressed.
Fig. 5 *s*. The interior of the dorsal valve, showing the form of the muscular impression. The foramen is not very distinctly defined, but there is no perforation of the beak, though in other specimens there is a minute perforation in the beak of the dorsal valve.
Fig. 5 *t*. Several of the plications enlarged, showing more distinctly the character of the surface.

Position and locality. In the shale of the Niagara group, and also in the lower part of the succeeding limestone. It is extremely abundant at Lockport, though the specimens are usually compressed. It is likewise common in all the localities of this rock, from Wolcott in Wayne county, to the Niagara river.

631. 45. ATRYPA RUGOSA (*n. sp.*).

PL. LVI. Fig. 1 *a* – *n*.

Rhomboidal, circular or suboval ; valves almost equally convex ; beak of the dorsal valve elevated above the ventral valve, and abruptly incurved ; surface marked by strong plications, which bifurcate once, twice or thrice before reaching the margin ; dorsal valve with a strong mesial depression, in the bottom of which are one or two plications ; a corresponding ridge on the ventral valve, with two or three plications ; plications crossed by strong elevated lamellæ, which give a very rugose character to perfect specimens.

This species is closely allied to the following, and both possess many characters in common with *Terebratula imbricata* of MURCHISON (Sil. System), *T. marginalis* of DALMAN. In our

shell, however, the beak is never extended and perforate at the apex, as in the species cited, nor is the mesial sinus and ridge so broad; the surface is marked by fewer plications, which are always crossed by strong, concentric lamellæ.

In the young shells of this species the ventral valve is nearly flat, as shown in the figure, and there is no distinct ridge upon the dorsal valve. In the next stage we find a distinct sinus and elevation, which are more conspicuous as the shell becomes larger. The plications number from four or five to nine on each side of the central lobe and sinus; and they are crossed by prominent imbricating lamellæ, which, when worn off, leave the plications nodulose. This shell may readily be mistaken for the following, but a comparison of the two with the description will enable any one to distinguish them.

Fig. 1 *a*. The dorsal valve of a young individual, which is marked by two stronger plications in the centre.
Fig. 1 *b*. Cardinal view of the same, showing the nearly flat ventral valve.
Fig. 1 *c*. Ventral view of a larger specimen, where the mesial lobe and sinus are developed.
Fig. 1 *d*. Profile view of the same specimen, showing convexity of both valves.
Fig. 1 *e*. Front view of the same.
Fig. 1 *f*. Dorsal valve of another specimen, where the sinus is less developed.
Fig. 1 *g*. Front view, showing the slight mesial depression and elevation.
Fig. 1 *h*, *i*. Dorsal and ventral valves of a specimen of medium size.
Fig. 1 *k*. Front view of the same, showing the strong elevation in the centre.
Fig. 1 *l*. Profile view of the same.
Fig. 1 *m*. Dorsal valve of a large individual.
Fig. 1 *n*. An enlargement of the plications, showing character of surface.

Position and locality. In the shale of the Niagara group at Lockport.

632. 46. ATRYPA NODOSTRIATA (*n. sp.*).

Pl. LVI. Fig. 2 *a* – *u*.

Compare *Terebratula imbricata*, etc., as above.

Shell subrhomboidal, depressed globose; beak of dorsal valve small, short, and slightly elevated; valves nearly equal, or the ventral valve deeper than the dorsal valve; surface marked by strong rounded plications, which bifurcate several times before reaching the margin; plications crossed by strong imbricating laminæ, which, where worn, give a nodulose character to the plications; dorsal valve in old specimens with a broad undefined mesial depression, which extends half way to the beak; a corresponding elevation on the ventral valve, which does not assume the character of a defined ridge.

This species is very similar to the preceding, but differs in all its stages of growth. In the young shells, the valves are nearly equally convex; in the more advanced condition, there is scarcely any evidence of a mesial sinus or depression, but this feature gradually becomes conspicuous, and finally there is a broad depression, without defined margins in the dorsal valve,

and a corresponding elevation in the ventral valve. It never presents the decided mesial sinus and lobe of *A. rugosa*. The plications, of which there are from ten to twenty on each valve, are more rounded than those of that species, though this character is not sufficient for discrimination. The shell is larger, often very rotund in its perfect condition, and, when compressed or distorted, may easily be mistaken for *A. reticularis* with which it is associated.

From the resemblance of this fossil to the figures of MURCHISON, Pl. 12, fig. 12, I had been inclined to refer it to the same species; but a more careful comparison, together with a direct comparison with Swedish and Bohemian specimens of *T. marginalis* (DALMAN), has led to a different conclusion. In our specimen the beak is never straight and extended, but small and closely incurved : there is sometimes a perforation, which appears more as if due to accident than nature; but this does not correspond with the perforation in *T. imbricata* (*T. marginalis*). The absence of a defined mesial sinus in our specimens is another feature of importance, as well as the coarser plications with their strong imbricating lamellæ.

In its largest dimensions our species exceeds the foreign analogue, approaching in size to the *A. reticularis* of this period, from which it can be readily distinguished by its stronger plications.

Fig. 2 *a*, *b*. Dorsal and ventral view of a young specimen.
Fig. 2 *c*. Profile view of the same specimen, which is compressed.
Fig. 2 *d*, *e*. Dorsal and ventral view of a specimen below the medium size.
Fig. 2 *f*. Profile view of the same.
Fig. 2 *g*, *h*. Dorsal and ventral views of a specimen of medium size, which is slightly more elongated than usual.
Fig. 2 *i*, *k*, *l*. Dorsal, ventral and profile view of a more rotund form.
Fig. 2 *m*, *n*. Ventral and profile view of a large specimen in its natural condition.
Fig. 2 *o*. Profile view of a larger specimen which is extremely compressed.
Fig. 2 *p*. The plications enlarged, showing the imbricating lamellæ.
Fig. 2 *r*, *s*, *t*, *u*. Front views of different specimens, showing the absence of a sinus in the young shell, and its increase as the shell becomes larger.

Position and locality. In the shale at Lockport.

633. 47. ATRYPA CAMURA (*n. sp.*).

PL. LVI. Fig. 3 *a* - *t*.

Subrhomboidal, semioval or depressed globose (varying in form by age); valves nearly equally convex, or the ventral a little deeper than the dorsal; beak of the dorsal valve small, acute, projecting beyond the cardinal line of the ventral valve, and slightly incurved; surface marked by simple angular plications on each side, and by one or two smaller ones in the centre; plications crossed by fine threadlike concentric striæ, with a few stronger imbricating lamellæ below the centre; an oval aperture or foramen below the beak.

This is a unique little species, appearing, in the young state, in very rotund forms, with a pointed elevated beak, beneath which there appears a minute oval or triangular foramen, which undergoes some change with the advancing growth of the shell. The number of plications is usually about five or six on each side of the smaller ones in the centre; and there is scarcely any increase of number in older shells, but they become broader, so that the appearance of the surface is variable from this cause. The beak is more prominent in young specimens than in older ones, where it is often scarcely elevated above the hinge-line. Although variable in form and proportions, it is readily distinguished from other species of the group.

Fig. 3 *a*, *b*. Ventral and profile views of a young specimen.
Fig. 3 *c*, *d*. Ventral and profile views of a larger specimen than the preceding.
Fig. 3 *e*. Ventral view of a specimen having the beak of the dorsal valve well preserved.
Fig. 3 *f*. The beak of the same enlarged, showing the foramen.
Fig. 3 *g*. Profile view of the same.
Fig. 3 *h*. Dorsal view of a specimen, larger than the preceding.
Fig. 3 *i*, *k*. Dorsal and ventral valves of a larger compressed specimen.
Fig. 3 *l*, *m*. Views of a more rotund specimen, showing the beak much reduced, with the foramen not surrounded.
Fig. 3 *n*, *o*. Specimens which are more extended laterally than the preceding forms, the last one being almost cylindrical.
Fig. 3 *p*, *r*. Front views of two specimens, showing slight indications of a sinus, which, however, never becomes an important feature.
Fig. 3 *t*. The beak and foramen of a full-grown individual.

Position and locality. In the shale of the group at Lockport.

456. 27. ATRYPA NEGLECTA.

PL. LVII. Fig. 1 *a* – *p*.

Atrypa neglecta, page 70, pl. 23, fig. 4 *a* – *f*, this volume.

Ovoid or subpyramidal; beaks acute; shell gradually enlarging from the beaks to the base, which, in old shells, is deeply sinuate; ventral valve more convex than the dorsal valve; surface marked by simple sharp plications, which are crossed by fine concentric striæ, and sometimes by a few concentric imbricating lines of growth; dorsal valve with a mesial sinus below the middle, and a corresponding fold upon the ventral valve.

In the young shells the valves are equal, and there is neither sinus nor elevation; but as the shell advances in size, the sinus becomes conspicuous. There are generally three and sometimes four plications in the sinus, and four or five elevated on the opposite valve. The plications usually appear as if smooth, except near the base, where there are some strong imbricating lines of growth. It is a very common species, and sufficiently distinct in all its phases to be readily recognized.

Fig. 1 *a*, *b*. Ventral and front views of a young specimen, where the valves are equal and without a sinus.

Fig. 1 *c*. A somewhat larger specimen, where the sinus and elevation are slightly developed.

Fig. 1 *d* – *h*. Figures of specimens presenting varieties of form and size, and number of plications in the sinus.

Fig. 1 *i* – *m*. Profile views of specimens which are not compressed.

Fig. 1 *n*, *o*, *p*. Front views showing the elevation of the plications, and the depression of the same in the sinus.

Position and locality. In all localities of the shale of the group from Wolcott to the Niagara river, but more particularly at Lockport.

634. 48. ATRYPA INTERPLICATA.

Pl. LVII. Fig. 2 *a* – *g*.

Terebratula interplicata. Sowerby : Murchison's Sil. System, pag. 631, pl. 13, fig. 23.

Shell spheroidal or subobovate, ventricose in the middle and towards the beaks; ventral valve much more convex than the dorsal valve; beaks very short, closely incurved, the dorsal one scarcely so high as the ventral one; surface plicated; plications three or four on each side at their origin, with an interplication between each pair, except the central ones, commencing about half way from beak to base; two, three or four central plications on each valve, often simple from their origin to the base, and these are depressed on the one and elevated on the other valve, forming the mesial sinus and fold, which continue more than half way from base to beak; plications crossed by concentric striæ and a few imbricating lines of growth.

The shell described is apparently identical with the species of the Wenlock shale. Our specimens are often much distorted by pressure; and the great convexity of the ventral valve, and its prominence near the beak, causes it, when compressed from below, to project above the beak of the dorsal valve. The plications appear as if simple, and the interplications do not come from a bifurcation, but rise in the depression between : this gives a peculiar feature to the surface, and is a reliable character for distinguishing the shell even when much compressed. Nearly all the specimens examined appear to be full grown individuals, and I have had no opportunity of tracing it in its various stages of growth.

Fig. 2 *a*. Dorsal valve of this species.

Fig. 2 *b*. Dorsal view, where the ventral valve near the beak is elevated above the beak of the dorsal valve.

Fig. 2 *c*, *d*. Profile views of the specimens 2 *a*, *b*.

Fig. 2 *e*, *f*. Front views of two specimens, one of which is compressed.

Fig. 2 *g*. An enlargement of several plications, showing the interplications and concentric striæ.

Position and locality. In the shale of this group at Lockport.

635. 49. ATRYPA BIDENTATA.

Pl. LVII. Fig. 3 *a* - *h*.

Terebratula bidentata.	Hisinger,	Vet. Acad. Handl. 1826, p. 343, t. vii, f. 5.
—	—	Idem, Anteckn. iv, tab. vii, fig. 5.
—	—	Dalman, Vet. Acad. Handl. 1827, pag. 142, tab. vi, fig. 5.
—	—	Hisinger, Petref. suecica, pag. 81, pl. xxiii, fig. 7.
—	—	Sowerby : Murchison's Sil. System, 1839, pag. 625, pl. 12, fig. 13 *a*.

Triangular; beak of dorsal valve acute, and extended in a nearly straight line; valves unequal, the ventral one more convex; strongly plicated, with one or two of the plications depressed on the dorsal and elevated on the ventral valve; a foramen beneath the apex of the beak of the dorsal valve.

A comparison with the Swedish specimens shows no appreciable difference of character between our specimens and one there known as *Terebratula bidentata*. The allied form in the Clinton group is quite distinct from this one, as already shown, and must be regarded as another species. We have moreover knowledge of the fact that it occurs in the same association here as at Dudley in England, and Gothland in Sweden.

This species, in the young state, may be easily confounded with *Atrypa neglecta;* but the plications are less numerous and more angular, and the beak nearly straight and more extended, and its proportional width is usually greater.

Fig. 3 *a*, *b*. Ventral and dorsal views of the same specimen.
Fig. 3 *c*, *d*. Similar views of a larger individual.
Fig. 3 *e*, *f*. Profile views of a young and old individual.
Fig. 3 *g*. Front view of a specimen, showing the sinus and slight elevation.
Fig. 3 *h*. Several plications enlarged to show the surface markings.

Position and locality. In the shale at Lockport.

636. 50. ATRYPA CUNEATA.

Pl. LVII. Fig. 4 *a* - *r*.

Terebratula cuneata.	Dalman,	Vet. Acad. Handl. 1827, pag. 141. tab. vi, fig. 3.
—	—	Hisinger, Petrif. Suecica, 1837, p. 81, t. xxiii, f. 5.
—	—	Sowerby : Murchison, Sil. System, pag. 625, pl. 12, fig. 13.

Triangular or cuneiform, proportions of width and length variable, usually depressed, plicated; plications ten to twelve, strong, simple, diverging from the beak, and the lateral ones curved towards the margin, three or four central ones depressed on the dorsal valve and elevated on the ventral valve; crossed by filiform striæ, and sometimes by a few stronger imbricating lines of growth; beak of dorsal valve nearly straight and extended beyond the ventral valve, perforated at the extremity.

This shell presents considerable variety of form and proportions; but after an examination of a large number of specimens, I am unable to find differences on which to found a specific

distinction. Few perfect specimens have been found, notwithstanding it is a very common species : they are usually much depressed and distorted, and it is only after some experience that one learns to recognize the species in its various phases. The Swedish specimens of this species, with which I have had an opportunity of comparing our own, are usually better preserved, and the proportions less distorted. In other respects, there is no difference between the specimens from these distant localities.

Fig. 4 *a*, *b*. Ventral views, of two specimens of this species.
Fig. 4 *c*, *d*. Dorsal views of a specimen of ordinary size, and of another of very large dimensions.
Fig. 4 *e*. Dorsal view of a specimen having a greater proportional width than is usual.
Fig. 4 *f*, *g*, *h*. Profile views of specimens of different size.
Fig. 4 *i*. Profile of fig. 4 *e*, showing the great depth of the ventral valve.
Fig. 4 *k* – *p*. Front views of young and old specimens, showing the former without a sinus, and its gradual increase to 4 *p*, which is a front view of the specimen shown in fig. 4 *e* and *i*.
Fig. 4 *r*. Several plications enlarged, showing the concentric filiform striæ.

Position and locality. In the shale at Lockport, and on the Niagara river above Lewiston : more rarely in other localities of the same rock.

637. 51. ATRYPA ——?

Pl. LVII. Fig. 5 *a*, *b*.

Several specimens, having the character of the one figured, have been seen. The shell is cuneate and compressed, the base rounded. Along the centre of the ventral valve there is a depressed line, from which the plications diverge. This feature may arise from a sharp depression along the centre, which has infolded the plications, giving them the appearance of radiating or diverging from this line ; though it is scarcely possible that such an accident could have produced the characters exhibited.

Fig. 5 *a*. Ventral view.
Fig. 5 *b*. Dorsal view, showing the simple direct plications.

Position and locality In the shale at Lockport, associated with the preceding species.

638. 52. ATRYPA DISPARILIS (*n. sp.*).

Pl. LVII. Fig. 6 *a* – *m*.

Suboval, plano-convex ; dorsal valve very convex, arcuate, with the beak extended and perforate at the apex, slightly curved over the ventral valve, which is flat or concave ; surface strongly plicated, the dorsal valve with two very prominent plications down the centre, and two, three or four smaller ones on each side ; ventral valve with a smaller plication down the depressed centre, and two to four on each side ; plications crossed by fine, nearly obsolete concentric striæ, and a few stronger imbricating lines of growth.

This very peculiar little shell is easily recognized from the great disparity of the valves, the ventral one being always quite plane or concave, while the dorsal one is extremely convex. The number of plications is variable, and there is sometimes a tendency to bifurcation or interplication among the lateral ones. There is, in the Delthyris shaly limestone, a species very similar to this one, but it is a stronger shell. There is likewise in that rock another species of similar form, but with finer plications or striæ.

Fig. 6 *a*, *b*. A young individual, with scarcely two defined plications on each side of the centre.
Fig. 6 *c*, *d*. Ventral and dorsal valves of a specimen, with three plications on each side of the central pair.
Fig. 6 *e*. Another specimen having four plications.
Fig. 6 *f*. Profile view of a full grown individual.
Fig. 6 *g*. Front view of a specimen.
Fig. 6 *i*, *k*. The interior of a dorsal valve, and the same enlarged, showing the perforation of the apex extending to the cardinal line.
Fig. 6 *l*, *m*. The interior of the ventral valve, and the same enlarged.

Position and locality. In the shale at Wolcott, Wayne county.

639. 53. ATRYPA BREVIROSTRIS(?).

Pl. LVIII. Fig. 1 *a*–*f*.

Compare *Terebratula brevirostris*, Sowerby in Murchison's Sil. System, pag. 631, pl. 13, fig. 15.
Also *T. interplicata*, Idem, pag. 631, pl. 13, fig. 23.
And *A. interplicata*, pag. 275, pl. 56, fig. 2, of this volume.

Transversely elliptical or ovoid, gibbous; ventral valve more convex than the dorsal; beaks short, nearly equal; surface plicated; plications 20 to 24, sharp, bifurcating or interplicated; five or six of the plications depressed in the dorsal valve, and a corresponding number elevated in the ventral valve; concentrically striated.

This shell is closely allied to *A. interplicata*, and perhaps only a variety of that species, though it corresponds with the description of *T. brevirostris* ut supra. The sinus is broader and less deep than the ordinary specimens of *A. interplicata*, and I have not been able to find a succession of forms connecting those of that species figured with the present one, which nevertheless possesses many similar features.

Fig. 1 *a*, *b*. Ventral and dorsal views of a specimen.
Fig. 1 *c*. Profile view of the same.
Fig. 1 *d*. Cardinal view.
Fig. 1 *e*. Front view.
Fig. 1 *f*. An enlargement of the plications, showing concentric striæ.

Position and locality. In the shale at Lockport.

640. 54. ATRYPA OBTUSIPLICATA (*n. sp.*).

PL. LVIII. Fig. 2 *a* - *h*.

Spheroidal, or more or less gibbous; ventral valve extremely convex; beak of dorsal valve small, closely incurved over the ventral valve; surface plicated; plaits simple, rounded, about 18 to 20, three or four of which are depressed in the dorsal valve and projecting in front, filling a deep sinus in the margin of the ventral valve; a corresponding elevation on the ventral valve, which reaches from the base two-thirds of the way to the beak; plications crossed by fine subimbricating concentric striæ.

This shell is easily distinguished from the other species of this group, by its rounded form and obtuse plications in the perfect shell, which are subangular in the cast. The proportion of the two valves is variable, the ventral one often becoming extremely convex, with the sinus in front greatly elevated. The number of plications varies from sixteen to twenty-two in the greatest extremes of size I have seen; while three, and rarely four, are depressed on the one valve, and four or five elevated on the opposite valve.

Fig. 2 *a*, *b*, *c*. Ventral, dorsal and profile views of a specimen of the ordinary size.
Fig. 2 *d*. Front view of the same.
Fig. 2 *e*. Ventral view of a specimen which is more expanded at the sides.
Fig. 2 *f*. Front view of a specimen where the ventral valve is much elevated, and the sinus very deep.
Fig. 2 *g*. Ventral valve of a compressed specimen.
Fig. 2 *h*. Several plications enlarged, showing the concentric striæ.

Position and locality. In the shale and lower part of the limestone at Lockport.

641. 55. ATRYPA PLICATELLA?

PL. LVIII. Fig. 3 *a* – *e*; and 4 *a*, *b*.

Terebratula (*Anomites*) *plicatella*, LINNE, WAHLENBERG, DALMAN, HISINGER, &c.
Terebratula lacunosa, SCHLOTHEIM, Nachtr. 1, pag. 68, pl. XX, fig. 6.
— — SOWERBY : MURCHISON, Sil. System, pag. 624, pl. 12, fig. 10.
Not *T. lacunosa*, DALMAN and HISINGER.

Obovate, outline subtriangular; surface strongly plicated; plications simple, acute, crossed by prominent threadlike striæ; beak of the dorsal valve sharp, slightly extended, and scarcely incurved; three or four plications on the dorsal valve depressed, and strongly elevated in front; an equal number of plications on each side of the mesial sinus and elevation.

This species differs from the preceding in the more angular form of the shell, the extended sharp beak of the dorsal valve, and in the sharp prominent striæ, which contrast in a very decided manner with the rounded striæ and closely incurved beak of *A. obtusiplicata*. The figure of *T. lacunosa* (SOWERBY), from the Wenlock limestone, bears a close resemblance to our fossil,

except that a greater number of plications are represented in the figure than our shell possesses. A comparison with Swedish specimens of *T. plicatella* shows no appreciable difference, except such as might be expected from the different conditions of preservation of the shell, and the material in which it is imbedded. This species is comparatively rare in our strata, though abundant in strata of the same age in Gothland, and other localities in Sweden.

Fig. 3 *a*, *b*. Ventral and dorsal view of this species.
Fig. 3 *c*. Cardinal view of the same.
Fig. 3 *d*. Profile view.
Fig. 3 *e*. Several of the plications enlarged, showing the concentric striæ.
Fig. 4 *a*, *b*. Dorsal and profile views of a larger specimen, showing a greater number of plications than the specimens fig. 3. This is probably only a variety of the same species.

Position and locality. In the shale of the Niagara group at Wolcott.

642. 56. ATRYPA APRINIS.

Pl. LVII. Fig. 7 *a* – *g*.

Terebratula aprinis. De Verneuil, Geol. Russia and the Ural Mountains, Vol. 2, pag. 90, pl. x, fig. 10.

Shell small, roundish oval, scarcely longer than wide; valves almost equally convex; margin not sinuate; surface marked by 24 or 28 simple rounded plications, which are crossed by fine elevated striæ, and near the base by imbricating lines of growth; beak of dorsal valve extended and incurved, and vertically truncated by a roundish foramen; central longitudinal line of the ventral valve marked by a wider space between the plications, and the dorsal valve by a small plication in the centre.

This species bears a very close resemblance to the figure of *T. aprinis* cited, and the description corresponds so closely that it seems unnecessary to regard it as a distinct species. It is an extremely neat and pretty little shell; the only one in this group of strata, where the apex of the dorsal valve is positively perforated by a round aperture for the passage of the peduncle of attachment, as in the *Terebratulæ* of modern geological periods. It is exceedingly rare, but a single perfect specimen having been seen, and a second imperfect one; showing that its proportion to the number of individuals of other species of this family is not one in fifty thousand.

Fig. 7 *a*, *b*. Ventral and dorsal views of the specimen.
Fig. 7 *c*. Profile view of the same.
Fig. 7 *d*. Front view of the same.
Fig. 7 *e*. Enlargement of the beak of the dorsal valve.
Fig. 7 *f*. View showing the elevation of the striæ.
Fig. 7 *g*. Several plications enlarged, showing the concentric striæ.

Position and locality. In the shale of the Niagara group at Lockport.

(*Collection of* Col. Jewett.)

643. 57. ATRYPA CORALLIFERA (*n. sp.*).

Pl. LVII. Fig. 5 *a* – *t*.

Rhomboidal or subtriangular, the base being often nearly straight, more or less convex, and sometimes gibbous; valves nearly equal, a deep sinus in the dorsal and a corresponding elevation in the ventral valve; beak of the dorsal valve closely incurved over the ventral valve; surface covered by a finely reticulated membrane-like envelope, having the appearance of a flustroid coral; cast punctate, the ventral valve with a deep slit down the centre of the mesial fold, while the dorsal valve shows the cast of a small rostral cavity, without subdivisions or laminæ on either side.

This species is readily recognized by its peculiar surface marking, which appears like one of the finely reticulated corals of the Flustra tribe. This covering, however, is the outer portion, or entire shell; for when removed, the characteristic features of the cast are visible, and the whole surface has a finely punctate character. In some specimens the shell has become much thickened, imbricating lines of growth are more or less distinctly visible, and the intervals between the reticulating spaces are punctate, in similar manner to the corals of the Genus Callopora. A slight exfoliation of the surfaces, however, in specimens having this character, and in others, shows a simple punctate surface with fine concentric lines.

Fig. 5 *a*. A young individual of this species.
Fig. 5 *b*. A larger specimen of this species.
Fig. 5 *c*, *d*. Ventral and dorsal views of a specimen of the ordinary or prevailing size.
Fig. 5 *e*, *f*. *g*, *h*. Front views of different specimens, one of which is compressed, and the others retain their natural proportions.
Fig. 5 *i*, *k*. Profile views of two individuals, one of which is very gibbous.
Fig. 5 *l*, *m*. Cardinal views of other individuals.
Fig. 5 *n*, *o*. Casts of the dorsal valves of two individuals, the last one larger and proportionally more extended laterally than any other specimen observed.
Fig. 5 *p*. Cast of the ventral valve.
Fig. 5 *r*. An enlargement of the surface, presenting its ordinary character.
Fig. 5 *s*. An enlargement of the surface, where the shell is thickened, and the spaces between the reticulate openings is punctate.
Fig. 5 *t*. An enlargement of the surface of the cast of this species, showing the punctate character.

Position and locality. This species has been found in the shale at Lockport, and at Rochester.

ACEPHALA OF THE NIAGARA GROUP.

Fossils of this class are comparatively rare throughout the group; the single species, *Avicula emacerata*, being almost the only one which is common. In these fossils the Clinton group is much more prolific, as shown by the forms figured on Plates 27 and 30. We must, therefore, necessarily attribute much influence to the general conditions of the period; for we find in the less calcareous, and more arenaceous shales and impure sandstones of the Clinton group, a much greater development of the acephalous bivalves than in the succeeding period, which, in most other palæozoic forms, is far more prolific. The same condition in regard to these forms prevails through the succeeding rocks of the Silurian period; and it is not until we reach the Hamilton group, that we find them as freely developed, and as numerous as in the higher portions of the lower silurian strata.

472. 6. AVICULA EMACERATA.

Pl. LIX. Fig. 1 *a* – *e*.

Avicula emacerata. Conrad, Jour. Acad. Nat. Science, Vol. viii, 1842, pag. 241, pl. 12, fig. 15.
— — Hall, Geol. Rep. 4th Dist. N. York, 1843, p. 109, and fig. 4, 4 *a*, p. 108.
— — Id. page 83 of this volume.

Obliquely somewhat obovate, plano-convex, the right valve flat, nearly smooth, or with fine concentric striæ, and a few radii on the wing; left valve convex, and marked by strong radiating striæ, which are decussated by less conspicuous concentric striæ; hinge-line straight; posterior wing extended nearly or quite as far as the posterior margin of the shell, and terminating in an acute point, between which and the body of the shell the wing is more or less deeply arcuate; anterior wing short, triangular, with the extremity obtuse or rounded; umbo often elevated a little above the hinge-line.

This species is readily recognized by its left valve, the strong rays of which are regularly cancellated by concentric striæ. The right valve is rarely seen, and it appears to have been extremely thin and fragile, nearly or quite flat, marked on the body of the shell by concentric lines only, while the wing has sometimes a few obsolete radiating striæ. In consequence of the depressed form of this valve, the line of separation between the wing and the body of the shell is not distinctly marked. In the convex valve the extent of the posterior wing is variable, and the anterior wing is sometimes continued in the direction of the hinge-line, and sometimes curved downwards, and the extremity considerably below the cardinal line. All the specimens seen in this group occur in the soft shale, and they are consequently more or less compressed.

Fragments or single valves of this species are not uncommon; and in a few instances, slabs of shale have been seen entirely covered by the separated valves.

Fig. 1 *a*. A young individual of this species, having the radiating and concentric striæ equally developed.

Fig. 1 *b*. A larger individual: this one is about the ordinary size of the specimens obtained.

Fig. 1 *c*. A large individual, preserving the surface markings in a good degree of perfection.

Fig. 1 *d*. The right valve of this species, showing the plain nearly flat body of the shell, and striated wing.

Fig. 1 *e*. An enlargement of a portion of the surface, showing the character of the diverging and concentric striæ.

Position and locality. In the shale of the group at Lockport, Rochester, and other places.

644. 8. AVICULA UNDATA (*n. sp.*).

Pl. LIX. Fig. 2.

Subrhomboidal, oblique; left valve convex, much elevated in the middle, umbo prominent; surface marked by strong concentric striæ and stronger undulations; posterior wing distinct, extending nearly or quite as far as the posterior margin of the shell; anterior wing short, rounded at the extremity.

The form of this shell is very similar to the last, except that it is somewhat less oblique to the cardinal line. The surface is strongly marked by concentric lines, without radiating striæ.

Position and locality. In the shale of this group at Rochester.

645. 9. AVICULA SUBPLANA (*n. sp.*).

Pl. LIX. Fig. 3 *a, b, c.*

Extremely depressed; left valve subrhomboidal the height equal to about three-fourths of the length; elevated towards the umbo, and nearly flat below the centre of the valve; posterior wing scarcely distinct from the body of the shell, truncated at its extremity; cardinal line equal to or less than the length of the shell; surface marked by concentric striæ, which are scarcely undulated on the wing; right valve smaller, nearly flat, with the wing more extended, surface similarly marked; anterior wing on both valves scarcely conspicuous.

The general appearance of this shell is similar to the right valve of *A. emacerata;* but it is distinguished by the similarity of the two valves where both are present, and, in either one, from the less distinctness of the wing, the absence of radiating striæ on the body or the wing, and of undulations in the concentric striæ as they pass from the body of the shell to the wing. A careful examination shows faint radiating undulations upon the surface of both valves, but they never become prominent striæ.

This shell is associated with *A. emacerata*, but is a less common species. It approaches in many respects the *A. naviformis* of Conrad (*A. retroflexa* of Hisinger), but is less convex and the surface less conspicuously striated; but occurring only in the soft shale, the surface markings are probably not so prominent as they would be under other circumstances.

Fig. 3 *a*. A left valve of ordinary size, where the extremity of the cardinal line is extended slightly beyond the width of the shell.

Fig. 3 *b*. A larger shell, where the cardinal line is less extended than the width of the shell.

Fig. 3 *c*. A fragment of shale with the right valves of two individuals, showing a greater extension of the cardinal line, and a more distinct wing than in the left valve.

Position and locality. In the shale at Lockport; often occurring in the same specimen with *A. emacerata.*

646. 10. AVICULA? ORBICULATA (*n. sp.*).

Pl. LIX. Fig. 4.

Compare *Avicula orbicularis*, Sowerby in Murchison, Sil. System, pag. 635, pl. 20, fig. 2 & 3.

Suborbicular, depressed, rounded anteriorly; posterior wing short; surface concentrically striated.

Several fragments of this species have fallen under observation, but they are for the most part too obscure for identification. The shell is large and suborbicular in its perfect condition, convex in the middle and upper part, with elevated umbones. The specimen figured is compressed, the shell almost entirely removed, and the outlines of the general form and the concentric striæ only partially preserved.

Position and locality. In the shale at Rochester.

647. 2. POSIDONOMYA? RHOMBOIDEA (*n. sp.*).

Pl. LIX. Fig. 5.

Rhomboidal, inequilateral, alate posteriorly, with an oblique ridge from the beak to the posterior basal margin; cardinal line straight, less than the length of the shell; base rounded; anterior side short; surface marked by concentric striæ, and on the centre of the shell by stronger undulations.

This shell approaches in many of its characters the preceding species, but the short hinge-line and erect character of the shell indicate a different genus. It is allied to *Posidonomya? alata* of the Clinton group, but is an entirely distinct species.

Position and locality. The only specimen which I have seen is from the collection of the Rev. Mr. Walcott, and was found at Lockport.

648. 22. MODIOLOPSIS? UNDULOSTRIATA (*n. sp.*).

Pl. LIX. Fig. 6 *a, b.*

Subrhomboidal, longer than high; surface marked by strong subimbricating ridges or folds, and intermediately by fine undulating striæ.

The only specimen seen is imperfect at the anterior extremity, the posterior extremity and beak alone remaining.

Fig. 6 *a*. The shell, natural size.
Fig. 6 *b*. A portion of the surface enlarged.

Position and locality. In the shale of this group at Lockport.

474. 19. MODIOLOPSIS SUBALATUS?

Pl. LIX. Fig. 7.

Compare *M. subalatus*, page 84 of this volume, pl. 17, figs. 5 and 6.

Obovate, the posterior extremity rounded, and broader than the anterior extremity; umbo slightly prominent, and elevated above the cardinal line; surface marked by fine concentric striæ.

This is apparently a large individual of *M. subalatus* of the Clinton group. It differs from the other species of this genus in the narrow anterior extremity being proportionally more extended, with little evidence of the strong muscular impression.

Position and locality. In the shale of this group at Wolcott.

478. 4. ORTHONOTA CURTA?

Pl. LIX. Fig. 8.

Reference *O. curta*, p. 86 of this volume, pl. 17, fig. 11.

A fragment of slate, presenting a cardinal view of the two valves of a species of *Orthonota*. From the condition of the specimen, it is impossible to determine any difference between it and the species of the Clinton group.

Position and locality. In the shale of the group at Wolcott.

GASTEROPODA OF THE NIAGARA GROUP.

The difficulty of finding reliable characters in the shells of Gasteropoda, is greater than in any other family of fossils. The form is liable to great variation, both from natural and artificial causes. The surface markings are variously developed, or developed in very different degrees, and these characters are likewise the first to suffer from abrasion or solution. There are other variations of character dependent upon age, which modify the form and proportions as well as surface characters. Under such circumstances the number of nominal species can scarcely fail of being much increased; and where a few specimens only fall under observation, it is often impossible to connect them, from the want of others showing intermediate characters.

The following specimens figured on Plate 60, fig. 1 *a* – *v*, present, in their extremes, characters sufficiently different to authorize the establishment of species; but after a comparison of these and numerous other specimens, I am satisfied that they all belong to a single species, presenting numerous gradations of character naturally, and other phases induced by accidental causes.

Genus PLATYOSTOMA (Conrad).

"Shell subglobose; spire short; aperture very large, suborbicular, dilated; labrum joining "the body-whorl at right angles to the axis of the shell."

This description alone may not be sufficient to separate species of this genus from other genera. The larger proportion of the specimens of those species given by Mr. Conrad show a lower spire, either from compression or other causes; and they approach so nearly to those fossils referred to Natica, Nerita and Naticopsis, and sometimes to Euomphalus, that we have no sure guide to determine us in the reference of species.

The presence of a sinus in the outer lip has been regarded as a character sufficient for the reference of species to Pleurotomaria; and yet in other respects the shells may vary to extreme degrees, and the form and character of this sinus is equally variable and extreme. In some of the following specimens there is a broad shallow sinus in the outer lip, and an arching of the striæ to correspond therewith. Sometimes the back of the shell is marked by a band more or less elevated and conspicuous, extending from the sinus nearly to the end of the first volution. In other specimens there is almost no evidence of the sinus, and scarcely a visible arching of the striæ. In one specimen the band and arching of the striæ is visible in the upper part of the last volution; while for the last half inch before reaching the aperture, the striæ are not visibly undulated, nor is there any band or elevation. This character, therefore, I infer to be of less importance than is usually supposed; and if it may be present or absent in the same species, it is clear that this alone can not be relied upon for generic distinction.

649. 2. PLATYOSTOMA NIAGARENSIS (*n. sp.*).

PL. LX. Fig. 1 *a - v.*

Compare *Nerita haliotis*, Sow. in MURCHISON, Sil. System, pag. 625, pl. 12, fig. 16.

Globose; volutions three or four; body-whorl large, inflated towards the aperture which is dilated; sutures deep; spire depressed (rarely elevated); shell thin; surface striated across the volutions, and in well preserved specimens longitudinally marked by filiform undulating striæ.

The spire appears to be depressed often when the shell retains its natural proportions, and at other times from pressure; in a few examples, it is considerably elevated. The fine undulating longitudinal striæ do not always appear, and sometimes only upon a portion of the surface, even when there is no appearance of abrasion. In other examples they have evidently been worn off, leaving the transverse striæ well preserved.

Fig. 1 *a*, *b*, *c*. Young individuals, where the spire is depressed as low as the outer volution. These specimens show only transverse striæ.

Fig. 1 *d*. An individual having the spire equally depressed, and the surface conspicuously marked by longitudinal striæ.

Fig. 1 *e*. Profile view, showing the depressed spire.

Fig. 1 *f*. A small specimen having an elevated spire, with the surface marked as in fig. 1 *d*.

Fig. 1 *g*. View looking on the spire of a similar specimen.

Fig. 1 *h*. A small specimen having the spire much elevated, and the volutions longitudinally and transversely striated.

Fig. 1 *i*, *k*, *l*. Back, summit and front views of a globose specimen preserving its natural proportions. The spire is moderately elevated, the volutions very rotund, and the aperture tolerably well preserved. The surface is strongly marked by transverse striæ and faint indications of longitudinal ones. On the middle of the last whorl there is an elevated band reaching half way to the aperture, beyond which the surface is plainly striated.

Fig. 1 *m*, *n*. Two views of a similar specimen, having the aperture somewhat more expanded.

Fig. 1 *o*, *p*. Two views of a larger individual with an expanded aperture and a strong fold upon the back of the volution, and a sinus in the margin of the aperture.

Fig. 1 *r*. A similar larger specimen.

Fig. 1 *s*, *t*. View of spire, and partial front view of a large specimen from which the shell is partially exfoliated. In this one there is no evidence of a band on the middle of the volution, and but a slight arching backwards of the striæ.

Fig. 1 *u*, *v*. View of the summit of two other individuals having the usual depressed spire of this species.

Position and localities. This species occurs at Lockport, Rochester, Wolcott, and other places where the shale is exposed. It is never abundant, though occurring in nearly all localities.

650. 3. PLATYOSTOMA HEMISPHERICA.

PL. LX. Fig. 2 *a*, *b*.

Euomphalus hemisphericus. HALL, Geol. Rep. 4th Dist. N. York, 1843, 109, fig. 1 & 2.

Depressed globose; volutions about four; surface of volutions striated transversely, and, near the aperture, marked by some strong lines of growth.

This species differs from the last, in the less rapid expansion of the last volution. It is only found in the condition of casts in the limestone, and therefore we know little of its original surface markings beyond the marks of striæ preserved in the cast.

Fig. 2 *a*. View of the summit.

Fig. 2 *b*. Front view. The shell is so much compressed, that the figures can give no true idea of the aperture.

Position and locality. In the limestone above the shale at Rochester.

GENUS ACROCULIA.

This genus, constituted by Prof. PHILLIPS, corresponds in part to the PLATYCERAS of Mr. CONRAD; and since this author has adopted the name ACROCULIA, I shall use it in this place. Species of this genus first appear in the Niagara group, or possibly in the upper limestone of the Clinton group; not a single species having been seen in lower silurian rocks. In the Niagara group we know but the two following species; and it is only at the period of the Delthyris shaly limestone of the Helderberg, that it becomes fully developed in a great variety of forms, and gradations of form which are unparalleled in any other formation. In the Oriskany sandstone, species of this genus become nodose, and in the upper limestones of the Helderberg there are others covered with long spines. In the succeeding Hamilton group it is not more frequent than in the Niagara group, one or two species being at present known.

651. 1. ACROCULIA NIAGARENSIS (*n. sp.*).

PL. LX. Fig. 3.

Apex involute, scarcely forming a volution, gradually expanding below with two or three longitudinal folds or undulations, transversely striated; striæ undulating across the elevations and depressions of the surface.

The specimen is imbedded in shale, and only one side can be entirely seen. The shell is rounded with gentle longitudinal undulations, which do not rise into a ridge or angle.

Position and locality. In the shale at Lockport.

652. 2. ACROCULIA ANGULATA (*n. sp.*).

Pl. LX. Fig. 4 *a* – *d*.

Apex attenuated, involute, forming one or two minute volutions, below which the shell extends in a broad curve, expanding rapidly towards the aperture which is much dilated; surface angulated, a sharp carina on the upper and lower outer margin of the volution, an obtuse carina on the middle of the back, and the inner margins angulated; transverse section unequally pentangular; surface finely striated; striæ undulating over the surface, arching upwards on the sides, and downward or towards the aperture between the outer angles and the central carina, upon which they are twice undulated or bent.

This species will be readily recognized by its angular form, which is always more or less perfectly defined. In many specimens the apex does not form visible convolutions, and in others there is sometimes a distinct volution of the larger part of the apex, so that the margin of the aperture is brought in contact with the upper part of the shell. There is likewise considerable variation in the degree of obliquity of the partial spire.

Fig. 4 *a*. The back of a small specimen, where the shell is scarcely preserved.
Fig. 4 *b*. Upper side of the same.
Fig. 4 *c*. Back of another specimen, where the angles, carina, and surface striæ are well preserved.
Fig. 4 *d*. Upper side of the same, showing in part the expanded aperture and the minute volutions of the attenuated apex.

Position and locality. In the shale at Lockport. A single specimen (very similar to this species, and perhaps only a variety of the same, forming a single volution nearly in the same plane) has been found in the upper limestone of the Clinton group at Lockport.

CEPHALOPODA OF THE NIAGARA GROUP.

The Cephalopoda of this group form no very conspicuous feature among its organic contents. Notwithstanding the extensive excavations at Lockport, and the opportunities for examination at Rochester and other places, the species obtained are comparatively few, most of them rare, and all usually in a bad state of preservation. This is in remarkable contrast with the strata of the lower portion of the system, which everywhere contain remains of Orthocerata.

The specimens obtained afford little opportunity of investigating their internal structure; and we are forced to depend upon the often obscure surface markings alone, for specific discrimination.

653. 1. GOMPHOCERAS?

PL. LXI. Fig. 1 *a, b.*

Subfusiform, aperture narrowed, gradually tapering to the extremity; surface striated transversely.

This fossil has the general form and appearance of GOMPHOCERAS, though I am unable to discover any marks of septa. The greatest expansion appears to be at about one third of the distance from the aperture to the apex.

Fig. 1 *a.* A young individual much compressed, in the shale.
Fig. 1 *b.* A larger individual from the limestone.

Position and locality. In the shale at Rochester, and in a fragment of limestone below the cliff at Niagara Falls.

654. 8. CYRTOCERAS? CANCELLATUM (*n. sp.*).

PL. LXI. Fig. 2 *a, b, c.*

Arcuate; section tranversely oval; surface transversely striated; shell thin; surface beneath the shell showing faint longitudinal striæ.

The specimens figured are two fragments of the larger extremity of different individuals, one of them being apparently the outer chamber only.

Fig. 2 *a.* A fragment in shale, which is entirely compressed. The shell is retained on the larger part of the surface, and, where exfoliated, the surface is marked by longitudinal striæ.
Fig. 2 *b.* A fragment of a similarly marked specimen from limestone.
Fig. 2 *c.* Section of the same, showing the dorsal position of the siphuncle.

Position and locality. The specimen fig. 2 *a* is from the shale at Lockport, and the other is from a fragment of limestone below the cliff at Niagara Falls.

655. 32. ORTHOCERAS —— (*Species undetermined*).

PL. LXI. Fig. 3.

A fragment of a shell, apparently an ORTHOCERAS, with strong, projecting, undulating, and imbricating laminæ. It belongs to a species otherwise unknown at this period.

Position and locality. In the limestone of this group at Rochester.

656. 33. ORTHOCERAS IMBRICATUM?

PL. LXI. Fig. 4 *a*, *b*, *c*; and PL. LXII. Figs. 1, 2, 3.

Compare *Orthoceratites imbricatus*, WAHLENBERG, Acta Soc. Sci. Upsal. 1827, p. 89.
" — — HISINGER, Petref. Suecica, 1837, pag. 29, pl. ix, fig. 9.
" *Orthoceras imbricatum*, SOW. in MURCHISON, Sil. System, pag. 620, pl. 9, fig. 2.

Cylindrical? gradually tapering; septa distant one-third to one-fourth the diameter, four to eight in the space of an inch; surface annulated at the septa.

All the specimens seen of this species are flattened, and the shell partially or entirely removed. The cast of the interior shows a projection at the septum; and the interior of the shell, which is seen in another specimen, shows a depression at the same point. Specimens from which the shell is removed are covered with minute flustroid corals, of various species, one of which is figured on Plate 40 E, fig. 6 *a*, *b*, page 172 of this volume.

In the compressed specimens the septa are oblique or undulating; but this probably arises from pressure, since in the fragment of a cast (fig. 3, pl. 62) which is less compressed, the septa appear regularly arching.

Fig. 4 *a*, *b*, *c*. Fragments of small individuals of this species. The surfaces of the cast are marked by the presence of minute corals.

PLATE lxii. fig. 1. A compressed cast of a large individual, the surface of which is marked in like manner by corals.

Fig. 2. The interior of the shell of a large specimen of this species.

Fig. 3. A fragment of a large specimen which is less compressed than usual.

The septa in this species are often unequally distant, or there appears to be an intercalated septum.

Position and locality. In the shale of this group at Lockport and Rochester.

657. 34. ORTHOCERAS VIRGATUM?

PL. LXIII. Fig. 2 *a*, *b*, and fig. 3.

Compare *Orthoceras virgatum*, SOW. in MURCHISON, Sil. System, pag. 622, pl. 9, fig. 4.
Also *O. angulatum*, WAHLENBERG, l. c. p. 9; HISINGER, Pet. Suecica, p. 28, t. x, f. 1.
And *O. canaliculatum*, SOW. in MURCHISON, Sil. System, pag. 632, pl. 13, fig. 26.

Very gradually tapering; surface marked by longitudinal angular ridges, which are arranged at unequal distances, or with smaller ones intercalated.

The fragments of this species which have been obtained, give but an imperfect idea of the entire shell. The only surface markings visible are the angular longitudinal ridges, which are nearly equal and closely arranged in one specimen, and more distant and with smaller intercalated ones in the other. In neither of these specimens is there any visible transverse marking. This differs from *O. angulatum* of WAHLENBERG and HISINGER, in being straight, and in tapering more gradually than in the figure given by the latter. In this respect it resembles more nearly the *O. virgatum* of SOWERBY. The imperfection of the specimens, however, give no means of deciding satisfactorily as to its specific identity or difference.

Fig. 2 *a*. A fragment where the longitudinal ridges are equal and closely arranged.
Fig. 2 *b*. A fragment enlarged.
Fig. 3. A fragment where the longitudinal ridges attenuate in size.

Position and locality. In the shale of the Niagara group at Rochester.

658. 35. ORTHOCERAS CANCELLATUM (*n. sp.*).

PL. LXIII. Fig. 1 and 4 *a*, *b*; and PL. LXV. Fig. 4 *a*, *b*.

Cylindrical? gradually tapering; siphuncle? Surface marked by longitudinal angular ridges, and intermediately by finer longitudinal striæ; transversely marked by striæ of equal size, which, decussating with the longitudinal striæ, give the surface a cancellated appearance.

The longitudinal ridges scarcely differ from those of the preceding species, but in that one I have never been able to discover either longitudinal or transverse striæ between the ridges.

Fig. 1. A part of a large individual, where the surface markings are scarcely preserved. The stronger ridges have been worn down, and only fine striæ are visible, except at a single point, where the same characters are preserved as in 4 *a* and 4 *b*.
Fig. 4 *a*. A small fragment, having the characters of the surface preserved in a tolerable degree of perfection.
Fig. 4 *b*. A portion of the same enlarged.
PLATE LXV. fig. 4 *a*, *b*. An impression of the exterior of this species, in iron pyrites, in which the sharp striæ are well preserved.

Position and locality. In the shale of this group at Rochester and Lockport.

659. 36. ORTHOCERAS ——?

PL. LXIII. Fig. 5.

Several fragments of an ORTHOCERAS, having fine transverse ridges or coarse striæ, have been found at Rochester. They approach in character to *O. imbricatum*, but I have been unable to decide upon their identity.

660. 37. ORTHOCERAS UNDULATUM.

PL. LXIV. Fig. 1 *a -f*; and PL. LXV. Fig. 3.

Compare *Orthoceras annulatum*, SOWERBY, Min. Conchology, Vol. ii, 1818, p. 77, t. 133.
" — — HISINGER, Anteckn. v, tab. iv, fig. 6.
" — — ID. Vet. Acad. Handl. 1826, t. vii, fig. 8.
" — — ID. Petref Suecica, 1837, p. 28, t. x, f. 2.

Not *O. undulatum*, SOWERBY.
" *O. defrancii*, TROOST.

Cylindrical, very gradually tapering; siphuncle subcentral; annulated by strong rounded annulations, which are distant from each other one-fourth to one-fifth the diameter; surface of the shell marked by undulating and more or less imbricating laminæ.

In a single imperfect specimen, where the siphuncle is visible, it appears to be a little eccentric, but this appearance may be due to pressure. The specimens obtained have been usually in the soft shale, and completely flattened, so that septa and siphuncle are obliterated. The shell is frequently more or less abraded or dissolved, and the characters of the surface are variable. Sometimes the shell is entirely removed, and the annulations alone mark the surface. A comparison with Swedish specimens leaves no doubt of the identity of our species with *O. undulatum* of HISINGER; and the figures in MURCHISON'S Sil. System, from the Wenlock formation, are evidently identical with ours. It is extremely doubtful, however, if *O. annulatum* of Min. Conchology is the same species, particularly since all the evidence we have of its geological position would go to show that it belongs to a later period, and we have in our successive formations several annulated species of Orthoceratites which are not very unlike that one. Under these circumstances I prefer to adopt the name of HISINGER, until it be demonstrated that the two are identical, when the name given by Mr. SOWERBY will have precedence.

Fig. 1 *a*. A fragment of this species on a slab of shale: the sharpness of the laminæ has been much reduced either by maceration or solution.

Fig. 1 *b*. Another fragment where the laminæ are nearly obsolete.

Fig. 1 *c*. A fragment replaced by gypsum, and preserving only the annulations. The substitution of the sulphate of lime has doubtless taken place from the solution of the original shell and the calcareous interior, and we have merely a cast preserved.

Fig. 1 *d*. A fragment near the smaller extremity, showing the laminæ but partially preserved. The very gradual diminution shows the species to have been extremely elongated; and I have seen fragments of a single individual, more than two feet in length, and imperfect at both extremities.

Fig. 1 *e*. Transverse section of an imperfect and somewhat distorted specimen, showing the position of the siphuncle.

Fig. 1 *f*. Vertical section showing the convexity of a septum.

PLATE lxv, fig. 3. A fragment of this species from near the aperture. The shell is nearly all removed by maceration, and the interior is mostly covered by the little coral SAGENELLA.

Position and locality. In the shale of this group at Lockport, Rochester and other places, and more rarely in the limestone at Lockport.

661. 5. CONULARIA NIAGARENSIS (*n. sp.*).

Pl. LXV. Fig. 1 *a–h.*

Compare *Conularia quadrisulcata,* Miller.
" — — Sowerby, Min. Conchology, Vol. iii, 1821, p. 107, t. 260.
" — — J. Sow. in Murchison, Sil. System, pag. 626, pl. xii, fig. 22.
Conularia quadrisulcata. Hall, Geol. Rep. 4th District, 1843, pag. 110, fig. 2.

Broad, pyramidal, tapering abruptly; angles with deep abrupt channels; centre of each side with a shallow scarcely defined depression, which produces a more abrupt bending of the striæ; transverse striæ fine and closely arranged, directed from the angles obliquely to the centre, where they are more abruptly bent in crossing the slight depression; striæ papillose-granulate, intermediate spaces marked by longitudinal striæ, and grooves which alternate with the points upon the transverse striæ.

This species is quite distinct from the lower silurian species; and since the name of *C. quadrisulcata* was applied by Mr. Sowerby to silurian and carboniferous specimens alike, we are at liberty to give another name, till the application of *C. quadrisulcata* shall be determined. The Wenlock species, to which Mr. J. D. C. Sowerby has applied the name of *C. quadrisulcata,* is probably identical with ours, holding the same geological position.

In the Niagara species the transverse ridges are nodulose or papulose, with sharp deep grooves between, which are partially crossed on the upper side of the ridge by an elevated line from the papulose point of the ridge. The transverse ridges, as well as the points upon them, are comparatively closer together than in the Trenton species, in which the interspace is more distinctly grooved longitudinally; while in the Niagara species the ridges are ornamented with prominent distinct points, which are likewise shown in the cast, and the interspaces are narrower and very distinctly grooved. The arrangement of the transverse striæ is not equal and uniform, being sometimes much more crowded for a short distance than the prevailing character. From partial or entire exfoliation of the shell, and from specimens showing the interior of the shell, and from casts of the same, there is considerable variety of aspect and character presented.

Fig. 1 *a.* A fragment of a small specimen preserving the shell in great perfection. The striæ are regularly and closely arranged, the intermediate spaces being scarcely wider than the ridges.

Fig. 1 *b.* An enlargement of this surface, showing the character of the striæ and intermediate spaces.

Fig. 1 *c.* An impression of the exterior of a similar specimen, where the depressions between the striæ are distinct, and show the longitudinal striæ, with the narrow punctured depressions between.

Fig. 1 *d.* An enlargement of the same.

Fig. 1 *e*. The interior of the shell of a large specimen, showing the characters of the preceding, but proportionally stronger.

Fig. 1 *f*. An enlargement of the same.

Fig. 1 *g*. A cast of the interior, from near the base of the shell. In this specimen the tops of the ridges appear to be grooved on each side; while in the middle, where they are more abruptly bent, the two sides coalesce in one.

Fig. 1 *h*. The interior of a shell, showing only transverse ridges, except at intervals where broken.

This species appears under so many aspects, from the conditions of preservation, and from other accidental causes, that several figures are necessary to determine its characters.

Position and locality. In the shale at Lockport, Rochester, Wolcott and other places, and in the lower part of the limestone at Rochester.

662. 6. CONULARIA LONGA (*n. sp.*).

Pl. LXV. Fig. 2 *a* – *d*.

Elongated, gradually tapering; angles strongly but not very deeply grooved; transverse striæ or ridges strong, nodulose; intermediate spaces three or four times as wide as the striæ, distinctly grooved.

This species differs from the preceding in being less expanded towards the aperture, and much elongated: the interspaces between the transverse striæ are proportionally much wider than in the *C. niagarensis*. Two or three specimens only have been seen.

Fig. 2 *a*. A part of a large individual, showing one obtuse angle, with the strong channel, and a part of each of the adjoining sides.

Fig. 2 *b*. A portion of the same enlarged.

Fig. 2 *c*, *d*. A fragment of another individual, and an enlargement showing the character of the mould.

Position and locality. In the shale at Lockport.

CRUSTACEA OF THE CLINTON AND NIAGARA GROUPS.

The Trilobites of the Clinton group form no very conspicuous feature among its organic remains, and in many parts of the group they scarcely appear at all. In the Niagara group, however, these fossils are among the most important and characteristic forms of the lower strata, and are every where seen in this position in the State of New-York. On examining westward, however, the shaly portion of the group is scarcely conspicuous; and the limestone, having greatly increased in thickness, predominates over all the other deposits of the Middle Silurian period. In this limestone, trilobites are of rare occurrence, and not characteristic of the formation; while there is a vast increase in the number of corals, compared with the same rock in New-York. It is not until we trace this group many hundreds of miles to the west and southwest, that we find it assuming in some degree the characters by which it is distinguished in New-York, and it again becomes marked by the presence of trilobites and crinoids.

Although we observe that several species of trilobites are typical of the shale of the Niagara group from its commencement in central New-York, yet we rarely find entire specimens east of the Genesee river. From this line onward to Lockport in Niagara county, there appears to be a constantly increasing number of individuals, and a greater degree of perfection in the specimens obtained. From this circumstance, and from the fact that in the western part of the State crinoids flourished in great numbers at the same time, we may infer that many of the fragments (consisting mostly of bucklers and caudal shields of trilobites), found in the thinning eastern extension of the shale, have been drifted from localities farther west.

The ten species already known in the Niagara group belong to nine distinct genera, giving two species only of the Genus Proetus. If to these we add four distinct species of the Clinton group, not known in the Niagara period, we have fourteen species, with the addition of one more genus, Acidaspis, fragments of which have been seen in the Niagara shale. In the succeeding strata of the Silurian system we have scarcely another genus to add to those of this period, and the number of species in all the Upper Silurian strata will scarcely equal those of the Lower Silurian period.

In addition to the Trilobites, we have a single species of Beyrichia, and one of Cytherina, ascertained; and probably a second species of the former genus, which is not satisfactorily determined.

TRILOBITES OF THE CLINTON GROUP.

Genus CYBELE (Loven).

ENCRINURUS, Emmerich.

This genus was described, at about the same time, under the name of Encrinurus by Emmerich, and Cybele by Loven. The latter name is, on many accounts, preferable; and is likewise accompanied by a more full description, and with good illustrative figures.

663. 1. CYBELE PUNCTATA.

Pl. A LXVI. Fig. 1 *a-k*.

For *references*, etc., see page 245, Vol. i, Pal. N. Y*.

Buckler semicircular or subcrescentiform, the posterior angles extended into long spines; glabella clavate, not lobed; surface of glabella and cheeks tuberculous; body composed of eleven articulations; caudal shield with seven to nine articulations in the lateral lobes, and twenty-one in the middle lobe; every fourth or fifth articulation of the middle lobe tuberculated; each of the lateral articulations more or less distinctly tuberculated; oculiform tubercles prominent.

This species usually occurs in fragments, the caudal shields and imperfect bucklers alone being found, except in rare instances. I have seen two individuals in a tolerably perfect condition, but the surface is so much injured that the markings are nearly obliterated. These individuals are larger, and of somewhat different proportions from the Trenton limestone specimens. The number of articulations in the middle lobe of the caudal shield is greater than in the Trenton species; and there are other characters, which, a comparison of specimens induces me to believe, warrant the separation.

Fig. 1 *a*. An individual nearly entire, showing the proportion of parts. The glabella is erroneously represented in the engraving as being lobed, while it is only tuberculated.

Fig. 1 *b*, *c*. The glabella and base of buckler of two individuals of different size.

Fig. 1 *d*. The cheek separated at the facial suture.

Fig. 1 *e*. Profile of glabella, showing the strong indentations at the base.

Fig. 1 *f*. An enlarged portion, showing the prominent tubercles. These specimens are all casts, so that the character of the tubercles in their original condition is not fully known.

Fig. 1 *g*, *h*. The caudal shields (imperfect at the extremities) of two individuals.

Fig. 1 *i*. A small individual.

Fig. 1 *k*. An enlargement of several articulations of the caudal shield.

Position and locality. The fragments of this species have been found principally in the neighborhood of Medina, Orleans county. The entire individual is from Reynale's basin, Niagara county.

* At the time I published the description of the allied species from the Trenton limestone, I was induced to refer it to the Genus Ceraurus, from certain characters which it possesses in common with that genus.

664. 5. CALYMENE CLINTONI.

Pl. A LXVI. Fig. 5 *a* – *d*.

Hemicrypturus clintoni. Vanuxem, Geol. Rep. 3d District, pag. 79, fig. 2, and p. 80.

Buckler short, sublunate, width three or four times the length; glabella four-lobed, narrower in front, the posterior lobe larger than either of the others, and the anterior one scarcely larger than the adjoining ones; body broad above, middle lobe gradually diminishing towards the caudal shield; lateral lobes of nearly the same width as the middle lobe; caudal shield trilobate, the middle lobe with eight or nine articulations, the lateral ones smooth: surface granulate?

The only specimen yet observed in a tolerably perfect condition is the one figured, the caudal shield and cheeks being all that are usually found. The facial suture is nearly vertical from each side of the glabella to the eye, where it turns and passes to the posterior angle, apparently coming out upon the margin a little within the angle on the base of the shield. The eye, judging from the base preserved on the cheek, is larger than usual in Calymene, and the anterior part of the facial suture more directly vertical. The articulations of the abdomen are thirteen, as in Calymene; but we have a peculiarity in the absence of articulations on the lateral lobe of the caudal shield, which assimilates the species with Asaphus, or, we should more properly say with Homalonotus, since the body has thirteen articulations. This trilobite does not certainly belong to the Hemicrypturus of Green; for the reasons that the buckler of that genus is described as oculiferous, and not lobate, and the abdomen with eight articulations. Moreover Green proposes to arrange under this genus "the *Asaphus expansus* of Dalman, and several other known species," which, if allied to that genus, prove conclusively that the present form should not be thus referred. The principal objection to a reference to the Genus Calymene, arises from the smooth lateral lobes of the caudal shield; since we do not yet know the form and character of the eyes, except from the outline of the base on the cheek. Nevertheless there appears to me no greater objection to admitting a species with this character under Calymene, than to admitting species with articulate and non-articulate caudal shields under the same genus, as in Homalonotus.

Fig. 5 *a*. An individual having the cheeks partially separated at the sutures, and crushed. The glabella and lower portion of the buckler are in a state of good preservation.

Fig. 5 *b*. A profile view of the same.

Fig. 5 *c*. A cheek of a larger individual separated from the buckler.

Fig. 5 *d*. A caudal shield of a large individual in the iron ore.

Position and locality. This species appears in fragments in the iron ore on Steele's creek in Herkimer county, and in numerous other localities between this point and Wayne county. The nearly entire specimen was found at Martville, Cayuga county, in the green shale in the higher part of the group.

298. 2. CALYMENE BLUMENBACHII, *Var.?* SENARIA.

Pl. A LXVI. Fig. 6 *a* – *e*.

Reference *Calymene senaria*, Conrad, Ann. Rep. N. Y. Geology, 1841, p. 49.
Calymene senaria. Hall, Palæontology N. York, Vol. i, pag. 238, pl. 54, fig. 3.

Fragments of this species occur throughout the Clinton group. The specimen fig. 6 *a* has a greater proportional breadth than either the Niagara or Trenton specimens, but I am unable to find any important differences in other respects. The caudal shield fig. 6 *b* is much larger than any specimens seen in the Niagara group.

Fragments of *Homalonotus delphinocephalus* and *Phacops limulurus* (fig. 7 and 8) likewise occur in the Clinton group as low down as the ferruginous sandstones of Oneida county, which appear to be near the base of the formation. They are extremely rare at this period, but their existence is proved, though the circumstances were more favorable to their complete development at the period of the Niagara group. The Bumastis likewise (Plate A 66, fig. 9) existed in considerable numbers at the same period. The specimens have evidently been a long time macerated in water, and are always separated at the sutures, the central part of the buckler and the entire caudal shield alone remaining of the individual. These fragments are sometimes packed closely together, lying one within the other, and forming layers of two or three inches in thickness. A fragment of a mass of this kind is shown in fig. 9 *e*, and in the weathered surface the peculiar porous structure of the crustacean covering is sometimes observable.

The imperfect specimens of trilobites figured on Plate A 66 give a very good idea of the condition of these fossils in the Clinton group, and form a strong contrast with the remains of the same family in the shale of the Niagara group, where the conditions were not only more favorable for their growth and perfection, but also for their preservation.

Of the trilobites common to this and the succeeding group, the Calymene appears in the lowest position, and no fragments of the other species have been found associated with it. In the middle and higher parts of the group, however, the Homalonotus, Phacops and Bumastis commence their existence.

665. 3. ACIDASPIS —— (*Species undetermined*).

Pl. LXVI. Fig. 2.

Several fragments of the lateral portions of the buckler have been found, and the single caudal extremity figured. The whole are so imperfect, that it is impossible to determine the specific characters.

666. 3. PHACOPS TRISULCATUS.

Pl. LXVI. Fig. 3 *a*, *b*.

Calymene? trisulcata. Hall, Geol. Rep. of 4th District N. York, 1843, pag. 72, fig. 9 ; des. p. 74.
Compare *Phacops* (*Calymene?*) *Downingiæ*, Murchison, Sil. System, pag. 655, pl. xiv, fig. 2.

Buckler semicircular, posterior angles obtuse ; front rounded ; glabella lobed, the divisions angular, separated by narrow sharp grooves ; eyes small ; caudal shield short, with few articulations ; surface?

The only specimen of this species which has fallen under my observation is the small one figured, and in this the surface is partially crushed and the markings obliterated. The divisions of the glabella correspond with *P. downingiæ*, but the front of the buckler is more rounded and the caudal shield shorter. It is possible, however, that larger and better preserved specimens may show a more intimate relation between the two.

Fig. 3 *a*. The individual of the natural size.
Fig. 3 *b*. Enlargement of the buckler, several ribs of the body, and the caudal shield ; in which the characters are distinctly represented as seen under the magnifier.

Position and locality. In the upper green shale of the Clinton group, associated with *Atrypa hemispherica* and *Leptæna corrugata*.

667. 5. CERAURUS INSIGNIS.

Pl. A LXVI. Fig. 4.

Cheirurus insignis. Beyrich, Ueber einige bœmische Trilobiten, Berlin, 1845.
See page 306 of this volume.

The discovery of the fragment figured on this plate was the first indication I had of the existence of this genus in the upper silurian strata. The imperfect heads of two other individuals, from the shale of the Niagara group, have since been obtained.

Genus BEYRICHIA (M'Coy).

This fossil body has been very appropriately separated by Mr. M'Coy from Agnostis, to which such bodies have heretofore been referred.

We have three or four species of this in our successive groups, beginning with the Clinton group.

668. 1. BEYRICHIA LATA.

Pl. A LXVI. Fig. 10 *a - e.*

Agnostus latus. Vanuxem, Conrad, Rep. N. Y. Geology.

Semioval or subreniform, unequally trilobate or trinucleate; on one valve an oval subcentral lobe reaching more than half way across, with a depression on each side, beyond which the surface is elevated; ventral margin bordered by a narrow defined rim; on the other valve a depression corresponding to the lobe, and the surface elevated on either side; surface granulate?

We know nothing of this species, except from casts in ferruginous slate and sandstone, or equally ill-defined specimens in iron ore. In the best preserved specimens, the surface appears to have been granulate or tuberculate.

Fig. 10 *a.* A fragment of ferruginous slate, covered with the separate valves of this fossil.
Fig. 10 *b.* A valve having a subcentral depression.
Fig. 10 *c.* A valve with a subcentral lobe or nucleus.
Fig. 10 *d*, *e.* The interior of the shell, or impression made by the cast.

Position and locality. In the ferruginous shale associated with the iron ore at Wadsworth's quarries, and in the ferruginous sandstones below, at New-Hartford, Oneida county; in numerous localities in the same position farther west, and in the green shale of the group at Sodus and Rochester.

TRILOBITES OF THE NIAGARA GROUP.

The following species of trilobites occur in the Niagara group. Several of them are abundant, being found, either as fragments or otherwise, in many localities; while others are rare, and but occasionally met with in the more perfect exposures of the rock, or in recent extensive excavations.

669. 1. BUMASTIS BARRIENSIS.

PL. LXVI. Fig. 1 - 15.

Bumastis barriensis. MURCHISON, Sil. System, 1839, pag. 656, pl. 7 bis, fig. 3 *a, b, c, d;* and pl. 14, fig. 3 *a, b.*

Illænus (*Bumastis*) *barriensis.* BURMEISTER, 1843, p. 120; IDEM, Ray. Soc. translation, p. 103.

Bumastis barriensis. Geol. Rep. 4th Dist. N. York, 1843, p. 102 : Tables of organic remains (same volume), no. 19, fig. 3.

General form elongate elliptical, the two extremities nearly equal; head prominent, rounded in front; eyes large, semilunar or subreniform, situated near the margin; body composed of ten articulations, having the middle lobe much wider than the lateral lobe, the longitudinal furrow being indicated by a simple bend in the articulations; extremities of the articulations somewhat obliquely truncated; caudal extremity semielliptical (or spheroidally triangular?), without any trace of trilobation, strongly articulated to the body by the middle of the anterior side; crust extremely thin, except on the margins of the caudal shield; surface lamellose granulate or lamellose punctate, sometimes only lamellose near the margins.

I have retained this species under the Genus BUMASTIS, though the difference between it and ILLÆNUS is not of vital importance. Considerable variety of aspect is presented in our specimens, and the variable proportion of parts at first induced me to regard it as a species distinct from the fossil described by MURCHISON. A comparison of a larger number of specimens, however, has satisfied me that there is but a single species, and that it is identical with the one described in the Silurian System.

The body seems to have been somewhat loosely articulated, and to have admitted of considerable contraction and extension. In one specimen, having a length of more than two and a half inches, the body occupies only half an inch; while in another specimen more than an inch shorter than this one, the body is almost as long. In another specimen of three and a half inches in length, the body is twice as long as in the specimen first named. All these variations take place from the great extension or close contraction of the articulations of the body. The surface marking is likewise subject to considerable variation, but the differences in this respect are not found to be in any manner coincident with the changes in proportions of the body.

In some specimens the entire surface is, as described by MURCHISON, covered by thin imbricating lamellæ with waved edges. In other specimens this character is only visible around the margin of the buckler and caudal shield, and to some extent on the extremities of the articulations, while the central and higher parts of the surface are granulated or punctate.

In specimen fig. 5 of the plate, the entire surface, except the margins, is beautifully punctate; while in some other specimens this character is not observed, or only combined with the lamellose striæ. The punctate character appears to be secondary, and to result from the exfoliation of an outer crust, which is granular; and the entire exfoliation of the crust sometimes leaves a punctate surface beneath.

Fig. 1 & 2. Young specimens of this trilobite.
Fig. 3 & 4. Larger specimens of the same, showing slightly different proportions.
Fig. 5. A larger individual where the articulations of the body are closely pressed together, and the cephalic shield slightly overlapping the upper edge.
Fig. 6. A large individual preserving its natural proportions.
Fig. 7 & 8. The central portions of the cephalic shield as they occur in the shale, entirely flattened.
Fig. 9. An unusually large cephalic shield, preserving the cheeks which are somewhat distorted.
Fig. 10. The cheek with a part of the eye attached, and the same enlaaged.
Fig. 12. A part of the caudal shield and two articulations enlarged, showing the lamellar striæ with intermediate granular surface.
Fig. 13. A portion of another caudal shield of another specimen, preserving the punctate crust in one part, showing the striated surface where the crust is broken off around the margin, and above this the punctate surface, which sometimes marks well preserved casts.
Fig. 14 & 15. Enlargements of the punctate surface of the shell and cast of this fossil.

Position and locality. In the shale at Lockport, and rarely in the limestone above. Fragments have been found at Rochester and other places.

670. 4. PHACOPS LIMULURUS.

PL. LXVII. Fig. 1 - 8.

Asaphus limulurus. GREEN, Monograph, 1832, p. 48.
Compare *Trilobus caudatus*, BRUNNICH in Kiæb. Selsk. Skrivt nya Saml. I, 1781, p. 392, n. 3.
" *Asaphus caudatus*, BRONGNIART, Crust. Fossiles, 1822, pag. 22, pl. 2, fig. 4 *a*, *b*, *c*, *d*.
" *Trilobus caudatus*, SCHLOTHEIM, Nachtræge, 1823, pag. 35, no. 11 (p. 21, 4).
" — — PARKINSON, Organic Remains, Vol. iii, pl. 17, fig. 17.
" *Asaphus caudatus*, DALMAN, Palæaden in Vet. Acad. Handl. 1826, pag. 236, 2, and 296, 2, pl. ii, fig. 4.
" — — HISINGER, Petref. Suec. 1837, p. 13, t. ii, f. 2.
" *A. longicaudatus*, MURCHISON, Sil. System, 1839, pag. 653, pl. 14, fig. 11, 12, 13 & 14.
" *Phacops caudatus*, BURMEISTER, Pl. iv, fig. 9 : not description and citations same author, p. 94.

Not *Entomostracitus caudatus*, WAHLENBERG, Nov. Act. Soc. Sci. Upsal. 1821, pag. 28, pl. ii, fig. 3.

" *Asaphus mucronatus*, BRONGNIART, l. c. p. 24, t. iii, f. 9.

" — — DALMAN, HISINGER, loc. cit.

" *A. tuberculocaudatus*, MURCHISON, loc. cit.

" *Phacops mucronatus*, EMMERICH.

Buckler sublunate, with the spines at the posterior angles extended; front extended in a short obtusely angular point; glabella lobed; anterior lobe broad, separated from the three smaller lobes on each side by a broad oblique furrow, which communicates with the longitudinal furrow separating the cheeks from the glabella; lower lobes separated by sharp transverse grooves, the lower lobe continuing across the centre in a slightly defined ridge; eyes of medium size, the base opposite the two upper of the three small lobes of the glabella; facial suture extending to the margin of the shield, on a line with or a little above the base of the eyes; body with eleven articulations, axis broadest in the middle, the articulations with thickened obtuse terminations, but not tuberculate; articulations of the lateral lobes deeply grooved from the base more than two thirds of their length, and having the extremities bent rather abruptly downwards; caudal shield with the central lobe consisting of fifteen articulations, which terminate in an elevated obtuse point below; lateral lobes with eight articulations, all except the upper one grooved throughout their whole length till they are merged in a thickened border; this thickened border, extending along the two sides of the pygidium, is united below the termination of the central lobe, and extended into a long spinelike process; entire surface granulated.

This species has produced much confusion in the attempts to identify it with European species, and we are not at this time any more certain of its identity or difference than we were ten years since. I have had no opportunity of seeing a veritable specimen of *P. caudatus* of Europe, and therefore have not made a direct comparison which could decide the question. I have been inclined to believe that a part of the specimens figured by BRONGNIART are identical with our species, as is the pygidium figured by DALMAN and HISINGER, as well as *A.* (*Phacops*) *longicaudatus* of MURCHISON, but not *A. tuberculato-caudatus* of that author. The figure of BURMEISTER certainly very much resembles ours, but he cites descriptions and figures which can not be intended for our species.

M. DE VERNEUIL has regarded the Niagara species as closely allied to *P. mucronatus* or *P. longicaudatus* of MURCHISON; but I am not inclined to adopt his view, for several reasons; for although *P. mucronatus* and *P. longicaudatus* may be identical, yet specimens of *P. mucronatus* from Geinitz in Bohemia, when compared with ours, show the front of the glabella to be broader, equalling or exceeding its length, and with no extension in front; the anterior portion is of different form, and separated on the lower side by a scarcely oblique sharp groove or furrow, while in ours it is broad and oblique. The anterior of the three small lateral lobes of the glabella is similar to that of *P. limulurus;* the middle or second one is narrowed at its extremities, and the lower one is rounded or nucleiform, and narrowed at its base, almost separating from the axis; while in *P. limulurus* the middle lobe is not narrowed at the ex-

tremities, and the lower is not nucleiform, but continues across the axis as a transverse ridge. In addition to these minor differences, the facial suture from the base of the eye extends towards the margin in a broad curve, coming out much below a line through the posterior margin of the eyes, and far lower than in our species. In the caudal shield, likewise, the upper margin is nearly direct, and the outer angles scarcely curved; while the arching form of this portion, and the rounded angles, are conspicuous in our specimens, and are shown in the figure of DALMAN, and in *A. longicaudatus* of MURCHISON.

A great difficulty has doubtless arisen from the differences between the cast and the fossil with the crust remaining. The *Phacops* (*Asaphus*) *limulurus*, *P.* (*A.*) *caudatus* and *P.* (*A.*) *wetherellii* of GREEN, are undoubtedly one species (as are likewise *P.* (*A.*) *micrurus* and *P.* (*A.*) *pleuroptyx*, which are no other than *Phacops hausmanii*), and the one which is here described; and we can only account for this multiplication, by supposing that he possessed specimens in variable degrees of preservation.

In all the Niagara specimens, the slight extension in the centre of the front of the buckler is observable, though sometimes so slight as scarcely to attract attention. The front lobe of the glabella is somewhat oval, and separated from the other part, except in the centre, by a broad defined furrow which is expanded at its junction with the longitudinal furrows; the two other transverse furrows or grooves below this, on either side, scarcely reach the longitudinal furrows, and, in specimens somewhat compressed, they appear like narrow, oblong, deep indentations, which terminate similarly at both extremities. These features are unlike the same parts in *P. mucronatus*.

I have shown that the spine at the extremity of the pygidium, which is of variable length, is formed at the end of the middle lobe, by the meeting of the thickened reflexed border of the lateral lobes. This is hollow for a short distance, and beyond that point it is a solid spine. When the crust of the animal separates, this spine separates with it, leaving the caudal extremity obtuse and scarcely extending beyond the articulations of the middle lobe. Such specimens are more common than others, and are usually regarded as perfect specimens: if, however, the adhering stone has not been mutilated, the impression of the border can be seen surrounding the extremity; and if the specimen extends far enough, the impression of the spine may also be seen.

This is perhaps the most common and abundant trilobite in the whole series, except *P. macrophthalmus* (*P. bufo*, GREEN).

Fig. 1. An individual of the ordinary size of this species, in the Niagara group.

Fig. 2. A smaller individual. This, like all the young specimens I have seen, is narrowed towards the posterior part of the body, more than older specimens.

Fig. 3. The separate cephalic shield, destitute of the crust, which is of very common occurrence in localities where perfect specimens are not found.

Fig. 4. The caudal shield preserving the crust, and the extension of the same into a long slender spine.

Fig. 5. A specimen of shale covered with fragments of trilobites and other fossils, among which are two caudal shields of this species preserving the crust.

Fig. 6. The caudal extremity and a few articulations of the abdomen from which the crust is separated, showing the difference of form thus produced in this part of the fossil. The faint line beyond this shows the limit of the impression of the margin and spine in the shale.

Fig. 7. The inner surface of the crust (separated from the specimen fig. 6), showing its extension laterally in a thick border beyond the marks of articulation, and posteriorly into the spine.

Fig. 8. The eye of this species enlarged, showing the elevation, form and structure of the surface.

Position and locality. Shale of the Niagara group, Lockport.

667. 5. CERAURUS INSIGNIS.

PL. LXVII. Figs. 9 & 10.

See page 300 of this volume.

Buckler nearly semicircular, with the posterior angles extended into sharp spines; glabella clavate, lobed; anterior portion very convex, a little extended laterally beyond the posterior portion, and causing the longitudinal furrow to form a curve at this point; the posterior lateral furrow oblique, reaching to the centre, and joining the transverse furrow at the base of the glabella; the posterior lobes are thus circumscribed, and triangular in form; the anterior and second furrow are sharp, and almost directly transverse or slightly arched; surface granulate, granulations unequal in size; surface of cast punctate.

The fragments of this species correspond so well with the figures of BEYRICH, that I can have no doubt of the identity of our species with the Bohemian one. It is only recently that I have discovered, among some old collections, the two fragments figured, and I had previouly supposed that the genus was confined to the Lower Silurian period*. The fragments preserve so strongly the characteristics of CERAURUS, that I can not hesitate for a moment to refer it to that genus, which has precedence in point of time over CHEIRURUS; and the figures of this and other species given by BEYRICH show conclusively that the two are identical.

Fig. 9. The central portion of a cephalic shield, preserving the form and proportions of the glabella and the outer crust in part, with the spine at one of the posterior angles.

Fig. 10. Another similar fragment, where the base of the eye is preserved on one side, with the posterior spine of the buckler. The anterior portion is broken, and the extension in front may be due to pressure.

Position and locality. In the shale of this group at Rochester.

* It is only since the publication of the first volume of the Palæontology of New-York, that I have seen the papers of BEYRICH cited above.

671. 7. CALYMENE BLUMENBACHII*, Var. NIAGARENSIS.

Pl. LXVII. Figs. 11 & 12.

Ch. Lyttleton, 1750, Phil. Transactions, Vol. xlvi, no. 496, pag. 598 – 600, pl. i, ii.
C. Mortimer, Idem, p. 600 – 602.
E. Mendez da Costa, 1753, Phil. Transactions, Vol. xlviii, p. 296, i.
Torrubia, App. para la Hist. Nat. Espana, Tom i, p. 83, § 13, no. 96, t. iii, no. 4.
Guettard, 1757, Mem. de l'Acad. Roy. des Sciences, Tom. xv, pl. ix (vii), fig. 2.
Entomolithus paradoxus, Linne in Act. Soc. Scient. Holmiensis, 1759, p. 22, t. i, f. 3.
— — Idem, Museum Tessinianum, t. iii, fig. 2.
Lehman in Nov. Comm. Petrop. T. x, pag. 429, tab. xii.
Wilckens, Stralsund Magazine, 1768, T. 4, tab. i, figs. A. 2.
Klein, Specimen descript. Petref. Goth. 1770, T. xv, fig. 5 – 7.
Walch, Text zu Knorrs Abbild. der Verstein. 1771, Vol. iii, p. 222, t. ix, f. 1, 5.
Oniscus no. 3, Bechman, Nov. Comm. Soc. Reg. Gottingen, 1773, t. iii, pp. 101, 102.
Trilobus tuberculatus. Brunnich, 1781, Nya. Saml. etc. I, pag. 389, no. 1.
— — Gehler, Programme, 1793, p. 7, f. 1 – 6.
Entomolithus paradoxus, Blumenbach, 1810, Abbild. Naturl. Gegenst. v, T. L.
Trilobites paradoxus, Parkinson, Organic Remains, 1811, iii, pl. xvii, figs. 11, 13, 14.
— — Schlotheim, Petref. 1820, p. 39, 2.
Entomostracites tuberculatus, Wahlenberg, Nov. Act. Soc. Sci. Ups. 1821, p. 31, 6.
Calymene blumenbachii, Brongniart, Crust. Foss. 1822, pag. 11, pl. i, fig. 1 A, B, C, D.
— — Schlotheim, Nachtr. 1823, 2, p. 13, 1, and 33, 1 (*Tril. blumenbachii*).
— — Dalman, Palæaden, 1826, pag. 35, 1, tab. i, figs. 2, 3 *a – c*.
— — Payton, Trilobites of Dudley, 1827, fig. 14.
— — Green, Monograph, 1832, p. 28.
— — Idem, Monthly Am. Jour. Geol. 1832, p. 558.
— — Eaton, Geol. Textbook, 1832, pag. 31, pl. 2, fig. 19.
— — Kloden, Verst. de Merk. Brand. 1834, 105.
— — Harlan, in Trans. Geol. Soc. Pa. Vol. i, 1835, p. 99; also in Phys. Researches, p. 300.
— — Bronn, Lethea Geognostica, 1835, 1, p. 110, t. ix, fig. 3.
— — Quenstedt, Wiegmans Archiv, 1835, 1, p. 342.
— — Buckland, Bridgewater Treatise, 1836, Vol. i, p. 389; ii, pl. 46, figs. 1 – 3.
— — Hisinger, Lethea Suecica, 1837, p. 10, t. i, f. 3 & 4.
— — Boeck, Geog. Norw. i, no. 16, 1838.
— — Murchison, Sil. System, 1839, pag. 653, pl. vii, figs. 5 – 7.
— — Emmerich, Dissertation, 1839, 39, 3.
— — Von Buch, Beitr. zur Geog. Russland, 1840, p. 47.
— — Milne-Edwards, Crust. iii, 318, 1.
Calymene senaria, Conrad, Ann. Rep. N. Y. Geology, 1841, p. 49.
Calymene niagarensis. Hall, Geol. Rep. 4th Dist. N. York, 1843, p. 102, and fig. 3, p. 101.
C. senaria, Hall, Palæont. N. York, Vol. i, 1847, p. 238, pl. 64, fig. 3 (Trenton limestone, &c).

* I have given below the synonymes and references to this species, from all the works within my reach, and from others which I have not seen, on the authority of Burmeister. Perhaps no other single species has been so generally cited in works upon this subject as the *Calymene blumenbachii*, to which we shall hereafter refer our species whether of the Trenton limestone or Niagara group.

Buckler semicircular or sublunate; glabella marked by three tubercles on either side, the lower of which is much more prominent, and the upper one scarcely distinct; body gradually tapering from the base of the head, composed of thirteen articulations, those of the middle lobe being bent abruptly upwards at their extremities, which are prominent; articulations of the lateral lobes compressed towards their extremities, and rounded, a distinct longitudinal groove reaching nearly their whole length, but usually visible only about half their length, or to the arching of the ribs; caudal shield with about eight articulations in the middle lobe and five in each lateral lobe, those of the lateral lobe grooved nearly to the margin, which is thickened and reflexed; entire surface granulated.

There has been much difficulty in identifying our specimens positively with the European species known under this name. A comparison with a Dudley specimen shows some slight differences, but perhaps not sufficient for a separation of species. Our specimens are always smaller; the second or smaller lobe of the glabella is less conspicuous, being in fact often scarcely visible, while the front is slightly narrower; the articulations of the middle lobe of the body are less prominent and rounded at their terminations, and never nodulose. Beyond these and other similar minor differences, the two correspond.

Between the Niagara and Trenton specimens, I am able to perceive really but slight differences; and a comparison with specimens from Gothland shows that there is too little difference for the satisfactory establishment of distinct species. We must therefore regard the *Calymene blumenbachii* as appearing in the Trenton limestone and the intervening rocks to the termination of the Niagara period. In the lower Helderberg limestones, which are prolific in fossil trilobites, there is no representative of this species; but in the Schoharie grit there is a large species having similar characters, but differing too widely to be referred to the same.

In the shale of the Niagara group this species is extremely abundant, often occuring in groups upon the surfaces of slabs of the shale. It is rarely found in the limestone of this group in New-York; though at Springfield, Ohio, it occurs in limestone of the same age.

Fig. 11. An entire individual of the largest size, found in the shale of the Niagara group.

Fig. 12. A fragment of shale having upon its surface three entire specimens of this species. At *a* there is the caudal shield of a HOMALONOTUS, and at *b* the caudal shield of *Phacops limulurus*.

Position and locality. In the shale of the Niagara group at Lockport, Rochester and other places; also in the limestone at Lockport.

503. 1. HOMALONOTUS DELPHINOCEPHALUS.

Pl. LXVIII. Figs. 1 - 14.

Trimerus delphinocephalus, Green, Monograph, 1832, pag. 82, pl. 1, fig. 1; Idem, Monthly Am. Journal of Geology, p. 560.
— — Harlan, Trans. Geol. Soc. Pa., Vol. i, p. 105.
*Brongniartia platycephala**, Eaton, Geol. Textbook, 1832, pag. 32, pl. 2, fig. 20.
Ogygia latissima, Silliman, Am. Journal of Science, Vol. 20, p. 136.
Homalonotus delphinocephalus, Murchison, Sil. System, 1839, pag. 651, pl. 7 bis, fig. 1 *a*, *b*.
H. ahrendi, Rœmer, Verst. des Harzgebirges, 1843, p. 39, t. xi, f. 5.
H. delphinocephalus, Hall, Geol. Rep. 4th Dist. N. York, 1843, p. 103.
— — De Verneuil, Note sur le parallelisme, etc., 1847, p. 47.
H. atlas, *giganteus* and *herculaneus*, Castelnau, Essai sur le Syst. Sil. d'Amerique septentrionale.

Head ovate or subtriangular, arcuate at the base, more or less convex in the middle and depressed in front, often subacute at the extremity; glabella scarcely defined; margin around the front often elevated; posterior margin of buckler marked by a strong continuous ridge or pseudo-articulation; facial suture in front, parallel and coincident with, or slightly within, the flexure of the margin, passing thence obliquely through the eye, and, turning, comes to the margin a little above the posterior angle; articulations of the body thirteen; central lobe or axis broad, scarcely defined, the articulations continuous, with a slight bend along the line of separation; articulations with a broad deep groove or furrow running nearer to the anterior margin, and continuing across the axis and into the lateral lobes to the point where they bend downwards, below which it is a sharp impressed line; lateral articulations falciform, flattened, much expanded and rounded at the extremities, anterior margin arcuate; caudal shield triangular, acute and acuminate at the extremity; middle lobe with eleven to thirteen articulations, lateral lobes with seven to nine articulations; surface papulose-granulate or scabrous.

This species was first named by Green, from a specimen much smaller than the ordinary size, and his figure and cast have therefore proved unsatisfactory in the identification of the larger and more common specimens. Our specimens are unquestionably identical with the species figured by Murchison from the Wenlock limestone. This species and the *Homalonotus* (*Dipleura*) *dekayii* have been most strangely confounded; arising, no doubt, in the first place, from the unfortunate mistakes in regard to localities and consequent geological position. Although occurring at Rochester, Lockport and other places in the same rock, yet I have never seen a perfect individual from any place except the former; and it was never known at Williamsville, the locality cited by Green, and quoted by European authors. On the other hand, *Dipleura dekayii* of Green is cited as not uncommon at Lockport, while in fact it never occurs in that place, nor in the same rock. On the authority of Green, however, specimens from Lockport have been labelled *Dipleura dekayii*, till the error has been widely

*I have had an opportunity of examining the imperfect specimen from which the figure and description of Eaton were made, and there is no doubt of the identity with the species under consideration.

propagated; and this trilobite, when described by European authors, brings together as its localities the names of *Lockport*, *Madison*, *Steuben*, *Cazenovia* and *Rochester*, which, to those knowing the geological position of the places, shows a species ranging from the base of the Upper Silurian to the uppermost Devonian strata. The *Homalonotus* (*Dipleura*) *dekayii* is now known to most American students in geology to be limited in its range to the Hamilton group, and its principal localities in New-York are in Madison county.

This species is readily recognized, and easily distinguished from the only other known American species, by the distinct trilobation of the tail in all its stages of growth, as well as by the comparatively more slender and elongated form of the body, and by the more acute caudal extremity. The deep furrow in the articulations leaves the anterior portion of each one appearing like an intercalated articulation; and without some knowledge, it is not easy to decide whether it belong to the wider portion before or behind it. The broad, flattened and falciform terminations of the articulations of the lateral lobes are very remarkable, but they do not differ sufficiently from *H. dekayii* to render this character important. The surface marking is peculiar, appearing as if made by a triangular graver with a double edge, which has cut and lifted up a minute triangular point, directed more or less backwards or towards the margin. The minute characters of this marking vary in some degree upon different parts of the animal, but is always conspicuous on those parts which have been little exposed to wearing action.

Figs. 1, 2 & 3. Individuals of different sizes, from the smallest yet seen.
Fig. 4. An individual of medium size, and remarkable for having the caudal extremity obtuse.
Fig. 5. A large individual of this species, where the caudal extremity is very acute.
Fig. 6. A small specimen rolled up. This position is very rare for this species, though quite common in the *H. dekayii*.
Figs. 7, 8 & 9. The head and caudal shield as they occur separately in the rock. In many localities this species is found in no other condition.
Fig. 10. The head of a large individual, with a part of the glabella broken up, and which has carried with it the hypostoma or clypeus, the impression of which is still visible.
Fig. 11. The lower side of this separated fragment, showing the clypeus.
Fig. 12. A lateral view of several of the articulations of the body, as shown when the individual is bent a little downwards in the middle.
Fig. 13. Several articulations still more expanded, showing their entire form.
Fig. 14. A portion of the surface from the caudal extremity enlarged, showing the characteristic little papulous elevations.

Position and locality. The principal locality of this species is at Lockport, where large numbers of specimens have been obtained. It occurs in fragments, consisting of the separated cephalic and caudal shields, at Rochester, Wolcott and other places.

Genus LICHAS (Dalman), 1826.

Paradoxides, Bigsby, Green, 1832.
Platynotus, Conrad, 1838.
Metopias, Eichwald, 1842.
Nuttainia, Portlock (not Eaton), 1843.
Platynotus and *Arctinurus*, Castlenau, 1843.
Nuttainia, Emmerich, 1845.
Lichas, Loven, Beyrich, 1845.
Platynotus, Hall, 1843 & 1846.

This genus of Dalman had been overlooked by palæontologists, till revived by Loven and Beyrich in 1845. Dr. Loven's paper fell under my notice as the first volume of Palæontology was passing through the press, though I did not then give due weight to his arguments, knowing, as I should have done, that his position enabled him to determine by actual comparison the characters of Dalman's Genus Lichas, which, in his own figures, is not very satisfactory*. The papers of Dr. Beyrich did not come under my notice till a year after the publication of my volume, and therefore I had no opportunity of profiting by the facts there presented.

The Lockport species, as well as that of the Trenton limestone, will fall under the now well established Genus Lichas. We have also one or more species in the Lower Helderberg limestone, and perhaps others may be found.

672. 1. LICHAS BOLTONI.

Pl. LXIX ; and Pl. LXX. Fig. 1 *a - l*.

Paradoxides boltoni, Bigsby, Jour. Acad. Nat. Sci. Phil. 1825, Vol. iv, p. 365.
— — Green, Monograph, 1832, pag. 6, pl. 1, fig. 5 ; Idem, Monthly Am. Jour. Geology, 1832, p. 360.
— — Harlan, Trans. Geol. Soc. Pa. 1834, Vol. i, p. 103 ; Idem, Med. and Phys. Researches, p. 401.
Platynotus boltoni, Conrad, Annual Rep. Pal. N. York, 1838, p. 118.
— — Hall, Geol. Rep. 4th Dist. N. York : Tables of Organic Remains, no. 19.
Arctinurus boltoni, Castlenau, Essai sur le Syst. Sil. de l'Amerique Septentrionale, 1843, p. 21, t. 5, f. 3.
Compare *Nuttainia hibernica*, Portlock, Geol. Report Londonderry, &c. 1843, pag. 274, pl. 4, fig. 1 ; pl. 5, fig. 1 – 3.

Body and head depressed, axis convex or rounded, lateral lobes often entirely flat ; buckler lunate, extended in front into a kind of proboscis ; glabella convex, broad and prominent in front, separated by a groove from the proboscis, narrowed posteriorly to the middle, and separated by a distinct groove from a large lateral lobe on each side, the base expanded to

* A note, explanatory of these facts, was printed at the end of Vol. I, but unfortunately was left out of all except a few copies of the volume.

nearly the same width as the front, and reaching to the base of the eye-tubercles; lateral lobes of the glabella oval-ovoid, having their longitudinal axis directed obliquely forward; oculiform tubercles auriform, broader at the base; transverse furrow broad and well defined, extending nearly to the posterior angles of the buckler; facial suture coming to the base of the buckler about half way between the base of the eye and the posterior angle; thorax composed of eleven articulations; axis convex, gradually tapering to the posterior extremity; lateral lobes with the articulations flat, falcate, a distinct broad groove extending the entire length, and terminating in the acute extremity. Pygidium laciniate; axis marked by two narrow articulations above, and a third posterior one which is prominent and very convex in the middle, from whence it abruptly slopes downward, becoming confluent with the expanded border; lateral lobes composed of three articulations which are much expanded in the middle, but contract to acute points below, forming the laciniate margin. Entire surface scabrous, having the acute pustulose points directed backwards.

The under side of the crust shows puncta corresponding to the pustulose elevations on the upper side, and the same striated or lamellose surface towards the extremities. The clypeus is attached directly below the front of the glabella : it is broadly rounded in front, and obtusely bifurcate behind. A little behind the centre it is depressed in the middle; and on each side, equidistant from the margin and each other, are two strongly marked depressions, from which proceed grooves extending obliquely forwards, and curving round the anterior portion of the clypeus. A little outside and behind these depressions are two others, less deep, and communicating with the groove just mentioned by a more shallow one. Margin of the clypeus striated; central portion with oblong or angular punctures.

This species, in an entire condition, is one of the rarest as well as most beautiful trilobites of the group, though fragments of the buckler and pygidium are not unfrequently found in the shale. It is easily recognized, however, from any other species, by the peculiar surface marking : the form and terminations of the articulations either of the body or tail, and the glabella and other portions of the head are equally characteristic. The form alone, of the eyes, is all that can be determined; since in all the specimens seen, they are more or less crushed, and the upper margin projects beyond the base so that the lateral or vertical portion is broken off, or left attached to the matrix. In the larger number of specimens the eye-tubercle is so mutilated that it is scarcely to be recognized as that organ, and is not always distinguished from the lobes of the glabella. The projecting portion anterior to the prominent front of the glabella, appears rather to be an expansion of the margin or border which surrounds the front of the buckler; and at its edge, and beneath, is striated or lamellose. A partial exfoliation of the crust from the upper surface shows beneath it the same striated surface, which, at the base, extends inward nearly as far as the point where the facial suture comes out, and gradually narrows above, till at the lateral anterior margins of the glabella it has scarcely a perceptible width; but from this point it again expands, forming the projection in front. The outer extremities of the articulations, for more than one-third of their length in the upper part of the body, and one half their length in the lower part, are striated, or sharply grooved across in lines continuous with

those from the buckler, and which pass entirely around the posterior margin of the pygidium, occupying two-thirds of its width. I have never yet seen a specimen having the outer crust preserved entire, to the extremities of the articulations; but some fragments of it usually remain to show its original extent.

The groove extending along the lateral articulation commences near the upper margin: thence bending downward, and running along near the centre, it gradually approaches the lower margin, and terminates at the apex on the lower margin.

Several magnificent specimens of this species have been found at Lockport, two or three of which are each about seven inches long and five broad. I have rarely seen individuals less than five inches in length; and in all the collections made by different individuals at this place, I have seen only two small ones of about three inches in length.

PLATE LXIX.

Fig. 1. A large individual of this species, as perfect as usually found of this size. The eye tubercles are crushed, and so much mutilated that their form is not well preserved. The extent of the scabrous outer crust can be inferred from the patches still remaining.

PLATE LXX.

Fig. 1 *a*. The head of an individual smaller than the preceding, in which the form of the eye tubercles is more distinctly preserved, as well as the form and direction of the lateral lobes of the glabella.

Fig. 1 *b*. The under side of the head and several articulations; showing the clypeus attached below the front of the glabella. This specimen is from the collection of Col. JEWETT.

Fig. 1 *c*. A fragment of another specimen, showing the impression left after the removal of the clypeus.

Fig. 1 *d*. The under side of the glabella, where the clypeus is removed.

Fig. 1 *e*. Profile of the buckler, showing the elevation of the eye in a specimen where it is very well preserved.

Fig. 1 *f*. A fragment of the glabella and base of the buckler. Fragments of this kind are very common, and, with the pygidia, are the only portions found in some localities.

Fig. 1 *g*. A pygidium of a specimen of medium size, showing more pointed terminations of the articulations.

Fig. 1 *h*. A smaller pygidium with the terminations broken.

Fig. 1 *i*. A young individual of this species, having the base of the buckler broken. The caudal extremity presents some slight deviations from the ordinary appearance of larger specimens, but appears in the two small individuals seen, and in a separate small pygidium fig. 1 *h*.

Position and locality. In the shale at Lockport and Rochester, at Sweden in Monroe county, and at Wolcott in Wayne county. Perfect specimens have been found only at Lockport. The most perfect specimen I have seen is in the collection of the Albany Institute. The matrix is also preserved with it, showing the cavities of the eyes, from which the form has been taken in the figure of a head, Pl. 70, fig. 1 *a*.

673. 1. BRONTEUS? NIAGARENSIS (*n. sp.*).

PL. LXX. Fig. 3.

Compare *Bronteus laticauda*, BEYRICH, Uber einige Bohmische Trilobiten, 1845, pag. 42, pl. 1, figs. 8 and 9.

Caudal extremity broad, somewhat semicircular ; axis defined, six or nine sulcations on each side.

It is with some hesitation that I refer this fragment to the Genus BRONTEUS. The articulations appear to terminate in a broad expanded border like the species of that Genus, but the specimen is clearly imperfect, and being in a granular limestone, it can not be decided positively that they may not extend in laciniate points as in LICHAS. In fact it may perhaps be another species of that genus. The specimen, however, has more the aspect of BRONTEUS than of LICHAS, and it is quite different from *L. boltoni*.

Fig. 3. The imperfect caudal shield.

Position and locality. The specimen was taken from a large fragment of limestone in the Niagara river below the Canada fall. The limestone is evidently from the cliff above.

674. 1. ARGES PHLYCTANODES.

PL. LXX. Fig. 2 *a, b, c.*

Calymene phlyctanodes. GREEN.

Compare *Arges speciosus* (*Trochurus speciosus*), BEYRICH, Uber Trilobiten.

Buckler extremely arched in the middle; central lobe elongate oval, very prominent in the middle ; a short lateral lobe on each side, which is rounded in front and narrowed behind, extending not quite so far as the glabella ; a prominent node on each side, between the eye and the longitudinal furrow ; anterior border prominent, and marked by a row of short spine-like processes ; posterior margin marked in like manner. Entire surface covered with short spine-like pustules with smaller ones between : in the depression at the base of the glabella are three distinct short spines.

The specimen figured is the only one that I have obtained : it consists of the central portion of the head, the sides beyond the facial suture being separated. The remarkable convexity and protuberance of the central lobe is quite sufficient to distinguish this fossil, which possesses all the important characteristics of the Genus ARGES. The character of the pustulo-spinous surface is very remarkable, and quite unlike any other trilobite of the group. Judging from the form of the base, the eyes were roundish and very protuberant.

Our species is closely allied to *Arges speciosus* (*Trochurus speciosus*), BEYRICH ; but the anterior lateral lobes do not reach as far back in that species, and in ours there is no small prominence behind the second lateral lobe.

There is a specimen of this species in the collection of the Academy of Natural Sciences, labelled *Calymene phlyctanodes*, in the same manner as other specimens labelled by Prof. GREEN, and I have presumed it to be the original one described by him.

Fig. 2 *a*. The posterior part of the buckler, showing the lateral lobes and the prominent central one.

Fig. 2 *b*. The front of the same, a view directly opposite to the previous one.

Fig. 2 *c*. Profile view of the same. This figure is incorrectly represented by the engraver, who has confounded the posterior lobe or protuberance with the expanded portion below the eye. The pustulo-spinous protuberances are likewise not properly represented in the engraving.

Position and locality. The specimen figured was found in the shale of the Niagara group near Albion, Orleans county.

Genus PROETUS (Steininger, Loven).

ÆONIA, Burmeister; FORBESIA, M'Coy.

The description given by Burmeister of the Genus Proetus, would not admit the two following species, on account of the spiniform projections of the posterior angles of the cephalic shield. In other respects, however, particularly the undivided glabella, facial suture, etc., the description correponds with our specimens.

The *Asaphus stokesii* of Murchison, with which one of ours is allied, if not identical, has been referred by Loven to the Genus Proetus; while Burmeister has placed it under his Genus Æonia, an important character of which is a lobed glabella, and the angles of the buckler projecting in long spines.

It is quite evident that there is some confusion here, which can not be satisfactorily cleared up at present. I have no doubt but there are two distinct genera here confounded, and that Æonia (taking the characters of the glabella as a guide) will be found in our Hamilton group, and is probably a devonian type; while the one with smooth, unlobed glabella and buckler, and spinous posterior angles, will characterize our middle silurian strata.

675. 1. PROETUS CORYCŒUS.

Pl. LXVII. Fig. 15.

Asaphus corycœus. Conrad, Jour. Acad. Nat. Science, Vol. viii, pag. 277, pl. 16, fig. 15.

Sub-oval; width about two-thirds the length; head a little more than half the length of the body; axis wide and rather prominent, tapering abruptly in the caudal shield; cephalic shield crescentiform, with long posterior spines reaching to the sixth articulation of the thorax; border of shield striated parallel to the margin; glabella prominent, broad in front and narrower behind; cheeks convex; eyes large, reniform, placed near the glabella, and reaching to the neck-furrow below; facial suture turning from below the base of the eye abruptly outwards, and coming to the base of the shield half way between the axal furrow and the margin; axis of the thorax prominent, convex, and wider than the lateral lobes, except in the last articulations, where it is equal in width to the lateral lobe; articulations of the lateral lobes grooved

along the centre, abruptly bent downwards at their extremities, and terminating in sharp points; caudal axis with eight articulations; lateral lobes with five broad shallow grooves extending to the margin; extremities of the articulations of the thorax, and margin of caudal shield, striated like the margin of the cephalic shield.

This rare species is very peculiar, and remarkably distinct from any species of the genus known to me, and from the described species which have fallen under my observation. It possesses the characteristics of the genus, as illustrated in the best specimens figured. In the character of the caudal extremity, it approaches more nearly to *Proetus* —— sp. (SALTER, pl. vi, fig. 4, Memoirs Geol. Survey of Great Britain, Vol. ii, part 1), but it is probably a distinct species.

In one of the specimens examined, the termination of the facial sutures in front is distinctly visible; and the space between them in the margin is equal to one-third of the margin of the shield, exclusive of the spines at the posterior angles.

Fig. 15. A specimen, natural size.
Fig. 15 *a*. The cheek, separated at the facial suture.

Position and locality. In the shale of the Niagara group at Lockport.

676. 2. PROETUS? STOKESII.

PL. LXVII. Figs. 13 and 14.

Reference, *Asaphus stokesii*. MURCHISON, Sil. System, 1839, pag. 625, pl. 14, fig. 6.
" *Proetus* (*Asaphus*) *stokesii*. LOVEN, 1845, pag. 50, T. 1, fig. 3.
" *Æonia stokesii*. BURMEISTER, Organization of Trilobites: RAY, Soc. translation, p. 100.
Compare *Forbesia latifrons*, M'COY, Sil. Fossils of Ireland, pag. 49, pl. 4, fig. 11.
" *Proetus latifrons*, SALTER, Memoirs Geol. Survey of Great Britain, Vol. ii, part 1, pag. 337, pl. vi, fig. 1.

Oval, convex; width about five-sevenths of the length; head a little more than three-fifths the length of the body; axis rather prominent and narrow; cephalic shield crescent-form, with long posterior spines; margin elevated, and the space between it and the cheeks and glabella depressed in a broad shallow groove; glabella oval, smooth, very prominent in front; cheeks convex; eyes small, prominent, close to the glabella; spines rather thick and strong, reaching to the eighth segment of the body; axis of the body (in a specimen not compressed) narrow and prominent; caudal shield with the lateral lobes marked by six or seven ribs, which are divided half way from the axis, and terminate in a thickened border. Surface granulate.

Two individuals of this species only have been seen; one of them is in soft shale, and somewhat flattened, the eyes obliterated, the glabella and part of the axis of the body and tail worn or broken, while the margin of the cephalic shield with the spines is well preserved. The other specimen is partially folded, and the caudal axis not visible. In this specimen the prominent glabella and one cheek are well preserved, as well as the spines of the cephalic shield and articulations of the thorax.

From the similarity of our specimens with the figure of MURCHISON, I have been induced to refer them to the same species, though there may still be some doubt as to absolute identity. Neither of the specimens enables me to count ten articulations in the thorax; eight only being visible in the folded specimen, and only the same number in the flattened and somewhat mutilated specimen in shale. The most striking peculiarity of the species is in the cephalic shield, which reminds one strongly of the CEPHALASPIS.

Fig. 13. An individual in soft shale, with the crust partially exfoliated.
Fig. 14. An individual in limestone, partially folded, and having the buckler imperfect.

Position and locality. In the shale, and in the thin layers of limestone associated with the same, at Lockport.

677. 1. BEYRICHIA SYMMETRICA (*n. sp.*).

PL. LXVII. Fig. 16.

Compressed, smooth (or very finely granulate?); dorsal side straight; base slightly emarginate; extremities nearly similar; a fold or border extending entirely around the ventral edge; on each side, equidistant from the centre, a lateral tubercle extends from the dorsal margin to the ventral edge on each side of the emarginate centre. Within these tubercles or ridges is another ridge, commencing on the dorsal margin, and running nearly parallel to the lateral ridge, curving around and again reaching the dorsal margin, leaving a deep central pit. The groove between the two ridges becomes wider and deeper, receding from the dorsal margin, owing to the increasing elevation and expansion of the lateral ridges.

This species approaches in some degree to the *B. complicata* of SALTER; but the lateral tubercles only unite on the ventral edge, while the central one is very marked and distinct, being in fact a continuous ridge from the dorsal margin, reaching nearly across the shell, and curving suddenly backwards. The two extremities are so nearly symmetrical, that no appreciable difference can be noticed. The lateral tubercles or ridges are often so much expanded as to prevent the ventral margin from being seen when looking directly upon the specimen.

Fig. 16. Specimen natural size and enlarged.

Position and locality. This species occurs with the following upon the calcareous layers in the Niagara shale. It is extremely minute, and not readily distinguished on a cursory examination.

678. 2. CYTHERINA SPINOSA (*n. sp.*).

PL. LXVII. Figs. 17–22.

Minute, subreniform; dorsal side straight, scarcely so long as the greatest length of the shell and slightly pointed at one extremity; external surface granulate; a sharp spine with the

base affixed just above the middle of the shell, the point extending above the dorsal margin; surface towards the ventral margin depressed; margin thickened and abruptly inflected.

This fossil is often abundant on the surface of thin slabs of limestone, and presenting only the interior surface as in figs. 17 and 18, it attracts little attention, not being distinguished from the ordinary forms of CYTHERINA. A more critical examination usually shows the exterior surface of one or two of these, and sometimes we may fortunately detect a fragment where the larger number are in this position. But although satisfied from the general form of the apparently distinct shells, that they are identical, it is a difficult task to separate them from the adhering matrix, and examine the exterior and interior of the same individual. Having done this in several instances, there can be no longer any doubt but all those separate valves, showing the interior only, are furnished with a spine upon the back. By carefully clearing away the shale or calcareous matter along the dorsal margins, the spine may be seen projecting above the line, thus proving its existence, when the shell can not be separated from the matrix, and the exterior examined.

The exterior surface, aside from the spine, differs from all the other Cytherinæ in the curved depression parallel to the ventral margin, and in the thickening of this margin and its abrupt inflexion. The interior sometimes shows an indentation at the base of the spine. In the character and aspect of its external surface, this fossil has much the appearance of BEYRICHIA.

Fig. 17. A fragment of calcareous shale covered with these shells, showing the internal surface.
Fig. 18. An enlargement of a single individual, showing the ordinary appearance of the interior under a magnifier.
Fig. 19. A fragment covered with shells of this species, showing the external surface, with a few of those showing the interior.
Fig. 20. The exterior of a single individual, much enlarged.
Fig. 21. The interior, showing the spine projecting beyond the dorsal margin.
Fig. 22. Profile view, showing the thickened ventral margin.

Position and locality. In the shale of the Niagara group at Lockport: usually covering the surfaces of thin calcareous layers in the shale.

REMAINS OF FISHES.

Thus far all the remains of fishes, the only class of vertebrata existing at this period so far as we have been able to discover, consist of imperfect and obscure fragments of bones. Probably all those in the Clinton group are parts of defensive fin-bones of one or two species, since they present no marks by which we are able to recognize distinctions between them.

Many years since, I discovered in the Niagara shale at Rochester the impression of a part of an ichthyodorulite several inches in length, but it was too imperfect to give any satisfactory description. The second discovery of any thing of this kind in the Niagara shale, consisted of the base of one of these spines or defensive fin-bones, found by Col. JEWETT at Lockport in 1847. The first specimen found exhibited only that portion originally imbedded in the flesh, presenting beautiful and almost symmetrical markings upon its surface, which were probably for muscular attachments. So unlike the markings of any fish rémains was this specimen, that it was regarded as belonging to the Crustaceans rather than the Fishes. Some time afterwards, however, a very fortunate discovery by the same gentleman enabled us to determine the nature of the specimen previously found; for in the second instance, a beautiful spine of six inches in length was terminated at its base by an enlargement for the muscular attachment, having the same form and markings of the surface as the previous one, leaving no longer any doubt as to the identity of the two.

No other specimens have since rewarded the labors of collectors, and we may conclude that they are exceedingly rare.

It is extremely interesting to be able to present, from this geological period, a well marked specimen of this kind, which exhibits not only the characters of the genus, but also shows from the size that it belonged to a large fish. The base of the larger specimen proves more conclusively that the species must have attained a very large size and great weight; for the portion of the spine still remaining, and which was originally imbedded in the flesh, is more than two inches in length, and one inch and a quarter in diameter just above the base. This is, perhaps, the largest specimen of this kind known; and we have not yet discovered, in our Onondaga and Corniferous limestones, any thing equalling it in size. A single specimen of another species in the Delthyris shaly limestone (silurian) is nearly as large as this one; while of a considerable number known in our higher strata, not one equals this in its dimensions.

The occurrence of fishes even so low down in our series as this, has been for a long time doubted, and we have yet no evidence of the existence of this class of animals in our lower silurian strata. Notwithstanding the immense number of specimens of other organisms (and of species to the number of more than 400) which have been collected from the lower silurian rocks of the United States, not a single fragment of an ichthyic character has fallen under my observation, though I have examined numerous localities extending over a large area between the Hudson and the Mississippi rivers; and when we reflect that there are, scattered

over this extent, numerous careful collectors, it will be admitted that, if such remains do exist, they are extremely rare.

In England, however, we have positive evidence of the existence of such remains in strata of the age of our Trenton limestone and Hudson-river group; and although we may not feel quite satisfied of the existence of such organisms at a period below the silurian, we are compelled by the evidence before us to admit that fishes were coeval with the earlier fossiliferous deposits of this country. From the Clinton group upwards, we have these remains in every successive rock as far as the Red Sandstone of the Catskill mountains.

Genus ONCHUS (Agassiz).

1. ONCHUS DEWEII.

Pl. LXXI. Fig. 1 *a–d.*

Spine slender, elongated, gradually attenuated and incurved, longitudinally grooved; anterior side marked by the bases of shorter spines; basal portion (or part enclosed beneath the surface) enlarged and projecting in the middle towards the posterior side; lower extremity constricted. The surface of this portion is ornamented by imbricating, narrow lanceolate elevations which are obliquely striated. This ornamental marking terminates just above the constricted base, which appears to have been more firmly fixed in the tendinous envelope, while the ornamented upper portion marks the attachment of smaller muscles.

Fig. 1 *a.* A fragment of shale, retaining the base of the spine, with about two inches of the lower portion, and the impression beyond this nearly to the apex.

Fig. 1 *b.* A fragment, retaining the impression of the base and lower portion of the spine of the preceding specimen, with the higher portion of the spine itself. The part of the spine remaining in these two specimens is about six inches; and from the appearance of the broken summit, it was originally more than an inch longer.

Fig. 1 *c.* The basal portion of a much larger specimen, showing very distinctly the ornamented surface and constricted base. There are some slight differences in the surface markings between this and the smaller one, but these are probably not of specific importance.

Fig. 1 *d.* An enlargement from the surface of 1 *c.*

If the spine were projected from this base, taking the same proportions as in the smaller specimen, its entire length could scarcely have been less than two feet; and taking the length of the larger base alone, as compared with the length of the other, the larger spine would have been about twenty-eight inches in length. The bases of the shorter species, or barbs, appear as if upon one side of the specimen figured: this is apparently due to pressure, as the specimen appears to be distorted, and no similar markings occur on the opposite side.

Position and locality In the shale of the Niagara group at Lockport and Rochester.

CORALLINE LIMESTONE OF SCHOHARIE AND THE BASE OF THE HELDERBERG.

In the neighborhood of Schoharie, and extending along the base of the Helderberg mountains and along the Hudson river, there is a thin mass of limestone, characterized by an immense number of corals, chiefly favosites, and which forms a band so distinct from any other limestone that it has been for many years known by this name. Besides the corals, it contains other fossils peculiar to it, and which in some localities are sufficiently characteristic in the absence of corals.

In its western extension, this limestone can be traced as far as Herkimer county; but being only a few feet thick, its continuity further westward has not been ascertained in a satisfactory manner.

This limestone, at Schoharie, rests upon a green shale, which appears to be the only representative of the various masses of which the Clinton group, in its full development, is composed; and in its farther extension westward, it is clearly traced above that group of rocks. At Schoharie, and elsewhere, it is succeeded by a shaly ash or drab-colored limestone, which I regard as the Onondaga-salt group, but which has thinned out to a very insignificant mass of fifteen or twenty feet thick.

Both the coralline and the drab-colored limestone, which is nearly destitute of fossils, have been included with the tentaculite limestone above, as the "*Water-lime group;* though the fossils of the upper and lower members are entirely dissimilar, and the few known in the central portion are unlike either.

I believe it can be conclusively shown that this coralline limestone is no other than the Niagara limestone, and indeed representing the entire Niagara group. In the first place, it holds the same position, being above the Clinton group and below the Onondaga-salt group. The Niagara group can be traced continuously from the western line of the State to Oneida county, where it has become very thin, and contains but a few fossils. The limestone has become entirely concretionary or brecciated (as shown by Mr. VANUXEM), a character which is here very conspicuous, and pervading the entire rock, but which is also a feature at the west where the mass is thicker. Over a part of Oneida county and the western part of Herkimer, there is a space where no representative of the Niagara group has been traced continuously; not that the place where it should occur has been examined, and it found to be wanting, but because there are no good exposures of the strata which enable one to examine and determine satisfactorily the presence or absence of a thin bed like this one. In tracing the same line eastward, however, into Herkimer county, there is a thin mass of limestone holding the same place, but more closely united perhaps with the drab limestone above, which is the thinned Onondaga-salt group. Here it has been united with the Water-lime group as elsewhere, though really without sufficient reason. In Herkimer county it contains numerous corals, among which is *Catenipora escharoides*, a coral that has never been seen above the Niagara group

in the rocks of New-York; and the other corals are similar to those of the Niagara group, while none of them have ever been found in the tentaculite limestone with which it is grouped. Tracing this rock from Herkimer county, it becomes more distinctly developed, and better exposures are seen, till we have it presenting the characters noticed at Schoharie. At this place a portion of the mass is a concretionary limestone, if this character be of any importance in the identification of the two masses. Its position, I hold, however, is sufficient to entitle it to rank as of the same age with the Niagara group; and though many of the fossils are distinct, there are still many which are identical; and when we recollect that the conditions under which the sediment in the western and the eastern part of the State were deposited were very different, and that the depth of the sea was unequal, we shall find an explanation for this difference in the fauna.

In order that no confusion may arise from a mingling of the fossils from the Niagara group, as known in Western New-York and in Canada, as well as still farther to the west, with the fossils of the Coralline limestone around the base of the Helderberg, I have given them on separate plates, and by this means a comparison between the two will be facilitated.

The most remarkable and peculiar fossils of this rock at Schoharie, are the large spiral univalve shells, some of which are probably true Gasteropoda, but one or two of which have apparently a separate structure like the Cephalopoda. All these, together with one or two species of BELLEROPHON, are forms unknown in the Niagara group in Western New-York.

679. 3. DIPLOPHYLLUM CORALLIFERUM (*n. sp.*).

PL. LXXII. Fig. 1 *a*, *b*, *c*.

Cæspitose, growing in small tufts; stems small; central area small; interior structure not known.

Two groups of this species have been observed, both of which have the spaces between the stems and the entire mass surrounded and overgrown by a species of STROMATOPORA. We may infer from this fact that the conditions of the locality were not favorable to the existence of this coral; since, after attaining so small a size, it has been completely enveloped in another coral of, apparently, much slower growth.

The stems are smaller than the species previously described, and the central area proportionally less. There are also numerous small stems among the full grown ones upon the surface of the mass, where the ends are presented. This character is not observed in the Lockport species.

Fig. 1 *a*. The ends of numerous stems of this coral, enclosed in a mass of STROMATOPORA.
Fig. 1 *b* & 1 *c*. Enlargements from different cells of this coral.

Position and locality. From the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

680. 1. COLUMNARIA INEQUALIS (*n. sp.*).

PL. LXXII. Fig. 3 *a*, *b*, and 4 *a*, *b*, *c*.

Coral in hemispheric or irregular masses composed of angular (5 or 6-sided) tubes, which open on the surface in a cell more or less deep; rays twenty to thirty; lamellæ apparently equal, often undulating; interspaces showing numerous connecting plates; lamellæ uniting in the centre without any apparent axis; full grown terminal cups often very deep, with numerous young ones interpolated; structure prismatic, walls of cells separable, outer surface deeply striated; vertical section showing an exterior cellular structure, the interior showing lamellæ diverging upwards and outwards.

This coral presents so many characters in common with the specimens of COLUMNARIA figured and described by GOLDFUSS and LONSDALE, that I can not hesitate to refer it to this genus, though not possessing fully the characters given by Prof. DANA. In the specimens examined the masses have not attained any large size, though one or two of them may have been five or six inches in diameter. The cells opening upon the surface are very unequal in size, a large number being those of small or young polyps which appear to be interposed between the walls of contiguous cells. The full grown cells are distinctly angular, of five, six or seven unequal sides; while the young cells are often triangular, and sometimes distinctly oval, the walls being usually more or less curved. Solid specimens sometimes separate in prisms, the exterior walls of which are deeply striated or fluted, arising from the arched union of contiguous lamellæ; thus leaving the more prominent parts of the surface representing the spaces between the lamellæ, while the narrow indentation represents the place of the lamella. When the exterior surface is weathered, it presents a cellular structure, from the intersection of the lamellæ and connecting dissepiments, as in fig. 4 *b*. When the columns are still farther weathered, this external cellular portion is sometimes worn away, and the interior portion alone remains, as in fig. 4 *c*, the natural position of which is reversed.

Fig. 3 *a*. A part of the surface of a small irregular mass, showing fewer young cells than is usual.

Fig. 3 *b*. Several of the same enlarged.

The elevated point in the centre gives a wrong impression as to the character of the cup. Such elevated points, where they do exist, are apparently accidental or unnatural. The transverse dissepiments connecting the lamellæ are not well shown in these figures.

Fig. 4 *a*. A portion of a specimen, showing the prismatic structure of the coral.

Fig. 4 *b*. A weathered portion enlarged, showing the cellular exterior structure.

Fig. 4 *c*. A reversed figure, the lower extremities of several columns enlarged, showing the mode of weathering, and the structure after the removal of the exterior cellular area.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

515. 1. FAVOSITES NIAGARENSIS?

PL. LXXIII. Fig. 1 *a–e*.

See page 125, plate 34 A of this volume.

In all the specimens of this coral from the Coralline limestone, which I have examined, I am unable to discover any character by which to distinguish it from the Niagara species. The size of the columns, though extremely variable, is less than in *F. gothlandica*. The dissepiments are often partially or entirely removed, and the space between them unequal; and we may add to this, that all the specimens are either solid and crystalline, or have the interior lined with crystals, so that the more minute structure is not visible. The solid specimens furnish very beautiful polished surfaces, and many of them have been distributed to collectors by the Messrs. GEBHARD of Schoharie.

Fig. 1 *a*. A fragment of stone, showing one mass in its natural position, while the other is reversed. This condition, in numerous instances, proves that they were not all covered by sediment in the position in which they grew, but have been to some extent transported.

Fig. 1 *b*. A surface showing the ends of the columns.

Fig. 1 *c*. A broken surface, showing the cellular structure: the walls and dissepiments are covered by fine quartz crystals.

Fig. 1 *d*. A small mass of this species.

Fig. 1 *e*. A polished surface of another smaller specimen.

Many hundreds of these corals, of a nearly spherical form, may be seen where the diameter scarcely exceeds an inch, and in many instances they are of much less size. This species, with the *Stromatopora concentrica*, are far more abundant than all the other corals of the rock. These together often form almost the entire mass for a considerable thickness, there being just enough sedimentary matter to cement the corals: the worn and weathered surfaces present the masses in all possible positions, and consequently afford sections in every direction.

Position and locality. The specimens figured were all found in the Coralline limestone at Schoharie. (*Collection of* JOHN GEBHARD junior.)

681. 2. STROMATOPORA CONSTELLATA.

PL. LXXII. Fig. 2 *a, b*.

Compare *Stromatopora polymorpha* of GOLDFUSS.

Massive, hemispheric, spheroidal or irregular; composed of thin concentric layers, which are penetrated by minute vertical tubes or cells; surface of layers nodose, each elevation being marked by an irregular stellate impression with undulating and bifurcating rays; intermediate spaces smooth, or having only the minute cell apertures.

This species presents no important characters to distinguish it from the *S. concentrica*, except the uneven surface of the laminæ, and the stellate impressions upon these elevations. The

size of the minute cell is apparently the same as in *S. concentrica ;* and in such specimens as break only vertically, there is no positive means of distinguishing this species beyond the undulations of the laminæ which correspond to the uneven surface. It seems indeed probable that it may be only a variety of the *S. concentrica*, presenting this peculiarity in its mode of growth.

Fig. 2 *a*. A portion of the surface of one of these masses, showing the nodose stellate laminæ.
Fig. 2 *b*. An enlargement of the surface of two of these nodes.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

523. 1. STROMATOPORA CONCENTRICA.

PL. LXXIII. Fig. 2, 2 *a*, and 2 *b*.

See page 136, plate 37, fig. 1, of this volume.

Masses of various forms, undistinguishable from this coral as it occurs at Lockport and elsewhere in the Niagara group, are found in great numbers in this limestone at Schoharie. In many cases where vertical sections are seen, the laminæ are so regular that the nodose elevations of the preceding species can not exist, and we have therefore no visible characters to distinguish it from *S. concentrica.*

Fig. 2, 2 *a*, & 2 *b*. Individual masses of various forms.

Position and locality. Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

Mr. GEBHARD has discovered the *Catenipora escharoides* in the lower part of the drab-colored limestone, which rests on the concretionary compact mass below, to which the term Coralline limestone is applied. The same condition is true of the Catenipora found in Herkimer county, where it appears to have continued its existence a short time after the commencement of the argillaceous drab-colored deposit, though the coral itself is often connected with a nodule or irregular fragment of more compact limestone, like the rock below ; and the same feature is observed in the Schoharie specimen.

BRACHIOPODA OF THE CORALLINE LIMESTONE.

682. 31. ORTHIS INTERSTRIATA (*n. sp.*).

Pl. LXXIV. Figs. 1 *a*, *b*, and 2 *a*, *b*.

Semioval, subplano-convex; cardinal line straight, equal to the width of the shell; dorsal valve convex, and much elevated towards the beak; ventral valve nearly flat; striæ strong, not arcuate, having smaller interstitial ones commencing below the beak; interior of shell showing striæ as if regularly dichotomous; concentrically marked by rather strong striæ.

This shell, in its dorsal valve, has much the aspect of *O. testudinaria*, but the striæ are stronger and not arcuate; the concentric lines also are stronger than in that species. It is comparatively rare in this limestone, and, so far as known, restricted to it.

Fig. 1 *a*. The interior of the ventral valve, showing regularly dichotomous striæ.
Fig. 1 *b*. The striæ enlarged.
Fig. 2 *a*. The dorsal valve of a smaller specimen.
Fig. 2 *b*. The surface enlarged, showing the interstitial striæ.

Position and locality. In the Coralline limestone at Schoharie.

683. 27. LEPTÆNA —— *sp.*

Pl. LXXIV. Fig. 3 *a*, *b*.

Semi-oval; hinge line slightly extended beyond the width of the shell. A small portion of the shell, preserved on the margin of our specimen, shows thin sharp radiating striæ with fine concentric striæ between them; the other portion of the specimen preserves only the direction of the striæ, and the punctate surface of the interior.

From the imperfect condition of the two specimens examined, it is difficult to characterize with accuracy the shell in its perfect state.

Fig. 3 *a*. A specimen showing the form of the shell.
Fig. 3 *b*. An enlargement, showing the thin radii and connecting concentric lines.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* John Gebhard junior.)

684. 28. LEPTÆNA BIPARTITA (*n. sp.*).

Pl. LXXIV. Fig. 4 *a*, *b*, and 5 *a*.

Shell elongated, semioval; dorsal valve nearly flat, ventral valve slightly concave; surface with strong radiating striæ and intermediate finer ones; interior surface entirely punctate; dorsal valve with the muscular impression much elongated and distinctly bipartite.

It is difficult to characterize a species when only the mutilated interior of the shell exists, though the form of the muscular impression is in this case almost sufficient to distinguish the species.

Fig. 4 *a*. The interior of the ventral valve, with the dental laminæ worn off.
Fig. 4 *b*. An enlargement from the surface of this specimen.
Fig. 5 *a*. The impression of the dorsal valve, with some portions of the shell remaining.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

685. 2. STROPHODONTA TEXTILIS (*n. sp.*).

PL. LXXIV. Fig. 6 *a–d*.

Semioval, wider than high; hinge line slightly extended beyond the width of the shell; surface marked by numerous close flat striæ, which are crossed by fine concentric striæ, giving the surface a finely textile appearance; hinge line crenulated.

The specimen figured is the ventral valve, on which the shell is preserved near the base and partially elsewhere, but broken away along the hinge line. The casts of the muscular impression are also preserved.

Fig. 6 *a*. The ventral valve described.
Fig. 6 *b*. The hinge line enlarged, showing impressions of the crenulations.
Fig. 6 *c*. A farther enlargement of a portion of the same, showing the crenulations.
Fig. 6 *d*. A portion of the surface enlarged, showing the fine concentric striæ.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

686. 10. SPIRIFER —— *sp.*

PL. LXXIV. Figs. 7, 8 *a–d*.

These specimens all have the external portion of the shell exfoliated. They are closely allied to *S. crispus;* but two of them are of a much larger size than this species usually attains. There are evidences also of four or five costæ, which scarcely rise above the surface. In one of them still remain some marks of concentric striæ, but not sufficient to decide positively the relations of the species. The specimens are all attached to the rock, and in two of them the outlines are somewhat obscured by it.

This is evidently closely allied or identical with *S. crispus*, and not with the species in the tentaculite limestone above, which has sharper plications and more distinct concentric striæ, as well as longitudinal striæ between them, as in *S. sulcatus* of the Niagara group.

Fig. 7. The dorsal valve of a specimen, showing evidences of five plications on each side of the mesial sinus.

Fig. 8 *a*, *b*, *c*. A very convex dorsal valve, where the evidences of plications are more obscure, though the surface still preserves marks of concentric striæ.

Fig. 8 *d*. A smaller specimen having the angle partially covered by the stone.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

623. 6. SPIRIFER CRISPUS.

PL. LXXIV. Fig. 9 *a–h*.

Reference page 262, pl. 54, fig. 4.

After examining numerous specimens of this shell, I am unable to find any distinctive features by which to separate it from the Niagara specimens. In those represented, the outer surface is more or less exfoliated, and the plications are but faintly visible. This character, in specimens from the Niagara shale, is very variable; some of the specimens showing distinct plications, while others are almost entirely smooth. In one specimen from the Coralline limestone, a broken and depressed portion of the shell shows concentric striæ undistinguishable from those of the Niagara shale. Even the exfoliated specimens preserve evidences of these concentric striæ, and are quite undistinguishable from similarly exfoliated specimens from the Niagara group. From all these circumstances, I can have no hesitation in referring the specimens from the Niagara and the Coralline limestone to the same species.

Fig. 9 *a–h*. Different views of several specimens of this shell, showing very clearly its identity in form with those figured on Pl. 54, the latter having the plications more strongly developed.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

687. 58. ATRYPA NUCLEOLATA (*n. sp.*).

PL. LXXIV. Fig. 10 *a–m*.

Compare *Atrypa nitida*, page 268, plate 25, fig. 1, of this volume.

Shell round oval or oval ovoid; beak of the dorsal valve often much extended, and incurved over the ventral valve; surface concentrically striated; front of the shell indented, the indentation connected with a depression or groove down the centre of the dorsal valve, and sometimes a similar one on the lower half of the ventral valve.

This species approaches very closely the *A. nitida* of the Niagara group, but is less elongated, and the indentation in front and the groove down the centre of the dorsal valve are more conspicuous in the species from the Coralline limestone. There are sometimes, however,

specimens which do not possess these characters, and the shell is then not easily distinguished from those in the Niagara group. This is peculiarly true of specimens collected in the Niagara limestone in the eastern part of Wayne county, and in Cayuga county, where they have not the full development which the same species has in the shale at Rochester, Lockport, and elsewhere. It is the most common brachiopod in this limestone.

Fig. 10 *a*, *b*, *c*. Views of the ventral valve in several specimens of different size.
Fig. 10 *d*, *e*, *f*. Front views of the same specimens, showing the indentation.
Fig. 10 *g*, *h*. Dorsal valve and cardinal views of another specimen.
Fig. 10 *i*, *k*. Dorsal and ventral views of a larger individual, where the indentation is scarcely perceptible.
Fig. 10 *l*, *m*. Profile views of fig. 10 *i* and fig. 10 *k*.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

688. 59. ATRYPA LAMELLATA.

PL. LXXIV. Fig. 11 *a*–*h*.

Compare *Atrypa rugosa* and *A. nodostriata*, page 271 and 272, plate 56 of this volume.

Sub-rhomboidal, the ventral valve more convex; beak of the dorsal valve incurved, small, acute and prominent; surface marked by six or seven plications on each side of the mesial lobe and sinus, which are simple from their origin; mesial sinus marked by two plications, with three corresponding ones on the opposite valve (rarely three plications in the sinus, and four on the corresponding elevation); plications crossed by strong imbricating lamellæ, which are deeply arched, giving the surface a rugose aspect.

This species bears a close resemblance to *A. rugosa* cited above; but all the specimens examined are nearly uniform in size, and not so large as the larger ones of that species. The plications also are simple from their origin, though marked by imbricating lamellæ much in the same manner.

Fig. 11 *a*. Ventral valve of a full grown specimen.
Fig. 11 *b*. Several plications enlarged.
Fig. 11 *c*, *d*. Ventral and front view of a smaller specimen.
Fig. 11 *e*, *f*. A specimen showing scarcely any sinus or elevation.
Fig. 11 *g*, *h*. Profile views of different specimens, the lower figure perhaps flattened from compression.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

689. 60. ATRYPA —— *sp.*

PL. LXXIV. Fig. 12 *a*, *b*, *c*.

Rhomboidal; surface of ventral valve marked by about 19 angular plications, three of which are very slightly elevated in front; scarcely visible concentric striæ, which are waved on the plications.

This species occurs with the preceding, scarcely differing in form. In a single specimen the plications are more numerous, less raised on the mesial elevation, and almost destitute of concentric striæ, features which eminently characterize the other species.

Fig. 12 *a*. A fragment of stone, on which are grouped several specimens of the preceding species, with a single one of this species in the centre.

Fig. 12 *b*. Another view of the same.

Fig. 12 *c*. Profile of the elevation of the striæ.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

ACEPHALA OF THE CORALLINE LIMESTONE.

The following have not been seen in any other rock; and though differing from those of the Niagara group in the western part of the State, they are likewise equally distinct from those of the Lower Helderberg limestones which succeed this rock.

690. 10. TELLINOMYA? EQUILATERA.

PL. LXXV. Fig. 1 *a*–*d*.

Cast of shell nearly equilateral, oval; anterior extremity more rounded than the posterior, which is sometimes slightly alate; a distinct groove extends from the inside of the beaks obliquely backwards nearly to the posterior extremity, above and behind which the cast is more compressed; surface showing faint marks of concentric striæ.

This species is the most common acephalous bivalve in this rock. It is always found in the condition of casts, which, when well preserved, show the impression of concentric striæ, and a distinct, rather deep, groove extending from the beak nearly to the posterior extremity. In less perfect specimens, the nearly equal extremities and oval form are usually sufficient to characterize the species.

Fig. 1 *a*, *b*. Similar views of two specimens, showing a slight difference in form, probably due to pressure.

Fig. 1 *c*. Cardinal view of fig. 1 *a*.

Fig. 1 *d*. View of the posterior slope, showing the groove in each valve.

Position and locality. In the Coralline limestone of Schoharie.

(*Collection of* JOHN GEBHARD junior.)

691. 11. AVICULA? —— *sp.*

PL. LXXV. Fig. 2 *a*, *b*, *c*.

Equivalve? extremely convex along the middle obliquely backwards; anterior wing short; posterior one not separated from the body of the shell by any distinct sinus.

A single imperfect specimen only has fallen under my observation; and this being a cast, without external markings, it is impossible to characterize the species satisfactorily.

Fig. 2 *a*, *b*, *c*. Right and left valve, and profile view of the specimen.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

692. 12. AVICULA SUBRECTA (*n. sp.*).

PL. LXXV. Fig. 3.

Shell slightly oblique, gradually expanding from the beak; anterior wing short, triangular; posterior wing wide, triangular, separated from the shell by a subdefined sinus; surface finely striated; striæ crossed by obscure concentric lines of growth.

The single specimen examined is not well preserved, though the general form and surface markings can be determined. The posterior wing is imperfect along the hinge line, as well as on the outer margin. It is clearly a distinct species from any shell previously described from our strata, and, so far as known, is restricted to the thin mass in which this specimen has been found.

Fig. 3. Left valve of *A. subrecta*.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

693. 13. AVICULA SECURIFORMIS (*n. sp.*).

PL. LXXV. Fig. 4, 5 *a*, and 5 *b*.

Shell wide (width nearly one-sixth greater than the height), subrhomboidal, oblique; anterior wing scarcely existing; posterior wing narrow and small; posterior margin of the shell extending more than one-fourth of the width beyond the extremity of the wing; surface of the cast (fig. 4) marked by concentric lines of growth, and on the margin with faint impressions of radiating striæ.

The specimens 4, 5 *a* and 5 *b* appear all to belong to the same species; the former being a cast of the interior of the left valve, while the two other figures show the interior of the same valve in specimens of different size. The central part of the cast is roughened from weathering, and whatever markings there may have been upon it are obliterated. Towards the margin,

however, the concentric lines of growth are visible, and in a still less degree the radiating striæ. The valve fig. 5 *a* is a young shell, and the radiating striæ are very conspicuous, while the lines of growth are still visible. The specimen fig. 5 *b* maintains nearly the same proportions as fig. 4, and showing slight indications of radiating striæ upon the interior, though in a less degree than in fig. 5 *a*.

In the young shell the wing is not so distinct as in the older individuals; and in fig. 5 *b*, this part of the shell is represented too large.

Fig. 4. Cast of the left valve.
Fig. 5 *a*. The interior of the left valve of a young shell.
Fig. 5 *b*. The interior of the left valve of a full grown individual.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

694. 14. AVICULA LIMÆFORMIS (*n. sp.*).

PL. LXXV. Fig. 6 *a*, *b*.

Shell slighly oblique; height much greater than the width; anterior wing scarcely defined; posterior wing slightly extended beyond the width of the shell, and strongly wrinkled; surface marked by strong radiating plications, most of which continue undivided to the base; concentric lines of growth conspicuous.

The specimen fig. 6 *a* is a cast of the interior of the right valve, the posterior wing of which is broken off: the plications are quite distinct and angular, being of less width than the spaces between. In the specimen fig. 6 *b*, which is the interior of the right valve, the spaces between the plications are nearly flat, and much wider than elevated folds of the exterior surface. In this specimen also the posterior wing is imperfect.

The aspect of fig. 6 *a* is unlike AVICULA; but in comparison, it should be recollected that the wing in entire specimens is much more extended, and the figure should have been drawn to show this character.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

Several other species of this class of shells have been found in this limestone, but they are uniformly in the condition of casts, and often so much distorted by pressure and obscured by weathering that they afford no very satisfactory information.

GASTEROPODA OF THE CORALLINE LIMESTONE.

The most common species in this rock are one of BELLEROPHON and one of BUCANIA. These, as well as all the others, are usually distorted by pressure, and otherwise very imperfect. They are nevertheless so peculiar as to be readily recognized, even in that condition, when compared with other species of the same genera from other strata.

695. 4. PLATYOSTOMA —— *sp.*

PL. LXXVI. Fig. 1.

The specimen figured is an imperfect cast. It is not unlike *P. hemispherica* of the Niagara group, but the imperfection of specimens renders it impossible to make satisfactory comparisons.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

696. 21. PLEUROTOMARIA SUBDEPRESSA (*n. sp.*).

PL. LXXVI. Fig. 2 *a*, *b*.

Trochiform; volutions angular, marked by three carinæ on each; spaces between the carinæ marked by oblique striæ; shell rather coarse and strong.

The specimen figured is imperfect, showing about four volutions: the first one is scarcely distinct in the figure; one or more of the last volutions are entirely wanting. In its general character this species resembles one in the succeeding rock, but the volutions enlarge much more rapidly from the apex, and the angles are more prominent.

Fig. 2 *a*. Profile view of the fragment.
Fig. 2 *b*. View of the apex of the same.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

697. 17. MURCHISONIA? OBTUSA.

PL. LXXVI. Fig. 3.

Shell elongated; spire consisting of seven or eight volutions; volutions rounded, ventricose, more prominent on the lower side; aperture somewhat expanded.

The specimen is a cast, wanting one volution. The surface is nearly smooth, though there are slight indications on each volution of a carina just below the centre, with bent striæ proceeding from it. The form of the shell is too peculiar to be mistaken.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

698. 18. MURCHISONIA? TEREBRALIS (*n. sp.*).

PL. LXXVI. Fig. 4.

Shell very slender, extremely elongated, very gradually enlarging from the apex; volutions eleven in the fragment, slightly expanded towards the lower side; surface markings unknown.

This specimen is a fragment consisting of eleven volutions; the apex, with at least three volutions, being broken off. The shell is imbedded in the rock, and the surface worn down so much that its markings are obliterated. The slender form of the shell, and great number of volutions, are very remarkable, although not alone sufficient to distinguish this from other species in a succeeding rock (See plate 83).

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

699. 10. BUCANIA —— *sp.*

PL. LXXVI. Fig. 5, and 6 *a*, *b*.

Several specimens of this species have been examined, but they are all casts, and so much distorted that it is impossible to characterize them. The large umbilicus denotes that they belong to this genus, rather than BELLEROPHON.

This species evidently attains a large size, as shown in fig. 5, which possesses no character to distinguish it from the small one 6 *a*, *b*.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

700. 5. BELLEROPHON AURICULATUS.

PL. LXXVI. Fig. 7 *a*, *b*.

Convolute; volutions somewhat flattened from the dorsal side; last volution rapidly enlarging; aperture expanded, curving outwards and nearly reflexed at the lateral angles. The remains of a carina, with arched striæ diverging therefrom, are visible upon the dorsal side.

The specimen is a cast, preserving slight evidences of the external markings, but still sufficient to indicate their character. This species is associated with the preceding; but even in the usually imperfect condition of both species, they can be distinguished from each other.

Position and locality. In the Coralline limstone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

Several other species of Gasteropoda have been examined, but they are all too imperfect to be characterized.

CEPHALOPODA OF THE CORALLINE LIMESTONE.

I find it necessary to place under this class the two following very remarkable species from this rock. In their external form and general features they resemble Gasteropoda, but a careful examination has satisfied me that they are septate. They are probably the earliest representatives of spiral chambered shells. The chambered character does not appear to be accidental, or the result of the animal gradually leaving the apex of the shell, as would appear to be true of EUOMPHALUS; but a peristent character existing at all stages of growth.

GENUS TROCHOCERAS.

Turbinate or trochiform; spire elevated, more or less ventricose, umbilicated; aperture rounded or round-oval; volutions above the outer one septate; siphuncle submarginal or dorsal.

In the specimen from which the generic description is principally made, the septa are strongly arched from the inner basal angle of the volution to the outer one, advancing on the outer angle towards the aperture.

701. 1. TROCHOCERAS GEBHARDII* (*n. sp.*).

PL. LXXVII. Fig. 2; and PL. LXXVII A. Fig. 1 *a-d.*

Shell trochiform; spire moderately elevated; elevation, compared with width of base, about as four to five; umbilicus large and deep; volutions in the upper part of the shell nearly triangular, becoming oval and roundish towards the aperture, distinctly and rather prominently angular on the inner edge; septa highly arched on the base of the volutions; siphuncle not distinctly visible; surface of the shell unknown.

I have before me two specimens of this shell, one of which is represented on Plate 77. fig, 2. In this one the upper part of the shell is still adhering to the compact limestone; the two last volutions are free, and the umbilicus is open nearly to the apex of the shell. The umbilicus measures three inches in depth, and two and a half inches in diameter across the base. A considerable part of the last volution has been broken off from the aperture upwards. As nearly as can be ascertained, both from this and another specimen, nearly the whole of the last volution is free from septa, and corresponds to the outer chamber of other cephalopods. On removing

*I take pleasure in dedicating this remarkable and peculiar species to my friend JOHN GEBHARD junior, whose untiring labors during the past eighteen years have done so much in the development of the geology and palæontology of his own county, and by whose labors Schoharie has been made classic ground. But for the zeal and persistent labor bestowed by Mr. GEBHARD on the rocks of Schoharie, it would have been impossible for me, with the time and means at my disposal, to have procured the many beautiful and unique specimens which have been kindly loaned to me by their owner for use in this work, a large part of which will appear in the succeeding volume.

the outer volution shown in fig. 2, pl. 77, in which septa are but indistinctly visible, we have the specimen as shown in fig. 1 *a*, pl. 77 *a*, in which the septa are strongly shown on the inner angle and base of the volution, as well as on the side within the umbilicus. Towards the outer margin of the volution, there is some appearance of the existence of a siphuncle.

It will be observed in both the figures referred to, that each successive volution is visible in the umbilicus, extending beyond the one next below. This arises from the inner basal angle of each volution projecting, while the upper inner angle is rounded and retiring.

PLATE LXXVII.

Fig. 2. View of the base of a specimen, looking into the deep umbilicus.

PLATE LXXVII A.

Fig. 1 *a*. View of the base of the preceding specimen, after the removal of the last volution, showing the direction of the septa.

Fig. 1 *b*. The base of another specimen, which has the upper portion enclosed in solid limestone. The higher visible portion shows the marks of septa. The specimen shows the volution towards the aperture narrower than above. This feature may be partly due to pressure; though in other specimens it is shown that the horizontal diameter of the volution decreases, while the vertical diameter increases towards the aperture.

Fig. 1 *c*. A transverse section just above the first volution. The lower angle in this figure requires to be carried farther to the right.

Fig. 1 *d*. A transverse section, about one half or two-thirds of a volution above the aperture.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

702. 2. TROCHOCERAS TURBINATA (*n. sp.*).

PL. LXXVII. Fig. 1.

Turbinate; spire elevated; volutions about six, ventricose; shell nearly twice as high as wide; siphuncle subdorsal; surface striated.

Two specimens having the form of fig. 1 have been examined, both presenting the same general characters. In the one figured, the last volution is broken away, leaving a portion of the striated shell adhering to the base of the next whorl as shown in the figure. Where the latter is worn and slightly weathered, there appears a cylindrical tube, with septa attached at equal distances. This feature is fully exposed for a short distance, and its form can be traced beneath the surface still farther.

With this evidence, I can not hesitate to refer the specimens to the same genus as the one previously described.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

703. 4. ONCOCERAS EXPANSUM (*n. sp.*).

PL. LXXVII A. Fig. 2 *a*, *b*.

Shell ventricose, rapidly expanding in the middle; septa closely arranged, very slightly convex; siphuncle subdorsal; surface?

This fragment, from the rapid expansion towards the aperture, is sufficiently characteristic to indicate a distinct species. The fragment consists of about five septa preserved in their natural form, though destitute of the shell.

Fig. 2 *a*. Lateral view of the specimen.
Fig. 2 *b*. Transverse section, showing the position of siphuncle.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

In addition to the specimens described above, Mr. GEBHARD has recently discovered a specimen of TROCHOCERAS much more depressed than *T. gebhardii*, and which may prove distinct from that one, though it is impossible to decide from the single imperfect specimen in question. He has also discovered an ORTHOCERAS, which may prove characteristic of the mass; though from the fragment in my possession, I am unable to describe it with sufficient accuracy to be made available.

The Coralline limestone exists in place at several localities on the east side of the Helderberg, but I have had no opportuity of examining these places in detail. It is not improbable that many more species may be added to those already known.

CRUSTACEA OF THE CORALLINE LIMESTONE.

The Crustacea known in this rock, consist of a single species of trilobite, and a single species of CYTHERINA.

704. 8. CALYMENE CAMERATA.

PL. LXXVIII. Fig. 1 *a*–*f*.

Calymene camerata. CONRAD, Jour. Acad. Nat. Sci. Philadelphia, Vol. viii, p. 278, 1842.

Cephalic shield wide, subcrescent-form; anterior margin elevated in a strong fold, a deep groove separating it from the front of the glabella and cheeks; glabella broader and nearly straight in front, furnished on each side with three distinct tubercles, the posterior one very large and prominent, the anterior one minute; eyes opposite to the central lobe of glabella; the furrow between the glabella and cheeks very deep; a projecting lobe from behind the eye touches or unites with the middle of the three lobes of the glabella, and a similar projecting

plate from the inner anterior angle of the cheek touches the front lobe of the glabella near its anterior angle. Axis of the body convex, nearly as wide as the lateral lobes; pleura convex and straight for half their length, and then gently curved downwards and flattened, grooved along the centre. Caudal shield with eight rings in the middle lobe; lateral lobes with six flat ribs strongly bent downards; surface granulate, with larger tubercles on the glabella and other parts.

The specimens examined are all imperfect, and the surface markings are also more or less obliterated. The characteristic features are the deep furrow along the front and cheek margins, and between the glabella and cheeks, and the projecting lobes from the inner margins of the cheeks which touch or unite with the glabella, arching over the axal furrow. In the two separated cephalic shields, the portion beyond the facial suture is wanting, and in the more entire specimen it is too obscure to be characterized.

Fig. 1 *a*. A specimen preserving eleven articulations of the thorax, and a large part of the cephalic shield.

Fig. 1 *b*. The central part of the cephalic shield, the lateral portions being separated at the suture. In this specimen, the connexion of the cheeks with the glabella is shown upon one side.

Fig. 1 *c*. Another cephalic shield, in which the central portions are better preserved.

Fig. 1 *d*. The caudal shield.

Fig. 1 *e*. Front view of the cephalic shield, from which the marginal rim is broken, showing the arched projections from the eye to the glabella.

Position and locality. In the Coralline limestone at Schoharie.

(*Collection of* JOHN GEBHARD junior.)

705. 3. CYTHERINA ALTA?

PL. LXXVIII. Fig. 2 *a-d*.

Reniform, wider posteriorly, very convex in the middle, and somewhat depressed towards the two extremities; dorsal margin straight, much shorter than the width of the shell; a small node near the anterior dorsal angle; surface papulous.

Mr. CONRAD cites *Cytherina alta* from the Tentaculite limestone, and it is possible the present may be identical with that one; but in specimens examined, this species is more nearly equal at the two extremities; while in those in the tentaculite limestone, the anterior end is narrower than the posterior. I have not seen surfaces of the latter well preserved.

Fig. 2 *a*, *b*, *c*. Individuals of different size. The minute tubercle referred to is shown in fig. 1 *c*.

Fig. 2 *d*. An enlargement of the surface, showing the papulose character.

Position and locality. In the Coralline limestone at Schoharie.

ONONDAGA-SALT GROUP.

Since the publication of my report on the Fourth Geological District of New-York, in 1843, I have had but small opportunity of making farther investigations for fossils in this group. In all the localities, within the State, which have been examined, however, no new species have been discovered. Even where they do occur, the surface markings are so much obliterated that it is nearly impossible to characterize the species in a satisfactory manner. Several of those figured in the report cited above are too obscure to be regarded as characteristic and important species, until other specimens shall be found. There are moreover other considerations, which induce me to hesitate as to the propriety of attempting to characterize a formation like that of the Onondaga-salt group, by fossils, until a much larger number shall have been found. The rarity of specimens, the few species yet recognized, and the imperfect condition of these, a condition induced by the nature of the formation, all show that the period was one unfavorable to the existence of organized beings; and the few which occur near the base of the formation might perhaps be regarded as a continuation of species from the upper part of the Niagara group, and those near the termination of the group may belong to those forms called into existence after the cessation of the causes giving origin to the greater part of this series, and during the period of gradual change which ushered in the formations of the Tentaculite limestone and the succeeding rocks. In support of this view in reference to the upper strata we have the fact that the higher drab-colored layers of the Onondaga-salt group graduate into the Tentaculite limestone in some places; while in the western part of the State, where the latter rock is not recognizable, the line of demarkation between the drab layers and the succeeding limestone is very conspicuous. In the western part of New-York, the only well marked fossil of these higher beds of the Onondaga-salt group is the EURYPTERUS, several specimens of which have been found near Williamsville in Erie county. Within a few months past, my friend LEDYARD LINCKLAEN, esquire, of Cazenovia, has sent me a specimen containing a part of the head of an EURYPTERUS, and several impressions of the SPIRIFER peculiar to the Tentaculite limestone. The character of the rock is intermediate in color, texture and composition, between the ordinary drab-colored layers of the Onondaga-salt group, and those of the Tentaculite limestone. The conditions most favorable to the development of this peculiar fossil, the EURYPTERUS, evidently existed just at the close of a period marked by extensive deposits of mud and saline matter, the greater portion of which had been deposited, and an increased proportion of calcareous matter taking place in the sediment when the organism in question came into existence.

This example may not be an unusual one; and indeed we well know that species often pass the apparent or physical limits of formations, being little affected by the incipient changes which have finally produced a distinct formation characterized by numerous organisms. In the present instance we have but a single species, so far as we know, and it may perhaps be equally claimed for both groups.

I have repeated, in this volume, figures of but two of the species already given in the Report of the Fourth District. These are fig. 3, plate 83, and fig. 1 *c*, plate 84, which will be described in connexion with the other species on the same plates. In addition to these, the following species, represented in the woodcut (figs. 1, 2, 5, 6 and 7), were found near Newark in Wayne county, and are described in the Report of the Fourth Geological District of New-York, page 138.

Fig. 1. Cornulites —— *sp.*
2. Orthoceras læve.
3. Loxonema boydii, see also fig. 3, pl. 83.
4. Euomphalus sulcatus, " fig. 1 *c*, pl. 84.
5. Spirifer —— *sp.*
6. Atrypa —— *sp.*
7. Avicula triquetra.

FOSSILS FROM THE LIMESTONE AT GALT, CANADA WEST.

The fossils from this locality are peculiar, being nearly all of new species, and, with one or two exceptions, different from those within the limits of New-York. My attention was first called to the peculiar bivalve shells on Plates 80 and 81, in 1847. In 1848, I visited the locality, and obtained many other species. From the nature of the limestone, which appeared to succeed the well characterized limestone of Niagara falls, and from the similarity of some of the fossils with those of the Onondaga-salt group of New-York, I was inclined to refer the formation to the base of the latter group. A simple inspection of the Plates 79 – 84, will show that these fossils are typical of a distinct period from that of the Niagara group; and though the few species yet known from the base of the Onondaga-salt group in New-York seem scarcely sufficient to indicate a well marked period, or to claim positive identity in age with those of the Galt limestone, yet we are compelled either to regard them thus, or to rank the latter as a group entirely distinct from any yet recognized. The Galt fossils, as a group, are not only distinct from those of the Niagara period, but equally distinct from those of the succeeding geological periods of the Lower and Upper Helderberg limestones. They do in fact make a nearer approach to those regarded as devonian types, than to any group of silurian age; and yet we are able to prove their position to be quite below the limestone holding *Pentamerus*

galeatus, and numerous other silurian species which characterize the limestones at the base of the Helderberg. And whether we regard them as of the age of the Ondondaga-salt group or not, we know that they lie above the strata typified by the numerous fossils already described as belonging to the Niagara group, and strictly should form no part of that group. It is true, nevertheless, that in many places to the west of Cabot head, the Niagara group is very similar in its lithological character to the Onondaga-salt group, though less argillaceous, and never friable as some beds of the latter are. The species of PENTAMERUS figured on Plate 79 is apparently identical with one which extends far westward, descending into the Niagara limestone; and I presume it is the same species alluded to in the report of Mr. MURRAY to Mr. LOGAN, as extending throughout the rock, but being more abundant near the top*. The same remark may, however, be true of the *Pentamerus oblongus*, which at the west extends throughout the limestone of the Niagara group, while within New-York it is restricted to the Clinton group, and is unknown above this position†.

706. 4. PENTAMERUS OCCIDENTALIS (*n. sp.*).

PL. LXXIX. Figs. 1 *a–s*, and 2.

Shell ovoid, more or less elongated, becoming ventricose with age; surface marked by numerous simple plications or strong striæ, which are scarcely equal to the spaces between them; single plate of the dorsal valve extending more than half way to the base of the shell, becoming thickened towards the beak; plates of the ventral valve separated along their base, reuniting only near the beak.

All the specimens of this species which I have seen are more or less imperfect from the removal of the shell, and even the best specimens have the outer part of the shell exfoliated.

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* GEOLOGICAL SURVEY OF CANADA: Report of progress for 1848 and 1849, page 16.

† While the preceding pages were passing through the press, I received from Mr. LOGAN, the Geologist of Canada, a communication relative to the rocks at Galt, and enclosing the following memoranda from Mr. MURRAY, who has particularly examined this district.

"MONTREAL, Dec. 24, 1850.

"With regard to the age of the group of rocks which appear at Galt, and which Mr. HALL proposes to class as a part of the Gypsiferous instead of the Niagara formation, this season's examination has tended to show that his suggestion is founded upon correct data.

"The rocks in question are extensively displayed on the Grand river, from Middleton bridge on No. 21, 6th com. of Dumfries, all the way to the forks of the Speed above Preston; at Guelph, upon the Speed; between Elora and Fergus on the Grand river; and on the banks of the Rocky Sauquin. The fossil Mr. HALL proposes to call *Megalomus canadensis*, was found in all these localities, but most numerous at Galt and at Elora, and in all cases only among the upper beds of a group of limestone strata of peculiar character. Numerous spiral shells, among which we supposed we could recognize the *Loxonema boydii* and *Euomphalus sulcatus*, and numerous corals, were found associated with the *M. canadensis*, and also in most of the lower beds of the group, especially at Elora, where there is a vertical section of the group exhibiting about 80 feet. There is an undoubted difference in mineral as well as fossil character, between these limestones and others on which they repose. The inferior rock is a dark brown, and sometimes almost black, very bituminous limestone, interstratified with black bituminous shales; whereas the upper one is of a pale yellowish or drab color, sometimes granular in structure, and apparently entirely free from bituminous matter. The transition from the lower to the higher rock is well developed at Guelph on the River Speed."

The species passes through a variety of forms, mostly induced by age, and the extremes might easily be mistaken for distinct species. In the young specimens, the depth of the valves is much less than in older ones; the beak of the dorsal valve is also much more elongated and acute, and less incurved than in older specimens, where it is obtuse and much incurved. The shell, particularly towards the beaks, becomes thickened by age, and the imperfect specimens often show numerous lamellæ. The interior plates, particularly of the dorsal valve, have the distinct laminæ, of which they are composed, separated by weathering.

The larger specimens of this species approach in form to *Pentamerus knightii;* but the ribs are smaller, and the ventral valve more elongated.

Fig. 1 *a*. Cast of the dorsal valve of a young specimen, preserving the shell towards the base.
Fig. 1 *b*. Interior of the preceding, showing the elongated beak and foramen.
Fig. 1 *c*. Profile view of a young specimen, the shell being nearly all removed.
Fig. 1 *d*. Dorsal valve of the preceding specimen.
Fig. 1 *e*. Cast of the dorsal valve of a small specimen, showing the original thickness of the shell at the beak from the extension of the central plate.
Fig. 1 *f*. Cast of the dorsal valve of a larger specimen.
Fig. 1 *g* & *h*. Ventral valves having the shell partially preserved.
Fig. 1 *i*. Profile view of a ventricose specimen, the beak of the dorsal valve being reduced by abrasion.
Fig. 1 *k*. Cardinal view of the largest individual seen, showing the numerous laminæ of which the thick shell is composed at the beak. The foramen is incorrectly represented in the figure: it should extend beneath the beak of the dorsal valve.
Fig. 1 *l*. Profile view of the same.
Fig. 1 *m*. Cast of the dorsal valve, having the beaks little extended. The space between the cast and the surrounding stone indicates the thickness of the shell, and the central plate is shown to be composed of several (at least six) distinct laminæ.
Fig. 1 *o*. A cast of the dorsal valve, the two sides separated more than usual.
Fig. 1 *p*. The interior of the dorsal valve, where the outer laminæ of the central plate have become separated by the removal of the inner ones, giving the appearance of two plates.
Fig. 1 *r*. The interior of a dorsal valve, showing the separated laminæ of the internal plate near the beak.
Fig. 1 *s*. Cardinal view of an imperfect specimen, the ventral valve showing the two plates extending from near the beak downwards.
Fig. 2. The interior of a small dorsal valve, perhaps a distinct species.

Position and locality. In the light colored limestone at Galt, Canada West. And in the limestone on Lime island, St. Mary's river; Point St. Vital, Lake Huron; at numerous points on the north shore of Lake Michigan, and on the peninsula between Green Bay and Lake Michigan.

ACEPHALA.

Genus MEGALOMUS.

Shell equivalved, longitudinal; umbones at the anterior extremity, abruptly incurved or acuminate; shell thick, anterior extremity extremely incrassated, and along the hinge-line thickened interiorly nearly across the cavity, and in the left valve showing several shallow folds or indentations; muscular impression large and strong, extending deeply into the shell, with two smaller circular pits just above.

The general character of this shell is like that of Megalodon, though there are important differences. In Megalomus, there is no depression in the thickened interior portion of the shell (of the left valve) above the muscular impression; nor is the elevated tooth-like projection below and anterior to this depression, in Megalodon, present in Megalomus, the similarity in this part being simply in the folds on the posterior edge. The character of the muscular impression is similar, though in Megalodon it is less deep and more longitudinal than in our shell.

707. 1. MEGALOMUS CANADENSIS (*n. sp.*).

Pl. LXXX. Fig. 1 *a-e*; Pl. LXXXI. Fig. 1 *a-f*; and Pl. LXXXII. Fig. 1 *a-i*.

Shell ovoid, sub-cylindrical, the depth of both valves being equal to the height; beaks anterior, incurved, a distinct groove along the inner edge of the dorsal margin from beneath the beak two-thirds the distance to the posterior extremity; shell extremely thick on the anterior portion, composed of numerous laminæ, which, when seen vertically, have an apparent fibrous structure; muscular impression very deep, the sides striated; two smaller and shallower pits above the larger one. Exterior surface of shell concentrically striated.

The cast of this species, when not distorted, is very prominent at the beaks and along the dorsal side, gradually sloping off to the posterior end. Below the umbones, and for some distance backwards, it is abruptly contracted or depressed from the thickening of the shell at this part; while the lower portion, with the cast of the muscular impression, projects forward as far as, or a little in advance of the umbones. Between the muscular impression and the umbones, there usually remain several folds with corresponding indentations, marking the impressions of the teeth or plications of the hinge. From the muscular impression, a shallow groove extends backwards parallel to the margin of the shell, till it gradually dies out on the posterior half of the shell.

This fossil is found, for the most part, in the condition of casts, showing a great variety of form and proportions, which seem all to be the result of distortion from pressure or other causes. After examining a great number of these casts, I am unable to find any characters indicating more than a single species. The comparatively few specimens retaining the shell exhibit less distortion, and generally the proportions are well preserved.

PLATE LXXX. Fig. 1 *a* – *e*.

Fig. 1 *a*. The anterior half of a large individual, preserving the shell. The line continued, marks the outline of the entire valve.

Fig. 1 *b*. View of the anterior extremity, showing the umbones, and a part of the dorsal margin; below the umbones : where the shell is broken away, is shown the position of the muscular impressions extending deep into each valve.

Fig. 1 *c*. The dorsal side of the same specimen.

Fig. 1 *d*. A fragment of the left valve of another specimen.

Fig. 1 *e*. Dorsal view of a cast of this species.

PLATE LXXXI. Fig. 1 *a* – *f*.

Fig. 1 *a*. Cast of a large individual, presenting the ordinary characters of specimens when not distorted.

Fig. 1 *b*. A cast of a much shorter specimen : probably the form is in part due to pressure on the posterior end.

Fig. 1 *c*. View of the anterior extremity of the specimen 1 *b*.

Fig. 1 *d*. Dorsal view of the same.

Fig. 1 *e*. A cast of a specimen somewhat distorted by pressure, which has projected the lower anterior end beyond the beaks above.

Fig. 1 *f*. View of the anterior end of the specimen fig. 1 *e*.

Although the lateral views of the several specimens present considerable difference, there seem to be no characters by which they can be distinguished ; and the figures on the following plate show still farther the variations due to pressure.

PLATE LXXXII. Fig. 1 *a* – *i*.

Fig. 1 *a*, *b*, *c*. Lateral views of casts, showing degrees of distortion.

Fig. 1 *d*. A dorsal view where the umbones have been depressed, leaving the space between them projecting.

Fig. 1 *e*. Dorsal view of a cast, where the umbones have been pressed forward much beyond their natural relation.

Fig. 1 *f*, *g*. Anterior and lateral views of a small specimen, preserving the shell.

Fig. 1 *h*. The interior of a part of the left valve, showing the deep large muscular impression and the two smaller pits above, with the folds on the thickened portion of the shell. The groove beneath the umbo is likewise seen in the figure.

Fig. 1 *i*. The left valve of a specimen having the shell broken away, showing the numerous distinct laminæ of which it is composed. The deep muscular impression is well shown, extending from the base at the anterior extremity upwards beneath the umbo.

Position and locality. In the limestone at Galt, Canada West.

GASTEROPODA.

708. 19. MURCHISONIA BIVITTATA (*n. sp.*).

PL. LXXXIII. Fig. 1 *a*, *b*.

Spire elongated; volutions numerous (more than twelve), rounded, a little flattened in the cast, very gradually increasing from the apex; aperture unknown; surface unknown; columella marked by a double spiral fold or carina.

I refer this species to the Genus MURCHISONIA, without having been able to verify the characters of the surface. The specimens examined are all casts, with the single exception of fig. 1 *b*, which shows the interior of the shell and the broken edges of a longitudinal section. The succeeding species is marked by a carina below the centre of the volution, as shown in a mould of the shell, indicating its relations with MURCHISONIA. The present species, of similar form and general characters, I have therefore referred to that genus. The very gradual increase in the size of the volutions is one of the striking characters of the species, though exceeded in the following one.

Fig. 1 *a*. A cast of six volutions from the central part of the shell. There were originally about five or six above the highest one shown in the figure.

Fig. 1 *b*. A longitudinal section of several volutions, showing the columella, marked by a double spiral fold, and the edges of the broken shell.

Position and locality. In the limestone at Galt, Canada West.

709. 20. MURCHISONIA LONGISPIRA (*n. sp.*).

PL. LXXXIII. Fig. 2 *a*, *b*.

Spire extremely elongated and very slender; volutions numerous, rounded on the surface and carinated below the centre; surface unknown.

The mould of one specimen of this species shows impressions of a carina below the centre of the volution, but the impressions of striæ are not preserved. In the fragment fig. 2 *b*, nineteen volutions are visible; and in a mould of the same species, I have counted twenty-five, and the base still imperfect. The columella is proportionally larger than in the preceding species, and shows no fold or carina. The slender spire and more numerous volutions are sufficient to distinguish this one from all the other species of the rock, and indeed from any species known in our strata.

Fig. 2 *a*. A mould of the middle part of the spire, preserving a portion of the shell and columella near the base.

Fig. 2 *b*. A fragment showing in the upper part the cast of the interior; the lower part of the specimen preserves the shell, which is divided longitudinally.

Position and locality. In the limestone at Galt, Canada West.

710. 21. MURCHISONIA BOYDII.

PL. LXXXIII. Fig. 3.

Loxonema boydii. Report on the 4th Geological District of New-York, 1843, p. 138 ; fig. 3, p. 137.

Spire moderate ; volutions about six, gradually enlarging to the last one, which is somewhat ventricose ; umbilicus small.

The few impressions of striæ remaining upon the cast are not sufficient to decide whether the fossil be a LOXONEMA or MURCHISONIA ; and since all the Galt specimens, which are of the same age, appear to belong to MURCHISONIA, I have concluded to refer this one to the same genus. This species approaches in form to *M. loganii*, but is much smaller, and the volutions slightly more oblique.

Position and locality. In the argillaceous limestone near the base of the Onondaga-salt group, Newark, Wayne county. I have also obtained at Galt, fragments of a species undistinguishable from this one.

711. 22. MURCHISONIA LOGANII (*n. sp.*).

PL. LXXXIII. Fig. 4 *a, b.*

Subfusiform ; spire elongated, consisting of about eleven or twelve volutions, which increase somewhat rapidly in size from the apex ; last volution expanding towards the aperture ; columella large, without fold or carina ; surface markings unknown.

This species is readily distinguished from either of the preceding, by the more rapid enlargement of the volutions, as well as their smaller number. The centre is traversed by a large columella, which opens in an expanded umbilicus. I have not been able to discover the evidences of a carina in the moulds, since they are so thickly studded with minute crystals of calcareous spar as to obliterate or obscure any such marking. The volutions in the cast are more regularly rounded or ventricose than in the preceding species, and, in those I have examined, retain no impression of carinæ or striæ.

Fig. 4 *a.* A specimen, the upper part of which is a mould of the shell, while the lower part preserves the cast of the interior with some portions of the shell and columella.

Fig. 4 *b.* A cast preserving several volutions below the apex.

Position and locality. In the limestone at Galt, Canada West.

712. 23. MURCHISONIA MACROSPIRA (*n. sp.*).

PL. LXXXIII. Fig. 5.

The specimen consists of the mould, showing the impression of four and part of the fifth volution, marked by a strong carina along the centre ; last volution showing a large canal extending downwards in the direction of the spire.

This species is larger and stronger than the preceding.

Position and locality. In the limestone at Galt, Canada West.

713. 24. MURCHISONIA TURRITIFORMIS (*n. sp.*).

PL. LXXXIII. Fig. 6 *a*, *b*.

Spire elongated, turritiform, composed of numerous flattened volutions; surface unknown; columella small.

This species is readily distinguished by its flattened volutions, which, in the cast, present the marks of a carina near or a little below the centre. One specimen preserves five volutions, being imperfect at both extremities: the shell, originally, had probably not less than fifteen volutions.

Fig. 6 *a*. The cast of two volutions, near the base of the shell.
Fig. 6 *b*. A cast of five volutions, imperfect at both extremities.

Position and locality. In the limestone at Galt, Canada West.

714. 2. SUBULITES VENTRICOSA (*n. sp.*).

PL. LXXXIII. Fig. 7 *a*, *b*.

Subulate; volutions about six, somewhat rapidly increasing, the last one ventricose and equalling in length all the others; surface unknown.

The two specimens are both in the condition of casts. In neither of them have I been able to see the aperture; but the general form of the shell, the mode of convolution, and the form of the last whorl, are so similar to the other species of the genus, that I have thus referred it.

Fig. 7 *a*. A small specimen having much of the last volution broken off, but preserving the spire complete.
Fig. 7 *b*. A large individual with the spire incomplete, but preserving the last volution entire.

Position and locality. In the limestone at Galt, Canada West.

715. 5. CYCLONEMA SULCATA.

PL. LXXXIV. Fig. 1 *a*–*d*.

Shell ventricose; volutions about four, subangular, rapidly increasing from the apex, last one ventricose; surface marked by strong spiral striæ, which appear to be arranged in pairs, with a deeper groove between each pair; aperture rounded, the columellar side nearly straight; umbilicus small.

The original of this species is given in fig. 1 *c*; and from the close similarity of the other specimens, I have been induced to refer them all to one species. Neither of them are perfect; the shell being removed from a great part of the surface, and exfoliated when remaining. The umbilicus, which is represented in the woodcut, is seen in a cast, and in the larger specimens it

is closed by the columella a little within the base. In the Galt specimen, fig. 1 *a*, *b*, the shell is preserved on the lower half of the last volution only.

Fig. 1 *a*, *b*. Two views of a specimen of this shell.
Fig. 1 *c*. A small individual.
Fig. 1 *d*. An impression of the base of this shell in limestone.

Position and locality. Fig. 1 *a*, *b*, *d*, are from the limestone at Galt, Canada West; fig. 1 *c* is from the Onondaga-salt group, Newark, Wayne county, N. Y.

716. 22. PLEUROTOMARIA BISPIRALIS (*n. sp.*).

PL. LXXXIV. Fig. 2 *a*, *b*.

Volutions about four or five, rapidly increasing from the apex, subangular, and marked above and on one side by thin sharp carinæ or spiral elevated lines.

This species is extremely rare, a single mould of the exterior only having been found.

Fig. 2 *a*. A cast from the mould fig. 2 *b*.
Fig. 2 *b*. A mould of this species, showing four volutions.

Position and locality. In the limestone at Galt, Canada West.

717. 23. PLEUROTOMARIA? —— *sp.*

PL. LXXXIV. Fig. 3.

Cast composed of two or three volutions, which expand rapidly from the apex; the marks of a strong double carina are preserved on the last volution; aperture much expanded.

Position and locality. In the limestone at Galt, Canada West.

718. 24. PLEUROTOMARIA SOLARIOIDES (*n. sp.*).

PL. LXXXIV. Fig. 4 *a*, *b*.

Spire depressed, composed of about five volutions which are externally rounded; lateral diameter of volutions greater than the vertical; base discoid, flattened; umbilicus broad, reaching to the apex.

This species is about the size of *P. lenticularis* of the lower silurian rocks, but it is readily distinguished by its rounded volutions.

Fig. 4 *a*. The base of a specimen, showing the umbilicus. The outline of the shell is obscured by the adhesion of the surrounding stone.
Fig. 4 *b*. The upper surface of an imperfect specimen.

Position and locality. In the limestone at Galt, Canada West.

719. 25. PLEUROTOMARIA PERLATA (*n. sp.*).

Pl. LXXXIV. Fig. 5 *a, b, c.*

Shell depressed; volutions about seven, flattened above, outer one angular on the margin; base discoid, depressed towards the large umbilicus; surface unknown.

This species, in the character of its volutions, resembles *P. lenticularis;* but they are more numerous, and more depressed. Numerous imperfect specimens have been obtained, but in none of these is the shell preserved, and they usually consist of fragments of two or three volutions. This species, as well as the preceding, can be readily identified with the figures given.

Fig. 5 *a.* View of the upper surface of an imperfect cast.
Fig. 5 *b.* Profile view of the same.
Fig. 5 *c.* Parts of two volutions near the base of the shell.

Position and locality. In the limestone at Galt, Canada West.

720. 11. BUCANIA ANGUSTATA (*n. sp.*).

Pl. LXXXIV. Fig. 6 *a, b.*

Volutions narrow, rounded on their sides, expanding near the aperture.

The specimen figured is a rough cast in limestone, preserving no remains of surface markings. The volutions are less extended laterally than any other species of equal size known in our strata.

Fig. 6 *a, b.* Dorsal and lateral views of the same specimen.

Position and locality. In the limestone at Galt, Canada West.

721. 9. CYRTOCERAS ARCTICAMERATUM (*n. sp.*).

Pl. LXXXIV. Fig. 7 *a–d.*

Elongated, slender, gradually tapering and gently incurved; septa numerous, slightly convex; section transversely oval; siphuncle dorsal.

This species possesses some characters in common with *C. multicameratum* of the Trenton limestone, but the septa are still more closely arranged, and the section in perfect specimens is clearly oval.

Fig. 7 *a.* A fragment of a cast, preserving, in a length of two inches, thirty-five septa.
Fig. 7 *b.* A longitudinal section of another specimen. The waved and irregular condition of the septa appears as if due to accidental causes.

Fig. 7 *c.* A fragment of a cast, showing the siphuncle.
Fig. 7 *d.* A transverse section, showing the position of the siphuncle on the dorsal margin.

Position and locality. In the limestone at Galt, Canada West.

722. 7. CALYMENE —— *sp.*

PL. LXXXIV. Fig. 8.

The specimen is a rough cast of the glabella, in limestone. The three lateral tubercles are more distinct and prominent than in *C. blumenbachii.*

Position and locality. In the limestone at Galt, Canada West.

Several other species of univalve and bivalve shells were collected from the same locality with the preceding, but they are all too imperfect for description.

ADDITIONS AND CORRECTIONS.

PHRAGMOCERAS?

PLATE LXXVIII. Fig. 3 *a*, *b*.

THE two individuals figured on Plate 78 were found near the junction of the Coralline limestone, and the ash-colored rock above which is the continuation of the Onondaga-salt group. The condition of the specimens in soft argillaceous shale is such as to leave some doubt as to their true nature and relations.

590. 1. STEPHANOCRINUS ANGULATUS.

Reference pag. 212, Pl. xlviii, fig. 1 of this volume; also Pl. lxxxv, figs. 1, 2, 3 & 4.

Since the description and figures of this fossil were completed, Col. JEWETT of Lockport has shown me two individuals, preserving tentacula attached to the margin, along a slight groove in the base of the depressions between the angular processes which ornament the summit of the body. These tentacula or fingers consist of ten branches, each composed of a double series of plates above, but uniting below in a series of coalescing plates, which have a different arrangement.

Fig. 1 is a lateral view of a specimen bearing tentacula, the base and summits of the spines being broken off.

Fig. 2 is a view of the summit of the same specimen enlarged, showing the tentacula folded inwards between the spine-like processes, and nearly filling up the central space.

Fig. 3 is a portion highly magnified, showing, as far as can be actually seen, the arrangement of these tentacula and the plates at their base. There are doubtless intermediate plates connecting the outer one on the right hand, and the two on the left hand, with the others; but they are partially or entirely removed, and the whole are so minute as to render it impossible to present more than is here given. This discovery adds another interesting and important feature to the characters of this peculiar fossil.

Fig. 4 represents a restored form of this species, the characters represented being such only as may be seen in the examination of numerous specimens in their imperfect condition.

The paper of M. RŒMER, illustrating this species, was only received more than a year

after the letter-press and plates of this species had been finished, and therefore too late to be cited in the body of this work.

CALCEOCRINUS (*new genus*).

PLATE LXXXV. Figs. 5 & 6.

This peculiar crinoid presents the point of attachment for the column, and a portion which appears to be the base or pelvis, in which a separation into two plates only is visible. One of the plates is convex, the other nearly flat or concave, both having the upper margins slightly serrated.

In general appearance, this fossil has the character of the root of a crinoid; but from finding many of the same form, and always free, it would appear to belong to the terminal portion of the animal. It is probable that the plates are so closely anchylosed as to obscure or obliterate the lines of suture.

Other specimens and farther examinations are required to decide the character of this fossil.

EUCALYPTOCRINUS.

PLATE LXXXV. Fig. 7.

This figure represents a side view of one of the solid arms and tentacula of this fossil. It presents some features differing from the figure on Plate xlvii.

609. 1. PALÆASTER NIAGARENSIS.

Reference p. 247 of this volume, Pl. li, figs. 21 – 23; also Pl. lxxxv, figs. 8, 9 & 10.

Fig. 8 represents the lower side of the extremity of one of the arms of this species, which is more obtuse than usual.

Fig. 9 : the upper side enlarged, showing the character of the tubercles upon the surface.

Fig. 10 represents the arrangement of the ossicula and tubercles on the lower side, the space on one side of the centre being shown.

723. 2. TENTACULITES NIAGARENSIS (*n. sp.*).

PLATE LXXXV. Figs. 11 & 12.

Slender, acute : annulations rounded, eight or nine in the space of $\frac{1}{8}$ of an inch; intermediate spaces marked by transverse rounded striæ.

Fig. 11. Specimen natural size. Fig. 12. A portion of the same enlarged.

The description and figure of this species were accidentally omitted in its proper place.

724. 2. CORNULITES —— (*sp.?*).

PLATE LXXXV. Figs. 13 - 16.

The specimens here figured preserve the outer covering and surface marking in a very good degree, and from this circumstance present some characters not usually observed in species referred to this genus. The annulated character is less conspicuous, and in some individuals scarcely an important feature.

The specimens for the most part preserve some appearance of gentle annulations, which are marked with conspicuous waving striæ crossed by finer longitudinal ones : the latter are often partially or entirely obliterated. In addition to the annulations mentioned, the surface often presents waved irregular elevations which leave the broader rings very inconspicuous.

In figs. 13 and 15, the limits of the successive rings, so well marked in the cast, are scarcely visible; while in 14 and 16, they become prominent : the latter figure is compressed towards the larger extremity.

Fig. 17 represents an enlargement of the longitudinal striæ.

One or two of these specimens are hollow; preserving, within the thin striated covering, a series of thick and strong annulations : they were originally hollow bodies, apparently without septa or divisions of any kind.

NOTE A.

TRACKS OF GASTEROPODA AND CRUSTACEA IN THE CLINTON GROUP (Pag. 26 - 37).

SINCE this volume has been printed, I have had an opportunity of seeing many markings of the kind described in these pages, together with others of different character. In the summer of 1850, in company with Mr. J. D. WHITNEY of the U. S. Geological Survey of the Lake Superior District, I traced the continuation of the Clinton and Niagara groups northwestwardly along the shores of Lakes Huron and Michigan. There, on the peninsula of Green Bay, markings of similar character were found upon the surfaces of arenaceous layers of the Clinton group. Among these are two forms differing from any described in this volume, as well as from each other*. One of these consists of simple parallel cutting lines which are more deeply impressed at one extremity, and, continuing for a greater or less distance, become gradually less deeply marked, and finally terminate, to be repeated in the same direction over a considerable extent : these I have regarded as due to crus-

* These I have described in the Report of Messrs. FOSTER and WHITNEY, U. S. Geologists of the Lake Superior Land District.

taceans. The other consists of a median groove or depression marked on each side by a double series of imprints, the one a little within the other, as if made by some quadrupedal animal : each series of these impressions, however, present an appearance as if made by a double claw or foot, rather than by a single one. In general character they are very similar to those in the Potsdam sandstone, which have been referred by Prof. Owen to a chelonian. The continuous uninterrupted impression of the trail, however, is quite unlike the markings made by existing animals of this character; and yet it is evident that the limbs, or appendages making the imprints, extended to some distance from the body, and were strong enough to be capable of partially supporting it, leaving an undisturbed space between the imprints and the median groove. We infer, therefore, that such a track could not have been made by an annelid of the ordinary character. At the same time, the imprints do not present any character from which we can infer with probability that they were made by any vertebrate quadrupedal animal.

Upon the same slab with the imprints just alluded to, are others somewhat similar to those on Plates xv and xvi of this volume.

After farther examination of the tracks illustrated on Plates xv and xvi, and a comparison with other specimens of a similar character, I am disposed to refer their origin to crustaceans rather than to any vertebrate animal. It is impossible, however, to know, at the present time, their true origin, and any speculative opinions regarding them must be received with caution.

NOTE B.

CORALS OF THE CLINTON AND NIAGARA GROUPS.

Since this volume has been printed, I have seen the work of Milne-Edwards and Jules Haime upon the fossil corals of the palæozoic formations*, but too late to give any satisfactory notice of its contents. A considerable number of American species are described, and among them several which are likewise described in this volume. For want of sufficient time, I am compelled to defer a full notice of these to the future portions of this work devoted to the corals.

In the present volume I have attempted no separation of the true corals from the bryozoid forms, the whole being included under the denomination of Corals. The limit, indeed, does not yet seem to be well determined, and the characters sometimes relied upon fail in the examination of a large number of species. The arrangement in the plates of this volume, and the order of description among the species, with the exception of two

* Monographie des Polipiers Fossiles des Terrains Palæozoiques.

or three forms, presents the gradation of types from the corals of the family Cyathophyllideæ to the bryozoid forms.

NOTE C.

CRINOIDEÆ.

THYSANOCRINUS. It may be uncertain whether the portions of crinoids referred to this genus on Plate xlii, figs. 2, 3 & 4, really belong to it, or to some other genus. An opportunity of examining some other specimens has suggested a doubt as to the propriety of this reference.

In the genera GLYPTASTER and LYRIOCRINUS, I have detected the existence of tentacula attached to the plates of the arms. The same character probably exists in DENDROCRINUS and MACROSTYLOCRINUS; but up to this time, I have failed to discover it in ICHTHYOCRINUS and LECANOCRINUS. I have likewise ascertained the existence of tentacula in the STEPNANOCRINUS, as shown on Plate xlviii. Since these appendages exist also in the cystideans, we may infer that they form a part of the organization in all Crinoideæ.

Genus HEMICYSTITES, page 69. This genus is apparently identical with AGELACRINITES of VANUXEM, the description and figure of which I had overlooked at the time this volume was written. This name was given by Mr. VANUXEM to a fossil of the Hamilton group, to indicate the occurrence of several in connexion or proximity to each other; a circumstance, however, which will not be found constant, or of generic importance.

INDEX TO THE GENERA AND SPECIES DESCRIBED IN THIS VOLUME.

LIST OF PLATES.

*** The numbers on the left hand indicate the figures on the plates, and those on the right refer to the pages containing the detailed description of the several specimens.

ERRATA IN THE REFERENCES TO THE PLATES.

*** The volume having been printed some time before the plates were engraved, and even while many of the figures were still to be delineated, several discrepancies occurred in the references, which will be found rectified in the descriptions accompanying the plates.

Page 6. Pl. iii, fig. 3, should be Pl. ii, fig. 3; and Pl. ii, fig. 1, should be Pl. iii, fig. 1.
10. Pl. iv A should be Pl. iv (bis).
11. Modiolopsis primigenius should refer to Pl. iv (bis), fig. 2.
20. Pl. v (bis) should be Pl. v A.
24. Pl. ix, the fig. 1 *a*, *b*, *c*, should be fig. 1, 2, 3; and fig. 2, same plate, page 25, should be fig. 4.
66. Pl. xxii, the fig. 2 should be fig. 3, and fig. 3 should be fig. 2.
125 & 126. Pl. xxxiv A should be Pl. xxxiv (bis).
129. Pl. xxxv should be Pl. xxxv (bis).
136. Stromatopora concentrica should refer also to Pl. xxxvii A, fig. 1.
171. Lichenalia concentrica should refer also to Pl. xxxvii A, fig. 2.
187. Pl. xli, the fig. 3 should be fig. 4.
281. Pl. lvii should be Pl. lviii.
300. Pl. lxvi should be Pl. A lxvi.
350. Pl. lxxxiv should be Pl. lxxxiii.

PLATE 1.

Fig. 1. 382. 1. ARTHROPHYCUS HARLANI. (Pag. 5.)

This specimen is a portion of a slab covered with fragments of the branches of this species. Some of them are worn nearly smooth. and others have a longitudinal depressed line.

MEDINA SANDSTONE.

(PLANTS.)

PLATE 1.

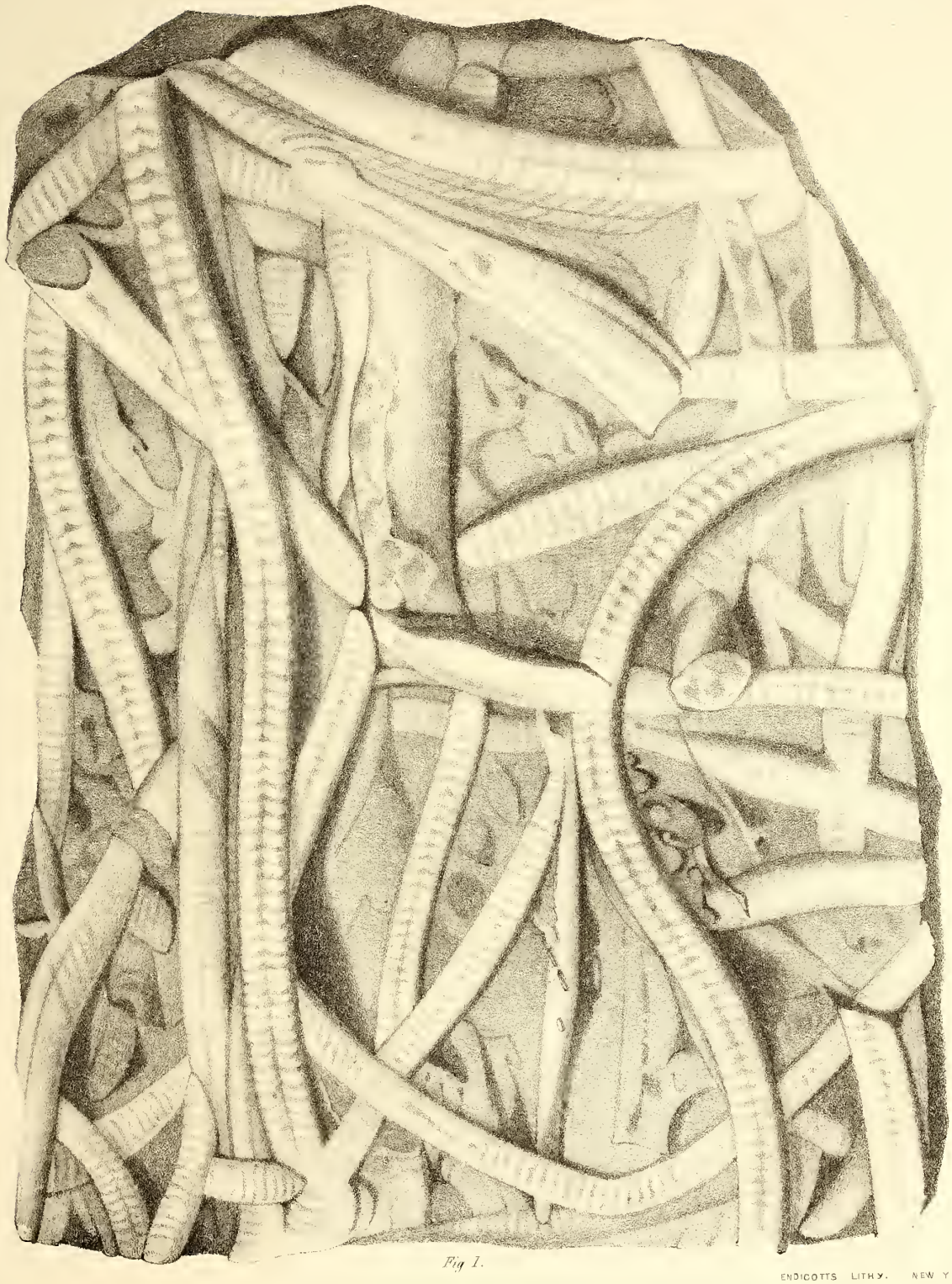


Fig 1.

ENDICOTTS LITH.Y. NEW YORK.

PLATE 2.

Fig. 1. 382. 1. ARTHROPHYCUS HARLANI. (Pag. 5.)

1 *a*. A fragment, showing the base of a large stem which diverges into numerous branches.

1 *b*. A similar fragment, showing a second bifurcation above the first.
Specimens like the above are of rare occurrence.

1 *c*. A fragment of a branch somewhat spirally twisted and flattened. This specimen gives evidence that the plant grew in an erect or a suberect position, and that the pressure from above caused it to assume its present form. The fragment shows also two broken stems with bifurcating branches.

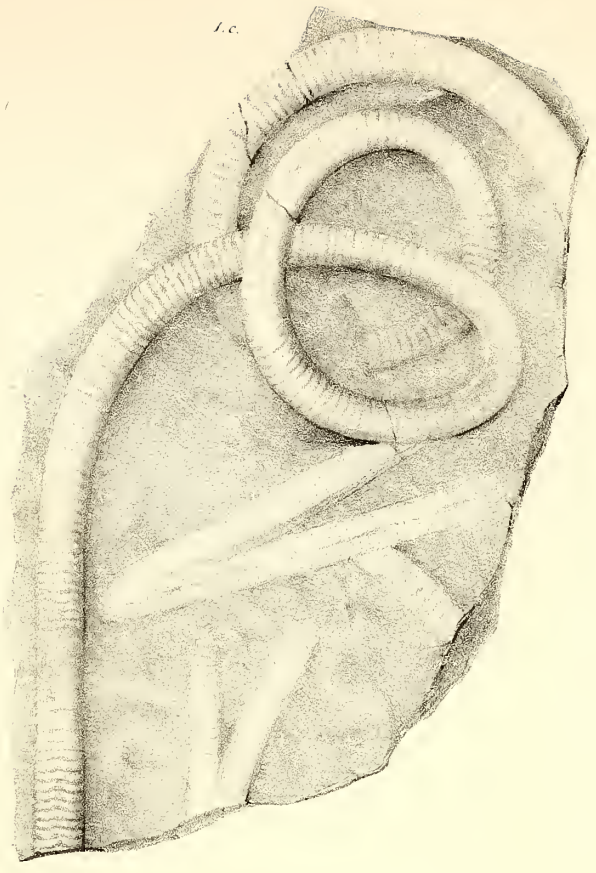
Fig. 2. 383. 2. ARTHROPHYCUS ——— ? (Pag. 6.)

Fig. 3. 384. 2. SCOLITHUS VERTICALIS. (Pag. 6.)

(PLANTS.)

1. a

1. c.



1. b

2.

3.

On Stone by E. J. Swinton.

Lith. of R. H. Pease, Albany.

PLATE 3.

Fig. 1.	386. 1. Dictuolites beckii.	(Pag. 6.)
Fig. 2.	385. 6. Palæophycus tortuosus.	(Pag. 6.)
Fig. 3, 4.	*Fucoides auriformis*, and *F. heterophyllus.*	(Pag. 7.)

MEDINA SANDSTONE.

(PLANTS.)

PLATE 3.

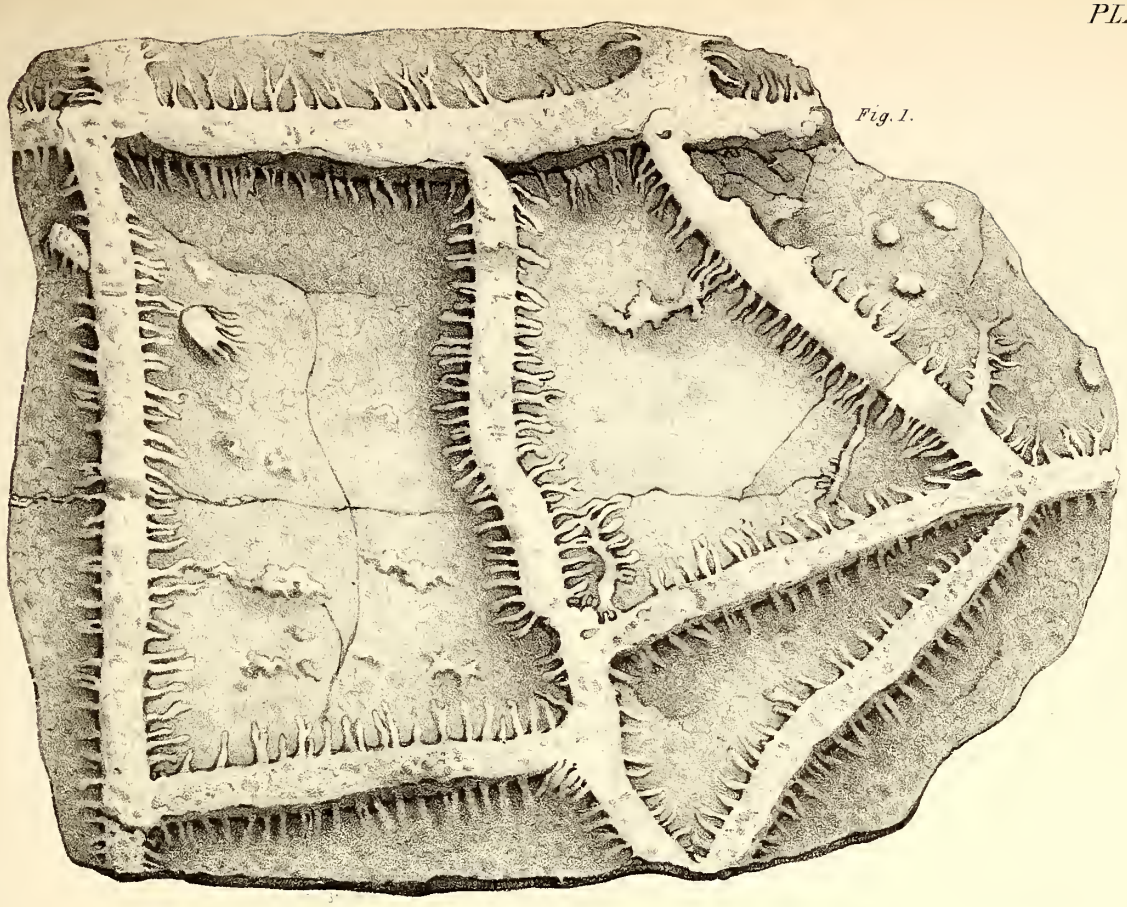


Fig. 1.

Fig 2.

a.

b.

Fig. 3

Fig. 4.

ENDICOTTS LITHY

PLATE 4.

Fig. 1. 387. CHÆTETES ——— ? (Pag. 7.)

Fig. 2. 388. 12. LINGULA CUNEATA. (Pag. 8.)

2 *a*. A specimen of large size, nearly destitute of a shell.

2 *b*. A small fragment of sandstone, showing upon its surface three individuals of different size.

2 *c*. A small individual, preserving the shell nearly entire. The two last are associated with a small species of CYTHERINA, fig. 8.

2 *e*. A small fragment from a slab of sandstone, where the LINGULÆ have been drifted by the waves. From the beak of each one extends a small ridge of stone which accumulated here, protected by the shell during the receding of the wave.

Fig. 4, 5. 389. 22. ATRYPA OBLATA. (Pag. 9.)

4 *a*. View of the ventral valve. 4 *b*. View of base. 4 *c*. Profile view.

5. The dorsal or larger valve imbedded in sandstone, which covers the lower part of the shell. It is impossible to say positively that this is identical with the preceding; but the partially imbedded specimen affords no positive characters to distinguish it.

Fig. 6. 390. 23. ATRYPA PLICATA. (Pag. 10.)

Fig. 7. 395. 15. MURCHISONIA? CONOIDEA. (Pag. 13.)

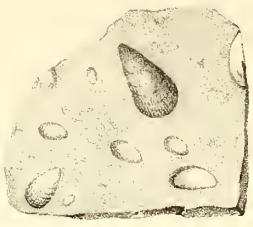
Fig. 8. 400. 2. CYTHERINA CYLINDRICA (Pag. 14.)

(BRACHIOPODA)


1


2a.

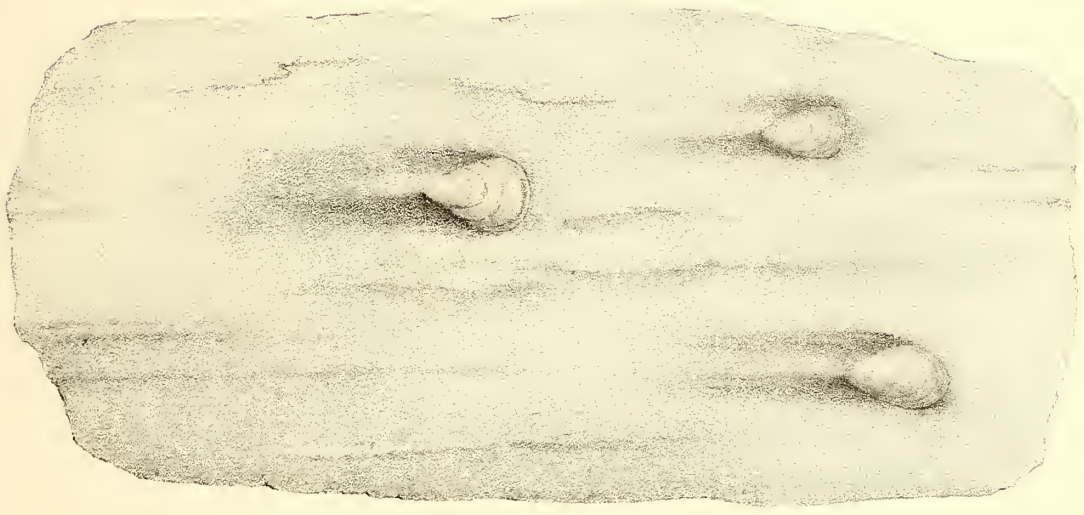

2.b.


2.c.

8a


3.

8b


2e.


4a


4b


4c.


5.


6.


7.

Swinton, Del..

Lith. of R.H. Pease, Albany.

PLATE 4 (bis).

Fig. 1. 391. 17. MODIOLOPSIS ORTHONOTA. (Pag. 10.)

1 *a*. Right valve of a small specimen, with the posterior extremity rounded and the anterior one extended.

1 *b*. Right valve of a larger specimen, having the anterior extremity less prolonged.

1 *c*. View of the hinge-line and cardinal area of the last.

Fig. 2. 392. 18. MODIOLOPSIS? PRIMIGENIUS. (Pag. 11.)

2 *a*. A small specimen, with the beak very prominent, and almost vertically truncated at the posterior extremity.

2 *b*. A cast having the markings almost entirely obliterated, and showing a fold or depression along the hinge-line.

2 *c*. A specimen partially preserving the shell, which is alated on the posterior dorsal margin, and slightly acute in front.

2 *d*. A fragment preserving an impression of the shell, showing the concentric and radiating lines.

2 *e*. A portion of the same enlarged.

Fig. 3. 393. 19. PLEUROTOMARIA? PERVETUSTA. (Pag. 12.)

3 *a*. Profile view of a specimen. 3 *b*. View of the base. 3 *c*. View of the apex.

3 *d*. A fragment of the sandstone containing numerous individuals of this species, with *Bucania trilobata*.

Fig. 4. 394. 20. PLEUROTOMARIA LITOREA. (Pag. 12.)

4 *a*. Profile view of specimen. 4 *b*. View of the apex.

Fig. 5. 396. 7. BUCANIA TRILOBATUS. (Pag. 13.)

5 *a*. Side view of a specimen. 5 *b*. Dorsal view of the same.

3 *d*. The upper figure in this specimen, and the lower lefthand figure, are of this species.

Fig. 6. 397. 2. ONCOCERAS GIBBOSUM. (Pag. 13.)

6 *a*. Ventral view of the specimen. 6 *b*. Lateral view. 6 *c*. Section of same.

Fig. 7. 398. 26. ORTHOCERAS ———. (Pag. 14.)

7 *a*. Lateral view of the fragment. 7 *b*. Section showing position of siphuncle.

Fig. 8. 399. 27. ORTHOCERAS MULTISEPTUM. (Pag. 14.)

8 *a*. A fragment of a small specimen, showing a part of the outer chamber.

8 *b*. A fragment of a larger specimen, showing the commencement of the outer chamber, with a narrow one at the termination of the others.

MEDINA SANDSTONE.

(SHELLS)

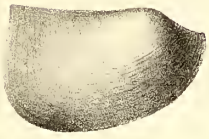

1a.


1b.


1c.


2a.


2b.


2c.

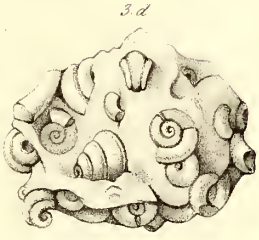

2d.


2e.


3a.


5b.


5a.


3d.

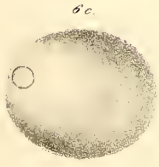

4a.


6a.


3b.


3c.


4b.

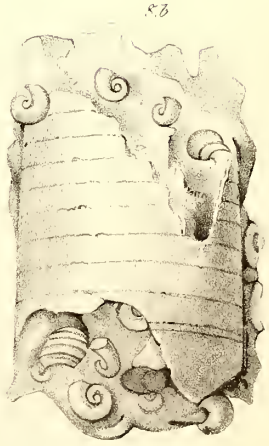

6c.


7b.


6b.


7a.


8a.


8b.

Mrs Brooks Del

Lith. of R. H Pease Albany

PLATE 5.

Fig. 1. 401. 6. BUTHOTREPHIS GRACILIS. (Pag. 18.)

1 *a*. A small delicate specimen of this species The engraving represents the branches rather too slender and acute.

1 *b*. An elongated stipe with numerous branches.

1 *c*. A fragment with several branches which are again subdivided.

1 *d*. A large individual having fewer branches in proportion to its size, than the preceding, and approximating in character to the succeeding forms.

Fig. 2. 402. 7. BUTHOTREPHIS GRACILIS, *var.* INTERMEDIA. (Pag. 19.)

2 *a*. A slender specimen with few branches. 2 *b*. A more rigid specimen with numerous branches.

Fig. 3. 403. 8. BUTHOTREPHIS GRACILIS, *var.* CRASSA. (Pag. 19.)

3 *a*, *b*, *c*, are common forms of this species in its proper and coarser varieties.

3 *d*. A large specimen, with the branches extremely diverging and mostly simple.

(PLANTS)

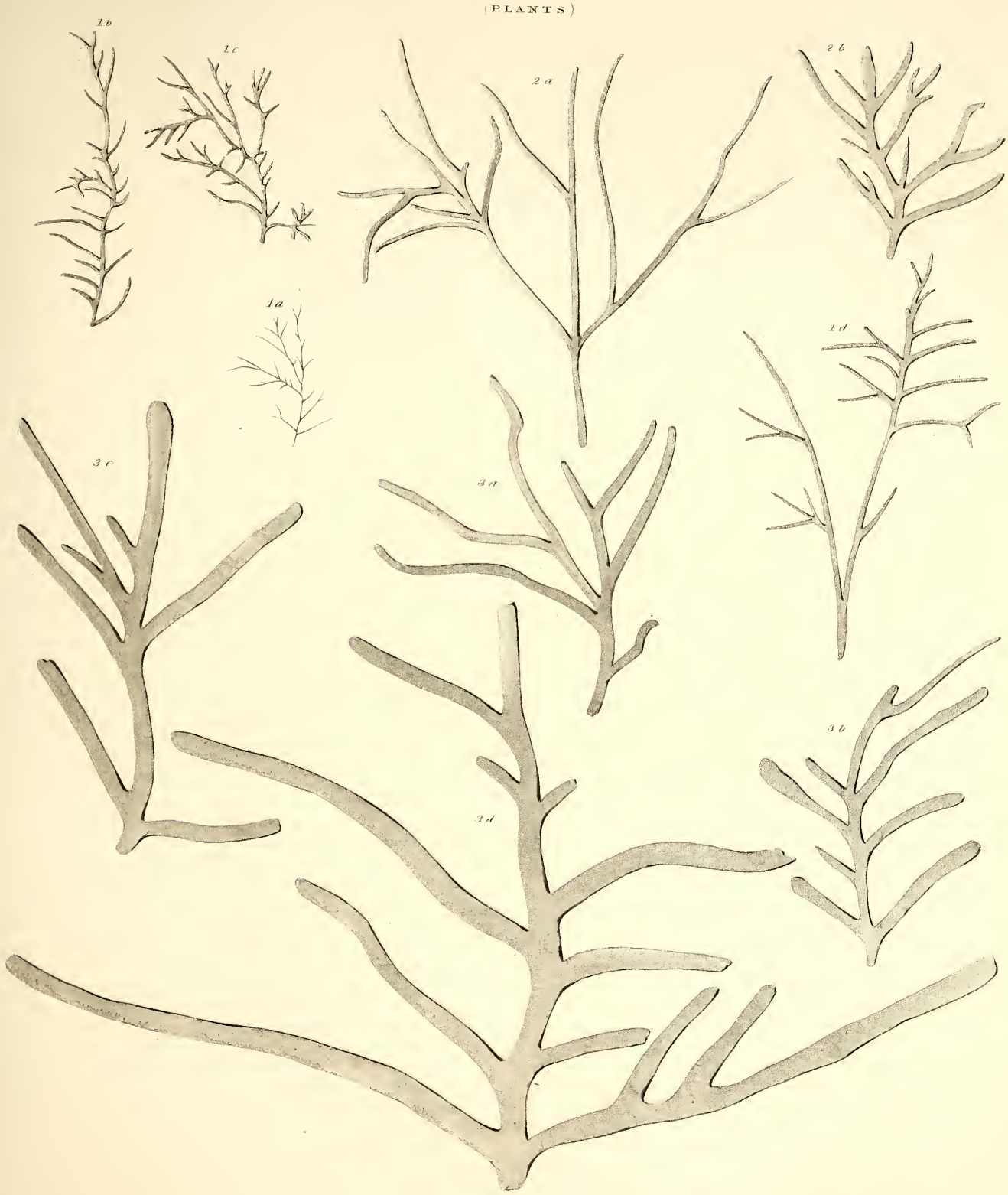


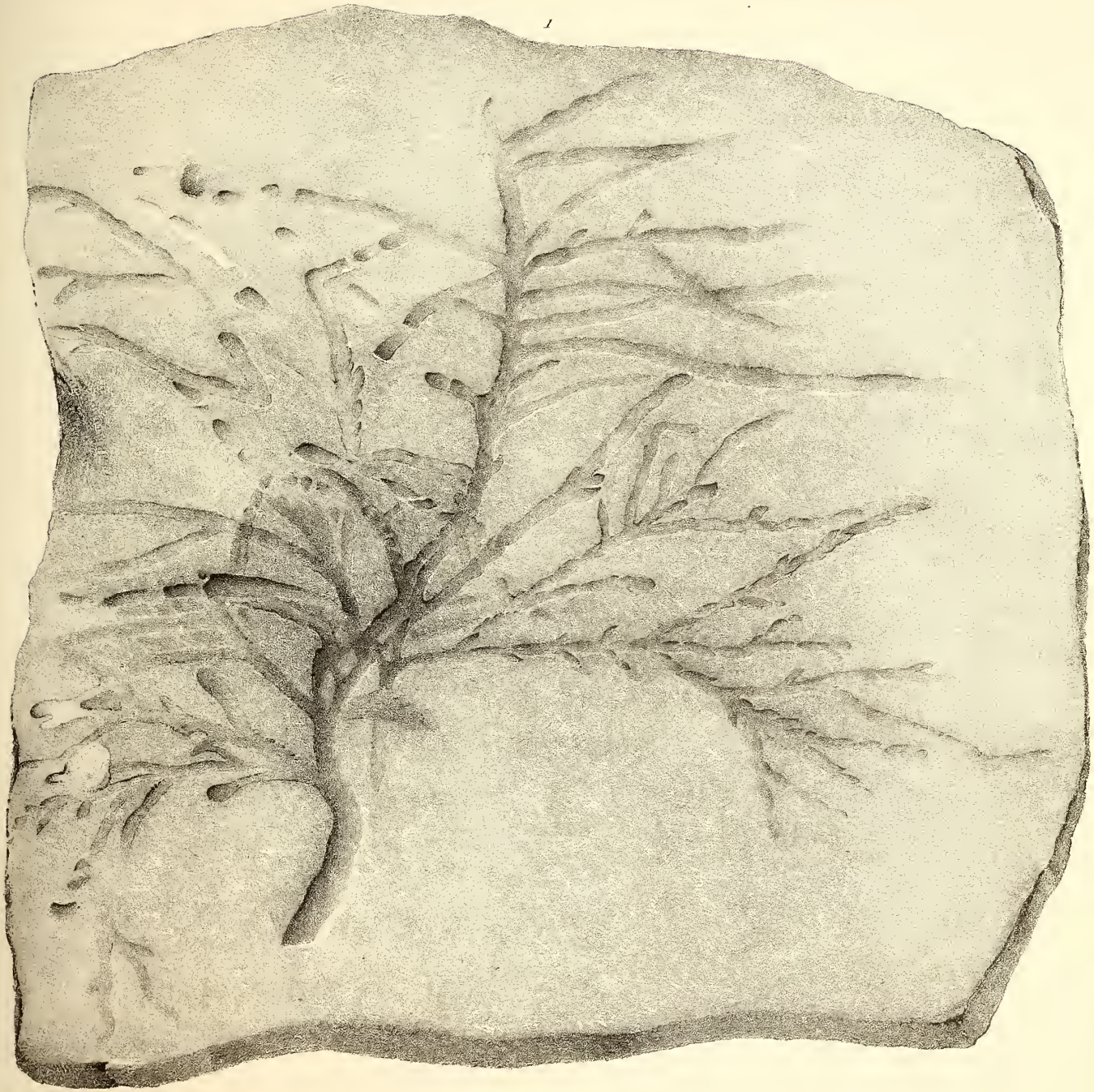
PLATE 5 a.

Fig. 1. 404. 9. Buthotrephis gracilis ? (Pag. 20.)

CLINTON GROUP

(PLANTS.)

1



Swinton del

R H Pease Lith

PLATE 6.

Fig. 1. 405. 10. Buthotrephis palmata. (Pag. 20.)

1. A specimen showing numerous branches diverging from nearly the same point.

Fig. 2. 406. 11. Buthotrephis impudica. (Pag. 20.)

Fig. 3. 407. 12. Buthotrephis ramosa. (Pag. 21.)

CLINTON GROUP.

(PLANTS.)

Fig 1.

Fig 3.

Fig 2.

ENDICOTT LITH Y. NEW YORK.

PLATE 7.

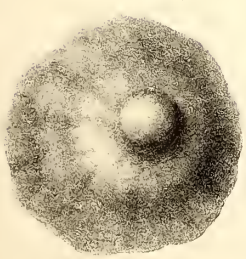
Fig. 1. 405. 10. BUTHOTREPHIS PALMATA. (Pag. 20.)

1 *a*. A specimen where the branches separate at different distances from the base.

1 *b*. Another specimen, apparently of the same species, showing successive branches from a single stem.

Fig. 2. *Roots of Buthotrephis?* (Pag. 21.)

(PLANTS.)



On Stone by F. J. Swinton.

Lith. of R. H. Pease, Albany

PLATE 8.

Fig. 1. 411. 1. Rusophycus clavatus. (Pag. 23)

1 *a*. A specimen with two stems, apparently proceeding from a single root.
1 *b*. A smaller single specimen.

Fig. 2. 412. 2. Rusophycus subangulatus. (Pag. 23.)

2 *a*. A specimen of large size, and greater than the ordinary length.
2 *b*. Two fragments of smaller size.

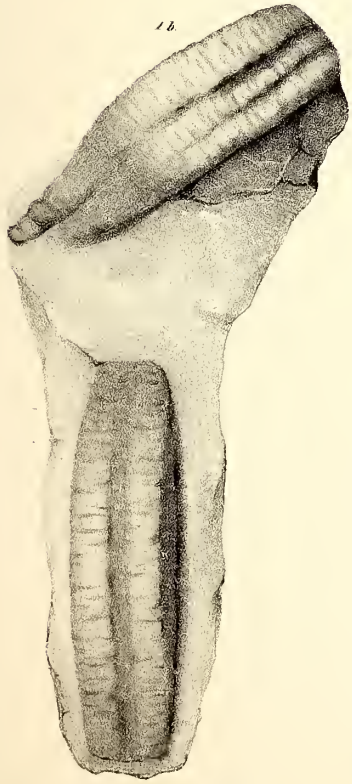
Fig. 3. 410. 9. Palæophycus ——— ? (Pag. 22.)

Fig. 4 *a*, *b*, & 5. *Roots of some marine plants?* (Pag. 25.)

Fig. 6. 413. 3. Rusophycus pudicus (Pag. 24.)

(PLANTS.)


1 a.


1 b.

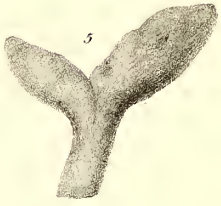

2 a.


2 b.


3.


4 a.


4 b.


5


6 a.


6 b.

On Stone by F. J. Swinton.

Lith. of R. H. Pease, Albany.

PLATE 9.

Fig. 1, 2, 3. 414. 4. Rusophycus bilobatus. (Pag. 24.)

1. A well marked specimen with a stipe attached.
2. A flattened specimen, showing the point where a stem was broken off.
3. A large and well preserved specimen, showing no marks for the attachment of a stem.

Fig. 4. *Stems of a marine plant.* (Pag. 25.)

CLINTON GROUP.

(PLANTS.)

Fig. 4 a.

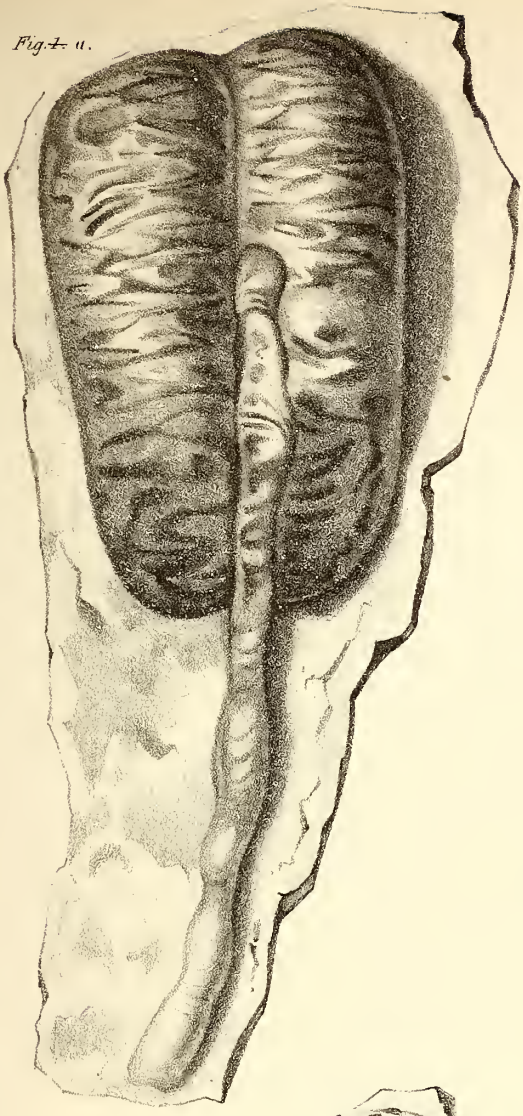


Fig. 4.

Fig. 3.

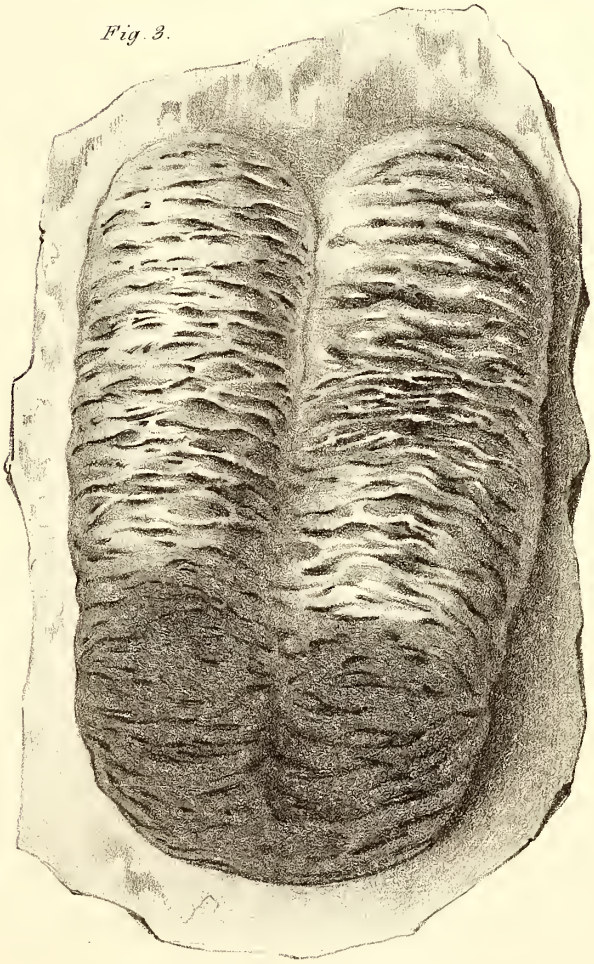


Fig. 2.

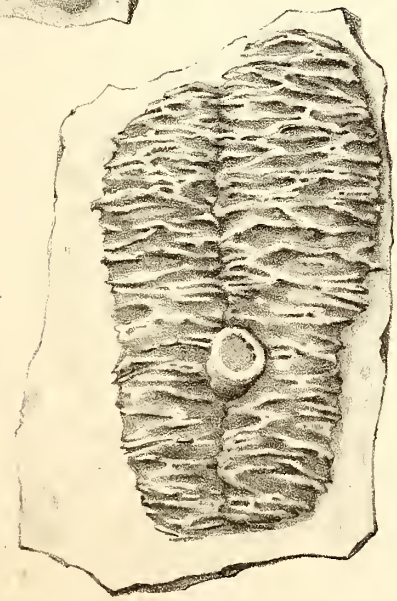


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PLATE 10.

Fig. 1, 2. 408. 7. PALÆOPHYCUS? STRIATUS. (Pag. 22.)

1 *a*. A fragment of a stem having the striated surface well preserved, with a more elevated line along the centre of the portion exposed.

1 *b*. A fragment from near the base, with the rootlets preserved.

1 *c*. A similar fragment, giving indications that the stem was hollow.

1 *d*. A fragment of a small specimen, showing the upper termination.

2 is perhaps the expanded termination of one of these stems, which has been much flattened: it is represented of the natural size.

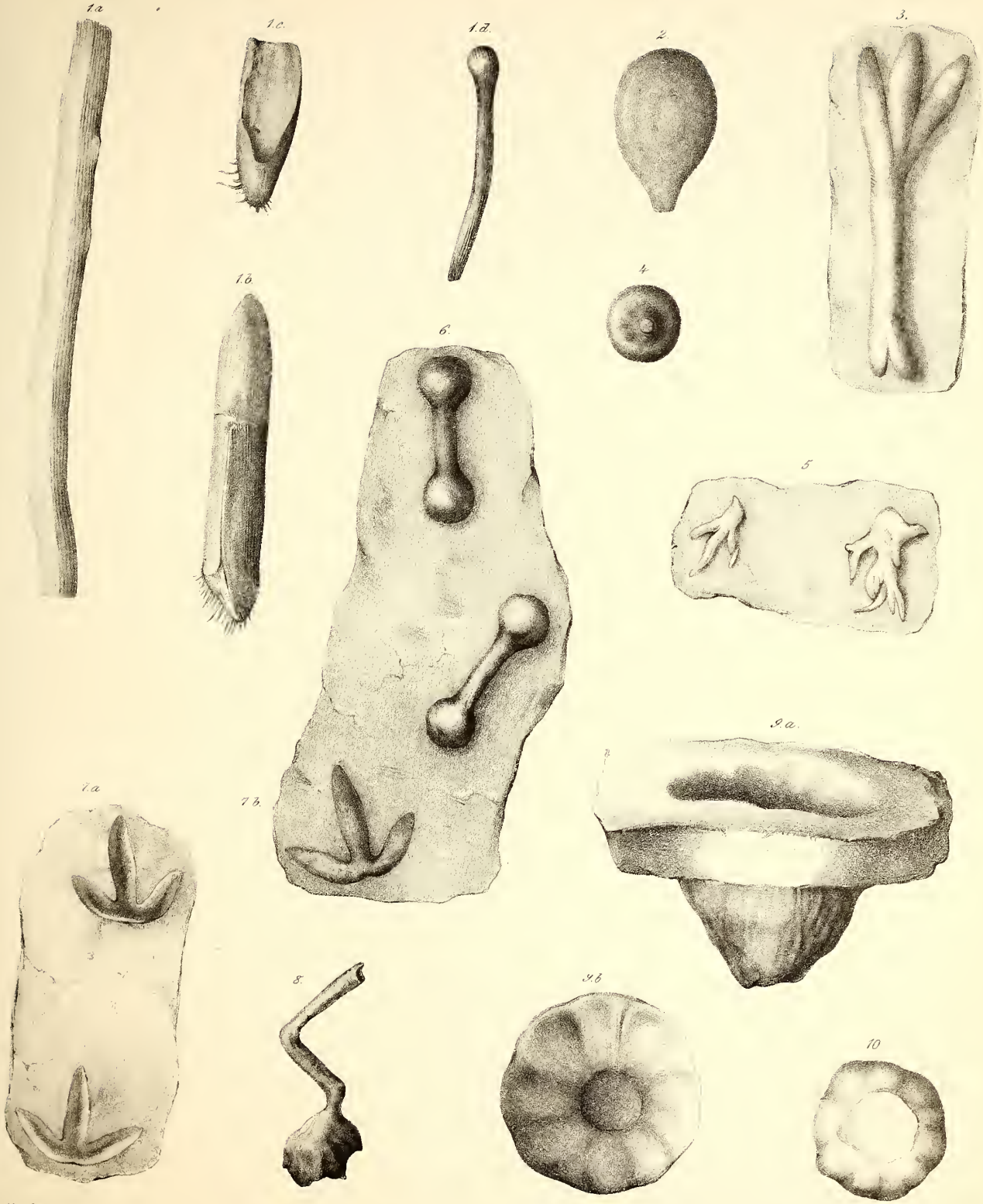
Fig. 3. 409. 8. PALÆOPHYCUS ———? (Pag. 22.)

Fig. 4, 5, 6 & 8. *Roots of different species of marine plants, &c.* (Pag. 25.)

Fig. 7. 415. 1. ICHNOPHYCUS TRIDACTYLUS. (Pag. 26.)

Fig. 9 *a*, *b*, & 10. *Roots of Buthotrephis.* (Pag. 21.)

(PLANTS)



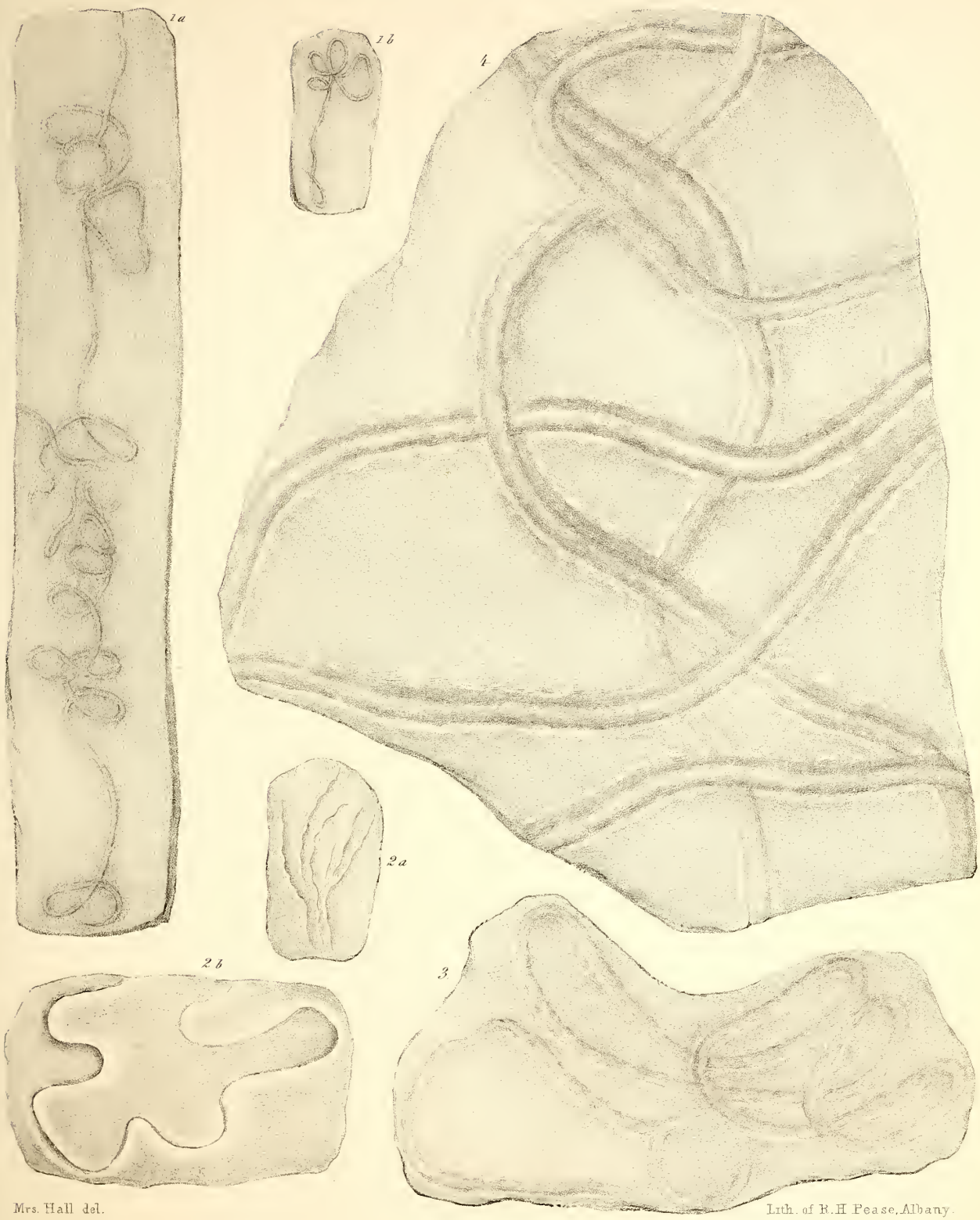
Mrs Bell, Dell

Lith. of S. Hollings, Albany

PLATE 11.

Fig. 1 *a*, *b*; 2 *a*, *b*; 3 & 4. *Trails of Gasteropoda.* (Pag. 27.)

(TRACKS OF GASTEROPODA)



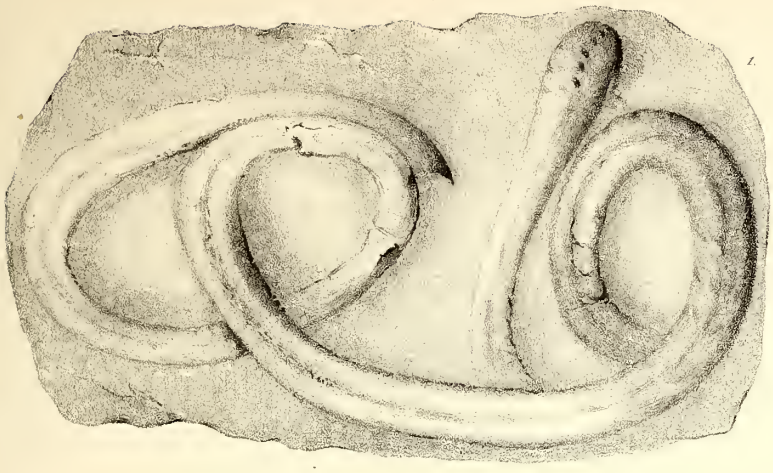
Mrs. Hall del.

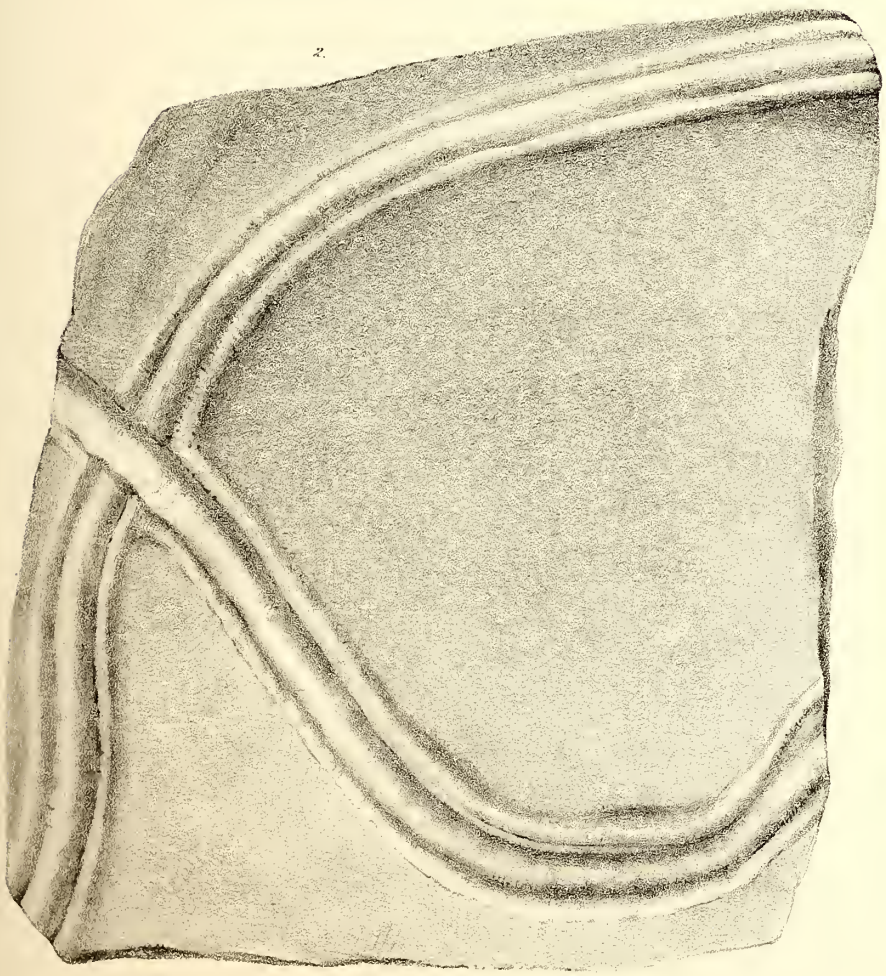
Lith. of R.H Pease, Albany.

PLATE 12.

Fig. 1, 2, 3, 4. *Trails of Gasteropoda.* (Pag. 29.)

(TRACKS OF GASTEROPODA.)





On Stone by F J Swinton

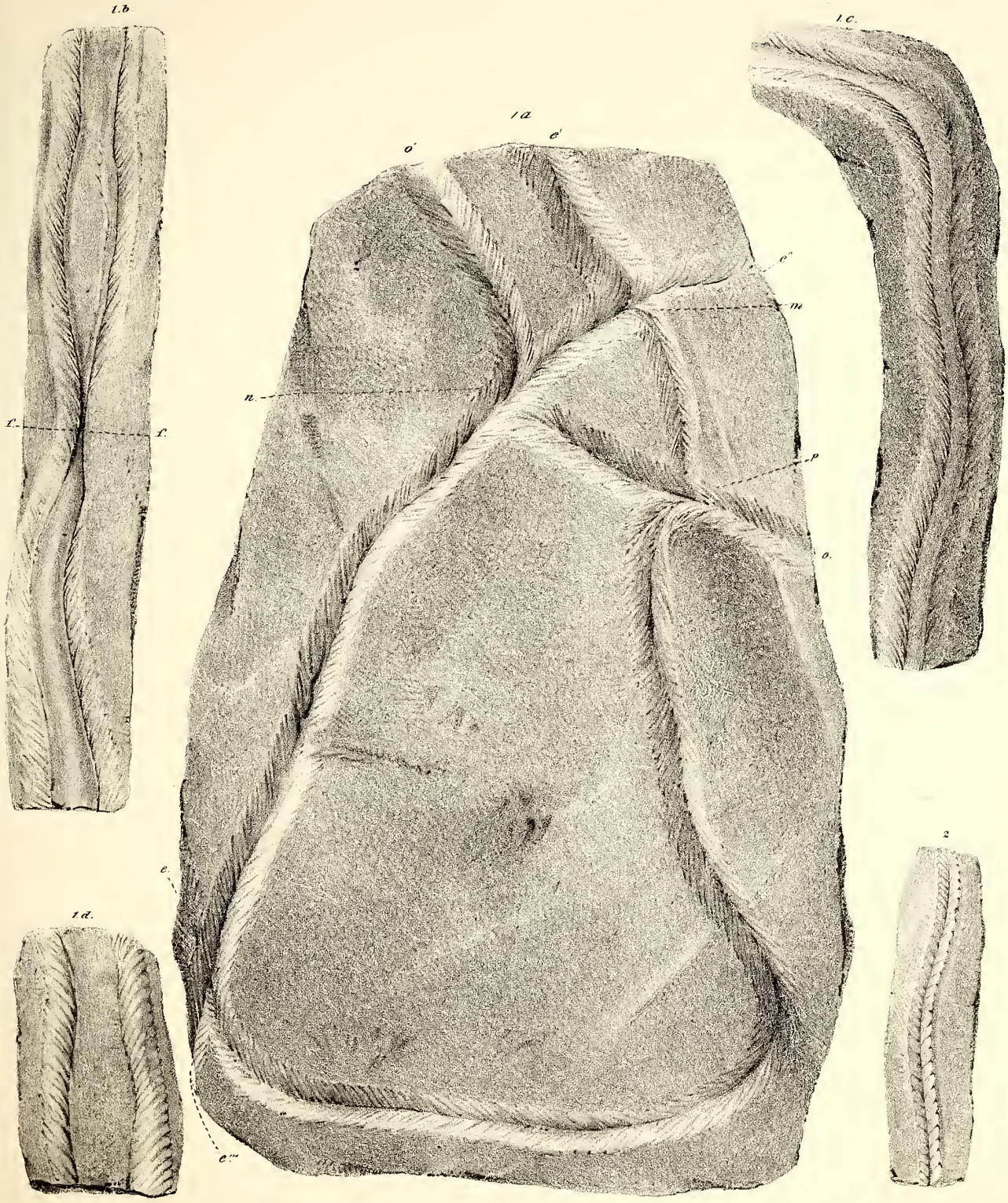
Lith of R H Pease. Albany.

PLATE 13.

Fig. 1 *a*, *b*, *c*, *d*, & 2. *Trails of Annelida.* (Pag. 30.)

CLINTON GROUP.

(TRACKS.)



S. M. Hall, Del..

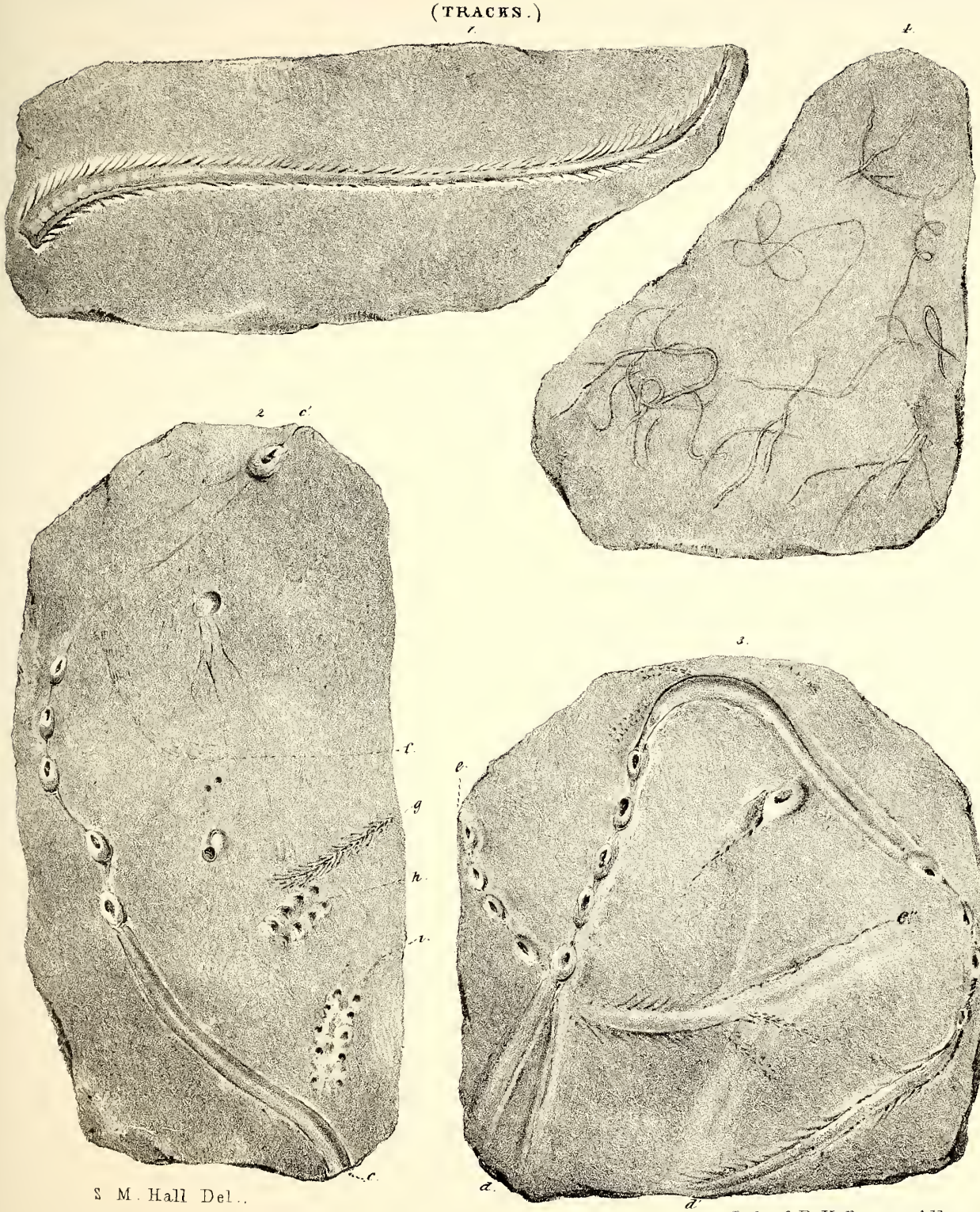
Lith. of R.H. Pease, Albany.

PLATE 14.

Fig. 1, 2, 3.	*Trails of Annelida?*	(Pag. 31.)
Fig. 4.	*Trails of small Gasteropoda.*	(Pag. 31.)

CLINTON GROUP.

(TRACKS.)



S. M. Hall Del.

Lith. of R. H. Pease, Albany.

PLATE 15.

Fig. 1, 2, 3, 4, 5, 6. *Tracks of Crustacea or Fishes.* (Pag. 35.)

1

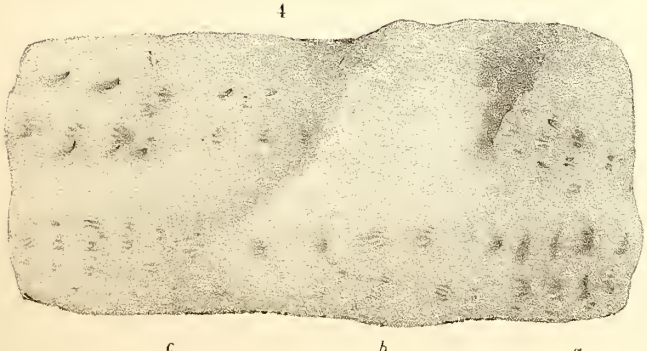
2

6

3

5

4



c b a

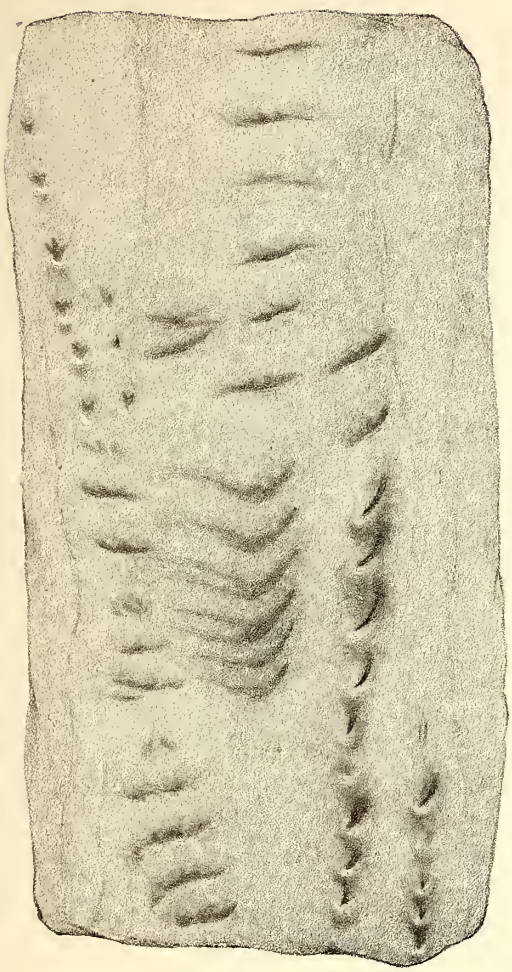
On Stone by Swinton.

Lith. of R.H. Pease, Albany

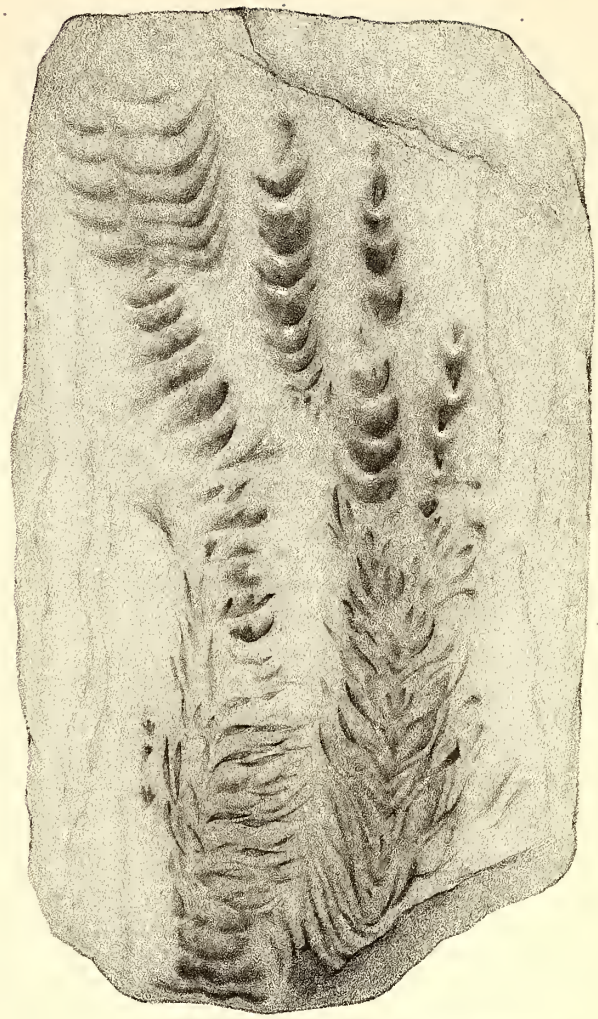
PLATE 16.

Fig. 1, 2, 3, 4. *Tracks of Crustacea or Fishes.* (Pag. 36.)

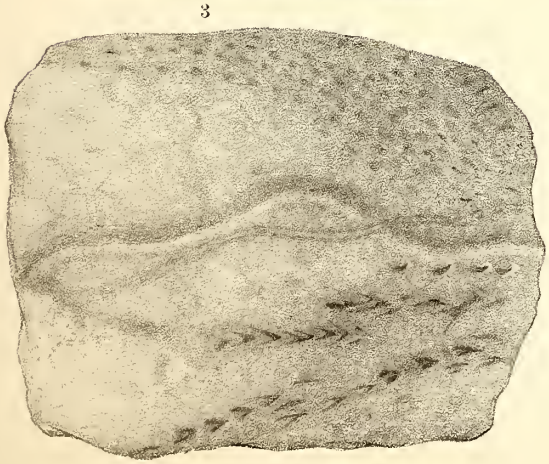
1



2



3



4

On Stone by F. J. Swinton.

Lith of R. H. Pease, Albany

PLATE A 17.

Fig. 1. 416. 15. GRAPTOLITHUS CLINTONENSIS. (Pag. 39.)

1 *a*. A lamina of slate, with fragments of this species upon the surface. Where imbedded in the soft green shale, the depth of the serratures and the pointed extremities are not so clearly preserved.

1 *b*. A fragment of a stipe, showing the depth of the serratures and the curved extremities.

1 *c*. A similar fragment, showing the opposite side.

1 *d*. A small fragment which is less flattened, the axis more solid, and the teeth appearing shorter.

1 *e* & 1 *f*. Enlargements from the previous figure.

1 *g*. A small fragment of the same species, showing some small nodes at the base of the teeth.

1 *h*. A portion of 1 *g* enlarged.

Fig. 2. 417. 16. GRAPTOLITHUS VENOSUS. (Pag. 40.)

2 *a*. A piece of slate, with numerous fragments of *G. clintonensis* and *G. venosus*. The latter are much more indistinct than the former, and can scarcely be brought out without a magnifier.

2 *b*. A fragment of *G. venosus* enlarged.

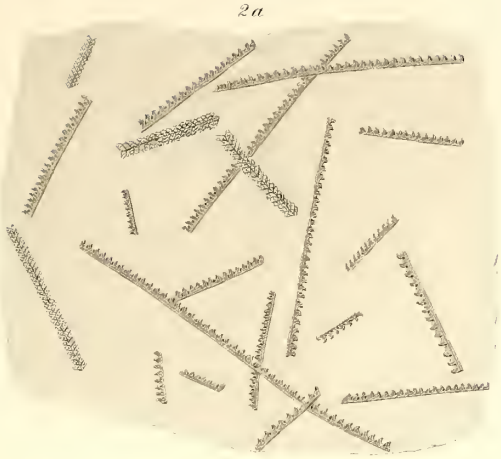
2 *c*. A fragment (enlarged), which appears to be the upper extremity of the stipe of this species.

2 *d*. A fragment of this species still farther enlarged.

(GRAPTOLITES)

1b

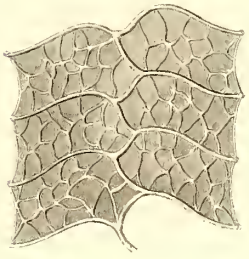
2a



2c

2b

1e

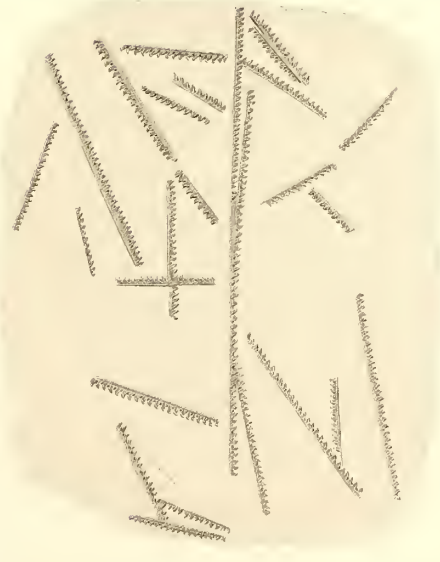


1h

1g

1f

1a



1c

1d

PLATE 17.

Fig. 1. 101. 2. Chætetes lycoperdon. (Pag. 40.)

1 *a*. The upper surface of a flat massive form.
1 *b*. Figure showing the height of the same specimen.
1 *c*. The lower surface of the same specimen.
1 *d*. Section of a small hemispheric mass.
1 *e*. Several columns enlarged.
1 *f*. Openings of cells enlarged.
1 *g*. A ramose specimen on limestone.
1 *h*, *i*, *k*. Sections of the branches of several ramose specimens through the centre, and on one side of the centre, showing the arrangement of the cells.
1 *l*. Several of the cells enlarged.

Fig. 2. 418. 2. Favistella favosidea. (Pag. 41.)

2 *a*. A fragment of a large mass : cells natural size.
2 *b*. Three of the cells enlarged, showing the double walls which coalesce at intervals.
2 *c*. A small spheroidal mass of the same species.
2 *d*. A section of a spherical mass of this species, showing the radiating cells.
2 *e*. A small fragment showing the rays within the cells.
2 *f*. Several of these cells enlarged, showing the rays, etc.

Fig. 3. 419. 1. Caninia bilateralis. (Pag. 41.)

3 *a*. Posterior view, showing the shorter posterior side and oblique cup, which has about 48 rays.
3 *b*. Anterior side of another specimen, showing the mode of increase by the addition of new rays or lamellæ.
3 *c*. An enlarged view of the cup of another specimen.
3 *d*. A longitudinal section, showing the internal characters.
3 *e*. A young specimen, lateral view.
3 *f*. Enlarged view of the cup, showing the irregular union of the lamellæ in the centre.
3 *g*. A large individual : view a little on one side of the anterior face. Rays 50 or more.
3 *h*. An irregular form, apparently of this species.

Fig. 4. 420. 1. Cyclolites rotuloides. (Pag. 42.)

4 *a*, *b*. The upper surface of two individuals of different size. 4 *c*. Lateral view of the same.
4 *d*. Base of another individual. 4 *e*. Several rays enlarged.

(CORALS)

M. K. Brooks, Del.

James Tuthill, Sculp.

PLATE 18.

Fig. 1. 421. 1. CANNAPORA JUNCIFORMIS. (Pag. 43.)

1 *a*. A portion of a hemispherie mass, showing the mode of growth.
1 *b*. A small fragment where the tubes are parallel.
1 *c*. Showing the tubes surrounding and radiating from some foreign cylindrieal body, upon which the polyps have grown.
1 *d*. Several tubes enlarged.
1 *e*. Transverse seetion, showing the stellate orifices of the tubes.
1 *f*. A similar section, where the cells are hollow.

Fig. 2. 422. 1. CATENIPORA ESCHAROIDES. (Pag. 44.)

Fig. 3. 423. 1. HELOPORA FRAGILIS. (Pag. 44.)

3 *a*. Fragment of the ordinary character. 3 *b*. A fragment showing the thickeued termination.
3 *c*. A speeimen having a single branch, the stipe and braneh both having enlarged extremities.
3 *d*. The specimen 3 *b* enlarged. 3 *e*. A portion of another speeimen enlarged.
3 *f*. A small speeimen of limestone with fragments of this eoral upon its surfaee.

Fig. 4. 424. 7. STICTOPORA CRASSA. (Pag. 45.)

4 *a* & *b*. Two fragments, natural size.
4 *c*. A portiou enlarged, showing the striated surface of the intereellular spaees.

Fig. 5. 425. 8. STICTOPORA RARITORA. (Pag. 46.)

5 *a*, *b*. Two specimens of this species. 5 *c*. A portion enlarged.

Fig. 6. 426. 1. PHÆNOPORA EXPLANATA. (Pag. 46.)

6 *a*. A small unworn fragment, of the natural size.
6 *b* & *d*. A similar fragment, with the surfaee somewhat abraded.
6 *e*. A portion enlarged.

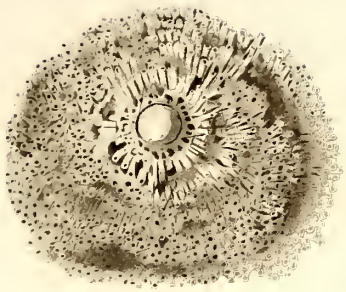
Fig. 7. 427. 2. PHÆNOPORA CONSTELLATA. (Pag. 47.)

7 *a*. A portion of a large speeimen, showing the entire width of the stipe. The speeimen shows only the bases of the eellules, the upper portion with the eentre having been broken away.
7 *b*. A fragment presenting easts of the eellules, the calcareous matter being removed.
7 *c*. A surfaee showing the bases of the cellules at their origin.
7 *d*. A portion of 7 *a* enlarged.
7 *e*. A portion of surface of 7 *b* enlarged.

Fig. 8. 428. 3. PHÆNOPORA ENSIFORMIS. (Pag. 48.)

8 *a*. A single individual of the natural size. 8 *b*. A portion of the same enlarged.
8 *c*. A fragment of stone having several speeimens upon the surfaee.

(CORALS.)



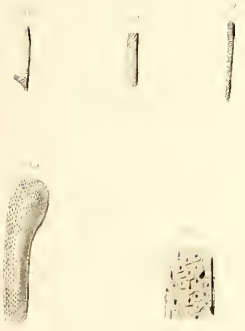


PLATE 19.

Fig. 1. 429. 1. RHINOPORA VERRUCOSA. (Pag. 48.)

1 *a*. Fragment of the natural size.

1 *b*. A fragment of the natural size, showing a ramose elevated ridge running over the surfaee.

1 *c*. A portion enlarged, showing the form and arrangement of the eells.

Fig. 2. 430. 2. RHINOPORA TUBULOSA. (Pag. 49.)

2 *a*. A fragment of this speeies, of the natural size.

2 *b*. A seetion of 2 *a*, showing the form, the interior being filled with shaly matter.

2 *c*. A portion of the surfaee enlarged, showing the form and arrangement of the eellules.

Fig. 3. 431. 4. RETEPORA ANGULATA. (Pag. 49.)

3 *a*. The poriferous face of a portion of a frond (the speeimen preserved in shale).

3 *b*. The non-poriferous faee of another individual. 1 *c*. A portion of 3 *a* enlarged.

3 *d*. A portion of the non-poriferous faee of 3 *b* enlarged.

3 *e*, *f*, *g*, *h*. The poriferous faee of two small fragments from calcareous strata, natural size and enlarged. In these the pores are very eonspieuous, and the fenestrules differing in size and form in the two specimens.

Fig. 4. 432. 1. FENESTELLA PRISCA? (Pag. 50.)

4 *a*. The base of a frond, showing the external poriferous face. 4 *b*. A portion of the same enlarged.

4 *c*. The non-poriferous faee of a portion of a frond.

4 *d*. Several of the fenestrules near the base enlarged, showing distinetly the oval form.

4 *e*. Several of the fenestrules enlarged (from a portion of the surfaee whieh has been worn down), showing a quadrangular form.

4 *f*. A surfaee of stone, preserving the impression of the poriferous and non-poriferous faees of this coral.

4 *g*. A portion enlarged, showing the thin sharp lines of impression of the braneles of the poriferous face.

4 *h*. Enlargement of the spaees filling the fenestrules on the non-poriferous faee.

4 *i*, *k*, *l*, *m*. Similar enlarged portions of the impressions of the two faees of the coral.

Fig. 5. 433. 2. FENESTELLA TENUIS. (Pag. 51.)

5 *a*. A portion of the frond of this speeies, natural size.

5 *b*. A portion of the poriferous faee magnified.

5 *c*. A portion of the non-poriferous faee magnified, showing distinetly the form of the fenestrules.

CLINTON GROUP

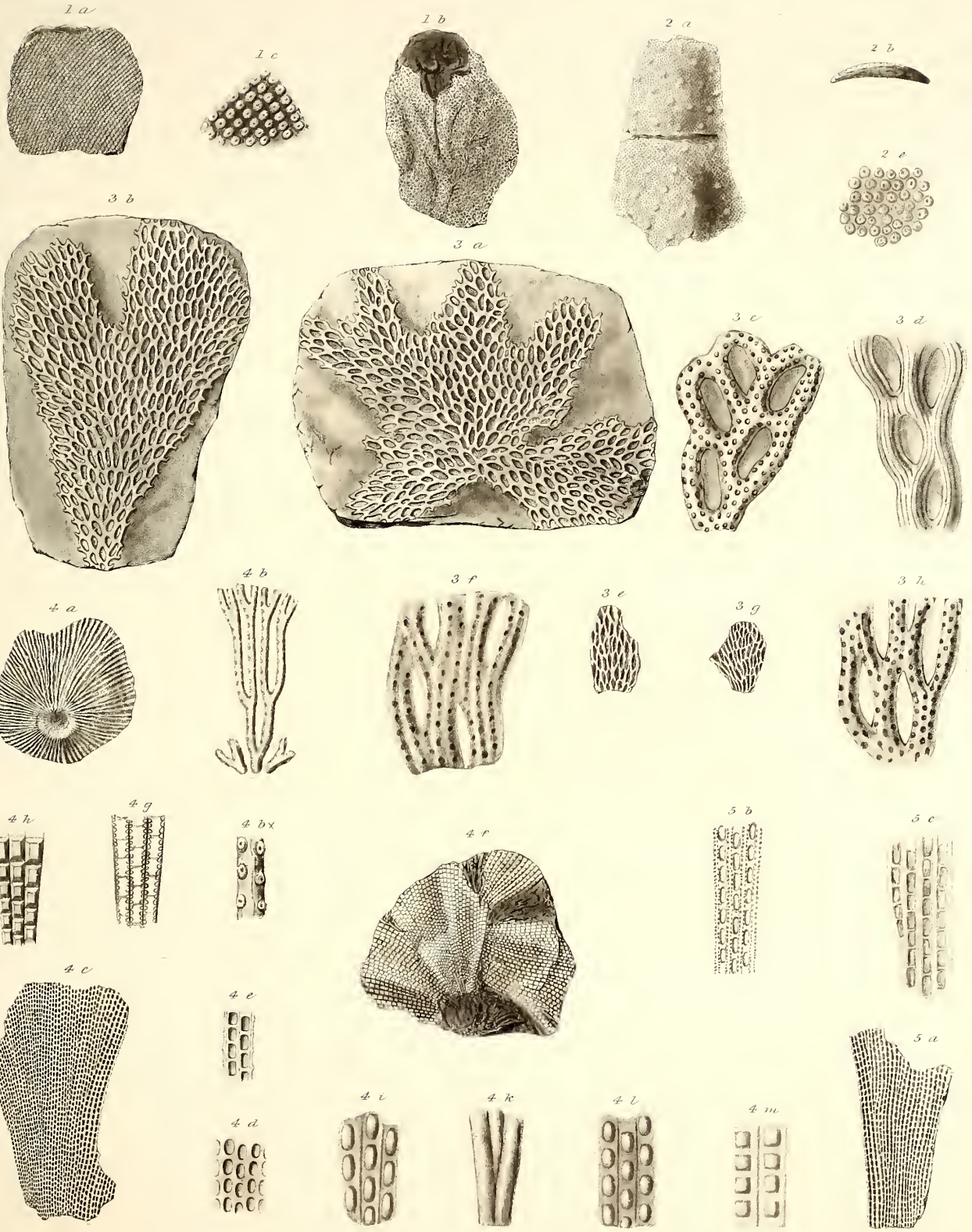


PLATE 20.

Fig. 1. 434. 13. Lingula oblonga. (Pag. 54.)

1 *a*. A young individual of this species. 1 *b*. A specimen of the ordinary size of this shell.
1 *c*. Specimen longer than the usual form.
1 *d*. A portion of the surface enlarged, showing the longitudinal striæ and concentric lines of growth.

Fig. 2. 435. 14. Lingula oblata. (Pag. 54.)

2 *a*. A figure of an individual of the ordinary size of this species.
2 *b*. A portion of the surface enlarged.
2 *c*. The inner surface of a specimen, showing the longitudinal depressed line.

Fig. 3. 436. 15. Lingula perovata. (Pag. 55.)

3 *a*. Specimen natural size. 3 *b*. The specimen enlarged.

Fig. 4. 437. 16. Lingula lamellata. (Pag. 55.)

4 *a*. A single valve, preserving the form and character of the shell very perfectly.
4 *b*. A portion of the surface enlarged.

Fig. 5. 438. 17. Lingula acutirostra. (Pag. 56.)

Fig. 6. 439. 21. Orthis circulus. (Pag. 56.)

6 *a*. A view of the ventral valve, showing the beak of the dorsal valve.
6 *b*. View of the dorsal valve. 6 *c*. Profile view of the shell. 6 *d*. Front view of the same.
6 *e*. Cardinal view of the same. 6 *f*. Cast of the dorsal valve of this species.
6 *g*. The striæ enlarged, showing their mode of bifurcation and increase.

Fig. 7. 440. 22. Orthis elegantula? Var. (Pag. 57.)

7 *a*. Dorsal valve of a specimen of medium size, somewhat distorted by pressure.
7 *b*. Hinge-line and beak of dorsal valve. 7 *c*. Dorsal valve of a large individual.
7 *e*. The cast of a dorsal valve of a small individual.
7 *f*. Cast of the dorsal valve somewhat compressed.
7 *g*. Dorsal valve with the shell partially removed. 7 *h*. Dorsal area of 7 *g*.
7 *i*. Showing the flattened striæ. 7 *k*. Several of the striæ enlarged.

Fig. 8. 441. 23. Orthis trinucleus. (Pag. 58.)

8 *a*. Interior of ventral valve. 8 *b*. Cast of ventral valve.

Fig. 9. 442. 24. Orthis tenuidens. (Pag. 58.)

9 *a*. Ventral valve with the shell partially removed.
9 *b*. A more perfect cast, showing the form of the muscular impression.
9 *c*. The last enlarged. 9 *d*. The impression of a dorsal valve. 9 *e*. The last enlarged.

Fig. 10. 469. 40. Atrypa gibbosa. (Pag. 79.)

10 *a* & *c*. Casts of the dorsal valve. 10 *b*. Cast of the ventral valve.
10 *d*. Cast of the dorsal valve, differing slightly from the preceding.
10 *e*. Profile view of the dorsal valve.

CLINTON GROUP.

(BRACHIOPODA.)

F. J. Swinton, Del

Lith. of R. H. Pease, Albany.

PLATE 21.

Fig. 1. 146. 9. LEPTÆNA SERICEA. (Pag. 59.)

1 *a*. A large individual, preserving the shell nearly entire.

1 *b*. A specimen preserving a portion of the shell, and showing in the east the puncta which are so characteristic in this species.

1 *c*. A cast of the same, showing the strong puncta produced by the small spines of the interior of the shell.

1 *d*. A portion of the shell enlarged, showing the larger and smaller striæ.

1 *e*. A similar portion of the cast, showing the puncta.

Fig. 2. 443. 18. LEPTÆNA CORRUGATA. (Pag. 59.)

2 *a*. A young individual, with the striæ very unequal, and the folds on the hinge-line scarcely conspicuous.

2 *b*. A larger individual, with the shell partially removed from near the beak.

2 *c*. The interior of a dorsal valve, showing the striæ equally bifurcating.

2 *d*. An old individual, with the shell entirely removed about the beak, and partially removed from other portions; the concentric striæ being still partially preserved.

2 *e*. An obscure cast in sandstone, where the striæ appear to be nearly equal.

2 *f*. A portion of the surface of the shell enlarged.

Fig. 3. 444. 19. LEPTÆNA PATENTA. (Pag. 60.)

3 *a*. The interior of the concave valve, showing the muscular impression.

3 *b*. The exterior of the concave valve of another individual.

3 *c*. A portion of the surface enlarged.

Fig. 4. 445. 20. LEPTÆNA PROFUNDA. (Pag. 61.)

4 *a*. The interior of the ventral valve, which is worn on the upper part, and striato-punctate below.

4 *b*. A portion of the surface enlarged.

Fig. 5. 445. 20. LEPTÆNA PROFUNDA? (*young shell?*). (Pag. 61.)

5 *a*. Outer surface of specimen. 5 *b*. Profile view of the same. 5 *c*. The striæ enlarged.

Fig. 6. 446. 21. LEPTÆNA OBSCURA. (Pag. 62.)

6 *a*. Specimen found in Saquoit creek.

6 *b*. Cast from the shaly sandstone associated with the ore beds in the town of Kirkland.

Fig. 7. 447. 22. LEPTÆNA ORTHIDIDEA. (Pag. 62.)

7. Cast of the dorsal valve of this species, from a fragment containing several others.

Fig. 8. 448. 23. LEPTÆNA DEPRESSA. (Pag. 62.)

Fig. 9. 449. 1. STROPHODONTA PRISCA. (Pag. 63.)

9 *a*. The specimen, natural size. 9 *b*. The crenulated hinge-line, enlarged.

Fig. 10. 450. 1. CHONETES CORNUTA. (Pag. 64.)

10 *a*, *b*. Two specimens of the natural size (ventral and dorsal views), having the spiniform tubes attached.

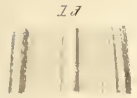
10 *c*. A small fragment of green slate, with several valves upon the surface, some of them destitute of spines.

10 *d*. The dorsal valve enlarged, showing its appearance when magnified to double the natural size.

10 *e*, *f*. Enlarged portions of casts of the hinge and dental processes of the dorsal and ventral valves, as seen under a magnifier. 10 *g*. Portion of the surface enlarged.

CLINTON GROUP

(BRACHIOPODA)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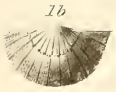
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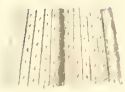
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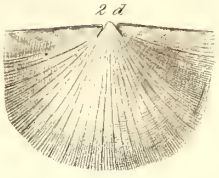
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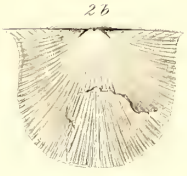
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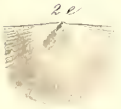
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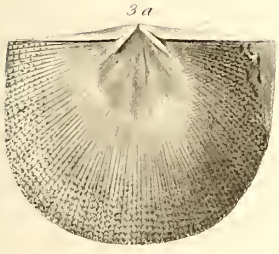
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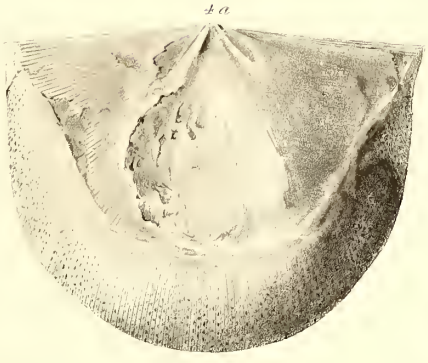
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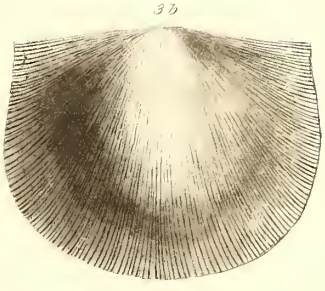
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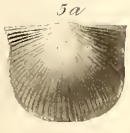
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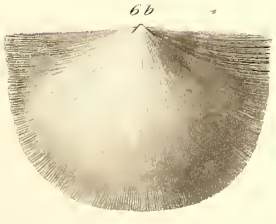
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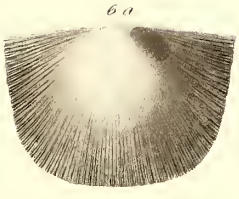
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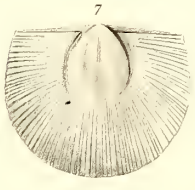
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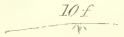
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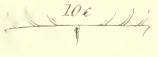
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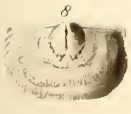
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10g


10d


10c


10a


10b


9a

T. M. Hall. del.

PLATE 22.

Fig. 1. 172. 1. SPIRIFER BIFORATUS, *var.* LYNX. (Pag. 65.)

1 *a*. Ventral valve, with a very short hinge-line. There are four mesial plates, and twelve or thirteen on each side.

1 *b*. The ventral valve of another specimen, having the mesial lobe worn smooth, and ten ribs on each side.

1 *c*. The dorsal valve of a large specimen, having four ribs in the mesial sinus, and ten on each side.

1 *d*. The interior of the dorsal valve, showing the form of the muscular impression, and the papillose surface on each side.

1 *e*. Cardinal view of the ventral valve, showing the projecting dental processes.

Fig. 2. 452. 3. SPIRIFER RADIATUS. (Pag. 66.)

2 *a*. Ventral view of a specimen having the cardinal extremities somewhat contracted, and the dorsal area very wide and fully exposed.

2 *b*. Profile view of the same.

2 *c*. A specimen with the dorsal extremities more extended, and the area broad.

2 *d*. An individual much extended in width, having the cardinal extremities rounded and the area almost closed. 2 *e*. A similar specimen, larger than the last.

2 *f*. A specimen with the hinge-line very much contracted and the angles rounded, with the area nearly closed.

2 *f* †. A portion of the surface enlarged, showing the character of the striæ.

2 *g*. A specimen which has apparently suffered no pressure. The beaks are approximate, the dorsal one much curved, and the area nearly closed. The cardinal extremities are rounded, and the whole contour of the shell very round. 2 *h*. Profile view of the last.

2 *i*. Front view of the same, showing the elevation of the mesial lobe.

2 *k*. Ventral view of a larger specimen with the cardinal extremities rounded, the beak much elevated and incurved, and the area very small. 2 *l*. Profile view of the last.

2 *m*. Dorsal view of the same. 2 *n*. Front view of the same.

2 *o*. Dorsal view of a larger specimen, having the extremities rounded, and the beak much elevated and incurved.

2 *p*. Ventral view of the same, showing the area nearly closed.

2 *r*. Cardinal view of the same shell.

2 *s*. Dorsal view of a specimen with the shell partially exfoliated, showing the direction of the dental plates.

2 *t*. Dorsal area of a single valve, showing the narrow foramen.

Fig. 3. 451. 2. SPIRIFER ———. (Pag. 66.)

(BRACHIOPODA.)

PLATE 23.

Fig. 1. 453. 24. ATRYPA CONGESTA. (Pag. 67.)

1 *a*. A young specimen. 1 *b*, *c*. Dorsal and front view of a young specimen.
1 *d*, *e*, *f*. Ventral view of three different specimens, showing the progressive development in the lateral folds of the ventral valve.
1 *g*, *h*. Front view of *e* & *f*, showing the deep sinus in the ventral valve, and the linguiform process of the dorsal valve. 1 *i*. Profile view of a full grown specimen.
1 *k*, *l*. Dorsal valve and cardinal view of a specimen, where the lateral folds are more than usually developed.
1 *m*. Interior of the dorsal valve, showing the simple dental processes on each side of the foramen.
1 *n*. A portion of the surface enlarged, showing the striæ.

Fig. 2. 454. 25. ATRYPA QUADRICOSTATA. (Pag. 68.)

2 *a*, *b*. Ventral and front view of a young shell of this species.
2 *c*, *d*. Ventral and front view of an older individual.
2 *e*. Profile view of the same. 2 *f*. A portion of the surface enlarged, showing the striæ.

Fig. 3. 455. 26. ATRYPA BIDENS. (Pag. 69.)

3 *a*, *b*. Ventral valve of two specimens of different age.
3 *c*. Front or base of the larger specimen, showing the elevation of the sinus. 3 *d*. Profile view of the same.

Fig. 4. 456. 27. ATRYPA NEGLECTA. (Pag. 70.)

4 *a*. A specimen with seven plications on each side of the mesial fold.
4 *b*, *c*. Profile and front views of the same specimen.
4 *d*, *e*, *f*. Ventral, dorsal, and profile view of a specimen with only five plications on each side of the mesial fold.

Fig. 5. 457. 28. ATRYPA EQUIRADIATA. (Pag. 70.)

5 *a*, *b*. Ventral and profile view of a small specimen.
5 *c*, *d*, *e*. Dorsal valves of three individuals of different size.

Fig. 6. 458 29. ATRYPA EMACERATA. (Pag. 71.)

6 *a*, *b*. Two individuals of this species in green shale.
6 *c*. The surface enlarged, showing the concentric striæ.

Fig. 7. 459. 30. ATRYPA ROBUSTA. (Pag. 71.)

7 *a*, *b*. Dorsal and ventral valve of a full grown specimen. 7 *c*. Profile view of the same.
7 *d*. Front view of the same, showing the three plications in the mesial sinus, and four on the elevation.

Fig. 8. 460. 31. ATRYPA RETICULARIS. (Pag. 72.)

8 *a*. A specimen of the ordinary size of this species in the Clinton group.
8 *b*, *c*. Ventral and front view of a young specimen, in which the valves are equally convex, and the concentric laminæ very rugose.
8 *d*, *e*. Dorsal valve and profile view of an older specimen, with the valves almost equally convex.
8 *f*, *g*. Ventral valve and cardinal view of a specimen slightly larger than the preceding, in which the dorsal valve is more convex, with a slight depression in the ventral valve, reaching from the beak halfway to the base.
8 *h*. The dorsal valve of a specimen where the shell is partially exfoliated.
8 *i*. The cast of the dorsal valve of a similar form, where the plications are flat and undivided.
8 *k*, *l*. The ventral and dorsal valves of a young specimen, where the ventral valve is flatter than the dorsal, and has a distinct mesial depression.
8 *m*, *n*. Front and profile view of a similar form, showing the inequality of the valves and the mesial depression.

Fig. 9. 461. 32. ATRYPA PLICATULA. (Pag. 74.)

9 *a*, *b*. Ventral valve and profile view of a young specimen.
9 *c*. Profile view of another specimen, in which the valves are still quite unequal.
9 *d*, *e*. Front view of a young shell and a full grown individual.
9 *f*, *g*. Dorsal and ventral valves of a specimen having the ordinary characters of full grown individuals.
9 *h*. A larger individual.

Fig. 10. 462. 33. ATRYPA HEMISPHERICA. (Pag. 74.)

10 *a*, *b*. Dorsal and ventral valve of young specimens.
10 *c*. A large dorsal valve, showing the concentric striæ.
10 *d*. A group of individuals on a fragment of stone. 10 *e*. A cast of the ventral valve.
10 *f*. Several plications enlarged. 10 *g*. Profile of the elevation of the plications.

Fig. 11. 463. 34. ATRYPA PLANOCONVEXA. (Pag. 75.)

11 *a*. A young individual. 11 *b*. Ventral valve, with the plications nearly all simple.
11 *c*. Dorsal valve of the same specimen, showing the plications more dichotomous.
11 *d*. The dorsal valve, having a few of the plications in the middle larger than the others, and a small interstitial one in the centre.
11 *e*. The dorsal valve of another specimen, in which all the plications are dichotomous, numbering twenty-six below the centre. 11 *f*. Profile view of a specimen of ordinary size.
11 *g*. A cast of the ventral valve. 11 *h*. The interior of the hinge of a ventral valve.
11 *i*. Profile of the elevation of the plications.

(BRACHIOPODA)

PLATE 24.

Fig. 1. 464. 35. ATRYPA NAVIFORMIS. (Pag. 76.)

1 *a*. View showing the ventral valve, with the elevated beak of the dorsal valve.
1 *b*. View of the dorsal valve of a full grown shell.
1 *c*, *d*. Front and cardinal view of the same shell.
1 *e*. Profile view of the same. 1 *f*. A portion of the surface enlarged.
1 *g*, *h*, *i*, *k*. Several views of a young shell, the front 1 *i* showing a scarcely formed sinus, contrasting in this respect very strongly with fig. 1 *c*.

Fig. 2. 465. 36. ATRYPA CYLINDRICA. (Pag. 76.)

2 *a*. View of the ventral valve, showing the beak of the dorsal valve elevated above it.
2 *b*. Dorsal valve of the same. 2 *c*. Profile view of the same.
2 *d*, *e*, *f*. Ventral, dorsal and profile views of a smaller shell.
2 *g*. Cardinal view of the last. 2 *h*. Front view of the same.

Fig. 3, 4. 466. 37. ATRYPA INTERMEDIA. (Pag. 77.)

3 *a*. View of the ventral valve. 3 *b*. Profile of the same. 3 *c*. Cardinal view.
3 *d*. Front view, showing the scarcely sinuous margins.
3 *e*. A specimen with the shell partially removed, showing three strong elevated lines in the cast.
3 *f*. A cast of this species.
4 *a*, *b*, *c*, *d*. Ventral, profile, cardinal, and front views of a young shell, apparently of the same species.

Fig. 5. 467. 38. ATRYPA ——— (cast). (Pag. 78.)

5 *a*. Cast of dorsal valve. 5 *b*. Profile of the same.

Fig. 6. 468. 39. ATRYPA CYLINDRICA? (cast). (Pag. 78.)

6 *a*. Dorsal view of cast. 6 *b*. Profile of the same.

Fig. 7. 471. 2. PENTAMERUS FORNICATUS. (Pag. 81.)

7 *a*. Ventral valve, with the large elevated beak of the dorsal valve incurved over it.
7 *b*. Dorsal view of the same specimen.
7 *c*. Cardinal view, showing the great convexity of the dorsal valve.
7 *d*. Profile view of the same.

CLINTON GROUP

(BRACHIOPODA)

James Hall del

Engraved & Printed by Gavit & Duthie

PLATE 25.

Fig. 1. 470. 1. PENTAMERUS OBLONGUS. (Pag. 79.)

1 *a*. Ventral view of a perfect specimen, the form being somewhat depressed, and slightly indicating the trilobate character of the base.

1 *b*. The dorsal valve of a larger specimen, somewhat trilobate in form.

1 *c*. The dorsal valve of a smaller specimen, more distinctly trilobate.

1 *d*. The ventral valve less elongated and proportionally wider than the prevailing forms.

1 *e*. The dorsal valve of a small specimen, having the trilobate form, with an unusually thick and prominent beak.

1 *f*. A ventral valve nearly circular in form, being somewhat wider than long.

1 *g*. A small dorsal valve of nearly circular form, excepting the prominence of the beak.

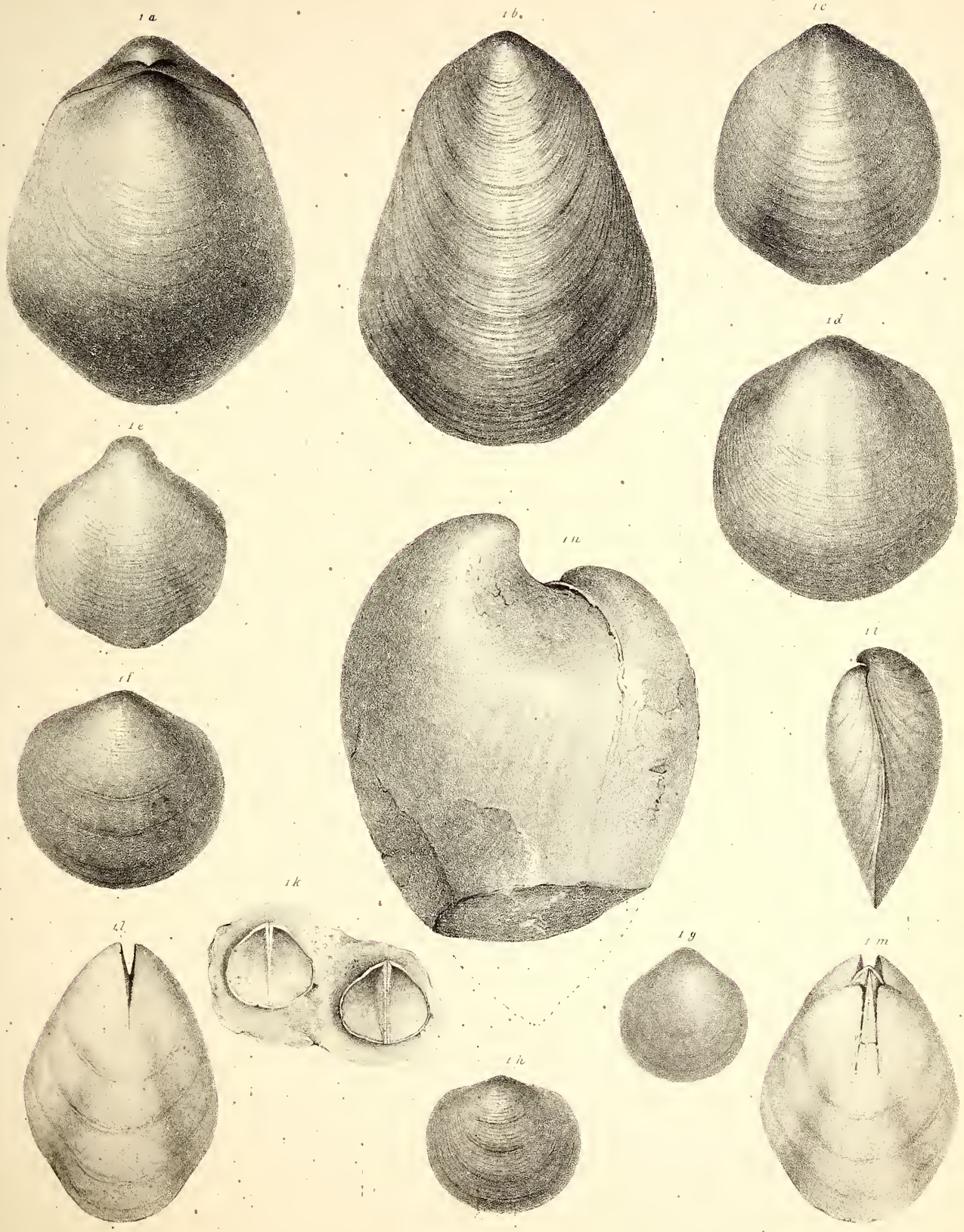
1 *h*. A small ventral valve of circular form.

1 *i*. A profile view of a small perfect specimen.

1 *k*. The interior of two fragments of dorsal valves, showing that the single plate is in effect composed of double laminæ, produced by the folding inwards of the inner lamina of the shell.

1 *l*, *m*. Dorsal and ventral view of a silicified cast of this species, showing in a very satisfactory manner the internal structure.

(BRACHIOPODA.)



Lith. of R. H. Pease Albany.

On Stone by F. J. Swinton.

PLATE 26.

Fig. 1. 470. 1. PENTAMERUS OBLONGUS. (Pag. 79.)

1 *a*, *b*. A cast: views of the dorsal and ventral valves of a very large and gibbous specimen.

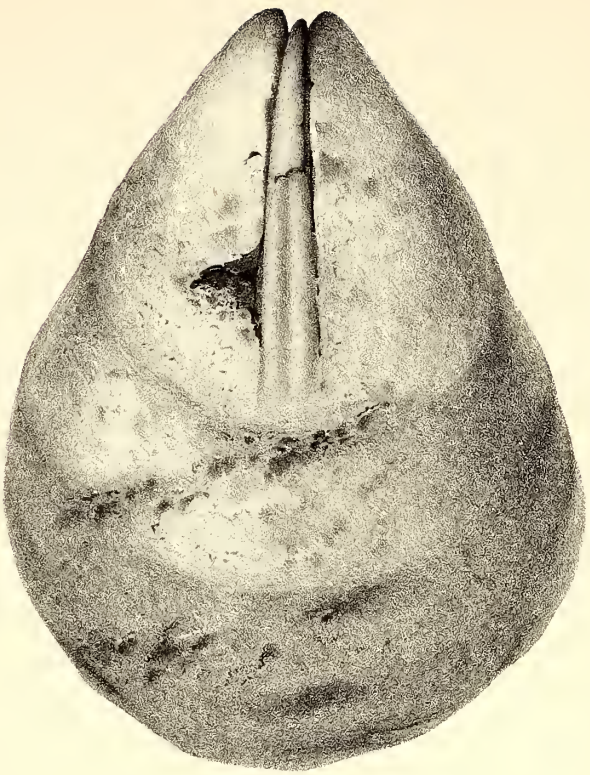
1 *c*. Cardinal view of the same, showing casts of the interlaminar spaces.

1 *d*. Profile view of the same, showing strong concentric ridges of growth.

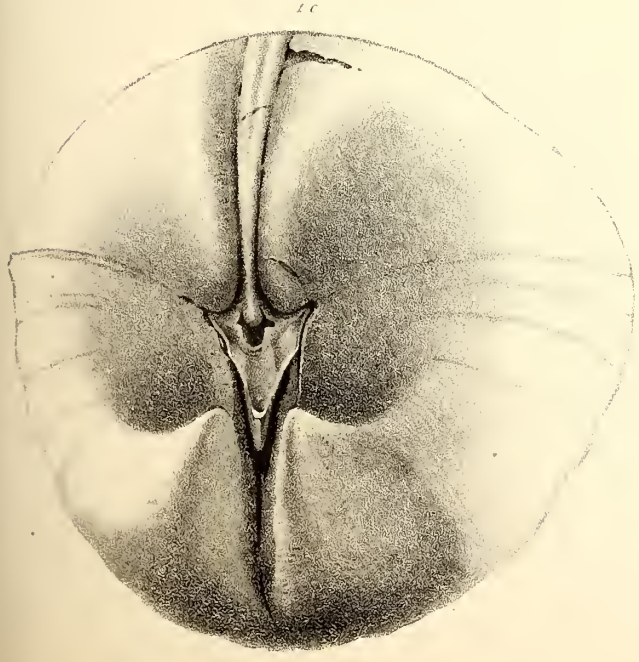
(BRACHIOPODA.)

1 a

1 b



1 c



1 d

Lith. of R. H. Pease Albany. On Stone by F.J.Swinton.

PLATE 27.

Fig. 1 *a*, *b*. 472. 6. AVICULA EMACERATA. (Pag. 83.)

Fig. 2. 473. 7. AVICULA RHOMBOIDEA. (Pag. 84.)

2 *a*. A large individual, in which the anterior wing is less prominent than usual.

2 *b*. A smaller specimen.

2 *c*. A young specimen, having the length nearly equal to the height.

2 *d*. The posterior portion of another specimen, having the striæ more perfectly preserved and the angle of the wing more extended.

Fig. 3, 12. 480. 1. PYRENOMŒUS CUNEATUS. (Pag. 87.)

3. This specimen, though differing to some extent in form, I have referred to the same species. It retains the shell, which is faintly striated, the beak remarkably elevated, and the anterior extremity abruptly rounded.

12 *a*, *b*. The casts of opposite valves of specimens nearly of the same size.

12 *c*. The cast of a large individual, showing several prominent folds parallel to the lines of growth.

Fig. 4. 479. 1. POSIDONIA? ALATA. (Pag. 87.)

Fig. 5, 6. 474. 19. MODIOLOPSIS SUBALATUS. (Pag. 84.)

5. A fragment of slate, with figures of the right and left valve.

6 *a*, *b*. Figures of the right valve of two specimens of large size.

Fig. 7. 475. 6. TELLINOMYA LATA. (Pag. 85.)

Fig. 8, 9. 476. 7. TELLINOMYA MACHÆRIFORMIS. (Pag. 85.)

8 *a*. The left valve of an individual of ordinary size. 8 *b*. The right valve of a large individual.

8 *c*. The right valve of a smaller individual.

8 *d*. A small portion of the surface much enlarged, showing the concentric striæ.

9. (*Cypricardia angusta*, Geol. Rep. 4th District, pag. 76, fig. 6.)

Fig. 10, 13. 477. 8. TELLINOMYA CURTA. (Pag. 86.)

Fig. 11. 478. 4. ORTHONOTA CURTA. (Pag. 86.)

11 *a*. The right valve of a specimen of natural size and proportions.

11 *b*. A specimen of the left valve, narrowed by pressure.

CLINTON GROUP.

(ACEPHALA.)


1a.


1b


2a


2b.


2c


2d.


3


5

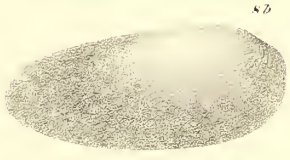

4


6a

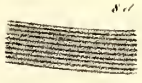

6b


7


8a


8b


8c


8d


9


10.


11a


11b


12a.


12b


12c


13

Swinton Del et Lith

Lith. of R. H. Pease, Albany.

PLATE 28.

Fig. 1. 481. 1. CYCLONEMA CANCELLATA. (Pag. 90.)

1 *a*, *b*, *c*, *d*. Views of several specimens, showing an increasing size and slight variation in form.

1 *e*. View of the aperture, the shell being slightly compressed in a vertical direction.

1 *f*, *g*. View of the front of the shell, and aperture of the same.

1 *h*. Portion of the surface enlarged, showing the character of the striæ.

Fig. 2. 482. 2. CYCLONEMA VENTRICOSA. (Pag. 90.)

2 *a*. Front view of the shell. 2 *b*. View of the mouth.

2 *c*. A portion of the surface enlarged, showing the character of the striæ.

Fig. 3 *a*, *b*. 483. 3. CYCLONEMA? OBSOLETA. (Pag. 90.)

Fig. 4. 485. 1. PLATYOSTOMA. (Pag. 91.)

4 *a*. View looking upon the top of the spire.

4 *b*. Profile view showing the slight elevation of the spire.

4 *c*. Another specimen, view looking upon the spire.

4 *d*. View of the aperture, which is angular at the outer margin, probably from pressure.

Fig. 5. 484. 4. CYCLONEMA CANCELLATA? (Pag. 91.)

5 *a*. The cast of the shell, which is smooth. 5 *b*. A portion of the shell from the base, enlarged.

Fig. 7. 486. 16. MURCHISONIA SUBULATA. (Pag. 91.)

7 *a*. A young specimen of this species. 7 *b*. An elder specimen of the same.

7 *c*, *d*. Two specimens of the largest size observed; the last one wanting one or more of the upper volutions.

Fig. 8. 487. 8. BUCANIA STIGMOSA. (Pag. 92.)

8 *a*. Dorsal valve of an imperfect specimen.

8 *b*. A portion of the same enlarged, showing the elevated decussating striæ, and another portion where these are obliterated by abrasion or exfoliation.

8 *c*. Dorsal view of a cast of this species, with the aperture and a part of the last volution broken off.

8 *d*. Lateral view of the same specimen.

8 *e*. Transverse section of the last volution, where broken off.

Fig. 9. 488. 9. BUCANIA? BELLA-PUNCTA. (Pag. 93.)

Fig. 10. 396. 7. BUCANIA TRILOBATA. (Pag. 93.)

10 *a*. A specimen, natural size.

10 *b*. A large individual, much compressed in a longitudinal direction.

Fig. 11. 489. 3. ONCOCERAS SUBRECTUM. (Pag. 94.)

11 *a* A lateral view of the fragment.

11 *b*. A portion of the surface enlarged, showing a suture on one side.

Fig 12. 494. 1. CORNULITES FLEXUOSUS. (Pag. 98.)

12 *a*. A specimen, somewhat tortuous in form and partially compressed, covered with the external striated shell.

12 *c*. A specimen, nearly entire, exhibiting the usual form and surface characters of this fossil.

12 *d*. A fragment of a specimen more curved than usual.

12 *e*. A longitudinal section of the last, showing the tube filled with fragments of crinoids and shells.

Fig. 13. 495. 1. DISCOSORUS CONOIDEUS. (Pag. 99.)

13 *a*. One of these bodies of the natural size, preserving eight or nine rings from the apex to the base.

13 *b*. The base of one of these discs from another individual.

13 *c*. A section of one of these discs exposed by fracture, showing the radiating and fibrous structure of the body.

(GASTEROPODA)

M.E.Brooke, Del.

James Duthie, Sculp.

PLATE 29.

Fig. 1. 490. 4. Ormoceras vertebratum. (Pag. 94.)

1 *a*. A fragment of the cast of a specimen, having the edges of the septa slightly projecting.

1 *b*. Longitudinal section, showing the arching of the septa and form of the siphuncle.

1 *c*. A fragment where the laminæ of the shell have become silicified and separated, so that the septa and siphuncle appear to be composed of double laminæ. The interior of the siphuncle is hollow in this specimen.

1 *d*. A fragment of the siphuncle, and several of the septa attached. The siphuncle is worn down in part, exhibiting a section having the laminæ thickened, while other portions retain their entire character.

1 *e*. A fragment of the siphuncle, with parts of the septa attached. At the lower part the shell is removed, showing a cast of the interior of the siphuncle, having the contractions and expansions corresponding to those of the outer covering.

1 *f*. A fragment having the walls of the siphuncle broken down, and the cast of the interior standing out very prominently.

1 *g*. A portion of the cast of the siphuncle enlarged, showing the rugæ impressed upon it by the interior rugose surface of the siphuncle.

Fig. 2. 491. 28. Orthoceras virgulatum. (Pag. 96.)

2 *a*. A small fragment preserving the shell. 2 *b*. A section of the last.

2 *c*. A silicified fragment broken through the centre longitudinally, except the lower part.

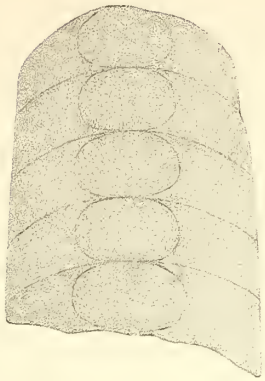
Fig. 3. 492. 29. Orthoceras annulatum? (Pag. 96.)

Fig. 4 *a*, *b*. 493. 30. Orthoceras abruptum. (Pag. 97.)

(ORTHOCERATA)

1a.

1b.



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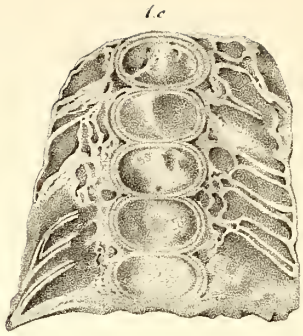

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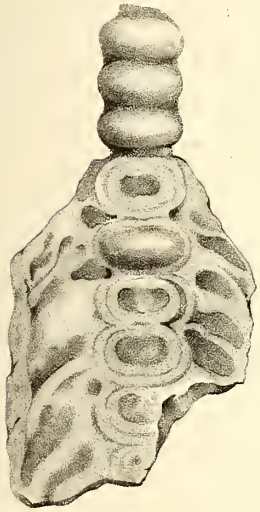

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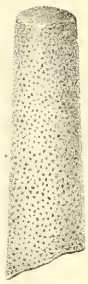
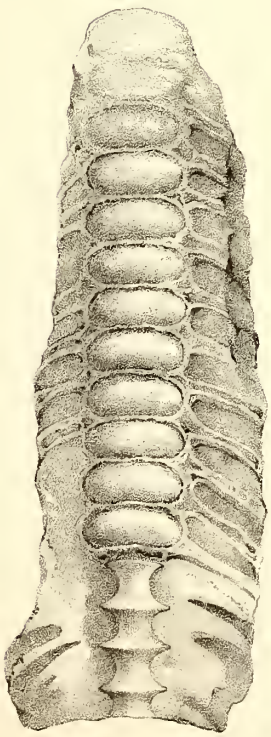


2b.

1g.

1f.

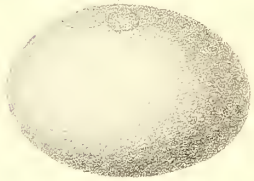
1e.



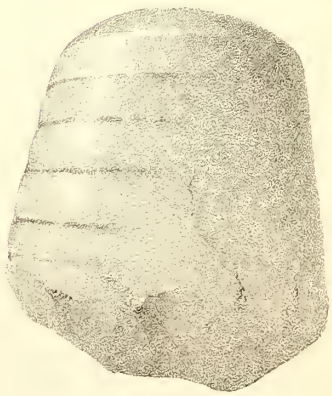
2c.

3.

4b.



4a.



Swinton, Del.

Lith. of R. H. Pease, Albany.

PLATE 30.

Fig. 1. 496. 1. MYALINA MYTILIFORMIS. (Pag. 100.)

1 *a*. The right valve of this species somewhat compressed, and having the anterior expansion broken off in part.

1 *b*. The right valve of another specimen, less compressed than the preceding.

1 *c*. A specimen preserving both valves, which are partially open along the cardinal line. The lower portion of both valves is broken off.

1 *d*. The left valve of the preceding specimen, compressed so that it appears much narrower than its natural form.

Fig. 2. 497. 20. MODIOLOPSIS OVATUS. (Pag. 101.)

2 *a*. The left valve of a specimen of ordinary size.

2 *b*. The right valve (imperfect) of a large individual.

Fig. 3, & 4 *a*. 498. 21. MODIOLOPSIS SUBCARINATUS. (Pag. 101.)

3 *a*. A young individual of this species.

3 *b*, *c*. The right valves of two individuals of medium size.

3 *d*. The left valve of an older individual.

4 *a*. This individual has nearly the same form as figs. 3 *b* and 3 *c*, but is more compressed, and concentric folds are not at all conspicuous.

Fig. 4 *b*. 499. 9. TELLINOMYA ELLIPTICA. (Pag. 102.)

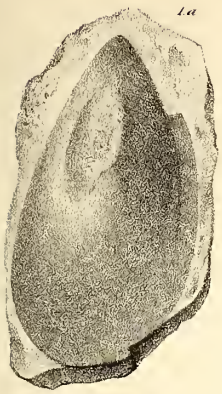
Fig. 5. CYPRICARDIA? (*n. s.*). (Pag. 102.)

5 *a*. View looking upon the cardinal line.

5 *b*. Lateral view of left valve, which is crushed, showing the outline of the right valve beyond.

(GRAY SANDSTONE.)

(ACEPHALA.)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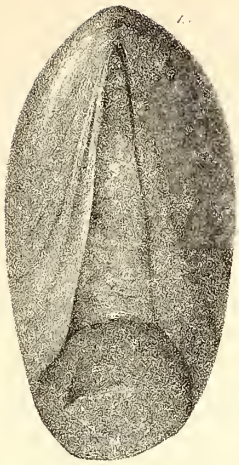
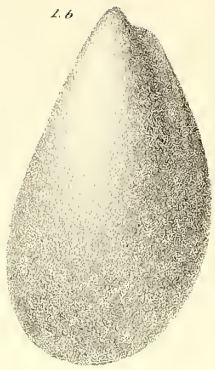

1.


d.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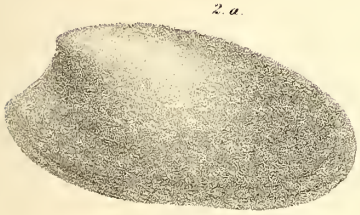
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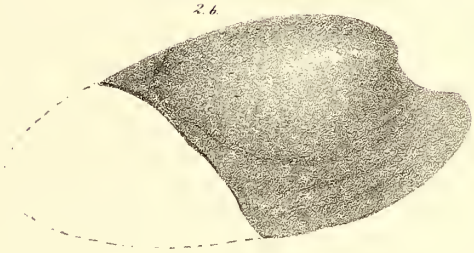
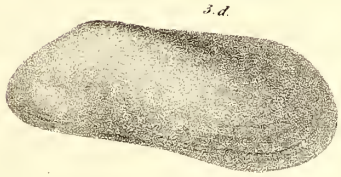

2.b.


3.a


3.b


3.d.


3.c


5.a


4.b


4.a


5.b

PLATE 31.

Fig. 1. 500. 3. PENTAMERUS OVALIS. (Pag. 103.)

1. A small valve, having a width slightly greater than the length.
1 *a*. A larger valve, having a length nearly once and a half the width.

Fig. 2. 446. 21. LEPTÆNA OBSCURA? (Pag. 103.)

Fig. 3. 501. 1. PLATYOSTOMA. (Pag. 103.)

3 *a*. A large specimen of this species, having a portion of the last volution broken off.
3 *b*. A smaller specimen, with the expanded portion of the last volution broken off.

Fig. 4. 502. 31. ORTHOCERAS CLAVATUM. (Pag. 104.)

4 *a*. A fragment near the smaller extremity of the shell.
4 *b*. A smaller fragment preserving a portion of the outer chamber.

Fig. 5 *a*, *b*. 503. 1. HOMALONOTUS DELPHINOCEPHALUS. (Pag. 104.)

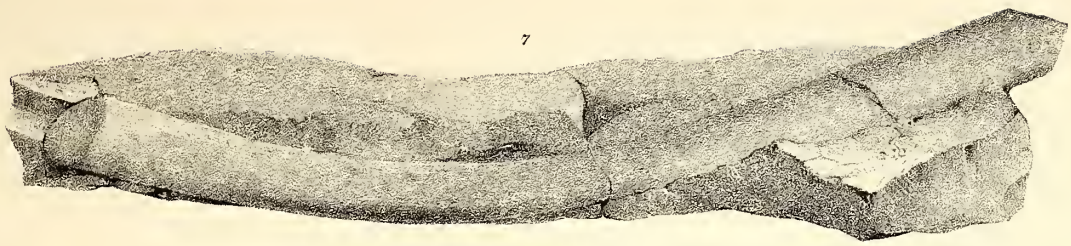
Fig. 6. 504. FRAGMENT OF ICHTHYODORULITE. (Pag. 104.)

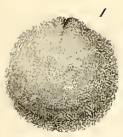
Fig. 7. *Fragment of the rib of some vertebrate animal?* (Pag. 105.)

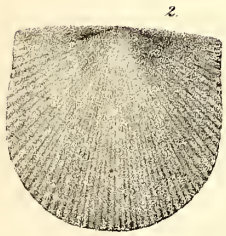
CLINTON GROUP.

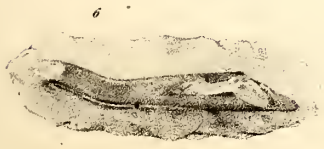
(GRAY SANDSTONE.)

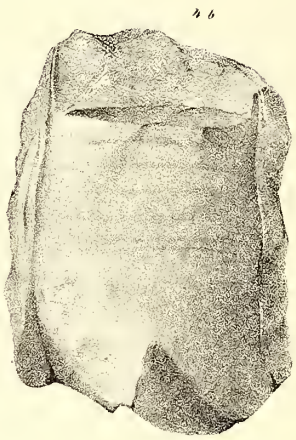
(MISCELLANEOUS.)

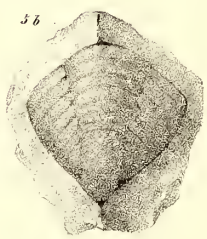


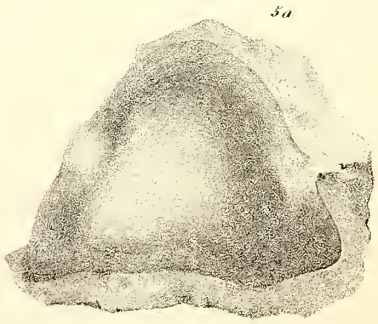












On Stone by F. J. Swinton.

Lith. of R. H. Pease, Albany.

PLATE 32.

Fig. 1. 505. 7. Streptelasma calicula. (Pag. 111.)

1 *a*. Anterior view, showing the interstitial or additional rays on each side of two continuous rays.

1 *b*. Lateral view, showing interstitial rays on one side of a continuous ray.

1 *c*. The opposite side of the same individual, showing the same character as fig. 1 *b*.

1 *d*. View showing the interior of the cup, and posterior or shorter side of the coral.

1 *e*. Transverse section, showing the number of rays with the alternating dentate processes.

1 *f*. A vertical section showing the depth of the cup. The margin above is broken off.

1 *g*. An unusually large individual of this species : lateral view.

1 *h*. An individual more straight than usual.

1 *i*. A small individual with the enveloping membrane or cup entirely destroyed, leaving only the rays.

4 *k*. An enlarged portion of the margin of the cup, showing that the dentate process between the rays appears externally, and extends downwards equally with the full ray.

Fig. 2. 506. 1. Polydilasma turbinatum. (Pag. 112.)

2 *a*. An individual (larger than the prevailing size), somewhat weathered on the surface, and showing, slightly, the lamellæ.

2 *b*. A specimen of ordinary size, much weathered, and showing the lamellæ in pairs and bifurcating above.

2 *c*. A specimen showing two bases or points of attachment.

2 *d*. A specimen of ordinary size, divided vertically, showing the depth of the cell, which is filled with fragments of corals.

2 *e*. The cell of another individual, having the margin somewhat worn.

2 *f*. Several of the lamellæ enlarged, showing the termination of the alternate ones at the point where the cup deepens.

2 *g*. A transverse section near the base of a small specimen, showing the arrangement of the lamellæ and the absence of transverse dissepiments.

2 *h*. An individual of more elongated form than usual. The upper part is a bud from one side of the centre of the lower cup, which the partial wearing down has made to appear as a continuation of the same.

2 *i*. A longitudinal section showing a confused cellular structure below the centre of the cell.

Fig. 3. 419. 1. Caninia bilateralis. (Pag. 113.)

3 *a*. View of the specimen, showing the cup with the depression in the dissepiments on the anterior side.

3 *b* & 3 *c*, showing the arrangement and coalescing of the lamellæ in the cup.

Fig. 4. 507. 1. Conophyllum niagarense. (Pag. 114.)

4 *a*. A specimen of the turbinate form, showing the rays externally. The denticulate rays within the cup are also well shown, and the denticles between the dissepiments near and below the upper margin of the cup on the outside.

4 *b*. A turbinate specimen, showing the denticulate lamellæ on the external surface.

4 *c*. A small turbinate specimen with the surface worn, showing the successive dissepiments, and the denticulate lamellæ within the cup.

4 *d*. The external surface of an unweathered specimen, where the edges of the transverse dissepiments project at intervals.

4 *e*, *f*, *g*. Portions of the interior of the cup enlarged, showing the condition of preservation of the denticulated lamellæ.

4 *h*, *i*, *k*, *l*. The exterior of specimens of various sizes, more or less worn, showing in 4 *h* particularly the arrangement of the dissepiments where partially worn down.

4 *m*. A small specimen, showing a section through the centre, with deep transverse cup-form septa.

4 *n*. A specimen showing apparently lateral budding.

* Fig. without number, enlargement of a portion of the surface of *Fenestella*.

(CORALS)


1a
1b
1c
1d
1e
1f
1g
1h
1i
1k
2a
2b
2c
2d
2e
2f
2g
2h
2i
2k
2l
3a
3b
3c
4a
4b
4c
4d
4e
4f
4g
4h
4i
4k
4l
4m
4n

PLATE 33.

Fig. 1. 508. 1. Diplophyllum cæspitosum. (Pag. 116.)

1 *a*. A single cell with a lateral bud on one side. The weathered portion near the top of the specimen shows very distinctly the transverse dissepiments.

1 *b*. A specimen cut obliquely, showing the transverse dissepiments in the inner circle of the cell.

1 *c*. A group formed by budding from a single stock below. One of the buds is broken off near the base. The exterior surface is well preserved in this specimen, showing the fine transverse striæ.

1 *d*. A small group, showing one mode of budding. The continuation of the righthand portion of the figure has been broken off.

1 *e*. A cylindrical specimen, contracted at intervals from intermitted growth, and showing a tendency to budding at these points. On the lefthand side are two buds broken off; and on the righthand side are the germs of three other buds which have not expanded.

1 *f*. A portion of fig. 1 *a* enlarged, showing the transverse dissepiments uniting the lamellæ.

1 *g*, *h*. The cell natural size and enlarged, showing the denticulated appearance of the lamellæ, arising from the dissepiments being partially preserved at the junction with the lamellæ.

1 *i*. A vertical section of the cell.

1 *k*. A fragment showing the ends of the several stems standing out above the weathered surface, having the exterior portion still cellular, while in many of them the centre is solid.

1 *l*. A polished section of a less crystalline specimen, showing the ends of several stems.

1 *m*. A part of a larger group, showing the manner of budding and increase.

1 *n*. A single stem with two buds in the lower part, which are broken off near the stock; while near the upper part the buds are numerous, and thrown out on all sides.

1 *o*. A longitudinal section of several stems, showing the transverse dissepiments, which, near the base of one stem, are bent downwards in the middle, and are otherwise irregular in other parts of the stem.

1 *p*, *r*. Longitudinal sections from two different groups, showing irregularity in the transverse septa of the centre of the cell.

Fig. 2. 509. 2. Diplophyllum cæspitosum? (Pag. 118.)

Fig. 3. 510. 1. Syringopora? multicaulis. (Pag. 119.)

3 *a*. A small part of a larger group of these tubes from a silicious specimen.

3 *b*. A transverse section, showing the ends of the tubes.

3 *c*, *d*. The end of a tube, natural size and magnified.

3 *e*. A separated tube, showing contraction at intervals, with a shorter one at the base, and a bud proceeding appararently from between them.

3 *f*. A longitudinal section from the top of the cup downwards, showing in the upper part the simple rays, and below the complicated oblique septa.

3 *g*. A longitudinal section of a tube, the middle of the figure reaching to the centre of the tube, and showing oblique septa, while at the two ends only the lamellæ are seen.

CORALS

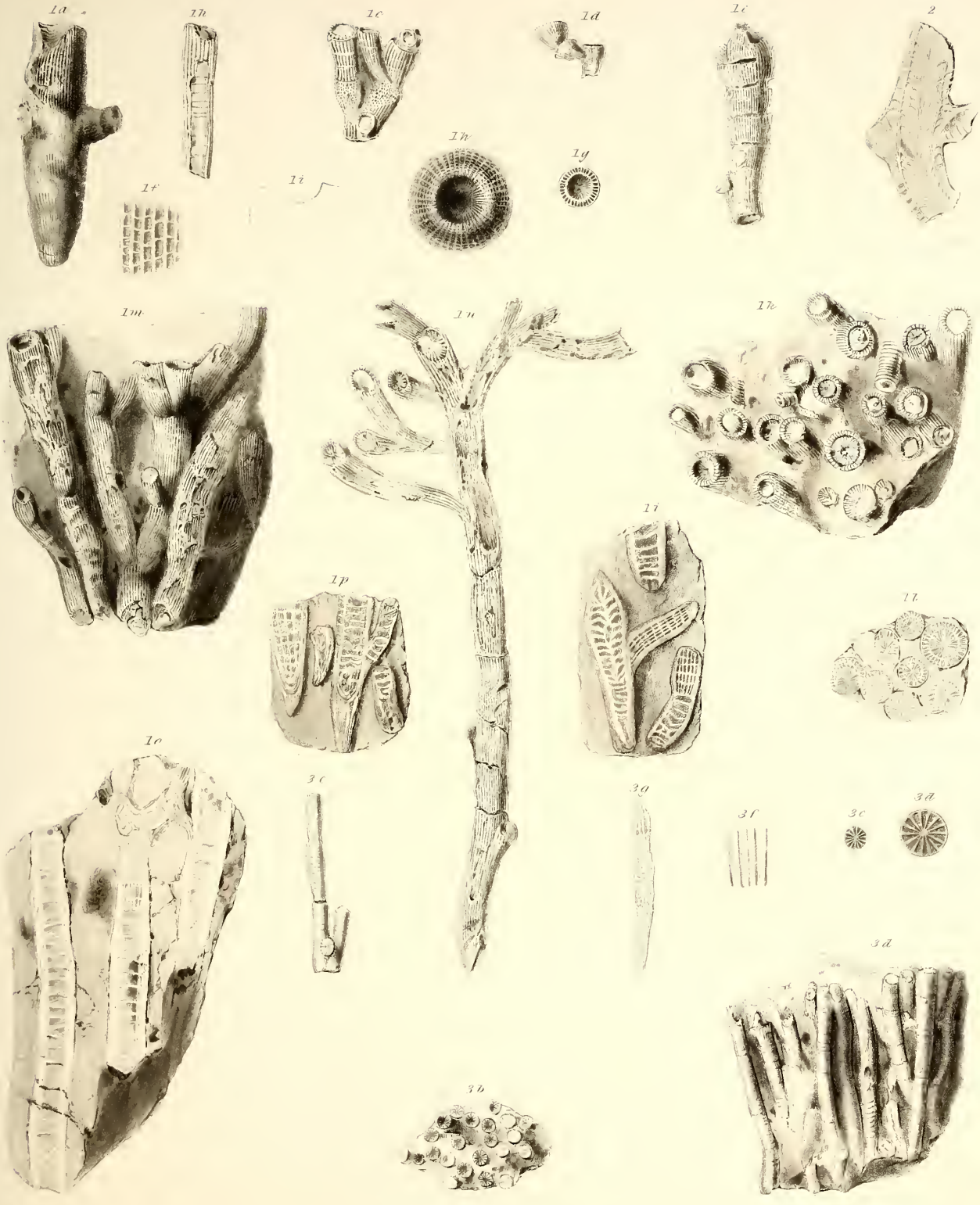


PLATE 34.

Fig. 1. 511. 1. ASTROCERIUM VENUSTUM. (Pag. 120.)

1 *a*. A vertical section of a solid spheroidal mass, showing its columnar character, and the lines indicating stages of growth.

1 *b*. The base of a smaller solid specimen, showing the coral surrounding, and the columns diverging from a stem of the *Syringopora multicaulis*.

1 *c*. A vertical section, with the cells open, showing the internal character.

1 *d*. A portion enlarged, showing the arrangement of the spiniform rays between the septa.

1 *e*. A similar section where the rays are nearly obsolete.

1 *f*. A section enlarged, showing the surface of the walls of the cell, where the rays are broken off.

1 *g*. A single space between two septa, greatly enlarged.

1 *h*. A transverse section of the cells parallel to the surface.

1 *i*. The same enlarged.

1 *j*. Surface of a specimen of this coral where the radiating lamellæ are nearly obliterated, and showing a columnar structure.

Fig. 2. 512. 2. ASTROCERIUM PARASITICUM. (Pag. 122.)

2 *a*. A small spheroidal form, attached to a coral which projects beyond the base.

2 *b*. A small spheroidal specimen.

2 *c*. A spheroidal mass with the cells open on a part of the surface, showing the unequal size of the openings; the interspaces are also very wide.

2 *d*. A smaller mass enclosing a piece of a crinoidal column, which projects on both sides of the coral.

2 *e*. Sections of a spherical mass, which enclosed a fragment of an ichthyodorulite.

2 *f*. A portion of the surface from a large specimen, where the cells are filled, and the whole mass is columnar.

2 *g*. A small portion from the base of the last, showing the weathered surface of the columns.

2 *h*. The ends of the tubes enlarged, showing the stellate character.

2 *i*. Showing the papillose surface of the interior of the tube when the rays are broken away, leaving the bases projecting.

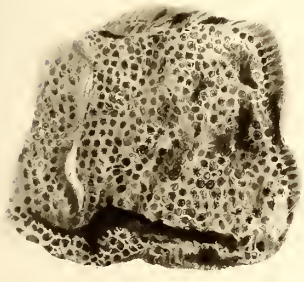
(CORALS)

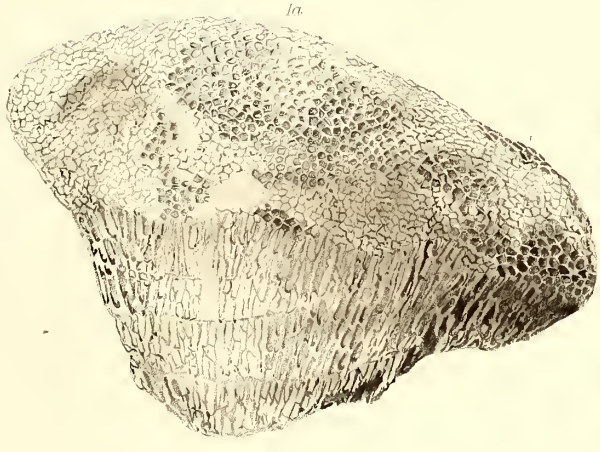

1c


1b


1d

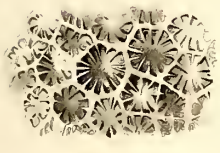

1e


1h


1a


1g


1f

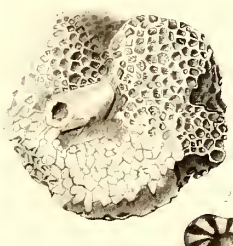

1i


1j

2a


2b

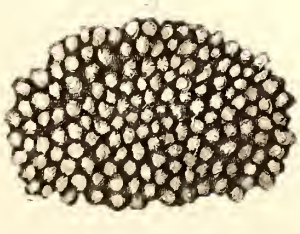

2c


2d


2e


2f


2g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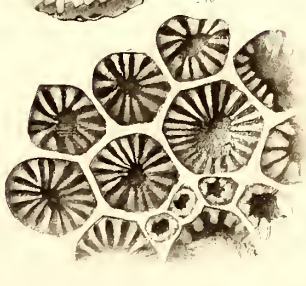

3b


3c

PLATE 34 A.

Fig. 1. 513. 3. ASTROCERIUM PYRIFORME. (Pag. 123.)

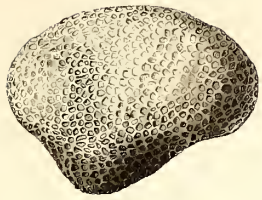
1 *a*. A spheroidal form of this species.
1 *b*. A turbinate form, the cells increasing rapidly from a narrow base.
1 *c*. An irregular turbinate form of larger size.
1 *d*. A portion enlarged, showing the internal structure of the cells.
1 *e*. An enlarged portion from the inner walls of the cells, showing the granulated or papillose surface from the bases of the spiniform rays.

Fig. 2, 3. 514. 4. ASTROCERIUM CONSTRICTUM. (Pag. 123.)

2 *a*. A fragment of a hemispheric mass, natural size.
2 *b*. A portion of the same enlarged, showing the constricted growth at intervals.
2 *c*. A transverse section of the same enlarged, showing the stellate character of the ends of the columns.
3 *a*. A small hemispheric form of this species.
3 *b*. The base of the same, showing its mode of growth upon the valve of an ATRYPA.
3 *c*. Profile view, showing the form and elevation.
3 *d*. The base of a larger specimen, which commenced its growth upon a small shell.
3 *e*. A portion of the surface enlarged, showing the form and apparent stellate character of the cells.

1d.

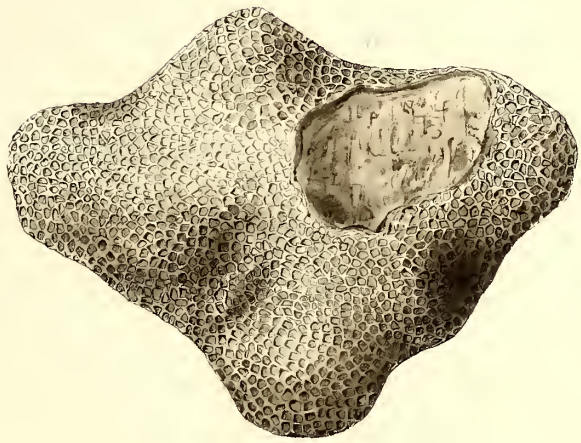
1a



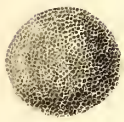
1e

2a

2b

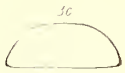


3a

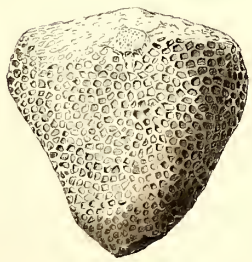


3c

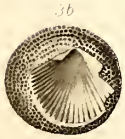
3c



1b



3b



1d

PLATE 34 A (bis).

Fig. 4. 515. 1. FAVOSITES NIAGARENSIS. (Pag. 125.)

4 *a*. A fragment from the limestone at Goat island, showing the ends of the cells which are open.

4 *b*. A portion enlarged, showing the transverse septa and pores in the walls of the cells.

4 *c*. A small spherical form, having the cells open, and the walls replaced by siliceous matter.

4 *d*. A small portion enlarged, looking into the cells and showing the perforated walls.

4 *e*. A worn specimen from the lower part of the limestone at Lockport. The cells are open, but there are no pores visible.

4 *f*. A section of a small mass of apparently the same species, showing the septa bent downwards.

4 *g*. A longitudinal section of another specimen, in which the septa appear at irregular intervals, some of them at great distances, probably from a part of the original number having been obliterated; and others in close proximity, showing that this feature can not be relied upon to characterize specific distinctions.

4 *h*. Transverse section, showing the ends of the cells and the separation of the walls, forming distinct and separate tubes.

4 *i*. A larger and better preserved specimen of this species.

Fig. 5. 516. 2. FAVOSITES FAVOSA? (Pag. 126.)

5 *a*. A longitudinal section of a small hemispherical mass.

5 *b*. Section of another specimen, where the septa are more distant and irregular.

5 *c*. The solid columns of the same species.

5 *d*. Transverse section of the cells.

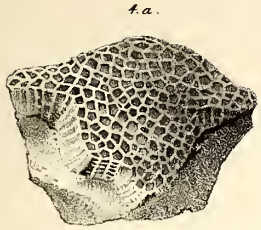
5 *e*. An impression left by the exterior surface of one of these masses.

5 *f*. A larger individual of the same species, having the septa more uniformly disposed.

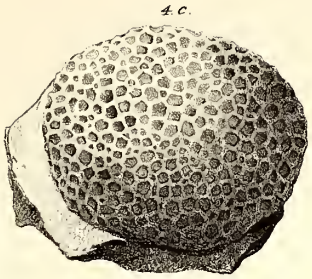
5 *g*. A portion of the last enlarged.

NIAGARA GROUP.

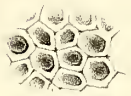
(CORALS)


4 a.


4 b.

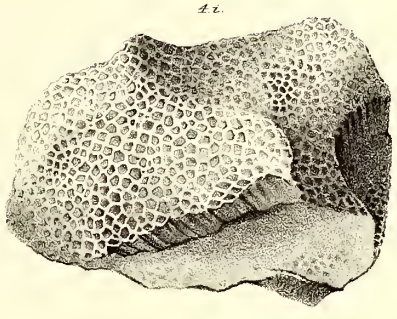

4 c.

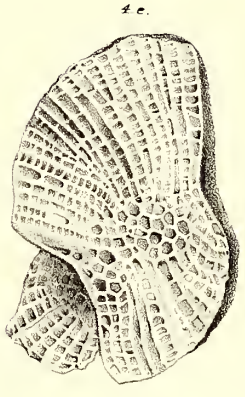

4 f.

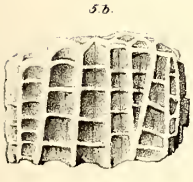

4 h.

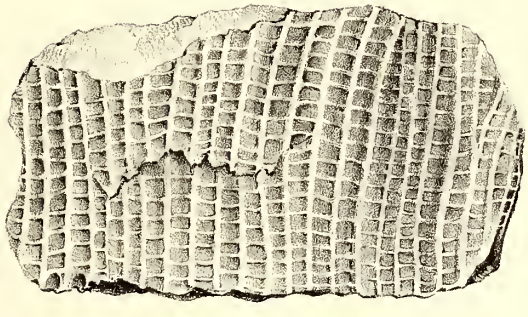

4 d.

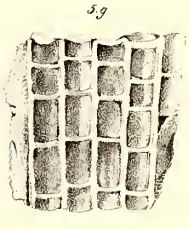

4 g.


4 i.

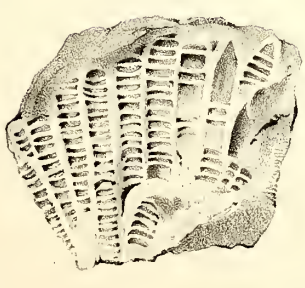

4 e.


5 b.

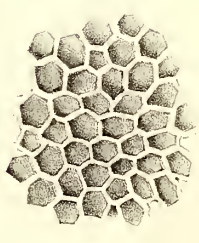

5 f.


5 g.


5 c.


5 a.


5 e.


5 d.

On Stone by Swinton.

Lith. of Rich^d H. Pease, Albany.

PLATE 35.

Fig. 1. **517. 1. Catenipora escharoides.** (Pag. 127.)

1 *a*. A portion of a hemispheric specimen, giving the usual characters of the species as it occurs in New-York.

1 *b*. The base of the same specimen, showing its mode of growth from below, and the increase by interstitial cells, which appears like a bifurcation of a single tube.

1 *c*. A fragment from a strong growing mass, preserving the transverse striæ, and showing tubes somewhat larger than the preceding figure.

1 *d*. An individual where the growth is more slender, and the reticulate spaces are smaller.

1 *e*. A vertical section of the same, contrasting with fig. 1 *c*.

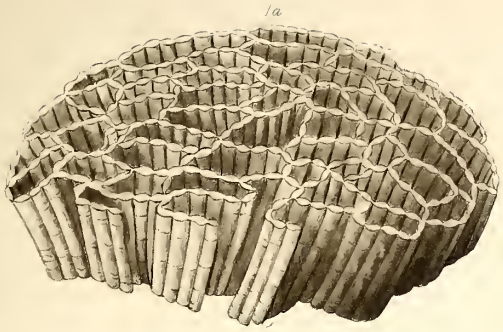
1 *f*. A vertical section of fig. 1 *c*, showing the transverse septa of the tubes, and also a confused cellular structure, which is probably due to crystallization, from the infiltration of siliceous matter into the interior.

1 *g*. A vertical section of a well preserved specimen, showing the external striated character of the tubes, when magnified.

1 *h*. A longitudinal section of the interior of several tubes magnified, showing the striæ.

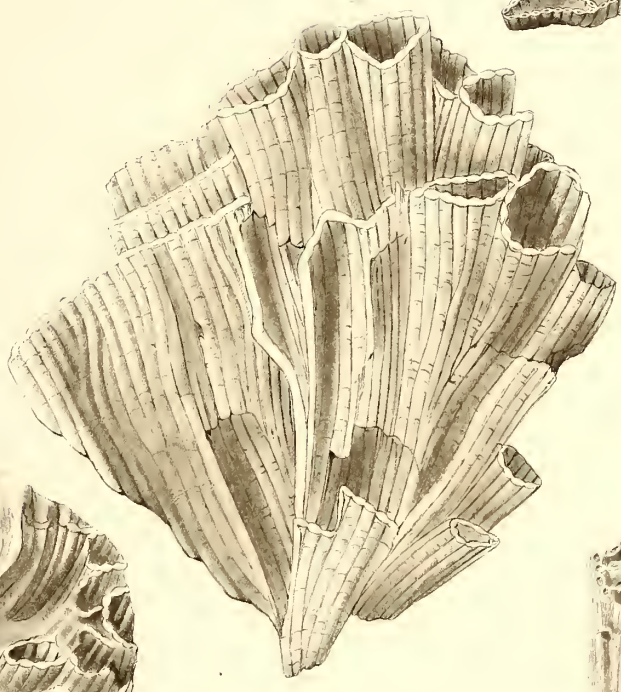
1 *i*. A figure showing the vertical section of a mass of this coral, where the spaces are filled, and the whole intimately combined with the surrounding stone.

(CORALS.)


1a

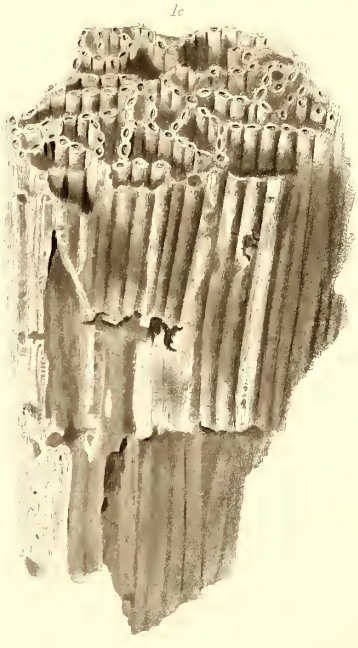

1d


1e


1


1f


1b


1c


1g


1h

M.E. Beyrich del.

PLATE 35 (bis).

Fig 2. 518. 2. CATENIPORA AGGLOMERATA. (Pag. 129.)

2 *a*. A weathered surface of a mass of this species, showing some irregularities in the arrangement of the series of cells.

2 *b*. A transverse section of an upper weathered surface, showing the form of the openings, and the arrangement in parallel lines with slight interruptions.

2 *c*. A vertical section, showing the transverse septa within the tubes.

2 *d*, *d*. A vertical section magnified, showing the concave septa and the cellular interspaces between the tubes.

2 *e*. The external surface of several tubes enlarged, showing an obscurely striated surface.

2 *f*. A fragment showing the lower or convex surface of the septa.

2 *f*†. Profile of the same enlarged.

2 *g*. The openings of several tubes enlarged, contrasting with similar figures from the varieties of the preceding species.

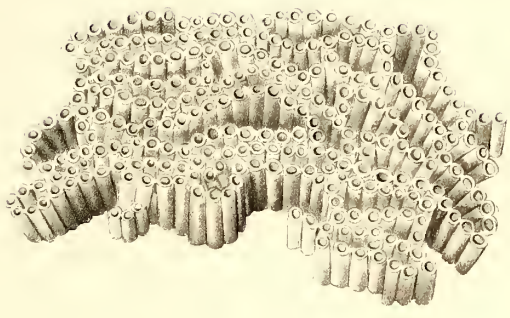
(CORALS.)

2d

2d

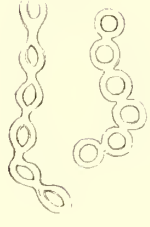
2e

2a

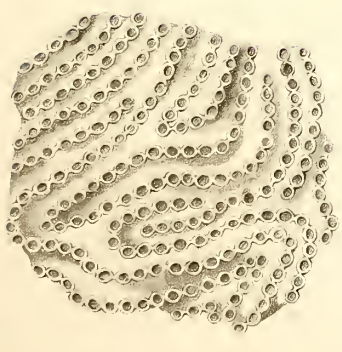


2f-1

2g

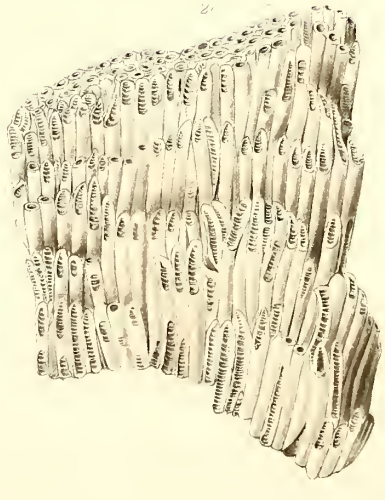


2b



2f

2c



M E Brooks, Del

Lith[d] H Pos

PLATE 36.

Fig. 1. 519. 1. HELIOLITES ELEGANS. (Pag. 130.)

1 *a*. A portion of the surface, showing the openings of the cells.

1 *b*. A vertical section produced by weathering.

1 *c*. Enlargement of 1 *a*, showing the variable appearance of the cells.

1 *d*. Enlargement of 1 *b*, showing the cells as they appear when weathered.

1 *e*. A magnified view of a polished transverse section.

1 *f*. A magnified view of a polished vertical section.

1 *g*. A magnified view from the lower side of the coral.

Fig. 2. 520. 2. HELIOLITES SPINIPORA. (Pag. 131.)

2 *a*. A calcareous mass where the interstices between the rays are crystallized and prominent, the entire surface presenting a confused stellate appearance.

2 *b*. A portion of the same enlarged, showing more definitely the limits of the stellate cells and the intercellular lamellar or granular surface.

2 *c*. Several of the cells near the base of the same specimen enlarged, showing a different appearance from 2 *b*. In these cells the centre is depressed.

2 *d*. A vertical section of the small specimen fig. 2 *a*.

2 *e*. A portion of the same enlarged, showing the spiniform ascending rays in the cell and the transverse septa in the interspaces.

2 *f*. A figure from a polished piece of crinoidal limestone, showing a nearly transverse section of a spheroidal mass of this coral, with a vertical section of another individual which apparently commenced growth upon the preceding one. On the right hand is a section of a smaller species, also growing on the first.

2 *g*. This figure is enlarged from the surface of the polished specimen, showing the characters very distinctly.

2 *h*. A portion of the vertical section in the same figure enlarged, showing the lamellæ in the interior of the cells with interrupted transverse septa?

2 *i*. An enlarged figure of a vertical section, showing the transverse septa crossing the cell directly and interruptedly; also in other cells having the appearance of spiniform ascending rays, as in fig. 2 *e*.

2 *k*. A portion of the surface of a weathered specimen, presenting the principal varieties of appearance assumed by this coral.

2 *l*, *m*, *n*. Enlargements showing the different aspects of the surface in fig. 2 *k*.

[CORALS]

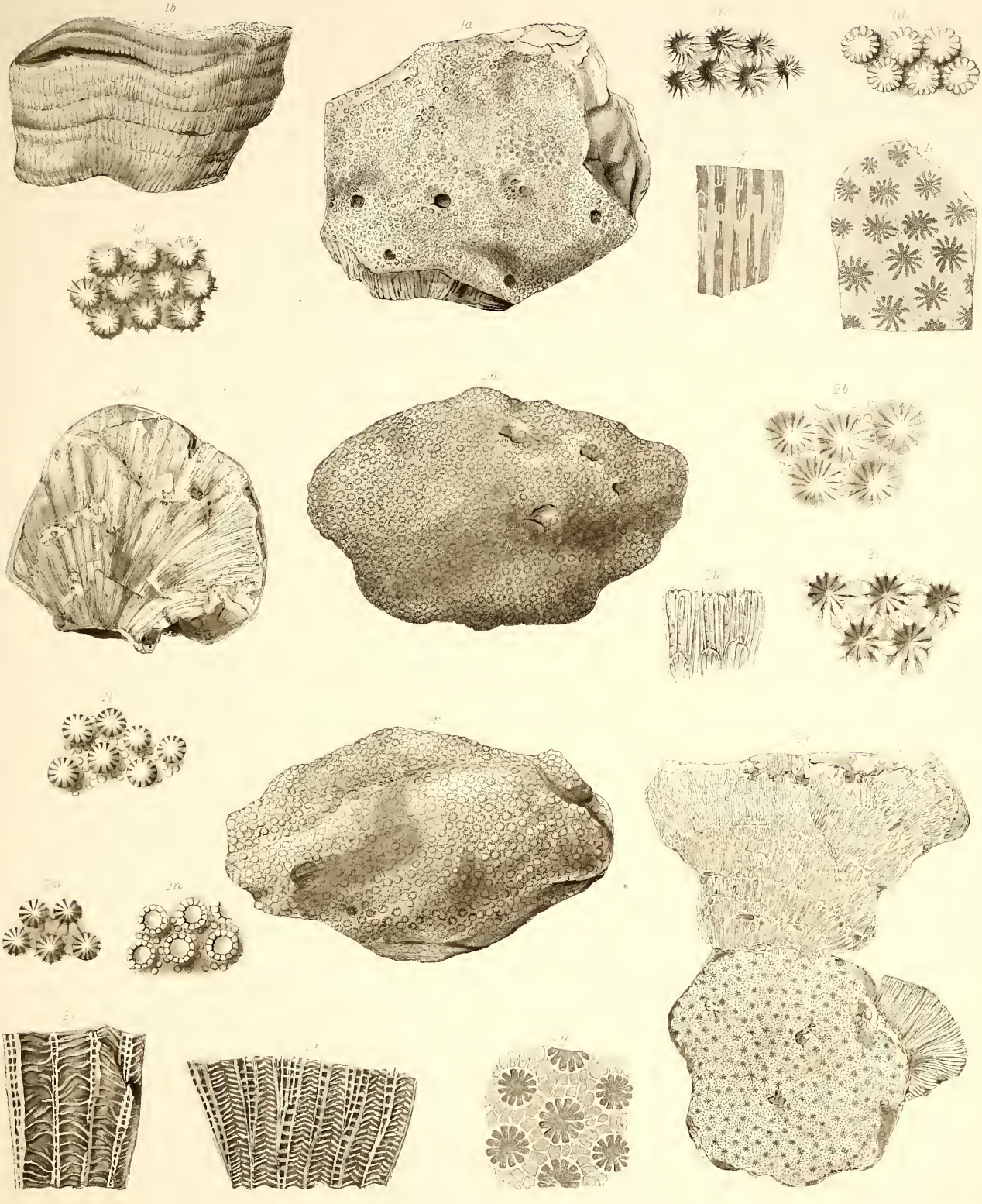


PLATE 36 A.

Fig. 1. 521. 3. HELIOLITES PYRIFORMIS? (Pag. 133.)

1 *a*. A weathered vertical section of a hemispheric mass, showing the tubes partially in relief upon the surface, with interspaces more abraded.

1 *b*. An enlargement of several tubes, showing the structure of the interior.

1 *c*. An enlargement from another part of the same specimen, where the cylindrical tubes stand out in relief.

1 *d*. A portion of the surface of the same specimen, showing the openings of the cells upon the surface, and the intercellular spaces.

1 *e*. An enlargement from fig. 1 *d*, showing the structure of the surface and the openings of the cells.

1 *f*. The base of a weathered calcareous specimen, where the lamellæ and septa are nearly all obliterated, showing the striated interior and exterior of the tubes.

1 *g*. An enlargement of a portion of the preceding figure.

1 *h*. A fragment where the walls of the tubes are preserved, the elevated edges appearing to be produced by twelve points or granules, with here and there slight evidences of rays.

1 *i*. The same enlarged, showing more distinctly the characters mentioned, and also the unequal distances of these tubes from each other; in some cases the walls being nearly or quite in contact, while in others they are widely separated.

1 *k*. A weathered surface, showing the exterior and interior surface of these cells.

1 *l*. A weathered surface of a specimen preserving the cylindrical tubes, where the intercellular spaces have been filled with crystalline matter, which has assumed a minutely tubular or cylindrical form.

1 *l* †. An enlargement of several of the fluted cells and tubular interspaces.

1 *m*. Transverse section of the same, showing the ends of the minute tubes.

Fig. 2. 522. 4. HELIOLITES MACROSTYLUS. (Pag. 135.)

2 *a*. A transverse section, natural size; the rays for the most part obliterated.

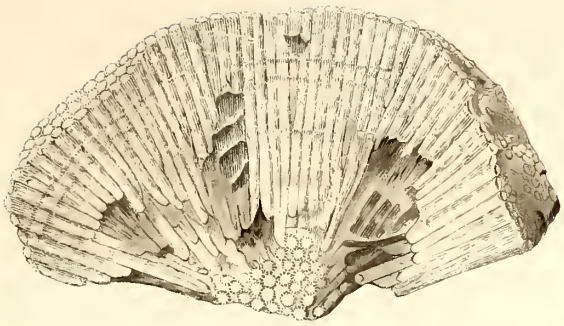
2 *b*. A part of the same enlarged.

2 *c*. A vertical section, showing the striated surfaces and close arrangement of the tubes.

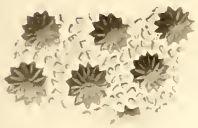
2 *c* †. An enlargement of a single cell from 2 *c*.

[CORALS]

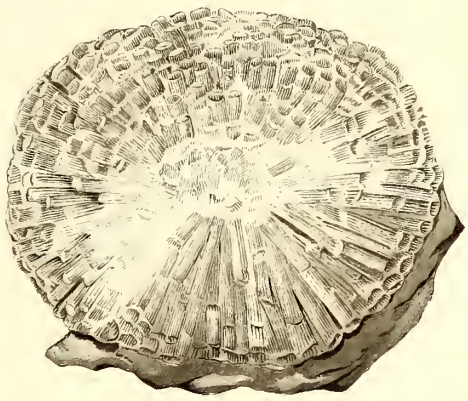

1d

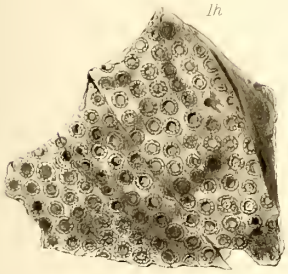

1a


1c

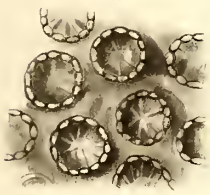

1e


1b


1f


1h


1g

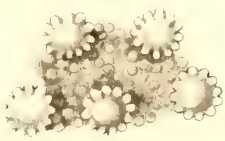

1i


11


11+


11


20+


1m


2c


2a

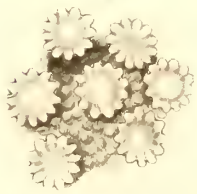

2b

PLATE 37.

Fig. 1. 523. 1. STROMATOPORA CONCENTRICA. (Pag. 136.)

1 *a*. The surface of a small hemispheric mass, showing the edges of the thin laminæ which are unequally weathered.

1 *b*. A magnified portion of the same surface, showing the circular ends of the cylindrical tubes.

1 *c*. A magnified portion, showing the weathered edges of successive laminæ which are indented by the cells, giving them the appearance of being arranged in concentric lines.

1 *d*. A transverse section of a small mass.

1 *e*. A magnified portion of the same.

1 *f*. A larger mass, showing the effects of weathering upon the thin concentric laminæ.

1 *g*. The base of the same specimen, showing several centres of growth.

PLATE 37 A.

Fig. 1. 523. 1. Stromatopora concentrica. (Pag. 136.)

The base of a large individual of this species.

Fig. 2. 567. 1. Lichenalia concentrica. (Pag. 171.)

2 *a*. A nearly perfect frond. 2 *b*. An enlargement of the surface of the same.

NIAGARA GROUP.

(CORALS.)

2a

2b

1a

On Stone by Swinton.

Lith of R.H Pease, Albany

PLATE 38.

Fig. 1. 524. 1. CLADOPORA SERIATA. (Pag. 137.)

1 *a*. A small group of the parallel stems of this coral, closely arranged.

1 *b*. A similar group in limestone, where the stems are less closely arranged.

1 *c*. An enlarged stem, showing the form and character of the cells.

1 *d*. A portion of the surface, showing the apertures where the stem is worn.

1 *e*. A vertical section of several stems, where the cells are open.

1 *f*. A single one enlarged. 1 *g*. The ends of several cells where the tubes are open.

1 *h*. A single one enlarged, showing a transverse section of the tubes, the inner or nearest the axis being smaller than the outer ones, indicating the increase in size towards the surface.

1 *i*. A polished specimen of limestone, showing the solid ends of the stems of this coral.

1 *k*. A figure of a branch, upon the outer margin of a group of parallel stems.

1 *l*, *m*. Small separate stems showing modes of branching.

Fig. 2. 525. 2. CLADOPORA CESPITOSA. (Pag. 138.)

2 *a*. A view of this species from the base : the upper part of the branches are imbedded in limestone.

2 *b*. A part of a stem enlarged, showing the openings on the surface.

2 *c*. A longitudinal section, showing the arrangement of the cells.

Fig. 3. 526. 3. CLADOPORA CERVICORNIS. (Pag. 139.)

3 *a*. A fragment of a branch of the natural size.

3 *b*. A portion enlarged, showing more distinctly the form of the apertures.

Fig. 4, 5. 527. 4. CLADOPORA FIBROSA. (Pag. 139.)

4 *a*. A small branch, showing a tendency to regular bifurcation in its mode of growth.

4 *b*. An enlarged portion, showing the weathered openings and the fibrous prismatic structure of the longitudinal section.

5 *a*. A large branch, which is solid, and worn so as to show the prismatic structure.

5 *b*. A portion enlarged, showing a structure and arrangement analogous to the preceding figure 4 *b*.

(CORALS)

PLATE 39.

Fig. 1. 528. 5. CLADOPORA MULTIPORA. (Pag. 140.)

1 *a*. A part of a broken and macerated specimen, showing its irregularly reticulated character.
1 *b*. A fragment showing the terminations of several small branches, with a portion enlarged 1 *b* †.
1 *c*. A fragment enlarged, showing the forms of the mouths of the cells where little worn.
1 *d*. A similar portion enlarged, from a surface somewhat more worn than the preceding specimen.
1 *e*. A fragment where the surface is much worn, presenting simple circular pores on a smooth surface.
1 *f*. A longitudinal section, showing the interior structure of the coral.
1 *g*. A transverse section of a single stem, showing radiating tubular cells.

Fig. 2. 529. 6. CLADOPORA MACROPHORA. (Pag. 140.)

2 *a*. A fragment of a frond having the cells filled and solid, separating in prismatic forms.
2 *b*. A portion enlarged, showing the structure.

Fig. 3. 530. 7. CLADOPORA RETICULATA. (Pag. 141.)

3 *a*. A part of a large frond, showing the branches and reticulations of the natural size.
3 *b*. An enlarged portion, showing the form and arrangement of the cells upon the surface.
3 *c*. A similar enlargement where the surface is worn.
3 *d*. A longitudinal section enlarged, showing the interior arrangement of the tubular cells.
3 *e*. A fragment of another frond having only six longitudinal rows of pores on the branches, which gives a greater lateral distance between the openings on the surface, though presenting no appreciable difference in the longitudinal distance.

Fig. 4. 531. 1. LIMARIA RAMULOSA. (Pag. 142.)

4 *a*. A single bifurcating branch of this species, somewhat worn.
4 *b*. A fragment which is trichotomous. 4 *c*. The surface enlarged.
4 *d*. The end of a stem enlarged, showing the structure.

Fig. 5. 532. 2. LIMARIA FRUTICOSA? (Pag. 143.)

5 *a*. A fragment of the natural size, showing a disposition to branch in a palmate form, the section above showing five distinct centres, from which the cells radiate.
5 *b*. A portion of the surface of the same enlarged.

Fig. 6. 533. 3. LIMARIA LAMINATA. (Pag. 143.)

6 *a*. The uneven upper surface, showing the apertures of the cells.
6 *b*. A vertical section, showing the interruption in the growth of the enveloping laminæ.
6 *c*. The apertures of the cells enlarged, when little worn.
6 *d*. The apertures of the cells as they appear when much worn.

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(CORALS)

Pl. 39

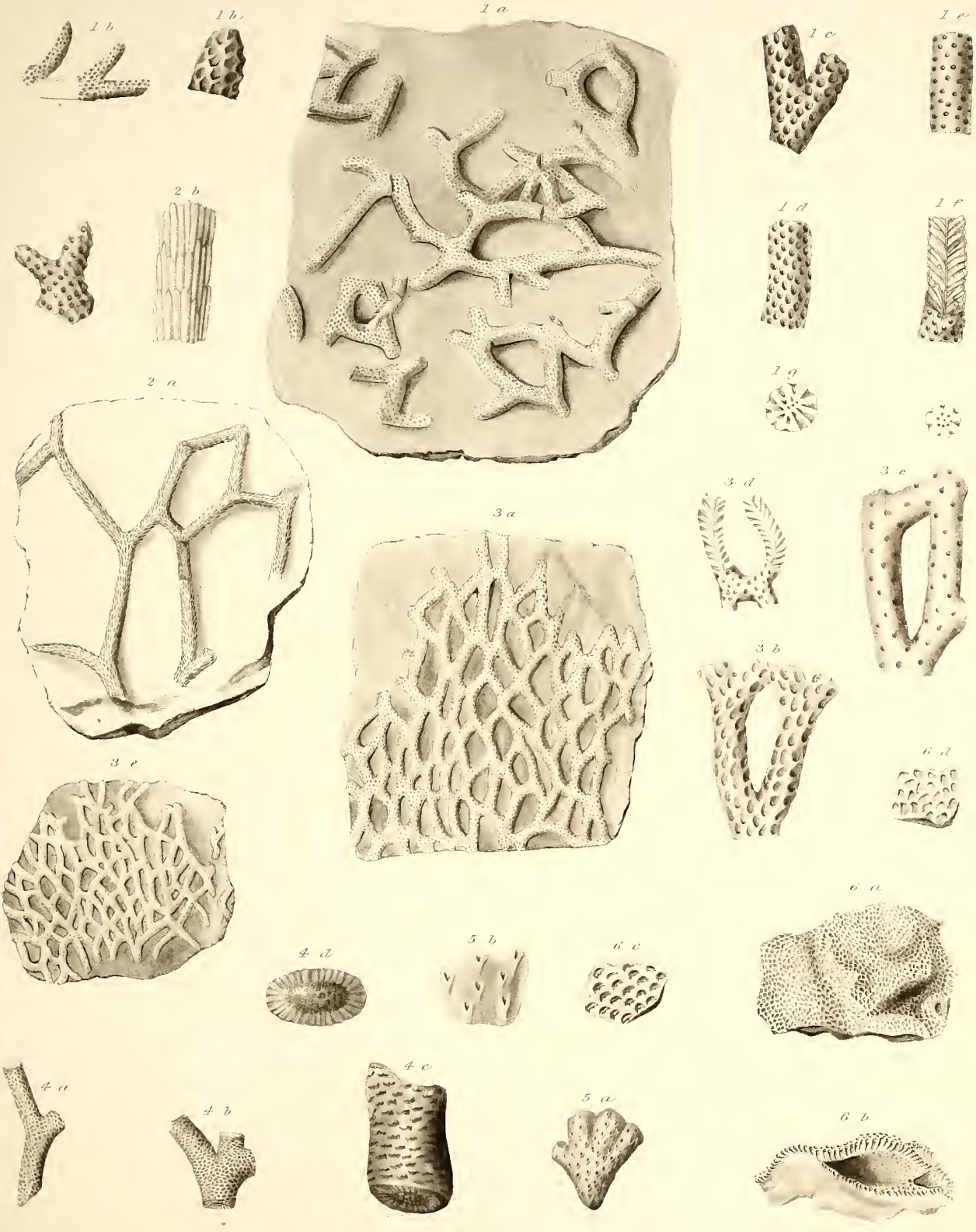


PLATE 40.

Fig. 1. 534. 1. Callopora elegantula. (Pag. 144.)

1 *a*. The base of a specimen, showing numerous diverging stems which are irregularly branched.
1 *b*. A continuation of some of the branches of the last specimen, showing an individual of *Cladopora multipora*, attached and growing from the stems of this coral.
1 *c*. A fragment showing the circular openings unequally distributed over the surface.
1 *d*. A smaller bifurcating branch, having the cells more evenly distributed.
1 *e*. A fragment showing the hollow terminations of the branches.
1 *f*. A fragment enlarged where there are no circular apertures on one side, a striated or minutely cellular surface alone existing. The transverse section of the stem in the annexed figure 1 *f* † shows that the increase of growth was made mostly on one side, and this side is the one on which the tubular cells exist, while that side represented in 1 *f* has increased very little.
1 *g*. A fragment having a tortuous or irregular form, caused by contraction from the obliteration or cicatrizing of the cell apertures, and consequent cessation of growth at these points.
1 *g* †. Magnified portions from the surface of 1 *g*.
1 *h*. An enlargement at one of those points where the growth has ceased, and the intercellular space appears to be solid or simply striated upon the surface.
1 *i*. An enlargement of 1 *c*, showing the irregular distribution of the apertures of the cells.
1 *k*. A similar enlargement where the cells are in contact.
1 *l*. An enlargement showing the stellate apertures, with another figure 1 *l* † somewhat more highly magnified than the preceding.
1 *m*. An oblique section of a stem enlarged.
1 *n*. An enlarged portion of the section of another stem, showing the transverse septa crossing the intercellular spaces, with a single tubular cell crossed by several septa.

Fig. 2. 535. 2. Callopora florida. (Pag. 146.)

2 *a*. An enveloping mass, consisting of several distinct layers, which, at the commencement of growth, attached itself to a branch of *C. elegantula*.
2 *b*. A portion of the surface enlarged, showing the form of the apertures and of the intercellular spaces.
2 *c*. A portion of a more perfect specimen, showing the elevated points at the angles of the cells.
2 *d*. A section enlarged, showing the tubular structure, its connexion with *C. elegantula*, and the surface of *C. aspera* in its connexion with the other two.
2 *e*. A fragment giving some appearance of branching in a palmate form.
2 *f*. A section showing the septate character of the intercellular spaces.

Fig. 3. 536. 3. Callopora laminata. (Pag. 146.)

3 *a*. The surface showing the openings of the natural size.
3 *b*. A section showing its mode of growth in concentric laminæ.
3 *c*. The lower surface, showing the concentric striated membranous covering.
3 *d*. A portion of the surface enlarged, showing the form of the mouths of the cells.
3 *e*. A section enlarged, showing the vertical tubular cells and transverse septa.

Fig. 4. 537. 4. Callopora aspera. (Pag. 147.)

4 *a*. A fragment of this species, enclosing in its lower part a crinoidal column, and in the upper being hollow and expanding laterally.
4 *b*, *c*. Sections of the two extremities. 4 *d*, *e*. The upper extremities of two stems of this coral.
4 *f*. A lateral view of the termination of a stem which is apparently solid throughout, but consisting of enveloping laminæ which ceased to extend in some parts while they were added to parts of the stem adjoining.
4 *g*. An enlarged portion, showing the apertures of the cells and the intercellular spaces where the surface is partially worn.
4 *h*. An enlarged portion where the minute points surrounding the cell are very conspicuous, leaving the cells scarcely visible to the naked eye.
4 *i*. A transverse section of a stem enlarged, showing the columnar character and septate interspaces with open tubular cells.

Fig. 5. 538. 5. Callopora nummiformis. (Pag. 148.)

5 *a*. The upper surface of the specimen, natural size. 5 *b*. A portion magnified.

Fig. 6 *a*, *b*. Callopora, n. s. undescribed.

NIAGARA GROUP
(CORALS)

PLATE 40 A.

Fig. 1. 539. 1. TREMATOPORA TUBERCULOSA. (Pag. 149.)

1 *a*. A fragment with parts of several branches, showing the tubercnlous character very distinctly.
1 *b*. A smaller bifurcating branch of the same species.
1 *c*. A small branch scarcely showing the tuberculous charaeter.
1 *d*. The surface magnified, where the apertures are close together, and irregular in their arrangement.
1 *e*. A surface somewhat worn, where the openings are less closely arranged.
1 *f*. The apertures of several cells, showing minute points or spinules around the aperture.
1 *g*. A transverse section of a stem enlarged, showing the internal structure.

Fig. 2. 540. 2. TREMATOPORA COALESCENS. (Pag. 150.)

2 *a*. A fragment showing several branches coalescing.
2 *b*. A portion of the surface enlarged, showing the apertures where worn and unworn. The eells are to some extent unequally distributed over a part of the coral.

Fig. 3. 541. 3. TREMATOPORA TUBULOSA. (Pag. 151.)

3 *a*. A fragment of a stem of the natural size. 3 *b*. A section of the end of the stem.
3 *c*, *c*. Portions of the surface enlarged, showing the form and arrangement of cells.

Fig. 4. 542. 4. TREMATOPORA PUNCTATA. (Pag. 151.)

4 *a*. A coral of this species envcloping a fragment of a crinoidal stem.
4 *b*. A portion of the surface enlarged, showing the form and arrangement of the apertures, which are sometimes close together and in other parts separated.
4 *c*. A section of the stem enlarged, showing the structure of the coral.

Fig. 5. 543. 5. TREMATOPORA OSTIOLATA. (Pag. 152.)

5 *a*. A specimen showing the coral surrounding the stem of a crinoid, and throwing out branches in several directions. 5 *b*. A fragment of a bifurcating branch.
5 *c*. An enlargement of the surface from the same specimen.
5 *d*. A fragment slightly nodose, and having the apertures of the cells somewhat irregularly distributed over the surface, and the oval form rather more elongated than in the preceding figure.
5 *e*. A portion of the surface of the same enlarged.
5 *f*, *g*. Fragments showing the irregular mode of branching.
5 *h*. An enlarged portion of fig. 5 *g*, where the elevated border of the aperture is more perfectly preserved.
5 *i*. The end of a stem enlarged, showing the arrangement of cells and interspaces.
5 *k*. A portion of the last still further magnified, showing the structure of the intercellular spaces, and the empty or solid cells without visible septa.
5 *l*. A longitudinal section of a hollow stem enlarged, showing the direction of cells.
5 *l* †. Magnified from 5 *l*.
5 *m*, *n*. A small bifurcating stem, and an enlargement of the same, showing some slight variation in the character of the apertures of the cell.

Fig. 6. 544. 6. TREMATOPORA SOLIDA. (Pag. 153.)

6 *a*. A fragment of a solid stem, spreading and slightly flattened above.
6 *b*. A fragment of a bifurcating stem.
6 *c*. Enlargements of the surface, showing form and arrangement of the cells.

Fig. 7, 8. 545. 7. TREMATOPORA STRIATA. (Pag. 153.)

7 *a*. The base or attached portion of an individual of this species, having two diverging branches.
7 *b*. The same enlarged, showing the form of the apertures of the cells and the strongly striated base.
7 *b* †. A portion still farther magnified from 7 *a*, *b*. 7 *c*. A small fragment of the same species.
8 *a*, *b*. The fragment natural size and enlarged. 8 *b* †. A portion still farther magnified from 8 *a*.

Fig. 9. 546. 8. TREMATOPORA GRANULIFERA. (Pag. 154.)

9 *a*. A bifurcating branch of this species, where the surface is beautifully granulated.
9 *b*. An enlarged portion of the same specimen.
9 *c*, *d*. A small cylindrical stem, and an enlargement, showing the fibrous structure in a longitudinal direction.
9 *e*. A stem having several branches.

Fig. 10. 547. 9. TREMATOPORA ASPERA. (Pag. 154.)

10 *a*. A fragment of a stem of the natural size.
10 *b*. A portion magnified, showing the spinulose surface and crenulated margins of the apertures.
10 *c*. Two small fragments showing a peculiar mode of branching.

Fig. 11. 548. 10. TREMATOPORA SPINULOSA. (Pag. 155.)

11 *a*. Fragment of a small cylindrical stem without branches. 11 *b*. A bifurcating branch.
11 *c*. An enlargement of the surface, showing the spinules.

Fig. 12. 549. 11. TREMATOPORA SPARSA. (Pag. 155.)

12 *a*. A bifurcating branch of this coral, scarcely worn.
12 *b*. A simple slender branch of the same species, having the surface worn.
12 *c*, *d*. Enlargements from the surfaces of the same.

13 *a*. Undescribed species of TREMATOPORA. 13 *b*. Surface enlarged.
14. Termination of a branch of *Callopora elegans*, from fig. 1 *e*, Plate 40

NIAGARA GROUP

(CORALS)

PLATE 40 B.

Fig. 1. 550. 1. STRIATOPORA FLEXUOSA. (Pag. 156.)

1 *a*. A bifurcating stem, showing the spreading branches to be lax or flexuous.

1 *b*. A fragment showing some differences in form of apertures and enclosing spaces.

1 *c*. A fragment showing irregular branching.

1 *d*. Several apertures with the enclosing angular spaces enlarged.

1 *e*. A transverse section enlarged, showing the form of cells internally.

Fig. 2. 551. 9. STICTOPORA PUNCTIPORA. (Pag. 157.)

2 *a*. A fragment of a bifurcating stipe of this species, natural size.

2 *b*. A portion of the surface enlarged, showing form and arrangement of cells.

2 *c*. An enlargement of the fragment referred to above, showing the bases of two cylindrical stems connected with the flattened stipe, and the rows of cells continuous from one to the other.

Fig. 3. 552. 1. DIAMESOPORA DICHOTOMA. (Pag. 158.)

3 *a*. A fragment of a stem bifurcating above and longitudinally divided below, showing the striated interior.

3 *b*. The surface enlarged, showing the form and arrangement of apertures.

3 *c*. An enlarged portion where the ridges between rows of cells are conspicuous.

3 *d*. A fragment of a stem preserving a cylindrical form, and commencing to bifurcate above. In the transverse sections of the two branches, one is solid while the other is hollow.

Fig. 4. 553. 1. CLATHROPORA ALCICORNIS. (Pag. 159.)

4 *a*. A portion of the stipe and branches of an individual of this species, natural size.

4 *b*. A portion enlarged, showing the oblong quadrangular apertures.

4 *c*. An enlargement of another portion of the surface, showing a difference in the form of the apertures.

Fig. 5. 554. 2. CLATHROPORA FRONDOSA. (Pag. 160.)

5 *a*. A fragment from a much larger frond.

5 *b*. A small fragment where the perforations are smaller, though the coral does not apparently differ in other respects from the preceding.

5 *c*. An enlarged portion of the surface, showing the arrangement of cells in reference to the perforations.

5 *d*. An enlargement where the cells are arranged in series parallel to the axis of the branch.

5 *e*. A section of a branch enlarged, showing arrangement and upward divergence of the cells.

NIAGARA GROUP.

(CORALS)

PLATE 40 C.

Fig. 1. 555. 5. RETEPORA DIFFUSA. (Pag. 160.)

1 *a*. A part of a frond of this species, natural size.

1 *b*. A strong branch with numerous bifurcating branchlets, which are thickened at their extremities.

1 *c*. A portion of the striated surface enlarged.

1 *d*. A similar enlargement of the celluliferous surface.

1 *e*, *f*. Parts of figs. 1 *c* and 1 *d* still further enlarged.

Fig. 2. 556. 6. RETEPORA ASPERATO-STRIATA. (Pag. 161.)

2 *a*. A fragment of the base with the point of attachment, showing the exterior surface of an expanded funnel-shaped frond.

2 *b*. A portion of a similar frond, showing the external or striated surface.

2 *c*. A smaller fragment, showing the root with a part of the frond, where the interstices are smaller than in the preceding.

2 *d*. An enlargement of the striated surface, showing the asperate character of the striæ.

2 *d* †. A still farther enlargement of the surface, showing the character of the papulous surface.

2 *e*, *f*. The celluliferous side of two fragments of this species.

2 *g*, *h*. Enlargements from the two preceding fragments, showing the difference in form and arrangement of the cells.

Fig. 3. 557. 1. HORNERA? DICHOTOMA. (Pag. 163.)

3 *a*, *b*. A bifurcating fragment, natural size, and a part of the surface enlarged, showing the form and arrangement of the cells.

3 *d*. The striated or non-celluliferous surface, natural size and enlarged.

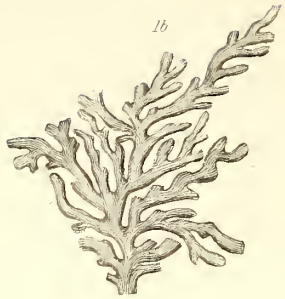
NIAGARA GROUP.

(CORALS.)


1d.

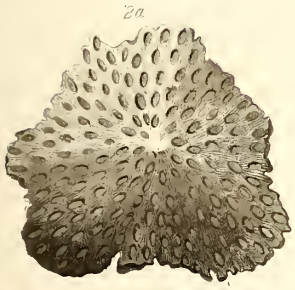

1c

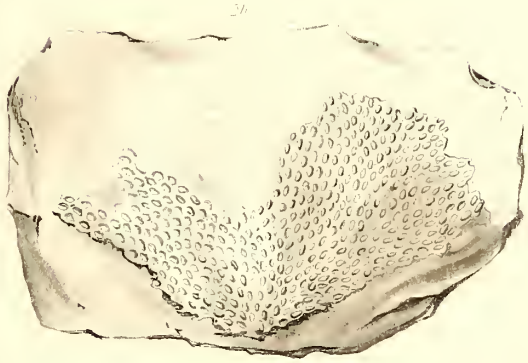

1a


1b


1f


1e


2a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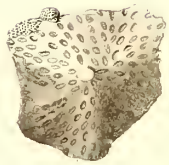
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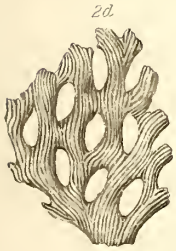
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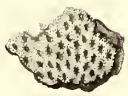
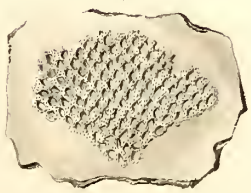

2e


2g


3a


3b


1d


1


2h


2d

Rich[d] H Pease Sc

PLATE 40 D.

Fig. 1. 558. 3. FENESTELLA ELEGANS. (Pag. 164.)

1 *a*. A portion of a frond, showing the non-celluliferous side.
1 *b*. A portion enlarged, showing the form of fenestrule, striated surface of branches, etc.
1 *c*. The impressions of the celluliferous side in the shale.
1 *d*. A fragment showing the celluliferous side of the coral.
1 *e*. The same enlarged, showing the form and arrangement of the cells.
1 *f*. Another specimen of the celluliferous side.
1 *g*. The same enlarged, showing the form and appearance of the cells where the surface is somewhat worn.

Fig. 2. 559. 4. FENESTELLA TENUICEPS. (Pag. 165.)

2 *a*. The exterior surface of a large cyathiform frond which has been crushed.
2 *b*. A portion of the last enlarged, showing the cells where the edges of the branches are worn.
2 *b* †. A still farther enlargement of 2 *b*.
2 *c*. An enlarged view, looking into the cells from a direction obliquc to the surface of the frond.
2 *d*, *e*. Lateral and basal view of a fragment of the cup broken off just above the root.
2 *f*. A specimen showing a fragment of the non-poriferous face of *Polypora incepta* and of *Fenestella tenuiceps*.
2 *g*. A portion of the latter enlarged, showing the form of fenestrules and the granular worn surface.
2 *h*. A portion of another fragment enlarged, showing the striated surface of the branches.

Fig. 3. 560. 5. FENESTELLA CRIBROSA. (Pag. 166.)

1 *a*. A fragment natural size. 3 *b*. A portion of the same magnified.

Fig. 4. 561. 6. FENESTELLA ———. (Pag. 166.)

Fig. 5. 562. 1. POLYPORA INCEPTA. (Pag. 167.)

5 *a*. The inner surface of a part of a large frond.
5 *b*. A portion of the same enlarged, showing the striated surface of the branches and the transverse bars.
5 *c*. A cup-form specimen, showing the inner or non-celluliferous surface.
5 *d*. The celluliferous face enlarged.
5 *e*. The non-celluliferous face enlarged.
5 *f*. Several branches from the celluliferous face greatly enlarged, showing the bifurcation of the branches, and the increasing rows of pores from the point of bifurcation upwards.

CORALS

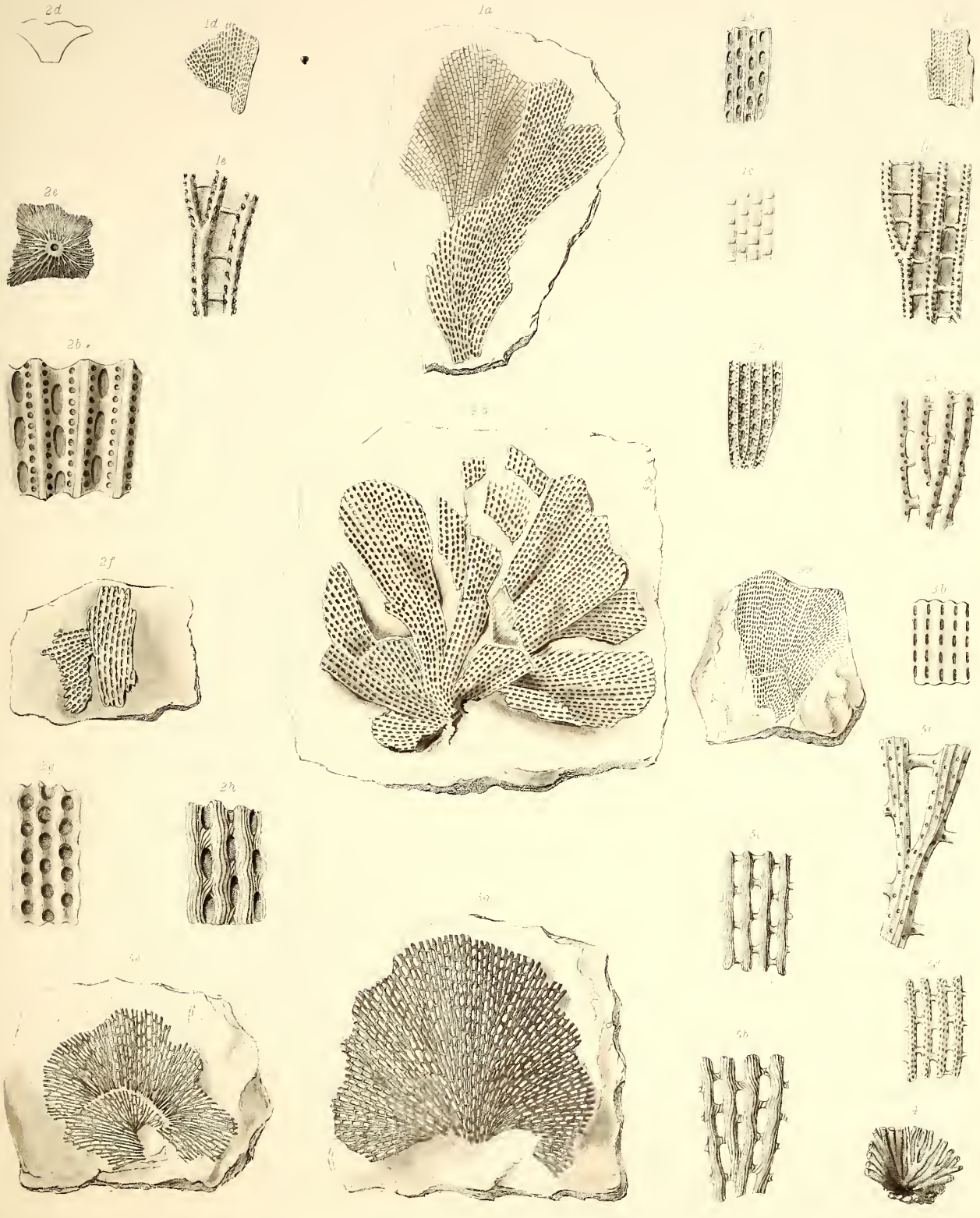


PLATE 40 E.

Fig. 1. 563. 1. CERAMOPORA IMBRICATA. (Pag. 169.)

1 *a*, *b*. Upper surface of two specimens of different size. 1 *c*. Profile outline, natural size.
1 *d*. Vertical section magnified, showing structure and arrangement of the tubular cells.
1 *e*. The centre of fig. 1 *a* magnified, showing the upper extremities of the tubes bending outward, and the form of apertures.
1 *f*. A portion of the surface enlarged, looking into the cells, and showing the alternating and imbricating arrangement.
1 *h*. An individual of the same species, somewhat compressed, and the surface worn.
1 *i*. An enlarged portion of the surface of 1 *h*.

Fig. 2. 564. 2. CERAMOPORA INCRUSTANS. (Pag. 169.)

2 *a*. The surface of this coral, natural size.
2 *b*. The interior of the shell, showing the extension of the coral over the edge of the valve.
2 *c*. Profile showing the nodulose surface.
2 *d*. An enlargement of the surface, showing form and arrangement of cells.

Fig. 3. 565. 3. CERAMOPORA FOLIACEA. (Pag. 170.)

3 *a*. A portion of a frond, natural size.
3 *b*. The surface enlarged, showing form and arrangement of cells.
3 *c*. A portion of the surface enlarged, showing the foliate impressions and arrangement of cells around them.

Fig. 4. 566. 3. RHINOPORA TUBERCULOSA. (Pag. 170.)

4 *a*. A fragment of a larger frond.
4 *b*. A portion of the surface enlarged, showing the papillose cells, and tubercles with smooth summits.
4 *c*. A small portion still farther enlarged, showing some variety in the form of the apertures.

Fig. 5. 567. 1. LICHENALIA CONCENTRICA. (Pag. 171.)

5 *a*. The concave side of a young specimen. 5 *b*. The convex side of another larger individual.
5 *c*. A larger imperfect frond, one half of which only remains.
5 *d*. A fragment showing the condition of these fronds when drifted together.
5 *e*. An enlargement of the cellulifcrous side, where the cells are strongly developed.
5 *f*. Another fragment where the cells scarcely rise above the surface.
5 *g*. An enlargement of the non-cellulifcrous side, showing the form and arrangement of the stigmata.

Fig. 6. 568. 1. SAGENELLA MEMBRANACEA. (Pag. 172.)

6 *a*. A fragment of an Orthoceras covered by this coral, showing at two points *a'*, *a''*, the growth of other corals upon this one.
6 *b*. An enlarged portion of the surface, showing the form and arrangement of the cells in this species, and in a species of CALLOPORA which covers it in parts.

Fig. 7. *An incrusting Coral enveloping a Stephanocrinus.* (Pag. 173.)

7 *a*. The coral enveloping a broken crinoid. 7 *b*. An enlargement of a portion of the surface.

Fig. 8. *An incrusting membrano-calcareous Coral.* (Pag. 173.)

8 *a*. A portion of Lichenalia, on which this coral is growing.
8 *b*. An enlargement showing mode of growth and character of tubes.

NIAGARA GROUP

(CORALS BRYOZOA)

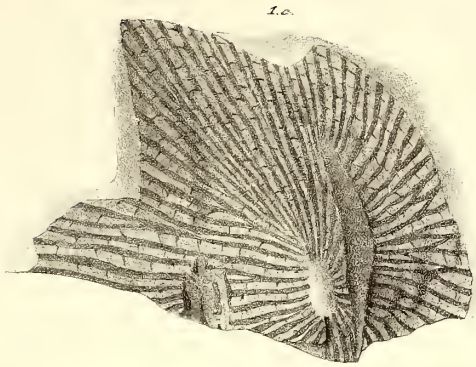
PLATE 40 F.

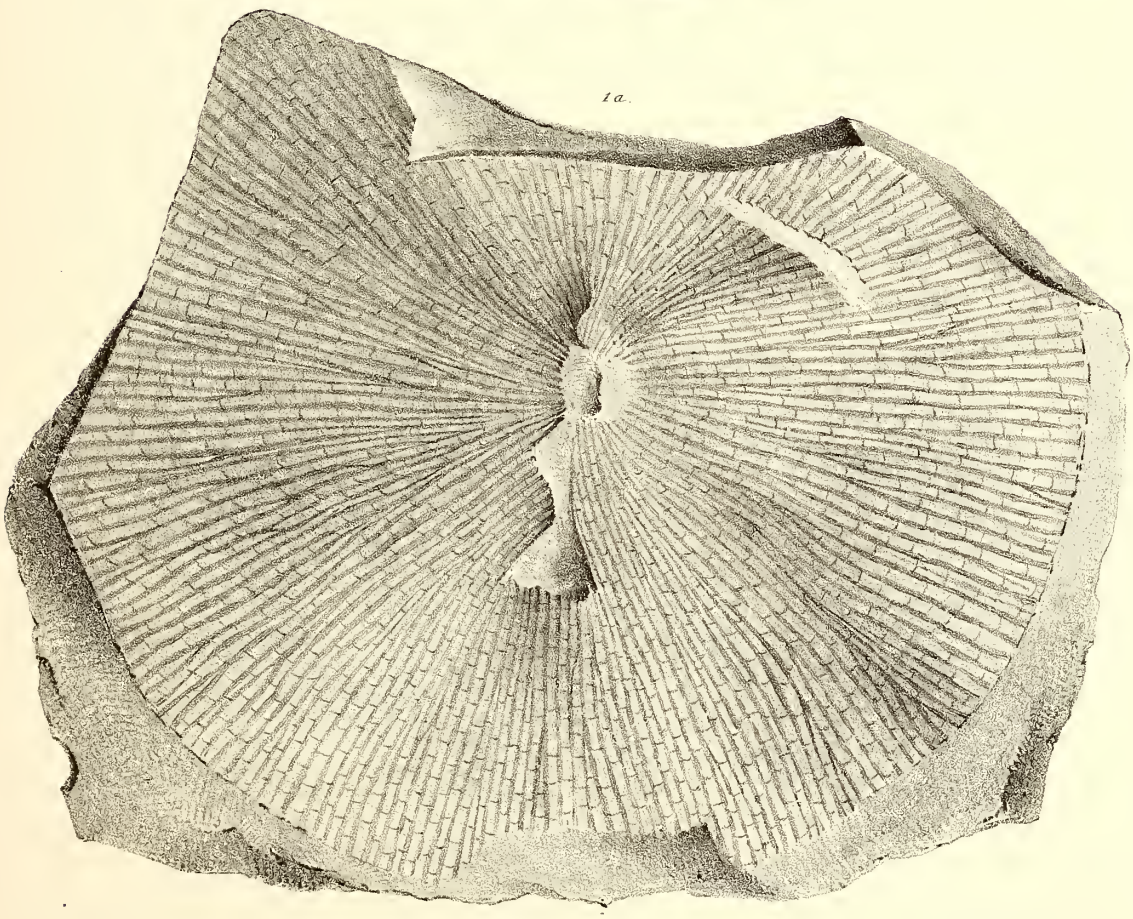
Fig. 1. 569. 1. Dictyonema retiformis. (Pag. 174.)

1 *a*. A large nearly circular frond of this species. 1 *b*. An enlargement from a similar frond.

NIAGARA GROUP.

(CORALS.)





On Stone, by Swinton.

Lith. of R. H. Pease, Albany.

PLATE 40 G.

Fig. 1. 570. 2. Dictyonema gracilis. (Pag. 175.)

1 *a*. A portion of a frond, showing the branches neatly defined, and spreading only in a moderate degree.

1 *b*. A part of another frond, where the branches appear to spread more rapidly, but have otherwise the essential characters of the preceding.

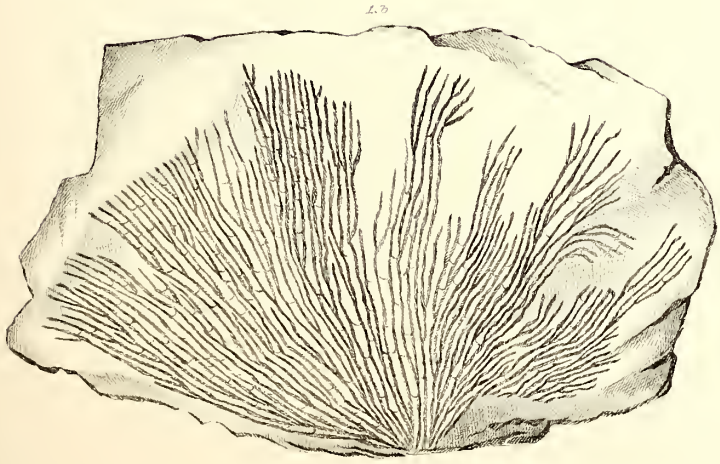
1 *c*, *e*. Enlargements, showing the indented or corrugated surface of the branches.

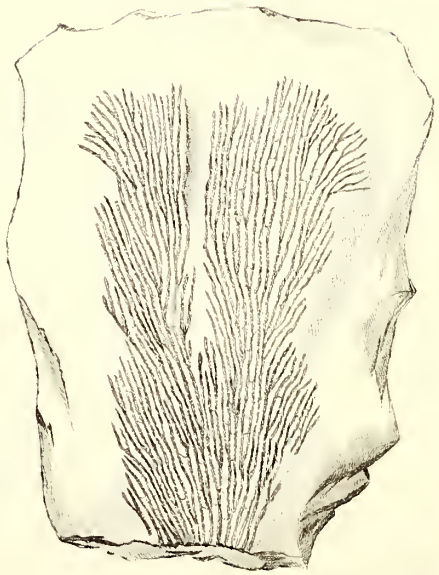
1 *d*. An enlargement of several branches, where the margins appear indented or subserrate.

Fig. 2. 571. 1. Inocaulis plumulosa. (Pag. 176.)

2 *a*. A part of several stems upon the surface of the shale.

2 *b*. An enlarged portion, showing the structure.





Lith. Stone by Lr. & Dr.ª H. Pease & Co. Albany

PLATE A 41.

Fig. 1. 576. 1. CARYOCRINUS ORNATUS. (Pag. 182.)

Fig. 2. 572. 1. CLOSTEROCRINUS ELONGATUS. (Pag. 179.)

2 *a*. The specimen natural size.

2 *b*. The structure of the calyx enlarged, showing one side with column below.

2 *c*, *d*, *e*, *f*. Portions of the columns and sections, natural size and magnified.

Fig. 3. 573. 2. GLYPTOCRINUS PLUMOSUS. (Pag. 180.)

3 *a*. A portion of a single finger, with the tentacula attached.

3 *b*. Two joints of the finger enlarged, with several of the tentacular joints attached.

3 *c*. A fragment of the column, probably of the same species.

3 *d*. A few joints of the same enlarged, showing the longitudinal line of separation between the five parts of the plate.

3 *e*. The end of the same column enlarged.

3 *f*. A small fragment of the rock, with the surface nearly covered with the joints of this crinoid.

3 *g*. Several of these joints enlarged, showing their variable character.

Fig. 4. 574. 3. GLYPTOCRINUS ———. (Pag. 181.)

Fig. 5. 575. 1. ICHTHYOCRINUS? CLINTONENSIS. (Pag. 181.)

Fig. 6. *Undetermined species.* (Pag. 181.)

6 *a*. The specimen of the natural size. 6 *b*. The tentacula enlarged. 6 *c*. Section of the same.

Fig. 7. *Joints of undetermined Crinoidea.* (Pag. 182.)

7 *a*. One of these rings, presenting a smooth globular surface, with a smooth opening in the centre. The thickness of this one is nearly a quarter of an inch.

7 *b*. The impression left in the iron ore by a larger individual, the thickness of which was more than a quarter of an inch.

7 *c*. A very thick one, with a small opening in the centre.

7 *d*. A small specimen of the same character. 7 *e*. View of the edge of a very thin specimen.

Fig. 8. 577. 2. TENTACULITES MINUTUS. (Pag. 183.)

8 *a*. A small fragment of the green shale, preserving several specimens of this fossil.

8 *b*. Two specimens drawn separate from the shale, of the natural size.

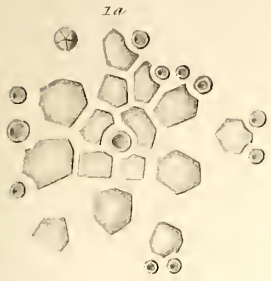
8 *c*. An individual enlarged.

8 *d*, *e*. Portions of two individuals still farther magnified, showing in one an apparent crenulation of the rings.

Fig. 9. 578. 3. TENTACULITES DISTANS. (Pag. 184.)

9 *a*. An individual of the natural size. 9 *b*. A portion of the same enlarged.

(CRINOIDEÆ)


1a


2a


2d


2c


2b


2f


2e


3a


3b

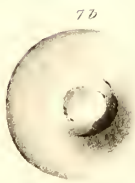

4


5


7c


7d


7a


7b


7c


3c


3d


3e


3f


3g


6d


6c


9b


8a


8c


8d


9a


8c


8b

PLATE 41.

Fig. 1. 579. 1. HOMOCRINUS PARVUS. (Pag. 185.)

1 *a*. An individual, natural size, with a portion of the column attached.

1 *b*. The head and arms of another individual. 1 *c*. The specimen fig. 1 *b* enlarged.

1 *d*. A figure showing the structure and form of plates.

1 *e*. A part of one of the arms enlarged. 1 *f*. A portion of the column of 1 *a* enlarged.

Fig. 2, 3. 580. 2. HOMOCRINUS CYLINDRICUS. (Pag. 186.)

2 *a*. The body and part of the column, natural size. 2 *b*. An enlarged portion of the column.

2 *c*. The structure, showing the single intercalated plate, and the division of the succeeding scapular plate.

3 *a*. The body of an individual somewhat more rotund than the preceding, showing the same general structure.

3 *b*. The base of the specimen which has one of the larger joints adhering, showing the central articulating portion, while the outer portion of the face is smooth.

3 *c*. A figure showing the structure of the specimen.

Fig. 4. 581. 1. GLYPTORASTER BRACHIATUS. (Pag. 187.)

4 *a*. The specimen as it appears on the surface of a slab of shale.

4 *b*. A part of one of the arms enlarged, showing more distinctly the arrangement of the plates of the arms.

(CRINOIDEÆ)

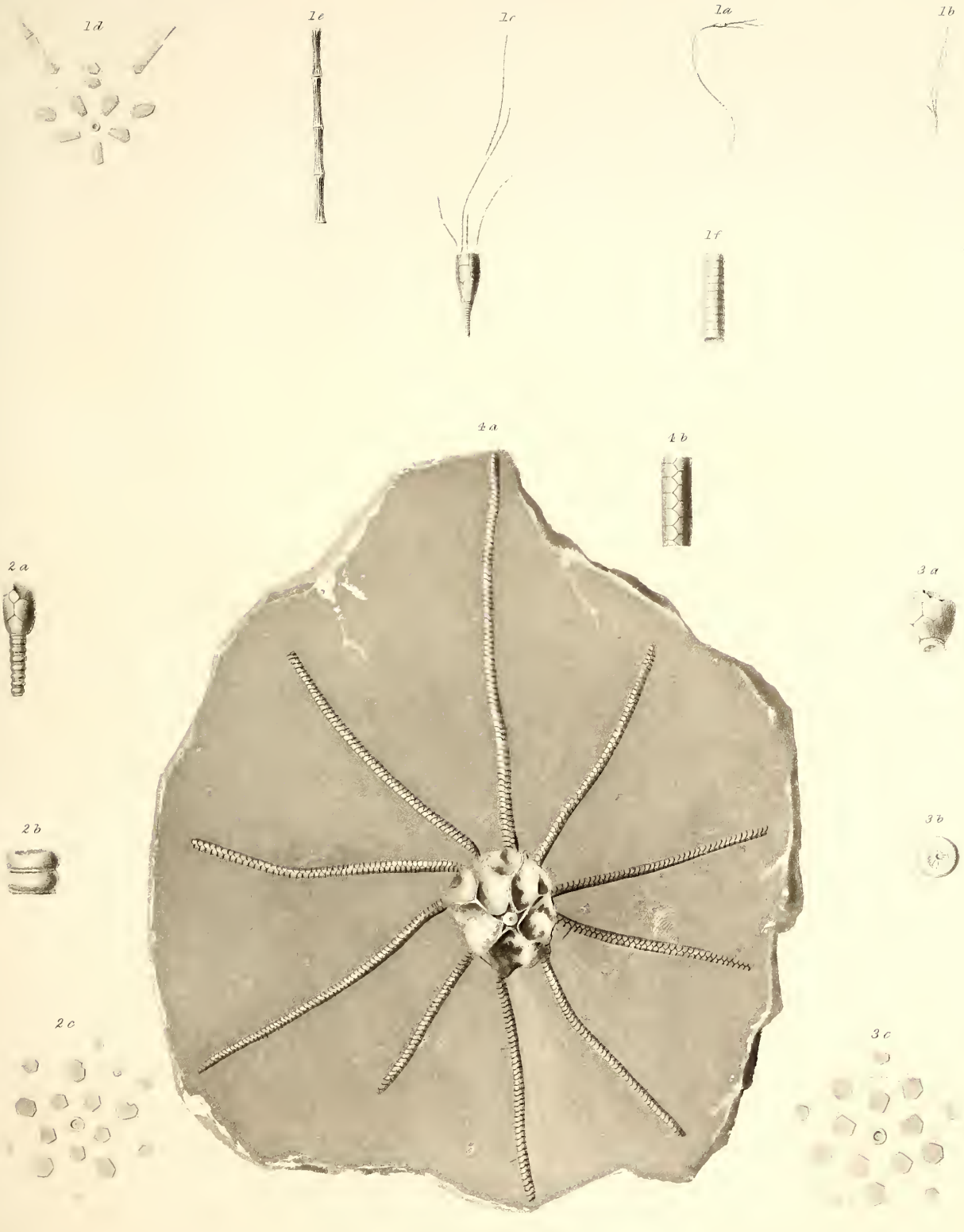


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PLATE 42.

Fig. 1. 582. 1. THYSANOCRINUS LILIIFORMIS. (Pag. 188.)

1 *a*. An imperfect specimen of the head of this species, with a portion of the column attached.

1 *b*. The structure of this species; the upper portion of the figure including to the base of three of the arms, and the continuation of two of them made out from the exposed side of the specimen fig. 1 *a*.

1 *c*. A portion of one of the fingers enlarged, showing only one side with the tentacula attached.

1 *d*. The base of the fingers enlarged, showing the commencement of the double series of plates.

1 *e*. A single scapular plate enlarged.

1 *f*. A portion of the column enlarged, showing the alternation of one thick plate with two thinner ones, and, below this, of one thick and one thin one.

Fig. 2. 583. 2. THYSANOCRINUS CANALICULATUS. (Pag. 189.)

2 *a*. A fragment of one of the fingers, showing the tentacula on one side.

2 *b*. Two joints of the same enlarged, showing attachment of tentacula, form and proportion of joints, etc.

2 *c*. The exterior of the finger enlarged, showing the union of two series of joints.

2 *d*. Vertical section enlarged, showing the position of the contracted tentacles.

Fig. 3. 584. 3. THYSANOCRINUS ACULEATUS. (Pag. 190.)

3 *a*. The upper part of a crinoid, showing the contracted fingers and tentacula, five of which are seen in the figure.

3 *b*. An enlargement of the back of a part of one of the fingers, showing the joining of the plates.

3 *c*. Several joints of the finger enlarged, showing the tentacula attached, the form, etc. of the joints.

3 *d*. Several joints from another individual enlarged, showing the first joints of the tentacula to be less extremely alternating than in fig. 3 *c*.

Fig. 4. 585. 4. THYSANOCRINUS IMMATURUS. (Pag. 191.)

4 *a*, *b*. Lateral view of the specimen, natural size and enlarged.

4 *c*. The upper margin of the broken cup. 4 *d*. The base of the cup, natural size.

4 *e*. Showing the structure of the cup, and form of the plates as far as the divisions of the arms.

4 *f*. The base enlarged, showing the relations of the first and second series of plates, leaving out of view the overlapping edges of the latter.

Fig. 5, 6. 586. 1. MYELODACTYLUS CONVOLUTUS. (Pag. 192.)

5 *a*. A fragment rolled together, forming more than a single convolution.

5 *b*. Three joints of the finger enlarged, showing the tentacula to the fifth joint.

6 *a*. A fragment of a similar finger, showing the broad groove on the inner side, and the minute perforations on the truncated inner angles of the plate.

6 *b*. The outer side or back of the same fragment, showing a nodulose surface.

6 *c*. Several joints enlarged, showing the character of the inner side.

6 *d*, *e*. The back enlarged, showing in *e* the minute groove for the passage of a tendon to the external surface.

6 *f*, *g*. Articulating surface of the plates, natural size, from two different specimens.

6 *h*. The same enlarged, showing the form of canal, the pentagonal muscular impression with ridges for the attachment of muscles, and the minute grooves extending to the back of the column.

Fig. 7. 587. 1. DENDROCRINUS LONGIDACTYLUS. (Pag. 193.)

7 *a*. A specimen of this species, with the arms broken off, but preserving a large portion of the long proboscis which is flattened.

7 *b*. A portion of the proboscis enlarged, showing the form and arrangement of the plates of which it is composed.

7 *c*. Portion of the upper part of the column enlarged. 7 *d*. Section of the base of the cup.

(CRINOIDEÆ)

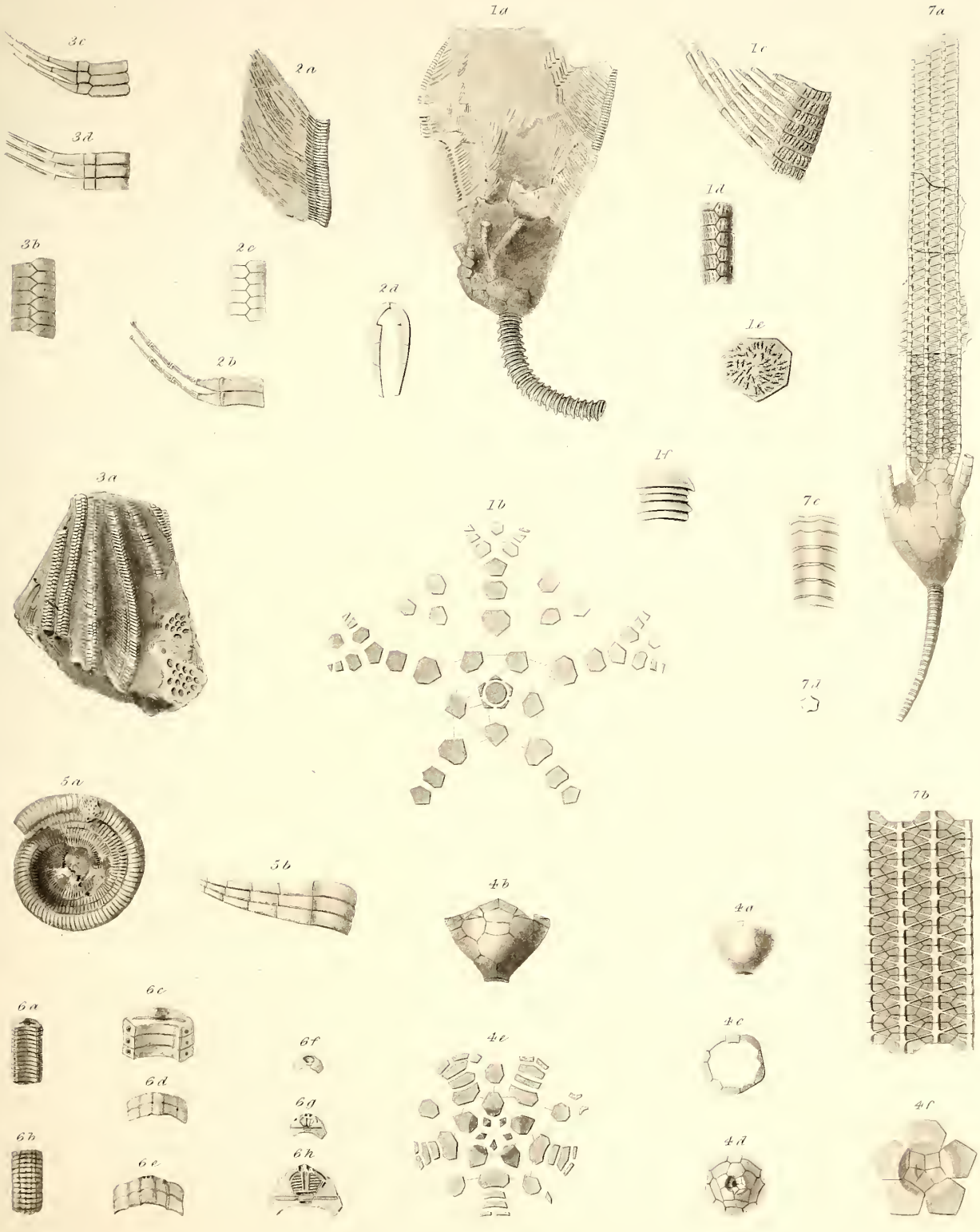

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PLATE 43.

Fig. 1. 587. 1. Dendrocrinus longidactylus. (Pag. 193.)

1 *a*. An individual, natural size, partially imbedded in shale.

1 *b*. Figure showing the structure of the cup, the commencement of the proboscis, and the arms.

1 *c*, *d*, *e*. Detached plates from the upper part of the cup of other individuals.

1 *f*. A portion of a branch near the lower part.

1 *g*. A similar fragment near the extremity of the branches of the fingers.

1 *i*. A fragment of an arm somewhat unequally bifurcating, but having surface aspect and structure like this species.

1 *h*. The end of the joint enlarged, showing the articulating rays extending only a short distance from the centre.

1 *k*. Several joints of the preceding enlarged. 1 *l*. Column joint at base of cup.

Fig. 2. 588. 1. Ichthyocrinus lævis. (Pag. 195.)

2 *a*. An individual of medium size, slightly compressed : a portion of the column still remains attached.

2 *b*. A smaller individual, having the arms extended upon the stone in which it is partially imbedded.

2 *c*. A young individual of the same species. 2 *c* †. The base of the same.

2 *d*. The crown of another individual, where the arms are regularly incurved and enfolded, leaving in the centre a cavity filled with stone.

2 *e*. A figure showing the structure as far as the third or fourth subdivisions.

2 *f*. The base enlarged, showing the three undeveloped plates, the five pelvic plates resting on the column, and the small space occupied by the scapular plate resting on the column.

2 *g*. The same, showing the relative position of the pelvic and secondary plates.

2 *h*, *i*, *k*, *l*. Successive joints from the arms and subdivisions, showing the form of the plate, looking upon its lower surface.

2 *m*. Lateral view of a fragment of one of the fingers, showing the union of the plates.

2 *n*, *o*. Fragments of columns of this species.

2 *p*. The end of a column enlarged, showing the crenulations on the outer margin, and the small, circular or obscurely pentagonal canal.

(CRINOIDEA)

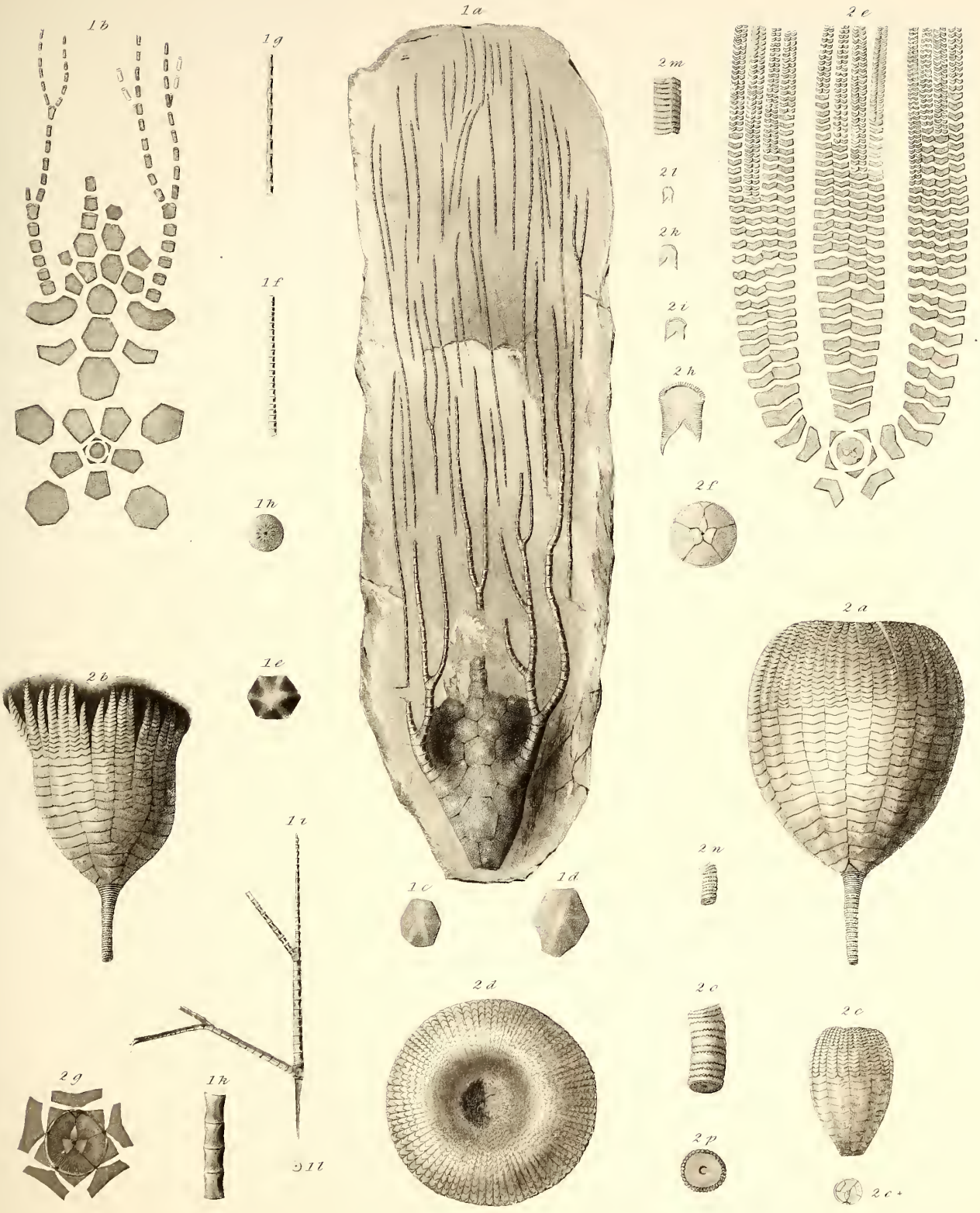

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PLATE 44.

Fig. 1. 589. 1. LYRIOCRINUS DACTYLUS. (Pag. 197.)

1 *a*. An individual of medium size, preserving the cup and the arms nearly to the extremities.

1 *b*. A smaller specimen, preserving a portion of the column, and leaving four of the arms only visible.

1 *c*. A larger specimen, showing the arms and column well preserved.

1 *c* †. Section of the column.

1 *d*. The structure as made out from the specimen fig. 1 *a*. The commencement of three pairs of fingers is shown, and the simple joints at the base of the other pairs in the same relative position.

1 *e*. A single plate enlarged, showing the character of the surface, and the increased ornament at the margins or junction with adjoining plates.

1 *f*. A fragment of a column enlarged, showing more distinctly the alternating larger and smaller joints.

1 *g*. The end of the column enlarged.

Fig. 2. 591. 2. LECANOCRINUS ORNATUS. (Pag. 201.)

2 *b*. A small specimen of this species.

2 *a*. A larger individual, showing the same form as the preceding

2 *c*. Base of the anchylosed pelvic plates, with a single joint attached.

2 *d*. The interior of the same.

2 *e*. The same enlarged, showing more distinctly the triangular cup and sutures of the plate.

2 *f*. Lateral view of the same specimen.

2 *g*. The plates separated, showing the structure of the crinoid as far as the first divisions of the arms.

2 *h*, *i*. A costal and arm-joint enlarged, showing the character of the surface markings.

2 *k*. A fragment of a column, composed of irregularly alternating thicker and thinner plates, which are also interrupted, or not continuous laterally, each joint being often composed of several pieces overlapping each other.

2 *l*, *m*. The end view of this fragment, and the same enlarged, showing form of canal and crenulations of the surface.

Fig. 3, 4, 5, 6, 7, 8, 9. *Columns of undetermined Crinoidea.* (Pag. 230.)

3 *a*, *b*. A fragment of a column, of the natural size, with section of the same.

3 *c*, *d*. Enlargements of the same.

4 *a*. A fragment coiled upon the surface of a peice of shale.

4 *b*. A small portion of the same enlarged.

5 *a*, *b*. A fragment of a column where the joints are thin, the edges of the wider ones being slightly crenulated, having two or more thin joints between.

6 *a*, *b*, *c*. Columns composed of smooth equal joints, having lateral branches or side arms.

7 *a*. A fragment of the base of a column where it diverges into the radicles.

7 *b*, *c*. The articulating surface, natural size and enlarged, showing the strong somewhat dichotomous striæ.

8. A fragment of a column with the radicles attached.

9 *a*, *b*, *c*. The base of another species, with the radicles attached.

(CRINOIDEÆ)

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PLATE 45.

Fig. 1. 590. 1. Lecanocrinus macropetalus. (Pag. 199.)

1 *a*. An individual preserving a portion of the column.

1 *b*. A larger specimen, showing the intercalated plates between the costal and scapular series.

1 *c*. The opposite side of the same specimen, showing the simple structure.

1 *d*. A smaller specimen, showing the side with the intercalated plates as in fig. 1 *b*.

1 *e*. The crown of this specimen, showing the infolded arms. 1 *f*. The base of the same.

1 *g*. The structure of this species, as shown in the preceding figures.

1 *h*. A fragment of the column enlarged, with a section of the same size, showing the crenulations near the outer margin of the joints, the form of the canal, etc.

Fig. 2, 3, 4, 5, 6, 10, 11. *Columns of undetermined Crinoidea.* (Pag. 231.)

2. Structure of the basal portion of Ichthyocrinus, with an intercalated plate, showing its analogy with Lecanocrinus.

3 *a*, *b*. A fragment of a small column, composed of unequal joints with rounded edges, having scattered spines upon the edges of the thicker joints.

3 *c*, *d*. Enlargements of the same, showing the form of joints, and the striæ upon the articulating surface.

4 *a*, *b*, *c*, *d*. A fragment similar to the preceding, having the spines more numerous and proportionally longer, while the articulating surfaces are concave at one end and convex at the other.

5 *a*, *b*, *c*. A fragment of a column, having the joints composed in part of thin irregular plates not continuous on the margins.

6 *a*, *b*, *c*. A fragment of a compressed column, having two distinct centres, though appearing as one externally. It is composed of alternating joints of equal thickness, but of unequal width.

10 *a*, *b*. A fragment of a root, with numerous radicles, of an undetermined species; with a section of the same, showing a large irregularly triangular canal.

11 *a*, *b*. A fragment of a root, with few radicles; and a section of the same, showing a hexagonal canal.

Fig. 7. 604. 2. Myelodactylus brachiatus. (Pag. 232.)

7 *a*. A small fragment enlarged, showing two lateral appendages.

7 *b*. Transverse section of the same. 7 *c*. Section of one of the cylindrical appendages.

7 *d*. A larger convolute fragment, with several appendages near the lower part.

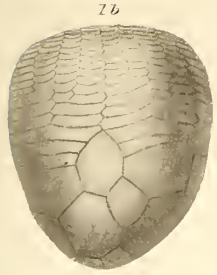
7 *e*. The convex or outer side of this specimen, which has a depression along the centre, from the upper part, nearly to the base, where it gradually becomes obsolete.

Fig. 8, 9. 605. 3. Myelodactylus ———? (Pag. 232.)

8 *a*, *b*. A fragment, which is compressed either naturally or by accident. The section 8 *b* shows the form of section.

9 *a*, *b*, *c*. Another fragment, and the section, showing the difference of form in the two.

(CRINOIDEÆ)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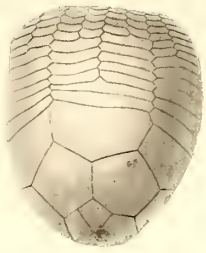
1a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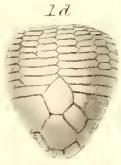
1e


1f


1d

1h


2


3c


3d

3b

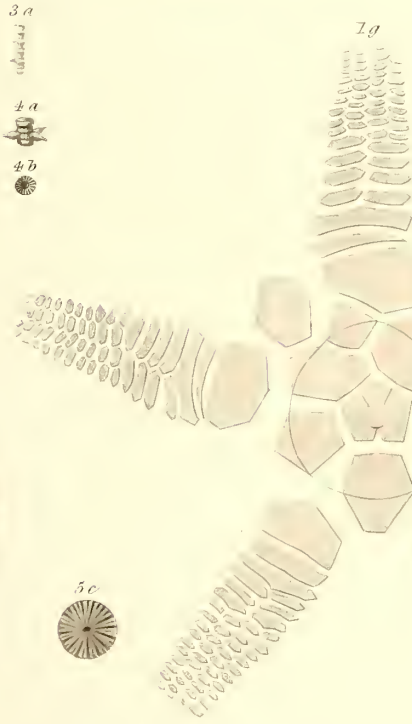
3a


4c


4d


4a

4b


1g


7e


7a


7b


5b


7c


5a

5c


7d


8a


6a


6b


6c


11b


8b


9b


9a


9c


10a


10b


11a

S.M.Hall, Del.

James Duthie Sculp

PLATE 46.

Fig. 1, 2. 595. 1. Saccocrinus speciosus. (Pag. 205.)

1 *a*. A specimen preserving the greater part of the body, with several arms attached, which are nearly entire.

1 *b*, *c*. The bifurcation of two of the arms, showing a slight difference in the arrangement of the plates at these points.

1 *d*, *e*. Fragment and section of the column.

1 *f*, *g*. Enlargements of the same, showing the slightly nodulose margins of the alternating joints, the crenulations towards the margin of the section, and the round canal.

1 *h*. Another fragment of a column, showing the nodulose joints more distant from each other.

1 *i*. Section of the same.

1 *k*, *l*. Enlargements of the two preceding figures. Fig. 1 *h* shows the canal to be much larger than in 1 *e*, and the striated surfaces extending to it; while in *e*, *g*, there is shown a smooth space between the margin of the canal and the commencement of the striæ.

1 *m*, *n*. A fragment from the same column, farther from the summit, where the joints are equal and smooth.

2. The body of another specimen, probably of the same species.

Fig. 2. 592. 3. Lecanocrinus simplex. (Pag. 202.)

2 *a*, *b*. The specimen, natural size and enlarged.

2 *c*. The crown, showing the ten subdivisions of the arms closely enfolded.

2 *d*. An enlargement showing the ornamental surface of the plates.

2 *e*. The structure of the cup, carried to the third plate beyond the divisions of the arms.

Fig. 3. 593. 4. Lecanocrinus calículus. (Pag. 203.)

3 *a*. The fragment described, showing intercostal and interscapular plates.

3 *b*. Shows the structure of the specimen and arrangement of plates.

Fig. 4. 594. 1. Macrostylocrinus ornatus. (Pag. 204.)

4 *a*. The specimen described, showing the body and four of the arms, all broken off before reaching their termination.

4 *b*. The structure as ascertained from the specimen 4 *a*.

4 *c*, *d*. Two costal plates enlarged, showing their striate and tuberculo-striate character.

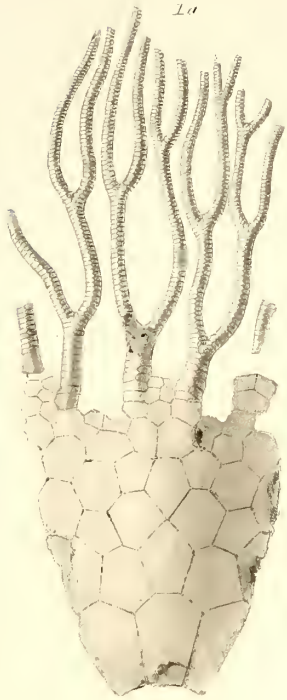
4 *e*. A pelvic plate enlarged, showing a striate surface only.

4 *f*. A plate from near the base of the arms, showing the tubercnlo-crenate upper edge.

4 *g*. Several joints from the upper part of the arms enlarged, showing the strong tubercle on the back of each plate, with smaller ones on each side.

(CRINOIDEÆ)


2

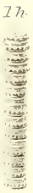

1a


1b


1c


1i


1l


1h


1k


1d

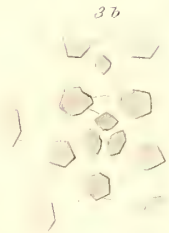

1e


1g


1f


1m


1n


3b


2c


2a

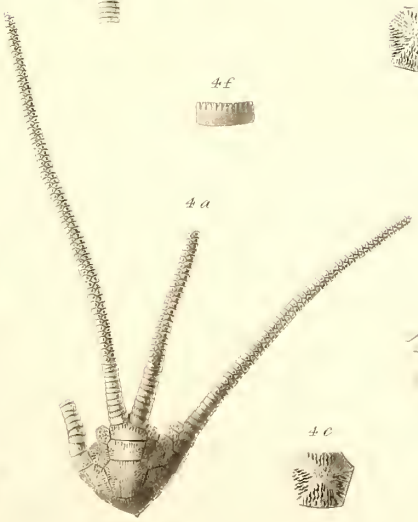

2d


2b


4d


3a

4f


4a


4b


2e


4g


4e

4c

PLATE 47.

Fig. 1, 2, 3. 596. 1. EUCALYPTOCRINUS DECORUS. (Pag. 207.)

1. An individual with lower portion of the cup broken off.

2 *a*. An individual retaining a portion of the column, and having the summit somewhat spreading.

2 *b*. A young specimen having the same characters as the preceding.

2 *c*. The structure of the species as shown in the preceding and other specimens.

2 *d*. A fragment of one of the fingers, showing the articulation of the tentacula, and their direction inward and upward.

2 *f*. Transverse section, showing the pentapetalous canal.

2 *g*. A fragment from the column of 2 *b* enlarged. 2 *h*. A fragment of a very minute column.

3 *a*. Vertical view of a fragment, looking upon the summit, showing the convergence of the fingers, and the union of the interstitial ribs around the canal.

3 *b*. Lateral view of the preceding specimen, which is broken off near the base of the arms.

3 *c*. View from below, showing a portion of the cavity; the sides arching over, and contracting to the angular canal which extends to the summit.

3 *d*. Another specimen, showing a longitudinal section of the upper part, and a portion of the cavity below.

Fig. 4. 597. 2. EUCALYPTOCRINUS CÆLATUS. (Pag. 210.)

4 *a*. The specimen, somewhat broken in the upper part.

4 *b*. The surface of one of the interstitial ribs enlarged.

4 *c*. Several of the joints of the fingers enlarged and separated, showing their deep interlocking with each other, and the character of their surface marking.

4 *d*. A scapular plate enlarged, showing the elongated tubercular ornament.

4 *e*. The large costal or intercostal plate enlarged, and showing the peculiar arrangement of the tubercles upon its surface.

Fig. 5. 598. 2. EUCALYPTOCRINUS PAPULOSUS. (Pag. 211.)

5 *a*. A fragment of the cup, having the base and arms broken off.

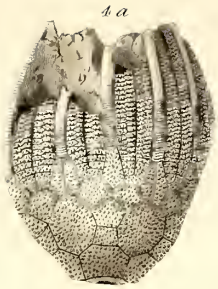
5 *b*. Several of these plates enlarged, showing more distinctly the arrangement of tubercles and pore-like openings mentioned above.

NIAGARA GROUP

(CRINOIDEA)


3a


1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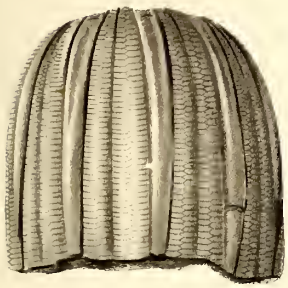
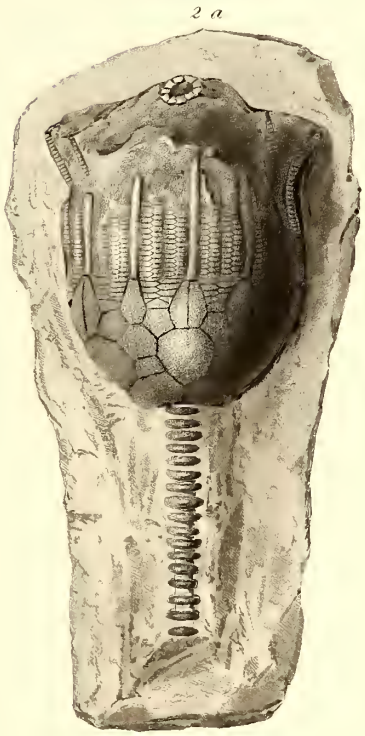

3b

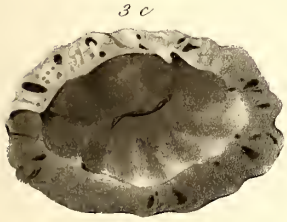

4d


4e


4c


4b


2a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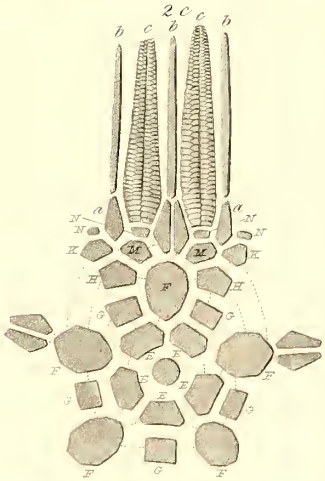
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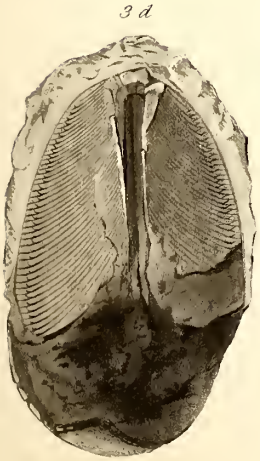

3d


2e

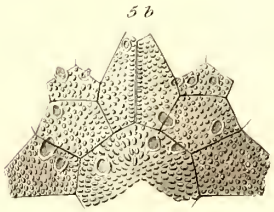

2f


2g


2b


2h


2d


5b

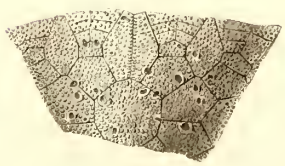

5a

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PLATE 48.

Fig. 1. 599. 1. STEPHANOCRINUS ANGULATUS. (Pag. 212.)

1 *a*. A specimen of the ordinary form and proportions, having a part of the column attached.

1 *b*. A specimen more elongated, and somewhat flattened.

1 *c*. A specimen with very prominent carinæ.

1 *d*. A similar larger specimen, with the body somewhat rotund and the carinæ very strong.

1 *e*. Three of the costal plates arranged laterally, showing the single and two converging carinæ, and the succeeding coronal plates.

1 *f*. The lefthand side of one of the heptagonal pelvic plates, above which the costal plates divide, showing one of the carinæ extending from the base obliquely to the summit.

1 *g*. The base of a specimen, showing the three divisions, and the depression for the attachment of the column.

1 *h*. Figure showing the form and arrangement of plates of the body.

1 *i*. The crown, as it usually appears when destitute of the plates, diverging from and supporting the central proboscis.

1 *k*. The crown, preserving the plates as described above.

1 *l*. An enlarged figure, showing the structure and arrangement of the plates forming the summit.

1 *m*. A transverse section at the base of the costal plates, showing the subdivisions of the plates, and the projecting angles of the carinæ.

Fig. 2. 600. 2. STEPHANOCRINUS GEMMIFORMIS. (Pag. 215.)

2 *a*. An individual somewhat larger than the ordinary size.

2 *b*. A specimen with a few joints of the column attached.

2 *c*. The crown of an individual, as it is usually seen.

2 *d*, *e*. The base of one of these, and the same enlarged, showing the rapidly expanding form which becomes nearly round or very obtusely pentagonal at the centre.

2 *f*. The structure of this species as shown from fig. 2 *a*

NIAGARA GROUP

(CRINOIDEÆ)


1b


1a


1c

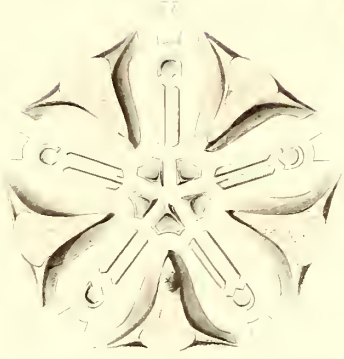

1d


1i


1m


1e


1g




1k

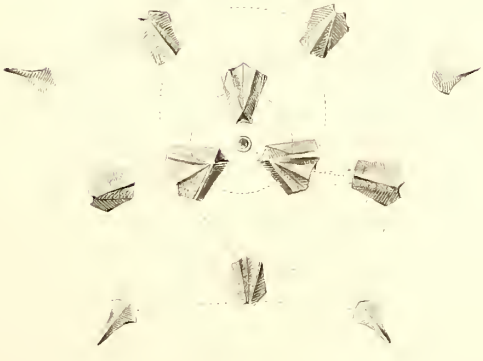

1l


2e


1h


2a


2d




2c


2f


2b

PLATE 49.

Fig. 1. 601. 1. CARYOCRINUS ORNATUS. (Pag. 216.)

1 *a*. An individual of this species, the medium size, showing a portion of the column below.

1 *b*. A larger individual, destitute of a column.

1 *c*. The base of the same or a similar specimen, showing the form and arrangement of the pelvic plates, and succeeding costal plates.

1 *d*. A specimen of a large size, having a portion of the column still attached.

1 *e*. A small specimen, slightly more elongated than usual, where the pores are less strongly developed than in many other specimens, and the markings of the surface very minutely granulate in regular concentric lines, without tubercles or ridges of any kind.

1 *f*. A specimen of about the same size, having a character precisely the reverse of the preceding.

1 *g*. A young specimen with a part of the column attached.

1 *h*. A small specimen with several of the arms still remaining attached.

1 *i*. A fragment of slate enclosing the arms of a large individual.

1 *k*. A portion of a single arm or finger, natural size, showing it to be composed of a double series of joints.

1 *l*. Enlargement of a single plate of the tentacula.

1 *m*. A fragment showing the inner margin with the tentacula attached.

1 *n*. A large separate plate, showing the arrangement of rows of pores, and surface marking of the ordinary character.

1 *n* †. A portion of a pelvic plate highly magnified, showing the vesicular tubercles in place of the pores.

1 *o*. A plate where the radiating ridges are developed between and by the side of the rows of pores, with scattered tubercles over the remainder of the surface.

1 *o* †. A portion of a scapular plate highly magnified, showing the pores with two, three, and more apertures, opening like little vesicles upon the surface of a tubercle.

1 *o**. The interior of a scapular plate, showing that the apertures of the pores are simple.

1 *p*. A similar plate where the ridges and tubercles are more strongly developed

1 *p* †. Parts of other scapular plates, showing the vesicular tubercles, and the same where they have increased in size and coalesced.

1 *r*. An enlargement of several of the little pustular elevations, terminated above by the opening of the pore.

1 *s*. The inside of one of the hexagonal plates, showing the openings of the pores on the inner side, and the grooves extending from them to the margins of the plates.

1 *t*. An enlargement of the preceding figure, showing more distinctly the character of these little grooves.

1 *t* †. The inner side of one of the heptagonal plates, showing the arrangement and divergence of the grooves from the pores.

1 *u*. The interior of a specimen, preserving thin sharp ridges, marking the direction of the grooves to the margin of the plates.

1 *v*. A view of the summit of a specimen, where the plates are well preserved.

1 *x*. The structure of the summit or crown of another specimen, showing the arrangement of the plates, arms and mouth, in reference to each other, and to the scapular plates.

1 *y*. This figure represents the structure of this species from the base to the summit of the scapular plates.

1 *z*. An enlargement of a portion of the column of fig. 1 *d*, showing the crenulated edges of the joints.

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NIAGARA GROUP

(CRINOIDEA)

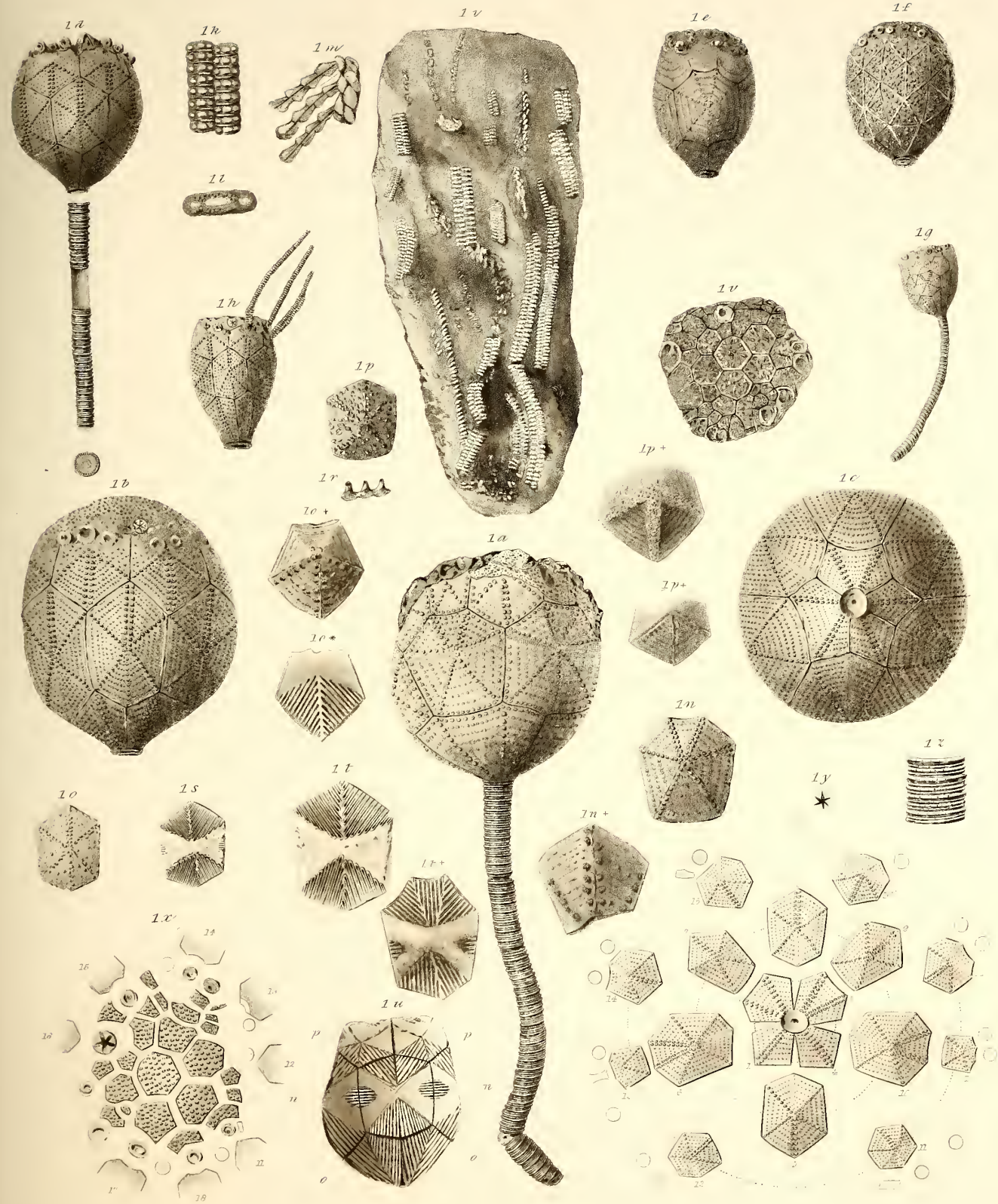

PLATE 49 a.

Fig. 1. 601. 1. Caryocrinus ornatus. (Pag. 216.)

1 *a*. An individual of this species, preserving a portion of the column more than seven inches in length.

1 *b*. A portion of the column enlarged, showing the edges of the joints quite smooth and flat.

1 *c*, *c*. Views of the ends of the column, showing the articulating striæ reaching to the canal.

1 *d*. A specimen having a small univalve shell attached, with its aperture setting closely down upon the summit, and covering the mouth of the crinoid.

1 *e*. The summit of a specimen of medium size, showing the triangular form, the arrangement of the arms, and position of the mouth.

1 *f*. An individual of medium size, nearly globular in form, marked by strong ridges parallel to and between the rows of pores, with intermediate strong tubercles.

1 *g*. The structure of Caryocrinus when spread out, showing the bilateral arrangement of its parts as before described.

Fig. 2. 602. 1. Melocrinites sculptus. (Pag. 228.)

2 *a*. View of the base of this species, showing the plates slightly separated.

2 *b*. A figure showing the structure and relative position of the plates.

2 *c*. The interior of a cup which is much elevated in the centre.

Fig. 3. 603. 1. Heterocystites armatus. (Pag. 229.)

3 *a*. Profile view of the specimen, showing the form of plates, the angular nodes, and the projection on one side indicating an aperture, marked *o*.

3 *b*. Several plates enlarged, showing the granular surface, with the strong striæ at the junction of the plates.

3 *c*. The structure as far as can be ascertained from the specimen, showing position of aperture at *o*.

Fig. 4, 5, 6, 7, 8. *Plates of undetermined Crinoidea.* (Pag. 230.)

4. This specimen has much the form of a pelvic plate of the preceding species, but the base is very narrow.

5 & 6. These plates are apparently of the *Lecanocrinus macropetalus*, or a closely allied species.

7. A plate of an unknown crinoid, the exposed surface of which is finely granulated, and the margins apparently thickened.

8. Plate of an unknown crinoid, but probably of *Dendrocrinus*.

NIAGARA GROUP.

(CRINOIDEÆ.)

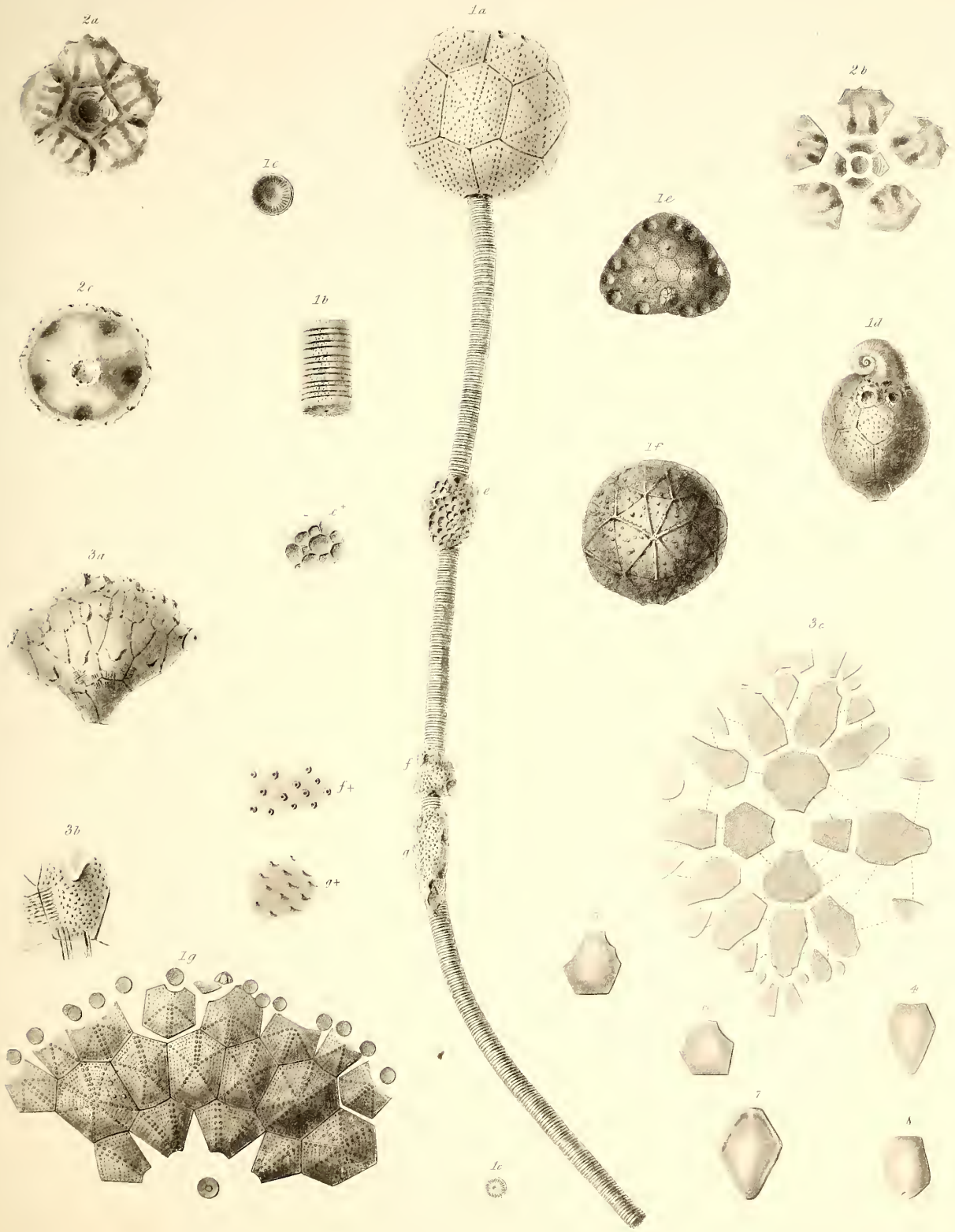

PLATE 50.

Fig. 1 – 18. 606. 1. CALLOCYSTITES JEWETTII. (Pag. 239.)

1. The posterior side, showing the ovarian aperture destitute of plates closing it.
2. The right side, showing the pectinated apertures.
3. The anterior side, showing the pectinated apertures near the base, and the position of the intercalated quadrangular plate.
4. View of the base, showing the large foramen opening from the column.
5. A portion of the base of the arm plates on the left side.
6. Two plates from the right side of the body, enlarged, showing the relative form and proportions of the pectinated apertures.
7. One of these pectinated apertures still farther enlarged, and defining more clearly the transverse bars and the spaces between.
8. A portion of the surface enlarged, showing the polygonal spaces, which are separated by scarcely elevated ridges.
9. The structure and arrangement of the arms and plates composing them.

9 *a*. A portion of an arm with the tentacula attached from another specimen.

9 *b*. The same enlarged. 10. The bases of the arms enlarged.

11. The structure of the body, including the first and second series of plates, and a part of the third series.
12. An individual having a slightly different form.
13. The arms spread out in a plane, and showing their relation to the ovarian and pectinated apertures.
14. Section of the column, showing the large canal.
15. A portion of one of the arms enlarged, showing the sinuated groove, with the bases of tentacula marked *b b*. 16. The granulated surface of the plates of the arm magnified.
17. A fragment of a column very similar to that attached to the body fig. 12.
18. An enlargement of the same, showing the crenulated edges of the joints.

Fig. 19 – 29. *Fragments of columns of Cystideæ.* (Pag. 242.)

19. Several joints of a column, near the base, having the joints connected and reflexed, with the margins strongly crenulate.
20. An enlargement of two joints from the preceding figure.
21. A fragment of a column where the joints are composed of interrupted plates, which extend only a short distance, gradually thinning away, and being overlaid by the thin edge of another one.
22. An enlargement of the same.
23 & 24. A fragment of a column with the joints carinated and reflexed on their outer margins, and finely crenulate.

The separate plates figs. 25 and 26, 27 and 28, belong to the same or a similar species. The exterior surface of 27 is covered with a minute coral like AULOPORA, and the ornament has been obliterated. Fig. 28 is the inside of the same plate, showing concentric lines of growth.

29. An enlargement of the small branching coral on fig. 27.

NIAGARA GROUP

(CYSTIDEÆ)

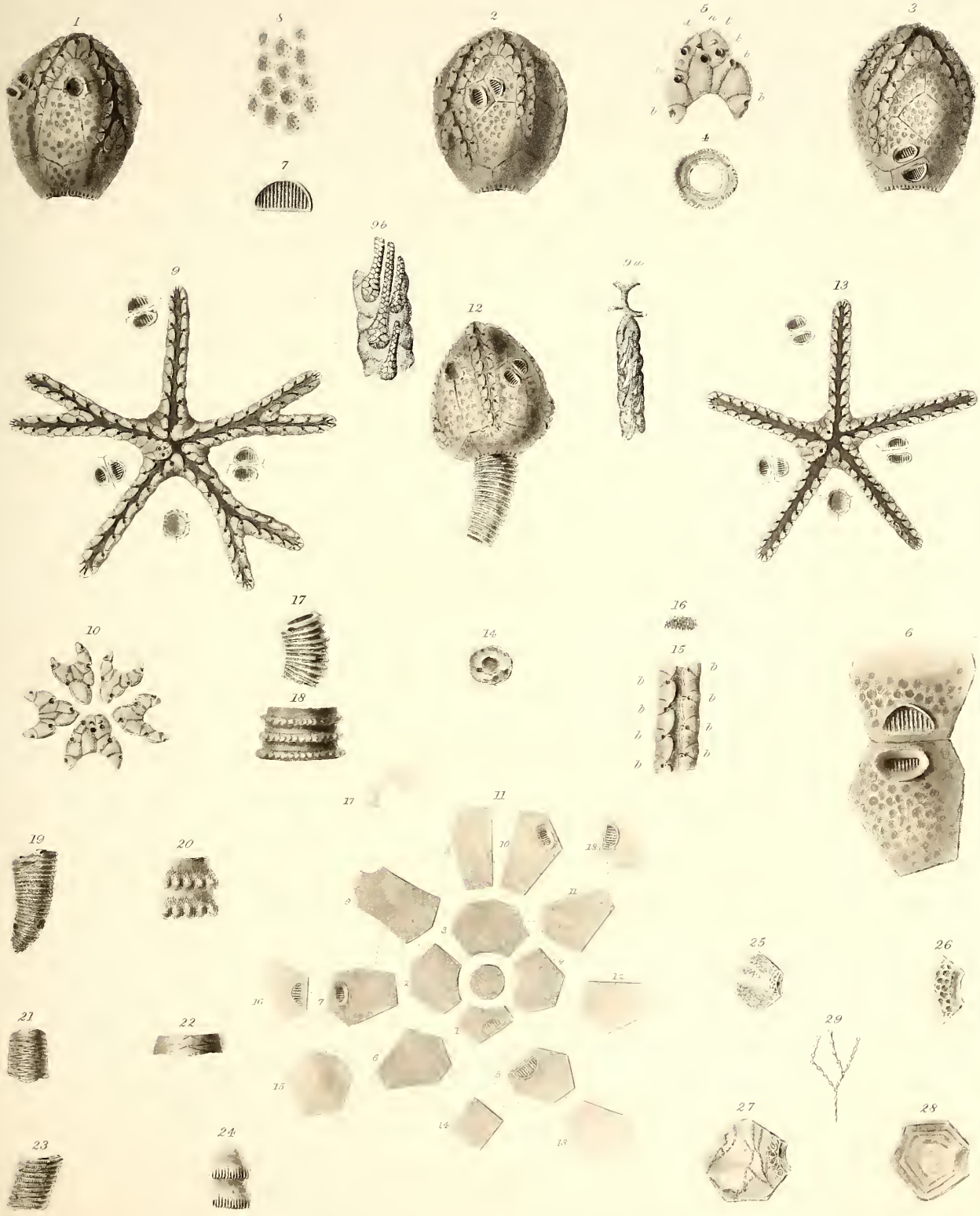

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PLATE 51.

Fig. 1 – 17. 607. 1. Apiocystites elegans. (Pag. 243.

1. The posterior side, showing the ovarian aperture, the shallow groove in which the arms are lodged, and the base of the larger tentaculum.
2. The left side, showing the pectinated apertures and arrangement of plates on that side.
3. The right side, showing the pectinated apertures and the protruding plates of the ovarian pyramid.
4. The anterior side, showing the pectinated apertures at the base, the grooves for the anterior pair of arms, and the base of the large tentaculum at the summit.

4 *a*. The base of fig. 4.

5. Diagram showing the structure of one specimen having an intercalated quadrangular plate between the first and second series of plates.
6. Diagram of the structure of another specimen, where there are only the usual number of plates in the first and second series.
7. A diagram of the structure of the upper part of a specimen where the arms are preserved.
8. A part of the preceding diagram enlarged, showing the plates at the base of the arms, the position of the mouth, and anal pore in reference to the other parts.
9. The brachial plates on the left side enlarged, showing the oral and anal orifices, with the bases of the two nearest tentacula.
10. A part of one of the arms enlarged, showing the filament of ossicula running along the groove, and the base of the tentacula.
11. A still farther enlargement, showing the first joints of the tentacula.
12. A lateral view of the same.
13. An enlargement of the ovarian pyramid and the surrounding plates.
14. Profile of the same, showing the elevation of the pyramid.
15. One of the pentagonal ovarian plates, with the three adjoining ones at the base, much enlarged.
16. The pectinated plates of one of the higher pairs, showing the form and proportion of the two apertures.
17. Another plate enlarged, to show the tuberculous character of the surface.

Fig. 18, 19, 20. 608. 1. Hemicystites parasitica. (Pag. 246.)

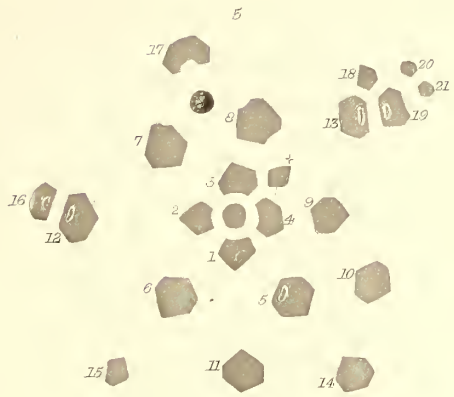
18. An individual of the natural size.
19. The plates of the ovarian pyramid enlarged, showing a double series.
20. The specimen No. 18 enlarged, showing more distinctly the arrangement of the plates, arms, etc.

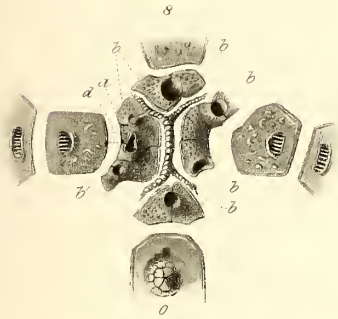
Fig. 21, 22, 23. 609. 1. Palæaster niagarensis. (Pag. 247.)

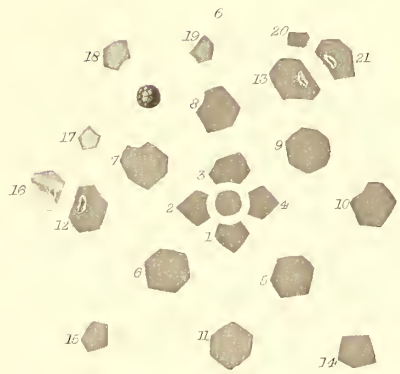
21. The lower side of the specimen, of the natural size. 22. One of the arms enlarged.
23. Several of the ossicula, with the short spines as they appear bordering the avenue.

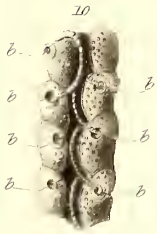
NIAGARA GROUP

(CYSTIDEÆ)









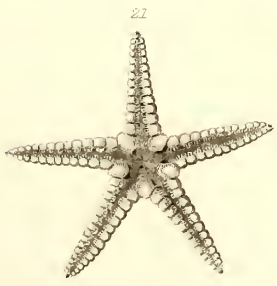


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PLATE 52.

Fig. 1. 612. 25. Orthis pisum. (Pag. 250.)

1 *a*, *b*. Young specimens of this species.

1 *c*. The ventral valve of a full grown individual, showing the beak of the dorsal valve.

1 *d*. Profile view of the same, the shell slightly compressed. 1 *e*. View of the beaks of the same.

Fig. 2. 613. 26. Orthis pyramidalis. (Pag. 251.)

2 *a*, *b*, *c*, *d*. Dorsal, ventral, cardinal and profile views of a specimen of the ordinary size.

2 *e*, *f*, *g*, *h*. Similar views of a much larger shell.

2 *i*. An enlargement of the surface, showing the sharp plications crossed by concentric striæ.

Fig. 3. 440. 22. Orthis elegantula. (Pag. 252.)

3 *a*, *b*. The dorsal valves of young individuals.

3 *c*. The dorsal valve of a full grown individual, having the beak somewhat more extended than in other specimens.

3 *d*. Ventral view of the same specimen. 3 *e*. Profile view of the same specimen.

3 *f*. Cardinal view of the same, showing the elevation of the dorsal valve.

3 *g*. Ventral view of a shorter specimen. 3 *h*. Cardinal view of the same.

3 *i*. Cast of a dorsal valve of an elongated specimen. 3 *k*. Cardinal view of the same.

3 *l*, *m*. The interior of the dorsal valves of a young and full grown individual.

3 *n*. The interior of a ventral valve, showing the muscular impresssion, lamellæ, etc.

3 *o*. The same enlarged. 3 *p*. The interior of a similar shell, showing a slight variation in character.

3 *r*. Cardinal view of the same, showing the dental lamellæ, and the callosity at the apex of the foramen.

3 *s*. An enlargement of the surface.

Fig. 4. 614. 27. Orthis hybrida. (Pag. 253.)

4 *a*, *b*, *c*. Figures of specimens showing three gradations of size.

4 *d*, *e*. Cardinal and profile views of fig. 4 *c*.

4 *f*. A specimen having the valves more convex than usual.

4 *g*. Profile view of the same specimen, showing the nearly equal convexity of the valves.

4 *h*. A cardinal view of a specimen, showing the convexity of the dorsal valve.

4 *i*, *k*. The interior of the dorsal valve of this species, showing the muscular impression divided by a longitudinal ridge.

4 *l*. An enlargement of the muscular impression of the preceding specimen.

4 *m*. The interior of the ventral valve, with a scarcely defined muscular impression.

4 *n*. A cast of the ventral valve of this species, showing the bilobate character of the muscular impression, the cavities of the teeth, etc.

4 *o*. An enlargement of the surface, showing the longitudinal diverging and fine concentric striæ.

Fig. 5. 615. 28. Orthis puncto-striata. (Pag. 254.)

5 *a*. View of the ventral valve of a small specimen, showing the beak of the dorsal valve, and a part of the area above it. 5 *b*. A profile view of the same specimen.

5 *c*. A cardinal view of a larger specimen, showing the great convexity of the valves.

5 *d*. A large dorsal valve which has been flattened by pressure. 5 *e*. The interior of the same.

5 *f*. Several of the striæ enlarged, showing the puncta between.

Fig. 6. 616. 29. Orthis flabellulum, Var.? (Pag. 254.)

6 *a*, *b*, *c*. Dorsal, profile and ventral views of a compressed specimen.

6 *d*. The interior of a ventral valve. 6 *e*. A cast of a ventral valve.

6 *f*. Cardinal view of a specimen, which is partially a cast.

6 *g*. Cardinal view of the specimen fig. 6 *a*.

Fig. 7. 616. 29. Orthis flabellulum? Var.? (Pag. 255.)

7 *a*, *b*. Dorsal and ventral views of the specimen.

7 *c*. Profile view of the same. 7 *d*. Cardinal view the same.

Fig. 8. 617. 30. Orthis fasciata. (Pag. 255.)

8 *a*. A cast of the ventral valve, showing an extended hinge-line. 8 *b*. A cast of the dorsal valve.

PLATE 53.

Fig. 1, 2. 437. 16. LINGULA LAMELLATA. (Pag. 249.)

1. A specimen preserving the shell, and having the beak acute.
2. A specimen where the shell is removed, leaving the surface with faint concentric lines and a few longitudinal striæ.

Fig. 3. 610. 8. ORBICULA TENUILAMELLATA. (Pag. 250.)

Fig. 4. 611. 9. ORBICULA? SQUAMIFORMIS. (Pag 250.)

4 *a*. An individual of the natural size.

4 *b*. The same enlarged, to show more distinctly the characters of the surface.

Fig. 5. 618. 24. LEPTÆNA TRANSVERSALIS. (Pag. 256.)

5 *a*, *b*, *c*. Dorsal and ventral views of two small individuals, where the hinge-line is much extended into acute points.

5 *d*. A larger specimen, where the hinge-line is slightly extended on one side, while the other is less extended.

5 *e*, *f*. Dorsal and ventral views of a large individual, having the hinge-line slightly extended.

5 *g*. Cardinal view, showing the extreme convexity of the dorsal valve, and the inflection of the cardinal margin.

5 *h*. An enlargement of the surface, showing the coarser striæ with intermediate finer ones.

5 *i*. The interior, showing a striato-punctate character, with reticulations like the lines of bloodvessels.

5 *k*. The interior of the ventral valve, showing the strong parallel laminæ, and prominent points on either side for the muscular attachment.

5 *l*. A profile or cardinal view of the preceding specimen, showing the strong elevated laminæ for muscular attachment.

Fig. 6. 448. 23. LEPTÆNA DEPRESSA. (Pag. 257.)

6 *a*, *b*, *c*. Dorsal and ventral views of young specimens, where only a narrow portion of the margin is deflected.

6 *d*. A larger individual.

6 *e*. An individual of the ordinary full grown size, regarded as a mature form.

6 *f*. A very large individual, having the undulations more numerous, but less conpicuous than in fig. 6 *e*.

6 *g*, *h*. Dorsal view of two small individuals, showing a slight difference in the character of the foramen, etc.

6 *i*. The interior of a ventral valve, showing the muscular impression and dental laminæ.

6 *k*. The interior of the shell, showing the punctate surface.

6 *l*. The exterior striated surface, with fine concentric striæ crossing them.

Fig. 7. 619. 25. LEPTÆNA STRIATA. (Pag. 259.)

Fig. 8, 9, 10. 620. 26. LEPTÆNA SUBPLANA. (Pag. 259.)

8 *a*. The interior of the convex valve of a young individual, where the width is greater than the length.

8 *b*. A specimen from which the shell is partially removed. 8 *c*. The striæ enlarged.

9 *a*. Cast of the ventral valve, apparently identical with the preceding, showing the muscular impression and the remains of the dental laminæ.

9 *b*. The interior of the valve of another specimen, showing the dental laminæ of the same form as in the preceding figure.

10 *a*. A large individual having sharp prominent striæ which are dichotomous, and crossed by finer striæ, which remain in the depressions only.

10 *c*. Several of the striæ enlarged, showing the concentric striæ.

10 *b*. Cardinal view of another similar specimen, showing the narrow extended area and foramen.

(BRACHIOPODA.)

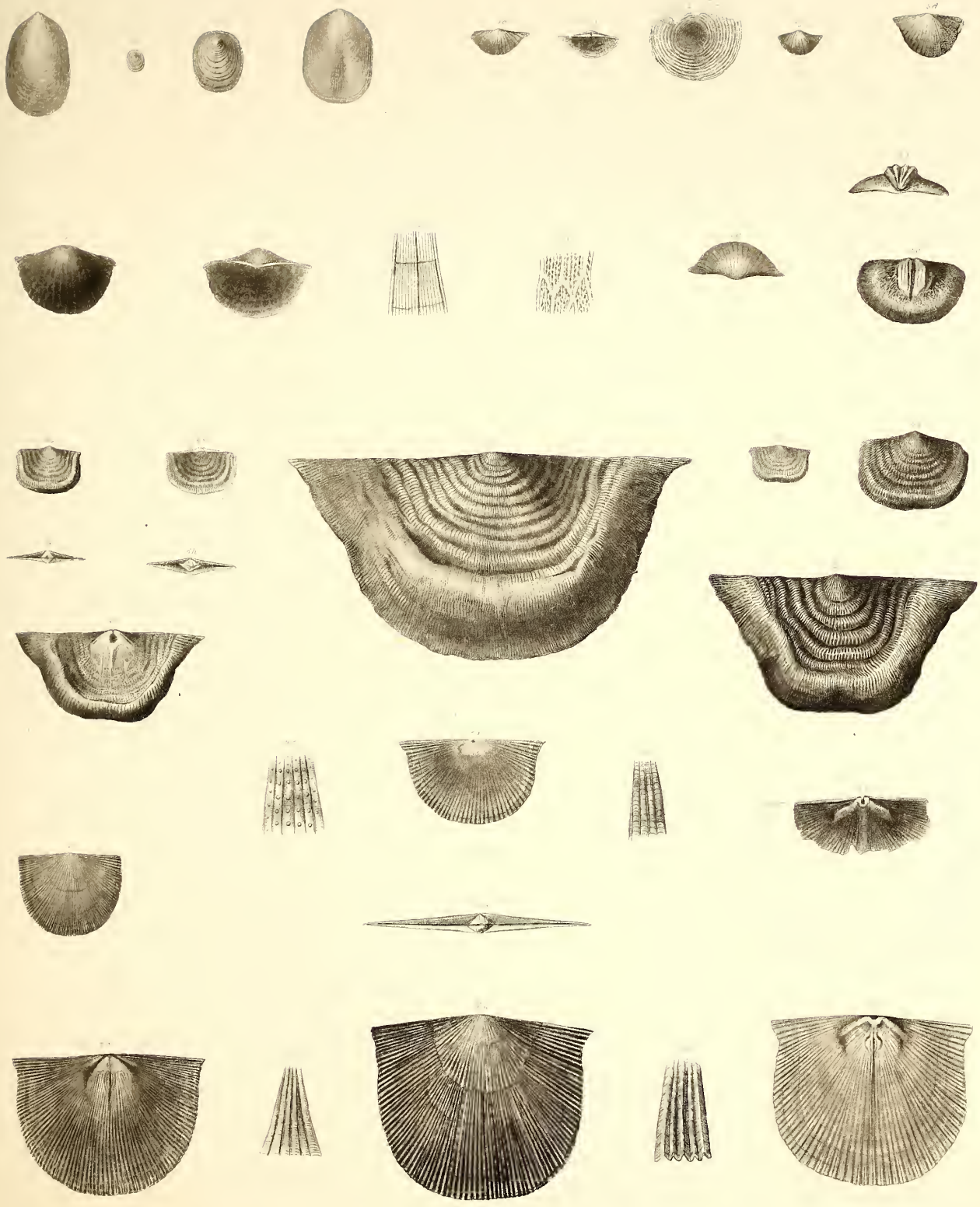

PLATE 54.

Fig. 1. 621. 4. SPIRIFER BILOBUS. (Pag. 260.)

1 *a*, *b*. Ventral and dorsal view, where the extremities of the hinge-line are scarcely extended.
1 *c*, *d*. Another specimen, where the extremities of the hinge-line are auriculate.
1 *e*. Front view of a specimen, showing the bilobate character.
1 *f*, *g*. Profile views of two specimens, one of which is much more convex than the other.
1 *h*, *i*. Enlarged figures of a specimen, representing the prevailing form.
1 *k*. Interior of the ventral valve.

Fig. 2. 622. 5. SPIRIFER SULCATUS. (Pag. 261.)

2 *a*. A small specimen, having the cardinal extremities scarcely extended.
2 *b*, *c*. Views of specimens where the cardinal line is extended into mucronate points.
2 *d*. An unusually large specimen, having the hinge-line less extended than the preceding.
2 *e*. A specimen where the length and breadth are nearly equal.
2 *f*. Front view of fig. 2 *b*. 2 *g*. Front view of 2 *e*.
2 *h*, *i*. Profile views of different specimens.
2 *k*. An enlargement of the surface, showing the longitudinal striæ crossing the lamellæ.

Fig. 3. 623. 6. SPIRIFER CRISPUS. (Pag. 262.)

3 *a*, *b*, *c*. Ventral views, presenting the ordinary characters of well preserved specimens.
3 *d*. An individual, still preserving its natural proportions.
3 *e*, *f*, *g*. Profile views of three specimens, showing the variable elevation of the beak of the dorsal valve, and width of the area.
3 *h*, *i*. Front views of specimens, showing a different proportional convexity.
3 *k*. A portion of the surface enlarged.

Fig. 4. 624. 7. SPIRIFER BICOSTATUS. (Pag. 263.)

4 *a*. A dorsal valve of an individual of this species.
4 *b*. Ventral view of the same, showing the area and foramen, the beak of the ventral valve being broken off.
4 *c*. Profile view, showing the form of the dorsal valve.
4 *d*. Front view, in which the elevation of the ventral valve is given as it appears to have been in its perfect state.
4 *e*. An enlarged portion of the surface, showing the character of the striæ.

Fig. 5. 625. 8. SPIRIFER NIAGARENSIS. (Pag. 264.)

5 *a*, *b*. Ventral and dorsal views of a young specimen. 5 *c*. Front view of the same.
5 *d*. Profile view of another more gibbous specimen.
5 *e*, *f*, *g*. Ventral, front and profile views of a well preserved specimen.
5 *h*, *i*. Ventral and profile views of a well preserved specimen of the ordinary size of this species.
5 *k*. A flattened dorsal valve of about the same size as the preceding specimen.
5 *l*. A flattened ventral valve of a specimen somewhat larger than the preceding.
5 *m*. A large specimen, having the form well preserved. 5 *n*. Front view of the specimen fig 5 *h*.
5 *o*. Cardinal view of a small specimen, where the area is nearly closed.
5 *p*. Cardinal view of a specimen where the lower part of the shell is compressed.
5 *r*. The interior of a dorsal valve, showing the strong lamellæ on each side of the triangular foramen.
5 *s*. An enlargement of the striæ.
5 *t*. Section of the plications, showing their form and the number of striæ upon the surface.

Fig. 6. 452. 3. SPIRIFER RADIATUS. (Pag. 265.)

6 *a*, *b*. Ventral and front view of a small specimen.
6 *c*. A large specimen entirely flattened, which causes the beak to project as shown in the figure.
6 *d*. A specimen from which the shell is partially exfoliated, showing the form of the muscular impression.
6 *e*. Cardinal view of the same, showing the entire extent of the dorsal area and foramen.
6 *f*. The interior of a dorsal valve, showing the extension of the plates or laminæ on each side of the foramen, with a central one commencing below the beak. 6 *g*. Several of the striæ enlarged.
6 *h*. Transverse section showing comparative elevation and width of striæ.

Fig. 7. 626. 9. SPIRIFER PYRAMIDALIS. (Pag. 266.)

7 *a*. The ventral valve of this species. 7 *b*. Dorsal valve of the same.
7 *c*. Cardinal view, showing the area and long linear foramen which is closed.
7 *d*. Profile view of the same.
7 *e*. Several of the plications enlarged, showing the concentric striæ.

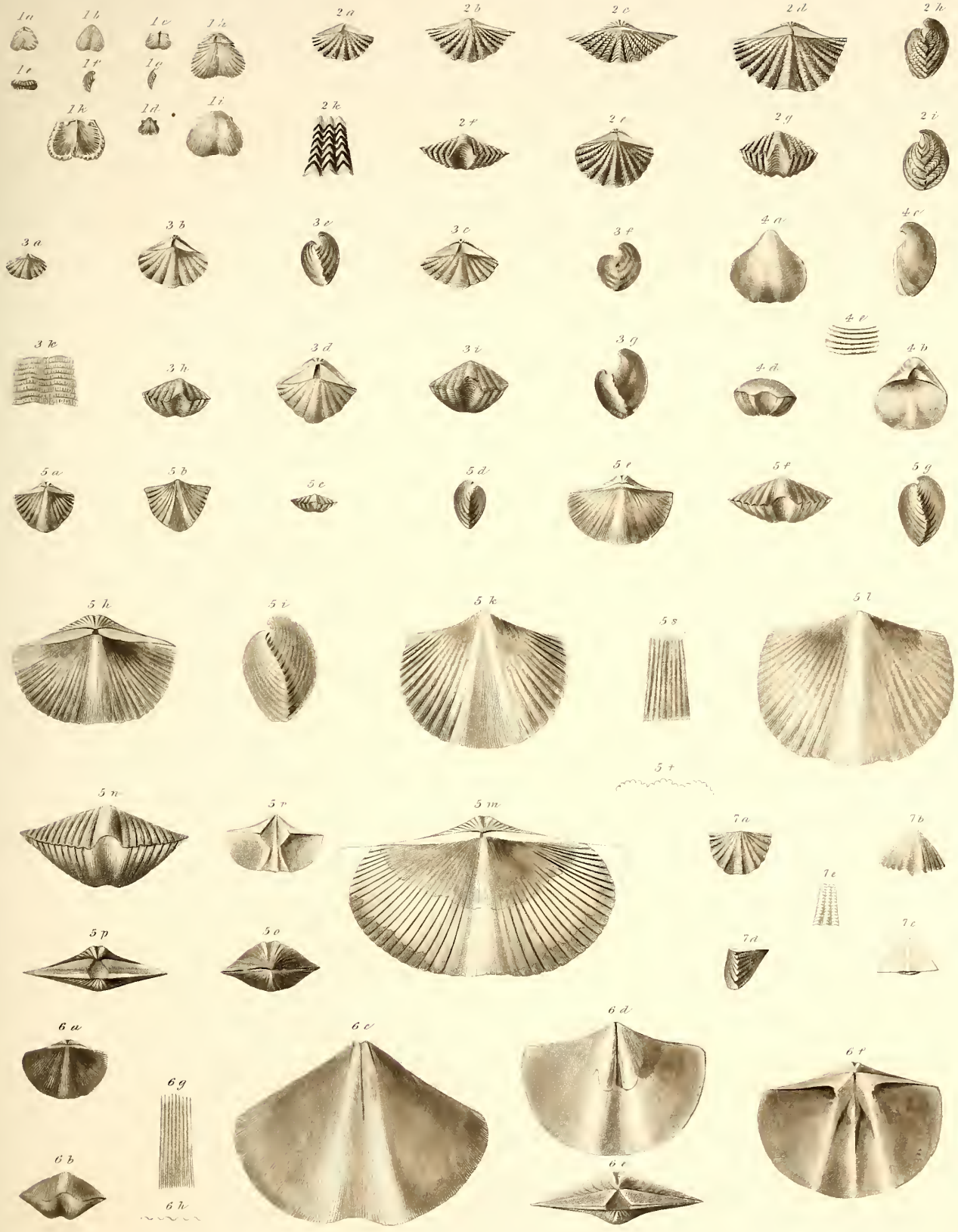
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PLATE 55.

Fig. 1. 627. 41. ATRYPA NITIDA. (Pag. 268.)

1 *a*, *b*, *c*. Ventral views of three individuals of small size. 1 *d*. Profile view of fig. 1 *c*.
1 *e*. A gibbous specimen, where the outline is narrow in proportion to the length.
1 *f*. Profile view of the same specimen. 1 *g*. Front view of the same.
1 *h*, *i*, *k*. Ventral, profile and front views of a specimen, where the valves are very much thickened towards the bases.
1 *l*. A large individual of the same species.
1 *m*, *n*. Profile and cardinal views of other specimens.
1 *o*. Ventral view of a large specimen, which is inequilateral from pressure.

Fig. 2. 628. 42. ATRYPA NITIDA, *var.* OBLATA. (Pag. 269.)

2 *a*. Ventral view of a specimen of this variety. 2 *b*. Dorsal view of a large specimen.
2 *c*. Profile view of the same.

Fig. 3. 629. 43. ATRYPA ——— (*Species undetermined*). (Pag. 269.)

3 *a*. Dorsal view of this species. 3 *b*. Front view of the same.
3 *c*. Cast of the dorsal valve of a specimen having the general external features of this species.
3 *d*. Cardinal view of the same. 3 *e*. Lateral view of the same.

Fig. 4. 630. 44. ATRYPA CRASSIROSTRA. (Pag. 269.)

4 *a*. Ventral view of a full grown specimen. 4 *b*. Profile view of the same.
4 *c*. Front view of the same.

Fig. 5. 460. 31. ATRYPA RETICULARIS. (Pag. 270.)

5 *a*. A young individual of this species. 5 *b*. Cardinal view, showing the compressed form.
5 *c*. A larger individual. 5 *d*, *e*. Cardinal and profile views of the same.
5 *f*, *g*, *h*. Ventral, profile and front view of a specimen, showing, in the last figure, the slight sinus in the dorsal valve, and the elevation of the margin of the ventral valve.
5 *i*. Profile view of a flattened specimen.
5 *k*, *l*, *m*. Ventral, profile, and cardinal view of a globose specimen of medium size.
5 *n*, *o*. Dorsal and front view, showing the sinus more conspicuously than the preceding figure.
5 *p*. A large individual: view of the ventral valve.
5 *r*. Profile view of the same specimen, which is compressed.
5 *s*. The interior of the dorsal valve, showing the form of the muscular impression.
5 *t*. Several of the plications enlarged, showing more distinctly the character of the surface.
5 *u*. A cast of the dorsal valve.

(BRACHIOPODA)

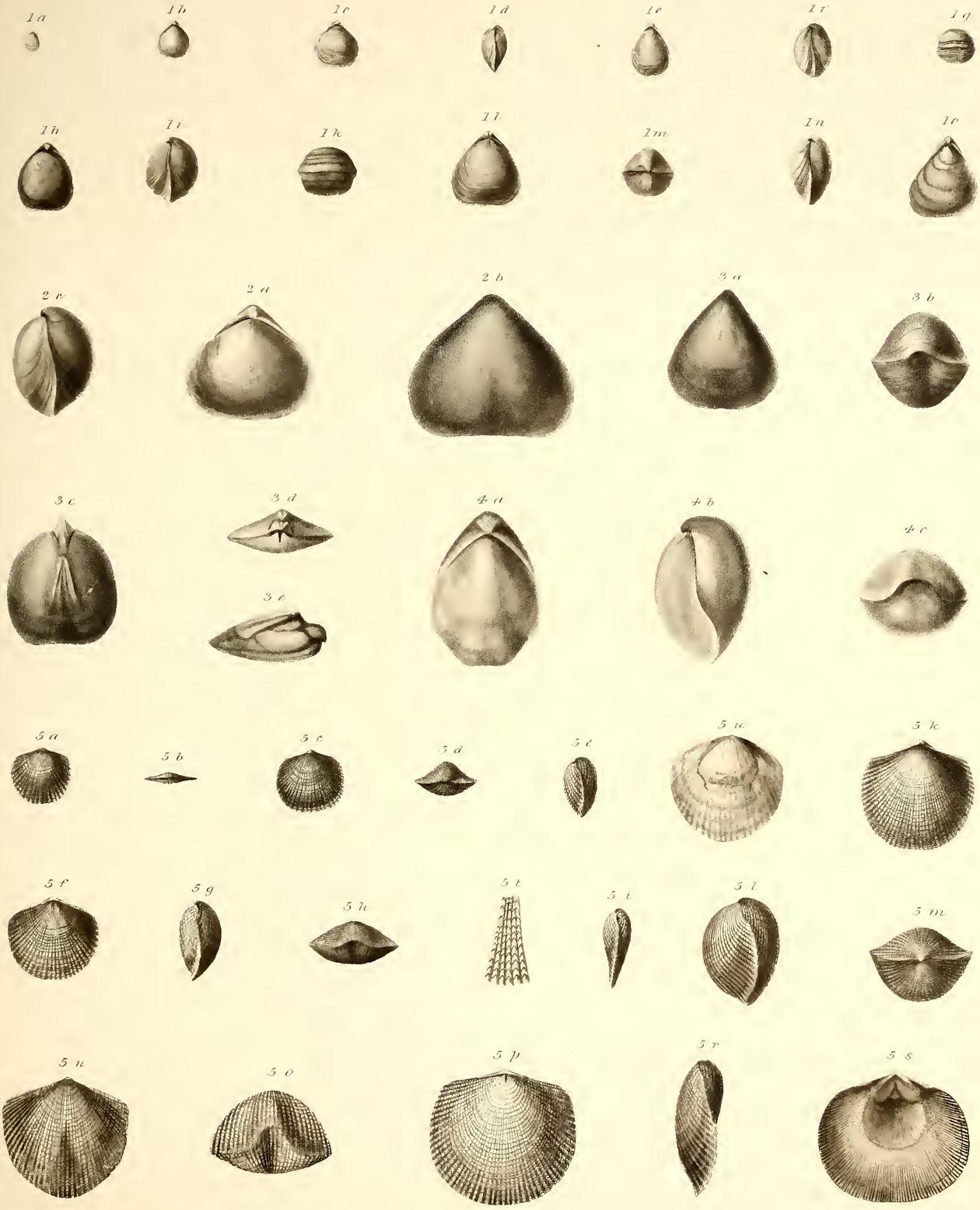

PLATE 56.

Fig. 1. 631. 45. ATRYPA RUGOSA. (Pag. 271.)

1 *a*. The dorsal valve of a young individual, which is marked by two stronger plications in the centre.
1 *b*. Cardinal view of the same, showing the nearly flat ventral valve.
1 *c*. Ventral view of a larger specimen, where the mesial lobe and sinus are developed.
1 *d*. Profile view of the same specimen, showing convexity of both valves.
1 *e*. Front view of the same.
1 *f*. Dorsal valve of another specimen, where the sinus is less developed.
1 *g*. Front view, showing the slight mesial depression and elevation.
1 *h*, *i*. Dorsal and ventral valves of a specimen of medium size.
1 *k*. Front view of the same, showing the strong elevation in the centre.
1 *l*. Profile view of the same. 1 *m*. Dorsal valve of a large individual.
1 *n*. An enlargement of the plications, showing character of surface.

Fig. 2. 632. 46. ATRYPA NODOSTRIATA. (Pag. 272.)

2 *a*, *b*. Dorsal and ventral views of a young specimen.
2 *c*. Profile view of the same specimen, which is compressed.
2 *d*, *e*. Dorsal and ventral views of a specimen below the medium size.
2 *f*. Profile view of the same.
2 *g*, *h*. Dorsal and ventral views of a specimen of medium size, which is slightly more elongated than usual.
2 *i*, *k*, *l*. Dorsal, ventral and profile views of a more rotund form.
2 *m*, *n*. Ventral and profile views of a large specimen in its natural condition.
2 *o*. Profile view of a larger specimen which is extremely compressed.
2 *p*. The plications enlarged, showing the imbricating lamellæ.
2 *r*, *s*, *t*, *u*. Front views of different specimens, showing the absence of a sinus in the young shell, and its increase as the shell becomes larger.

Fig. 3. 633. 47. ATRYPA CAMURA. (Pag. 273.)

3 *a*, *b*. Ventral and profile views of a young specimen.
3 *c*, *d*. Ventral and dorsal views of a larger specimen than the preceding.
3 *e*. Ventral view of a specimen having the beak of the dorsal valve well preserved.
3 *f*. The beak of the same enlarged, showing the foramen. 3 *g*. Profile view of the same.
3 *h*. Dorsal view of a specimen, larger than the preceding.
3 *i*, *k*. Dorsal and ventral valves of a larger compressed specimen.
3 *l*, *m*. Views of a more rotund specimen, showing the beak much reduced, with the foramen not surrounded.
3 *n*, *o*. Specimens which are more extended laterally than the preceding forms.
3 *p*, *r*. Front views of two specimens, showing slight indications of a sinus.
3 *t*. The beak and foramen of a full-grown individual.
3 *u*. Enlargement of the surface of this species.

NIAGARA GROUP

(BRACHIOPODA)

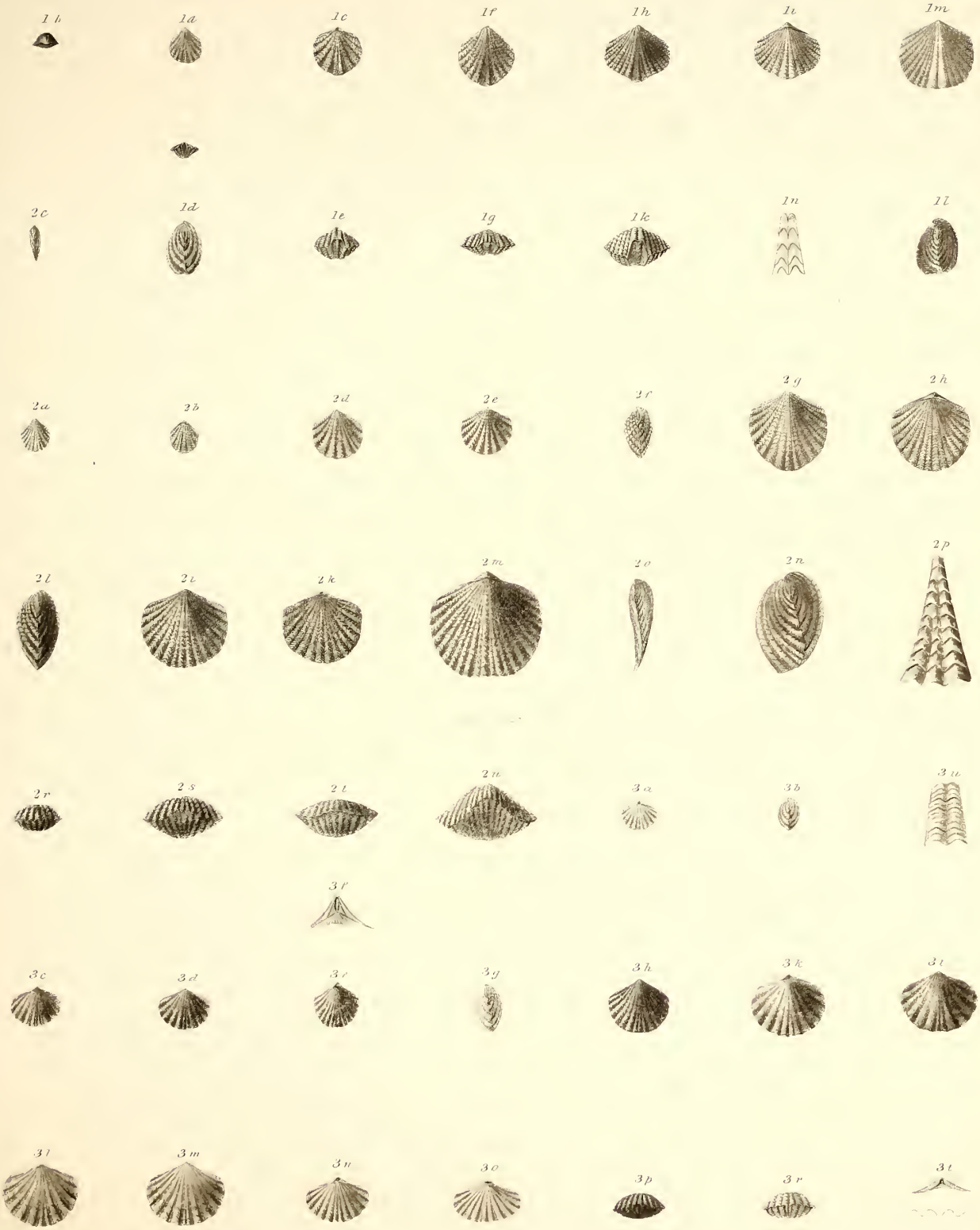

PLATE 57.

Fig. 1. 456. 27. ATRYPA NEGLECTA. (Pag. 274.)

1 *a*, *b*. Ventral and front views of a young specimen, where the valves are equal and without a sinus.
1 *c*. A somewhat larger specimen, where the sinus and elevation are slightly developed.
1 *d* – *h*. Figures of specimens presenting varieties of form and size, and number of plications in the sinus.
1 *i* – *m*. Profile views of specimens which are not compressed.
1 *n*, *o*, *p*. Front views showing the elevation of the plications, and the depression of the same in the sinus.

Fig. 2. 634. 48. ATRYPA INTERPLICATA. (Pag. 275.)

2 *a*. Dorsal valve of this species.
2 *b*. Dorsal view, where the ventral valve near the beak is elevated above the beak of the dorsal valve.
2 *c*, *d*. Profile views of the specimens 2 *a*, *b*.
2 *e*, *f*. Front views of two specimens, one of which is compressed.
2 *g*. An enlargement of several plications, showing the interplications and concentric striæ.

Fig. 3. 635. 49. ATRYPA BIDENTATA. (Pag. 276.)

3 *a*, *b*. Ventral and dorsal views of the same specimen.
3 *c*, *d*. Similar views of a larger individual. 3 *e*, *f*. Profile views of a young and old individual.
3 *g*. Front view of a specimen, showing the sinus and slight elevation.
3 *h*. Several plications enlarged to show the surface markings.

Fig. 4. 636. 50. ATRYPA CUNEATA. (Pag. 276.)

4 *a*, *b*. Ventral views of two specimens of this species.
4 *c*, *d*. Dorsal views of a specimen of ordinary size, and of another of very large dimensions.
4 *e*. Dorsal view of a specimen having a greater proportional width than usual.
4 *f*, *g*, *h*. Profile views of specimens of different size.
4 *i*. Profile of fig. 4 *e*, showing the great depth of the ventral valve.
4 *k* – *p*. Front views of young and old specimens.
4 *r*. Several plications enlarged, showing the concentric filiform striæ.

Fig. 5. 637. 51. ATRYPA ———? (Pag. 277.)

5 *a*. Ventral view. 5 *b*. Dorsal view, showing the simple direct plications.

Fig. 6. 638. 52. ATRYPA DISPARILIS. (Pag. 277.)

6 *a*, *b*. Young individuals with scarcely two defined plications on each side of the centre.
6 *c*, *d*. Ventral and dorsal valves of a specimen, with three plications on each side of the central pair.
6 *e*. Another specimen having four plications.
6 *f*. Profile view of a full grown individual. 6 *g*. Front view of a specimen.
6 *h*. The beak and foramen of the dorsal valve.
6 *i*, *k*. The interior of a dorsal valve, and the same enlarged.
6 *l*, *m*. The interior of a ventral valve, and the same enlarged.

Fig. 7. 642. 56. ATRYPA APRINIS. (Pag. 280.)

7 *a*, *b*. Ventral and dorsal views of the specimen. 7 *c*. Profile view of the same.
7 *d*. Front view of the same. 7 *e*. Enlargement of the beak of the dorsal valve.
7 *f*. View showing the elevation of the striæ.
7 *g*. Several plications enlarged, showing the concentric striæ.

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PLATE 58.

Fig. 1. 639. 53. ATRYPA BREVIROSTRIS (?). (Pag. 278.)

1 *a*, *b*. Ventral and dorsal views of a specimen. 1 *c*. Profile view of the same.
1 *d*. Cardinal view. 1 *e*. Front view.
1 *f*. An enlargement of the plications, showing concentric striæ.

Fig. 2. 640. 54. ATRYPA OBTUSIPLICATA. (Pag. 279.)

2 *a*, *b*, *c*. Ventral, dorsal and profile views of a specimen of the ordinary size.
2 *d*. Front view of the same.
2 *e*. Ventral view of a specimen which is more expanded at the sides.
2 *f*. Front view of a specimen where the ventral valve is much elevated, and the sinus very deep.
2 *g*. Ventral valve of a compressed specimen.
2 *h*. Several plications enlarged, showing the concentric striæ.

Fig. 3, 4. 641. 55. ATRYPA PLICATELLA? (Pag. 279.)

3 *a*, *b*. Ventral and dorsal views of this species.
3 *c*. Cardinal view of the same. 3 *d*. Profile view.
3 *e*. Several of the plications enlarged, showing the concentric striæ.
4 *a*, *b*. Dorsal and profile views of a larger specimen, showing a greater number of plications than the specimen fig. 3. This is probably only a variety of the same species.

Fig. 5. 643. 57. ATRYPA CORALLIFERA. (Pag. 281.)

5 *a*. A young individual of this species. 5 *b*. A larger specimen of this species.
5 *c*, *d*. Ventral and dorsal views of a specimen of the ordinary or prevailing size.
5 *e*, *f*, *g*, *h*. Front views of different specimens, one of which is compressed, and the others retain their natural proportions.
5 *i*, *k*. Profile views of two individuals, one of which is very gibbous.
5 *l*, *m*. Cardinal views of other individuals.
5 *n*, *o*. Casts of the dorsal valves of two individuals, the last one larger and proportionally more extended laterally than any other specimen observed.
5 *p*. Cast of the ventral valve.
5 *r*. An enlargement of the surface, presenting its ordinary character.
5 *s*. An enlargement of the surface, where the shell is thickened, and the spaces between the reticulate openings is punctate.
5 *t*. An enlargement of the surface of the cast of this species, showing the punctate character.

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PLATE 59.

Fig. 1. 472. 6. AVICULA EMACERATA. (Pag. 282.)

1 *a*. A young individual of this species, having the radiating and concentric striæ equally developed.

1 *b*. A larger individual : this one is about the ordinary size of the specimens obtained.

1 *c*. A large individual, preserving the surface markings in a good degree of perfection.

1 *d*. The right valve of this species, showing the plain nearly flat body of the shell, and striated wing.

1 *e*. An enlargement of a portion of the surface, showing the character of the diverging and concentric striæ.

Fig. 2. 644. 8. AVICULA UNDATA. (Pag. 283.)

Fig. 3. 645. 9. AVICULA SUBPLANA. (Pag. 283.)

3 *a*. A left valve of ordinary size, where the extremity of the cardinal line is extended slightly beyond the width of the shell.

3 *b*. A larger shell, where the cardinal line is less extended than the width of the shell.

3 *c*. A fragment of shale with the right valves of two individuals, showing a greater extension of the cardinal line, and a more distinct wing than in the left valve.

Fig. 4. 646. 10. AVICULA? ORBICULATA. (Pag. 284.)

Fig. 5. 647. 2. POSIDONOMYA? RHOMBOIDEA. (Pag. 284.)

Fig. 6. 648. 22. MODIOLOPSIS? UNDULOSTRIATA. (Pag. 284.)

6 *a*. The shell, natural size. 6 *b*. A portion of the surface enlarged.

Fig. 7. 474. 19. MODIOLOPSIS SUBALATUS? (Pag. 285.)

Fig. 8. 478. 4. ORTHONOTA CURTA? (Pag. 285.)

NIAGARA GROUP.

(ACEPHALA.)


1a.

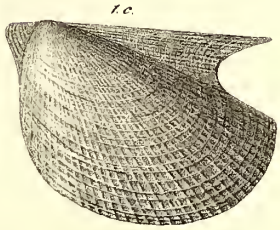

1b.

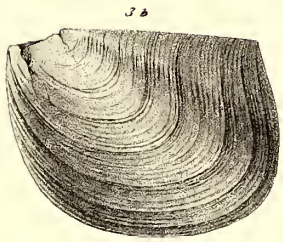

1d.


1c.


2


3a.


1c.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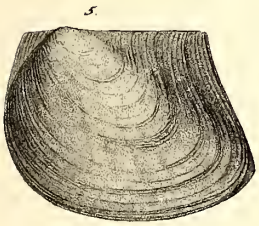
4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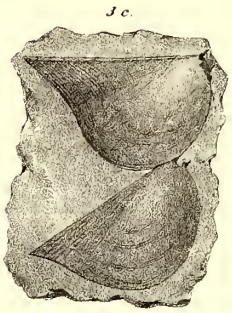
3c.


6a.


6b


7.


8

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Lith of R.H Pease, Albany

PLATE 60.

Fig. 1. 649. 2. PLATYOSTOMA NIAGARENSIS. (Pag. 287.)

1 *a*, *b*, *c*. Young individuals, where the spire is depressed as low as the outer volution.

1 *d*. An individual having the spire equally depressed, and the surfaee conspieuously marked by longitudinal striæ.

1 *f*. A small specimen having an elevated spire, with the surfaee marked as in fig. 1 *d*.

1 *g*. View looking on the spire of a similar speeimen.

1 *h*. A small speeimen having the spire much elevated, and the volutions longitudinally and transversely striated.

1 *i*, *k*, *l*. Baek, summit and front views of a globose specimen preserving its natural proportions.

1 *m*, *n*. Two views of a similar speeimen, having the aperture somewhat more expanded.

1 *o*, *p*. Two views of a larger individual with an expanded aperture and a strong fold upon the back of the volution, and a sinus in the margin of the aperture.

1 *r*. A similar larger specimen.

1 *s*, *t*. View of spire, and partial front view of a large speeimen from whieh the shell is partially exfoliated.

1 *u*, *v*. View of the summit of two other individuals having the usual depressed spire of this species.

Fig. 2. 650. 3. PLATYOSTOMA HEMISPHERICA. (Pag. 288.)

2 *a*. View of the summit.

2 *b*. Front view. The shell is so much depressed, that the figures can give no true idea of the aperture.

Fig. 3. 651. 1. ACROCULIA NIAGARENSIS. (Pag. 288.)

Fig. 4. 652. 2. ACROCULIA ANGULATA. (Pag. 289.)

4 *a*. The baek of a small speeimen, where the shell is seareely preserved.

4 *b*. Upper side of the same.

4 *c*. Baek of another speeimen, where the angles, earina, and surface striæ are well preserved.

4 *d*. Upper side of the same, showing in part the expanded aperture and the minute volutions of the attenuated apex.

NIAGARA GROUP

(GASTEROPODA)

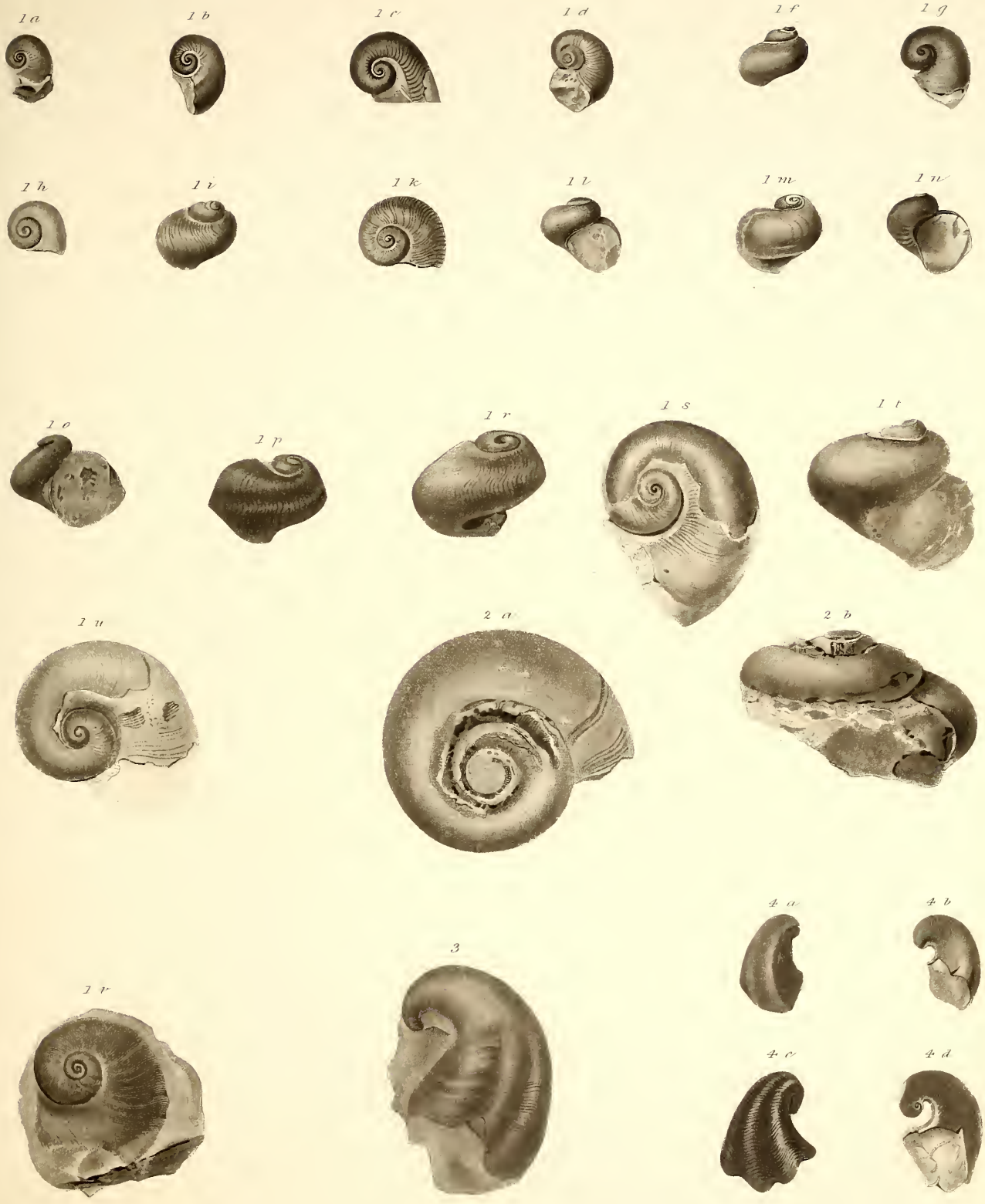


PLATE 61.

Fig. 1. 653. 1. GOMPHOCERAS? (Pag. 290.)

1 *a*. A young individual much compressed, in the shale.

1 *b*. A larger individual from the limestone.

Fig. 2. 654. 8. CYRTOCERAS? CANCELLATUM. (Pag. 290.)

2 *a*. A fragment in shale, which is entirely compressed. The shell is retained on the larger part of the surface, and, where exfoliated, the surface is marked by longitudinal striæ.

2 *b*. A fragment of a similarly marked specimen from limestone.

2 *c*. Section of the same, showing the dorsal position of the siphuncle.

Fig. 3. 655. 32. ORTHOCERAS ——— (*Species undetermined*). (Pag. 291.)

Fig. 4. 656. 33. ORTHOCERAS IMBRICATUM? (Pag. 291.)

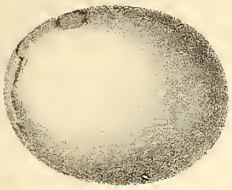
4 *a*, *b*, *c*. Fragments of small individuals of this species.

(ORTHOCERATA)

1a.

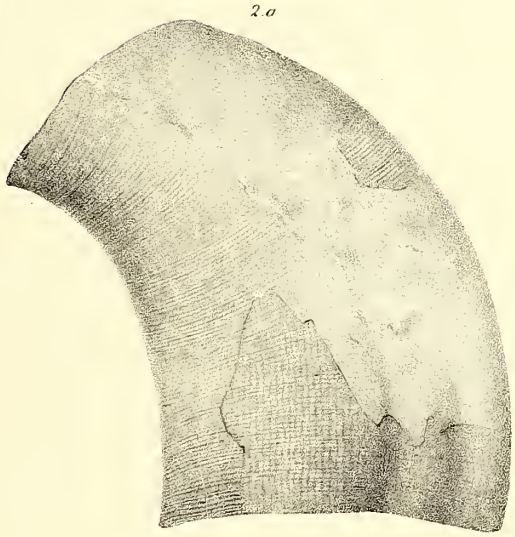
1b.

2c



2b

2a



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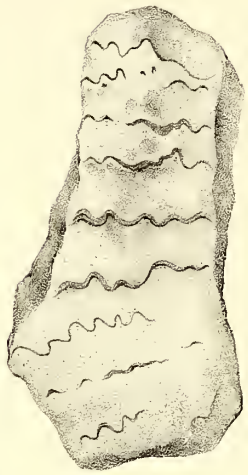


4c

4a

4b

On Stone by F. J. Swinton.

Lith. of R. H. Pease, Albany

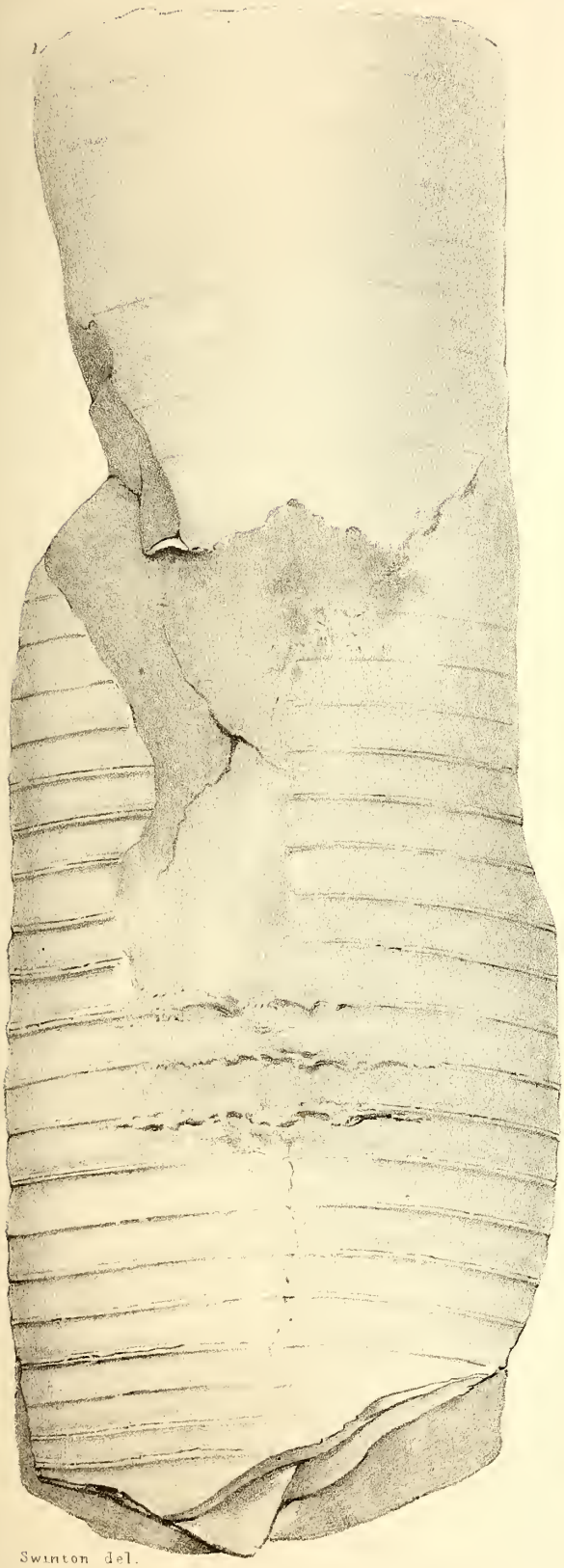
PLATE 62.

Fig. 1, 2, 3. 656. 33. ORTHOCERAS IMBRICATUM? (Pag. 291.)

1. A compressed cast of a large individual, the surface of which is marked by corals.
2. The interior of the shell of a large specimen of this species.
3. A fragment of a large specimen which is less compressed than usual.

(ORTHOCERATA.)

1



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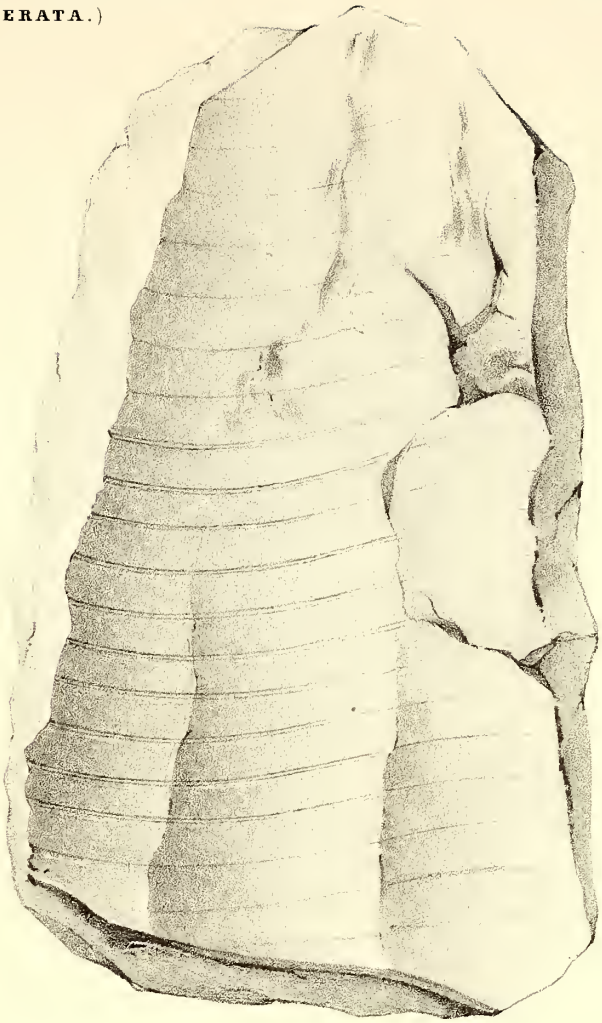

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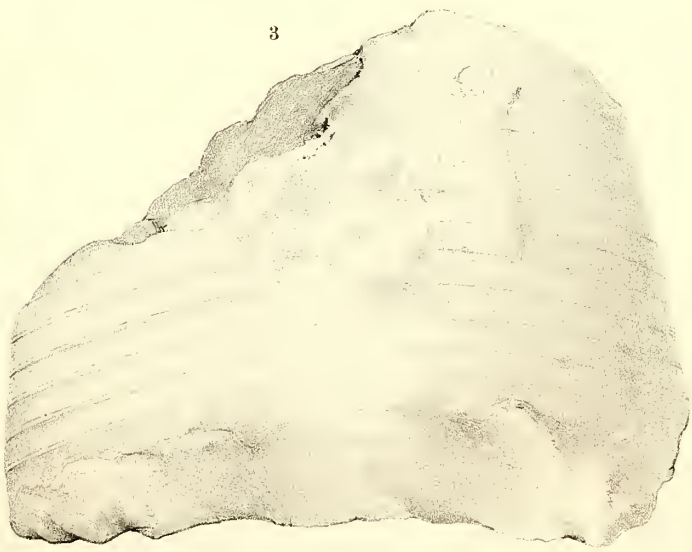


Swinton del.

Lith. of R.H. Pease, Albany

PLATE 63.

Fig. 1, 4. 658. 35. ORTHOCERAS CANCELLATUM. (Pag. 292.)

1. A part of a large individual, where the surface markings are scarcely preserved.
4 *a*. A small fragment, having the characters of the surface preserved in a tolerable degree of perfection.
4 *b*. A portion of the same enlarged.

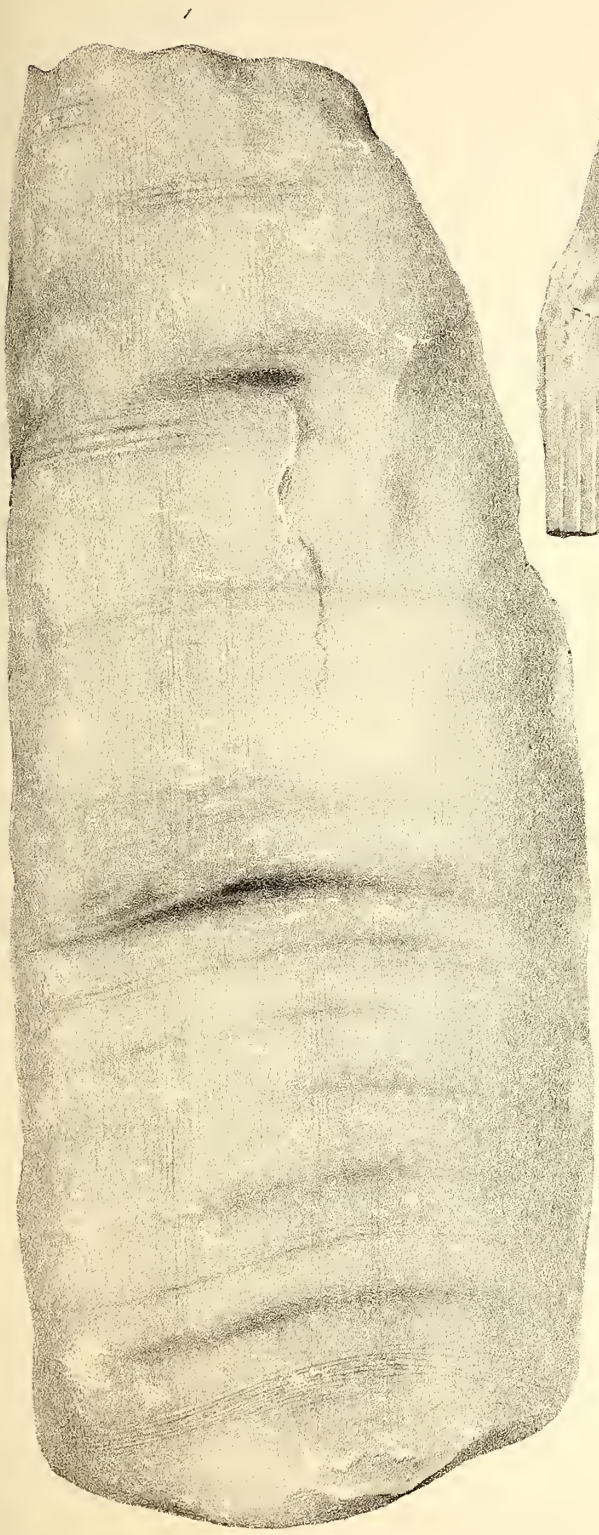
Fig. 2, 3. 657. 34. ORTHOCERAS VIRGATUM? (Pag. 291.)

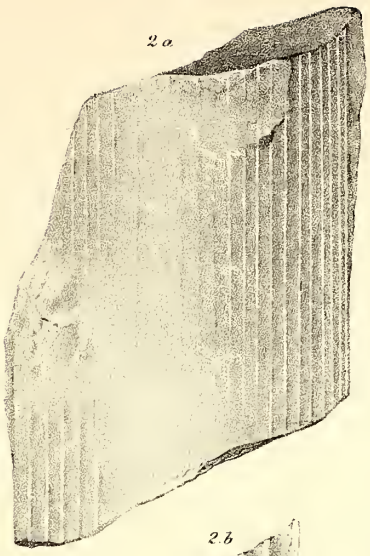
2 *a*. A fragment where the longitudinal ridges are equal and closely arranged.
2 *b*. A fragment enlarged.
3. A fragment where the longitudinal ridges attenuate in size.

Fig. 5. 659. 36. ORTHOCERAS ———? (Pag. 292.)

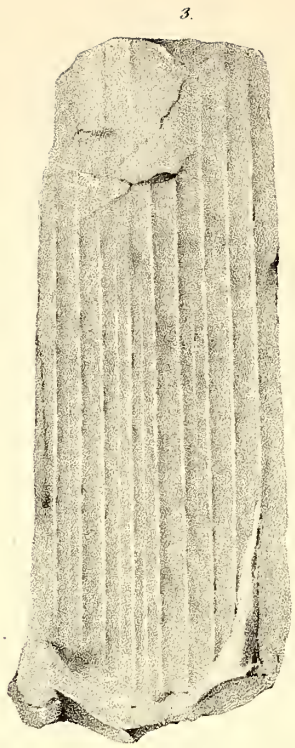
NIAGARA GROUP.

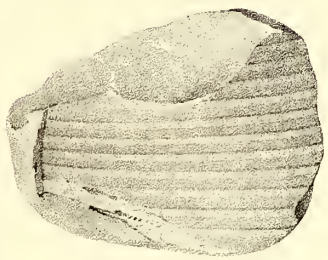
(ORTHOCERATA.)


1.

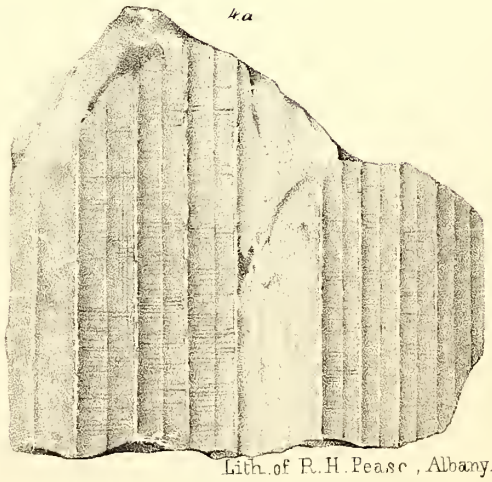

2 a.


2 b.


3.


5.


4 b.


4 a.

On Stone by T.J. Swinton.

Lith. of R.H. Pease, Albany.

PLATE 64.

Fig. 1. 660. 37. ORTHOCERAS UNDULATUM. (Pag. 293.)

1 *a*. A fragment of this species on a slab of shale.

1 *b*. Another fragment where the laminæ are nearly obsolete.

1 *c*. A fragment replaced by gypsum, and preserving only the annulations.

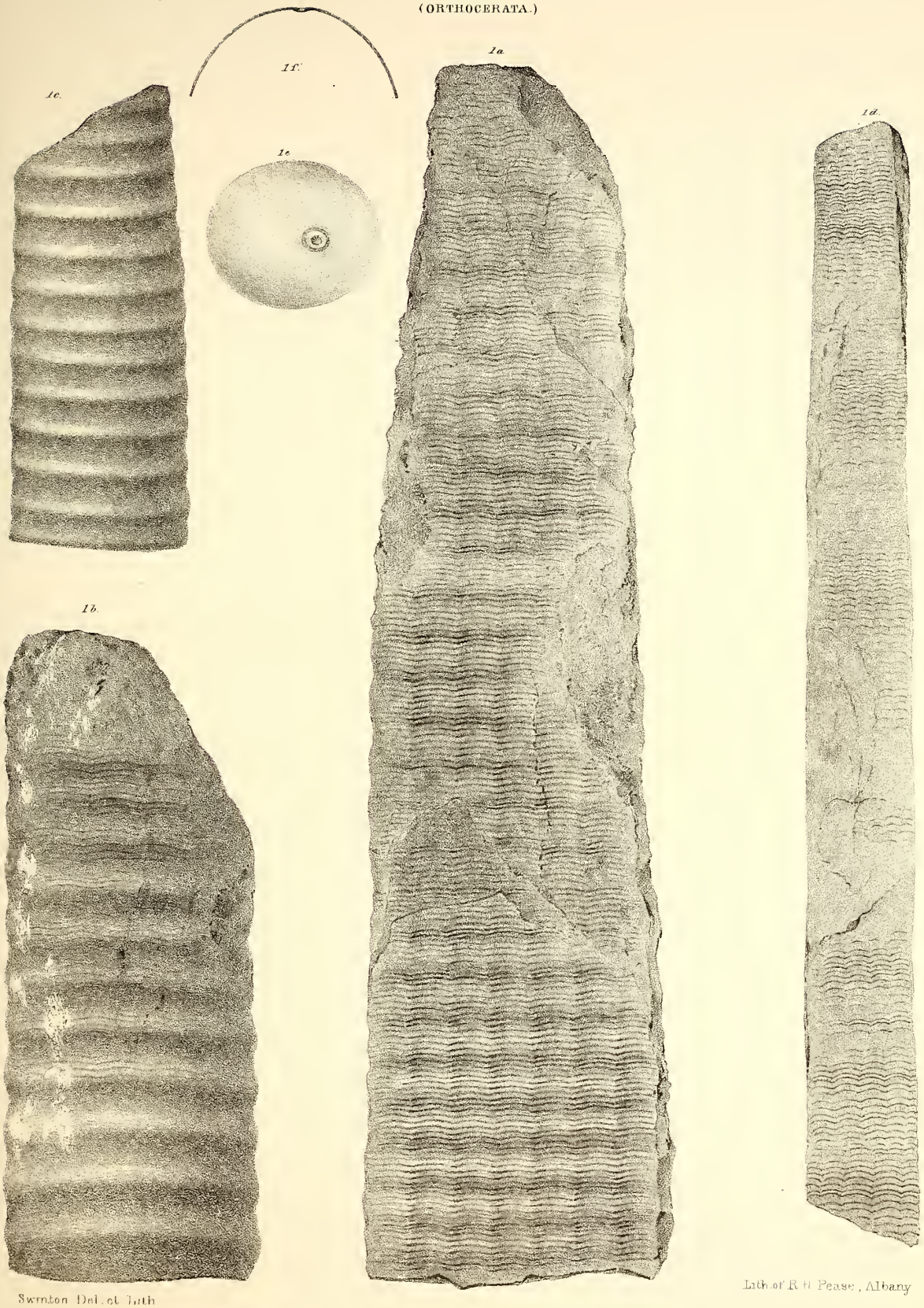
1 *d*. A fragment near the smaller extremity, showing the laminæ but partially preserved.

1 *e*. Transverse section of an imperfect and somewhat distorted specimen, showing the position of the siphuncle.

1 *f*. Vertical section showing the convexity of a septum.

NIAGARA GROUP.

(ORTHOCERATA.)



Swinton Del. et Lith

Lith. of R. H. Pease, Albany

PLATE 65.

Fig. 1. 661. 5. CONULARIA NIAGARENSIS. (Pag. 294.)

1 *a*. A fragment of a small specimen preserving the shell in great perfection.

1 *b*. An enlargement of this surface, showing the character of the striæ and intermediate spaces.

1 *c*. An impression of the exterior of a similar specimen, where the depressions between the striæ are distinct, and show the longitudinal striæ, with the narrow punctured depressions between.

1 *d*. An enlargement of the same.

1 *e*. The interior of the shell of a large specimen, showing the characters of the preceding, but proportionally stronger.

1 *f*. An enlargement of the same.

1 *g*. A cast of the interior, from near the base of the shell.

1 *g* †. An enlargement of the surface of 1 *g*.

1 *h*. The interior of a shell, showing only transverse ridges, except at intervals where broken.

Fig. 2. 662. 6. CONULARIA LONGA. (Pag. 295.)

2 *a*. A part of a large individual, showing one obtuse angle, with the strong channel, and a part of each of the adjoining sides.

2 *b*. A portion of the same enlarged.

2 *c*, *d*. A fragment of another individual, and an enlargement showing the character of the mould.

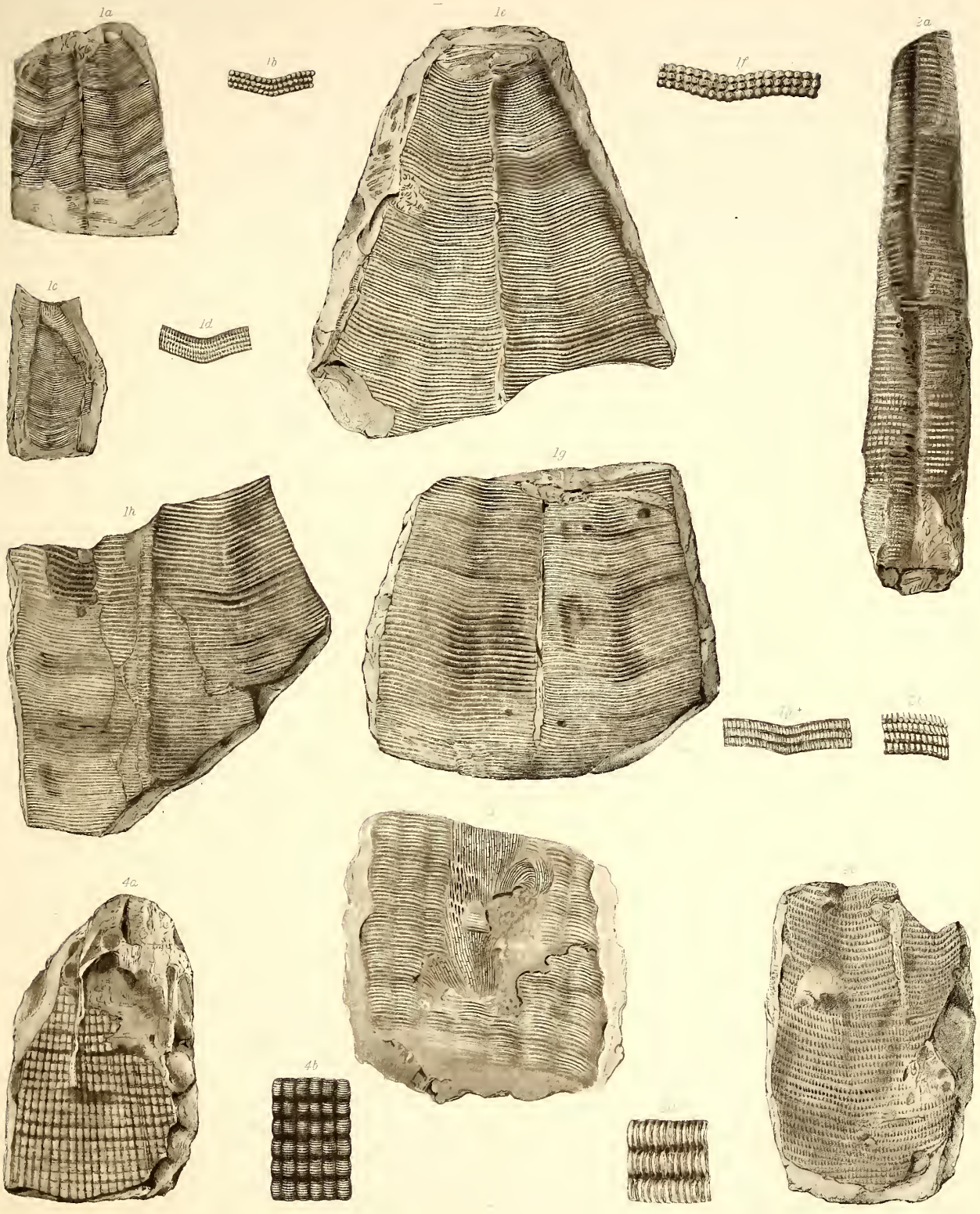
Fig. 3. 660. 37. ORTHOCERAS UNDULATUM. (Pag. 293.)

A fragment of this species from near the aperture.

Fig. 4. 658. 35. ORTHOCERAS CANCELLATUM. (Pag. 292.)

4 *a*, *b*. An impression of the exterior of this species, in iron pyrites, in which the sharp striæ are well preserved.

(CEPHALOPODA.)



Swinton

PLATE A 66.

Fig. 1. 663. 1. CYBELE PUNCTATA. (Pag. 297.)

1 *a*. An individual nearly entire, showing the proportion of parts.
1 *b*, *c*. The glabella and base of buckler of two individuals of different size.
1 *d*. The cheek separated at the facial suture.
1 *e*. Profile of glabella, showing the strong indentations at the base.
1 *f*. An enlarged portion, showing the prominent tubercles.
1 *g*, *h*. The caudal shields (imperfect at the extremities) of two individuals.
1 *i*. A small individual.
1 *k*. An enlargement of several articulations of the caudal shield.
1 *l*. The surface magnified, showing pustules of different size.

Fig. 2. 665. 3. ACIDASPIS ——— (*Species undetermined*). (Pag. 299.)

Fig. 3. 666. 3. PHACOPS TRISULCATUS. (Pag. 300.)

3 *a*. The individual of the natural size.
3 *b*. Enlargement of the buckler, several ribs of the body, and the caudal shield.

Fig. 4. 667. 5. CERAURUS INSIGNIS. (Pag. 300.)

Fig. 5. 664. 5. CALYMENE CLINTONI. (Pag. 298.)

5 *a*. An individual having the cheeks partially separated at the sutures, and crushed.
5 *b*. A profile view of the same.
5 *c*. A cheek of a larger individual separated from the buckler.
5 *d*. A caudal shield of a large individual in the iron ore.

Fig. 6. 298. 2. CALYMENE BLUMENBACHII, *var.?* SENARIA. (Pag. 299.)

6 *a*. An individual of large size, much expanded laterally.
6 *b*. The caudal extremity of the same, of remarkably large dimensions.
6 *c*. The glabella of the same. 6 *d*, *e*. The caudal extremities of two individuals.

Fig. 7. Fragments of *Homalonotus delphinocephalus*. (Pag. 299.)

Fig. 8. Fragments of *Phacops limulurus*. (Pag. 299.)

Fig. 9. 669. 1. BUMASTIS BARRIENSIS. (Pag. 299.)

9 *a*. The central portion of the cephalic shield, from shaly limestone of the Clinton group.
9 *b*. Front view of the same, showing the elevation.
9 *c*. The caudal shield of another individual. 9 *d*. View showing the convexity of the same.
9 *e*. Section of a fragment of limestone, which is mainly composed of the cephalic and caudal shields of this trilobite.
9 *f*. Magnified view of a weathered portion of one of these shields.

Fig. 10. 668. 1. BEYRICHIA LATA. (Pag. 301.)

10 *a*. A fragment of ferruginous slate, covered with the separate valves of this fossil.
10 *b*. A valve having a subcentral depression.
10 *c*. A valve with a subcentral lobe or nucleus.
10 *d*, *e*. The interior of the shell, or impression made by the cast.

CLINTON GROUP

(TRILOBITES)

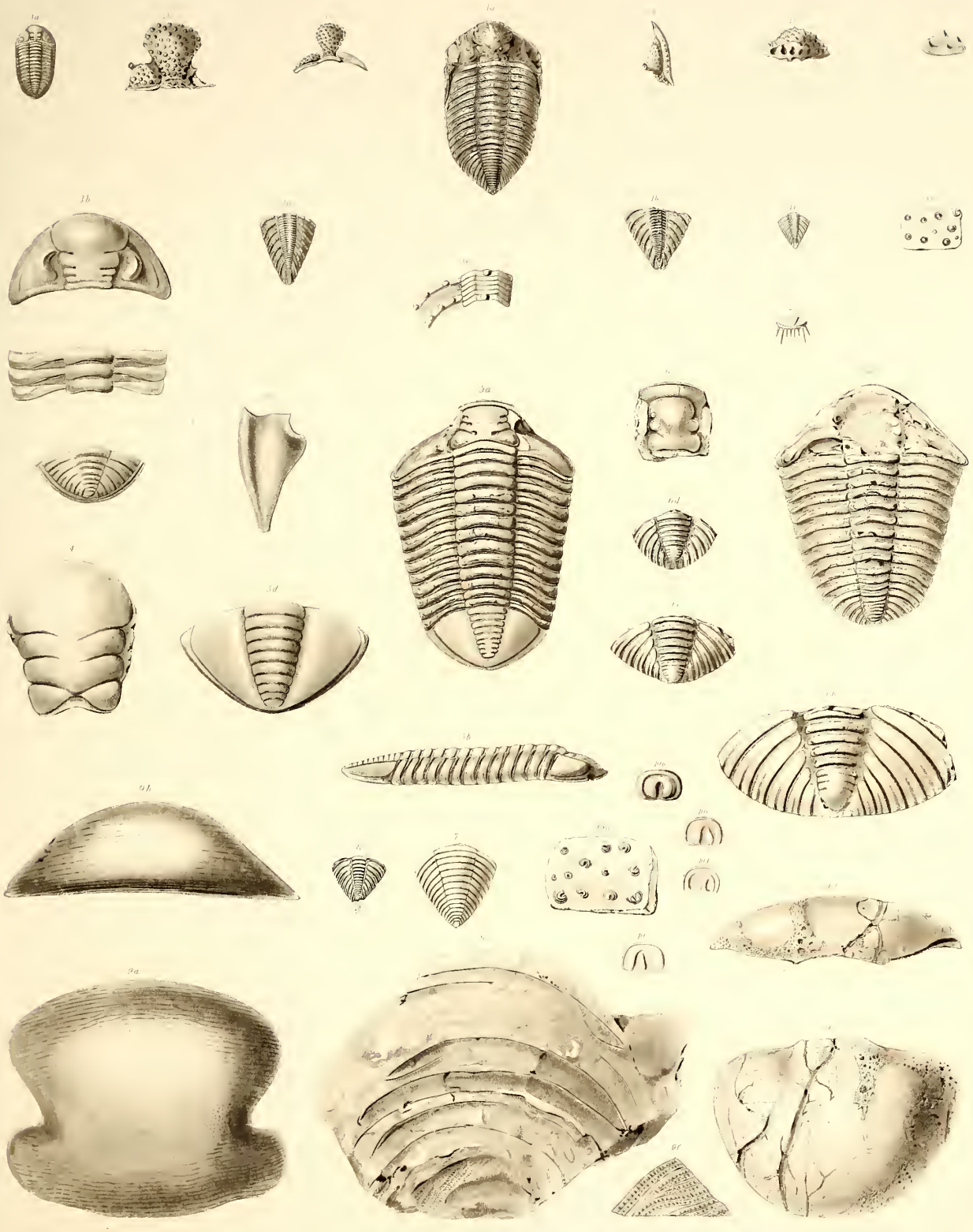


PLATE 66.

Fig. 1 – 15. 669. 1. Bumastis barriensis. (Pag. 302.)

1 & 2. Young specimens of this trilobite.

3 & 4. Larger specimens of the same, showing slightly different proportions.

5. A larger individual where the articulations of the body are closely pressed together, and the cephalic shield slightly overlapping the upper edge.

6. A large individual preserving its natural proportions.

7 & 8. The central portions of the cephalic shield as they occur in the shale, entirely flattened.

9. An unusually large cephalic shield, preserving the cheeks which are somewhat distorted.

10 & 11. The cheek with a part of the eye attached, and the same enlarged.

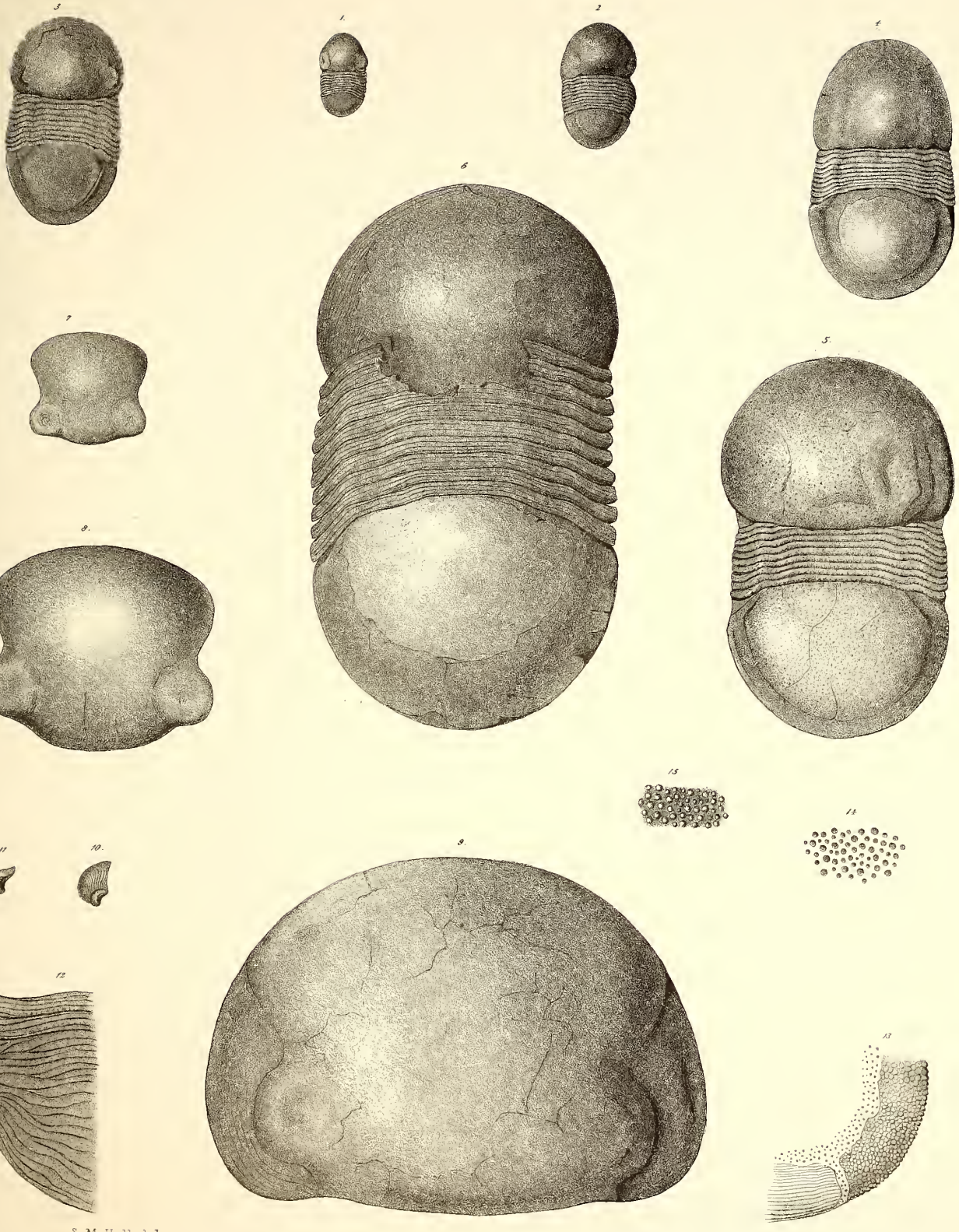
12. A part of the caudal shield and two articulations enlarged, showing the lamellar striæ with intermediate granular surface.

13. A portion of another caudal shield of another specimen, preserving the punctate crust in one part, showing the striated surface where the crust is broken off around the margin, and above this the punctate surface, which sometimes marks well preserved casts.

14 & 15. Enlargements of the punctate surface of the shell and cast of this fossil.

NIAGARA GROUP.

(TRILOBITES.)



S. M. Hall, del

Lith. of R. H. Pease, Albany

PLATE 67.

Fig. 1 – 8. 670. 4. PHACOPS LIMULURUS. (Pag. 303.)

1. An individual of the ordinary size of this species, in the Niagara group.
2. A smaller individual. This, like all the young specimens I have seen, is narrowed towards the posterior part of the body, more than older specimens.
3. The separate cephalic shield, destitute of the crust, which is of very common occurrence in localities where perfect specimens are not found.
4. The caudal shield preserving the crust, and the extension of the same into a long slender spine.
5. A specimen of shale covered with fragments of trilobites and other fossils, among which are two caudal shields of this species preserving the crust.
6. The caudal extremity and a few articulations of the abdomen from which the crust is separated, showing the difference of form thus produced in this part of the fossil.
7. The inner surface of the crust (separated from the specimen fig. 6), showing the extension laterally in a thick border beyond the marks of articulation, and posteriorly into the spine.
8. The eye of this species enlarged, showing the elevation, form and structure of the surface.

Fig. 9, 10. 667. 5. CERAURUS INSIGNIS. (Pag. 306.)

9. The central portion of a cephalic shield, preserving the form and proportions of the glabella and the outer crust in part, with the spine at one of the posterior angles.
10. Another similar fragment, where the base of the eye is preserved on one side, with the posterior spine of the buckler.

Fig. 11, 12. 671. 7. CALYMENE BLUMENBACHII, *var.* NIAGARENSIS. (Pag. 307.)

11. An entire individual of the largest size, found in the shale of the Niagara group.
12. A fragment of shale having upon its surface three entire specimens of this species. At *a* there is the caudal shield of a HOMALONOTUS, and at *b* the caudal shield of *Phacops limulurus*.

Fig. 13, 14. 676. 2. PROETUS? STOKESII. (Pag. 316.)

13. An individual in soft shale, with the crust partially exfoliated.
14. An individual in limestone, partially folded, and having the buckler imperfect.

Fig. 15. 675. 1. PROETUS CORYCŒUS. (Pag. 315.)

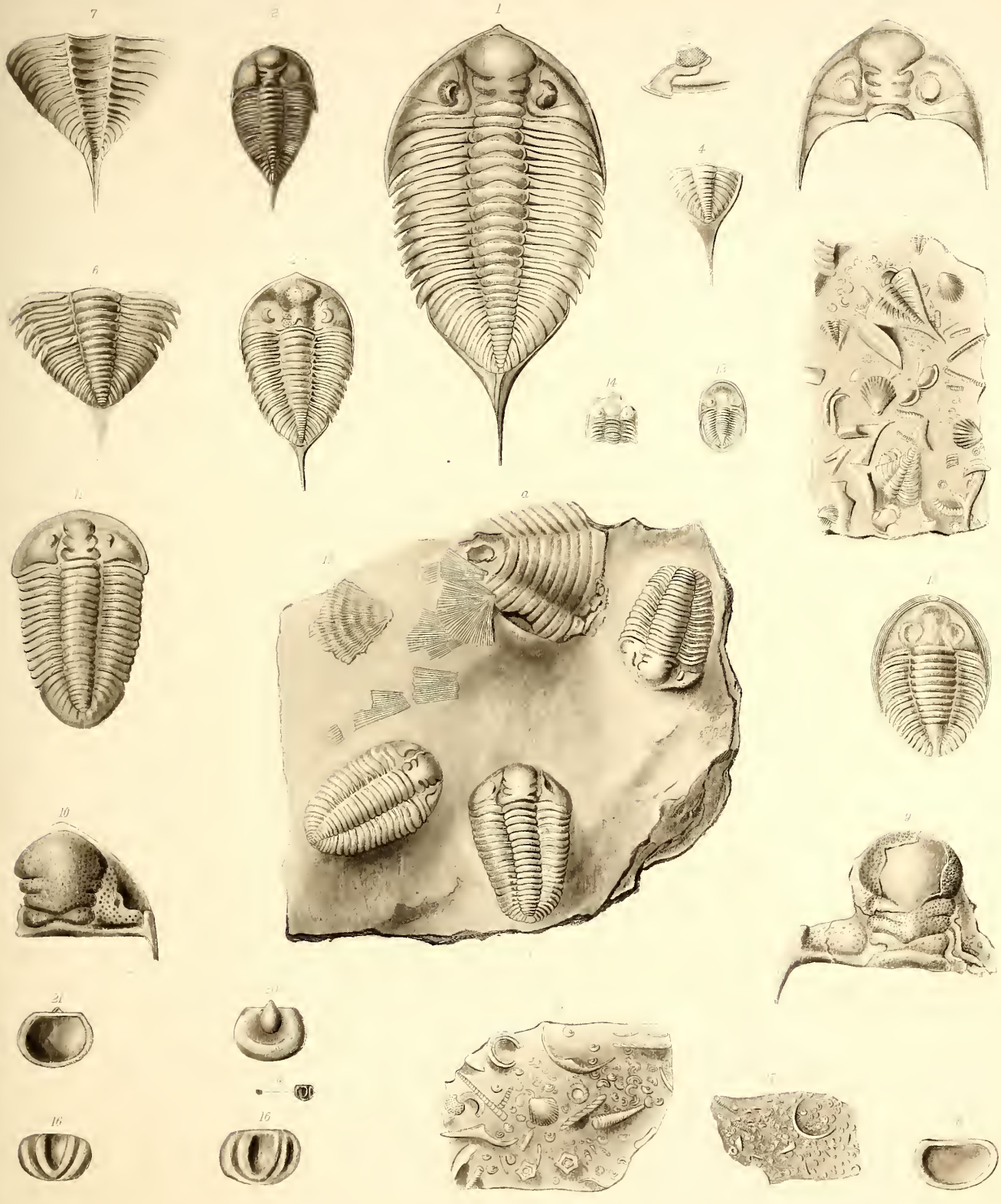
Fig. 16. 677. 1. BEYRICHIA SYMMETRICA. (Pag. 317.)

Specimen natural size and enlarged.

Fig. 17 – 21. 678. 2. CYTHERINA SPINOSA. (Pag. 317.)

17. A fragment of calcareous shale covered with these shells, showing the internal surface.
18. An enlargement of a single individual, showing the ordinary appearance of the interior under a magnifier.
19. A fragment covered with shells of this species, showing the external surface, with a few of those showing the interior.
20. The exterior of a single individual, much enlarged.
21. The interior, showing the spine projecting beyond the dorsal margin.

(TRILOBITES)



Bacon & Britton Albany

PLATE 68.

Fig. 1 – 14. 503. 1. HOMALONOTUS DELPHINOCEPHALUS. (Pag. 309.)

1, 2 & 3. Individuals of different sizes, from the smallest yet seen.

4. An individual of medium size, and remarkable for having the caudal extremity obtuse.

5. A large individual of this species, where the caudal extremity is very acute.

6. A small specimen rolled up. This position is very rare for this species, though quite common in the *H. dekayii*.

7, 8 & 9. The head and caudal shields as they occur separately in the rock.

10. The head of a large individual, with a part of the glabella broken up, and which has carried with it the hypostoma or clypeus, the impression of which is still visible.

11. The lower side of this separated fragment, showing the clypeus.

12. A lateral view of several of the articulations of the body, as shown when the individual is bent a little downwards in the middle.

13. Several articulations still more expanded, showing their entire form.

14. A portion of the surface from the caudal extremity enlarged, showing the characteristic little papulous elevations.

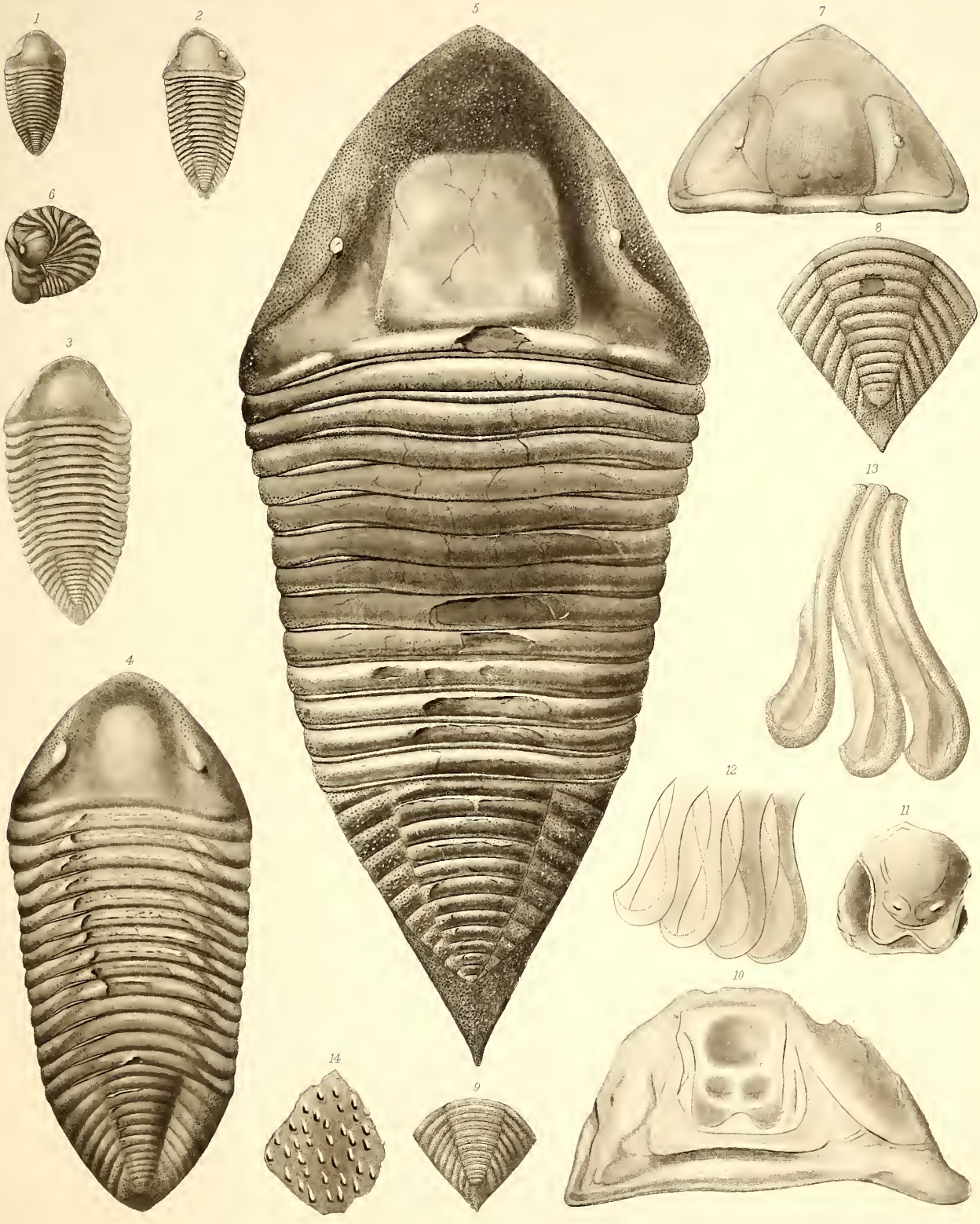

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PLATE 69.

Fig. 1. 672. 1. LICHAS BOLTONI. (Pag. 311.)

A large individual of this species, as perfect as usually found of this size. The eye tubercles are crushed, and so much mutilated that their form is not well preserved. The extent of the scabrous outer crust can be inferred from the patches still remaining.

(TRILOBITE)

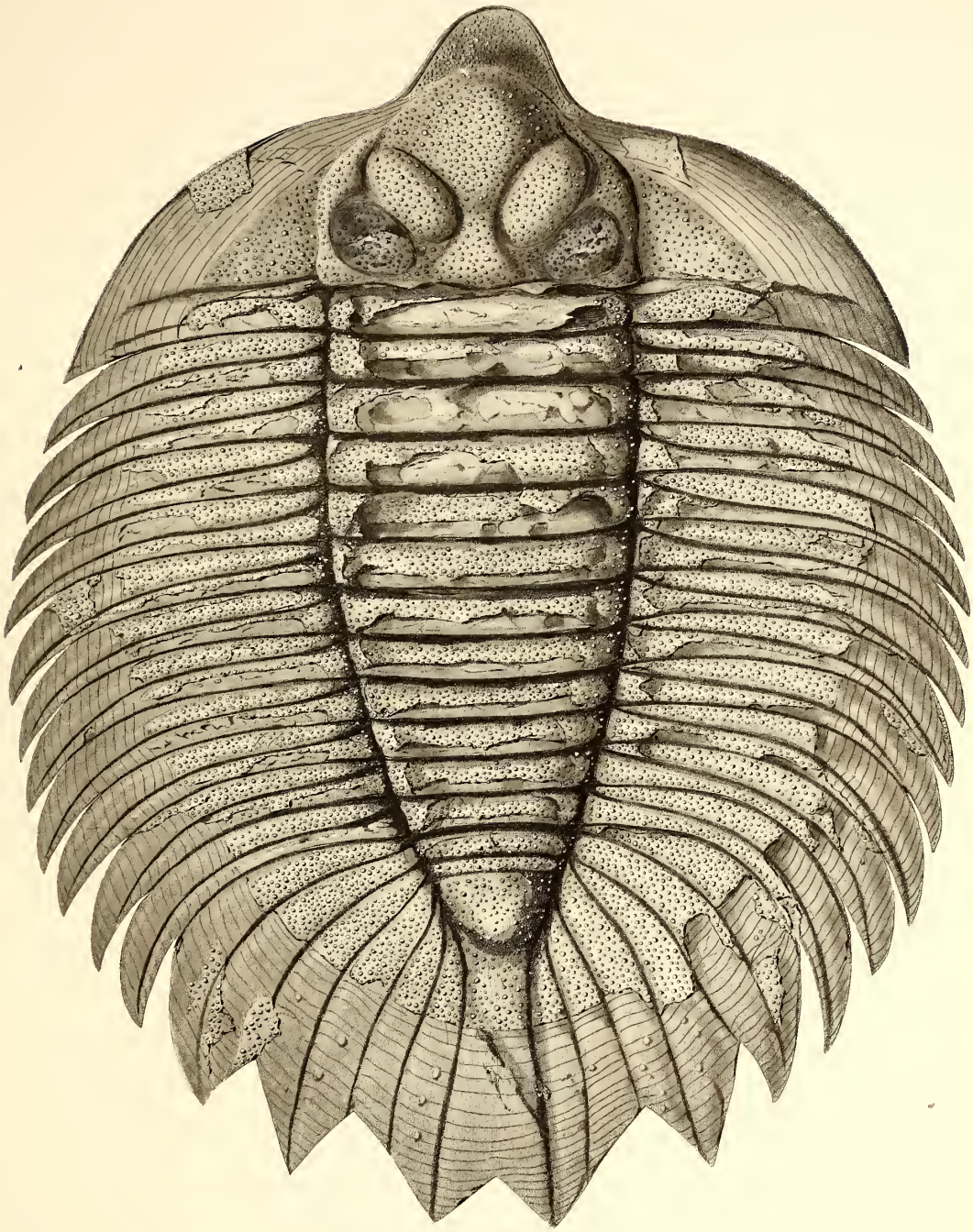


PLATE 70.

Fig. 1. 672. 1. LICHAS BOLTONI. (Pag. 311.)

1 *a*. The head of an individual smaller than the preceding, in which the form of the eye tubercles is more distinctly preserved, as well as the form and direction of the lateral lobes of the glabella.

1 *b*. The under side of the head and several articulations, showing the clypeus attached below the front of the glabella.

1 *c*. A fragment of another specimen, showing the impression left after the removal of the clypeus.

1 *d*. The under side of the glabella, where the clypeus is removed.

1 *e*. Profile of the buckler, showing the elevation of the eye in a specimen where it is very well preserved.

1 *f*. A fragment of the glabella and base of the buckler.

1 *g*. A pygidium of a specimen of medium size, showing more pointed terminations of the articulations.

1 *g* †. A portion of the crust magnified from 1 *g*.

1 *h*. A smaller pygidium with the terminations broken.

1 *i*. A young individual of this species, having the base of the buckler broken.

Fig. 2. 674. 1. ARGES PHLYCTANODES. (Pag. 314.)

2 *a*. The posterior part of the buckler, showing the lateral lobes and the prominent central one.

2 *b*. The front of the same, a view directly opposite to the previous one.

2 *c*. Profile view of the same.

Fig. 3. 673. 1. BRONTEUS? NIAGARENSIS. (Pag. 314.)

NIAGARA GROUP

(TRILOBITES)

M.F. Brooks, Del.

PLATE 71.

Fig. 1. 1. Onchus deweii. (Pag. 320.)

1 *a*. A fragment of shale, retaining the base of the spine, with about two inches of the lower portion, and the impression beyond this nearly to the apex.

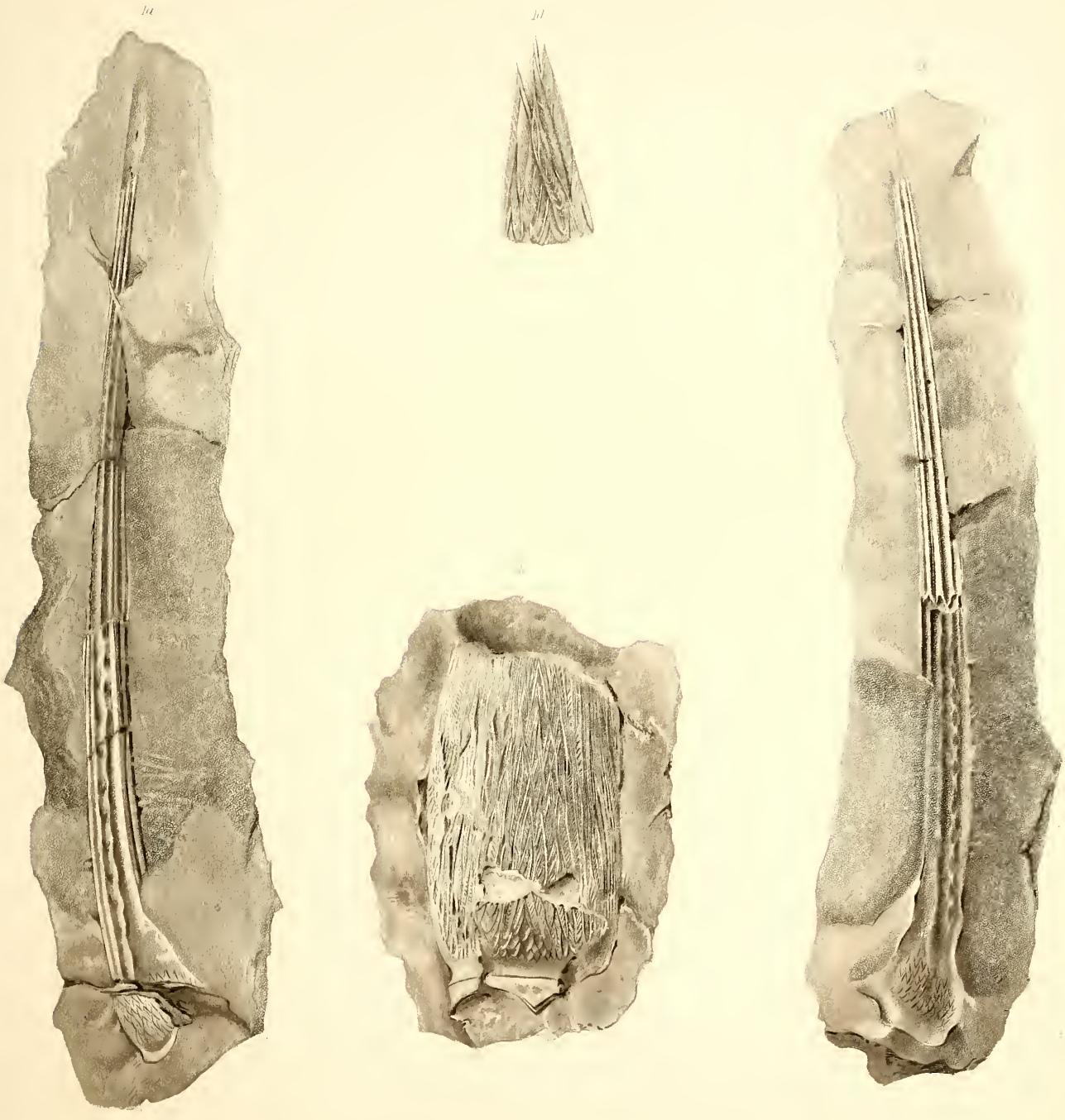
1 *b*. A fragment, retaining the impression of the base and lower portion of the spine of the preceding specimen, with the higher portion of the spine itself.

1 *c*. The basal portion of a much larger specimen, showing very distinctly the ornamented surface and constricted base.

1 *d*. An enlargement from the surface of 1 *c*.

NIAGARA GROUP.

(FISHES)



Rich.d H Pease

PLATE 72.

Fig. 1. 679. 3. DIPLOPHYLLUM CORALLIFERUM. (Pag. 322.)

1 *a*. The ends of numerous stems of this coral, enclosed in a mass of STROMATOPORA.

1 *b*, *c*. Enlargements from different cells of this coral.

Fig. 2. 681. 2. STROMATOPORA CONSTELLATA. (Pag. 324.)

2 *a*. A portion of the surface of one of these masses, showing the nodose stellate laminæ.

2 *b*. An enlargement of the surface of two of these nodes.

Fig. 3, 4. 680. 1. COLUMNARIA INEQUALIS. (Pag. 323.)

3 *a*. A part of the surface of a small irregular mass, showing fewer young cells than is usual.

3 *b*. Several of the same enlarged.

4 *a*. A portion of a specimen showing the prismatic structure of the coral.

4 *b*. A weathered portion enlarged, showing the cellular structure.

4 *c*. A reversed figure, the lower extremities of several columns enlarged, showing the mode of weathering, and the structure after the removal of the exterior cellular area.

(CORALS.)

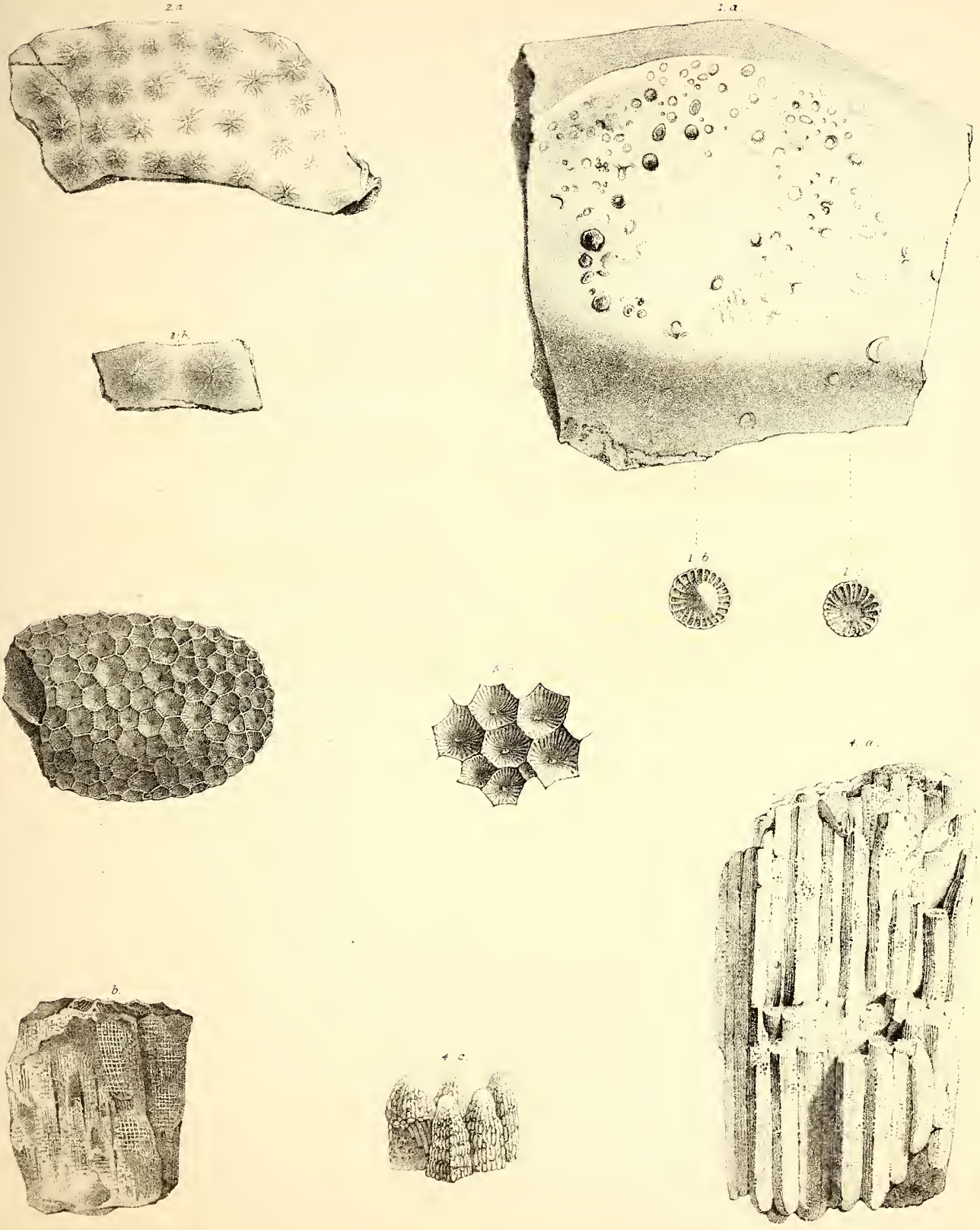


PLATE 73.

Fig. 1. 515. 1. FAVOSITES NIAGARENSIS? (Pag. 324.)

1 *a*. A fragment of stone, showng one mass in its natural position, while the other is reversed.

1 *b*. A surface showing the ends of the columns.

1 *c*. A broken surface, showing the cellular structure : the walls and dissepiments are covered by fine quartz crystals.

1 *d*. A small mass of this species.

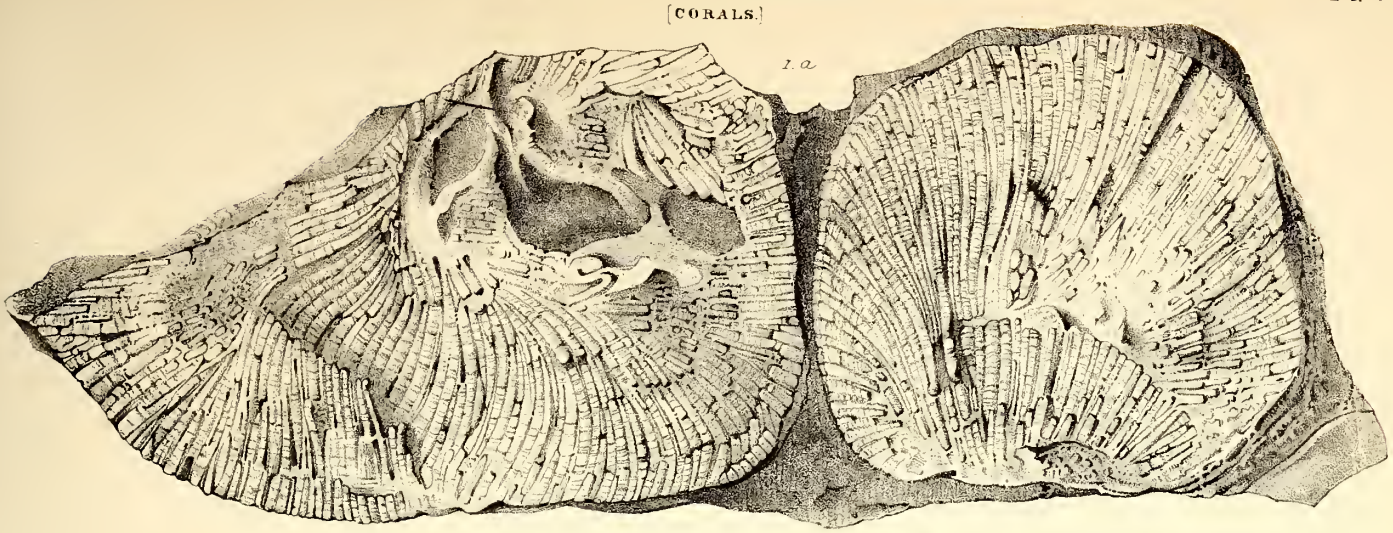
1 *e*. A polished surface of another smaller specimen

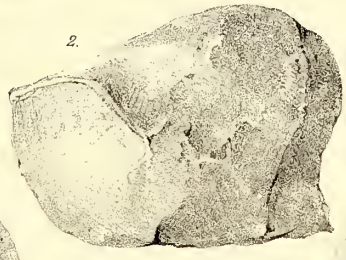
Fig. 2. 523. 1. STROMATOPORA CONCENTRICA. (Pag. 325.)

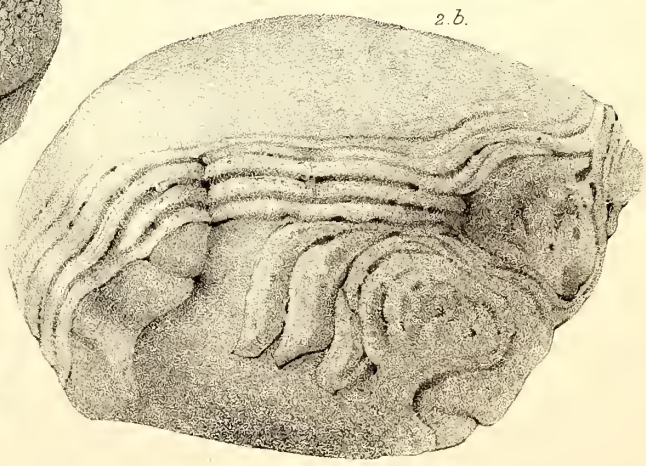
2 & 2 *a*, *b*. Indvidual masses of various forms.

CORALLINE LIMESTONE.

[CORALS.]







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WM. ENDICOTT & CO. LITH. N. YORK.

PLATE 74.

Fig. 1, 2. 682. 31. ORTHIS INTERSTRIATA. (Pag. 326.)

1 *a*. The interior of the ventral valve, showing regularly dichotomous striæ.

1 *b*. The striæ enlarged. 2 *a*. The dorsal valve of a smaller specimen.

2 *b*. The surface enlarged, showing the interstitial striæ.

Fig. 3. 683. 27. LEPTÆNA ———. (Pag. 326.)

3 *a*. A speeimen showing the form of the shell.

3 *b*. An enlargement, showing the thin radii and connecting concentric lines.

Fig. 4, 5. 684. 28. LEPTÆNA BIPARTITA. (Pag. 326.)

4 *a*. The interior of the ventral valve, with the dental laminæ worn off.

4 *b*. An enlargement from the surface of this specimen.

5 *a*. The impression of the dorsal valve, with some portions of the shell remaining.

Fig. 6. 685. 2. STROPHODONTA TEXTILIS. (Pag. 327.)

6 *a*. The ventral valve described.

6 *b*. The hinge-line enlarged, showing impressions of the crenulations.

6 *c*. A further enlargement of a portion of the same, showing the crenulations.

6 *d*. A portion of the surfaee enlarged, showing the fine eoncentric striæ.

Fig. 7, 8. 686. 10. SPIRIFER ———. (Pag. 327.)

7. The dorsal valve of a specimen, showing evidences of five plications on each side of the mesial sinus.

8 *a*, *b*, *c*. A very convex dorsal valve, where the evidences of plications are more obscure, though the surfaee still preserves marks of coneentrie striæ.

8 *d*. A smaller specimen having the angle partially covered by the stone.

Fig. 9. 623. 6. SPIRIFER CRISPUS. (Pag. 328.)

9 *a* – *h*. Different views of several specimens of this shell, showing very elearly its identity in form with those figured on Pl. 54, the latter having the plications more strongly developed.

Fig. 10. 687. 58. ATRYPA NUCLEOLATA. (Pag. 328.)

10 *a*, *b*, *c*. Views of the ventral valve in several speeimens of different size.

10 *d*, *e*, *f*. Front views of the same specimens, showing the indentation.

10 *g*, *h*. Dorsal valve and cardinal views of another specimen.

10 *i*, *k*. Dorsal and ventral veiws of a larger individual, where the indentation is scarcely perceptible.

10 *l*, *m*. Profile views of fig. 10 *i* and fig. 10 *k*.

Fig 11. 688. 59. ATRYPA LAMELLATA. (Pag. 329.)

11 *a*. Ventral valve of a full grown specimen. 11 *b*. Several plications enlarged.

11 *c*, *d*. Ventral and front view of a smaller specimen.

11 *e*, *f*. A specimen showing scareely any sinus or elevation.

11 *g*, *h*. Profile views of different specimens, the lower figure perhaps flattened from compression.

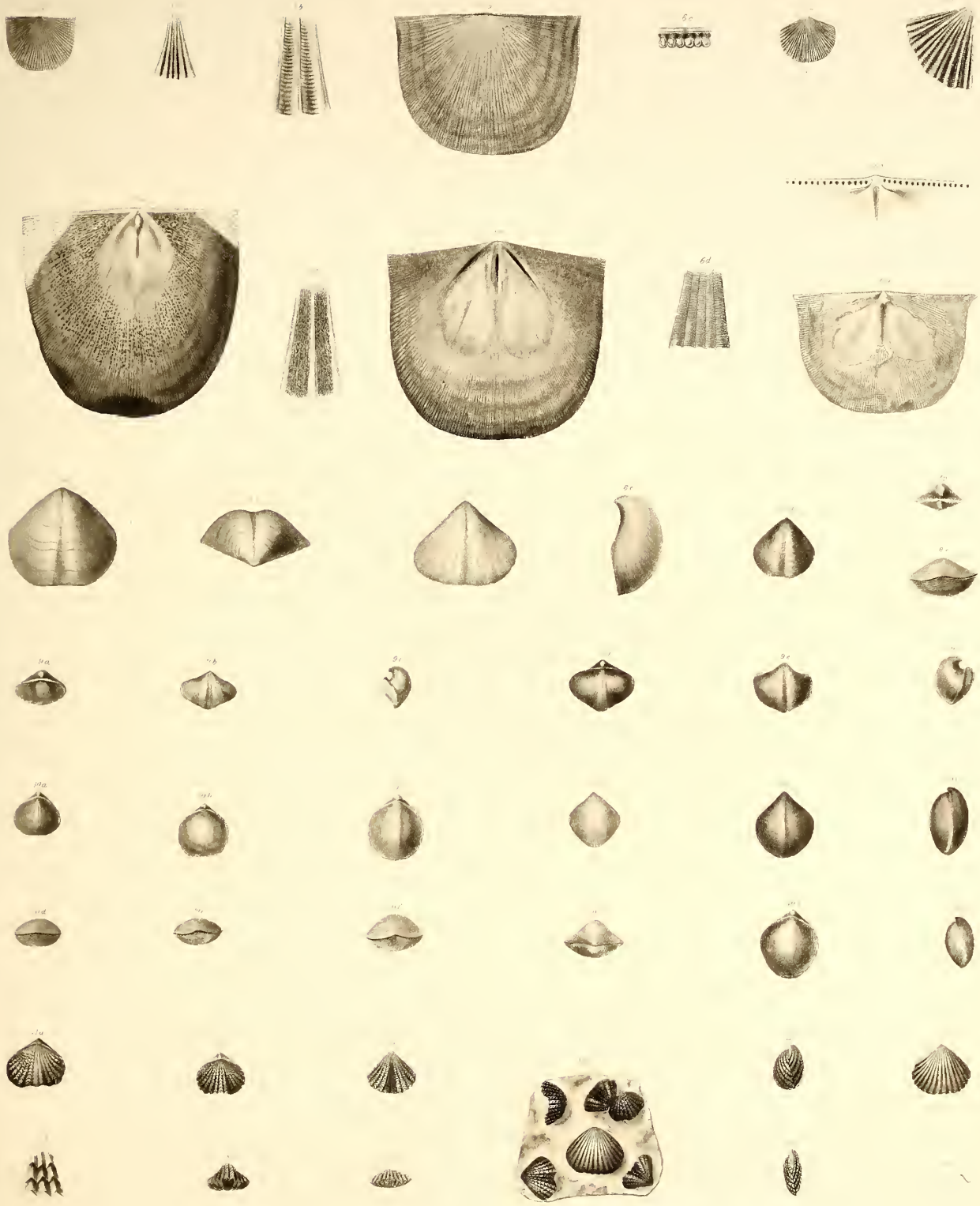
11 *i*. Dorsal valve of an individual in which the plications are worn smooth.

11 *k*. Profile showing the elevation of the plications.

Fig. 12. 689. 60. ATRYPA ———. (Pag. 330.)

12. A fragment of stone, on which are grouped several specimens of the preceding species, with a single one of this species in the centre.

(BRACHIOPODA.)



M H Del

PLATE 75.

Fig. 1. 690. 10. TELLINOMYA? EQUILATERA. (Pag. 330.)

1 *a*, *b*. Similar views of two specimens, showing a slight difference in form, probably due to pressure.
1 *c*. Cardinal view of fig 1 *a*.
1 *d*. View of the posterior slope, showing the groove in each valve.

Fig. 2. 691. 11. AVICULA? ———. (Pag. 331.)

2 *a*, *b*, *c*. Right and left valve, and profile view of the specimen.

Fig. 3. 692. 12. AVICULA SUBRECTA. (Pag. 331.)

Left valve of *A. subrecta*.

Fig. 4, 5. 693. 13. AVICULA SECURIFORMIS. (Pag. 331.)

4. Cast of the left valve. 5 *a*. The interior of the left valve of a young shell.
5 *b*. The interior of the left valve of a full grown individual.

Fig. 6. 694. 14. AVICULA LIMÆFORMIS. (Pag. 332.)

6 *a*. Cast of the interior of the right valve, in which the plications are quite distinct and angular.
6 *b*. Interior of the right valve of another specimen, in which the spaces between the plications are nearly flat.
6 *c*. Portion enlarged.

CORALLINE LIMESTONE.

(ACEPHALA.)

1a.

1b

1c.

2a

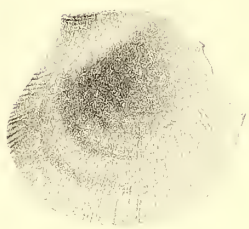
3.

1d

2b

4

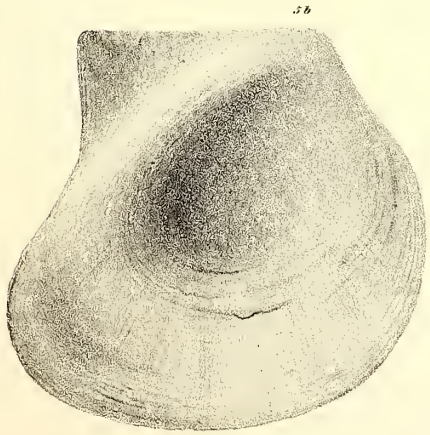
5a



2c.

6c

5b



6a

6b

Mrs Hall del
Swinton lith

Lith. of R. H. Pease Albany

PLATE 76.

Fig. 1. 695. 4. PLATYOSTOMA ———. (Pag. 333.)

Fig. 2. 696. 21. PLEUROTOMARIA SUBDEPRESSA. (Pag. 333.)

2 *a*. Profile view of the fragment. 2 *b*. View of the apex of the same.

Fig. 3. 697. 17. MURCHISONIA? OBTUSA. (Pag. 333.)

Fig. 4. 698. 18. MURCHISONIA? TEREBRALIS. (Pag. 334.)

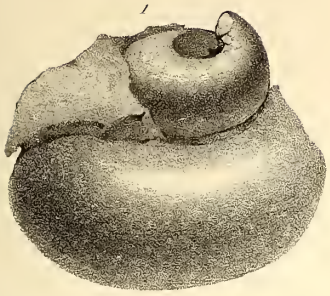
Fig. 5, 6. 699. 10. BUCANIA ———. (Pag. 334.)

5. An individual of large size. 6 *a*, *b*. Two smaller specimens.

Fig. 7 *a*, *b*. 700. 5. BELLEROPHON AURICULATUS. (Pag. 334.)

CORALLINE LIMESTONE.

(GASTEROPODA.)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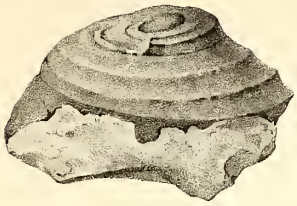
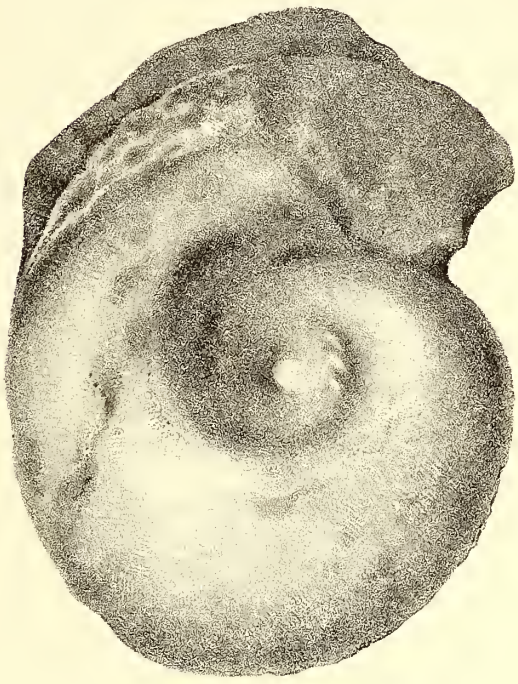

2a


2b.


5


3


4


7a


7b


6a


6b

Swinton Del et Lith

Lith of R H Pease, Albany

PLATE 77.

Fig. 1.	702.	2.	Trochoceras turbinata.	(Pag. 336.)
Fig. 2.	701.	1.	Trochoceras gebhardii.	(Pag. 335.)

CORALLINE LIMESTONE.

(CEPHALOPODA.)

EPHCOTTS LITH.

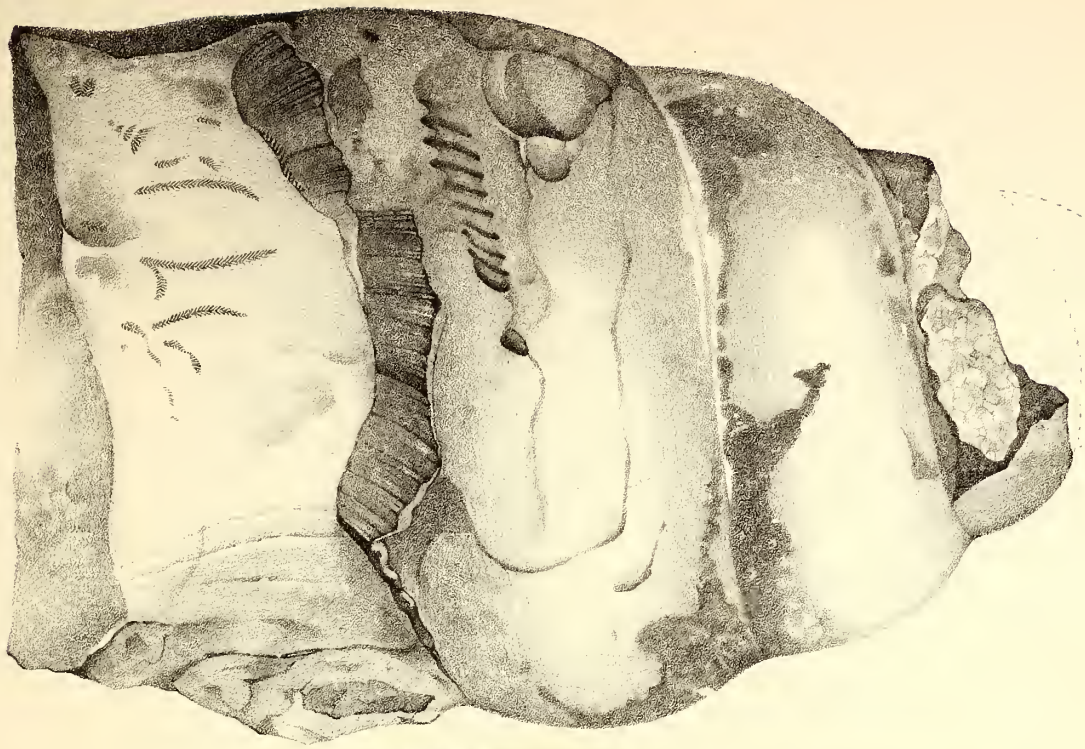


Fig. 1.

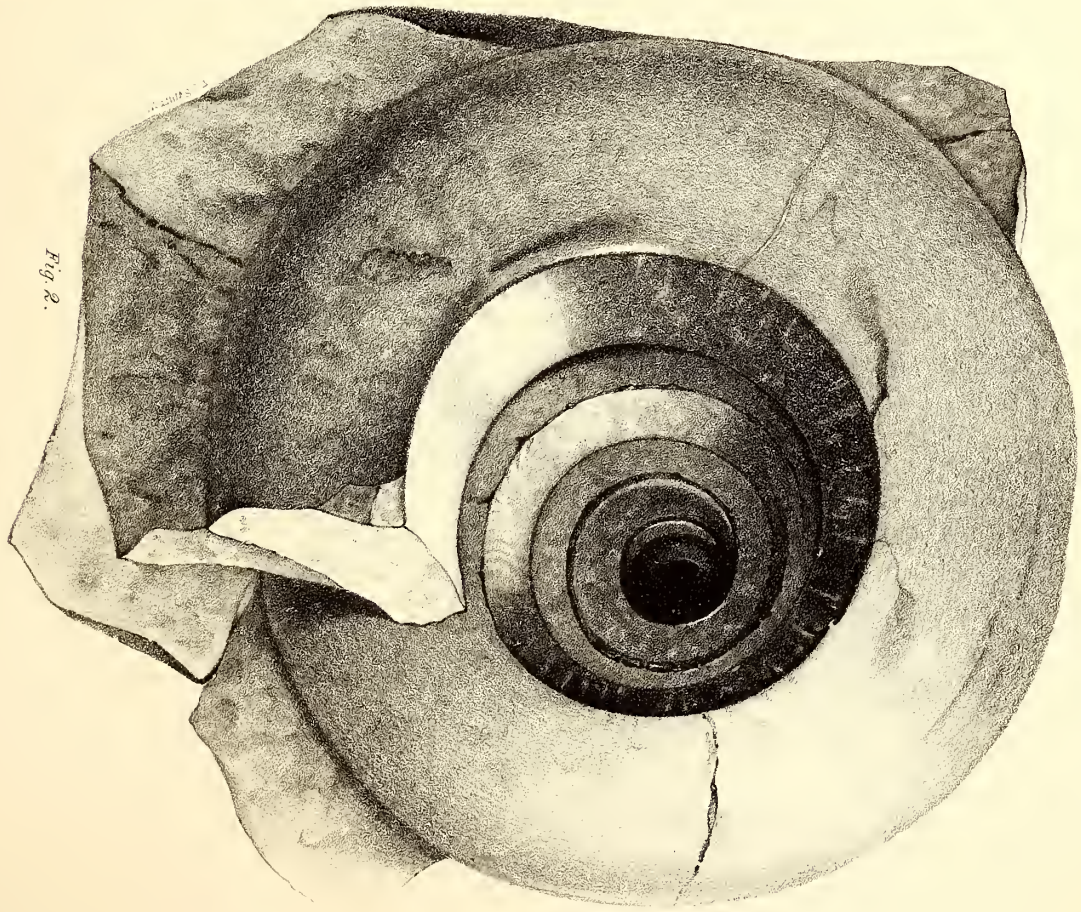


Fig. 2.

NEW YORK.

PLATE

PLATE 77 a.

Fig. 1. 701. 1. Trochoceras gebhardii. (Pag. 335.)

1 *a*. View of the base of the preceding specimen, after the removal of the last volution, showing the direction of the septa.

1 *b*. The base of another specimen, which has the upper portion enclosed in solid limestone.

1 *c*. A transverse section just above the first volution.

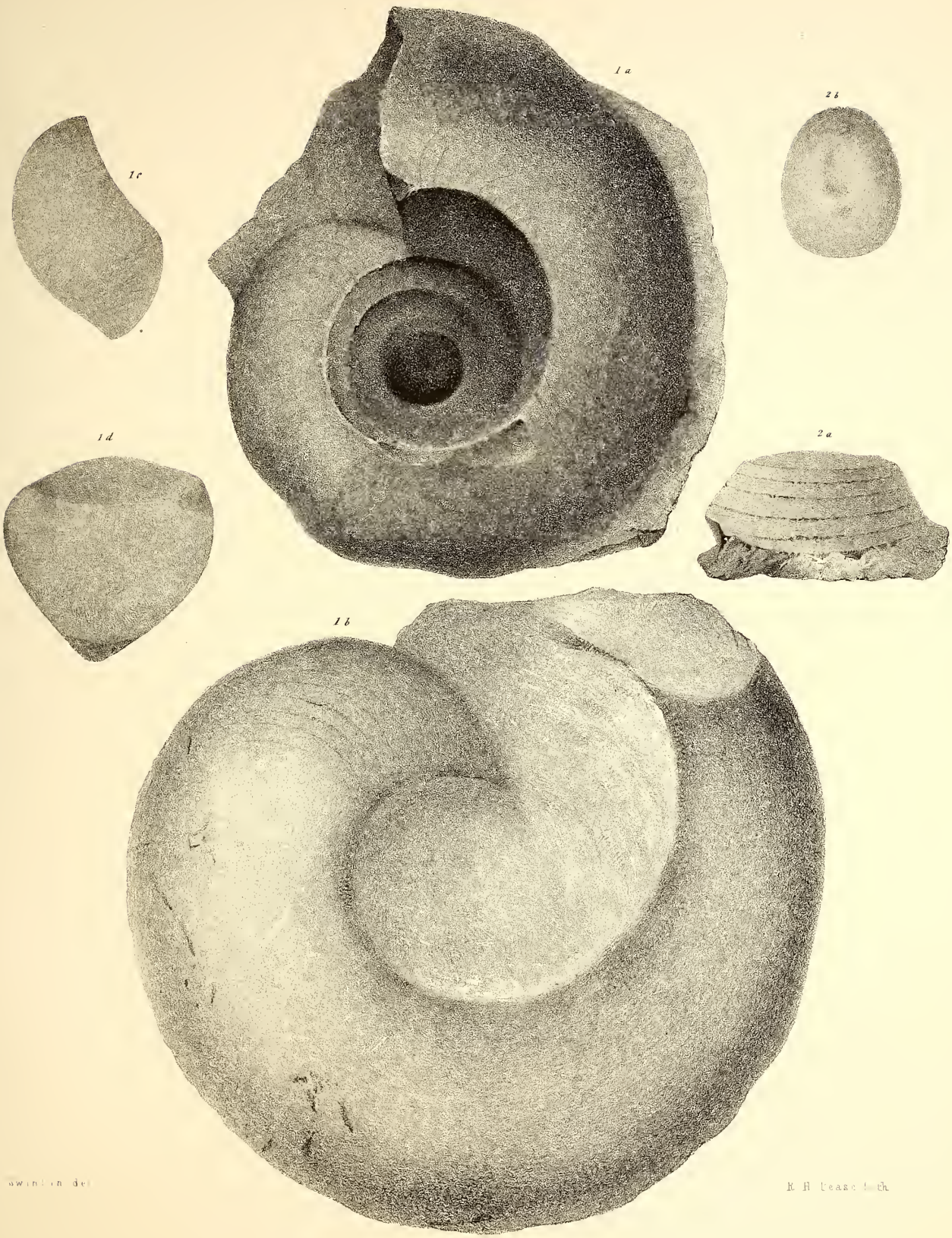
1 *d*. A transverse section, about one half or two-thirds of a volution above the aperture.

Fig. 2. 703. 4. Oncoceras expansum. (Pag. 337.)

2 *a*. Lateral view of the specimen.

2 *b*. Transverse section, showing the position of siphuncle.

(SHELLS.)



Swinton del. E.H. Pease lith.

PLATE 78.

Fig. 1. 704. 8. CALYMENE CAMERATA. (Pag. 337.)

1 *a*. A specimen preserving eleven articulations of the thorax, and a large part of the cephalic shield.

1 *b*. The central part of the cephalic shield, the lateral portions being separated at the suture.

1 *c*. Another cephalic shield, in which the central portions are better preserved.

1 *d*. The caudal shield.

1 *e*. Front view of the cephalic shield, from which the marginal rim is broken, showing the arched projections from the eye to the glabella.

Fig. 2. 705. 3. CYTHERINA ALTA? (Pag. 338.)

2 *a*, *b*, *c*. Individuals of different size.

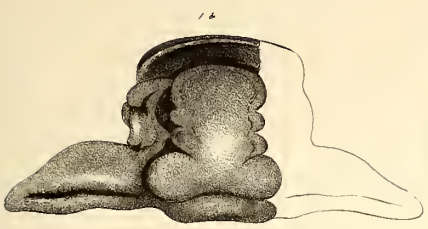
2 *d*. An enlargement of the surface, showing the papulose character.

Fig. 3 *a*, *b*. PHRAGMOCERAS?

For description, see Appendix.

CORALLINE LIMESTONE.

(CRUSTACEA &c.)



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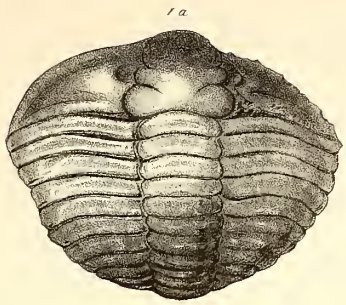
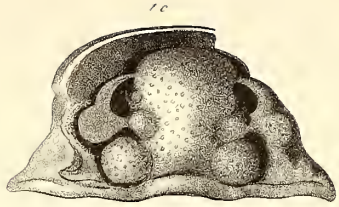


1c.



1d.

2c.

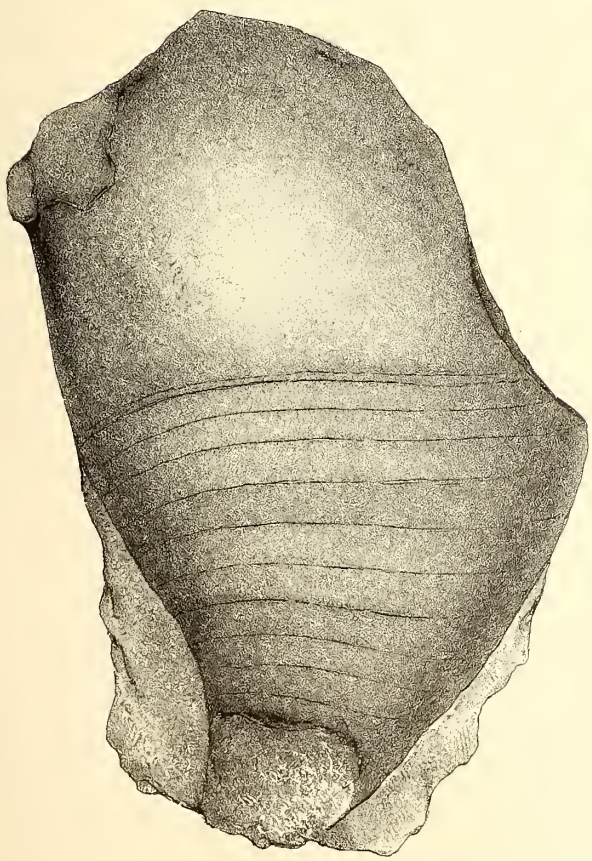
2b.

2a.

1e.

2d.

3a



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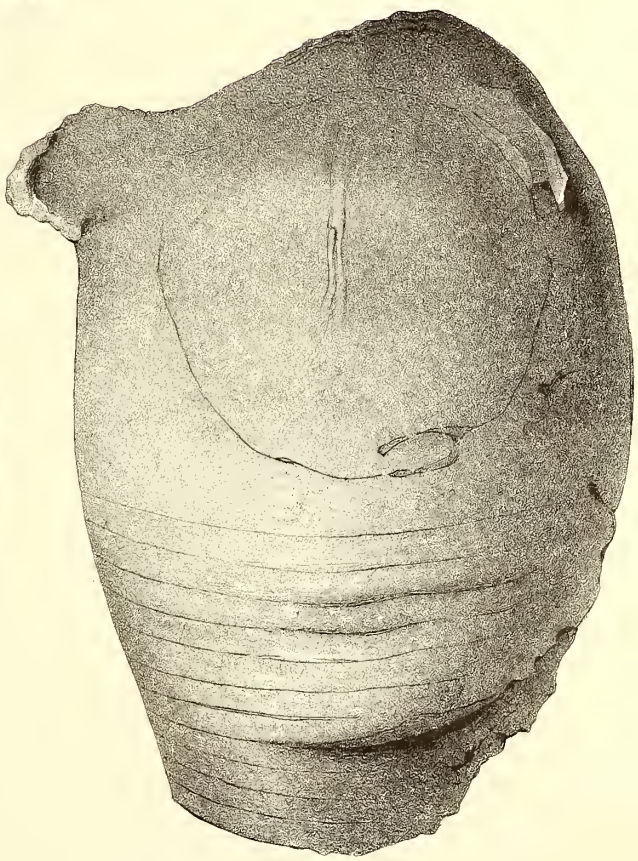


Swinton del et lith

Lith of R.H. Pease, Albany

PLATE 79.

Fig. 1, 2. 706. 4. PENTAMERUS OCCIDENTALIS. (Pag. 341.)

1 *a*. Cast of the dorsal valve of a young specimen, preserving the shell towards the base.

1 *b*. Interior of the preceding, showing the elongated beak and foramen.

1 *c*. Profile view of a young specimen, the shell being nearly all removed.

1 *d*. Dorsal valve of the preceding specimen.

1 *e*. Cast of the dorsal valve of a small specimen, showing the original thickness of the shell at the beak from the extension of the central plate.

1 *f*. Cast of the dorsal valve of a larger specimen.

1 *g & h*. Ventral valves having the shell partially preserved.

1 *i*. Profile view of a ventricose specimen, the beak of the dorsal valve being reduced by abrasion.

1 *k*. Cardinal view of the largest individual seen, showing the numerous laminæ of which the thick shell is composed at the beak.

1 *l*. Profile view of the same.

1 *m*. Cast of the dorsal valve, having the beaks little extended.

1 *o*. A cast of the dorsal valve, the two sides separated more than usual.

1 *p*. The interior of the dorsal valve, where the outer laminæ of the central plate have become separated by the removal of the inner ones, giving the appearance of two plates.

1 *r*. The interior of a dorsal valve, showing the separated laminæ of the internal plate near the beak.

1 *s*. Cardinal view of an imperfect specimen, the ventral valve showing the two plates extending from near the beak downwards.

2. The interior of a small dorsal valve, perhaps a distinct species.

ONONDAGA SALT GROUP.

(BRACHIOPODA)


1.a.


1.b.

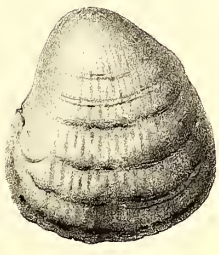

1.c.


1.d.


1.e.

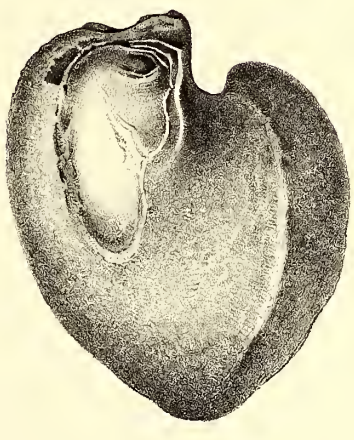

1.f.

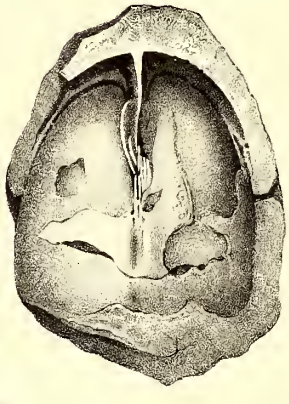

1.g.


1.h.

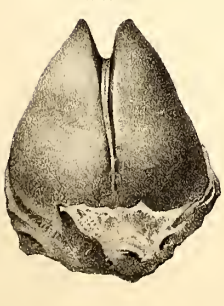

1.i.

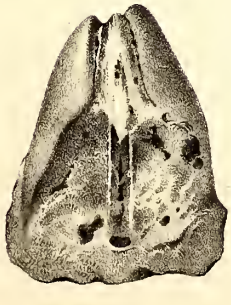

1.k.

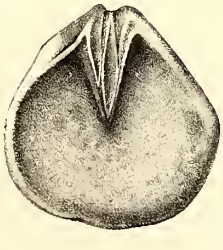

1.l.

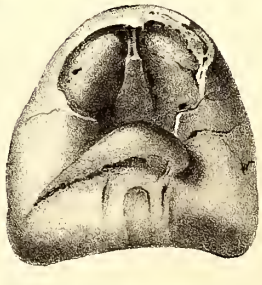

1.m.


2.


1.o.


1.p


1.r.


1.s.

M.E.Brooks Del.

Lith. of R.H.Pease Albany.

PLATE 80.

Fig. 1. 707. 1. MEGALOMUS CANADENSIS. (Pag. 343.)

1 *a*. The anterior half of a large individual, preserving the shell. The line continued, marks the outline of the entire valve.

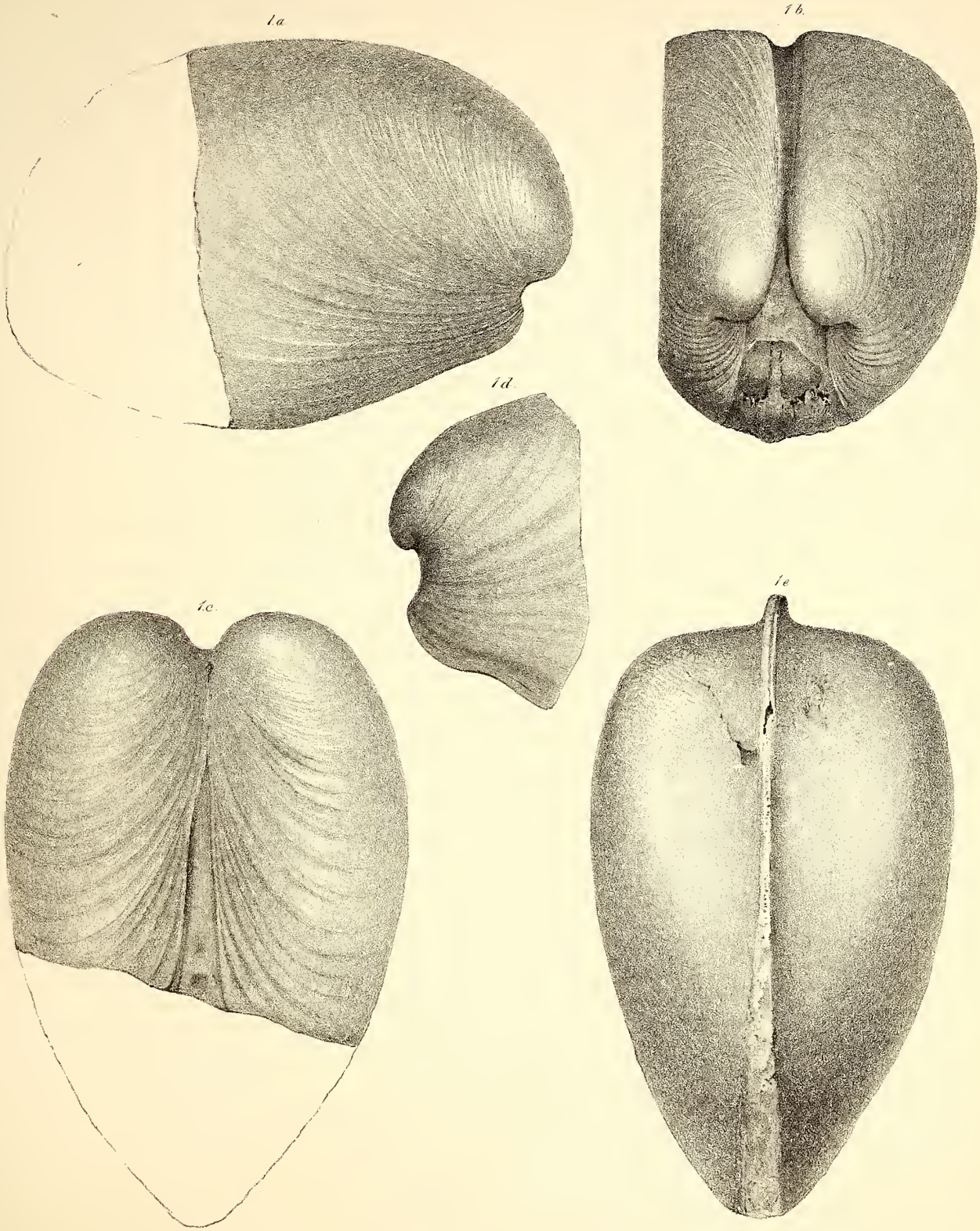
1 *b*. View of the anterior extremity, showing the umbones, and a part of the dorsal margin.

1 *c*. The dorsal side of the same specimen.

1 *d*. A fragment of the left valve of another specimen.

1 *e*. Dorsal view of a cast of this species.

(ACEPHALA.)



On Stone by T J Swinton.

Lith. of R H Pease, Albany

PLATE 81.

Fig. 1. 707. 1. MEGALOMUS CANADENSIS. (Pag. 343.)

1 *a*. Cast of a large individual, presenting the ordinary characters of specimens when not distorted.

1 *b*. A cast of a much shorter specimen : probably the form is in part due to pressure on the posterior end.

1 *c*. View of the anterior extremity of the specimen 1 *b*.

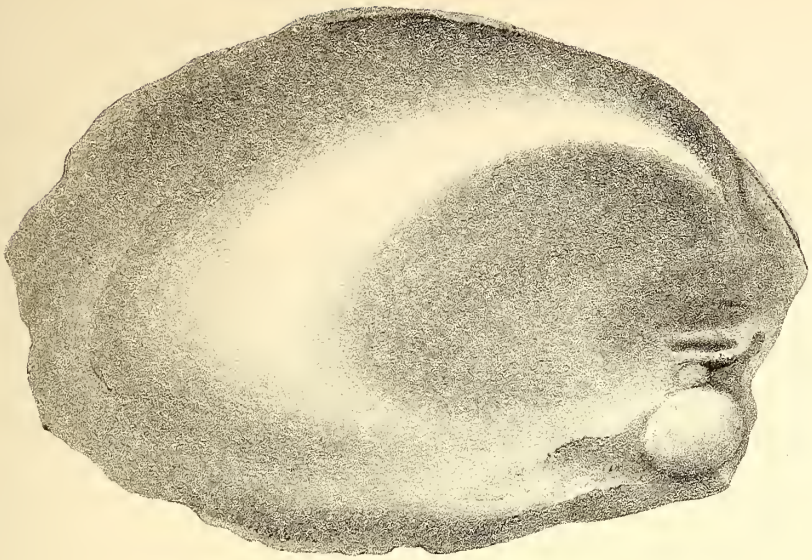
1 *d*. Dorsal view of the same.

1 *e*. A cast of a specimen somewhat distorted by pressure, which has projected the lower anterior end beyond the beaks above.

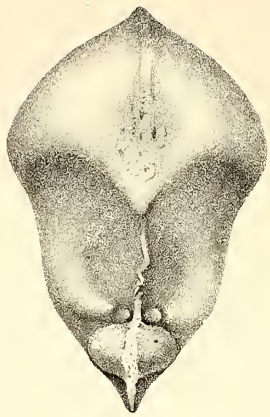
1 *f*. View of the anterior end of the specimen fig. 1 *e*.

ACEPHALA.

1a

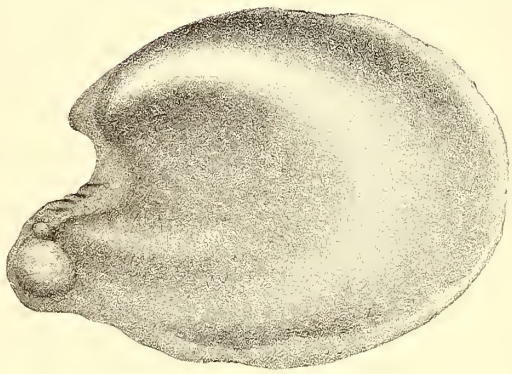


1f



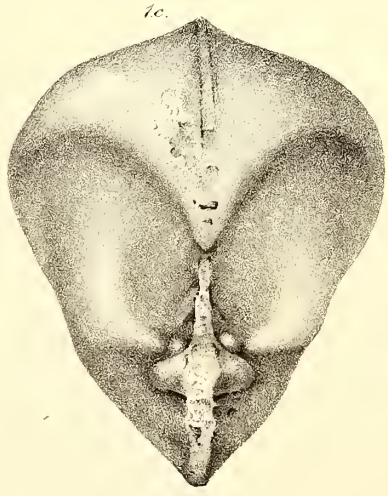
1d

1e



1b

1c.



Swinton, Del.

Lith. of R. H. Pease, Albany.

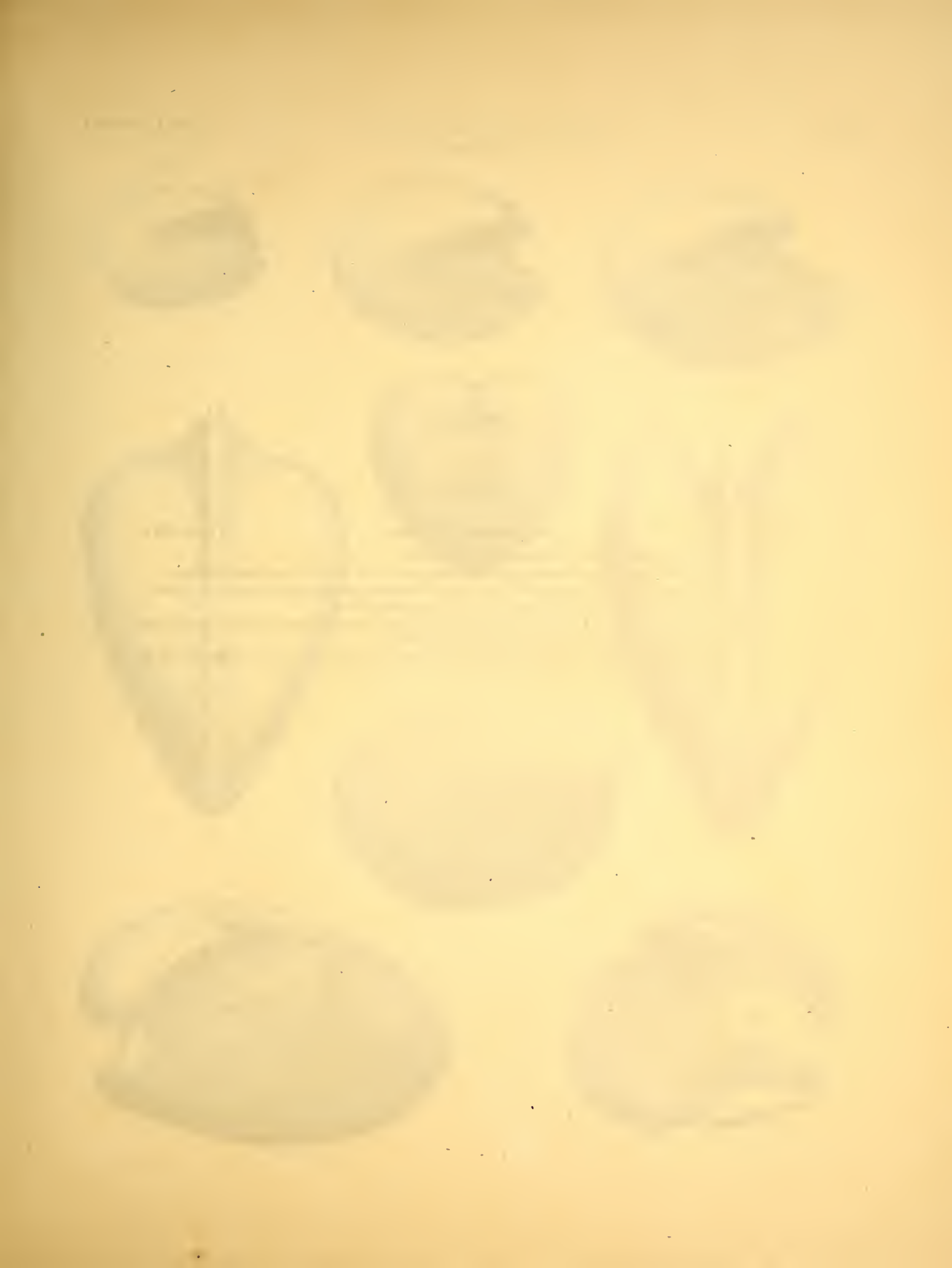


PLATE 82.

Fig. 1. 707. 1. MEGALOMUS CANADENSIS. (Pag. 343.)

1 *a*, *b*, *c*. Lateral views of casts, showing degrees of distortion.

1 *d*. A dorsal view where the umbones have been depressed, leaving the space between them projecting.

1 *e*. Dorsal view of a cast, where the umbones have been pressed forward much beyond their natural relation.

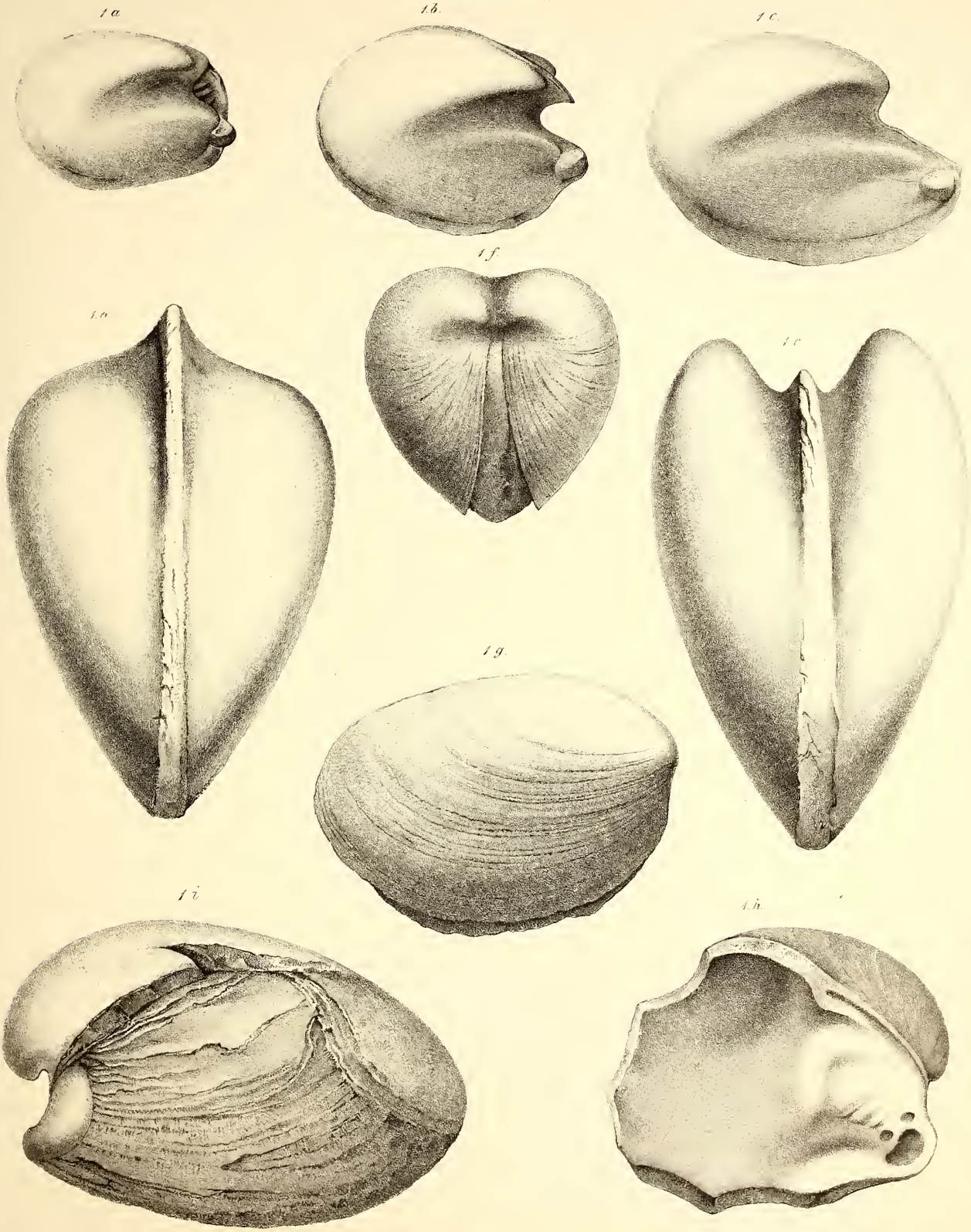
1 *f*, *g*. Anterior and lateral views of a small specimen, preserving the shell.

1 *h*. The interior of a part of the left valve, showing the large museular impression and the two smaller pits above, with the folds on the thickened portion of the shell.

1 *i*. The left valve of a specimen having the shell broken away, showing the numerous distinct laminæ of which it is composed.

ONONDAGA SALT GROUP.

(ACEPHALA)



M.E. Brooks Del.

Lith. of R.H. Pease. Albany

PLATE 83.

Fig. 1. 708. 19. Murchisonia bivittata. (Pag. 345.)

1 *a*. A cast of six volutions from the central part of the shell.

1 *b*. A longitudinal section of several volutions, showing the columella, marked by a double spiral fold, and the edges of the broken shell.

Fig. 2. 709. 20. Murchisonia longispira. (Pag. 345.)

2 *a*. A mould of the middle part of the spire, preserving a portion of the shell and columella near the base.

2 *b*. A fragment showing in the upper part the cast of the interior; the lower part of the specimen preserves the shell, which is divided longitudinally.

Fig. 3. 710. 21. Murchisonia boydii. (Pag. 346.)

Fig. 4. 711. 22. Murchisonia loganii. (Pag. 346.)

4 *a*. A specimen, the upper part of which is a mould of the shell, while the lower part preserves the cast of the interior with some portions of the shell and columella.

4 *b*. A cast preserving several volutions below the apex.

Fig. 5. 712. 23. Murchisonia macrospira. (Pag. 346.)

Fig. 6. 713. 24. Murchisonia turritiformis. (Pag. 347.)

6 *a*. The cast of two volutions, near the base of the shell.

6 *b*. A cast of five volutions, imperfect at both extremities.

Fig. 7. 714. 2. Subulites ventricosa. (Pag. 347.)

7 *a*. A small specimen having much of the last volution broken off, but preserving the spire complete.

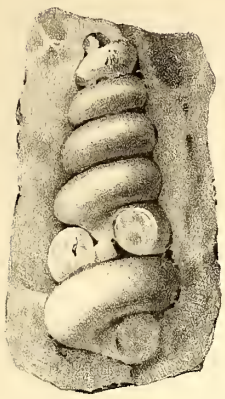
7 *b*. A large individual with the spire incomplete, but preserving the last volution entire.

Fig. 8. 722. 7. Calymene ———. (Pag. 350.)

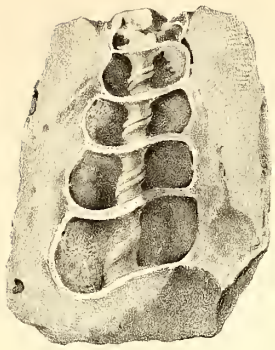
ONONDAGA SALT GROUP.

(GASTEROPODA)

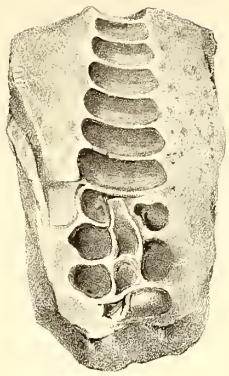
1. a.



1. b.

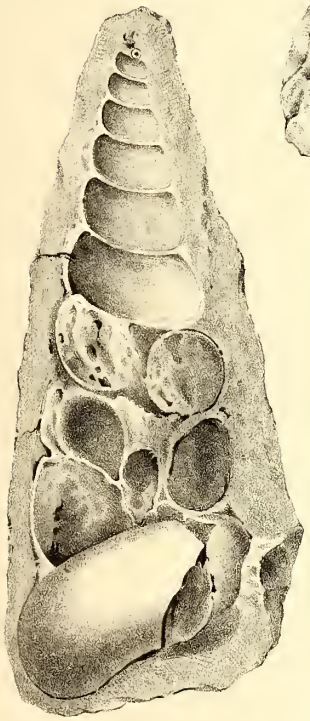


2. a



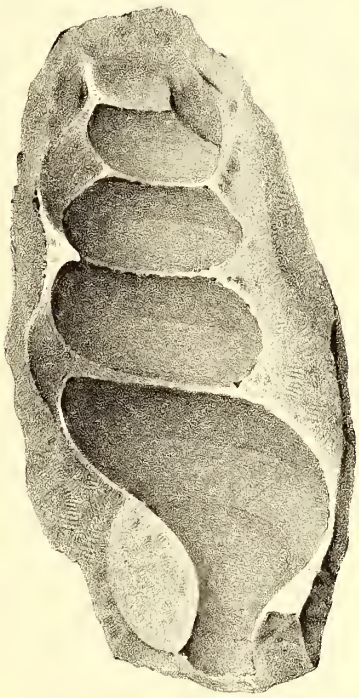
2. b

4. a.



8.

5.

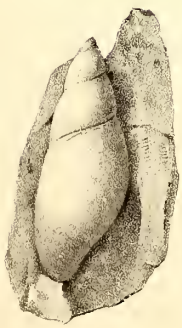


3.

4. b.

6. b.

7. b.



6. a.

7. a.

Lith. of E. Pease, Albany.

PLATE 84.

Fig. 1. 715. 5. Cyclonema sulcata. (Pag. 347.)

1 *a*, *b*. Two views of a specimen of this shell. 1 *c*. A small individual.

1 *d*. An impression of the base of this shell in limestone.

Fig. 2. 716. 22. Pleurotomaria bispiralis. (Pag. 348.)

2 *a*. A cast from the mould fig. 2 *b*. 2 *b*. A mould of this speceis, showing four volutions.

Fig. 3. 717. 23. Pleurotomaria? ———. (Pag. 348.)

Fig. 4. 718. 24. Pleurotomaria solarioides. (Pag. 348.)

4 *a*. The base of a specimen, showing the umbilicus. The outline of the shell is obscured by the adhesion of the surrounding stone.

4 *b*. The upper surface of an imperfect specimen.

Fig. 5. 719. 25. Pleurotomaria perlata. (Pag. 349.)

5 *a*. View of the upper surface of an imperfect cast. 5 *b*. Profile view of the same.

5 *c*. Parts of two volutions near the base of the shell.

Fig 6. 720. 11. Bucania angustata. (Pag. 349.)

6 *a*, *b*. Dorsal and lateral views of the same specimen.

Fig. 7. 721. 9. Cyrtoceras arcticameratum. (Pag. 349.)

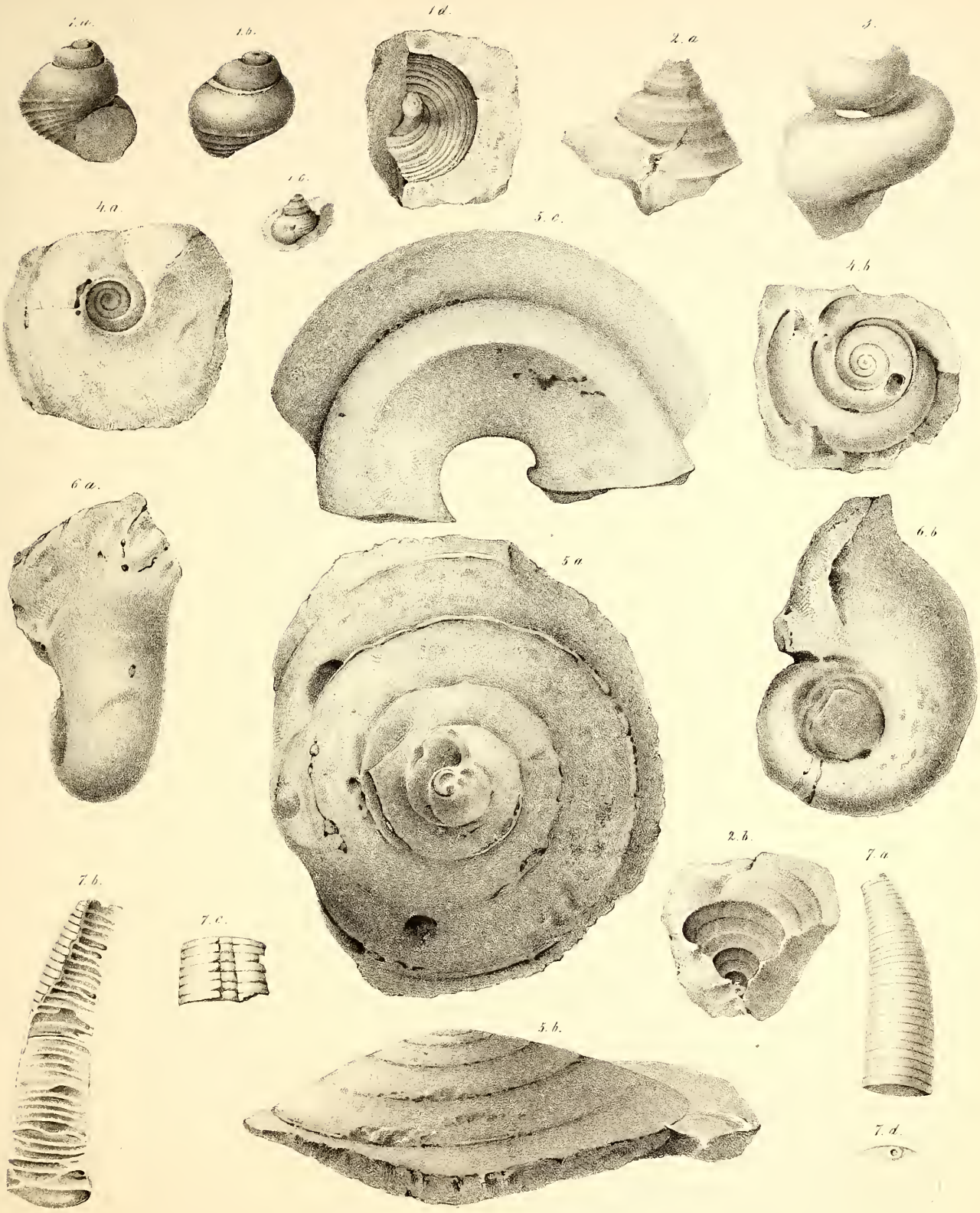
7 *a*. A fragment of a cast, preserving, in a length of two inches, thirty-five septa.

7 *b*. A longitudinal section of another specimen.

7 *c*. A fragment of a cast, showing the siphunele.

7 *d*. A transverse section, showing the position of the siphuncle on the dorsal margin.

(GASTEROPODA &c.)



Luth. H.S. Page. Albany

PLATE 85.

Fig. 1 – 4. 590. 1. Stephanocrinus angulatus. (Pag. 351.)

1. Lateral view of a specimen bearing tentacula.
2. The upper side or summit of the same specimen, enlarged.
3. A part of one side highly magnified, showing the structure and arrangement of the plates of the tentacula.
4. A figure representing the species as restored from isolated parts.

Fig. 5 & 6. Calceocrinus. (Pag. 352.)

Fig. 7. 596. 1. Eucalyptocrinus decorus. (Pag. 352.)

Lateral view of the plates of the arm and tentacula.

Fig. 8 – 10. 609. 1. Palæaster niagarensis. (Pag. 352.)

8. A fragment of one of the arms.
9 & 10. Enlarged views of parts of the upper and lower surface.

Fig. 10, 11. 723. 2. Tentaculites niagarensis. (Pag. 352.)

11. An individual, natural size. 12. An enlarged portion.

Fig. 13 – 17. 724. 2. Cornulites ——. (Pag. 353.)

13. An imperfect specimen, preserving the surface markings.
14. A specimen in which the annulations are more distinct.
15. A specimen having the annulated character somewhat obscure, and the surface markings prominent.
16. An individual apparently nearly entire, having the annulations and surface sculpture well preserved. The specimen is compressed towards the larger extremity.
17. A portion of the surface enlarged, showing the longitudinal striæ.

Fig. 18. A Coral of the character of Lichenalia. (Pag. 353.)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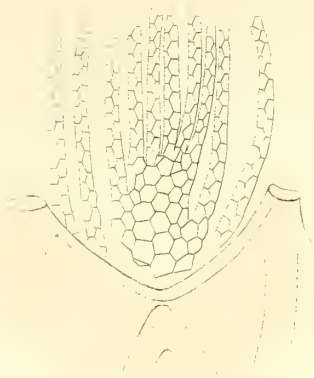


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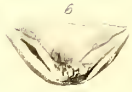
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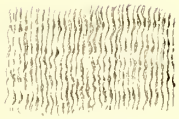
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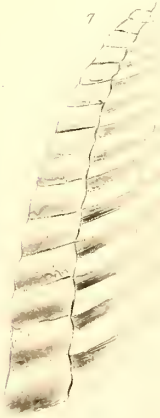
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