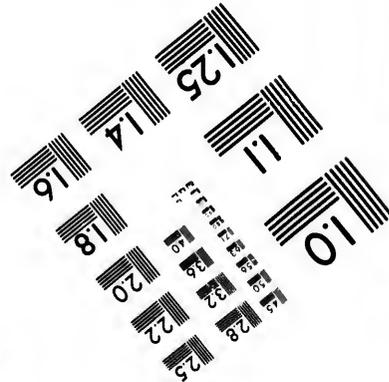
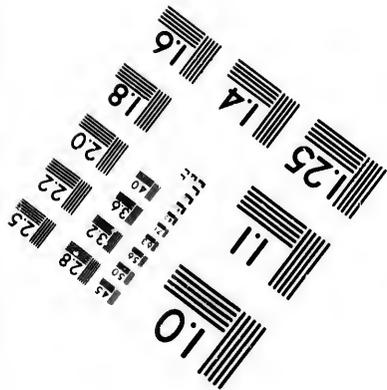
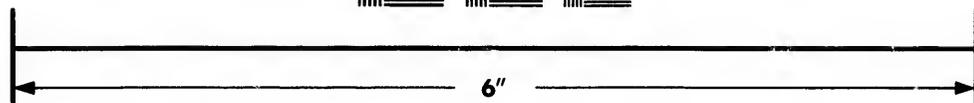
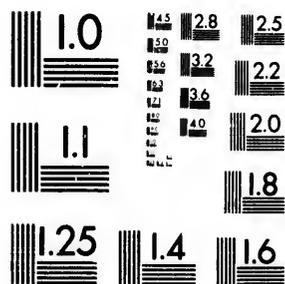


**IMAGE EVALUATION
TEST TARGET (MT-3)**



**Photographic
Sciences
Corporation**

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

**CIHM/ICMH
Microfiche
Series.**

**CIHM/ICMH
Collection de
microfiches.**



Canadian Institute for Historical Microreproductions / Institut canadien de microreproductions historiques

© 1982

Technical and Bibliographic Notes/Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

Coloured covers/
Couverture de couleur

Covers damaged/
Couverture endommagée

Covers restored and/or laminated/
Couverture restaurée et/ou pelliculée

Cover title missing/
Le titre de couverture manque

Coloured maps/
Cartes géographiques en couleur

Coloured ink (i.e. other than blue or black)/
Encre de couleur (i.e. autre que bleue ou noire)

Coloured plates and/or illustrations/
Planches et/ou illustrations en couleur

Bound with other material/
Relié avec d'autres documents

Tight binding may cause shadows or distortion along interior margin/
La reliure serrée peut causer de l'ombre ou de la distortion le long de la marge intérieure

Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/
Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.

Additional comments:/
Commentaires supplémentaires:

Photoprints of plates XX-XX

Coloured pages/
Pages de couleur

Pages damaged/
Pages endommagées

Pages restored and/or laminated/
Pages restaurées et/ou pelliculées

Pages discoloured, stained or foxed/
Pages décolorées, tachetées ou piquées

Pages detached/
Pages détachées

Showthrough/
Transparence

Quality of print varies/
Qualité inégale de l'impression

Includes supplementary material/
Comprend du matériel supplémentaire

Only edition available/
Seule édition disponible

Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image/
Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X	14X	18X	22X	26X	30X
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	12X	16X	20X	24X	28X
					32X

The copy filmed here has been reproduced thanks to the generosity of:

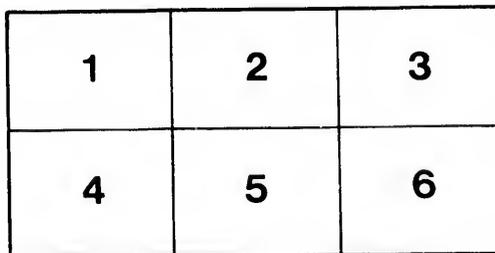
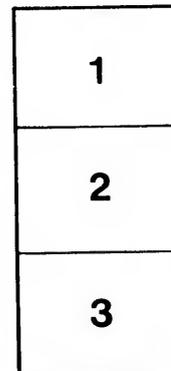
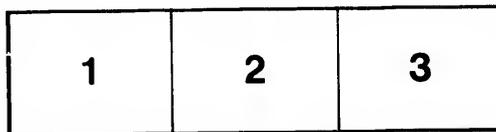
Library of Congress
Photoduplication Service

The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Original copies in printed paper covers are filmed beginning with the front cover and ending on the last page with a printed or illustrated impression, or the back cover when appropriate. All other original copies are filmed beginning on the first page with a printed or illustrated impression, and ending on the last page with a printed or illustrated impression.

The last recorded frame on each microfiche shall contain the symbol \rightarrow (meaning "CONTINUED"), or the symbol ∇ (meaning "END"), whichever applies.

Maps, plates, charts, etc., may be filmed at different reduction ratios. Those too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:



L'exemplaire filmé fut reproduit grâce à la générosité de:

Library of Congress
Photoduplication Service

Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

Les exemplaires originaux dont la couverture en papier est imprimée sont filmés en commençant par le premier plat et en terminant soit par la dernière page qui comporte une empreinte d'impression ou d'illustration, soit par le second plat, selon le cas. Tous les autres exemplaires originaux sont filmés en commençant par la première page qui comporte une empreinte d'impression ou d'illustration et en terminant par la dernière page qui comporte une telle empreinte.

Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole \rightarrow signifie "A SUIVRE", le symbole ∇ signifie "FIN".

Les cartes, planches, tableaux, etc., peuvent être filmés à des taux de réduction différents. Lorsque le document est trop grand pour être reproduit en un seul cliché, il est filmé à partir de l'angle supérieur gauche, de gauche à droite, et de haut en bas, en prenant le nombre d'images nécessaire. Les diagrammes suivants illustrent la méthode.

errata
to

pelure,
on à



32X

747

S

6
42

747

1

Howe, James, 1811-1898. Organic remains of the Pleistocene epoch

GEOLOGICAL SURVEY

204

OF THE

STATE OF WISCONSIN,

1859-1863.



PALÆONTOLOGY.



PART THIRD.

*6
4277*

QE747
W6H2

sen
wo
or
kno
as
"P
con
as
per
Ra
of
the
pro
Le
des
nu
the
ord
of
roo
pre
ex
by
wh
an

*
on
Pri

YSL

1957

The Report upon the Geology of Wisconsin, already published,* presents, in an introductory chapter, a concise history of the origin and working of the Survey, to the time of the publication of the volume, or to the close of the year 1861. The name of the writer, without his knowledge or solicitation, was incorporated in the original Act of 1857, as one of the Geologists, and by a subsequent Act of 1860, he was made "Principal of the Geological Commission," and directed to make certain contracts, etc.

The work of the Survey, in its several departments, was carried on as rapidly and as successfully as the organization, required by law, would permit. The volume already published, was communicated to Governor Randall in December, 1861, and copies were distributed to the members of the Legislature, in February following. At that time the work on the Palæontology was well advanced, and required only the means for providing illustrations, as then stated, to be ready for presentation to the Legislature, preliminary to publication.

Many of the new or little known species of fossils had already been described in one of the Annual Reports. Drawings of a considerable number of species had been made, and two plates illustrating fossils of the Trenton Limestone, had been engraved at the writer's expense, in order to show the character of the work contemplated. Large collections of soils, rocks, minerals and fossils had been made and deposited in the rooms of the University buildings. The want of suitable cases only, prevented these collections from being arranged, thus presenting an exhibition of the mineral and agricultural resources of the State, and by this means laying the foundation of a scientific and practical museum, which might have been of great utility to the students of the University, and the people of Wisconsin generally.

* Report on the GEOLOGICAL SURVEY OF THE STATE OF WISCONSIN. Volume I. James Hall, on general Geology and Palæontology, and J. D. Whitney, on the Upper Mississippi Lead region. Printed by authority of the Legislature of Wisconsin, January, 1862.

Notwithstanding all this evidence of progress, and with copies of the first volume in its hands, the Legislature of 1862, in violation of the provisions of the Act of 1857, and in violation of contract stipulations, made expressly under the provisions of the Acts of 1857 and 1860, repealed the laws and suspended all appropriations for the work. Since that time, repeated applications to successive Legislatures have met with a steady refusal to refund to the writer the money actually expended by him for the purposes of the Survey, or to pay for his own services performed according to the conditions of his contract with the GOVERNOR OF THE STATE OF WISCONSIN, under the laws already cited.

Under these circumstances the "Superintendent of the Geological Survey" has been compelled to seek a publication of the results of his labors elsewhere. The investigations upon the Potsdam Sandstone, with descriptions and illustrations of the fossils of that formation in Wisconsin and adjacent parts of Iowa, have already been published. The work upon the fossils of the Trenton and Galena Limestones; of the Hudson River Group, and of the Devonian Rocks of the State, is in progress, and the results will appear in due time. The present, is the third in order, of a series of papers resulting from the study of the fossils of the Geological formations of Wisconsin.

J. H.

January, 1871.

copies of the
ation of the
stipulations,
and 1860,
ork. Since
ve met with
expended by
ervices per-
GOVERNOR OF

e Geological
results of his
adstone, with
n in Wiscon-
. The work
t the Hudson
in progress,
the third in
fossils of the

J. H.

ORGANIC REMAINS

OF THE

NIAGARA GROUP AND ASSOCIATED LIMESTONES.



BY JAMES HALL.

I. RELATIONS OF THE NIAGARA GROUP WITH THE LECLAIRE, RACINE AND GUELPH LIMESTONES.



IN the study of the fossils of the Niagara group and associated strata, previous to the publication of the final *Report on the Fourth Geological District*, and also to the publication of the second volume of the *Paleontology of New York*, I separated a few species found in the impure drab-colored limestone from Wayne county, New York.

The limestone containing these fossils became exposed only in the bed of the canal during its excavation; and the low country, or deeply drift-covered surface in the vicinity, did not admit of any exposure of the rock in place. The materials were thrown out of the excavation in connection with the soft marls of the Onondaga salt group, and the specimens of rock containing the fossils preserved the peculiar cellu-
liferous structure and characteristic color of the argillaceous limestone of that formation. Differing so essentially from any known beds in the Niagara group, I did not hesitate to refer them to the Onondaga salt group, since there was no evidence of any other formation in the neighborhood.*

*The same reference of the species had, in fact, been made during the Geological Survey, and they were thus published in the *Report on the Fourth Geological District*, in 1843.

Throughout the State of New York, the country along the junction of the Niagara and Onondaga salt formations is low and level, or covered by drift accumulations; and no opportunity offered of discovering any exposure of similar beds along the course of the outcrop. In some places in Monroe county we have been able to trace the two formations to within a few feet of their contact with each other; but no fossiliferous beds, similar to those of Wayne county, have been found. Subsequently, after a considerable portion of Vol. ii of the *Paleontology of New York* had been printed, my attention was called to some peculiar fossils collected at Galt, in Canada West; and in visiting that locality, I discovered some species identical with those before known, from beds which I had regarded as of the Onondaga group in New York. As this limestone at Galt (and Guelph) was clearly above the great Niagara limestone of the Falls, and contained an almost entirely different set of fossils, I very naturally inferred that it belonged to the next higher formation, or the Onondaga salt group, and that the Wayne county locality was a feeble representation of the limestone of Galt.* For these reasons the two were treated as identical, and referred to the age of the Onondaga salt group; an opinion at that time sustained by the members of the Canadian Geological Survey.

At a later period, during the Geological Survey of Iowa, I recognized, at the Leclaire rapids on the Mississippi River, a limestone holding the same relative position, having the same lithological character, and containing some identical and many similar fossils with the limestone of Galt or Guelph, in Canada West; and I thus announced its apparent relations in the *Report on the Geology of Iowa*, 1857, Vol. i, p. 75:

"Should the identity of the limestone of these two distant localities be proved, it will afford sufficient ground for separating these beds from the Onondaga salt group, and for establishing a distinct group. It seems quite probable that the limestones of this period have their eastern extremity in Central New York, where, from their small development, as well as from similarity of lithological character, there seemed no sufficient ground for separating them from the non-fossiliferous beds of the Onondaga salt group.† Since, however, in Canada, these beds attain considerable importance, and (admitting the conclusions above given) acquire a still greater thickness and

* The name "Galt" being considered objectionable on account of a similar term already in use, and the same rock occurring also at Guelph, it has been called the "Guelph formation" in the nomenclature of the *Geological Survey of Canada*.

† My views regarding the presence of the Onondaga salt group proper in Wisconsin and Iowa have somewhere been called in question, and I have only to remark in this place that I have seen no reason on my own part, nor facts adduced on the part of others, to change my opinion in reference to the occurrence of this formation in the localities I have heretofore cited.

more distinctive character on the Mississippi River, it seems necessary to elevate them to the same rank as the other groups of the series."

Some two or three years later I explored the geology of the central and eastern portions of Wisconsin and the adjacent parts of Illinois. I here found the limestone of Racine, and a part of Waukesha and some other localities, resembling in all respects that of Leclaire and holding many of the same fossils. It is likewise underlaid by the even-bedded darker-colored limestone, bearing *Halgysites catenulatus*, *Pentamerus oblongus*, and many large Orthoceratites, which are everywhere regarded as evidence of the Niagara age. I could not hesitate, therefore, to parallelize the succeeding beds with the limestone of Leclaire, though we had failed to trace that formation across the country in a continuous outcrop. At the same time, on critical examination of the collection of fossils made at Racine and at some other points, I detected many species known as characteristic of the Niagara formation in the State of New York, requiring its recognition as a member of that group (rather than of the Onondaga salt group), and uniting with it as identical in position the Leclaire limestone.*

At the same time, we have recognized from Racine and adjacent localities, including Leclaire in Iowa and a single locality in Illinois, the following species which are identical or very closely allied to those from Galt in Canada West: *Pentamerus occidentalis*, an *Obolus*-like fossil, a *Favosites* and a species of *Amplexus* which are identical in several localities, *Cyclonema sulcata*, *Murchisonia logani*, *Murchisonia* identical or closely allied to *M. mylitta*, BILLINGS, an undescribed *Murchisonia* from Racine identical with one from Galt, *Subulites ventricosa*, *Pleurotomaria soluroides*? *Loxonema longispira*, besides other forms which are closely allied to species of the Guelph limestone.

An examination of several localities in Wisconsin shows that this peculiar fossiliferous limestone is very unequally distributed. At Racine it has a very considerable thickness; † while in other places, either from denudation or other causes, it is very thin, or even absent. In some places in the vicinity of Milwaukee and Waukesha, there are indications of beds of passage from the regularly bedded limestones below to the unequally bedded rock above. There appears indeed very good evidence of the irregular or unequal accumulation of this higher rock in many of the localities along a considerable portion of the outcrop; and where the lower

* Report on the Geology of Wisconsin, p. 67. 1861

† I am inclined to believe that I have over-estimated the thickness of the limestone at Leclaire from the presence of lines of false bedding, but I have had no opportunity of a re-examination of the locality.

part of the formation comes to the surface, the upper rock does not appear to be developed. I am therefore induced to believe that this limestone at Racine, the mass at Leclaire and extending thence into Iowa, as well as the Guelph formation in Canada and the feeble representation of the same in New York, are really lenticular masses of greater or less extent, which have accumulated upon the unequal surface of the ocean bed in a shallow sea during the latter part of the Niagara period. These isolated masses of limestone have close relations with each other, while their relations with the Onondaga salt group, though very intimate in the single locality in Central New York, become less and less conspicuous in a westerly direction.

In the *Geology of Canada*, published in 1863, the Guelph limestones are described as constituting a distinct formation; but Sir. W. E. LOGAN remarks:

"It has already been stated that the strata seen near the mouth of the Rivière aux Sables, at Chief's Point, probably strike along the coast by Lyell Island to Cape Hurd, and belong in part to the Niagara formation, whose characteristic fossils are met with in several localities along the shore. These strata, however, have for the most part the lithological characters of the Guelph formation, and some of their undescribed species of MURCHISONIA have a strong resemblance to others found in this series. The *Pleurotomaria huronensis*, which belongs to the Guelph rocks, occurs on Lyell Island associated with *Pentamerus oblongus* and other characteristic Niagara species; so that it is not impossible that some of the strata along this coast may constitute a passage between the Niagara and Guelph formations.

"The Guelph formation appears to be absent from the State of New York; and in Canada it probably has the form of a great lenticular mass, the limit of which between Niagara and Guelph is uncertain, though it appears to extend beyond Ancaster. In the other direction, it seems to thin out in Lake Huron, before reaching the northern peninsula of Michigan."

I should not omit to say here, that so far as my investigations have extended on the islands of Lake Huron and Lake Michigan, with the peninsula between the latter and Green Bay, I have found the presence of the lower portions of the Niagara group, with the general absence of the higher beds. At the same time, along this great extent few fossils occur except *Pentamerus oblongus*, *Halyssites catenulatus*, and two species of FAVOSITES, with some other corals; and it is only on continuing the observations to the southward in Wisconsin, that we find a larger number of the Niagara species proper. This indication of beds of passage, pointed out by Sir W. E. LOGAN, will, I presume, be found in all or nearly all localities where a junction of the two formations can be seen.

II. DESCRIPTIONS OF FOSSILS OF THE NIAGARA GROUP.

ECHINODERMATA.

In the *Report of Progress of the Geological Survey of Wisconsin* for 1860,* I described several species of Crinoidea, two Cystideans, several species of Brachiopoda, Gasteropoda and Cephalopoda, from the limestones of Racine and Waukesha; leaving a considerable number of species undescribed for want of satisfactory material. It has not been in my power to make such collections as I then anticipated; and the following descriptions relate almost exclusively to species that have been in my cabinet for several years, and which were studied, and many of them determined, at the time of making the report above cited.

Some of the Crinoidea are very interesting; but the Cystideans possess a peculiar interest, as offering forms which, so far as I know, have not been discovered in any other localities. The specimens, with few exceptions, are casts of the interior of the test, or impressions of the exterior left in the matrix. A few of the species retain the plates to such an extent that the structure can be determined. Since it appears probable that we shall, for some time at least, be dependent upon similar imperfect materials for our knowledge of these fossils, I shall endeavor to give such descriptions as will enable the student to recognize the species, with the hope that some of them at least will be illustrated at a future period.

GENUS GOMPHOCYSTITES, N. G.

[γομφος, *clavus*; κυστις, *vesica*.]

Body elongate pyriform, very narrow at the base, gradually enlarging above, and inflated near the upper extremity. Surface composed of numerous series of polygonal plates which have a spiral arrangement. Apertures upon the upper surface, one of them being subcentral, and the other a little eccentric. Arms sessile, lying in grooves excavated in the surface of the plates, originating near the

* *Report of the Superintendent of the Geological Survey*, Legislative Documents, 1861.

mouth, and curving spirally outwards and downwards over the body, reaching to or even below the point of its greatest diameter. The central aperture appears to have been closed by a pyramid of five or six small plates.

The fossils of this genus are remarkable for their elongate form, attenuate base and swelling upper extremity; they were probably supported upon a short pedicel, but we do not know its character. The body is composed of numerous ranges of short hexagonal or polygonal plates, the spiral arrangement of which can be traced in their marking upon the cast.

In a fragment of one of these from the Niagara shale of New York, there is but a single subcentral opening visible, the arms all originating on one side of this. In the casts of other species from Wisconsin, there is evidence of a smaller aperture near the round subcentral one.

A large proportion of the specimens observed are unsymmetrical in greater or less degree, and this feature is apparently very variable in the same species. In a view of the summit, the position of the apertures and disposition of the arms resemble *AGELACRINUS*, but the plates are of different character, being strongly granulose, and the sutures of the plates are so close as to make it difficult to distinguish them.

GOMPHOCYSTITES TENAX, N. S.

PLATE XII, FIG. 15; PLATE XII *a*, FIGS. 1, 2.

Upper part of body ventricose, somewhat rapidly attenuated below; principal aperture round, subcentral; the pyramid of plates which probably closed the orifice are unknown, leaving a margin of small unequal plates. The plates forming the summit of the body are small, polygonal, with surface strongly granulose. The arm-plates appear to have been furnished with tentacula, as in *APIOCYSTITES* and other genera.

Formation and Locality.—This species occurs in the Niagara group at Lockport, New York. Collection of Col. E. JEWETT.*

GOMPHOCYSTITES GLANS, N. S.

PLATE XII, FIG. 14; PLATE XII *a*, FIGS. 4, 5.

Body elongate, clavate, with the upper extremity extremely ventricose, often more or less unsymmetrical, and the summit unequally convex on the upper side, somewhat abruptly contracted below, and thence

* Now in the collection of the Cornell University.

gradually attenuate. Principal aperture subcentral; arms originating close to the aperture, and curving in a spiral direction over the summit and along the sides to the point of greatest expansion, or sometimes a little below.

The specimens of this species are from one to three inches in length, with a diameter in the greatest expansion of from less than half an inch to an inch and a half.

The illustrations are of a large unsymmetrical specimen, and one of symmetrical form somewhat smaller.

Formation and Locality.—In the limestone at Racine, Wisconsin.

GOMPHOCYSTITES CLAVUS, N. S.

PLATE XII^a, FIG. 3.

Body clavate, gradually expanding to the upper part which is elongate ovate, nearly or quite symmetrical, summit regularly convex; principal aperture at the apex, and essentially central. Arms originating from one side of the central aperture, curving a little spirally downwards, and reaching below the apex a distance about equal to the greatest diameter of the body.

Below the expanded portion, the body becomes obtusely pentagonal, a feature but obscurely shown in the cast; base unknown.

This species is very nearly symmetrical, and much more gradually expanding from below to the greatest diameter, and less abruptly rounded above; while the arms have a more nearly vertical direction.

It is possible that this may be only a modification in form of the *G. glans*; but among a considerable number of specimens of that species, I have not observed gradations to this form; and I therefore designate it as a distinct species until it can be proved identical, or until its relations with the preceding species can be more satisfactorily determined.

Formation and Locality.—In the limestone at Racine, Wisconsin.

GENUS HOLOCYSTITES, N. G.

[ὅλος *totus*; κύστος, *vesica*.]

Body elongate, sub-cylindrical, elliptical or sub-ovate, composed of numerous (six or more) ranges of comparatively large plates, or of alternating series of large and small hexagonal or polygonal

plates; apertures at or near the summit, one of them central or subcentral, the other eccentric. Supported on a short pedicel. Sessile arms none; free arms unknown; no evidence of pectinated rhombs.

The specimens referred to this genus are generally composed of large plates in pretty regular alternating series, or sometimes a range of large plates alternating with a range of small ones. There are no indications of sessile arms as in *Gomphocystites*; though there may have been free arms around the central aperture of the summit. The surface of the plates is strongly granulose, and sometimes marked by ridges and central nodes.

I had originally referred these forms with some doubt to the genus *Caryocystites*,* but an examination of other specimens has shown that there is no lateral aperture as in the species of that genus, and I therefore propose a distinct generic term.

HOLOCYSTITES CYLINDRICUS, HALL.

PLATE XII, FIGS. 4, 5; PLATE XIII, FIGS. 7, 8.

Caryocystites cylindricus, HALL. Ann. Rep. Geolog. Survey Wisconsin for 1860, p. 23. 1861.
Geology of Wisconsin, 1, p. 69. 1862.

Body elongate obovate or subcylindrical, rounded at top and abruptly contracted at base near the junction with the column; basal plates undetermined. Above the basal plates the first range consists of eight elongate hexagonal plates, their length once and a half their greatest width, gradually expanding in width from below upwards; these are succeeded by a second, third, fourth and fifth range of eight plates in each, all somewhat regularly hexagonal, their length a little greater than their width. Of these, the fourth range is usually the widest, situated at a little more than one-third the length of the body from the summit, and at the point of greatest diameter. In the sixth range above the basal, the plates are much smaller than the others, and narrower at the upper end. Alternating with these last, is a seventh range of smaller plates, surrounding those of the summit, and enclosing the summit openings. Column small, round, rapidly tapering below the point of attachment. Surface of plates granulose.

* *Annual Geological Report of Wisconsin for 1860*, published 1861; and *Geology of Wisconsin*, Vol. i, p. 69. 1862.

Several specimens, more or less entire, exhibit the characters here given. While the surface of the plates is coarsely granulose, there is no evidence of ridges or nodes. Some of the specimens show irregularities in the form and proportions of the plates, indicating the possibility of a gradation between this and the following species; but the material I have is not sufficient to determine this question.

Formation and Locality.—In the limestone at Racine and Waukesha, Wisconsin.

HOLOCYSTITES ALTERNATUS, HALL.

PLATE XII, FIG. 9; PLATE XIIa, FIG. 6.

Caryocystites alternatus, HALL. Ann. Rep. Geolog. Survey Wisconsin for 1860, p. 23. 1861.
Geology of Wisconsin, I, p. 69. 1862.

Body extremely elongate, subcylindrical, the greatest diameter above the middle and nearer the apex. Summit irregularly rounded, a little flattened or depressed on the side of the aperture; base gradually tapering to the summit of the column. The body is composed of twelve ranges of plates varying in size and shape; in some of the ranges they are large, mostly octagonal, eight in number in each range. In the alternating ranges they are smaller, five or six-sided, and about as many as in the ranges of large plates. Near the summit, and apparently between the eleventh and twelfth ranges from the base, there is a distinct aperture, with another smaller one more nearly on the summit. Surface strongly granulose. These apertures correspond to the mouth and anal aperture as described by VON BUCH in *CARYOCYSTITES*; but the lower lateral one, or ovarian aperture, has not been recognized in this or any other species of this genus.

The specimens of this species are partial casts, but the forms of the plates are fully preserved, and the structure of the body is very distinctly shown. The specimens with alternations of larger and smaller ranges of plates are usually less robust than those where the series are more nearly equal in size.

Formation and Locality.—In the limestone of Racine, Wisconsin.

HOLOCYSTITES ABNORMIS, N. S.

PLATE XII, FIGS. 7, 8.

Body subcylindrical, abruptly attenuate below to the short column, composed of about eight or nine ranges of plates; summit rounded; the principal aperture near the centre is marked by a depression of

the surface. In the third range from the base, two or more of the large plates are surrounded by smaller ones; but the four ranges of plates below the dome are large plates of nearly equal size and equal length and breadth. Surface of plates granulose.

Formation and Locality.—In limestone of the age of the Niagara group at Racine, Wisconsin.

HOLOCYSTITES WINCHELLI, N. S.

PLATE XII, FIG. 3.

Body clavate or elongate ovate, ventricose above, and the summit abruptly rounded; rapidly contracting towards the base, which is unknown. The subcentral aperture of the summit is very large. The form is unsymmetrical, being flattened on one side and arcuate, perhaps partially from accident.

The specimen described is imperfect at the base, but from the aperture at the summit to the broken lower extremity it preserves eight ranges of plates. The lower ones are hexagonal and in alternating series; but approaching the summit and following the curve of the arcuation, there are apparently three or four plates in direct succession, which are truncate above and below, but maintain a hexagonal form from becoming wider above, and having a short sloping side adjacent to the upper straight margin.

This species is readily distinguished from the three preceding ones by the elongate-ovate ventricose form, and the more numerous ranges and smaller plates, as well as their arrangement in direct succession. The two or three lower ranges of plates preserved, somewhat resemble those of *H. cylindricus*, but they are quite free from nodes. It is impossible to know the entire number of ranges of plates from the base upwards, since no perfect specimens are in the collection. There are fourteen or sixteen plates in the circumference, some obscurity existing on one side.

The specimen preserving eight ranges of plates has a length of about two inches, and the diameter where broken off below is more than half an inch. A section below the summit is subelliptical, having its greatest diameter nearly an inch and a half, and the shorter diameter a little more than one inch.

Formation and Locality.—In the limestone of the Niagara group at Waukesha, Wisconsin.

The two following species, both on account of their form and the great number of small polygonal plates, may prove distinct from the typical forms of this genus:

Holocystites ovatus, n. s.

PLATE XII, FIG. 2.

Body from the summit to near the base symmetrically ovoid; a little depressed at the central aperture, and elevated at the eccentric one; sides regularly curving; composed of more than ten ranges of alternating polygonal plates, which are as wide as long, or wider, elevated in the centre, and coarsely granulose.

A specimen of one inch and three-fourths in length, and perfect at the base, shows ten ranges of plates between the broken lower margin and the summit aperture. The greatest diameter of the same individual is one inch and a half, while it is about half an inch in diameter where broken off, and there have probably been two or three ranges of plates below that point. A section below the summit is very broadly elliptical, and this has probably been the original form.

This species differs from *H. scutellatus* in being a more robust form, with less elongate base, and with plates larger, more equal in size, and prominent in the middle; while the larger plates in that species have central nodes from a nearly flat surface.

Formation and Locality.—In the limestone of the Niagara group at Waukesha, Wisconsin.

Holocystites scutellatus, n. s.

PLATE XII, FIG. 1.

General form of body ovoid ventricose, abruptly attenuate below, and swelling above into an ovate outline; composed of twelve or more ranges of plates, which are somewhat irregularly disposed, there being in the upper part a distinct arrangement of one large polygonal plate surrounded by smaller ones, this large plate having a node in the centre. The summit is broadly rounded, with evidence of one large subcentral aperture, and a depression indicating a second aperture. Surface of plates strongly granulose.

The ventricose ovate form and abruptly attenuate base are distinguishing features of this species. Though the *H. cylindricus* sometimes

assumes an ovate form with attenuate base, yet the species here described has a much larger number of plates, which are differently disposed.

Formation and Locality.—In limestone of the age of the Niagara group at Waukesha, Wisconsin.

GENUS APIOCYSTITES, FORBES.

APIOCYSTITES IMAGO, N. S.

PLATE XII, FIG. 12; PLATE XIIa, FIG. 9.

Body irregularly elliptical, about three-fifths as wide as long, a little larger above than below the middle. Basal plates occupying more than one-fourth of the entire height of the body. Second range consisting of five large plates. In the third range the plates are about half the size of those of the second range. The fourth range consists of at least six plates; the two over the ovarian aperture are smaller than the others. The fifth range consists of six plates of smaller size than the others, and of a pentagonal form, the upper margins being determined by the number of apical plates, which are unknown. The ovarian aperture is situated over the right superior angle of the hexagonal basal plate, and the space is excavated from the upper margin of the plates of the third range and the lower margin of one of the fourth range. The pectinated rhombs upon the right side of the ovarian aperture occupy the adjacent margins of two plates, and are on the same parallel with the aperture. The other pectinated rhombs are not preserved in the specimen. The plates of the four lower ranges are longitudinally ridged in the middle, and in their perfect condition have probably had a central node. The circa-ovarian plates, and those of the centre of the summit or apex, have not been determined.

The specimen described is a cast, but so well preserved as to indicate very satisfactorily its most important characters. It is a more elongate form than any cystidean of this group (*PSEUDOCRINITES*, *APIOCYSTITES*, *etc.*) that I have seen from American rocks.

Formation and Locality.—In the Racine limestone of the Niagara group at Racine, Wisconsin.

GENUS HEMICOSMITES, Vox Buch.

This genus was established by Vox Buch for a fossil figured by PANDER, under the name of *Echinospherites malum*.

The body consists of four series of plates; the basal series containing four plates, of which two are hexagonal and broad, and two narrower and pentagonal, similar to those of CARYOCRINUS. The second or subradial series consists of six plates, which are likewise very similar to those of CARYOCRINUS, except that three, instead of two, are truncated at their upper margins; and two of them are excavated on their upper adjacent lateral angles for the ovarian aperture which lies between these and the base of one of the plates of the succeeding range. In the third range of plates this genus differs from CARYOCRINUS in having nine instead of eight plates; the ninth comes in by a truncation of a plate of the second range, which corresponds to the plate directly opposite the ovarian aperture of the other genus. The mouth is represented by VOX BUCH as central. It is not known to possess arms or tentacula.

Among the fossils of the Niagara group in New York are some separated plates which I have supposed may belong to this genus; but their relations have not been fully established; though I have little doubt that further examinations in some of the more prolific localities will show the occurrence of this genus.

Among the cystideans of the same group in Wisconsin there are several specimens which preserve the structure and general features of this genus; but they are for the most part obscure.

HEMICOSMITES SUBGLOBOSUS, n. s.

PLATE XII, FIG. 13.

General form subglobose, a little longer than wide, somewhat narrower above than below; the ovarian aperture above the middle of the length; scarcely produced at the base, which is sometimes subtruncate or even a little depressed. [This latter feature is probably due to accident.] In the lower range the plates are short, and the second range consists of comparatively wide plates, giving it a greater proportional width than the typical species of the genus. The mouth is at the summit, but it cannot be determined whether it is or is not

probosciform. The ovarian aperture is situated above the second range of plates, and is apparently more nearly at the summit of the plate on the right, which has a somewhat different form from the corresponding plate in *Hemicosmites pyriformis*. The plates of the body are granulose and marked by striae parallel to the margins, having the centre elevated in a low node from which there are radiating ridges to the angles of the plate.

Formation and Locality.—In the Racine limestone of the Niagara group, Racine, Wisconsin.

Among the collections from Racine, and associated with the preceding species, there are several specimens of a peculiar form, apparently cystideans, but of different structure from any described genus, which, from the nodes or spines upon the surface of the species known, I propose to name **ECHINOCYSTITES**.

GENUS ECHINOCYSTITES, n. g.

Body subspheroidal, composed of four ranges of plates. The basal plates are probably four, and are succeeded by two ranges of five plates each and a series of dome plates. The mouth is central, with an eccentric or lateral ovarian aperture.

ECHINOCYSTITES NODOSUS, n. s.

PLATE XII, FIGS. 10, 11.

Body subglobose, base slightly protuberant in the centre; basal plates short. The five plates of the second range are large, forming part of the basal curve, and extending up the sides; they are furnished with strong nodes which are directed obliquely downwards. In the third range the plates are of equal size with the second range, and nodose in like manner; the sides of the body between the nodes being nearly straight in the vertical direction; the nodes of the lower range project a little beyond those above. Number and form of the summit plates not determined. There is evidence of a central aperture, which is probably the mouth; while at the upper lateral angles of two adjacent plates of the third series, and succeeded by a plate of the fourth series, is situated the ovarian aperture.

The specimens examined are casts of the interior, some of which retain parts of the test, and preserve, in a greater or less degree, marks of the structure.

Formation and Locality.—In the Racine limestone of the Niagara group, Racine, Wisconsin.

The two following species I place among the Cystidæ with some hesitation, notwithstanding the unsymmetrical form and peculiar character of one of them, which closely resembles in its general features the *Holocystites*.

In many of the Crinoidea proper, we find the plates arranged in successive order of one, two or three following each other directly in what are termed the radial series; while between these rays are interradial plates in the usual order of a larger one below, which supports two plates in the second range, followed by a like or greater number in the third range.

In the Cystideans of the described genera the plates do not follow this order of arrangement, and cannot be separated into radial and interradial series, according to the usual mode in Crinoidea. In the Cystideans, where there are a considerable number of plates, they are arranged in alternating order, so that each succeeding range above the second have their lower margins more or less pointed and inserted partially between and resting upon the sloping upper faces of those of the preceding range. This feature is seen conspicuously in *Holocystites*, where the plates are numerous. It sometimes happens, that owing to a curving form the plates follow each other in direct order.

Among the specimens which I had provisionally placed among the *Holocystites* is a small species of unsymmetrical, sub-clavate form, having the two lower ranges of plates alternating as in that genus, while above these the plates are arranged in consecutive order, until we reach the last range, where every alternate one is omitted, thus producing a contraction of this part.

Since this form cannot be consistently referred to any described genus, I propose the name *CRINOCYSTITES*.

GENUS CRINOCYSTITES, n. g.

Body elongate, composed of plates of sub-equal size. The number of basal plates undetermined. These support five hexagonal or heptagonal plates in the second range, and upon the upper edges of these, three plates of similar form follow in direct succession; and upon the third is a fourth plate supporting one or two arms. Between the upper sloping faces of the plates of the second range,

there is inserted a pentagonal plate, which supports a range in direct succession of two or three hexagonal plates. The summit is unsymmetrical, and in one specimen there is an apparent central aperture or mouth, and an eccentric or central aperture; and the margin is marked by what appears to be the bases of slender arms or tentacula.

Such a structure, in the ordinary nomenclature of the Crinoidea, would be described as a range of basal plates, succeeded by a radial series of four or five plates.

The distinctly unsymmetrical form of one of the species having this structure, together with the peculiar character and parts of the summit, give it a decidedly cystidean aspect; while it cannot be allied with the crinoidean genera at present known.

CRINOCYSTITES CHRYSALIS, N. S.

PLATE XII a, FIGS. 10, 11.

Body small, claviform, unsymmetrical, gradually enlarging from the base for half its length and then swelling a little more rapidly, and again contracting more abruptly towards the summit. The expansion being greater on one side, while the other is nearly straight or a little concave, gives an unsymmetrical form. There are about six ranges of plates; the lower range being comparatively long, the number unknown; the second range consists of elongate heptagonal plates which, on their upper truncate faces, support in direct series three smaller hexagonal plates, and above the last one there is apparently a small arm-bearing plate. Between these direct series of plates there is an intermediate or interradial series of three plates alternating with the others, the upper ones of which are pointed above, allowing the fourth plate of each of the adjacent radial series to join at their lateral margins, giving but five plates in the range immediately below the summit. The summit is unsymmetrical, showing evidence of two apertures and five slender arms or tentacula. Surface of plates striate.

Formation and Locality.—In limestone of the age of the Niagara group at Racine, Wisconsin.

GENUS EUCALYPTOCRINUS, GOLDFUSS.

This genus has usually been described as having five basal plates; but Dr. Troost, in his Memoir on the Crinoidea, has described the genus as having four basal or pelvic plates.

In the study of the collections from Waldron, Indiana, in 1861-62, this feature was fully ascertained, thus confirming the original observations of Dr. Troost.*

The basal plates of the species of this genus are usually small, and either concealed in the depression or covered by the column.

The form and relations of these plates are shown in fig. 1, which



FIG. 1.

represents the basal and first radial plates of *Eucalyptocrinus calutus* as seen from the inside, and showing more conspicuously than on the exterior.

In the original specimen both these and the lower part of the first radial plates are covered by the column. In the diagram, fig. 2, the basal plates of *E. calutus* are given of the natural size, and in their relation with the first radial plates; the plates are shown from the exterior, the ring indicating the extent of the column.

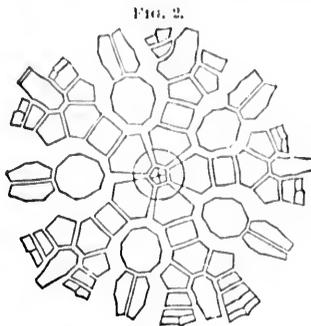


FIG. 2.

This determination of the basal plates will remove the Genus EUCALYPTOCRINUS from its present position among the Crinoidea which have five basal plates, and bring it into association with MELOCRINUS.

EUCALYPTOCRINUS CORNUTUS, N. S.

PLATE III, FIGS. 8, 9, 10.

Body (without the arms) somewhat turbinate, distinctly angular, with the base broadly truncate and more or less concave. Basal plates comparatively large, extending from the centre nearly one half the distance to the edge of the truncation. First radial plates large, forming the circumference of the base, and abruptly bending upwards they extend nearly one-third the height of the calyx; second radial plates small; third radials much larger than the

* I did not at that time publish an account of this structure in my paper on the Waldron fossils, wishing that it might first appear in the publication of Dr. Troost's Memoir; but since that has been delayed, I notice it in this place, giving Dr. Troost the credit of the original discovery.

second, supporting the first supraradials, which are of moderate size. The first interradial plate is comparatively large, commencing just above the edge of the basal truncation, and supporting two smaller plates above. Each of the first radial plates, on the part just above the basal truncation, bears a strong central spine, with a prominent rounded ridge on each side, extending to the upper lateral margin and joining a similar ridge on the interradial plate, and another ridge extends from the upper side of the central spine, and joins a similar ridge on the succeeding plate; this is continued to the third radial, where it divides and extends on the supraradials. The interradial plates of the first series are marked by similar strong ridges, which culminate in a prominent node or short spine in the centre. The finer surface markings are not known. Arms unknown.

The specimens occur in a magnesian limestone; the test has been dissolved, leaving casts of the interior and impressions of the exterior surface, and it is from these that we are able to derive the form and character. This species is readily distinguished by its strong nodes and ridges, and the spines upon the first radial plates.

EUCALYPTOCRINUS CORNUTUS, var. *EXCAVATUS*, HALL.

PLATE XI, FIGS. 6, 7.

This variety differs from the typical forms in having the base deeply and broadly excavated; the cavity embracing the basal, and nearly the entire length of the first radial plates. The plates are marked by ridges and nodes. In some of the specimens the second radial plates are very imperfectly developed, being reduced to a mere flattened node which is entirely surrounded by the first and third radial plates.

In these specimens the dome has not been observed, and the arms and axillary plates are unknown. The third radial plate is truncated above by a long narrow plate, and the first interradial by two narrow plates separated by a vertical suture, and has in all respects thus far the character of the genus; but above this, the cavity appears to have been larger, and shows no marks of the axillary plates, as usual in the dome of *EUCALYPTOCRINUS*.

Formation and Locality.—In limestone of the age of the Niagara group at Waukesha and Racine, Wisconsin.

EUCALYPTOCRINUS CRASSUS, HALL.

PLATE XI, FIGS. 2, 3.

Eucalyptocrinus crassus, HALL; in Transactions of the Albany Institute, IV, p. 197. 1862

Specimens which are casts of the interior and impressions of the exterior, present the general aspect of this species. It is extremely variable in form. Sometimes it is regularly turbinate and convex on the sides; other specimens are extremely elongate and sometimes abnormal in their development, having the supraradial plates united at their lateral margins, and the second interradials with the first axillary plate resting upon their upper sloping sides, instead of the truncated upper face of the interradial and third radial plates. This variation sometimes extends only to one or two of the rays, and sometimes, as far as can be seen, to all the plates of these series.

Formation and Locality.—In limestone of the Niagara group at Racine, Wisconsin.

EUCALYPTOCRINUS ORBICUS, N. S.

PLATE XI, FIG. 1.

Body small, reversed conical; base narrowly rounded or obtusely pointed; basal plates small and curving upwards. First radial plates comparatively large; the second and third smaller. The two supraradial plates join at the lateral margins, and the narrow interbrachial rests upon them, and does not truncate the third radial. First interradial plate large, narrowly truncate above.

This species occurring in several specimens is a remarkable form of EUCALYPTOCRINUS, being much more slender than any other species of the genus known to me; and presenting the peculiar relations of the interbrachial plates, which are elevated to a higher position than they occupy in the normal structure of the genus.

The position of the interbrachial plates, which appear to be uniform in this species, is sometimes observed in specimens of *E. crassus*.

Formation and Locality.—In limestone of the Niagara group at Racine, Wisconsin.

EUCALYPTOCRINUS ORNATUS, HALL.

PLATE XI, FIGS. 4, 5.

Eucalyptocrinus ornatus, HALL. Rep. Prog. Geol. Survey Wisconsin for 1860, p. 20. 1861.

This species is common at Racine and Waukesha. It occurs as casts of the interior, but retaining the marks of its structure in a greater or less degree of perfection. The impressions of the exterior in the compact limestone are very well marked and characteristic of the species.

Some specimens of the casts have a somewhat obtusely pentagonal form, with a broad spreading base, and a constricted upper margin. In this condition they much resemble in form and proportions the *Rhodocrinus melissa* of the Niagara shale at Waldron, Indiana.

EUCALYPTOCRINUS CÆLATUS, HALL.

Eucalyptocrinus cælatus, HALL. Paleontology of New York, 11, p. 210, Plate 47, fig. 4.

Some specimens of casts of the interior and impressions of the exterior surface of a species of *Eucalyptocrinus*, from Waukesha, appear to me not to be distinguishable from the New York species.

GENUS CYATHOCRINUS, MILLER.

CYATHOCRINUS PUSILLUS, HALL.

Cyathocrinus pusillus, HALL; in Transactions Albany Institute, IV, p. 200. 1862. Compare *Poteriocrinus pisiformis*, ROEMER. Die Silur. Fauna des Westlichen Tennessee, p. 54, Plate iv, fig. 7.

Specimens of a small species of CYATHOCRINUS or POTERIOCRINUS, resemble the one described by ROEMER, presenting characters somewhat intermediate between that species and *C. pusillus*.

Formation and Locality.—In limestone of the age of the Niagara group at Racine, Wisconsin.

CYATHOCRINUS CORA, N. S.

PLATE XI, FIGS. 13, 14.

Body rotund, somewhat broadly turbinate, rounded below, and gently contracted a little below the middle of the subradial plates and swelling out above; having the upper margins of the radial plates incurved and prominent in the middle. There is a single small anal plate. The basal plates are comparatively large, rising above the

curve of the base to nearly one-third the height of the cup. The subradial plates form nearly one-half the height. The column is large and round. Arms unknown. The surface of the plates in the casts is marked by strong radiating striae.

Formation and Locality.—In limestone of the age of the Niagara group at Racine, Wisconsin.

CYATHOCRINUS WAUKOMA, N. S.

PLATE XI, FIGS. 11, 12.

Calyx rotund below, subhemispheric; the sides above the middle of the subradial plates nearly straight or but little spreading. Basal plates small; subradial plates large, curving upward for about half their length; radial plates about as large as the subradial. The subradial plates have been marked by a central node, from which radiate strong ridges to the margins, joining similar ridges on the adjacent plates. Two of these from the lower sides of each of the radial plates converging to near the centre of that plate, and uniting, extend in a single ridge to the upper margin. The surface markings beyond the strong ridges are unknown.

This species is of different form, with more elevated sides and different surface markings from *C. pusillus*, which occurs in the same formation.

Formation and Locality.—In limestone of the Niagara group at Racine and Waukesha, Wisconsin.

GENUS ICHTHYOCRINUS, CONRAD.

ICHTHYOCRINUS SUBANGULARIS, HALL.

PLATE XI, FIGS. 15, 16.

Ichthyocrinus subangularis, HALL; in Trans. of the Albany Institute, IV, p. 201. 1862.
Ichthyocrinus corbis, W. & M.; in Mem. Bos. Soc. Nat. Hist., I, p. 89. 1865.

This species is more narrowly turbinate than the *I. laevis* of the Niagara group in New York, and has the calyx distinctly angular.

The original of the species occurs at Waldron, associated with well marked Niagara forms; and a specimen of the same species has been found at Bridgeport, Illinois, in limestone of the age of the Niagara group.

Possibly a larger collection of specimens may show gradations from the rounded and broadly turbinate typical species of the genus, to the narrow and subangular forms of Indiana and Illinois; but we have no intermediate forms at the present time.

GENUS RHODOCRINUS, MILLER.

RHODOCRINUS (LYRIOCRINUS) SCULPTILIS, N. S.

Body turbinate, rounded at the base, with the arm bases prominent. Basal plates (?) concealed beneath the column attachment. Subradials long, heptagonal. First radials wider than long, heptagonal. Second radials much smaller than the first, somewhat quadrangular in general form, but having the upper or lateral angles more or less widely truncated. Third radials broad and short, much smaller than the second, and supporting on each of the upper sloping sides two or three supraradials; giving two arms for each ray. The first interradial plates are hexagonal or heptagonal, supporting two or three smaller plates in the second range, with several smaller plates above. The arms, as far as known, are two from each ray. The dome is depressed convex, with a somewhat large proboscis on the anal side (the spaces between the arms being a little greater on that side). The surfaces of the plates are marked by node-like ridges radiating from the centre, and the sutures between the plates are deeply marked and apparently nearly flat in the bottom.

The specimens vary from three-fourths of an inch to one inch in height, with a diameter of one-half to three-fourths of an inch. They occur as casts of the interior, and the characters of the exterior have been derived from the natural mould in the limestone.

Formation and locality.—In limestone of the age of the Niagara group at Waukesha, Wisconsin.

RHODOCRINUS? RECTUS, N. S.*

PLATE XI. FIG. 10.

Body subcylindrical, rounded below; basal plates of medium size; those of the second range much larger, and supporting three other plates in direct superposition, the last one or fourth plate of the series sustaining two small arm plates. The intermediate range consists of four plates in direct succession, the last one narrowed above and

* Published in the first edition of the Report, page 318 as *Crinocystites? rectus*, and corrected in the addenda, page 379, as follows: Having made some careful examinations of the structure of this species, I am induced to believe that it possesses five basal plates, which are shown to be succeeded by five others, holding the place of subradials, and supporting two interradial plates, while the oblique upper faces of the subradials support in succession three radial plates.

lying between the arm-bearing plates. The position of the aperture has not been determined.

The specimen described has a length of one inch and a diameter of five-eighths of an inch.

Formation and Locality.—In the Racine limestone of the Niagara group at Racine, Wisconsin.

Among the collections from which the preceding species have been described, there are some other obscure or imperfect fragments which apparently belong to cystidean forms, but they are not in a condition to be designated.

These localities in Wisconsin have proved more prolific in species of this family of fossils than any others known to me, and some of the forms are more remarkable than any heretofore described from rocks of this age. In nearly every locality where these cystideans occur, the *Caryocrinus ornatus* has been found. The specimens, however, are for the most part small or of medium size, and usually more elongated than the same species in the Niagara group of New York or in Tennessee.

GENUS GLYPTASTER, HALL.

GLYPTASTER OCCIDENTALIS, HALL.

PLATE X, FIG. 3.

Glyptaster occidentalis, HALL; in Transactions of the Albany Institute, IV, p. 204. 1862.

The original specimens of this species were derived from the Niagara shales and shaly limestones at Waldron, Indiana. Among the collections from Racine, are some casts which are undistinguishable from those of Waldron, and I have thus referred them.

There are, however, some casts of a less rotund form, which is apparently a distinct species.

GLYPTASTER PENTANGULARIS, N. S.

PLATE X, FIG. 4.

Body reversed pyramidal, pentangular, regularly expanding to the bases of the arms. Basal plates five, small; subradial plates short, showing the commencement of ridges which unite on the first radial plates. First and second radials marked by a central longitudinal ridge, which divides on the third radial plate, as in other species of the genus. Interradial spaces quite flat.

G. W. 4

This species is much more slender in form than *G. occidentalis*. In its casts which is the usual condition of the specimens, the smaller individuals resemble the *Stephanocrinus angulatus*, with which it corresponds in size and proportions. The larger specimens have a length of an inch and a half, with a diameter of one inch at the summit.

Formation and locality.—In limestone of the Niagara group at Racine, Wisconsin.

GENUS ACTINOCRINUS, MILLER.

ACTINOCRINUS (SACCOCRINUS) WHITFIELDI.

Megistocrinus marcouanus, W. & M.; in Mem. Bos. Soc. N. H., I, p. 87, Plate ii, fig. 5.
infelix, W. & M.; in Mem. Bos. Soc. N. H., I, p. 110, Plate ii, fig. 7.

Actinoocrinus christyi, HALL; in Transactions of the Albany Institute, IV. 1862.

Not *Actinoocrinus christyi*, SHUMARD. Geol. Rep. of Missouri, p. 191, Pl. A, fig. 3. 1855.

This fine species resembles the *Actinoocrinus (Saccocrinus) speciosus*, HALL (*Pal. N. Y.*, II, p. 205, Pl. 46, fig. 1); differing however in the size and proportions of the plates, and the more prominent ridges upon the plates of the radial series; but principally differing in having a second bifurcation of the ray before the arms become free.

This species from Waldron sometimes attains a length of nearly three inches, and having a diameter at the summit of one inch and a half. Some specimens of casts from Wisconsin have the form and arrangement of parts corresponding with the Waldron specimens. Most of these are small, scarcely exceeding an inch in height, but a single specimen from Waukesha is nearly three inches in length; and a fragment of another from Racine indicates an individual of still larger dimensions. The casts of the smaller specimens have the arm — bases more prominent than is usual in the Indiana specimens.

Formation and Locality.—The original specimens are from a calcareous shale of the Niagara group at Waldron, Indiana. It occurs in limestone of the Niagara group at Racine and Waukesha, Wisconsin.

ACTINOCRINUS (SACCOCRINUS) SEMIRADIATUS, N. S.

PLATE X, FIG. 1.

Body elongate, urn-shaped, slightly constricted near the top of the first radial plates, the sides above being sub-parallel; base obtusely rounded. Basal plates rather large, forming about one-fifth the height of the calyx. First radial plates very large, nearly equalling half the entire height of the calyx, much higher than wide; second

radials small, elongate, hexagonal; third radials smaller than the second, wider than high, and variable in form, being mostly heptagonal, supporting on their upper sloping faces supraradials, the number and extent of which are unknown. First interradial plates large, hexagonal, succeeded by two vertical ranges of smaller polygonal plates. Anal area unknown.

The specimen from which the above description is taken is an internal cast, imperfect on one side, so that the entire characters are not seen; but the large size of the first radial plates, and the constriction of the sides above the middle of these plates, is very remarkable. From the characters on the cast it would appear that the plates were marked by rather strong radiating ridges, which rising from a point above the centres of the first radials, pass to the interradial plates above, while the first radials are smooth below, and in their upper part are marked by sharp rounded ridges, rising from the same point as the oblique ridges, extending upwards and bifurcating with the divisions of the ray as far as preserved in the specimen.

This feature of narrow rounded ridges, following the divisions of the rays, is approached in some specimens of *Saccoocrinus christyi* = *A. (S.) whitfieldi*; but the oblique ridges have not been observed, while the entire calyx is much less expanded than in that species.

Formation and Locality.—In limestones of the age of the Niagara group, at Racine, Wisconsin.

GENUS MACROSTYLOCRINUS,* HALL.

CYTOCRINUS,† ROEMER.

MACROSTYLOCRINUS STRIATUS, HALL.

PLATE X, FIGS. 7, 8.

Macrostylocrinus striatus, HALL; in Transactions Albany Institute, IV, p. 207. 1862.

The originals of this species are from Waldron, Indiana. A cast of a species of this genus from Racine is similar in form and proportions, and is probably identical with those from Waldron.

* *Palaeontology of New York*, Vol. ii. 1852.

† *Silurische Fauna des Westlichen Tennessee*. 1860.

GENUS MELOCRINUS, GOLDFUSS.

MELOCRINUS VERNEULI, TROOST.

PLATE X, FIG. 5.

- Actinocrinus verneuli*, TROOST; in Proc. Amer. Asso. Adv. Science, II, p. 60. 1849.
Actinocrinus obpyramidalis, W. & M.; in Mem. Bost. Soc. N. H., p. 87, Plate ii, fig. 4. 1865.
Turbinocrinites verneuli, TROOST, MS.
 Not *Actinocrinus verneulianus*, SUMMARD. Geol. Rep. of Missouri, p. 193, Plate A, fig. 1.

Body turbinate, strongly lobed at the arm-bases. Basal plates four; succeeded by five radial series of three plates each, and subdividing upon the last one. Interradial series composed of one, two and three plates in the successive ranges. Anal area scarcely differing from the other interradian spaces.

This species has the structure of MELOCRINUS, and though differing in form from the typical species of the genus, I see no sufficient reason for separating it at the present time.

Formation and Locality.—In limestone of the age of the Niagara group at Racine, Wisconsin. Dr. TROOST's specimens are from Decatur county, Tennessee.

GENUS GLYPTOCRINUS,* HALL.

GLYPTOCRINUS NOBILIS, HALL.

PLATE X, FIGS. 9, 10.

- Glyptocrinus nobilis*, HALL. Rep. Progress Geol. Survey Wisconsin for 1860, p. 21. 1861.

Body large, robust; from base to the first bifurcation of the ray sub-hemispherical; arm-bases above this point prominent, giving a strongly lobed form; dome highly elevated, the distance from the base of the free arms to the base of the proboscis being once and a half as great as the distance below. Proboscis strong, subcentral, entire length unknown. Basal plates of moderate size, spreading almost horizon-

*In a paper upon some Niagara fossils from Indiana, published in the Transactions of the Albany Institute in 1860, I made some observations upon the Genera GLYPTOCRINUS, GLYPTASTER, BALANOCRINUS and LAMPTEROCRINUS. At that time I had overlooked the fact, that the generic name BALANOCRINUS had been proposed by Prof. AGASSIZ, in 1846, in *Bulletin Soc. des Sciences Naturelles, Neuchatel*; and therefore the same name proposed by Dr. TROOST in his Catalogue of 1849, for a very different fossil, cannot be sustained. In 1860, Dr. FERDINAND ROEMER proposed the name LAMPTEROCRINUS in *Die Silurische Fauna des Westlichen Tennessee*, for the same fossil to which Dr. TROOST had given the name BALANOCRINUS, and this later generic designation will necessarily be adopted.

It may however, on the final revision of the crinoidean genera, become a question, whether those forms now distinguished as GLYPTOCRINUS, GLYPTASTER and LAMPTEROCRINUS should not constitute a single genus.

tally from the column. First radial plates large, second radials hexagonal, much wider than high; third radials broadly pentangular, supporting on each upper sloping side a series of four supraradials; the upper one of which is a bifurcating plate, and supports on the upper oblong sloping edges a series of arm plates; giving eight arms to each ray, so far as determined. First interradial plate large, six or seven sided, with two smaller plates in the second range, three in the third, and several small polygonal plates above, filling the interbrachial spaces and connecting with the dome plates. Anal series unknown. Dome near the base, composed of small polygonal plates, gradually increasing in size towards the proboscis; the dome is strongly lobed, and the depressions correspond with the interbrachial spaces. Surface of calyx plates marked by a single set of strong radiating ridges, which connect at the sutures with those of the adjoining plates; the interspaces occupied by one or more small round nodes, which are sometimes confluent. The ridge along the radial series is much the strongest, and forms a node on the centre of each plate. The dome plates are marked by similar, but less distinct lines, and a small round node on the centre of each plate.

This species differs from *G. decadactylus* (*Paleontology New York*, Vol. i, p. 281, Plates lxxvii and lxxviii) in the larger size; the shortness of the base; the very large dome, and strong proboscis; as well as in the surface marking and greater number of arms.

Geological Formation and Locality.—In limestone of the age of the Niagara group, Racine, Wisconsin.

GLYPTOCRINUS ARMOSUS (McCHESNEY).

PLATE X, FIG. II.

Glyptocrinus siphonatus, HALL. Rep. Progress Geol. Survey Wisconsin for 1860, p. 22. 1861.

G. siphonatus, 20th Report St. Cab., first edition; rectified in description of plates.

Eucalyptocrinus armosus, McCHESNEY. New Paleozoic Fossils, etc., p. 95. Feb., 1861.

Body large, broadly obovate, the greatest width being above the origin of the arms; calyx narrow below, spreading gradually to the bases of the arms; dome inflated on the anterior (?) side. Arms rising from the body in pairs with deep constrictions between; arrangement and forms of plates of calyx not fully determined; those of the dome are small and polygonal.

The above description is drawn from internal casts. This species differs from *G. nobilis* in the much greater length of calyx which is not contracted in the lower part, while in that species it is broad and spreading. It appears not to have had a proboscis; but in the casts there is the filling of a cavity which has passed from the summit of the dome between the postero-lateral arms, where it turns outwardly, as if 't had opened on the exterior surface in the form of an anal aperture

Geological Formation and Locality.—In rocks of the age of the Niagara group; Racine, Wisconsin.

GENUS LAMPTEROCRINUS, ROEMER.

LAMPTEROCRINUS INFLATUS, HALL.

PLATE X, FIG. 6.

Balanocrinus inflatus, HALL. Report Progress Geol. Survey Wisconsin for 1860, p. 22. 1861.

Body below the arms subturbinate, with sides somewhat inflated in the lower part; arm-bases prominent, leaving deep interbrachial spaces; dome low, strongly inflated on the anal side, surmounted by a slender subcentral proboscis. Basal plates small, pentagonal. Subradial plates proportionally large, hexagonal. First radials heptagonal, a little larger than the subradials; the form of the second and third radials undetermined; the second are as large as the subradials; the third very small. Interradial plates, six; the first hexagonal, as large as the second radials, with two in the second range, and three in the third range, uniting with the dome plates. Anal plates numerous; form and arrangement unknown.

The above description has been drawn from the internal casts of several specimens, which exhibit the division of the plates.

This species differs from *B. sculptus*, TROOST; *Lampteroocrinus tennesseensis*, ROEMER (*Silurian Fauna of Western Tennessee*), in being more distinctly turbinate or obconical; in the deeper interbrachial spaces; the inflation of the dome on the anal side; and in its uniformly smaller size.

BRACHIOPODA.

GENUS OBOLUS, EICHWALD.

COMPARE TRIMERELLA, BILLINGS.

OBOLUS CONRADI, N. S.

PLATE XIII, FIGS. 1, 2; PLATE XXV, FIGS. 1, 2, 3.

Shell depressed orbicular or subdiscoid; width usually greater than the length, gibbous in the middle and compressed towards the margins. Dorsal valve more convex than the ventral. Surface unknown.

The rostral portion of the valves is extremely thickened, for muscular attachments; and this area extends in an elevated plate or transverse septum which becomes free at its anterior margin, except where it is supported in the middle by a vertical septum. The interior surface of this plate, towards the antero-lateral margins, is marked on each side by a rhomboidal muscular scar, varying somewhat in the two valves, and in different individuals. On each side and just without the upper or posterior lateral margins of this plate, there is a depressed oval or reniform muscular scar, varying in character and area in the two valves. In the dorsal valve, and probably in the ventral valve also, there is an elongate ovate imprint, extending from a narrow point, at what may be regarded as the extremities of the hinge line, close to the cardino-lateral margins, and gradually expanding below, reaching nearly half way to the anterior margin of the shell. This transverse plate in the ventral valve sometimes shows muscular markings just below the rostral area as well as anteriorly. The cast of the rostral cavity is small and neatly defined, with marks similar to those of dental lamellæ (?) along the cardinal slopes. The cast of the dorsal valve shows the impression of a broad, shallow, spoon-shaped plate, with the median septum extending nearly to the base of the shell.

The figures on Plate xiii are given from casts of the dorsal and ventral valve. The impressions from these are given on Plate xxv of this edition of the Report.

Some ten years since, having these fossils under consideration, I proposed a new generic name for them; but sending drawings to Mr. DAVIDSON, he gave me the opinion of himself and Mr. WOODWARD that

they belonged to the Genus *OROLUS*. There are certain points of difference, however, which I have been inclined to believe are of generic importance, and I am not entirely satisfied in referring them to that genus, as illustrated, though closely allied to it.

In the mean time, Mr. BILLINGS has published a Genus *TRIMERELLA*, illustrating it by a specimen from the Guelph limestone. Now the fossils under consideration, in the earlier stages of growth, have the transverse plate but partially attached at the sides; and the processes shown in Mr. BILLINGS' figures are sometimes slightly simulated by the casts of the spaces on each side of the median septum, which extend between this transverse plate and the exterior shell. There are, however, no evidences of three longitudinal septa.

The exterior of the shell is unknown, but probably is essentially smooth, or with only lines of growth. From the fact that in numerous specimens collected from these rocks there is no shell preserved, I infer that it was calcareous and not phosphatic as in *LANGULA* and *DISCINA*, which usually preserve the shell in all the dolomitic limestones.

Formation and Locality.—In the Leclaire limestone, upper part of the Niagara group, at Leclaire, Iowa, and in limestone of the same age at Racine, Wisconsin.

GENUS STROPHODONTA, HALL.

STROPHODONTA PROFUNDA, HALL.

PLATE XIII, FIGS. 3, 4.

Leptana profunda, HALL. Palaeontology N. Y., II, p. 61, Plate xxi, figs. 4, 5. 1852.
Strophomena niagarensis, W. & M.; in Mem. Bost. Soc. Nat. Hist., I, p. 92, Plate ii, fig. 9. 1865.

Shell large, the full grown individuals having a width of more than two inches, with a length exceeding one inch and a half; deeply concavo-convex; the extremities sometimes angular or extended, but more often in the casts obtuse or rounded. Surface of young shells somewhat regularly marked by strong elevated striæ, with four, five or more finer striæ between. In older shells the striæ become more irregularly fasciculate, and the stronger ones rise in unequal ridges upon the surface. This feature is, in greater or less degree, impressed upon the casts of the interior, which, combined with strong vascular markings, gives a distinguishing character to specimens in that condition. The hinge line is crenulate, with a broad foramen; the muscular impression of the ventral valve is ovate or flabelliform, and extends for two-fifths the length of the shell.

There is a central longitudinal callosity extending from the apex sometimes for one-third of the length of the muscular impression.

The *Strophomena niagarensis* of WINCHELL & MARCY (loc. cit.), appears to me to be identical with this. The specimens in my possession, from western localities, show a considerable variety of form and proportions, and yet preserving the essential character of the species.

A specimen communicated by Prof. WINCHELL under the name *S. niagarensis*, has the divaricator scars proportionally a little more elongate than usual, but the same feature is preserved in other specimens.

The specimen figure 3 is of a young or medium size, preserving a part of the exterior surface of the ventral valve on the lower margin, while the other portion is the impression of the exterior of the dorsal valve. Fig. 4 is the cast of the interior of the ventral valve.

Formation and Locality.—In limestone of the Niagara age, at Racine, Wisconsin; Bridgeport, Illinois, and Waldron, Indiana.

GENUS SPIRIFERA.

SPIRIFERA EUDORA, HALL.

PLATE XIII, FIGS. 5, 7.

Spirifer eudora, HALL. Rep. Progress Geol. Survey Wisconsin for 1860, p. 25. 1861.

S. eudora, HALL. Transactions of the Albany Institute, IV, p. 211. 1862.

Shell of moderate size, transversely subovate, length and width as three to four, valves extremely gibbous; hinge-line less than the width of the shell below; cardinal extremities rounded; area moderately high; foramen triangular, a little higher than wide; marked by three to four simple, strong, angular plications on each side of the mesial fold and sinus. Dorsal valve regularly arcuate; beak somewhat incurved; mesial fold of moderate width, flattened above and slightly depressed in the lower part. Ventral valve most prominent near the umbo; beak strongly incurved over the area; mesial sinus broad and deep.

The minute surface markings, as shown in specimens from Waldron, Indiana, are fine radiating striæ, precisely like those of *S. macropleura* of the Lower Helderberg group of New York. The specimens from Wisconsin are all casts of the interior.

This species bears some resemblance to *S. macropleura*, but it is proportionally more gibbous, the front more rounded, the area higher, and the plications not directed so obliquely outwards from the beak.

Formation and Locality.—In limestone of the age of the Niagara group, Racine, Wisconsin, and also in rocks of the same age at Waldron, Indiana.

SPRIFERA GIBBOSA, HALL.

PLATE XIII, FIGS. 3, 8.

Spirifer gibbosus, HALL. Rep. Progress Geol. Survey Wisconsin for 1860, p. 25. 1861.

Shell somewhat below the medium size, gibbous; beaks slightly incurved, area less than the width of the shell below, about three times as wide as high; cardinal extremities rounded; foramen large, higher than wide; valves marked by about four simple low rounded plications on each side of the mesial elevation. Dorsal valve extremely gibbous on the nabe, regularly arcuate transversely; mesial elevation broad, flattened above; plications not extending to the beak. Ventral valve deeper than the dorsal, but less arcuate; mesial depression broad and deep, rounded at bottom. Surface of both valves (in well preserved specimens) show evidence of fine radiating striae.

This species resembles *S. crispus* of the Niagara group in New York, but is much larger, frequently more than twice as wide as that species; the mesial elevation is wider and not so high. The specimens described are all internal casts, so that the external surface characters cannot be fully given.

Formation and Locality.—In limestone of the age of the Niagara group, Racine, Wisconsin.

SPRIFERA Plicatella, var. radiata, Sow.

PLATE XIII, FIGS. 9-11; PLATE XXV, FIGS. 4-6.

- Spirifera plicatella*, var. *radiata*, Sow., *Delthyris lineatus* (text), *radiatus* (index): Sow. Min. Con., V, p. 493, figs. 1, 2. 1825: not *Anomia lineatus*, MARTIN.
Spirifer radiatus, J. DEU, Sow. Silurian System, Plate xii, fig. 6. 1830.
Spirifer radiatus, M'COY. Synopsis of the Silurian fossils of Ireland, p. 37. 1848.
Spirifer plicatellus, SALTER; in Memoirs Geol. Survey of Great Britain, II, p. 328. 1848.
Spirifer cyrtæna, DAVIDSON; in Bul. Soc. Géol. de France, 2d series, V, p. 324. 1848.
Spirifer radiatus, HALL. Phil. N. Y., II, pp. 66, 265, Plate xxii, fig. 3; Plate liv, fig. 6. 1852.
Spirifer plicatellus, var. *radiatus*, SALTER. Siluria, Plate ix, fig. 12; Plate xxii, fig. 7. 1859.
Spirifera plicatella, LINDSTROM; in Proc. Royal Acad. of Science of Stockholm, p. 358. 1860.

It seems not worth while to risk the addition of another synonym for any variety of this very variable species, but the Wisconsin specimens commonly referred to it present some unusual characteristics. The form is rhomboidal or transversely oval, and usually very gibbous. The car-

dimal extremities are rounded and the area more or less distinctly defined. Some remains of surface striæ are sometimes distinguishable on the cast, and this marking is often well preserved in the matrix from which the shell has been dissolved. Sometimes the margins of the valves, or their impression in the cast, are undulated, and there are obscure remains of broad low plications, which usually extend but a short distance, though sometimes continuing nearly to the beak. The latter forms may perhaps be regarded as *S. plicatella* proper; such specimens are very gibbous, with a high area and broad deep sinus in the ventral valve, while they differ in form from the simply striated specimens.

The peculiarity noticed in the smooth or finely striated species is the presence of distinct lamellæ in the dorsal valve (as shown in fig. 9 of Plate xiii) diverging from the apex and presenting all the characters of the dental lamellæ of the ventral valve. These marks upon the cast are not simply sharp cut depressions, but the edges of distinct thin plates, which are joined to the inside of the shell, sometimes for half its length. A specimen, fortunately broken, shows the interior of a shell without filling, and these dorsal lamellæ are seen extending downwards half way to the base, and uniting with the shell precisely as the dental lamellæ of the ventral valve. These lamellæ are divided near their origin, and give off the crura from which the spires have continued.*

Specimens of this character are rhomboidal, gibbous, with distinct mesial sinus and fold; small specimens like the one figured, are more common than larger ones, though they are sometimes found of much larger size, and assuming a transversely oval form. From all the observations made, it appears as though the dorsal lamellæ were much stronger in the young shell, and that they become partially absorbed or almost entirely disappear in the older shells. In specimens regarded as the same species from Indiana and New York, the evidence of lamellæ is confined to the apex of the valve, and is never observed to extend towards the front of the shell.

Formation and Locality.—This species is common in limestone of the Niagara age, at Racine, Wauwatosa and elsewhere in Wisconsin, and at Bridgeport, Illinois.

* These features are more fully shown in fig. 6 of Plate xxv.

SPIRIFERA META, N. S.

PLATE XIII, FIGS. 12, 13.

Spirifer radiatus, pars, HALL. Palaeontology N. Y., II, p. 66, Plate xxii, figs. 2s, 2t.
Compare *Cyrtia myrtia*, BILLINGS. Palaeozoic Fossils, p. 165, fig. 149.

Shell small, semioval in outline. Ventral valve low pyramidal; height equal to one half the width, or a little less; length and height nearly equal; hinge-line equaling the entire width of the shell; ventral valve with the area erect or slightly arcuate; foramen narrow; deltidium highly convex, perforated near the apex; sinus broad, nearly one-third the entire width of the valve, deep, and somewhat angular at the bottom. Dorsal valve regularly convex, the mesial fold moderately elevated, very narrow at the umbonal region; the interior of the ventral valve possessing very strong dental lamellæ, which extend more than one-third its length. Exterior surface of shell marked by a few distinct concentric lines of growth, and fine close radiating striae.

This species is of the type of *Spirifer trapezoidalis*, DALMAN; but differs in its greater proportional width on the hinge, the less elevation of the ventral and more convex dorsal valve. From *S. (Cyrtia) myrtia*, BILLINGS, it differs in the same particulars, as well as the rounding of the hinge-extremities. In fact these two species, *S. myrtia*, and *S. trapezoidalis* are so closely allied that a careful comparison with each other might lead to an identification. The specimens with elevated area, figured on Plate xxii, Vol. ii, *Palaeontology*, N. Y., as varieties of *S. radiatus*, are of this species.

Formation and Locality.—In limestones of the age of the Niagara group, near Milwaukee, Wisconsin, and in the Clinton group, at Rochester, N. Y.

SPIRIFERA NOBILIS, BARRANDE.

PLATE VIII, FIGS. 14, 15, 16, 17.

Spirifer nobilis, BARRANDE. Silurische Brachiopod. Böhmen; in HAIDINGER's Naturwissenschaftliche Abhandlungen, Band 2, Tab. xviii, fig. 2, a, b.

Spirifer racinensis, M'CHESNEY. Palaeozoic Fossils, p. 84. 1861.

Spirifer inconstans, HALL. Rep. Progress Geol. Survey Wisconsin for 1860, p. 26. 1861.

Shell transversely elliptical, the length a little more than half the width; hinge-line two-thirds as long as the greatest width of the shell; cardinal extremities rounded; both valves moderately convex, marked by strong angular dichotomizing plications. Dorsal

valve most prominent on the umbones; mesial fold broad and simple on some specimens, and on others divided into two, three or more plications in front; beak produced and moderately incurved. Ventral valve larger than the dorsal; beak very prominent, but little incurved; area high; deltidium large, height and width nearly equal; sinus broad and deep, simple or with two or more plications. Entire surface marked by strong distinct radiating striae. The specimens are casts of the interior and exterior.

From the figures and descriptions of BARRANDE (loc. cit.), I am compelled to regard this American species as identical with the Bohemian form. Not only is the general form and dichotomizing of the plications similar, but the peculiar elevation and attenuation of the beak of the ventral valve represents very precisely the Racine specimens.

This species may be readily distinguished from others by the strong angular bifurcating plications, the number of which vary in different individuals; some being nearly simple, having but four or five on each side of the mesial fold, while others have nearly double that number on the front margin. The number of plications on the mesial fold and sinus are subject to the same variation.

Formation and Locality.—In limestone of the age of the Niagara group, Racine, Wisconsin.

GENUS PENTAMERUS, SOWERBY.

PENTAMERUS MULTICOSTATUS, HALL.

PLATE XIII, FIGS. 22, 23, 24.

Pentamerus multicostatus, HALL. Rep. Progress Geol. Survey Wisconsin for 1859, p. 1. 1860.

Shell obtusely subcuneate, the valves nearly equally convex below the middle, ventricose on the umbones; sides somewhat straight, and abruptly widening from the beaks; greatest width in front, nearly equal to the length of the shell. Surface marked by numerous, even, rounded, little elevated striae, which are preserved on the lower half of the cast. Both valves are often slightly impressed in the centre below the middle. Longitudinal septa of the dorsal valve reaching more than one-third the length from the beak. The spoon-shaped cavity of the ventral valve is narrow and deep, and the septum reaches more than half way to the base of the shell.

This species of PENTAMERUS is usually from one inch to an inch and a half in length. It is readily distinguished from other species in the rock by its narrowness at the beaks, and by the numerous longitudinal striae which mark the casts.

Formation and Locality.—In limestone of the age of the Niagara group, at Wauwatosa and Waukesha, Wisconsin.

PENTAMERUS (PENTAMERELLA) VENTRICOSUS.

PLATE XIII, FIGS. 18-21.

Pentamerus ventricosus, HALL. Rep. of Prog. Geol. Survey Wisconsin for 1859, p. 2. 1860.

Shell ventricose, subglobose, wider than long; hinge-line extended and abruptly rounded at the extremities. Ventral valve much the more convex, and broadly sinuate below the middle of the shell; the sinusity sometimes not reaching the beak, but prolonged into a broad linguiform extension in front. The sinus of the ventral valve and the mesial fold of the dorsal valve are marked by three or four obscure, or sometimes conspicuous, rounded plications. The casts are marked by strong concentric laminae of growth, and some faint, rather broad, radiating striae: muscular impression of the ventral valve broad, subcordiform, and radiatingly striated. The triangular pit beneath the beak small and shallow, and the median septum short, reaching no more than one-fourth the length along the curve of the valve. Dorsal valve having the septa united at the base of junction with the shell, spreading very slightly above, and reaching nearly half way to the basal margin.

This shell presents some variation from the strict characters of PENTAMERUS, and will probably fall under the proposed genus PENTAMERELLA.*

Formation and Locality.—In limestone of the age of the Niagara group, at Waukesha, Saukville and elsewhere in Wisconsin, and at Bridgeport? Illinois.

* See page 193 of this Report.

LAMELLIBRANCHIATA.

The following species, including several heretofore described, have been recognized in the Niagara limestone of Wisconsin and adjacent parts of Illinois.

GENUS AMBONYCHIA, HALL.

AMBONYCHIA APHLEA, N. S.

PLATE XIV, FIG. 3.

Shell somewhat obliquely ovate; anterior side broadly rounded; beak in the east acute; hinge-line straight, and about half the length of the shell. The posterior basal extremity is somewhat abruptly rounded. Muscular impressions large, situated below the centre of the length of the shell. The greatest width of the shell is equal to about two-thirds the length.

This species is proportionally broader and shorter, with the beaks less extended than *A. acutirostra* from the same horizon.

One specimen measures one inch and seven eighths in length and one inch and a quarter in width. Other specimens are smaller than the one measured.

Formation and Locality.—In limestone of the age of the Niagara group, at Wauwatosa, Wisconsin, and Bridgeport, Illinois.

AMBONYCHIA ACUTIROSTRA, HALL.

PLATE XIV, FIG. 2.

Ambonychia mytiloides, HALL. Rep. Progress Geol. Survey of Wisconsin for 1859. 1860.

This species is proportionally longer than the preceding, less expanded on the anterior margin, and has the beaks elongate and attenuate. In many respects it resembles the *Myalina mytiliformis* of the grey sandstone of the Clinton group.

These species are probably not true *Ambonychia*, but in the condition in which they occur, we have not sufficient characters remaining, to authorize their separation.

Formation and Locality.—In limestone of the age of the Niagara group, near Milwaukee, and at Wauwatosa and Racine, Wisconsin.

GENUS AVICULA, KLEIN.

AVICULA UNDATA.

Avicula undata, HALL. Palaeontology of New York, II, p. 283, Plate lix, fig. 2.

A specimen from Racine, Wisconsin, and another from Bridgeport, Illinois, resemble this species from the Niagara group of New York.

AVICULA EMACERATA, CONRAD.

Avicula emacerata, CONRAD; in Jour. Acad. Nat. Sci. Phila., VIII, p. 241, Plate xii, fig. 15.
 HALL. Geol. Report Fourth District N. Y., p. 109.
 HALL. Pal. N. Y., II, pp. 83, 282, Plate lix, fig. 1a-c.

This species occurs at Racine, Wisconsin, and at Bridgeport, Illinois.

GENUS PTERINEA, GOLDFUSS.

PTERINEA BRISA, N. S.

PLATE XIV, FIG. I.

Compare *Pterinea striacosta*, McCHESENEY. New Palaeozoic Fossils.

Body of the shell obliquely subovate, extremely inequilateral; anterior wing rather long, distinctly sinuate at its junction with the body of the shell, posterior wing short, not extending so far as the posterior extremity of the shell; umbo prominent, rising a little above the hinge-line. Muscular impression large and nearly round, situated near the middle of the length of the shell. In the cast, beneath the beak or just anterior to it, there is one short curving dental pit, with a smaller accessory one separated by a callosity. The surface of the shell is marked by strong radiating and concentric striae, which, on the partial decomposition of the shell, present a cancellated texture resembling that of a bryozoan.

In one specimen measured, the width from the two extremities along the hinge-line is nine-tenths of an inch; and from the umbo to the postero-basal margin, in the direction of the umbonal slope, it has the same extent; the length vertically from the hinge-line is six-tenths of an inch.

Formation and Locality.—At Bridgeport, Illinois.

GENUS CYPRICARDINIA, HALL.

PROBABLY = SEDGWICKIA, M'COY.

CYPRICARDINIA ARATA, N. S.

PLATE XIV, FIG. 6.

Shell subovate, varying from moderately to extremely gibbous; body of the shell subovate, alate posteriorly; beaks near the anterior end, which is short and rounded. Surface marked by strong concentric lamellose ridges.

The species resembles in form the *Modiolopsis* (*Cypricardinia*) *undulostriata* of the Niagara shale of New York; but the concentric ridges are stronger, and the fine undulating striae are not visible in any of the western specimens.

Formation and Locality.—In limestone of the Niagara group, at Racine, Wisconsin, and Bridgeport, Illinois.

GENUS MODIOLOPSIS, HALL.

MODIOLOPSIS DICTÆUS, N. S.

PLATE XIV, FIG. 7.

Shell broadly subovate, moderately convex, becoming somewhat gibbous on the umbo; beak about one-fifth distant from the anterior extremity; gradually expanding posteriorly so that half way between the beak and the posterior margin it is once and a half as wide as in the line just anterior to the beak. The straight hinge extends about half the length of the shell, and the cardinal margin is thence gradually curved to the posterior end. The cast of the hinge-line shows two narrow lateral folds or teeth. Surface concentrically striated.

The length of a specimen measured is about one inch, with the greatest width seven-eighths of an inch.

The form of this species is very similar to *Modiolopsis modiolaris* of the Lower Silurian rocks; but the hinge-line does not rise so abruptly on the posterior side of the beak, and the contraction below the beaks is not observed.

Formation and Locality.—In limestone of the Niagara group, at Racine, Wisconsin, and at Bridgeport, Illinois.

MODIOLOPSIS RECTUS, N. S.

PLATE XIV, FIGS. 4, 5.

Shell elongate, narrow, moderately convex, beaks subanterior; hinge-line long and straight; the greatest width of the shell is at the posterior end of the cardinal line, narrowed equally above and below towards the posterior extremity. The anterior muscular impressions large and strongly defined. The casts show that there has been one strong subtriangular tooth beneath the beak of the right valve, with one or two smaller ones, with corresponding pits, in the opposite valves. The lateral teeth are very slender. The surface has been marked by concentric striae, and a few strong undulations which are preserved in the casts. The length is about one inch with the greatest breadth half an inch.

This species resembles *Modiolopsis (Tellinomya) macheraiformis* of the Clinton group of New York, from which it differs in having the beaks more nearly anterior and in being less narrowed posteriorly; while the greatest width is at the posterior extremity of the hinge-line, instead of at the beaks.

Some specimens, which are scarcely specifically distinct from those described, have proportionally a somewhat greater width, but in other respects are identical.

Formation and Locality.—In limestone of the Niagara group, at Waukesha and Racine, Wisconsin, and at Bridgeport, Illinois.

MODIOLOPSIS SUBALATUS, HALL.

Modiolopsis subalatus, HALL. Palaeontology N. Y., II, pp. 84, 285, Plates xxvii, lix.

Some specimens from Racine, Wisconsin, and Bridgeport, Illinois, are apparently identical with this species of the Niagara group of New York. The specimens are casts and more or less crushed and imperfect.

GENUS AMPHICELIA, N. G.

The Acephala present great difficulties in the way of satisfactory generic reference; and it is often scarcely possible to arrive at certainty with regard to their true relations.

A single species from Wisconsin, which is somewhat numerous in individuals, has the general exterior aspect of the more elevated forms

of Le
perly
The
The c
beaks
valve
exten
the sh
It
tooth
factor
than
that

Amb
Amp
Shell
u
u
i
r
h
s

Th
there
teeth
stron
the s
Th
mens
corre
eight
lengt
Ov
in fo
eleva

of *LEPTODOMUS* of McCoy; but it cannot nevertheless be referred properly to that genus.

The general form of the shell is subrhomboidal, with elevated beaks. The casts present evidence of a large triangular cartilage pit beneath the beaks; and just anterior to this, and separated by a thin process on each valve, is an apparent second pit. No teeth have been discovered on the extension of the hinge-line. The muscular impressions are faint and the shell thin.

It is possible that there may have been a cartilage pit and adjacent tooth, as in *MACTRA* and *AMPHIDISMA*—a feature which cannot be satisfactorily determined except from an examination of better specimens than we possess. There is a flattened external ligamental area not unlike that of the *Arcaea*.

AMPHICELIA LEIDYI, N. S.

PLATE XIV, FIGS. 13, 14, 15.

Ambonychia neglecta (?), McCHESENEY. *New Paleozoic Fossils*, p. 88. 1861.

Amphicelia neglecta (?) McCHESENEY. *Trans. Chicago Acad. Sci.*, 1, p. 41, Plate ix, fig. 2. 1867.

Shell equivalve, inequilateral, somewhat rhomboidal, gibbous except upon the expanded posterior side; height and width subequal; umbones gibbous; beaks much elevated and incurved, pointed, falling from one-fourth to one-third the width within the anterior margin, which declines from the hinge-line at a very obtuse angle; hinge-line equaling somewhat more than half the width of the shell.

The casts show a large triangular pit beneath the beak, and sometimes there is evidence of a thin dividing septum. There are no visible lateral teeth. The surface of the casts is usually smooth, or showing only a few strong lines of growth. In a single specimen preserving a portion of the shell, the surface is marked by fine close radiating striae.

The height of the shell from beak to base measures in different specimens from two to two and a quarter inches, with a width almost precisely corresponding. The depth of the two valves is about one inch and five-eighths. Some smaller specimens, which may be of this species, have a length and breadth of half these measurements.

Owing to pressure and other causes, the species exhibits great variation in form and proportions. Among the specimens are two with less elevated and more approximate beaks, and less gibbous form, with a

greater extension in front and greater width behind; which may prove specifically distinct.

Formation and Locality. In the limestone at Racine and Wauwatosha, Wisconsin, and at Bridgeport and another locality* (unknown) in Illinois.

GENUS CYPRICARDITES, CONRAD.

CYPRICARDITES (?) QUADRILATERA, N. S.

PLATE XIV, FIGS. 8, 9, 10.

Shell somewhat quadrilateral, the angulated umbonal slope dividing the valve into nearly equal areas. Valves inflated, height and depth nearly equal; beaks closely incurved and sharply angulated; the angulation gradually becoming obtuse, and continuing along the umbonal slope to the postero-basal margin. A cast of the right valve shows a conspicuous muscular prominence just anterior to the beak, with two strong lateral folds marking the cardinal line; the entire surface is marked by low concentric undulations. On each side and parallel with the umbonal slope there is an extremely narrow groove and fold, indicating radiating lines upon the surface of the shell. Just posterior to the beak there commences a distinct groove, with a slight ridge on the lower side, which continues about half way between the hinge-line and the umbonal angulation, but not parallel with either, and extending to the posterior margin of the shell.

This species is angulated like many of the extreme forms of *MYALINA*; but the strong muscular marking, with lateral hinge-teeth, prohibit its reference to that genus.

Formation and Locality.—In limestone of the Niagara group, at Bridgeport, Illinois.

Among the collections obtained from Wisconsin, there is a single shell which is not referable to any established genus, though well preserved in its general form and external characters. Although it would be very desirable to know more of its structure before giving a generic name, I shall nevertheless propose a designation. Its general form indicates that it belongs to the Cardiaceae, and this is confirmed by all that can be learned of its structure.

* Two specimens were received several years since from Prof. C. U. SHEPARD, which were credited to Illinois, but the record of the particular locality had been lost.

Shell

v
s
t
h
e
f
c
f

Th
of A
while
beaks
Th
infor
Fo
Wau
of R

GENUS PALÆOCARDIA, N. G.

PALÆOCARDIA CORDIFORMIS, N. S.

PLATE XIV, FIGS. 11, 12.

Shell cordiform; valves obliquely subovate, ventricose; umbones gibbous, with the beaks prominent, attenuate and incurved; hinge-line very short, extending a little in advance of the beaks, and showing the margins separated. The anterior end gradually rounding into the basal margin. In the partial cast the posterior slope shows a ridge on each side rising just behind the beak, and in a line slightly divergent from the cardinal margin, reaching about half way to the posterior extremity, where it becomes obsolete. The surface is marked by fine close radiating striæ.

This species has the general aspect of some of the more gibbous forms of AMBONYCHIA, but the short hinge-line separates it from that genus, while the extreme prominence of the umbones and incurvation of the beaks give it the aspect of a true CARDIUM.

The specimen was given to me by Dr. DAY of Wauwatosa, who informed me that it was found in a quarry a little east of that village.

Formation and Locality.—In limestone of the Niagara group, near Wauwatosa, Wisconsin; in beds which are probably a little below those of Racine and Waukesha.

ich may prove

and Wauwatosa,
(own) in Illinois.

pe dividing the
ight and depth
angulated; the
g along the um-
the right valve
rior to the beak,
line; the entire
On each side and
y narrow groove
ace of the shell.
et groove, with
about half way
, but not parallel
of the shell.

forms of MYALINA;
eeth, prohibit its

group, at Bridge-

e is a single shell
h well preserved
it would be very
generic name, I
orm indicates that
all that can be

SHEPARD, which were

GASTEROPODA.

The following species have been identified with known forms, or determined as new:

GENUS PLATYCERAS, CONRAD.

PLATYCERAS NIAGARENSIS, HALL.

Acroculia niagarensis, HALL. Paleontology, N. Y., 11, p. 288, Plate 60, fig. 3.

Formation and Locality.—In the limestones of Racine and Waukesha, Wisconsin.

GENUS PLATYOSTOMA, CONRAD.

PLATYOSTOMA NIAGARENSIS, HALL.

Platyostoma niagarensis, HALL. Paleontology, N. Y., 11, p. 287, Plate 60, fig. 1.

Formation and Locality.—In the limestones of Racine and Waukesha, Wisconsin.

GENUS STRAPAROLLUS, MONTFORT.

STRAPAROLLUS MOPSUS, N. S.

PLATE XV, FIGS. 21, 22.

Shell discoid; whorls four or more, cylindrical, very gradually enlarging, the outer one sometimes a little flattened on the upper side for a part of its extent; suture line strongly marked; umbilicus very wide, and showing all the volutions. Spire depressed, rising little above the surface of the outer volution. The proportion of height and width is about as one to three. The individuals measure from half an inch to seven-eighths of an inch in diameter. A specimen having the latter measurement is three-tenths of an inch in height. Some fragments of outer volutions indicate specimens of larger size.

Specimens of this species, when compared with the figures of *S. duphne*, BILLINGS, have a very similar aspect on the lower side; but the elevation of the spire, as given in the description, is much too great for our species.

Formation and Locality.—In limestone of the Niagara group, at Racine and Waukesha, Wisconsin.

GENUS CYCLONEMA, HALL.

CYCLONEMA ? ELEVATA, N. S.

PLATE XV, FIG. 1.

Shell conical; spire elevated, gradually tapering, embracing an angle of about forty-five degrees. Volutions rounded, ventricose, about five; gradually enlarging to the aperture, which has been nearly circular.

The cast from which the species is described, possesses evidence of revolving striae, without indications of a central band.

Height nine-tenths of an inch; width six-tenths of an inch.

Formation and Locality.—In limestone of the Niagara group, at Racine, Wisconsin.

GENUS HOLOPEA, HALL.

HOLOPEA HARMONIA ? BILLINGS.

Holopea harmonia, BILLINGS. New species of Silurian Fossils, p. 158, fig. 142. 1862.

There are several specimens in the collection, so nearly corresponding with the figure given by Mr. BILLINGS, that I must regard them as the same species. In a specimen of the same size as the figure cited, the middle of the last volution is subearimate and flattened above. The spire is a little more elevated than the figure, and the last volution a little more ventricose below. It may prove to be a distinct species. Another specimen of similar form does not possess the flattened band, while the lower side of the last volution is flattened.

Formation and Locality.—In limestone of the Niagara group, at Racine, Wisconsin.

HOLOPEA GUELPHENSIS, BILLINGS.

PLATE XV, FIG. 18.

Holopea guelphensis, BILLINGS. New species of Silurian Fossils, p. 159, fig. 143. 1862.

Several fragments of a species, differing from any other in the collection, resemble the Canadian species; but being all quite imperfect, no full comparisons can be made.

Formation and Locality.—In limestone of the Niagara group, at Racine, Wisconsin.

GENUS PLEUROTOMARIA, DE FRANCE.

PLEUROTOMARIA OCCIDENS, N. S.

PLATE XV, FIGS. 11, 12; PLATE XXV, FIGS. 9, 10.

Pleurotomaria labrosa, var. *occidens*. Twentieth Rep. N. Y. St. Cab., 1st edit., p. 343. 1867.

Shell somewhat rhomboidal-ovate; spire moderately elevated; volutions about three, the last one rapidly expanding, subangular, and marked by a spiral band a little above the middle; upper side somewhat flattened; lower side rounded, and in the last one becoming ventricose. Surface marked by strong revolving and transverse striae.

An examination of other specimens of this species proves it to be distinct from the *P. labrosa* to which I had heretofore referred it as a variety.

PLEUROTOMARIA HALEI, HALL.

PLATE XV, FIGS. 13, 14.

Pleurotomaria halei, HALL. Report of Progress Geol. Survey Wisconsin for 1860, p. 34. 1861.

Shell suborbicular, the spire moderately ascending, the height equal to a little more than two-thirds the greatest diameter, consisting of three or four volutions which are rounded on the top, and expanding somewhat rapidly in size; the last one quite ventricose, and in the east is subangular on the periphery; the under side of the last volution is rounded from the edge into the rather large umbilicus. The surface, as preserved in a mould of the exterior in the stone, is marked on the upper side of the volution by ten or twelve moderately strong revolving ridges, which are smaller and more closely arranged towards the suture, where there is a slightly depressed or flattened space. These are crossed by numerous less strong, closely arranged transverse striae, which bend backwards from the suture, and have a strong retral curve on the narrow concave band of the periphery. Surface characters of under side undetermined.

This species is so entirely distinct in its form and surface characters from any other species yet known in our Silurian rocks, that it can be readily distinguished. It is more nearly allied with forms such as *P. lucina* of the Upper Helderberg and Hamilton groups of New York.

Formation and Locality.—In limestone of the age of the Niagara group at Racine, Wisconsin and Bridgeport, Illinois.

PLEUROTOMARIA (TROCHONEMA) HOYI, HALL.

PLATE XV, FIG. 10; PLATE XXV, FIGS. 11, 12.

Pleurotomaria hoyi, HALL. Report of Progress Geol. Survey Wisconsin for 1860, p. 35. 1861.

Shell broadly depressed-conical, the spire moderately elevated, consisting of about four volutions which are gradually enlarged from the apex, the last becoming slightly ventricose towards the aperture. Volutions flattened upon the upper side, and the entire height of each one showing above the other; periphery somewhat flattened, with a depressed band truncating the upper angle. Lower side of volutions flattened, except the outer half of the last one, which is rounded towards the aperture, and abruptly descending into the wide umbilicus. Surface finely striated on the lower side of the volution, with a deep retral curve on the band, where the striae are somewhat fasciculate. The periphery of the cast is sometimes marked by three or four strong but obscure striae below, and parallel to the revolving band.

This species resembles *P. umbilicata* of the Trenton limestone, but the volutions are more elevated above each other, and the upper surface is wide and flat.

Formation and Locality.—Limestone of the Niagara group, at Racine, Wisconsin.

PLEUROTOMARIA IDIA, N. S.

PLATE XV, FIGS. 15, 16.

Pleurotomaria idia, HALL. Report of Progress Geol. Survey Wisconsin for 1860, p. 35. 1861.

Shell depressed orbicular, moderately convex above, and broadly umbilicate beneath, with four volutions which are moderately convex above, and gradually increase in size from the apex, the outer half of the last one being more ventricose and regularly rounded on the periphery, and curving into the broad umbilicus; aperture, or section of volution near it, broadly ovate. Surface characters unknown.

This species differs from the last in being less elevated, in its more gradually increasing volutions, broader umbilicus and absence of angularity on the periphery.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

PLEUROTOMARIA AXION, N. S.

PLATE XV, FIG. 17.

Shell subconical, volutions about four, the apical one minute, the first three volutions small, rounded and gradually expanding, while the last one becomes extremely ventricose and evenly rounded; suture line deeply impressed and more than half of the preceding volution exposed above it. The aperture has been subcircular and very large. Surface marked by strong revolving striæ, which are crossed by concentric striæ of less strength, giving a cancellated structure. The middle of the volution is marked by a rather wide and little elevated band, upon which the striæ have a slight retral curve.

The surface characters are very similar to those of *P. lucina* of the Lower Helderberg and Hamilton groups of New York; but the shell is more elevated and attenuate towards the apex, and the suture is more deeply marked. Its form is intermediate between the species just cited and *P. lineata*.*

The species described is from a gutta percha cast and an impression in limestone.

Formation and Locality.—In limestone of the age of the Niagara group, at Bridgeport, Illinois.

GENUS TROCHONEMA, SALTER.

TROCHONEMA (EUNEMA) FATUA, N. S.

PLATE XV, FIGS. 7, 8.

Spire elevated; shell turritiform, consisting of about four or five volutions, which gradually increase to the last one which is moderately ventricose; volutions biangular, leaving a flattened space upon the back about equal to the flattened space between the upper angle and the suture line; lower side of the last volution rounded; aperture ovate-elongate.

The specimens are casts of the interior, and in this condition are readily distinguished from any other species of similar form in these rocks.

* See *Fifteenth Report on the State Cabinet of Nat. Hist.*, p. 165, Plate v.

A gutta percha cast shows the surface to be finely striated; the flattened space on the back of the volution is margined on each side by a slender carina, and the striæ between are apparently coarser than those above or below. The height of the specimens varies from less than one inch, to one inch and seven-eighths. The transverse diameter of the last volution is about one inch.

This species has a more elevated spire than *T. umbilicata* of the Trenton limestone, and, so far as can be determined, has had no umbilicus.

Formation and Locality.—In limestone of the Niagara group, at Racine and Greenfield, Wisconsin.

TROCHONEMA (CYCLONEMA ?) PAUPER, HALL.

PLATE XV, FIGS. 5, 6, 9; PLATE XXV, FIG. 13.

Pleurotomaria pauper, HALL; in Twentieth Report N. Y. State Cabinet, 1st edit., p. 343. 1867.

Shell small, obtusely conical, the apical angle from seventy to eighty degrees. Volutions three, four or more, rapidly increasing in size from the apex, rounded above and on the sides, a little flattened on the top below the suture line, the last one subangular below; suture distinct, not channelled. Aperture rounded or slightly elongated, and scarcely subangular above on the inner side. Umbilical cavity rather large, marked by three or four revolving bands. Surface strongly striated; the upper part of each volution marked by five or six revolving cariniform striæ above the stronger carina upon the angle of the outer volution. These are crossed by fine lines of growth, which are not always preserved in the fossil.

Owing to the thickness of the shell, the internal casts do not often preserve more than three or four bands indicating the exterior striæ, and the apical angle is usually less than that of the exterior shell.

This species has been identified by Prof. WINCHELL as *Pleurotomaria halei*; and two specimens communicated by him under this name, are in all respects identical with the species described by me under the name *Pleurotomaria pauper*, from which genus it must be separated on account of the exterior character of the shell which has since been discovered.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin, and Bridgeport, Illinois.

GENUS MURCHISONIA, PHILLIPS.

MURCHISONIA CONRADI, N. S.

PLATE XV, FIG. 19.

Shell turreted, somewhat rapidly ascending, consisting of about seven volutions which are distinctly carinated on the middle or scarcely above the middle. Above the carina the surface is slightly concave, and below the carina very slightly rounded; while the lower side of the last volution is regularly rounded and somewhat ventricose.

The surface has been finely striated with irregular undulations, corresponding with the lines of growth where the striæ have become crowded. The entire length of shell to the base of the last volution is one inch and nine-tenths, and the diameter near the base nine-tenths of an inch.

This species is described from an impression in the limestone and a gutta percha cast from the same. It is a well marked species; differing from every other in these rocks in the sharply carinate volutions and elevated spire. In some characters it is allied to *M. xantippe*, BILLINGS, but the spire is more elevated: the length of that one, from the carina of the last volution to the apex of the figure, is the same as the length from the same point to the carina of the second volution above, in our specimen; while the diameters of the lower volutions in the two are about equal.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

MURCHISONIA LAPHAMI, HALL.

PLATE XV, FIG. 20.

Murchisonia laphami, HALL. Report of Prog. Geol. Survey Wisconsin for 1860, p. 36. 1861.

Shell turritiform, robust; volutions seven or eight, gradually increasing from the apex, rather ventricose on the exterior, with close sutures; the upper half of the volutions very slightly flattened; giving a perceptible angularity in the region of the revolving band. Section of volution broadly ovate, the breadth equal to four-fifths of the height, and the greatest diameter on the lower third. Surface marked near the middle of the volution by a somewhat broad band,

the margins of which are prominent; the upper part of the volutions are marked by fine transverse striae, which are directed gently backwards from the suture to the revolving band.

This species very closely resembles specimens of the *M. logani* of the Guelph limestone of Canada West, but the volutions of that species are more ventricose, and the spire more rapidly ascending.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

MURCHISONIA HERCYNIA? BILLINGS.

Compare *Pleurotomaria gonopleura*, W. & M.; in Mem. Bost. Soc. Nat. Hist., I, p. 98. 1865.

In a paper by Mr. BILLINGS, already cited, he has described *Murchisonia hercyna*, a conical shell with flattened volutions and without a carina. Among the Wisconsin collections from Racine there is a single specimen of similar form, preserving about four or five volutions which are of precisely similar character, except that they are a little more rapidly expanding, and the two lower ones show a slight convexity of the upper part of the volution. The east of the interior has the volutions sub-angular above and below.

GENUS EUNEMA, SALTER.

EUNEMA? TRILINEATA, HALL.

PLATE XV, FIG. 3.

Shell turreted; spire ascending, composed of four or five volutions, which are moderately rounded and gradually increasing in size to the last which is somewhat ventricose. Surface of volutions marked by slender revolving lines or ridges, crossed by close concentric striae which in some places are elevated in bands or fascicles.

The surface characters are remarkable for a shell in this geological position, and more nearly resemble those of the Devonian or Carboniferous fauna.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

GENUS LOXONEMA, PHILLIPS.

LOXONEMA LEDA, N. S.

PLATE XV, FIG. 2.

Loxonema — sp., HALL; in Twentieth Report of N. Y. State Cab., 1st edit., p. 346. 1867.

Shell turreted. Spire rapidly ascending, composed of eight or more volutions, which are moderately convex on their surfaces, a little more abruptly rounded below the middle, and very gradually increasing in diameter; suture close, not very distinctly marked, apical angle about twenty degrees; columellar side of aperture elongated or pointed. Other characters of aperture unknown. Surface characters obscure; faint indications of transverse ridges crossing the larger volutions exist in the matrix.

This species was originally compared by me (loc. cit.) with *L. fitchi*, to which its imperfect cast bears some resemblance; but a critical examination shows it to be a very distinct species. The species referred by Prof. WINCHELL to *L. subulata* is apparently identical with *L. leda*, judging from a cast of the upper volutions communicated by him. It is, at any rate, very distinct from *L. subulata*, the spire being much less rapidly ascending.

Formation and Locality.—In limestone of the age of the Niagara group, at Wauwatosa, Wisconsin, and Bridgeport, Illinois.

GENUS SUBULITES, CONRAD.

SUBULITES VENTRICOSUS, HALL.

PLATE XV, FIG. 1.

Subulites ventricosa, HALL. Palæontology of New York, II, p. 347, Pl. 83, fig. 7.

Subulites brevis, W. & M.; in Mem. Bos. Soc. Nat. His., I, p. 100, Pl. ii, fig. 19. 1865.

This species occurs at Wauwatosa; received from Dr. H. DAY; and also at Bridgeport, Illinois.

GENUS BUCANIA, HALL.

BUCANIA ANGUSTATA, HALL.

Bucania angustata, HALL. Palæontology of New York, II, p. 349, Pl. 84, fig. 6.

A specimen undistinguishable from the species occurring at Galt, Canada West, has been found at Racine, in Wisconsin.

Among the collections from Wauwatosa, Waukesha, Racine and other localities of the Niagara group, in Wisconsin, there are remains of other species of GASTEROPODA than those here described; but their condition is such that, for the most, their description or illustration would add little to our positive knowledge of the subject. The description of the interior casts of species of this class of fossils is usually even less satisfactory than that of other fossils in a similar condition; but as it seems unlikely that we shall get them in any other form, we are compelled to make such use of them as will aid in further comparisons of the fossils of these rocks from other localities.

edit., p. 346. 1867.

eight or more
surfaces, a little
very gradually
distinctly marked,
side of aperture
structure unknown.
transverse ridges

with *L. fitchi*, to
critical examina-
referred by Prof.
eda, judging from
It is, at any rate,
rapidly ascending.
the Niagara group,

Pl. 83, fig. 7.

ii, fig. 19. 1865.

Dr. H. DAY; and

Pl. 84, fig. 6.

occurring at Galt,

CEPHALOPODA.

GENUS NAUTILUS, BREYN.

NAUTILUS OCCIDENTALIS, HALL.

- Cyrtoceras giganteum*, MCCHESENEY. Descrip. New Palæozoic Fossils, p. 67. Jan., 1860.
Lituities occidentalis, HALL. Rep. Prog. Geol. Survey Wisconsin for 1869, p. 31. Feb., 1860.
Lituities cancellatum, MCCHESENEY. Descrip. New Palæozoic Fossils, p. 96. 1861.
Nautilus (Lituities) occidentalis, HALL. Geological Report of Wisconsin, p. 441. 1862.

Shell very large, subdiscoidal. Volutions two or more, rapidly expanding, contiguous, the outer portion of the last volution becoming free and extending in a nearly straight line, while the earlier portions are compressed on the ventral side by the dorsum of the preceding volution; septa distant; section elliptical; siphuncle small, sub-central. Surface marked by regular equal fillet-like striæ or ridges, which are curved backwards on the dorsum; and in more perfect individuals, these are cancellated by finer longitudinal or revolving striæ.

Specimens sometimes measure twelve inches in the greatest diameter of the disc.

This fossil was published by me, under the name *occidentalis*, in 1860. The name *giganteum*, given by MCCHESENEY, being preoccupied, the name *cancellatum* was given a year later by that author. It appears to me that these forms are not true LITUITES, and that they should be referred to the Genus NAUTILUS; therefore since there is already a *Nautilus giganteus*, the name *occidentalis* has precedence of *cancellatus*.

Formation and Locality.—In limestone of the age of the Niagara group, near Milwaukee, Wisconsin, and at Joliet, Illinois.

NAUTILUS CAPAX, HALL.

- Lituities capax*, HALL. Report of Progress Geol. Survey Wisconsin for 1859, p. 3. 1860.

This species differs from *N. occidentalis* in its more rotund form, the section of the outer volution being very broadly elliptical or nearly circular, and showing rapid expansion towards the aperture.

The materials possessed by me are fragmentary, but sufficient to leave no doubt of specific distinction between it and the preceding species.

Formation and Locality.—In limestone of the age of the Niagara group, at Waukesha and Racine, Wisconsin. I also have seen some large fragments of the same species in the collection of Prof. MARCY from Bridgeport, Illinois.

GENUS TROCHOCERAS, BARRANDE, HALL.

TROCHOCERAS DESPLAINENSE, M'CHESNEY.

PLATE XVI, FIGS. 8, 9, 10.

Trochoceras desplainensis, M'CHESNEY. New Paleozoic Fossils, p. 68, Plate viii, fig. 1. 1860.

Shell dextral, trochiform, making a little more than two volutions, the apex rising to about the same plane with the top of the adjacent volution, gradually expanding, and the other chamber continued in a more nearly direct line. Section of the volutions essentially circular; siphuncle small, central. The three outer septa measure on the dorsum seven-eighths of an inch. Surface marked by strong oblique angular ridges, which are curved backward on the dorsum, gradually increasing in distance, and finally there is a considerable space below the aperture, marked only by lines of growth. The intervals between the annulations are regularly concave.

I have identified this form with *T. desplainense*, M'C.; having before me a cast of the specimen described and figured by that author, in which about two volutions can be distinguished. The original of the cast had apparently been a little flattened from pressure; and I have a specimen, not figured, presenting a similar aspect. Another specimen, having its natural proportions preserved, is more rotund. It does not appear that there have ever been much more than two volutions in the full grown shell, and the section is essentially circular, though the lateral diameter may be a little greater when the dorso-ventral diameter is measured to the bottom of the depression between the annulations, but not otherwise. The differences indicated in the distance of the septa do not seem to be important. This species bears considerable resemblance to *Trochoceras trochoides* of BARRANDE, Plate xxix, figs. 16-21.

Formation and Locality.—In limestone of the age of the Niagara group, Racine, Wisconsin.

TROCHOCERAS COSTATUM, HALL.

PLATE XXV, FIG. 15.

Trochoceras costatum, HALL. Report Progress Geolog. Survey of Wisconsin for 1860, 1861.

Shell depressed trochiform, sinistral, greatest diameter about two and a quarter inches; spire depressed convex; volutions about one and a half to two,* gradually expanding from the apex; section sub-circular; umbilicus broad and shallow. Siphuncle undetermined. Surface marked by strong sharply elevated annulations, which increase in distance and regularity with the growth of the shell, gradually diminishing on the last volution and becoming more or less obsolete, or appearing as gentle undefined elevations towards the aperture. Near the apex of the shell there are about twelve of these annulations in the space of half an inch, and on the outer volution, opposite the same point, there are barely six in the same space.

This species is a little less in size than the *T. desplainense*; the annulations are more numerous and more sharply elevated, not increasing in size on the outer volution beyond the point opposite the apex of the shell. Taking a single volution from near the apex, there are nearly twice as many annulations as in the species cited. The sinistral direction of the volutions is, however, a conspicuously distinguishing feature.†

The species was originally described from imperfect material, and the figure given is from a gutta-percha cast in a well preserved impression of the exterior of the lower or umbilical side of the shell.

This species may be compared with *T. pulchrum* of BARRANDE, Plate xvii, figs 8-16, but is more finely costate.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine and near Milwaukee, Wisconsin.

* Originally stated as three or four by mistake.

† Since it sometimes happens that the *Trochoceras desplainense* is quite flat upon the upper side, or that the inner volutions are a little depressed below the outer one, it might perhaps be suspected that the *T. costatum*, of which the umbilical side is represented in the figure, is an exaggerated condition of the former species, with the inner volution still more depressed. This, however, is not true, for the volutions are clearly sinistral, and as represented are in their natural relations. It is, perhaps, the first American species of this character that has been recognized, but M. BARRANDE distinctly describes the two forms, and has figured several species with sinistral spires. In his generic description, he says, "the shell consists of several turns of the spire or of a single volution more or less complete, but exhibiting almost always a marked defect of symmetry. The enrolment is sometimes dextral and sometimes sinistral according to the species, but the dextral forms greatly predominate. In *T. asperum* we find both modes, varying in individuals, and the same in *T. sandbergeri*."

TROCHOCERAS NOTUM, N. S.

PLATE XVI, FIGS. 1, 2.

The entire shell unknown; a fragment of the outer volution shows it to have been strongly annulated, with the annulations bending backward on the dorsal side. The transverse diameter is greater than the dorso-ventral diameter, and the direction of the volutions has been dextral. The siphuncle is subcentral and small.

It is distinguished from *T. costatum* by the dorso-ventral compression of the volutions, and by the dextral direction of the spire. The volutions have been in contact, and their number, though unknown, is probably about two.

It differs from *T. desplainense* in the dorso-ventral compression of the volutions, and less conspicuous and more closely arranged annulations.

Formation and Locality.—In limestone of the age of the Niagara group, at Bridgeport, Illinois.

TROCHOCERAS (GYROCERAS) BANNISTERI, WINCH. AND MAR.

PLATE XXV, FIG. 17.

Gyroceras bannisteri, WINCHELL and MARCY; in Mem. Bost. Soc. of Nat. Hist., I, p. 102.

Shell consisting of about one and a half volutions, which increase in size somewhat rapidly: spire gently ascending; umbilicus broad and comparatively deep, the lateral diameter of the volutions being greater than the dorso-ventral diameter. Surface marked by low subangular annulations, which, turning gently backwards on the sides of the shell, are more abruptly bent into a shallow sinus on the dorsum. These annulations apparently become obsolete towards the aperture; on the other parts of the shell, there are about six or seven in a space equal to the dorso-ventral diameter.

This species differs from either of the species described, in its more rapid enlargement from the apex, and in the finer annulations.

These observations are made upon a cast in gutta-percha, sent to me by Prof. WINCHELL, under the name of *Gyroceras bannisteri*. The cast has the appearance of a very pretty species of TROCHOCERAS, of more delicate proportions than those described in this paper.

Formation and Locality.—In limestone of the age of the Niagara group, at Bridgeport, Illinois.

GENUS LITUITES, BREYN.

LITUITES MARSHI, N. S.

PLATE XVI, FIGS. 6, 7.

Shell of medium size, consisting of three or more closely enrolled volutions, which increase in size very gradually from the apex: section circular or subcircular; slightly flattened on the dorsum, and marked on the sides by sharp, strong, oblique annulations with regularly concave spaces between. These ridges, rising on the ventral margin, are directed obliquely backward as they cross the sides of the volutions, reaching the centre of the dorsum at a point opposite the origin of the second preceding one, having their greatest elevation on the sides of the shell, and making a somewhat abrupt retral curve, become nearly obsolete on the dorsum. Septa moderately distant, deeply and uniformly concave; the chambers regularly increasing in depth with the diameter of the shell. The space of three chambers, measured on the side of the shell, are equal to the dorso-ventral diameter of the volution. The dorsal margins of the septa are directed forward, giving a broad retral curvature on the sides of the volution. Siphuncle small, subcentral. Surface of shell and form of aperture unknown.

This beautiful species is readily distinguished by its slender volutions, and the strong oblique ridges, which in the outer part of the shell are a little more distant than the septa, while on the inner volutions they are nearer to each other, the increase in the distance of the annulations being a little more rapid than that of the septa. Owing to the retral curving of the annulations, and the advancing curvature of the septa, the ridges are cut by the latter near the dorso-lateral angle of the volution, throughout the greater part of the extent of the shell. The specimen preserves a little more than two volutions, and we have no portion of the chamber of habitation. Inferring from the prevailing characters of similar forms of this genus, there has probably been nearly or quite another volution at the apex, which is not preserved.

Formation and Locality.—In limestone of the Niagara group, at Kanakee, Illinois.

A fru
ventric
ing fro
than tv
between
tral ape

The
three-f
is two
arcuate
the out
diameter
margin

The
lar vase

In fig
a view



This
stone
more

GENUS PHRAGMOCERAS, BRODERUP.

PHRAGMOCERAS NESTOR, N. S.

A fragment preserving the outer chamber and several of the septa, is ventricose, broadly expanded in the dorso-ventral direction, and measuring from the extreme limits of the apertures, which are marginal, more than two and a half inches; the length of the narrow constriction between them being one inch and a quarter. Both the dorsal and ventral apertures are marginal and expanded.

The length of the outer chamber along the middle is an inch and three-fourths, and the dorso-ventral diameter in the middle of the length is two and a quarter inches. The septate portion has been abruptly arcuate, the length of the part remaining being four times as great on the outer as on the inner side of the curve. The greater and lesser diameters of the septa are about as seven to ten. The siphuncle is submarginal.

The cast of the outer chamber is marked by what appears to be regular vascular impressions extending outwards from the first septum.

In fig. 3 a lateral view is given of the specimen described, and in fig. 4, a view of the aperture.

FIG. 3.

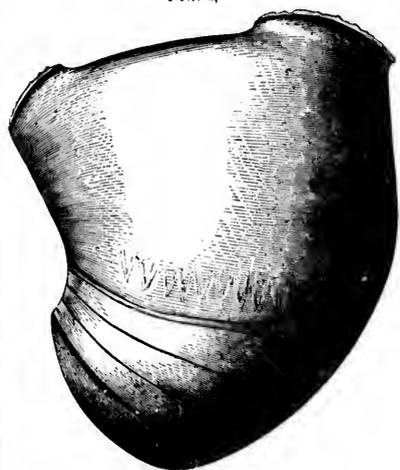
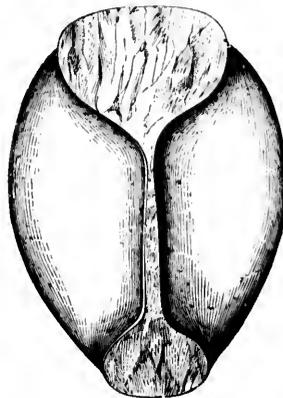


FIG. 4.



This species differs from the *P. hector*, BILLINGS, of the Guelph limestone of Canada, in being more narrowly elliptical in section, and much more expanded in the dorso-ventral direction at the aperture, as well as

in the greater length and more extreme constriction of the intermediate portion of the aperture.

This species should be compared with *P. ventricosum* and *P. arcuatum*, MURCHISON, *Siberian System and Siluria*.

Formation and Locality.—In limestone of the Niagara group, at Wauwatosha, Wisconsin.

GENUS CYRTOCERAS, GOLDFUSS.

CYRTOCERAS LUCILLUM, N. S.

PLATE XVIII, FIG. 7.

Shell arcuate, gradually expanding towards the aperture, section elliptical, a little narrower on the inner side of the curve; septa moderately convex, closely arranged; siphuncle small, submarginal on the outer side of the arch. Surface marked by regular, equal, neatly defined annulations, which have a slight retral arch on the exterior curve, indicating a similar sinuosity in the margin of the aperture. The annulations are closely arranged; on the smaller parts of the shell, they are in the proportion of twenty in the space of an inch; while on the inner side of the curve they are more approximate, and on the outer side more distant. On the larger part of the shell the annulations number five or six in the space occupied by seven in the smaller parts.

Formation and Locality.—In limestone of the Niagara group near Wauwatosha, Wisconsin.

CYRTOCERAS FOSTERI, HALL.

PLATE XVI, FIGS. 11, 12, 13.

Cyrtoceras fosteri, HALL. Report Progress Geol. Survey Wisconsin for 1860, p. 43. 1861.

This species is known to me only in the Niagara limestone near Chicago.

CYRTOCERAS DARDANUS, HALL.

PLATE XVII, FIGS. 3, 4, 5.

Cyrtoceras dardanus, HALL. Report Progress Geol. Survey Wisconsin for 1860, p. 43. 1861.

This species was originally described from fragments, which in all the specimens seen can be readily identified. Some other imperfect specimens which have come under my notice since the publication of the original description, have induced me to suppose that the fossil may belong more properly to the Genus GYROCERAS. The species occurs at Waukesha and Wauwatosha, Wisconsin.

Shell sm
the
enti
ing
mea
incl
dors

This s
in these
The spec
remaini
stone.
the septa
TOCERAS
so far as
Forma
at Racin

Shell sm
ing
cha
its
the
side

Forma
at Racin

Shell ra
abr
str
ex

CYRTOCERAS BREVICORNE, N. S.

PLATE XVIII, FIGS. 8, 9; PLATE XXV, FIG. 11.

Shell small, gently curving and very rapidly expanding from the apex, the diameter of the outer chamber nearly equaling one half of the entire length of the shell; septa somewhat closely arranged, curving upward on the dorsum, moderately concave, the four outer ones measuring five-eighths of an inch on the back and less than half an inch on the ventral side. Siphuncle small, and lying close to the dorsal margin. Surface of shell unknown.

This species is the most rapidly expanding form of any yet discovered in these rocks, and may be easily distinguished by this feature alone. The specimen figured retains a single chamber besides the outer one, the remaining portions being restored from the impression in the adhering stone. Another fragment retains the chamber of habitation, and six of the septa below. The fossil is associated with a smaller species of CYRTOCERAS (*C. pusillum*), and a TROCHOCERAS; and is not an abundant form, so far as known.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

CYRTOCERAS PUSILLUM, N. S.

Shell small, slender, making half a revolution, somewhat rapidly expanding near the aperture; section broadly elliptical; the length of the chamber of habitation, as preserved, about equal to once and a half its lesser diameter. Septa moderately concave, arching forward on the back so as to give a depth once and a half as great as on the sides. Siphuncle dorsal. Surface unknown.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

CYRTOCERAS LATERALE, N. S.

PLATE XVIII, FIGS. 4, 5, 6.

Shell rather above the medium size, very gently curving, and the sides abruptly expanding above the middle, the ventral line being nearly straight, dorsal line more strongly arcuate; shell more rapidly expanding transversely than in the opposite direction, giving to the

middle of the shell a broad and somewhat flattened appearance. The outer chamber gently converges again above the last septum, and is broadly constricted below the aperture, where it is nearly straight for a short distance. Section transversely oval, and a little flattened on the ventral border in the middle portion of the shell, while in the lower or smaller part it is circular. Septa distant about one-sixth the transverse diameter of the shell, moderately concave, their margins directed slightly upwards on the lateral portions of the shell, giving a broad shallow sinus on the dorsal and ventral sides. Siphuncle small, situated near the dorsal margin. Surface of the shell marked by obscure longitudinal ridges, distant from each other from a sixteenth to a tenth of an inch in different individuals and on different parts of the shell. The impressions of these ridges are distinctly seen on well-preserved casts of the interior.

This species is readily distinguished from the others of the genus associated with it, by the slight curvature and the greater transverse diameter; the relative diameters of the specimens figured, in its larger part, being as four to five. The relative distance of the septa may vary somewhat in different individuals, judging from other specimen before me, but not materially affecting characteristic features of the species. The outer two septa, next the chamber of habitation, are often crowded closely together.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

CYRTOCERAS RIGIDUM, HALL.

PLATE XVI, FIGS. 3, 4, 5.

Shell small, consisting of about one revolution, gradually expanding to a diameter of three-fourths of an inch with a height of two inches. Septa unknown; outer chamber deep. Siphuncle apparently dorsal. Surface of cast marked by strong obliquely transverse annulations which become gradually stronger from the concave side, and are gently curved backward on the middle of the dorsum. Spaces between the annulations concave, without any evidence of intermediate smaller ridges. Exterior surface unknown, the specimen being a cast of the interior.

The

Lituit
Cyrtoc
N

Shell l

in

pe

a

ra

n

o

th

th

ce

fi

This

and, v

inches

a half

of hab

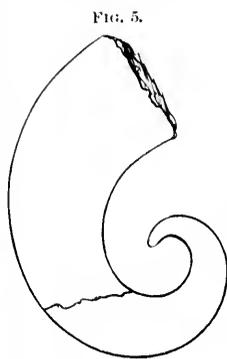
at the

able f

The

of Pu

The figures referred to are the dorsal and lateral views of a fragment, with a transverse section. The accompanying outline, fig. 5, shows the form of the entire cast of the interior, as nearly as can be given with the materials in my possession.



This species, in the external markings of the cast, is quite similar to *Trochoceras notum*, and not very unlike *T. costatum*; but the enrollment of the shell in the same plane is a distinguishing feature.

Formation and Locality.—In limestone of the age of the Niagara group, at Bridgeport, Illinois.

CYRTOCERAS HERCULES, WINCH. AND MAR.

PLATE XVII, FIGS. 6, 7.

Lituites hercules, WINCHELL & MARCY; in Mem. Bost. Soc. N. H., 1, p. 102, Plate iii, fig. 9.
Cyrtoceras (Phragmoceras?) ampliacorne, HALL; in 1st edit. Twentieth Rep. N. Y. State Cab. N. H., p. 358. 1867.

Shell large, strongly curved, making an entire volution, rapidly expanding toward the outer chamber, which is less arcuate than the septate portions of the shell; transverse section broadly elliptical, becoming a little flattened on the sides towards the outer chamber. Septa rather deeply concave and comparatively distant; three of them, measured on the dorsum, being nearly equal to the diameter of the outer part of the largest one measured. The dorsal margins of the septa are advanced so that a direct transverse section would cut the ventral margin of the next preceding one. Siphuncle small, central or subcentral. Entire form of aperture unknown. Surface finely striated, with the striæ curving backward to the dorsum.

This is one of the most robust species of the genus known in our rocks, and, were the outer chamber entire, would measure full seven and a half inches in height, with a transverse measurement of more than five and a half inches. The dorso-ventral diameter of the base of the chamber of habitation is two inches and eight-tenths, with a transverse diameter at the same point of two inches and three-tenths. It is likewise remarkable for its great curvature and central siphuncle.

The flattening of the sides gives the shell in some respects the aspect of *PHRAGMOCERAS*; but the curvature is so broad and regular, and the

outer chamber so extended and gradually expanding, that it presents an aspect more like *CYRTOCERAS*.

Formation and Locality.—In limestone of the age of the Niagara group, at Waukesha, Wisconsin.

GENUS ONCOCERAS, HALL.

ONCOCERAS ORCA, HALL.

PLATE XVII, FIGS. 1, 2.

Cyrtocerasorca, HALL. Report Progress Geol. Survey of Wisconsin for 1860, p. 42. 1861.

This species should properly be referred to the Genus *ONCOCERAS*, of which it is the only representative at present known to me in this formation in Wisconsin.

GENUS GOMPHOCERAS, SOWERBY.

GOMPHOCERAS SEPTORIS, N. S.

The outer chamber of a *GOMPHOCERAS*, including the first septum, shows a submarginal siphuncle, with broad sub-elliptical section. The lateral aperture extends to a point nearly half way from the apex to the first septum, and is continued in a narrow constriction nearly to the

FIG. 6.



apex, where it is united with the larger aperture: the margin of this is contracted into tubular folds, so narrow as to present the appearance of three small rounded lateral apertures, with a similar one on the dorsal side.

FIG. 7.



This peculiarity of the aperture is sufficient for specific determination, when compared with any species known to me.

Fig. 6 is a lateral view of the outer chamber, and fig. 7 represents the form of the aperture.

Formation and Locality.—In limestone of the Niagara group, at Waukesha, Wisconsin. Dr. H. DAY.

GOMPHOCERAS SCRINIUM, N. S.

PLATE XVIII, FIGS. 1, 2, 3.

Gomphoceras marcyae, WINCHELL & MARCY; in Memoirs Boston Society Nat. Hist., Vol. I, p. 100, Plate iii, fig. 8.

A specimen consisting of the outer chamber and first septum, is of moderate size, transversely subcircular, with a very slight angularity on

the ven
septum
being
trilobed
subtrian
as three
Siphun
the cen
Form
port, I

Orthoc
Orthoc
vii,
Orthoc
Orthoc
Orthoc
Orthoc
Orthoc

This
group
and m
presen
sidera
eviden
fine u
exteri

Orth
Gom

The
very
not e
the d

the ventral side. Outer chamber rapidly contracting from near the last septum to the aperture, giving it a somewhat conical form, the length being less than the transverse diameter of the septum. Aperture trilobed, the ventral opening small; dorsal opening moderately large and subtriangular; the proportions of the transverse and axial diameters are as three to four. Septa moderately deep, with a very regular convexity. Siphuncle situated at one-third the distance from the ventral margin to the centre. Surface marked only by irregular lines of growth.

Formation and Locality.—In limestone of the Niagara group, at Bridgeport, Illinois.

GENUS ORTHOCERAS, BREYER.

ORTHOCERAS ANNULATUM, SOWERBY.

PLATE XX, FIGS. 4, 5, 6; PLATE XXIV, FIGS. 2, 3, 4.

Orthoceras annulatum, SOWERBY. Mineral Conchology, II, p. 77, Tab. cxxxiii. 1818.

Orthoceratiles undulatus, HISINGER. Anteckn. V, Tab. iv, fig. 6. Vet. Akad. Handlingar, Tab. vii, fig. 8. 1826.

Orthoceratiles undulatus, HISINGER. Lethæa Suecica, p. 28, Tab. x, fig. 2. 1827.

Orthoceras annulatum, MURCHISON. Silurian system and Siluria.

Orthoceras undulatum, HALL. Pal. New York, II, p. 293, Plates lxiv, lxv.

Orthoceras nodocostum, M'CHESNEY. New Palæozoic Fossils, p. 94, Plate 9, fig. 5. 1861.

Orthoceras nodicostatum, M'CHESNEY. Chicago Academy of Sciences, Vol. i, p. 53, Plate ix, fig. 5.

This species is of common occurrence in the shales of the Niagara group in New York. It is found in the lower beds exposed at Waukesha and near Wauwatosa, in Wisconsin. The specimens are casts, usually preserving only the marks of the strong annulations, which vary considerably in their sharpness and degree of elevation; but there is no evidence of specific distinction among the forms of this character. The fine undulating transverse striæ are preserved in the impressions of the exterior surface, associated with the casts.

ORTHOCERAS COLUMNARE, HALL.

PLATE XIX, FIGS. 4-6, 8.

Orthoceras columnare, HALL. Rep. Progress Geol. Survey Wisconsin for 1859. Feb., 1860. Compare *O. canaliculatum*, SOWERBY, Silurian System, T. 13, fig. 26.

The species described by me from Wisconsin is elongate cylindrical, very gradually tapering. The siphuncle is central, of medium size, and not expanded between the septa. The septa are distant about one half the diameter.



FIG. 7.

The surface is longitudinally fluted by low ridges which are about one-sixth of an inch distant from each other. This feature is of course variable upon specimens of different size. The intermediate striae are not preserved in the casts, in which condition the species is usually found.

In the typical specimens, the septa are very distant, and in this respect it is conspicuously different from *O. loxias*, which has a very similar external character. This character may be subject to some variation.

Formation and Locality.—This species occurs in strata below the Racine and Waukesha beds proper, and in the same horizon with *O. annulatum*.*

ORTHO CERAS MEDULLARE, HALL.

PLATE XX, FIGS. 1, 2.

Orthoceras medullare, HALL. Rep. Prog. Geol. Survey Wisconsin for 1859, p. 4. Feb., 1860.
Orthoceras striatilineatum, M'CHESNEY. New Palaeozoic Fossils, p. 94. Feb., 1861.

Shell cylindrical, often a little compressed, gradually, and in some specimens more rapidly tapering. The septa are distant nearly half the diameter, but are subject to considerable variation in the same individual, so that nearly three chambers are sometimes included in a length equal to the diameter. The siphuncle is large and slightly expanded between the septa.

The surface is marked by strong, sharp, subequal longitudinal striae, which are cancellated by fine transverse striae. The longitudinal striae are often alternated by finer sharp striae in the same direction. Surface of the cast smooth, and by this character it is distinguished from the casts of *O. columnare* and *O. angulatum*.

Formation and Locality.—In limestone of the Niagara group, at Waukesha and Wauwatosa, Wisconsin.

*The *Orthoceras scammoni*, M'CHESNEY, *New Palaeozoic Fossils*, is probably identical with this species. Two specimens received from Prof. MARCY offer some elucidation of the characters of the fossils not before understood. A single specimen combines in itself characters of *O. columnare* and *O. scammoni*; and unless we can find sufficient differences, on a further examination of collections, to sustain the separation, the *O. scammoni* and others, as well as that referred by me to *O. angulatum*, will fall under *O. columnare*, which has priority in time over those described by M'CHESNEY. The cancellated figs. 10 and 11, of Plate XIX, are apparently only the well preserved impressions of the external surface markings of the same species. It is probably also the same species which has been described by Mr. BILLINGS, in 1866, as *Orthoceras cadmus*.

Orthoceras
Orthoceras
Orthoceras
Orthoceras
Compar

Speci
York re
latter a
marking

The s
siphunc
between

The
the she
fectly p
exterior

This
publish
irregula
inch in
name C
to *O. a*
one, w
parison
the var
so larg
cited.

Form
at Rac

Shell
co
of

ORTHOCERAS ANGULATUM, WAHL.

PLATE XIX, FIGS. 10, 11; PLATE XXIV, FIG. 1.

Orthoceras angulatum, WAHLENBERG. *Novr Acta Soc. Sci. Upsal*, p. 90. 1827.*Orthoceras angulatum*, HISINGER. *Lethæa Suecica*, p. 28, Tab. x, fig. 1.*Orthoceras virgatum*, SOWERBY; in MURCHISON'S Silurian System, p. 622, Tab. ix, fig. 4.*Orthoceras virgatum?* HALL. *Paleontology N. Y.*, II, p. 291, Plate lxiii, figs. 2, 3.Compare *O. canaliculatum*, SOWERBY; in MURCHISON'S Silurian System, p. 632, Tab. xiii, fig. 25.

Specimens from Wisconsin are apparently identical with those of New York referred as above; the former being casts of the interior, while the latter are preserved in a soft calcareous shale, and have the surface markings more or less obscured.

The septa are distant about one-fourth the diameter of the shell. The siphuncle is central or subcentral, with scarcely an apparent expansion between the septa.

The longitudinal ridges are angular, and about one line distant when the shell is an inch in diameter. The finer surface striæ are but imperfectly preserved on the cast, and it is only in the impressions of the exterior that these markings become conspicuous.

This is probably the species described by Mr. M'CHESNEY, in a paper published in 1861, under the names *O. scammoni*, *O. hoyi*, *O. lineolatum*, *O. irregulare* = *O. woodworthi*. The last one figured in a fragment less than an inch in length. A gutta-percha cast sent by Prof. WINCHELL under the name *O. scammoni*, corresponds very well with specimens referred by me to *O. angulatum*. Should the species prove distinct from the European one, we may select a name from among those above cited. The comparison of a considerable collection of specimens from Bridgeport and the various localities in Wisconsin has not convinced me that we have so large a number of species of a character so similar as those above cited.

Formation and Locality. — In limestone of the age of the Niagara group, at Racine, Wisconsin, and Bridgeport, Illinois.

ORTHOCERAS CREBESCENS, N. S.

PLATE XIX, FIGS. 1, 2, 3.

Shell large, rapidly tapering; transverse section circular; septa deeply concave, four and a half of the intervals being equal to the diameter of the shell. Siphuncle moderately large, central or subcentral,

strongly constricted at its junction with the septa, and expanded between. Surface of cast (the usual condition in which the specimens are found) obscurely marked by longitudinal ridges in the most perfectly preserved individuals, their distance varying from a sixteenth to an eighth of an inch; but these are usually so inconspicuous as not to be observed.

In one specimen, preserving a portion of the outer chamber (fig. 1), the septa become much crowded in the upper part; but whether this is a constant feature, or only exceptional, cannot be determined. In specimen figure 2, the septa are oblique to the axis of the shell, caused by the eccentricity of the siphuncle.

This species is easily distinguished from the others with which it is associated, by its large size, rapidly increasing diameter, circular section and large siphuncle. The exterior surface characters have not been determined.

Formation and Locality.—In limestones of the Niagara group, at Racine, Wisconsin.

ORTHO CERAS ALIENUM, N. S.

PLATE XXIV, FIGS. 5, 6, 7.

Shell cylindrical, very gradually tapering, a broad constriction of the outer chamber a little below the aperture; septa deeply concave, about four or five in the diameter of the outer one measured; the length of the outer chamber equal at least to twice the diameter of the shell. Siphuncle central, moderate in size, scarcely constricted at the junction of the septa. Surface of the cast smooth; exterior surface unknown.

This species is only known in the form of casts of the interior, and is distinguished from the others described by its very gradual enlargement towards the aperture, below which it is broadly constricted. The shell tapers at the rate of a line in an inch of the length. The siphuncle is a cylindrical tube, which is scarcely constricted at the junction of the septa, and has a diameter of five-sixteenths of an inch where the shell is one inch and three-eighths in diameter.

Formation and Locality.—In limestone of the Niagara group, at Racine, Wisconsin.

Shell lar

vers

on t

of t

the

larg

shel

The s

of organ

walls of

Surface

The p

what th

of ORTH

the par

features

measuri

having

being in

Other

as the

chambe

quite st

The

of a sh

tions w

have co

now co

This

acters

was fou

symme

regards

Such a

and th

ORTHOCERAS ABNORME, N. S.

PLATE XVIII, FIG. 10; PLATE XXV, FIG. 18.

Shell large, gently curving and rapidly expanding from the apex; transverse section circular; septa distant, the space of three measured on the convex side nearly equal to the diameter of the outer margin of the larger one measured, their distance gradually increasing with the diameter of the shell. Siphuncle central or subcentral, very large, its diameter nearly equaling one-half the diameter of the shell, greatly constricted at its junction with the septa.

The siphuncle is partially occupied by a central core, or a replacement of organic deposition, with radiating ramifications which reach the outer walls of the siphon, and are connected with the filling between the septa. Surface characters, form of outer chamber and aperture unknown.

The peculiar features of this species are the curving form, giving somewhat the aspect of *CYRTOCERAS* with the character of septa and siphuncle of *ORTHOCERAS*. The distant septa and extremely large siphuncle, with the partial filling observed in numerous specimens, are distinguishing features. It is a large rapidly expanding form, the specimen figured measuring about five inches in length with the outer chamber preserved, having a diameter of two inches and three-tenths, the greatest curvature being in the lower part.

Other fragments identified with this species, show the same curvature as the one figured; while as they increase in size towards the outer chamber, the curvature diminishes, and the extreme portion is probably quite straight.

The organic deposition in the centre of the siphuncle has the aspect of a shrunken flexible or sub-elastic tube, with slender tubular ramifications which extend to the exterior walls, and appear as if they might have communicated to the chamber without, since the slender rami are now continuous with the matter filling these chambers.

This central deposition of matter, with radiating rami, presents characters identical with those on which the Genus *ACTINOCERAS* of BRONN was founded. I have heretofore indicated their irregularity and want of symmetry as an argument against their organic structure. M. BARRANDE regards these features as due to an organic deposition within the siphuncle. Such an origin would account for their generally characteristic features and their absence of structure, which would certainly be indicated in

some specimens, had the parts been at all shelly in texture. At least one other species in the same formation preserves a similar feature in the siphuncle.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

ORTHOCERAS NIAGARENSE, N. S.

PLATE XX, FIG. 3.

Shell elongate, gradually tapering; section broadly elliptical; septa deeply concave, depth of chamber about five lines where the diameter is one and a half inches; siphuncle eccentric. Surface annulated by low rounded undulations which are from one to two lines distant, according to the size of the shell; intermediate spaces regularly concave. In the larger parts of the shell there are about three annulations to each chamber. The finer surface markings unknown.

This species in its young state is rather slender and very gently tapering, and, though attaining a pretty large size, is not as robust as most of the associated forms. It bears considerable resemblance to the Niagara shale species which I have referred with doubt to the *O. imbricatum*, WAHL.; but the annulations are not so sharply elevated, and the septa are comparatively more distant. The section, in all the specimens examined, is elliptical. It is possible that this may be the species described by Mr. BILLINGS under the name *O. oberon*, the principal difference being in our specimens the prevailing elliptical form of the tube.

The specimen figured is about nine inches in length, and is represented of the natural size.

Formation and Locality.—In limestone of the age of the Niagara group, at Waukesha and Pewaukee, Wisconsin.

ORTHOCERAS LOXIAS, N. S.

PLATE XIX, FIG. 7.

Shell of medium size, elongate, somewhat rapidly enlarging from the apex; section circular; siphuncle central or subcentral, scarcely constricted at the junction of the septa; septa distant about one-fourth the diameter; chamber of habitation unknown. Surface marked by sharply angular longitudinal carinae with regularly con-

cave
fully
the
obse
space
obse
cond

The sin
more rapi
figured is

The sp
external
that it wa
specimen
northwest
ascertaini
stone has
more rese
bay. A
filling of
exterior s
me to ref

g.

cave interspaces, which, on the larger part of the shell, are distant fully three-sixteenths of an inch and gradually converge towards the apex. The shell is silicified so that the finer markings are obscured, but there are indistinct transverse striae crossing the spaces between the ridges. No fine longitudinal striae have been observed, though they may have existed on the shell in its original condition.

The similarity of this species to *O. columnare* is obvious, but it tapers more rapidly, and the septa are less distant. The length of the specimen figured is about eight and a half inches.

The species has been illustrated in this connexion from its general external similarity to figs. 4, 6, 8 and 9, and from a belief, originally, that it was from the same horizon, or not far removed therefrom. The specimen has been a long time in my possession, and was obtained in the northwestern lake region many years since, but I have no means of ascertaining the particular locality. The weathered surface of the limestone has the aspect of the Niagara limestone; but the fresh fracture more resembles some beds of the Clinton group, in the vicinity of Greenbay. A critical examination of the rock, the nature of the crystalline filling of some of the cavities, together with the silicification of the exterior shell and the principal part of the interior, septa, &c., induces me to refer the species, with some hesitation, to the Lower Silurian age.

G. W. 10

ure. At least
ilar feature in

Niagara group,

liptical; septa
es where the
entric. Surface
om one to two
mediate spaces
there are about
rface markings

y gently taper-
robust as most of
to the Niagara
e *O. imbricatum*,
, and the septa
the specimens
be the species
principal differ-
a of the tube.
d is represented

Niagara group,

urging from the
central, scarcely
stant about one-
known. Surface
h regularly con-

CRUSTACEA.

In the *Annual Report on the Geology of Wisconsin for 1860* (published in 1861), I described two new species of ILLÆNUS, a new CALYMENE, and a species of DALMANITES,* and in the list of species appended to the *Geology of Wisconsin*, Vol. i, p. 423, I noticed a species of ACIDASPIS (*A. danai*) from the limestone of the Niagara group.

A farther study of the collections in my possession, from the limestones of Racine, Waukesha, and from near Milwaukee, with a few from Illinois, has shown several other trilobites; among which the following may be noticed.

GENUS ILLÆNUS, DALMAN.

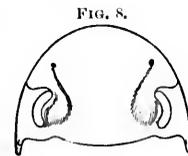
ILLÆNUS ARMATUS, N. S.

PLATE XXII, FIGS. 1-3; PLATE XXV, FIG. 22.

Head short and gibbous, varying in its proportions from nearly twice as wide as long, to length equalling two-thirds the width; elevated in the centre. The dorsal furrow makes a short rounded arch from the base of the shield, and terminates in a perceptible impression, on a line with the base of the eye and half way between it and the anterior margin. Eyes very prominent, situated close to the posterior margin; palpebral lobe short; furrow above it scarcely longer than the sinus below the eye. Cheeks small, making not more than one-fourth of the width of the head, and the suture coming to the anterior margin a little in advance of the eye. The posterior angles prolonged into short spines which extend directly backwards. The pygidium in several specimens has the proportions of length and breadth as 5 to 7, 6 to 8, and 7 to 10. The largest head identified as belonging to this species has a length of about one inch.

In fig. 8, the head is represented of the natural size, and fig. 9 is a profile view of the same.

Compared with *Illænus* (*Bumastus*) *barriensis*, the head is more prominent in the middle, more produced in front, and the eyes



* *Illænus imperator* of the Niagara group, *I. taurus* of the Trenton limestone, *Calymene mamillata* of the Hudson river group, and *Dalmanites vigilans* of the Niagara group.

are more
prolongat
a feature
also more

Format
port, Illi

Head lar
from
Dor
thro
min
eye
of
wit
kno
art
ven

The
a little
about h
abruptl



The
readily
glabell
it diff

are more prominent. The more conspicuous difference, however, is the prolongation of the posterior angle of the cheek into a short strong spine, a feature which I have not observed in *I. burriensis*. The pygidium is also more nearly semicircular, being broader in proportion to its length.

Formation and Locality.—In limestone of the Niagara group at Bridgeport, Illinois, and at Grafton and Racine, Wisconsin.

ILLENUS INSIGNIS, N. S.

PLATE XXII, FIGS. 9, 10, 11.

Head large; glabella prominent and somewhat regularly arcuate from front to base; anterior border with the margin a little recurved. Dorsal furrows distinctly marked from the base of the head for three-fourths the distance to the anterior margin, where they terminate in a distinct rounded pit; palpebral lobe large, elongate, the eye being situated at some little distance from the posterior margin of the head. Facial suture running out on the anterior border within the line of the eye. The full extent of the cheek is not known. The form of the glabella and the convexity of a single articulation of the thorax indicate the general form to have been very convex.

The pygidium is parabolic, very convex; about as long as wide or a little longer. Anterior margin nearly straight along the middle for about half the width, for the attachment of the axis of the thorax, and abruptly receding towards the sides.

FIG. 10.

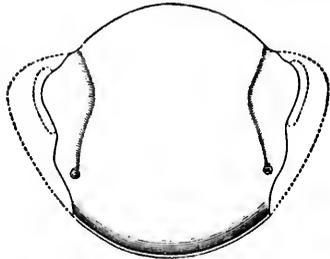
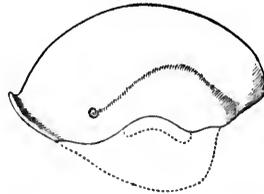


FIG. 11.



The specimens are mostly casts of the interior, but the species is readily recognized by the elongate and regularly arcuate form of the glabella, and the strongly marked dorsal furrows, and in these respects it differs conspicuously from any other species in the formation. A

FIG. 9.



t, and the eyes
 nestone, *Calymene mam-*
-ra group.

single specimen partially preserving the crust does not show the glabellar furrows so distinctly as the casts.

In fig. 10, the head is represented showing the dorsal furrow and direction of the facial suture, and in fig. 11, a profile view is given of the same.

I received several years since a specimen of this species from Prof. C. U. SHEPARD, who collected it with other Niagara fossils in Illinois, but the record of the particular locality had been lost.

Formation and Locality.—In the limestone of the Niagara group at Waukesha and Milwaukee, Wisconsin, and from a similar horizon in Illinois.

ILLENUS IMPERATOR, HALL.

PLATE XXII, FIGS. 15-17; PLATE XXIII, FIGS. 2, 3.

Illenus imperator, HALL. Report Progress Geol. Survey Wisconsin for 1860, p. 49. 1861.

This species, which was originally described from some large caudal shields with a few of the articulations of the thorax, has proved to be not rare.

The head is large and broad, moderately convex, and pretty regularly arching from the base to front; the glabella occupies about one-third the entire width; dorsal furrows wide, extending about half the entire length of the head, and curving outwards at the anterior extremity.

One large head has a length of three inches and a half, with a width between the facial sutures of four and a quarter inches. The eyes and cheeks are but partially known.

The caudal shields present gradations in size, from a length of half an inch by a width of seven-eighths of an inch, to those of less than three inches long with a width of four and a half inches. The proportions of length and breadth of the pygidium are not constant, though its wide and very depressed form is always characteristic.

The position of this species is somewhat lower in the group than the Racine and Waukesha beds.

ILLENUS (BUMASTUS) IOXUS, HALL.

PLATE XXII, FIGS. 4-10.

Compare *Bumastus barriensis*, MURCHISON. Silur. Syst., p. 656, Pl. vii, bis, fig. 3a-d. 1839.
Bumastus barriensis, HALL. Palæontology N. Y., II, p. 302, Plate lxvi, figs. 1-15.

There are several slight differences between the American (Wisconsin) specimens referred to this species, and the figures and descriptions of the English form of *I. barriensis*, as given in the *British Decade* 2, Plates 3

and 4. No or strongly obliquely; angle to its suture, for shield is p inner mar

The dif no means specimens

The Ne same form



direction

This sp sin, at Ra

It usu tions of t head bei head figu

Glabella

mar

con

dir

mo

pro

rea

ang

the

and 4. None of these differences, however, appear to be very important or strongly marked. On the head the eye is placed a little more obliquely; the movable cheek is comparatively longer from the posterior angle to its anterior margin; the facial suture lines unite with the rostral suture, forming an abrupt angle instead of a rounded one; the rostral shield is proportionally narrower from side to side, especially on the inner margin, where it unites with the hypostoma.

The differences in the pygidium are not readily observed. We have no means of comparing the articulations of the thorax in the Wisconsin specimens.

The New York specimens usually referred to *I. barriensis* have the same form of head and pygidium as those of Wisconsin, and differ from

the figures of the British species in the direction of the terminations of the pleura. Notwithstanding the differences are not conspicuous, I am inclined to regard them as of the same importance as those which distinguish closely allied species.

The form of the rostral shield and the direction of the suture lines are shown in the accompanying fig. 12.

This species is of common occurrence in the Niagara group of Wisconsin, at Racine, Waukesha, Wauwatosa, and other places.

It usually occurs as separated heads and pygidia, with detached portions of the thorax. It has sometimes attained a very large size, the head being two and a half inches in length; equalling in size the largest head figured from the Niagara shale of New York.

ILLENUS CUNICULUS, N. S.

PLATE XXII, FIG. 12.

Glabella subquadrangular in outline, broadly rounded on the anterior margin, with the edge sharply recurved; general surface regularly convex, a little more arcuate transversely than in a longitudinal direction; length and breadth very nearly equal. Palpebral lobes moderately elevated, somewhat triangular in form, and laterally produced; situated very near the occipital border. Suture line reaching the posterior margin of the head, a little within the outer angle of the eye lobe, and slightly indented in front of the eye; thence directed toward the anterior margin with a slightly sigmoid



FIG. 12.

curve; the distance between the sutures on the anterior margin but little less than in front of the eyes.

This species, in comparison with *I. armatus*, *I. barriensis* and *I. imperator*, has the glabella more elongated, while it is less convex than *I. insignis*, with shorter, and laterally more produced, palpebral lobes. The posterior position of the eye lobe is likewise a distinguishing feature.

Formation and Locality.—In limestone of the Niagara group, at Wauwatosia; and a single specimen of doubtful locality, received from Mr. I. A. LAPHAM, has the aspect of the Bridgeport rock.

GENUS BRONTEUS, GOLDFUSS.

BRONTEUS ACAMAS, N. S.

PLATE XXI, FIGS. 19, 20; PLATE XXV, FIG. 21.

Bronteus occasus, WINCH. & MAECY. Mem. Bost. Soc. of Nat. Hist., I, p. 104, Plate iii, fig. 12.

A cast of the head is broad; depressed convex; the anterior portion plain; dorsal furrow extending a little more than one-third the entire length. A single glabellar furrow, with a distinct anterior lobe, are visible. The palpebral lobe is comparatively broad and moderately elevated.

The pygidium is somewhat semi-elliptical or parabolic, wider than long; the axis is short, somewhat semi-oval, with one or more transverse furrows near the anterior margin, while the terminal portion is marked by two faint longitudinal depressions, which are scarcely defined grooves. The median rib, at its origin, is about twice as wide as the lateral ones, increasing gradually, and below the middle of its length more rapidly, to the margin; where it is four or five times as wide as at its origin, and entirely simple. There are seven lateral ribs on each side, which are very slightly elevated, and the four anterior ones curve gently forward.

The specimens are for the most part casts of impressions, so that the entire surface characters cannot be ascertained. The head is imperfect, the occipital ring and cheeks being broken off; but there are several nearly entire pygidia in the collection.

The pygidium of this species resembles the *Bronteus planus* of CORDA, as illustrated by BARRANDE (*Système Silurien du centre de la Bohême*, Pl. xlii, fig. 34, and Pl. xxxviii, fig. 3), and it is difficult to point out distinguishing characters. The head associated with these pygidia is more nearly like that of *Bronteus tenellus* (BARRANDE, *ut sup.*, Pl. xlvii, figs. 36, 37); but it differs from that in some important particulars.

This species
York. (P
Plate xxv,
WINCHELL U
Formation
Wisconsin.

Acidaspis d
A. i

Head tran
anterior
spines
in front
than
slight
with
rise a
a new
the f

This sp
illustrate
in being
the straig
whether
which is
specimen
the creat
him.

Forma
Bridgepo

This species has the pygidia more elongate than *B. niagarensis* of New York. (*Pal. N. Y.*, Vol. ii, p. 314, Pl. lxx, fig. 3.) The figure given on Plate xxv, fig. 10, is made from a specimen communicated by Prof. WINCHELL under the name of *Bronteus occasus*.

Formation and Locality.—In limestone of the Niagara group, at Racine, Wisconsin.

GENUS ACIDASPIS, MURCHISON.

ACIDASPIS DANAI, HALL.

PLATE XXI, FIGS. 8, 9.

Acidaspis danai, HALL; in Catalogue of Fossils, Geol. Wisconsin, I., p. 423. 1862.
A. danai, WINCHELL, MAR.; in Mem. Bost. Soc. N. H., I., p. 106, Plate iii, fig. 13. 1865.

Head transverse, somewhat quadrangular, about twice as wide as long; anterior and antero-lateral border ornamented with nodes and short spines. Glabella strongly defined by the dorsal furrows, narrower in front than at the base; distinctly lobed, the middle lobe larger than the others, separated by deep, strong furrows. A strong, slightly diverging spine from each side of the base of the glabella, with a strong node or short spine in the centre. The ocular ridges rise a little in front and one side of the glabella, and continue in a nearly direct line to the base of the eyes which are in a line with the front of the anterior lobes of the glabella.

This species more nearly resembles *Acidaspis vesiculosus*, BEYRICH, as illustrated by BARRANDE (Pl. xxxviii, fig. 13). It differs from that one in being more transverse, in the narrower front of the glabella, and in the straight instead of curving ocular ridges. We have not ascertained whether this species has spines from the posterior borders of the cheeks, which is probable, as in the allied European species. Fig. 9 is from a specimen communicated by Prof. WINCHELL, but I am not able to detect the crenulations on the anterior border, as shown in the figure given by him.

Formation and Locality.—The original specimen is marked as from Bridgeport, near Chicago.

GENUS LICHAS, DALMAN.

LICHAS BREVICEPS? HALL.

PLATE XXI, FIGS. 12, 13, 14.

Lichas breviceps, HALL.; in Transactions Albany Institute, IV, p. 222. 1862.

The specimens figured are a head, which in all important characters corresponds with *L. breviceps* as described by me. The pygidium, fig. 14, occurs on the same specimen of rock, and corresponds in size to the head, both figures being enlarged two diameters.

The pygidium differs from the pygidia associated with the head of *L. breviceps* in the Waldron locality only in the central posterior indentation, and in this respect corresponds with *L. nevus*, which it otherwise closely resembles. It is therefore unnecessary to propose any other name until we have better material. Figs. 12 and 14 are from Bridgeport, Illinois. The specimen fig. 13 is from Grafton, Wisconsin, and is represented of the natural size, the terminal portion having been restored to correspond with fig. 14.

LICHAS ——— (SP.).

The pygidium of a species of this genus in limestone from Grafton, Illinois, has a strong rounded axis, with four rings besides the terminal one. The lateral lobes are somewhat convex, but the extremities are broken off, so that its entire form cannot be determined.

LICHAS PUGNAX, WINCH. AND MARC.

PLATE XXV, FIG. 20.

Lichas pugnax, WINCH. & MARCY, Mem. Bost. Soc. Nat. Hist., I, p. 103, Plate iii, fig. 10. 1865.

The figure given is of the pygidium of the original specimen in the collection of Prof. MARCY.

Formation and Locality.—In the Niagara limestone at Bridgeport, Illinois.

LICHAS OBVIUS, N. S.

PLATE XXV, FIG. 19.

Glabella gibbous, broad in front, length equal to the width between the eyes; occipital and dorsal furrow sharply defined; lateral lobes simple, of nearly equal width throughout, suddenly contracting near the base; surface finely pustulose.

Formation and Locality.—In limestone of the Niagara group, at Lyons, Iowa. From Dr. FARNSWORTH.

Sphaerexochus
Sphaerexochus
Sphaerexochus

This species
mirus of EU
for comparison
of the head
European species
so abrupt, and
are more frequent
part of the

This fossil
localities of

Calymene n.
Calymene bl.

This species
Wisconsin
exterior of

Pygidium
elevated
sion
are not
not t

This species
in the group
there are

g.

GENUS SPHÆREXOCHUS, BEYRICH.

SPHÆREXOCHUS ROMINGERI, HALL.

PLATE XXI, FIGS. 4-7.

Sphærexochus mirus, of authors; not *S. mirus* of BEYRICH.*Sphærexochus romingeri*, HALL. Geological Report of Wisconsin, p. 434. 1862.*Sphærexochus mirus*, HALL; in Twentieth Rep. State Cab., 1st edit., p. 334. 1867.

This species was at first supposed by me, to be identical with the *S. mirus* of Europe, but a farther careful study of it with larger collections for comparison, has shown certain differences in the form and proportions of the head, size of the cheek, etc., warranting its separation from the European species. The annulations on the axis of the pygidium are not so abrupt, nor the posterior extension so great; while the lateral lobes are more free at their extremities, giving a very different aspect to this part of the fossil.

This fossil is pretty widely distributed, occurring at nearly all the localities of the Niagara group in Wisconsin and Illinois.

GENUS CALYMENE, BRONGNIART.

CALYMENE NIAGARENSIS, HALL.

Calymene niagarensis, HALL. Geological Report, 4th District, N. Y., p. 101, fig. 3.*Calymene blumenbachii* var. *niagarensis*, Palæontology of New York, vol. ii, p. 307.

This species occurs in nearly all the localities of the Niagara group in Wisconsin. Its most common condition is that of impressions of the exterior crust, while casts of the interior are less frequently obtained.

GENUS ENCRINURUS, EMMERICH.

ENCRINURUS NEREUS, N. S.

PLATE XXI, FIG. 15.

Pygidium triangular; length and breadth about equal. Axis sharply elevated and marked by about eighteen rings, with a farther extension upon which no markings are distinguishable. The lateral lobes are marked by eight or nine distinct costæ, which, in the cast, are not tuberculated.

This species differs from the one in the Clinton group of New York, in the greater number of ribs on the lateral lobes of the pygidium, while there are fewer annulations on the middle lobe.

Formation and Locality.—In limestone of the age of the Niagara group, at Racine, Wisconsin.

GENUS DALMANIA, EMMERICH.

DALMANIA VIGILANS, HALL.

PLATE XXI, FIGS. 16, 17, 18.

Dalmanites vigilans, HALL. Rep. Progress Geol. Survey of Wisconsin for 1860, p. 51. 1861.

General form of body not determined. Cephalic shield convex, semi-elliptical, the breadth about twice as great as the length (exclusive of the frontal projection); the border is extended in front into a triangular flattened process, the base of which is little less than one-half as wide as the width of the anterior portion of the glabella. In older individuals this projection becomes more obtuse and sometimes rounded; the lateral borders are broad, flattened, separated from the cheeks by a distinct groove, extended posteriorly into spines which are equal in length to the glabella. Glabella large, depressed convex, widening in front to twice its width at the posterior margin, divided into lobes by three pairs of transverse furrows exclusive of the occipital furrow, which is distinct and continuous. The two posterior furrows are distinct at the sides, but do not extend entirely across the glabella except in very faint depressions. The anterior furrows are deep, very distinct, situated a little anterior to the eyes, extending each about one-third across the glabella, and giving to the frontal lobe a transversely elliptical outline. The occipital ring is narrow, ornamented on the middle by a single short sharp spine. Eyes very prominent, short reniform, containing about thirty-five vertical ranges of lenses, the middle ones of which have nine each. Cheeks small, prominent on the anterior portion, marked near the posterior margin by a deep groove, the continuation of the occipital furrows. Thoracic segments unknown. Pygidium somewhat elongate triangular, extended posteriorly into an acute spine; central lobe or axis marked by ten or twelve narrow rings; the lateral lobes less prominently marked by ten flattened ribs, which terminate in a narrow flattened margin. Eight of these ribs are double throughout their entire length; the posterior ones are directed obliquely backwards.

This s
ontology



lobes is
species a
Geology
Wisconsin

Compar
Compar
Ceraur
Ceraur

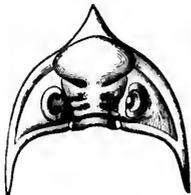
A ca
given b
glabella
I am in
another
species

In t
have di
an imp
dage di
anterio

just an
This
by M.
and A
BEYRI

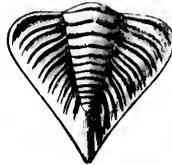
This species somewhat resembles *D. limulurus* (*Phacops limulurus*, Palaeontology N. Y., II, Plate 67, fig. 1); but differs in the proportionally larger

FIG. 13.



glabella, the larger and more prominent eyes, and the extension of the anterior border. The pygidium is less rounded on the anterior margin, the spine is more obtuse, the flattened margin outside of the ribs is narrower, and the number of ribs on the lateral

FIG. 14.



lobes is greater. In figs. 13 and 14, the head and pygidium of this species are represented.

Geological Formation and Location.—In Niagara limestone, at Waukesha, Wisconsin.

GENUS CERAURUS, GREEN.

CHEIRURUS, BEYRICH.

CERAURUS NIAGARENSIS, N. S.

PLATE XXI, FIGS. 10, 11.

Compare *Cheirurus insignis*, BEYRICH. *Ub. Bohm, Tril. p. 12, fig. 1.*
 Compare *Cheirurus insignis*, BARRANDE. *Syst. Sil. du Centre de la Bohême, p. 782, Plate 41.*
 Compare *Cheirurus insignis*, CORDA. *Prod., p. 133, Plate vi, fig. 70.*
Ceraurus insignis, HALL. *Palaeontology N. Y., II, pp. 300, 306, Plate 67, figs. 9, 10.*
Ceraurus insignis, HALL; in *Twentieth Rep. State Cab., 1st edit., p. 335. 1867.*

A careful comparison of our specimens with the figures of *C. insignis*, given by BARRANDE, shows certain differences in the general form of the glabella, the direction of the furrows and form of posterior lobes, which I am inclined to regard as of specific importance, and therefore propose another specific name. The New York and Wisconsin specimens of this species preserve the same characteristics.

In the collection loaned to me for examination by Prof. WINCHELL, I have discovered the hypostoma of a CERAURUS attached to the front of an imperfect glabella, which I infer belongs to this species. This appendage differs from the hypostoma of *C. insignis* in being more rounded anteriorly, and not so deeply notched at the sides, while the border just anterior to the notch is not expanded as in the European species.

This species was, I believe, first identified with the European *C. insignis* by M. E. DEVERNEUIL, in his memoir on the parallelism of the European and American palaeozoic formations.* A comparison with the figures of BEYRICH then satisfied me that our species was identical with the Euro-

* *Bulletin Soc. G. ol. de France, 1847.*

pean one, and I expressed this opinion in Vol. ii, *Palæontology N. Y.* The species occurring in Tennessee, which is probably the same as ours, has been identified by Dr. ROEMER with *Cerurus bimucronatus* of MURCHISON, which he regards as synonymous with *Calymene speciosa* of HISINGER, not of DALMAN. Our species bears as close a resemblance to *C. quenstedti* and *C. obtusatus* of BARRANDE as it does to *C. insignis*.

GENUS LEPERDITIA, ROUALT.

LEPERDITIA FONTICOLA, N. S.

PLATE XXI, FIGS. 1, 2, 3.

Obliquely ovate or subreniform, gibbous in the middle; hinge-line straight, and equalling two-thirds the entire length, and about equalling the greatest width. Valves equal or subequal; posterior side rounded, wider than the anterior; base broadly rounded, and somewhat abruptly contracted towards the anterior end; greatest gibbosity in the middle; eye tubercle nearer the cardinal margin than the anterior extremity, with a distinct depression between it and the gibbous centre.

The specimens are casts of the interior, and occur in considerable numbers in some of the beds where there are few or no other fossils. It has a length of .47 of an inch, and the cardinal line is .29 of an inch. The greatest width is .30 of an inch. Some individuals are larger, while the greater number are smaller than the dimensions here given.

Formation and Locality.—In limestone of the Niagara group, near Fond du Lac, Wisconsin.

The fol
paper by
Vol. I, N
entitled
at Chicag

I had o
by LONST
syllable h
is perhap
however,

The fo
MARCY, a
I. corbis,



my desc
of this p
plates, an
casts alo

Beside
of Prof.

* The bas
externally,
exterior of

SUPPLEMENTARY NOTES.

The following notes are mainly in reference to species described in a paper by Profs. ALEXANDER WINCHELL and OLIVER MARCY, published in Vol. I, No. 1, of the *Memoirs of the Boston Society of Natural History*, entitled "An Enumeration of Fossils collected in the Niagara Limestone at Chicago, Illinois."

HOLOCYSTITES, HALL.

(Page 333.)

I had overlooked the fact that the name HOLOCYSTIS had been proposed by LONSDALE for a genus of corals. The difference of the terminal syllable has in many cases been regarded as a sufficient distinction, and is perhaps preferable to adopting a new name. Should it be objected to, however, I propose the name MEGACYSTITES.

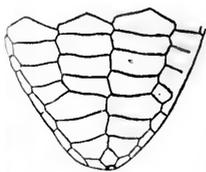
ICHTHYOCRINUS SUBANGULARIS, HALL.

(Page 367.)

The following figure, from a specimen kindly loaned me by Prof. MARCY, and which I suppose to have been used in the description of *I. corbis*, shows the form and arrangement of the plates of the base and lower parts of the rays, differing in no essential particular from specimens I have identified with *I. subangularis*.* The suture lines of this specimen had been marked with pencil, previous to coming into my hands, and it shows distinctly the series of three radial plates as well as subradials. The specimen from which my description and figure of *I. subangularis* was made (Plate xi, fig. 15, of this paper), is from Bridgeport. It preserves the substance of the plates, and is more fit for comparison of external characters than internal casts alone.

Besides the specimen used for the diagram, there is, in the collection of Prof. MARCY, another one which equally shows the structure of the

* The basal plates proper of *ICHTHYOCRINUS* have heretofore been shown by me to be undeveloped externally, or are covered by the summit of the column; and the lower plates, shown on the exterior of the calyx, are properly subradials, the basals being too minute for representation.



base, first and second radials. Both specimens are casts of the interiors of the fossil, and show not only the real structure, but the obscurely angular form of the lower part of the body.

ACTINOCRINUS (SACCOCRINUS) WHITFIELDI, HALL.

(Page 370.)

An examination of the figure, and a subsequent examination of a specimen labelled *Megistocrinus marcouanus*, in Prof. MARCY'S collection, and which appears to have been the original of the figure given, leaves no doubt regarding its identity with *A. whitfieldi*. The bifurcations of the rays take place in precisely the same manner in the two individuals; and differences as great as those indicated in the plates and form of the body, can be detected between many of the individuals from Waldron, and are of no specific importance. Prof. W. points out a difference in the number of interradial plates, stating that they are always less than fifteen. But in the two interradial areas of his specimen which show plates, on either of them can be counted fifteen plates, or even more than this number, if we enumerate the smaller ones in the upper part of the area. In one of the areas, sixteen plates can be distinctly counted.

Megistocrinus infelix, W. & M., is only a smaller individual of the preceding species, possessing all the characters of the Waldron specimens and none others. The number of interradial plates may appear less, as those of the upper part of the area are too small to be counted in a cast of the interior, especially since this cast is very indistinctly preserved in some of its parts. The constrictions of the interradial and anal areas between the arm-bases is a character common to all the Waldron specimens, when preserving the margin of the dome. This feature is well shown in *Saccoocrinus speciosus*,* figured by RÆMER. The bifurcation of the rays take place at the same height as in the Waldron species of the same size; the ridges along the radial series are subject to much variation, but these differences are of no specific value. Both Prof. WINCHELL'S figure and specimen leave no doubt of the identity of this form with *Actinocrinus whitfieldi*.

Megistocrinus necis, W. & M. The specimen communicated by Prof. WINCHELL, under this name, I should regard as *A. (S.) whitfieldi* with the summit unusually constricted, but showing no marks of specific distinction.

* The fossil referred by Dr. RÆMER to *Saccoocrinus speciosus* is probably not of that species, but more likely identical with the Waldron species.

I am in
extravagan
on each s
ones in th
of this a b
depression

This is
so nearly
more prop
small ant
second sh
and subce
AVICULA t
WINCHELL
oblique at

The hi
PTERINEA,
plate mer
of Prof. M
for a stro
the large
not ally i
and until
shall leav
eric name
scarcely v
tion to
identity v
inclined
may be t

PENTAMERUS (PENTAMERELLA) VENTRICOSUS, HALL.

(Page 382.)

I am inclined to regard the *P. chicagocensis* of W. & M., as only an extravagant form of the above species. Their figure gives five plications on each side, while the specimen (quite imperfect) shows two strong ones in the centre, a much smaller one adjacent on the side; and outside of this a broad, low elevation, while the third one is not defined by any depression between it and the margin of the shell.

AVICULA UNDATA, HALL.

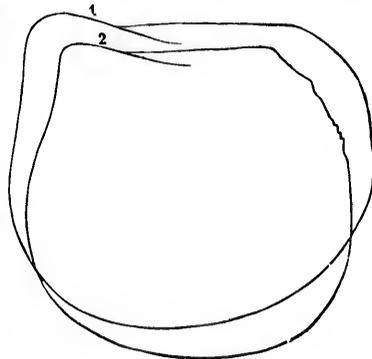
(Page 384.)

This is not to be regarded as a true AVICULA, but as having characters so nearly identical with those of that genus, that this reference seemed more proper than any other. The species is *not* a PTERINEA. It has one small anterior tooth in each valve; and an oblique posterior tooth, with a second shorter one in the right valve. The muscular scar is large and subcentral. These characters appear to me more nearly those of AVICULA than of PTERINEA. The teeth are correctly described by Prof. WINCHELL as "posterior, linear, diverging teeth," which are quite oblique at the posterior extremity.

AMPHICELIA LEIDYI, HALL.

(Page 387.)

The hinge structure of this species will not sanction its reference to PTERINEA, made by Profs. WINCHELL and MARCY. The striated hinge-plate mentioned by them, and which I have seen through the kindness of Prof. MARCY, appears as if oblique or expanding outward, giving space for a strong external ligament, while the large pit beneath the beaks does not ally it very nearly with PTERINEA; and until we know more about it, I shall leave it under its proposed generic name of AMPHICELIA, though it is scarcely worth while to seek any relation to LEPTODOMUS. In regard to identity with *P. neglecta*, I have been inclined to the opinion that there may be two species of this genus in



the rocks of Wisconsin and Illinois; numerous specimens presenting differences of outline, which are easily recognizable. The accompanying outline figures are, 1, copied from the figure given by M'CHESNEY of *Ambonychia neglecta*; and 2, from *Amphicetia leidyi*. It may require farther comparison, with larger collections, to demonstrate the identity or difference of these forms.

PLATYOSTOMA NIAGARENSIS, HALL.

(Page 300.)

Platyceras campanulatum, W. & M., seems to be only one of the many phases assumed by the above species, in its wide geographical distribution.

PORCELLIA SENEX, WINCH. AND MAR.

"Shell small, consisting of one and a half or two very rapidly enlarging, detached whorls, which are somewhat oblique in the young shell, but afterwards continue very nearly in one plane. Toward the aperture the shell is flattened and subnodulous on the dorsum."

The specimen is a cast of the interior of a PLATYCERAS, closely allied to *P. niagarensis*; and the spire is oblique throughout its entire extent, the two sides of the shell being nowhere symmetrical. There are a few undulations on the back, from inequalities of growth at the aperture, which has been deeply sinuate; but there is no evidence of the narrow carina on the dorsum, or slit at the aperture, characteristic of PORCELLIA.

PLEUROTOMARIA HALEI, HALL.

(Page 302.)

Notwithstanding the fact that Prof. WINCHELL has identified *P. axion* as the species he referred to *P. halei*, the specimens which he sent to me under the latter name are not of that species, but of *Pleurotomaria (Trochonema?) pauper*. In Prof. MARCY'S collection there are numerous specimens of the latter species, and one fine cast of *P. halei*; but neither in this collection, nor in that sent by Prof. WINCHELL, is there any specimen of *P. axion*.

Subulites
want of s
should be

Prof. W
nodocostum
specimens
and leave
sents ann
without th
longitudin

I have
name *O. n*
ing, in P
taken. T
has taken
annular s
nodes.

Specim
worthenan
bella of
hypostom
pygidium
the one d
tions of J
I. armatu
municate

The re
tunate.

* *O. n*
a.

SUBULITES VENTRICOSUS, HALL.

(Page 398.)

Subulites brevis, W. & M., may prove a distinct species. Should the want of symmetry be found a constant feature, the specific distinction should be maintained.

ORTHO CERAS ANNULATUM, SOWERBY.

(Page 411.)

Prof. WINCHELL, in referring specimens of the above species to the *O. nodocostum* of M'CHESNEY,* says, "No annular striæ can be seen on our specimens. The longitudinal ridges are barely discernible on the shell, and leave no trace upon the cast." The figure of Mr. M'CHESNEY represents annular striæ upon his specimens, and I have never seen the shell without these markings; and the casts, or partial casts, usually show the longitudinal ridges more distinctly than the shell.

I have received from Prof. WINCHELL a gutta-percha cast, under the name *O. nodocostum*; and I have likewise had an opportunity of examining, in Prof. MARCY'S collection, the matrix from which this cast was taken. This matrix, although obscured by the crystalline matter which has taken the place of the shell, nevertheless preserves the marks of annular striæ, quite as distinctly as it does the longitudinal ridges or nodes.

ILLÆNUS ARMATUS, HALL.

(Page 418.)

Specimens communicated by Prof. WINCHELL under the name of *Illænus worthenanus*, are the glabellæ of the above species, and one part of a glabella of CERAURUS with hypostoma attached, which is probably the hypostoma described on page 105, vol. i, *Mem. Bost. Soc. Nat. Hist.* The pygidium accompanying these, under the same name, is apparently the one described on page 105, and belongs to *I. armatus*. In the collections of Prof. MARCY there are several glabellæ and imperfect heads of *I. armatus*, and a very good head of *I. insignis*; all of which were communicated under the name *Illænus worthenanus*.

LICHAS PUGNAX, WINCH. AND MAR.

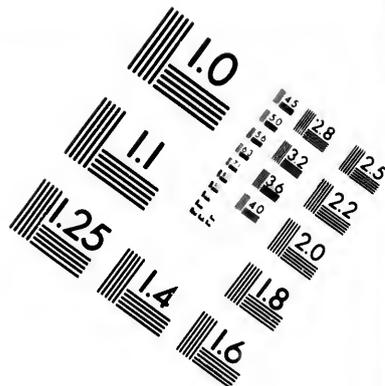
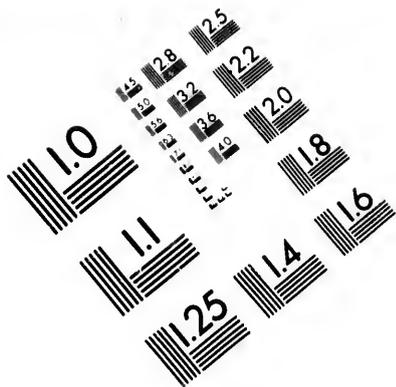
The representation of the pygidium by Prof. WINCHELL is very unfortunate. The third or posterior annulation of the figure is the anterior

* *O. nodicostatum*, as corrected in Transactions of the Chicago Academy of Sciences.

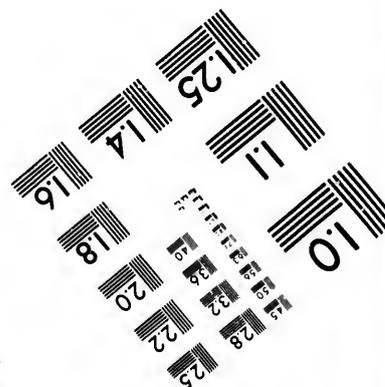
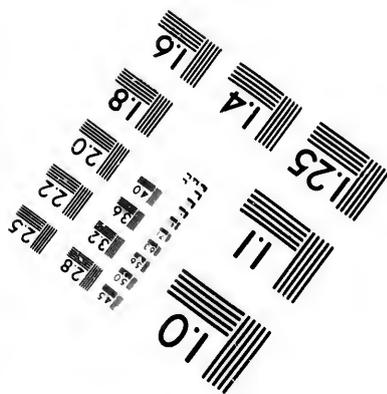
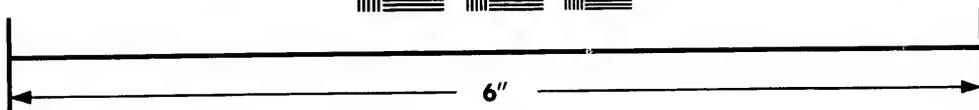
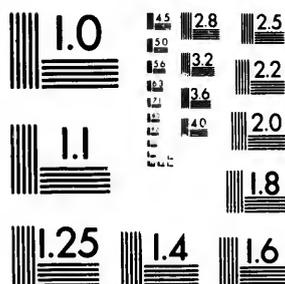
one of the axis. The two anterior annulations of the figure do not belong to the pygidium, and do not exist in the specimen; nor is there anything resembling them. The anterior margins of the lateral lobes, as well as the anterior border of the single annulation, clearly show the limits of the pygidium in that direction. The left lateral lobe should be carried a little higher at the axial furrow, and the right side be continued in a similar manner, leaving off the two anterior rings of the axis. This condition is clearly shown in the original specimen.

e figure do not
n; nor is there
e lateral lobes,
learly show the
eral lobe should
ght side be con-
rings of the axis.





**IMAGE EVALUATION
TEST TARGET (MT-3)**



**Photographic
Sciences
Corporation**

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

15 28 25
16 32
18 22
19 20
18

**CIHM/ICMH
Microfiche
Series.**

**CIHM/ICMH
Collection de
microfiches.**



Canadian Institute for Historical Microreproductions / Institut canadien de microreproductions historiques

11
10
11
10

© 1982

t
e
,
e
l
-
s.

III. LIS

Recepta
R.

Diplopl
Favosit
F.
F.
F.
F.
Halysit
H.
Heliolit
*Petraia
Stroma
*Zaphre

*Cladop
*C.
C.
*C.
*C.
Fenest
*Lichen
Polyp
*Stictop

Actino
A.
Apioey
Caryo
Crinoc
Cyath
C.
C.
Echin
Eucal
*E.
E.
E.
Eucal
E.

*Spec
† In t
same a

III. LIST OF FOSSILS OF THE NIAGARA GROUP, OCCURRING IN THE WISCONSIN,
ILLINOIS AND IOWA LIMESTONES.

FORAMINIFERA.

- Receptaculites hemisphericus, HALL. Geolog. Report of Wisconsin. 1861.
R. infundibulus, HALL. Id. pa. = *Ischadites tessellatus*, WINCH. & MAR.†

ZOÖPHYTA.

- Diplophyllum caespitosum, HALL. Pal. N. Y., II, p. 116, pl. 33, fig. 1.
Favosites favosa, GOLD. Pal. N. Y., II, p. 126, pl. 34 bis., fig. 5.
F. *gothlandica*? = F. niagarensis, HALL.
F. niagarensis, HALL. Pal. N. Y., II, p. 125, pl. 34 bis., fig. 4 a, b.
F. striata, SAY, in Amer. Jour. Sci., VII., p. 381 = ? F. favosa, GOLD.
F. venusta (HALL), WINCH. & MAR.
Halysites catenulatus, LINN.
H. macrostylis, HALL. Pal. N. Y., II, p. 135, pl. 362, fig. 2.
Heliolites pyriformis, GUETT. Pal. N. Y., II, p. 133, pl. 36 A, fig. 1.
*Petraia calicula (HALL) = *Streptelasma calicula*, HALL. Pal. N. Y., II, p. 111, pl. 32, fig. 1.
Stromatopora concentrica, GOLDF.
*Zaphrentis turbinatum (HALL) = *Polydasma turbinatum*, HALL. Pal. N. Y., II, p. 112.

BRYOZOA.

- *Cladopora fibrosa, HALL. Pal. N. Y., II, p. 139.
*C. lichenoides, WINCH. & MAR.
C. reticulata, HALL. Pal. N. Y., II, p. 141, pl. 39, fig. 3.
*C. seriata, HALL. Pal. N. Y., II, p. 137.
*C. verticillata, WINCH. & MAR.
Fenestella elegans, HALL. Pal. N. Y., II, p. 164.
*Lichenalia concentrica, HALL. Identified by WINCH. & MAR.
Polypora incepta, HALL. Pal. N. Y., II, p. 167.
*Stictopora punctipora, HALL. Identified by WINCH. & MAR.

ECHINODERMATA.

- Actinocrinus (Saccoerinus) semiradiatus, HALL.
A. (Saccoerinus) whitfieldi, HALL, = *Actinocrinus christyi*, HALL.
Aplocystites imago, HALL.
Caryocrinus ornatus, SAY. (Pl. xi, fig. 17 of this Report.)
Crinocystites chrysalis, HALL.
Cyathocrinus cora, HALL.
C. pusillus, HALL, = *Lecanocrinus pusillus*, WINCH. & MAR.
C. waukoma, HALL.
Echinocystites nodosus, HALL.
Eucalyptocrinus caelatus, HALL. Pal. N. Y., II, p. 210, pl. 47, fig. 4.
*E. chicagoensis, WINCH. & MAR.
E. cornutus, HALL.
E. cornutus var. excavatus, HALL.
E. crassus, HALL.
Eucalyptocrinus obconicus, HALL.
E. ornatus, HALL.

*Species which have not come under the observation of the writer.

†In the *Memoirs of the Boston Society of Natural History*, vol. 1, 1865; as also the subsequent citations of same authors.

- Glyptaster occidentalis, HALL.
 G. pentangularis, HALL.
 Glyptocrinus armosus (M'CHESNEY), = *G. siphonatus*, HALL.
 *G. carleyi, HALL. Trans. Alb. Ins., IV, p. 203. Identified by WINCH. & MAR.
 G. nobilis, HALL.
 Gomphocystites clavus, HALL.
 G. glans, HALL.
 G. tenax, HALL.
 Hemicosmites subglobosus, HALL.
 Helycystites abnormis, HALL.
 H. alternatus, HALL.
 H. cylindricus, HALL.
 H. ovatus, HALL.
 H. scutellatus, HALL.
 H. sphaericus, WINCH. & MAR.
 H. winchelli, HALL.
 Ichthyocrinus subangularis, HALL, = *I. corbis*, WINCH. & MAR.
 Lampteroocrinus inflatus, HALL.
 Macrostylocrinus striatus, HALL.
 Megistocrinus marcouanus, WINCH. & MAR., = Actinocrinus (Saccocrinus) christyi, HALL.
 M. infelix, WINCH. & MAR., = *M. marcouanus*, WINCH. & MAR.
 M. necis, WINCH. & MAR. = Actinocrinus (Saccocrinus) christyi, HALL.
 Melocrinus verneuili (TROOST), HALL, = *Actinocrinus obpyramidalis*, WINCH. & MAR.
 Rhodocrinus? rectus, HALL, = *Crinocystites? rectus*, HALL.
 R. (Lyriocrinus) sculptilis, HALL.
 Tarbinocrinus verneuili, TROOST, = Melocrinus verneuili (TROOST), HALL.

BRACHIOPODA.

- Atrypa nodostriata, HALL. Pal. N. Y., II, p. 272.
 A. reticularis, LINN.
 Meristina nitida (HALL), = *Atrypa nitida*, HALL. Pal. N. Y., II, p. 268.
 Obolus conradi, HALL.
 Orthis elegantula, DALMAN.
 O. flabellites, HALL.
 O. hybrida, SOWERBY.
 Pentamerus arcuosus, † M'CHESNEY, = ? *P. ventricosus*, HALL.
 *P. crassoradius, † M'CHESNEY. New Pal. Fossils, p. 87. 1861.
 P. multicoelatus, HALL.
 P. oblongus, SOWERBY, Silurian System, = *P. bisinuatus*, M'CHESNEY.
 P. occidentalis, HALL. Pal. N. Y., II, p. 341.
 P. trisinuatus, M'CHESNEY. New Pal. Fossils, = *Athyris?* p. 86.
 P. (Pentamerella) ventricosus, HALL, = ? *P. chicagoensis*, WINCH. & MAR.
 Rhynchonella cuneata, DALMAN.
 R. neglecta, HALL. Pal. N. Y., II, pp. 70, 274.
 *Spirifera crispa, SOWERBY.
 S. eudora, HALL.
 S. gibbosa, HALL.
 S. meta, HALL.
 S. niagarensis, CONRAD; in Jour. Acad. Nat. Sci. Phil., VIII, p. 261.
 S. nobilis, BARRANDE, = *S. inconstans*, HALL; *S. racinensis*, M'CHESNEY.
 S. plicatella var. radiata, SOWERBY.
 S. similior, WINCH. & MAR., = Pentamerus.
 Strophomena rhomboidalis, WALL.
 Strophodonta profunda, HALL. Pal. N. Y., II, p. 61, = *Strophomena niagarensis*, W. & M.
 S. semifasciata, HALL; in Trans. Alb. Ins., IV, p. 210, = *Strophomena macra*, W. & M.
 Trematospira matthewsoni, M'CHESNEY; New Pal. Fossils, p. 71. 1860.

† In a revision of his paper, Mr. M'CHESNEY has omitted these two species of Pentamerus as well as others of his previously described forms, without giving any explanation for so doing.

Ambonych
 A. ap
 Amphicoeli
 Avicula em
 A. u
 Conocardia
 C. or
 Cypricardi
 Cypricardi
 Edmondia
 Modiolopsi
 M. r
 M. s
 Paleocard
 Pterinea b
 *P. c
 *P. r
 P. v
 Bucania a
 B. c
 B. c
 B. p
 Cyclonem
 Eunema?
 *Holoepa c
 H. r
 H. r
 *H.
 Loxonem
 Murchis
 M.
 M.
 *Platycer
 *P.
 Platyost
 Pleurotor
 P.
 P.
 P.
 P.
 P.
 *P.
 Porcellio
 Strapar
 Subulites
 Tremano
 Trochou
 T.
 Cyrtoc
 C.
 C.
 C.

LAMELLIBRANCHIATA.

- Ambonychia acutirostra, HALL, = *A. mytiloides*, HALL.
 A. aphea, HALL.
 Amphicœlia leidy, HALL = ? *Ambonychia neglecta*, M'CHESNEY.
Avicula emacerata, CONRAD. Pal. N. Y., 11, p. 282.
 A. mdata, HALL. Pal. N. Y., 11, p. 283.
Conocardium niagarensis, WINCH. & MAR.
 C. ornatum, WINCH. & MAR.
Cypriocardinia arata, HALL.
Cypriocardites? *quadrilatera*, HALL.
Edmondia nilesi, WINCH. & MAR., = ? *Modiolopsis nilesi*.
Modiolopsis dietzeus, HALL.
 M. rectus, HALL, = *Cleidophorus macchesneyanus*, WINCH. & MAR.
 M. subulatus, HALL.
Palæocardia cordiformis, HALL.
Pterinea brisa, HALL.
 *P. cyrtodontoides, WINCH. & MAR.
 *P. revoluta, WINCH & MAR., = ? *P. striacosta*, M'CHESNEY.
 P. volans, WINCH. & MAR.

GASTEROPODA.

- Bucania angustata*, HALL.
 B. chicagoensis, M'CHESNEY, New Pal. Fossils, p. 69. 1860.
 B. crassolare, M'CHESNEY, New Pal. Fossils, p. 91. 1861.
 B. pervoluta, M'CHESNEY, New Pal. Fossils, p. 91. 1861.
Cyclonema? *elevata*, HALL.
Eunema? *trilineata*, HALL.
 **Holopea chicagoensis*, WINCH. & MAR.
 H. guelphensis, BILLINGS.
 H. harmonia? BILLINGS.
 *H. niagarensis, WINCH. & MAR.
Loxonema leda, HALL.
Murchis *conradi*, HALL.
 M. hercyna? BILLINGS.
 M. laphani, HALL.
 **Platyceras campanulatum*, WINCH. & MAR., = *Platystoma niagarensis*, HALL.
 *P. niagarensis, HALL, = *Acroculia niagarensis*, HALL. Pal. N. Y., 11, p. 288.
Platystoma niagarensis, HALL. Pal. N. Y., 11, p. 287.
Pleurotomaria axion, HALL.
 P. gonopleura, WINCH. & MAR.
 P. halei, HALL.
 P. halei, WINCH. & MAR., = *Trochonema (Cyclonema?) pauper*, HALL.
 P. (Trochonema) hoyi, HALL.
 P. idia, HALL.
 *P. sigaretoides, WINCH. & MAR.
Porcellia senex, WINCH. & MAR., = *Platyceras*.
Straparollus mopsus, HALL.
Subulites ventricosus, HALL, = *S. brevis*, WINCH. & MAR.
Tremanotus alpheus, HALL, = *Bellerophon (Bucania) perforatus*, WINCH. & MAR.
Trochonema (Eunema) fatua, HALL.
 T. (Cyclonema?) *pauper*, HALL.

CEPHALOPODA.

- Cyrtoceras brevicorne*, HALL.
 C. dardanus, HALL.
 C. fosteri, HALL.
 C. hercules (WINCH. & MAR.) = *Lituites hercules*, WINCH. & MAR.

- Cyrtoceras laterale, HALL.
 C. lucillum, HALL.
 C. pusillum, HALL.
 C. rigidum, HALL.
 Gomphoceras scrinium, HALL, = *G. marcyæ*, WINCH. & MAR.
 G. septoris, HALL.
 Lituites marshii, HALL.
 Nautilus capax, HALL, = *Lituites capax*, HALL.
 N. occidentalis, HALL.
 Oneoceras oreus, HALL.
 Orthoceras abnorme, HALL.
 O. alienum, HALL.
 O. angulatum, HALL.
 O. annulatum, SOWERBY.
 *O. cameolare, M'CHESNEY. New Pal. Fossils. 1861.
 O. columnare, HALL, = *O. scammoni*, M'CHESNEY. New Pal. Fossils. 1861.
 O. crebescens, HALL.
 *O. hoyi, M'CHESNEY. New Pal. Fossils. 1861.
 *O. laphami, M'CHESNEY. New Pal. Fossils. 1861.
 *O. lineolatum, M'CHESNEY. New Pal. Fossils. 1861.
 O. loxias, HALL.
 O. medullare, HALL.
 O. niagarensis, HALL.
 *O. woodworthii, M'CHESNEY, = *O. irregulare*, M'CHESNEY.
 Phragmoceras nestor, HALL.
 Trochoceras (*Gyroceras*) bannisteri, WINCH. & MAR.
 T. costatum, HALL.
 T. desplainense, M'CHESNEY. New Pal. Fossils. 1860.
 T. notum, HALL.

CRUSTACEA.

- Acidaspis dami, HALL.
 Bronteus acamas, HALL, = *Bronteus occasus*, WINCH. & MAR.
 Calymene blumenbachii var. niagarensis, HALL.
 Ceraurus niagarensis, HALL.
 Dalmania vigilans, HALL.
 Enechinurus nereus, HALL.
 Illaenus armatus, HALL.
 I. cuniculus, HALL.
 I. imperator, HALL.
 I. insignis, HALL, = ? *I. worthenanus*, WINCH. & MAR.
 I. (*Bumastus*) loxus, HALL.
 Lichas breviceps? HALL.
 *L. decipiens, WINCH. & MAR.
 L. obvius, HALL.
 L. pugnax, WINCH. & MAR.
 Sphaerexochus romingeri, HALL.
 Leperditia fonticola, HALL.

ERRATA.

Page 367, line 25, for *Ichtyocrinus* read *Ichthyocrinus*.
Page 371, line 19, dele *Saccoerinus christyi* =.
Page 378, line 31, for LANDSTROM read LINN.
Page 380, line 29, for PLATE VIII read PLATE XIII.
Page 435, line 28, for identified read designated.

PLATE X.

ACTINOCRINUS (*SACCOCRINUS*) *SEMI-RADIATUS*, HALL.
Page 370.

FIG. 1. In internal cast of a specimen of this species, showing the characters as described.

RHODOCRINUS? *RECTUS*, HALL.
Page 368.

FIG. 2. View of an interior cast, presenting one of the interradial areas, and two of the radial series.

GLYPTASTER OCCIDENTALIS, HALL.
Page 369.

FIG. 3. Lateral view of a well preserved cast of this species.

GLYPTASTER PENTANGULARIS, HALL.
Page 369.

FIG. 4. An internal cast of this species, preserving the impressions of the plates.

MELOCRINUS VERNEULLI, TROOST.
Page 372.

FIG. 5. An internal cast of this species. The constriction between the arms is not quite so deep as in some examples.

LAMPTEROCRINUS INFLATUS, HALL.
Page 374.

FIG. 6. Lateral view of a well preserved cast of this species, which preserves the markings of the plates in an unusual degree.

MACROSTYLOCRINUS STRIATUS, HALL.
Page 371.

FIG. 7. External characters of this species, taken from a gutta-percha cast in the natural mould.
" 8. The internal cast of the same individual.

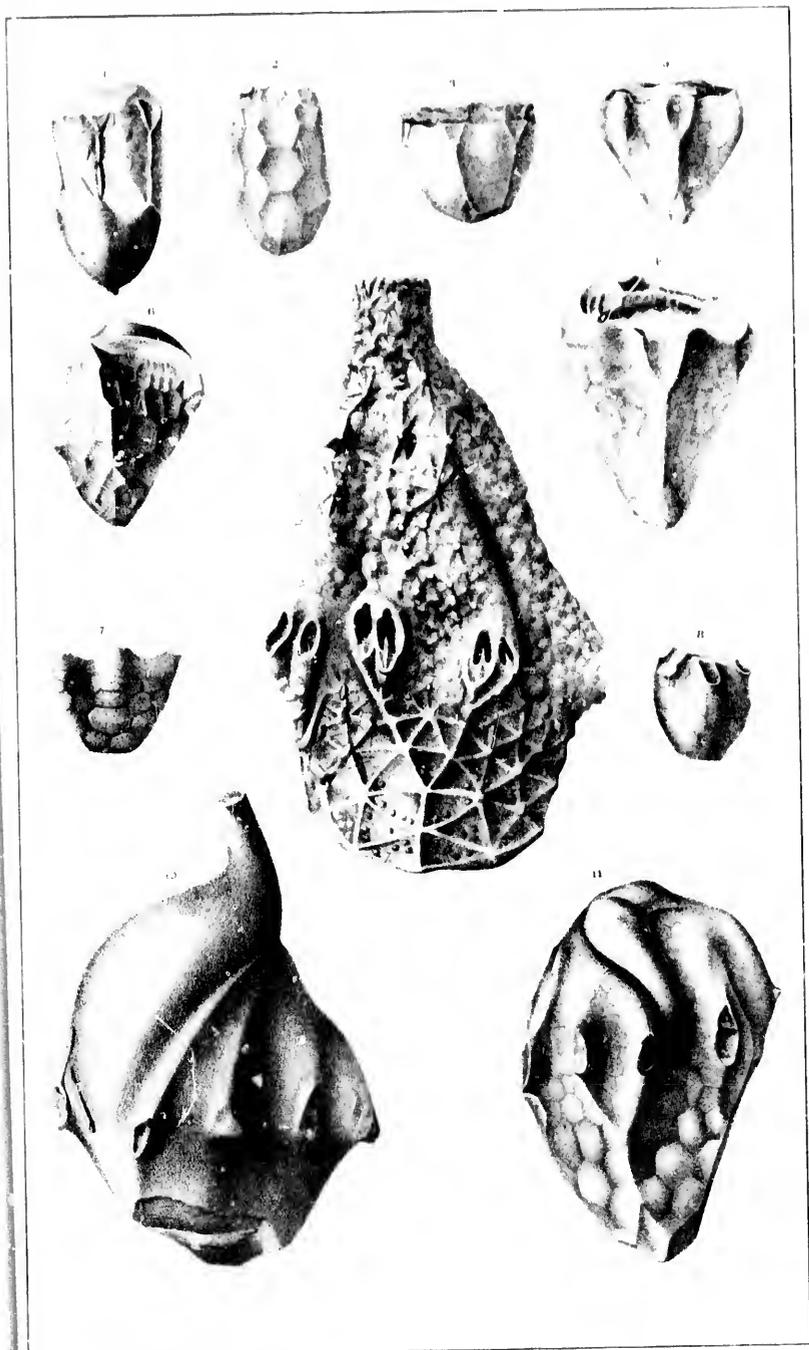
GLYPTOCRINUS NOBILIS, HALL.
Page 372.

FIG. 9. A view of the external surface as obtained from an impression in the natural mould.
" 10. Lateral view of an internal cast of this species. The base has been broken off.

GLYPTOCRINUS ARMOSUS, M'CHESNEY.
Page 373.

FIG. 11. Lateral view of an unusually well preserved internal cast, on which the boundaries of the plates are well marked. The similarity in general form between this species and *G. nobilis* is very remarkable, the conspicuous difference in the cast being the strong elevated proboscis in the latter; while in the former the organ occupying this position curves backwards, lying close upon the summit, and is directed downwards to the line of the arm-bases.





described.

o of the radial

not quite so deep

the markings of

he natural mould.

natural mould.
roken off.

the boundaries of
een this species and
ast being the strong
upping this position
l downwards to the

PLATE VI.

EUCALYPTOCRINUS OBCONICUS, HALL.

Page 365.

- FIG. 1. Lateral view of a specimen of this species, showing the structure of the body and first bifurcation of the rays.

EUCALYPTOCRINUS CRASSUS, HALL.

Page 365.

- FIG. 2. Lateral view of a well preserved cast of this species, which shows the structure of the body in a very satisfactory manner.
“ 3. Basal view of the same specimen as fig. 2.

EUCALYPTOCRINUS ORNATUS, HALL.

Page 366.

- FIG. 4. Basal view of the calyx of a specimen of this species. The figure is from a gutta-percha impression taken in the natural mould of the exterior, and shows the surface markings of the plates.
“ 5. View of an internal cast of this species, of large size, which preserves the impressions of the lines of growth of the plates.

EUCALYPTOCRINUS CORNUTUS, VAR. ENCAVATUS, HALL.

Page 364.

- FIG. 6. Basal view of an internal cast of this species, showing the deeply excavated base.
“ 7. Lateral view of the same specimen as fig. 6.

EUCALYPTOCRINUS CORNUTUS, HALL.

Page 363.

- FIG. 8. Shows the cavity left in the rock by the solution of the substance of the crinoid. The inside of the cavity is occupied by the cast of the interior of the cup of the specimen.
FIGS. 9, 10. Basal and lateral views of a gutta-percha cast made in the natural mould left by the removal of the substance of the crinoid.

CYATHOCRINUS WAUKOMA, HALL.

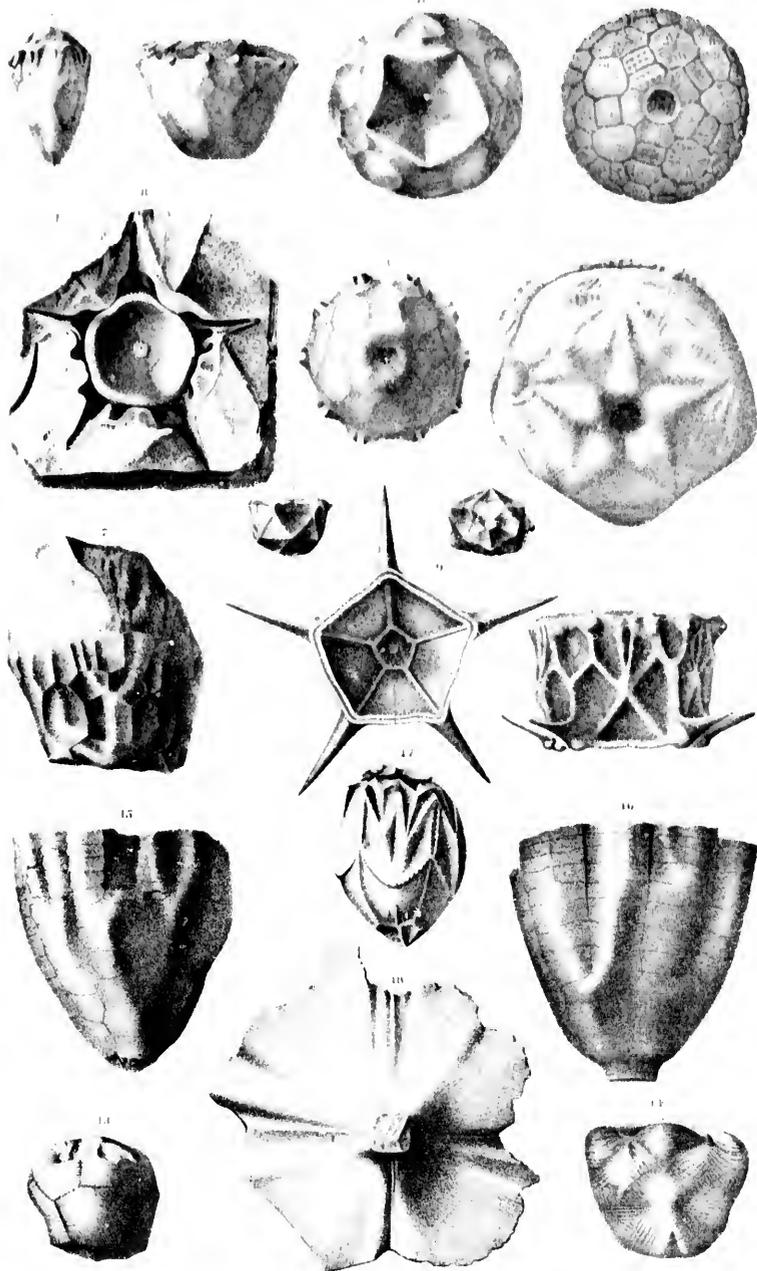
Page 367.

- FIGS. 11, 12. Lateral and basal views of an internal cast of this species.

CYATHOCRINUS CORA, HALL.

Page 366.

- FIG. 13. View of the anal side of a specimen of this species, showing the position of the anal plate.
“ 14. Lateral view of a larger individual of the species, showing more distinctly the radiating lines of the plates. (Some larger specimens observed are very decidedly constricted above the base.)



the body and first

structure of the

from a gutta-percha
the surface mark-

the impressions

...

erated base.

the crinoid. The
top of the specimen,
mould left by the

of the anal plate.
exactly the radiating
sidedly constricted

FIG.

“

FIG.

FIG.

PLATE XI—Continued.

ICHTHYOCRINUS SUBANGULARIS, HALL.

Page 367.

- FIG. 15. Lateral view of a specimen from Bridgeport, Illinois, preserving the substance of the plates.
" 16 View of a specimen from Waldron, Indiana, from which the species was originally described.

CARYOCRINUS ORNATUS, SAY.

- FIG. 17. Lateral view of an internal cast of a specimen of this species, possessing the usual characters of the species as they occur at these localities.

CRYPTODISCUS.

- FIG. 18. The calyx of a CRINOIDEAN ? of a new and peculiar type, for which the name CRYPTO-DISCUS is suggested.

PLATE VII.

HOLOCYSTITES SCUTELLATUS, HALL.

Page 357.

FIG. 1. Lateral view of the specimen described. The plates on the left side are obscured by adhering rock.

HOLOCYSTITES OVATUS, HALL.

Page 357.

FIG. 2. Lateral view of a specimen of this species

HOLOCYSTITES WINCHELLI, HALL.

Page 356.

FIG. 3. A view of the specimen described, which is imperfect at the base and summit.

HOLOCYSTITES CYLINDRICUS, HALL.

Page 354.

FIG. 4. A view of a well preserved individual of large size, on which the limits of the plates are strongly marked.

" 5. View of a smaller individual.

" 6. View of a small specimen (preserving a portion of the short column), on which the angular prominences of the plates and the surface pustules are well preserved.

HOLOCYSTITES ABNORMIS, HALL.

Page 355.

FIG. 7. Lateral view of a cast of a large specimen, which preserves the limits of the plates and the minutely pustulose texture of the surface.

" 8. View of a smaller specimen. The peculiar arrangement of the plates in the lower part of the body is seen in both this and the preceding specimen.

HOLOCYSTITES ALTERNATUS, HALL.

Page 355.

FIG. 9. View of a very distinctly marked specimen of this species, showing the position of the summit aperture and the arrangement of the plates of the body.

ECHINOCYSTITES NODOSUS, HALL.

Page 300.

FIGS. 10, 11. Lateral and summit views of the specimen described.

APIOCYSTITES IMAGO, HALL.

Page 358.

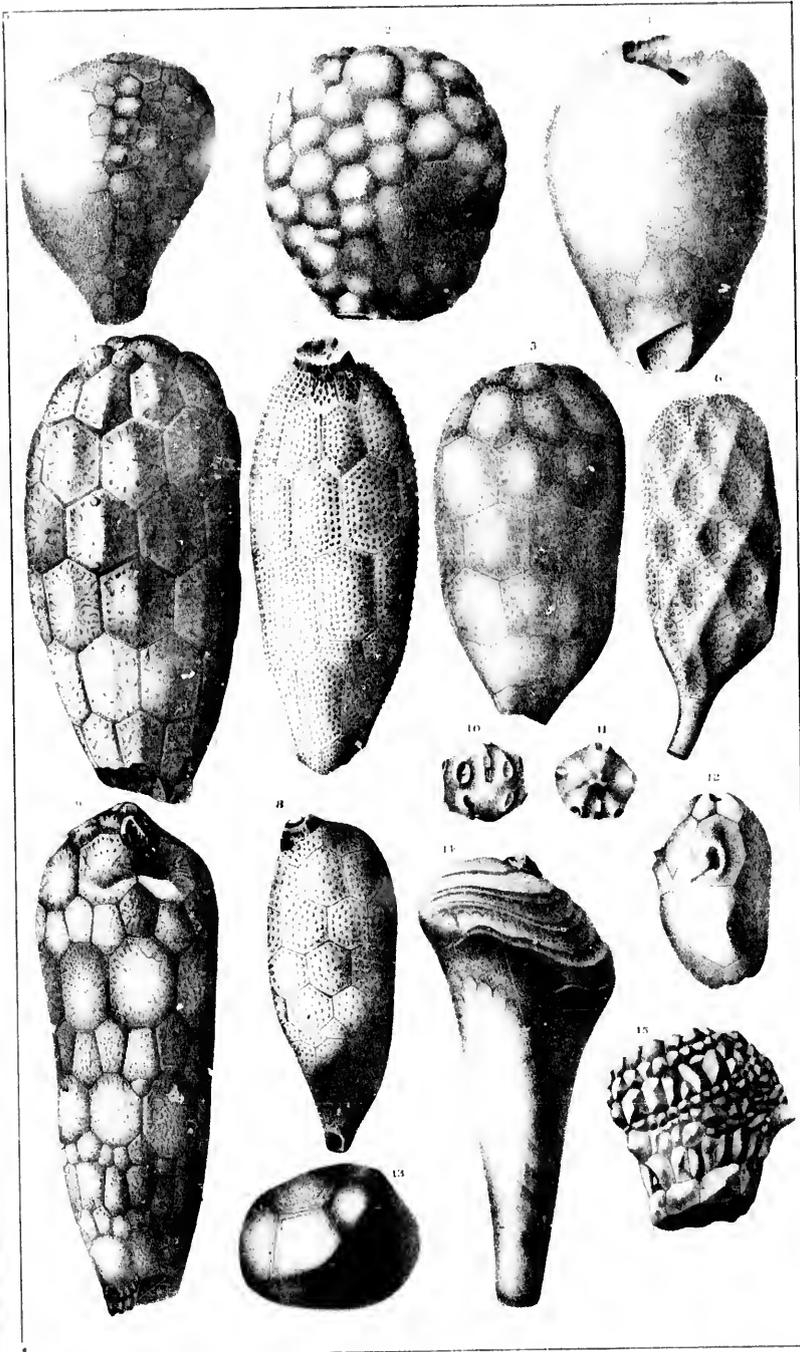
FIG. 12. Lateral view of the specimen, showing the structure of the body and the position of the openings.

HEMICOSMITES SUBGLOBOSUS, HALL.

Page 359.

FIG. 13. View of a specimen which shows the structure of the body.





are obscured by

summit.

imits of the plates

nn), on which the
ell preserved.

s of the plates and
s in the lower part

the position of the

and the position of the

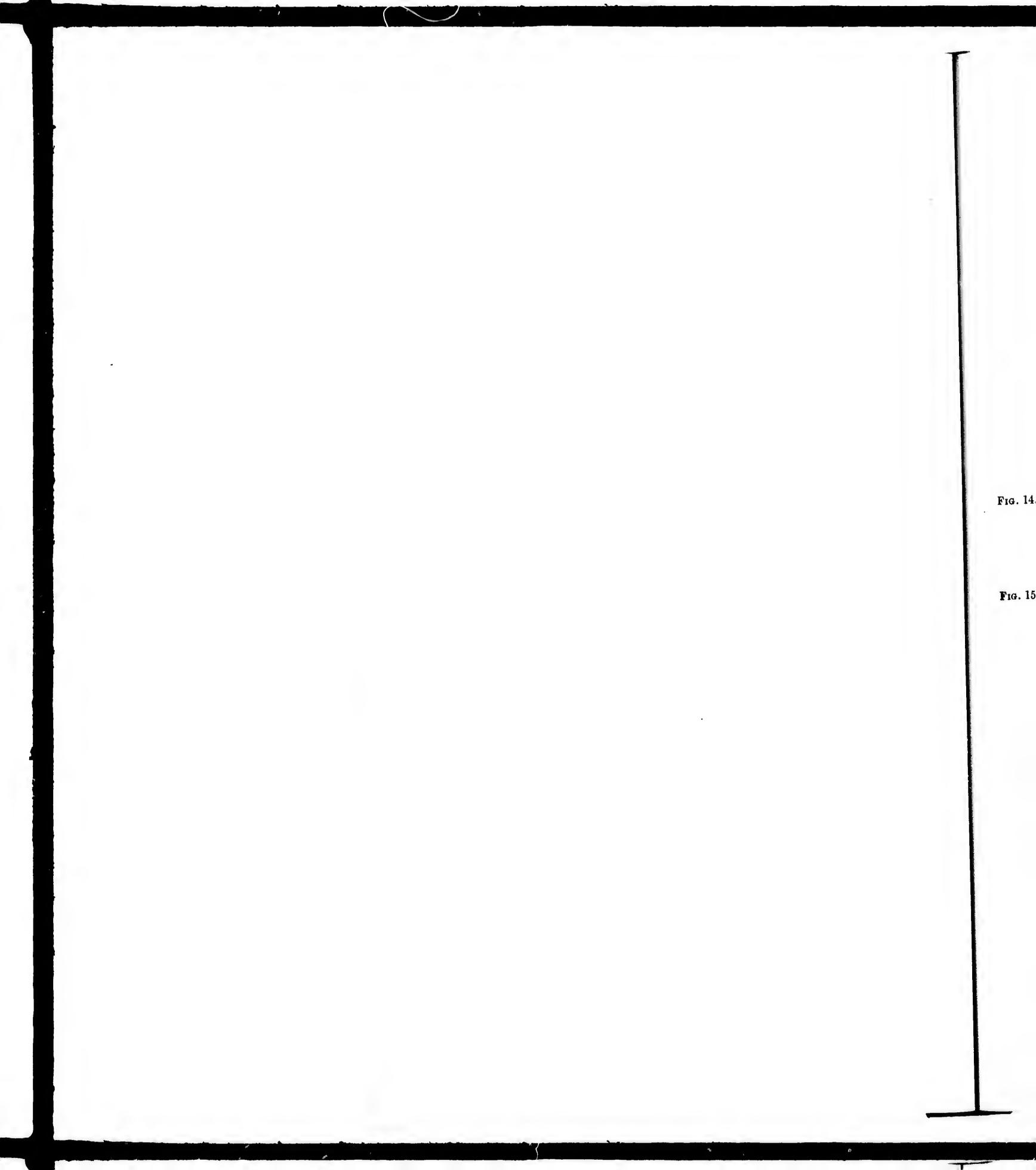


FIG. 14.

FIG. 15.

PLATE XII—Continued.

GOMPHOCYSTITES GLANS, HALL.

Page 352.

FIG. 14. Lateral view of a cast of a specimen, which shows the general form, the position of the central opening, grooves of the spiral appendages of the dome, and impressions of some of the plates of the dome and body.

GOMPHOCYSTITES TENAX, HALL.

Page 352.

FIG. 15. Enlarged view of a specimen from Lockport, New York, which preserves the plates of the upper part of the body and dome, showing their spiral arrangement and nodose character.

PLATE XIIa.*

GOMPHOCYSTITES TENAX, HALL.

Page 352.

- FIG. 1. Lateral view of the upper part of the body, showing the arrangement of plates; the spiral grooves indicating the places of the sessile arms are at the upper margins of the ranges of smaller plates. The plates are more or less irregularly disposed in some parts of the body, but they appear, like others of the genus, to have a generally spiral arrangement. (Enlarged to two diameters.)
- " 2. The summit, showing the arrangement of the spiral arms and the central aperture. The diagram is made from an imperfect specimen, and the position of the eccentric aperture could not be ascertained.

GOMPHOCYSTITES CLAVUS, HALL.

Page 353.

- FIG. 3. A fragment (natural size), showing the disposition of the spiral arms and the obtusely angular form of the body below.

GOMPHOCYSTITES GLANS, HALL.

Page 352.

- FIG. 4. Lateral view of a specimen, showing the entire form and the disposition of the spiral arms.
- " 5. The anterior ? view of another individual of the same species.

Holocystites alternatus, HALL.

Page 355.

- FIG. 6. A posterior ? view of a specimen (natural size), showing the position of the eccentric aperture, form and relation of plates, etc.

Holocystites cylindricus, HALL.

Page 354.

- FIG. 7. View of a nearly entire individual, showing the central aperture in a depression at the summit. The plates of the lower part are broken off.
- " 8. A smaller individual, in which the plates have been strongly ridged, preserving a portion of the column. The lower ranges of plates are somewhat obscure, and the dotted lines indicate depressions, which may be sutures or only grooves in the larger plates.

Apocystites imago, HALL.

Page 358.

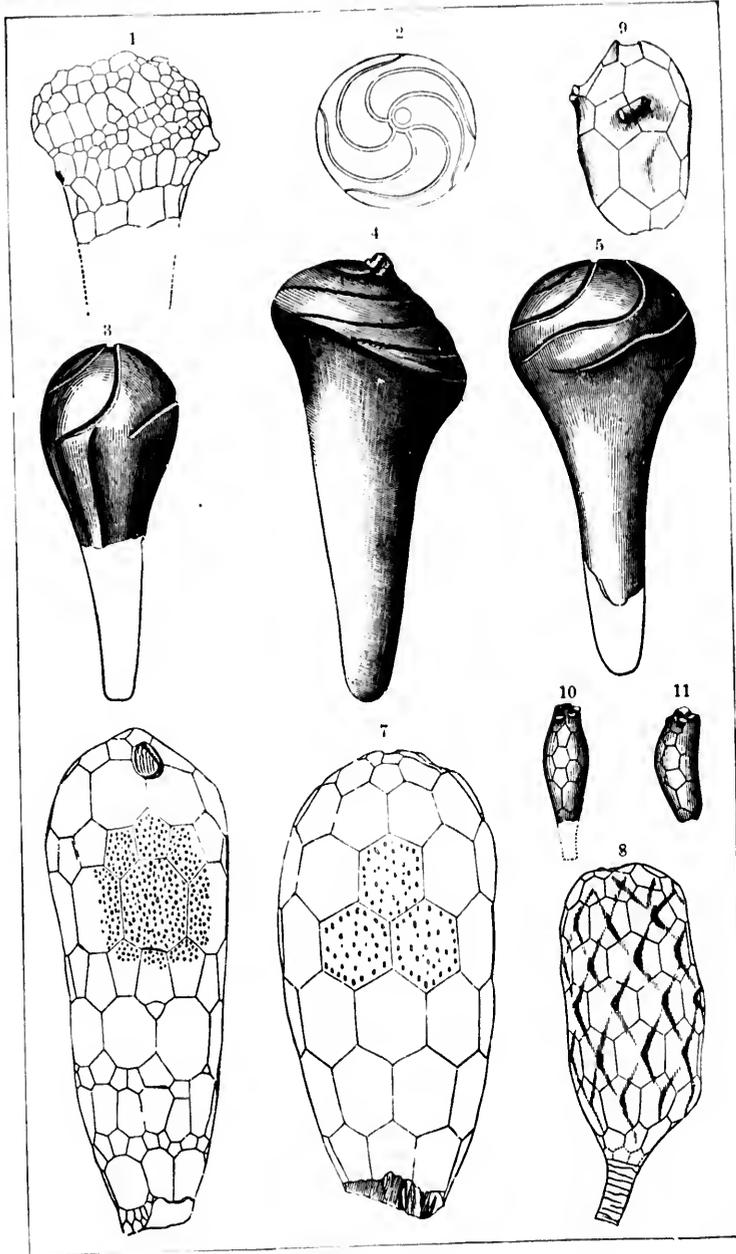
- FIG. 9. Lateral view of the specimen, showing the ovarian aperture on the left-hand side of the figure, and the right pectinated rhomb. (Figure natural size.)

Crinocystites chrysalis, HALL.

Page 362.

- FIG. 10. View of the gibbous side of the specimen.
- " 11. Lateral view of the same specimen.

*This plate accompanied the original paper as Plate I. It is now arranged with the other plates in its order as XIIa.



ment of plates; the upper margins of the plates are generally disposed in some order to have a generally

central aperture. The position of the eccentric

apertures and the obtusely

position of the spiral

position of the eccentric

in a depression at the

aperture, preserving a portion obscure, and the dotted lines in the larger plates.

on the left-hand side of the

the other plates in its order

PLATE XIII.

OBOLUS CONRADI, HALL.

Page 375.

- FIG. 1. View of the cast of the dorsal valve, showing the longitudinal septum and the filling of the cavities beneath the margins of the transverse plate.
" 2. Cast of a ventral valve, showing the impression of the transverse plate, the median depression of the hinge plate, and the cavities left by the teeth-like processes.

STROPHODONTA PROFUNDA, HALL.

Page 376.

- FIG. 3. Impression of the surface of the concave valve of a small individual, with a portion of the filling of the cavity between the valves, showing the impression of the ventral valve on the margin.
" 4. Impression of the interior of the ventral valve of a large individual. The muscular imprints in the figure are not represented so long as they are in the original specimen.

SPIRIFERA EUDORA, HALL.

Page 377.

- FIG. 5. Dorsal view of a specimen of this species.
" 7. Profile of the same specimen, showing the gibbosity of the valves, and the height and curvature of the area.

SPIRIFERA GIBBOSA, HALL.

Page 378.

- FIG. 6. View of a dorsal valve of this species.
" 8. Cardinal view of a specimen.

SPIRIFERA PLICATELLA, VAR. RADIATA, SOWERBY.

Page 378.

- FIG. 9. Dorsal view of a small individual, showing the extension of the lamellæ in the dorsal valve as seen in young specimens.
" 10. Ventral view of the same individual, showing the extent of the lamellæ in the ventral valve.
" 11. Profile of the specimen.

SPIRIFERA META, HALL.

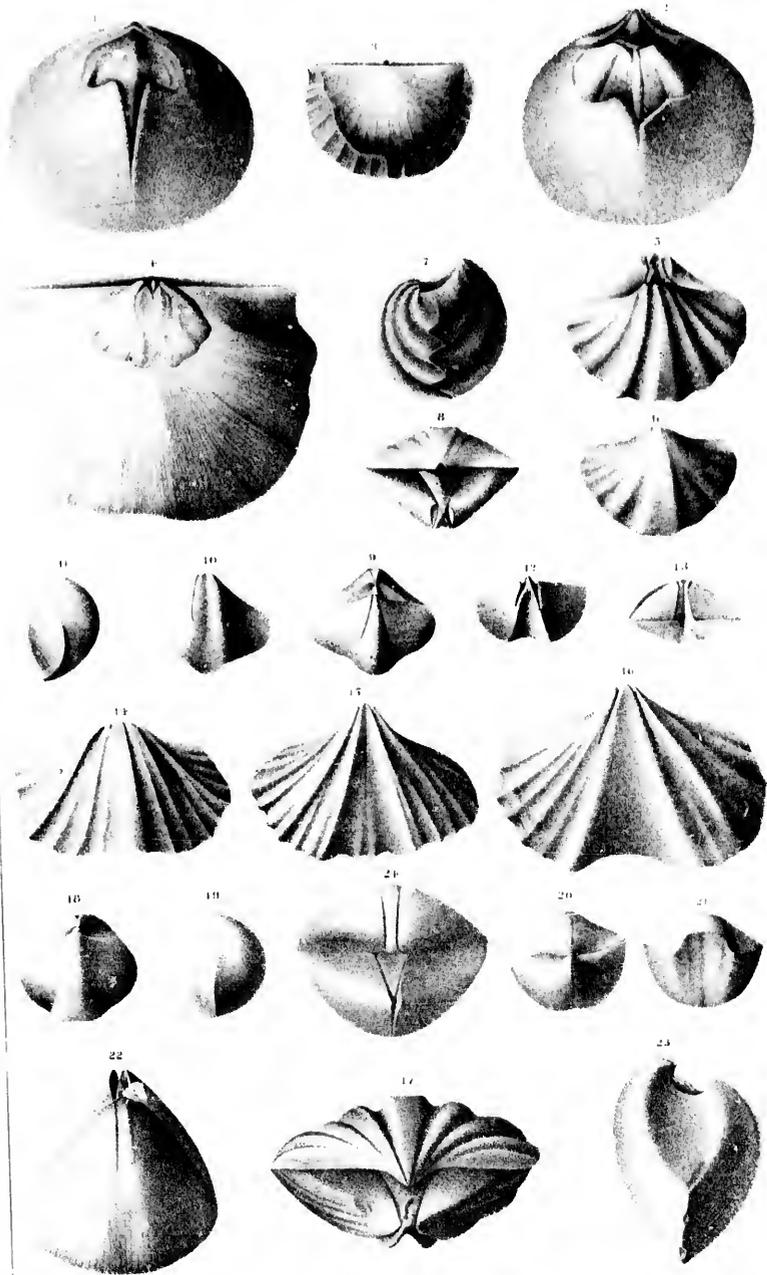
Page 380.

- FIG. 12. Ventral view of a specimen.
" 13. Cardinal view of the same individual, showing the height and extent of the straight area.

SPIRIFERA NOBILIS, HALL.

Page 380.

- FIG. 14. Dorsal view of an individual of medium size.
" 15. Ventral view of a specimen, showing plications in the mesial sinus.
" 16. Ventral view of a large individual.
" 17. Cardinal view of the specimen fig. 16.



d the filling of
e, the median
processes.

th a portion of
of the ventral

The muscular
in the original

and the height

lar in the dorsal

lar in the ventral

f the straight area.

Figs. 18-21

Figs. 22-24

PLATE XIII—Continued.

PENTAMERUS (PENTAMERELLA ?) VENTRICOSUS, HALL

Page 382.

FIGS. 18-21. Dorsal view, profile, cardinal and front views of a medium-sized individual of the species, showing slight indications of plications on the mesial fold and sinus.

PENTAMERUS MULTICOSTATUS, HALL.

Page 381.

FIGS. 22-24. Dorsal view, profile, and cardinal views of an internal cast of this species, preserving the impressions of the costæ on the anterior margin.

PLATE XIV.

PTERINEA HRISA, HALL.

Page 381.

- FIG. 1. View of the left valve of a specimen of this species partly denuded of the shell. The large quadrangular muscular impression is seen near the posterior wing; the anterior and posterior teeth are also visible.

AMBONYCHIA ACUTIROSTRA, HALL.

Page 381.

- FIG. 2. View of the left valve of a full grown individual.

AMBONYCHIA APHEA, HALL.

Page 381.

- FIG. 3. View of the left valve, showing impressions of the lateral teeth.

MODIOLOPSIS RECTUS, HALL.

Page 386.

- FIG. 4. The right valve of a small specimen, showing the muscular impressions.
" 5. The left valve of a larger individual, showing muscular impressions and teeth.

CYPRICARDINIA ARATA, HALL.

Page 385.

- FIG. 6. View of the right valve of a specimen of this species, of the natural size.

MODIOLOPSIS DICTEUS, HALL.

Page 385.

- FIG. 7. View of a cast of the left valve, showing impressions of the lateral teeth.

CYPRICARDITES ? QUADRILATERA, HALL.

Page 388.

- FIG. 8. A cast of the right valve of the species.
" 9. View of the anterior slope, showing the filling of the anterior muscular impression near the beak.
" 10. The posterior slope of the valve, showing the lateral teeth and impression of the elevated muscular scar.

PALEOCARDIA CORDIFORMIS, HALL.

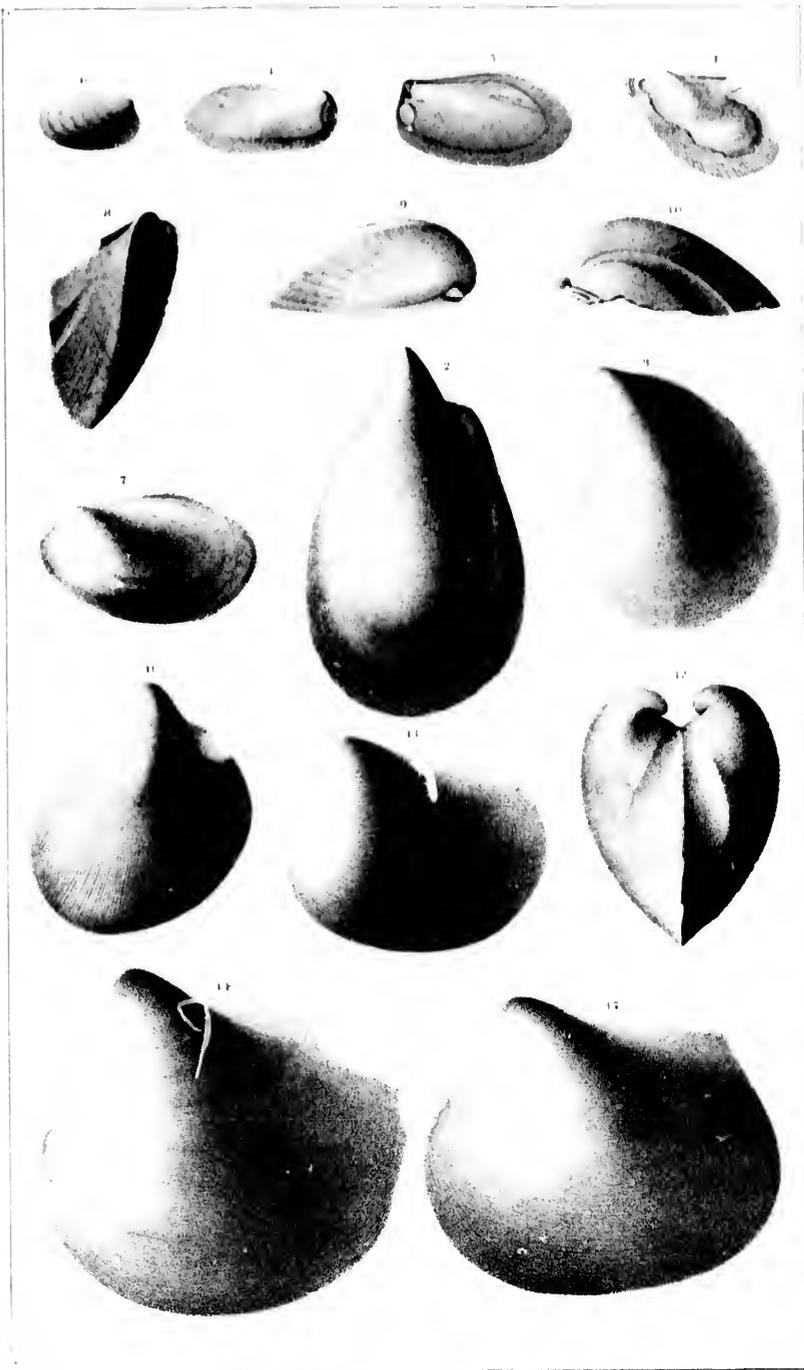
Page 389.

- FIG. 11. The right side of the cast, showing the muscular scar.
" 12. Posterior profile of the cast.

AMPHICELIA LEIDYI, HALL.

Page 387.

- FIG. 13. Cast of a left valve of a small individual.
" 14. Cast of the left valve of a large specimen, in which there are faint traces of muscular impressions.
" 15. Cast of another individual, having somewhat different proportions and a more perfect outline.



the shell. The
ing; the anterior

ns.
and teeth.

size.

teeth.

ular impression near
pression of the elevated

int traces of muscular
ns and a more perfect

PLATE XV

SERULITES VENTRICOSUS, HALL.

Page 308.

FIG. 1. View of an individual of this species, somewhat restored in the upper part.

LOXONEMA LEDA, HALL.

Page 308.

FIG. 2. Figure from a gutta-percha cast taken in the natural mould; faint remains of indistinct transverse striæ are visible.

EUNEMA? TRILINEATA, HALL.

Page 307.

FIG. 3. Figure taken from a gutta-percha cast of the natural mould in the rock.

CYCLONEMA? ELEVATA, HALL.

Page 301.

FIG. 4. View of a cast of this species.

TROCHONEMA (CYCLONEMA?) PAUPER, HALL.

Page 305.

FIG. 5. View of the aperture, taken from a gutta-percha cast made in the natural mould.
" 6. Basal view of the same specimen as fig. 5, showing the umbilicus.
" 9. A small internal cast of this species.

TROCHONEMA (EUNEMA) FATTA, HALL.

Page 304.

FIG. 7. View of an internal cast of this species.
" 8. The figure is from a gutta-percha cast, and shows the longitudinal striæ very perfectly.

PLEUROTOMARIA (TROCHONEMA) HOVI, HALL.

Page 303.

FIG. 10. View of a cast of this species.

PLEUROTOMARIA OCCIDENS, HALL.

Page 302.

FIG. 11. Lateral view of a specimen of this species, which preserves a portion of the surface.
" 12. View of the spire, taken from a gutta-percha cast in the natural mould.

PLEUROTOMARIA HALEI, HALL.

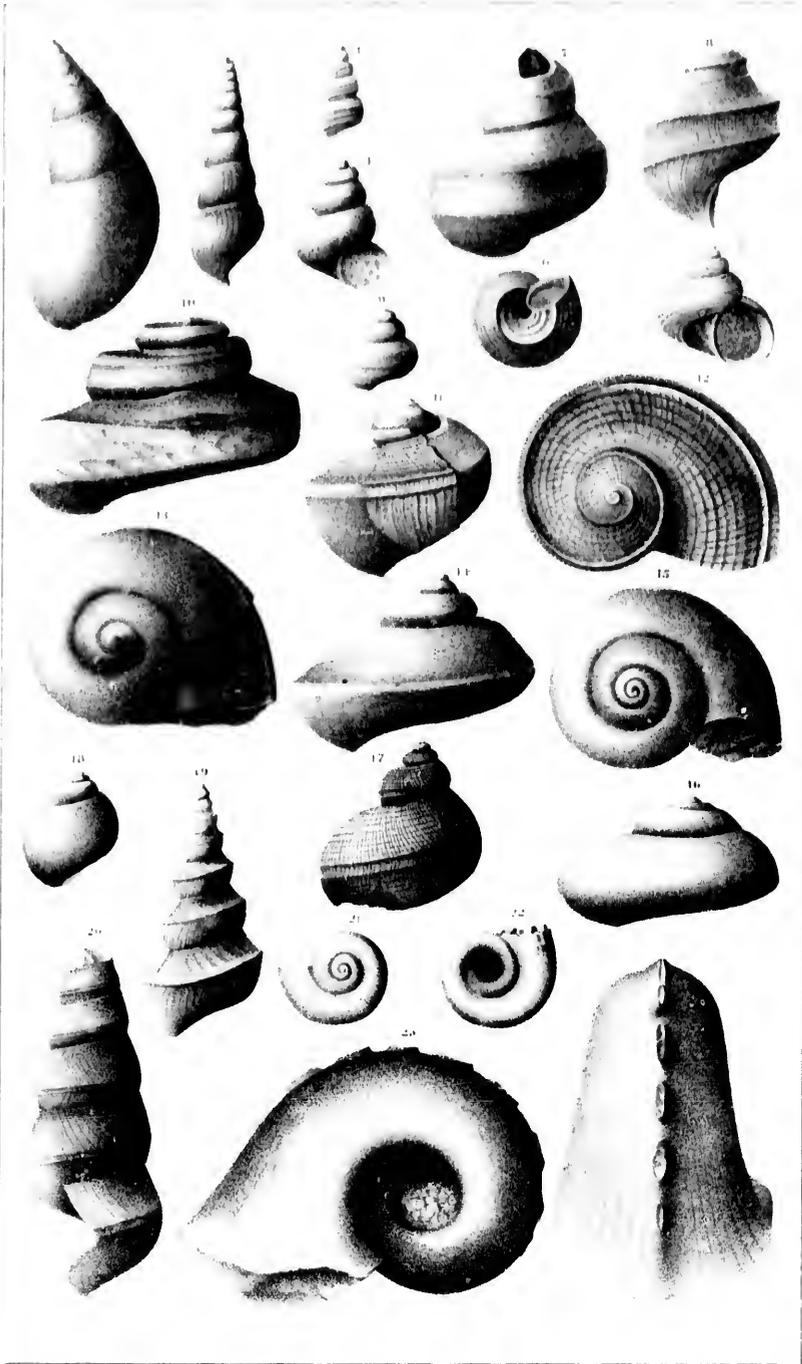
Page 302.

FIG. 13. View of the spire of a cast of this species.
" 14. The elevation of the spire.

PLEUROTOMARIA IDIA, HALL.

Page 303.

FIGS. 15, 16. Vertical and lateral views of a cast of this species.



part.

striae of indistinct

apical mould.

striae very perfectly.

of the surface.
mould.

Fig

Fig

Fig

Fig

Fig

Fig
“

PLATE XV—Continued.

PLEUROTOMARIA AXION, HALL.

Page 394.

FIG. 17. View of a specimen of this species taken from a gutta-percha cast.

HOLOPEA GUELPHENSIS, BILLINGS.

Page 391.

FIG. 18. View of a cast which has been referred to this species.

MURCHISONIA CONRADI, HALL.

Page 396.

FIG. 19. View of a specimen of this species taken from a gutta-percha cast.

MURCHISONIA LAPHAMI, HALL.

Page 396.

FIG. 20. The figure is from an impression taken in the natural mould, and shows the characters of the surface and form of the aperture.

STRAPAROLLUS MOPSUS, HALL.

Page 390.

FIGS. 21, 22. Upper and lower sides of a specimen of this species.

TREMANOTUS ALPHEUS, HALL.

Page 390.

FIG. 23. Lateral view of a specimen, showing the umbilicus.

" 24. Dorsal view, showing the filling of the dorsal perforations, and the radiating striæ near the aperture.

PLATE XVI.

TROCHOCERAS NOTUM, HALL.

Page 403.

- FIG. 1. Dorsal view of a fragment of this species.
" 2. A septum showing its convexity and the position of the siphuncle.

CYRTOCERAS RIGIDUM, HALL.

Page 408.

- FIG. 3. Lateral view of the outer portion of the cast, showing the curvature of the shell and the character of the undulating ridges.
" 4. Dorsal view of the same.
" 5. Transverse section, showing the form.

LITUTES MARSHII, HALL.

Page 404.

- FIG. 6. Lateral view of a specimen of the natural size, showing the oblique costæ and the outline of the septa.
" 7. Profile showing the flattened dorsum, the concavity of the septa and the position of the siphuncle.

TROCHOCERAS DESPLAINENSE, M'CHESNEY.

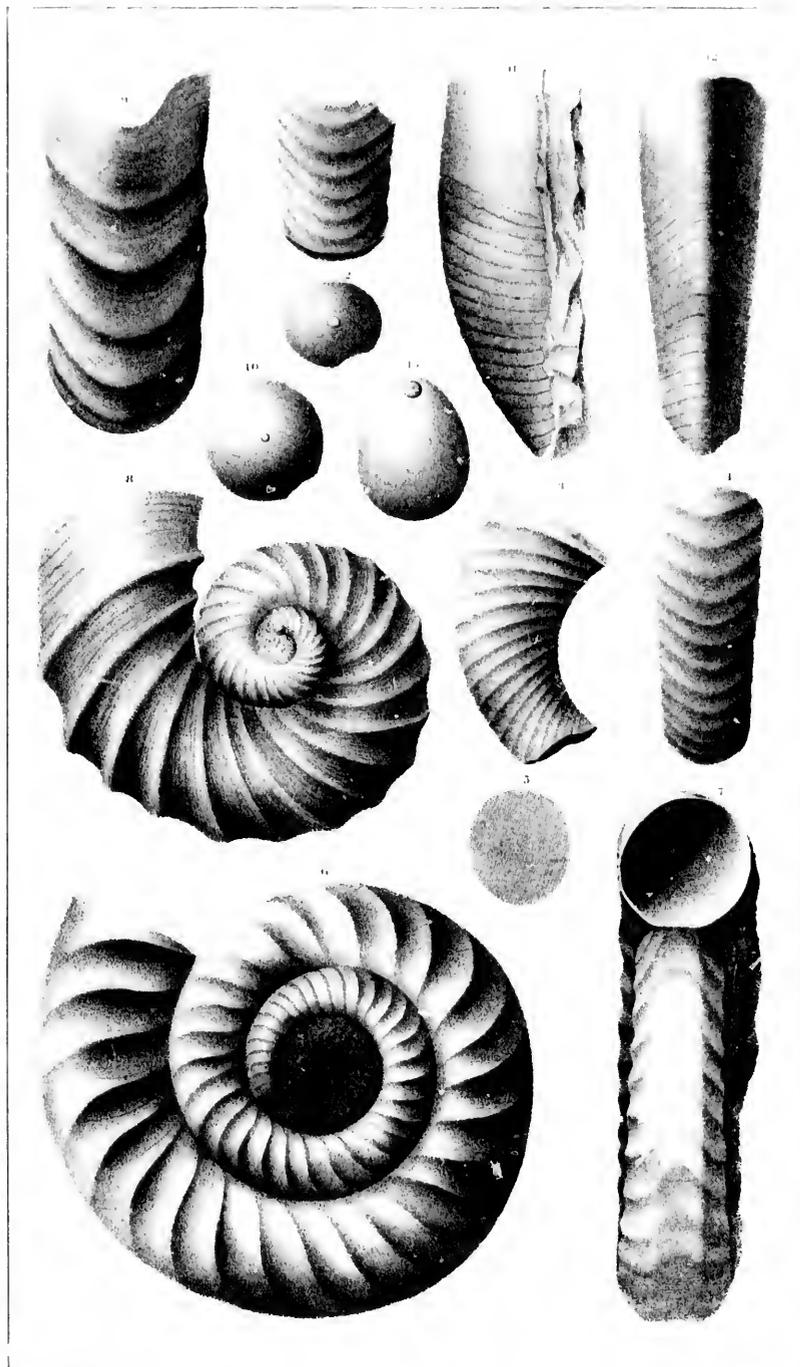
Page 401.

- FIG. 8. View of the upper side of spire, taken from an impression in the natural mould in the rock, showing the strong oblique costæ.
" 9. Dorsal view of the outer part of the last volution, showing the sinus in the margin of the aperture.
" 10. Transverse section, showing the convexity of the septa and position of the siphuncle.

CYRTOCERAS FOSTERI, HALL.

Page 406.

- FIG. 11. Lateral view of the specimen described.
" 12. Dorsal view of the same.
" 13. Transverse section, showing the convexity of the septa and position of the siphuncle.



R. P. Whitely, del.

W. H. Dall, lit.

the shell and the

and the out-
and the position

al mould in the
the margin of the
the siphuncle.

the siphuncle.

PLATE XVII.

ONCOCERAS ORCAS, HALL.

Page 410.

- FIG. 1. Dorsal view of a large specimen.
- " 2. Lateral view of the same. The figures are reduced to two-thirds the natural size.

CYRTOCERAS DARDANUS, HALL.

Page 406.

- FIG. 3. Lateral view of a specimen which preserves a part of the outer chamber and a small portion of the shell.
- " 4. Lateral view of an individual where the septa are not curved upward on the dorsal margin.
- " 5. Transverse section of the specimen fig. 4.

CYRTOCERAS HERCULES, WINCH. AND MAR.

Page 409.

- FIG. 6. Lateral view of a large specimen which preserves a portion of the outer chamber, and also some of the surface striae near the lower end.
- " 7. Transverse section, showing the form of the shell. The two figures are reduced one-third in size.





natural size.

r and a small por-
the dorsal margin.

uter chamber, and
s are reduced one-

PLATE XVIII.

GOMPHOCERAS SCRINIUM, HALL.

Page 410.

- FIG. 1. Lateral view of the outer chamber, the lower end showing the concavity of the septa.
" 2. View of the aperture of the same individual.
" 3. A transverse section of another individual, showing the size and position of the siphuncle, with muscular or vascular markings at the margin.

CYRTOCERAS LATERALE, HALL.

Page 407.

- FIG. 4. Dorsal view of a specimen, showing septa and preserving the remains of faint longitudinal ridges.
" 5. Lateral view of the same individual.
" 6. The outer circle of the figure represents the form of section and the position of the siphuncle of this species,—the inner portion that of *C. lucillum*.

CYRTOCERAS LUCILUM, HALL.

Page 406.

- FIG. 7. Lateral view of a specimen of this species. The figure is somewhat restored. See inner portion of figure 6 for transverse section.

CYRTOCERAS BREVICORNE, HALL.

Page 407.

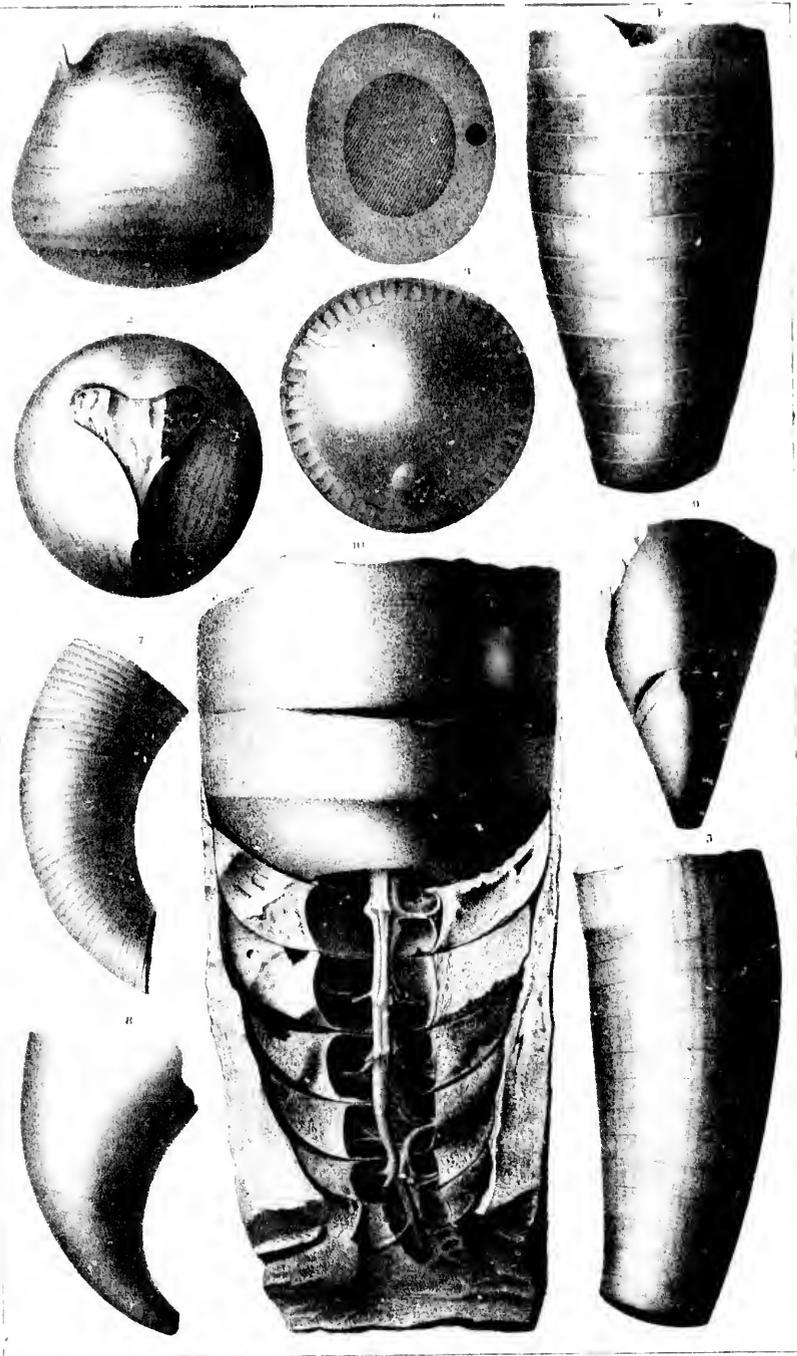
- FIG. 8. Lateral view of the specimen described. The specimen consists of the filling of the outer chamber and the matrix of the lower part, which has been represented from a cast in the cavity.
" 9. Dorsal view of the same.

ORTHO CERAS ABNORME, HALL.

Page 415.

- FIG. 10. View of a specimen of this species having the filling of the chambers in the lower part broken away, showing the siphuncle, and the inner core with its numerous ramifications uniting with the walls of the siphuncle. The view is taken looking obliquely upon the specimen, so that the real amount of curvature is not observable.





of the septa.
of the siphuncle,

faint longitudinal
e position of the

tored. See inner

illing of the outer
sented from a cast

in the lower part
numerous ramifica-
looking obliquely
servable.

PLATE XIX.

ORTHO CERAS CREBESCENS, HALL.

Page 413.

- FIG. 1. View of a large specimen, preserving the outer chamber and several of the septa; the lower end showing the depth of the septa.
" 2. View of another individual, having part of the septa in the lower end removed, and exposing the siphuncle.
" 3. A smaller individual, which preserves traces of the longitudinal ridges.

ORTHO CERAS COLUMNARE, HALL.

Page 411.

- FIG. 4. A fragment preserving the filling of four chambers, which are very distant.
" 5. A transverse section of the lower end of the preceding specimen.
" 6. View of another specimen, preserving nine chambers, which are very irregular in their distances. In the upper part there is a small piece of the shell represented, showing the surface characters.
" 8. A fragment of this species of smaller size, preserving essentially the same characters.

ORTHO CERAS LOXIAS, HALL.

Page 416.

- FIG. 7. Figure of specimen of natural size, preserving about seventeen of the septa, with the shell partially preserved, or replaced by mineral matter on the other parts of the surface. This species is not positively known in the Niagara limestone, and should therefore have been omitted from the index of the fossils of the Niagara group.

ORTHO CERAS ANGULATUM, WAHL.

Page 413.

- FIG. 9. A fragment of this species of about six inches in length, preserving above twenty septa and a part of the chamber of habitation; from Racine, Wisconsin.
" 10. From an impression of the exterior of a specimen similar to fig. 9, and from the same locality.
" 11. From an impression of the exterior of a similar form, from Bridgeport, Illinois. The specimen, at a point where it is one inch and five-eighths in diameter, preserves above twenty longitudinal ridges in the semi-circumference, giving more than forty in the entire circumference. The character of surface in these impressions is precisely like that of *O. cancellatum*, HALL, from the Niagara group of New York, and differs in no essential particular from the minute surface markings of *O. columnare*.

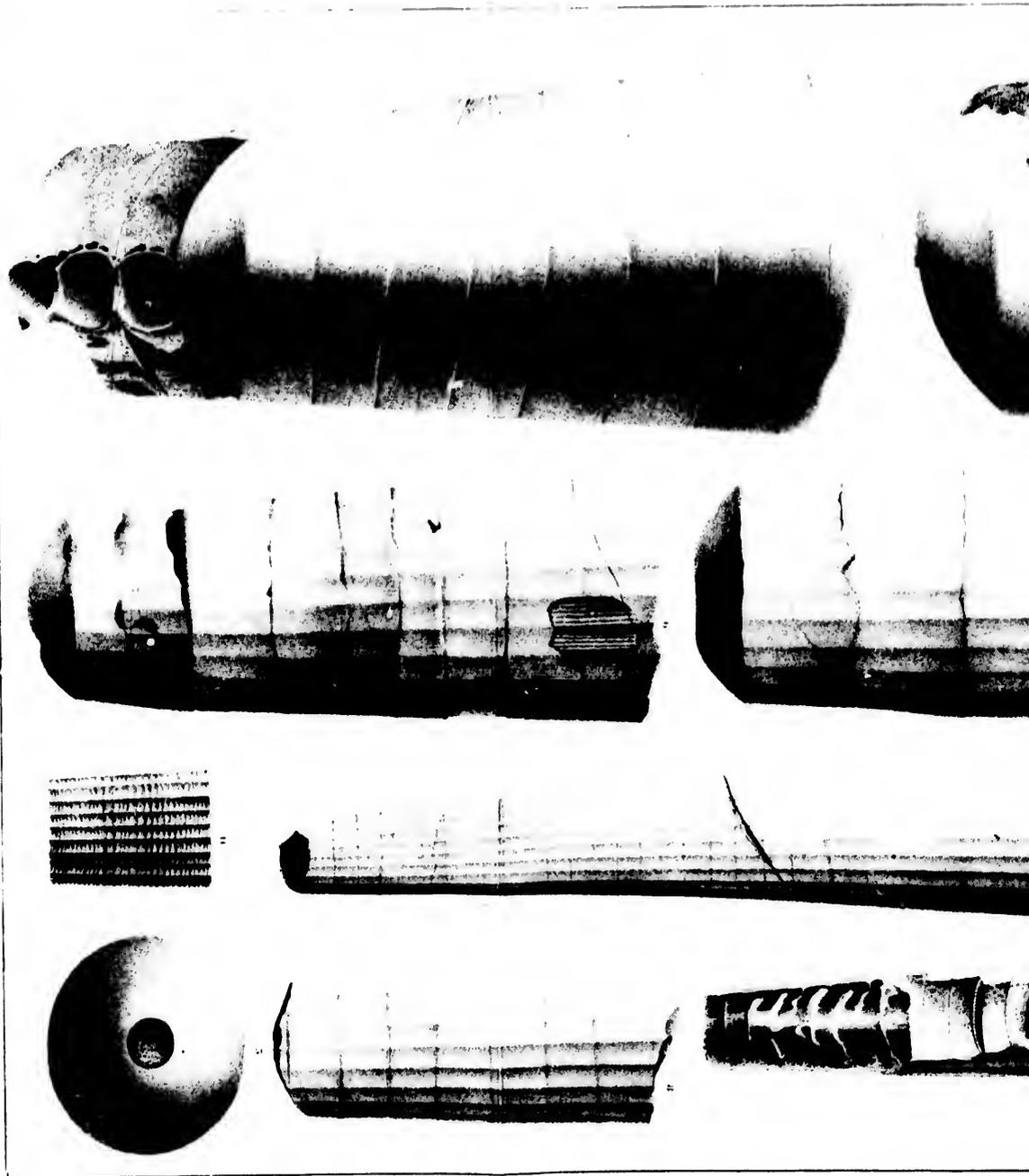
septa; the
removed, and

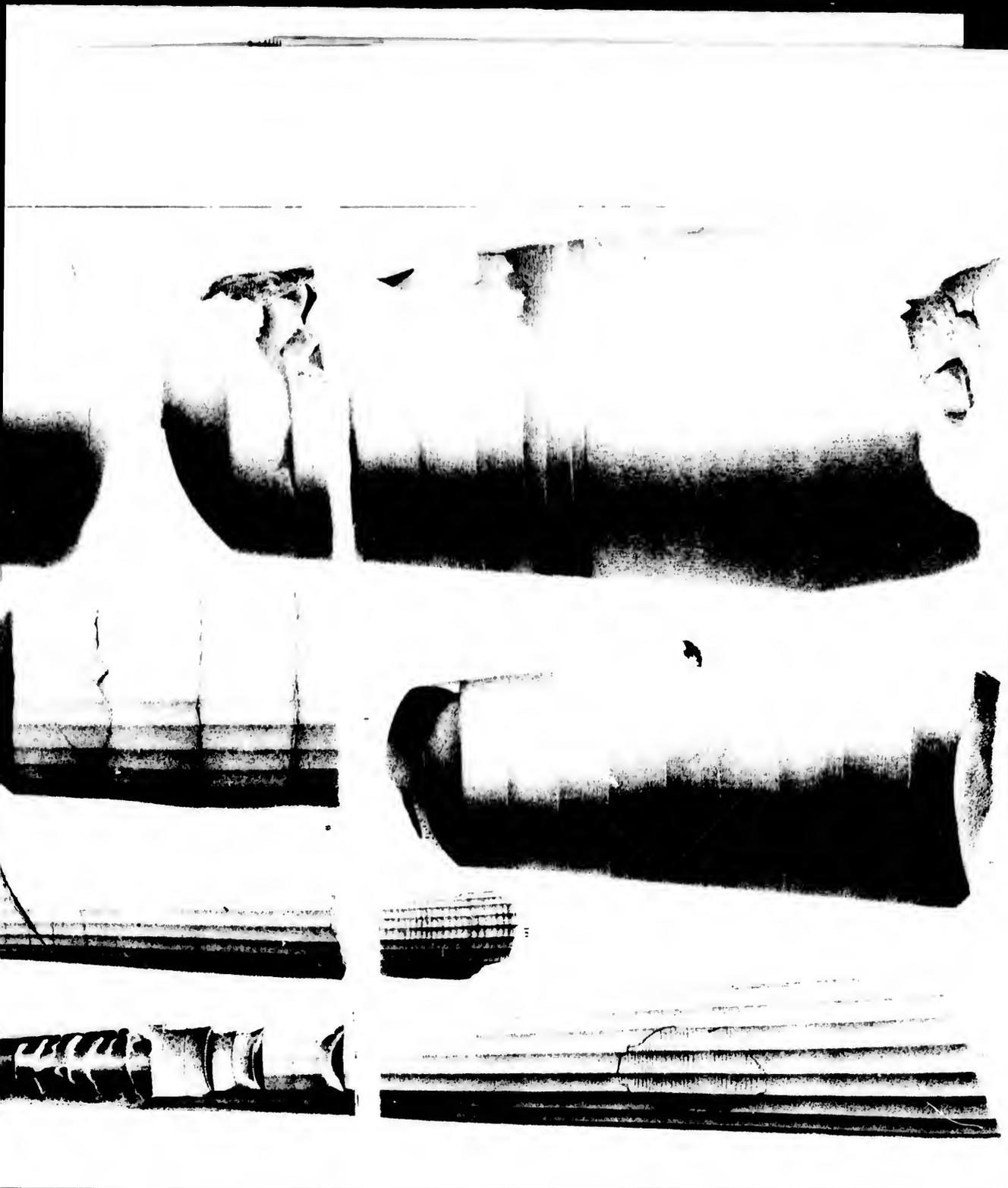
in their
l, showing
characters.

h the shell
e surface.
l therefore

seventy septa
in the same

nois. The
erves above
forty in the
precisely like
d differs in





VERSCHIEDEN

AN DER

in
ce
to
to
to
no
ca

re
se
oll

ng
ste

nd
he

PLATE XX.

ORTHO CERAS MEDULLARE, HALL.

Page 412.

- FIG. 1. A fragment of a large individual, preserving several of the septa and a portion of the outer chamber, together with considerable of the shell, showing the character of the exterior surface.
- " 2. A section of the same individual, showing its elliptical form and the position of siphuncle.

ORTHO CERAS NIAGARENSE, HALL.

Page 416.

- FIG. 3. A view of the specimen described, showing the oblique undulations and several of the septa.

ORTHO CERAS ANNULATUM, SOWERBY.

Page 411.

- FIG. 4. A natural cast of the interior of a part of the outer chamber. The annulations are very distinct and sharp, while the parallel encircling striæ are very obscure or scarcely distinguishable. The longitudinal ridges are unusually well preserved, and give a nodose character to the annulations.
- " 5. A fragment of the septate portion of a specimen of this species, showing the obscure impressions of longitudinal ridges with the annulations not strongly elevated.
- " 6. A view of the upper extremity of fig. 5, showing the broadly elliptical form of the section and the position of the siphuncle.

The New York specimens occur in soft calcareous shale, and often preserve the marks of obscure longitudinal ridges, interrupting the parallel transverse striæ, giving a very obscurely nodose aspect to the surface. This is shown in Pal. N. Y., Vol. ii, plate 64, fig. 1 a. The same character is more distinctly shown in Murchison's beautiful figure of this species, which in all its features corresponds with the better preserved specimens in the Niagara group. Those from Illinois and Wisconsin present a great variety in the degree of this marking, owing to the more or less complete solution and removal of the shell and the nature of the enclosing material. In many specimens there are no nodes preserved on the surface. The undulating transverse striæ are rarely well preserved, but they are quite distinct occasionally. Specimens also occur in which the undulating striæ and nodes are both well preserved. The specimen, fig. 4, is quite an extreme one.

portion of the
the character of
n of siphuncle.

several of the

ations are very
ure or scarcely
ed, and give a

ng the obscure
elevated.
orm of the sec-

marks of obscure
scurely nodose
same character
all its features
rom Illinois and
e more or less
erial. In many
verse striæ are
ur in which the
an extreme one.

1 of the
racter of
phuncle.

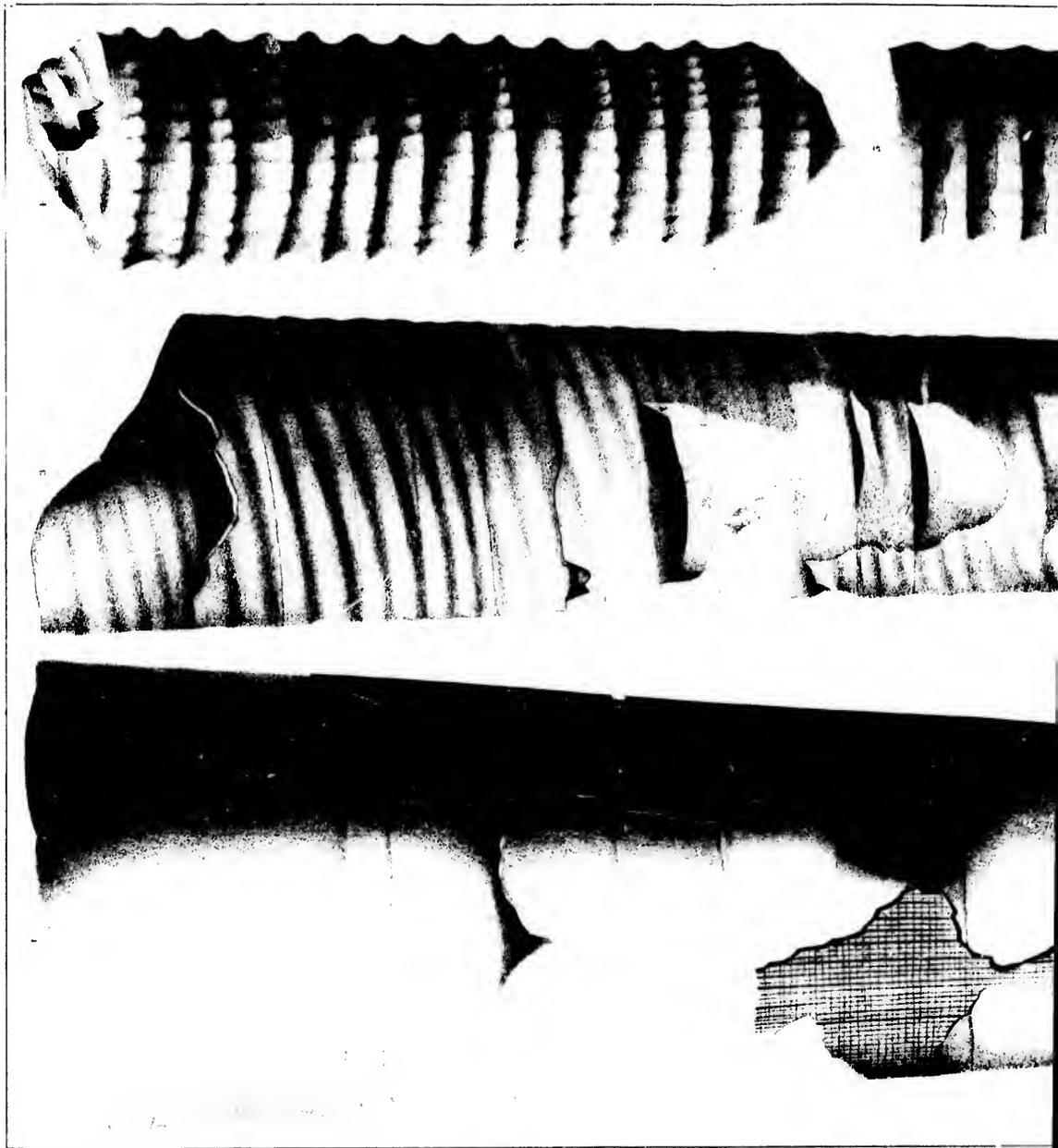
al of the

are very
scarcely
d give a

obscure
d
the sec-

obscure
nodose
haracter
features
nois and
or less
In many
striae are
hich the
ame one.

Plate XV



CEPHALOPODA

State Mus. Nat. Hist. 20

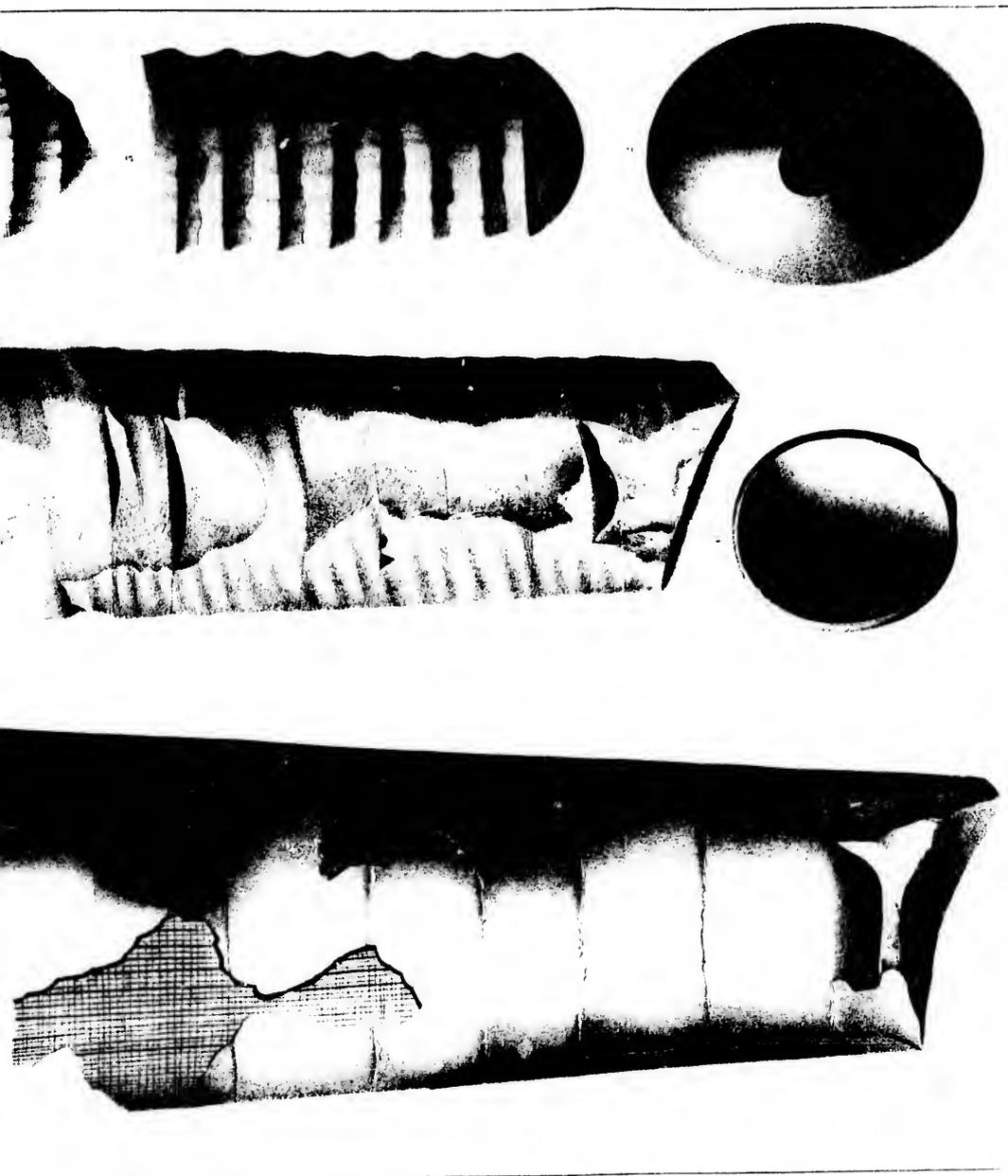


PLATE XXI.

LEPERDITIA FONTICOLA, HALL.

Page 428.

FIGS. 1-3. Enlarged views of three different individuals, showing some variations in the proportions and also in the nodes of the surface.

SPHEREXOCHUS ROMINGERI, HALL.

Page 425.

FIGS. 4, 5. Two views of a glabella of this species, natural size.

" 6. Profile view of the glabella and movable cheek of a small specimen. The figures are enlarged to three diameters.

" 7. The pygidium enlarged to two diameters.

ACIDASPIS DANAI, HALL.

Page 423.

FIG. 8. A specimen preserving the glabella and portions of the movable cheeks. The figure is of the specimen originally described.

" 9. Figure of another individual, showing some modifications in the lateral lobes of the glabella.

CERAURUS NIAGARENSIS, HALL.

Page 427.

FIG. 10. The glabella and part of one of the fixed cheeks of a specimen of this species.

" 11. The hypostoma of this species? from a specimen in the collection of Prof. WINCHELL.

LICHAS BREVICEPS? HALL.

Page 424.

FIG. 12. The glabella and movable cheek of a specimen, enlarged to two diameters.

" 13. Figure of the internal cast of a pygidium; natural size.

" 14. An enlarged figure of the lower surface of a pygidium.

ENCRINURUS NEREUS, HALL.

Page 425.

FIG. 15. Figure of the pygidium of this species enlarged to two diameters.

DALMANIA VIGILANS, HALL.

Page 426.

FIG. 16. View of the head of a specimen denuded of the eyes.

" 17. Profile view of another specimen, preserving the cast of the eyes, the crust having been dissolved.

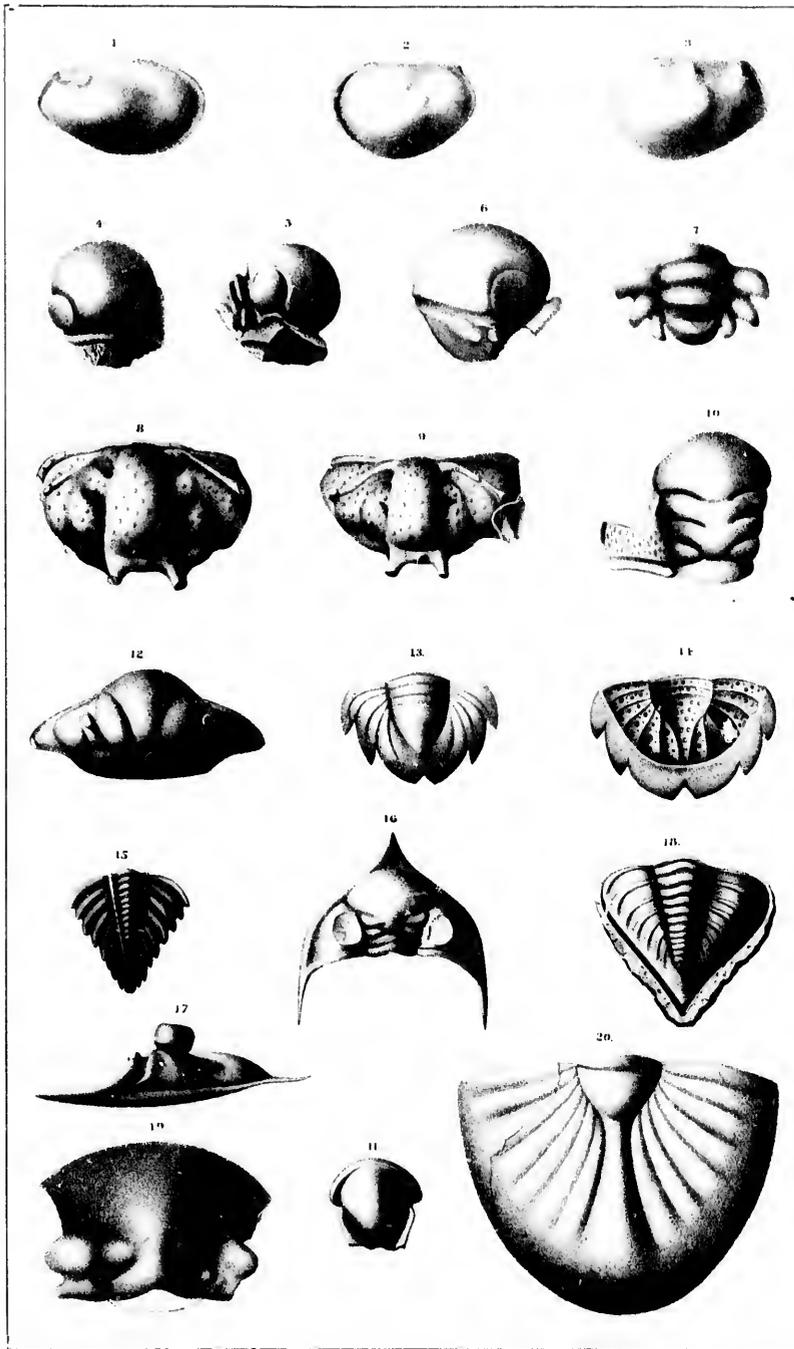
" 18. Cast of a pygidium of this species.

BRONTEUS ACAMAS, HALL.

Page 422.

FIG. 19. Cast of the glabella of this species, natural size.

" 20. The pygidium natural size, but slightly restored on one margin.



E. P. Whitford, Jr.

Figures 1-20

the propor-

figures are

the figure is of
s of the gla-

es.
WINCHELL.

st having been

PLATE XXII.

ILLENUS ARMATUS, HALL.

Pages 418, 433.

- FIG. 1. Upper view of the head of a well preserved individual.
" 2. Profile view of the same.
" 3. The pygidium and last thoracic segment, found associated with the head and supposed to be of the same species.

ILLENUS (BUMASTUS) IOXUS, HALL.

Page 420.

- FIG. 4. Upper view of the head of a small individual.
" 5. Profile view of the same.
" 6. Upper view of a medium sized individual.
" 7. Lower view of the same, showing the extent of the infolding of the border, and the direction of the suture on the under surface.
" 8. Profile view of the same individual.
" 9. The movable cheek of a large specimen.
" 10. A pygidium of the form commonly found associated with the other remains referred to this species.
" 11. A small glabella, referred with doubt to this species.

ILLENUS CUNICULUS, HALL.

Page 421.

- FIG. 12. View of the glabella of this species.

ILLENUS INSIGNIS, HALL.

Page 419.

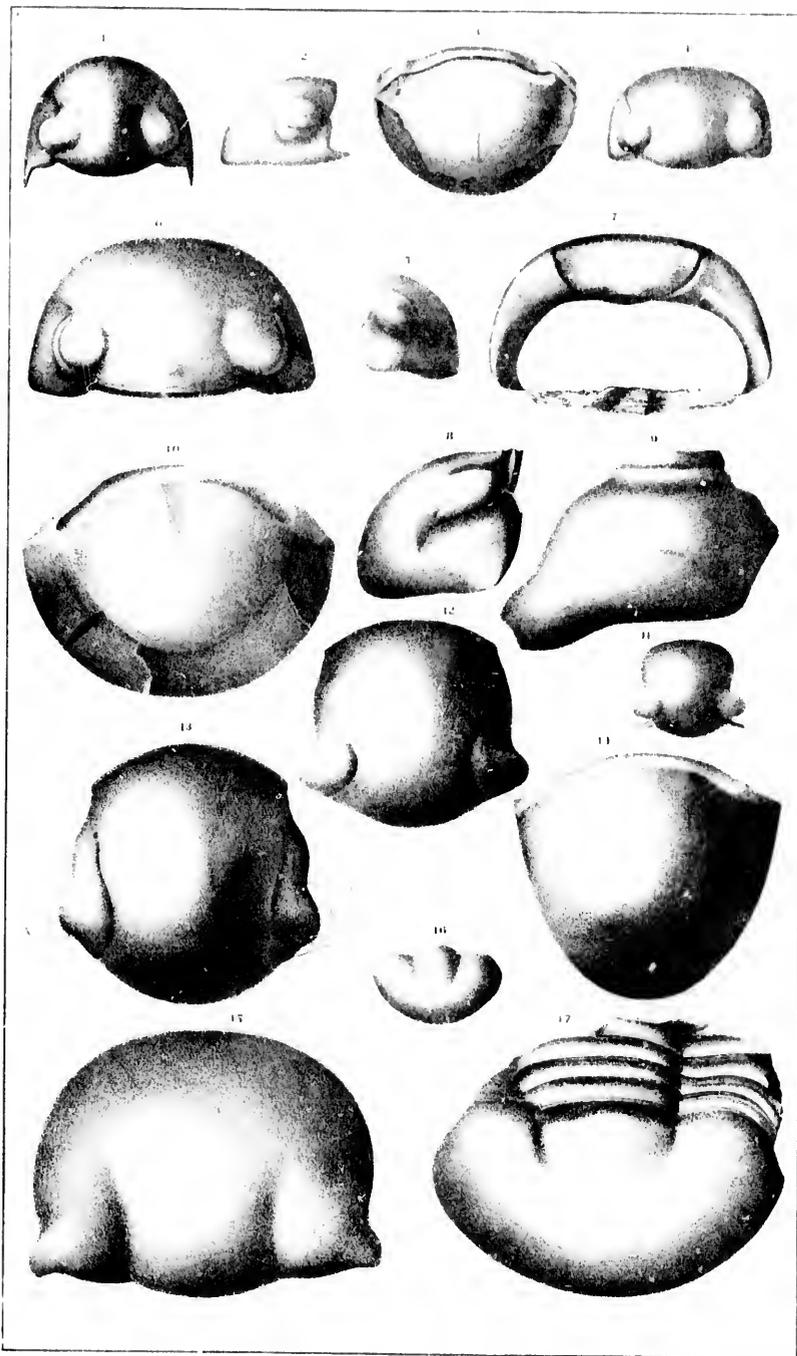
- FIG. 13. The glabella and fixed cheeks, with the movable cheeks restored in outline.
" 14. The pygidium referred to this species.

ILLENUS IMPERATOR, HALL.

Page 420.

- FIG. 15. The head of a large individual. The figure is reduced to one-half the natural size.
" 16. The pygidium of a very small specimen of the species.
" 17. The pygidium and parts of four of the thoracic segments, reduced in size one-half.





and supposed to

r, and the direc-

ains referred to

ne.

natural size.

e one-half.

PLATE XXIII.

ILLENUS (BUMASTUS) IOXUS, HALL.

Page 420.

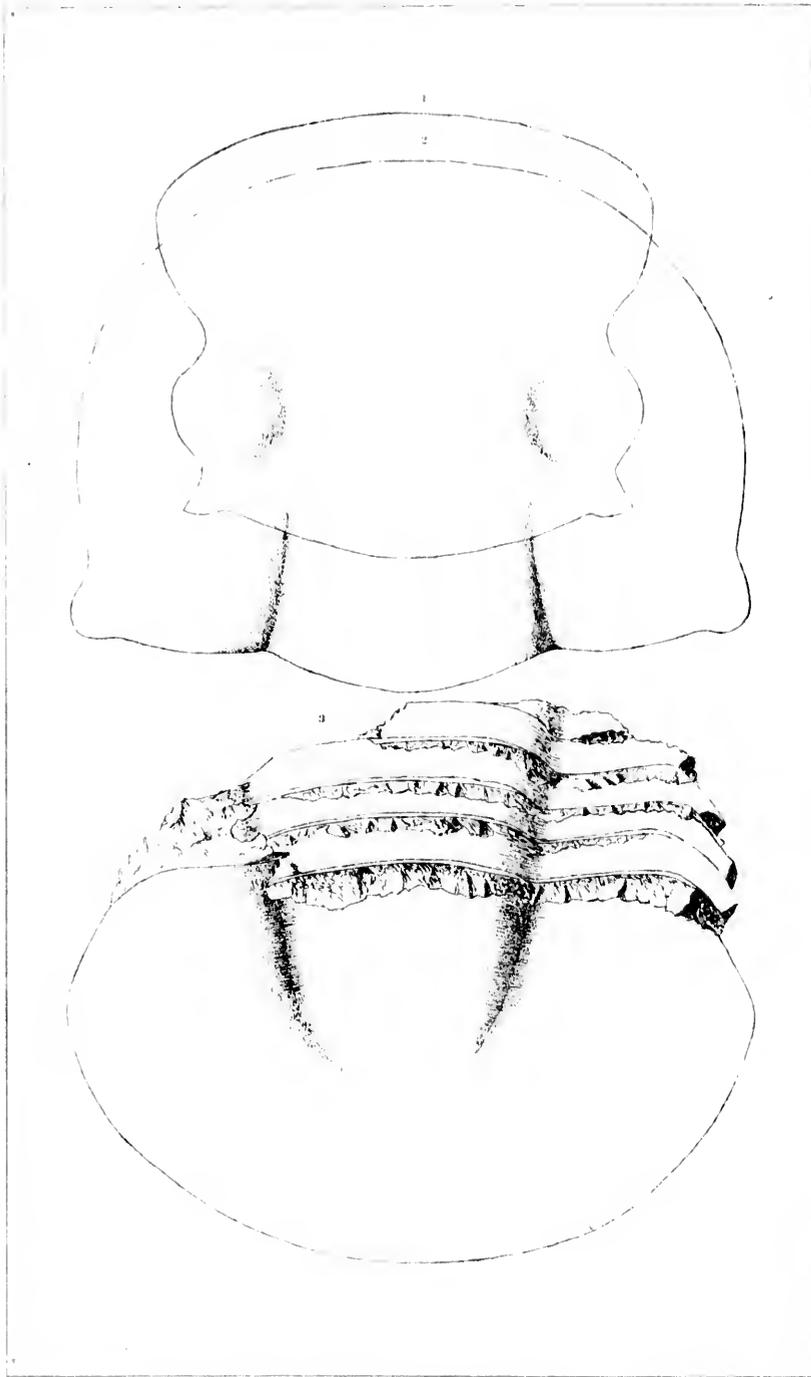
FIG. 1. The glabella and palpebral lobes of a large individual.

ILLENUS IMPERATOR, HALL.

Page 420.

FIG. 2. The glabella and palpebral lobes of a specimen of this species, natural size.

“ 3. The pygidium and part of four thoracic segments of this species, natural size.
These figures represent the natural size of reduced figures 15 and 17 of Plate 22.



size.
al size.
f Plate 22.

PLATE XXIV.

ORTHO CERAS COLUMNARE, HALL.

Page 411.

- FIG. 1. View of a very fine specimen of this species, showing the surface markings, form of the septa, size and proportions of the siphuncle. From a specimen in the collection of Prof. Marcy.

ORTHO CERAS ANNULATUM, SOWERBY.

Page 411.

- FIG. 2. A specimen (a cast of the interior) of this species, showing the septa and siphuncle.
 " 3. A fragment, showing the angular form of the annulations and the lines of the septa.
 " 4. A fragment, showing the transverse or concentric undulating striæ, and the longitudinal ridges, forming nodes where they cross the annulations.

CYRTO CERAS LATERALE, HALL.

Page 407.

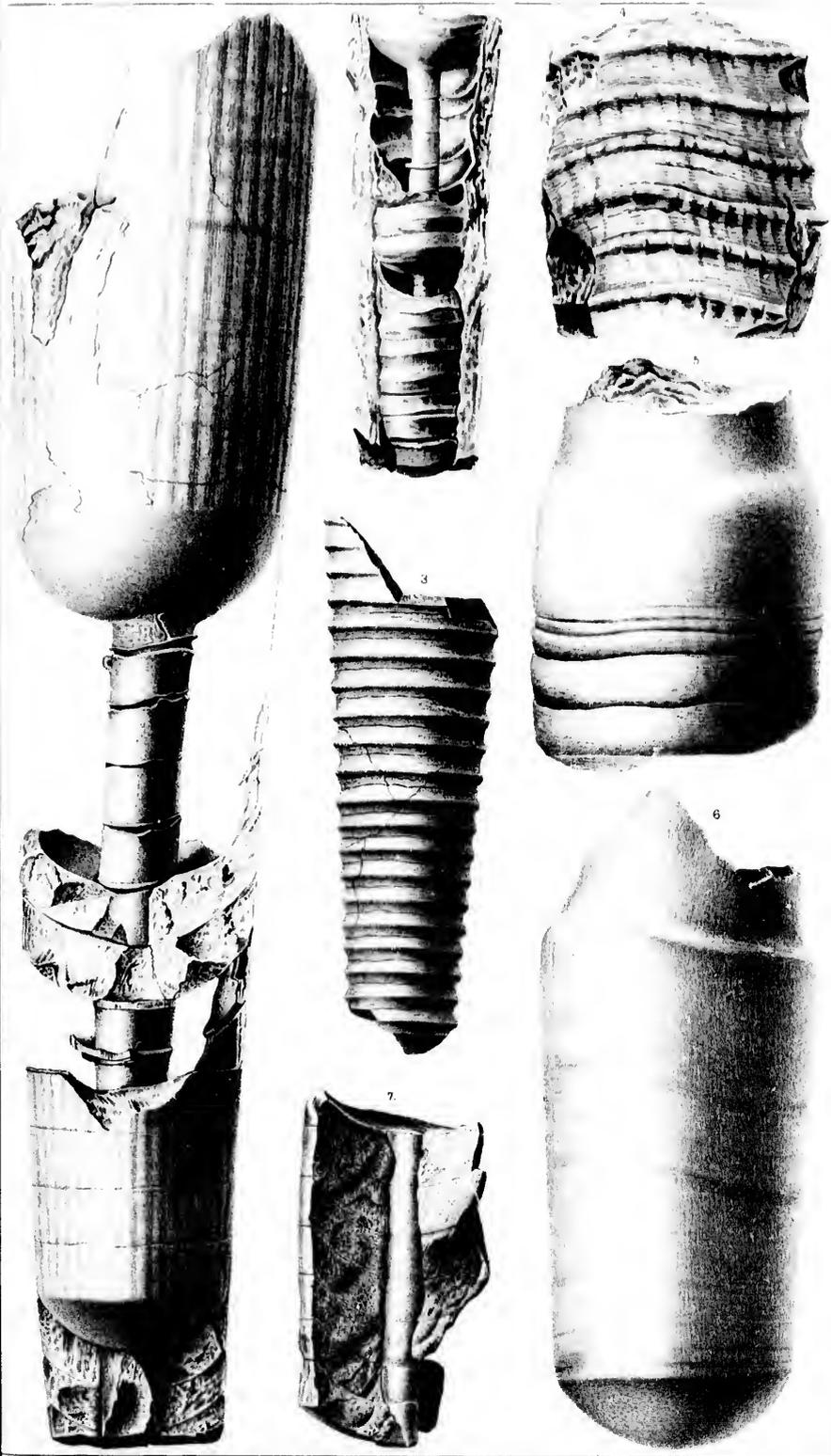
- FIG. 5. View of a specimen of this species, showing a few of the septa, and the outer chamber strongly constricted below the aperture. This figure is erroneously referred in the text to *O. alienum*.

ORTHO CERAS ALIENUM, HALL.

Page 414.

- FIG. 6. View of a cast of the outer chamber of this species, showing the gradually tapering form and the broad constriction near the aperture.
 " 7. A section of a fragment, showing the septa and siphuncle.





P. Whitfield, del.

A. J. Rhoads, lith.

form of the
lection of

uncle.
septa.
ngitudinal

chamber
red in the

ering form

PLATE XXV.

OBOLUS CONRADI, HALL.

Page 376.

- FIG. 1. Interior of a ventral valve, made from a cast in the natural mould.
 " 2. Interior of a smaller ventral valve, obtained by the same process as fig. 1. The dotted lines show the extent of the cavities beneath the transverse plate.
 " 3. Interior of a dorsal valve, taken from a gutta-percha cast in the natural mould. The figures 2 and 3 are from the same casts as those figured on plate 13.

SPIRIFERA PLICATELLA. var. RADLATA, SOW.

Page 378.

- FIG. 4. Dorsal view of a large cast, showing the cavities left by the removal of the dental lamellæ and the septum of the dorsal valve.
 " 5. Cardinal view of the same specimen as fig. 4, showing also the extent of the area.
 " 6. An oblique view of the interior of both valves, showing the septa and dental lamellæ.

PENTAMERUS (PENTAMERELLA) VENTRICOSUS, HALL.

Page 382.

- FIGS. 7, 8. Dorsal and front views of an individual, showing the plications more distinctly than usual.

PLEUROTOMARIA OCCIDENS, HALL.

Page 392.

- FIG. 9. Lateral view of a very fine specimen, showing the external characters of the species.
 " 10. View of the aperture. This specimen is from the Niagara limestone of Lyons, Iowa, received from Dr. Farnsworth.

PLEUROTOMARIA (TROCHONEMA) HOYI, HALL.

Page 393.

- FIGS. 11, 12. Lateral and basal views of a specimen of this species, showing the surface striæ and the wide umbilicus.

TROCHONEMA (CYCLONEMA?) PAUPER, HALL.

Page 395.

- FIG. 13. Lateral view of a specimen in the collection of the Michigan University, at Ann Arbor, received under the name of *Pleurotomaria Halei*.

CYRTOCERAS BREVICORNE, HALL.

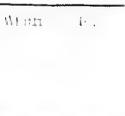
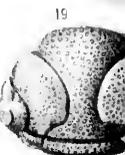
Page 407.

- FIG. 14. Lateral view of a specimen, showing the septa.

TROCHOCERAS COSTATUM, HALL.

Page 402.

- FIG. 15. Lateral view of the upper surface, from a gutta-percha cast in the natural mould.





W. H. ...

... in Stone by A. J. Abbott et al.

Howen & Co. Phila. Pa.

FIG. 16.

FIG. 17.

FIG. 18.

FIG. 19.

FIG. 20.

FIG. 21.

FIG. 22.

* Trochoc
tened above
undetermin
moderately
moderately
on the back

Surface m
sides of the

the former c
This spec

flattening of
which it dif

Formation

Farnsworth

PLATE XXV—Continued.

TROCHOCERAS AENEAS,* HALL.

FIG. 16. View of the upper surface of the specimen described.

TROCHOCERAS (GYROCERAS) BANNISTERI. WINCH. & MAR.

Page 408

FIG. 17. View of the specimen taken from a gutta-percha cast, of the umbilical side showing it to be a dextral species.

ORTHO CERAS ABNORME. HALL.

Page 415.

FIG. 18. Transverse section of a specimen, showing the ramifying processes within the siphuncle.

LICHAS ORVIUS. HALL.

Page 424.

FIG. 19. View of the glabella and lateral lobes of a specimen from the Niagara limestone at Lyons, Iowa.

LICHAS PUGNAX. WINCH. & MAR.

Page 424.

FIG. 20. The pygidium of this species, from the same specimen as the figure by Messrs. Winchell and Marey, omitting the thoracic segments. Collection of Prof. Marey.

BRONTEUS ACAMAS. HALL.

Page 422.

FIG. 21. View of a small pygidium of this species. This figure is from the original of *Bronteus occasus*, W. & M.

ILLENUS ARMATUS. HALL.

Page 418

FIG. 22. A pygidium of this species, enlarged to two diameters, from a specimen loaned by Prof. Winchell. The specimen shows a broad oval impression on each side of the median line and anterior to the middle. Similar marks have been observed on other specimens, and they may have been the areas of muscular attachment.

* *Trochoceras aeneas*, nov. sp.—Shell sinistral, closely coiled, volutions somewhat rapidly increasing in size, flattened above and rounded on the dorsum, the inner ones not projecting above the outer; number of volutions undetermined. Septa numerous, about four in a distance equal to the greatest diameter of those measured, moderately concave, but appearing more deeply so from the flattening of the volution; strongly arching forwards on the back, and less strongly on the ventral side.

Surface marked by moderately sharp undulations which are directed backwards from the inner to the outer sides of the volution, and arranged a little more closely than the septa, eleven of the latter equalling thirteen of the former on the dorsal margin.

This species differs from *T. costatum*, the only other sinistral species occurring in the same association, in the flattening of the upper side; the concentric undulations are finer than any other except *T. bannisteri*, from which it differs in the flattened dorsum.

Formation and locality.—In rocks of the Niagara group, at Lyons, Iowa. The specimen was received from Dr. Farnsworth.



