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GEOLOGICAL SURVEY OF ILLINOIS.

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VOLUME III.

GEOLOGY AND PALÆONTOLOGY.

GEOLOGY,

BY A. H. WORTHEN,

AND ASSISTANTS

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PALÆONTOLOGY,

BY F. B. MEEK AND A. H. WORTHEN.

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PART II.

PALÆONTOLOGY.

By F. B. MEEK and A. H. WORTHEN.

—37 July 10, 1868.

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LOWER SILURIAN SPECIES.

FOSSILS OF THE TRENTON GROUP.

RADIATA.

ECHINODERMATA.

CYSTOIDEA.

GENUS COMAROCYSTITES, Billings, 1864.

[*χομαρον*, a strawberry; *χυστις*, a bladder.]

Comarocystites, BILLINGS, 1854. Canadian Journal, vol. ii. p. 227; Report Geol. Survey Canada, p. 288, 1856; Decade iii., Canadian Organic Remains, p. 61, 1859.

Mr. BILLINGS describes this genus as follows: "Body ovate, the smaller extremity being the base; pelvis small, of three plates, above which are from eight to eleven irregular rows of plates, mostly hexagonal; mouth near the summit provided with a valvular apparatus; arms free, grooved, and composed of a single series of joints bearing pinulæ; ambulacral orifice in the apex between the arms; column round and smooth. The plates of the only species that has been collected present, in some conditions of preservation, a peculiar vesicular structure of their exterior surfaces, while sometimes they are solid and smooth.

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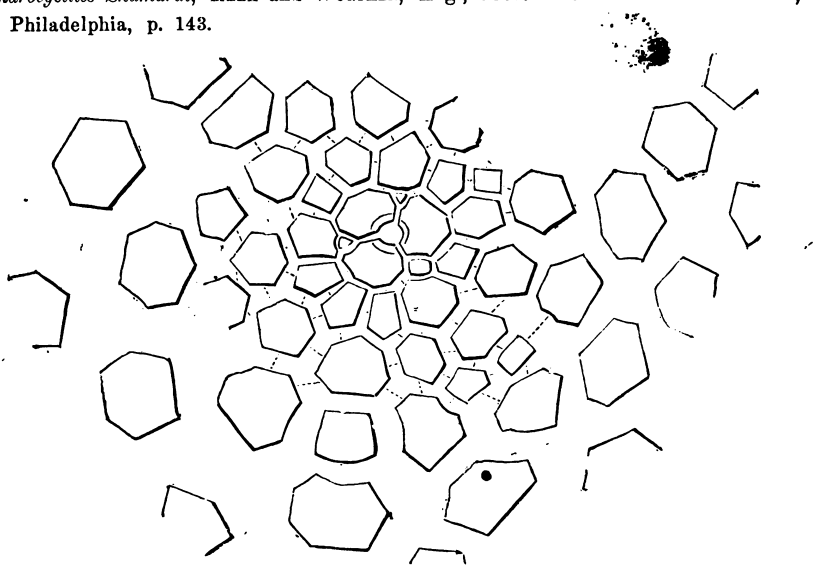
COMAROCYSTITES SHUMARDI, M. & W.

Pl. 1, fig. 1 *a*, *b*.

Comarocystites Shumardi, MEEK and WORTHEN, Aug., 1865. Proceed. Acad. Nat. Sci., Philadelphia, p. 143.



Comarocystites Shumardi. Diagram showing the anatomy as far as known.

Body obovate, the summit being more broadly rounded than the lower extremity; hight about one-tenth greater than the breadth. Basal pieces wider than long, irregularly nine or ten sided, some of the sides being very short; extending out horizontally from the column, and having, at each of the sutures, a small supplementary piece wedged in between, so as sometimes to come nearly in contact with the end of the column. Succeeding ranges of plates above, five, very irregularly arranged, and differing in size and form, but increasing in diameter from below upward, mostly hexagonal or heptagonal in form; all deeply concave on the outside, with prominent sharp carinæ at the sutures; when these angular prominences are weathered or worn, slit-like pores are seen passing through the sutures, which they cross at right angles, being partly common to each of the contiguous plates.

Hight, 1.50 inch; breadth, 1.30 inch; greatest breadth of

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one of the plates next to upper range, 0.44 inch. Arms and openings of the summit unknown.

This species is nearly allied to *C. punctatus*, Billings, the type of the genus, from which it may be distinguished by having only five ranges of plates above the base, instead of seven or eight, as well as by the greater size of the plates near the summit, some of which measure as much as three times the diameter of those of the corresponding pieces in the Canadian species of equal size. It is true these are probably, to some degree, variable characters in this genus, but not, we should think, to the extent exhibited between the Canadian species and our specimens, in which latter they are constant. Again, where the sutures of our species have been worn so as to expose the perforations, they are seen to be less crowded, and not so numerous as in *C. punctatus*, while none of the plates, even where apparently perfectly preserved, show any traces of surface striæ.

The deep concavity of the external surface of the plates in this genus, and the sharply carinated character of the sutures between, together with the irregularity in the size, form and arrangement of the plates, give a very peculiar appearance to the fossil, that might, at a first glance, cause it to be mistaken for a coral. When only found in the condition of detached plates, they present a singular appearance, well calculated to mislead even an experienced Palæontologist who had not seen the entire fossil, or enough of the plates united, to show their true characters. The fact that they are all deeply concave, and when unworn, smooth on the outside, while the inner side is convex and strongly rayed, would naturally lead to the conclusion that the outside is the inner side, and *vice versa*. When a few of the plates are found united, however, it is at once seen that the deep concavity is on the outside, and the convexity and rays within. These rays extend one from the prominent middle of each plate to each of its sides, where they connect with those coming from the middle of the adjacent plates. When three or four of the united plates are placed with the inside upward, the spaces between the rays are seen to present the form of deep, triangular pyramidal cavities, the apex of each cavity terminating at the meeting of the corners of each three of the contiguous plates. The rays are as prominent as the convex centers of the plates, and quite narrow or linear within, but widen rapidly toward the sides of the plates. They are also each split longitudinally into parallel laminæ by a series of profound slits extending nearly to the outer surface of the plates, and it is these slits that are seen, like pores, at the prominent angular sutures, where the edges of the plates at the latter have been worn partly away. It is difficult to understand the use of these deep slits, or divisions of the internal rays, since, as noticed by Mr. Billings, they seem never to pass entirely through the plates, excepting where the prominent edges of the latter have been worn away.

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Named in honor of Dr. B. F. Shumard, of St. Louis, whose labors in western Geology and Palæontology are well known.

Locality and position.—Cape Girardeau, Missouri. Trenton division of Lower Silurian.

COMAROCYSTITES SHUMARDI, var. OBCONICUS, M. & W.

Pl. 1, fig. 2 *a*, *b*.

Comarocystites Shumardi, var. obconicus, MEEK and WORTHEN, Aug., 1865. Proceed. Acad. Nat. Sci., Philadelphia, p. 144.

A single specimen in the collection from the same locality and position as the species just described, differs in being obconical instead of obovate, its lower half tapering downward gradually to the column. Its basal plates also rise nearly vertically from the column, instead of extending out horizontally as in the typical form of *C. Shumardi*. It has a part of the column attached, showing it to be very nearly cylindrical, and composed of thin plates. In form this specimen agrees nearly with Mr. Billings' figure 2, plate 5, Decade iii., Geol. Survey of Canada, from which it differs in having only five ranges of plates above the base. It also agrees with the species we have just described, it having its plates above the middle proportionally larger, one of these plates in a specimen only 0.72 inch in hight, measuring nearly a third more in diameter than those of Mr. Billings' species, near 1.50 inches in hight.

It is quite probable this form may belong to a distinct species, but as we are not aware to what extent these curious fossils may vary, we merely call attention to it as a variety of *C. Shumardi*.

Locality and position, same as last.

MOLLUSCA.

LAMELLIBRANCHIATA.

GENUS MODIOLOPSIS, Hall, 1847.

(Palæont. N. Y., vol. 1, p. 157.)

MODIOLOPSIS MODIOLIFORMIS, M. & W.

Pl. 1, fig. 7 *b* and 8.

SHELL sub-rhomboidal, very oblique, between two and a half and three times as long as wide, very convex along the umbonal slopes, from the beaks to the posterior basal extremity.

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Hinge rather short, ranging at an angle of about 38° to 40° above the oblique umbonal slope, and passing almost imperceptibly into the posterior dorsal outline, which slopes backward with a moderate convexity to the narrowly rounded posterior basal extremity; basal margin extending obliquely forward, with apparently a gently convex, or perhaps nearly straight outline, near the middle; anterior side very short, and abruptly rounded. Beaks very close to the anterior end, gibbous or sub-angular, and incurved. Surface with rather obscure concentric striæ, and a few indistinct wrinkles of growth. Hinge and interior unknown.

Length, measuring obliquely from the most prominent part of the posterior basal extremity to the anterior end, about 2.10 inches; hight, at right-angles to the umbonal ridge, near 0.80 inch; convexity, as near as can be determined from an accidentally depressed specimen, about 0.80 inch.

The only specimen of this species we have seen, has suffered some distortion from nearly vertical pressure, which makes its valves appear more convex than natural, and has a somewhat crushed ventral margin, so as to make it less prominent than it must be in perfect examples. Hence, the outline of the base, of figure 8, particularly toward the front, can not be relied upon as strictly that of a perfect example of the species. It seems to have presented much the form of a true *Modiola*. As we know nothing of its hinge and interior, we only place it provisionally in the genus *Modiolopsis*, to which, however, we have not much doubt it belongs.

Locality and position: Trenton group, of Lower Silurian. Mineral Point, Wisconsin.

MODIOLOPSIS ORTHONOTA, M. & W.

Pl. 1, fig. 7 *a*.

SHELL longitudinally sub-oblong, the length being about twice and a half the hight; valves quite convex, the greatest convexity being near the middle, in front of which they have an undefined concavity commencing in the umbonal region, and widening and deepening to the base, in front of the middle; cardinal margin long, very nearly straight, or but slightly

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arched; posterior margin obliquely sub-truncated, and sometimes very faintly sinuous above, and rather narrowly rounded near the middle; basal margin sub-parallel to the dorsal, but most convex behind the middle, in consequence of a broad sinuosity situated mainly between the middle and the front; anterior side short, rather abruptly sloping above, and narrowly rounded below. Beaks depressed upon a line with the dorsal margin, rather obtuse, and placed less than one-seventh the entire length of the valves behind the anterior extremity. Surface marked with moderately distinct concentric striæ of growth, crossed on the dorsal slope by an obscure sulcus, extending obliquely from the posterior side of the beaks to the middle of the obliquely sub-truncated upper part of the posterior margin.

Length, about 2.45 inches; hight, 0.94 inch; convexity, 0.80 inch.

In the figure of this species, the entire breadth of the anterior margin is not shown, owing to the fact that its lower edge is partly hidden in the matrix. The upper part of the posterior margin is represented as rounding too regularly into the dorsal outline, so as to completely obliterate the oblique truncation of that edge. The concentric undulations on the posterior half of the shell are also represented much too strong; while the long obscure sulcus on the dorsal slope is not represented in the figure.

This species seems to be nearly related to *M. Gesneri* of Billings (New Lower Sil., Foss., Canada, p. 43, fig. 45—1862), but it is less convex posteriorly, its greatest convexity being at about the middle instead of behind it. Its dorsal outline is also straighter, and its upper posterior edge more truncated, while Mr. Billings neither figures nor mentions the obscure sulcus seen along the dorsal slope of our specimen.

We have before us, from the Galena limestone, at Pine creek, Ogle county, Illinois, some internal casts agreeing more nearly with Mr. Billings' species.

Locality and position: Dunleith, Illinois; Trenton division of the Lower Silurian.

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GENUS CYPRICARDITES, Conrad, 1841.

(Ann. Report Palæontol., N. Y., p. 51.)

GENUS OR SUBGENUS VANUXEMIA, Billings, 1858.

(Report Canadian Geological Survey for 1857, p. 186.)

VANUXEMIA? DIXONENSIS, M. and W.

Pl. 1, fig. 5 *a*, *b*.

Vanuxemia Dixonensis, MEEK and WORTHEN, 1866. Proc. Chicago Acad. Sci., vol. 1, p. 16.

SHELL of medium size, thick, obliquely ovate, very gibbous; beaks tumid, very oblique, rather obtuse, somewhat incurved and terminal; anterior side a little concave just below the beaks, but without a defined lunule, thence descending with a regular curve into the rounded base; dorsal outline declining from near the beaks, with a regular oblique arch to the postero-basal margin, which rounds into the base. Hinge margin rather short, arched, somewhat gaping, and apparently provided with a narrow area, just outside of which there is an impressed line on each valve, extending from the inner posterior side of each beak backward, so as to define a lanceolate escutcheon (see fig. 5 *b*). Surface with rather strong, subimbricating marks of growth, which are distinct on the lower and posterior sides of the valves, but become obsolete over the umbonal region. Hinge and interior unknown.

Length, measuring obliquely from the beaks to the postero-basal margin, 1.23 inches; greatest breadth, at right-angles to this oblique axis, 0.90 inch. Greatest convexity, near middle of the vales, 0.95 inch.

Not having seen the hinge and interior of this shell, we can not be sure that it really belongs to the group *Vanuxemia;* but we place it provisionally in that genus, or subgenus, until its internal characters can be determined. It has the form and general external appearance of *Vanuxemia*, however, though it differs from the typical species upon which that genus was founded, in having no little protuberance in front, just below the beaks—there being at that point a lunle or excavation. It also seems to be a more gibbous and proportionally narrower species than those described from the same horizon by Mr. Billings. In some

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respects it agrees more nearly with *Megalomus* of Hall, and it is possible that we should call it *Megalomus Dixonensis*. These two groups, however, are thought by Mr. Billings not to be distinct.

Locality and position: Dixon, Illinois, from the Trenton division of the Lower Silurian.

CEPHALOPODA.

GENUS ORTHOCERAS, Auct.

ORTHOCERAS (ORMOCERAS) BACKII, Stokes?

Pl. 1, fig. 4.

Ormoceras Backii, Stokes, 1837. Geol. Trans., 2d ser., vol. V, p. 709, referring to fig. 1, p. 30, vol. I. of same.

Conotubularia Cuvierii, Troost? 1838. Mem. Soc. Geol. Fr. t. III, p. 88, pl. 9, fig. 1, and pl. 10, fig. 7.

Ormoceras tenuifilum, Hall, 1847. Palæont. N. Y., vol. I, p. 55, pl. xv, fig. 1 *a*, *b*, *c*; pl. xvi, fig. 1 *a*, *b*, *c*, *d*, *e*, and pl. xvii, fig. 1 *a*, *b*.

ALTHOUGH this fragment is too imperfect to afford satisfactory specific characters, it is of some interest, since it presents an example of the curious mammillary appearance sometimes produced by a kind of organic deposit, often formed on the interior of these shells, the true nature of which was, we believe, first pointed out by Prof. Barrande, of Bohemia. The specimen figured consists entirely of a cast of the interior of the fossil; the shell itself, as well as its septa and siphuncle, being entirely dissolved and removed, so as to leave only the cast of the internal parts, composed of the yellow, finely-granular dolomitic matrix.

The organic deposit mentioned above, was not merely formed upon the interior of the outer walls of the shell, but also on both sides of the septa, and partly filled the large siphuncle. As the mammillary protuberances seen in the figure are merely casts, they of course represent concavities or pits in the organic incrustation of the interior. The siphuncle was large, ventral, and much expanded or swollen out between the septa. Along its middle there is a cast of the interior of a central cavity, which in the specimen figured, is exposed by the breaking away of one side of the fossil, and lies loose, though it can not be removed, owing to its enlargement within the expansions of the siphuncle farther up. These enlargements of the cast of the interior of the siphuncle, occur one within each expansion of the latter; and each sends off, all around, little horizontal branches (not well represented in the figure), evidently internal casts of canals radiating from the central cavity, and apparently passing through

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the walls of the siphuncle, so as to connect with the interseptal cavities. The transverse section of the shell is subelliptic.

Locality and position: Homer, LaSalle county, Illinois; Trenton group of the Lower Silurian.

ARTICULATA.

CRUSTACEA.

GENUS LICHAS, Dalman, 1827.

(Palæad. p. 72.)

LICHAS CUCULLUS, M. and W.

Lichas cucullus, MEEK and WORTHEN, Dec., 1865. Proceed. Acad. Nat. Sci., Phil., p. 266

GLABELLA very convex; middle lobe strongly elevated, or subconical, nearly three times as wide anteriorly (measuring around the front) as behind, sloping abruptly from the highest point behind the middle, with a straight or slightly concave outline, back to the neck furrow, and rounding with a regular, convex, rapidly descending curve, to the rounded front; lateral slopes declining abruptly, and separated from the lateral lobes by a linear but well defined furrow, arching forward from the neck furrow, and curving laterally on the anterior slope. Lateral lobes about half as high and three-fourths as long as the middle one, from which they slope abruptly outward; nearly as wide behind as the posterior extremity of the middle lobe at the neck furrow, but not more than half its breadth at the summit, and less than one-third its anterior breadth. Outside of these, on each side, the much smaller and lower palpebral lobes are separated from them by a linear furrow, similar and nearly parallel to those separating the lateral lobes from the central one. Neck furrow moderately well defined; neck segment very much depressed below the other parts, and sloping backward; apparently equaling about half the breadth across between the two lateral lobes behind.

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Surface showing, under a magnifier, small, unequal, rather scattering pustules, with smaller intermediate granules.

Length of head, including the neck segment, 0.70 inch; do., excluding same, 0.66 inch; height, 0.60 inch; breadth, 0.96 inch; do. of middle lobe at posterior extremity, 0.28 inch; do. of same at summit, 0.41 inch; do. of same at front, 0.60 inch.

Compared with the corresponding parts of *L. Trentonensis*, this species will be at once distinguished, by its much more elevated and differently formed glabella, as well as by its less convex lateral lobes, and the presence of a defined furrow between the lateral and the palpebral lobes. Its surface is also much less strongly and distinctly pustulous. This latter character, and its proportionally narrower neck segment, as well as its more conical middle lobe, readily distinguish it from *L. Hibernicus*, of Portlock, which it more nearly resembles. It differs too distinctly from *L. Boltoni*, of the Niagara Group, to render a comparison necessary.

Locality and position: Alexander county, Illinois. Trenton division, Lower Silurian.

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FOSSILS OF THE GALENA BEDS.

PROTOZOA.

GENUS RECEPTACULITES, Defrance, 1827.

(Dict. Sci. Nat. XLV.)

RECEPTACULITES GLOBULARIS, Hall.

Pl. 2, fig. 2 *a*, *b*.

Receptaculites globulare, Hall, 1861. Suppl. Wisconsin Geological Report, p. 16.

BODY obovate, or subglobose, rounded and slightly umbilicate above, and tapering to a rather broad base of attachment below. Cells arranged in the usual regularly curved lines, with transversely elongated rhomboidal apertures, which become exceedingly narrow and crowded on the sides; transverse ridges between the cells and the intervening grooves well defined, and becoming, like the cells, very closely compacted together on the sides.

This is probably the form described by Poof. Hall, under the above name, though it is proportionally longer than the specimens upon which the species was founded, which are said to be usually wider than long. We have others, however, from the same locality, agreeing more nearly with his description, and apparently not separable specifically from this.

Locality and position: Scales' Mound, Illinois; from the Galena division of the Lower Silurian series.

RECEPTACULITES ————?

Pl. 2, fig. 1 *a*, *b*.

BODY depressed-subglobose; slightly umbilicate above, and apparently attached by a broad base below. Cells presenting,

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at the apertures, the usual transversely elongated rhombic outline, with each a small, round, contracted perforation within, and all becoming narrower and more elongated transversely, as they recede from the middle outward,* so as to be very closely compacted and extremely narrow on the sides. Transverse ridges between the cells, linear and well developed, becoming more and more closely crowded down the sides, until they appear to be in contact, and almost close the apertures of the cells below the middle.

Height, 1.16 inches; breadth, 1.68 inches.

This seems to differ from the last only in being larger and more depressed. It is probably a different species; but as several allied forms have been already named and described from these rocks, and not yet figured, we are left in doubt in regard to its specific relations, and scarcely feel warranted in identifying it with any of the described species, or in regarding it as new.

Locality and position: Galena division of the Lower Silurian; Galena, Illinois.

RECEPTACULITES OWENI, Hall.

Pl. 2, fig. 3.

Coscinopora sulcata, Owen, 1844. Geological Report Iowa, Wisconsin and Illinois, p. 40, pl. vii., fig. 5 *a*, *b*; (not Goldfuss).

Receptaculites Oweni, Hall, 1861. Report Rrogress Wisconsin Geological Survey, p. 13.

BODY in the form of a broad, nearly flat, or somewhat undulated, circular disc, with a small, funnel-shaped, or umbilicoid central depression above, corresponding to the narrow, projecting base of attachment on the under side. From this point, where the disc is very thin, it increases in thickness in all directions to the periphery, which curves downward. Cell rows curving so strongly, as they radiate from the center, as to perform nearly one entire turn in a specimen eight inches

* This character is not represented in figure 1 *b*, owing to the fact that the rows of cells are not drawn as curved enough near the periphery; and hence the cells are made too large on that part of the fossil. They should have been represented as becoming more contracted outward as well as inward, from about half way between the center and the periphery of the figure. The same defect also occurs in fig. 2 *a*, though to a less extent. In figure 1 *a* and 2 *b* they are correct.

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in diameter, the curve always decreasing regularly from the center outward; while intercalated rows are occasionally developed between those coming from the center. Cell apertures quadrangular, or more or less rhombic at the surface, but abruptly contracting within to a smaller circular, or nearly circular, opening* into the larger cylindrical cells of the interior. Ridges between the cells moderately well developed, and running parallel to the curves of the cell rows, so as to intersect each other at more or less nearly right angles. They are sometimes, however, interrupted by obscure traces of nearly straight furrows, passing from cell to cell in direct radiating lines from the middle of the body outward.† Cells generally increasing in size from the center to the circumference of the disc, and always separated by spaces less than their own breadth, often showing traces of transverse wrinkles within, as if left by the remains of diaphragms.

Breadth of the largest specimen in the collection (incomplete at the margins), 7.50 inches; thickness of same at the middle, 0.12 inch; do. at periphery, 0.52 inch; breadth of largest cells at the periphery, 0.13 inch.

Locality and position: Galena, Dixon, and other Illinois localities, in the Galena limestone (of the Lower Silurian), of which it is very characteristic. It also occurs at the same horizon in Wisconsin and Iowa.

* Made too small in the figure.

† This character is rather too distinctly represented in the figure, on plate 2.

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RADIATA.

ZOOPHYTA.

? GENUS CHÆTETES, Fischer, 1837.

(Oryct. du Gouv. Mascou, p. 159.)

CHÆTETES PETROPOLITANUS, Pander? (sp.)

Pl. 2, fig. 8 *a*, *b*.

Favosites petropolitanus, Pander, 1830. Russischen reiche, p. 105, pl. 1, fig. 6, 7, 10 and 11; probably, also, pl. 2, fig. 12 to 15; McCoy (1846), Sil. Foss. Ireland, p. 64, pl. 4, fig. 21.

Calamopora fibrosa (pars), Goldf., 1833. Petref. Germ., vol. I, p. 215, pl. 64, fig. 9, (not pl. 28, fig. 3).

Favosites hemisphericus, Kutorga, 1837. Sweit. Beitr. Zur geogn. und palæont. Dorpat's, p. 40, pl. 8, fig. 5, et pl. 9, fig. 3.

Calamopora fibrosa, Eichwald, 1840. Sil. Syst. in Esthand, p. 197.

Favosites lycopodites, Vanuxem, 1842. Report Third Geol. Dist. N. Y., p. 46, fig. 3; Mather's Report First Dist., p. 357, fig. 3.

Chætetes petropolitanus, Lonsdale, 1845. In Geol. Russ. vol. I, p. 596, pl. *A*, fig. 10; Keyserling (1846), Petschora-land, p. 180; d'Orb. (1845), Prodr. vol. I, p. 25; Edwards and Haime (1851), Polyp. des Terr. Palæoz., p. 263.

Chætetes lycoperdon (pars), Hall, 1847. Palæont. N. Y., vol. I, p. 64, pl. 23, fig. 1, and pl. 24, fig. 1 *a–h*.

Monticulipora petropolitana, Edw. and Haime; Brit. Foss. Corals, p. 264; Hist. Nat. Corall. t. III (1860), p. 272.

CORALLUM more or less hemispherical, the upper side being convex, and the lower flat or concave, and protected by a thin concentrically wrinkled epitheca. Calices radiating from the central region upward and outward, generally hexagonal at the surface, but apparently more rounded within, and numbering about seven to eight in the space of one-tenth of an inch; (diaphragrus unknown).

Greatest diameter of the largest specimen seen from this horizon, 2.30 inches; height, 0.90 inch.

This appears to be the form that has been by others in this country referred to the Russian species, *C. petropolitanus*, but as we have never seen any evidence of the division of the calices by the development of longitudinal partitions within, as is said by Lonsdale to be the case with *C. petripolitanus*, it may possibly be distinct. If the difference of structure said to distinguish such species as this

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from *C. petropolitanus* really exists, it would not only be specifically, but generically distinct, and probably fall into Lonsdale's genus, *Stenopora*, to which it has already been referred by some.

In regard to the zoological position of this genus, as well as respecting which one of several names that have been applied to it should be retained, rather widely different views have been maintained. Most authors have classed it with the *Zoophyta*; but Prof. Agassiz's investigations of the recent genus *Millepora* have led him, from analogy, to believe the genus *Chætetes* and *Favosites* belong more probably to the Hydroid group, of Acalephs, while others have supposed the former, at least, to belong to the *Polyzoa*. As we are not here making an especial investigation of any of these groups, however, we merely place this genus along with the *Zoophyta*, without thereby intending to express any opinion on these mooted points.

Locality and position: Galena division of the Lower Silurian, at Scales' Mound, Illinois.

MOLLUSCA.

BRACHIOPODA.

GENUS LINGULA, Bruguiere, 1792.

(Encyc. Meth. 1, tab. 250.)

LINGULA QUADRATA, Eichwald.

Pl. 2, fig. 4 *a*, *b*, *c*.

Crania quadrata, EICHWALD, 1829. Zool. Specialis, vol. I, p. 273, pl. 4, fig. 2.
Lingula quadrata, EICHWALD, 1840. Sil. Syst. in Esthland, p. 164; also Urwelt Russland (1840), heft 1, p. 15; and (1842) *ib.* heft 11, p. 58; MURCHISON DE VERN. and KEYSERLING (1845); Geol. Russ. and Ural Mts., vol. II, p. 292; HALL (1847), Paæont. N. Y., vol. I, p. 96, pl. xxx, fig. 4 *a*, *b*, *c*, and Wisconsin Report (1862), p. 46, fig. 1.

SHELL thin, attaining a large size; longitudinally semielliptic, approaching oblong, the sides being generally somewhat straightened and nearly parallel; the front rounded, or faintly subtruncate, and the posterior margins converging to the beaks at a wide angle, or more or less rounded at their points, which are obtuse; valves moderately and nearly equally convex. Surface of both valves marked by distinct concentric striæ, which along the middle of the valves are crossed by radiating lines, generally most strongly defined on exfoliated surfaces, and on

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the interior, particularly near the front, where they usually leave their impressions on internal casts. Internal mesial ridge of the dorsal valve generally rather stout, and extending forward from the beak beyond the middle.

Length of larger specimens, 1.50 inches; breadth about 0.90 inch.

This fine species resembles *L. Lewissii*, Sowerby, *L. tenuigranulata*, McCoy, and *L. granulata*, of Phillips; but differs from them all, in having a more elliptic and less oblong form; while its surface markings are quite distinct from those of the latter two species, both of which also exceed it in size.

Locality and position: Jo Daviess county; in the Galena beds of the Lower Silurian. It also occurs at the same horizon in Iowa and Wisconsin; likewise in the Trenton limestone of New York, and in the Lower Silurian rocks of Russia.

LAMELLIBRANCHIATA.

Genus AMBONYCHIA, Hall, 1847.

(Palæontol. N. Y., vol 1, p. 168)

Ambonychia intermedia, M. and W.

Pl. 2, fig. 5 *a*, *b*.

Shell (internal cast) rhombic subcordate, gibbous in the umbonal and anterior and central regions, compressed and subalate postero-dorsally; hinge line apparently a little shorter than the greatest antero-posterior diameter of the valves, and ranging at an angle of about 90° with the anterior margins of the shell; beaks prominent, gibbous pointed, and strongly incurved with a slight forward obliquity; anterior side truncated nearly vertically above, and rounding obliquely into the base, which is rather narrowly rounded; posterior side abruptly cuneate, in outline subtruncate, or moderately convex above, and rounding into the base below. Surface marked by rather fine, regular, radiating costæ, or coarse striæ, generally only obscurely defined near the free margins, to the interior of which they impart a finely crenated appearance.

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Greatest diameter, measuring obliquely from the beaks to the most prominent part of the base, 0.80 inch; anterio-posterior do., 0.50 inch; convexity, 0.55 inch.

This little shell seems to be intermediate in its characters between *A. bellistriata* and *A. radiata*, having the fineness of striæ, and the convexity and incurved character of beaks, seen in the first, and the shorter and much less oblique hinge of the latter. The internal casts are somewhat excavated just under the beaks in front, and sometimes show a small protuberance almost between the beaks there, apparently like the cast of a little cavity at the termination of the hinge plate, such as are seen in some species of *Myalina*, and in *Amphicœlia*.

At first we were inclined to refer these casts to *A. bellistriata*, but their much shorter and less oblique hinge seems to be a constant character, never seen in that species.

In making comparisons with our figure 5 *b*, it should be remembered that this engraving represents the radiating striæ a little too coarse and too oblique, there being about four of them on the margin of the shell, in the space of one-tenth of an inch. The beaks are also scarcely pointed and curved forward enough in this figure, while its anterior margin is slightly too prominent in the middle, and its anterior umbonal region not convex enough from the compressed posterior dorsal alation.

Locality and position: Mount Carroll, Illinois; Galena division of the Lower Silurian.

Genus TELLINOMYA, Hall, 1847.*

(Palæontol., N. Y., vol. 1, p. 151.)

Tellinomya ventricosa, Hall.

Pl. 2, fig. 7 *a*, *b*, *c*.

Tellinomya ventricosa, Hall, 1861. Wisconsin Geological Report of Progress, p. 27; Final Report same (1862), p. 38, fig. 8.

Shell rhombic subovate, nearly one-third longer than high, very gibbous in the umbonal region, and along the posterior umbonal slopes, with, in internal casts, an oblique concavity just before the posterior umbonal ridge; anterior side considerably wider than the other, abruptly cuneate, and in outline rounded; posterior side narrow, and apparently subangular in outline;

* Not *Tellimya*, Brown, 1827—*Tellinomya*, Agassiz, 1846.

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base very prominent anteriorly, and ascending, with a more or less distinct sinuosity near the middle, to the narrow posterior end; dorsal outline sloping nearly equally toward both extremities; beaks (in casts) rather prominent, and nearly central, or sometimes very slightly in advance of the middle. Impressions of adductor muscles very deep, the anterior ones larger than the posterior. Hinge strong, narrowing from the extremities to the beaks, toward which the two slopes converge at an angle of about seventy degrees; denticles, about eleven behind, and ten in front, to each valve, deeply interlocking, but not curved. Surface unknown.

Length of internal cast, 0.70 inch; height, 0.52 inch; convexity, 0.40 inch.

As we only know this form from imperfect internal casts, of course we can not be very positively sure our specimens belong to the same species as Prof. Hall's, though they agree so nearly that there is not much room for doubting their identity. In comparing our figures, however, it should be remembered that the anterior basal outline, in figure 7 *c* is not prominent enough, which makes the base too straight, instead of a little sinuous along the middle.

Our shell is also closely allied to the species *contractus* of Salter (Decade 1, Canadian Organic Remains, pl. viii, figs. 4 and 5), which, however, seems to be a less robust and more compressed species. Yet it is not very improbable that a comparison of a good series of specimens might show these shells all to belong to one species.

It is possible Mr. Salter's name, *Ctenodonta*, may have to be adopted for this genus, because Brown had established a recent genus of *Mollusca*, under the name *Tellimya*, in 1827; and Prof. Agassiz had corrected the orthography of this name to *Tellinomya*, in 1846. Certainly if such corrections are considered admissible at all, and the name of the recent genus is to be used as corrected, the name *Tellinomya* could be no longer retained for the fossil type.

Locality and position: Mount Carrol, Illinois, in the Galena beds of the Lower Silurian. The typical specimens upon which the species *T. ventricosa* was founded, were found in the Trenton limestone at Belloit and at Mineral Point, Wisconsin. It also occurs near Dubuque, Iowa, and at the Falls of St. Anthony, Minnesota. We likewise have an internal cast of apparently the same species from the Trenton limestone at Dixon, Illinois.

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TELLINOMYA ALTA, Hall.

Pl. 2, fig. 6 *a*, *b*.

Tellinomya alta, HALL, 1861. Geological Report of Wisconsin, p. 27.

SHELL (internal cast) small, subtrigonal, moderately convex; base regularly rounded; beaks much elevated, nearly central, arching slightly backward* (represented too straight in the figure); anterior and posterior sides sloping abruptly from the beaks at an angle of about 85°, the posterior slope (right side of fig 6 *b*) concave, and the anterior convex in outline; muscular impressions comparatively shallow, those on the posterior side circular, and the others oval. Denticles of hinge very fine. Surface unknown.

Length of internal cast, 0.60 inch; height, 0.55 inch; breadth, 0.34 inch.

This form, of which we have seen but a single internal cast, agrees very well with the description of *Tellinomya alta*, which, however, is only known to us from the description, no figures of it having yet been published. It is evidently related, as suggested by Prof. Hall, to *Ctenodonta astartiformis* of Salter, but differs in being proportionally wider, with straighter beaks. We agree with Mr. Salter, in the opinion that these short triangular forms are probably more than specifically distinct from the typical form of the genus, *Tellinomya nasuta*, though related to it in many respects.

Locality and position: Same as last.

GENUS CYPRICARDITES, Conrad, 1841.

Cypricardites, CONRAD, 1841. Annual Report Palæontology, N. Y., p. 51.
Cyrtodonta, BILLINGS, 1858. Canadian Geol. Report for 1857, p. 179.
Palæarca, HALL, 1859. Twelfth Ann. Rep. Regents Univ. N. Y., on State Cab. N. H., p. 9.

VERY different views are entertained among Palæontologists, in regard to which of the names cited above should be retained for this genus. In first proposing the genus *Cypricardites*, Mr. Conrad included in it, provisionally, various bivalves, generally, at that time, only known from external characters, but which have since been found not to be all congeneric; while some of them have been separated under other names. From Mr. Conrad's diagnosis, how-

*From analogy, we have to regard the side to which the beaks are turned as the posterior, in forms like this and *T. astartiformis*, Salter, as suggested by that author.

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ever, and a figure prepared by him of the hinge of the species from which his diagnosis was made out, it is evident that he regarded this figured species as the illustrative example of the genus; and hence, as well as from the fact that it was the only one of the species then figured by him, we are compelled to regard it as the type of the genus, although not the first one described by him in the text. That his description of the hinge was derived from the species figured will be readily understood from his diagnosis, which reads as follows: "Equivalve, profoundly inequilateral; hinge with four or five cardinal teeth; anterior one largest and most prominent; lateral teeth short, and very remote from the cardinal teeth."

In 1858, Mr. Billings, not having seen Mr. Conrad's figure (as the plate containing it was, it appears, only distributed with a few copies of his Report), proposed the name *Cyrtodonta* for the genus, giving a good description and full illustrations of several species, in some instances showing the hinge very satisfactorily. In 1859,* Prof. Hall also proposed a new generic name, *Palæarca*, for this group, and, for a time, there was apparently some difference of opinion in regard to which of these names had priority of date; but a farther inquiry into the precise date of the actual issue of the two publications showed that Mr. Billings' name, *Cyrtodonta*, was first issued. About the same time, Prof. Hall called attention to Mr. Conrad's figure, which had long been in his possession, of the hinge of *Cypricadites*, and suggested that this name may have to take precedence for this genus, which view he has adopted in his later publications.

Although the credit of having first made known the true characters of this genus certainly belongs to Mr. Billings, it seems to us clear that the inflexible law of priority leaves no alternative but to adopt Mr. Conrad's name, since no Palæntologist who will read his description, in connection with an examination of his illustrative figure of the hinge of the type of his *Cypricardites*, need be long in doubt in regard to the particular group for which that name was really intended.

We have long suspected that Prof. Hall's proposed genus, *Aegilops*, 1850 (Third State Cab. N. H. Report Regents University N. Y., p. 171), may have been founded on a distorted internal cast of a species of this genus, though we only know it from the figures and a brief description.

*Prof. Hall claimed, in the Twelfth Annual Report Regents University, 1859, p. 10, that his name, *Palæarca*, was proposed in 1857 (by misprint, 1847), being *in print* in his third volume, with a description and figures; but as that volume was not *published* at that time, nor for some time after, every one familiar with the rules of nomenclature must be aware that this would have no bearing whatever on the question of priority, even if *Cypricardites* had never been published.

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CYPRICARDITES ————————?

Pl. 3, fig. 9 *a*, *b*, *c*, *d*.

As we only know this form from imperfect internal casts, and several similar species have already been named, and only briefly characterized without illustration, we do not feel warranted in naming it as a new species, although it may not have been described. It seems to have been moderately convex and subcircular in form, and was characterized by an internal thickening of the anterior part of the valves. This thickening extended back from the front, nearly to the middle of the valves, where it ended abruptly, so as to leave on the internal cast a kind of blunt ridge, extending down from a little behind the beaks to below the middle of the valves, nearly at right-angles to the hinge, as seen in fig. 9 *a* and *b*. The hinge margin must have also been much thickened between the beaks, which together with the other thickening mentioned, left a comparatively thin cavity in each beak, thus giving a peculiar sharp angularity to the anterior margins of internal casts of the umbones. The cast shows that there were two oblique anterior teeth between the beaks, in the left valve, and three in the right. The posterior teeth, and muscular impressions, as well as the external surface of the shell, are unknown.

Locality and position: Mount Carroll, Illinois; Galena division of the Lower Silurian.

CYPRICARDITES OBLIQUUS, M. and W.

Pl. 2, fig. 9 *a*, *b*.

SHELL longitudinally sub-oblong, oblique, gibbous in the umbonal and central regions; ventral margin nearly straight along the middle, and rounding up at the extremities; anterior side very short, or nearly obsolete; dorsal outline unknown; beaks very gibbous, oblique, distinctly incurved, and nearly terminal; anterior muscular impressions very shallow, nearly circular, and placed close to the margin. Internal casts showing a few distinct, obscure, concentric undulations, and a broad obscure concavity or depression, extending from the anterior side of the beaks, obliquely backwards to the middle of the base, along the under side of a broadly rounded, undefined umbonal convexity. Surface markings unknown.

Length, 1.14 inches; height, or diameter at right-angles to

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the greatest length, apparently about 0.70 inch; convexity, about 0.70.

We only know this form from internal casts, none of which have the dorsal margins entire. Figure 9 *b*, therefore, does not represent the dorsal outline as in the complete shell, in which it is probably more elevated along the middle. Nor is the hinge line parallel to the dorsal outline, as seen in the figure, but ranging very obliquely across the beaks; so that if the anterior end of the specimen were raised so as to bring the hinge in a horizontal position, the longer axis of the valves would range at an angle of near 90° below it. The specimen shows nothing of the hinge excepting some indistinct marks of two or three oblique teeth, just under or nearly between the beaks. The casts of the anterior muscular scars are represented too prominent, and not more than half large enough, in fig. 9 *a*.

This species is evidently allied to *Cyrtodonta subcarinata*, Billings, (Canadian Geological Report, 1858, p. 181, fig. 5, 6 and 7), and may possibly be identical with it; but as it seems to differ materially in having its beaks more prominent, and its anterior margin below them much less so, we do not feel warranted in identifying it with that species.

Locality and position: Scales' Mound, Illinois; Galena beds of Lower Silurian.

GASTEROPODA.

GENUS BELLEROPHON, Montfort, 1808.

(Conch. Syst. I, p. 50.)

BELLEROPHON (BUCANIA?) PLATYSTOMA, M. and W.

Pl. 3, fig. 8 *a*, *b*.

SHELL (as determined from internal casts) composed of about three volutions, which increase rather moderately in size, until near the aperture, where the last one is suddenly and very greatly expanded; inner turns rounded on the dorsum, and rounding narrowly into the umbilicus on each side; but the outer one gradually developed a mesial dorsal carina, which becomes quite distinct near the aperture; umbilicus open, and showing the inner volutions in internal casts; aperture very large, owing to the great expansion of the lip, which seems to spread out flat upon a plane. (Surface unknown).

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The specimens of this species we have seen, are too imperfect to afford accurate measurement, though it was probably not less than 1 70 inches in its greatest diameter, and possibly more including the expanded lip. Some idea of the size of the aperture may be formed from the fact that some specimens show that the lip spread out farther than the remaining portion on the right side of figure 8 *b*, of plate 3, and even these are broken at the margin; hence, it is evident that the aperture of specimens of the size of the one figured, must have measured not less than 1.60 inches across. The umbilicus must be, of course, small, and may possibly be closed, in specimens retaining the shell, though we suspect that it was not entirely closed.

Internal casts of this species, with the expanded portion of the lip broken away, look like some forms of *B. bilobatus*, but they have a wider umbilical, impression, while the lip in more perfect specimens is seen to be greatly more expanded. In the latter character, it must be more like *B. Canadensis*, of Billings, from which it differs entirely in being without costæ.

Locality and position: Galena beds of the Lower Silurian; at Galena, Illinois.

Genus OPHILETA, Vanuxem, 1842.

(Report III. Geol. Dist. N. Y., p. 36.)

Ophileta Owenana, M. and W.

Pl. 3, fig. 6 *a*, *b*.

? *Euomphalus*, cast, Owen, 1844. Report Geol. Explorations in Iowa, Wisconsin and Illinois, p. 80, pl. xv., fig. 8.

Shell planorbicular, concave on both sides; the concavity above deeper than the umbilicus, which is wide and shows all the volutions. Whorls about three and a half, widest on the outer side, which is nearly vertically flattened, or a little convex, but rounding (in internal cast) to the rather narrowly rounded base; upper side very much elevated and carinate near the outer margin; thence sloping abruptly inward. Aperture rhombic ovate, its longer diameter ranging obliquely outward and upward, rather acutely angular above. Surface markings unknown.

Greatest breadth, 0.95 inch; height, 0.39 inch.

This is probably the form figured by Dr. Owen, in his report cited above, though its whorls seem to be more rounded on the under side than represented

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in his figure. As our specimens are only internal casts, however, it is possible the whorls may be angular below, in testiferous specimens.

We know of no species with which this is liable to be confounded. It will be readily distinguished from *O. compacta* of Salter, by its more rapidly increasing, less numerous whorls, always rounded, or subangular instead of flat below. Named in honor of Dr. D. D. Owen, deceased.

Locality and position: Galena division of the Lower Silurian; at Galena, Illinois.

Genus TROCHONEMA, Salter, 1857.

(Canad. Org. Rem., Dec. 1, p. 27.)

Trochonema umbilicata, Hall? (sp.)

Pl. 3, fig. 5 *a*, *b*.

Pleurotomaria angulata, Conrad, 18—. Proceed. Acad. Nat. Sci., Philad., vol. 1, p. 330? Owen, 1844, Report Geol. Expl. Iowa, Wisconsin and Illinois, p. 86, pl. xviii, fig. 5 (also 4?); (not Sowerby).

Pleurotomaria umbilicata, Hall, 1847. Palæontol. N. Y., vol. 1, p. 43, pl. x, fig. 9 *a*, *b*, *c*, (*d*, *e*, *g*, *h*?), and pl. xxxviii, fig. 1 *a*, *b*, *c*, *d*, *e*, *f*, *g*.

Trochonema umbilicata, Salter, 1859. Decade 1, Canadian Org. Rem., p. 27, pl. vi, fig 3; Hall, 1862, Report Geol. Survey, Wisconsin, p. 440.

Shell (as determined from internal casts) depressed subconical, generally wider than high; volutions about three and a half, increasing moderately in size, showing more or less distinct indications of four revolving angles, the first near the suture, the second at the top of the periphery, the third at its base, and the fourth on the middle of the under side. Of these angles, the first and second are the most distinct, while the third is obtuse, and the fourth nearly obsolete on internal casts; but all becoming nearly obsolete on the smaller volutions. Between the first angle and the suture, the surface slopes inward; between the first and second, outward, with a slight concavity, and between the second and third there is a rather broad, vertically flattened space; between the third and fourth (nearly obsolete) angles around the middle of the under side of the body whorl, the surface is convex, thence sloping into the umbilicus, which is rather large and subconical in the

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internal cast. Aperture obliquely obovate, its longer diameter ranging downward and outward. Surface unknown.

Length or height, 0.80 inch; breadth, 1 inch.

We have preferred to give only such characters of this form as the specimens before us exhibit, because we are not quite sure they are really identical with *P. umbilicata* of Hall. If that species varies, however, to the extent indicated by Prof. Hall's figures, it would probably include our shell. We have very little doubt in regard to its identity with the specimens figured by Dr. Owen.

Those figured by Mr. Salter, being in an excellent state of preservation, and showing the external characters perfectly preserved, present quite a different aspect, in being rather more elevated, and in having all their angles much more strongly defined, and the spaces between them more distinctly flattened, or even concave. Whether or not this is entirely due to the fact that our specimens are all internal casts, is not very easy to determine, though this may be the case. In one specimen before us, apparently agreeing with that under consideration, from the Trenton group at Rockton, Illinois, the mould of the exterior, seen in the matrix, shows a distinct horizontal truncation, or flattening of the upper edge of the whorls, between the upper angle and the suture. If this is really the same species as that here described, this character would seem to indicate a specific difference from the form figured by Mr. Salter.

In regard to our figure 5 *b*, we should remark that the upper flattened slope of the body whorl, as seen in profile on the left side of the figure, is made too concave in outline, in consequence of an accidental break in the specimen. It is also worthy of note, that extremely obscure traces of *two* revolving furrows on this flattened slope of the internal cast, are incorrectly represented in the figure as *three* or *four sharp lines*. In the specimen they are not defined lines, but furrows, so faintly indicated as only to be visible by a cross light, and then indistinctly. A similar furrow is also seen on the outer vertical flattened space, just below the second angle. These furrows are probably merely accidental, and not connected with external surface markings, as no traces of them are seen on any of the other casts of the same form, from the same locality and position. Figure 5 *b* also does not represent the under side of the body volution convex enough below the third angle.

Locality and position: Galena division of the Lower Silurian; Mount Carroll, Illinois.

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GENUS RAPHISTOMA, Hall, 1847.

(Palæont. N. Y., vol. I, p. 28.)

RAPHISTOMA LENTICULARIS, Conrad (sp.)

Pl. 3, fig. 7 *b*, (*a*, *c* ?)

? *Trochus lenticularis*, SOWERBY, 1839. Silurian Researches, p. 642, pl. 19, fig. 11.

Pleurotomaria lenticularis, CONRAD, M. S. EMMONS, 1842, Geol. Report N. Y., p. 392, fig. 2, and p. 293, fig. 2 and 3.

Pleurotomaria lenticularis, HALL, 1847. Palæont. N. Y., vol. I, p. 172, pl. xxxvii, fig. 6 *a*, *b*, *c*, *d*; OWEN, 1844, Report Geol. Explorations Iowa, Wisconsin and Illinois, p. 86, pl. xviii, fig. 6.

Raphistoma lunticularis, SALTER, 1859. Decade 1, Canadian Org. Rem., p. 12; HALL, 1862, Wisconsin Geol. Report, p. 39, fig. 4.

SHELL lenticular; breadth generally a little more than twice the height; convexity often nearly equal above and below; volutions about four and a half, flattened or slightly concave, with a moderate slope above, coincident with that of the spire, the outer or last one sharply carinate around the periphery, and convex below, the greatest convexity being near the umbilicus, into which the slope is abrupt; suture merely linear, and not very distinctly defined; umbilicus nearly as wide as the outer volution, as seen in internal casts; aperture transversely rhomboidal, the breadth being about one-fourth wider than the height. (Surface markings in our specimens not preserved).

Breadth of one of the larger specimens, 1.16 inches; height, 0.57 inch; breadth of aperture, 0.55 inch; height of same, about 0.42 inch.

The larger specimens, such as that represented by fig. 7 *b*, of pl. 3, now before us, agree well, on direct comparison, with natural casts of *R. lenticularis*, from the Trenton beds at Watertown, N. Y.* We suspect, however, that the one represented by fig. 7 *a*, *c*, may belong to a distinct species, as it has a smaller umbilicus. How far this may be due, however, to the fact that it retains the shell, while the other specimens are internal casts, we have not the means of determining.

* Our specimens agree more nearly, in the narrowness of the whorls, with the New York examples, than that figured by Prof. Hall, in the Wisconsin Report, cited above.

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We adopt the name *Raphistoma* for this type of shells provisionally, without pretending to have thoroughly studied the group with the view of determining its relations to *Scalites*, *Pleurotomaria* and the allied types, for which investigation we have not the necessary material at hand. We have the impression, however, that when the great genus, *Pleurotomaria*, embracing as it is now understood, some five or six hundred species, is thoroughly and critically studied, it will be found divisible into a number of genera, and that none of the Silurian forms *like that under consideration*, will be considered congeneric with Defrance's original type of the genus (*P. tuburculosa*) as first proposed by him.

In regard to the identity of *Raphistoma*, with *Scalites*, of Conrad, as has been suggested by several eminent authorities, although they are certainly nearly related, we would remark that we can not avoid the impression that *Scalites*, as typified by *S. angulatus*, with its distinctly canaliculated suture, singularly truncated lip, and imperforated and curved columella, ought to be regarded as constituting a distinct genus.

Locality and position: Galena beds of Lower Silurian; Carroll county, Illinois. *R. lenticularis* is also common in the Trenton group, New York, and at about the same horizon in this State and Wisconsin.

Genus MURCHISONIA, d'Archiac and d'Verneuil, 1841.

(Bull. Soc. Geol. Fr., xii, p. 154.)

Murchisonia bicincta, Hall?

Pl. 3, fig. 4.

Murchisonia bicincta, Hall, 1847. Palæont. N. Y., vol. I, p. 177, pl. xxxviii, fig. 5 *a–h*; ? Salter, 1859, Decade 1, Canadian Organic Remains, p. 19, pl. iv, fig. 5, 6, 7;
? Murchisonia perangulata, Hall, 1847. Palæont. N. Y., vol. I, p. 41, pl. x, fig. 4.

Shell obliquely conical, higher than wide; spire rather short for a *Murchisonia;* volutions about six, increasing rapidly in size; in internal casts distinctly carinate around the middle of the lower turns, but the carina obsolete on the upper ones; body whorl with a second obtuse angle below the middle carina, and a slightly concave space between this and the other, while the under side, between the lower angle and the umbilicus, is only moderately convex. Surface in our specimens unknown.

Height, 1.20 inches; breadth, 1 inch; apical angle about 55°.

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Our specimens of this form being merely internal casts, can not be identified with positive certainty, though they seem to agree in most respects with the above cited species. It is worthy of note, however, that they have the under side of the body volution less convex than represented in some of the figures, and the description of *M. bicincta*, given from New York specimens. To some extent, this is due to the distortion of specimens represented by our figure, but it is clearly manifest that this shell could never have had its body whorl and aperture, nearly so produced below, as represented in Mr. Salter's figure 6, cited above, which seems to represent a distinct form.

Our specimens show a small umbilical opening, but as they are internal casts, we can not doubt but this was filled by the columella. Of course they show no surface markings; nor can we see any traces on them of a third revolving angle above the most prominent one around the middle of the whorls, mentioned in the description of *M. bicincta*.

The surface of *M. bicincta* is described as being "marked by fine sharp striæ, which bend gently backwards, and are but slightly undulated in passing the upper carina [the third one not seen on our specimens], from which they turn more suddenly backwards to the mesial band, making an abrupt retral angle, and then bending forward below, pass in a vertical direction to the suture," on the upper turns. On the last volution, the striæ are said to "pass vertically to the lower slight carina, which corresponds to the suture in the other volutions, thence bending slightly backwards, curve into the umbilicus." The spiral band seems to be coincident with the middle, or most prominent angle, and is provided with two revolving marginal lines, in the New York shell.

Locality and position: Galena division of the Lower Silurian; Jo Daviess county, Illinois.

CEPHALOPODA.

Genus ORTHOCERAS, Auct.

Orthoceras anellum, Conrad.

Pl. 3, fig. 3.

Orthoceras anellus, Conrad, 1843. Proceed. Acad. Nat. Sci., vol. i, p. 334.
Orthoceras anellum, Hall, 1847. Palæont. N. Y., vol. i, p. 202, pl. xliii, fig. 6 *a*, *b*, *c*, *d*, *e*, *f*.

Shell slender, very gradually tapering, and a little arcuate; section nearly or quite circular; septa moderately concave, slightly oblique, and separated by spaces a little less than one-fifth the diameter of the shell; siphuncle very small, or scarcely

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one-ninth the diameter, situated slightly more than its own diameter on one side of the center. Surface ornamented with distinct, regular, angular annulations, narrower than the spaces between, which are regularly rounded; annulations slightly oblique, and alternating very regularly with the septa. (Surface striæ not seen in our specimen).

The best specimen of this form we have seen, is an imperfect cast, consisting of nine chambers in addition to the large outer, or body chamber; the whole measuring 2.23 inches in length. At the lower broken extremity it measures 0.50 inch in diameter, and near the middle 0.55 inch in diameter; from near which point it tapers very gradually again to a diameter of 0.50 inch near the aperture. The specimen is partly embedded in the matrix, in which an impression of the shell is continued on below, showing that the chambered part continued on at least 1.40 inches further, without materially diminishing in size, at which point the mould is broken away.

In regard to the identity of this shell with *O. anellum* of Conrad, we are by no means clearly satisfied, having no specimens of the New York form for comparison, while the figures and descriptions of that species in the Palæontology of New York * are not, as noticed by Mr. Billings, such as to afford entirely satisfactory means of comparison. Prof. Hall's figure 6 *a*, cited above, was drawn from a specimen found in the Trenton beds at Mineral Point, Wisconsin; while only the smaller specimen, represented by figure 6 *d*, is from the New York locality. This latter specimen is represented with obtusely rounded annulations, and angular constrictions between, while the figure of the Mineral Point specimen represents both annulations and constrictions angular. The latter, however, is probably incorrect, as we have now before us, from Mineral Point, a specimen agreeing so exactly in all other characters with the description and figure 6 *a*, that we can scarcely doubt that it belongs to the same species, while its annulations are angular, and the slightly wider constrictions between, regularly rounded. Our Mineral Point specimen does not show the siphuncle, but Prof. Hall's figure 6 *b*, represents it in his specimen from that locality, nearly twice as large as in the specimen we have figured and described, and distinctly more excentric. If this is correct, our shell may be distinct from the Mineral Point form; otherwise we could scarcely doubt its identity. The question, however, whether or not the New York species, with its rounded annulations, is identical with either of those western specimens, we have not at hand the necessary materials to decide with confidence, and we therefore merely refer our shell provisionally to *O. anellum*.

* We have no copy of Mr. Conrad's description at hand.

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It might be thought that the absence of any traces of fine longitudinal striæ, both upon the internal cast, and in the mould of our figured specimen, would alone exclude it from *O. anellum*, which would certainly be the case, if we could be sure it never possessed such markings; but it is evident that the material forming the matrix, is too coarse to preserve any traces of such delicate sculpturing. This marking is well preserved, however, by the fine compact matrix of the Mineral Point specimen, which is also slightly arcuate, like that we have figured.

Our figure represents the septa and annulations too oblique; and the apparent abrupt tapering, and rounding of the lower extremity of the mould left in the matrix, is due to the oblique fracture of the rock, and not to the natural termination of the fossil.

We should mention here, that Mr. Billings has described, from the Chazy beds (Report Canadian Geol. Survey, 1859, p. 461), under the name of *O. Maro*, apparently a very similar form to that here described, though differing in some details.

Locality and position: Galena division of the Lower Silurian; Rockford, Illinois.

ARTICULATA.

CRUSTACEA.

Genus ILLÆNUS, Dalman, 1826.

(Palæad., p. 51.)

Illænus taurus, Hall.

Pl. 3, fig. 2.

Illœnus taurus, Hall, 1861. Wisconsin Report of Progress of the Geol. Survey, p. 27. Compare *Illœnus Americanus*, Billings, 1859. Can. Nat. and Geol., vol. 4, p. 371.

Body obovate, the widest part being across the back part of the cephalic shield. Head large, gibbous, and so strongly arched as to present nearly a semicircular curve from the anterior to the posterior margin; posterior lateral angles rounded; outline of front, as seen from above, nearly semicircular, its lower margin straight across the middle and outward to, or a little beyond, the anterior extremities of the cheeks, the lower margins of which curve down a little between this faint sinuosity and their rounded posterior extremities; posterior outline

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nearly straight; dorsal furrows distinct, continued between one-third and one-fourth the length of the head (measuring over the curve) forward from the posterior margin, and distant from each other more than one-third the direct breadth of the head; eyes situated near the posterior edge of the shield, and remote from the dorsal furrows, nearly on a line with the abrupt geniculations of the thoracic segments; cheeks apparently small and subovate (but their outline not clearly seen in our specimens).

Thorax scarcely half the length of the head, measuring over the curve of the latter, rather distinctly narrowing posteriorly, and composed of ten segments; its trilobation well defined, the middle lobe being broadly rounded or depressed convex, and nearly one-third wider than the lateral lobes, as seen from above; lateral lobes distinctly flattened above, from the middle one out to the geniculations of the pleuræ, where they are suddenly deflected downward almost at right angles to the upper side.

Pygidium about half as large as the cephalic shield, but much less arched, or strongly convex, rounded in outline behind; mesial lobe moderately well defined, rather convex, nearly one-half the length of the pygidium, and about one-third its breadth in front, where it projects forward with a rounded outline; anterior margin on each side of the mesial lobe transverse, and straight, out to the geniculations of the pleuræ, from which point the anterior lateral extremities are truncated nearly at right angles to the straight anterior edge.

Entire length, following the convexity of the head and pygidium, 2.95 inches; of which the head forms 1.43 inches, the thorax 0.67 inch, and the pygidium 0.85 inch; breadth of head 1.67 inches.

Although we have not had an opportunity to compare this form with authentic examples of *I. taurus*, and no figure of that species has yet been published, we can scarcely entertain a doubt in regard to the identity of our specimens with that form. At any rate, they agree as nearly with the description of *I. taurus* as different individuals of a species can be expected to do.

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We should explain here, however, that the only specimens we have seen are merely internal casts, and that the one from which the figure given on plate 3 was drawn has the eyes broken off, while the breaks in the surface left by this accident were not represented by the artist. A careful examination, however, shows them to have been located near the posterior lateral angles of the cephalic shield. As represented in the figure, only about half the length of the head is seen, owing to the fact that it is bent down nearly at right angles to the longer axis of the thorax.

We are indebted to Capt. E. H. Beebe, of Galena, for the use of the best specimen of this species we have seen.

Locality and position: Galena division of the Lower Silurian; Galena, Illinois.

ILLÆNUS CRASSICAUDA, Wahlenb. ? ?

Pl. 3, fig. 1 *a*, *b*.

Entomostracites crassicauda, WAHLENB., 1821. Nov. Act. R. Soc. Upsal, vol. VIII, p. 27, No. 2, tab. 2, figs. 5 and 6; p. 294, No. 1, tab. 8, figs. 5 and 6.

Illænus crassicauda, DALMAN, 1826. Vet. Acad., HANDL., p. 248, pl. v, fig. 1 *a*, *b*, *c*; HEISINGER, 1837, Leth. Suecica, p. 16, tabs. 3. and 4; PORTLOCK, 1843, Geol. Londonderry, p. 300, pl. x, fig. 3 *a*, 3 *b*, 4 and 5; HALL ? 1847, Palæont. N. Y., vol. I, p. 229, pl. lx, fig. 4 *a*, *b*, *c*, *d*.

Illænus Trentonensis, EMMONS ? 1842. Geol. Report, p. 300, fig. 3.

THE only specimen of this species we have seen, being much compressed and otherwise distorted, and having no other figures and descriptions of *I. crassicauda* at hand for comparison (here at Springfield), than those given by Gen. Portlock and Prof. Hall, from very imperfect specimens supposed to belong to that species, it is only provisionally that we have concluded to refer the form under consideration to *I. crassicauda*. On comparison with the last described species, it is seen to differ in having its head much less convex, and proportionally larger; while its dorsal furrows are shorter and wider apart. The mesial lobe of its thorax is also wider, and its pleuræ not so distinctly geniculated; while the anterior margin of its pygidium is much nearer straight in outline, and less distinctly trilobate. Like that species, however, it has the eyes situated very near the posterior margin of the head, and remote from the axis, and the posterior lateral angles of the cheeks rounded. Its cheeks are comparatively small, rather prominently rounded below, and pointed anteriorly. The facial sutures intersect the posterior margin of the head just behind the eyes, with a distinct outward obliquity, and the eyes are moderately large and prominent for a species of this genus. The right one is seen at the right posterior angle of the head in fig. 1 *b*.

Our specimen has the head folded upon the thorax and pygidium, and the whole rather strongly compressed together somewhat obliquely, so as to spread

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out the cheek on the right side (see fig. 1 *b*), while that on the opposite side is folded under. The posterior margin of the head is also folded under so as nearly to hide the short dorsal furrows, in fig. 1 *b*, as may be seen by fig. 1 *a*. The latter figure does not quite show the full size of pygidium, the margin of which is somewhat worn off in the specimen; its lateral extremities are also erroneously represented in the figure, as they are really rather distinctly truncated, at an obtuse angle with the front margin, instead of produced forward to a sharp point on each side, as seen in the figure. The thorax is slipped a little forward under the posterior edge of the cephalic shield, so as to hide, apparently, one segment. So far as can be seen, the surface seems to be without striæ or granules.

Locality and position: Same as last.

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FOSSILS OF THE CINCINNATI GROUP.

RADIATA.

ECHINODERMATA.

CRINOIDEA.

GENUS HETEROCRINUS, Hall, 1847.

(Palæontol. N. Y., vol 1, p. 27)

HETEROCRINUS CRASSUS, M. and W.

Pl. 4, fig. 1 *a*, *b*, *c*.

Heterocrinus crassus, MEEK and WORTHEN, Aug., 1865. Proceed. Acad. Nat. Sci., Phila., p. 147.

BODY robust, but rather small compared with the arms and column, wider above than the length from the base to the summit of the first radials; distinctly truncated at its connection with the column, from which point the sides expand rather distinctly upwards; subpentagonal in outline, as seen from below. Basal pieces pentagonal, wider than long, and all excavated or indented on the outside, at the superior angle and down the middle. First radial pieces longer than the basal, about three-fourths as long as wide, broadly truncated above, and pentagonal in form; all deeply indented at their inferior lateral angles, so as to leave a broad, rounded, undefined ridge or prominence, descending from the middle to the basal pieces. Succeeding radial pieces nearly as wide as the first, but much shorter; in four of the rays, all transversely oblong, and about three or four times as wide as long, excepting the fourth or fifth piece, which is pentagonal, and supports,

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on its sloping upper side, the first divisions. In one ray on the anal side the second piece is pentagonal, larger than that of any of the others, and supports an arm-like range of anal pieces on its short sloping left side, above which the other pieces present the same size and form seen in the other rays.

Arms after the first division on the last radial, bifurcating again on the sixth or seventh piece, after which they are known to divide again in one arm, on the sixth piece, which is as far as our specimens show the structure.

Surface usually appearing smooth, but sometimes showing traces of scattering granules. Column comparatively large, distinctly pentagonal, and expanding upward near the base of the body, where it is composed of irregularly alternating thicker and thinner segments; central perforation small and round.

Height of body from base to the summit of first radial pieces, 0.35 inch; breadth at summit of first radials, about 0.67 inch; length of five succeeding radial pieces, 0.46 inch; breadth of do., about 0.15 inch. Breadth of column at its connection with the base, 0.32 inch.

This is perhaps the largest and most robust species of the genus known. It is composed of thick, strong plates, and the indentations or excavations at the points where the superior angle of each basal plate connects with the inferior lateral angles of the first radials, together with the more shallow depressions extending down from these points to the lower margin of the basal pieces, give a pentagonal outline to the body—the five angles being coincident with those of the column.

Locality and position: Cincinnati Group of the Lower Silurian series; Oswego, Kendall county, Illinois.

HETEROCRINUS SUBCRASSUS, M. and W.

Pl. 4, fig. 5 *a*, *b*, *c*, *d*.

Heterocrinus subcrassus, MEEK and WORTHEN, Aug., 1865. *Ib.* p. 148.

THIS species agrees so nearly with the last in most of its characters, as to render a detailed description unnecessary. It

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will be readily distinguished, however, by its smaller size, as well as its less robust appearance, and the different aspect of its arms. This latter difference consists in the more slender appearance of all the divisions, and particularly in the joints of which they are composed, having their upper margins projecting beyond the base of each succeeding piece above, so as to present a kind of upward imbricating appearance and roughness, not seen in the arms of *H. crassus*.

As in the last, its rays bifurcate first on the fifth and sixth pieces, and one of them supports an arm-like series of anal pieces, on the left side of the second radial, above which it bifurcates regularly on the sixth piece. After the first regular division on the last radial piece, some of the arms are seen to divide again on the fourth, others on the fifth, and others on the sixth pieces, after which one division is known to bifurcate on the sixth piece, and still again on the thirteenth.

Breadth of body at the summit of the first radial pieces, 0.27 inch; height of do., 0.13 inch; length of rays from top of first radial pieces to the first bifurcation, 0.21 inch; entire length of arms, from first division to extremities, about 1.50 inches. Breadth of column at its connection with the base, 0.15 inch.

One of the specimens (see fig. 5 *c*) shows rising up from the summit, between the arms, the remains of a kind of trunk or proboscis similar to that of *Poteriocrinus*, *Dendrocrinus*, etc. We have not been able to make out the form of the plates composing this part, but they are seen to be strengthened by a mesial vertical ridge, and transverse sharp costæ, in pairs. The stout series of anal pieces seen extending up on the left side of this part, in fig. 5 *c*, are more like arm pieces, though differing in form from those of the arms. This series probably performed the office of a support to the proboscidiform extension of the body, with which it connects. The presence of this peculiar upward prolongation of the body, would suggest affinities of the genus to the *Poteriocrinidæ*, from which, however, these forms seem to differ in having no subradial pieces. It is possible, however, that there may be minute basal pieces within the series here regarded as such; and that the latter are really subradials. Of this, however, we have been unable to find any evidence. So far as we have been able to see, the proboscis mentioned above appears to be very similar to that of *Dendrocrinus proboscidiatus*, of Billings.

Locality and position: Cincinnati, Ohio; Cincinnati Group of the Lower Silurian.

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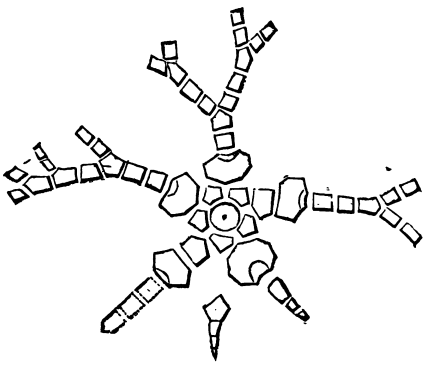
GENUS HYBOCRINUS, Billings, 1866.

HYBOCRINUS? INCURVUS, M. and W.

SUBGENUS ANOMALOCRINUS, M. and W.

Pl. 4, fig. 3 *a*, *b*.

Heterocrinus incurvus, MEEK and WORTHEN, Aug., 1865. *Ib.*



Hybocrinus? incurvus. Diagram showing structure.

BODY expanding rapidly from the base to the summit of the first and second radial pieces, where it is more than twice as wide as high; composed of the five basal, five first radial, and two second radial pieces. Basal pieces pentagonal, of moderate size, wider than long, and forming together a low, rapidly-expanding, pentagonal cup. First radial pieces in three of the rays from three to five times as large as the basal pieces, wider than long, two hexagonal and one heptagonal—all with their superior lateral angles strongly incurved between the arms, and each with a small protuberant, rounded facet above, for the reception of the small succeeding radials. In the remaining two rays, the first pieces are smaller and lower than those of the others, and each pentagonal in form, with the upper side horizontally truncated in its entire breadth, for the reception of a larger second radial, which in these two rays agrees in size and form, as well as in being included as a part of the walls of the body, with the large first pieces of the other rays. Succeeding radials not more than one-third as wide as those included in the walls of the cup, and forming small, rounded, widely separated free arms, consisting of one to three quadrangular and one pentagonal pieces to each ray. Arms above the first bifurcation on the second or third pentagonal free radial, in two of the rays seen, bifurcating again on the third piece, and, in one instance, sending off nearly at right-

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angles from the second piece after the first division, a strong tentacle, or small lateral branch.

First anal piece pentagonal, longer than wide, and resting between the left sloping side of a large second primary radial, and the right sloping side of a first primary radial, with rather less than half its length projecting above the former, and without extending down so as to bring its base in contact with any of the other plates below. In the individual examined, this piece is strongly incurved, and supports on its inner truncated end an oblong, narrow second anal, which in its turn supports a smaller third piece, all of which are arranged in a right line, and probably form one side of the proboscis.

Surface smooth or only with traces of fine granules. Sutures a little concave. Column comparatively strong and rounded near the base, where it is composed of short joints, and marked with obscure, regular longitudinal striæ.

Height of body on the anal side, 0.28 inch; do. on the opposite side, 0.22 inch; greatest breadth above (allowing for a slight accidental compression), about 0.38 inch; breadth of free arms at their connection with the body, 0.08 inch; breadth of column at its connection with the base, 0.16 inch.

This species presents points of analogy both to *Heterocrinus*, Hall, and *Hybocrinus*, Billings, and yet seems to differ from both to such an extent, that if we could be sure some of its peculiarities are not abnormal in our specimen, we would be inclined to view it as the type of a new genus. As we have seen but the one specimen, however, which is not complete in all its parts, we have concluded to place it, for the present at least, as the type of a subgenus under *Hybocrinus*. It differs from the typical species of *Heterocrinus* in having the column round instead of pentagonal, and in having only the first primary radial pieces in three of the rays, and two in each of the others, included as a part of the walls of the body; while its succeeding primary radials are very narrow, and form small, rounded, distantly separated arms, instead of being nearly as wide as those soldered in the walls of the cup. Another peculiarity is the strongly incurved superior lateral angles of the large radial pieces around the margin of the cup, between the arms, and the absence of the prolongation of the body in the form of a proboscis above.

In the rather unsymmetrical form of the body, the slender proportions of the free arms, and its general aspect, it agrees with *Hybocrinus*, from which it

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differs in having but one anal piece connected with the walls of the cup, and in having two of the rays and two of the primary pieces included in the wall, while its free arms bifurcate twice or oftener, instead of being simple from their origin. The latter, however, is only a specific character.

For this interesting specimen we are indebted to Mr. David H. Shæffer, of Cincinnati, Ohio.

Locality and position: Same as last.

Genus POROCRINUS, Billings, 1856.

Porocrinus, Billings. Report Geol. Survey of Canada, 1856, p. 279; Canadian Org. Rem., 1859, Decade IV., p. 33.

Generic formula.—
Basal plates, 5.
Subradials, 5.
Radials, 1+5.
Proper interradials, 0.
Anals, 2.

Mr. Billings' description of this genus reads as follows: "Cup conical; basal plates five, pentagonal; subradials five, three hexagonal and two heptagonal; primary radials five; one large azygos interradial supported on the truncated summit of the anterior subradial, and one small one situated over the suture between the anterior subradials, and having above it on one side the large azygos, and on the other the left anterior primary radial; several small pectinated rhombs, similar to those of the *Cystoidea*."

As remarked by Mr. Billings, this genus has the structure, so far as the form and arrangement of the plates forming the base and lateral walls of the cup are concerned, of *Poteriocrinus;* from which it differs in the important character of having pectinated openings analogous to those of the *Cystoidea*. It also differs from *Poteriocrinus* in wanting the extension of the body above the arm bases; while the openings of its vault are also different from those of *Cyathocrinus*.

Our specimens of the following described species also appear to show that this interesting type probably presented another character in common with the *Cystoidea*—that is, the possession of several rounded and non-pectinated openings. Of these openings there are apparently three, one on the anal side, and two on the anterior side.* They are all nearly on the same horizon as the

* It is possible that some of these supposed openings, however, may be pectinated apertures, but they look like simple openings.

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bases of the free arms, though the anal opening is a little lower than the other two.

So it would seem this genus presents, as it were, a combination of the characters of the typical *Crinoidea* and *Cystoidea*. With the regularity of structure and arrangement of parts of a true Crinoid, it has the pectinated and other openings of a Cystidean. It differs, however, from the *Cystoidea*, in having the pectinated openings located at the junction of the *corners* of the plates, instead of *passing through them near one of the sides*, while the little bars protecting these openings are arranged obliquely, instead of at right angles to the margins of the plates, as in the *Cystoidea*.

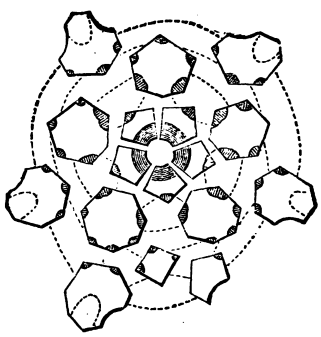
Our species also shows that the conical form of the cup is not a generic character.

POROCRINUS CRASSUS. M. and W.

Pl. 4, fig. 2 *a*, *b*.

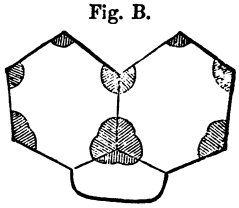
Porocrinus crassus, MEEK and WORTHEN, August, 1865. Proceed. Acad. Nat; Sci., Philad., p. 115.

Fig. A.



Porocrinus crassus.
Diagram showing structure of the body.

Fig. B.



One of the basal pieces and two of the subradials, enlarged, as seen in a side view, to show more clearly the pectinated openings.

BODY subovoid or a little higher than wide. Base depressed, rather widely truncated below, pentagonal in outline, two and a half to three times as wide as high, with a comparatively large pentagonal central perforation; basal pieces wider than long, pentagonal in outline. Subradial pieces twice to three times as large as the basal, about as wide as high, three hexagonal, and two on the anal side heptagonal. First radial pieces of about the same size as the subradials, apparently all irregularly heptagonal, each with, near its upper extremity, a

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small outward-sloping subcordate, or oval, flattened surface, for the articulation of the second (first free) radial piece; four of them with each one, and the fifth with two, of the superior lateral margins deeply sinuous and forming in part the margins of the large rounded openings of the summit. Anal pieces two; the first smaller than the other, quadrangular in form, resting between the superior sloping sides of two of the subradials, and supporting, on its right upper sloping edge, one side of one of the first radials, and on its left one of the oblique sides of the second anal piece. Second anal oblique, wider (obliquely) than its diameter in the direction of its vertical axis, irregularly pentagonal, resting with its base upon the upper truncated side of one of the subradials, and its left side against one of the first radials; while its upper right margin connects with another, and its sinuous oblique superior side forms the under margin of the anal opening. Pectinated areas situated in deep excavations, those at the angles of the basal and subradial pieces largest, and obscurely trilobate; the smaller ones at the angles above oval or subcircular. Surface ornamented with strong radiating costæ, extending from the center to each of the sides of the plates, and all widening from the center outwards. (The latter character and the furrowing of the sutures are not well represented in the figures.) Sutures distinctly furrowed, even on the truncated under side of the base.

Length, 0.72 inch; breadth, about 0.66 inch.

This species will be at once distinguished from *P. conicus*, of Billings, the typical species of the genus, by its oval instead of obconic form (being widest a little below the arms, and rounded in above) and the strong radiating costæ of its plates. We know of no other form with which it need be compared.

Like the typical species, its free arms commenced with the second radial, and were evidently slender and nearly cylindrical, or a little compressed laterally, and provided with a very small furrow above. We have not seen the column, but it appears to have been large at its connection with the base, and probably pentagonal.

Nor have we been able to see the structure of the small crown occupying the

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narrow space within the area surrounded by the arms, but it seems to consist of about three or four comparatively large plates.

Locality and position: Oswego, Kendall county, Illinois; Cincinnati Group, Lower Silurian System.

POROCRINUS PENTAGONIUS, M. and W.

Pl. 1, fig. 3.

Porocrinus pentagonius, MEEK and WORTHEN, August, 1865. Proceed. Acad. Nat. Sci., p. 146.

BODY pentagonal-obovoid, being more or less rounded above, and tapering at an angle of about sixty degrees from the middle of the prominent subradials to the summit of the column; base forming about one-fifth of the entire height, and having the form of an expanding pentagonal basin, with flattened sides; basal pieces pentagonal, and nearly twice as wide as high. Subradial pieces as long as wide, and equaling nearly half the length of the body—the only one visible on all sides in our specimens, hexagonal in form; each prominent in the middle, from which point a well-defined ridge radiates so as to connect with similar ridges on each of the surrounding plates; the ridges passing laterally and upwards intersect the sides of the plates, but the one passing downwards from the middle of each subradial coincides with its central inferior angle, where it connects with a corresponding ridge extending up the sutures between the basal pieces; the arrangement of the ridges being such as to divide the surface into a series of large triangular, slightly concave areas, in which are placed the pectinated openings. These openings, at the corners of the basal and subradial pieces, consist of about twelve of the linear fissures to each plate; those at the junction of the plates above smaller, with a proportionally smaller number of fissures. Form and arrangement of the anal and radial pieces, as well as of the arms, unknown.

Surface finely granulo-striate, the granules being ranged in lines parallel to the ridges, particularly on the ridges below

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the middle of the subradials, so as to present, as seen under a good magnifier, a finely substriated appearance.

Column rounded, and expanding rapidly upwards near the base, where it is composed of very thin segments with minutely crenated edges; farther down the segments are proportionally thicker and more coarsely crenate.

Length of body, 0.43 inch; breadth, at the middle of the subradials, 0.40 inch. Breadth of column at its connection with the base, 0.15 inch; do. 0.72 inch below, 0.05 inch.

This species will be readily distinguished from *P. conicus*, of Billings, by its broader, more ovoid, and more angular form, owing to the much greater prominence of its subradial pieces, and particularly by the well-defined ridges radiating from the center of the plates. In the latter character it approaches more nearly the last described species, *P. crassus*, from which it differs in a marked degree, in having its under side, below the middle of the subradial pieces, greatly more tapering, and the base much smaller, and not wider than the head of the column, as well as proportionally higher. It also differs in having its greatest breadth at the middle of the subradial pieces, which are much more prominent; while its pectinated openings are not sunken, nor its sutures furrowed, as in the last.

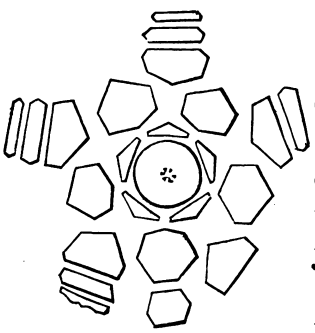
Locality and position: Trenton division of the Lower Silurian, at Dixon, Illinois.

Genus DENDROCRINUS, Hall, 1852.

(Palæontol. N. Y., vol. II, p. 193.)

Dendrocrinus Oswegoensis, M. and W.

Pl. 4, fig. 4.



Dendrocrinus Oswegoensis.
Diagram showing structure of body.

Body obconic, but rather widely truncated for the reception of the column at the base. Basal pieces very short, or only forming a mere ring, not very readily distinguished from the upper joint of the column. Subradial pieces comparatively large, as wide as long, four of them hexagonal, and one on the anal side heptagonal, the latter being

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truncated above for the reception of the first anal piece; the angle at the middle of the under side of each of them very obtuse, or nearly obsolete. First radial pieces nearly as large as the subradials, a little wider than long, of nearly equal size, and all pentagonal, or with occasionally one of the superior lateral angles truncated, so as to form a sixth angle; each, in four of the rays, seem to support on its superior broadly truncated side, in direct succession, a series of much shorter, but equally wide radials, the number of which is unknown, though in three of the rays of the specimen described, two of the pieces are left, all the others being broken away. In the fifth ray (immediately on the right of the anal series) the second radial piece seems to have been of a different form from those of the other rays; but the specimen is too imperfect to show its true nature. First anal piece about two-thirds as large as the subradials, hexagonal, and resting upon the superior truncated side of one of the subradials, between two of the first radials, and connecting on the right above with a second radial; sutures slightly indented at the corners of the plates. Column, near the base, rather large, round, and provided with a very distinctly five-rayed, star-shaped central canal. (Other parts unknown).

This species differs considerably in its general physiognomy from the typical forms upon which the genus *Dendrocrinus* was founded, particularly in the great breadth of the radial pieces above the proper body of the crinoid. Some of the species described by Mr. Billings, however, with the structure of *Dendrocrinus*, show gradations in this character, between these forms, with broad, nearly flat radial pieces, in contact all around below the first bifurcation, excepting on the anal side, and those with slender rounded arms and free rays, as in the typical species. Similar differences are also observed among the species of several of the Carboniferous genera.

Specifically, this form seems to agree most nearly with *D. latibrachiatus*, of Billings, from which it differs in its proportionally much shorter and wider basal pieces, and its much larger size, as well as more robust aspect. It also differs in having the sutures at the meeting of the corners of the plates a little indented.

Locality and position: Oswego, Kendall county, Illinois; in the Cincinnati oup of the Lower Silurian series.

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MOLLUSCA.

BRACHIOPODA.

GENUS STROPHOMENA, Rafinesque, 1820. ?

(*Strophomenes*, R.—*Strophomena*, BLAINV. (1825), Malac. p. 513.)

STROPHOMENA UNICOSTATA, M. and W.

Pl. 4, fig. 11 *a*, *b*.

SHELL transversely subsemicircular, the greatest breadth being on the hinge margin, which terminates in rather acutely angular extremities; lateral margins generally nearly straight, or more or less concave in outline, and converging from the extremities of the hinge to the front, which is rounded, a little straightened, or slightly sinuous in the middle; geniculation of both valves from the ventral side, very abrupt all around the anterior and lateral margins, to near the extremities of the hinge. Ventral valve almost perfectly flat, and without any traces of concentric wrinkling on the disc between the hinge and the geniculated front and lateral margins; beak very small, or scarcely distinct from the cardinal margin, and showing the usual minute perforation; area narrow, but a little wider than that of the other valve, and slightly arched, and provided with a rather wide triangular fissure, closed by the convex pseudo-deltidium and the cardinal process of the other valve. Dorsal valve with the disc or visceral region flattened, and, like that of the other valve, without any traces of concentric undulations; deflected anterior and lateral margins conforming nearly to those of the other valve; beak nearly obsolete; area linear, and provided with a marginal furrow for the reception of the edge of the other valve; cardinal process rather small, cordate or bilobed, with the socket on each side for the reception of the teeth of the other valve well defined; interior with muscular scars generally moderately distinct (the cavity for their reception represented too

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small in fig. 11 *b*), and separated by a small mesial ridge; other parts of the visceral region occupied by rather crowded granules. Surface of both valves ornamented by fine, crowded, radiating striæ, which increase by intercalation and division, while one of those on the middle of the ventral valve is generally five or six times as large as the others, and really forms a distinct mesial rib.

Breadth of largest specimen seen, 1.28 inch; length, 0.56 inch; number of striæ in 0.10 inch, on the disc of the ventral valve near the deflected edge, 12 to 16.

This species will be readily distinguished from *L. rhomboidalis*, and other allied forms, by having its flattened disc of both valves always (as shown by a large series of specimens) without any traces of concentric undulations or wrinkles, and particularly by its single mesial rib on the outside of the ventral valve. These characters, being constant, in a large number of individuals, found at different localities, lead us to regard it as a distinct species from any of those yet defined, with which we are acquainted.

We retain the name *Strophomena* for this group, rather from deference to various high authorities in Palæontology, who range such shells under that name, than from being clearly satisfied that they properly belong to the genus so named by Rafinesque. At any rate they present quite a different physiognomy from the forms usually referred to that genus, such as *L. alternata*, in their flattened disc, abruptly geniculated front and lateral margins, and visceral region margined by a distinct ridge, as well as in some other characters. Rafinesque defined his genus, and the species he ranged under it, so loosely and briefly, that it is impossible for any one, from his descriptions, (which were not accompanied by figures), to be positively sure exactly what type he had in view, while he did not cite any known species, or refer to any published figure. In such cases it has been the general custom of naturalists to follow the first succeeding author who adopted the genus, with an intelligible description, figure or citation, in deciding in regard to the particular type for which the name is to be retained. The first author who adopted *Strophomena* after Rafinesque was Defrance, in 1824, but he did it in a mere list, without figures or description. In 1825, however, Blainville adopted the genus in his Malacology, giving a description of the genus, and figures of a species (*rugosa*, Raf.) Hence it is to this type we must go if we adopt the genus at all. But a moment's examination of Blainville's figures will convince any one that they do not represent one of these peculiar forms like that under consideration, but a resupinate shell, with a wide Orthis-like area, similar to *S. planumbona* of Hall, if not indeed that very species, which Prof. Hall now thinks related to *Streptorhynchus*. It

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is therefore evident that, unless this shell is congeneric with such forms as *S. rhomboidalis*,=(*S. depressa*, of authors), our species cannot be properly ranged in the same genus. We have the impression that a proper application of the rules of nomenclature would require that Dalman's name *Leptæna* should be retained for the group of which *S. rhomboidalis* is the type. (A conclusion already adopted, we believe, by Prof. Shaler in one of the Bulletins of the Cambridge Museum.) If so, our species here described will have to be called *Leptæna unicostata.*

Locality and position: Savannah, Illinois; in the Cincinnati Group of the Lower Silurian. It also occurs at the same horizon in Iowa.

LAMELLIBRANCHIATA.

Genus AMBONYCHIA, Hall, 1847.

(Palæont. N. Y., vol. I, p. 163.)

Subgenus MEGAPTERA, M. and W., 1866.

Pl. 4, fig. 9 *a*, *b*.

Megaptera Casei, M. and W.

Ambonychia (*Megaptera*) *Casei*, Meek and Worthen, March, 1866. Proceed. Chicago Acad. Sci., vol. I, p. 22.

Shell trigonal, compressed, subequivalve, extremely inequilateral, posterior side long, compressed and strongly alate; the wing very large, produced, pointed, and not separated from the alate posterior margin by a distinctly defined sinus; margin below the wing, sloping obliquely forward to the basal angle; cardinal margin the longest part of the shell, straight and much compressed from immediately behind the beaks. Anterior side truncated nearly vertically from the beaks, about half way down the front, thence sloping slightly backwards to the basal angle. Basal margin produced downwards, and terminating in a distinct angle, slightly in advance of the middle. Umbonal slopes very prominent, angular, or sometimes apparently bicarinate, straight, and extending from the beaks, near the anterior margin, to the most prominent part of the base, ranging at an angle of about 65° below the horizon of the

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hinge-line, and provided with a longitudinal sulcus below the middle of the valves. Beaks straight, rising a little above the cardinal margin, and quite terminal. Surface ornamented with distinct, irregular, alternately larger and smaller, thread-like radiating striæ, with less distinct concentric lines, and a few distinct, stronger marks of growth, which sometimes form prominent, imbricating, subspinous projections on the umbonal angle.

Length, as inferred from the direction of the lines of growth, about 2 inches; height, 1.73 inch; convexity, 0.64 inch.

We consider this curious shell to be the type of a new subgenus, which we were first inclined to place under *Pterinea*, but on examining some internal casts, we ascertained it has the hinge teeth (at any rate those just in front of the beaks) of *Ambonychia*, while it shows no traces of the deep-seated, oblique posterior teeth, or of the strong anterior muscular impression and anterior ear of *Pterinea*. In form it approaches more nearly *Pteronites*, of McCoy, but as it is much less oblique, and has the posterior wing greatly more produced than the Carboniferous types upon which that genus was originally founded, while its beaks are quite terminal, and there appears to be no little lobe or ear in front of them, we have concluded to leave it provisionally under *Ambonychia*. From the typical forms of that genus, however, it differs extremely, in the great development of its posterior wing.

None of the specimens give any indications of the valves gaping in front, unless it may have been very near the beaks, where there is probably a small anterior wing. One cast shows some appearance of the impression of the adductor muscle, occupying a sub-central position back of the umbonal ridge, on the alate portion of the shell; while another shows the pallial line extending around up the front, nearly to the inner apex of each beak.

Named in honor of Mr. L. B. Case, of Richmond, Indiana, who discovered the only specimens of this species we have seen.

Locality and position: Richmond, Indiana; upper part of the Cincinnati Group (Hudson River Group, as formerly understood). Lower Silurian.

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GENUS DOLABRA, McCoy, 1844.

(Carb. Foss. Ireland, p. 64.)

DOLABRA STERLINGENSIS, M. and W.

Pl. 4, fig. 10 *a*, *b*, *c*.

Dolabra sterlingensis, MEEK and WORTHEN, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 260.

SHELL rhombic-cordate, being cordate in outline, as seen in an anterior and posterior view, and obliquely rhomboidal, as seen from either side. Posterior margin obliquely truncated, with a long slope, which is slightly convex above, and faintly sinuous near the middle; posterior basal extremity produced obliquely backwards and downwards, with a more narrowly rounded or sub-angular outline; basal margin ascending forward, with a moderately convex curve, and rounding up more or less gradually into the very short or almost obsolete anterior side; hinge line short; cardinal area moderately developed. Beaks prominent, placed nearly over the anterior margin, strongly incurved, and compressed antero-posteriorly; umbonal ridges very prominent, sub-angular, and extending from the beaks obliquely to the posterior basal extremity, at an angle of about 45° below the horizon of the hinge, thus dividing each valve into two subequal areas, of which the one behind is flattened or slightly concave between the ridge and the moderately prominent postero-dorsal edge, and that in front and below it convex. Surface marked with concentric striæ of growth. (Hinge and interior unknown).

Greatest length, measuring obliquely from the beaks to the posterior basal extremity, 2.20 inches; diameter at right-angles to the same, 1.50 inch; convexity of the two valves when closed, 1.50 inch.

This species is evidently related to *Cyrtodonta Hindi*, of Billings (see Palæozoic Fossils of Canada vol. I, p. 151, fig. 131 *a*, *b*), from the same geological horizon. It differs, however, in several important specific characters, being proportionally much more gibbous, shorter, and, in consequence of its hinge

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line forming a wider angle with its umbonal axis, distinctly less oblique. It also differs in having its anterior side much less prominent and more broadly rounded below the beaks, which consequently have the appearance of being almost terminal. Its beaks are likewise more compressed antero-posteriorly, and its hinge line shorter. Our specimen does not show the cardinal area very satisfactorily, though it is evidently moderately well developed, and shorter than in Mr. Billings' species.

Until the hinge and interior of this shell can be examined, it is scarcely possible to determine very clearly its generic character, but on comparison with *Cucullæa angustata*, Sowerby, the type of McCoy's genus, *Dolabra*,* and other more obliquely truncated species, such as *C. unilateralis*, Sowerby, *C. amygdalina*, Phillips, as figured in Phillips' Palæozoic Fossils, we can scarcely doubt the propriety of referring it to the genus *Dolabra*. Some of these species have much the form and general external appearance of the genus *Cucullæa*; while Sowerby's figure of an internal cast of the so-called *C. angustata* (Geol. Trans. (2), vol. V, pl. 53, fig. 25), seem to indicate a very similar hinge to that of *Cucullæa*. They appear to want the prominent posterior muscular support and the radiating costæ or striæ of the more modern species of true *Cucullæa*, of which, however, they are evidently palæozoic representatives.

Locality and position: Cincinnati group, of Lower Silurian series; at Sterling, Illinois.

GASTEROPODA.

? Genus CYRTOLITES, Conrad, 1838.

(Ann. Report Palæont. N. Y., p. 118.)

Cyrtolites imbricatus, M. and W.

Pl. 4, fig. 12.

Shell subdiscoid; volutions from three to three and a half, increasing rapidly in size—their dorso-ventral diameter being to the transverse as 50 to 40; inner ones nearly half embraced by the last turn; all having the dorsal carina well defined, and the greatest convexity near, or a little within, the middle of

* The genus *Dolabra*, as first proposed by Prof. McCoy, included along with the typical species, such as *Cucullæa angustata*, and *C. unilateralis*, Sowerby, *C. amygdalina*, Phillips, etc., other forms belonging to the subsequently established genus, *Schizodus*, King. After the separation of the latter group, however, the name *Dolabra* was of course left for the other genus.

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each side, which is sub-angular, excepting near the aperture on the last whorl. Umbilicus moderately wide, and rather deep basin-shaped, showing about half of each inner turn. Surface ornamented by numerous raised, undulated, and vaulted lamellæ, rather irregularly disposed, and becoming crowded and distinctly imbricating near the aperture.

Greatest diameter, 0.86 inch; convexity, about 0.40 inch; dorso-ventral diameter of the last turn, near the aperture, 0.50 inch.

This species is related to the well known *C. compressus*, Conrad, from which it differs materially in the much more rapid increase of the dorso-ventral diameter of its volutions, as well as in having the inner sides of its whorls sloping into the umbilicus from the most prominent sub-angular central region, instead of rounding abruptly into the same. Its lamellæ, although strongly undulated, are less regularly so than in *C. compressus*; while they are more prominent, irregular, and more distinctly imbricating, near the aperture. These lamellæ are not well represented in the figure.

Locality and position: Alexander county, Illinois; Cincinnati group of the Lower Silurian series.

PTEROPODA.

Genus TENTACULITES, Schlotheim, 1820.

(Petref., p. 377.)

Tentaculites tenuistriatus, M. and W.

Pl. 4, fig. 7 *a*, *b*.

Tentaculites tenuistriatus, Meek and Worthen, 1865. Proceed. Acad. Nat. Sci., p. 254.

Shell attaining a rather large size, gradually tapering, and a little curved; annulations large, prominent, rather obtuse near the smaller end; separated by rounded constrictions of about 0.10 inch breadth at the larger extremity of a specimen one inch or more in length. Surface marked by numerous, very fine, regular, closely arranged longitudinal striæ, most distinctly marked in the rounded depressions between the annulations. Aperture circular.

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Length, 1.16 inches; breadth at the aperture, measuring upon one of the rings, 0.25 inch; do., between the rings, 0.19 inch; space occupied by four rings, and the three intervening spaces at the larger end, 0.30 inch; while the same space includes six rings at the smaller end.

This species resembles rather closely the enlarged figure of a form from the same horizon, referred by Prof. Hall to his *T. flexuosus*, (pl. 78, fig. 2 *b*, Palæont. N. Y., vol. I); but its annulations are sharper, and its longitudinal striæ more crowded; while the natural size of the New York species is much smaller.

Dr. Shumard has also described, under the name *T. incurvus* (Missouri Report, p. 195), a similar form, though his species is much smaller, with more crowded rings, while it also differs in having minute annular striæ.

Locality and position: Cincinnati Group of Lower Silurian series; Alexander county, Illinois.

TENTACULITES OSWEGOENSIS, M. and W.

Pl. 4, fig. 6 *a*.

Tentaculites Oswegoensis, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 254.

SHELL attaining a rather large size, very gradually tapering to an acute point, distinctly arched, particularly towards the smaller extremity; section circular; annulations rather prominent, somewhat obtuse, from three to three and a half in a space equaling the transverse diameter, diminishing very regularly in size, and in their distance apart, from the larger to the smaller extremity. Surface without longitudinal or (visible) transverse striæ.

Length, 1.45 inches; greatest transverse diameter, 0.16 inch; space occupied by six annulations, and five of the intermediate constrictions, at the larger end, 0.35 inch.

This species has much the general appearance of curved individuals of *T. elongatus*, Hall, from the Lower Helderburg group (Upper Silurian), of New York, but is decidedly more strongly arched, proportionally more slender, and has more closely arranged annulations, while it shows no traces of the annular striæ seen on the New York species.

From our *T. tenuistriatus*, described on the preceding page, it will be distinguished by its more slender form, more closely arranged rings, and the absence

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of longitudinal striæ. The last mentioned character, and its much larger size, will also distinguish it from *T. incurvus*, of Shumard, (Missouri Geological Report, pl. *B*, fig 6 *a*, *b*.)

Locality and position: Oswego, Kendall county, Illinois; in the Cincinnati group of the Lower Silurian.

TENTACULITES STERLINGENSIS, M. and W.

Pl. 4, fig. 8.

Tentaculites Sterlingensis, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 255.

SHELL small, slightly arched, and gradually tapering to a point; section circular; annulations prominent, angular, rising abruptly from the surface, usually about their own breadth apart; constrictions between the annulations, with fine, sharply elevated, longitudinal striæ, which are not continued upon the rings.

Length, 0.56 inch; breadth at the larger end, 0.08 inch; annulations five in the space of one-eighth of an inch, at the larger end, and nine or ten in the same space at the smaller end. Longitudinal striæ, five in the space of 0.02 inch.

It is not improbable that this will prove to be the form from the so-called Hudson River group, referred by Prof. Hall to his *T. flexuosus*, in vol. I, p. 284, Palæont. N. Y. As that specific name, however, was founded upon a Trenton fossil, described as being septate, and having nine rings in one-eighth of an inch (being, as is now supposed, the column of a *Cystidian*), the name *flexuosus* could not be properly applied to this form, which is a true *Tentaculite*.

It will be distinguished from *T. incurvus*, of Shumard, from the Cape Girardeau limestone, which it resembles in size and form, by having its annulations arranged about their own breadth, instead of twice that distance apart, as well as in having the longitudinal striæ only defined *between* the rings, instead of of also *upon* them.

It seems to be *very* closely allied to *T. distans*, Hall, of the Clinton group, but differs in being curved instead of straight, as well as in being less rapidly expanding towards the larger end.

From the last of the two foregoing species it will be readily distinguished by its much smaller size, more sharply elevated rings, and distinct longitudinal striæ.

Locality and position: Sterling, Illinois; Cincinnati group of the Lower Silurian series.

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UPPER SILURIAN SPECIES.

FOSSILS OF THE NIAGARA GROUP.

PROTOZOA.

SPONGIÆ.

GENUS ASTYLOSPONGIA, Roemer.

(Sil. Fauna West. Tenn., p. 7.)

ASTYLOSPONGIA ?? CHRISTIANI, M. and W.

Pl. 5, fig. 3 *a*, *b*, *c*.

ELONGATE-SUBOVATE, approaching an elliptic outline, rounded at the extremities; irregularly divided longitudinally by narrow, moderately deep furrows, into about eight lobes. Furrows straight, or more or less oblique, and a little flexuous, not converging regularly to a point at each extremity, but becoming more curved or flexuous near the ends, so as to impart a somewhat twisted appearance to the extremities; usually extending the entire length, but a few of them shorter, or not more than half the length of the fossil, the shorter ones generally starting from one end and terminating near the middle. Surface apparently smooth. Internal structure unknown.

Length, 1.22 inches; greatest breadth, 0.66 inch.

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At the same time that we refer this fossil, provisionally, to the genus *Astylospongia*, we have many doubts in regard to its relations to that group, or even whether it is really a sponge at all or not, as we have not been able to see any structure in it, beyond the fine granular appearance of the magnesian limestone from which it was obtained. The slightly twisted character of its longitudinal furrows, produces some remote resemblance to the internal casts of those curious pear-shaped *Cystidians*, for which the name *Gomphocystites* has been proposed, and suggests the inquiry whether it may not be an internal cast of an allied *Cystidian*. Until other specimens, showing something more of its structure, can be examined, however, it seems scarcely possible to decide positively in regard to its true nature.

Named in honor of Mr. J. B. Christian of Mt. Carroll, to whom we are indebted for the only specimen we have seen.

Locality and position: Niagara group; Carroll county, Illinois.

(***Incerta sedes.***)

GENUS PASCEOLUS, Billings, 1853.

(Canadian Geol. Rep., p. 342.)

PACEOLUS? DACTYLIOIDES, Owen (sp.).

Pl. 5, fig. 2 *a*, *b*, *c*.

Lunulites? dactioloides, OWEN, 1844. Report Geol. Expl. Iowa, Wis. and Illinois (Octavo), p. 69, pl. XIII, fig. 4.

HEMISPHERICAL, the under side being flat or nearly so, and the other convex, while the periphery is rather sharply rounded, or subangular. Entire surface occupied by regular, closely crowded, hexagonal pits, or shallow depressions, separated by slender raised divisions. On the upper convex side these pits are of uniform size, and each one perforated in the middle by a minute circular opening passing into the interior; while those of the under or flat side are imperforate, and diminish in size from the periphery towards the center. They also differ from those above, in showing a slight tendency to arrange themselves into curved lines crossing each other, as in *Receptaculites*, from which, however, they differ in being distinctly hexagonal.

Height, or convexity, 0.50 inch; greatest breadth, 1.17 inches.

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Although Dr. Owen's figure of the fossil described by him under the name *Lunulites? dactioloides*, represents the cells as being nearly circular, and more distantly separated than those of the form under consideration, there is little room to doubt, judging from his description—("truncated spherical, with five or six-sided cellular depressions in rows around the circumference, like those of a thimble")—that it is really the same, especially since it came from the same rock, and is the only fossil resembling his figure yet known from this horizon.

In regard to its zoological relations, however, we are in considerable doubt, and we only place it provisionally in Mr. Billings' genus *Pasceolus*, because it presents much the same general appearance, while we are not sure whether it is, as we now see it, merely a cast of the interior, or of the exterior. If the former, it may have been incased in a shell composed of solid hexagonal plates as in *Pasceolus;* but if it is a cast of the exterior, it would be widely different from that type, in having the whole surface occupied by hexagonal pits, instead of solid convex plates. Even if covered by plates, however, it would still differ from *Pasceolus* in having these plates, on the under side, diminishing in size to the center, and showing a tendency to range themselves in curved lines, like the cells in *Receptaculites.* It differs very decidedly from the latter, however, in having the pits of the surface all hexagonal, instead of quadrangular or rhombic, while we have no reason to believe that it has any of the internal characters of that genus.

It is possible our fossil should be referred to Eichwald's genus *Cyclocrinites*, but we are left in doubt on this point, because *Cyclocrinites* is not only said to be covered with plates, but to be provided with openings like the *Cystidians*, to which group it is generally referred by good authorities.* We can scarcely believe it possible that the fossil under consideration had any other openings than the minute perforations in the middle of the depressions of the upper side, or is in any way related to the *Cystoidea.* Mr. Billings, to whom we sent drawings of it, for comparison with his genus *Pasceolus*, writes that he thinks it most probably generically distinct from that type, and a new genus, holding an intermediate position between *Pasceolus* and *Receptaculites.* We are strongly inclined to adopt this view, but prefer to place it, provisionally, for the present, until other specimens giving more satisfactory information in regard to its structure can be obtained, under *Pasceolus.* In case it shall be found distinct from all the genera with which we have compared it, we would propose to call it *Cerionites*, in allusion to its resemblance to honey-comb.

If *Tetradium* and *Receptaculites* are sponges, as has been suggested by some, this type will doubtless also be found to belong to the same section of that group.

Locality and position: Niagara group of the Upper Silurian; Carroll county, Illinois.

* *Pasceolus* has also been referred by Mr. Niles and Prof. Verrill to *Cyclocrinites*, but Mr. Billings thinks it destitute of the openings characterizing that group.

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RADIATA.

ECHINODERMATA.

GENUS SACCOCRINUS, Hall, 1852.

(Palæont. N. Y., vol. II, p. 205.)

In some of his later publications, Prof. Hall abandons this genus, and refers one of the species (*S. Christyi*) to *Actinocrinus*. Although, in the form, number and arrangement of the plates composing the body of these crinoids, they agree very closely with *Actinocrinus*, they still differ so materially in the elongate, sack-like form of their body, as to present a peculiar physiognomy, readily distinguishing them from the typical Carboniferous forms upon which the genus *Actinocrinus* was originally founded. In addition to this, at least the only species the arms of which are known to us (*S. speciosus*, Hall), differs from the typical species of *Actinocrinus*, in having their divisions bifurcating *after they have passed into a double series of interlocking pieces* The structure of the arms is perhaps not generally of much importance as a means of distinguishing the genera of crinoids, but the character of having each division, after passing into a double series, continued on without farther bifurcations, seems so constant in true *Actinocrinus*, as apparently to give more importance to the structure of these parts than in other groups.' At any rate, these elongated Silurian forms are certainly separable from *Actinocrinus* upon better grounds than some of the Upper Silurian species, such, for instance, as *Homocrinus scoparius*, Hall, (vol. III, Palæont. N. Y., pl. 1), can be separated from *Poteriocrinus*. They are also distinguished, upon analogous characters of general physiognomy, and other more important peculiarities, from *Megistocrinus*, to which they have sometimes been referred.

SACCOCRINUS CHRISTYI, Hall? (sp.)

Pl. 5, fig. 1.

Actinocrinus Christyi, HALL, 1863. Trans. Albany Inst., vol. V, p. 196; (not SHUMARD, 1855.)
Actinocrinus Whitfieldi, HALL, 1865. Eighteenth Rep. Regents Univ., N. Y., on State Cab. Nat. Hist.

BODY attaining a large size, elongate, obconical; without any constriction below the arm bases, which are abruptly spreading, with more or less deep sinuses between those belonging to the principal divisions of the rays and a larger one between the two posterior rays, on the anal side. Base (in internal casts) somewhat rounded, and only moderately promi-

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nent, its plates being more spreading than those of the next series above. First radial plates comparatively large, longer than wide, two heptagonal and three hexagonal, the upper truncated side of each being short. Second radials larger than wide, about half as large as the first radials, and (all?) hexagonal, with the upper and lower sides shorter than the others. Third radial pieces one-half to two-thirds as large as the second, about as long as wide, and generally heptagonal in form; the upper sloping sides of each supporting two secondary radials, each of which is succeeded by another, upon which a second bifurcation takes place; in the inner two of these last divisions there are apparently, in direct succession, three small tertiary radials, the last of which supports two free arms, while in each of the two outer divisions there appear to be two tertiary radials or brachial pieces, the last of which supports a single free arm, thus making (at least in the anterior and lateral rays) six arms to each ray.

Interradial pieces about ten to each interradial space; the first one generally slightly larger and proportionally wider than the second radials, hexagonal in form, and each supporting two smaller hexagonal and pentagonal pieces in the next range, above which the others are placed two in each range, and diminish rapidly in size as they pass up between the rays to connect with the vault. There are also, in each interaxillary space, some five or six smaller pieces, and one in some of the interbrachial spaces.

Anal series unknown, beyond the fact that they are numerous and comparatively small above the second or third range.

Vault flat, or nearly so, and composed of numerous small pieces; its opening placed between the middle and the anal side, and apparently provided with a proboscis.

Length from base to arm bases (internal cast), 2.26 inches; greatest breadth of do. just below arm bases, 1.50 inches.

As we know this crinoid mainly from internal casts, we can not be quite sure in regard to the nature of its external surface. On one specimen, however, apparently of the same species, we observe remains of a distinct linear ridge,

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extending up each of the radial series of plates and their bifurcations to the arm bases. Although the base is somewhat rounded in the internal casts, it was doubtless truncated below for the connection of the column, in specimens retaining the plates. In casts, the area of each plate is slightly concave, and the positions of the sutures between are marked by a raised line.

In general appearance this form nearly resembles *S.* (*Megestocrinus*) *infelix* of Winchell and Marcy, which Prof. Hall thinks not distinct from his *S. Christyi*, but it differs from the description of *S. infelix* in having eight or ten more arms. It would also differ in the same character from *S. Christyi*, if the number of the arms in that species has been correctly made out. As Prof. Hall seems to have been in some doubt, however, on this point, we have concluded to refer our specimens provisionally to *S. Christyi*, for the present, and if this form should hereafter prove distinct, it may be called *S. sacculus.*

In a tolerably well preserved specimen of *S. Christyi*, now before us, from Waldron, Indiana (the original locality), and apparently agreeing in all its other known characters with the description of that species, we observe obscure but unmistakable indications of numerous fine striæ radiating from the central region to the sides of all the larger plates—those passing to any one side being all parallel with each other. These lines might be readily overlooked, and, where the surface has been slightly worn, they would always be entirely obsolete. Prof. Hall mentions no such character in the description of his species, though it might not have been preserved on his specimens.

Locality and position: Bridgeport, near Chicago, Illinois; in the limestone of the age of the Niagara group of the Upper Silurian series.

MOLLUSCA.

BRACHIOPODA.

GENUS HEMIPRONITES, Pander, 1830.*

(Beitr. Zur. Geol. Russ., p. 25.)

HEMIPRONITES SUBPLANUS, Conrad? (sp.).

Pl. 6, fig. 6 *a*, *b*.

Strophomena subplana, CONRAD, 1842. Jour. Acad. Nat. Sci., Philad., VIII, p. 258; HALL, 1843, Geol. Report, 4 Dist. New York, p. 104, fig. 1.
Leptæna subplana, HALL, 1852. Palæont. N. Y., vol. 2d, p. 259, pl. 53, fig. 8–10.
Strophomea (*Streptorhynchus*) *subplana*, HALL, 1862. Geol. Report Wisconsin, p. 437.

SHELL semioval, or more than semicircular in outline, compressed, resupinate, subequivalve, approaching plano-convex;

* This is the same genus named *Streptorhynchus* by Prof. King, in 1850.

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hinge line about equaling the greatest breadth of the valves at any point farther forward; front and anterior lateral margins forming a regular semicircular curve. Ventral valve nearly flat, or a little convex at the umbo, and slightly concave towards the front; beak not projecting beyond, nor very distinct from, the cardinal margin; cardinal area (mainly hidden in the matrix in our specimens) apparently of moderate breadth, inclined backwards, and extending to the extremities of the hinge. Dorsal valve slightly and rather evenly convex; beak not distinct from the cardinal margin. Surface of both valves ornamented with distinct, abruptly raised radiating striæ, with flat intervening depressions, in which there are generally from one to three or four smaller and shorter striæ, one of which is sometimes nearly as large at the border as the principal ones, but soon becomes smaller, and generally dies out near the middle of the valves, while the smallest ones are still shorter; crossing all of these, there are numerous extremely fine, regular, closely arranged concentric striæ.

Breadth of one of the largest specimens, 1.30 inches; length, 1.05 inches; convexity, 0.18 inch.

As we have not seen the hinge and interior of this shell, we are not sure that it belongs to the genus *Hemipronites*=(*Streptorhynchus*). From its resemblance to *H. subplanus*, of New York, however, which has been referred by Prof. Hall to *Streptorhynchus*, we are led to place it in that genus. We strongly suspect, however, that it will be found to be, at least specifically, distinct from the New York species, and it is only because that shell is said to vary in the nature of its striæ that we have concluded to refer ours, even provisionally, to *H. subplanus*. On comparison with one authentic New York specimen of that species, and several good examples of the form from Waldron, Indiana, generally identified with it, we find our shell differs in the following characters:—in the first place, it is distinctly less extended on the hinge line in proportion to the length of its valves. Its striæ also differ in presenting a greater inequality between the size of the largest or primary ones, that extend entirely to the beaks, and the smaller; while the spaces between them all are generally wider, and more flattened, and the concentric striæ slightly smaller and more crowded. Those on each side of the umbones are likewise generally a little more curved. Our specimens are in nearly all cases more or less exfoliated, and in this condition the striæ seem to be very abruptly elevated, and narrower

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than the flattened spaces between. In one specimen, however, there are some remaining portions of the external surface of the shell, and on this the striæ, although prominent, are proportionally wider, and apparently rather distinctly flattened on top.

Should this form prove to be distinct from the *H. subplanus*, we would propose for it the name *Hemipronites* (or *Streptorhyncus*) *propinquus*.

Locality and position: Dark gray limestone at Thebes, Alexander county, Illinois; apparently of the age of the Niagara division of the Upper Silurian.

Genus OBOLUS, Eichwald, 1829.

(Zool. Spec. 1, p. 274.)

Obolus [Trimerella?] Conradi, Hall.

Pl. 5, fig. 7 *a*, *b*.

Obolus Conradi, Hall, 1868. Twentieth Rep. Regents Univ. N. Y., on State Cab. N. H., p. 368, pl. 13, fig. 2.

Shell large, orbicular, or slightly wider than long, lenticular; surface with obscure concentric marks of growth; beaks very small and but slightly prominent; thickened cardinal marginal narrow. Muscular and other scars in the central region of the valves very strongly defined.

Breadth, 1.53 inches; length, 1.30 inches; convexity, about 0.65 inch. Some specimens show that it attained a third larger size, however, than that from which these measurements were taken.

Our specimens of this shell are only internal casts, and moulds of the exterior in the matrix. These casts are in various conditions of preservation, and from this fact and individual variations, the impressions of the internal markings differ considerably, as may be seen by comparing our figure with Prof. Hall's. We do not believe these differences, however, to be specific. At first we were struck with their similarity to *Obolus Davidsoni* of Salter, but, on comparing a good series of specimens with Mr. Davidson's figures of casts of that species, it will be easy to see that they are distinct. In the first place, its two central muscular scars have a different form, and in some better specimens (more recently obtained) than that we have figured, they are marked with distinct radiating striæ, like those of the cardinal muscles in some species of *Chonetes* and *Strophomena*. As in *O. Davidsoni*, these muscular scars are situated one on each side of a rather broad, rounded ridge in the cast, (a raised furrow in the shell.) In well preserved internal casts, however, there are two more or

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less projecting free processes, extending back so as nearly or quite to cover the muscular scars, exactly as in *Trimerella* of Billings, excepting that they are shorter. In the specimen from which our figure was drawn, these are broken away. They evidently occupied deep cavities extending back under the muscular scars, which were thus, as it were, upon a kind of broad horizontal septum, supported by a thick mesial partition. These processes (casts of cavities) are always more or less developed in our well preserved specimens, and, when not broken away, as in the specimen figured on pl. 6, give these casts a very different appearance from those represented by Mr. Davidson's figures of *O. Davidsoni*.

From the gradations, however, in this character, exhibited in our specimens, which in nearly all their other characters so closely resemble *O. Davidsoni*, we can scarcely doubt the generic identity of our shell with *Trimerella*, which only differs in this respect in the *degree* of the development of this character. At any rate, we have, from the same locality and position as that from which the form under consideration was obtained, casts of a more oval (larger) species, agreeing exactly with the characters of *Trimerella*, and yet we would scarcely separate them more than specifically from the species here described.

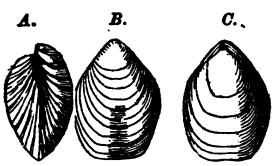
Locality and position: Port Byron, Illinois, and Leclaire, Iowa; Niagara division of the Upper Silurian.

Genus CENTRONELLA, Billings, 1859.

(Canadian Naturalist, p. 131.)

Centronella Billingsiana, M. and W.

Pl. 6, fig. 5 *a*, *b*, *c*, and the following cuts.



Centronella Billingsiana.
A, profile view. *B*, ventral view. *C*, dorsal view.

Shell attaining a moderately large size, subovate in form; valves nearly equally convex, the ventral being a little more gibbous than the other, particularly in the umbonal region; greatest breadth near the middle, or slightly in advance of it; posterior lateral slopes nearly straight, or sometimes a little concave in outline, and converging to the beaks at various an-

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gles of from 70° to 80°; front usually rather narrowly rounded, faintly subtruncate, or very slightly sinuous. Dorsal valve regularly convex, and without any traces of a sinus or mesial ridge; beak rather gibbous and distinctly incurved. Ventral valve with a shallow, rather narrow mesial sinus, generally moderately well defined at the front, and extending to the central region, where it gradually becomes obsolete; beak moderately prominent, rather pointed, somewhat arched, with apparently a very small perforation at the extremity, connected when the deltidium is removed, with a comparatively large triangular opening extending to the incurved beak of the opposite valve. Surface of both valves marked with obscure concentric striæ of growth.

Length of the largest specimen in the collection, 0.63 inch; breadth, 0.50 inch; convexity, 0.34 inch.

The internal characters of this shell are unknown to us, but it presents the form and other external appearances of the genus *Centronella*. It may be at once distinguished from *C. glans-fagæ* and *C. hecate*—the typical species of the genus—by its larger size, more nearly equivalve form, and gibbous dorsal valve. It is much more nearly allied to a form for which Mr. Billings has proposed the name *C. tumida* (Devonian Fossils of Canada West, p. 63, fig. 98), but differs in having no traces of a mesial sulcus on the dorsal valve, nor of a ridge on the ventral. It is also less gibbous.

Our figures on plate 6 do not give a very accurate representation of this species; consequently we have had the foregoing cuts prepared. Fig. 5 *a*, of the plate, is too broadly rounded in front, and has the posterior lateral slopes rather too concave in outline, while the shading makes the ventral beak look too flat, and the figure under the beaks of that of the other valve too small.

Locality and position: Alexander county, Illinois, in a thin local bed of gray limestone; apparently near the horizon of the Niagara division of the Upper Silurian.

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GENUS MERISTELLA, Hall, 1860.

(Ann. Report Regents Univ. N. Y., on State Cab. N. H., p. 74)

MERISTELLA? (sp).

Pl. 6, fig. 4 *a*, *b*.

THE specimens of this shell yet obtained are too imperfect to be satisfactorily compared with the described species, or to be clearly characterized. It seems to have been moderately gibbous, and about as wide as long, with the ventral valve a little more convex than the other, and provided with a narrow, shallow mesial sinus, extending from the front nearly to the beak, which is somewhat pointed and closely curved over and upon that of the other valve. The surface shows fine, rather obscure concentric lines, and some stronger marks of growth, with (as seen under a magnifier, on exfoliated surfaces) obscure traces of minute radiating striæ, probably due to the fibrous structure of the shell, rather than to surface markings.

The figures on plate 6, drawn from a crushed and distorted specimen, do not convey a very correct idea of this shell, being too narrow in proportion to the length, and not convex enough, while the narrow sinus of the ventral valve (fig. 4 *b*) is made, by erroneous shading, to look too sharply defined, like a mere stripe of color.

Locality and position: Same as last.

LAMELLIBRANCHIATA.

GENUS PTERINEA, Goldfuss, 1832.

(Naturh. Atl., taf. 312.)

PTERINEA THEBESENSIS, M. and W.

Pl. 6, fig. 3, and annexed cut.

Pterinea Thebesensis. Cut of the left valve, natural size.

SHELL (left valve) obliquely rhombic-oval, longer than high, moderately convex in the central and umbonal regions; cardinal margin less than the greatest length, bordered behind by an obscure marginal ridge, and ranging very obliquely to the umbonal axis, or nearly parallel to the greater diameter of the

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valve; basal margin forming a broad semicircular curve; anterior side truncated, sometimes obliquely and sometimes nearly vertically, a little rounded at its rectangular connection with the hinge above—rather distinctly gaping (unless the margin of the other valve is warped inwards); posterior margin most prominent, and narrowly rounded below the wing; posterior wing abruptly flattened from the swell of the umbo, rectangular at the extremity, and considerably shorter than the margin below, from which it is separated by a faint oblique sinuosity; anterior wing a very short, inconspicuous, round, rather convex lobe, obscurely defined by a faint, oblique concavity, extending down from the anterior side of the beak, which is moderately convex, depressed, and placed about half way between the middle and the anterior extremity. Surface marked by fine concentric striæ, and near the anterior truncated (gaping?) margin, by rather distinct subimbricating marks of growth.

Length, 0.80 inch; height, 0.50 inch; convexity (of left valve), 0.20 inch.

This shell is related to such forms as *Pterinea? subplana* (=*Avicula subplana*, Hall, 2d vol. Palæont. N. Y., pl. 59, fig. 3 *a*, *b*), and some of the forms referred by Prof. McCoy to *Pterinea retroflexa*, Wahlenb. (sp). It differs from all of these shells, however, in having its posterior wing always considerably shorter than the margin of the valve below it, and in the peculiar truncation and apparent gap of the anterior margin. This appearance of a gap is not produced by an emargination, but by a lateral curve of the margin that gives a warped appearance to the valve, as seen from the front. If the other valve had its anterior margin laterally curved, so as to correspond to this, there may have been no gap, but in that case the other valve must have been concave, at least in front. In the comparative shortness of its posterior wing, our shell more nearly resembles *Posidonomya? rhomboidea*, Hall (2d vol. Palæont. N. Y., pl. 59, fig. 5), which is almost certainly a *Pterinea*. It differs, however, in having its posterior wing more abruptly flattened, and defined from the umbonal convexity, as well as in the warped (and gaping?) character of its anterior side, and its much less angular anterior wing.

The figure on plate 6, of this species, failing to represent the true characters of the shell, the annexed cut is added to illustrate it.

Locality and position: Same as the last two.

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GENUS AMBONYCHIA, Hall, 1847.

(Palæont. N. Y., vol. 1, p. 163.)

AMBONYCHIA ACUTIROSTRIS, Hall.?

Pl. 5, fig. 8 *a*, *b*, and 9 *c*.

Ambonychia mytiloides, HALL, 1860. New species Foss. from the Niagara Gr. of Wisconsin, extr. from Geol. Report for 1859, p. 2; (not *A. mytiloides*, Hall, 1847, vol. 1, Palæont. N. Y., p. 315.)

Ambonychia? mytiloidea, HALL, 1862. Geol. Rep. Wisconsin, p. 437; WINCHELL and MARCY, 1865, Enumeration Foss., p. 108.

Ambonychia acutirostra, HALL, 1865. Report of Regents of Univ. of N. Y., on State Cab. of N. H., p. 336.

SHELL obliquely subovate, gibbous anteriorly and in the umbonal region, and more compressed posteriorly, and around to the base; hinge very short, and ranging obliquely at an angle of about thirty-five to forty degrees with the longer axis of the valves; posterior margin truncated or nearly straight, and declining at a very wide or scarcely perceptible angle from the extremity of the hinge above, and rounding below into the more or less regularly rounded posterior margin; anterior margin truncated immediately in front of the beaks (in casts), at something less than right angles to the hinge above, and sloping and rounding obliquely into the posterior basal margin below. Posterior hinge teeth short, three to each valve, placed at the posterior extremity of the hinge and ranging obliquely backwards and downwards; beaks very prominent, oblique, slightly incurved, and very nearly terminal. Surface unknown.

Length of internal cast, measuring obliquely from the beaks to the posterior basal margin, 1.74 inches; greatest antero-posterior diameter, measuring at right angles to the longitudinal diameter, 1.25 inches; convexity, 1.03 inches.

Our identifications of this species were originally made by comparison with Prof. Hall's descriptions only. A few days before these descriptions were sent to the press we had an opportunity to compare our specimens with his figure of *A. acutirostris*, published in the Twentieth Report Regents Univ. N. Y., on State Cabinet of Nat. History. From this figure we are left in some doubt in

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regard to the identity of our shell with Prof. Hall's species, though the differences are not so great as some defects in the outlines of our figures would indicate. The most important difference would appear to be observable in the more oblique direction of the hinge line in our shell. If this character be found constant, there would be little room for doubting the propriety of separating these shells specifically, in which case, that we have figured might be called *A ? obliquua.* That these shells really belong to the genus *Ambonychia* is doubtful, as suggested by Prof. Hall.

The defects alluded to in the outline of our figures consist in the too great prominence of the anterior basal margin of figure 8 *a*, as well as of the middle portion of the anterior side of fig. 8 *b*. The beaks of 8 *a* should also be more pointed, and slightly curved downwards at the immediate points. The impressions of the posterior hinge-teeth in fig. 8 *b* should range obliquely backwards and downwards. In some respects the specimen from which our figure 8 *b* was taken resembles a form figured by Prof. Hall under the name *A. aphæa*, in Twentieth Regents' Report, pl. 14, fig. 3, though it has a straighter hinge, and we have no doubt of its specific identity with that represented by fig. 8 *a*.

Locality and position: Niagara division of the Upper Silurian, at Bridgeport, near Chicago, Illinois. Prof. Hall's typical specimens of *A. acutirostris* were from the same horizon near Milwaukee, Wisconsin, though he says he has seen a specimen from Bridgeport he believed to be the same.

Genus AMPHICŒLIA, Hall, 1864.

Amphicœlia, Hall, 1864. Supp. to Eighteenth Report Regents Univ. N. Y., p. 35.

This group was indicated by Prof. Hall (with doubt) as subgenus under *Leptodomus*, McCoy, as follows: "The general form of the shell is subrhomboidal, with elevated beaks. The casts present the appearance 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; or the whole may be a large cartilage pit divided by a thin septura. No teeth have been discovered on the extension of the hinge line. The muscular impressions are faint and the shell thin."

Having had an opportunity to examine numerous examples of the type of this group, from the original locality, we fully concur with Prof. Winchell and Prof. Marcy* in the opinion, which had been for some time entertained by us, that it is entirely distinct from *Leptodomus*, either as originally defined and illustrated by Prof. McCoy, or as subsequently extended by that author.†

* Enumeration Foss. Niag. Li. at Chic., Mem. Bost. Soc. Nat. Hist., Vol. I, No. 1, p. 108.

† We expressed this opinion in the 2d vol., p. 339. Prof. Hall has since adopted the conclusion that this type has no near relations to *Leptodomus*. (See Regents' Report, 1868 (for 1867), p. 387.

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The type of *Amphicœlia*, however, is widely removed from all of these shells by its broad, flat, longitudinally striated cardinal plate, like that of *Pterinea* and *Myalina*, and cavity at the anterior extremity of the hinge as we often see in the latter genus. In short it belongs to the *Aviculidæ*, near *Pterinea*, and *Ambonychia*. It differs from both of these groups generically, however, in wanting their hinge teeth, as well as from the former in wanting the well developed, deep, anterior muscular impression.

So far as we have been able to see, from the examination of numerous specimens, the pit or cavity between the beaks is not double, or divided by a septum, as suggested by Prof. Hall. It is a simple cavity, located at the obtusely angular intersection of the somewhat thickened anterior margin, and the anterior extremity of the hinge is very similar to that seen in some species of *Myalina*. Specimens in the possession of Prof. Marcy show that there was no distinct byssal opening in front, at least in adult shells, while the valves appear to fit closely all around.

The almost, if not quite, equivalve character of this shell might be supposed to throw doubts upon the suggestion that it belongs to the *Aviculidæ*. The fact, however, that its broad, striated cardinal area inclines more or less over to the right, in both valves, indicates a want of exact symmetry of the two valves not at all apparent in the internal cast, and much as we often see in *Myalina*, and other types of that family.

AMPHICŒLIA NEGLECTA, McChesney.

Pl. 5, fig. 9 *a*, *b*, (not *c*).

Ambonychia neglecta, McChesney, 1861. New species Palæozoic Fossils, p. 88.
Amphicœlia Leidyi, Hall, 1865. Supp. to Eighteenth Report Regents Univ. N. Y., p. 85.
Pterinea (*Amb.*) *neglecta*, McChesney, 1865. Expl. pl. 9, Illustrations Palæozoic Fossils.
Pterinea neglecta, Winchell and Marcy, 1865. Mem. Boston Soc. Nat. Hist., vol. I, p. 96.
Amphicœlia neglecta, McChesney, 1868. Trans. Chic. Acad. Sci., vol. I, p. 41, pl. 9, fig. 2.

SHELL nearly or quite equivalve, subquadrate, suborbicular, or somewhat longer than high, rather gibbous in the umbonal and anterior regions, and more compressed and subalate posterodorsally; hinge line straight, less than the greatest length of the shell; cardinal area wide—its longitudinal striæ rather fine; posterior margin subtruncate, at a more or less obtuse angle with the hinge above, and rounding regularly into the base below, which forms a regular semicircular curve; anterior side very short, and rounding from below the beaks into the base; beaks prominent, gibbous, incurved, and placed about

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one-fourth the entire length of the valves behind the most prominent part of the anterior margin. Surface marked by fine, regular, rather flattened, radiating striæ. Posterior muscular impression rather large, shallow, oval, and placed about half way between the middle and the posterior margin, and above the middle of the valves; pallial line extending around from the posterior muscular scar, and up the front towards the beaks. (No anterior muscular scar yet seen.)

Length of a large internal cast, 2.57 inches; height of do. to cardinal ridge (exclusive of the area), 2.08 inches; convexity, 1.50 inches.

Locality and position: This fossil is common, in the condition of internal casts, at the quarries in the Niagara limestone at Bridgeport, near Chicago, Illinois. Prof. Hall also gives Racine and Wauwatosa, Wisconsin (same position), as other localities where it occurs. At Bridgeport it is nearly always in the condition of internal casts, and even these are rarely found entire. It is occasionally found, however, in the condition of external casts, showing portions of the striated outer surface preserved.

GASTEROPODA.

Genus PLEUROTOMARIA, Defrance, 1824.

(Dict. Sci., Nat. Atl. Pl. Foss., 86.)

Pleurotomaria Casii, M. and W.

Pl. 5, fig. 5.

Shell attaining a rather large size, higher than wide; spire conical, a little more than equaling the length of the lower half of the body volution. Whorls about five and a half—very convex; those of the spire each showing three-fourths of its entire height above the next succeeding one; upper ones (in casts) rounded; last one large and ventricose, and, like the next above, subangular around near the middle, below which it is somewhat produced, and rounds into a small umbilical opening in the cast, probably entirely closed by the columella in specimens retaining the shell. Spiral band appa-

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rently of moderate breadth, occupying the obtuse angle a little above the middle of the body whorl, and passing around near the middle of the others. Suture deep, in consequence of the convexity of the volutions. Aperture subcircular. Surface of internal casts showing, on the upper convex slope of the body whorl, and that of the next above it, obscure transverse ridges, curving backwards as they extend out from the suture, probably parallel to the lines of growth. Crossing these, there is an undefined revolving ridge (represented too prominently in the figure) on the body whorl, a little more than half way out from the suture towards the spiral band. (Other surface markings unknown.)

Height, 2.14 inches; breadth, about 1.85 inches. Slope of spire nearly straight; divergence, about 75°.

This fine species will be readily distinguished from any Silurian form known to us, resembling it in other respects, by the transverse ridges of the upper side of its body whorls. It doubtless had other distinguishing finer sculpturing not seen on the cast. In size and form, it seems to have presented some general resemblance to *Murchisonia vitellia*, Billings (New Lower Sil. Foss., June, 1862, p. 155, fig. 138), but differs in having more rounded whorls and the transverse ridges, and obscure revolving ridge of the upper side of the volutions.

Locality and position: Niagara division of the Upper Silurian; Bridgeport, near Chicago, Illinois.

PLEUROTOMARIA CYCLONEMOIDES, M. and W.

Pl. 5, fig. 4.

SHELL conoid-subglobose, nearly as wide as high; volutions about four and a half, increasing rather rapidly in size, all rounded, last one ventricose, and regularly rounded from the suture above into the small umbilical pit below, which in internal casts is a small perforation, probably closed by the columella in testifirous specimens; suture well defined in consequence of the convexity of the whorls; aperture nearly circular. Surface ornamented by rather large revolving lines (generally well defined on internal casts), two of which, just above the middle of the body volution, and at the middle of

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those of the spire, are a little larger than the others, and include the spiral band between them; crossing all of these are seen, on well preserved specimens, smaller and more closely arranged transverse striæ, giving the surface a cancellated style of ornamentation.

Height, 0.86 inch; breadth, 0.81 inch; spire with slightly convex slopes; divergence, about 83°.

In general appearance the casts of this shell are not unlike a form figured by Prof. Hall in the Twentieth Report of the Regents Univ., N. Y., on State Cab. Nat. H., pl. 15, fig. 9, under the name *Trochonema (Pleurotomaria) pauper;* but our species will be readily distinguished by its much more numerous revolving ridges.

Locality and position: Niagara division of the Upper Silurian; at Bridgeport, near Chicago, Illinois, where it is found in the condition of internal casts. Our figure is defective in not showing indications of two other revolving lines above those represented on the body volution, and several smaller ones on the next turn. Its body volutions should also be represented as a little more produced below at the aperture.

Genus SUBULITES (Conrad), Emmons, 1842.

(In Emmons' Geol. Report N. Y., p. 392.)

We have elsewhere alluded to the close relations between this genus and *Polyphemopsis*, of Portlock, founded upon the Carboniferous species, *P. elongata*, Portlock, and *P. fusiformis*, Sowerby, sp. This close resemblance is more obvious, on comparison of species like that described below, with Portlock's types, than in comparing the latter with the typical forms of *Subulites*. It is possible that the base of the aperture of the Lower Silurian, *S. elongatus*, of Conrad (the type of *Subulites*), may, when entire, present some differences from that of the Carboniferous shells upon which *Polyphemopsis* was founded, as it seems to have the columella straighter, and the aperture drawn out as if it terminated in an effuse extension resembling a short canal. In case such a difference exists, however, and is of generic or subgeneric importance, the species described below would certainly fall into the group *Polyphemopsis*, as good specimens show that it has exactly the same form of aperture, with the same curved base of its columella and oblique curve of the lower part of its body whorl, seen in the typical *Polyphemopsis fusiformis*, from which its only

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essential specific differences consist in having rather more convex and not quite so many volutions.*

The twisting or bending of the body whorl, is very marked in the species described below, and supports the suggestion made by us some time since, that these shells probably belong to the *Eulimidæ*, in which this irregularity of form is not uncommon.

In case it should be determined that *Subulites* and *Polyphemopsis* are not generically distinct, a question will arise in regard to which name should take precedence. Conrad's manuscript name was published, and a species figured (without a generic description) by Dr. Emmons, in 1842, and again by Dr. Owen, in the same way, in 1844; and the genus was not described until Hall published a diagnosis in 1847; while Portlock's name, *Polyphemopsis*, was published in 1843. Those who maintain that a genus can not be established without a description, would be compelled to adopt *Polyphemopsis*, and those who maintain that the publication of a name, with a figure of an example, is sufficient to establish a genus, would adopt *Subulites*.

SUBULITES (POLYPHEMOPSIS) BREVIS, W. and M.

Pl. 5, fig. 6.

Subulites brevis, WINCHELL and MARCY, 1865. Mem. Boston Soc. Nat. Hist., vol. I, p. 100, pl. 2, fig. 9.

? Subulites ventricosus, HALL, 1852. Palæont. N. Y., vol. II, p. 347, pl. 83, fig. 7 *a*, *b*.

Subulites ventricosus, HALL, 1865. Extract Eighteenth Report Regents University N. Y., p. 42; Twentieth do., pl. 15, fig. 1.

SHELL subfusiform, always more or less bent to one side at the suture between the spire and body volution; aperture and spire of nearly equal length; volutions about six, a little convex, last one rather ventricose; suture shallow; aperture narrow, obliquely sub-ovate, effuse below, and angular above. Columella with the oblique curvature and basal truncation of the genus strongly marked. (Surface unknown.)

Length, 1.50 inches; breadth of body whorl, about 0.65 inch.

We are not quite sure this is the shell figured and described by Prof. Winchell and Prof. Marcy, as it seems to be rather more ventricose. As it agrees, how-

* It is an interesting fact, worthy of note in this connection, that there is a little shell found in the St. Cassian beds of Austria, described by Munster, under the name of *Melania fusiformis*, and recently made the type of a new genus *Euchrysalis*, by Laube (see Fauna der St. Cassian, part III, p. 42, 1868), that seems remarkably similar, excepting in its smaller size, to *Subulites elongatus*, of Conrad.

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ever, more nearly with their figure and description than any other form known to us from that locality, and their specimen was very imperfect, it may belong to the same species. It is probably identical with *S. ventricosus*, Hall, though our specimens seem to be more ventricose, and, as noticed by Professors Winchell and Marcy, more bent.

Our figure of this shell is unfortunately not accurate in all respects, as it makes the second volution too convex on the left side, and shows only very indistinctly the suture between the body volution and the next one above. A part of the lip of the body whorl, on the left side, is also hidden in the matrix.

Locality and position: Bridgeport, near Chicago, Illinois. Niagara division of Upper Silurian.

ARTICULATA.

CRUSTACEA.

GENUS DALMANITES, Auct.

DALMANITES DANÆ, M. and W.

Pl. 6, fig. 1 *a, b, c, d, e, f.*

Dalmania Danæ, MEEK and WORTHEN, Dec., 1865. Proc. Acad. Nat. Sci., Philad., p. 264.

ATTAINING a large size, entire outline ovate. Cephalic shield rather compressed, nearly semicircular, about twice as wide as long, rounded in front, and nearly straight or slightly concave in outline behind, with posterior lateral angles produced into mucronate spines extending backwards to the fourth or fifth thoracic segment. Glabella composing rather more than one-third the entire area of the shield, and slightly more convex than the cheeks, including the neck segment, as long as its greatest anterior breadth, and about twice as wide (exclusive of the alæ, or fixed cheeks) in front as behind; separated from the cheeks on each side by a well defined furrow; anterior lobe composing about half its entire area, transversely elliptical, and a little less than twice as wide as long, usually showing, in internal casts, a shallow pit near the middle of its posterior side; lateral furrows well defined—anterior

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one oblique, the other two transverse, and not always strongly defined quite out to the lateral margins; anterior lateral lobe longer, more oblique, and, at its outer end, wider than either of the other two. Occipital segment widest and most prominent in the middle, scarcely equaling the transverse diameter of the posterior extremity of the glabella; neck furrow well defined, but deepest on each side, and arching a little forward in the middle; its continuations across the posterior sides of the cheeks broad, deep, and straighter than the posterior margin—extending nearly to the lateral margins of the cheeks, where they curve a little backwards. Cheeks sloping slightly around the outer side to a broad, shallow, undefined marginal depression, outside of which there is a moderately thick, somewhat rounded border, which does not extend entirely around the front of the glabella, but continues back into the posterior lateral spines. Eyes reniform, not oblique, nearly half as long as the antero-posterior diameter of the front lobe of the glabella, and situated slightly more than their own length in advance of the posterior margin of the cheeks, with (in casts) a moderately distinct marginal furrow around their outer bases; (height and other details unknown); palpebral lobes semicircular and depressed. Facial sutures cutting the lateral margins of the cheeks nearly opposite the posterior extremities of the eyes, and passing around the antero-lateral and front margins of the glabella so near the anterior border as scarcely to leave any perceptible band connecting the movable cheeks around the front.

Hypostoma obscurely subtrigonal, about one-eighth wider anteriorly than its length, moderately convex; anterior margin forming a broad, regular, convex curve; lateral margins contracted behind the anterior lateral angles, and converging a little posteriorly for about two-thirds the entire length, thence more abrubtly to the posterior extremity, which is transversely truncated, and provided on each side with a minute, slightly projecting point, while still farther forward, on each lateral margin, there appears to be traces of another minute slightly

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projecting irregularity of outline. Around the posterior and lateral margins there is a more or less distinct sulcus, behind which the posterior margin is flattened. Within this marginal sulcus there is, on each side, a little behind the middle, an oblique eye-like depression.

Thorax wider than long, the length being to the breadth as 21 to 28, nearly once and a half as long as the cephalic shield; mesial lobe as wide anteriorly as the posterior extremity of the glabella, and very slightly broader near the middle, where it is about three-fourths as wide as the lateral lobes, from which it is only separated by narrow, rather shallow furrows—most convex along the middle and flattened on each side; segments not clearly seen in the specimens examined. Lateral lobes somewhat more depressed than the mesial one, and sloping very gradually to the lateral margins. Segments equaling the antero-posterior diameter of the posterior lateral lobes of the glabella; each curving abruptly backwards at the outer extremity, and terminating in a flat, sharply pointed, or lanceolate projection, most produced in the posterior ones; provided with a deep, well defined, longitudinal furrow, which starts from the anterior side of the inner end, and curves at first a little obliquely outward, and then passes straight outward, slightly nearer the posterior than the anterior margin, to the middle of the flattened scythe-shaped outer ends, where they usually curve a little backwards and become obsolete.

Pygidium nearly semielliptic, or subtrigonal, the anterior lateral angles being somewhat rounded, and the lateral margins converging to the more or less pointed posterior extremity, with a broad convex curve; slightly longer than the cephalic shield, and rather more than two-thirds as wide; mesial lobe somewhat more convex than the lateral lobes, and two-thirds as wide, gently rounded, and tapering gradually to the posterior extremity, where it is apparently continued into an abruptly projecting caudal appendage; segments 12 to 13, straight, well defined (excepting near the termination) by distinct furrows, which are deeper on each side than at the

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middle. Lateral lobes with eight or nine well defined arched segments, which become more oblique posteriorly, and are defined to near the edge of the smooth margin; each divided by a furrow deeper than those between, and like in those of the pleuræ, the anterior division being slightly narrower than the other at the inner end.

Surface (of cast) smooth, excepting traces of small, scattering tubercles on the anterior lobe of the glabella.

Length of the largest specimen seen, exclusive of the little caudal appendage (the length of which is unknown), 4.93 inches. Length of pygidium, 1.50 inches; breadth of same, 2 inches; breadth of its axillary lobe, 0.55 inch. Length of thorax, 2.05 inches; breadth of same, 3 inches; breadth of its mesial lobe, 0.80 inch. Length of cephalic shield, 1.44 inches; breadth of same, 3 inches; length of posterior lateral spines, near 1.10 inches; length of glabella, exclusive of neck segment, 1.30 inches; anterior breadth of same, 1.35 inches; posterior breadth of same, 0.84 inch. Length of eyes, 0.39 inch; distance of same from posterior margin of cheeks, 0.42 inch.

Named in honor of Prof. James D. Dana, of New Haven.

We have described this fine species in as much detail as possible, because it is somewhat nearly allied to several of the already described species. Perhaps it is most nearly allied to the well known European *D. caudatus* of Brunnich, with which it agrees in size, form, and many of its details. In the first place, it differs, however, from that species in having the anterior margin of its cephalic shield decidedly more rounded than even the variety or form regarded by Mr. Salter as the female, while it shows no marginal rim (as seen from above) extending around the front of the glabella. Again, the eyes, instead of being placed about *half* their own length in advance of the posterior margin of the buckler, are rather more than their *entire* length from the posterior margin. The produced spine-like appendages of its cheeks are also, in all our specimens, uniformly distinctly smaller, and only extend back a little beyond the termination of the fourth thoracic segment, instead of to the sixth, as in *D. caudatus*. On comparing the hypostoma of our species with Mr. Salter's excellent figures of that of Brunnich's species, it is found to present marked and decided differences, as may be seen by a glance at our figure. In the ribs of the thorax we also observe differences, those of our species being more distinctly deflected

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backwards, and more sharply produced at their outer extremities, particularly the posterior ones. The differences in the pygidium are likewise well defined, its lateral margins forming almost a regular convex arch from the antero-lateral angles to the caudal projection (which seems to be shorter, and much narrower than *D. caudatus*), instead of being nearly straight, or even concave, in outline, posteriorly.

Most of these differences we have ascertained from a careful study of a good series of specimens, to be constant in our species, so that they can be relied upon as not being individual or sexual peculiarities.

In some respects this species is probably even more nearly allied to the common American *D. limulurus*, while in others it differs more widely. In size it far exceeds the largest examples of *D. limulurus* we have ever seen, while all our specimens show the difference in the obtusely rounded anterior extremity of the head, and the absence of a marginal rim around the middle of the front to be constant. The convex outline of the lateral margins of its pygidium, already mentioned, also contrasts strongly with that of *D. limulurus*, and even the largest specimens of our species, five inches in length, only show twelve to thirteen segments in the mesial lobe, instead of fifteen, as in the New York species. The caudal appendage, if produced at all, must also be much narrower at its origin in our species.

The greater number of segments in the mesial and lateral lobes of the pygidium, and the distinct granular surface of both *D. pleuroptyx* and *D. micrurus*, will alone serve to distinguish them from the species under consideration; while the hypostoma of *D. micrurus*, at least, is entirely different.

In first publishing this species, we suggested that if the name *Dalmania* could not be retained for this genus, in consequence of its having been previously used for a genus of *Diptera*, that Hawle and Corda's name *Odontocheile* (1847) would probably have to be adopted for it. We have, however, since been informed, by good authority in Entomology, that the name *Odontocheile* was also previously used in 1834 for a good genus of *Coleoptera*. Consequently we have adopted the sufficiently distinct name *Dalmanites*, first used, we believe, by Prof. Barrande.

Locality and position: Two miles above Thebes, Alexander county, Illinois. Apparently at near the horizon of the Niagara division of the Upper Silurian.

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FOSSILS OF THE LOWER HELDERBERG GROUP.

(SHALY LIMESTONE.)

RADIATA.

ZOOPHYTA.

GENUS STRIATOPORA, Hall, 1852.

Striatopora, HALL, 1852. Palæont. N. Y., vol. II, p. 156, pl. xl, B; Iowa Report (1858), p. 479.

WE are very much inclined to think that the name *Cyathopora*, used by Dr. Owen in 1844, in connection with a species of this genus, will have to be adopted for it. The only reason for doubting the propriety of retaining this name is, that he merely gives a very brief description, *without saying* whether he intended it as a description of the typical species, or of the genus, or for both together, as is not unfrequently done. He merely speaks of it as "a new coralline," and describes it as follows:

"*Cyathopora Irwensis*, (see plate No. 11, after page 72*)—twig-like, single or branching; cellular. Cells diverging from the axis to the circumference, and opening on the surface in distinct cup-shaped mouths, with an elevated margin, one inch and one-half long, one-seventh of an inch in diameter." (Report Geol. Expl. Iowa, Wisconsin and Illinois, p. 69, 1844.)

The fact that he has the name of this fossil in the index of his larger Report on the Survey of Wisconsin, Iowa and Minnesota (published in 1852), printed *Cyathophora Iowensis*, might seem to indicate that he had from the first only intended to refer the new species to the genus *Cyathophora* of Michelin. Yet he always calls it *Cyathopora* in the first of the above mentioned Reports, and

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* This reference is made by Dr. O. to his own figure.

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even at the only place he mentions it in the body of the latter work, he writes it *Cyathopora*, and only has it *Cyathophora* in the index, where it may be an accidental error. The fact that he alludes to it in both his Reports as "a new coralline," while he makes no such allusion to any of his other new *species*, would favor the conclusion that he regarded it as a new *genus*. The strongest reason for the latter conclusion, however, is the wide dissimilarity of the coral he was describing to *Cyathophora* of Michelin, which is an aggregated, massive Stylina-like coral, widely different from his little branching "twig-like" fossil. It therefore seems exceedingly improbable that Dr. Owen could have intended to refer his species to such a genus as *Cyathophora*, and as there was no established genus *Cyathopora*, it would appear to be very probable that he intended to establish such a genus when he wrote his description.

Until such questions in nomenclature can be settled by the establishment of some more fixed rules than prevail at present, we merely retain the name *Striatopora* provisionally, without intending to express a positive opinion respecting its claims to precedence.

In regard to the generic identity of the coral described by Dr. Owen, with that upon which the genus *Striatopora* was founded, there can be no doubt. Indeed Prof. Hall has since described and figured Dr. Owen's typical species, *C. Iowensis*, under the name *Striatopora rugosa*. (See Iowa Report, vol. 1, part II, p. 479, pl. 1, fig. 6, 1858.) If the generic name *Striatopora* is to be retained, the name of the Iowa species will of course become *Striatopora Iowensis*.

STRIATOPORA MISSOURIENSIS.

Pl. 7, fig. 4.

CORALLUM slender, ramose; branches cylindrical; cells obliquely ascending from an imaginary axis, rather distantly separated, slender and rounded within, but enlarging and curving outwards to the surface, where they terminate in comparatively large, transversely oval, or subrhombic mouths, alternately arranged, and directed more or less obliquely upwards, with a sharp, rather prominent lip below; striæ distinct, ascending from each cell, and continued up the upper side of the enlarged opening, to the lower margins of the succeeding openings above.

Length unknown; diameter of an imperfect branch, about 0.20 inch.

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This specie is perhaps most nearly allied to *S. flexuosa*, Hall, from the Niagara group of New York, but has its cell mouths very differently formed, being generally transversely rhombic in form, and opening more obliquely upwards. Their striæ are also more distinct. It is much less robust than the Hamilton group species *Iowensis* of Owen (=*rugosa*, Hall), which has stouter branches, with more rounded cell mouths, not nearly so distinctly striated within. Its cells are much less crowded, and have less round and more strongly striated openings than *S. Linnæana* of Billings.

Should Dr. Owen's name *Cyathopora* be retained for this genus, the name of our species will have to be written *C. Missouriensis*.

We regret that the engraver was not very successful in representing this fossil in the figure given on plate 7.

Locality and position: Bailey's Landing, Perry county, Missouri; in a limestone of the age of the "Shaly limestone" of the New York Lower Helderberg division of the Upper Silurian.

ECHINODERMATA.

GENUS EDRIOCRINUS, Hall, 1859.

(Palæont. N. Y., vol. III, p. 119.)

EDRIOCRINUS POCILLIFORMIS, Hall.

Pl. 7, fig. 5 *a*, *b*.

Edriocrinus pocilliformis, HALL, 1859. Palæont. N. Y., vol. III, p. 121, pl. v, fig. 8–12.

BODY, below the summit of the first radial pieces, obconical; base slightly wider than high, rounded below, and a little oblique, faintly scalloped above, for the reception of the succeeding range of plates. First radial pieces slightly longer than the base, oblong (being longer than wide), and each distinctly sinuous and transversely grooved above, for the reception of the second radials; second radial pieces, and other parts above, unknown. First anal piece slightly narrower than the first radial pieces, and of the same form and length, but truncated instead of sinuous above; second anal piece of the same breadth as the first, and resting upon the upper truncated edge of the latter; its length unknown. Surface smooth, or finely granular.

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Length, to summit of first radial pieces, 0.45 inch; breadth, to top of do., 0.35 inch.

We have, of course, exceedingly few, and little marked characters, to guide us in identifying this species with *E. pocilliformis*, which is only known from its detached little base. So far as can be determined, however, our specimen agrees exactly in this part.

It is an interesting fact, that this remarkable genus should have been represented so long after, by so nearly allied a type as the genus *Cotylederma*, of Quenstedt, from the Jurassic rocks. It seems to differ from *Cotylederma* only in having an anal piece on the same range with the first radials, the relations between the two groups being exactly the same as between *Hexacrinus* and *Platycrinus*.

Locality and position: Same as last.

MOLLUSCA.

BRACHIOPODA.

Genus Orthis, Dalman, 1828.

(Uppstalln. p. 110.)

Orthis hybrida, Sowerby?

Pl. 7, fig. 7 *a*, *b*, *c*, *d*.

Orthis hybrida, Sowerby, 1839. Murchison's Silurian System, p. 630, pl. 13, fig. 11; Hall, (1843), Geol. Report 4th Dist. N. Y., p. 107, fig. 7; Palæont. N. Y., (1852), Vol. II, p. 253, pl. lii, fig. 4 *a–a*.

Compare *O. oblata*. Hall, 1857. Report Regents Univ. N. Y., on State Cab. N. H., for 1856, p. 41; Palæont. N. Y., vol. III, pl. x, fig. 1–22.

Shell rather small, resupinate, nearly equivalve, compressed or moderately convex, suborbicular, the breadth being to the length about as 50 to 45; lateral margins rounded; front more broadly rounded, or nearly straight along the middle; hinge line very short, and not imparting any angularity to the posterior lateral outline. Dorsal valve moderately convex, with sometimes a very faint depression along the middle, toward the beak*; beak extending a little beyond the hinge,

* The shading on fig. 7 *a* makes this depression appear too distinct.

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and slightly arched. Ventral valve flattened anteriorly, but more convex in the umbonal region; beak scarcely projecting beyond that of the other valve, arched but not strongly incurved; area very small; foramen comparatively rather large. Surface ornamented by numerous fine, bifurcating striæ, which, on the posterior lateral regions of the valves, curve gracefully outward. A few concentric marks of growth are also sometimes seen.

Length of a specimen somewhat less than the largest, 0.37 inch; breadth, 0.40 inch; convexity, 0.17 inch.

Although this shell occurs in the same horizon as *O. oblata*, of Hall, from which it can scarcely be distinguished, excepting by its smaller size, and *O. hybrida* has not, we believe, been identified in this country as high in the series as this occurs, we are completely at a loss to see how our shell can be distinguished from the latter in any way. It is much smaller than large adult specimens of *O. oblata*, and proportionally less transverse; but on placing it by the side of a young individual of that shell, of its own size, they are seen to be so exceeding similar in form and almost every respect, that we doubt whether any one would ever suspect them to be distinct, if they occurred together. Yet, on a close inspection, the striæ on the shell under consideration are seen to be very slightly finer than on a young individual of *O. oblata* of its own size. That is, in a specimen of our shell of the size we have figured, seven to eight striæ may be counted in the space of one-tenth of an inch at the margin, while six to seven occupy the same space on the margin of *O. oblata*. As slight as this difference is, it is perceptible to the unassisted eye, when attention is directed to it.

On comparison with *O. hybrida*, however, our shell is seen to agree, not only in size and form, but even in this slightly finer character of striæ. Consequently, unless it may possibly present some internal differences, it would certainly puzzle any one to point out any appreciable distinction.

It may, we think, be fairly questioned whether or not the larger size, and other slight differences, on which *O. oblata* has been separated from *O. hybrida*, may not be due to a more robust development, produced by more favorable local conditions, than to any valid specific distinctions.

Locality and position: Same as last.

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ORTHIS SUBCARINATA, Hall.

Pl. 7, fig. 6 *a*, *b*, *c*, *d*.

Orthis subcrinata, HALL, 1857. Ann. Report Regents Univ. N. Y. for 1856, p. 43; Extr. from same (1857), p. 3; Palæont. N. Y., vol. III (1859), p. 169, pl. xii, fig. 7–21.

SHELL quadrato-subcircular, or transversely suboval, moderately convex; lateral margins more or less round; front forming a semicircular curve, or somewhat straightened, or even slightly sinuous in the middle; hinge margin less than the breadth of the valves, sometimes, though rarely, imparting an obtusely subangular outline to the posterior lateral margins. Dorsal valve depressed, convex near the beak, flattened around the anterior lateral margins, and concave along the middle, the concavity commencing very narrow at the beak, and rapidly widening, and becoming less defined towards the front; beak projecting little beyond the hinge, and somewhat curved. Ventral valve rather distinctly more convex than the other, particularly along the middle, where it rises into a rounded ridge, most prominent at the umbo, and soon dying out anteriorly, while the lateral slopes from this ridge are straight, or sometimes, near the umbo, a little concave in outline; beak smaller, but little more prominent than that of the other valve, and not very strongly incurved; area narrow, and becoming sublinear towards the lateral extremities of the hinge. Surface ornamented by numerous fine radiating striæ, increasing in number mainly by intercalation, and on the lateral and posterior lateral regions, curving gracefully outwards.* Subimbricating concentric marks of growth are also usually more or less distinctly defined at intervals.

Length of the largest specimen seen, 0.52 inch; breadth, 0.60 inch; convexity, 0.29 inch.

This species has much the appearance of *O. testudinaria*, of the Lower Silurian, but attains a much larger size, and has distinctly finer and less fasciculated radiating striæ, scarcely marked by concentric striæ; while it is likewise dis-

* They are represented rather too straight in the figures, particularly on the sides of figure 6 *d*.

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tinguished by internal differences. It also differs from *O. elegantula*, of the Upper Silurian, in having its dorsal valve more convex, and its ventral one less so, with a less prominent and incurved beak, and a narrower area; while there are also, as shown by New York specimens, internal differences.

It is most nearly allied to its (in New York) associate forms, *O. planoconvexa* and *O. perelegans*, of Hall, but differs from them both in its internal characters, while it is a more convex species than the first, and less so than the second.

We know nothing of the interior of our specimens, and as we have seen but two complete individuals, the identification is not made with entire confidence, though we have not much doubt as to their identity. The individual we have figured has a rather distinctly more quadrangular form than is usual amongst the New York examples of *O. subcarinata*, and a straighter cardinal outline, but not more so, nor even as much, as one of the individuals of that species figured on plate 12 of the Third Vol. Palæontology of New York; while our other specimen agrees more nearly in this respect with the usual forms of *O. subcarinata*.

From the form we have referred to *O. hybrida*, the shell under consideration will be at once distinguished by its subcarinate *ventral* valve, and compressed *dorsal* one; the *dorsal* valve in *O. hybrida* being the more convex, and the *ventral* the more compressed at the front.

Locality and position: Same as last.

Genus STROPHOMENA, Raf., 1820.

(*Strophomenes*, Raf.—*Strophomena*, Blainv. (1825), Malac., p. 513.)

Strophomena (Strophodonta) cavumbona, Hall?

Pl. 7, fig. 10 *a*, *b*.

Strophodonta cavumbona, Hall, 1857. Report Regents Univ. N. Y. for 1856, p. 51; Palæont. N. Y., vol. III (1859), p. 187, pl. xxi, fig. 1—8.

Shell semioval, length about five-sixth the breadth; hinge margin equaling the greatest breadth, with the crenulations fine and oblique; posterior lateral extremities nearly or quite rectangular; lateral margins straight, and parallel posteriorly, or sometimes very faintly sinuous near the extremities of the hinge, and rounding to the front, which forms a regular semicircular curve. Dorsal valve more or less distinctly concave at the umbo, and forward to the middle, and flattened on each side behind, but quite convex around between the middle and the anterior lateral margins, which curve distinctly downwards;

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beak not projecting beyond the hinge; interior showing scarcely any traces of the muscular scars, but rather distinctly striated, marked with small scattering granules. Surface ornamented by rather distinct, bifurcating, radiating striæ, but little curved on the lateral regions. Ventral valve unknown.

Length, 0.85 inch; breadth, 1.03 inches; convexity, 0.28 inch.

This shell seems to agree in most of its characters with *S. cavumbona*, excepting in being distinctly longer in proportion to its breadth, and in having lateral margins straighter, and its posterior lateral angles not so pointed. None of our specimens have the surface well enough preserved to show the fine concentric lines on the striæ, if they existed.

The specimen from which figure 10 *b* was drawn, is deeply concave, excepting in the umbonal region (which is convex, but made too much like an *angular* ridge in the figure); and owing to the distinctness of its striæ, it was some time before we could be fully satisfied that it is not the *outside* of the ventral valve of a strongly resupinate species. A careful examination, however, shows that it has the granulated character of the internal surface of such shells; while an examination of its hinge line, under a magnifier, shows the remains of the crenulations. On examining the convex cast in the matrix, represented by figure 10 *a*, from this concave specimen, we find that although showing the impressions of the striæ, and scattering granules quite distinctly, it exhibits scarcely a trace of muscular scars, which latter fact would also seem to indicate that it is rather a cast of the outside than of the inside of the valve; but on removing some small fragments of the shell about the beak, unmistakable evidences of the remains of the biparlite cardinal process were seen penetrating the matrix, which leave no room to doubt that the specimen 10 *b* shows the interior of a dorsal valve, from which the cardinal process and some of the inner laminæ have been removed in breaking open the rock, and carried with the cast. This partial exfoliation would, to some extent, account for the distinctness of the striæ, and absence of muscular scars within. This, however, was evidently a characteristic of the interior, as shown in the cast represented by figure 10 *a*.*. Two other casts of the interior of the same valve are also very distinctly striated, while one of them shows traces of the muscular scars.

Although we have referred this shell provisionally to *S. cavumbona*, we are very much inclined to believe, from its greater proportional length, and straight sides, with less angular cardinal extremities, that it will be found to be specifically distinct; if so, it may be called *S. rectilateraria*.

* This figure is not made to look convex enough in front of the middle.

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Locality and position: Bailey's Landing, Perry county, Missouri; from a limestone of the age of the Delthyris shaly limestone of the New York Upper Silurian series.

GENUS MERISTA, Suess, 1851.

MERISTA LÆVIS, Vanuxem? (sp.)

Pl. 7, fig. 8 *a*, *b*, *c*.

Atrypa lævis, VANUXEM, 1843. Report Third Geol. Dist. N. Y., p. 120, fig. 2; HALL (1857), Ann. Report Regents University of N. Y. for 1856, p. 94; Palæont. N. Y., vol. III (1859), p 247, pl. 39.

SHELL ovate, rather ventricose, breadth about three-fourths to five-sixths the length, greatest breadth generally in front of the middle. Dorsal valve moderately convex, more or less arched from the beak to near the front (which is usually a little raised in the middle), and sloping to the anterior lateral margins, which, in the wider specimens, are somewhat flattened; beak rather pointed and incurved. Ventral valve more convex than the other in the umbonal region, forming a regular arch from the beak to the front, which is a little produced and impressed in the middle, to correspond to the raised front of the other valve; a faint, very narrow mesial sinus also continues backward to near the middle of the valve; beak rather pointed and strongly curved over, and upon that of the other valve.* Surface with obscure concentric lines, and at intervals stronger marks of growth, and faint traces of obscure radiating striæ, most distinctly seen upon exfoliated surfaces and internal casts.

Length of largest specimen seen, 0.88 inch; breadth, 0.77 inch; convexity, 0.45 inch.

The identification of species in a genus like this, from a few imperfect specimens, showing none of the internal characters, can, of course, only be regarded as provisional. Indeed, it is even possible that specimens showing the interior

* In the specimen there appears to be a round perforation in the end of the beak, but as it is not seen in other specimens, we believe it to be due to an accidental break, and have not had it represented in the figure, but thought it proper to mention the fact. Of course, if it is a natural perforation, the shell is not a *Merista*.

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of our shell, might prove it to belong to a distinct genus from *M. lævis*. The specimen we have figured, although in most respects the best we have seen, is made to present an unnatural narrow appearance, in consequence of the anterior lateral margins being broken away; other specimens, however, having these margins entire, are proportionally wider anteriorly, and seem to agree nearly in outline with specimens of the New York shell of the same size. A defect in the engraving also makes the concentric ridges of growth much too obscure on figure 8 *c*, and the radiating striæ too distinct, and defined near the beak, where they are obsolete. The faint mesial sinus in figure 8 *b*, is likewise made too broad.

None of our specimens are near so large as the larger individuals of the New York shell. It is worthy of note, however, that nearly all the forms, either identical with, or representing New York species, found at this western locality, are somewhat smaller than their representatives in the east.

Locality and position: Same as the last.

Genus ZYGOSPIRA, Hall, 1862.

Stenocisma, Hall, 1857. Palæont. N. Y., vol. I, p. 142; Meek, Palæont. Upper Mo., 1864, p. 16; (not Conrad, 1839.)
Zygospira, Hall, 1862. Fifteenth Ann. State Cab. Report Regents Univ. N. Y., p. 154.
Cœlospira, Hall, 1863. Sixteenth do., appendix D., p. 60.
Compare *Anoplotheca*, Sandberger, 1856. Sitzungsb. Kais. Akad. Wiss. XVIII, p. 104.

It seems to us doubtful whether these little shells should be separated more than subgenerically from *Atrypa*. If distinct from that group, however, it is highly probable that Sandberger's older name, *Anoplotheca*, will have to be retained for the group. Sandberger's type (his *A. lamellosa*) is a very similar little shell, in form and general appearance, to those for which the names *Zygospira* and *Cœlospira* were proposed, and it also has internal spires arranged apparently in the same way, excepting that they seem to have their apices directed a little obliquely outwards. He also states that *Terebratula lepida*, Goldfuss, and *T. sublepida*, Murchison, de Vern. and Keyserling, two other similar species, present the external characters of his genus.

All these little shells differ from the typical forms of *Atrypa* in general appearance, mainly in their smaller size, and their generally flat or concave dorsal, and convex ventral, valve. There may be good generic difference between *Cœlospira* and *Zygospira*, but none such seem to us to have yet been pointed out.

Note by F. B. Meek.—In the Palæontology of the Upper Missouri, page 16, I appended a note in regard to Prof. Hall's name *Zygospira*, which reads as follows:

"In the Fifteenth Report Regents of the University of N. Y., 1862, pp. 154–5, Prof. Hall proposes the name *Zygospira* for a genus of which *Producta modesta*, Say, is the type. It seems, however, that Mr. Conrad had suggested for this shell the generic name *Steno-*

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cisma; which Prof. Hall proposed in the first vol. Pal. N. Y. (1847, p. 142) to adopt, should this type prove to belong to a distinct genus. As there was, therefore, no necessity for a new name, *Stenocisma* will have to take precedence over *Zygospira*."

In the Twentieth Report of the Regents Univ. N. Y. on the State Cab. Nat. Hist. for 1867, issued in 1868, and only recently seen by me, Prof. Hall manifests great indignation at the above note, and pretends to see in it all sorts of disingenuous meanings certainly never thought of by the writer. I have no fears, however, that any other person, not suffering under some unfortunate mental affliction, will understand it otherwise than as intended—that is, as merely an effort to correct a manifest error of nomenclature, by which Prof. Hall had associated two different names with the same genus. And be it remembered, that his error is none the less such for all he has said about it.

But if Prof. Hall had contented himself with casting reflections upon me alone, in his remarks, I should scarcely have thought it worth while to notice his imputations of unworthy motives, or his efforts to hold up (with what degree of fairness I leave for others to judge), as an example of the general reliability of my work, an inaccuracy in regard to the original type of *Stenocisma*, into which I was entirely led by this error of his own, in proposing, in 1847, to "restore," as he expressed it, the name *Stenocisma* to *Producta modesta*, Say. That I was so misled by him will be better understood by the following quotation of the paragraph in which he proposed, in 1847, to restore the name *Stenocisma* to Say's type. At the end of his description of this shell, under the name *Atrypa modesta*, he remarks as follows:

"This species, with the three preceding ones, form a group presenting characters which may require a separation from the true *Atrypæ*. These characters consist in the elevation of the dorsal valve along the center, with a depression or sinus on the ventral valve, being the reverse of the usual arrangement. The beak is incurved, with a perforation at the apex, which occupies also a part of the deltidial area, being usually narrow and long."

"Mr. Conrad, some time since, proposed the name *Stenocisma* for some specimens of the group *Atrypæ* or *Terebratulæ*, which he subsequently abandoned. Should the characters here noticed be found persistent, and accompanied by a narrow foramen, I propose to restore the name first indicated by Mr. Conrad for the genus."

Now at the time I wrote the note in the Palæontology of the Upper Missouri, which appears to be so offensive to Prof. Hall, and for a long time after its publication, all my efforts to find where Mr. Conrad had proposed the name *Stenocisma* (or *Stenoschisma*), had been unsuccessful. This arose from the fact that he did not publish it among the descriptions of fossils, or with the usual heading, but merely indicated it, incidentally, in the middle of a rather long paragraph of his general remarks on the fossils of the New York rocks, and, even as there used, it is the less liable to catch the eye, in looking over the pages, because it was not printed in Italics, or even in larger Roman letters than the other matter on the same page. Consequently it was overlooked, and all my impressions of the genus were derived from Prof. Hall's remarks, quoted above.*

Believing I could rely upon Prof. Hall's knowledge of the particular forms the group *Stenocisma* was originally intended to include, and that he must be well enough acquainted with the rules of nomenclature to be aware that he could not "restore the name first indi-

* Prof. Hall affects to think me very censurable for not referring to the work and page where the name *Stenocisma* was originally published. He forgets, however, that *he* did not make any such reference in proposing, in 1847, to restore that name; and I have no doubt now but he failed to do so for the very same reason that I did—that is, because he could not find it. Surely, if he had examined Mr. Conrad's remarks, he would not have fallen into the error he did in transferring the name to *A. modesta*; and if he had not done that, he would have had no occasion to find fault with my note, which in that case would never have been published.

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cated" for a genus, by transferring it to an entirely different group from that for which it was first proposed, I naturally enough inferred that Mr. Conrad's type must have been the species *A. modesta*, or some congeneric form. I was the more strengthened in this belief too, by the fact that Prof. Hall, in proposing the name *Zygospira* for the *A. modesta* group in 1862, said nothing about its differing from the type of *Stenocisma*, nor did he then make any allusion whatever to the fact that he had in 1847 proposed to restore for this type, the name *Stenocisma*—which fact he seemed to have entirely forgotten, as I really believe he had, until reminded of it by my note.

He says *now*, on page 272 of the Regents' Twentieth Report on State Cab. N. H., that he "intended to restore the name *Stenocisma*, should these species [*A. modesta*, etc.] be found to possess characters corresponding with those given by Mr. Conrad." This, however, it will be observed, was not his original language, which is, "should the characters *here noticed* be found *persistent*"* (that is, the characters he had just mentioned), "and accompanied by the narrow foramen," which he had just described as "being usually *narrow* and *long*."

But Prof. Hall says "we have the assertion, however, from this Palæontologist [alluding to me] that Mr. Conrad had suggested for this shell (*A. modesta*) the generic name *Stenocisma*." My language was, "it seems, however, that Mr. Conrad had suggested," etc., meaning, of course, that it seemed so from the manner in which Prof. Hall had proposed to *restore* that name. Not being in the habit of speaking positively when in doubt, I used the words *it seems*, to convey the idea that I had not seen Mr. Conrad's description and was relying upon indirect evidence in regard to his type.

A little more than a year back, in looking through the annual Report of the New York Survey, for 1839, I happened to find, for the first time, on page 59, Mr. Conrad's remarks indicating the genus *Stenocisma*, which I quote below, from the middle of a paragraph, leaving the names, as in the original, in Roman letters:

—"The genus Terebratula is wholly unknown, and the shells usually referred to that genus, I propose to group under the generic name Stenocisma, derived from two Greek words signifying narrow fissure, a character these shells possess under the imperforate apex of the larger valve, and which serves to connect the genus with Delthyris, from which it differs in having no cardinal area. This last named character on the other hand connects it with the genus Strigocephalus. I refer to it the common Silurian bivalve Terebratula Schlotheimii, von Buch."

From this, I of course at once saw Mr. Conrad had not mentioned any shell of the type of *A. modesta*, in connection with his proposed genus *Stenocisma*, but, on the contrary, only cited a very dissimilar European shell forming the type of the genus *Camarophoria*† and that consequently, Prof. Hall was wholly in error, in proposing to restore the name

*He evidently *now* wishes he had said "consistent" instead of "persistent" in the original, as he adds the former word in brackets, after the latter, in quoting the sentence. It will scarcely be maintained, however, that I am responsible for not understanding it as if the word consistent had been originally used, since, as every Naturalist will at once see, this would change the whole meaning of the sentence.

†Prof. Hall now says it was his Lower Helderberg *Rhynchonella formosa*, that Mr. Conrad identified with *T. Schlotheimii*, of Europe, as he knows from a drawing of that species in his possession, with the name *T. Schlotheimii* written under it in Mr. Conrad's own hand; and as it belongs to a distinct genus, he proposes to regard it as the type of *Stenocisma*. This may be well enough, though the drawing and written name only prove this to be *one* of the types referred by Mr. Conrad to *T. Schlotheimii*; for, although Mr. Conrad's identifications were generally very reliable for that early day, it is evident he had confounded several different forms under von Buch's name, since he states, on p. 58 of his Report for 1839, that *T. Schlotheimii* ranges down as low as the Trenton limestone in New York, through several of the Silurian formations, and of course far below the range of *R. formosa*.

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Stenocisma to the group typified by the species *A. modesta.* After seeing this, I prepared for this place a brief note of explanation, but now have had to extend it to greater length, in consequence of Prof. Hall's late remarks.

There is another note at the foot of the same page of the Upper Missouri Palæontology, and immediately under that to which Prof. Hall takes exceptions, in which I mentioned that his name *Goniocœlia* (1861) is a synonym of *Pentagonia*, Cozzens, (1846). He appears not to have noticed this, at any rate he does not hold it up as an example of the accuracy of my corrections of nomenclature; though he quietly drops his own name *Goniocœlia*, and adopts *Pentagonia*, as I suggested would have to be done.

In regard to the personalities used by Prof. Hall, in his remarks under consideration, I would merely state that I have no reply in kind. I have yet to learn that arguments used either in the discussion of scientific subjects, or questions relating to scientific nomenclature, gain anything in force or elegance by the use of such language; and, besides, for other reasons that will be readily appreciated by all gentlemen, I would rather be the subject of a whole chapter of such *refined* expressions every day of my life, than to be guilty of applying one of them to Prof. Hall, or to any other person, in a scientific publication.

ZYGOSPIRA SUBCONCAVA, M. and W.

Pl. 7, fig. 1 *a, b, c, d.*

SHELL very small, suborbicular, subplano-convex, in some examples a little longer than wide, and in others slightly wider than long; cardinal margins sloping from the beaks at a variable, but always obtuse, angle; lateral margins more or less rounded, or sometimes obtusely subangular at their connection with the more straightened cardinal slopes; front generally rounded.* Dorsal valve slightly, or rather distinctly, convex on each side, and concave along the middle, the concavity being very narrow at the beak, and widening rapidly toward the front. Ventral valve convex along the middle, and sloping laterally; beak small, rather pointed, curved nearly at right angles to the plane of the valves, and projecting slightly beyond the hinge. Surface marked by ten or twelve coarse striæ, or small costæ, some of which bifurcate, while two, on the elevated part of the ventral valve, are generally more prominent, toward the umbo, than the others. A few comparatively strong, regular, concentric marks of growth are also sometimes seen on the larger individuals.

* In the specimen from which our figures were drawn, the anterior margin is broken a little, so as to make it slightly straighter than natural.

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Length, 0.22 inch; breadth, 0.21 inch; convexity, 0.12 inch.

Although we at one time believed this little shell to be only a variety of *Z. concava* (=*Leptocœlia concava*, Hall), farther comparisons with New York specimens of that species have led us to the conclusion that it must be specifically distinct, though an allied representative form. In general appearance, size, &c., it is much like *Z. concava*, but a careful comparison shows it to differ in the following characters: In the first place, its dorsal valve is moderately, or rather distinctly, convex on each side, instead of flat; while the concavity along its middle is widest and deepest *at the front*, instead of near the middle. Again, it has a smaller number, and rather larger, as well as more depressed, costæ, which become nearly obsolete towards the front and sides.*

Figure 1 *b* shows the convexity of the dorsal valve in the most compressed specimen we have seen; while in the only other specimen we have showing that valve, it is considerably more convex. In both of these examples the beak of the dorsal valve is also somewhat incurved, instead of straight, as in *Z. concava*.

Locality and position: Limestone at Bailey's Landing on the Missouri river, in Perry county, Missouri; of the age of the Delthyris shale, of the N. Y. Lower Helderberg (Upper Silurian) series.

Genus TREMATOSPIRA, Hall, 1859.

(Regents' State Cab. Report, p. 27.)

Trematospira? imbricata, Hall.

Pl. 7, fig 2 *a*, *b*, *c*, *d*, *e*.

Leptocœlia imbricata, Hall, 1857. Ann. Report Regents Univ. N. Y., for 1856, p. 108; Palæontology N. Y., vol. III, p. 246, pl. xxxviii, fig. 8—13.

Shell small, rhombic-suborbicular, plano-convex, or concavo-convex; length sometimes a little greater, and in other examples somewhat less, than the breadth; cardinal margins sloping at various angles from the beaks; lateral margins more or less rounded, or obtusely subangular, front rather irregularly rounded. Dorsal valve nearly flat on each side, and more or less concave in the middle; beak not incurved. Ventral valve convex along the middle, and sloping to the

* The costæ on the enlarged figure 1 *d* are represented proportionally too small, and more numerous than they should be, as well as too strongly defined near the margins.

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sides; beak incurved a little beyond the hinge. Surface ornamented by about seven to ten rounded plications on each valve, two of which, on the middle of the ventral valve, are larger and more prominent than the others, while the middle one on the other dies out before reaching the beak. Crossing the whole are distinct, rather distant, regularly arranged, imbricating lamellæ of growth.

Length, 0.27 inch; breadth, 0.23 inch; convexity, 0.10 inch.

We have seen only two good specimens of this little shell, and of course are unprepared to say to what extent it may vary. The two we have seen are proportionally a little narrower than most of the New York examples of *T. imbricata*, and one of them (the one we have figured) has the dorsal valve decidedly concave, though the other has it nearly flattened, or very slightly convex, on each side, and a little concave along the middle. Their costæ are also slightly larger and less numerous than on the majority of the New York specimens with which our comparisons have been made. Without more specimens, it is not possible to decide whether these are specific differences or not, though we incline to the latter opinion, because the New York specimens vary considerably in most of these characters.

We observe Prof. Hall states, on page 60, Appendix D, of the Sixteenth Ann. Report Regents University of New York, that "*Leptocœlia imbricata* proves to be a *Trematospira*." Without knowing the internal characters of this species, we are of course unprepared to express any decided opinion on this point. Yet it is worthy of note that, in addition to the deeply concavo-convex form of some of these shells, which would alone seem to indicate a different arrangement of the internal spires from what we see in *Trematospira*, we have been entirely unable to detect any traces of the punctate structure, at least doubtfully given as characteristic of the typical forms upon which *Trematospira* was proposed—in either New York or western examples of the species *imbricata*. It is possible, however, that very carefully prepared sections, from well preserved examples, might show such punctures.

Locality and position: Same as last.

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GENUS CYRTINA, Davidson, 1858.

(Monogr. Brit. Carb. Brach, p. 66.)

CYRTINA DALMANI, Hall (sp.)

Pl. 7, fig. 3 *a*, *b*.

Cyrtia Dalmani, HALL, 1857. Report Regents University New York for 1856, p. 64; Palæont. N. Y., vol. III, p. 206, pl. xxiv, fig. 1 *a–y*.

SHELL small, trigonal; very inequivalve; hinge equaling the greatest breadth, which is usually nearly twice the length. Ventral valve very convex, or subpyramidal; beak elevated, somewhat pointed and but slightly curved, or nearly straight; area triangular, wider than high, distinctly defined, flat, or very slightly arched; foramen narrow, and closed (excepting near the beak) by a convex deltidium; ventral sinus of moderate depth and breadth, sometimes angular; lateral slopes with each four or five simple, rather rounded, or subangular plications, of which the two bounding the mesial sinus are larger and more prominent than the others; surface with concentric imbricating marks of growth.

Length, 0.25 inch; breadth, 0.40 inch; convexity, 0.25 inch.

We have only seen ventral valves of this shell, none of which have the area quite as high as some individuals of the *C. Dalmani*; but as that form varies considerably in this respect, and we have been unable to discover any reliable specific differences in the few specimens yet seen of the shell under consideration, we can but refer it to the New York species. Although we have not seen the interior, and none of our specimens are in a condition to show the shell structure, we can scarcely doubt that it is a *Cystina*, since we can see that it has a distinct mesial septum extending to and apparently connecting with the interior of the deltidium, as is the case with some species of that group, but unknown, we believe, in *Cyrtia*. The interior of the New York specimens have not been illustrated, but the shell is described as being "granulo-punctate."

Locality and position: Same as last.

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Genus SPIRIFER, Sowerby, 1815.

(Min. Conch., vol. II, p. 42.)

Subgenus TRIGONOTRETA, Kœnig, 1825.

Spirifer perlamellosus, Hall.

Pl. 7, fig. 9 *a*, *b*.

Spirifer perlamellosa, Hall, 1857. Regents' Report University of N. Y., for 1856, p. 57.
Spirifer perlamellosus, Hall, 1859. Palæont. N. Y., vol. III, p. 201, pl. xxvi, fig. 1–2.

Our specimens of this shell are too imperfect to enable us to give a full description, or to compare, in detail, all its characters with the New York species. As far, however, as they show its specific characters, it seems to agree exactly with *S. perlamellosus*. None of them are as large as the larger individuals of the species found in the east, but they show the same rather large, rounded plications, crossed by distinctly projecting, undulating lamellæ of growth, marked by traces of very fine radiating striæ. As in the New York examples, the mesial fold of the dorsal valve is prominent and round; and the beak and area of the ventral valve distinctly incurved.

Locality and position: Bailey's Landing, Perry county, Missouri; from a limestone of the age of the Delthyris shaly limestone of the New York Lower Helderberg Group. Upper Silurian.

GASTEROPODA.

Genus PLATYCERAS, Conrad, 1840.

(Palæont. N. Y., p. 205.)

Platyceras, Conrad, 1840. Ann. Report Palæont. N. Y., p. 205; Hall (1859), Report Regents University N. Y., p. 16; Palæont. N. Y., vol. III (1857), p. 309; Meek and Worthen, (1866), Proc. Acad. Nat. Sci., Philad., p. 202.
Acroculia, Phillips, 1841. Palæozoic Fossils, p. 93; Rœmer (1843), Verst. d. Harzgeb., p. 26; de Koninck (1843), Terr. Houill., p. 332; Hall (1852), Palæont. N. Y., vol. II, p. 218.
Capulus, in part, of authors (not Montfort?)

The genus *Platyceras* was proposed by Mr. Conrad for a group of shells, mainly if not entirely confined to the Palæozoic rocks, and most generally referred by European authors to Montfort's genus *Capulus*, published in 1810 (=*Pileopsis*, Lemarck, 1812). Mr. Conrad's description of this genus reads as follows: —

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"I propose to group in this genus the *Pileopsis tubifer*, *P. vetusta* and *Nerita haliotis*, Sowerby, and perhaps *Bellerophon cornuarietes*. These shells are suboval, or subglobose, with a small spire, the whorls of which are sometimes free and sometimes contiguous; the mouth is generally campanulate or expanded."

During the following year, Prof. Phillips proposed in his "Palæozoic Fossils," the name *Acroculia*, for this same group of shells, with the following description: —

"*Provisional characters.*—Obliquely spiral, the apex free, the aperture ample, without columella, a sinus in the right lip." He mentions but the two species, *Pileopsis vetusta*, Sowerby, and a new species of his own, *A. sigmoidalis*, both of which are typical species of *Platyceras*.

In this country Mr. Conrad's name has been generally adopted for these shells, which is certainly proper, if we separate them from *Capulus*, since his name has priority of date over that proposed by Prof. Phillips. Although agreeing with those who regard these shells as being probably distinct from the existing genus *Capulus*, we believe they are more nearly allied to that group than is generally supposed to be the case by most American Palæontologists. The only reason assigned by Prof. Hall for separating them from the modern genus is that he had never observed in them any traces of the peculiar horse-shoe shaped muscular scar so conspicuous in the genus *Capulus* * We have, however, found a similar muscular impression in two distinct species of this genus, one of which seems to be a variety of *P. subrectum*, Hall, from the Keokuk group, while the other is a new species described by us in this volume, under the name *P. subplicatum*, from the Waverly group, of Ohio. In both of these, internal casts show an elongated muscular impression on each side, connected by a linear band passing around behind. It is also worthy of note that both of these species belong to the nearly or quite straight section of the genus, for which Prof. Hall at one time proposed the name *Orthonychia*,† and, hence, are less nearly like the modern typical forms of the genus *Capulus*, than the majority of the Palæozoic species.

A careful examination of extensive collections of these shells, from our western palæozoic rocks, has also led us to believe that the animal was probably similar in habits to *Capulus* and other types of the family *Capulidæ*, to which they evidently belong, ‡ in being sedentary. This is shown by specimens found

* Twelfth Annual Report Regents University New York, p. 16, 1859.

† Report Fourth District New York, 1843.

‡ In a sheet entitled "Iowa Geological Survey, Supplement to vol. I, part ii, 1859," issued in 1860, Prof. Hall described a patelliform *Platyceras*, from Nauvoo, Illinois, under the name of *P. fissurella*, which he says has a perforation just anterior to the apex. Although this is merely mentioned as a specific character, distinguishing it from an otherwise similar species, described in the same paper, Conchologists will readily understand that such an opening, near the apex of the shell, if natural, must have been, judging from all analogy, for an excurrent or anal siphon, as in the *Fissurellidæ*, and hence would not

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attached to crinoids and other objects in such a manner that the sinuosities of the lip exactly correspond to the irregularities of the surface, to which they are attached. For instance, we have now before us one of these shells attached to the side of a *Pentremites Godoni*, so as entirely to cover one of the pseudambulacral fields and two of the intermediate areas, and yet the sinuosities of its lip conform so exactly to the irregularities of the side of the *Pentremite* that the connection looks as if it might have been air tight. The corresponding undulations of the lines of growth likewise show clearly that this nice adaptation of the margins of the lip to the irregularities of the surface of the *Pentremite* could not have resulted from accidental pressure when the edge of the lip was somewhat yielding, since the curves in the marks of growth are seen to extend up the sides of the shell some distance from the margin, where there could have been no flexibility.

This habit of attaching themselves to crinoids, has led some to think the crinoids were in the act of devouring these mollusks at the moment when they perished, and that these mollusks constituted the chief food of the crinoids. So far as our observations go, however, we do not think the evidence sufficient to establish this conclusion, since these shells are as often attached to the side of the crinoid below the horizon of the arms as to the summit, and hence out of reach of the mouth, while the conformity of the margins of the shell to the inequalities of the surface to which they are found attached, rather indicate that they grew there. The probability seems to be, that like various other sedentary marine animals, these mollusks, in their very young state, floated freely about until they found a suitable place to attach themselves. We were at one time inclined to think there might also be some reason for believing that the adult shell, at least sometimes, changed its station, from the fact that in some instances we observe the lines of growth indicating strong sinuosities in the lip during a part of the growth of the shell, which afterwards became suddenly obliterated, to give place to a different set of irregularities, as if the animal had changed its station and adapted the sinuosities of its lip to a new surface. This, however, may have been produced by the lateral expansion of the lip, by which it was brought into contact with different inequalities as the shell increased in size, or from accidental breaks in the lip, during the life of the animal. We have no evidence that they possessed the power of excavating a depression in the surface of attachment, as in *Amalthea*, or of secreting a shelly layer or support under the foot, as in *Hipponyx*.

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only remove the species from the genus *Platyceras*, but from the family *Capulidæ*, and place it in the *Fissurellidæ*, regarded by some systematists as belonging to a distinct order from that including the *Capulidæ*. A careful examination, however, of the typical specimen of *P. fissurella*, and other examples of the same species from the original locality, now in the possession of one of the writers, leads us to think the perforation alluded to (which only exists in one of the specimens), is almost beyond doubt an accidental break in the shell, and not a natural perforation.

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Prof. Hall has proposed to establish two subordinate groups under this genus, more or less distinct from the typical forms of *Platyceras*. These may be distinguished thus: —

1. *Platyceras*, Conrad. (Typical.) Shell with apex incurved or spiral; surface concentrically striated, sometimes radiately plicate, rarely spiniferous. *Pileopsis tubifer*, Sow.

2. *Orthonychia*, Hall. Shell arched or straight, with concentric striæ. *Platyceras subrectum*, Hall.

3. *Igoceras*, Hall. Differing from the last in having the surface cancellated. Ex. *P. plicatum*, Conr. (sp.)

It is, however, often very difficult to distribute the species into these groups, owing to the numerous gradations by which they blend into each other.

PLATYCERAS SUBUNDATUM, M. and W.

Pl. 7, fig. 13 *a*, *b*, and 14 *a*, *b*.

Compare *Platyceras multisinuatum*, and *P. intermedium*, HALL; Palæont. N. Y., vol. III, pl. 58.

SHELL obliquely irregular-oval, composed, at maturity, of about three and a half rounded volutions, the first two and a-half or three of which increase rather rapidly in size, are closely coiled together, and depressed with the spire on a level with, or below, the upper side of the outer turn; body portion, in adult shells, very rapidly expanding, so as to cause the upper side to rise considerably above the inner turns, with which, however, it continues very nearly or quite in contact, even at the aperture, which is large and subcircular, or transversely oval; lip with its margin all around, excepting on the inner side, undulated in adult shells, so as to form some eight or ten more or less defined sinuses, with projecting processes between. Surface in the young shell with fine, somewhat undulated, striæ of growth, which in the adult become more strongly defined, and more distinctly undulated towards the aperture, as they cross short, more or less distinct, longitudinal ridges, or obscure, rounded plications, developed there.

Greatest length of an adult shell, 1.90 inches; transverse diameter of the aperture, 1.40 inches; height of same, about 1.30 inches.

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Although this shell resembles several of the New York forms, and we at one time supposed it to be the *P. Gebhardi*, further comparisons with good specimens of that species, and *P. ventricosum*, from New York, and Cumberland, Maryland, have led us to the conclusion that it cannot be properly referred to either of those forms. At any rate, it differs from them both, as well as from some of the other more or less similar New York forms, upon quite as good characters as those by which they are distinguished from each other. From *P. Gebhardi* and *P. ventricosum* it differs in having the body whorl rather distinctly plicated, and nearly or quite contiguous at the aperture, and its lip strongly undulated or sinuous all around, excepting on the inner side, in adult specimens. Its volutions also expand more rapidly than those of *P. Gebhardi*. In the subplicate character of its body volution, and its undulated or sinuous lip, it resembles *P. multisinuatum*, Hall; yet it differs from that shell in having its spire more depressed, its volutions more rapidly expanding, and the last one never becoming distinctly free, while they are all without traces of plications, excepting the last one near the aperture. In some respects it is more nearly like *P. intermedium*, Hall, but it differs from that form in not having the body straight and free, and in having its lip more strongly undulated and plicated, as well as in having its apex more spiral.

We are aware that there is great difficulty in separating the species of such shells, and that after all the care and study that can be bestowed upon them, we cannot always feel quite confident that our conclusions are free from error. We can only say, however, that with an earnest desire to identify the shell under consideration with some of the New York species, we have felt that we would be more liable to err in doing so, than to regard it as a distinct species, and that, if the characters relied upon to distinguish the several New York forms mentioned are valid specific distinctions, our shell cannot be properly referred to any of them.

It is proper that we should explain here, that the irregularities in the dorsal outline of our figure 14 *a*, are due to some adhering portions of the matrix. A fracture across the spire of this specimen also shows that it has the same number of turns seen in figure 13 *b*. The adhering portion of the matrix that hides the smaller turns of the spire, also makes the body volution appear quite free from the spire. The lip, however, comes very nearly or quite in contact with the recurved spire, as may be seen by the other view of the same specimen, represented by figure 14 *b*.

Locality and position: Bailey's Landing, Perry county, Missouri; in limestone representing the "Shaly Limestone" of the N. Y. Lower Helderberg series. Upper Silurian.

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PLATYCERAS SPIRALE, Hall.

Pl. 7, fig. 12 *a*, *b*, *c*.

Platyceras spirale, HALL, 1859. Palæont. New York, vol. III, p. 331, pl. 63, fig. 4–9.

SHELL having a more or less irregularly elongated, and twisted, very rapidly ascending, spiral, or subspiral form; the few turns being more or less rounded, rather slender, and widely disconnected, or drawn out, excepting at the apex, where the small first volution is, in most examples, abruptly and closely coiled. Aperture subcircular, and, in large shells, expanded; lip somewhat sinuous. Surface, in young shells, smooth, excepting fine, rather obscure lines of growth; but in adults, with usually a few longitudinal plications on one side, crossed by stronger, undulating marks of growth.

Large specimens of this species sometimes attain a length of two and a half inches, with an aperture expanded to one and a quarter inches in diameter. It is a very variable shell, in general form, but always has its whorls much drawn out, excepting the first one or two. Our specimens agree quite as well with New York examples of *P. spirale*, as the latter do with each other. Those we have figured have the apex of the spire broken away, but another smaller one, too much enveloped in the matrix to be readily drawn, shows that its apex is closely coiled, as in the New York specimens. Another larger individual, also mainly embedded in the matrix, has the plications as well defined on one side as in figure 8, of the New York illustrations cited above.

Locality and position: Bailey's Landing, Perry county, Missouri; Lower Helderberg division of the Upper Silurian.

PLATYCERAS (ORTHONYCHIA) PYRAMIDATUM, Hall?

Pl. 7, fig. 11.

Platyceras pyramidatum HALL, 1859. Palæont. N. Y., vol. III, p. 336, pl. 64, fig. 7, and 9.

SHELL subpyramidal, or subconical, being nearly or quite straight, and much expanded, except at the apex, which is more or less attenuated; aperture subcircular, or irregularly subquadrangular, in consequence of the development of a few

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irregular, large obtuse folds around the lower part of the shell; lip with a few broadly rounded irregular undulations, or shallow sinuosities. Surface marked by lines of growth, which are obsolete above, but become stronger and distinctly undulated parallel to the outline of the lip, below the middle.

Length of a specimen with a part of the apex broken away, 2.10 inches; breadth, about 1.40 inches.

This shell agrees in its general appearance with *P. pyramidatum*, and most probably belongs to that species; but as we have only a single imperfect specimen for comparison, and the typical specimens upon which the species *pyramidatum* was founded (or at any rate those figured), are merely imperfect casts, the identification can only be regarded as provisional. It will be observed that our figure represents the shell as being more ventricose in the middle, and less expanded at the aperture, than the New York species. This, however, is partly due to distortion, from accidental pressure. The specimen shows no traces of the longitudinal striæ, doubtfully given as one of the characters of the New York shell.

It is not possible to say whether the apex in these shells was straight or curved, from our specimen, or those figured in the New York Palæontology, in all of which it is broken away.

Locality and position: Same as last.

ARTICULATA.

CRUSTACEA.

Genus ACIDASPIS, Murchison, 1839.

(Sil. Syst., vol. II, p. 658.)

Acidaspis hamata, Conrad (sp.)

Pl. 7, fig. 16.

Dicranurus hamatus, Conrad, 1841. Ann. Report Palæont. N. Y., p. 48, pl. —, fig. 1.
Acidaspis hamata, Hall, 1859. Palæont. N. Y., vol. III, p. 371, pl. lxxix, fig. 15–19.

Of this species, we have but the single fragment figured, which consists of the curious bifurcating appendage extended from the back part of the head, in the form of two elongated, hooked spines. The hooked extremities curve down into the matrix, and are not seen in our figure.

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Although this fragment agrees well with the corresponding part of Conrad's species, so far as can be seen, we can not be positively sure that it is really the same, for there might be two otherwise distinct species agreeing exactly in this appendage.

Locality and position: Same as last

GENUS DALMANITES, Auct.

(*Dalmania*, Emmrich, 1845 (not Rob., 1830),=*Odontochile*, Corda, 1847 (not Lap., 1834.)

DALMANITES TRIDENTIFERUS, Shumard.

Pl. 7, fig. 16.

Dalmania tridentifera, SHUMARD, 1855. Geol. Report Missouri, p. 199, pl. B, fig. 8 *a*, *b*.

"HEAD sub-semicircular, but little elevated, granulose; external border wide, slightly raised, and with a broad shallow groove extending nearly the entire length; front extended into a remarkable three-lobed process, about four lines wide at the base, and three and a half lines long; the lobes angulated and bent slightly upwards; one, a little largest, projects forward from the middle of the process, and occupies about half its length; the others arise from behind the central lobe, and project laterally, one on either side, their extremities being about five lines apart. On each side of the process the border is notched about half its width. The genal angles are broad, flattened-convex, and slightly curved at the tip; their length about equal to the head, exclusive of the frontal process. Glabella very moderately convex; frontal lobe transverse, somewhat lozenge-shaped, with the angles rounded, occupying more than one-half the length of the glabella, including the occipital ring, and separated from the cheeks by a well-defined dorsal furrow, which becomes obsolete in front; lateral furrows well impressed, and extending rather more than one-third the distance across the glabella; anterior pair directed obliquely backwards, forming, with the axis, an angle of about seventy degrees; second pair directed forwards; posterior pair transverse. Eyes large, lunate, very close to the glabella, and extending from the occipital to the anterior lateral furrows.

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The visual surface of each eye contains about 38 vertical rows of lenses, the maximum number of a row being ten, the whole number about 350. The cheeks are very slightly convex."

"Pygidium sub-trigonal, flattened-convex; border from a-half to a line wide, prolonged posteriorly into a pointed spine from one to two lines long. Axis but little raised above the lateral lobes, forming about one-fourth the entire width, tapering gradually, rounded and slightly prominent at the extremity, from which an obscure carina extends to the caudal spine; rings fourteen, flattened-convex, separated by narrow grooves; lateral lobes, with nine or ten segments, gently curved, and their extremities coalescing with the border; furrows rather wide but shallow, each with two shallow pits near the border, separated by a slightly raised carina."

Having but fragments of this species, and believing that it will probably be found in the same rock in the south-western part of this State, we have thought it desirable to give Dr. Shumard's entire description for the use of students who may not have access to the Missouri Report, as it was drawn up from much better specimens than those we have.

Our figured specimen shows only the under side of the margin of the head, with its tridentate anterior process, and produced posterior lateral spines. It will be observed, that the divisions of the tridentate process appear not to be so long and pointed as in Dr. Shumard's figure. This, however, is due to the fact that these divisions curve upwards so as to be partly hidden in the matrix, as we have ascertained since the figure was drawn, by working away some of the surrounding rock. Its anterior margins, immediately on each side of the tridentate process, are also less sinuous than in Dr. Shumard's figure. But as our specimen came from the same locality and position as his, we can but regard this difference as being due either to the fact that our specimen shows only the under side, and his the upper, or to a slight individual variation.

This species is evidently a representative of the New York Shaly Limestone *D. tridens*, of Hall, which has the same kind of a tridentate process, though much longer, extending from the anterior margin of the head. It is interesting to see so many representative forms of the New York Shaly Limestone fossils at this western locality.

Locality and position: Bailey's Landing, Perry county, Missouri; Shaly Limestone of the Lower Helderberg Group of the N. Y. Upper Silurian.

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DEVONIAN SPECIES.

FOSSILS OF THE ORISKANY GROUP.

MOLLUSCA.

BRACHIOPODA.

GENUS LEPTÆNA, Dalman, 1827.

(Uppstalln. af Terebr.)

LEPTÆNA? NUCLEATA, Hall.

Pl. 8, fig. 8 *a*, *b*, *c*, *d*.

Leptæna nucleata, HALL, 1857. Ann. Rep. Regents Univ. N. Y., for 1856, p. 47.
Leptæna? nucleata, HALL, 1859. Palæont. N. Y., vol. III, p. 419, pl. xciv, fig. 1 *a*, *b*, *c*, *d*.

SHELL very small, semicircular, concavo-convex, greatest breadth on the hinge margin; length from three-fourths to two-thirds the breadth; lateral extremities rather acutely angular, or forming less than right angles; front regularly semicircular in outline. Ventral valve very gibbous in the central region, with lateral extremities compressed; beak strongly incurved, with its point extending a little beyond the hinge margin; area very narrow, and rendered oblique by the curving of the beak; interior with a prominent linear mesial ridge, or low septum, extending from the beak nearly to the middle of the valve, and leaving a very distinct slit in the beak of internal casts.* Dorsal valve moderately concave, and rough-

* This slit is carried a little too far forward in fig. 3 *d*, and should end more abruptly.

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ened internally by sharply elevated radiating lines, more or less broken up into projecting points, over a fan-shaped area, occupying most of the interior surface; beak and area obsolete; cardinal process prominent, narrowed at the base, and faintly trifid at the extremity, like that of some species of *Productus*. Surface of both valves smooth, excepting a few subimbricating marks of growth. (Muscular scars unknown.)

Length, 0.15 inch; breadth, 0.20 inch; convexity, about 0.10 inch.

This curious little shell does not present the form or internal characters of *Leptæna*, and will probably be found to be a new generic type. As we only know it from moulds and casts in the matrix, however, we prefer to leave it provisionally under the name *Leptæna*, rather than attempt to found a new genus upon such inferior specimens as we have yet seen. It seems to agree exactly with the New York species, which is not yet known to occur at any other western locality.

Locality and position: Cherty limestone, belonging to the horizon of the Oriskany sandstone of the New York Devonian series; Township 14, Range 2, Alexander county, Illinois.

Genus RHYNCHONELLA, Fischer, 1809.

(Mem. Soc. Imp. Mosc. II.)

Rhynchonella speciosa, Hall.

Pl. 8, fig. 9.

Rhynchonella speciosa, Hall, 1857. Report Regents University, N. Y., for 1856, p. 81; Palæont. N. Y. (1859), vol. III, p. 444, pl. ciii A, fig. 1—6.

Shell attaining a large size, sub-equivalve, in young examples subovate, becoming longitudinally oblong-oval, and extremely gibbous in adult specimens, which are often longer than wide; without mesial fold or sinus in either valve; sides flattened and often more or less straightened, and nearly parallel, or but slightly convex; front subtruncated, or more or less rounded; anterior and lateral margins of both valves abruptly curved, or deflected towards each other, and united by deeply interlocking, sharply angular serratures. Dorsal valve very convex, but somewhat flattened on top; beak regularly

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incurved; cardinal margin deeply sinuous on each side of the beak for the reception of corresponding rounded prominences of the margin of the other valve; interior provided with a thickened cardinal process, from which a prominent mesial septum extends forward towards the middle of the valve. Ventral valve somewhat less convex than the other, which it nearly resembles in other respects, excepting that its rather obtuse beak is a little more prominent and arched over that of the other valve; entire breadth of deflected anterior margin somewhat prominent, and occupying a corresponding broad shallow sinuosity of the margin of the other valve. Surface of both valves ornamented with numerous, simple, regular plications, which are flattened or rounded on the posterior portions of the valves, but become more prominent and subangular on the front.

Length of an adult shell, 2.07 inches; breadth, 1.44 inches; convexity, about 1.50 inches.

This is one of the largest and most symmetrical species of the genus known. It is remarkable for having neither mesial fold nor sinus, the valves being nearly equally convex. We are not aware of its occurrence at any other western locality.

Locality and position: Bald Rock, Jackson county, Illinois; in a light gray subcrystalline, cherty limestone, of the age of the Oriskany sandstone, of the New York Devonian series.

GENUS EATONIA, Hall, 1857.*

(Regents' State Cab. N. H. Report for 1856, p. 90.)

EATONIA PECULIARIS, Conrad, sp.

Pl. 8, fig. 2 *a*, *b*, *c*, *d*.

Atrypa peculiaris, CONRAD, 1841. Annual Report Palæontology N. Y., p. 56; VANUXEM, (1842), Geol. Report Third Dist. N. Y., p. 123, fig. 3; HALL (1843), Geol. Report Fourth Dist., p. 148.

Eatonia peculiaris, HALL, 1859. Twelfth Ann. Rep. Regents Univ. N. Y., p. 37, fig. 1–7; Palæont. N. Y., vol. III (1859), p. 244, pl. xxxviii, fig. 21–26, and pl. ci, fig. 2.

SHELL rather under medium size, slightly longer than wide,

* Prof. Hall *used* the name *Eatonia* in 1857, in the Regents' Report for 1856, but he did not *describe* the genus until 1859.

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or with length and breadth nearly equal, becoming rather convex in adult examples, greatest convexity and breadth generally in front of the middle; subtruncated, or more or less prominent in outline in front; sides converging more or less rapidly to the beaks. Dorsal valve more convex than the other, particularly in the middle, thence rounding off rather rapidly to the sides; anterior margin rising in the middle to a more or less prominent mesial fold; beak incurved. Ventral valve compressed, convex near the beak, and flattened, or a little concave towards the sides, which are so abruptly deflected at right-angles to the flattened disc, as to present distinctly rectangular margins from near the beak to the front; anterior margin curving abruptly towards the other valve, and produced into a tongue-shaped projection, filling a corresponding sinuosity (not an imargination) in the front of the dorsal valve, on each side of which the immediate edges of both valves show a few crenatures, or rudimentary plications, scarcely visible externally; beak a little more prominent than that of the other valve, and somewhat arched, with a small rounded terminal foramen. Surface marked with small, moderately distinct, bifurcating radial striæ, one of which is sometimes a little larger than the others in the middle of the mesial sinus of the ventral valve, and corresponds to a slightly larger furrow between two of those on the middle of the fold of the other valve.

Length, 0.75 inch; breadth, 0.70 inch; convexity, 0.50 inch.

We have seen only one tolerably good specimen, and some fragments of this shell; but as far as we have been able to compare its characters with those of authentic examples of *Eatonia peculiaris*, from New York, we have been unable to find any reliable specific differences. The only nearly perfect individual seen (that figured), seems not to have the mesial fold quite so distinctly elevated at the front margin, as in the New York examples; but as it has that part slightly distorted by pressure (the distortion is not represented in the figure), and the New York specimens vary somewhat in the distinctness of the mesial elevation, we have scarcely any doubt in regard to its identity with the New York shell. So far as we know, this species has not been found at any other locality west of New York.

Locality and position: Same as last.

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GENUS LEPTOCŒLIA, Hall, 1857.*

(Regents' Report for 1856, p. 107.)

LEPTOCŒLIA FLABELLITES, Conrad, (sp.)

Pl. 8, fig 3 *a*, *b*, *c*.

Atrypa flabellites, CONRAD, 1841. Ann. Report Palæont. N. Y., p. 55.

Leptocœla propria, HALL, 1857. Ann. Report Regents Univ. N. Y., for 1856, p. 108; Extr. from same (1857), p. 68.

Leptocœlia flabellites. HALL, 1859. Palæont. N. Y., vol. III, p. 449, pl. cvi, fig. 1 *a–f*; and pl. ciii B, fig. 1 *a–g*.

SHELL flabelliform, or suborbicular, generally a little wider than long, compressed plano-convex; cardinal margins straight on each side, and converging to the beaks, at an angle of about 100° to 150°; sides somewhat rounded, or sometimes obtusely subangular at the terminations of the cardinal slopes; anterior margin more or less rounded. Dorsal valve nearly flat; beak slightly less prominent than that of the other valve, and not incurved. Ventral valve moderately convex along the middle, and sloping to each side; beak curved so as to be directed nearly at right-angles to the plane of the shell, rather small, and provided with a minute rounded opening at the apex; bounded on the inner side by the deltidium. Surface of each valve ornamented by about fourteen simple, depressed, or subangular radiating plications, two of which on the middle of the ventral valve are larger and more prominent than the others, with a smaller one depressed between them, so as to form a small mesial sinus, corresponding to a low mesial elevation towards the front of the other valve, formed by the two middle plications, which are a little larger and more prominent than those on each side, from which they are separated by deeper furrows than those between the lateral ones. A few obscure undulations of growth are also sometimes seen crossing the plications.

* Prof. Hall used this name in the Regents' Report for 1856, published in 1857, but without a generic description. He described the genus in the Regents' Twelfth State Cab. Report, in 1859.

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This species varies somewhat in proportional length and breadth; the wider specimens also have the lateral slopes of the cardinal margin diverging from the beaks at a greater angle. The specimen from which our figures were drawn is somewhat distorted and exfoliated, and does not show the specific characters as clearly as some since obtained. We have no doubt of its specific identity with the New York shell, which has not, we believe, been found at any other locality west of that State.

Locality and position: Dry fork of Clear creek, Union county, Illinois; from a Cherty limestone of the age of the Oriskany sandstone of the New York Devonian series.

Genus SPIRIFER, Sowerby, 1815.

(Min. Conch., 11, p. 42.)

Subgenus TRIGONOTRETA, Koenig, 1825.

Spirifer Engelmanni, M. and W.

Pl. 8, fig. 5 *a*, *b*, *c*, *d*.

Shell of medium size, rather convex, about twice as wide as long; hinge line equaling the greatest breadth; lateral extremities compressed and rather acutely angular; anterior lateral margins converging with a somewhat convex outline to the rather deeply sinuous front; valves nearly equally convex, the dorsal being most prominent anteriorly, and the ventral towards the umbo. Dorsal valve distinctly compressed in the posterior lateral regions; mesial elevation without plications, very narrow at the beak, but widening and becoming rather rapidly more elevated in front, where it is subangular, or more or less rounded; beak but little prominent, and with the narrow area incurved. Ventral valve distinctly more gibbous than the other in the umbonal region, and strongly arched; lateral slopes convex, excepting near the hinge; mesial sinus smooth, commencing very narrow at the beak, and widening and deepening to the front, not defined on either side from the convex lateral slopes by prominent marginal plications;* beak prominent and distinctly incurved; area of

* The marginal plication on the left side of the sinus in fig. 5 *b* is made to appear too prominent and not rounded enough. In the shell, the surface rounds into the sinus on both sides.

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moderate height, rather well defined, with nearly parallel margins near the beak, but narrowing rapidly to the extremities, distinctly arched and inclined back over the hinge; foramen wider than high, but narrowing near the beak. Surface ornamented by 12 to 15 simple, rather rounded plications, on each side of the mesial fold and sinus, crossed near the front by a few rather distinct ridges of growth.

Length, 0.93 inch; breadth, 1.70 inches; convexity, 0.80 inch.

It is probable that specimens of this species, with the surface not exfoliated, would show some more or less distinct, finer undulating marks of growth. We also think we have seen, on some of the specimens, indications of fine radiating striæ. Internal casts of the ventral valve show that its rostral cavity is large, and marked with the curved radiating striæ often seen in analagous species.

This species will be at once distinguished from the next, by its more ventricose ventral valve, with its strongly incurved produced beak and area, as well as by having the plication on each side of the mesial sinus of the ventral valve more depressed, and the lateral slopes more convex. Its cardinal area is also not so high, and much more arched and inclined back over the hinge. It may perhaps be regarded as a representative of the New York Oriskany species *S. arrectus*, Hall, from which it differs in having smaller plications, a less prominent dorsal valve, and a much more strongly arched ventral beak.

Named in honor of Mr. Henry Engelmann, who collected the specimens described, while engaged in surveying some of the southern counties.

Locality and position: Cherty limestone of the age of the N. Y. Oriskany division of the Devonian; Township 12, Range 2, Union county, Illinois.

SPIRIFER HEMICYCLUS, M. and W.

Pl. 8, fig. 6 *a*, *b*, *c*, *d*; and 7 *a*, *b*.?

SHELL nearly semicircular, moderately convex; breadth nearly or quite twice the length; hinge margin equaling the greatest breadth; lateral extremities rather acutely angular, or sometimes a little rounded. Dorsal valve moderately convex in the central region and compressed at the lateral extremities, beak incurved; mesial ridge narrow, abrubtly elevated, its sides being nearly perpendicular, somewhat flattened or a

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little concave on top, and without plications;* area narrow and incurved. Dorsal valve more convex than the other at the beak; lateral slopes nearly straight; beak moderately prominent and but little curved, somewhat remote from that of the other valve; area of medium height, very sharply defined by the straight angular lateral slopes of the beak, narrowing regularly to the extremities of the hinge, but slightly arched, or nearly flat, and ranging at right angles to the plane of the valves, or inclined a little backward; foramen nearly or quite as wide as high; mesial sinus corresponding in size to the narrow mesial elevation of the other valve, and very sharply defined by the prominence of the first plication on each side. Surface ornamented by from ten to twelve, simple, moderately distinct, subangular plications, on each side of the mesial fold and sinus.

Length of the most nearly perfect specimen seen, 0.60 inch; breadth, 1.25 inches; convexity, 0.45 inch.

The specimens of this species yet obtained are all more or less broken and distorted, so that we have not the means of giving very good figures of it, though most of its characters can be made out from the different specimens taken together. Although not unlike several of the described species, we have been unable to identify it satisfactorily with any of them, and believe it to be new. Its most marked characteristics are the straightness or very slight convexity of the slopes of its ventral valve, from the mesial sinus to the lateral extremities, and its sharply defined mesial sinus, and cardinal area, as well as the narrowness and abrupt elevation of its mesial ridge. All of these characters, it is true, occur in other species, but not, so far as we have been able to find, all combined in any one species agreeing with this in form, surface-markings, and other respects. *S. varicosus*, Hall (Ann. Report Regents Univ., N. Y., for 1856, p. 130, 1857), for instance, seems, judging from the description alone, for we have not yet seen that shell or a figure of it, to be quite similar, and yet differs in sometimes having a plication in the mesial sinus; and particularly in having the surface "marked by regular distinct imbricating lines of growth, which sometimes give a subnodose character to the plications." It is true most of our specimens have the surface exfoliated, but one of them shows the orginal surface of the plications to be without any such markings.

*The mesial ridge is not correctly represented in fig. 6 *d*, not being prominent enough; while the appearance of a plication on its right side is a defect in the shading. It is also represented too wide and too round on top in fig. 6 *a*.

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The internal casts represented by figures 7 *a*, *b*, pl. 8, were found in the same horizon, and may belong to the same species, though we are not sure they do, as their plications are larger, and the impression of the area in the matrix (see 7 *a*, *b*) shows it not to be so high, and considerably more inclined back over the hinge.

Locality and position: Cherty Limestone of the age of the Oriskany Sandstone of the Devonian series, at several localities in Union county, Illinois. The casts 7 *a*, *b*, however, are from the same horizon in Alexander county.

Genus RENSSELÆRIA, Hall, 1859.

(Regents' State Cab. N. H. Report, p. 39.)

Rensselæria Condoni, McChesney.

Pl. 8, fig. 4 *a*, *b*.

Rensselæria Condoni, McChesney, 1861. Palæozoic Fossils, p. 85.
Rensselaria Condoni, McChesney, 1865. Explanations of pl. vii, Palæozoic Fossils (fig. 2)
Rensselæria Condoni, McChesney, 1867. Trans. Chicago Acad. Sci., vol. I. p. 36, pl. vii, fig. 2.
Compare *Meganteris ovalis*, Hall, 1857. Regents' Report for 1856, p. 101; =*Rensselæria ovalis*, of same, Third vol. Palæont. N. Y., p. 458, pl. cvi, fig. 2 *a–l*.

Shell compressed, sublenticular, broad-oval or subcircular in outline, the length but slightly exceeding the breadth, widest near the middle; sides and front rounded, the latter more narrowly; lateral margins truncated, and inflected at right-angles to the plane of the valves. Ventral valve a little more convex than the other; beak projecting a little beyond that of the other valve, incurved, and having its lateral slopes rather angular, so as to give somewhat the appearance of there being a cardinal area. Dorsal valve slightly and evenly convex. Surface apparently smooth. Internal characters as in *R. ovalis*. Punctate structure readily seen by the aid of a pocket lens.

Length and breadth of the largest specimen seen, 1.10 inches; convexity, about 0.38 inch. Other individuals proportionally a little larger.

We have seen no good specimens of this shell; but a few of those obtained since plate 8 was engraved, are in a much better condition than those figured. So far as we have yet been able to see, it seems to agree in all respects with *R. ovalis*, Hall, excepting that none of the specimens show any traces of radiating

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striæ. It should be remembered, however, that all of the few examples yet obtained, were broken from a hard matrix, and have the surface badly preserved; while New York specimens of *P. ovalis*, in the same condition, often show no remains whatever of striæ. One of the latter now before us, from Schoharie, New York, shows no traces of radiating striæ, and agrees well with those under consideration. We are nearly satisfied in regard to the specific identity of the Illinois shell with *R. ovalis*, but prefer to retain for it the name *R. Condoni*, until we can have more satisfactory means of deciding whether it is distinct or not.

Locality and position: Cherty limestone of the age of the Oriskany sandstone of the New York Devonian; on Clear creek, and other localities west of Jonesboro, Union county, Illinois.

GENUS STRICKLANDINIA, Billings, 1863?*

(Canad Nat., vol. VIII., p. 370.)

STRICKLANDINIA ELONGATA, var. CURTA.

Pl. 8, fig. 1 *a*, *b*, *c*, and pl. 9, fig. 5?

Pentamerus elongatus, VANUXEM, 1842. Geological Report Third District N. Y., p. 132, fig. 1; HALL (1843), Geol. Report Fourth District N. Y.. No. 34, fig. 4.
Meganteris elongatus, HALL, 1837. Tenth Ann. Rep. Regents Univ. N. Y., p. 123.
Rensselæria elongata, HALL, 1859. Twelfth Ann. Rep. Regents Univ. N. Y., p. 38.
Stricklandia elongata, BILLINGS, 1861. Devonian Fossils Canada, p. 58, fig. 91 and 92.
Stricklandinia elongata, BILLINGS, 1863. See DAVIDSON'S Monogr. Brit. Sil. Brach. (1867), part VII, No. ii. p. 157.

SHELL obovate, subequivalve, in a majority of specimens not more than one-fourth to one-third longer than wide, the widest part being behind the middle; in young individuals moderately gibbous, but becoming extremely so in large adults, which are in some examples about one-eighth more convex than wide; greatest breadth and convexity behind the middle; sides truncated and flattened (or even a little concave) at right-angles to the plane of the valves, the flattened or concave space being widest in gibbous examples, which present a subhexagonal outline, as seen in an end view (fig. 1 *c*, pl. 8); hinge margin round-

* Mr. Billings first described this genus under the name *Stricklandia*, in 1859; but on learning, at a later date, that this name had been previously used for a genus of plants, he proposed the name *Stricklandinia* for the genus of shells.

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ing off laterally from the beaks in testiferous specimens, but generally somewhat straightened in internal casts; front narrowly rounded. Dorsal valve a little less convex than the other, being most prominent along the middle, on each side of which its slopes are a little flattened to the truncated lateral margins; beak incurved; ventral valve, with much the form of the other, excepting the slightly greater convexity and more prominent beak, which is sometimes pointed at the apex, and strongly curved over and upon that of the other valve. Surface nearly smooth, with a few obscure wrinkles, or marks of growth, towards the front of adult specimens.

Length of the largest individual seen (internal cast), 1.92 inches; breadth, 1.30 inches; convexity, 1.47 inches.

Internal casts of this species show that the chamber in the beak of the ventral valve is well developed, moderately large, and triangular. In the dorsal valve there were two short, closely approximated plates, united at the bottom of the valve, and supporting at their inner edges the internally produced crura. In most of the casts of the dorsal valve the two short plates are as well developed as we sometimes see in true *Pentamerus*, and evidently inclosed a narrow chamber that extended along the bottom of the valve. In this character of the dorsal valve these shells differ from the typical forms of the genus *Stricklandinia*, and in this and other characters resemble *Pentamerus* so closely that we should have doubted the propriety of referring them to any other genus, were it not that our specimens show the shell structure to be distinctly punctate. The punctures are easily seen with a common hand lens, and are very regularly and closely arranged. We are not aware whether in any of the typical species of *Stricklandinia* the punctate structure has been observed; though from the analogy of that type to *Rensselæria*, it probably has the same shell structure.*

In regard to the specific relations of our shell to *S. elongata*, of Vanuxem, we are in considerable doubt. The fact that we only know that shell from the figures of two individuals (Vanuxem's original type, and one figured by Mr. Billings), representing the exterior of the shell, while our specimens are mainly internal casts, renders our comparisons very unsatisfactory. All four specimens, however, differ from both of the figures alluded to, in being widest *behind* the

* Since this was written, we observe Prof. Hall proposes (Regents' Twentieth State Cab. N. H. Report, p. 163) to separate the New York species, *Pentamerus elongatus*, of Vanuxem, from *Stricklandinia*, of Billings, under the name *Amphigenia*, in consequence of its want of a cardinal area, and the possession of a punctate structure. Should this separation be sustained, and our shell prove to be specifically distinct from the New York form, it will have to take the name *Amphigenia curta*.

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middle. They are all likewise smaller than the New York and Canadian examples figured, and with the exception of the specimen from which our figures 1 *b* and 1 *c* were drawn, much shorter in proportion to their breadth, a majority of them not being more than about one-fifth longer than wide, and others even proportionally shorter. The young shell was quite as wide as long. It is probably a distinct species, but we prefer to regard it as a variety of that form (*elongata* is said by Mr. Billings to be quite variable) until we can have more satisfactory means of comparison.

Locality and position: Cherty limestone of the age of the Oriskany sandstone of the New York Devonian series; Union county, Illinois. Smaller casts, possibly of the same species, also occur in the overlying sandstone at the same locality. In New York the species *elongata* occurs in the Onondaga limestone, but in Canada it is also found in the Oriskany sandstone and Corniferous limestone.

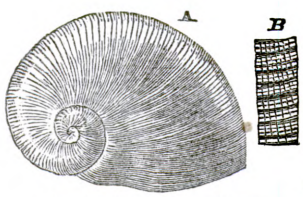
GASTEROPODA.

GENUS STROPHOSTYLUS, Hall, 1859.

(Regents' State Cab. N. H. Report, p. 21.)

STROPHOSTYLUS? CANCELLATUS, M. and W.

Pl. 8, fig. 12 (and 11 *a*, *b*?)



Strophostylus? cancellatus.

Fig. A, view of upper side of a nearly perfect specimen.
Fig. B, enlargement of surface markings of same.

SHELL depressed, obliquely oval, height about two-thirds the breadth; spire depressed nearly upon a level with the body whorl; volutions three, increasing very rapidly in size, generally wider than high; last one very large and ventricose, lapping a little upon the others at the suture above, and flattened or slightly concave near the aperture just outside of the suture, which is merely linear; aperture large, sub-orbicular; outer lip thin, very oblique, meeting the volution above nearly at right angles, and extending very much farther forward above than the lower margin of the aperture. Surface ornamented by fine, rather distinct, lines of growth, starting from the suture at first, slightly forward, but immediately curving very ob-

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liquely backwards as they extend outwards, and pass over the rounded outer side parallel to the oblique margin of the lip; crossing these there are also finer raised revolving lines, which become more widely separated, and less distinct or even obsolete on the body volution as they approach the aperture.

Height of the most nearly perfect specimen seen, 0.75 inch; breadth, 1.20 inches.

At first we were inclined to regard this as a *Platyceras*, allied to *P. ventricosum*, or *P. Gebhardi*, but some better specimens, obtained since the figures on plate 8 were drawn, show that the body volution does not become free at the aperture, and that there is a columella. None of them, however, are in a condition to show very clearly whether the columella has the peculiar twisted character of *Strophostylus*, though we think we have seen some evidences that it has. The figures on plate 8 were unfortunately drawn from internal casts (the best we had at that time), and do not convey a very clear idea of the shell. Those retaining the shell (one of which is represented by the foregoing cut) show that the volutions do not round into the suture above, but lap upon the next volution within, so as to leave merely a linear suture. This character, together with a slight concavity, or flattening of the upper side of the body whorl near the suture, and the remarkable obliquity of the lines of growth and the margin of the lip, give the shell very much the appearance of a *Lunatia* or *Neverita*, as seen from above.

Our description is drawn up from the best testiferous specimen represented by the annexed wood cut It is probable these smaller specimens are distinct from that represented by figures 11 *a*, *b*, which has the body whorl more ventricose, and prominent below, and not increasing quite so rapidly in breadth. There are, however, some associated smaller specimens, having the same form as that represented by figure 11, showing exactly the same surface markings seen on that from which the foregoing description was made out. Should these less depressed and more ventricose forms, such as that represented by figures 11 *a*, *b*, prove distinct, they may be called *S. ventricosus*.

We should explain here that the striæ seen on fig. 11 *b*, were intended, in the drawing, to represent faint traces of marks of growth seen on the internal cast, but in the engraving they are made too sharp, so as to look like surface striæ, for which, however, they do not curve as much as they should, and are not near oblique enough, particularly on the right lower side of the figure.

Locality and position: The large specimen (fig. 11) is from the light-gray subcrystalline limestone at Bald Rock, Jackson county, Illinois, of the age of the Oriskany Sandstone of the New York Devonian series. Smaller specimens of the same form also occur, with the more depressed form represented by fig. 12, at the same horizon at Bald Knob, Union county.

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Genus Platyceras, Conrad, 1840.*

(Ann. Rep. Palæont. N. Y., p. 205.)

Platyceras spirale, Hall?

Pl. 8, fig. 10.

Platyceras spirale, Hall, 1859. Palæont. N. Y., vol. III, p. 331, pl. lxiii, fig. 4–9.
Compare *P. tortuosum*, Hall; ib. p. 472, pl. cxiii, fig. 1–5.

In regard to the relations of this shell to *P. spirale*, we can only say that the few imperfect specimens we have yet seen show no reliable characters by which it can be certainly distinguished. It is not improbable, however, that a good series of well preserved specimens might prove it to be entirely distinct, since the identification of species in a genus like this, from a few fragmentary specimens, is of course very far from satisfactory.

It was evidently a slender, elongated, tortuous, rather thick shell, more or less expanded at the aperture. It generally shows no plications, and has but faint indications of lines of growth, on the remaining portions of the shell. The only larger individuals in the collection, like that from which fig. 10 was drawn, have all had the upper part of the spire broken away. A smaller specimen, however, from the same locality and position, probably belonging to the same species, shows some obscure indications of a few irregular longitudinal plications, crossed by undulating lines of growth, and has its immediate apex spiral, as in some examples of *P. spirale*.

The only reasons why these shells might not, upon quite as good grounds, be referred to the New York Oriskany Sandstone species, *P. tortuosum*, are the more expanded character of the aperture of the larger specimen, and the spiral apex of the smaller one. It is worthy of note however, that only one of the figured specimens of *P. tortuosum* has the apex of the spire preserved, and *it* is only an internal cast. Indeed it must be confessed, that in regard to the distinctions between the figured specimens of *P. spirale* and some of those referred to *P. tortuosum*, not very much can be said; and had some of the latter been found associated in the same bed with the typical examples of *P. spirale*, few would ever suspect them to be distinct. The fact that *P. spirale* is a Lower Helderberg species, and that *P. tortuosum* occurs in the Oriskany Sandstone, cannot, alone, be relied upon to prove them to be distinct, especially when several species of other genera, and one of this (*P. Gebhardi*), are acknowledged to be common to both of these horizons.

Locality and position: Bald Rock, Jackson county, Illinois; from Cherty light-gray limestone, belonging to the horizon of the Oriskany Sandstone of the New York Devonian series.

* For remarks on this genus see page 384.

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FOSSILS OF THE CORNIFEROUS GROUP.

RADIATA.

ZOOPHYTA.

GENUS PLEURODICTYUM, Goldfuss, 1829.

(Petref. Germ., vol. I, p. 113.)

PLEURODICTYUM PROBLEMATICUM, Goldf.?

Pl. 9, fig. 1 *a*, *b*, *c*.

Astroita, PETER WOLFART, 1719. Hist. Nat. Hass. infer., p. 30, tab. 25, fig. 5; LIEBKNECHT, 1759, Hass. Subterr., tab. 2, fig. 4.

Corps particuliers, etc., KNORR et WALCH, 1775. Rec. des mon. des Catastr., t. III, p. 199, supp. pl. 10*b*, fig. 1, 2, 3.

Pleurodictyum problematicum, GOLDFUSS, 1829. Petref. Germ., t. I, p. 113, pl. 38, fig. 18; BRONN (1835–37), Leth. Geog., t. I, p. 56, tab. 3, fig. 12; PHILLIPS (1841), Palæozoic Foss., p. 19, pl. 9, fig. 24; DEVERNEUIL et HAIME (1851), Bull. Geol. Soc. Fr., t. VII, p. 164; EDWARDS and HAIME (1845), Arch. Mus., t. V, p. 210, pl. 18, fig. 3, 4, 5, 6.

CORALLUM depressed, subhemispherical, or semilenticular; concavo-convex, the under side being concave and provided with an epitheca, and the upper convex. Corallites somewhat irregular in size and form, more or less angular, often hexagonal, short, increasing rapidly in size, and so distinctly radiating from the middle upwards and outwards, that the lower series lie nearly or quite parallel to the concave base, and even decline as they extend out from near the middle to the periphery—those rising from near the middle, shorter than the others; connecting pores, as indicated by their casts, rather numerous, and apparently irregularly arranged, some-

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times passing through the corners as well as the sides of the walls between the corallites.

Breadth of the largest specimen seen, 1.38 inches; height, 0.40 inch.

Our specimens of this coral agree so nearly with some of Edwards and Haime's figures of *Pleurodictyum problematicum*, that we have concluded to refer it provisionally to that species, without being quite convinced of its exact specific identity. Edwards and Haime's figures 4 and 4 *a*, of the plate cited in the synonymy, seems to agree exactly with our specimens in all respects; but their figure 5, representing a vertical section, shows the corallites less spreading than in our specimens, in which the lower series radiate horizontally, or even decline a little at the periphery. Nor do any of our specimens show the casts of distinct striæ or septa on the inner walls of the corallites, as seen in some of Edwards and Haime's figures; though in this respect they agree quite well with others of their figures. None of our specimens show any traces of the peculiar Serpula-like tube sometimes seen within European specimens of *P. problematicum*, but as this is not always present in the typical examples, we agree with those who regard it as the work of some boring, tube-secreting animal, and not a part of the coral itself.

It will be observed that Edwards and Haime's figure 5, as well as Goldfuss' figure 18 *b*, pl. 38, represent the base of *P. problematicum* as having the epitheca smooth, excepting very distinct concentric striæ or wrinkles of growth; while figure 4 of the former authors, represent its cast as being marked with numerous small pits, apparently left by distinct granules, on the under side of the epitheca, without any traces of concentric wrinkles. Our specimens agree with the latter, where well preserved, and none of them show any indications of concentric markings. We are at a loss to account for these differences in the different European specimens. At first we were inclined to think the pitted appearance might have been produced by the connecting points of the bases of the corallites on the *inner* side of the general base, and that the concentrically wrinkled specimens showed casts of the *under* or *outer* side of the epitheca. The fact, however, that the little pits are greatly more numerous than the corallites, and can be seen in our specimens under the *sides* of the lower horizontally arranged corallites, are sufficient evidences that they were not produced by their starting points.

Dr. Rominger has ingeniously suggested that *Pleurodictyum* (which is only known as casts), is really only the cast of a *Favosites* (Am. Jour. Sci., vol. XXXV, p. 82), and we are by no means satisfied that he is not correct. Indeed our first impression in regard to our specimens, before we thought of comparing them with *Pleurodictyum*, was that they were cases of a small species of *Favosites*. On comparing them with Edwards and Haime's figures of

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P. problematicus, however, we were at once satisfied that they must belong to the same genus, if not indeed to the same species.

After a careful study of our specimens, we can see but one objection to Dr. Rominger's view. That is, that in looking in between the lower side of the lower horizontally extended corallites, and the cast of the pitted base, we can see numerous little bars passing across this thin space (evidently occupied in the perfect fossil by the thin common base), exactly like those passing across between the corallites. As the latter must be the casts of little pores connecting the corallites, as seen in *Favosites*, their presence between the under sides of the casts of the lower corallites, and that of the lower surface of the base, would also indicate the existence of numerous pores passing *through the base*, a character, we believe, not yet known to exist in *Favosites*. Still it is worthy of note that no pores are represented in Goldfuss' or Edwards and Haime's figures, showing the wrinkled exterior of the base of *Pleurodictyum*.

Our figures are defective in not showing numerous little projecting points (casts of pores) all over the casts of the corallites, as well as those passing across between them. Generally these are broken off, but their remains can be usually seen, on a careful examination, on all sides. The casts being in rough sandstone, the casts of the pores are not readily distinguished from the general granular appearance of the matrix.

Locality and position: Yellowish friable sandstone, referred to the horizon of the Onondaga period of the New York series; four miles west of Jonesboro, Union county, Illinois.

Genus BARYPHYLLUM, Edwards and Haime, 1850.

(Brit. Foss. Corals, p. lxvi.)

Baryphyllum?? arenarium, M. and W.

Pl. 9, fig. 2 *a*, *b*.

As is the case with all the other fossils yet obtained from the same bed, we only know this coral from moulds left in the sandstone matrix. They were evidently compressed or discoidal, with an oval or more or less nearly circular outline; and all appear as if about one-half of the upper side had been slightly concave, and the other convex. Several of them show some indications of a faintly impressed fosset (an obscure ridge in the mould) in the concave half, while in other instances there would seem to have been a ridge there, that left a *furrow* in the mould, as is seen extending up from the middle to the top of fig. 2 *b*. This, however, is much too strongly defined in the figure, being in the specimen merely a very shallow furrow, without well defined edges. Some specimens, such as that represented by fig. 2 *a*, show no traces of this fosset in

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the mould of the concave half. In the impression of the convex half, they all seem to have had a ridge or larger septum extending from the middle to the margin, on a line with and directly opposite the fosset mentioned. This is seen on the lower half of figure 2*b*, where it appears as a furrow in the mould. The rays are obscure and numbered from about sixty-eight to eighty, those in the concave half being generally smaller and more closely arranged than the others.

Of course, we are by no means sure this coral belongs to the genus *Baryphyllum*, but we merely refer it provisionally to that group, until specimens can be obtained showing more clearly its characters. Probably we should call it *Combophyllum arenarium*; but we rather incline to the opinion that it will not properly fall into any of the established genera.

Locality and position: Same as last.

Genus ZAPHRENTIS, Raf. and Cliff., 1820.

(Ann. Gen. des sc. Phys. de Bruxelles, t. V, p. 234.)

Zaphrentis (sp. undt.)

Pl. 9, fig. 3 *a*, *b*.

All the specimens of this fossil yet found in this rock are merely casts of the calices, and of course do not retain enough of the characters of the species to enable us to make satisfactory comparisons, or to characterize it fully. It was evidently rather under medium size, and provided with a moderately deep calice, and a well defined fosset. The impressions show the septa to have been rather stout, somewhat twisted towards the middle of the cup, and numbering about 50 to 60 principal ones, with shorter ones below.

Locality and position: Same as last.

MOLLUSCA.

BRACHIOPODA.

Genus ORTHIS, Dalman, 1828.

(Uppstalln., p. 110.)

Orthis (undetermined).

Pl. 9, fig. 4.

This species has the general appearance, in the condition of an internal cast, of *O. musculosa*, Hall, but is much smaller. As we have only a cast of the

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dorsal valve, however, we have not the means of arriving at a satisfactory conclusion in regard to its relations. It is very convex, or nearly hemispherical, (its outline being nearly circular) and shows short impressions of regular striæ around the margins, and a prominent conical cardinal process at the beak.

Length, 0.87 inch; breadth, 0.93 inch; convexity of dorsal valve, 0.33 inch.

Locality and position: Same as last

Genus Strophomena, Raf., 1820.

(*Strophomenes*, Raf.; *Strophomena*, Blainv. (1825), Mal., p. 513.)

Strophomena (Strophodonta) sp.?

Pl. 9, fig. 9, (and 7 *a*?)

Shell small, very convex, or exclusive of the ears, subhemispherical; length and breadth nearly equal; hinge line finely crenate, usually slightly longer than the breadth of the valve at any point in front of it, and terminating in rather distinct angles, in consequence of the sinuous character of the posterior lateral margins; front regularly rounded. Ventral valve very gibbous; beak curved, area of moderate breadth. Surface of internal cast showing remains of rather coarse radiating striæ.

Length, 0.54 inch; breadth (on hinge), 0.58 inch; convexity, 0.24 inch.

A single impression, in the same matrix, of the interior of a dorsal valve (represented by fig. 7 *a*), of the same size and form, at first supposed to belong to another species, probably belongs to this. This valve was evidently nearly flat, or a little concave on the outside, excepting around the free border, which was deflected upwards. It shows the impression of a small mesial ridge, and a small muscular scar on each side of it, while the bifid cardinal process is moderately prominent.

Figure 7 *b*, from the same locality and position, may possibly be a cast of the exterior of the dorsal valve of the same species. It differs, however, in being a little convex on the outside, and shows no indications of the upward deflection of the margin. Figure 8, also from the same matrix, represents a cast of the exterior of a nearly flat valve, apparently belonging to a distinct, more coarsely and unequally striated species, less extended on the hinge, and resembling a young *Hemipronites crenistria*.

Without more and better specimens of these little shells (those we have seen are mere casts in sandstone) for comparison, it seems scarcely possible to arrive

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at very satisfactory conclusions respecting their relations to each other, and to the described species. Consequently we have concluded not to attempt to name any of them as new species, at present.

Locality and position: Same as last.

STROPHOMENA (STROPHODONTA), (sp.)

Pl. 6, fig. 6 *a*, *b*.

As we have only seen casts of this shell, in friable sandstone, we have not felt warranted in identifying it with any of the known species, and for the same reason we can not be quite sure that it is new. It is much compressed, wider than long, and usually has the hinge line a little shorter than the greatest breadth of the valves near the middle, though the posterior lateral extremities are rather distinctly angular. The surface of both valves is marked by very fine, angular, radiating, crowded striæ, (more curved on the lateral region than represented in figure 6 *b*), and crossed by about two or three widely distinct sub-imbricating marks of growth.

Locality and position: Same as last.

GENUS PRODUCTUS, Sowerby, 1814.

(Min. Conch., vol. I, p. 153.)

PRODUCTUS EXANTHEMATUS, Hall ? ?

Pl. 10, fig. 3 *a*, *b*, *c*.

Productus exanthematus, HALL, 1857. Tenth Ann. State Cab. N. H. Report Regents University of New York, p. 174.

SHELL very small, wider than long, semioval in outline, very convex; hinge about equaling the greatest breadth; anterior and anterio-lateral margins forming a regular semicircular curve. Ventral valve strongly arched from beak to front; umbo rather gibbous and incurved; ears small, generally nearly rectangular, and not very distinct from the slope of the umbo; surface ornamented with more or less elongated tubercles, sometimes assuming the character of little irregular ribs, some of which evidently bore spines that were comparatively long and erect; very minute concentric striæ are also seen by the aid of a magnifier on well preserved surfaces. Dorsal valve

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moderately concave, and showing obscure, irregular, elongated pits, instead of tubercles, and marked with the same minute concentric striæ seen on the other valve.

Length of largest specimen, 0.40 inch; convexity, 0.25 inch.

We are far from being satisfied that this is the species described by Prof. Hall, since it is next to impossible to form any very satisfactory conclusions in regard to the characters of a species in a genus like this, from a two and a half line description of a single dorsal valve, without a figure or measurements by which we can have any idea even of its size. We are led to suspect, however, that our shell *may* possibly be the same, because Prof. Hall says he thinks his species probably identical with a form found at the "Bake-oven," on the Mississippi, in this State, that was identified with *P. subaculeatus*, by Norwood and Pratten, since, on comparing our shell with specimens of the latter from that locality, we can see no essential difference, excepting that some of the "Bake-oven" specimens are nearly twice as large as those under consideration.

It is quite probable that this shell is not distinct from some of the European forms sometimes referred to *P. subaculeatus*; but we do not believe it identical with that species, as figured and described by Mr. Davidson, in his Monog. Brit. Devonian Brachiopoda, part VI, pl. xx, fig. 1 and 2, from which it differs not only in being much smaller, but in being proportionally more convex, and in having its tubercles more distinctly elongated into ribs.

The engravings of our shell on plate 10 are defective in making the tubercles look like little round spine bases, instead of elongated tubercles, sometimes assuming the characters of ribs, while the radiating lines seen extending up to the beak, on fig. 3 *a*, do not exist on the fossil. The two straight spines extending from the left ear of fig. 3 *c*, seem rather to belong to another specimen of the same species, lying in the matrix immediately along side (but not represented in the figure).

Locality and position: The specimens figured are from a light-gray, rough-fractured, silicious limestone, two miles west of Jonesboro, Union county, Illinois; believed to be of the age of the Corniferous or Onondaga division of the New York Devonian series. Larger specimens of apparently the same species occur in the Hamilton beds, at the "Bake-oven," on the Mississippi, in Jackson county, Illinois.

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Genus SPIRIFER, Sowerby, 1815.

(Min. Conch. II, p. 42.)

Subgenus TRIGONOTRETA, Kœnig, 1825.

Spirifer perextensus, M. and W.

Pl. 10, fig. 1 *a*, *b*, *c*, *d*.

Shell greatly extended transversely, or about four times as wide as long, rather compressed or but moderately convex, subequivalve; anterior lateral margins straight or nearly so; hinge line equaling the greatest breadth; lateral extremities produced and acutely pointed. Ventral valve a little more convex than the other; beak not very prominent, and but little arched; area rather narrow (wider, however, at the beak than represented by figure 1 *c*), becoming very narrow, with nearly parallel sides, towards the lateral extremities, and arching a little in the region of the beak; mesial sinus commencing very narrow at the beak, and widening and deepening regularly to the front, rounded and smooth within, and sharply defined by the marginal plication on each side; lateral slopes nearly straight, or a little convex from the mesial sinus to the extremities, but regularly arched from the hinge to the front, each ornamented by from 18 to 24 simple, regular, somewhat rounded plications, more than half of which are directed so that if produced they would not reach the beak, but intersect the hinge line, near which they become obsolete. Dorsal valve less convex in the umbonal region than the other, beak moderately incurved, area distinctly narrower than in the other valve; mesial fold very narrow near the beak, rather depressed and flattened, or even a little concave along the middle, with nearly vertical sides; lateral slopes slightly concave on a line from the mesial ridge to the lateral extremities, and ornamented with ribs as in the other valve. Surface with rather obscure marks of growth, somewhat undulated in crossing the costæ, and more distinctly defined in the mesial sinus and upon the mesial fold.

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Length, 0.90 inch; breadth, about 3.56 inches; convexity, about 0.60 inch.

This seems to be one of the most extremely transverse species of the genus, and in this respect resembles *S. pinnatus* of Owen, particularly the variety for which he proposed the name *S. ligus*. It is more transverse in proportion to length, however, and not so convex. Its area is also less developed, its anterior lateral margins straighter, and its mesial fold flattened or concave on top, instead of rounded. We have likewise been unable to see on our shell any traces of the fine radiating striæ seen on Dr. Owen's species, though it is possible better specimens might show them. Even then, however, the other differences would readily distinguish the two shells.

It is more nearly related to *S. paradoxus*, Schlot, (sp.), and may possibly be identical with that species, or at least with some of the forms that have been referred to it. It differs from Quenstedt's figure of that species (Hanb. der. Petref. tab. 38, fig. 18), however, very decidedly, in having much more numerous and smaller costæ; while its anterior lateral margins, as shown by the marks of growth, were always much straighter in outline. It nevertheless agrees much more nearly, in these respects, with an Eifel form figured by Schnur (Palæontographica III, tab. xxxii *b*), under the name *S. paradoxus*, but has the plications smaller on the central region, and its area proportionally higher near the beak; while its decidedly flattened mesial fold gives it a very different appearance.

Locality and position: Same as last.

SPIRIFER PARADOXUS, Schlot. ?? (sp.).

Pl. 10, fig. 2.

Terebratulites paradoxus, SCHLOT. 1813. Im Taschenb. VII, tab. 2, fig. 6; Petref. 1, 249.
Spirifer paradoxus, QUENST. 1852. Handb. Petref., 478, t. 38, fig. 18; SCHNUR, 1854, Palæontographica, III, p. 198, tab. xxxii *b*, fig. 1 *a*, *b*, *c*; ? DAVIDSON 1864, Monogr. Brit. Devonian Brachiopoda, pl. viii, fig. 11 and 13.

WE have seen but one specimen of this form, and it only consists of an internal cast of a ventral valve, with part of the shell remaining on the right side. It differs from the last in not having so many, nor so large plications, which are also less prominent, and more roughened by the marks of growth. Its mesial sinus is likewise deeper and more angular in the middle, and less sharply defined on each side. It may possibly be a variety of the last, though it would be readily distinguished by its larger ribs from any of the specimens of that form we have yet seen.

It agrees more nearly with the published figures of *S. paradoxus*, but the form of its rostral cavity, as indicated by the internal cast, is unlike that of

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S. paradoxus, as illustrated by Quenstedt and Davidson. In this, as well as most of its other characters, however, it seems to agree more nearly with Schnur's figure of casts of that shell, given in the Palæontographica.

Length, 0.95 inch; breadth, 3 inches; convexity of ventral valve, 0.40 inch.

Locality and position: Same as last.

ARTICULATA.

CRUSTACEA.

GENUS DALMANITES, Auct.

Dalmania, EMMRICH, 1845 (not Rob. 1830),—*Odontochile*, CORDA, 1847, (not Lap. 1834).

SUBGENUS ODONTOCEPHALUS, Conrad, 1840.

(Ann. Rep. Palæont. N. Y., p. 204.)

ALTHOUGH this type is generally regarded as not being distinct from *Dalmanites*, it seems to us to present sufficiently well marked distinctive characters to rank at least as a good subgenus, if not indeed as a well defined genus. The fact that the peculiar perforated expansion of the anterior margin of the head seems to be always coexistent with the bifurcated character of the caudal extremity in these trilobites, certainly seems to indicate fundamental differences in the structure of other parts of the animal, from the typical forms of *Dalmanites*, in which neither of these characters exist. In addition to this, the fact that there is a *group* of species presenting these characters, also favors the same conclusion.

Our specimens show clearly that the extended border of the anterior margin of the head is really *perforated* by oblong, or elongate-oval, isolated openings, passing entirely through, and not merely provided with ridges and depressions, or divided by deep sinuses, extending in between tooth-like projecting processes, as has been supposed to be the case with some of the N. Y. species. Some species, however, *may* possibly have the margin not quite continuous between the bars separating these perforations, but we doubt whether this is the case in any but specimens that have had the margin broken away.

ODONTOCEPHALUS ——— ?

Pl. 9, fig. 10.

OF this trilobite we have merely impressions in the sandstone matrix, of the expanded and perforated anterior margin of the head. These show it to have attained a large size. It evidently differs from the form found in the limestones above and below the sandstone in which it occurs, in having but ten of

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the elongated perforations of the alate anterior margin of the head (which are also more widely separated), instead of twelve, as well as in having this part much more broadly rounded in outline. As the specimen figured represents only the alate margin, it is probable that if the posterior angles of the cheeks were produced backwards into spines, that they extended farther even than indicated by the dotted lines, and that the whole animal may have been near five inches in length.

In the number of perforations passing through the alate anterior margin, it agrees with *O. selenurus*, of Conrad, but it seems to differ in the greater breadth and outline of this part, and probably attained a larger size. It may possibly be identical with some of the species indicated from the Lower Helderberg rocks of New York, and not yet figured, but we are inclined to believe it new. If so, it may be called *Dalmanites* (*Odontocephalus*) *arenarius*.

Locality and position: Four miles west of Jonesboro, Union county, Illinois; in a friable sandstone apparently occupying the horizon of the Onondaga or Corniferous beds of the N. Y. Devonian.

DALMANITES (ODONTOCEPHALUS) ÆGERIA, Hall? (sp.)

Pl. 10, fig. 4 *a*, *b*, *c*.

Dalmania ægeria, HALL, 1861. Fifteenth Ann. Rep. Regents Univ. N. Y., p. 85.

CEPHALIC shield semielliptic, moderately convex, with the posterior lateral angles produced backwards into long acutely pointed spines; anterior margin produced and narrowly rounded in outline, its perforated border wide, or measuring about two-sevenths the entire length of the head, from the front to the posterior margin of the occipital ring, and provided with twelve narrow-oval perforations, gradually decreasing in length posteriorly, and separated by eleven narrow bars, the middle one of which is longest. Glabella separated from the cheeks by well defined furrows; anterior lobe subrhomboidal, and wider than long; anterior lateral lobe a little longer than either of the others behind it; furrows between them all, excepting the anterior ones, transverse, narrow, and none of them extending entirely across; neck furrow, and its continuations across the posterior margins of the cheeks, well defined; eyes prominent, somewhat reniform, as seen from above, placed less than their own antero-posterior diameter in advance of the posterior margin of the cheek, provided with about twenty-five

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lenses in the row around the lower margin; cheeks sloping off abruptly from the eyes (in internal casts) to a broad, well-defined furrow, extending around to the lateral margin of the anterior lobe of the glabella.

Pygidium subtrigonal, rather depressed; lateral margins a little concave in outline behind; divisions of its posterior extremity short, parallel, and so closely approximated that the sinus between them is scarcely wider than one of the divisions; mesial lobe but little more convex than the lateral, and distinctly narrower, well defined by the furrow on each side, and showing about ten or eleven distinct segments, with space enough behind for three or four more; lateral lobes with each nine or ten segments, the posterior one being small, and directed nearly backwards; margins beyond the segments narrow and sloping.

The specimens of this form we have seen consist only of the head and pygidium. The former are mainly casts, with some portions of the crust remaining. None of the specimens of the pygidium we have seen seem to be quite large enough to belong to the same individuals as the larger heads, though from their constant association, we can scarcely doubt that they belong to the same species. The surface of the pygidium is very finely and obscurely granular; while the casts of the head show indications of rather coarse granules or small pustules on the anterior lobe of the glabella.

As no figures of *O. ægeria* have yet been published, we can not be quite sure that our specimens belong to that species. As far as the characters of the form under consideration are known, it seems to agree so nearly, however, that we are very much inclined to believe it the same, though it is quite possible a comparison of specimens might show them to be distinct.

The specimen from which our figure 4*a* was drawn is mainly a cast somewhat distorted by pressure, though it is made to appear too flat in the figure. The segments in the lateral lobes of figures 4*b* and 4*c*, are also erroneously carried quite out to the margin. The margin extends a little beyond the terminations of the furrows between the segments, in the form of a narrow, smooth border.

Locality and position: Light-gray subcrystalline limestone, of about the age of the Corniferous division of the New York Devonian series; four miles west of Jonesboro, Union county, Illinois. It also occurs at a lower horizon in a similar limestone, believed to belong to about the position of the New York Oriskany sandstone, one mile east of Bald Knob, Union county, Illinois.

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FOSSILS OF THE HAMILTON GROUP.

PROTOZOA.

SPONGIÆ.

GENUS ASTRÆOSPONGIA, Roemer, 1854.

ASTRÆOSPONGIA HAMILTONENSIS, M. and W.

Pl. 10, fig. 6.

Astræospongia Hamiltonensis, MEEK and WORTHEN, 1866. Proceed. Chicago Acad. Sci., vol. 1, p. 12.

WE merely know this species from a biscuit-shaped nodular mass, showing on one side numerous six-rayed calcareous stars, 0.13 inch in diameter, measuring across from the extremities of the opposite rays. The specimen is not in a condition to show the general form of the whole body, if freed from the matrix, but as near as can be determined it seems to have been of a discoid or compressed, subglobose form. The star-like spicula agree so exactly in form, size, and their mode of aggregation, with those of *Astræospongia meniscus* of Roemer, from the Upper Silurian beds of Tennessee (Sil. Fauna West Tenn., p. 14, pl. i, fig. 6 *a–d*), that we confess we can see no difference whatever between them, as seen in our specimen, and represented in Roemer's figures. From their different geological positions, we were led to infer, that if we could compare perfect specimens of each, good specific differences would probably be observed; still it may not be really distinct.

Our specimen measures 2.50 inches in its greater diameter, and about 1.20 inches in thickness, though the peculiar star-like structure does not pervade the whole mass, particularly its entire thickness. The thickness of each individual ray of the stars is about 0.02 inch, and their length 0.06 inch. They are invariably six-rayed.

Locality and position: New-Buffalo, Iowa; Hamilton division of the Upper Devonian.

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RADIATA.

ZOOPHYTA.

Genus MICROCYCLUS, M. and W.

(*μικρος*, small; *κυκλος*, a circle; in allusion to its small size and circular form.)

Corallum free, or with a minute central point of attachment, discoidal, without columella; calice very shallow, or nearly obsolete, and provided with a single small fossette; septa short, nearly regularly radiating, or with a few of those nearest the fossette converging a little towards its sides; epitheca well developed.

This little coral seems to be related to *Combophyllum* and *Baryphyllum*, Edwards and Haime, but differs from the first in having a well developed epitheca, and from the latter, not only in that character, but in having its fossette simple, and its costæ nearly regularly radiating. It also presents similar differences from *Hadrophyllum*, of Edwards and Haime. As we have sought in vain amongst the established groups for a genus that will receive it, we have been compelled to propose a new genus for its reception.

Microcyclus discus, M. and W.

Pl. 11, fig. 7 *a*, *b*.

Corallum depressed-discoid; periphery sharp, under side flat and protected by the concentrically wrinkled epitheca; upper side slightly convex, flat or a little concave in the middle; fossette small, shallow and extending from the center to the margin. Septa very short, thick, extending only about half way in from the margin towards the middle (the central region being smooth), numbering from twenty to twenty-five at their inner ends, but each bifurcating so as to double this number at the margin; sometimes the one on the side opposite the fossette is divided into three.

Breadth of one of the largest individuals, 0.77 inch; height, 0.15 inch.

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Locality and position: "Devil's Back-bone," Jackson county, Illinois; from the Hamilton group of the Devonian.

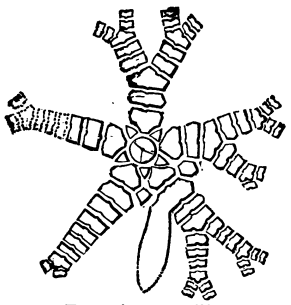
ECHINODERMATA.

GENUS TAXOCRINUS, Phillips, 1843.*

TAXOCRINUS GRACILIS, M. and W.

Pl. 13, fig. 3.

Taxocrinus gracilis, MEEK and WORTHEN, Aug., 1865. Proceed. Acad. Nat. Sci., Philad., p. 142.



Taxocrinus gracilis.
Diagram showing the structure out to second bifurcation of rays.

BODY small, expanding moderately from the base. Basal pieces very small, and looking like the last joint of the column divided into three pieces; subradial pieces so small and narrow as to allow the lower middle extremity of the first radials to come nearly, or, in some instances, quite down upon the basal pieces; four of them triangular and more or less wedge-shaped so as to project up between the first radials as much as half the length of the latter; the fifth one larger than the others, and apparently minutely truncated above by the anal piece, so as to present a quadrangular or subpentagonal outline. First radial pieces considerably larger than the subradials, of nearly equal length and breadth, or a little wider than long, hexagonal in form, the inferior sloping and upper horizontal sides much longer than the others. Second radials, in four of the rays, shorter than the first, wider than long, and generally hexagonal; in the fifth ray of the specimen under investigation, the second piece seems to have its right margin enormously and perhaps abnormally developed, and extended obliquely upwards, so as to fill the whole interradial space above the comparatively minute interradial piece, quite up as far as the second bifurcation of the rays, with one solid plate. In

* For a description and synonymy of this genus, with remarks on its affinities, etc., see vol. ii, p. 268, of the Reports Illinois Geological Survey.

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the ray containing this singularly developed second piece, there are two other primary radial pieces succeeding it, of near the natural size and form, upon the last (fourth) one of which the first bifurcation takes place; after this each of the divisions bifurcate again on the fourth piece, while the two outer ones send off subdivisions, one on the sixth and one on the seventh piece. In the ray immediately to the right of that just described, no division takes place until upon the eighth piece, all the pieces between the second and eighth being transversely oblong or about twice as wide as long, and gradually diminishing in size. In two of the other rays, the first division takes place on the third piece, and the second and third divisions also on the third piece, the arms rather rapidly diminishing in size with each bifurcation. In the fifth ray there appears to be no bifurcation for some distance out, though its exact structure cannot be made out from the specimen examined.

Interradial pieces very small, rather longer than wide, somewhat wedge-shaped above, and resting between the short superior lateral sloping sides of the first radials, and supporting on each superior sloping side a short truncated margin of the contiguous second radials, which generally meet over the little interradial, so as to isolate it from the free space above, though not always. Anal piece a little larger than the interradials, hexagonal in form, and apparently resting with one short side upon a minutely truncated upper side of the largest subradial; while it connects on the right with a first and second primary radial, and on the left with a second and third primary radial, and one first secondary radial.

Surface of body apparently smooth, but showing granules on some of the divisions of the arms. Patelliform accessory pieces not developed between the primary radial pieces, but quite distinct between some of the secondary. Column, as in other species of the group, round and tapering downwards from the base, near which it is composed of very thin pieces.

This species, although somewhat like *T. interscapularis*, Hall (Iowa Report, pl. 1, fig. 3), from the same locality, will be at once distinguished by its more

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spreading rays, greater interradial and interbrachial spaces, and particularly by its proportionally smaller and shorter interradial pieces, as well as by having the latter resting upon the superior lateral truncated sides of the first radials, instead of upon one of the second, while it has no interaxilary pieces, as seen in *T. interscapularis*. It likewise shows some differences in the bifurcations of its arms, after the first division.

A marked feature in the specimen from which the description was made out, is the extraordinary development of the right margin of one of the second primary radial pieces, by which it is made to fill the entire adjacent interradial space. This, however, as already stated, is probably abnormal.

Locality and position: Same as last.

MOLLUSCA.

BRACHIOPODA.

GENUS ORTHIS, Dalman, 1827.

(Uppstalln., p. 110.)

ORTHIS MCFARLANEI, Meek.

Pl. 13, fig. 10 *a*, *b*, *c*, *d*.

Orthis McFarlanei, MEEK, 1868. Transactions Chicago Academy of Science, vol. I, p. 88, pl. xii, fig. 1.

SHELL subcordate, resupinate, very gibbous; length (in adult examples) greater than the breadth; cardinal and umbonal regions very narrow; posterior lateral margins straight, and rapidly diverging forward to the widest part of the valves, which is a little in advance of the middle; hinge line short, or scarcely equaling half the greatest breadth of the valves; cardinal area moderate, nearly twice as high in the ventral valve as in the other, strongly arched in the dorsal valve, and slightly in the ventral, where it is less than half as high as wide, and ranges nearly at right-angles to the plane of the valves; foramen about two-thirds as wide as high. Smaller or ventral valve convex in the lateral and umbonal regions, the most gibbous part being near the beak, which is short and a little incurved at the point; provided with a broad

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rounded mesial sinus, which commences very shallow near the middle of the valve and widens and deepens rather rapidly towards the front margin, to which it imparts a broadly sinuous outline. Larger or dorsal valve very gibbous, particularly in the region of the umbo, which, in adult shells, projects considerably beyond that of the other, and is at all ages strongly incurved. Surface marked by fine radiating and bifurcating striæ, about nine or ten of which may be counted in the space of 0.10 inch.

Length, 1.05 inches; breadth, 1 inch; convexity, 0.83 inch.

This fine species will be readily recognized by its general form, being nearly always longer than wide, with a very short hinge and an unusually gibbous, narrow, strongly incurved dorsal umbo, which even projects beyond that of the other valve. These peculiarities of form give the shell much the general appearance of some species of *Pentamerus*.

Under a microscope, worn and partly exfoliated surfaces show very distinctly the minute punctures; also occasional larger openings in the striæ, so often seen in the shells of this genus.

Locality and position: Independence, Iowa; Hamilton Group of the Devonian system. It also ranges far northward, being originally described from a locality on Mackenzie river, lat. 67 degrees, 15 min., N. British America.

ORTHIS IOWENSIS, var. FURNARIUS, Hall.

Pl. 13, fig. 9 *a*, *b*.

Orthis Iowensis, HALL, 1858. Geological Report of Iowa, vol. I, part II, p. 488, pl. ii, fig. 4 and 5; BILLINGS (1859), HINDS' Report Exploration Assiniboine, Sarkatchewan, etc., p. 193; MEEK (1868), Transac. Chicago Acad. Sci., vol. I, p. 90, pl. xii, fig. 2 *a–h*.

SHELL attaining a rather large size, robust, resupinate, suborbicular in adult examples, a little wider than long, and sometimes more or less emarginate in front, rather compressed in young specimens, but becoming more gibbous with age; hinge very short. Ventral valve much less convex than the other, its greatest convexity being at the umbo, while its anterior margin in mature specimens is often more or less sinuous, or impressed in the middle; cardinal area very small, but well defined and arched; foramen generally a little higher than

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wide; beak small, arched, and projecting a little beyond the hinge line, being less prominent than that of the other valve. Dorsal valve rather gibbous and regularly arched; beak prominent, strongly incurved; cardinal area rather narrow and distinctly arched; anterior margin in large specimens more or less raised in the middle, for the reception of the depressed margin of the other valve. Surface ornamented with fine, regular radiating striæ, which bifurcate and increase by intercalation, so as to preserve a nearly uniform size and arrangement on all parts of the shell, those on each side of the beaks curving gracefully outwards to the posterior lateral margins, while distinct subimbricating marks of growth traverse the valves concentrically at intervals.

Breadth, 1.40 inches; length, 1.20 inches; convexity, 0.60 inch.

This species will be at once distinguished from the last, by its broader, more rounded, and less convex form, as well as by its less prominent dorsal umbo. None of the Illinois or Iowa specimens we have seen, are of quite so large a size as the species is known to attain at distant northern localities, nor so sinuous or emarginate in front; though they agree exactly with the medium sized and smaller individuals from the latter localities. It seems to be closely allied to *O. striatula*, d'Orbigny, as figured by Schnur, in Dunker and von Meyer's Palæontographica, vol. III, tab. xxxviii, fig. 1 *a–i*.

Locality and position: Rock-Island, Illinois, and New-Buffalo and Independence, Iowa; in calcareous shales of the age of the Hamilton group of the New York Devonian. Also in the same position, on Athebasca river, British America.

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GENUS STROPHOMENA, Raf., 1820.

(*Strophomenes*, RAF.; *Strophomena*, BLAINV. (1825), Malac., p. 513.)

STROPHOMENA RHOMBOIDALIS, Wahlenb. (sp.)

Pl. 10, fig. 7 *a*, *b*.

Anomites rhomboidalis, WAHLENB., 1821. Acta. Soc. Ups., vol. III, p. 65.
Productus depressus, SOWERBY, 1823. Min. Conch., pl. cccclix, fig. 3.
Producta rugosa, HEISINGER, 1826. Vetensk. Akad. Handl., p. 333.
Leptæna rugosa, DALMAN, 1827. Kongl. Vetensk. Handl., p. 106, pl. i, fig. 1.
Productus quadrangularis, STEININGER, 1831. Bemerk. uber die Vestein. des Eifels, p. 35.
Strophomena pileopsis, DUMONT, 1832. Const. Geol. de la Prov. de Liege, p. 354.
Productus elegans, STEININGER, 1834. Mem. Soc. Geol. de France, vol. I, p. 361.
Strophomena rugosa, BRONN, 1835. Lethæa Geog. 1, p. 87, pl. ii, fig. 8.
Producta analoga, PHILLIPS, 1836. Geol. Yorks., vol. II, p. 215, pl. vii, fig. 10.
Orthis rugosa, v. BUCH, 1837. Ueber Delth., p. 70.
Leptæna tenuistriata, SOWERBY, 1838. Sil. Syst.. tab. xxii, fig. 2 *a*.
Leptæna distorta, J. SOWERBY, 1840. Min. Conch., vol. VII, pl. dcxv, fig. 3.
Leptæna nodulosa, PHILLIPS, 1841. Palæozoic Foss. Cornw., pl. xxiv, fig. 94.
Leptæna depressa, DE KON., 1843. An. Foss. Belg., p. 215, pl. xii, fig. 3; and others.
Leptagonia rugosa, MCCOY, 1844. Synop. Carb. Foss. Ireland, p. 118.
Leptagonia multirugata, MCCOY, 1844. Ib. pl. xviii, fig. 12.
Strophomena rhomboidalis, var. *analoga*, DAVIDSON, 1860. Carb. Syst. Scotland, Geologist, vol. III, p. 102; Monogr. Brit. Carb. Brach., p. 119, pl. xxviii, fig. 1 and 2; Brit. Devonian Brach. (1865), p. 76, pl. xv, fig. 15–17.

THIS species has been so often described, and is so well known, as not to require any extended description here. It is only necessary to state that our specimens seem to agree well with the Devonian shell so generally referred to the species *rhomboidalis*.

In regard to the identity of the different forms for which the various names mentioned in the foregoing synonymy were proposed, different opinions are entertained amongst Geologists and Palæontologists. On this point, however, we are not prepared at present to express a decided opinion, and have consequently merely taken the foregoing synonymy from Mr. Davidson's Monographs, without pretending to have investigated in detail, the claims of the various proposed species therein included. That most of them are synonyms, we do not entertain much doubt; yet it seems very improbable that the same species could have survived all the great changes of physical conditions that must have taken place from the Lower Silurian to the Carboniferous epochs inclusive. It appears to us more probable that there are several distinct species generally confounded under this one name, that are perhaps inseparable by any characters observable in the shell alone, but which presented well marked differences in the structure of the animal. Conchologists are well aware of instances amongst recent Mollusca, where species clearly separable upon well marked differences of the

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softer parts of the animal, have shells so nearly alike, that if only known to us in the fossilized condition of our Palæozoic species, would scarcely be suspected to be distinct.

Locality and position: "Bake-oven," on the Missouri, in Jackson county. Hamilton Group of the Devonian series.

GENUS TROPIDOLEPTUS, Hall, 1857.*

(Regents' Report for 1856, p. 151.)

TROPIDOLEPTUS CARINATUS, Conrad, (sp.)

Pl. 13, fig. 2 *a*, *b*, *c*.

Strophomena carinata, CONRAD, 1839. Ann. Geol. Report N. Y., p. 64; (not *S. carinata*, CON., 1842).

Leptæna laticosta, DE VERNEUIL., 1847. Bull. Soc. Geol. Fr., 2d ser., tome IV, p. 705; SCHNUR (1853), Palæontographica, vol. III, p. 220, pl. xl, fig. 2.

Strophomena laticosta, SANDBERGER, 1855. Die Brachiop. des Rheinischen Schicht. Syst. Nassau, p. 66, pl. xxxiv, fig. 8.

Tropidoleptus carinatus, HALL, 1857. Report Regents University N. Y., for 1856, p. 151 and 152, fig. 1 and 2; Regents' Report for 1859, p. 31, fig. 1, 2, 3 and 4.

SHELL varying from transversely suboval, to longitudinally semielliptic, plano-convex; hinge generally a little less than the greatest breadth of the valves, somewhat rounded or more or less angular at the extremities; anterior lateral margins rounding to the front, which is regularly rounded, or rarely faintly subangular in the middle. Dorsal valve a little concave, generally provided with a shallow mesial sinus; beak very small and projecting slightly beyond the hinge margin, straight or curved very slightly outwards; cardinal process somewhat prominent. Ventral valve moderately convex, rather flattened towards the posterior lateral extremities, greatest convexity a little behind the middle; beak small, slightly arched, and projecting very little beyond the cardinal margin; area generally narrow, with nearly parallel sides, and extending to the extremities of the hinge, ranging nearly parallel to the plane of the valves; foramen broad, subtrigonal, the upper angle being rounded at the beak, nearly closed by the cardinal pro-

* Prof. Hall *named* this genus in 1857, but did not *describe* it, so far as we have been able to learn, until 1859 (Regents' Report, p. 31).

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cess. Surface ornamented by about eighteen to twenty regular, simple, depressed and rounded plications on each valve, the middle one of which, on the ventral valve, is somewhat larger than the others, so as sometimes to produce a faintly subcardinate appearance; while a corresponding slightly larger furrow occupies the mesial line of the opposite valve; lines of growth fine, rather distinct, and with the regularly and coarsely punctate structure of the shell, giving the surface a beautiful ornate appearance, as seen under a common pocket lens.

Length of one of the larger western specimens, 0.90 inch; breadth, 1 inch; convexity, 0.20 inch.

This shell varied considerably in form at different stages of its growth, and in different individuals. As may be seen by the marks of growth, young specimens are sometimes transversely semicircular, with rather acutely angular lateral extremities. As the shell increased in size, it grew more rapidly in length than in breadth, and the lateral extremities became more obtusely angular, or even a little rounded. These variations of form at different ages, are as clearly indicated by the marks of growth on some New York specimens before us as in the western examples. The particular individual we have figured, has the lateral extremities nearly rectangular, but in others from the same locality they are more rounded, as in those from New York. We know of no other shell with which this is liable to be confounded.

Locality and position: Same as last.

GENUS PENTAMERUS, Sowerby, 1813.

(Min. Conch., tab. 28.)

PENTAMERUS COMIS, Owen? (sp.)

Pl. 13, fig. 6 *a*, *b*, *c*.

Atrypa comis, OWEN, 1855. Report Geol. Survey Wisconsin, Iowa and Minnesota, p. 583, pl. iii A, fig. 4.

Pentamerus occidentalis, HALL, 1858. Iowa Report, vol. I, part II, p. 514, pl. vi, fig. 2 *a*, *b*, *c*; (not *P. occidentalis*, HALL, 1852, Palæont. N. Y., vol. II, p. 341, pl. lxxxix, fig. 1 *a–s*, and 2.)

Pentamerus galeatiformis, MEEK and WORTHEN, 1866. Report Geol. Survey Illinois, vol. II, p. 325; where it is by typ. err. *geleatiform.*

SHELL globose-subovate, very gibbous, generally about as wide as long. Dorsal valve moderately convex; beak incurved; front slightly depressed in the middle, so as to form a very

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shallow sinus, and sometimes provided with a few short, obscure, rounded irregular plications; lamellæ of interior nearly parallel, and not quite extending to the middle. Ventral valve very convex, particularly in the region of the umbo, which is prominent, and strongly incurved over and upon that of the other valve; front sometimes slightly raised in the middle and faintly subplicated, so as to form at the immediate margin an obscure mesial prominence, and a few folds corresponding to the irregularities of the margin of the other valve; internal chamber and mesial septum rather short. Surface smooth.

Length and breadth, 0.88 inch; convexity, 0.70 inch.

This species has much the general appearance of some of the smoother varieties of *P. galeatus*; but so far as yet known it never has its plications near so strongly developed, nor continued so far back from the front margin, as we usually see in that species; while casts show that the internal chamber and septum of its ventral valve, as well as the septa of its dorsal valve, are shorter.

Although Dr. Owen's figure and description of his *Atrypa comis* are not very satisfactory, we have now little doubt but it was the above described species that he named. It is true, he mentions no plications, but they are often so very obscure on this shell that they might be readily overlooked; while some very faint indications of plications seem to be seen on the left side of his figure.

We know little of the internal characters of this shell from any specimens we have had an opportunity to see, but Prof. Hall expresses the opinion in the Twentieth Ann. Rep. Regents Univ., N. Y., on the State Cab. Nat. Hist., p. 163, that it presents differences of generic importance from *Pentamerus*, and he proposes for the type the name *Gypidula*. If this separation should be sustained, the name of the species will become *Gypidula comis*, if we are right in identifying the species with Owen's figure.

Locality and position: Rock-Island, Illinois; Hamilton Group of the Devonian series.

PENTAMERUS SUBGLOBOSUS, M. and W.

Pl. 13, fig. 5 *a*, *b*, *c*.

SHELL small, subglobose, about as wide as long. Dorsal valve wider than long, evenly and rather distinctly convex, regularly arched from beak to front; beak short and incurved. Ventral valve strongly arched, more convex than the other,

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the greatest convexity being a little behind the middle; beak short and distinctly incurved, so as to come in contact with that of the other valve, but not distinctly overlapping it. Surface of each valve ornamented with about nine or ten small, angular plications, four or five of which are a little larger and very slightly more prominent than the others, on the middle of the ventral valve, and a few of those at the immediate front of the dorsal valve slightly more depressed; plications scarcely extending back beyond the middle, and crossed by very fine undulating lines of growth.

Length, 0.52 inch; breadth, 0.54 inch; convexity, 0.43 inch.

This little shell will be distinguished from the last by its more numerous, more angular, and more strongly defined plications, as well as by its shorter and less attenuated ventral beak. Its dorsal valve is also proportionally more convex, and more regularly arched. So far as yet known, it is also a considerably smaller shell; while young individuals of the last described species, of corresponding size, or even one-third larger, are entirely without any traces of plications.

Locality and position: Rock-Island, Illinois; Hamilton Group of the Devonian series.

Genus ATRYPA, Dalman, 1827.

(Vet. Akad. Handl., xx.)

Atrypa aspera, Schlotheim (sp.)

Pl. 13, fig. 7 *a*, *b*, *c*, *d*.

Terebratulites aspera, Schlotheim, 1813. Min. Taschenb., vol. VII, pl. 1. fig. 7; Petrefact., p. 263.

Atrypa aspera, Dalman, 1827. Vet. Akad. Handl., pl. 4, fig. 3; Heisinger (1837), Leth. Suec., pl. 21, fig. 12; Phillips (1841), Palæozoic Foss., pl. xxxiii, fig. 144; Davidson (1865), Monogr. Brit. Devonian Brach., pl. x, fig. 5–8; Meek (1868), Trans. Chicago Acad. Sci., vol. I, p. 96, pl. xiii, fig. 12; and of others.

Atrypa spinosa, Hall, 1843. Geol. Report Fourth Dist. N. Y., p. 200.

Terebratula aspera, Murch., Vern. and Keys., 1845. Geol. Russ., vol. II, p. 93, pl. x, fig. 13.

Atrypa aspera, var. *occidentalis*, Hall, 1858. Iowa Report, vol. I, part II, p. 515, pl. vi, fig. 3 *a*, *b*, *c*, *d*.

Shell longitudinally suboval, varying to subcircular, rarely a little wider than long; very gibbous and inequivalve in

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adult specimens. Ventral valve but slightly convex in the umbonal region, and distinctly sinuous, though not emarginate, in front; beak very small, a little prominent, and closely incurved upon that of the other valve; foramen minute. Dorsal valve much more convex than the other, and becoming very gibbous in adult specimens, regularly and strongly arched from beak to front; beak incurved. Surface of both valves ornamented with large, rounded, bifurcating plications, crossed at intervals by regular, distinctly elevated and vaulted concentric lamellæ, which are sometimes produced in the form of hollow spines.

Length of a large individual, 1.33 inches; breadth, 1.26 inches; convexity, 0.93 inch.

Specimens of this shell from Iowa and western Illinois generally have the plications much larger and less numerous than those found in the Hamilton group, of New York; and in this respect agree more nearly with some of the European examples. These more coarsely plicated western examples Prof. Hall proposed to designate as *A. aspera*, var. *occidentalis*. Even at the western localities, however, these shells vary considerably in this and other characters, as may be seen by the two individuals we have figured. Some authors regard all these shells as merely varieties of *A. reticularis*, Linn. (sp.), which is generally merely ornamented with more or less fine, radiating striæ, with projecting laminæ of growth. Although the varieties of these two types are sometimes very difficult to separate, it seems probable that the softer parts of the animal of each were nevertheless characterized by specific differences.

Locality and position: Rock-Island, Illinois, and New-Buffalo and Independence, Iowa; in Calcareous shales belonging to the horizon of the Hamilton Group of the New York Devonian series. This species is also very common in the same position in New York, and various other localities of the United States. Mr. Kennicott likewise brought specimens of it from the Devonian rocks of a distint locality, on Mackenzie river, British America, as high north as the seventy-sixth degree of latitude, and had others presented to him from near the same latitude in Russian America. It is also widely distributed in Europe.

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ATRYPA RETICULARIS, Linnæus, (sp.).

Pl. 13, fig. 11.

Anomia reticularis, LINN., 1767. Syst. Nat., vol. 1, 12th ed., p. 1152.
Terebratulites priscus, SCHLOTHEIM, 1820. Petrefact., vol. I, p. 262; II, p. 68, 69, t. xvii, fig. 2; t. xx, fig. 4.
Anomites reticularis, WAHLENB., 1821. Act. Soc. Upsalensis, VIII, p. 65.
Terebratula affinis, SOWERBY, 1823. Minn. Conch., vol. IV, p. 24, pl. cccxxiv, fig. 2.
Atrypa reticularis, DALMAN, 1827. Vet. Akad. Handl., pl. iv, fig. 2.*

THIS common and almost universally distributed species is so fully described in various works on geology and palæontology, as to render a formal detailed description of it here scarcely necessary. For the information, however, of students who may not have access to other works, it is proper to state that it is an exceedingly variable shell, both as to size and form. Its most usual form, however, is longitudinally suboval, or approaching obovate, the widest part being generally behind the middle, with cardinal margins more or less sloping from the beaks to rounded lateral borders, and the anterior margin somewhat narrowly rounded, or, in some examples, a little truncated. The dorsal valve is more convex than the other, with a strongly incurved beak. The ventral valve is compressed-convex in the umbonal region, more or less flattened or concave on each side, and impressed, or sometimes rather distinctly sinuous at the front; its beak is small, projecting little beyond that of the other valve, and closely curved over and upon it. The surface is ornamented with more or less fine, or coarse radiating striæ or ribs, with, at intervals, concentric marks of growth, from which, in well preserved specimens, project free laminæ, sometimes extending as much as an inch or more beyond the margins of the valves. As generally found, however, particularly as broken from a hard rock, these laminæ are removed from the surface, and the shell presents a very different appearance from that of a perfect example. The individual we have figured on plate 13 came from a shaly matrix, and retains portions of the projecting laminæ extending far out beyond the true margins of the valves, showing that it must have presented a transversely suboval, or nearly semicircular form, as indicated by the restored outline. The form of the valves, if the free laminæ were removed, would be nearly as indicated by the inner broken line.

Some varieties of this shell are considerably wider than long, and in these dilated forms the hinge line is straight, and often terminates in nearly or quite rectangular extremities. The radiating striæ are subject to great variations in size, which, together with other differences, have caused various specific names to be proposed upon these variations. Most palæontologists, however, regard

* For the long list of other names that have been applied to this species, or to forms supposed to be only varieties of it, see Mr. Davidson's Monographs of the British Silurian and Devonian Brachiopoda.

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all these as merely varieties of one extremely variable species, modified by local and other causes; while others think the series includes at least four or five closely allied but distinct species. The fact that several of these real or supposed varieties are mainly or entirely confined to particular horizons, seems to favor the latter conclusion. In this country, the large dilated variety, with a nearly or quite straight hinge, seems to be characteristic of the Hamilton group, or of beds belonging to near that division of the Devonian; while in the Silurian, the shell is generally much smaller, with the hinge margins usually more sloping from the beaks.

Length of a very large individual, exclusive of the extended laminæ, 1.90 inches; breadth, 2 inches; convexity, about 1 inch.

Locality and position: Rock-Island, Illinois, and New-Buffalo, and Independence, Iowa, in shaly beds of the age of the Hamilton group of the Devonian. It is also common at the same horizon, as well as in the Upper Silurian rocks of New York, and at numerous other localities in other American States. It likewise has a wider range in the Devonian beds of British America, and in the upper Silurian and Devonian rocks of Europe. In short, it seems to be, in some of its real or supposed varieties, almost universally distributed wherever fossiliferous Upper Silurian or Devonian rocks exist.

Genus SPIRIFER, Sowerby, 1815.

(Min. Conch. II, p. 42.)

Subgenus, TRIGONOTRETA, Kœnig, 1825.

(Icon, sect. part I.)

Spirifer fornacula, Hall.

Pl. 13, fig. 8 *a*, *b*, *c*.

Spirifer fornacula, Hall, 1857. Report Regents University of N. Y. for 1856, p. 154.

Shell attaining a medium size, thin, semicircular; hinge line equaling the greatest breadth, which is less than twice the length. Dorsal valve moderately convex; mesial fold narrow, smooth, rather depressed and rounded, or more or less flattened on top, with sometimes a faint furrow along the middle; beak projecting a little beyond the hinge, and distinctly incurved. Ventral valve distinctly more convex than the other, most prominent at the beak, thence sloping, with a moderate convexity, to the lateral and anterior margins; beak

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prominent, distant from the other, and but very slightly curved; area high, triangular, ranging nearly at right angles to the plane of the valves, strongly defined by rectangular margins, nearly flat or very slightly arched, and finely but obscurely striated vertically and longitudinally; foramen rather narrow, being higher than wide; mesial furrow narrow, rather shallow, smooth and rounded, or somewhat flattened within. Surface ornamented with from about fifteen to twenty-four simple rounded plications on each side of the mesial fold and sinus, and marked by fine concentric striæ of growth.

Length, 1.04 inches; breadth, 1.75 inches; convexity, 0.90 inch.

This shell seems to be *very* closely allied to several forms described by Prof. Hall under other names, but not yet figured. Until these have all been fully illustrated, it is impossible to make detailed comparison without specimens of all these forms. On comparison with specimens believed to be the form he has described under the name *S. segmentus*,* they are found to be very similar, though the form under consideration has its area slightly more arched, its foramen a little narrower, and the mesial fold rather more depressed; while its marks of growth are less strongly defined. The specimen figured by us, however, and the few others we have had an opportunity to examine, have the shell mainly exfoliated so as to give them an unnaturally smooth appearance.

Locality and position: "Bake Oven," Jackson county, Illinois, from beds of the age of the New York Hamilton group, of the Devonian.

SPIRIFER SUBUNDIFERUS, M. and W.

Pl. 10, fig. 5 *a*, *b*, *c*, *d*, *e*.

SHELL attaining a moderately large size, somewhat wider than long, transversely oval, rather convex; lateral margins compressed at the extremities of the hinge, and rounded in outline; front irregularly rounded, being most prominent in the middle at the termination of the mesial fold and sinus; hinge shorter than the breadth of the valve. Ventral valve a little

* *S. segmentus* Hall, seems to us to agree almost exactly, in every respect, with *S. subcuspidatus*, Schnur (Palæontographica, vol. III, p. 202, tab. xxxiii, fig. 3 *a–f*, 1854); not *S. subcuspidatus*, Hall, Iowa Report, 1858.

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more convex than the other; beak moderately prominent, and rather distinctly arched; area of moderate breadth near the beak, but becoming rapidly narrowed farther out, and scarcely extending to the ends of the hinge, strongly arched with the beak, and provided with a rather wide triangular foramen; mesial sinus somewhat flattened or rounded within, shallow or of medium depth and breadth, narrowing regularly from the front, but continued quite to the beak, and having on each side five well defined, stout, simple, broadly rounded plications (with faint indications of a sixth near each hinge extremity), separated by rounded furrows. Dorsal valve most convex anteriorly; mesial fold prominent, with abruptly sloping sides, and usually a shallow depression or furrow along its middle; lateral slopes convex, and each provided with four well defined, and one obscure, broadly rounded, simple plications; beak projecting beyond the hinge line, and distinctly incurved.

Breadth of largest specimen, 2.10 inches; length, 1.90 inches; convexity, 1.24 inches.

All the specimens of this shell we have seen are mainly casts, exhibiting little beyond the size, general form, and large plications. One of them, however, retains some portions of the shell, and at one place, about midway between the beak and lateral margin, a small piece showing the surface markings. On this may be seen, by the aid of a magnifier, delicate, minutely crenated, or pitted, concentric striæ, very regularly arranged, so that six of them may be counted in one-tenth of an inch, and apparently all undulated in crossing the round plications and intervening furrows.

Unfortunately our figures of this species are not engraved in a very satisfactory manner, too much of the shading being done by the general ruling. In attempting to lengthen up the plications by the means of a burnisher, they are also at places made to appear too angular; while the mesial fold on figure 5 *a* and 5 *d* is not prominent enough, and the sulcus along the middle of that of 5 *d* is too broad. The apparent bifurcation of one of the plications on the right side of figure 5 *a* is also an error, the plications being always simple and rounded.

This species is probably most nearly allied to *S. undiferus*, of Rœmer, but differs in having a smaller number of, as well as larger and more prominent, plications. Its area is also less defined, and narrows more rapidly outwards from the beak on each side.

Locality and position: Rock-Island, Illinois; in the Hamilton division of the Devonian series.

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GENUS CYRTINA, Davidson, 1858.

(Monogr. Brit. Carb. Brach., p. 66.)

CYRTINA TRIQUETRA, Hall (sp.)

Pl. 13, fig. 4 *a*, *b*, *c*, *d*.

Cyrtia triquetra, HALL, 1858. Iowa Report, vol. I, part II, p. 513.
Cyrtina triquetra, MEEK, 1868. Transactions Chicago Acad. Sci., vol. I, p. 99.

SHELL small, subpyramidal, wider than long; hinge line equaling the greatest breadth, and terminating in nearly rectangular lateral extremities; anterior outline more or less regularly rounded, with sometimes a faint mesial emargination. Dorsal valve semicircular, depressed-convex; mesial fold moderate, rounded and well defined; beak scarcely extending beyond the hinge line, and slightly arched. Ventral valve greatly elevated, the highest point being the beak, which is straight or very slightly arched; mesial sinus corresponding in size to the sinus of the other valve; area high, triangular, nearly flat, and standing at right-angles to the plane of the dorsal valve; foramen very narrow, closed by the pseudo-deltidium below, and open above. Surface ornamented by seven to eight or nine simple plications on each side of the mesial fold, and about nine to ten on each side of the mesial sinus, the two bounding the sinus being larger and more prominent than any of the others; marks of growth fine, and on well preserved specimens subimbricating; punctate structure visible by the aid of a pocket lens.

Length, 0.26 inch; breadth, 0.45 inch; convexity, 0.30 inch.

This species is chiefly distinguished from *C. acutirostris*, of Shumard (Missouri Report, p. 204, pl. C, fig. 3 *a*, *b*, *c*), by its smaller and more numerous plications. It is very similar to some of the forms referred to *C. heteroclyta*, by European authors.

Locality and position: Same as last.

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GENUS LINGULA, Bruguiere, 1792.

(Encyc. Meth. 1, tab. 250.)

LINGULA SUBSPATULATA, M. and W.

Pl. 13, fig. 1.

WE only know this shell from almost perfectly flattened specimens, apparently of the ventral valve. They have an elliptic outline, with length and breadth as five to three. Its lateral margins form very nearly elliptic curves from the beak to the front, which is rather more narrowly rounded than represented in our figure. The slopes of the cardinal margin are scarcely straight, even near the beak, which is only rather obtusely angular. Surface marked by fine concentric lines, and traces of more minute, less distinct radiating striæ.

The appearance of a depression, or of distinct, continuous radiating lines, along the middle, from the beak to the front, in our figure, is an error in the engraving. On internal casts some faint traces of radiating marks are seen near the beak, and sometimes forward to or beyond the middle, but not forming a distinctly defined band; nor is there any furrow on the internal cast.

Length, 0.53 inch; breadth, 0.32 inch.

This species has been sometimes referred to *L. spatulata*, of Hall, from the Genesee Slate, of the New York Devonian series; but in addition to being much larger, it is distinctly broader in proportion to its length, and has a more angular beak. It is still less like *L. concentrica*, from the New York Genesee Slate.

Locality and position: Near Jonesboro, Union county, Illinois; from the "Black Slate," at the top of the Hamilton division of the Devonian series.

LAMELLIBRANCHIATA.

GENUS PTERINEA, Goldf., 1832.

(Naturh Atl., tab. 312.)

PTERINEA? SUBPAPYRACEA, M. and W.

Pl. 11, fig. 5.

Pterinea? subpapyracea, MEEK and WORTHEN, 1866. Proceed. Chicago Acad. Sci., vol. I, p. 21.

SHELL (left valve) under medium size, obliquely suboval, moderately convex, very thin; anterior and basal margins forming a semicircular curve to the posterior extremity, which

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is narrowly rounded and somewhat produced near the middle, above which the posterior margin is nearly straight and ascends obliquely forward to the posterior wing. Beak rather obtuse, and placed considerably in advance of the middle of the shell. Hinge short, ranging at an angle of about twenty-eight degrees above the obliquely sloping posterior margin. Posterior wing small, compressed, considerably shorter than the posterior extremity of the valve, pointed at the extremity, and slightly sinuous behind; anterior wing shorter than the other, compressed, and apparently nearly rectangular. Surface ornamented with alternately larger and smaller thread-like, obscurely subcrenate radiating striæ, separated by wider flattened spaces; the whole being crossed by concentric lines, sometimes producing a sub-cancellated style of marking.

Length, measuring obliquely from the anterior wing to the narrowly rounded posterior extremity, 0.74 inch; height, or diameter at right angles to the hinge, 0.60 inch; length of hinge-line, 0.42 inch.

This shell resembles very closely the cretaceous species *Avicula Nebrascensis* of Shumard, from the Upper Missouri. Its widely different geological position, however, is alone a strong presumptive evidence that it must be specifically distinct. As we know nothing of its hinge or interior, we can only refer it provisionally to the genus *Pterinea*. If not a true *Pterinea*, it will doubtless have to be called *Avicula* or *Pteria subpapyracea*, depending upon which of these two names is to be retained for that genus.

The shading on our figure makes the posterior portion look too convex.

Locality and position: Falls of the Ohio river; Devonian.

Genus MODIOLOPSIS, Hall, 1847.

(Palæont. N. Y., vol. I, p. 157.)

Modiolopsis? perovata, M. and W.

Pl. 11, fig. 2.

Modiolopsis perovata, Meek and Worthen, 1865. Proceed. Acad. Nat. Sci., Philad., p. 246.

Shell longitudinally ovate, the widest part being a little behind the middle, compressed, very thin, extremely inequi-

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lateral and oblique; posterior side compressed, cuneate, regularly rounded in outline; anterior side very short, more narrowly rounded than the posterior margin. Dorsal outline forming a broad, nearly regular arch, from the beaks into the posterior border; base oblique, and somewhat straightened just in front of the middle, and rounding up towards the extremities. Beaks compressed, scarcely projecting beyond the rounded anterior outline, and placed directly over the anterior extremity. Surface marked with regular concentric striæ, and small, irregular furrows. Anterior muscular impression oval, distinct, located close to the margin, under the beak.

Length, 1.92 inches; height, 1.18 inches; convexity, 0.40 inch.

This species has much the general appearance of *Modiola concentrica*, (Hall, Geol. Fourth Dist. p. 196, fig. 9), but differs in having its anterior outline rounded, instead of protuberant and subangular in outline. Its margin is also more prominent in the antero-ventral region, and without "a longitudinal impression directly below the beaks."

Our figure of this shell is too narrowly rounded posteriorly, and too widely round in front. The beak in the anterior margin shows the cast of the muscular impression, and the end of the pallial line connecting with it, but these are not well represented in the figure. As we know nothing of the nature of its hinge, we of course only refer it provisionally to the genus *Modiolopsis*.

Locality and position: White Sulphur Springs, Delaware county, Ohio; Hamilton Group of Devonian series.

Genus GRAMMYSIA, de Verneuil, 1847.

(Bull. Soc. Geol. Fr., IV, p. 696.)

Grammysia? rhomboidalis, M. and W.

Pl. 11, fig. 5 *a*, *b*.

Grammysia rhomboidalis, Meek and Worthen, 1865. Proceed. Acad. Nat. Sci., Philad., p. 248.

Shell rather large, very gibbous, presenting a rhombic form as seen in a side view, and a distinctly cordate outline as seen in an anterior or posterior view; umbonal slopes extremely prominent and very oblique; beaks nearly terminal, approxi-

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mate at their points, rising above the hinge line, and distinctly curved inwards and forwards; anterior and antero-ventral regions immediately in front of the oblique umbonal ridge, abruptly contracted, with a broad undefined depression extending from the front part of the beaks obliquely to a point near the middle of the base; dorsal region between the umbonal ridge and the cardinal margin, a little concave near the beaks. Posterior margin obliquely truncated with a moderately convex outline to the posterior basal extremity, which is subangular, or very narrowly rounded; base rather long, a little convex in outline behind the middle, and straight or slightly sinuous just in front of it, but rounding obliquely upward anteriorly. Anterior side (which is imperfect in our specimen) short, or apparently not projecting much beyond the beaks, more or less obliquely rounded, and apparently somewhat gaping; cardinal margin (judging from casts) rather short, and inflected so as to form behind the beaks a distinctly defined, rather wide depression or escutcheon. Surface, as near as can be determined from casts, ornamented with small, regular concentric ridges. Hinge, muscular and pallial impressions, unknown.

Length, about 3.55 inches; height, 2.06 inches; greatest breadth (near the middle of valves), 2.42 inches.

The most marked peculiarities of this shell are the remarkable prominence and obliquity of its umbonal ridges (which near the beaks stand out as if compressed antero-posteriorly), and the nearly terminal, obliquely incurved character of the beaks. The specimen is not in a condition to show whether or not it has a distinct lunule in front of the beaks, but we suspect that it has. In some respects it resembles in form *Cyrtodonta Hindi* of Billings, from the Cincinnati group (=Hudson river beds) of Canada, but differs in having its umbonal ridges so much more prominent as to give greater convexity to the valves; while its umbones, although more prominent, are much narrower in their antero-posterior diameter. More important differences, however, are the presence of a broad undefined sulcus, extending obliquely from the anterior side of the beaks of our shell, to near the middle of its base, and the apparent slightly gaping character of its anterior side. Notwithstanding the general resemblance of these forms, there can be little doubt but they really belong to distinct fami-

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lies, since the Canadian shell doubtless belongs to the *Arcidæ*, while that before us appears to be related to the *Anatinidæ*.

Although we have placed our shell provisionally in the genus *Grammysia*, we strongly suspect that when its hinge and interior can be seen, it will be found to be either generically or subgenerically distinct from *G. bisulcata*, Con. sp., the type upon which that genus was founded. At any rate, it differs materially in form, and the prominence of its umbonal ridges, as well as in the absence of a mesial ridge and furrows, extending from the beaks to the middle of its basal margin, from that and other well determined species of the genus.

Should it be found necessary to establish a new genus for this shell, we have proposed to call it *Rhombocardia*. We remember a somewhat similar, but distinct species, from the New York Hamilton group, which, if we mistake not, has been described by Mr. Conrad.

Owing to the defective shading of the engravings of this shell, our figures look too flat, and fail to convey a correct idea of some of its characters.

Locality and position: "Bake Oven," Jackson county, Ill., Hamilton Group.

GASTEROPODA.

GENUS PLATYCERAS, Conrad, 1840.*

(Ann. Rep. Palæont. N. Y., p. 205.)

PLATYCERAS VENTRICOSUM, Conrad.

Pl. 11, fig. 4 *a*, *b*.

Platyceras ventricosum, CONRAD, 1840. Ann. Report Palæont. N. Y., p. 206; HALL (1859), Report Regents Univ. of N. Y., p. 17, fig. 1 and 2; Palæont. N. Y., vol. III, p. 311, pl. lvi, fig. 1–4 and 8; and pl. lvii, fig. 4; also p. 475, pl. cxviii, fig. 3–9.

SHELL obliquely subovate, composed of two and a-half to three very rapidly enlarging, contiguous volutions, the last one of which is remarkably large and ventricose; spire depressed below the upper side of the body whorl; aperture very large and circular; inner lip generally in contact with the spire so as to leave a moderately large umbilical cavity; surface traversed by fine striæ, and near the aperture, coarser somewhat undulated marks of growth, crossed by faint traces of extremely fine revolving lines.

* For remarks on this genus see page 384.

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Greatest transverse diameter of a large well developed specimen, 1.78 inches; height (which is also the height of the aperture), 1.40 inches; breadth of aperture, 1.25 inches.

Although *P. ventricosum* has not, we believe, been hitherto found above the horizon of the Oriskany sandstone, our specimen of the shell under consideration agrees so exactly in every respect with authentic examples of that species before us from New York, and Cumberland, Maryland, that we are completely at a loss to find any appreciable differences. Indeed it agrees quite as well with typical examples of *P. ventricosum* as they agree with each other. We have the more confidence in its identity with Mr. Conrad's species, because several species of other shells not found in New York above the Oriskany, are known to occur in the Hamilton group in Canada.

The specimen we have figured has the lip somewhat broken away on the upper side, so that figure 4 *a* does not show its outline entire. The lines of growth on that figure are also too oblique, and not undulated enough near the aperture. Figure 4 *b* is a somewhat oblique view, and shows the apex of the spire too distinctly. In looking directly into the aperture, so as to see its full outline, the apex of the spire is not visible.

Locality and position: New-Buffalo, Iowa; Hamilton group of the Devonian.

Genus ISONEMA, M. and W., 1865.

(ισος, equal; νημα, a thread, in allusion to its equal lines.)

Holopea, subgenus *Isonema*, Meek and Worthen, 1866. Proceed. Acad. Nat. Sci., Philad., p. 251.

Shell depressed sub-globose, turbinate, or conical-subovate, obtusely angular around the middle of the body whorl; aperture sub-rhombic; outer lip thin, entire; inner lip a little flattened or impressed in the umbilical region, apparently for the support of an operculum, very thin, or scarcely continuous above; axis imperforate; surface ornamented with transverse, very regular lines on the upper side of the volutions.

In 1865 we proposed the name *Isonema* for this type, as a subgenus under *Holopea*. Farther comparisons, however, have since led us to regard it as generically distinct from *Holopea*, from which it differs in its angular instead of rounded volutions, as well as in its imperforate axis, flattened inner lip, rhombic instead of rounded aperture, and strong regular lines of growth. From *Pleurotomaria* it will be at once distinguished by its entire lip, and the absence of a revolving band on the whorls. From *Cyclonema* it differs in being entirely

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without the characteristic revolving lines of that genus, and marked by strong transverse striæ.

In addition to the typical species here described, this genus includes *I. bellatula*=(*Loxonema bellatula*, Hall; 15th Report Regents Univ. N. Y., p. 163, fig. 4 and 5). These shells differ widely from *Loxonema* of Phillips, in their greatly more depressed, broad form, smaller number, and more angular whorls, and straight or slightly arched, instead of inversely sigmoid lines of growth.

ISONEMA DEPRESSA, M. and W.

Pl. 11, fig. 6 *a*, *b*, and the annexed cuts.

Holopea (*Isonema*) *deprsssa*, MEEK and WORTHEN, 1865. Proceed Acad. Nat. Sci., Philad., p. 251.

Fig. A, shows the aperture and columella.
Fig. B, back view of the shell showing the regular lines of the surface.

SHELL depressed subturbinate, considerably wider than high; spire very low; volutions nearly four, increasing rather rapidly in size, obliquely compressed, with a slightly convex outward slope above; last turn but little convex below, between the angular periphery and the imperforate umbilical region; suture well defined; aperture as wide as high. Surface with lines of growth strong, very regular, and numbering about four or five in the space of 0.10 inch on the upper side of the body whorl, where they sometimes bifurcate, and arch very slightly forward in passing across from the suture to the periphery, below which they suddenly become nearly obsolete and pass a little obliquely backwards to the umbilical region. Furrow on the flattened lower part of the inner lip, for the support of the operculum, well defined.

Height, 0.38 inch; breadth, 0.56 inch.

This species is allied to *I. bellatula*, Hall (sp.), but differs greatly in its more depressed form, being sometimes nearly twice as wide as high, while that species is represented as distinctly higher than wide, and described as being "moderately elongated." Our shell also has its periphery distinctly more angular. In surface markings and other characters, these shells are very similar.

In our figure 6 *b*, pl. 11, the transverse lines are too indistinct and too fine, but they are correctly represented in the above cut B.

Locality and position: Delaware county, Ohio; Devonian, of about the age of the Hamilton Group.

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CEPHALOPODA.

GENUS GOMPHOCERAS, Sowerby, 1839.

(In Murch. Sil. Syst., p. 621.)

GOMPHOCERAS TURBINIFORME, M. and W.

Pl. 12, fig. 2 *a*, *b*.

Gomphoceras (*Apioceras*) *turliniforme*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 258.

SHELL rather small, turbinate or obovate, very slightly unsymmetrical; section circular, or nearly so; chambered part rapidly expanding, with sides slightly convex above. Non-septate part very short, or three times as wide as long, rounding in abruptly above; aperture contracted, but exact form unknown. Septa only moderately concave, nearly equidistant at all points, excepting near the outer chamber and the apex, where they are more crowded; at about the widest part of the shell, separated by spaces equaling one-eighth its greatest diameter. Siphon small and marginal. Surface nearly smooth, or with only fine lines of growth.

Length of a specimen not quite complete at the smaller extremity, 1.16 inches; greater breadth, at the junction of the septate and non-septate parts, 1 inch; smaller diameter at the same place, 0.90 inch; greater diameter at the smaller extremity, 0.32 inch; smaller do. at same place, 0.30 inch; divergence of sides from smaller end, 30°.

This is a very short turbinate species, somewhat like *G. beta*, Hall, (15th Report Regents, pl. 7, fig. 1), but differs in being proportionally shorter and more ventricose, and in having the septa proportionally more crowded. It shows eleven septa in a space of three-quarters of an inch below the last one, while *G. beta* is described as having only seven or eight in the same space.

Its last three septa are crowded within a space only equaling one of the chambers below.

Locality and position: Charleston, Indiana; Devonian.

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GENUS CYRTOCERAS, Goldf., 1832.

(In Dechen's Germ. transl. de la Bache, p. 536.)

CYRTOCERAS SACCULUM, M. and W.

Pl. 12, fig. 3 *a*, *b*, *c*.

Gomphoceras sacculum, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 258.

SHELL small, subfusiform, or clavate, very slightly arched or convex on the ventral side, and nearly straight on the dorsal; a little compressed at right angles to the plane of the curve, particularly the non-septate part, which is more convex on the outer side of the curve than the inner; most ventricose a little above the last septum, thence tapering gradually to the lower extremity and towards the aperture, near which latter there is a slight constriction. Section transversely a little oval near the middle of the shell, and more decidedly so above, but nearly or quite circular towards the lower extremity. Aperture transversely oval, its smaller diameter being about two-thirds the greater; lip faintly sinuous at each end of the aperture and at the middle of the ventral or convex side. Septa but slightly concave; (distance between them not distinctly determinable from the specimen examined). Siphon very small, placed on the line of the shorter axis of the septa, about twice its own breadth from the ventral or outer side of the curve. Surface marked only with small annular striæ, slightly arched backwards near each end of the aperture, parallel to the faint sinuosities of the lip.

Length of specimen, imperfect at the smaller extremity, 1.27 inch; do. of nonseptate part, 0.67 inch; greatest transverse diameter of do., 0.53 inch; shorter diameter of do. at same point, 0.42 inch. Angle of divergence of septate half of the shell, measuring along each lateral margin, 24°. Breadth of aperture, 0.33 inch; smaller diameter of do., 0.22 inch.

This little shell has the general habit and appearance of *Gomphoceras*, and yet differs from the typical forms of that genus in being slightly arched and not having its aperture so remarkably contracted. In being a little curved, it

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more nearly resembles *Phragmoceras*, though its curvature is less decided. It is also worthy of note, that the comparatively small contraction of its aperture is mainly on the dorsal and ventral margins, while in *Gomphoceras* and *Phragmoceras* the contraction is mainly on each lateral margin. Since referring it to the genus *Gomphoceras*, further comparisons have led us to regard it as belonging more properly to the genus *Cyrtoceras*, although it seems to be an intermediate type between these genera. If Prof. Hall's proposed genus *Oncoceras* should be retained, it is possible this species might be included in it, as suggested by us in first publishing a description of it. In its peculiar Gomphoceras-like form, it resembles *C. heteroclytum* of Barrande (Syst. Sil. Bohme, vol. II, p. 550, pl. 118, fig. 15–18), though it is much less arched, and not so ventricose. The small sinus of its lip on the convex side of the shell shows it to be the ventral side.

Locality and position: White Sulphur Springs, Delaware county, Ohio. Hamilton Group of Devonian Series.

Genus GYROCERAS, de Koninck, 1844.

(Terr. Houill., 530.)

Gyroceras? constrictum, M. and W.

Pl. 12, fig. 1 *a*, *b*.

Of this species we have seen but the single specimen figured, which is merely an internal cast, consisting of a little less than one-half of a volution. It evidently increased very gradually in size from the smaller extremity, and a section of its volutions presents a transversely elliptic outline, the dorso-ventral diameter bearing the proportions to the transverse of about 20 to 30. About half of the specimen is septate, and the outer chamber appears to have been comparatively short, though its entire length is not known, as it is incomplete at the extremity. It is rather less curved than the septate part, and at about two inches from the last septum it shows a broad, shallow, undefined constriction on the outer side of the curve and the lateral margins, apparently near the aperture. The sides are rather narrowly rounded, and the inner and outer surfaces broadly so. On the outer side, however, there is some appearance of a broad, shallow, longitudinal, mesial concavity or impression, most marked on the non-septate part, near the constriction mentioned above.

On each dorso-lateral region (supposing the outer side of the curve to be the dorsal) a row of broad low nodes is seen, placed at intervals of one for about every third or fourth septum. The specimen is too imperfect to show very clearly the other prominences of the outer side, though there is some appearance of two other rows of still more obscure nodes, placed each about half-way between those mentioned and the middle, and of longitudinal ridges, though

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we are not quite sure that the engraving (fig. 1 *b*) represents these exactly right. On the inner side of the curve there are also several longitudinal ridges, as represented in figure 1 *a*.

On the outer side of the curve, the septa are distant from each other about one-seventh the transverse diameter, while on the inner side, they are distant about one-tenth, or one-twelfth the dorso-ventral diameter. The position of the siphuncle, and the nature of the finer surface markings, have not been determined.

We are not sure that this is a true *Gyroceras*, but merely suppose, from the curve of the fragment, that it most probably formed at least one entire turn, and hence could scarcely have been a *Cyrtoceras*. The difficulty of distinguishing these two genera, however, from such imperfect specimens, is such that a positive conclusion on this point is scarcely possible in this case.

Perfect specimens of this shell will doubtless show the nodes and ridges to be more prominent than they are on mere internal casts like that we have figured.

In the transversely elliptic form of its volutions, and some of its other characters, this species seems to have resembled *Gyroceras Logani*, Meek, from a distant northern locality on Mackenzie river, British America, but it differs in having its volutions proportionally broader, and much less tapering, as well as in the nature of its nodes and other prominences.

Locality and position: "Bake Oven," Jackson county, Illinois; in the Hamilton group. Devonian.

ARTICULATA.

CRUSTACEA.

GENUS PHACOPS, Emmerich, 1839.

PHACOPS RANA, Green, (sp.)

Pl. 11, fig. 1 *a–e*.

Calymene bufo, var *rana*, GREEN, 1832. Monograph Trilobites North America, p. 42.
Phacops rana, HALL, 1862. Report Regents University New York, Appendix D, p. 93.

ENTIRE form narrow-subelliptic, the breadth being generally about two-thirds the length; greatest breadth near the anterior part of the thorax; outline of sides nearly straight and subparallel, or converging a little posteriorly; convexity moderate. Head sub-semicircular, the posterior lateral extremities of the cheeks being a little produced backwards and narrowly rounded.

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Glabella gibbous, but somewhat depressed on top and rounding off abruptly in front, with anterior lobe large or forming more than one-third of the entire bulk of the head, and about two-thirds as long as wide—separated from the palpebral lobes and eyes, on each side, by well defined furrows, that diverge rapidly forward; posterior lobes minute, and separated from the anterior by a furrow extending entirely across, but much deeper on each side than in the middle, where it usually arches a little forward; neck furrow well defined, deepest on each side, and crossing over so as to leave a narrow ridge between it and the furrow passing across between the minute posterior and large anterior lobes; neck segment or occipital ring rather wide, and nearly as prominent in the middle as the anterior lobe of the glabella. Eyes large, nearly as prominent as the anterior lobe of the glabella, and with visual faces nearly vertical or very abruptly sloping, and forming a sub-semicircular curve; lenses large, numbering five or six in the vertical, and nine or ten in the oblique rows—the upper ones usually nearly obsolete; palpebral lobes nearly as prominent as the eyes. Cheeks falling off abruptly from the eyes.

Thorax one-third longer than the head, but somewhat wider anteriorly than long; axis very nearly as wide as the lateral lobes, and a little more convex; lateral lobes flattened on top, nearly half their breadth, and then rather abruptly rounded down to the lateral margins.

Pygidium semicircular, about twice as wide as long, regularly rounded behind; middle lobe more prominent, and rather distinctly narrower than the lateral, and showing eight to about nine or ten segments; lateral lobes with seven or eight segments.

Entire surface, excepting the furrows of the head and the lapping surfaces of the pleuræ, granular—the granules being distinctly larger on the anterior lobe of the glabella than elsewhere.

Length of an adult, 1.70 inches; breadth, 1.25 inches; convexity, 0.45 inch. Other fragments indicate a size about one-third larger.

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Our specimens of this species are somewhat more robust, and have a few more lenses in the eyes than specimens of *P. rana,* from the Hamilton group shale of New York, now before us; but they agree so nearly in other characters, that we see no sufficient reason for separating them.

This species is one of the types of Prof. McCoy's subgenus *Portlockia.*

Locality and position: "Bake Oven," Jackson county, Illinois; from the Hamilton group of the Devonian series. It also occurs in beds of the same age at New Buffalo, Iowa.

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CARBONIFEROUS SPECIES.

FOSSILS OF THE KINDERHOOK GROUP.

MOLLUSCA.

BRACHIOPODA.

GENUS RHYNCHONELLA, Fischer, 1809.

(Mem. Soc. Imp. Mosc. II, .)

RHYNCHONELLA MISSOURIENSIS, Shumard.

Pl. 14, fig. 7 *a*, *b*, *c*, *d*.

Rhynchonella Missouriensis, SHUMARD, 1855. Geol. Rep. Missouri, p. 204, pl. c, fig. 5 *a*, *b*, *c*.

SHELL attaining a medium size, subtrigonal, or sometimes approaching subpentagonal, moderately gibbous, about as long as wide, or sometimes slightly wider than long; greatest breadth near the middle; posterior lateral slopes rather straight, and converging to the beaks at an angle of about 100 degrees; sides more or less rounded; front rounded, or sometimes subtruncate. Dorsal valve depressed—convex in the umbonal and lateral regions, and concave in the middle, the concavity commencing narrow and shallow, generally behind the middle, and widening and deepening to the front, so as to form a broad, shallow, rather flat mesial sinus; depressed part of the front curving downwards, and a little produced, to fill a cor-

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responding sinuosity in the front of the other valve, the margins of the two valves meeting there, at rather less than a right angle, so that no emargination of the outline of the front is produced; beak small, rather pointed, projecting little beyond that of the other valve, over which it curves. Ventral valve considerably more convex than the other, the greatest convexity being generally in front of the middle, from which it rounds off abruptly behind and on each side, while in the middle it rises into a broad depressed, or moderately prominent, flattened or somewhat rounded, mesial prominence, rarely extending back much beyond the middle; beak incurved; cardinal margin broadly and rather distinctly sinuous on each side of the beak.

Surface ornamented by about nine to eleven broad, distinct, rounded, occasionally bifurcating plications, most of which, excepting the outer lateral ones, extend nearly to the umbones. Of these plications, three to four occupy the mesial sinus, and four to five the mesial fold, the greater number in each instance generally resulting from the bifurcation of one of the lateral ones. Distinct, rather coarse, irregular radiating striæ also mark every part of the surface, and are well defined on exfoliated surfaces, as well as upon internal casts,* while fine undulating lines, and occasional stronger marks of growth, traverse the surface concentrically.

Length of a mature specimen, 0.95 inch; breadth, 1 inch; convexity, 0.70 inch; do. of another more gibbous individual, of the same size, 0.76 inch.

Under the name *Rhynchonella Missouriensis*, it will be observed, Dr. Shumard figures two forms, differing materially in general appearance, as well as in size, and the distinctness of their plications. These he thought to be only different developments of the same species, as there were amongst the specimens some intermediate forms. The specimens from which our description was drawn up appear to agree, in all respects, with the larger one, from which his figures 5 *b* and *c* were drawn, excepting that they are not quite so gibbous, though some of them are nearly as much so. These larger, more strongly plicated shells, of

* These striæ are represented rather too fine and regular on the anterior part of all the figures, excepting on the mesial fold of figure 7 *d*.

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which we have a good series before us, are quite constant in all their characters excepting the usual differences of convexity; and we are strongly inclined to regard them as being really a distinct species, from the smaller, more obscurely plicated shells, like that from which Dr. Shumard's figure 5 *a* was drawn. They also not only differ in size and form, but in the distinct radiating striæ of the larger shell. On well preserved specimens of the smaller type, of which we have several specimens for comparison, very faint traces of something like minute radiating striæ may sometimes be seen, by the aid of the magnifier, but they are so fine and obscure as to leave doubts whether they are not rather due to the fibrous structure of the shell, than really to surface markings, and they never leave any traces on internal casts, like the coarser unmistakable surface striæ of the larger shell.

The differences mentioned above are so well marked and constant, in the collections we have had for comparison, that we would scarcely hesitate to name the shell we have figured as a distinct species, were it not for the fact, that on comparing good specimens of the smaller type with authentic British examples of *R. pugnus*, of the same size, we have been unable to find any reliable differences whatever by which they can be distinguished. Indeed, they agree quite as well with small examples of *R. pugnus* as any two specimens of them agree with each other—so that we have absolutely nothing but their uniform much smaller size to distinguish these smaller shells from *R. pugnus;* and if this should not be considered a valid specific difference, then Dr. Shumard's name would have to be retained for the larger shells we have figured and described, and another name would be unnecessary. Should future comparisons of more extensive collections, however, bring to light good distinctions between the smaller, obscurely plicated and non-striated shell represented by Dr. Shumard's figure 5 *a*, and *R. pugnus*, Martin (sp.), we would propose to restrict the name *Missouriensis* to that type, and to distinguish the larger, strongly plicated and distinctly striated shell we have figured, under the name *R. striato-costata.*

It is worthy of note, here, that although the shell under consideration resembles some varieties of *R. pugnus*, particularly that to which Phillips applied the name *R. sulcirostris*, a comparison with a good series of the various forms of *R. pugnus*, sent by Mr. Davidson from Berkshire, England, shows our shell to present the following differences: In the first place, it is uniformly a proportionally narrower shell, and *always* has its posterior lateral slopes converging to the beaks at a distinctly less obtuse angle, while its plications are stronger and continued farther back, and its radiating striæ much more distinct. Indeed, there are no traces of radiating striæ on any of the English specimens of *R. pugnus* we have seen, either testiferous species or internal casts, though Mr. Davidson says well preserved examples show fine striæ on the external surface.

Locality and position: Kinderhook, Pike county, Illinois; Kinderhook group of the Lower Carboniferous series.

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LAMELLIBRANCHIATA.

GENUS PERNOPECTEN, Winchell, 1865.

(Proceed. Acad. Nat. Sci., Philad., p. 125.)

PERNOPECTEN SHUMARDIANUS, Winchell?

Pl. 14, fig. 6 *a*, *b*. *

Avicula circulus, HALL, 1858. Geological Report Iowa, vol. I, part ii, p. 522, pl. vii, fig. 9; (not *A. circulus*, SHUMARD, 1855, Missouri Report, pl. C, fig. 14.)

Pernopecten Shumardianus, WINCHELL, 1865. Proceedings Acad. Nat. Sci., Philad., p. 126. Compare *A. Cooperensis*, SHUMARD, (1855), Missouri Report, pl. C, fig. 15,=? *Aviculopecten limaformis*, WHITE and WHITFIELD, (1862), Proceedings Boston Society Nat. History., vol. VIII, p. 295.)

SHELL very thin, orbicular, or subovate, the height in some examples equaling, and in others exceeding the antero-posterior diameter; valves subequal? much compressed—the greatest convexity being in the central region, and over a space narrowing thence up to the beaks, the superior lateral regions on each side being distinctly compressed or flattened, and separated from the more convex central region by two broad, shallow, undefined furrows or depressions, diverging from the beaks; ventral margin forming a semicircular curve; lateral borders less regularly rounded in outline; hinge line very short, in one valve at least, forming a retreating angle at the beaks; ears very small, subequal, distinctly flattened, more or less obtusely angular, and in one of the valves projecting above the beak, not properly defined by a marginal sinus on either side of either valve; beaks small, somewhat obtusely pointed, and scarcely projecting above the hinge line—their compressed lateral margins defined by the abrupt and distinct flattening of the ears, and diverging at an angle of about 125 degrees. Surface marked with very fine, obscure, concentric striæ, crossed, on well preserved specimens, by traces of more minute

* We regret that our figures do not fully express the neatness of outline and symmetry of form presented by the specimens of this shell. They also fail to show the broad, shallow depressions diverging from each side of the beak, and have the lateral outlines of the umbonal region too widely diverging and not straight enough.

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radiating striæ, which are scarcely visible without the aid of a magnifier, and curve gracefully outwards on the lateral regions.

Height of a large, rather broad specimen, from the ventral margin to the beak, 1.10 inches; do. to top of ears, 1.18 inches; transverse or antero-posterior diameter, 1.18 inches.

In regard to the true relations of this shell to forms that have been described under several other names, we are left in so much doubt as to be considerably perplexed respecting the proper disposition to make of it. We entirely agree with Prof. Winchell, that the form for which he has proposed the specific name *Shumardianus*, is clearly distinct, even generically, from *Aviculopecten circulus*, (sp.) of Shumard, to which Prof. Hall referred it; but, on comparing our shell with Prof. Hall's figure of Winchell's type, they will be seen to differ in several respects—particularly in the straight hinge line, and obliquely truncated or straightened posterior umbonal slope of the latter.* If we were sure that the specimens we have figured, and that figured by Prof. Hall, are not *opposite valves*, we should have no hesitation in regarding them as belonging to two clearly distinct species. But as they came from the same locality and position, and it is evident, from our specimens, that the shell varied considerably in form, and it has been shown, by one of the writers (F. B. M.), in the Report on the Coal Measure fossils of Nebraska, yet in manuscript, that a rather closely allied form has the hinge line in one valve straight, and in the other forming, at the beaks, a retreating angle, we are led to suspect that the form before us and the type of the *Shumardianus*, may really be the opposite valves of the same species.

On the other hand, the species *Shumardianus*, of Winchell, agrees so nearly with *Avicula Cooperensis*, of Shumard, which we believe to be the same since described by Dr. White and Mr. Whitfield, under the name *Aviculopecten limaformis*, that we strongly suspect them all to belong to the one species *Cooperensis*. We are aware this would not be suspected, from a comparison of the particular specimen we have figured, with that figured by Dr. Shumard, which shows a few obscure, abnormally developed radiating ribs. We have had that specimen, however, and others from the same original locality in Missouri, for comparison, and know that the presence of the radiating costæ represented in Dr. Shumard's figure, is a *very* rare character in that shell, nearly all the other individuals being completely destitute of such costæ, while only one other was seen to have extremely faint traces of them. It is also worthy of note, that the radiating costæ on Dr. Shumard's figure, are, by a slight exaggeration in the engraving, made to appear too strongly defined, even for that particular specimen, on which they are most distinct. It might be thought, however, that the apparent absence of minute radiating striæ on these shells would separate them from

* We should state, here, that amongst our specimens of the shell here described, some individuals show indications of the straightening of the posterior? umbonal margin seen in Prof. Hall's figure.

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that under consideration, but it should be remembered that the specimens upon which *Aviculopecten Cooperensis* and *A. limaformis* were proposed, are casts that would not retain such markings, while these striæ are so very minute and obscure, on most of the perfect specimens of the shell before us, that they often become obsolete and can rarely be seen without the aid of a magnifier.

The upper Coal Measure shell, described by Prof. Swallow under the name *Pecten aviculatus*, also agrees so closely with that here described (at least in all known external characters), as to give rise to the suspicion, notwithstanding the rather widely distinct geological horizons at which these shells occur, that they may be really the same species. Until all these questions can be settled by the comparison of good series of specimens of these several real or supposed species, we prefer to retain for our shell, provisionally, the name proposed by Prof. Winchell.

We should also state, here, that our shell is very closely allied to *Pecten Sowerbyi*, of McCoy, from the Mountain limestone of Ireland, but that species seems to have more elevated and more pointed ears, and more prominent, thread-like concentric striæ. It is extremely improbable that they belong to different genera, however.

With regard to the reference of this species to the genus *Pernopecten*, we should remark that it is only done provisionally, as we know nothing of its hinge and interior; and it was equally upon external characters alone that Prof. Winchell referred the type of the species *P. Shumardianus* to that group. The type of the proposed genus, *Pernopecten*, was *Aviculopecten limaformis*, White and Whitfield, which we have already stated, we believe to be synonymous with *A. Missouriensis*. We have never had an opportunity to see the hinge of either of these shells, but Prof. Winchell describes it as having a central triangular cartilage pit, and a transverse plate bearing, on each side of the middle, a series of smaller pits, diminishing in size from the middle outwards; and it was upon this character, chiefly, that he proposed to found the genus.*

Locality and position: Oolitic upper bed of the Kinderhook group, of the Lower Carboniferous, at Burlington, Iowa.

* It is remarkable that no such peculiarities exist in *Pecten aviculatus*, of Swallow, which can scarcely be distinguished, even specifically, from the shell here described, by any external characters, while it has all the hinge characters of *Entolium*, to which I have referred it in my report on the Nebraska Coal Measure fossils, yet in MS.—F. B. M.

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GENUS PTERINEA, Goldf., 1832.

(Naturh. Atl., taf. 312.)

PTERINEA? UNDULATA, M. and W.

Pl. 14, fig. 5.

THE only specimen of this shell we have seen consists of the two valves, opened and lying together, with portions of their margins broken away. It evidently presented an obliquely sub-rhomboid or aviculoid outline, the valves being rather compressed, oblique, and provided with strongly compressed, well developed wings or ears. The posterior ear is rather large, very flat, and separated from the swell of the umbo by a straight, oblique sulcus, most distinct in the left valve, and bordered above by a small marginal ridge, while the marks of growth show its posterior edge to be rather broadly and deeply sinuous, and its extremity somewhat acutely angular. The anterior ear is smaller, and also flat, at least in the right valve, in which it is nearly rectangular at the extremity, and rounds below into (apparently) a well defined byssal sinus, separating it from the margin below. The hinge seems to be shorter than the entire length of the valves, while the beaks are oblique and moderately convex, that of the left valve projecting a little above the hinge margin. The convex portion of the left valve is ornamented with moderately distinct, regular, concentric wrinkles and finer marks of growth, the latter of which are also faintly marked on the posterior ear. In the left valve, which is somewhat less convex than the other, the concentric wrinkles are smaller and more numerous than in the other; and not continued upon its posterior alation, though they are obscurely defined on the anterior ear.

As we only know this shell from casts of the exterior, and have not seen its hinge, of course we cannot be positively sure that it belongs properly to the genus *Pterinea*. If true Aviculas occur in these older rocks (which we doubt), it may have to take the name *Avicula* or *Pteria undulata*. Its most marked characters are the flatness of its alations and the regular concentric undulations of the convex portions of its valves.

Locality and position: Kinderhook group, of the Lower Carboniferous series, at Burlington, Iowa. We have also seen some imperfect casts, very similar to this species, and possibly not distinct from it, from the same horizon, at Kinderhook, Illinois. The latter are left valves, and seem to be a little more convex than in the typical example

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GASTEROPODA.

GENUS PLATYCERAS, Conrad, 1840.*

(Ann. Report Palæont. N. Y., p. 205.)

PLATYCERAS (ORTHONYCHIA?) SUBPLICATUM, M. and W.

Pl. 14, fig. 4 *a*, *b*, *c*.

Platyceras (*Orthonychia*) *subplicatum*, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 265.

SHELL small, depressed conical, somewhat oblique, rapidly expanding from the subcentral apex; anterior or longer slope slightly convex; posterior and lateral slopes more abrupt, and straight or a little concave; aperture irregularly subcircular; scars of adductor muscles obliquely elongated, subovate or sublunate, and vertically striated, placed a little above the middle of each side, and connected by a linear band passing around behind. Surface unknown, but internal casts show a few large, irregular, radiating folds or plications, extending from the margins of the lip more than half way up towards the apex.

Height, 0.36 inch; antero-posterior diameter, 0.63 inch; transverse do., 0.56 inch.

We have only seen internal casts of this shell, from which it is not possible to determine whether its immediate apex was incurved or not, though it seems to have been straight, or merely oblique. The plications are large, irregular and rounded in the cast. On the exterior of the shell they were doubtless crossed by more or less distinct lines of growth.

The casts of this species are of more than usual interest, because they show distinctly that in this group of shells the muscular scars were much as in the recent genus *Capulus*.

Specifically, this shell presents some general resemblance to *P. fissurella*, of Hall, but it is smaller, less oblique, and possesses larger radiating plications.

Locality and position: Richfield, Ohio, from the upper part of the Waverly group; believed to be of the same age as the Kinderhook group, of the Illinois Lower Carboniferous series.

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* See page 384.

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PLATYCERAS HALIOTOIDES, M. and W.

Pl. 14, fig. 3 *a*, *b*.

Platyceras haliotoides, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 264.

SHELL rather small, very obliquely ovate and depressed; composed of about two very rapidly enlarging, nearly or quite contiguous volutions, the last one of which is depressed above, narrowly rounded on the outer side, and forms almost the entire bulk of the shell; apex of the spire on a plane with the upper side of the body of the shell; aperture large, transversely oval, being wider than high; lip sometimes a little sinuous on the outer or dorsal side; surface with moderately distinct lines of growth. Exfoliated surfaces sometimes showing faint traces of revolving striæ, apparently not seen on the external surface.

Length, 0.73 inch; breadth, 0.54 inch; height, 0.41 inch.

This species will be recognized by its very oblique depressed form, and the narrowly rounded character of the outer side of its body whorl, which peculiarities give it much the form of a *Haliotis*. Its first turn, which is quite small, seems to have been sometimes free, or slightly detached from the body of the shell, and in other examples in contact with it. The marks of growth generally indicate a rather broad, moderately deep sinuosity of the lip on the dorsal or outer side.

Locality and position: Same as last.

GENUS PORCELLIA, Leveille, 1835.

(Mem. Soc. Geol. Fr., II, p. 29.)

PORCELLIA NODOSA, Hall.

Pl. 14, fig. 1 *a*, *b*.

Porcellia nodosa, HALL, 1860. In loose sheets, entitled "Iowa Geological Survey, supplement to vol. I, part ii, 1859," p. 4.

SHELL very large, consisting of about four closely contiguous, slender, gradually enlarging volutions, the transverse diameter of which is a little greater than the dorso-ventral; umbilicus wide and shallow; volutions rounded on the dorsum, and

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prominent around near the middle of each side, where they are each provided with from 12 to 14 prominent, transversely elongated, node-like ridges; dorsal fissure narrow and deep, or apparently extending back about half way around the outer volution. Surface cancellated by fine, but distinct, regular, transverse and longitudinal raised lines, the former of which do not curve backwards as they approach the dorsal slit.

Greatest breadth, 2.27 inches; convexity, or transverse diameter of the last turn near the aperture, measuring across between the highest part of the nodes on opposite sides, 1 inch; breadth of dorsal fissure, 0.10 inch.

This fine species, perhaps one of the largest of the genus known, is apparently most nearly allied to *P. Puzo*, Leveille, from which it differs in having rather less rapidly enlarging and more rounded volutions, and a smooth surface.

Locality and position: Barry, Pike county, Illinois; from a peculiar cherty calcareous band at the base of the Burlington limestone, formerly supposed to belong to that rock, but now known to contain fossils characterizing the oolitic upper bed of the Kinderhook group, at Burlington, Iowa. Lower Carboniferous.

Genus GYROCERAS, de Koninck, 1844.

(Terr. Houill., p. 530.)

Gyroceras? Rockfordensis, M. and W.

Pl. 14, fig. 2 *a*, *b*.

Nautilus (*Cryptoceras*) *Rockfordensis*, Meek and Worthen, 1866. Proceed. Acad. Nat. Sci., Philad., p. 275.

As the only specimen of this shell we have seen consists of not more than half of a volution, we are left in some doubt whether it is a *Cryptoceras* or a *Gyroceras*. Its volutions were evidently not embracing, as they are not at all concave on the inner side, but rounded all around, so as to present a slightly oval or subelliptic section, the transverse diameter of which is, to the dorso-ventral, as 132 to 110. The half volution curves around an umbilical cavity apparently rather more than half as wide as the greatest dorso-ventral diameter of the volution at the same point. The siphuncle, although not quite in contact with the dorsal side, is so near as to give the internal cast the deceptive appearance of having a small deep dorsal lobe. The septa are distant, measuring, on the dorsal side, about two-fifths the dorso-ventral diameter of the whorl at the point of measurement, and their edges pass almost directly around the whorls. (Surface, number of whorls, and aperture unknown.)

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Length of a half turn, including a small portion of the last chamber, measuring around the outer side, 3.78 inches; greatest transverse diameter at the larger end, 1.80 inches; dorso-ventral do., 1.60 inches.

We are not acquainted with any other species to which this is very nearly allied, so far as we have been able to make out its characters.

Locality and position: Goniatite limestone, of the Kinderhook division of the Lower Carboniferous series, at Rockford, Indiana.

ARTICULATA.

CRUSTACEA.

GENUS PROETUS, Steininger, 1830?

PROETUS ELLIPTICUS, M. and W.

Pl. 14, fig. 8.

Proetus ellipticus, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 267.

RATHER small, entire outline narrow-elliptic. Cephalic shield semielliptic, about one-third wider than long, and slightly longer than the thorax—regularly and rather narrowly rounded in front and straight behind, with postero-lateral angles produced into small spines, which extend back to the fourth thoracic segment; anterior and lateral borders with a narrow marginal rim, strongly deflected upwards, and separated from the cheeks and glabella by a deep furrow. Glabella more prominent than the cheeks, including the neck segment, a little more than twice as long as wide, broader behind than in front, where it is regularly rounded, separated from the cheeks on each side by moderately well defined furrows; neck segment more prominent in the middle than any part of the glabella, about twice as wide (antero-posteriorly) as the thoracic segments, and defined by a narrower, but distinct neck furrow, the continuation of which becomes wider, but rather less sharply impressed, as it extends straight across the posterior margins of the cheeks to their lateral marginal furrows; lateral furrows of glabella, excepting the posterior ones, nearly obsolete; posterior lateral lobes small, subovate, and nearly isolated by the rather obscure

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lateral furrows just in front of each being directed obliquely backwards and inwards, so as to intersect the neck furrow; the other lateral lobes, of which there seem to be indications of two on each side, are very small and nearly obsolete; anterior lobe composing nearly half of the glabella. Eyes lunate, not oblique, one-third as long as the glabella, but not so prominent, situated less than their own length in advance of the posterior margin of the cheeks near the glabella, and about half their length from the lateral margins of the cheeks; reticulations very fine. Facial sutures intersecting the posterior margins of the cheeks near the middle, and extending forward from the anterior side of each eye, at first close to the side of the glabella, but soon curving outwards and obliquely forward, so as to intersect the lateral margins nearly in front of the middle of the eyes.

Thorax about one-third wider than long, distinctly trilobate; mesial lobe prominent, about once and a half as wide as the lateral lobe, consisting, apparently, of only eight segments; a little widest near the middle, and tapering posteriorly; segments not arching forward, but strongly arched upward, rather flattened: Lateral lobes depressed, somewhat flattened near the mesial lobe, and rounding down rather distinctly to the lateral margins; segments narrow on their upper edges, flattened in the direction of the axis, and bent a little backwards below the knees, apparently rounded at the extremities.

Pygidium sub-semicircular, but a little rounded at the anterior lateral angles; about one-third wider than long, and as long as the glabella, exclusive of the neck segment and anterior marginal rim; rather more broadly rounded behind than the anterior margin of the glabella; mesial lobe prominent, about as wide anteriorly as the lateral lobes, and tapering backward to an obtuse point within the margin, where it ends rather abruptly and is a little depressed, but not flattened; consisting of nine or ten moderately defined segments; lateral lobes depressed below the mesial lobe, near which they are slightly flattened, thence rounding to the margins; each with about

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seven rather faintly defined segments, of which only the anterior one is marked with a longitudinal furrow, all extending to within a short distance of the margin, which seems to be slightly thickened.

Surface apparently nearly smooth, excepting the glabella, which is covered with small, rather closely arranged granules. A row of very small granules may also be seen, by the aid of a magnifier, along the posterior margin of the segments of the mesial lobe, both of the thorax and pygidium.

Entire length, 0.78 inch; do. of pygidium, 0.23 inch; do. of thorax, 0.25 inch; do. of head, 0.30 inch; breadth of same, 0.39 inch; do. of thorax, 0.36 inch; do. of pygidium, 0.34 inch. Length of glabella, including neck segment, 0.25 inch; exclusive of neck segment, 0.21 inch. Length of eyes, 0.10 inch; distance of same, in advance of posterior margin of cheeks, 0.06 inch.

At a first glance this species might be readily mistaken for *P. Swallowi*, of Dr. Shumard, from the same horizon. A more careful comparison, however, at once shows it to present well defined specific differences. In the first place, the outline of the anterior margin of its head is more regularly rounded, its entire cephalic shield longer in proportion to its breadth, while its postero-lateral angles are produced into small spines. Its glabella also differs in being a little narrower anteriorly than behind, instead of the reverse, and its sides straight instead of sinuous. The posterior lateral lobe of its glabella likewise differs in being entirely isolated by the furrow just in advance of it intersecting the neck furrow, and the other lateral furrows are less distinct than in *P. Swallowi*. Again, our species differs in having its glabella granular, and the segments of its mesial lobe each provided with a row of minute marginal granules, instead of having "the whole surface minutely punctate."

It is very probable we should call this species *Phillipsia elliptica*, as it seems to present most of the characters of that genus. Unfortunately, the characters distinguishing these groups seem not to have been very clearly defined.

Locality and position: Jersey county, Illinois. Kinderhook group, of the Lower Carboniferous series.

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FOSSILS OF THE BURLINGTON GROUP.

RADIATA.

ECHINODERMATA.

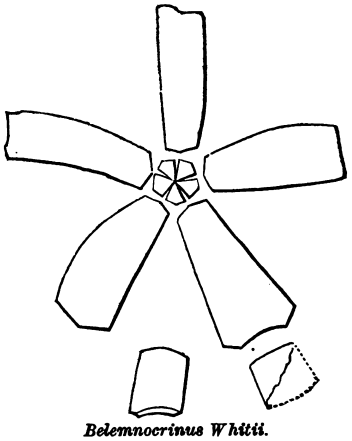
GENUS BELEMNOCRINUS, White, 1862.

(Proceed. Bost. Soc. N. H., IX, p. 14.)

BELEMNOCRINUS WHITII, M. and W.

Pl. 18, fig. 4 *a*, *b*, *c*.

Belemnocrinus Whitii, MEEK and WORTHEN, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 251.



Belemnocrinus Whitii.
Diagram (enlarged 2 diameters) showing body to top of subradials, including a first radial piece, and a part of the first anal.

BODY, below the summit of the subradials, ovoid-subcylindrical, and above this apparently rather rapidly expanding; rounded below. Basal pieces very small, forming a flat subpentagonal disc, as seen from below, anchylosed so as to obliterate the sutures in the specimen examined. Subradial pieces unequal, two of them narrow-oblong, or two and a-half to three times as long as wide, two about twice and a-half as long as wide, and the other narrow below, but nearly two-thirds as wide above as the entire length. First radials (or at least the only one remaining in the typical

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specimen) quadrangular, nearly half as long as the subradials, and slightly wider at the top than the smallest subradial; rather deeply sinuous above across its entire breadth, for the reception of the second radial. Cavity of the subcylindrical part of the body formed by the subradials, infundibuliform, the wide part above extending down about one-fourth of the length of the latter. Anal piece resting upon the slightly concave upper extremity of one of the largest subradial pieces, between two of the first radials; its form unknown. Surface nearly smooth, or merely granular.

A slightly impressed, distinctly defined, apparently obovate, flattened area seems to occupy the whole surface of the anal plate, a small portion of the upper margin of the subradial upon which it rests, and a large part of the first radial on one or both sides of the anal piece. (Column and arms unknown.)

Length of body to the summit of the first radial pieces, 0.57 inch; breadth of same at top, about 0.35 inch; do. of same at the summit of subradials, 0.25 inch.

This species differs from *B. typus*, of White, the only other known species of the genus, in its proportionally shorter and more oval form below the summit of the first radial pieces, and the greater expansion above; also in the greater inequality in the size and form of the subradial pieces; and in the peculiar flattened or impressed area in the region of the anal piece. It likewise differs in having the depression in the upper side of the only remaining first radial, for the reception of the second radial, proportionally broader; while the visceral cavity occupies near one-fourth the length of that portion of the body formed by the subradials, instead of only about one-tenth.

The specific name was given in honor of Prof. C. A. White, the able State Geologist of Iowa.

Locality and position: Lower bed of Burlington limestone, Lower Carboniferous series at Burlington, Iowa. Mr. Charles Wachsmuth's collection.

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GENUS CATILLOCRINUS, Troost, 1850.*

(Shumard, Cat. Pal. Foss., part 1, Echinod. p. 357, 1865)

CATILLOCRINUS WACHSMUTHI, M. and W.

Pl. 18, fig. 5.

Synbathocrinus (*Nematocrinus*) *Wachsmuthi*, MEEK and WORTHEN, 1866. Proceedings Acad. Nat. Sci., Philad., p. 251.

GENERAL form, when the arms are folded together, elongate-cylindrical; body below the arms small, and basin-shaped, being truncated below for the reception of apparently a rather large column; thence spreading rapidly to the summit of the large radials, which are apparently soldered together, and horizontally truncated above on the same plane all around. Arms simple, very slender, in contact all around, equal and elongated; rising abruptly from the truncated summits of the large radials, and numbering altogether about thirty-five; composed each of a single series of pieces twice as long as wide, and looking very much like the tentacles of other crinoids, excepting their greater length. (Form and arrangement of the plates of the body unknown.)

Height of body, 0.12 inch; breadth about 0.30 inch; breadth of the truncation of the base, 0.14 inch; length of arms, known to be at least 1.35 inches, but probably more when entire; breadth of do., 0.03 inch.

As stated, in first describing this crinoid, the only specimen known is not in a condition to show the structure of its body—consequently we were in great doubt in regard to its generic relations. From its general appearance, we were led to think it related to *Synbathocrinus;* but from the great number and slenderness of its arms, we could not believe it belonged to the typical section of that group, and proposed to designate it, provisionally, under the subgeneric name *Nematocrinus*. At that time we had not seen a specimen of Troost's rare type *Catillocrinus*, with the arms attached, and as no species of it had ever been figured, we had no idea of its general appearance. Since that time, however, we have had an opportunity to see a specimen of *Catillocrinus* retaining a portion of its arms, and, from its similarity to the form under consideration,

* Troost published this name in a list in 1850; but no description of the genus was published until Dr. Shumard gave it in a foot note, in his Catalogue, in 1865.

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we can scarcely entertain a doubt but this species really belongs to Troost's genus; although we yet know nothing of the structure of its body. We therefore remove it provisionally to the genus *Catillocrinus*.

Locality and position: Burlington, Iowa; from the upper part of the Burlington group of the Lower Carboniferous series.

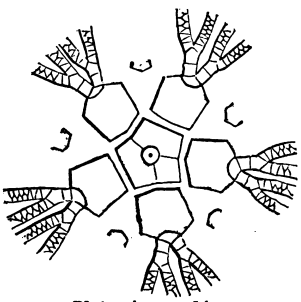
Genus PLATYCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

Platycrinus scobina, M. and W.

Pl. 16, fig. 9.

Platycrinus scobina, Meek and Worthen, 1861. Proceed. Acad. Nat. Sci., Philad., p. 129.



Platycrinus scobina.
Diagram showing structure of body and arms out beyond the bifurcations. (Natural size.)

Body rather small, cup-shaped; base basin-shaped, about twice as wide as high, and more than one-third the height of the body to the top of the first radials; pentagonal in outline, with slightly concave margins; facet for the reception of the column less than one-third the breadth of the base. First radial plates slightly broader than high, widening a little upwards from the base, and presenting a subquadrangular outline, the superior lateral angles being truncated for the reception of the anal and interradial pieces; facet for the reception of the second radial pieces not protuberant, concave, about one-third the breadth of the upper side of the first radial plates, and excavated down about one-fourth their length, or less. Second radial pieces small, triangular, and supporting on their superior sloping sides the first divisions of the arms. After dividing on the second radial pieces, the arms bifurcate again on the second piece, above which they are long, slender and simple. After the second bifurcation, they are each at first composed of a single series of wedge-shaped pieces, but gradually pass into a double alternating series of small pieces,

* For a description of this genus see vol. II, p. 170, Reports Geol. Survey Illinois.

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each of which is about as long as wide. Surface of basal and first radial plates ornamented with numerous, rather sharply elevated, irregularly arranged, minute nodes, or coarse granules, so as to present a rasp-like appearance, that suggested the specific name. Sutures of the base closely anchylosed; those between the first radials well defined.

In its surface markings this species is much like *P. Wortheni* of Hall, but it differs in having a distinctly protuberant instead of a flat or concave base, and in having but four arms to each ray instead of eight or nine.

Locality and position: Burlington group of the Lower Carboniferous series; Burlington, Iowa. Collection of Mr. Wachsmuth.

PLATYCRINUS PLANUS, Owen and Shumard?

Pl. 16, fig. 6.

Platycrinus planus, OWEN and SHUMARD, 1850. Jour. Acad. Nat. Sci., Philad., 2d series, vol. II, pl. 57, fig. 4; and (1854) Geol. Iowa, Wiscon. and Minn., p. 587, pl. 5 A, fig. 4; ?? DE KONINCK and LE HON (1854), Crinoidea Belg., p. 173, p. 5, fig. 6.

BODY large, composed of thin plates, exclusive of the arms truncato-suboval, being slightly longer than wide, and rounded below; base very large, pentagonal basin-shaped or considerably wider than high, rapidly spreading and rounding up from its rather large rounded facet for the reception of the column. First radials large, longer than wide, with a general oblong outline, and rising nearly vertically from the base; facet above, for the reception of the second radials, shallow, about one-third the breadth of the upper margins, and sub-semicircular in form. Second radials comparatively very small, wider than long, pentagonal or subtrigonal, and supporting, on their superior sloping sides, the first divisions of the arms, which each divide again on the second. Whether or not there are any other bifurcations before the arms pass into a double series of interlocking pieces, the specimens do not show very clearly, though we think there are not. Entire surface apparently nearly or quite smooth.

Height of body to top of first radial plate, 1.50 inches; breadth about 1.45 inches.

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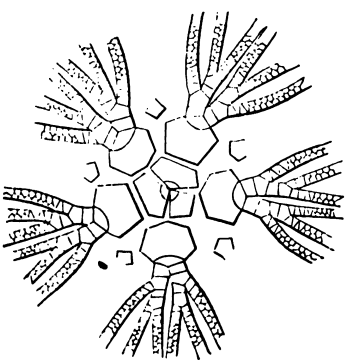
It is possible this crinoid may be distinct from that named by Owen and Shumard, but in the smooth species of this genus, when the vault and arms are removed, as was the case with Owen and Shumard's specimens, there are often so few characters left to distinguish allied species, as to render their proper discrimination very difficult. In the form we have figured, however, it is worthy of note that the excavations in the upper edges of the first radials, for the reception of the second, are more shallow than in Owen and Shumard's type. We doubt very much the identity of the Belgian form that has been referred to *P. planus*, with the American type. At any rate, the figures show it to expand much more rapidly at the top of the first radials; which also differ in having the facet for the reception of the second radials larger, and excavated down nearly half their length, thus indicating the existence of stouter and more spreading arms than in the American species. This question, however, can only be definitely settled by the comparison of more complete specimens than have yet been found.

Locality and position: Lower part of the Burlington group of the Lower Carboniferous or Mountain limestone, at Burlington, Iowa. Collection of Mr. C. Wachsmuth.

PLATYCRINUS (PLEUROCRINUS) ASPER, M. and W.

Pl. 18, fig. 9.

Platycrinus (*Pleurocrinus*) *asper*, MEEK and WORTHEN, 1861. Proceedings Acad. Nat. Sci., Philad., p. 129.



Platycrinus asper.
Diagram showing structure of body and arms out beyond bifurcations.

BODY small, rather deeply basin-shaped below the arms. Base much depressed, largely and deeply excavated below, with a narrow prominent marginal rim, which is notched at the sutures, and somewhat undulated. First radial plates broader than high, widening moderately upwards and presenting a sub-quadrangular outline, but really hexagonal, in consequence of the truncation of the superior lateral angles for the reception of the interradial and anal plates; sinus in the summit of each for the reception of the second radials, deep, semicircular, and equaling about half the breadth of the upper side; surface of each ornamented

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by a very prominent, sharply elevated carina, which passes across near the lower side, and up the lateral margins, being waved, or often broken up into isolated prominences. Second radial pieces triangular, wider than long, and nearly entirely received within the sinus in the upper margin of the first radials. First anal and first interradial plates of apparently about the same size, the former connecting with a range of small plates above, which form the under margin of the lateral anal opening. Sutures of the body plates broadly beveled to the raised marginal carinæ.

Arms, after the first division on the second radial plates, divided again on the second piece, above which the two inner branches bifurcate again on the second piece, thus making six arms in each ray, in the specimen under examination. Above this division, the arms are slender, very gradually tapering, and each composed of a double series of small alternating pieces (excepting near the points of bifurcation), and support, on their inner sides, rather closely set ranges of tentacles. Column a little compressed, and composed of rather thin pieces, with prominent crenulated margins near the base.

This species is rather remarkable for the very prominent marginal rim around its base, as well as along the margins of the other body plates, which character imparts a rather peculiar roughness to the whole body. Although there are several other more or less similar species, we know of none very liable to be confounded with this, when all its characters are taken into consideration.

Locality and position: Burlington group, of the Lower Carboniferous limestone series, Burlington, Iowa. Collection of Mr. Charles Wachsmuth.

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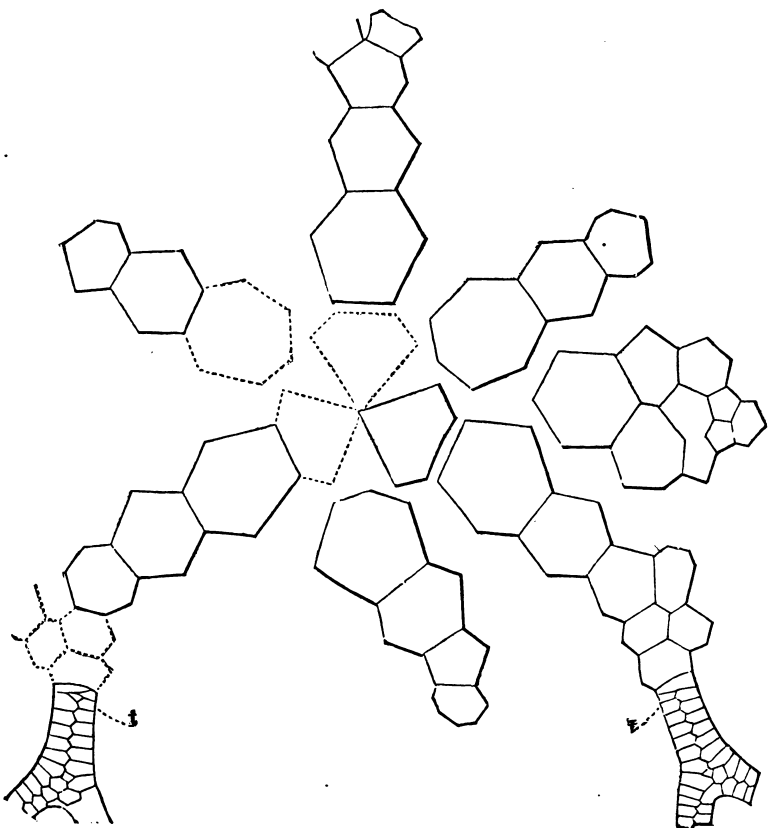
GENUS ACTINOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

ACTINOCRINUS (SACCOCRINUS?) AMPLUS, M. and W.

Pl. 16, fig. 2.

Actinocrinus (*Pradocrinus?*) *amplus*, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 133.



Actinocrinus (*Saccocrinus?*) *amplus.*

Diagram showing structure of body to third radials, and of two of the arms out to the bifurcation. (Natural size.)

BODY large, urn-shaped, composed of thin, smooth or finely granular plates. Base comparatively rather small, somewhat spreading; facet for the reception of the column large, or between one-half and two-thirds as wide as the base—provided

* For a description of this genus, see p. 147, vol. II, Report Geol. Survey Illinois.

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with a small marginal rim. Column strong, round, and composed of thin segments near the body, where it has a very minute round central cavity. First radial plates rather large, a little longer than wide, hexagonal and heptagonal. Second radial plates about two-thirds as large as the first, nearly or quite as wide as long, and all hexagonal. Third radials a little smaller than the second, hexagonal and heptagonal in form, and supporting on their superior sloping sides the two first brachial pieces, which are comparatively large, and each succeeded by three or four much smaller short brachials, before the arms become free and pass into double alternating ranges of small pieces. The first anal plate is as large as the first radials, pentagonal in form, and supports two pieces in the next range, one of which is hexagonal and one heptagonal, above which there are some twelve or thirteen other smaller pieces of various forms. The first interradial plates are larger than the second radials, irregularly hexagonal, and each surmounted by two rather small pieces in the second range, and three in the next, over which there are six or seven still smaller pieces, making eleven or twelve in each interradial space.

After the division of the rays on the third primary pieces, the brachials above the first pair curve nearly horizontally outwards, but are included as a part ot the walls of the body. Beyond the fourth or fifth brachial, the free arms each pass into a double series of small alternating pieces, of which there are eight or ten in each series between the body and the first bifurcation of each free arm. Beyond this the arms are stout, rounded below, and each composed of a double series of alternating pieces, but the only specimen known is not in a condition to show whether or not they bifurcate again. Resting upon the inner sloping sides of each pair of first brachial pieces there is a rather large interaxillary piece, with three or four much smaller pieces above. The tentacles are stout, and commence at the base of the free arms, at the points marked *t*, *t*, in the diagram.

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The vault is moderately convex, composed of innumerable minute pieces, and provided with a central or sub-central proboscis.

This crinoid has the general structure and arrangement of the pieces composing the body, as well as the disconnected arm bases, of the genus *Actinocrinus*, but not only differs in the elongated form of its body, from the typical species of that genus, but also in having its free arms bifurcating after they have passed into a double series of interlocking pieces. In these and other characters it seems to agree with the Upper Silurian genus *Saccocrinus*, though it is probable perfect specimens would show it to present some important differences from that group. So far as we know, it differs in the structure of its arms, mentioned above, from all of the Carboniferous types referred to the *Actinocrinus* group, excepting the so-called *A. divergens*, of Hall, from which it differs widely in all other characters.

Locality and position: Burlington, Iowa, in the Burlington division of the Lower Carboniferous series. The only specimens of this species we have seen belongs to the collection of Mr. Charles Wachsmuth, of Burlington, Iowa, to whom we are indebted for the use of the specimen figured.

ACTINOCRINUS (BATOCRINUS) PISTILLUS, M. and W.

Pl. 16, fig. 4 *a*, *b*.

Actinocrinus pistillus, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 152.

BODY, exclusive of the arms and proboscis, sub-pyriform; the sides rising nearly vertically from the base to the summit of the first radial pieces; thence gradually expanding to the secondary radials, after which they expand very rapidly, so as to cause the brachial pieces to be directed horizontally outwards, or nearly so, at about the middle of the body. Above the horizon of the arm bases, the dome rises at first vertically, but very soon rounds inward, and rises with a moderately convex slope to the base of the subcentral proboscis. Base truncated and flat below, with a thick dilated margin notched at the sutures, so as to present a trilobate outline, as seen from beneath; facet for the attachment of the column a little concave, and about one-third as wide as the base. Basal pieces twice as wide as high, and hexagonal in form, the inferior margin being much longer than any of the others. First radial

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pieces wider than long, smaller than the basal; three of them heptagonal and two hexagonal. Second radial pieces very small, twice as wide as high and transversely oblong, or sometimes with one of the superior lateral angles truncated by one of the interradials, so as to present an irregular pentagonal form. Third radials larger than the second, pentagonal or hexagonal in form, and supporting on each superior sloping side a secondary radial piece, each one of which is succeeded by another. On the superior sloping sides of the latter, in the anterior and one of the lateral rays, commence the brachial pieces, of which there are two ranges, on the last of which commence the free arms, thus giving origin to four arms in each of these rays. In the two posterior rays, however, and one of the lateral, after the second bifurcation on the last secondary radial, the latter supports on the outer sloping side a tertiary radial, which gives origin to two brachial pieces, making five arms to each of these rays, or twenty-three to the whole series.

After the first bifurcation on the third radial pieces, all the succeeding pieces of each ray are in direct contact, so as to leave no spaces for interaxillary plates; while the outer brachial pieces of each two contiguous rays connect over the anal and interradial spaces, so as nearly or quite to isolate the pieces filling those spaces, from the dome.

First anal piece of the same form as the first radials, but rather smaller than those of the anterior and antero-lateral rays; surmounted by three smaller hexagonal and heptagonal pieces in the second range, and three or four in the third, making seven or eight altogether. Interradial pieces four, (rarely five,) those of the inferior range being larger than the others.

Surface without costæ or visible granules, but roughened by the tubercular character of the plates. The tubercle occupying each first radial and the first anal, is larger than those on any of the other pieces of the side walls above, where they become smaller and less distinct with each succeeding range,

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until they are nearly or quite obsolete a few ranges below the arms. Upon the dome, however, the tubercles are prominent and well defined. The proboscis is unknown, but its base is stout, and rises rather abruptly from the dome, being placed nearly its own breadth nearer the anal than the opposite side.

The arms are also unknown. They evidently projected at first horizontally outwards from the body, and their bases are so crowded as to form an almost continuous rim around the body.

Height from base to horizon of arm openings, about 0.64 inch; height to base of proboscis, 1.22 inches. Breadth of dilated margin of base, 0.46 inch; breadth of same just above the rim, 0.38 inch; breadth of body at top of first radials, 0.55 inch; breadth of same at arm openings, 1.05 inches; breadth of base of proboscis, 0.43 inch.

This species is perhaps most nearly allied to our *A.* (*Batocr.*) *pistilliformis* of the Kinderhook group, from which it differs not only in having three more arms, but in the less abrupt contraction of its body immediately below the arm bases, as well as in having from four to six interradial pieces to each space, instead of only two or three. Both of these forms are related to *A. pyriformis* of Shumard, but they are readily distinguished by the much more elongated first radial pieces, as well as by the less attenuate lower part of their body, and their more convex or nodose body plates. They form together a subordinate section of the *Batocrinus* group.

Locality and position: Same as last.

Genus STEGANOCRINUS, M. and W., 1866.*

Steganocrinus pentagonus, Hall, (sp.)

Pl. 16, fig. 8.

Actinocrinus pentagonus, Hall, 1858. Report Geol. Survey of Iowa, vol. I, part II, p. 577, pl. 10, fig. 6 *a*, *b*.

Steganocrinus pentagonus, Meek and Worthen, 1866. Vol. II, p. 196, fig. 9, Report Geol. Survey Illinois.

Body, exclusive of the free rays and proboscis, pentagonal-subglobose, about as wide as high, more prominent below than above the horizon of the free rays. Base rather small, much

* For a description of this genus, see vol. II, p. 195, Reports Geol. Survey Illinois.

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wider than high, somewhat hexagonal in outline as seen from below, and without any projecting marginal rim. First radial pieces much larger than those of the base, moderately convex, three heptagonal, and two hexagonal. Second radial pieces somewhat smaller than the first, but generally nearly as long, all octagonal, and more or less curved upwards on each side to connect with the lower vault pieces. Third radial smaller than the second, heptagonal in outline, and projecting out nearly horizontally, rounded below, and very strongly curved up on each side, to connect with the pieces forming the upper side of the tubular rays; each supporting on their outer sloping sides two series of smaller pieces, which, however, do not immediately diverge, but apparently continue on out horizontally for some distance in close contact, forming the under side of each tubular ray, before the true bifurcation takes place; divisions of the free rays diverging at an angle of about sixty degrees, very long, straight, and, so far as known, continued on horizontally without farther divisions. Arms numerous, small, apparently short, and closely arranged along each side of the long straight divisions of the tubular rays. First interradial pieces about two-thirds as large as the first radials, all hexagonal, and each supporting above two somewhat smaller pieces, belonging as much to the vault as to the interradial series. First anal piece nearly as large as the first radial on each side of it, and supporting two smaller pieces in the next range, above which there are three still smaller pieces connecting with the vault.

Vault rather depressed; proboscis of moderate size, more or less eccentric towards the anal side, and rising abruptly from the vault—composed of subspiniferous pieces. Covering pieces of free rays, with prominent nodes or short spines.

Surface of body plates, with rather strong radiating ridges, extending one from the middle of each, to each of its sides, to meet others coming from the adjacent plates; those on the first radial and first anal pieces starting from a more or less prominent central protuberance.

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This extraordinary crinoid is the type upon which we proposed to found the genus *Steganocrinus*. The specimen figured belongs to Mr. Wachsmuth, and is the only example yet found with the greatly produced free rays attached. It is partly embedded in the matrix, with the upper side exposed, the proboscis, portions of the rays, and most of the true arms being broken away. By carefully working away the matrix under one side, we find it to present, so far as can be seen, the characters of *Actinocrinus pentagonus*, Hall, to which species we can scarcely doubt that it belongs. When the long rays are broken away, its body part resembles *Actinocrinus concinnus* of Shumard, in the same condition, so nearly that we suspect the latter will be found to belong to this genus when its entire rays can be seen. They certainly differ specifically, however, in the larger size and more robust growth of *A. concinnus*, which also has more ornately rayed body plates.

This species seems also to be related specifically to our *S. araneolus*, which, however, differs in being smaller and much more depressed.

Locality and position: Same as last.

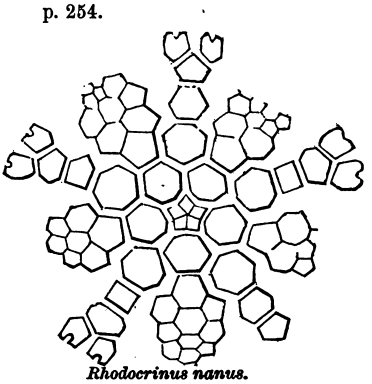
Genus RHODOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

Rhodocrinus nanus, M. and W.

Pl. 18, fig. 2 *a*, *b*.

Rhodocrinus nanus, Meek and Worthen, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 254.



Rhodocrinus nanus.

Diagram showing structure of body out to arm bases. (Enlarged two diameters.)

Body small, subglobose, with nearly vertical sides which round under below to the basal concavity. Base very small, and entirely concealed in the concavity of the under side, by the end of the column. Subradial pieces comparatively large, forming the under side of the body, and curved up so as to show nearly half the surface of each in a side view, hexagonal in general outline, but probably each with a seventh nearly obsolete angle at the middle

* For remarks on the relations of this genus to *Gilbertsocrinus*, Phillips, see p. 217, vol. II, Reports Geol. Survey Illinois.

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of the side connecting with the base. First radials nearly as large as the subradials, and regularly heptagonal in form; second radials rather more than half as large as the first, normally hexagonal, but sometimes pentagonal, and rarely quadrangular; third radials generally larger than the second, wider than long, pentagonal, hexagonal or heptagonal, and supporting upon their superior sloping sides, apparently the first brachial pieces, which are not free, but support the first free pieces in the next range; if there were no farther divisions of the free rays, there must therefore have been two arms to each ray, or ten in the entire series. First interradials smaller than the first radials, and resting upon the truncated upper sides of the subradials, regularly hexagonal in form, or rarely with the superior angle slightly truncated by the middle piece of the next range, so as to form a seventh angle; second range consisting of two, or rarely three, rather smaller generally hexagonal pieces, above which there are five or six other still smaller pieces connecting with the vault between the arm bases, thus making some eight or nine interradials to each area; anal pieces about the same number as in each interradial space, but a little larger in size and differently arranged, there being three pieces in each of the ranges above the first one, the middle ones of which continue on up in a right line to connect with the base of the proboscis above. Vault depressed to the level of the upper side of the arm bases, and provided with deep broad furrows or depressions radiating from near the middle to the interradial spaces, composed of small, irregular, rather tumid pieces. Opening of the summit at the end of a short, rather narrow lateral proboscis, which rises vertically, with its outer side nearly on a line with the vertical side of the anal area.

All the body plates are convex in the middle, from which point very obscure ridges radiate to each of their sides. The greater convexity and larger size of the radial pieces impart a somewhat pentagonal outline to the body, as seen from above

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or below. The surface is somewhat granular, and the column, which is composed near the base of alternately thicker and thinner pieces, is round, and pierced by a minute rounded cavity.

Height of body, 0.33 inch; breadth of do., 0.35 inch.

This neat little species is evidently closely allied to *R. Barrisi*, of Hall, from which it differs in having its body plates merely convex and provided with radiating ridges, instead of being "ornamented by sharp, angular nodes and spines;" also in having eight or nine interradial pieces to each area, instead of only four to six. Another difference is to be observed in the size of the third radial pieces, which in *R. Barrisi* are "minute," while in our species they are as large as the second radials. We only know the *R. Barrisi* from the published description, but we have been assured by Mr. Wachsmuth, who compared the form under consideration with authentic examples of that species, that they are easily distinguished.

Locality and position: Lower division of the Burlington group of Lower Carboniferous limestone series, at Burlington, Iowa.

Genus BURSACRINUS, M. and W., 1861.

(*βυρσα*, a purse; *κρινον*, a lilly, in allusion to the purse-like form of the typical species, as seen with its arms folded together.)

* *Bursacrinus*, Meek and Worthen, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 136; White (1862), Proceedings Boston Soc. Nat. Hist., vol. ix, p. 11.

Generic formula.—

Basal plates, 5.
Subradial plates, 5; four hexagonal and one heptagonal.
Radial plates, 2+5.
Interradial plates, 0.
Arms ten, bifurcating.

This genus has much the appearance of *Woodocrinus*, de Koninck, being, like that type, provided with five basal pieces, five subradials, and two pieces to each of the primary radial series; as well as in having about six broad, short pieces to each of the arms below their first division. It differs, however, materially in having but a single anal piece, instead of 18 to 20. Like *Woodocrinus*, it has the arms broad and flat, and connected all around so as to leave no spaces for interradial pieces. The only two species known are from the Burlington group of the Lower Carboniferous limestone series. (Type B. Wachsmuthi, M. and W.)

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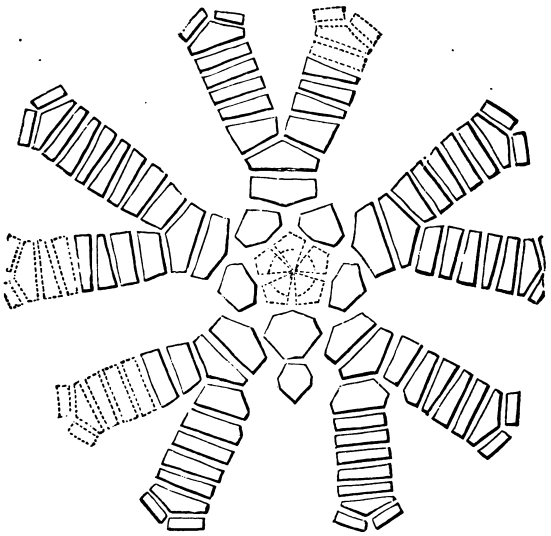
BURSACRINUS WACHSMUTHI, M. and W.

Pl. 17, fig. 6.

Bursacrinus Wachsmuthi, MEEK and WORTHEN, June, 1861. Proceedings Acad. Nat. Sci., Philad., p. 137.



Bursacrinus Wachsmuthi.
Diagram showing structure of body and rays out to second bifurcation. Nat. size.

BODY below the summit of the first radial plates turbinate, or obconical. Basal pieces unknown. Subradial plates of moderate size, a little wider than long, and all hexagonal, excepting one on the anal side, which is larger than the others, and heptagonal in form; the angles at the middle of the under side of each being less salient than that above. First radial plates about one-third larger than the subradials, near twice as wide as high, and all pentagonal, the upper side being transversely truncated. Second radial pieces of the same size and form as the first, but of course with the sloping sides above instead of below; supporting on their superior sloping sides the first divisions of the arms, which are broad, flat, and connected laterally with each other all around. Anal piece rather small, longer than wide, heptagonal, the angle at the middle of the summit being more salient than the others; supported upon the short truncated upper side of one of the subradials,

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and connecting on each side with the first and second radial plates, and the first of the arm pieces above.

After the first division on the second radials, the arms bifurcate again on the sixth or eighth piece, above which one is seen to bifurcate again on the twelfth piece, which is as far as they can be traced, in the only specimen seen, though they seem to be long, and probably bifurcate once or twice more above.

Between the first bifurcation of the rays on the second radial pieces, and the next division above, the arms are very wide, flat, and composed of short, slightly wedge-formed pieces, which are squarely truncated on each side. The next divisions above these are a little less than half as wide, and composed each of a single series of pieces, bearing near the same proportions of length and breadth as those below. The surface is finely granular, though there are no traces of nodes, costæ or other prominences on any of the plates. The sutures are merely linear, and not impressed.

The specific name of this crinoid was given in honor of Mr. Charles Wachsmuth, of Burlington, Iowa, who discovered the only specimen of the species we have seen.

Locality and position: Same as last.

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CYATHOCRINUS, MILLER, 1821.*

(Nat. Hist. Crinoidea, p. 85.)

CYATHOCRINUS ENORMIS, M. and W.

Pl. 16, fig. 3 *a*, *b*.

Poteriocrinus? enormis, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 137.

Cyathocrinus enormis, M. and W., 1865. Ib., p. 152.

BODY small, below the arms, irregularly cup-shaped; sides somewhat convex, expanding from the base; breadth greater than the height. Base small, spreading from the column, above which the plates are seen presenting small pentagonal faces. Subradial plates comparatively large, unequal, hexagonal in form, excepting one on the anal side, which is larger than the others, and subpentagonal in outline. First radial plates larger than the subradials, longer than wide, and irregularly subhexagonal or heptagonal; facet for the reception of the second radials small, shallow, and about one-third as wide as the plates. Arms above the first radial pieces slender, cylindrical, and composed of a single series of segments, from twice to three or four times as long as wide. In some of the rays the first division takes place on the second, in others on the third, and in the anterior ray, on the fourth piece above the first radials; after which they bifurcate irregularly once, twice, or oftener, on the second, third or fourth piece. The first anal plate is rather large, and rests upon the upper truncated side of the largest subradial plate, so as to project considerably above the first radials—its left side curving inwards, and its right connecting with another anal plate of nearly its own size, resting upon a sloping side of the first radial on the right. Above these are seen several other plates, which form, together, a kind of slender lateral proboscis, rounded on its outer side, and rising like an arm on a range with the true arms. Some little distance above its base, the

* For a description of this genus see page 175, vol. II, Reports Geol. Survey, Illinois.

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proboscis curves abruptly inwards between the arms, leaving at its left base apparently a cavity or opening in the vault, passing into the body between it and the arm on that side.

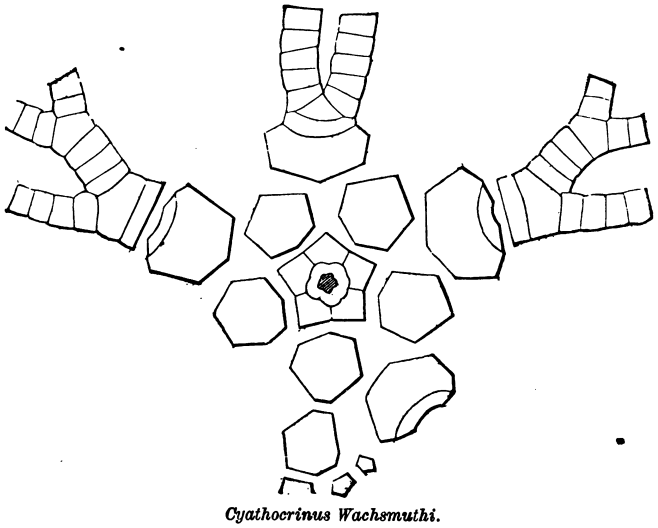
In the arrangement of the plates composing the body, as well as in the characters of its arms, this little crinoid agrees most nearly with *Poteriocrinus;* but instead of having its body produced above in the form of a large elongated trunk or proboscis, composed of small hexagonal pieces, as in that genus, it has merely a very small lateral proboscis, not larger than one of the arms, with apparently another independent opening in the vault, more nearly as in *Cyathocrinus.* As these characters are probably of more importance than the more or less variable differences in the number and arrangement of the anal plates and the structure of the arms, observed between *Poteriocrinus* and *Cyathocrinus*, we have been led to transfer this species from the former to the latter genus.

Locality and position: Same as last.

CYATHOCRINUS WACHSMUTHI, M. and W.

Pl. 16, fig. 5.

Cyathocrinus Wachsmuthi, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 136.



Cyathocrinus Wachsmuthi.

Diagram illustrating structure of body and arms out to second bifurcation. The first radial pieces are in part as if flattened out. The quadrangular subanal piece was accidentally omitted from the space near the left upper side of the first true anal, in the diagram, (right lower side in the fossil).

BODY, below the summit of the first radials, broad obconic. Base of moderate size, low and distinctly pentagonal, the angles formed by the extremities of the plates being a little incurved;

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facet for the column covering about one-third to one-fourth of each basal piece. Column obscurely pentagonal near the base, the angles being rounded; central canal comparatively large and pentagonal. Subradial plates five to six times as large as the basal pieces, about as long as wide, three of them hexagonal, and two on the anal side heptagonal, all indented or incurved at the sides and at the upper angles. First radials larger than the subradials, unequal in size, and wider than long; all heptagonal in consequence of the truncation of the upper lateral angles, apparently for the reception of small interradial or vault pieces, each having the angles below distinctly indented, and the upper side truncated and moderately concave for the reception of the succeeding plates. Second radials very short or nearly linear, and considerably wider than long. Third radials generally a little narrower and longer than the second, and more or less nearly triangular or pentagonal in form. Subanal piece of variable size, quadrangular, and indented at the angles; first true anal plate larger than the subanal piece, hexagonal or subpentagonal, resting upon a short upper truncated side of one of the subradials, and connected on each side with the first radials, while its right inferior sloping side rests against the subanal piece. The arms, after dividing on the third radials, are strong and rounded on the outer side; one of the divisions in each of the rays, excepting the anterior one, bifurcates again on the fourth pieces. All the divisions and subdivisions are rounded, gradually tapering, and composed each of a single series of pieces, as long as wide, or a little longer, and give off at intervals of two or three pieces, alternately on opposite sides, rather strong jointed lateral divisions, which extend obliquely outwards and bifurcate several times. Surface apparently merely irregularly granular, but on a close examination, traces of very small, radiating, slightly raised lines are seen on the subradial and radial plates, as well as passing up the principal divisions of the arms.

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The specific name of this fine crinoid was given in honor of Mr. Charles Wachsmuth, of Burlington, Iowa, to whom we are indebted for the use of the only specimens of the species we have seen.

Locality and position: Same as last.

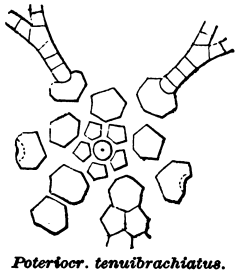
GENUS POTERIOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

POTERIOCRINUS TENUIBRACHIATUS, M. and W.

Pl. 16, fig. 1.

Poteriocrinus tenuilrachiatus, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 138.



Poteriocr. tenuibrachiatus.

Diagram (enlarged to 1½ diam.) showing structure of body out to first radials, inclusive, and of two of the rays a little beyond to the first bifurcation.

BODY small, cup-shaped, or subturbinate below the summit of the first radial plates. Base forming a low, pentagonal, saucer-shaped cup, composed of small pieces, showing each a pentagonal outline above the column. Subradial plates comparatively large, about as wide as long, three hexagonal and two, on the anal side, heptagonal, and a little longer than the others. First radial pieces somewhat larger than the subradials, wider than long, and pentagonal in form; facet for the reception of the second radials moderately prominent, a little concave, and from one-half to two-thirds the breadth of the plate. Anal plates, three—the first hexagonal, and resting between the upper sloping sides of two of the subradial pieces, while another on the left rests against this, and upon the superior truncated side of one of the subradials. A third piece is supported on the upper side of the lowest anal piece, and projects more than half its length above the radial on its right. The succeeding primary radial pieces, after the first, are much smaller, and generally a little wider than long. In all, excepting the anterior and one of the anterior lateral rays, where

* For a description of this genus see p. 179, vol. II, Reports Geol. Survey Illinois.

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the bifurcation takes place on the fifth plate, the first division of the arms is on the fourth primary radial. Above this the arms, which are very long, slender and rounded, divide again on the fourth piece, after which the divisions bifurcate three or four times, and become very attenuated. Each division is composed of a single series of pieces, usually about twice as long as wide.

The proboscis connects directly with the anal plates already described, and is made up of hexagonal plates, along the sutures of which vertical ranges of distinct, rather large pores are seen. Entire surface finely granular. Sutures linear, and not grooved or impressed.

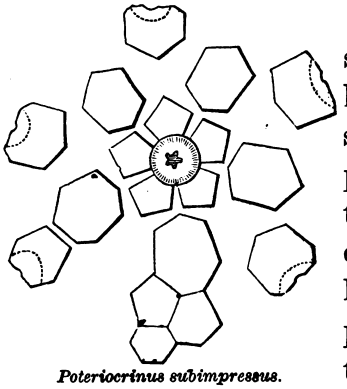
This species is similar to *P. calyculatus* of Hall, but may be at once distinguished by its sutures not being excavated, and by its much more slender arms, which are composed of elongated, instead of short, wedge-formed pieces.

Locality and position: Burlington group, of the Lower Carboniferous limestone series; Burlington, Iowa. Mr. Wachsmuth's collection.

POTERIOCRINUS SUBIMPRESUS, M. and W.

Pl. 18, fig. 1 *a*, *b*.

Poteriocrinus subimpressus, MEEK and WORTHEN, 1861. Proceed. Acad. Nat. Sci., Philad., p. 138.



Poteriocrinus subimpressus.
Diagram (nat. size) showing structure of body to the first radial pieces, inclusive.

BODY obconical. Base forming a shallow cup about twice as wide as high, expanding moderately from the summit of the column; composed of plates about as high as wide, and pentagonal in form, the angle at the middle of the upper side of each being a little indented. Subradial plates comparatively large, somewhat larger than wide, two of them heptagonal and three hexagonal. First radials a little smaller than the subradials, wider than long, pentagonal or in part hexagonal, and all truncated above for the reception

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of the second radials. First anal plate slightly larger than the basal pieces, pentagonal, and resting between the upper sloping sides of two of the subradial pieces; second anal piece of the same size as the first, hexagonal in form, and resting upon the upper truncated side of one of the subradials, while its left side connects with one of the first radials, and its right with the first anal piece, and a third hexagonal piece supported by the latter. (Succeeding parts unknown.)

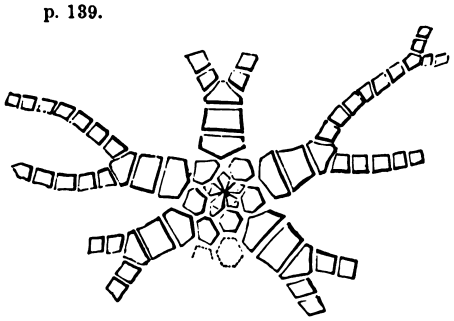
The column is round, and comparatively stout at its connection with the base, near which it is composed of rather thin segments of uniform size; central perforation of moderate size, and presenting a pentagonal section. The surface seems to be granular, and the subradial pieces show a very slight tendency to develop short, broad, obscure, radiating prominences near the sutures on each side, and below as well as sometimes at their connection with the first radials above. Sutures at the corners of the subradial and anal pieces more or less distinctly indented.

Locality and position: Burlington group, of the Lower Carboniferous limestone series, at Burlington, Iowa. Collection of Mr. Wachsmuth.

POTERIOCRINUS CARINATUS, M. and W.

Pl. 17, fig. 1.

Poteriocrinus carinatus, MEEK and WORTHEN, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 139.



Poteriocrinus carinatus.

Diagram (enlarged three diameters) showing structure of body and arms.

BODY small, basin-shaped, or rather rapidly spreading below the arms. Base very small, having the form of a pentagonal star, the angles of which project but slightly beyond the column. Subradial pieces small, about as wide as long, four of them hexagonal (the form of that on the anal side not seen); all

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rather prominent, and provided with a vertical carina near the upper angle. First radial pieces about twice as large as the subradials, as wide again as high, and pentagonal in form, the upper side being transversely truncated and longer than either of the others. Second radials slightly larger than the first, wider than high, quadrangular, and a little constricted around the middle. Third radials about the size of the first, or smaller, pentagonal in form, and, like the second, slightly constricted, the upper angles being rather salient. The anal plates are not all preserved in the specimen before us, though we can see that the first piece is of moderate size, pentagonal in form, and extends so far down between two of the subradials as to connect (apparently) by a very short side, with the produced extremity of one of the basal pieces. Its right superior sloping side supports one edge of a first radial above, and evidently supported another piece on its superior truncated edge, while it connects on the left with another resting on the upper truncated side of one of the subradials.

After the first division on the third radials, some of the arms bifurcate again on the fifth, sixth, or seventh piece, while others seem to be simple. They are all composed of pieces which are a little constricted around the middle, as long as wide, and alternately longer and shorter on opposite sides, the upper extremity of the longer side of each being a little projecting for the reception of the tentacles, so as to give a slight zigzag appearance to the arms. The tentacles are comparatively large, and composed of rather long joints. Owing to the length of the arm pieces, and the fact that only every alternate piece on the same side supports a tentacle, they are very widely separated and alternately arranged.

The surface seems to be granular, and each ray is provided with a distinct linear carina, commencing on the middle of each first radial piece and extending along each division of the arms to the extremities. The sutures between the primary radials seem to be a little gaping, as in *Scaphiocrinus*, to which

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the species appears to bear some relations in other respects, though it differs in having three primary radials to each ray.

The anal side of the specimen examined being imperfect, we are left in some doubt in regard to the generic characters of this species. In some respects it seems to agree more nearly with *Cyathocrinus* than with the typical forms of *Poteriocrinus*, though it evidently possessed more anal pieces than the former genus. The carinated character of its arms and primary radial pieces, is a peculiarity that will readily distinguish it from any otherwise similar species with which we are acquainted.

Locality and position: Same as last.

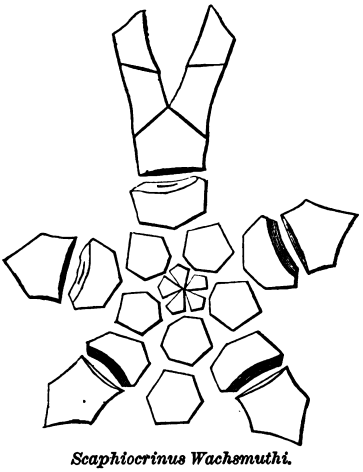
Subgenus SCAPHIOCRINUS, Hall, 1858.

(Geol. Report Iowa, 1, part II, p. 550.)

Scaphiocrinus Wachsmuthi, M. and W.

Pl. 16, fig. 7 *a*, *b*.

Poteriocrinus (*Scaphiocrinus*) *Wachsmuthi*, Meek and Worthen, 1861. Proceed. Acad. Nat. Sci., Philad., p. 141.



Scaphiocrinus Wachsmuthi.
Diagram (enlarged 2 diam.) showing structure to second radials, inclusive, and in one ray the commencement of the arms. The ring showing the size of facet of column was omitted on the basal pieces by the engraver.

Body small, inversely bell-shaped below the summit of the first radial plates, nearly twice as wide as high. Base small, little exposed in a side view, and not projecting much beyond the column, which is rounded and composed of rather thin segments near the body. Subradial plates about as high as wide, somewhat convex, four hexagonal, and one heptagonal. First radial plates from one-third to one-half larger than the subradials, wider than long, truncated above, and pentagonal in general form, the upper side being longer than the others, and the superior lateral angles more or less truncated. Second radial pieces somewhat larger than the first, distinctly constricted around the middle, about as long as wide, or sometimes longer, and pentagonal in outline,

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the superior angle being rather acute. First anal plate larger than the subradials, hexagonal in form, resting upon the truncated upper side of one of the subradial pieces, and projecting nearly half its length above the first radial plates on each side. Arms, after the second division on the second radial pieces, apparently simple, very long, and gradually tapering; each composed of a single series of joints, all of which are longer than wide, somewhat constricted around the middle, and alternately longer and shorter on opposite sides, the upper extremity of the longer side of each projecting out for the reception of the tentacles, so as to give the arms a zigzag appearance. Tentacles strong, and composed of joints twice to three times as long as wide, and very profoundly grooved on the inner side. Surface finely granular. Sutures well defined, with, at the corners of the subradial plates, particularly on the anal side, deep rounded pits.

This species seems to be related to *S. spinobrachiatus*, Hall, but differs in the form of its body, and in having longer arm pieces, which are also without the spines seen on those of that species. It has remarkably long arms, and a very neat bell-shaped body, below the top of the first radials.

Locality and position: Burlington group, of the Lower Carboniferous limestone series, at Burlington, Iowa. Collection of Mr. Wachsmuth.

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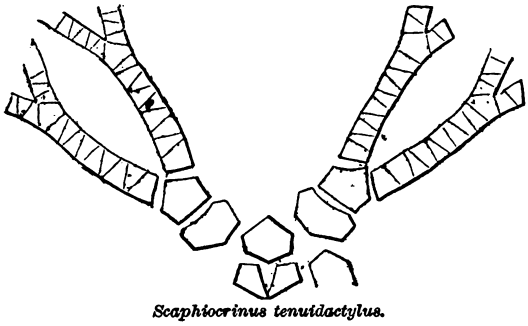
POTERIOCRINUS (SCAPHIOCRINUS) TENUIDACTYLUS, M. and W.

Pl. 18, fig. 10.

Poteriocrinus (*Scaphiocrinus*) *tenuidactylus*, MEEK and WORTHEN, 1865. Proceedings Acad. Nat. Sci., Philad., p. 156.



Scaphiocrinus tenuidactylus.

Diagram (natural size) showing structure of one side of body, and of arms to bifurcations.

BODY, in comparison with the length of the arms, small, inversely campanulate below the summit of the first radial pieces—being narrowly rounded below, and rather expanded above, where the breadth is nearly twice the height. Base less than half as wide as high, basin-shaped, the sides rounding under to the facet for the reception of the column, which is of medium size and a little concave. Basal pieces well developed, pentagonal, and wider than long. Subradial pieces twice or three times as large as the basal; those on the anterior side (the only ones seen) hexagonal. First radials wider, but shorter than the subradials; transversely truncated about three-fourths their entire breadth above, for the reception of the succeeding radial pieces; those on the anterior side curving a little outwards and having an irregular pentagonal outline, the superior lateral angles being more or less truncated, or rounding inwards. Second radials pentagonal, nearly as long as wide, rounded and constricted around the middle, with the central superior angle prominent, and the sloping margins on each side of it supporting the arms.

Anal pieces unknown. Arms long, slender, and in two of the anterior rays known to bifurcate on the tenth piece above the second primary radials, after which they are seen to be

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extended to a considerable length, without showing distinctly another division, though there is some appearance of such bifurcation in one of the branches, on the twentieth piece. Immediately after the division of the rays on the second primary radials, the arms are rounded and composed of wedge-shaped pieces, wider than long, and alternately thicker and thinner on opposite sides, each one supporting at its larger end a stout tentacle. Above the bifurcation, the divisions are very long, slender, somewhat angular on the outer side, and still composed of a single series of wedge-shaped pieces, each one of which is strongly protuberant laterally, for the reception of a tentacle at its larger end, the protuberances alternating on opposite sides, so as to give the arms a zigzag appearance, somewhat like those of *Platycrinus nodobrachiatus*, Hall. Surface apparently smooth, or only finely granular. Sutures not impressed between the plates of the body, but somewhat gaping between the first and second radials.

Height of body to the top of first radials, 0.41 inch; breadth, 0.60 inch. Length of arms to first bifurcation, 0.80 inch; entire length, including arms, more than 3 inches.

This species seems to be related to several of those described by Prof. Hall, from the same locality and position, but on comparison will be found not to agree, in all its characters, with the description of any of them. From his *S. spinobrachiatus* it evidently differs in not having the plates of the body convex, nor the sutures indented at their angles, as well as in the absence of spines on its arms, while its body is less broadly expanded. From *S. Whitei*, Hall, it differs in not having the "surface of the cup marked by deeply impressed pits," at the junction of the sides of the subradials, and between the first radial pieces; and from *S. Halli*, Hall, it differs in not having the arms simple after the first division on the second primary radials, as well as in some of the details of their divisions.

Locality and position: Same as last.

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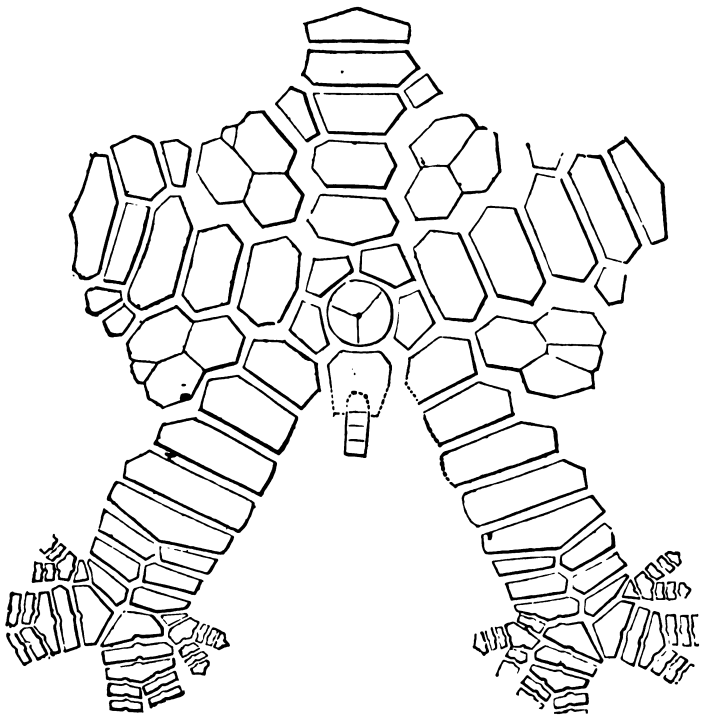
GENUS ONYCHOCRINUS, Lyon and Casseday, 1859.*

(Am. Jour. Sci. (2), xxix, p. 77.)

ONYCHOCRINUS DIVERSUS, M. and W.

Pl. 17, fig. 5 *a*, *b*.

Onychocrinus diversus, MEEK and WORTHEN, July, 1866. Proceed Acad. Nat. Sci., Philad., p. 256.



Onychocrinus diversus.

Diagram (nat. size) showing structure of the body, and of two of the rays out to arms. The free radial plates are represented as if flattened out, which makes them appear wider than natural.

BODY and rays forming together an irregular five-rayed star, the body being comparatively small and depressed, and distorted by the deeper excavation of the anal side; while the rays are large, stout, rigid and free, from the second radial pieces outward, and extend out horizontally on the same plane with the base. Basal pieces hidden by the column, or merely showing as a thin ring, scarcely distinguishable from the last segment

* For remarks on this genus, see vol. II, p. 242, Reports Geol. Survey Illinois.

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of the column, when the latter is attached. Subradial pieces comparatively rather large; four of them equal, wider than long, and all pentagonal, with the upper sloping sides longer than the lateral margins; the fifth one larger (particularly longer) than the others, and apparently hexagonal. Radial pieces five to each ray, thick and strong, and after becoming free on the second pieces, curving strongly up on each side, so as to make the underside of the free rays distinctly rounded; first radial pieces considerably larger than the subradials, of rather unequal size, wider than long, and heptagonal in form, with probably the exception of one or two of those on the anal side, which appear to be truncated on the lower side, so as to be hexagonal in outline. Succeeding radials diminishing gradually in length, the second, third and fourth being wider than long, hexagonal, pentagonal or rarely quadrangular in form, but all transversely oblong, as seen from below; while the fifth is pentagonal, as seen from beneath, having an obtuse middle angle on the outer side. Beyond this the rays are each composed of a double series of strong pieces, which are slightly disposed to assume an alternating arrangement, the two series continuing in close contact laterally to the fourth, then diverging abruptly at an angle of 90° to 100°, to form distinct rounded branches. At the outer bases of these branches an arm is given off on each side on the third piece from the commencement of the double series, and bifurcates so as to form a bunch of small armlets; beyond this the two main divisions of the rays continue on, each composed of a single range of pieces, until the third piece beyond the lateral arms just mentioned, after which they are each composed again of a double series of pieces, on the third of which another arm is thrown off on each side, and bifurcates as before. After this each main branch bifurcates without much divergence of the subdivisions, which are short and divided, so as to form together a bunch of small bifurcating arms, thus making altogether apparently not less than several hundred rounded armlets, or ultimate division of the rays, to the entire series.

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The rounded armlets are all short, and form clusters at the extremities of the divisions of the horizontally extended strong rays, where they curve upwards, and fold together in bunches like the fingers of a clenched fist. They are each composed of a single series of small pieces, which are wider than long, with a minute patelliform piece at the under side of each, as in *Forbesiocrinus*.

Interradials three or four to each space, with others above belonging apparently more properly to the vault; first interradial pieces hexagonal and resting in a notch between the upper sloping lateral margins of the subradials. Anal series, as far as known, consisting of a single free row of very small pieces resting upon the upper side of the largest subradial, so as to present much the appearance of an abortive armlet. Surface merely finely granular, with the exception of a small linear ridge along the middle of each armlet.

Height of body, exclusive of vault, 0.80 inch; antero-posterior diameter, 0.90 inch; transverse diameter, 1.40 inches; greatest transverse diameter between the extremities of opposite rays, 4 inches; length of each of the two main divisions of each ray, 0.85 inch. Column, at its connection with base, 0.28 inch in diameter, and composed of pieces only 0.01 inch in thickness, or ten to the tenth of an inch.

We have not seen any specimen of this species showing the vault, but we are inclined to believe it extended out over the free rays to the point where their divisions diverge, if not further, as in *Steganocrinus*.

In the second volume of Illinois Geol. Reports, we stated that we had never seen a specimen of this genus showing how the little arm-like range of anal pieces connected with the vault and the radials on each side. Since that time we have seen a fine specimen of Lyon and Casseday's typical species, showing this space to be occupied by numerous very minute pieces.

This species is related to *Onychocrinus asteriformis*=(*Forbesiocrinus asteriæformis*, Hall), but differs in attaining a much larger size, as well as in having the two main divisions of each ray widely divergent and proportionally longer, instead of nearly parallel. Again, it differs in having the subdivisions and armlets much more numerous; also in having always five primary radial pieces to each ray.

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If reliable characters should hereafter be discovered for separating generically *Taxocrinus* from *Forbesiocrinus*, it may be found necessary to range *Onychocrinus* as a subgenus under the latter, in which case the name of the species here described would become *Forbesiocrinus* (*Onychocrinus*) *diversus*.

Locality and position: Same as last.

GENUS TAXOCRINUS, Phillips, 1843.*

(Morris' Cat. Brit. Foss., p. 90.)

SUBGENUS FORBESIOCRINUS, de Kon. and Le Hon, 1854.

(Rech. Crin. Carb. Belg., p. 118.)

FORBESIOCRINUS AGASSIZI, var. GIGANTEUS.

Pl. 18, fig. 3.

?Forbesiocrinus Agassizi, HALL, 1858. Iowa Report, vol. I, part II, p. 630 (without description); Supplement to same (1865), p. 65.

Forbesiocrinus Agassizi, var. *giganteus*, MEEK and WORTHEN, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 131.

THIS large crinoid differs from the typical example of *F. Agassizi*, Hall, in having four, instead of three plates in each of the secondary radial series, while there are some differences in the number and arrangement of the anal and interradial plates. It also differs in having its column almost exactly cylindrical for a distance of at least four inches below the base, while that of *F. Agassizi* is described as "rapidly tapering below the summit." We suspect it may be distinct from the species described by Prof. Hall, but as it seems to agree with his description and diagram in most of its characters, excepting the points of difference we have mentioned, we have merely placed it as a variety of that species, until its relations to *F. Agassizi* can be determined from a comparison of specimens. Should it be found to be specifically distinct, it can take the name *F. giganteus*, or rather *Taxocrinus* (*Forbesiocrinus*) *giganteus*, for we believe these groups so intimately blended together by intermediate types, that they can only be separated as subgenera.

It is perhaps the largest species of this type known, and must have had a very large number of ultimate divisions of its free arms, which are proportionally short.

Locality and position: Same as last.

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* For a description of this genus see vol. II, p. 268, Reports Geol. Survey Illinois.

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GENUS GRANATOCRINUS (Troost), Hall, 1852.*

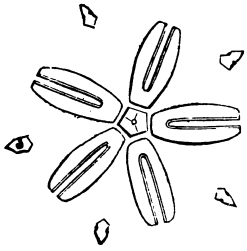
(List Crin., Proc. Am. Assoc. Cambr. meeting, p. 62, 1850.)

GRANATOCRINUS PROJECTUS, M. and W. (sp.)

Pl. 18, fig. 7.

Pentremites melo, var. *projectus*, MEEK and WORTHEN, 1861. Proceedings Acad. Nat. Sci., Philad., p. 142.

Granatocrinus melo, var. *projectus*, SHUMARD, 1866. Trans. St. Louis Acad. Sci., vol. II, p. 375.



Granatocrinus projectus. Diagram showing structure. (Natural size.)

THIS form is very much like *G. melo*, Shumard = (*Pentremites melo*, Owen and Shumard), but differs in having its base proportionally a little larger, and projecting so as to be distinctly seen in a side view, instead of being concave. Its pseud-ambulacral areas are also not continued down quite so near the base of the radial or fork-pieces, as in *G. melo;* while its small anal piece is more prominent. In first noticing it, we supposed it to be merely a marked variety of *G. melo*, but subsequent examinations of a large number of specimens of that species, in various conditions, have led us to the conclusion that it is a distinct species.

The figure given on plate 18 represents the typical specimen, enlarged to twice the natural diameter.

Locality and position: Same as last.

GRANATOCRINUS NORWOODI, O. and S? (sp.)

Pl. 18, fig. 8.

Pentremites Norwoodi, OWEN and SHUMARD, 1860. Jour. Acad. Nat. Sci., Philad., 2d ser., vol. II, p. 64, pl. 7, fig. 13; Geol. Report Iowa, Wisconsin and Minnesota, p. 591, pl. 5 A, fig. 13.

Elæacrinus Norwoodi, SHUMARD, 1865. Trans. St. Louis Acad., vol. II, p. 112.

Granatocrinus Norwoodi, SHUMARD, 1866. Ib., p. 375.

THE fossil we have figured under the above name belongs to Mr. Wachsmuth, of Burlington, Iowa, who found it in the Burlington group of the Lower Carboniferous series, at that place. So far as we know, it is the only example of any species of the *Granatocrinus* group, yet found, with the numerous little thread-

* Troost published the name *Granatocrinus*, for this group, in 1850, in a catalogue without a description. In 1862, Prof. Hall adopted it, and gave some remarks on its affinities in the Fifteenth Ann. Report Regents Univ. N. Y., p. 146. For farther remarks on this genus, see vol. II, p. 274, Reports Geol. Survey Illinois.

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like arms attached. As might have been expected, from the affinities of this type to *Pentremites*, these arms are in all respects similar to those of that genus. About thirty of them can be counted arising from each pseud-ambulacral area, though this is probably not the whole number, as they are folded together so that many of them are doubtless hidden from view. They are very slender, simple, of uniform size, without any perceptible taper, and composed each of a single row of pieces as long as wide, of which about seven may be counted in the space of 0.10 inch. We are not sure that any of them are entire, though it is evident that those attached near the lower part of the areas must be twice as long as the body. The column is round near the base, and composed of thin pieces of equal size; but further down, they are alternately smaller and larger, at regular intervals.

The body of the specimen is partly hidden by the arms, but as far as can be determined, it seems to agree so nearly with *G. Norwoodi*, that we have referred it provisionally to that species. At the same time, we can see that it presents some differences, which have led us to suspect that it may possibly be specifically distinct. In the first place, the parts of its radial pieces, forming the interambulacral spaces, are not more than half as wide as in specimens of *G. Norwoodi*, of the same size. These surfaces also slope inwards laterally, so as to form a rather deep groove along the suture between each two radial pieces, instead of forming a flat area across between the pseud-ambulacra, as in *G. Norwoodi*. Again, its pseud-ambulacral areas are proportionally nearly twice as wide as in *G. Norwoodi*, while the portions of the surface exposed are more coarsely granulated than is usual in that species, and the granules are somewhat differently arranged. We have elsewhere proposed, that in case it should be found distinct from *G. Norwoodi*, as we suspect it will be, to designate it as *G. fimbriatus*.

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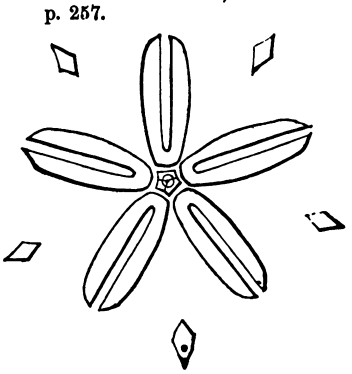
GRANATOCRINUS SHUMARDI, M. and W.

Pl. 18, fig. 6 *a?*, *b*.*

Granatocrinus Shumardi, MEEK and WORTHEN, 1866. Proceed. Acad. Nat. Sci., Philad., p. 257.



Granatocrinus Shumardi.
Diagram (nat. size) showing structure.

BODY elliptic-oval, the length and breadth being as about 67 to 44. Base having the form of a nearly flat pentagonal disc, with moderately prominent angles; facet for the attachment of the column round, and a little more than half as wide as the base. Radial pieces narrow subelliptic, or nearly three times as long as wide, most projecting and slightly narrower at the lower extremity, and nearly flat between the pseud-ambulacral areas, along the margins of which they project abruptly in the form of a prominent sharp carina; equaling five-sixths the entire length of the body, and each obliquely truncated on each side above, for the reception of the interradials. Pseud-ambulacral fields very narrow, extending very nearly the entire length of the body, with almost exactly parallel sides; rather convex, and each with a moderately distinct longitudinal mesial linear furrow, on each side of which about 65 pore pieces may be counted; lanceolate and supplementary pore pieces unknown. Interradial pieces about one-fourth the entire length of the body, rhombic in outline, or widest in the middle, and tapering nearly equally to the upper and lower extremities; all rather distinctly sloping inwards from the lateral angles to the middle, so as to present a notched appearance on their outer surfaces. (Openings of the summit unknown.)

Surface showing, by the aid of a good magnifier, in a cross light, microscopic longitudinal lines, near the lower end of the

* We are in some doubt whether the figure 6 *a*, here referred to, is a view of the under side of this species, or of *G. projectus*, not having access to the specimens at the time these descriptions are passing through the press.

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radial pieces, and on the interradials, much stronger lines parallel to their inferior sloping sides.

Length, 0.67 inch; breadth, 0.44 inch.

At a first glance this species might be mistaken for the common *G. melo*, of Owen and Shumard, from which it may be readily distinguished by several well marked characters. In the first place, it is narrower in proportion to length, and differs in having its pseud-ambulacral areas prominent instead of sunken, and bounded on either side by a sharply elevated carina; while its interambulacral areas are flat, or even a little concave, towards the lower part of the body, instead of being convex. It likewise differs in having scarcely a visible line, instead of a deep furrow along the sutures between the radial pieces; while its base is much larger, and not sunken, but on a level with the lower ends of the radial pieces, which are likewise more protuberant at their lower ends.

In its larger and more prominent base, this species agrees more nearly with *G. projectus*, from which, however, it differs in all the other peculiarities mentioned. Compared with the species *P. elongatus*, of Shumard, which it resembles in general form, it will be at once distinguished by its greatly narrower and more prominent pseud-ambulacral areas, larger radial pieces, and proportionally larger interradials, which extend up to near the center of the summit. These two forms may be regarded as the connecting links between the true *Pentremites* and the *Granatocrinus* group. *P. elongatus*, however, falls clearly into the former, while the form under consideration belongs to the latter genus.

The specific name of this fine species was given in honor of Dr. B. F. Shumard, of St. Louis, Missouri, who has given more attention to the *Blastoidea* than any other person in this country.

Locality and position: Burlington group of the Lower Carboniferous series, at Burlington, Iowa. Mr. Wachsmuth's collection.

ASTEROIDEA.

GENUS SCHŒNASTER, M. and W., 1860.*

SCHŒNASTER WACHSMUTHI, M. and W.

Pl. 17, fig. 4.

Schœnaster Wachsmuthi, MEEK and WORTHEN, July, 1866. Proceedings Acad. Nat. Sci., Philad., p. 259.

BODY flattened or much depressed, with a regular, distinctly pentagonal outline, the angles being produced into five rather

* For a description of this genus, see p. 277, vol. II, Reports Geol. Survey Illinois.

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attenuated rays, which are a little convex above, and apparently as much as two-thirds as long as the diameter of the disc, if not more. Disc concave in outline on the margin between the rays, and imparting a slightly alate character to the latter by extending a little along their margins; like the dorsal side of the rays, composed above of numerous small, slightly convex plates. Dorsal pores moderately distinct between the plates. Plates of the under side of the disc about as large as those of the dorsal side, but flattened, scale-like, crowded, and having the inward imbricating character of the genus strongly marked. Ambulacra (as seen in a compressed specimen) very narrow, their marginal plates moderately large, oval-oblong, comparatively thin, and very strongly imbricating outwards. Between these, two rows of short, flattened, spine-like scales are seen arising from the ambulacral furrow, and all inclining outwards or towards the extremities of the rays. (Other characters unknown.)

Diameter of disc, 1.32 inches; rays apparently extending as much as 0.90 inch or more beyond the margins of the disc.

This species will be readily distinguished from our *S. fimbriatus*, of the St. Louis limestone, the only other species of the genus known to us, by its smaller and less convex plates on the dorsal side, as well as by its much thinner, less oblique and more strongly imbricating row of plates along each side of the ambulacra, and particularly by its much narrower ambulacral furrows. We have not seen any traces of the row of short flattened marginal spines seen around the disc of *S. fimbriatus*, in the form under consideration; nor have the similar little appendages arising in a double row from the ambulacra of the latter been seen in *S. fimbriatus*. These, however, may be rather generic than specific characters, and consequently be found common to both species.

The specific name is given in honor of Mr. Charles Wachsmuth, of Burlington, Iowa, the discoverer of the only specimen we have seen.

Locality and position: Same as last.

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MOLLUSCA.

POLYZOA.

GENUS EVACTINOPORA, M. and W., 1865.

(Proceed. Acad. Nat. Sci., Philad., p. 165.)

POLYZOUM free? consisting of a few large, more or less thickened, and solid calcareous plates or laminæ, radiating from an imaginary vertical axis, so as to present, in a transverse section, a star-shaped or cruciform outline. Rays thickest and most dense on the under and outer edges, thinner and penetrated on each side by the pores within; each apparently divided along the middle by a thin lamina, separating the inner ends of the pores of the opposite sides; substance showing, in transverse sections, a more or less laminated structure, the laminæ being arranged parallel to the planes of the rays. Pores small, regularly arranged in quincunx, and separated by spaces equaling or exceeding their own breadth.

Type *E. radiata*, M. and W.

Since first proposing this genus, we have been led to suspect that it may possibly not be distinct from *Conodyctium*, of Munster; but as we have no good description or specimens of that genus at hand for comparison, and it is generally believed not to date back beyond the Jurassic period, in Europe, we have concluded to retain our name, provisionally, until the relations of our type to *Conodyctium* can be settled by a comparison of specimens. The fact, however, that the rounded end in our typical species (turned upwards on the plate) has the edges of all the rays thick and solid, while they become very thin as far as they can be traced towards the other extremity, certainly indicates that this rounded, thickened extremity is the inferior part of the fossil, as it is very improbable that it would have rested upon the thin edges of the rays, whether free or attached. Hence it would seem to have differed, in this respect, from *Conodyctium*, in which the larger rounded end is the upper extremity, while below it apparently tapers to a narrow base of attachment.

The three species we have here described are, so far as we have been able to ascertain, the only known examples of the genus (unless it is not distinct from *Condyctium*), and two of these, at least, came from the Burlington division of the Carboniferous limestone series, while the other is from the Lower Carboniferous, and, as we have reason to believe, from the same beds.

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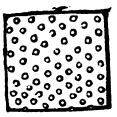
EVACTINOPORA RADIATA, M. and W.

Pl. 17, fig. 2 *a*, *b*.

Evactinopora radiata, MEEK and WORTHEN, August, 1865. Proceedings Acad. Nat. Sci., Philad., p. 165.



Evactinopora radiata. Pores enlarg'd about 2 diam.

POLYZOUM oval or subglobose, rounded below; rays eight, moderately thick, solid, and subcarinate on their free edges and much thinner within; pores of moderate size, round, occupying only the thin portions of the rays; regularly disposed, and separated by spaces equaling their own breadth, sometimes with margins apparently slightly raised.

Greatest transverse diameter across from the extremities of opposite rays, 0.90 inch; diameter of the nucleus formed by the union of the rays, 0.35 inch; thickness of the rays on the outer margin near the nucleus, 0.10 inch; do. of the thin poriferous portion, 0.03 inches; diameter of the pores, 0.02 inch.

This is the typical and smallest known species of the group, and also has the largest number of rays. We have not seen any specimen of it entirely free from the matrix, and consequently do not know the exact form of the whole fossil. It is probable, however, that the thin poriferous portions of the rays were produced so as to give the whole an oval form.

Our figure 2*b* was inadvertently drawn with the rounded part, which we believe to be the lower side, turned upwards.

Locality and position: The only specimen of this species we have seen is from the Lower Carboniferous limestone series of Missouri, but its exact locality and position is unknown.

EVACTINOPORA SEXRADIATA, M. and W.

Pl. 17, fig. 3.

THIS species we only know from a transverse section of a specimen embedded in the matrix. It will be readily distinguished, however, from the last, by having only six, instead of eight rays. Its rays are also proportionally longer and narrower, and differ in being abruptly thinner at their connection with the nucleus, as well as at their outer edges.

It is possible the number of rays may be a variable character, but with our present means of comparison, we can but regard this as a distinct species from the last.

Locality and position: Same as last.

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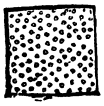
EVACTINOPORA GRANDIS, M. and W.

Pl. 15, fig. 2 *a*, *b*.



Evactinopora grandis. Pores enlarged about two diameters.

ATTAINING a very large size; but moderately convex below. Rays four, very long, and extending out at right angles so that as seen in a transverse section they present the form of a cross; moderately thick and rounded or subangular on the under edge, decreasing in thickness gradually upwards, and from their outer margins inwards, sometimes flexuous below; entire height unknown. Pores small, round, and regularly arranged in quincunx, at intervals of about twice their own breadth apart; extending inwards a little obliquely, from each lateral surface of the rays.

Figures 2 *a* and 2 *b* merely represent transverse sections of this fossil, as seen broken across, in the matrix. On the other side of the specimen represented by figure 2 *a*, however, the under side of the fossil is seen, showing the lower edges of the rays to be about 0.27 inch in thickness, rounded or obtusely angular, and rather strongly and irregularly flexuous. The height from the base to where the specimen is broken across, so as to show the section figured, is 1.30 inches, but it is probable that the entire height was much greater than this. Weathered transverse sections show some evidences of a mesial lamina along the middle of each ray between the inner ends of the pores of the two opposite sides. There are also some indications of an imperfect laminated structure in the whole of the solid substance of the rays penetrated by the pores, the laminæ being arranged parallel to the sides of the rays; and on following them in to where the four rays meet, they do not cross or end there, but those belonging to any one side of one of the rays curve out, and may be traced into the nearest side of the next ray.

This is evidently by far the largest species of this group known, and also differs from the others in having but four rays. As we have not met with an entire specimen, we have no certain means of knowing its full size, but one ray of one of those figured can be traced out to a length of 3.25 inches, at which point it is broken off. The entire transverse diameter was probably not less than seven inches. There are no traces of a scar of attachment below.

Locality and position: Burlington group of the Lower Carboniferous series, at Burlington, Iowa.

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Genus FENESTELLA, Lonsdale, 1839.

(Murchison's Silurian Syst.)

Subgenus LYROPORA, Hall, 1856.

(Proceed. Am. Assoc., Albany, p. 179.)

Fenestella (Lyropora) retrorsa, M. and W.

Pl. 15, fig. 1.

Of this species we only know the solid marginal support from which the expanded, reticulate portion has been entirely removed. The two divisions of the lateral support diverge at an angle of ninety degrees, and are comparatively straight and slender. As in other species of this group, they have their inner edges oblique, and not parallel to the plane of the fossil, while the minute, attenuated base of attachment is deflected towards the same side as the inner edges of the lateral marginal supports.

As we know nothing of the nature of the foliated expansion, that extended across like a net-work, between the diverging solid portions of this species, not much can be said in regard to its relations to the few described species of the group. It seems to be most nearly similar to *F. (Lyropora) subquadrans*, of Hall, from the Chester Limestone, but differs in having the little point of attachment deflected in the opposite direction, and the two lateral branches more widely diverging.

In regard to the importance of the characters distinguishing the genus, or subgenus, *Lyropora*, from *Fenestella* and *Polypora*, there is room for some difference of opinion. It would certainly seem that a peculiarity in the mode of growth, imparting so striking a difference to the general appearance of the whole fossil, as that distinguishing these forms, ought to be regarded as being at least of subgeneric importance. Yet when we examine the delicate net-work extending across between the solid divisions of the support in *Lyropora*, we find it presents in structure, and the arrangement of the animal cells, in some species, exactly the characters of *Fenestella*, and in others those of *Polypora*, as is the case in *Archimedes*, so that if we admit *Archimedes* and *Lyropora* to be good genera, we must include in each, species that present, in all excepting the mode of growth, the characters of both *Fenestella* and *Polypora*. On the other hand, if we admit the latter two types as being generically distinct, we must, on the same characters, divide *Lyropora* and *Archimedes* each into two distinct genera.

Locality and position: Same as last.

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BRACHIOPODA.

GENUS CHONETES, Fischer, 1837.

(Oryct. Mosc.)

CHONETES ILLINOISENSIS, Worthen.

Pl. 15, fig. 8 *a*, *b*.

Chonetes Illinoisensis, WORTHEN, 1860. Trans. St. Louis Acad. Sci., vol. I, p. 571.
Chonetes Logani, HALL, 1858. Iowa Geological Report, vol. I, part II, p. 598, pl. 12, fig. 1 *a–e*, and 2; not *C. Logani*, NORWOOD and PRATTEN (1854), Journal Acad. Nat. Sci., Philad , vol. III, p. 30, pl. II, fig. 12 *a*, *b*, *c*.

SHELL attaining a moderate size, transversely semioval, rather compressed; length generally a little more than two-thirds the breadth; lateral margins somewhat straightened behind, and usually intersecting the hinge nearly at right angles, but rounding to the front, which forms a broad semielliptic curve; hinge nearly or quite equaling the greatest breadth. Ventral valve most convex in the central and umbonal regions, and without a mesial sinus in front; ears somewhat compressed; area narrow; cardinal margin with five or six oblique spines on each side of the beak. Dorsal valve with concavity decidedly less than convexity of the other valve. Surface ornamented with numerous fine, closely arranged, round, dichotomous striæ, of which from one hundred to one hundred and twenty or more may be counted around the free margin of each valve.

Length of a medium sized individual, 0.47 inch; breadth of do., 0.65 inch; convexity of same, 0.13 inch; number of striæ in the space of 0.10 inch, at the free margin, twelve to fourteen.

By some oversight, Prof. Hall referred this shell, in the Iowa Report, to *C. Logani*, of Norwood and Pratten, from which it differs greatly in the fineness and much larger number of its striæ—*C. Logani* having only about thirty striæ to each valve, while in the shell under consideration there are from three to four times that number. It is much more nearly allied to *C. Shumardiana*, de Koninck, with which we are unable to compare it, not having any authentic specimens, nor any figure or description of that species at hand. Prof. Hall states that it differs from *C. Shumardiana* in being more coarsely striated, and in not having the fine granulations so characteristic of that shell.

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The shading of our enlarged profile figure 8*b*, makes the shell look proportionally too convex.

Locality and position: Jersey county, Illinois; Burlington division of the Lower Carboniferous limestone series. Also, at same horizon at Burlington, Iowa; and in the Kinderhook group at Wassonville, Iowa.

GASTEROPODA.

Genus METOPTOMA, Phillips, 1836.

(Geol. Yorks., ii, p. 223.)

From Phillips' figures, and very brief description of the genus *Metoptoma*,* it is evident he intended to include in it only those patelliform palæozoic shells with the posterior side more or less truncated. Mr. Billings, however, and some others, extend it so as to include circular or oval species, showing no traces of the posterior truncation, such as were referred by Phillips and others to *Patella*. Although it seems probable that the typical truncated forms and the oval or circular species without the posterior truncation, represent two distinct genera, it is perhaps practically impossible, in our present state of knowledge, to separate these groups, owing to the fact that there are so many intermediate forms; while it is very rarely, indeed, that we can have an opportunity too see the internal characters of these shells.

Phillips says nothing respecting the muscular impressions of his typical species, but his figure of his *M. oblonga*, which seems to represent an internal cast, shows apparently a horse-shoe shaped scar, like that seen in *Capulus*, *Hipponyx*, and the allied genera. Prof. de Koninck has also shown (Supp. to An. Foss. Belg., pl. LVIII, fig. 1 and 2) this scar very clearly in *M. pileus*, of Phillips, and *M. solaris*=(*Patella solaris*, de Kon.) From these figures it is evident, as observed by Prof. de Koninck, that the open end of the horse-shoe shaped scar is directed away from the truncated end of the shell, showing that the truncated margin is the posterior, instead of the anterior, as had been supposed by Phillips.

Metoptoma? umbella, M. and W.

Pl. 15, fig. 6 *a*, *b*, *c*; and 7.

Metoptoma (*Platyceras?*) *umbella*, Meek and Worthen, 1866. Proceedings Acad. Nat. Sci., Philad., p. 267.

Shell much depressed, patelliform, circular; apex central, or very nearly so; sides sloping about equally, with generally

* "Patelliform, face under the apex truncated."

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a slight concavity, in all directions; surface marked by fine lines and obscure wrinkles of growth. Muscular scar on each side, elongate-oval, and somewhat arched downwards, with a narrower band connecting them behind; aperture very large and nearly circular.

Length and breadth each about 1.70 inches; height, about 0.70 inch.

Although not a very uncommon shell, we have never seen a specimen of this species with the apex entire, though in some of the casts there is an appearance of its having been somewhat abruptly attenuated, and possibly curved. Hence we are not quite sure that it may not be more properly a greatly expanded *Platyceras*, since we now know that genus has similar muscular scars. It is much more depressed and expanded, however, than any species certainly known to belong to that genus, with which we are acquainted. In general, the specimens are regularly circular, or very slightly oval, and they are always without any traces of the peculiar truncation of the typical forms of *Metoptoma*, though some of them seem to show obscure indications of it in the slightly less prominent outline of the margin on one side.

One of the specimens (represented by figures 6 *a*, *b*, which is somewhat weathered), apparently agreeing with the others in other respects, shows some appearances of small, irregular, interrupted radiating costæ, especially on one side, apparently the anterior. This may possibly be specifically distinct from the others, but we cannot be sure of this without more specimens for comparison, since the typical specimens are mostly casts.

Prof. Winchell has described, from the Kinderhook beds at Burlington, Iowa, a somewhat similar species, under the name *Metoptoma undata* (see Proceed. Acad. Nat. Sci., Philad., July, 1865, p. 131), but, judging from his measurements, it must be distinctly less depressed than our shell, and differs in being "contracted at the aperture."

Locality and position: Burlington division of the Lower Carboniferous Limestone series, at Quincy, Illinois; also at same horizon on Honey creek, Henderson county, Illinois.

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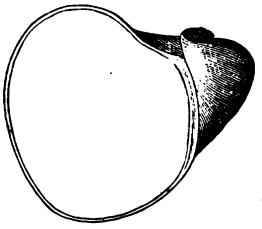
GENUS PLATYCERAS, Conrad, 1840. (See p. 384.)

(Ann. Report Palæont. N. Y., p. 205.)

PLATYCERAS [?] REVERSUM, Hall.

Pl. 15, fig. 4 *a*, *b*, and annexed cut.

Platyceras reversum, HALL, 1860. Appendix to Supplement of Iowa Report, volume I, part ii, p. 3.



Platyceras? reversum.
Cut showing the aperture, columella and spire.

SHELL transversely subovate, ventricose; volutions about one and a-half, increasing very rapidly in size from the apex; spire small, sinistral, depressed below the upper side of the body of the shell, and flattened and carinate near the apex, and closely incorporated with the inner lip, so as to form a kind of rudimentary columella; body volution very large; aperture large and subcircular. Surface with rather obscure striæ and faint undulations of growth.

Greatest transverse diameter, 1.30 inches; height (which is also the height of the aperture), 1.10 inches; breadth of aperture, 0.95 inch.

As remarked by Prof. Hall, this shell departs from the typical forms of *Platyceras*, in having some appearances of a columella, as well as in having its spire decidedly sinistral. In addition to this, the upper side of the spire, near the apex, is remarkably flattened, and distinctly carinated at the outer edge of the flattened space. On one specimen, this carina or ridge is continued spirally from the apex to near the middle of the body of the shell, gradually becoming more obtuse and less marked as it recedes from the point of the spire. In examining the flattened apex of these shells, the inquiry naturally suggests itself whether they may not have commenced their growth attached by this part of the shell to marine bodies? If so, their habits must have been entirely different from those of *Platyceras*.

On clearing away the matrix from the inner lip, since figure 4 *b* (which does not represent this part of the shell correctly) was drawn, we find there is an obscure, but unmistakable columella. It is not broad and twisted as in *Strophostylus*, but narrow, and furrowed along its entire length, as if for the support of an operculum. The whole aspect of the shell is exceedingly like that of some of the small spiral forms of *Exogyra*, in which the cardinal area is very

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narrow and very oblique, though we have no doubt in regard to these shells belonging to the *Gasteropoda.*

If the peculiarities mentioned should be regarded as of generic importance, we would suggest for this type the name *Exogyroceras*, from its resemblance to *Exogyra.* It is also possible that the species *P. biserialis*, which appears to be sinistral, will be found to present essentially the same characters, although it differs in the possession of spines.

In our figure 4 *a*, the spire is made to appear as if disconnected from the body of the shell, which is not the case, however, in the specimen.

Locality and position: Burlington group of the Lower Carboniferous limestone series, at Boonville, Missouri.

PLATYCERAS BISERIALIS, Hall.

Pl. 15, fig. 3 *a*, *b*.

Platyceras biserialis, HALL, 1860, Contributions to the Palæontology of Iowa, p. 90.

SHELL obliquely subovate, expanding rapidly from the apex; spire small, apparently not making more than one volution, and coiled nearly on a plane, though its apex, which is not well exposed to view in the specimen, has the appearance of being sinistral; aperture subcircular or broad-oval; lip somewhat irregular, deeply sinuous on the dorsal side. Body portion armed on each side by about four to six long tubular spines, arranged in rows, and directed outward nearly at right angles to the surface. Surface marked by fine striæ of growth, strongly undulated near the aperture, parallel to the irregularities of the lip.

This is, so far as we are aware at this time, the only shell resembling *Platyceras*, yet found in our Carboniferous rocks, that is provided with spines. It seems to differ from the Devonian spiniferous species, in having the spines very regularly arranged in a row on each side of the body part of the shell, instead of being irregularly scattered over the whole surface.

Locality and position: Burlington group of the Lower Carboniferous limestone series, at Quincy, Illinois.

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PLATYCERAS [ORTHONYCHIA] QUINCYENSE, McChesney.

Pl. 15, fig. 5 *a*, *b*.

Platyceras Quincyensis, McCHESNEY, 1861. Descriptions of New Palæozoic Fossils, p. 90; 1865, Illustrations of same, pl. vi, fig. 6 *a*, *b*.

Platyceras Quincyense, McCHESNEY, 1867. Transactions Chicago Acad. Sci., vol. I, p. 49, pl. vi, fig. 6.

SHELL obliquely conical, narrowing regularly from the aperture, apparently entirely straight; sides with five broad ridges radiating from the apex to the aperture; ridges regularly disposed, and each flattened or slightly concave along its middle, and separated from those on each side by rather deep, rounded furrows. Surface markings unknown. Aperture with a general subcircular form, but showing a tendency to a pentahedral outline.

As this species has only been found in the condition of internal casts, with the apex broken away, we have no means of determining the nature of its surface markings, or whether its immediate apex was straight or curved. From the general appearance of such casts as have been found, however, the shell seems to be straight throughout all its length. Its most marked character is the presence of five strong, more or less furrowed ridges, extending its whole length.

Locality and position: Same as last.

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FOSSILS OF THE KEOKUK GROUP.

RADIATA.

ECHINODERMATA.

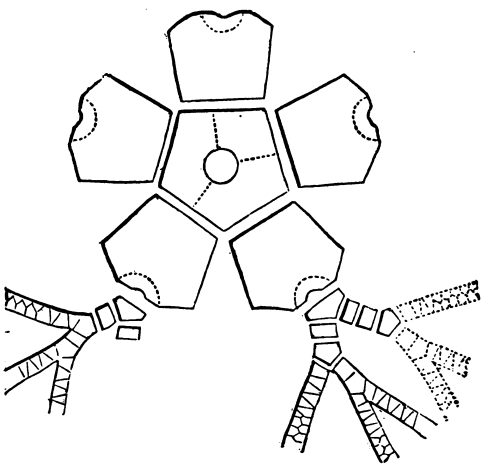
GENUS PLATYCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

PLATYCRINUS HEMISPHÆRICUS, M. and W.

Pl. 20, fig. 2 *a*, *b*.

Platycrinus hemisphæricus, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 162.



Platycrinus hemisphæricus.
Diagram showing structure out to the second divisions of the arms of two rays.

BODY rather above medium size, hemispherical, being rounded below, and about twice as wide as high; base broad; basin-shaped, and forming about one-third the entire height of the

* For a description of this genus see p. 170, vol. II, Reports Geol. Survey Illinois.

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cup, with a pentagonal outline, as seen from below; facet for the attachment of the column, between one-third and one-fourth the diameter of the base, and subelliptical in outline. First radial pieces larger than the basal, wider than high, nearly quadrangular, and widening moderately from below upwards; facet for the reception of the second radial, one-third as wide as the summit, and extending down nearly one-fourth the length of the plates; concave and sloping outwards, with a deep notch within. Second radial pieces very small, but filling the cavity in each of the first radials, from which they extend out nearly horizontally; pentagonal in outline, and each supporting on its superior lateral sloping margins the first divisions of the arms, which are comparatively small and bifurcate again on the second piece; beyond this the two outer divisions remain simple, but the two inner divide again on the second piece, making six arms to each ray, or thirty to the entire series. Arms, after the last divisions, long, slender, cylindrical, and composed at first of a simple series of quadrangular pieces, but passing gradually upwards into interlocking triangular pieces, and still farther up forming a double series of small, alternating, cuneiform pieces, supporting closely arranged, long-jointed tentacles. Anal, interradial and vault pieces unknown. Sutures, excepting between the basal pieces, distinctly, but not widely or deeply channeled.

Surface ornamented with rather small, but well defined, prominent nodes. On the base, these nodes are arranged in ten rows, five of which radiate from the facet for the reception of the column, one to each of the corners, while those between each of these form intermediate radiating rows, consisting at first of a single range, but becoming a double or triple range near the margin, when the three sometimes coalesce laterally. On the first radial pieces two rows pass from just beneath the facet for the reception of the second radials to each of the inferior lateral angles, while between these there is, at first, a single node, but farther down two or three rows, consisting of

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nodes which show a disposition to become elongated, or coalesce laterally, so as to form little transverse ridges. Above, there is also a row extending horizontally to each superior lateral angle, with a few less regularly arranged nodes on the sides below these. A single transversely elongated node sometimes also occurs on the little radials, and one less distinctly defined also sometimes on each of the pieces between this and the next bifurcation.

Breadth of body at summit of first radial pieces, 1.07 inches; height of do., 0.60 inch; breadth of base, 0.67 inch; breadth of second radial pieces at the summit, 0.54 inch; do. of second radials, 0.19 inch.

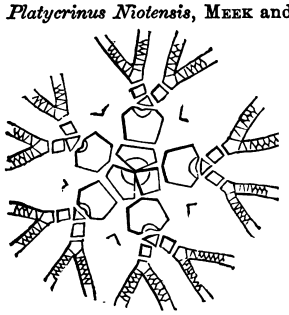
From the description and figures, it will be seen this species is rather closely related to *P. granulatus* of Miller, which it nearly resembles in form and general appearance. It is a larger and more robust species, however, and differs not only in the arrangement of the pustules on the base into distinct radiating rows, but according to Austin's figures and description (Monogr. Recent and Foss. Crinoid., p. 33, pl. iii, fig. 2), in having but six instead of seven arms to each ray as well as in having the arms above the middle composed of a double series of small wedge-shaped pieces, instead of consisting of a single series throughout. From its analogy to *P. granulatus*, of Miller, it will probably be found to possess, like that species, a long subcentral proboscis.

Locality and position: Crawfordsville, Indiana. Keokuk division of the Lower Carboniferous series.

PLATYCRINUS NIOTENSIS, M. and W.

Pl. 20, fig. 3.

Platycrinus Niotensis, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 162.



Platycrinus Niotensis.
Diagram showing structure out to the bifurcations of the arms.

BODY, below the summit of the first radial pieces, cup-shaped, wider than high; sides slightly ventricose above the base. Base, basin-shaped, several times as wide as high, moderately expanding, rather broadly truncated below, its lower margins projecting slightly downwards around the end of the column, and provided with three very small projections,

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one at the lower extremity of each of its sutures. First radial plates large, higher than wide, widening slightly from below upwards, subquadrangular and subpentagonal, with the superior lateral angles a little truncated by the interradial pieces; each with a concave facet for the reception of the second radials, equaling about half to one-third its breadth above, and excavated nearly one-fourth its length on the outer side, below the upper margin. Second radial pieces trigonal, very small, or scarcely more than filling the facet or excavation in the upper side of the first radials; rounded below, with each superior sloping side supporting secondary radials, on the second of which another bifurcation takes place, making four arms to each ray.

Arms, after the second division described above, simple, and at first composed each of a single series of wedge-shaped plates, but soon passing into a double series of small interlocking pieces, supporting on each side of the arms closely arranged series of long-jointed tentacles.

Column, near the base, compressed and tortuous, being composed of alternately thicker and thiner elliptic pieces, with a very minute central perforation.

Surface somewhat granular; sutures not grooved, nor distinctly apparent; those between the basal pieces indicated by a faint linear ridge.

Height, to summit of first radials, 0.30 inch; breadth, about 0.40. Greater diameter of column at base of body, 0.12 inch; smaller do., 0.09 inch. Breadth of one of the arms, 0.06 inch; length of do., apparently an inch or more.

In its general appearance, this species is not unlike *P. saræ*, of Hall (Iowa Report, p. 673, pl. xviii, fig. 4), though it is much smaller, has a proportionally much shorter base, and also differs in having but four instead of six arms to each ray. In one of the arms on the left of our figure, some restorations made in the drawing about its base, make it appear as if entirely simple after the first division on the second radial. It really bifurcates like the others, however, on the second piece above the second radial.

Locality and position: Niota, Hancock county, Illinois. Keokuk division of Subcarboniferous Limestone.

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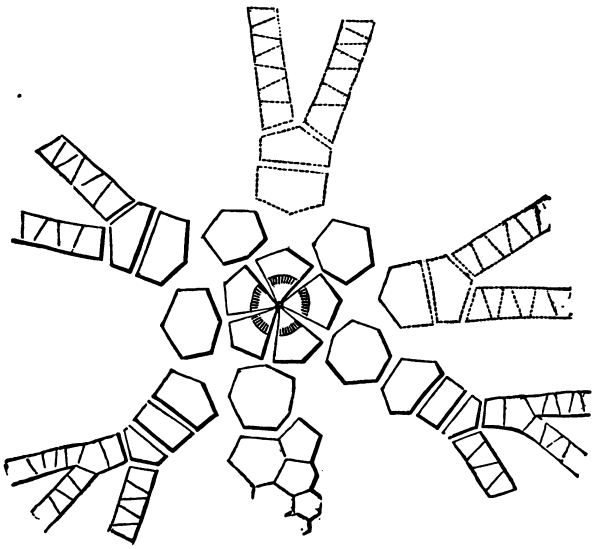
GENUS POTERIOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

POTERIOCRINUS INDIANENSIS, M. and W.

Pl. 20, fig. 4.

Poteriocrinus Indianensis, MEEK and WORTHEN, August, 1865. Proceed. Acad. Nat. Sci., Philad., p. 155.



Poteriocrinus Indianensis.
Diagram (nat. size) showing structure of body and arms as far as known.

BODY rather deeply cup-shaped, or truncato-obconic. Base basin-shaped, comparatively rather broadly truncated below by the facet for the attachment of the column. Basal pieces well developed, pentagonal, and about one-third wider than high. Subradials large, three pentagonal, and two on the anal side hexagonal, there being no defined angle at the middle of the under side of any of these plates. First radial pieces about half as large as the subradials, wider than long, rounded on the outside, and nearly pentagonal, or with one or both of the superior lateral angles slightly truncated, so as to give an obscurely hexagonal or heptagonal outline; all broadly truncated nearly their entire breadth above, and one on the imme-

* For a description of this genus see page 179, vol. II, Reports Geol. Survey, Illinois.

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diate right of the anal series, resting in part directly upon the upper truncated side of one of the subradials, and elevated almost its entire length above the horizon of those of the other rays. In the last mentioned ray, and the one on the immediate left of the anal series, the second piece is quadrangular, and wider than long, while the third is pentagonal and supports the first divisions of the arms on its superior sloping sides. These divisions in the ray on the right are simple, rounded, and each composed of a single series of somewhat wedge-shaped pieces; while the left branch of the one on the left of the anal series, bifurcates again on the second piece, making three arms in this ray, which are constructed like those already described, and continue simple as far as they can be traced. In the only other ray preserved in the specimen, the bifurcation takes place on the second radial, beyond which the arms continue simple.

First anal piece nearly as large as one of the first radials, hexagonal, and resting between the upper sloping sides of the subradials, partly under the first radial on the right, while it connects on the left with the second anal, and supports a third on its truncated upper side. Second anal piece rather large, longer than wide, hexagonal, and resting upon the superior truncated side of one of the subradials. Third anal piece smaller than the others, hexagonal, and surmounted by several other hexagonal pieces in direct succession, belonging to the proboscis.

Surface apparently smooth. Facet for the reception of the column rather large, and marked with distinct radiating striæ around the margins.

Length of body, to summit of first radial, about 0.48 inch, excepting in the ray on the immediate left of the anal series, where it is 0.58 inch; breadth, about 0.56 inch. Breadth of facet for the connection of the column, 0.26 inch. Usual diameter of the arms after the bifurcation, 0.12 inch.

Locality and position: Crawfordsville, Indiana, in the Keokuk division of the Lower Carboniferous Limestone series.

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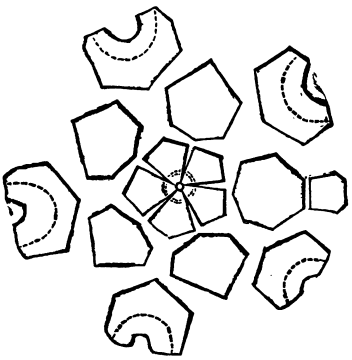
GENUS CYATHOCRINUS, Miller, 1821.*

(Nat. Hist. Crinoidea.)

CYATHOCRINUS FARLEYI, M. and W.

Pl. 20, fig. 1 *a*, *b* and 6 *c*.

Cyathocrinus Farleyi, MEEK and WORTHEN, July, 1866. Proceed. Acad. Nat. Sci., Philad., p. 252.



Cyathocrinus Farleyi. (Nat. size.)
Diagram showing structure of body to first radials, inclusive.

BODY, below the summit of the first radial pieces, rather deep, cup-shaped, or subglobose (oblique in typical specimen), and composed of thick, strong pieces; under side rounded. Base subdiscoidal or depressed basin-shaped, with a pentagonal outline, composed of unequal pentagonal pieces, very narrow at their connection with the column and widening rapidly to their late angles; all curving upwards at their superior outer extremities. Subradial plates three or four times as large as the basal pieces, about as wide as long, convex, and each provided with several irregular wart-like protuberances in the middle; four of them hexagonal, and one on the anal side heptagonal. First radials somewhat larger than the subradial pieces, wider than high, and each having a general pentagonal outline, but the superior lateral angles, which usually extend inwards somewhat between the second radials, are more or less truncated; facet for the reception of the second radials large, or occupying more than three-fourths the breadth of the upper side of each piece, and on the outer side excavated downwards near half the length of the plate, with a distinct outward slope. First anal piece about the size of the largest basal pieces, quadrangular in general outline, but having two other inconspicuous angles above, in consequence of small facets for the reception of three smaller pieces in the next range, probably more properly be-

* For remarks on this genus, see vol. II, p. 175, Reports Geol. Survey Illinois.

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longing to the base of the vault, than to the anal series of the body; resting squarely upon the truncated upper side of the heptagonal subradial piece, and connecting on each side with the adjacent first radials, above the horizon of the summits of which it does not project. Surface smooth or finely granular, with the exception of the irregular pustulose protuberances on the middle of each subradial plate. (Arms and column unknown.)

Height to summit of first radial pieces, 0.68 inch; breadth, 0.80 inch.

This species will be readily distinguished from all others known to us, by the peculiar little wart-like protuberances on the middle of each subradial piece. These are not incipient radial costæ, nor, properly, nodes, but irregular little pustular prominences, like drops of melted wax adhering to the surface. Some of them are confluent, while others are distinct and irregularly grouped. They rarely extend to the margins of the plates, and are almost entirely confined to the subradials, though there are some obscure indications of one or two small ones on the lower half of one of the first radials.

The specific name of this crinoid was given in honor of Dr. R. D. Farley, of Jerseyville, Illinois, to whom the survey is indebted for some interesting specimens.

Locality and position: Keokuk division of the Lower Carboniferous series, at Warsaw, Illinois.

CYATHOCRINUS? (sp. undetermined.)

Pl. 20, fig. 5 *a*, *b*, *c*.

BEING in doubt in regard to the affinities of this crinoid, of which we have only seen the individual specimen figured, we have concluded, for the present, merely to figure it without a specific name, hoping that when the attention of collectors is directed to it, better specimens may be obtained. In the possession of five small basal pieces, five subradials, and five first radials, all united to form the cup, without any anal piece between the first radials, it agrees exactly with the group of Coal Measure species for which we have proposed the name *Erisocrinus*. On a careful examination, however, it will be seen to differ in having the upper lateral extremities of the first radial pieces truncated so as to form a notch, evidently for the reception of interradial or vault pieces, and thus differing from *Erisocrinus*, which has the upper side of all the first radials evenly truncated on the same horizontal plane, entirely across, without any notches for interradials. It is possible that the absence of a first anal piece may be an

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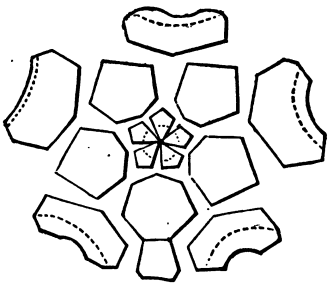
abnormal character, as we sometimes see in *Steganocrinus pentagonus*, Hall, (sp.) If so, it may be a true *Cyathocrinus*, or might possibly even belong to the species *C. tumidus*, of Hall. Until more nearly complete specimens can be examined, it is not possible, however, to settle these questions satisfactorily.

Locality and position: Same as last.

CYATHOCRINUS QUINQUELOBUS, M. and W.

Pl. 20, fig. 6 *a*, *b*, (not *c*.)

Cyathocrinus quinquelobus, MEEK and WORTHEN, August, 1865. Proceed Acad. Nat. Sci., Philad., p. 150.



Cyathocrinus quinquelobus. (Nat. size.) Showing structure of body out to first radials, inclusive.

BODY, below the top of the first radial pieces, broad basin-shaped, composed of very thick, strong plates; height, to the summit of the first radial pieces, less than half the width. Base very small, a little concave below, or forming a nearly flat pentagonal disc; basal pieces rather more than half hidden by the column, the portion of each exposed when the column is attached, nearly pentagonal, or subtrigonal, in form. Subradial pieces much larger than the basal, four of them hexagonal, and one on the anal side heptagonal; each with a strongly prominent, bicarinate protuberance, extending out horizontally, like the rays of a pentagonal star, upon which protuberances the body rests, when placed on a level surface, with the under side down. First radial pieces, two and a-half to three times as wide as high, pentagonal, and all transversely truncated their entire breadth above, for the reception of the succeeding radials, so as to present a broad, moderately concave, outward-sloping facet above; those of the two antero-lateral rays each nearly twice as long as the others, and provided, near the middle of the upper margin, with two or more angular nodes or prominences. Sutures, between the body-plates, close-fitting, and not very apparent. First anal piece small, quadrangular, wider than high, resting upon the truncated upper side of one

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of the subradials, between two of the first radial pieces, above which it does not project. Surface, finely and regularly granular. Facet, for the attachment of the column, of moderate size, a little concave, with a rather small, rounded central perforation, and traces of radiating striæ around the margin.

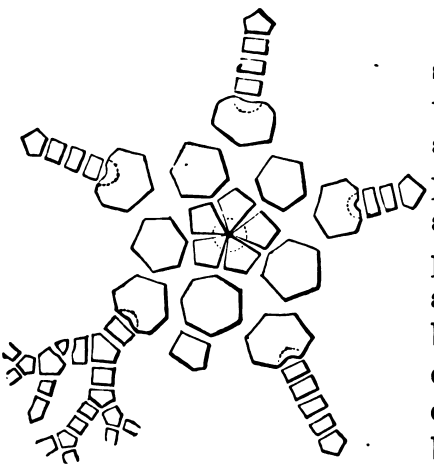
Height, to summit of first radial pieces, 0.55 inch; greater transverse diameter, at summit of first radials, 1.04 inches.

This species is evidently allied to *C. sculptilis* of Hall, from the Burlington Limestone; but it is much more robust, and has more prominent subradial pieces, with the prominences more grooved along the middle. Its base is also more concave, and its first radial pieces, particularly the anterior and posterior lateral, proportionally shorter; while it shows no tendency to develop ridges across from the subradials to the first radials, nor has it any surface striæ.

Locality and position: Same as last.

CYATHOCRINUS ARBOREUS, M. and W.

Cyathocrinus arboreus, MEEK and WORTHEN, 1865. Proceed. Acad. Nat. Sci., Philad., p. 160.



Cyathocrinus arboreus.

Diagram (nat. size) showing the structure of the body and rays out to the first bifurcation, and of one ray out to some of the divisions of the arms.

BODY rather under medium size, conoid-semioval below the top of the first radial pieces, about as wide as high. Basal pieces well developed, forming a low, basin-shaped cup; all pentagonal, and about as long as wide, the greatest breadth being slightly above the middle. Subradial pieces, three or four times as large as the basal, about as long as wide, usually arcuate, or a little concave on the outside, along the lateral margins—four hexagonal and one heptagonal. First radial pieces of near the same size as the subradials, and presenting a more or less nearly pentagonal outline; facet for the reception of the second radials, nearly equaling one-third the

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breadth of the first radial pieces, slightly protuberant and sloping outwards. Succeeding radials small, rounded on the outside, and varying from two to five in the different rays—there being but two in one of the posterior rays and five in the other, while the anterior has four, one of the anterior-lateral three, and the other four—all, excepting the last or axillary piece of each ray, being quadrangular. After the first division into two arms on the last radial pieces (at least in one of the anterior lateral rays), another division immediately takes place on the first piece of each principal branch, and of the four branchlets thus formed, the inner two extend directly upwards, and each bifurcates again on the second piece; while the two main lateral branchlets spread out on either side, each giving off above, two or more subordinate divisions, the first of which is seen to bifurcate at least once. The whole of the divisions and subdivisions being thus spread out like the limbs of a tree trained upon a wall. In one of the posterior rays, the bifurcations are as represented in the above diagram; while in the other, there is no bifurcation until on the sixth piece.

All the arms and their divisions are rounded, and the smaller divisions composed of joints that are longer than wide, while no tentacles have been observed connected with any of them.

The first anal piece is quadrangular, a little longer than one of the basal pieces, and rests directly upon the superior truncated side of one of the subradials, while it connects on each side with one of the large first radial pieces, above which it does not project. The sutures are slightly impressed, and the surface nearly smooth, or only obscurely granular.

Height, to summit of first radial pieces, 0.53 inch on the anal side, and 0.55 inch on the other; breadth, at top of first radial pieces, 0.53 inch; breadth of second and succeeding primary radial pieces, 0.15 inch.

We had intended to give a figure of this species on plate 20, but there was not room for it. Before the arrangement of the plate, however, the diagram showing its structure, given at the head of this description, was prepared. As

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this will assist the student in identifying the species, we have concluded to give it and the description here, along with the other forms from the same position.

Locality and position: Keokuk group, of the Lower Carboniferous series, at Crawfordsville, Indiana.

ECHINOIDEA.

*PERISCHOECHINIDÆ.**

GENUS LEPIDESTHES, M. and W.

(λεπις, a scale; εσθης, a garment; in allusion to the imbricating, scale-like arrangement of the plates forming the test, or covering.)

SUBSPHEROIDAL; interambulacral areas narrow, and composed of plates that imbricate from below upwards as well as outwards from the middle; ambulacral areas very wide, composed of numerous small pieces, scarcely differing in form, and all imbricating from above downward; the lower edges of those of each range lapping upon the next series below; ambulacral pores two to each piece, and nearly central. Anal opening, and apical disc, unknown. Jaws well developed. Entire surface ornamented with numerous very small granules of uniform size, probably for the articulation of minute spines, as in *Palœchinus*.

This curious type is evidently related in some respects to *Lepidechinus*, Hall, but differs remarkably, not only in the comparative breadth of its ambulacral and interambulacral areas, but in having the imbrication of the plates of these areas *in exactly the opposite direction.* That is, in *Lepidechinus* the interambulacral plates are said to imbricate from the dorsal side, and the ambulacral from below upwards; while in *Lepidesthes* the interambulacral series imbricate from below upwards (that is the upper edge of each interambulacral plate laps upon the lower edge of the next above), and those of the ambulacral series imbricating from above downwards.† A more important difference, however, is that observed in the comparative breadth of the ambulacral and interambu-

* See vol. II, Reports Illinois Geol. Survey, p. 225.

† Since these remarks were written, Prof. Hall has described a second species of the genus *Lepidechinus*, (*L. rarispinus*) from the Chemung Sandstone at Meadville, Pa. In this he states that the specimen shows clearly that the imbrication of all the plates are exactly the reverse of what he had supposed in *L. imbricatus*, the type of the genus; but suggests that he may have been mistaken in regard to which was the dorsal and which

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lacral areas. In *Lepidechinus*, for instance, the ambulacral areas are "sublinear, little wider than the width of an adjacent single plate of the interambulacral series in the middle of the body;" while in *Lepidesthes* these areas are each about once and a-half the breadth of the whole of each interambulacral field.

The most important difference is to be observed in the structure of the ambulacral areas, which in *Lepidechinus* have only two rows of pieces, and four rows of pores; while in the type under consideration we count *ten* rows of these pieces near the widest part of each field, and twenty rows of pores. It will therefore be seen that our fossil bears almost exactly the same relations to *Melonites*, that Prof. Hall's *Lepidechinus* bears to *Archæocidaris*. That is, it agrees with *Melonites* in the great breadth of its ambulacral fields, and numerous ambulacral pieces and pores, but differs from it in the curious imbricating character of all its plates, just as *Lepidechinus* agrees with *Archæocidaris* in its narrow ambulacra, with large tubercles on its interambulacral plates, and differs in its imbricating plates. Although our fossil presents some other differences from *Melonites* (such as the greater thinness of its plates, and the non-sulcated character of its ambulacral fields, as well as in having the middle two rows of its ambulacral plates not differing in form or size from those on each side), we can but think that if *Lepidechinus* is to be ranged, as has been proposed by Prof. Hall, as a subgenus under *Palæchinus*, that *Lepidesthes* should, upon the same grounds, stand as a subgenus under *Melonites*. We can not believe, however, that so marked a peculiarity as this imbricating character of the plates, seen in these fossils, is of mere subgeneric value. On the contrary, we suspect it will be found to be of even more than generic importance.

We are indebted to Mr. O. W. Corey, of Crawfordsville, Indiana, for the use of the only example of this type we have seen, and to him we have dedicated the species on which the genus is founded.

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the ventral side in *L. imbricatus*. This is highly probable, and if so, his genus would not differ from ours in the *direction* of the imbrication of the plates, but the other differences are amply sufficient to separate the two types generically.

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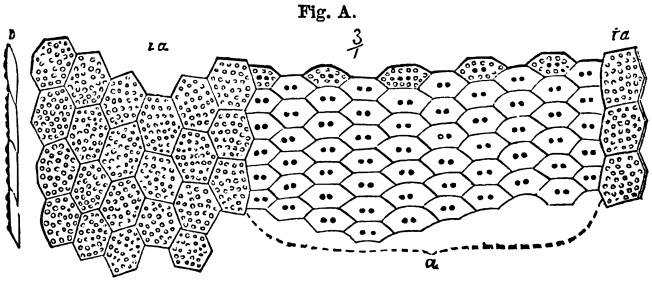
To facilitate comparisons of this type with *Melonites* and *Oligoporus*, we give the following diagrams: (A) illustrating the arrangement of the ambulacral and interambulacral pieces, in *Lepidesthes;* and (B and C) illustrating the structure of the ambulacra in *Melonites* and *Oligoporus:*

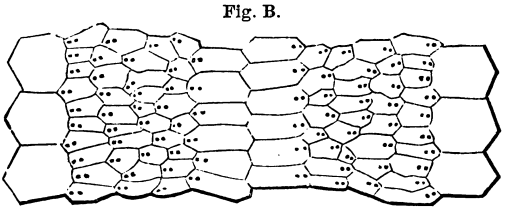
Fig. A.



Lepidesthes Coreyi.

Diagram (enlarged 3 diameters) showing the number and arrangement of the ambulacral pieces (*a*) near the middle of the body, with the two pores penetrating the middle of each piece, and, in a few of those above, the granules covering the whole surface of all the pieces. On the left, the interambulacral pieces (*ia*) are seen, showing their arrangement and the comparative narrow breadth of the interambulacral areas. By the side of these plates, (*b*) represents a section of them, illustrating their imbricating arrangement. On the right side of the ambulacral series only, the marginal row of interambulacral plates is represented.

Fig. B.

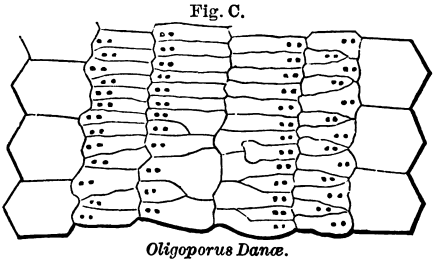


Melonites multipora.

Diagram (enlarged 2 diameters) of a part of the ambulacral series near the middle of the area, with some of the marginal row of interambulacral plates on each side.

It is difficult to understand what could have been the object of this peculiar imbricating arrangement of the plates in *Lepidechinus* and *Lepidesthes*, unless it was to impart some degree of mobility to the pieces composing their external crust, so that the animal could at will, or when subjected to accidental pressure, change its form—for instance, from a globose, or depressed globose, to an oval or elliptic outline, or the reverse. At any rate, the specimen from which the foregoing description of *Lepidesthes* was made out, shows that the fossil was susceptible of a considerable compression and distortion, without actually breaking or materially disarranging the plates, which are less than one-third as thick as in *Melonites*. The lapping edges of the plates are all beveled, so as to lie evenly together, and it is evident that the slightest movement of the plates upon each other, even if not perceptible to the eye, would be sufficient to materially change the general form of a body with its crust composed of such a vast number of small pieces.

Fig. C.



Oligoporus Danæ.

Diagram showing a portion of the ambulacral series of pieces enlarged two diameters, with a few of the marginal row of interambulacral plates on each side.

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LEPIDESTHES COREYI, M. and W.

(See cut A, opposite page.)

GENERAL form apparently subspheroidal, approaching a broad ovate outline. Interambulacral areas narrow, lanceolate, a little convex, composed, near the middle, of six or seven rows of hexagonal, very slightly convex, plates, the number of rows decreasing towards the extremities, first to five, then to four, and so on to the ends, where each seems to terminate in a single piece. Ambulacral areas nearly or quite flat, rather broad lance-oval in form, and once and a-half to twice as wide as the interambulacral fields; all occupied by numerous small transversely rhombic or subhexagonal pieces, with their lateral angles acute, and deeply interlocking, while the angles above and below are obtuse, or nearly obsolete, so that with their imbricating arrangement, and uniformity of size and shape (the middle rows not differing in these respects from the others), they present somewhat the appearance of the scales on the side of a fish. Of these pieces there are apparently about 10 or 11 rows near the middle of each field, and each has its two small round central pores closely approximated. Surface granules very small, and about 18 to 25 on each of the larger interambulacral pieces, with a proportionally smaller number on all the others, including the ambulacral pieces, which are generally one-third to one-half as large as those of the interambulacral areas.

The only specimen of this interesting type we have seen, is considerably distorted by pressure, and has lost about one-third of the upper side, including the apical disc. Its oral opening is comparatively rather small, round, and has the jaws protruding in a crushed condition. The entire length of the fossil, as near as can be determined in its present distorted condition, was about 1.80 inches, and its breadth about 1.60 inches. The breadth of the interambulacral areas, at the middle, is only 0.37 inch; while that of the ambulacral fields is about 0.60 inch.

Locality and position: Keokuk division of the Subcarboniferous series, at Crawfordsville, Indiana.

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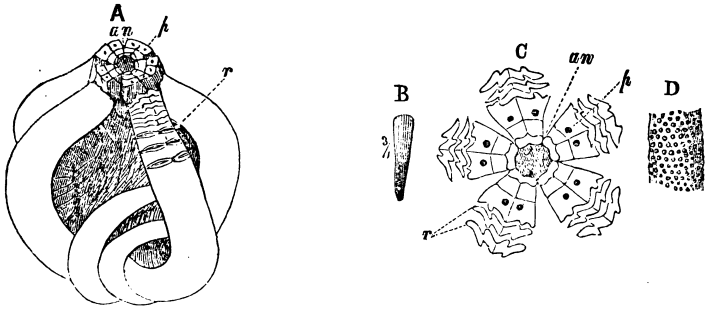
ASTEROIDEA.

GENUS ONYCHASTER, M. and W.

(*ονυξ*, a claw; *αστηρ*, a star; from the resemblance of its folded rays to the claws of a bird, and its general similarity to the *Asteroidea.*)

ONYCHASTER FLEXILIS, M. and W.



Onychaster flexilis.

A. General outline view of the whole fossil, natural size; *an* being the central opening of the disc, and *p*, genital ? pores. At *r*, the ossicles forming the skeleton of the dorsal side of one of the rays, are seen, as exposed by the removal of the outer granular integument.

B. One of the longitudinally striated spines from the inner side of the rays, magnified three diameters.

C. The disc, with two pairs of the interlocking pieces (*r*) connecting it with the dorsal side of each ray; (*an*) anal ? opening, (*p*) genital ? pores—all enlarged about two diameters.

D. A portion of the dorsal side of one of the rays, as seen covered with its granular integument, which hides the skeleton structure seen in figure A, at *r*.

THE interesting fossil on which we propose to found this genus and species, seems to differ so widely, in some of its characters, from the true Star-fishes, as well as from the Ophiurians, as to leave doubts whether it can be properly placed in either of these groups as now understood. And yet it certainly differs even more widely from the normal types of the *Crinoidea* and *Echinoidea.* In habit and general appearance, it most nearly resembles the Ophiurians, from which, however, it differs widely in structure. It is composed of a rather small sub-discoid body, and five long, slender, rounded, flexible arms or rays. In nearly all of the specimens yet found, the arms are folded together like the claws of a bird when grasping some small object. A few of them, however, have the arms opened out more or less, so as to show that they were very flexible, or capable of being moved about in all directions. They usually increase slightly in thickness for a short distance from the body, then taper very gradually to their extremities, being about 2.50 inches in length, and 0.22 inch in breadth, at the widest part.

On the dorsal side of the body of the specimen represented by the outline figure A, there is seen a comparatively large circular area or disc, composed of

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an outer circle of ten rather prominent pieces, united together in five pairs by close-fitting sutures, each piece being pierced by a round ovarian? pore (*p*). Immediately within this circle there is, apparently, another circle of ten smaller pieces, also united in five pairs, but without pores; and within this latter circle there is a third range of five still smaller, non-poriferous pieces, surrounding a central anal? opening (*an*, of fig. A and C);—the whole reminding one of the apical disc of an Echinoid, though differing in structure from this part of the known types of that group. It is also worthy of note, that there is some analogy between this disc and the body of a crinoid, excepting that there is a central opening, and that the first division of the radial series takes place immediately on the inner range of pieces corresponding to the basal pieces of a Crinoid, while all of the third range of pieces are pierced by pores. It is barely possible that in their early stages of growth, these fossils may have been attached like a Crinoid, by a column, connecting with the inner range of disc pieces, so as to close the central opening. Of this, however, we have no evidence, all the specimens yet seen being without any traces of such connecting column.

Immediately outside of the circle of ten pore pieces, mentioned above, each pair of these pieces is succeeded by two or three pairs of differently formed, interlocking, transverse pieces, in direct range, connecting them with the dorsal side of each of the five rays (see let. *r* of cut C). A little farther out the dorsal side of the rays, these transverse pieces are seen to become disconnected by more or less wide spaces (as at *r* of cut A), and gradually pass into pairs of lanceolate pieces, deeply furrowed longitudinally, while between the inner ends of the two pieces of each pair, there appears to be a pore-like opening. These latter disconnected pieces continue all the way out to the extremities of the rays, and, with numerous smaller intervening ossicles, form together, as it were, the skeleton or frame-work of the long flexible rays. It is only, however, when an outer granular integument has been removed, that this skeleton structure can be seen. In some parts of some of our specimens, this outer granular covering remains, and is seen to be composed of numerous small, rounded, rather prominent ossicles, regularly arranged in quicunx, as seen in fig. D, so as to give the surface a chagreen-like roughness. These ossicles were doubtless attached to, and secreted by, a soft dermal envelope, covering the whole surface, while the larger pieces within, formed the frame, as it were, of the whole structure, and probably furnished points of attachment for the muscles that moved the rays.

None of our specimens show clearly the inner side or ambulacral furrows of the rays, nor the under side of the body—consequently we know nothing of the nature or position of the mouth or of the ambulacra. In several instances, however, we have seen the remains of one or more rows of small, short, longitudinally striated spines (fig. B) along the inner side of the arms.

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The entire breadth of a mature individual, across between the extremities of the rays on opposite sides, if these rays were straightened out, would be about five to six inches.

Locality and position: Crawfordsville, Indiana; Keokuk division of the Lower Carboniferous series.

MOLLUSCA.

BRACHIOPODA.

GENUS PRODUCTUS, Sowerby, 1814.

(Min. Conch., vol. I, p. 153.)

PRODUCTUS MAGNUS, M. and W.

Pl. 20, fig. 7 *a*, *b*, *c*.

Productus magnus, MEEK and WORTHEN, June, 1861. Proceed. Acad. Nat. Sci., Philad., p. 142.

SHELL attaining a large size, subhemispherical, or in outline semioval; hinge-line equaling, or slightly exceeding, the greatest breadth of the valves at any other part; ears nearly rectangular, not arched. Ventral valve moderately gibbous, or forming a more or less nearly regular semicircular curve from the beak to the front, rounding down rather strongly on each side to the ears, which are not abruptly separated from the swell of the umbo; central region with a shallow, narrow, mesial sinus, extending from the front about two-thirds of the way to the beak; umbonal region not very prominent; beak small, incurved, and passing but slightly beyond the hinge-margin; interior unknown. Dorsal valve distinctly concave, but nearly flat over a large portion of the central region, and strongly curving up at the front and lateral margins, usually with a slight mesial ridge corresponding to the sinus of the other valve. Interior with a rugose ridge extending around near the front and lateral margins, so as to present a somewhat geniculated appearance, not seen on the outside; cardinal process stout, apparently rather short, and bifid ?, its base forming a short stout ridge, which soon becomes obsolete near

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the muscular scars, from between which a narrow ridge extends forward two-thirds to three-fourths the length of the valve, becoming sharply elevated and thin at the end; scars of adductor muscles elongated, parallel and rugose; reniform scars rather broad, and somewhat roughened by a few irregular wart-like prominences; spaces between the reniform scars and the mesial ridge flat, and without any traces of the subconical prominences seen in *P. giganteus;* posterior lateral regions irregularly pitted or punctured.

Surface of both valves ornamented by numerous rather coarse, often waved or flexuous, striæ, or small obscure costæ, that increase by intercalation and division, all sometimes becoming nearly obsolete on and near the ears; fine concentric striæ are also seen on all parts of the surface, and over the visceral region, very obscure traces of small concentric wrinkles likewise occur. On the ventral valve, bases of small spines are seen irregularly scattered, being most numerous, largest, and most closely arranged, on the ears and along the hinge-margin. No spines occur on the dorsal valve, but little pits seem to occupy their places.

Length of largest specimen seen, 3 inches; breadth, 3.30 inches; convexity, about 1.60 inches. Number of surface striæ in 0.20 inch, five or six.

This fine species is probably most nearly allied to some varieties of *Productus giganteus*, Martin (sp.), but presents well marked internal and external differences from all the forms usually regarded as varieties of that shell. Its most marked external differences consist in the distinct flatness of the visceral region of its dorsal valve, and its more angular ears, which are also never arched. The interior of its dorsal valve also differs in the possession of a rugose ridge near the front and lateral margins, and particularly in showing no traces whatever of the mammiform protuberances in the spaces partly encircled by the reniform scars. These scars, in our shell, are likewise different in shape from those of *P. giganteus*, and the ridge between them longer. Our own comparisons, it is true, have been made only with figures and descriptions of *P. giganteus*, but Mr. Thomas Davidson, of London, to whom specimens of our shell were sent, writes that he thinks it must be distinct from that species.

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Prof. Swallow has described a shell, from the Coal Measures of Missouri, under the name *Productus Americanus* (Trans. St. Louis Acad. Sci., vol. II, p. 91, 1862), that seems, from his description, and tracings made from his drawings of typical specimens, nearly allied to our species, and may possibly be the same. If so, the name *Americanus* will have to be ranged as a synonym under our name *magnus*, which was *published* some six or eight months in advance, though Prof. Swallow's paper was *read* first.

Locality and position: Monroe county, Illinois, and St. Genivieve county, Missouri; in the Keokuk division of the Lower Carboniferous limestone series.

Genus SPIRIFER, Sowerby, 1815.

(Min. Coch., II, p. 42.)

Spirifer propinquus, Hall.

Pl. 19, fig. 8 *a*, *b*, *c*.

Spirifer propinquus, Hall, 1858. Geological Report of Iowa, Vol. I, part II, p. 647.

Shell attaining a moderately large size, subtrigonal, very convex; breadth between twice and three times the length; hinge line the widest part; lateral extremities acutely angular. Ventral valve depressed pyramidal, the highest part being at the beak, which is not in the slightest degree arched; anterior and lateral slopes abrupt; mesial sinus rather narrow and deep, well defined, rounded and without plications; area large, perfectly flat, and somewhat inclined forward, with distinctly angular margins; foramen large, three-fourths as wide at the hinge line as its height. Surface with about twenty-four simple, rounded plications on each side of the mesial sinus, the lateral ones of which intersect the angular margin of the area, without reaching the beak; lines of growth rather obscure.

Length (of the ventral valve) about 1.30 inches; breadth, 3.70 inches; height of area (which is also the convexity of the valve), 1.25 inches; breadth of foramen, 0.80 inch.

This species evidently belongs to the same group as the punctate European form usually referred to *S. cuspidatus*, Sowerby, as it presents the same general outline, and is distinctly punctate; and we have also ascertained, by working out the matrix filling the foramen, that it likewise has the same deep-seated transverse plate between the dental laminæ, as well as the internal tube of that type.

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It differs specifically, however, from *S. cuspidatus*, in being much wider in proportion to its length, and in having its lateral extremities acutely angular and its ventral valve and area much lower, while it also has more numerous costæ.

In 1865–6, one of the writers* discovered that several of our American shells allied to, or in part identical with, *Spirifer cuspidatus*, Sowerby, as well as a specimen sent by Mr. Thomas Davidson, of Brighton, England, from Melicent, Ireland, with that name attached, all showed clearly a punctate structure, and that at least all of the American examples of these shells, the interior of which could be seen, also possessed a peculiar internal tube, attached to a transverse plate passing across between the dental laminæ, upon which latter character, Prof. Winchell had previously proposed to found a genus *Syringothyris*, the types of which, however, he thought were not punctate.†

As Dr. Carpenter, the distinguished Microscopist of London, had long back, after repeated careful examinations, failed to detect any traces of punctures in British examples of *S. cuspidatus*, and was quite confident that it must be impunctate, the question (which we had not the foreign specimens at hand to solve) was asked by one of us, in publishing the results of the examinations mentioned above, whether there might not be two British types confounded under the one name *S. cuspidatus*—that is, one rare one with a punctate structure and the internal tube of *Syringothyris*, and another, more common, without either.

At a later date, Dr. Carpenter re-examined many British examples of these shells, and at first thought his original conclusion correct, that is, that *none of them* are punctate, and that we were probably in error in regard to this character existing in the shells examined here.‡ Subsequently, however, after examining chippings sent by us from the American forms, as well as from the Irish specimen alluded to above, he confirmed the conclusion that these shells are really punctate. He then examined many British specimens of the form generally referred to *S. cuspidatus*, and arrived at the conclusion that there is amongst them two distinct types—one punctate, and possessing the internal tube, and another without either.¶

Still more recently, Prof. King, of Queens College, Galway, has investigated these shells, and maintains that there is but *the one* British type, *S. cuspidatus*, and that, when well preserved, it is *always* punctate and provided with the internal tube, which characters, he thinks, were only accidentally absent in a part of the specimens examined by Dr. Carpenter. Believing this punctate

* See paper by F. B. Meek, in Proceedings Acad. Nat. Sci., Philad., Dec., 1865, p. 275, published Feb., 1866. For further remarks on this subject, see a communication, by Prof. Hall, published in Proceed. Am. Philosoph. Society, for May, 1866.

† They have since been found to be punctate, however; see Am. Jour. Sci., May, 1867, p. 467.

‡ Ann. Mag. Nat. Hist., Aug., 1866, p. 144.

¶ Ibid., July, 1867.

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structure a character of sufficient importance to separate these shells generically from those forms like *S. striatus*, that have not a punctate structure, he proposes to retain the name *Syringothyris*, for the *S. cuspidatus* group, and *Spirifer* for the impunctate group.* Mr. Davidson also writes that he thinks there can be no doubt in regard to some of the British shells which he considers the true *S. cuspidatus* having the internal characters on which *Syringothyris* was proposed.

Admitting the accuracy of these examinations, and that these punctate shells should be separated generically, or subgenerically, from those without this character, the question arises whether or not the generally accepted rules of nomenclature will permit us to retain the name *Syringothyris?* Although there may be different opinions on this point, it certainly seems to us, that as *S. cuspidatus* was the only species described by Sowerby, in first proposing the genus *Spirifer*, and the first species to which he applied that name, it should be regarded as the type of the genus *Spirifer*. If so, then *Syringothyris* would apparently be an exact synonym of *Spirifer*, and Kœnig's name *Trigonotreta*, should be retained for the impunctate species like *S. striatus*.

If *Syringothyris*, however, is to be retained, the name of Prof. Hall's species we have here described, would become *Syringothyris propinqua*, as it has exactly the characters of the type for which that name was proposed.

Our figures and description of the species under consideration were made out from the original typical specimen of *S. propinquus*, which has not hitherto been figured.

Locality and position: Near Warsaw, Illinois; in the Keokuk division of the Lower Carboniferous series.

LAMELLIBRANCHIATA.

Genus AVICULOPECTEN, McCoy, 1851.

(Ann. Mag. Nat. Hist., vol, VII, p. 171.)

Aviculopecten Indianensis, M. and W.

Pl. 19, fig. 6 *a*, *b*.

Aviculopecten Indianensis, Meek and Worthen, 1866. Proceed. Chi. Acad. Sci., vol. I, p. 14.

Shell (left valve) rather compressed, not oblique; lateral margins rounding from near the middle into the regularly rounded ventral border; umbonal slopes converging to the beak at an angle of about ninety degrees; cardinal line less than the breadth of the shell. Anterior ear compressed so as

* Ann. Mag. Nat. Hist., July, 1868.

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to be rather distinct from the umbonal slope, subtrigonal in form, and a little rounded in outline so as to cause its margin to intersect the hinge at an obtuse angle, separated from the adjacent posterior margin by a rather wide, shallow, subangular sinus. Beak rather compressed. Posterior ear apparently of about the same size as the other, but more angular in consequence of the broadly rounded, shallow sinuosity of its margin being continued to the hinge line. Surface ornamented with depressed, irregular, nearly flat or somewhat rounded, radiating costæ, from forty to forty-five of which may be counted around the free border of the body part of the valve, and about eight or ten on each ear—those on the anterior ear being more distinct than on the other. Costæ sometimes bifurcating, but generally increasing by the intercalation of smaller ones between, which are rarely continued quite to the beak; all crossed by concentric, very thin raised lines, regularly disposed at intervals, about equaling the wider ribs on the body of the valve, but more closely arranged on the ears.

Transverse and longitudinal diameter each about 1.85 inches; convexity of left valve, 0.20 inch.

The specimen of this species from which the figure on plate 19 was drawn, is not in a very good state of preservation, and the engraving is unfortunately far from being satisfactory, but with the aid of the description, it is hoped the student may be able to identify the species. Figure 6*a* is a cast from the matrix, represented by figure 6*b*. In the latter, more of the posterior wing is seen than in the former, but it is probably not entirely complete in either. The anterior ear of figure 6*a* has the marks of the costæ wrongly represented parallel, instead of converging to the beak; on the same ear, seen on the right side of the mould, represented by figure 6*b*, there should be some ten or twelve costæ, instead of only two or three. As the mould is of the outside only, it of course does not show the cardinal plate.

Since the figures and description of this species were prepared, we have seen a specimen (also a left valve) from the same locality and position, agreeing with it quite closely in form and general appearance, but having the concentric markings more crowded, and the radiating costæ proportionally smaller and less strongly defined; while the latter are only very faintly indicated on the ears. If this is a variety of the same species, which we think very probable,

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it would show the species to vary considerably in the details of its surface markings.

Locality and position: Crawfordsville, Indiana; from the Keokuk division of the Lower Carboniferous limestone series.

GENUS ANTHRACOPTERA, Salter, 1862.

(Mem. Geol. Surv. Gr. Brit.; Country around Wigan, p. 37.)

ANTHRACOPTERA? FRAGILIS, M. and W.

Pl. 19, fig. 4.

Anthracoptera? fragilis, MEEK and WORTHEN, 1866. Proceedings Chi. Acad. Sci., p. 18.

SHELL thin, aviculoid, very oblique, moderately convex, the right valve being more compressed than the other. Hinge margin equaling about half the length of the shell, bordered by a linear ridge, and ranging at an angle of thirty-five degrees above the oblique umbonal axis, terminating posteriorly in a compressed angular wing, considerably shorter than the posterior part of the valves below, from which it is separated by a rounded marginal sinus. Anterior side short, narrowly rounded, and projecting beyond the beaks as a kind of lobe or pouch, separated from the umbonal gibbosity by a broad, undefined, very oblique depression, extending from the beaks to the anterior ventral margin. Posterior side compressed and obliquely produced; its margin rather narrowly rounded in outline, and sloping obliquely forward and upward, above; ventral border oblique, rather distinctly sinuous about midway between the middle and the anterior extremity. Beaks very oblique, moderately convex, little elevated above the hinge line, and placed about one-third the length of the hinge margin and anterior lobe, behind the anterior extremity; umbonal slopes convex, but not very prominent. Surface with fine, obscure, concentric striæ, and more distinct, somewhat imbricating marks of growth.

Length of a medium sized specimen, measuring obliquely from the anterior extremity to the posterior margin below the wing, 1.38 inches; height from the most prominent part of the base to the summit at the posterior extremity of the wing, 0.79 inch; convexity of left valve, 0.20 inch.

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This species has much the aspect of some of the more aviculoid forms of *Bakevellia*, but it is a thinner shell, and seems to have its cardinal margin more compressed, and apparently without the area seen in that genus. As near as can be determined, without a knowledge of its hinge and interior, it seems to be congeneric with the species represented by Mr. Salter's figure illustrating the characters of his genus *Anthracoptera;* though not, as we think, with his *A. carbonaria* (Jour. Geol. Soc., XIX, p. 79*), which has exactly the general external appearance of a true *Myalina*, and seems to be closely allied to some of our western Coal Measure species of that genus, always associated with marine types in the western states. As seen imbedded in the matrix, with the wing hidden or broken away, it has the appearance of a *Modiola.*

Locality and position: Near Warsaw, Illinois; Keokuk division of the Lower Carboniferous series.

Genus PLEUROPHORUS, King, 1844.

(Ann. Mag. N. H., vol. XIV, p. 313.)

Pleurophorus costatiformis, M. and W.

Annexed cut, and fig. 8? of pl. 19.

Pleurophorus costatiformis, Meek and Worthen, Dec., 1865. Proceed. Acad. Nat. Sci., Philad., p. 247.

Pleurophorus costatiformis.

Shell elongate, suboval, moderately convex, slightly arcuate; the dorsal and ventral margins rather long, and more or less nearly parallel, the former being a little concave in outline, and the latter convex; extremities narrowly rounded. Beaks small, depressed, or rising little above the hinge-line, very oblique, somewhat compressed, incurved, and placed very near the anterior end; lunule apparently small and deep. Surface ornamented by concentric striæ of growth, and a few larger, obscure, concentric wrinkles, crossed on the postero-dorsal region by five distinct, equidistant and radiating ridges, extending obliquely from the beak to the posterior margin, the lower one being the largest, and forming the umbonal ridge, while

* It is worthy of note, that the form figured by Mr. Salter, under the name *Anthr. carbonaria*, is widely different, in outline, from Prof. Dawson's figure of his *Naiadites carbonaria*, supposed to be the same (see Acad. Geol., 2d ed., p. 204, fig. 42), though this may possibly have resulted from distortion.

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the upper one runs parallel to the cardinal margin, and forms the edge of the long corslet, or escutchen.

Length, about 1.10 inches; height, 0.46 inch; convexity, near 0.43 inch.

It is remarkable that this species is so very similar to *P. costatus*, Brown (sp.), of the European Permian System, that, if some of the specimens were found in rocks of that age, few would ever suspect them to belong to any other species. Owing to the fact, however, that the *Lamellibranchiata* are generally more restricted in their geological range than some types of the *Brachiopoda*, we think it very improbable that a species of this class should have survived all the changes of physical conditions that occurred between the deposition of the Lower Carboniferous and Permian rocks.

The specimen figured on plate 19 was originally supposed to be a variety of this species, and by some oversight it was figured instead of the typical form. We are now nearly satisfied, however, that it is a distinct species, and, in addition to this, the figure alluded to, owing to defects in the engraving, fails to illustrate very clearly the characters of the specimen from which it was drawn. In order, therefore, to prevent confusion, and to give a better idea of the shell described, we add here a wood cut of the typical specimen from which the description was originally drawn up.

Locality and position: Keokuk division of the Lower Carboniferous series, at Warsaw, Illinois.

Genus LITHOPHAGA, Lamarck, 1812.

Lithophaga lingualis, Phillips? (sp.)

Pl. 19, fig. 1 and 2.

Modiola lingualis, Phillips, 1836. Geology Yorks., vol. II, p. 209, pl. v, fig. 21.
Lithophaga? lingualis, Meek and Worthen, 1865. Proceed. Acad. Nat. Sci., Philad., p. 245.

Shell elongated, very thin, rather compressed, widest posteriorly, where it is strongly compressed and somewhat narrowly rounded in outline; anterior end more convex, and very narrowly rounded or subangular in outline; greatest convexity from the umbonal region along nearest the dorsal side, back toward the middle; beaks extremely oblique, very nearly terminal and somewhat obtuse; dorsal margin generally a little concave in outline, from the beaks back to the central region. Surface marked by fine lines and irregular furrows of

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growth, often passing into little concentric wrinkles or undulations in passing over the most convex part of the valves.

Length of largest specimen, about 3.30 inches; height about 0.95 inch; convexity, about 0.50 inch.

We are by no means satisfied that this is the species described by Phillips, but prefer to refer it provisionally to that species, rather because we have been unable to find any very reliable differences, than from any great confidence in its exact identity. Some of our specimens are much larger than that figured by Phillips, but in all other known characters they are certainly very similar, so far as can be determined from his figure and very brief description.

As the hinge and interior of these shells are entirely unknown, we have no means of determining, with certainty, their generic relations. The shell (or, at any rate, all that remains of it in our specimens) is exceedingly thin, though we have been unable to see any indications of a prismatic structure in it. In one specimen, from Crawfordsville, Indiana, believed to be the same species, numerous, very minute cracks can be seen radiating with great regularity to the posterior, posterior-dorsal and basal margins, which they intersect nearly at right angles—those above curving upward, and those below downward. These have the regularity and direction of surface markings, but seem rather due to some peculiarity of the structure of the shell, than to surface sculpturing.

Locality and position: Warsaw, Illinois, and Crawfordsville, Indiana, in the Keokuk division of the Lower Carboniferous series.

Genus SEDGWICKIA, McCoy, 1844.

(Synop. Carb. Foss., Ireland, p. 61.)

Sedgwickia (Sanguinolites?) subarcuata, M. and W.

Pl. 19, fig. 3*b* (not 3 *a*).

Sedgwickia (*Sanguinolites*) *subarcuata*, Meek and Worthen, 1865. Proceedings Acad. Nat. Sci., Philad., p. 251.

Shell elongate, suboval, somewhat arcuate, rather convex in the central anterior and umbonal regions; anterior side sloping, with a slightly convex outline from the beaks forward, and rather narrowly rounded at the extremity; posterior side narrow and compressed above and behind the umbonal ridge, and obliquely truncated at the extremity; dorsal outline horizontal and concave behind the beaks; ventral margin forming a long, gentle, convex curve, nearly parallel to the dorsal mar-

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gin, curving up gradually toward the front, and very abruptly at the posterior basal extremity. Beaks moderately prominent, and placed about one-third the entire length of the shell from the anterior extremity; umbonal ridge prominently rounded from the beaks to near the posterior basal extremity. Surface of cast without visible concentric ridges or other markings.

Length, 2.20 inches; height, 0.95 inch; convexity, 0.72 inch.

We are by no means sure that this shell belongs to the genus *Sedgwickia*, as properly restricted to such forms as *S. attenuata* and *S. corrugata*, of McCoy, since it is more elongated, and wants the concentric ridges usually seen on these shells. In general outline, it approaches some species of *Cercomya*, Agassiz, such for instance as *C. striata*, from the Upper Jura, but its posterior seems to have been very nearly smooth. As we only know it from casts, nothing can be determined in regard to its hinge, nor have we any means of ascertaining the nature of its muscular and pallial impressions. Possibly we should call it *Allorisma subarcuata*, though its rather prominent umbonal ridge, compressed posterior dorsal region, apparently smooth surface, and convex anterior slope, without a depression in front of the beaks, give it a kind of *Lyonsia*-like aspect, not generally seen in the typical species of that genus.

Owing to a slight defect in the shading, the engraving of this species is made to appear as if there was a broad, shallow compression or concavity in the anterior ventral portion of the valves. This, however, is not the case, that portion of the valves being evenly convex.

Locality and position: Upper beds of the Keokuk division of the Lower Carboniferous series.

Genus ALLORISMA, King, 1844.

(Ann. Mag. Nat. Hist., xiv, p. 316.)

Allorisma (Chænomya?) hybrida, M. and W.

Pl. 19, fig. 3 *a*, (not 3 *b*.)

Chænomya? hybrida, Meek and Worthen, Dec., 1865. Proceedings Acad. Nat. Sci., Philad., p. 250.

Shell longitudinally oblong, moderately convex, somewhat arcuate; dorsal margin concave in outline, ventral border longer than the dorsal, and forming a broad, gentle curve, nearly parallel to the dorsal outline, excepting a very faint

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sinuosity in advance of the middle; posterior side a little compressed near the extremity, but rather distinctly gaping, truncated or somewhat rounded in outline; anterior margin sloping forward from the beaks above, and apparently narrowly rounded below. Beaks moderately prominent, somewhat compressed, and placed less than one-fourth the length of the valves from the anterior extremity; umbonal slopes not prominent; flanks evenly convex in the central region, and a little contracted anteriorly, so as to form a very faint undefined depression from the beaks to the base. Surface (of a cast) showing small, obscure, concentric ridges, which are most distinct and regular along the posterior umbonal slopes, where they are abruptly deflected upward at an obtuse angle; anteriorly they are smaller, more closely arranged, and deflected obliquely forward and upward.

Length, 1.90 inches; height to cardinal margin, 0.90 inch; to summit of beaks, 1 inch; convexity, 0.68 inch.

This form can only be referred provisionally to the genus *Allorisma*, since we know nothing of its hinge and muscular and pallial impressions, or finer surface characters. It has the form of the typical species of that group, excepting that its posterior extremity is rather more widely gaping, somewhat as in *Chænomya*, but not to the same extent. Its most peculiar surface character is the abrupt deflection of its obscure concentric ridges, which give it much the appearance of a *Goniomya*. Indeed, if found among Cretaceous or Jurassic fossils, we would not hesitate to call it *Goniomya hybrida*. As in some species of *Goniomya*, the ridges run parallel to the base along the middle of the valves, between the points where they are deflected, and do not form a V shaped angle. These peculiarities of the ridges are not well represented in the figure. In front of the beaks they are small, closely arranged, and, instead of curving as represented, they are nearly straight, parallel, and pass at first obliquely backward and downward, then backward parallel to the base, to the region of the posterior umbonal slopes, where they become larger, and are rather abruptly deflected upward and a little backward.

Locality and position: Keokuk division of the Lower Carboniferous series, at Nauvoo, Illinois.

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PLATE I.

PAGE.

Fig. 1. COMAROCYSTITES SHUMARDI, M. and W 292

1 *a*. View from below.

1 *b*. Side view of same.

Fig. 2. COMAROCYSTITES SHUMARDI, var. OBCONICUS, M. and W..294

2 *a*. Side view of an imperfect specimen with a part of the column attached, the body being filled with crystalline matter.

2 *b*. Side view of another specimen of same, showing the body only.

Fig. 3. POROCRINUS PENTAGONUS, M. and W.....332

Side view of body and column.

[By an oversight, the description of this species was inserted along with the fossils of the Cincinnati group.]

Fig. 4. ORTHOCERAS (ORMOCERAS) BACKII, Stokes?.....298

View of an internal cast, showing the irregularities formed by an organic deposit on the inside of the walls of the shell. Also of the mould of the large beaded siphuncle, with a cast of its central cavity.

Fig. 5. VANUXEMIA? DIXONENSIS, M. and W..... 297

5 *a*. A right side view.

5 *b*. Posterior dorsal view of the two valves united.

Fig. 6. LYCHAS CUCULLUS, M. and W..... ..299

6 *a*. Side view of the glabella.

6 *b*. Anterior view of same.

6 *c*. Posterior view of do.

Fig. 7 a. MODIOLOPSIS ORTHONOTA, M. and W.....295

Side view of left valve, as seen lying in the matrix.

Fig. 7 b, and 8. MODIOLOPSIS MODIOLIFORMIS, M. and W.....294

7 *b*. Dorsal view of the two valves united.

8. Side view of same, the basal margin being a little defective at the anterior end.

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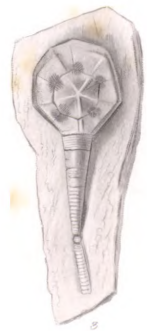
GEOLOGICAL SURVEY OF ILLINOIS

LOWER SILURIAN (Trenton Limestone) MISCELLANEOUS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1a


1b


2a


5a


5b


4


6a


2b


6b


7b


6c

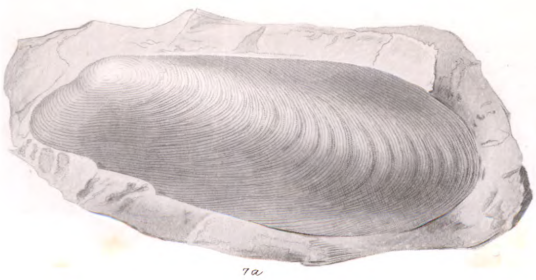
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PLATE II.

PAGE.

Fig. 1. RECEPTACULITES ———— ?..... 301

1 *a*. Side view

1 *b*. View of summit. [Cell mouths represented too large, especially near the outer margin.]

Fig. 2. RECEPTACULITES GLOBULARIS, Hall?..... 301

2 *a*. View of summit. [Cell openings too large.]

2 *b*. Side view.

Fig. 3. RECEPTACULITES OWENI, Hall..... 302

View of a fragment of a large specimen (under side); the central perforation being formed by the breaking away of the attenuated central protuberance of attachment. A part of the surface shows the rhombic or quadrangular cell mouths; while the right hand upper part of the figure shows the rounded form of the cells within, as seen where the surface has been broken away.

Fig. 4. LINGULA QUADRATA, Eichwald.....305

4 *a*. View of internal cast.

4 *b*. Side view of same.

Fig. 5. AMBONYCHIA INTERMEDIA, M. and W.....306

5 *a*. An anterior view of internal cast.

5 *b*. Lateral view of same. [Striæ a little too coarse, and too oblique]

Fig. 6. TELLINOMYA ALTA, Hall.....309

6 *a*. Anterior view of internal cast.

6 *b*. Side view of same.

Fig. 7. TELLINOMYA VENTRICOSA, Hall..... 307

7 *a*. Anterior view of an internal cast.

7 *b*. Dorsal view of same.

7 *c*. Side view of same. [Anterior ventral margin not prominent enough.]

Fig. 8. CHÆTETES PETROPOLITANUS, Pander (sp.).....304

8 *a*. Side view.

8 *b*. View of the concentrically wrinkled under side.

Fig. 9. CYPRICARDITES OBLIQUUS, M. and W..... 311

9 *a*. Anterior view of internal cast.

9 *b*. Side view of same.

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GEOLOGICAL SURVEY OF ILLINOIS

LOWER SILURIAN (Galena Formation) RADIATA & MOLLUSCA

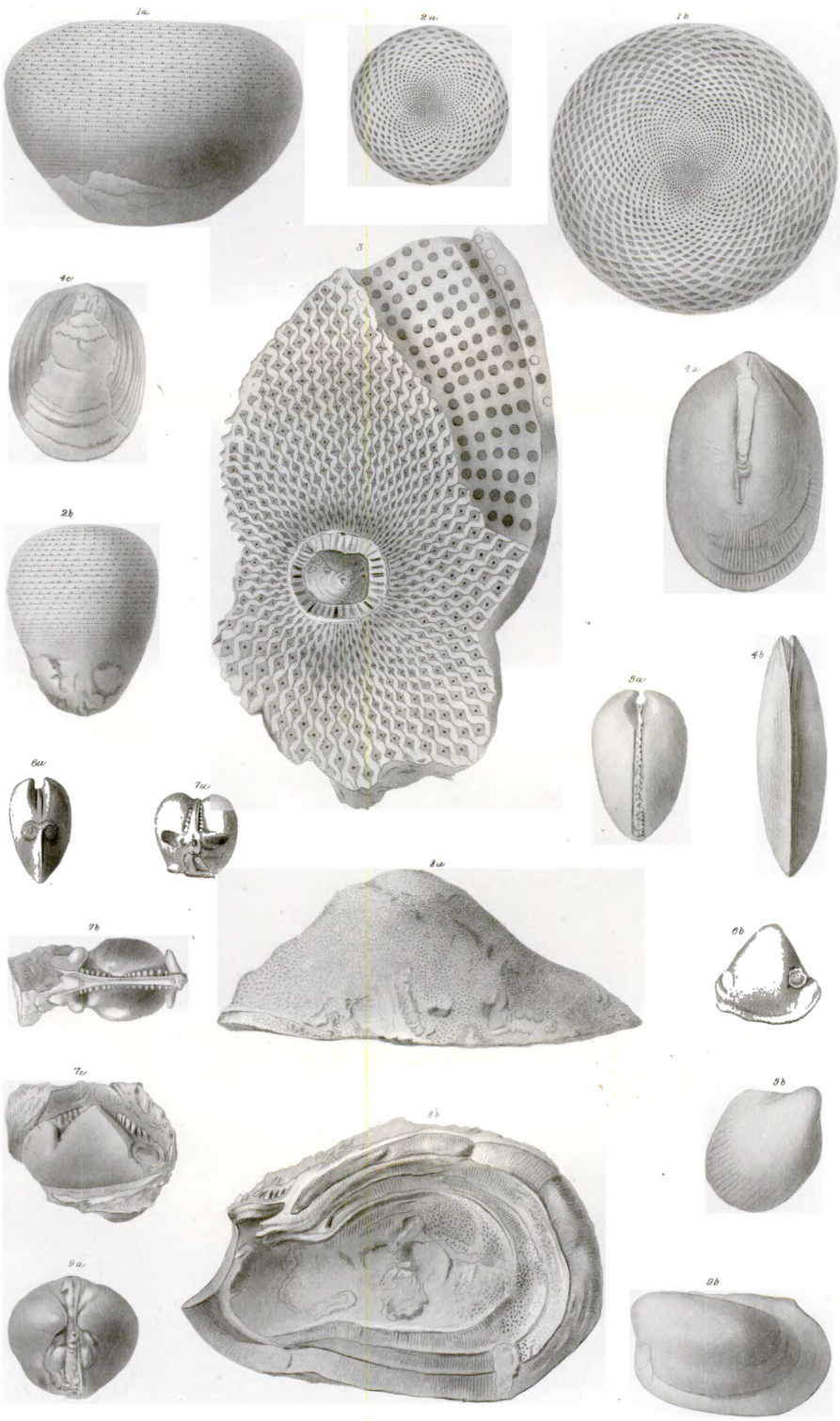

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PLATE III.

PAGE.

Fig. 1. ILLÆNUS CRASSICAUDA, Wahlenb.??.....322

1 *a*. Dorsal view, showing the pygidium and thorax; and posterior margin of the head. [The pygidium should have the anterior lateral margins truncated, instead of produced and acutely angular.]

1 *b*. An imperfect view of the glabella, with a part of its posterior margin obliquely folded under, and the cheek on the right flattened out by pressure.

Fig. 2. ILLÆNUS TAURUS, Hall.....320

Dorsal view of a cast, the head being arched over, so that only about one-half of its full length is seen.

Fig. 3. ORTHOCERAS ANELLUM, Conrad.....318

View of a part of internal cast. [Septa and annulations too oblique.]

Fig. 4. MURCHISONIA BICINTA, Hall?.....317

Side view of an internal cast.

Fig. 5. TROCHONEMA UMBILICATA, Hall? (sp.).....314

5 *a*. Front view of internal cast.

5 *b*. Back view of same. [Body whorl too concave, and with too many lines above.]

Fig. 6. OPHILETA OWENANA, M. and W.....313

6 *a*. View of under side of an internal cast.

6 *b*. Anterior profile view of same inverted, the specimen being so imbedded in the matrix that it could not be well drawn with the dorsal side above.

Fig. 7. RAPHISTOMA LENTICULARIS, Conrad (sp).....316

7 *a* and *c*. Under and profile views of a specimen referred doubtfully to this species.

7 *b*. Upper view of an internal cast of a larger specimen.

Fig. 8. BELLEROPHON PLATYSTOMA, M. and W.....312

8 *a*. Side view of an internal cast with the expanded lip mainly broken away.

8 *b*. Dorsal view of same.

Fig. 9. CYPRICARDITES ————?.....311

9 *a*. Right side view of an internal cast.

9 *b*. Anterior view of same.

9 *c*. Posterior view of same.

9 *d*. Cardinal or dorsal view of same.

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GEOLOGICAL SURVEY OF ILLINOIS

LOWER SILURIAN (Galena Formation) CRUSTACEA & MOLLUSCA

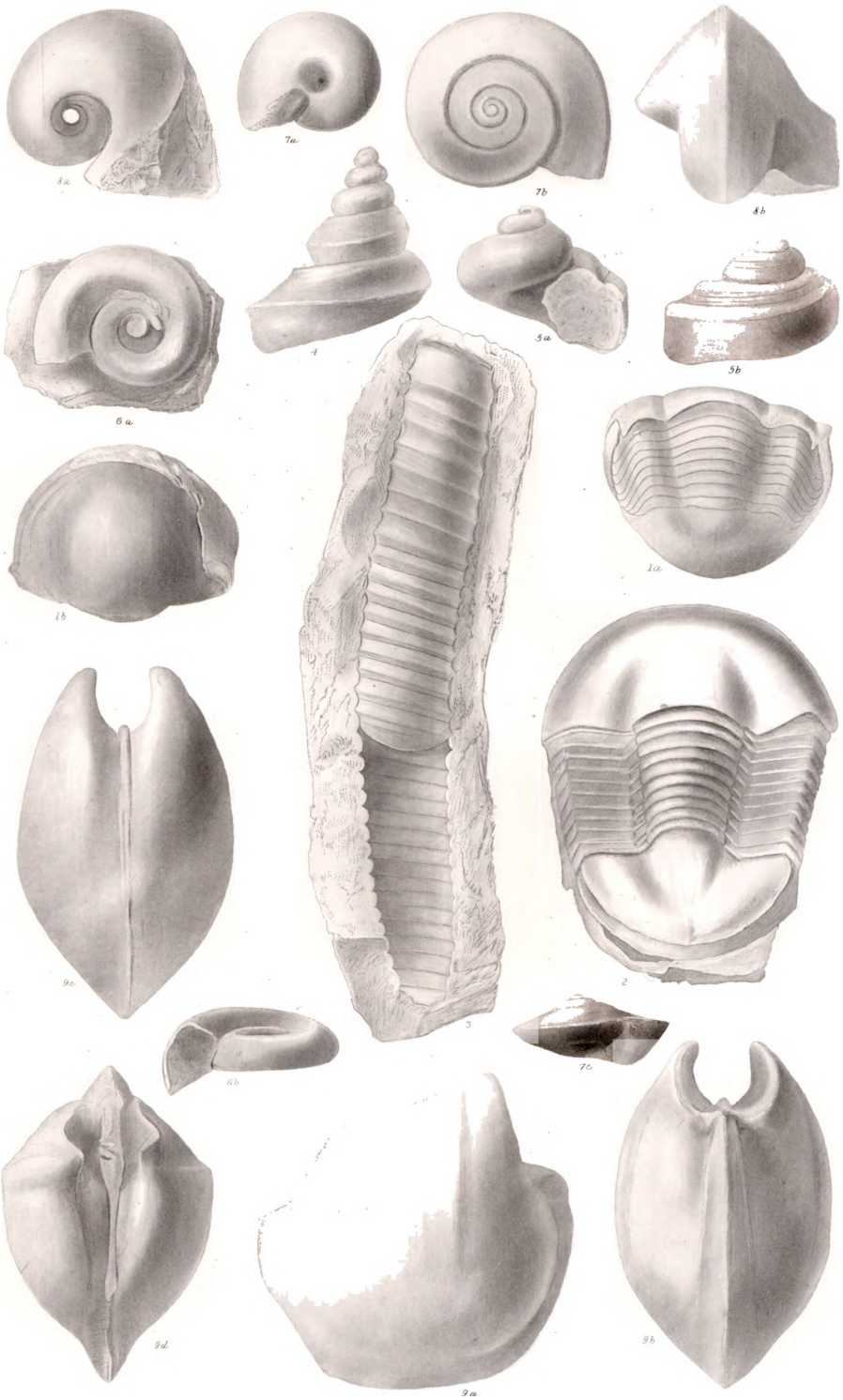

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PLATE IV.

PAGE.

Fig. 1. HETEROCRINUS CRASSUS, M. and W 324

1 *a*. Side view of body and portions of the free rays.

1 *b*. Opposite view of same.

1 *c*. View of the body of another specimen, with the pentagonal column attached.

Fig. 2. POROCRINUS CRASSUS, M. and W..... 330

2 *a*. Posterior view of body, showing the arrangement of the anal and other plates on that side, and the position of the anal opening above.

2 *b*. Anterior view of same.

Fig. 3. HYBOCRINUS? INCURVUS, M. and W.....327

3 *a*. Lateral view of body and portions of the arms, with a few joints of the column attached.

3 *b*. Another view of same.

Fig. 4. DENDROCRINUS? OSWEGOENSIS, M. and W.....333

Posterior-lateral view of an imperfect specimen, showing the arrangement of the plates in some of the rays, up to the third radials; also a few of the upper joints of the column connected with the base.

Fig. 5. HETEROCRINUS SUBCRASSUS, M. and W..... 325

5 *a*. Side view of a specimen with the arms and a portion of the column attached. [Basal pieces not well represented.]

5 *b*. Side view of another specimen, with portions of the arms and column remaining.

5 *c*. View of another specimen showing (imperfectly) the large proboscis extending above the remaining portions of the arms, and connected with the arm-like range of anal pieces on its left.

Fig. 6a. TENTACULITES OSWEGOENSIS, M. and W 342

Showing two entire specimens, and fragments of others imbedded in the same mass of limestone.

Fig. 7. TENTACULITES TENUISTRIATUS, M. and W..... 341

7 *a* and *b*. Side views of different specimens.

Fig. 8. TENTACULITES STERLINGENSIS, M. and W.....343

Showing two nearly entire specimens and fragments of others, in the same matrix.

Fig. 9. MEGAPTERA CASEI, M. and W..... 337

9 *a*. Left side view of a specimen with portions of the posterior margin and wing broken away.

9 *b*. Anterior view of same.

Fig. 10. DOLABRA? STERLINGENSIS, M. and W..... 339

10 *a*. A left side view

10 *b*. A posterior view of same.

10 *c*. An anterior view of same.

Fig. 11. STROPHOMENA UNICOSTATA, M. and W..... 335

11 *a*. View of outside of ventral valve.

11 *b*. Interior of dorsal valve.

Fig. 12. CYRTOLITES IMBRICATUS, M. and W..... 340

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GEOLOGICAL SURVEY OF ILLINOIS

LOWER SILURIAN (Cincinnatti Group) MISCELLANEOUS

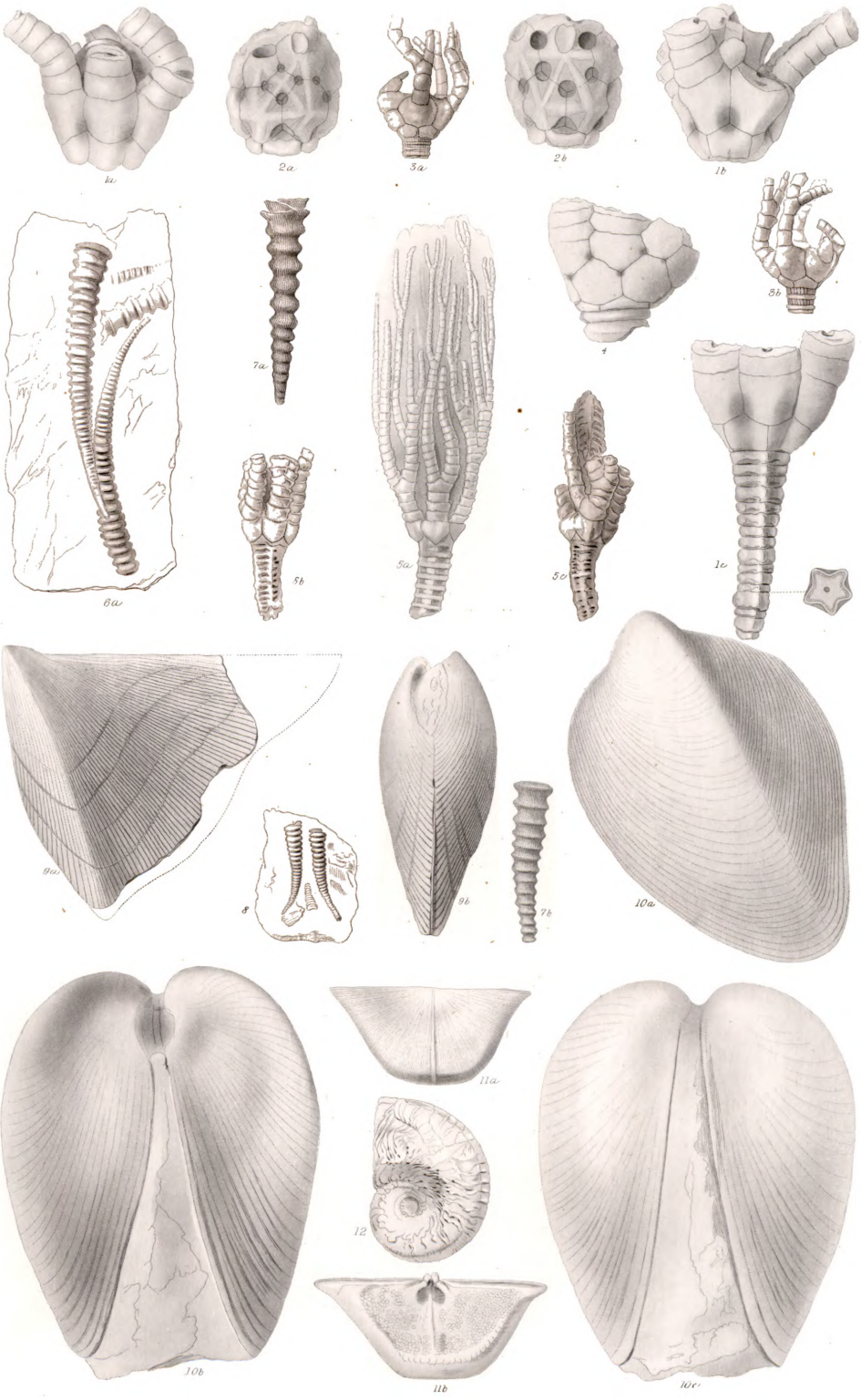

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PLATE V.

PAGE.

Fig. 1. SACCOCRINUS CHRISTYI, Hall? (sp)..... 347
Side view of the internal cast of body and arm-bases; the form of the plates being defined by obscure raised lines along the positions of the sutures.

Fig. 2. PASCEOLUS? DACTYLIOIDES, Owen (sp.) 345
2 *a*. View of under side.
2 *b*. Side view of same.
2 *c*. Convex or upper side of same.

Fig. 3. ASTYLOSPONGIA?? CHRISTIANI, M. and W.....344
3 *a*. Side view.
3 *b*, *c*. Opposite end views of same.

Fig. 4. PLEUROTOMARIA CYCLONEMOIDES, M. and W.....360
Side view of an imperfect internal cast. [Wants 2 or 3 more revolving lines on upper part of body whorl, and several smaller ones on the next above.]

Fig. 5. PLEUROTOMARIA CASII, M. and W..... 359
Lateral view of an internal cast.

Fig. 6. SUBULITES (POLYPHEMOPSIS) BREVIS, M. and W.....362
Side view of a cast, with a part of the lip imbedded in the matrix. [The suture between the body whorl and the next one above, is too faintly defined.]

Fig. 7. OBOLUS [TRIMERELLA?] CONRADI, Hall.....351
An internal cast.

Fig. 8. AMBONYCHIA ACUTIROSTRIS, Hall?.....356
8 *a*. Left view of an internal cast. [Anterior basal margin too prominent, and beaks scarcely pointed enough.]
8 *b*. Right view of another cast. [Middle of anterior margin too prominent, and scars of posterior hinge teeth should range obliquely downward and backward.]
9 *c*. Anterior view of the specimen represented by fig. 8 *a*.

Fig. 9. AMPHICŒLIA NEGLECTA, McChesney 358
9 *a*. Left side view of an internal cast.
9 *b*. Cardinal view of same.

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GEOLOGICAL SURVEY OF ILLINOIS

UP. SILURIAN (Niagara Group) MISCELLANEOUS

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PLATE VI.*

PAGE.

Fig. 1. DALMANITES DANÆ, M. and W. 363

1 *a*. An internal cast, showing more than half of a large individual.
1 *b*. The cephalic shield of a smaller specimen.
1 *c*. Profile side view of same.
1 *d*. Pygidium of a small specimen.
1 *e*. Profile view of same.
1 *f*. Hypostome found associated with the other specimens, and believed to be that of this species.

Fig. 2. CYCLONEMA?

[The specimen of this species was mislaid before we had an opportunity to prepare a description.]

Fig. 3. PTERINEA THEBESENSIS, M. and W. 354

Cast of a left valve. [See cut of a better specimen in text.]

Fig. 4. MERISTELLA? sp. 354

4 *a*. Dorsal view of a distorted specimen.
4 *b*. Ventral view of same
4 *c*. Profile view of do.

Fig. 5. CENTRONELLA BILLINGSIANA, M. and W. 352

5 *a*. Dorsal view of a somewhat distorted specimen.
5 *b*. Ventral view of same.
5 *c*. Profile of same.
[See, also, cuts in text.]

Fig. 6. HEMIPRONITES SUBPLANUS, Conrad? (sp). 349

6 *a*. Ventral valve. [Striæ too straight on posterior lateral margin.]
6 *b*. Dorsal valve, with portions of the shell about the beak removed

---

*The fossils figured on this plate came from a thin local band of limestone, supposed, at the time the plate was printed, to belong to the Lower Helderberg Group. Later investigations, however, have led us to believe it belongs more properly to the horizon of the Niagara Group.

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GEOLOGICAL SURVEY OF ILLINOIS

UP. SILURIAN (Lower Helderberg Group) ARTICULATA & MOLLUSCA

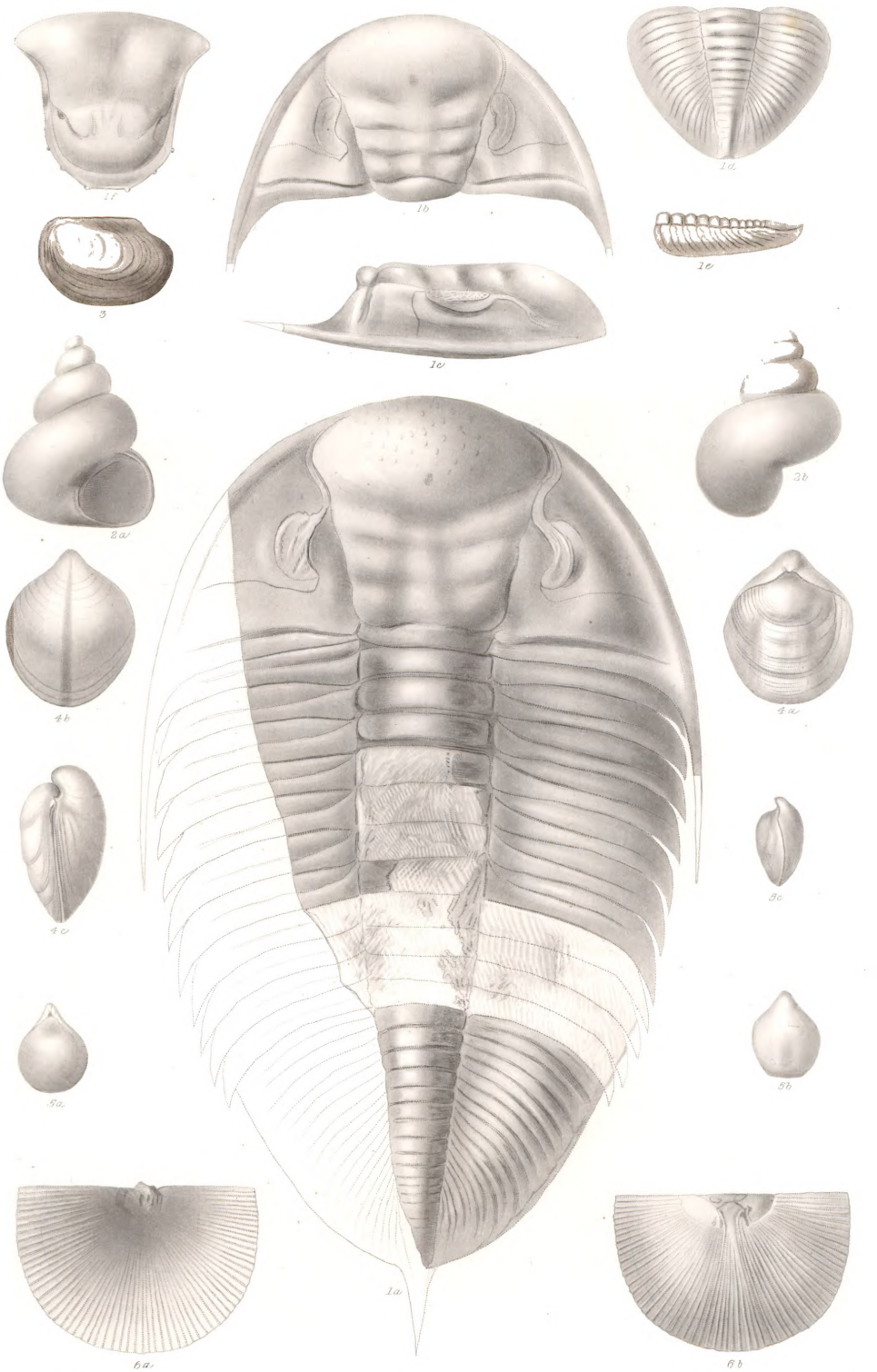

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PLATE VII.

PAGE.

Fig. 1. ZYGOSPIRA SUBCONCAVA 380

1 *a*. Ventral view, natural size.

1 *b*. Profile view of same.

1 *c*. Dorsal view of same.

1 *d*. Dorsal view enlarged. [Costæ too numerous and too small.]

Fig. 2. TREMATOSPIRA? IMBRICATA, Hall 381

2 *a*. Dorsal view, natural size.

2 *b*. Profile view of same.

2 *c*. Ventral view of same.

2 *d*. Dorsal view enlarged.

2 *e*. Ventral view enlarged.

Fig. 3. CYRTINA DALMANI, Hall (sp.) 383

3 *a*. View of ventral valve partly imbedded in the matrix.

3 *b*. View of area and foramen, as seen in another specimen imbedded in the limestone matrix.

Fig. 4. STRIATOPORA MISSOURIENSIS, M. and W 368

A somewhat weathered specimen, showing the striated cells.

Fig. 5. EDRIOCRINUS POCILLIFORMIS, Hall 370

5 *a*. Side view of a specimen composed of the basal and first radial pieces.

5 *b*. View of upper side of same.

Fig. 6. ORTHIS SUBCARINATA, Hall 373

6 *a*. Dorsal view, natural size.

6 *b*. Ventral view.

6 *c*. Cardinal view. [Not showing area correctly.]

6 *d*. Enlarged view of ventral side. [Striæ too straight on posterior lateral margins.]

Fig. 7. ORTHIS HYBRIDA, Sowerby? 371

7 *a*. Dorsal view, natural size.

7 *b*. Ventral view of same.

7 *c*. Profile view.

7 *d*. Ventral view of another specimen partly attached to the matrix.

7 *e*. Dorsal view enlarged.

7 *f*. Cardinal profile view. [Does not show the area very clearly.]

Fig. 8. MERISTELLA LÆVIS, Vanuxem? (sp.) 376

8 *a*. Profile or lateral view.

8 *b*. Ventral view of same.

8 *c*. Dorsal view. [Radiating striæ too distinct, and concentric markings too faint.]

Fig. 9. SPIRIFER PERLAMELLOSUS, Hall 384

9 *a*. Anterior view of a gibbous specimen.

9 *b*. Ventral view of another specimen.

9 *c*. Dorsal view of another example, with the lateral extremities broken away.

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Fig. 10. STROPHOMENA (STROPHODONTA) CAVUMBONA, Hall.....374

10 *a*. A cast of the inside? of a dorsal valve, with some of the inner laminæ attached.

10 *b*. View of a partly exfoliated interior of a dorsal valve, as seen imbedded in the matrix.

Fig. 11. PLATYCERAS PYRAMIDATUM, Hall?.....389

Side view of an imperfect specimen.

Fig. 12. PLATYCERAS SPIRALE, Hall 389

12 *a*. A specimen, with the apex and a portion of the lip broken away.

12 *b*. View of a nearly entire specimen.

12 *c*. View of another example with apex and lip broken away.

Fig. 13, 14. PLATYCERAS SUBUNDATUM, M. and W.....387

13 *a*. View of the under side of a small specimen, as seen in the matrix

13 *b*. Upper view of another specimen, attached to the rock.

14 *a*. View of a large individual, with some of matrix concealing the spire, so as to make it appear free from the body whorl. On one side may be seen a few large folds, which, with the undulations of the striæ, indicate a sinuous outline of the lip.

14 *b*. Another view of the same, showing the spire to be nearly or quite in contact with the body of the shell.

Fig. 15.* ACIDASPIS HAMATA, Conrad 390

Showing a part of hooked appendage of the posterior side of the head.

Fig. 16. DALMANITES TRIDENTIFERUS, Shumard.....391

View of the under side of the anterior and lateral margins of the head, with its tridentate appendage, as seen in the matrix.

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*By mistake numbered fig. 16 in the text.

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GEOLOGICAL SURVEY OF ILLINOIS

UP-SILURIAN

Lower Helderberg Group
Dithyris Shale

MISCELLANEOUS

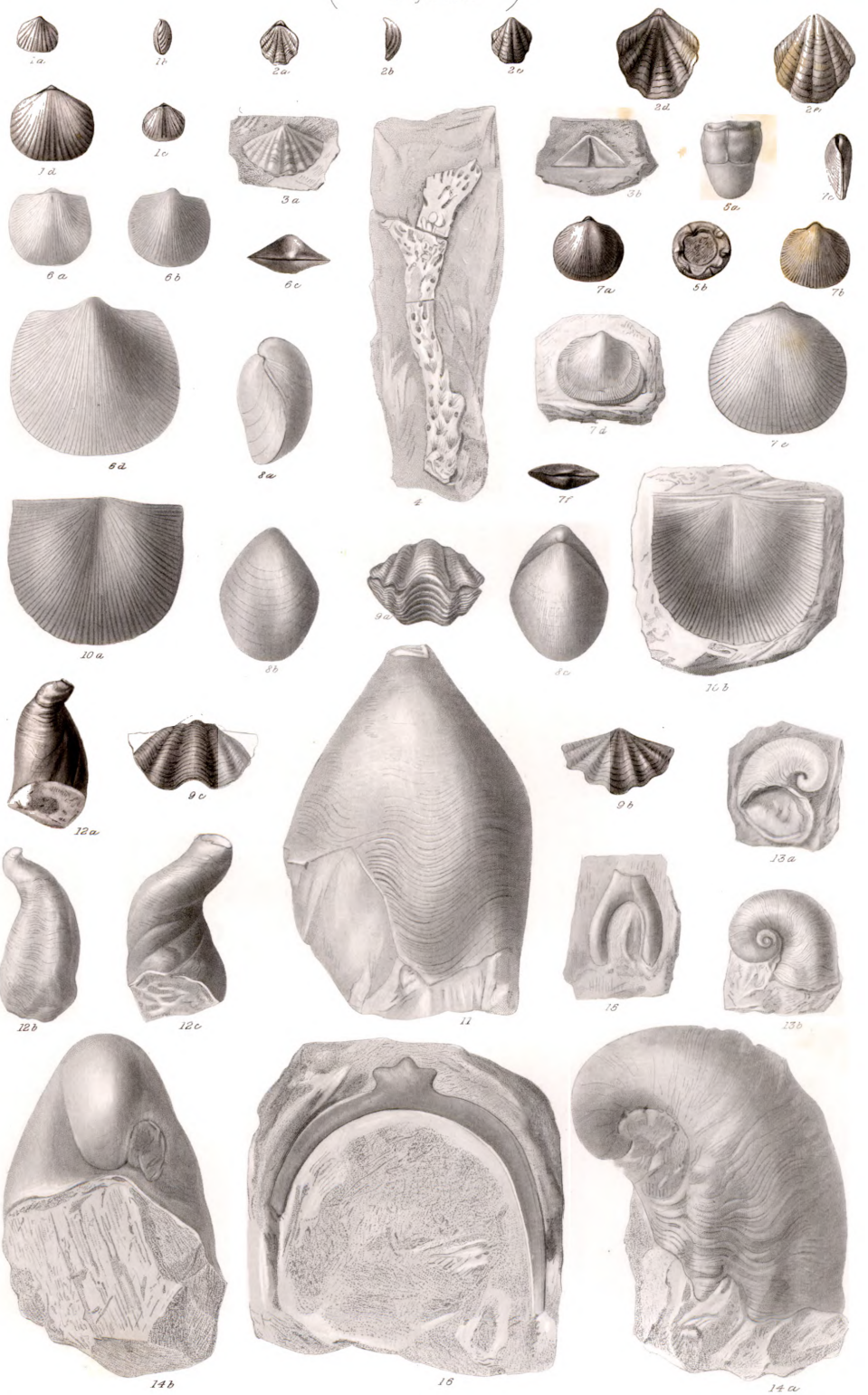

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PLATE VIII.

PAGE.

Fig. 1. STRICKLANDINIA? ELONGATA, var. CURTA 402
1 *a*. Dorsal view of an internal cast, imperfect in front.
1 *b*. Ventral view of another cast.
1 *c*. Posterior or cardinal view of same specimen as 1 *b*.

Fig. 2. EATONIA PECULIARIS, Conrad (sp.) 395
2 *a*. Side view.
2 *b*. Front view.
2 *c*. Dorsal view.
2 *d*. Ventral view.

Fig. 3. LEPTOCŒLIA FLABELLITES, Conrad (sp.) 397
3 *a*. Ventral view.
3 *b*. Dorsal view.
3 *c*. Profile. [Correct in outline, but showing no other character.]

Fig. 4. RENSSELÆRIA CONDONI, McChesney 401
4 *a*. Ventral view of an internal cast, with some remaining portions of the shell.
4 *b* Part of another internal cast, showing the cast of the rostral cavity of the ventral valve.

Fig. 5. SPIRIFER ENGELMANNI, M. and W. 398
5 *a*. Internal cast of ventral valve, showing the cast of its large, neatly striated rostral cavity.
5 *b*. Ventral view of the exterior of another specimen, with the front margin imperfect.
5 *c*. Dorsal view of same, showing the cardinal area and foramen.
5 *d*. Profile view of same.

Fig. 6 (and 7 a, b?) SPIRIFER HEMICYCLUS, M. and W. 399
6 *a*. Front view of a broken and distorted specimen.
6 *b*. Lateral view of same.
6 *c*. Dorsal view of another specimen.
6 *d*. Ventral view of same specimen as that from which 6 *a* was drawn.
7 *a* and *b*. Dorsal and ventral views of internal casts of an allied form.

Fig. 8. LEPTÆNA? NUCLEATA, Hall 393
8 *a* View of a cast of the exterior of dorsal valve, natural size.
8 *b*. View of an internal cast of ventral valve, natural size.
8 *c*. View of 8 *a*, magnified.
8 *d*. Do. of 8 *b*, magnified.

Fig. 9. RHYNCHONELLA SPECIOSA, Hall 394
View of the exterior of a ventral valve.

Fig. 10. PLATYCERAS SPIRALE, Hall 406
View of an internal cast, with the apex of the spire broken away.

Fig. 12 (and 11 a, b?) STROPHOSTYLUS? CANCELLATUS, M. and W. 404
11 *a*. An imperfect large specimen, possibly of this species.
11 *b*. Upper view of same.
12. An internal cast of one of the typical specimens.

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GEOLOGICAL SURVEY OF ILLINOIS

DEVONIAN (Oriskany Formation) MOLLUSCA

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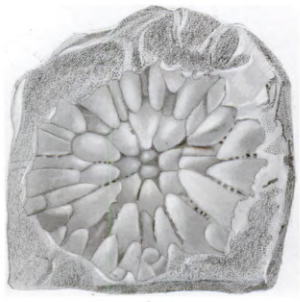
GEOLOGICAL SURVEY OF ILLINOIS

DEVONIAN (Oriskany – upper bed.) MISCELLANEOUS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2a


1b


4


3a

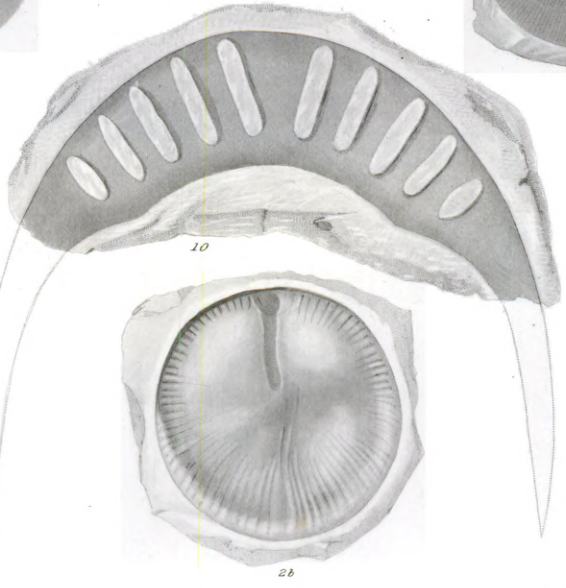

1c


5


3b


6a


6b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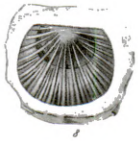
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7a


9

2b


7b

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PLATE IX.*

PAGE.

Fig. 1. PLEURODICTYUM PROBLEMATICUM, Goldf. 407

1 *a*. View of under side with the base removed so as to show the casts of corallites, and of the little connecting pores.

1 *b*. Upper view of another specimen, with the casts of most of the corallites removed, so as to show, in the middle, a cast of apparently the under side of the base or epithica.

1 *c*. Casts of other specimens as seen in the sandstone.

Fig. 2. BARYPHYLLUM? ? ARENARIUM, M. and W. 409

2 *a* A mould of the upper side, in a soft sandstone matrix.

2 *b*. Another mould of apparently the same, but circular in outline.

Fig. 3. ZAPHRENTIS (sp. undt.) 410

3 *a*. A cast of the interior of the calice.

3 *b*. Another view of same.

Fig. 4. ORTHIS (sp. undt.) 410

A cast of the interior of the dorsal valve, showing cavities left by the cardinal process, and socket plates.

Fig. 5. STRICKLANDINIA (sp. undt.)

A cast of the interior of the ventral valve.

Fig. 6. STROPHOMENA (STROPHODONTA) (sp. undt.) 412

6 *a*. A cast of the interior, showing the crenulations of the hinge, etc.

6 *b*. Mould of the outside of the same in the matrix, showing the very fine radiating striæ.

Fig. 7 and 9. STROPHOMENA (STROPHODONTA) (sp. undt.). 411

7 *a* Cast of the interior of a dorsal valve, showing the crenulations of the hinge, the cardinal process, etc.

7 *b*. Cast of the outside of the ventral valve of apparently the same species as 7 *a*.

9. Cast of the interior of the ventral valve of apparently the same species.

Fig. 8. STROPHOMENA? (sp. undt.)

8. Cast of the outside of another form from same locality and position as the above, but belonging to a distinct species.

Fig. 10. DALMANITES (ODONTOCEPHALUS) (sp. undt.) 416

An impression of the anterior alate and perforated margin of the head (nat. size.)

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*At the time this plate was printed, the sandstone from which the fossils illustrated on it were obtained, was supposed to belong more properly to the upper part of the Oriskany group; but later investigations have led to the conclusion that it belongs to about the horizon of the Onondaga division of the Corniferous group.

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GEOLOGICAL SURVEY OF ILLINOIS

DEVONIAN (Oriskany – upper bed) MISCELLANEOUS

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PLATE X.

PAGE.

Fig. 1. SPIRIFER PEREXTENSUS, M. and W. 414

1 *a*. View of ventral valve, imperfect at the lateral extremities.

1 *b*. View of same valve of a smaller individual, also imperfect.

1 *c*. Cardinal or posterior view of same, showing hinge, area, and foramen.

1 *d*. Dorsal view of another broken specimen.

Fig. 2. SPIRIFER PARADOXUS, Schlotheim ? 415

Ventral view of a specimen with the shell removed on the left side so as to expose the internal cast of the rostral cavity; while on the right side the shell remains in a partly exfoliated condition.

Fig. 3. PRODUCTUS EXANTHEMATUS, Hall ? 412

3 *a*. Side view of ventral valve.

3 *b*. Ventral view of same.

3 *c*. Same view of another specimen. [In all of these figures the bases of attachment of the spines are too small and too round. They are on the specimens little elongated tubercles. The radiating costæ are also represented (especially on fig. 3 *a*) too much like sharp lines, instead of obscure elongated nodes. The two spines on the left ear of fig. 3 *c*, belong to another specimen, apparently of same species, lying in the same matrix, but not represented in the figure.]

Fig. 4. DALMANITES (ODONTOCEPHALUS) ÆGERIA, Hall ? (sp.) 417

4 *a*. View of head in a somewhat crushed condition.

4 *b*. Pygidium found associated in the same matrix.

4 *c*. A smaller pygidium found in same association.

Fig. 5. SPIRIFER SUBUNDIFERUS, M. and W. 434

5 *a*. Dorsal view of a rather small specimen, with the external layers of the shell exfoliated.

5 *b*. Ventral view of same.

5 *c*. Side view of a large specimen with the shell mainly exfoliated.

5 *d*. Dorsal view of same.

5 *e*. Ventral view of same.

Fig. 6. ASTRÆOSPONGIA HAMILTONENSIS, M. and W. 419

A specimen consisting of the numerous six-rayed spicula imbedded in the matrix, but not in a condition to show the form of the whole fossil.

Fig. 7. STROPHOMENA RHOMBOIDALIS, Wahlenb. (sp.) 426

7 *a*. Dorsal view.

7 *b*. Profile view of same.

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GEOLOGICAL SURVEY OF ILLINOIS

DEVONIAN (Upper Helderberg & Hamilton Group) MISCELLANEOUS

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PLATE XI.

PAGE.

Fig. 1. PHACOPS RANA, Green.....447

1 *a*. Side view of head, with some of the body segments folded under.

1 *b*. An internal cast of the pygidium and portions of body segments.

1 *c*. An upper view of same specimen as 1 *a*.

1 *d*. Anterior view of head.

1 *e*. Lateral view of pygidium. (Same specimen as 1 *b*.)

Fig. 2. MODIOLOPSIS? PEROVATA, M. and W.....438

Side view of left valve.

Fig. 3. GRAMMYSIA? RHOMBOIDALIS, M. and W.....439

3 *a*. Dorsal view of an imperfect internal cast.

3 *b*. Lateral view of same.

Fig. 4. PLATYCERAS VENTRICOSUM, Conrad.....441

4 *a*. Side view. [Margin of lip, on left, not entire; and lines of growth not correctly represented.]

4 *b*. Another view of same.

Fig. 5. PTERINEA? SUBPAPYRACEA, M. and W.....437

View of left valve.

Fig. 6. ISONEMA DEPRESSA, M. and W. [See also cuts in text.].....443

6 *a*. View of lower side.

6 *b*. View of upper side.

Fig. 7. MICROCYCLUS DISCUS, M. and W.....420

7 *a*. View of under side, showing the concentrically wrinkled epitheca.

7 *b*. View of upper side of a smaller specimen, showing the septa and fossette.

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GEOLOGICAL SURVEY OF ILLINOIS

DEVONIAN (Hamilton Group) CRUSTACEA & MOLLUSCA

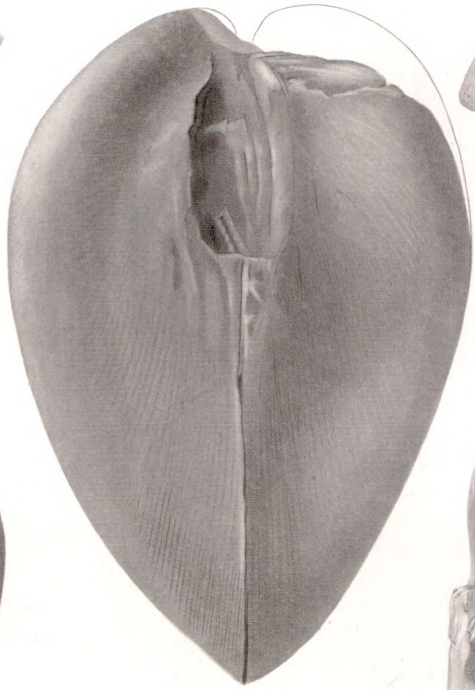

1a


2


1c


1b


1d


3a


7a


1e

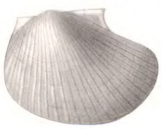

4a


4b


6a


3b


7b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6b

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PLATE XII.

PAGE.

Fig. 1. GYROCERAS CONSTRICTUM, M. and W. 446

1 *a*. View of the concave side of an imperfect internal cast of less than half of a volution, consisting in part of the outer or body chamber, and in part of the septate portion.

1 *b*. Opposite view of same.

Fig. 2. GOMPHOCERAS TURBINIFORME, M. and W. 444

2 *a*. Side view of an internal cast incomplete at both extremities.

2 *b*. Outline section of the smaller end, showing the position of the siphuncle.

Fig. 3. CYRTOCERAS SACCULUM, M. and W. 445

3 *a*. View of the convex side of a specimen with a portion of the smaller end broken away.

3 *b*. Lateral view of same.

3 *c*. View of concave or nearly straight side of same.

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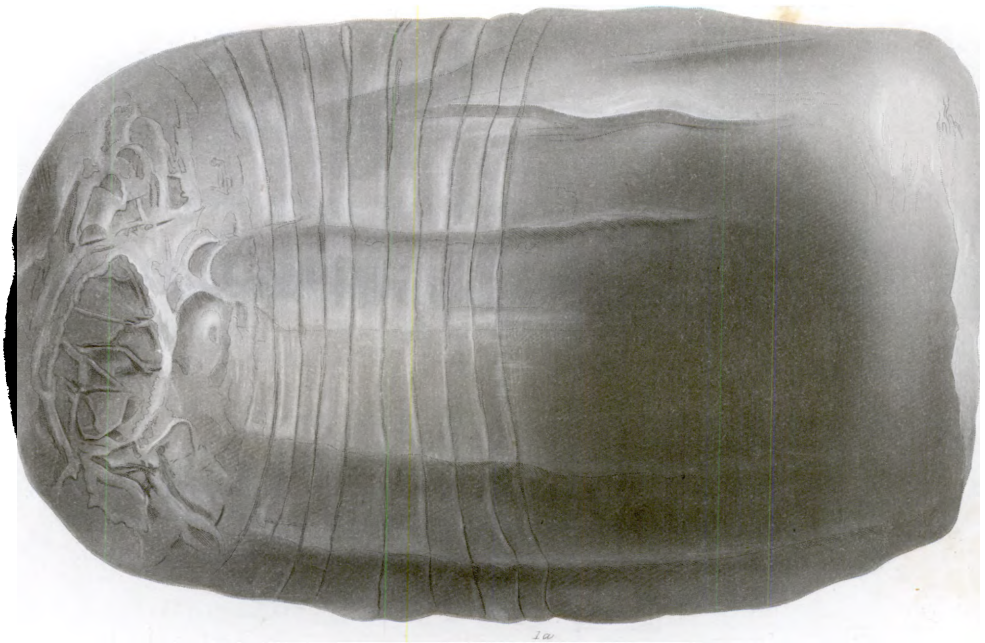
GEOLOGICAL SURVEY OF ILLINOIS

DEVONIAN (Hamilton Group) MOLLUSCA



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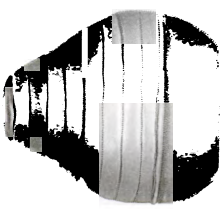

2a

3a

3b

3c

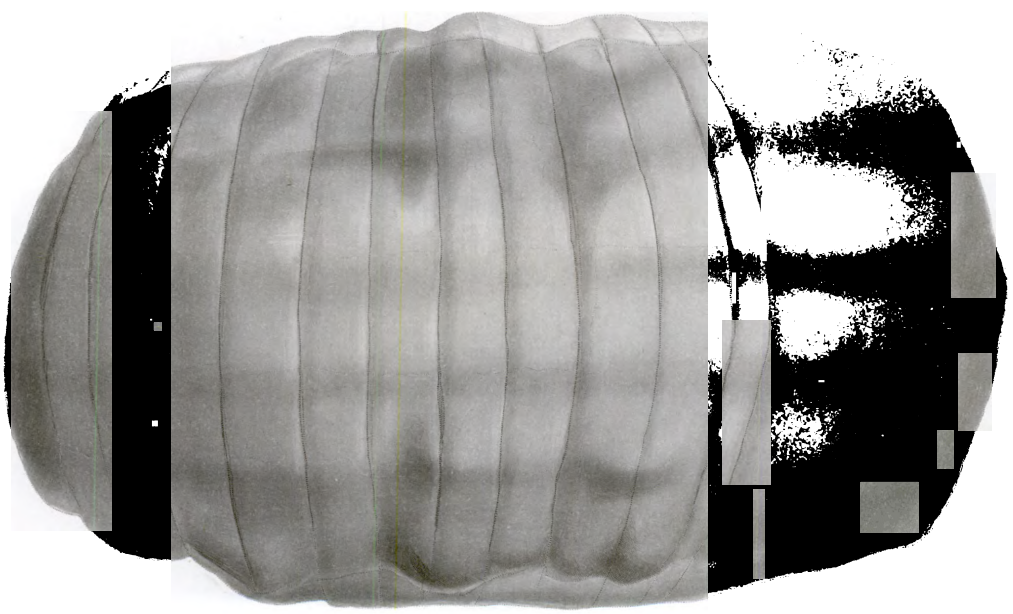

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PLATE XIII.

PAGE.

Fig. 1. LINGULA SUBSPATULATA, M. and W. 437
The specimen is flattened in shale, so as to fracture the shell a little along the middle, but the appearance of radiating lines there, is an error in the engraving.

Fig. 2. TROPIDOLEPTUS CARINATUS, Conrad (sp.) 427
2 *a*. Front view.
2 *b*. Ventral view.
2 *c*. Dorsal view.

Fig. 3. TAXOCRINUS GRACILIS, M. and W. 421
A side view of a nearly entire specimen, excepting the column.

Fig. 4. CYRTINA TRIQUETRA, Hall (sp.) 436
4 *a*. A lateral view.
4 *b*. An anterior view of same.
4 *c*. Cardinal view showing area and foramen.
4 *d*. View of dorsal or flat valve.

Fig. 5. PENTAMERUS SUBGLOBOSUS, M. and W. 428
5 *a*. Front view.
5 *b*. Dorsal view.
5 *c*. Lateral view of same.

Fig. 6. PENTAMERUS COMIS, Owen? (sp.) 428
6 *a*. Ventral view.
6 *b*. Lateral view of same.
6 *c*. Dorsal view of same.

Fig. 7. ATRYPA ASPERA, Schloth (sp.) 430
7 *a*. Ventral valve of a large, coarsely plicated specimen.
7 *b*. Lateral view of a smaller individual.
7 *c* and *d*. Dorsal and ventral views of same.

Fig. 8. SPIRIFER FORNACULA, Hall 433
8 *a*. Anterior view.
8 *b*. Lateral view of same.
8 *c*. Dorsal view.

Fig. 9. ORTHIS IOWENSIS, var. FURNARIUS, Hall 424
9 *a*. Dorsal view of a large specimen.
9 *b*. Internal view of ventral valve, smaller size.

Fig. 10. ORTHIS MCFARLANEI, Meek 423
10 *a*. Ventral view, showing the prominence of the dorsal umbo.
10 *b*. Profile view of same.
10 *c*. Front view.
10 *d*. Dorsal view.

Fig. 11. ATRYPA RETICULARIS, Linn. (sp.) 432
A very large specimen, with the free margins of the valves greatly extended in the form of thin laminæ, the proper outline of the valves being indicated by the inner broken line.

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GEOLOGICAL SURVEY OF ILLINOIS

DEVONIAN (Hamilton Group) CRINOIDEA & MOLLUSCA

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PLATE XIV.

PAGE.

Fig. 1. PORCELLIA NODOSA, Hall 458

1 *a*. Dorsal view of an internal cast.

1 *b*. Side view of same.

Fig. 2. GYROCERAS? ROCKFORDENSE, M. and W..... 459

2 *a*. Side view of an internal cast, imperfect at both ends.

2 *b*. View of the outer side of the curve of same, showing the thin portion of the cast covering the nearly marginal siphuncle, to be broken through at places, so as to give the deceptive appearance of a small marginal lobe in the septa.

Fig. 3. PLATYCERAS HALIOTOIDES, M. and W..... 458

3 *a*. View of the upper side of an internal cast.

3 *b*. An under view of the same, showing the form of the aperture.

Fig. 4. PLATYCERAS SUBPLICATUM, M. and W..... 457

4 *a*. Side view of an internal cast, showing one end of the horse-shoe shaped muscular scar.

4 *b*. An upper view of same.

4 *c*. An upper view of another specimen in which the muscular scar is obsolete.

Fig. 5. PTERINEA? UNDULATA 456

A view of an internal cast, consisting of the two valves opened out, with portions of the margin broken away.

Fig. 6. PERNOPECTEN SHUMARDIANUS, Winchell?..... 453

6 *a*. View of a large, nearly circular specimen.

6 *b*. View of a smaller oval specimen.

Fig. 7. RHYNCHONELLA MISSOURIENSIS, Shumard..... 450

7 *a*. Ventral view of an internal cast, retaining traces of the radiating striæ, which, however, are represented too fine and too regular.

7 *b*. Dorsal view of same.

7 *c*. Side view of same.

7 *d*. Front view of same.

Fig. 8. PROETUS ELLIPTICUS, M. and W..... 460

View of a nearly perfect specimen, magnified about two diameters.

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PLATE XV.

PAGE.

Fig. 1. FENESTELLA (LYROPORA) RETRORSA, M. and W. 504
A view of the thickened marginal support, with the thin reticulated expansion, occupied by the animal cells, all broken away.

Fig. 2. EVACTINOPORA GRANDIS, M. and W. 503
A specimen, as seen broken across transversely, and imbedded in the matrix, showing the great length of the rays, the direction of the pores penetrating the same; and, near the middle, some indications of the laminated structure of the rays.

Fig. 3. PLATYCERAS BISERIALIS, Hall 509
3 *a*. A lateral view, showing the curve of the beak, and the remaining portions of the spines on one side.
3 *b*. Another view of the same.

Fig. 4. PLATYCERAS (EXOGYROCERAS) REVERSUM, Hall. 508
4 *a*. Side view. [Wrongly represented with the spire free from the body; see wood cut in text.]
4 *b*. Another view of the same.

Fig. 5. PLATYCERAS QUINCYENSE, McChesney 510
5 *a*. View of an internal cast, with the upper part broken away.
5 *b*. Another view of the same.

Fig. 6 and 7. METOPTOMA? UMBELLA, M. and W. 506
6 *a*. An upper view of a somewhat weathered specimen, differing from the typical form of the species in being roughened apparently by remains of broken up costæ on one side, and other irregularities of surface. It may be called *M. umbella*, var. *rugosa*.
6 *b*. A side view of same.
6 *c*. View of an internal cast, showing the horse-shoe shaped muscular scar.
7. An upper view of one of the typical specimens, retaining the shell, but with the apex broken away.

Fig. 8. CHONETES ILLINOISENSIS, Worthen 505
8 *a*. View of ventral valve enlarged two diameters.
8 *b*. A profile view of same. [Too convex.]

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GEOLOGICAL SURVEY OF ILLINOIS

SUB - CARBONIFEROUS MOLLUSCA

(Burlington Beds)

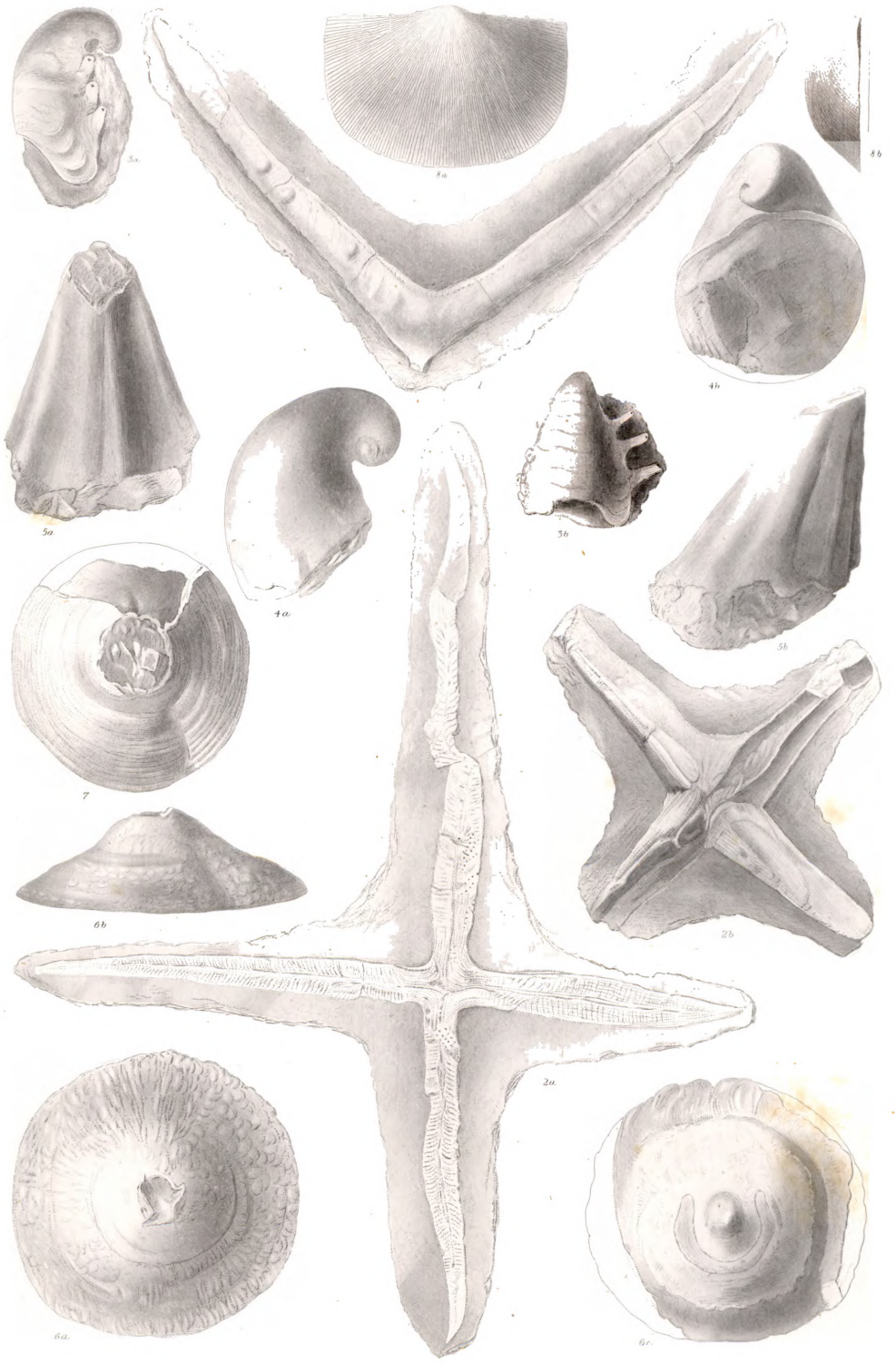

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PLATE XVI.

PAGE.

Fig. 1. POTERIOCRINUS TENUIBRACHIATUS, M. and W. 484
A side view of body and a part of the arms.

Fig. 2. ACTINOCRINUS? AMPLUS, M. and W. 470
A large specimen of body, with portions of arms and column attached, the whole being somewhat crushed and distorted by pressure.

Fig. 3. CYATHOCRINUS ENORMIS, M. and W. 481
3 *a*. Posterior lateral view of a specimen, showing the body and arms, with a piece of the column attached. Also showing the little arm-like lateral proboscis on the right, curving in between the arms.
3 *b*. Anterior view of same.

Fig. 4. ACTINOCRINUS (BATOCRINUS) PISTILLUS, M. and W. 472
4 *a*. Anterior view of the body and vault, with the arms, proboscis and column broken away.
4 *b*. Posterior view of same.

Fig. 5. CYATHOCRINUS WACHSMUTHI, M. and W. 482
Posterior view of a nearly entire specimen of body and arms, with a piece of the column attached.

Fig. 6. PLATYCRINUS PLANUS, Owen and Shumard? 467
A side view of body and portions of the arms.

Fig. 7. SCAPHIOCRINUS WACHSMUTHI, M. and W. 488
7 *a*. Posterior lateral view of body, with a portion of column attached.
7 *b*. An opposite view of another specimen, with a part of the arms in place.

Fig. 8. STEGANOCRINUS PENTAGONUS, Hall (sp.) 474
An upper view of the typical species of the genus, showing the vault (with the proboscis broken away) and portions of the long, free, covered rays, bearing, in some instances, portions of the arms along their sides.

Fig. 9. PLATYCRINUS SCOBINA, M. and W. 466
A side view of body and arms.

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GEOLOGICAL SURVEY OF ILLINOIS

SUB-CARBONIFEROUS (Burlington Beds) CRINOIDEA

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PLATE XVII.

PAGE.

Fig. 1. POTERIOCRINUS CARINATUS, M. and W. 486
A view of body and arms, with a portion of the detached column lying in the matrix.

Fig. 2. EVACTINOPORA RADIATA, M. and W 502
2 *a*. A view of under side, showing the thick non-poriferous edges of the rays.
2 *b*. A side view of the same inverted and partly hidden in the matrix.

Fig. 3. EVACTINOPORA SEXRADIATA, M. and W. 502
A transverse section, showing the outline of the six rays, and the small nucleus, as seen in the matrix.

Fig. 4. SCHŒNASTER WACHSMUTHI, M. and W. 499
A view of the under side of a crushed and distorted specimen.

Fig. 5. ONYCHOCRINUS DIVERSUS, M. and W. 492
5 *a*. An under view of the body and long free rays, with some of the divisions of the latter supporting the small arms at their extremities.

Fig. 6. BURSACRINUS WACHSMUTHI, M. and W. 479
A side view of the body and portions of the arms, the base and column being broken away.

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GEOLOGICAL SURVEY OF ILLINOIS

SUB-CARBONIFEROUS (Burlington Beds) MISCELLANEOUS

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PLATE XVIII.

PAGE.

Fig. 1. POTERIOCRINUS SUBIMPRESSUS, M. and W. 485

1 *a*. Posterior view of body with a piece of the column attached.

1 *b*. Anterior view of same.

Fig. 2. RHODOCRINUS NANUS, M. and W. 476

2 *a*. Posterior view of body, with a fragment of the column attached, and the arms and proboscis broken away.

2 *b*. Anterior view of same.

Fig. 3. FORBESIOCRINUS AGASSIZI, var. GIGANTEUS. 495

A side view of a very large specimen, as seen flattened in the matrix, with a few of the arms and a portion of the column attached.

Fig. 4. BELEMNOCRINUS WHITII, M. and W. 463

4 *a*. View of that portion of the body composed of the basal and subradial pieces, with one of the radials, and a part of one of the anal pieces attached.

4 *b*. An under view of same.

4 *c*. Another side view of same.

Fig. 5. CATILLOCRINUS WACHSMUTHI, M. and W. 465

A view of the body with the long thread-like arms attached.

Fig. 6. GRANATOCRINUS SHUMARDI, M. and W. 498

6 *b*. A side view magnified two diameters. [Fig. 6 *a*. probably represents an under view of *G. projectus*.]

Fig. 7 GRANATOCRINUS PROJECTUS. M. and W. 496

A side view magnified two diameters.

Fig. 8. GRANATOCRNUS NORWOODI, O. and S ? 496

A specimen with the delicate arms and a part of the column attached.

Fig. 9. PLATYCRINUS ASPER, M. and W. 468

A lateral view of a specimen consisting of the body and arms.

Fifi. 10. POTERIOCRINUS (SCAPHIOCRINUS) TENUIDACTYLUS, M. and W. . 490

A lateral view of body and arms.

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SUB-CARBONIFEROUS (Burlington Beds) CRINOIDEA.

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GEOLOGICAL SURVEY OF ILLINOIS

SUB-CARBONIFEROUS

(Keokuk Group)

MOLLUSCA

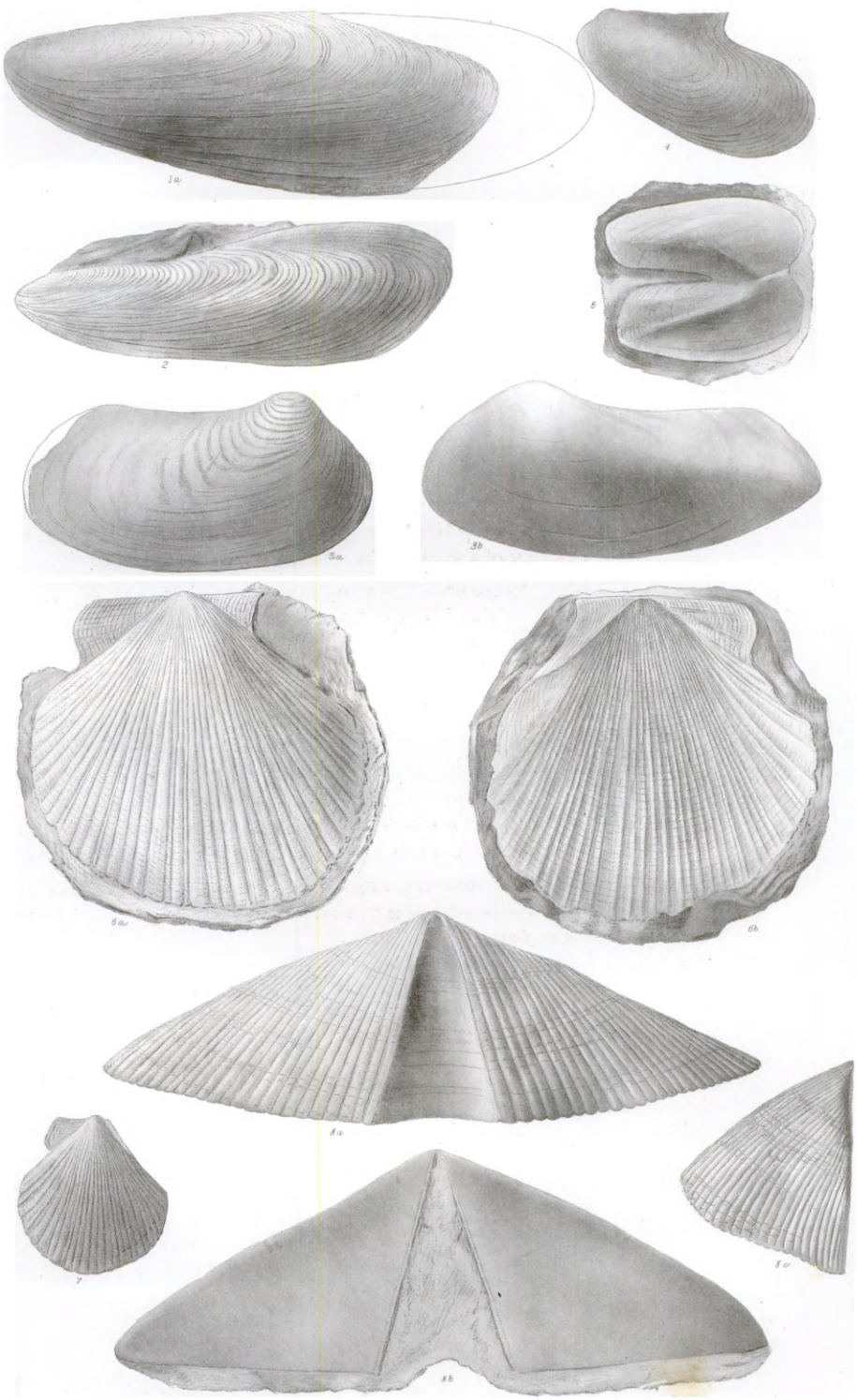

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PLATE XIX.

PAGE.

Fig. 1 and 2. LITHOPHAGA LINGUALIS, Phillips?.....536

1 *a*. Lateral view of a large specimen, with the posterior margin broken away.

2. Same view of a smaller, but more nearly perfect specimen.

Fig. 3 *a* (not 3 *b*). ALLORISMA (CHÆNOMYA?) HYBRIDA, M. and W.....538

View of right side. [The direction of the ridges of the surface not well shown.]

Fig. 3 *b*. SEDGWICKIA (SANGUINOLITES) SUBARCUATA, M. and W 537

Left view of an internal cast.

Fig. 4. ANTHRACOPTERA? FRAGILIS, M. and W.....534

View of left valve.

Fig. 5. PLEUROPHORUS COSTATIFORMS, M. and W.? 535

Internal cast of the two valves, opened out and lying together in the matrix. [See wood cut in text.]

Fig. 6. AVICULOPECTEN INDIANENSIS, M. and W.....532

6 *a*. Cast of the exterior of left valve.

6 *b*. Mould of same in the matrix.

Fig. 7. AVICULOPECTEN.

(Undetermined species, from the Keokuk beds at Crawfordsville, Ind.)

Fig. 8. SPIRIFER PROPINQUUS, Hall.....530

8 *a*. An anterior view of ventral valve.

8 *b*. A cardinal view of same, showing the high, flat area, and the large foramen.

8 *c*. Profile view of same specimen.

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GEOLOGICAL SURVEY OF ILLINOIS

(Keokuk Group)

Paulus Roetter del

A.H. Worthen direxit

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PLATE XX.

PAGE.

Fig. 1 and 6 *c*. CYATHOCRINUS FARLEYI, M. and W. 517

1 *a*. Posterior view of body without the arms.

1 *b*. Anterior view of same.

6 *c*. A lateral view of same.

Fig. 2. PLATYCRINUS HEMISPHÆRICUS, M. and W 511

2 *a* Side view of body and arms.

2 *b*. View of under side of same specimen.

Fig. 3. PLATYCRINUS NIOTENSIS, M. and W 513

Lateral view showing body with arms and a part of column attached.

Fig. 4. POTERIOCRINUS INDIANENSIS, M. and W 515

Posterior side view of a specimen, showing body and portions of arms.

Fig. 5. CYATHOCRINUS? (undetermined sp.) 518

5 *a* and *b*. Lateral views of body, consisting of basal, subradial and first radial pieces.

5 *c*. View of under side of same.

Fig. 6. CYATHOCRINUS QUINQUELOBUS, M. and W 519

6 *a* View of posterior side of body, without the arms.

6 *b*. View of same from below.

Fig. 7. PRODUCTUS MAGNUS, M. and W 528

7 *a*. View of the outside of ventral valve.

7 *b*. View of outside of dorsal valve, and beak of ventral do.

7 *c*. An internal view of dorsal valve.

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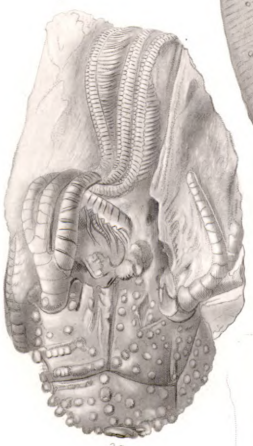
GEOLOGICAL SURVEY OF ILLINOIS

SUB-CARBONIFEROUS (Keokuk Group) CRINOIDEA & MOLLUSCA


1a


7a


1b


2a

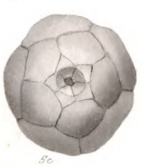

2b

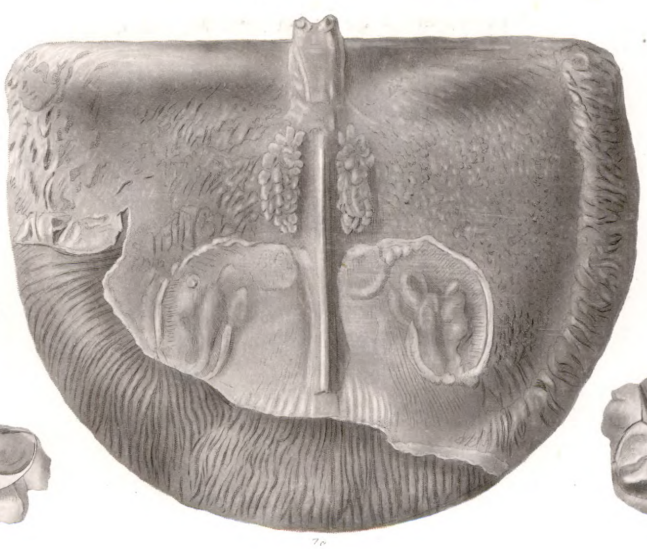

7b


3


4


5a


5c


7c


5b


6c


6a


6b

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