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ARTICLE V.—*On the Fauna of the Lower Carboniferous limestones of Spergen Hill, Ind., with a revision of the descriptions of its Fossils hitherto published, and illustrations of the species from the original type series.* By R. P. WHITFIELD.

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ARTICLE V.—*On the Fauna of the Lower Carboniferous limestones of Spergen Hill, Ind., with a revision of the descriptions of its Fossils hitherto published, and illustrations of the species from the original type series.* By R. P. WHITFIELD.

The following species of fossils, with a very few exceptions, which are now for the first time described, were originally described and published, without illustrations, in the Trans. Albany Institute, Vol. IV, by Prof. James Hall, the paper being read before the Society in Nov. 1856. The collection of fossils is now the property of the Am. Mus. Nat. Hist., and as they are an extremely interesting group, the descriptions have been much sought after. But the volume in which they were published being out of print, and copies of it extremely scarce, it has been deemed advisable to reprint in the present form the original descriptions, with comments and comparisons, and to illustrate the species for the purpose of preserving the authenticity of the collection now in the Museum as types, and at the same time avoid the necessity of its being done elsewhere from other specimens than those originally used. It is almost universally considered necessary to refer to the individual specimens first employed in the establishment of a species, whenever identification of forms are questioned. Oftentimes where the types are not readily accessible others are figured, and in that way become more or less typical, but are never so satisfactory to the real investigator as a good figure of the original specimen, no matter how imperfect that specimen may have been.

The collection at the time it was being described in the autumn of 1856 was mounted on cards, and the names and measurements marked on the back, and it has not been disturbed or its condition changed except by the addition of a few better preserved specimens, which are marked, and of labels on the face of the card, corresponding to the name given on the back. In selecting the material for the illustrations there have been in some cases better specimens or larger ones used, but at least one of the original specimens of each species has been figured, and in all cases where others have been used, the fact is mentioned in the description of the figure on the explanation of the Plates. The

descriptions were originally prefaced by some observations on the formations in which they occur, and on the other members of the Lower Carboniferous rocks, which have been superceded by subsequent publications, and which it is not necessary to repeat in this place. The formation in which the fossils are found, however, will need some remarks, for the purpose of localization.

The locality known as Spergen Hill (or Spurgeon's Hill), is near the railroad station of Harristown, a few miles S. E. of Salem, Washington Co., Ind. The formation has been considered as equivalent to the Warsaw division of the Lower Carboniferous limestones, but contains an intermingling of species known to occur in the Keokuk, Saint Louis and Chester limestones. The beds are exposed in the railroad cutting to a depth of fifteen or more feet, the greater part of the limestone being made up of these minute fossils. At Paynter's Hill, a short distance west of Spergen Hill (1½ m.?), the layers are exposed in the fields so as to become entirely weathered, forming a dark brownish-red soil, in which the fossils are often found entirely free from rock. At this locality the fossils are larger and somewhat differently preserved from those at Spergen Hill. There are also several species found here which do not occur at the former place. At Ellettsville, Ind., the same beds occur in great force, but do not contain very many fossils. The *Bellerophon* and *Euomphalus* occur quite abundantly however, and of very much greater size than at Spergen Hill. A portion of the beds at this locality, and at quarries near by, furnish much of the limestone used in the construction of the new State Capitol at Indianapolis. At Bloomington, Ind., it also occurs in pretty much the same condition as at Spergen Hill, but with fewer species and not usually as well preserved, being more chalky in composition and often more fragmentary, although many of them are of larger size. The formation has been observed at Alton, Illinois, where it is composed of thin shaly strata, bearing many of the characteristic species, but a much less number than at either Spergen Hill or Bloomington, while it is found to contain some that do not occur at any of the Indiana localities. Besides the layers which contain the fossils in such numbers, there are other beds similar in character or varying in composition, although classed as belonging

to the same geological formation, (Warsaw or lower St. Louis) found at several localities in Indiana and abundantly used for building stone and known and described in the Indiana Geological Reports as Oolitic limestones. In some of these the Ooliths are concretionary in structure, while in the beds which contain such numbers of these fossils the oolith-like bodies are mostly foraminiferous, and consist largely of specimens of the *Rotalia Baleyi*, Hall.

The conditions which existed during the deposition of these peculiar limestones are not readily determined. They must have been peculiar in character, for while being such as would sustain animal life in great abundance, there seem to have been adverse conditions which caused the species to become dwarfed in size to a remarkable extent, especially so where the individuals are the most abundant. Many of the species have been recognized at other localities, some in the Chester limestones above and others in the Keokuk beds below, and nearly always attaining a greater size, although retaining all the specific features, showing these to be only diminutive representatives of species, which, in some cases at least, have been described as distinct. In the remarks added to the descriptions several of these are pointed out, they being most particularly noticeable among the Brachiopoda.

In describing the species in this paper, the original description and measurement given by the author of the species is retained, being given in quotation marks, while the remarks now added are printed in a leaded type. In the description of the *Brachiopoda* the terms "dorsal" and "ventral" were originally applied in the reverse order from that in which they are at present understood; but a correction is added in brackets; except in the case of *Athyris hirsuta*, page 49, first paragraph, where the author himself has added the correction.

DESCRIPTION OF SPECIES.

FORAMINIFERA.

Genus ENDOTHYRA.

Endothyra Baleyi, Hall's sp.; (*Rotalia Baleyi*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 34;—Comp. *E. Bowmani*, Phillips; and *Involutina lobata*, Brady; see Palæont. Soc. London, Vol. 30, p. 92, Pl. 5, figs. 1–4.) **Plate 9, Fig. 34–36.**

"Shell depressed-orbicular, sub-equally convex above and below, smooth; margin rounded, indented by the septa; spire depressed, involved; last volution slightly oblique, consisting of eight loculi; aperture contracted.

"The general form of this fossil is depressed-globular, with the involutions deviating slightly from the same plane. Not unfrequently, however, the spire ascends in a greater or less degree, and one or more loculi become visible beyond the single volution. Sometimes seven loculi only are visible in the volution. The surface is smooth under an ordinary magnifier, and the outline is indented at the septa.

"It gives me great pleasure to offer the slight tribute of the name of this ancient species to one who has done so much for science in our country, and of whom it would be superfluous for me to say, that he stands at the head of his department;—of whose quiet, untiring zeal, patient investigation, and philosophical deduction, every student of science must speak with pride and satisfaction."

Mr. H. B. Brady in the Palæontological Society's papers above cited, has considered this species as the same with *Endothyra Bowmani* of Phillips, a common species in the Carboniferous limestones of England, Wales, Scotland and Ireland, and which is also found in other parts of the old world. The European examples, according to Mr. Brady's figures, correspond very closely with the American form, but are constantly of smaller size, and thinner and less robust in form. The number of segments is correspondingly variable in those of both countries, and consequently it becomes somewhat difficult to say why they should not be specifically identical. Forms of these low organ-

isms, at the present time, are known to have a very extended geographical distribution, and it is probable they may have had in the more remote geological periods. It seems however, as if the constant difference in size and the less robust form of the European examples in such closely allied and minute organisms might be of specific importance. I have, therefore, thought it prudent to retain Prof. Hall's name rather than adopt for the American specimens the older one of Prof. Phillips. The American specimens are usually about one-twentieth of an inch in their diameter, while the European examples according to Mr. Brady seldom exceed one thirty-fifth of an inch.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

ECHNIODERMATA.

Genus PENTREMITES, *Say.*

Pentremites Koninckana, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 4;—*Geol. Iowa* 1858, *p.* 656, *Pl.* 22, *fig.* 11.) **Plate 9, Fig. 33.**

"Small, globose, or sub-pyriform, upper part rounded, base sub-pyramidal, angular; basal plates small, the lateral edges short and covered by the column, allowing the base of three of the radial plates to come within the limits of the column area, the two other plates resting upon the longer sides of the larger basal plates. Radial plates short, convex in the middle and sloping to the sides, widening a little from the base upwards, and divided only half way down for the reception of the pseudo-ambulacral areas; interradial plates minute, linear or tapering very gradually upwards to a point, and having two extremely short oblique sides below. Pseudo-ambulacral areas broad, nearly plane, and extending only about half way from the summit to the base, rather deeply impressed at their rounded lower ends; poral plates varying from 6 to 13. Oral aperture small, pentagonal; anal aperture large, oval; ovarian opening small, nearly round; surface very finely and beautifully striated; striæ on the sides of the radial plates nearly vertical, but on the lower part they are deflected obliquely across so as to meet at an obtuse angle on the centre below the ambulacral areas. Column at its junction with the body round, relatively very large.

"Length, one-twelfth to one-fourth of an inch.

"This species resembles *P. caryophyllatus* of De Koninck, (Crinoides du Terrain carbonifere de la Belgique,) but differs in the shorter base and peculiarity of the basal plates, as well as in the

interradial plates, which in our species are extremely small and almost linear, the one on the annal side extending into that aperture. A single individual shows a nearly entire obliteration of one of the pseudo-ambulacral species."

The specimens described under this name are probably the young of *P. conoideus*, Hall. All the variations between them are in the direct course of development by additional growth. The short base, almost flat in the older specimens, is one of the most prominent characteristics of *P. conoideus*, but among a large number of small specimens of the species from the different localities none are found with flat bases, but as they increase in size this feature becomes more and more apparent. Occasionally medium sized individuals occur with unusually broad bases, giving them a more than commonly flattened form, but by far the greater number are the reverse in character.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Pentremites conoideus, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 5;—*Geol. Rept., Iowa* 1858, *p.* 655, *Pl.* 22, *fig.* 8–10.) **Plate 9, Fig. 32.**

"General form conoidal or pyramidal with the angles rounded; base subtruncate; apex a little flattened; plates of the base rather flattened; radial plates extremely elongated and deeply divided for the reception of the pseudo-ambulacral areas; interradial plates deeply inserted between the radial plates, long lanceolate, and very acutely pointed above; pseudo-ambulacral spaces very elongate, narrow, extending nearly to the base, with sides subparallel, convex along the median line; median line sharply depressed; poral plates varying with age from 25 to 50; ovarian apertures circular; anal aperture ovate and much larger than the others. Surface marked by fine, closely arranged striæ, which on the radial plates are parallel to the margins till near the summit, where they are stronger and diverge from the centre; striæ on the interradial plates diverging from the centre.

"Length, from one-fourth to three-fourths of an inch.

"In young specimens the base is more extended and the poral pieces much fewer than in older specimens.

"Associated with this species, and having a similar general aspect, I have observed a single specimen, having a length of three-fourths of an inch, of an obtusely quadrangular form, and having but four pseudo-ambulacral areas, one of them being much wider than the others. There are, however, five ovarian openings at the summit. This appears to be an individual where the two adjacent

sides of the radial plates have never been developed, while at the same time an effort has been made to preserve the symmetry of the ovarian openings."

This species differs from any of the many described from the carboniferous rocks of America in the conoidal form of the adult specimens, though young shells are common which present nearly the form of *P. pyriformis*, Say, and others that closely resemble *P. elegans* and *P. symmetricus*, Lyon. The preceding species comes first in the order as originally described by the author, but if they should be considered as belonging to the one species, *P. conoideus* should be retained for the species, as the other was founded upon immature specimens.

Locality.—This form has been recognized at Spergen Hill, Bloomington and Ellettsville, and at Paynter's Hill, Ind.; at Alton, Ill., if we consider the small individuals referred to *P. Koninckana.* It is also not uncommon near Boonville, Mo.

BRACHIOPODA.

Genus ORTHIS, *Dalman.*

Orthis dubia, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 12.) **Plate 6, Figs. 1–5.**

"Shell circular, or oval-ovate; valves nearly equally convex, the ventral [dorsal] valve somewhat more rotund; dorsal [ventral] valve flattened in the middle, with a broad depression extending thence to the front of the shell, giving it a sinuous outline; beak of dorsal [ventral] valve extended beyond the opposite valve, slightly incurved, with a triangular foramen; area very small, and (with the foramen of the dorsal [ventral] valve) nearly covered by the beak of the ventral [dorsal] valve, which curves towards the opposite valve, bringing the two almost in contact at their margins. Surface marked by fine rounded, closely arranged striæ, which increase by bifurcation and implantation; the striæ down the mesial depression are distinctly tubular, with minute, pore-like openings at intervals, directed downwards. These are probably the bases of minute tubular spines which were closely imbricated. Minute pore-like openings are sometimes seen on other parts of the shell, but never so conspicuous as in the dorsal [ventral] sinus.

"Length, .09 to .45, width .10 to .45 of an inch."

This species is more nearly allied to *Orthis Theimei* White, 1882.]

from the sandstones below the Burlington limestones at Burlington, Iowa, than to any other one. It differs, however, in the more pointed beak and rapidly sloping cardinal margins, in its narrower form and less regularly convex dorsal valve. The species is also remarkable for the thickening of the valves in older specimen, especially of the ventral valve. Subsequent collections have shown it to attain a considerably greater size than that given under the original description; specimens from Paynter's Hill measure five-eighths of an inch in length. In such examples the striæ become very much elevated and exsert, and the shell remarkably thickened.

Localities.—Spergen Hill, Paynter's Hill, and Bloomington, Ind., and Alton, Ill. It is present in the Mus. Collections from the Keokuk limestones from Keokuk and Augusta, Iowa; from Appanoose, Ill., and near Boonville, Mo.

Genus PRODUCTUS, *Sowerby.*

Productus biseriatus, Hall; (*Trans. Alb. Inst., Vol. 4, p. 12.*) **Plate 6, Figs. 8–12.**

"Shell longitudinally ovate; dorsal [ventral] valve extremely gibbous, without sinus, arcuate, marked by five or six elevated distant concentric undulations which are ornamented upon their dorsal margins by a single row of elongate pustules or nodes; and on their middle and basal margins by numerous smaller granulations; beak attenuate and extremely arcuate; ventral [dorsal] valve semi-oval, flattened near the base, having the greatest concavity near the beak, which is obtuse; surface of the ventral [dorsal] valve marked by eight or nine closely arranged, concentric bands, which are marked by granulations as in the dorsal [ventral] valve; hinge line scarcely so wide as the greatest width of the shell; extremities rounded."

The specimens of this species present all the features of *P. vittatus*, Hall; Geol. Rept., Iowa, 1858, p. 639, but dwarfed. The smaller individuals are also closely similar to the form known as *P. alternatus*, Norwood and Pratten, 1854, which is perhaps not distinct from *P. vittatus*. There are great variations among the specimens usually included under the name *P. vittatus*, and the passage from one to the other extreme, as marked by the three forms, is so gradual that it is doubtful if they should not all be included under the one name of *P. alternatus*.

Localities.—Spergen Hill, Paynter's Hill, and Bloomington, Ind., and Alton, Ill.

Productus Indianensis, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 13.) **Plate 6, Figs. 6 and 7.**

"Shell sub-ovate, gibbous, inflated; dorsal [ventral] valve without sinus, gradually contracting towards the beak which is large and strongly arcuate, obtuse at the extremity and very gibbous below; surface pustulose or aculeate, marked by extremely fine, concentric striæ, and a few irregular undulations; pustules or bases of spines irregularly distributed over the surface of the shell, with a linear series down each side below the hinge extremity; hinge line apparently less than the width of the shell."

It is extremely difficult to point out differences between this and the preceding species. The specimens are a little more ventricose on the umbo of the ventral valve than those referred to *P. biseriatus*, while the entire shell is more rotund. The surface marking, what little there is left on the specimens, is of the same character precisely as on that one, so the specific distinction will have to rest entirely on the external form. I have seen interiors of dorsal valves of this form which have a thickened border very distinctly marked, and which have not shown any evidence of the concentric undulations. But there are none in the collection that can be figured.

Locality.—Spergen Hill, Ind.

Genus SPIRIFERA, *Sowerby.*

Spirifera bifurcata, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 8.) **Plate 6, Figs. 13–15.**

"Shell semi-elliptical in general form; dorsal [ventral] valve gibbous; ventral [dorsal] valve depressed convex; plications, seven or eight, which appear to coalesce towards the cardinal margin; mesial fold with a defined depression in the centre, reaching half way to the beak; surface longitudinally striated and concentrically marked by fine lines.

"Length, .09, width .11 of an inch."

The individuals of this species in the original collection are extremely minute, and bear evidence of immaturity. Among the later collections are a number of larger specimens and others of intermediate sizes, showing a tendency to greater development in

the length of the hinge line and angularity of plications. The larger specimens present exactly the features of partially grown specimens of *Spirifera Leidyi*, N. & P. from the Chester limestones; and from this direction in the development by increased growth leave no doubt of these being dwarfed individuals of that species. A comparison of the three figures given, taking into consideration that they are enlarged six, three and two diameters respectively, will show this development of features.

Localities.—Spergen Hill, Ind.

Spiriferina Norwoodana; (*Spirifer Norwoodana*, Hall; *Trans. Alb. Inst. Vol.* 4, *p.* 7.) **Plate 6, Figs. 16 and 17.**

"Shell small, semi-elliptical, very gibbous, angles rounded; hinge line less than the greatest width of the shell. Dorsal [ventral] valve very convex and strongly arching near the beak, which is curved over the area; plications, about eight, the central ones very strong, and the mesial depression distinctly continued to the beak. Ventral [dorsal] valve ranging from depressed-convex to extremely convex, and marked by three strong plications on each side of the mesial fold, which has often a depressed line along the centre towards the base, with scarcely a distinct fold in the sinus of the dorsal [ventral] valve. Area small, high, not extending to the extremities of the hinge; foramen scarcely higher than wide; surface, in unworn specimens, marked by concentric, imbricating lamellæ.

"Length, .07 to .18, width .08 to .21 of an inch."

The shells of this species bear the the same relations to *Spiriferina Spinosa*, N. & P., that those of the above species do to *S. Leidyi*, except that these are rotund, in which feature they show more of an adult stage than do any of those of the other form. The shell of the best preserved specimen of this species preserves the spinose surface, and under a strong glass faint indications of the punctate structure so distinctive of *S. Spinosa* is discernable. As both *Spirifera Leidyi* and *Spiriferina Spinosa* occur of the normal form at three of these localities, it would be natural to suppose these dwarfed specimens may bear some close relations to those species.

Localities.—Spergen Hill, Ind., and Alton, Ill.

Genus ATHYRIS, *McCoy.*

Athyris hirsuta, Hall's sp.; (*Spirigera* (*athyris*) *hirsuta,* Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 8.) **Plate 6, Figs. 18-21.**

"Shell varying in form from ovate to sub-circular; beak prominent, slightly extended, front compressed, sometimes faintly sinuate. Valves nearly equally convex, the dorsal (ventral) valve most convex towards the beak; beak of dorsal (ventral) valve prominent, incurved so as to bring the minute foramen nearly on a line with the margin of the shell; beak of the smaller valve closely incurved beneath the beak of the opposite valve. Surface ornamented by concentric, imbricating lamellæ, which give origin to successive rows of minute spines.

"The cast shows faint impressions of radiating striæ, which are not visible on the external surface of the shell. A narrow impressed line is sometimes shown down the centre of the cast of the dorsal [ventral] valve; and a few specimens have a shallow depressed groove down the centre of the shell from beak to base in both valves. A cast of a large individual shows about seven turns of the internal spire.

"From the foregoing description it will be seen that this species is closely related to the *Terebratula Royssii* of Leveille, and to *T. planosulcata* of Phillips. It differs from the first in its small size and more ovate form, especially of young individuals, and in never having the distinct sinus possessed by that shell; while the beaks of our shell are more prominent and the slope on each side is less concave. The volutions of the internal spire in *T. hirsuta* are not more than half the number represented in *T. Royssii.* From the *T. planosulcata* it differs in its small size, in being less ventricose, especially towards the front margin, in the proportionally more prominent beaks and generally more elongate form. From the specimens examined the projecting spinose lamellæ in our shell are never so much extended as in that species."

The specimens of this species obtained in later collections are very much larger than those originally used, some of those marked Spergen Hill measuring nearly three-fourths of an inch in diameter. Comparing these larger individuals, there is no perceptible difference between them and specimens of *Athyris sublamellosa,* Hall, from the Chester limestones. The figured specimen of the latter species, as given in the Geol. Rept. Iowa, 1858, Pl. 27, fig. 1, has a very ventricose dorsal valve; this, however, is by no means a constant character, and some of the Spergen Hill examples are fully as ventricose on that side. The Chester examples also develop, in extreme large growth, a deeper sinus and fold, but this

feature is not seen in specimens when of the size of the large ones from Spergen Hill. I can see no essential distinction either between these and specimens from the Keokuk limestones usually referred to *A. planosulcata*, Phillips.

Localities.—Spergen Hill, Paynter's Hill and Bloomington, Ind., and Alton, Ill.

Athyris trinucleus, Hall's sp.; (*Terebratula trinuclea*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 7;—*Geol. Rept. Iowa*, 1858, *p.* 659, *Pl.* 23, *figs.* 4 and 5.) **Plate 6, Figs. 22-27.**

"Shell sub-pentagonal or ovate, robust; trilobate, lobes nearly equal; valves nearly equal, the dorsal [ventral] one gibbous towards the beak, a sinus in the centre, beginning above the middle of the valve, gradually becoming wider and deeper towards the base, in some specimens distinctly bounded by an obtusely angular ridge. Ventral [dorsal] valve varying from sub-circular to transversely oval and longitudinally ovate, most convex between the centre and the beak, and distinctly trilobate, lobes extending about half way to the beak; the middle lobe often marked by a distinct linear depression; beak of dorsal [ventral] valve strong, rounded and incurved, truncated vertically by a distinct rounded foramen. Surface marked by fine concentric lines, which undulate with the lobes, and are extremely sinuous near the margin of the shell.

"Old shells are often marked by strong imbricating lamellæ at unequal distances.

"Length, .20 to .51, width .19 to .46 of an inch."

This species has proved to be an *Athyris* instead of a *Terebratula*, as at first supposed. The species is quite variable in form, and bears a striking resemblance to *Athyris subquadrata*, Hall; from the Chester limestone.

Localities.—Spergen Hill and Bloomington, Ind., Alton, Ill., and near Boonville, Mo.

Genus EUMETRIA, *Hall.*

Eumetria Verneuilana, Hall's sp.; (*Retzia Verneuilana*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 9;—*Geol. Rept. Iowa*, 1858, *p.* 657, *Pl.* 23, *fig.* 1.) **Plate 6, Figs. 28-30.**

"Shell longitudinally ovate; valves almost equally convex; dorsal [ventral] valve most prominent near the beak, which is elevated and incurved so as to bring the circular foramen nearly on a line with the margins of the valves; foramen round; ventral

[dorsal] valve smaller, auriculated on the cardinal angles, beak small, scarcely rising above the straight cardinal margin; area small, triangular, not entirely confined to the larger valve, bounded by a distinct angular margin. Surface longitudinally striate, marked by about fifty rounded, beautifully punctate, simple striæ.

"Length, .10 to .32, width .08 to .27 of an inch, usually. Some specimens have a length of three-fourths of an inch."

There is a very strong resemblance between the larger individuals of this species and specimens of *Eumetria* (*Retzia*) *vera*, Hall; Geol. Rept. Iowa 1858, p. 704, Pl. 27, fig. 3, but the latter species is not so ventricose, has not the beak so strongly incurved, has a larger cardinal area, and usually but not always stronger surface radii. The present form often attains a considerable size, especially those from Paynter's Hill, and sometimes become extremely ventricose.

Localities.—Spergen Hill, Paynter's Hill, and Bloomington, Ind., and Alton, Ill.

Genus RHYNCHONELLA, *Fischer.*

Rhynchonella subcuneata, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 11;—*Geol. Rept. Iowa*, 1858, *p.* 658, *Pl.* 23, *fig.* 3.) **Plate 6, Figs. 47-49.**

"Triangular, subcuneate; front rounded, meeting the lateral slopes at an obtuse angle; sides sloping to the beak and meeting at an angle of 60° or 65°; valves nearly equally convex, dorsal [ventral] valve most convex towards the beak; beak of dorsal [ventral] valve very acute, scarcely incurved, and perforate by a triangular foramen; beak of ventral [dorsal] valve acute, closely incurved below the triangular foramen. Surface marked by about twelve to fourteen (and rarely sixteen,) strong, simple, angular plications, which are somewhat obsolete near the beak; scarcely any indication of a sinus; plications crossed by fine concentric striæ, and in old shells, at irregular distances, by stronger imbricating folds or wrinkles parallel to the lines of growth; sides of both valves beneath the beak free from plications, and forming a very distinct elongate-oval space.

"Length, .16 to .41, width .15 to .39 of an inch."

This species in its cuneate form is somewhat peculiar among the *Rhynconellidæ*. It also has a perforation in the beak which is not a common feature of that genus, but it does not possess the features of the beak and deltidial portions shown in the *Rhynchonella* (*Rhynchotreta*) *cuneata* of the Niagara formations, and can-

not be classed with those. The shell structure is decidedly fibrous, and the very young shells show the deltidium to be covered by a pair of minute plates with an opening in the upper part.

Localities.—Spergen Hill, Paynter's Hill, and Bloomington, Ind.

Rhynchonella mutata, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 10;—*Geol. Rept. Iowa,* 1858, *p.* 658, *Pl.* 23, *fig.* 2.) **Plate 6, Figs. 43-45.**

"Shell sub-trigonal, more or less gibbous, front broadly rounded or nearly straight, abruptly tapering to the apex, the two sides meeting at an angle of nearly 90°; ventral [dorsal] valve much more convex than the opposite one, which is often depressed, shell most convex near the anterior margin; beak of dorsal [ventral] valve nearly straight or but slightly incurved; foramen triangular; beak of the opposite valve obtusely angular and closely incurved against the dorsal valve. Surface marked by from twelve to sixteen strong, sub-angular plications, about four or five of which are depressed in the sinus of the dorsal [ventral] valve; sinus not deeply impressed on the margin of the shell; concentric striæ rarely visible.

"Length, .15 to .30, width .14 to .32 of an inch."

This is the largest of the Rhynchonellas found in these beds, after *R. subcuneata.* From the latter it is distinguished by its shorter and broader form, and from any of the other species associated with it by its coarser plications.

Locality.—So far as yet observed this species has not been obtained from these beds elsewhere than at Alton, Ill., but it has been observed in the Keokuk limestones just below the geode beds at Warsaw, Ill.

Rhynchonella macra, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 11.) **Plate 6, Figs. 40-42.**

"Shell triangular, flattened; apex acute; valves nearly equal; the dorsal valve a little more convex towards the beak, which is quite straight, extended beyond the lesser valve, and with a sub-triangular foramen, which is slightly rounded above. Surface marked by from eighteen to twenty-four small, rounded plications which are about equal to the spaces between.

"Length, .15 to .24, width .14 to .29 of an inch."

The peculiar flat form of this species will readily distinguish it from the other associated species, except from the young shells of

R. mutata. From such specimens it will be almost impossible to separate them without leaving some question as to their identity.

Locality.—This, like *R. mutata*, has only been found at Alton, Ill.

Rhynchonella ricinula, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 9.) **Plate 6, Fig. 46.**

"Shell very small, longitudinally ovate or sublenticular, neatly rounded in front; valves almost equally convex; beak of dorsal [ventral] valve straight, comparatively much extended, perforate by a triangular foramen; surface marked by from twelve to sixteen angular plications, which often terminate abruptly about one-third of the distance from base to beak, sometimes becoming obsolete on the upper half of the shell.

"Length, .11, width .10 of an inch."

The minute size of this shell might readily be considered as its chief specific feature, were it not that the young of other species are found in the same rock. Those of *R. macra* so nearly resemble it as to preclude any possibility of distinguishing between them, except by the adult aspect which the shells of this species present. As no adult forms of *R. macra* have been found at Spergen Hill or Bloomington however, they will give but little trouble. The very young shells of *R. subcuneata* and *R. grosvenori* are often mistaken for this one, and I cannot see that there is any sure means of distinguishing between them.

Locality.—The type specimens are from Spergen Hill, Ind.

Rhynchonella Grosvenori, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 10.) **Plate 6, Figs. 31-34.**

"Shell globose, or sub-triangular, rotund or depressed; ventral [dorsal] valve more convex than the other, greatest convexity of the two valves near the front, sloping abruptly towards the beak where the two sides meet at nearly a right angle; beak rather small, neatly defined, nearly straight or slightly incurved, with a linear or sub-triangular foramen; beak of opposite valve round and obtuse, closely incurved. Surface marked by from fourteen to eighteen distinct rounded, simple plications, which often become obsolete towards the beaks; four or five of the folds depressed, forming a sinus on the larger valve, with a corresponding elevation of five or six plications on the opposite valve.

"Length, .14 to .22, width .13 to .23 of an inch."

The nearly globular, or depressed globular form will readily

distinguish this from any other lower carboniferous species of the genus.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Genus CAMAROPHORIA, *King.*

Camarophoria Wortheni, Hall's sp.; (*Rhynchonella Wortheni*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 11.) **Plate 6, Figs. 35–39.**

"Shell small, longitudinally sub-trigonal, very abruptly tapering to the apex; ventral [dorsal] valve very convex or gibbous towards the front; dorsal [ventral] valve nearly flat and broadly sinuate in front, with a single broad, flattened plication, commencing near the margin, and filling a deep sinus in the opposite valve, corresponding to two short rounded plications on the front of the ventral [dorsal] valve; edges of the shell on each side of the mesial sinus sharply undulated, with indistinct marginal folds; beak of dorsal [ventral] valve pointed, straight, with a triangular foramen. Surface marked by fine concentric striæ, and some faint remains of finer radiating striæ.

"Length, .22, width .24 of an inch."

The generic relations of this species have not been absolutely determined, but it presents all the external features of *Camarophoria*, and shows some slight indications of the septa of the interior, but not enough to render its existence certain. Nearly all the Rhynchonelloid shells of this form in the carboniferous rocks of the west, which have been critically examined, prove to belong to this genus, and I feel inclined to think this one will also.

Locality.—Alton, Ill. Only two individuals of the species have been so far observed.

Genus TEREBRATULA, *Llhuyd.*

Terebratula turgida, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 6.) **Plate 6, Figs. 53–58.**

"Shell longitudinally ovate, often extremely gibbous, emarginate in front, dorsal [ventral] valve most convex in the middle, having a sinus extending to the base of the shell; beak large, rounded and prominent, incurved and pointed, with an oval or subcircular foramen just above or in the extremity. Ventral [dorsal] valve most convex in the middle or near the front, with or without a short sinus, in which is sometimes a short and obscure fold. Surface marked by strong concentric lines of

growth; and near the front, in some shells, are strong wrinkles or folds which distort the form of the shell.

"Length, .16 to .32, width .13 to .27 of an inch."

This is a very good miniature representative of *T. sacculus*, Sow., of the Carboniferous limestones of Europe, but although recognized at many localities in this country, is never of such large size as is common with that species. It is very variable in its degree of ventricosity, sometimes increasing enormously in adult individuals, although they may be of small size. Some individuals have a thickness through the valves fully equal to the entire length of the shell.

Localities.—Spergen Hill, Bloomington, Paynter's Hill and Ellettsville, Ind.; Pella, Iowa; Warsaw and Alton, Ill., and near Boonville, Mo. At Warsaw, Ill., it occurs of more than three-fourths of an inch in length.

Terebratula formosa, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 6.) **Plate 6, Figs. 59-64.**

"Shell longitudinally oval-ovate; dorsal valve more convex in the middle and upper part; beak extended upwards, prominent, incurved; valves compressed near the front, which is neatly rounded, the margin presenting a slight undulation; sometimes sinuate in front. Surface marked by fine concentric lines of growth, and sometimes by parallel stronger folds or wrinkles. Under the magnifier the shell presents a finely punctate structure.

"Length, .14 to .44, width .10 to .31 of an inch."

This is a beautiful and generally a very symmetrical species, but it varys much in form and also in size. The typical specimens were scarcely half an inch long, but among more recent collections specimens measuring about one and one-half inches have been observed.

Localities.—Spergen Hill, Paynter's Hill, Bloomington and Ellettsville, Ind.; Alton and Warsaw, Ill.

Genus CENTRONELLA, *Billings.*

Centronella crassicardinalis, N. sp. **Plate 6, Figs. 50-52**—Shell of about medium size and nearly circular outline, the length of the ventral valve being but slightly greater than the width; longitudinally it is strongly arcuate or curved from beak to base, but nearly flat transversely, except near the front where

it becomes slightly sinuate. Beak of the ventral valve projecting beyond the hinge fully one fourth the length of the valve, with the cardinal slopes very large, broad and flattened, making the extreme posterior edge of the valve rather sharply angular. Foramen small and round; deltidial opening large and triangular; teeth strong. The interior of the valve seems to have been largely occupied by the muscular scars, while the cardinal edges of the valve have been greatly thickened, so as to present a very unusual character. Dorsal valve unknown. Surface, as indicated by the ventral valve only, marked by concentric varices of growth.

The shell differs from all the other species of the genus yet noticed, in the flatness of the ventral valve, this part generally being ventricose and sub-angular.

Locality.—Spergen Hill, Indiana. Known only by a single ventral valve.

LAMELLIBRANCHIATA.

Genus PTERONITES, *McCoy.*

Pteronites Spergenensis, N. sp. **Plate 7, Fig. 1.**—Shell very inequilateral and oblique. Hinge line a little less than the length of the body of the valve, and marked by a narrow, linear cardinal or ligamental area. In the left valve the anterior wing is of moderate size, elevated on the surface and rounded on the margin, separated from the body of the shell by a moderate depression; posterior wing large, pointed at the extremity, depressed on the surface so as to bring it entirely below the body of the valve; outer margin broadly sinuate. Body of the valve very ventricose, becoming almost subangular along the umbonial region. Beak large, prominent and projecting beyond the line of the hinge. Right valve unknown. Surface of the left valve marked by proportionally very strong concentric, lamellose striæ, which are very regular in their distances, and elevated so as to present almost the character of ridges on the body of the shell. Length of largest specimen observed, measured along the body of the shell, about .33, height about .20 of an inch.

Locality.—Spergen Hill, Ind.

Genus NUCULA.

Nucula Shumardana, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 16.) **Plate 7, Figs. 2-6.**

"Shell obliquely ovate or sub-cuneate, gibbous towards the beaks; beaks anterior, elevated, approximate or in contact; anterior end vertically truncate; posterior side cuneate, sloping from the beak; cardinal line forming an angle of about 80° at the beak; base forming a broad curve from the anterior and posterior cardinal margins. Surface marked by regular equidistant, subimbricating striæ, rarely with unequal concentric folds. Hinge line somewhat strongly crenulate; ligamentary pit distinct, triangular.

"Length, .09 to .21, width .08 to .17 of an inch."

A very pretty species, and very closely resembling *N. parva*, McChesney, from the coal measures, both in size and form. In form it is very constant, the figures given being of the extremes found in the collection. The surface structure offers more variety, as some individuals are very regularly marked, and others are covered with strong varices, marking stages of growth. The dentition as obtained from separated valves is shown in fig. 6, Pl. 7, the teeth forming rounded tubercles.

Localities.—Spergen Hill and Bloomington, Ind.

Genus NUCULANA, *Link.*

Nuculana nasuta, Hall's sp.; (*Nucula nasuta*, Hall, *Trans. Alb. Inst., Vol.* 4, *p.* 17.) **Plate 7, Figs. 7-9.**

"Shell sub-ovate, abruptly contracted in front; posterior extremity rounded; beaks prominent, sub-central; anterior side shortest, and contracted both laterally and vertically into a proboscidial extension. Surface marked by regular lines of growth.

"Length, .14, width .09 of an inch."

In the above description the posterior side is referred to as anterior. In a specimen of very much larger size, obtained from later collections, (fig. 9) the proportions of parts are somewhat different from those of the type individuals, the posterior extension is less marked and the shell proportionally higher.

Locality.—Spergen Hill, Ind.

Genus CYPRICARDINIA, *Hall.*

Cypricardinia (?) Indianensis, Hall's sp.; (*Cypricardia Indianensis*, Hall, *Trans. Alb. Inst., Vol.* 4, *p.* 18. **Plate 7, Figs. 10–14.**

"Shell elongate-ovate, narrow and rounded in front; posterior end broader, somewhat compressed and subulate; base broadly curved; hinge line straight, less than the greatest length of the shell; a line or groove on the inner margin extending from the beak to the posterior extremity; beaks very small, near the anterior end; umbonial region gibbous. Surface marked by distinct, regular, imbricating lamellæ.

"Length from one-eighth to three-fourths of an inch."

The species appears to have all the external features of the genus *Cypricardinia*, Hall, both in the character of surface markings and in the general form and inequality of the valves; but the hinge dentition is somewhat different as shown on two right valves, and partially on others, from what I had supposed existed in that genus. So far as I am aware the hinge of *Cypricardinia* has never been fully determined from any characteristic species of the genus, but I have preferred to place it provisionally under that head rather than risk making a synonym by proposing a new generic name. It certainly does not belong to *Cypricardia*, but is more closely allied to the *Arcidæ*, and would be near *Macrodon* were it not for the inequality of the valves.*

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Genus CONOCARDIUM, *Bronn.*

Conocardium catastomum, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 13.) **Plate 7, Figs. 15–17 a.**

"Shell very small, elongate, sub-cylindrical or subclavate, gibbous in the middle; beaks minute, rising slightly above the hinge line, and anchylosed, anterior end obliquely truncated and obtusely angular on the umbonial slope; the anterior tubular wing minute; posterior end much extended, and constricted near the middle, swelling at the extremity and gaping below. Surface marked with small simple radiating folds which sometimes become obso-

* Some of the Arcidæ are unequivalve, but the inequality is of a different kind from what we see here, being caused by the less extension of the front margin of one valve, while here the entire valve is less ventricose as in *Peripleoma*.

lete on the anterior end and umbones. Minute undulating concentric striæ cross the radiating folds in well preserved specimens.

"Length from .125 to .20 of an inch."

The most peculiar feature of this species consists in the anchylosis of the valves along the hinge margin. Between the beaks there occurs a small tubercle of solid deposit, firmly uniting them, and often extending along the hinge in form of a callus. This feature not only occurs in adult individuals, but is also seen on many of small size to so great an extent as to have apparently precluded the possibility of any motion of the valves along the cardinal line. From the examination of a large number of individuals I believe, however, that the feature is caused by a deposit of compact, crystalline carbonate of lime on the inside of the shell after death, which has to some extent forced the beaks asunder and filled the space. On the removal of the chalky substance of the shell this layer is exposed, thus producing the appearance of anchylosis. In cutting specimens across at the beaks this feature is readily seen in section, the layer of carbonate of lime lining the entire extent of the shell. The idea of a perfect anchylosis of the beaks of a bivalve, it appears to me, is incompatible with the further growth of the shell, and especially so where there is a long hinge line. If in the case of this shell the apparent soldering of the valves at the beaks and along the hinge had occured, they never could have been separated in front for the admission of water or additional growth, and would as a matter of fact have resulted in the death of the animal. The minute size and peculiarly constricted form of the species, sometimes in the younger stages of growth being almost cylindrical, is a very marked and distinguishing character of the species.

Localities.—Spergen Hill, Ind.; and so far not found elsewhere.

Conocardium carinatum, Hall; (*Trans. Alb. Inst. Vol.* 4, *p.* 14.) **Plate 7, Figs. 18 and 19.**

"Shell subtrigonal, gibbous in the middle, anterior end cordate; hinge line straight; beaks very small, strongly incurved, rising little above the hinge line; posterior side straight above, sloping upwards from below, and gradually tapering to the extremity, faintly constricted at its junction with the body of the shell and gaping below; hiatus elongate-lanceolate, crenulate; umbonial

slope strongly carinated; carina reaching from beak to base where it is strongly salient; anterior side obliquely truncate, and abruptly produced into a small conical tubular extension of the hinge line. Surface marked by simple radiating ribs and extremely fine concentric striæ, which in passing over the ribs give the surface a granulated appearance. On the anterior slope the ribs are finer and closer than on the sides of the shell, and strongly curved.

"Length, from .20 to .33 of an inch."

The carina which forms a crest along the anterior umbonial ridge constitutes the distinguishing feature of this form. In other respects it does not appear to differ from *C. cuneatum*, Hall; and, as many specimens are found which are intermediate between the typical specimens of the two, it is probable they are only varieties of the one species.

Localities.—Spergen Hill and Bloomington, Ind.

Conocardium cuneatum, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 14.) **Plate 7, Figs. 24-26.**

"Shell sub-trigonal or abruptly clavate; hinge line straight; beaks anchylosed, incurved, very small, rising but little above the hinge line; umbonial slope angular; anterior side truncate, concave just within the angle of the umbonial slope, convex in the middle, and abruptly produced above, in continuation of the hinge line, in a tubular wing; posterior side vertically compressed, straight along the hinge line, and abruptly declining at the extremity, sloping along the base from the centre of the shell to the extremity. Hiatus elongate, extending forward to near the middle of the shell, rounded and expanded at the posterior extremity, and deeply crenulate in the margins of the narrower part. Surface marked by distinct radiating costæ, which often alternate in size or bifurcate on the posterior part of the shell; crossed by fine elevated concentric lines of growth, more or less closely arranged. Near the basal margin are some stronger subimbricating ridges parallel to the lines of growth.

"Length, .33 to .50 of an inch."

The remark "beaks anchylosed" as applied to this species cannot have the same signification as it does in the case of *C. catastomum*, as the most perfectly preserved specimen in the collection has the beaks clean, clear and perfectly free from each other, without any deposit or thickening of any kind between them. The suture of the hinge between the beaks and elsewhere is sometimes very close, and in some cases where the shells have

been dead and eroded previous to being imbedded, the line has become entirely obliterated by emaceration. This I presume is what is meant by the statement. The hiatus, or gaping of the valves on the postero-basal line, is sometimes very marked and the thickening of the internal ribs so prominent as to form strong interlocking teeth along the narrow part of it.

Localities.—Spergen Hill and Bloomington, Ind.

Conocardium Prattenanum; (*Trans. Alb. Inst., Vol.* 4, *p.* 15.) **Plate 7, Fig. 20.**

"Shell sub-fusiform; hinge line straight, beaks depressed, distinctly anchylosed; from the beaks along the anterior umbonial slope, [the] angle [is] obtuse and scarcely defined; anterior side obtuse, convex in the middle, and gradually sloping upwards from the angles; posterior part of the shell with a broad depression on each side, and again expanding at the extremity with an oblique angular fold, from the hinge line downwards to the hiatus; hiatus broad and expanded behind, narrowed abruptly at the junction of the oblique folds, and thence gradually to the middle of the shell. Surface marked by strong plications, which are much stronger on the anterior part of the shell, and more slender behind. The fold along the anterior umbonial slope bifurcates, sending off on each side a plication, which again bifurcates. Plications crossed by sharply elevated lines, which are more conspicuous on the posterior part giving it a cancellated appearance.

"Length, .20 of an inch."

Of this species a single specimen only exists in the collection. The beaks and upper part of the anterior face of the valves are imperfect, and the apparent anchylosis may be and probably is deceptive. The species is a very distinct and well marked one, differing materially from all the others in the collection in the few strong plicæ of the anterior end, and the stronger bifurcating plications of the anterior umbonial ridge.

Locality.—Alton, Ill.

Conocardium Meekanum, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 15.) **Plate 7, Figs. 21-23.**

"Shell sub-angularly ovate or abruptly clavate; hinge line nearly straight, declining at the posterior extremity and sometimes from the beaks; obliquely truncated anteriorly; anterior end convex in the middle, and margined by a narrow sulcus which reaches from beak to base just within the obtuse angle of the

umbonial slope; posterior end sloping on the base uniformly from the centre of the shell to the extremity, contracted behind the body of the shell; vertically depressed and slightly expanded laterally at the extremity. Surface marked by small, elevated, thread-like radiating lines, which on the posterior part of the shell are crossed by finer concentric striæ, giving that part of the shell a cancellated appearance. Anterior depressed end marked by much fainter radiating lines crossed by nearly obsolete traces of fine striæ, which converge towards the anterior tubular wing.

"Length, .20 to .33 of an inch."

The shells of this species bear considerable general resemblance to those of *C. cuneatum*, but are generally smaller. They vary considerably also among themselves as do those of that species. The one figured is of the broadest or most obtusely cuneate form; others being very much more slender and the umbonial ridge more oblique. One distinguishing feature between the two is in the coarser striæ marking the anterior end of the shell of this one, which are not regularly concentric as in *C. cuneatum*, but successively diverge from the umbonial ridge. The material in which the shells are preserved is well calculated to retain all the surface markings, and consequently the cancellation of the surface is beautifully preserved.

Locality.—Alton, Ill.

Conocardium equilaterale, Hall; (*Trans. Alb. Inst.*, *Vol.* 4, *p.* 16.)

"Shell triangular, sub-equilateral, scarcely gibbous in the middle; hinge line very straight; beaks small, rising a little above the hinge line; anterior end cuneate, sloping gradually from near the centre of the shell; umbonial ridge obtuse above, nearly at right angles to the hinge, and sub-dividing several times before reaching the base; posterior end cuneate, very gradually sloping from the body of the shell; extremity unknown. Surface marked by radiating striæ or folds, which are simple or bifurcating, and crossed by fine, regular, elevated, thread-like lines.

"Length and width nearly equal, about .125 of an inch."

Only a single individual of this species was obtained in all of the collections examined, and this has not been found in the collection since it came into the possession of the Am. Mus. Nat. History. Consequently I have not been able to give illustrations of the species.

Observations of the Genera MICRODON, *Conrad*, and CYPRICARDELLA and EODON, *Hall.*

In the original Spergen Hill paper, the genus *Cypricardella* is proposed for a group of similarly formed species which are somewhat abundant at one of the localities. Three of these species, *C. sub-elliptica*, *C. nucleata*, and *C. oblonga*, have certain characteristics common to each. A fourth included in the genus (*C. plicata*) possesses different features and belongs to an entirely distinct group.

The three species above alluded to are more or less quadrangular in form, with a slight umbonial ridge crossing the shell from the beak to the postero-basal angle, and the surface is marked by comparatively regular, elevated, concentric lines, which are bent abruptly in crossing the umbonial ridge referred to. The hinge plate in the interior is characterized in the right valve by a single well defined, triangular tooth, and an equally well defined triangular cavity behind it, which is bounded by a less distinct ligamental ridge further back. The ligament has been external, and the muscular scars are large and well defined. The pallial line is simple, and the shells are moderately ventricose and have a decidedly impressed escutcheon and lunular area. If one examines the shells and internal imprints of *microdon bellistriata*, Conrad, from the Hamilton shales of New York, all these features will be found to appear equally strong, and as distinctly marked, except the ventricosity of the valves as they are on the Spergen Hill specimens, only on a much larger scale. The greater flatness of the valves in the New York specimens is readily accounted for by the greater amount of compression which has taken place in the shales than in the limestones of the western locality. Had the genus *Microdon* been as well understood at the time *Cypricardella* was proposed, as it has become since, I doubt if the name would have ever appeared. The shells described under it are such perfect miniatures of the Hamilton forms that one is at once impressed by the perfect resemblance.

The name *Microdon* had been applied by Prof. L. Agassiz to a group of fishes previous to its application to these shells by Conrad, (which I have spoken of elsewhere) and by some it has been

thought unadvisable to retain it for this group on that account. In the Cat. Am. Pal. Foss., S. A. Miller, 1877, p. 244, Prof. Hall proposes to substitute the name *Eodon* for it, but it seems to me that if it is to be substituted at all, that of CYPRICARDELLA should be retained.

Genus MICRODON, *Conrad.*

Microdon (Cypricardella) sub-elliptica; (*Cypricardella sub-elliptica*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 17;—*Geol. Rept. Iowa*, 1858, *p.* 664, *Pl.* 23, *figs.* 11 and 12.) **Plate 7, Figs. 27-29.**

"Shell sub-elliptical, obliquely truncated at the posterior end; beaks minute at the apex, rising little above the hinge; umbones sub-gibbous, with an undefined elevation extending obliquely towards the posterior basal margin; anterior end narrower than the posterior, rounded at the extremity. Cardinal margin forming an angle with the beak of 25°; base forming a regular elliptical curve. Surface marked by regular, fine, concentric elevated lines which are equal to the spaces between.

"Length, .19 to .32, width .14 to .24 of an inch."

The proportionally greater height or shorter form, with rounded anterio-basal and posterior margins, will sufficiently distinguish this one from either of the other species associated with it.

Localities.—Spergen Hill and Bloomington, Ind.

Microdon (Cypricardella) nucleata; (*Cypricardella nucleata*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 17;—*Geol. Rept. Iowa*, 1858, *p.* 664, *Plate* 23, *fig.* 10?) **Plate 7, Figs. 35-36.**

"Shell inequilateral, sub-quadrangular, gibbous; anterior end short, rounded; posterior end broader, abruptly compressed, vertically truncated at the extremity; beak nearer the anterior end, small; posterior umbonial slope extremely gibbous (a broad undefined ridge) reaching to the base of the truncation. Surface marked by fine regular concentric lines parallel to the border of the shell.

"Length, .11 to .13, width .08 to .10 of an inch."

This is the smallest form observed, and is of nearly equal height and length in its typical form, but specimens of larger size are proportionally longer, as they increase more in length than in height with increased growth. In consequence of this feature it becomes very difficult if not impossible to distinguish between medium sized individuals of *M. oblonga* and large individuals of

this species, and leads one to suspect they may both belong to one species, especially as the surface markings bear the same proportions to the shell as do those of that species when of the same size.

Localities.—Spergen Hill and Bloomington, Ind.

Microdon (Cypricardella) oblonga; (*Cypricardella oblonga*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 18;—*Geol. Rept. Iowa*, 1858, *Pl.* 23, *fig.* 10?) **Plate 7, Figs. 30–34.**

"Shell oblong, sub-quadrangular; anterior end narrow, rounded; posterior end broader, flattened, and almost vertically truncate; cardinal margin nearly straight and horizontal behind, declining in front; base nearly parallel to the hinge line; beaks small, somewhat prominent, gibbous below; posterior umbonial slope gibbous or sub-angular, and extending obliquely downwards and backwards to the base of the truncation; lunule small, ovate, deep in the centre; escutcheon linear, distinct.

"Length, .09 to .30, width .06 to .20 of an inch."

This species occurs of larger size than either of the others associated with it. When small it is nearly equally high and long, but becomes gradually longer in proportion as it increases in size, so that specimens are often found much more than half as long again as high. In the Geol. Rept. Iowa, 1858, Pl. 23, fig. 10, a specimen of this species is figured as *C. nucleata*, probably by mistake. The specimen is one of the original series, and has always been attached to the card marked *C. oblonga*. It corresponds exactly in size to the measurements given of that species in the original description, being .30 of an inch long and .20 wide; while no measurements are given of *C. nucleata* exceeding one-half the width, and but little more than one-third the length.

Localities.—Spergen Hill and Bloomington, Ind.

Microdon (Cypricardella) sp.? **Plate 7, Fig. 37.**—Several examples of a shell resembling *M. oblonga* in its proportions of length and breadth, and having an elliptical outline corresponding somewhat to *M. sub-elliptica*, have been observed among the later collections from Spergen Hill. It does not appear to be distinct enough from the other forms to be entitled to rank as a distinct species, but appears to unite the two. A figure of one of them is given that attention may be directed to it, with the hope of obtaining further information.

Genus GONIOPHORA, *Murch.*

Goniophora plicata; (*Cypricardella plicate*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 18.) **Plate 7, Fig. 39.**

"Shell oblong, sub-quadrate, hinge line slightly arched, the base and hinge line nearly parallel; gibbous in the middle above, and anteriorly, depressed in the middle towards the base; beaks near the anterior end, small, and scarcely rising above the hinge margin; anterior end short, scarcely extending beyond the beak, rounded; posterior extremity doubly truncate; a strong fold or angulation extending from the umbo to the posterior basal margin, and a smaller similar fold midway between that and the hinge line, the intervals on the margin between these being truncate. Surface marked with concentric lines of growth.

"Length, .12, width .12 of an inch."

The hinge margin of this species is bounded by a narrow escutcheon, and the ligament has been external. These features together with the general form of the shell would throw it into the genus *Goniophora* unless the hinge features may differ, which is scarcely probable. The only other genus to which it has much resemblance is *Pleurophorus*, to which externally however it is not so nearly related.

Localities.—Spergen Hill and Bloomington, Ind.

Genus EDMONDIA, *DeKon.*

Edmondia subplana (*Cypricardia subplana*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 19.) **Plate 7, Fig. 38.**

"Shell ovate oblong; anterior end very short; posterior end extremely elongate, very gradually narrowing to the extremity which forms a symmetrical elliptic curve; cardinal and basal margins nearly parallel; beaks small; umbonial region depressed convex. A few obsolete concentric folds visible on the surface; intermediate portions, probably, finely striate.

"Length, .69, width .38 of an inch."

All the examples of this species which have been observed are imperfect. The type specimen (fig. 19) is very much water-worn, and although the hinge margin of the shell is very well exposed, it presents no dentition whatever. A second specimen of about the same size, a partial cast, shows a rather large posterior muscular imprint situated near the cardinal margin; but the anterior end is more imperfect. The structure of the hinge so far as

revealed, a simple margin with probably an external ligament, will come nearer to the characters of the genus *Edmondia* than to any other known carboniferous form. It certainly is not a *Cypricardia*, as that genus is known from recent species.

Localities.—Spergen Hill and Bloomington, Ind.

GASTEROPODA.

Genus PLATYCERAS, *Conrad.*

Platyceras acutirostris (*Capulus acutirostris*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 31;—*Geol. Rept. Iowa*, 1858, *p.* 665, *Pl.* 23, *fig.* 14.) **Plate 8, Figs. 13-15.**

"Shell obliquely conical, more abruptly contracted above, and continued in more slender proportions to the apex, which is incurved, making about a single volution without contact with the body of the shell; aperture sub-circular, margin sinuate; surface sub-plicate, with narrow sub-angular folds and wider depressed spaces; lines of growth strong, abrupt upon the angles and arching forwards on the spaces between."

There is a very great degree of variability among the specimens of this species, even at the typical localities, and particularly so when a more extended geographical distribution is considered. In the degree of expansion of the shell it is particularly variable, and also in the number and arrangement of the plicæ and consequent sinuses of the margin. The apex of the shell may also be short and minute, or long, pointed or enrolled.

Localities.—Spergen Hill, Paynter's Hill, Ellettsville, Bloomington, and Crawfordsville, Ind. Warsaw and elsewhere in Ill., and Tuscumbia, Ala.

Genus LEPETOPSIS, New Genus.

Shell patelliform, more or less regularly round or oval, apex sub-central, posterior to the middle and directed backward, the nucleus dextrally coiled; muscular imprint horseshoe-shaped, open (?) in front, consisting of an irregular narrow band which expands more or less at the anterior extremities. Surface of the shell marked by six very indistinct radiating lines, two anterior, two posterior, and two lateral. Type *L. Levitte*, White.

It seems as if there were already genera enough among the shells of this group to include any new form that might be discovered, but there is certainly need of some designation other than any existing one, under which forms of this kind that are comparatively numerous in the carboniferous limestones, can be placed. They have been usually called *Patella* or *Capulus*, and are often doubtfully referred to *Metoptoma*, but it is quite certain they do not properly belong to either of these genera. *Metoptoma* proper is a very distinct form, and Prof. Phillips, even when proposing that genus, referred forms congeneric with this one to *Patella*. It certainly seems like straining a point to refer these carboniferous shells to a living genus, simply on their general form, when among the living ones such diverse characters are found in the animals as to require several genera, where the shells are undistinguishable from external form alone. I have therefore preferred to risk proposing a new name rather than to refer them to a genus to which I am certain they do not belong. I am slightly in doubt concerning the opening in the muscular impression on the anterior side, as I have not been able to fully see this part. The genus bears some relations to *Anisomyon* M. & H. (see Invest. Pal. U. S. Geol. Surv. Territ., p. 285,) in its general appearance, but the nucleus is not reversed and the radiating lines are external, while those of that genus appear strongest on the inside, as ridges.

Lepetopsis Levettei, (*Patella Levettei*, White;—*Geol. Ind., 11th Rept., p.* 359, *Pl.* 39, *figs.* 4 *and* 5.) **Plate 8, Figs 9-12, and Fig. 8?**

Shell nearly regularly oval in outline, moderately to depressed convex; apex minute, slightly posterior to the middle of the length; anterior end of the shell more highly convex than behind, the latter portion slightly concave just behind the apex; shell somewhat lamellose in structure and marked by concentric lines of growth; the radiating lines which mark the surface are very faint or obsolete; when seen they divide the shell into six nearly equal parts; length of largest specimen one inch and one tenth; width a little less than one inch.

In the collection there are two shells, one of which is repre-

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sented by fig. 8, which appear to be the apical portions of a larger specimen; but possibly they may belong to this species, as both individuals figured show that the apex has been less rapidly expanding than the shell below. It is possible they may represent a distinct species, but they appear so immature that I hesitate to consider them in that light.

Locality.—Spergen Hill, Ind.

Genus EUOMPHALUS, *Sowerby.*

Euomphalis Spergenensis, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 19. *Straparollus spergenensis* (Hall) *S. A. Miller, Cat. Am. Pal. Foss.*) **Plate 8, Figs. 16-19.**

"Shell sub-discoid or planorbiform; spire composed of five or six turns, the inner ones coiled in the same plane, two or three of the outer ones only visible in profile; suture well defined on both sides; volutions rounded below with a distinct obtuse angulation on the upper side, a little distance from the suture; umbilicus nearly twice the breadth of the outer volution; aperture oblique, round-oval, with a slight expansion at the angle on the upper side of the volution. Surface marked by close, fine, equal striæ of growth.

"Diameter .30 to 1 inch; height .23 to .45 of an inch.

"This shell resembles the *E. lævis* of D'Archiac and DeVerneuil (Trans. Geol. Soc. Lond., vol. vi, 2d series, part 2, p. 363, plate 33, fig. 7). *E. planorbis* in part of De Koninck. (Carb. Fossils of Belgium, page 434, plate 25, fig. 7).

"Our shell agrees with the description of MM. D'A. and De V., with the exception of the form of the aperture. The figures given by these authors show the greatest diameter of the aperture to be transverse, while in the species here described the longest diameter is obliquely outwards and downwards from the axis of the shell. Our shells with five turns of the spire are much smaller than *E. lævis* of these authors, and our larger specimens are precisely of the same size as the four inner volutions of their figure.

"It is possible, however, that these deviations which appear constant in our specimens may prove to be only a variety not of specific value. Our specimens of this species, which are numerous, do not lead us to include the *E. planorbis* of D'A. and De V. as a variety."

The shells of this species are extremely variable, and where large collections of the various stages of growth are examined together, it becomes totally impossible to draw lines of distinction

between this and the other three forms associated with it. The var. *planorbiformis* differs only in the depression of the spire to nearly the plane of the outer volution, the number of volutions even here varying considerably. *E. planispira* has the volutions more slender as well as more numerous, and often the spire becomes so depressed as to present but very little difference between it and the umbilical side. The form originally given as *E. quadrivolvis* is perhaps more distinct and more readily distinguished than any of the others, still intermediate forms are so numerous as to cause great trouble in separating it from the more rapidly expanding specimens of *E. Spergenensis.* As the surface markings are alike in all the four varieties, it becomes a question as to whether they may not all belong to one very protean species. However, as they have been described as distinct forms I have given illustrations of each, that others may form their own conclusions.

Localities.—The typical form of *E. Spergenensis* has been observed at Spergen Hill and Paynter's Hill, Bloomington and Ellettsville, Ind. The other forms have been observed at each locality mentioned except Ellettsville, where it is possible they may occur, as I have seen but few specimens from that locality.

Euomphalus Spergenensis *var.* **planorbiformis,** Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 20. *Straparollus Spergenensis*, var. *planorbiformis* (Hall) *S. A. Miller; Cat. Am. Pal. Foss.*) **Plate 8, Figs. 20 and 21.**

"Shell discoid; spire flat or concave; volutions about four, rounded above and below; aperture nearly circular; umbilicus broad, not deep."

Euomphalus planispira, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 20. *Straparollus planispira* (Hall) *S. A. Miller; Cat. Am. Pal. Foss.*) **Plate 8, Figs. 22 and 23.**

"Shell discoid; spire flat or scarcely concave; volutions about five or six, slender, very gradually increasing in size, rounded above and below; suture well defined; aperture circular; umbilicus broad and shallow. Surface marked by fine, closely arranged and slightly undulating striæ.

"Diameter .36; height .12 of an inch."

"This shell is distinguished from either of the preceding by its slender volutions which increase much more gradually from the

apex. The volutions are round both above and below, though sometimes the lower side descends so abruptly to the umbilicus as to present the appearance of an obtuse or undefined angle on the last volution."

Euomphalus quadrivolvis, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 19. *Straparollus quadrivolvis* (Hall) *S. A. Miller; Cat. Am. Pal. Foss.*) **Plate 8, Figs. 24 and 25.**

"Shell planorbicular, spire depressed, composed of about four turns, the inner one scarcely rising above the last volution; volutions somewhat rapidly increasing from the apex, regularly rounded; aperture round-oval, slightly transverse; umbilicus less than the diameter of the outer volution. Surface marked by fine, closely arranged striæ of growth.

"Diameter .12 to .31; elevation .06 to .16 of an inch."

There is so much confusion in regard to the value of the names *Euomphalus* and *Straparollus* that I have preferred to leave these species where they were originally placed, rather than to burden the science with additional and useless references by changing them under uncertainty.

Genus NATICOPSIS, *McCoy.*

Naticopsis Carleyana; (*Natica Carleyana*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 31.) **Plate 8, Figs. 26 and 27.**

"Shell sub-globose; spire short, consisting of about three volutions, which increase very rapidly, the last one extremely ventricose; suture not distinctly defined; aperture ovate, straight on the columellar side; outer lip sharp; inner lip thickened; columella with a distinct groove near the base of the lip for the reception of the operculum; surface marked by fine elevated striæ corresponding to the lines of growth.

"Height .10 to .30; diameter .08 to .34 of an inch."

This species is very closely related to *N. nana*, M. & W., from the coal measures of the Western States, and if mingled with specimens of that species of the same lithological character it would be difficult to separate them. The inside of the aperture on the columellar side is thickened, and the shell imperforate, which characters would remove it from the genus *Natica* to NATICOPSIS. Among some later collections there are specimens which measure fully one-half inch in height, being much larger than those in the original collection.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.; being very rare at the latter locality, while extremely abundant at that first mentioned.

Genus MACROCHEILUS, *Phillips.*

Macrocheilus Littonanus (*Natica Littonana*, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 30.) **Plate 8, Fig. 28.**

"Shell short, sub-fusiform; spire depressed-conical; volutions about four, rapidly increasing from the apex, the last volution symmetrically ventricose and prolonged below; suture not strongly marked; aperture narrow-ovate, sharp above, and narrowing near the front; outer lip thin; inner lip thickened; surface striated.

"Height .25; diameter .19; last volution .17 of an inch."

This shell is very erect in form, the columella forming the central axis, unlike any form of *Natica*. The columella of the only specimen in the collection indicates the existence of a very slight twist, showing the features of the genus MACROCHEILUS to which I have referred it. The surface under a strong hand-glass appears to me to be entirely destitute of markings of any kind, and the suture line between the volutions to have been partially obliterated by a deposit like that of the recent *Ancillaria*.

Locality.—Bloomington, Ind.

Genus HOLOPEA, *Hall.*

Holopea (Callonema?) Proutana, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 30.) **Plate 8, Figs. 33 and 34.**

"Shell ovate-conical; spire somewhat rapidly tapering; volutions about six; moderately convex, last one ventricose, subangular in the direction of the suture line, and obliquely extended below; suture sharply defined; aperture round-ovate, oblique on the upper side; pillar lip slightly reflexed in the umbilical region; umbilicus none; surface marked by fine striæ parallel to the lines of growth.

"Length .62 to .50 of an inch."

There is considerable variation in the ventricosity of the volutions in this species, some of them being decidedly flattened in the direction of the spire, while others are quite round and the suture line very distinct. The angulation at the outer base of the last volution is also often obsolete. The shell is minutely perfo-

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rate, and has a decided umbilical depression at the top of the columella.

Its generic relations with *Holopea symmetrica*, Hall, the first species of the genus described is not very close, but perhaps as near as to any other described genus. It has exactly the characters of *Callonema*, Hall, as shown in *C. bellatula*, except in the surface ornamentation, which is given by the author as a generic feature; although *C. bellatula* and especially the New York form of it, known as *C. Lichas*, frequently becomes nearly smooth toward the aperture in old shells.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Observations on the Genera BULIMELLA and POLYPHEMOPSIS.

In the original paper on the Spergen Hill fossils, the author proposed the name *Bulimella* for a group of Gasteropods closely resembling the recent *Achatinas*. The name however had been previously employed by Pfeiffer for a genus in the same class, and this later one consequently becomes a synonym. Subsequently Messrs. Meek and Worthen, in the Geol. Rept. Ills., Vol. II, p. 372, refers the shells upon which the genus was founded to *Polyphemopsis, Portlock;* and also two others, generically identical, previously described as species of *Loxonema*. So far as I can understand from the remarks made by Capt. Portlock in proposing the genus *Polyphemopsis*, he founds it upon Sowerby's *Polyphemus fusiformis*, a species placed by Prof. Morris and other European authors under the genus *Macrocheilus*, established two years before *Polyphemopsis* and recognized by Capt. Portlock. If this reference is correct, as I believe it is, it destroys Portlock's genus, as it takes away his type. If we consider *P. elongatus* as the type, it is equally certain that it is not generically identical with the forms originally placed under *Bulimella*, as it has not the truncated columella characteristic of that genus. To be sure Capt. Portlock states in his remarks upon that species that "in some specimens it [the columella] has evidently been truncated." This does not prove it to be a generic feature of his *P. elongatus*, but only shows that he confounded two distinct species in description, while figuring only one. Messrs. M. & W. have also 1882.]

fallen into a similar error in placing shells of two entirely distinct genera under *Polyphemopsis*, *P. peracuta* being a true *Polyphemopsis* according to the features shown in Portlock's figures, while *P. inornata* and *P. nitidula* both belong to *Bulimella*.

Taking into consideration these facts, I propose to substitute for the name *Bulimella* given by Prof. Hall that of BULIMORPHA, and to retain the group as a valid genus.

BULIMORPHA, n. g.

Shell fusiform, spire produced; volutions convex, the last large; columella bent and truncated at the base, where it is separated from the outer lip by a notch as in the recent genus *Achatina*; outer lip very slightly notched near the upper end; surface of the shell smooth. Type *B. bulimiformis*, Hall.

Bulimorpha bulimiformis (*Bulimella bulimiformis*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 29;—*Polyphemopsis bulimiformis*, (Hall) *M. & W., Geol. Rept. Ills., Vol.* 2, *p.* 372.) **Plate 8, Figs. 37-39.**

"Shell fusiform, elongate; spire nearly equal to half the length of the entire shell; volutions about six, slightly convex in the middle, increasing somewhat rapidly, the last one equaling in length all the others; aperture elongate-oval, acute at each extremity, slightly sinuate at the upper outer angle; columella slightly curved, and truncate at the base; surface smooth or with faint lines of growth.

"Length .25 to .75 of an inch."

This species is the most common one occurring in these beds, and will be found to vary greatly in the proportional length and thickness as well as somewhat in the ventricosity of the volutions.

Localities.—Spergen Hill and Bloomington, Ind.

Bulimorpha canaliculata (*Bulimella canaliculata*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 29;—*Polyphemopsis canaliculata*, (Hall) *M. & W., Geol. Rept., Ills., Vol.* 2, *p.* 372.) **Plate 8, Fig. 41.**

"Shell sub-fusiform; somewhat elongate; spire short, scarcely equaling the length of the last volution; volutions about five, upper ones scarcely convex, rapidly diminishing to the apex, last volution longer than the spire above, slightly ventricose; suture canaliculate, the groove margined by a slight sharp carination at

the upper edge of the volution; aperture sub-ovate; surface smooth, or marked with fine lines of growth which are abruptly bent backwards at the carination on the upper edge of the volution which marks the notch in the upper angle of the aperture.

"Length .18 of an inch."

The notch mentioned in the above description is not a notch in the lip like that of *Pleurotomaria*, *Murchisonia*, &c., but is formed by the channeling of the suture only. This feature at once distinguishes this from any of the other species described.

Locality.—Spergen Hill, Ind. The locality as given under the original description includes Bloomington, Ind. also. Only one characteristic specimen exists in the collection, that being from Spergen Hill, Ind.

Bulimorpha elongata (*Bulimella elongata*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 30;—*Polyphemopsis elongata*, (Hall) *M. & W., Geol. Rept., Ills., Vol.* 2, *p.* 372. *Polyphemopsis teretiformis*, Hall; *Cat. Am. Pal. Foss., S. A. Miller, p.* 245.) **Plate 8, Fig. 40.**

"Shell extremely elongate; volutions seven or eight (perhaps nine), somewhat rapidly ascending, moderately convex, the greatest convexity a little above the middle, last one slightly ventricose; suture distinct, an undefined angular elevation below, corresponding to the notch in the lip; surface nearly smooth; direction of the striæ scarcely visible.

"Length .50 of an inch."

The undefined angular elevation below the suture mentioned in the description is remarkably obscure in the type specimen, and corresponds only to the "greatest convexity" which exists "a little above the middle" of the volutions. The species is very rare, nearly as much so as *B. canaliculata*, only the type specimen being found in good condition; a few other worn specimens only having been observed. The change of generic name will restore the original specific name of *elongata*, making it BULIMORPHA ELONGATA, Hall's sp.

Locality.—Spergen Hill, Ind.

Genus CYCLONEMA, *Hall.*

Cyclonema Leavenworthana (*Pleurotomaria Leavenworthana*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 24.) **Plate 8, Figs. 29-31.**

"Shell ranging in form from sub-globose to terete-conical and

elongate-ovate; spire conical, varying greatly in its elevation from the young to the old shell; volutions five to seven, neatly rounded and ventricose below; suture well defined; aperture round-oval; umbilicus none; surface marked by conspicuous, rounded, revolving striæ, which are less than the spaces between; striæ less conspicuous on the base of the last volution; the first line below the suture uniformly thinner and sharper than the others, and the spaces on each side wider.

"Length from .05 to .50 of an inch."

This shell is remarkably variable in the degree of expansion of the volution, the apical angle being in some cases nearly twice as great as in others, while the increase of the volution is equally variable. These changes give one the impression, when only a few individuals are examined, that there are two distinct species represented; but so many connecting forms can easily be obtained, that one soon abandons this view. The species presents no evidence of being a true *Pleurotomaria*, as there is no indication of a notch between any of the revolving striæ. The characters correspond much more nearly to those of *Cyclonema*, Hall, although it lacks the flattening of the columella that is seen in *C. bilix*.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Cyclonema subangulatum (*Pleurotomaria subangulata*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 25.) **Plate 8, Fig. 32.**

"Shell ovate-conical; volutions about five or six, angular above, the last one ventricose below; upper side of volution nearly rectangular to the direction of the spire; aperture ovate, the inner side straight or concave; umbilicus none; suture distinct; surface ornamented by unequal, revolving lines, those on the lower part of the last volution finer and more closely arranged, three of those on the periphery stronger and more distant, the upper one of these three stronger than the other two, forming the summit of the angle; midway between the angle and the suture is one strong angular striæ, and on the outer side, and sometimes on the inner side of this a finer one.

"Length .35 of an inch."

This shell is closely allied to *C. Leavenworthana*, and will most likely prove to be only a variety of that one. The carinated upper angle of the last volution is caused by the dropping out of the revolving line below it, and to some extent also that above, causing this individual line to stand out more prominently. In the form

of the lower part of the volution and in that of the aperture, they agree perfectly.

Locality.—Spergen Hill, Ind.

Genus LOXONEMA, *Phillips.*

Loxonema Yandellana, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 28.) **Plate 8, Figs. 35 and 36.**

"Shell terete-subulate; spire elongate, very gradually tapering to the apex, which is apparently obtuse; volutions about eight or nine, very little convex, the last one scarcely expanded; suture distinct; surface marked by fine thread-like striæ crossing the volutions with a slight undulation above the middle; aperture ovate.

"Length .20 to .50 of an inch."

This species has proved to be exceedingly rare, and so far as seen is usually quite small. The fragment figured represents the largest growth yet noticed, while the surface markings are much stronger proportionally than on any other specimen examined.

Locality.—Spergen Hill, Ind.

Loxonema vincta, see **Murchisonia vincta.**

The shell described in the original Spergen Hill paper as *Pleurotomaria concava* presents features entirely incompatible with those of any known genus so far as I can ascertain. It is trochiform, being broadly conical above and flattened or concave below, with a wide umbilicus extending to the nucleus of the spire, as in Solarium. The aperture is very oblique, and the periphery of the volutions is extended in form of a thin flange under which the succeeding volution is formed. No apertural slit exists, nor are the striæ of growth interrupted at the periphery, except when the expansion is broken off. The surface ornamentation consists of simple lines of growth above, while below the flattened surface is marked by revolving lines. For this and similar species I propose the generic name EOTROCHUS.

EOTROCHUS, N. Genus.

Shell conical above, flat or concave beneath, and broadly and deeply umbilicated. Aperture very oblique, and the outer angle of volutions strongly carinated or expanded. Surface ornamen-

tation unlike on the upper and lower surfaces. Type E, CONCAVA *Pleurotomaria concava*, Hall.

The genus differs from the umbilicated forms of the Trochidæ in not having the inner or umbilical surface of the volution distinct from the basal parts, (*i. e.* not forming a columella), but the lower or basal surface of the volution slopes gradually and smoothly into, and forms the sides of the umbilicus, giving an obliquely elliptical section to the volution. From the forms usually placed under *Onustus*, Humph. it differs but little except in the character of growth, and surface of the lower side of the volutions. So far as known, it forms no peripheral digitations or ornamentation as in that genus. In the Pal. Rept. of Ohio, Vol. 1, p. 221, Mr. F. B. Meek proposes the name *Pseudophorus* for a group of shells which he referred with doubt to *Xenophora*, Fischer, but which he does not characterize. The shell for which he proposed it, however, differs widely in character from the one under consideration; it being imperforate, although having a broad umbilical depression, and the lower surface of the shell is a direct continuation of the upper surface like the volution of *Platyostoma* or *Natica*, only being angulated on the periphery; while this one possesses a distinct system of growth and surface markings. This with the open umbilicus is sufficient to distinguish it as a separate generic group, the Ohio shell being only a flattened *Platyostoma*.

Eotrochus concavus, (*Pleurotomaria concava*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 24—*P. tenuimarginata*, Hall: *Cat. Am. Pal. Foss.*, S. A. Miller, p. 245.) **Plate 9, Figs. 21-23.**

"Shell trochiform; spire depressed-conical; volutions about five, flattened or slightly concave above; base of shell concave; periphery alate, alation curving downwards at the margin; aperture transversely ovate (the wider part at the pillar); umbilicus medium size, round; suture linear, rather indistinct; surface smooth or marked by obsolescent striæ, which turn abruptly backwards from the suture to the periphery; similar striæ are sometimes visible on the base of the shell, bending abruptly backwards on the alation.

"Diameter .25 to .75 of an inch; height from .20 to near .50 of an inch."

The original specimens of this species were so very poor that they seem to have led to some misconceptions of characters. On

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clearing away the rock from the base of some of the larger specimens, the surface of this part is seen to be marked by about thirteen flattened revolving lines, and with the strongest hand glass no oblique lines resembling those on the upper surface can be seen, although the apparent receding of the lower lip of the aperture would give this direction. The "pillar" spoken of in describing the form of aperture, should not be interpreted as indicating a solid columella, but only the wall of the open umbilicus. The largest specimen in the collection has a diameter of considerably more than one inch.

Localities.—Spergen Hill, Ind., and Alton, Ill. No individual from Bloomington is present in the collection.

Genus PLEUROTOMARIA, *D. France.*

Pleurotomaria subglobosa, Hall; (*Cat. Am. Pal. Foss.*, S. A. Miller, p. 245. *P. rotundata*, Hall, *Trans. Alb. Inst.*, *Vol.* 4, *p.* 23.) **Plate 9, Fig. 10.**

"Shell sub-globose; volutions about five or six, convex, the last one very rotund or ventricose; suture distinctly marked, and the volution depressed just below it, and rising in an obtuse, undefined angle, below which is a distinct depressed revolving line, and below this again a similar sub-angular elevation, which forms the upper limit of the broad periphery of the outer volution; thus making the upper side of the volution obscurely biangular with one depression between the angles, and the other towards the suture. [These angles and the depression between are distinctly visible in the cast.] Aperture broadly ovate; umbilicus small; surface marked by fine, closely arranged revolving striæ.

"Diameter .09 to .45; height .04 to .38 of an inch."

On the larger individuals of this species, the volutions are entirely round above and on the sides, completely destroying the subangulations spoken of in the description, the depressed band being most distinct in the small and medium sized individuals. But the term "biangular," is perhaps, too marked to apply to so round and globular a shell. The umbilicus is very distinct when clear of adhering rock, and its margin abrupt. On very well preserved specimens the under side is seen to be marked by very fine revolving lines, but those on the upper side of the volutions only are visible on most examples.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Pleurotomaria Swallovana, Hall; (*Trans. Alb. Inst., Vol. 4, p. 24.*) **Plate 9, Figs. 1 and 2.**

"Shell depressed, somewhat globose, spire little elevated; volutions about five, regularly rounded, the last one sub-ventricose, and sometimes a little more expanded at the periphery; suture well defined; aperture sub-circular, a little oblique on the pillar; umbilicus large, circular; a flattened band upon the periphery of the shell margined on each side by a distinct elevated line; volutions crossed by fine, even, thread-like striæ which are smaller than the spaces between them, more conspicuous on the upper side of the volutions and often obsolete on the lower side.

"Diameter .12 to .25; height .07 to .20 of an inch."

The general resemblance of this species is somewhat similar to that of *P. subglobosa*, but it is much more depressed, although very variable is this respect. The transverse striæ on the upper surface of the volution, and the situation of the band which is on the periphery in this case will serve to distinguish this species.

Localities.—Spergen Hill and Bloomington, Ind.

Pleurotomaria trilineata, Hall; (*Trans. Alb. Inst., Vol. 4, p. 25.*) **Plate 9, Fig. 20.**

"Shell ovate-conical; spire more or less elevated, acute at the apex; volutions about six, convex, last volution ventricose; suture distinctly defined; aperture sub-circular; columella perforate by a small umbilicus; surface marked upon the periphery by a comparatively broad spiral band, which is margined on each side by a linear groove; two other similar grooves between the band and the umbilicus, dividing the base of the shell into three spaces, each one equaling in width the spiral band; entire surface, except the spiral band, ornamented by revolving, thread-like striæ, which are crossed by fine lines of growth, the latter becoming stronger and curving slightly backward upon the spiral band; an almost imperceptible angulation just below the umbilicus.

"Length .125 to .50 of an inch."

The measurement ".125" as given in the original paper is probably a misprint and should be .25. The largest specimen which I have observed is about .75 of an inch high.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Pleurotomaria nodulostriata, Hall; (*Trans. Alb. Inst., Vol. 4, p. 21.*) **Plate 9, Fig. 5.**

"Shell turbinate; spire depressed-conical, obtuse at the apex;

volutions about four, rounded, somewhat depressed above, the last one ventricose below; suture distinct, rather sharply defined; aperture sub-circular, slightly flattened on the inner side; umbilicus rudimentary; surface marked by strong, revolving elevated striæ which are about equal to the spaces between them, excepting on the periphery of the outer volution where two or three are more distant, leaving a double spiral band; revolving striæ crossed by oblique striæ (parallel to the lines of growth) which are very conspicuous on the upper side of the volution, but become obsolete below the band. The revolving lines at the junction of the oblique striæ become nodulose on the upper half of the volution, and particularly near the suture.

"Diameter .12 to .18; height .10 to .18 of an inch."

In most of the specimens, especially the larger ones, the upper side of the volution is obliquely flattened in the direction of the apical angle, and the periphery vertically flattened. They vary greatly in the rate of increase, the apical angle varying from less than sixty to about ninety degrees in different specimens. There are apparently two strong varieties included among those referred to the species, one having coarse revolving lines on the lower side, the other marked by very fine lines, the latter having a very depressed spire and flattened periphery; though I think there are intermediate forms enough to unite them.

Localities.—Spergen Hill and Bloomington, Ind., and Alton, Ill.

Pleurotomaria Wortheni, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 23;—*Geol. Rept., Iowa,* 1858, *p.* 530, *Pl.* 23, *fig.* 13.) **Plate 9, Fig. 4.**

"Shell depressed sub-globose; spire but little elevated, oblique from the great expansion of the last volution; volutions about three, somewhat flattened above, rapidly expanding, so that the last volution makes nearly the whole bulk of the shell; obtusely angulate on the periphery; upper margin of the volutions marked by a row of strong nodes, which extend about one-third across; surface marked above by striæ parallel to the lines of growth which on the last volution disappear in passing over the angulate periphery; base of last volution marked by strong revolving lines on the space between the outer margin and the umbilical area; base deeply excavated about the umbilical region, but the umbilicus is unknown. Aperture sub-quadrate, upper edge of the outer lip projecting far over the lower.

Diameter .60; height .48 of an inch."

This shell is not a very characteristic form of *Pleurotomaria.*

In fact it approaches much nearer to the genus CRYPTÆNIA, Deslonch, Mem. Soc. Lin., Vol. VIII, p. 147, than to the true *Pleurotomaria*, as the slit in the periphery has been very obscure and concealed by the succeeding volutions. The form is also depressed and the aperture very oblique, receding very much on the lower side. I have not been able to ascertain the form of the umbilicus in *Cryptænia*, but in this species the depression is very broad and patulose, although the real perforation itself is very small indeed. The row of nodes mentioned in the description as characterizing the upper side of the volution, have the form of undulations of this part of the shell, are somewhat oblique and only pertain to the last one or one and a half volutions. The surface of the shell when not worn is covered by revolving lines both above and below, except within the umbilical depression, the very margin of this only being marked.

Localities.—Spergen Hill and Bloomington, Ind.

Pleurotomaria humilis, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 21.) **Plate 9, Fig. 3.**

"Shell depressed, trochiform, oblique, spire little elevated, consisting of three or four volutions which increase rapidly in size from the apex; volutions depressed-convex above, and declining to the periphery; base of the last volution less convex than on the upper side, sub-obtusely angular on the periphery which is marked by a narrow groove, little wider than the usual spaces between the revolving striæ; surface marked by revolving and transverse striæ which are stronger and more distant on the upper side of the volution, giving it a beautiful cancellated appearance; while they are closer and finer on the lower side of the shell; mouth transversely oval; umbilicus small.

"Diameter .10 to .19; height .07 to .14 of an inch."

The specimens upon which this species was founded, and of which the above is the description, are only the young shells of PLEUROTOMARIA WORTHENI, Hall, and their locality the same as of that species.

Pleurotomaria (?) Meekana, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 22.) **Plate 9, Figs. 8 and 9.**

"Shell depressed-conical; spire short, rapidly diminishing and obtuse at the apex; volutions about five, appressed above and sub-angular below, with the periphery vertical; suture distinct;

[*Oct. 20th,*

last volution large, not ventricose, biangular on the periphery, with a defined groove in the centre which is distinctly margined above and below by an elevated line; surface on the upper side of the volutions marked by revolving and transverse striæ of equal strength, which are regularly cancellated, (and when not worn there is a slight nodosity at the crossing). The revolving lines on the base of the last volution are closer and finer than those above, and equally, but less distinctly, crossed by the transverse lines which make a deep sinuosity on the periphery of the shell. Aperture sub-quadrate, with a deep notch in the outer margin at the termination of the revolving band; umbilicus of medium size.

"Diameter .18; height .13 of an inch."

The species is represented in the collection by only a single imperfect specimen, on which the characters are rather obscure. It has more the form of a *Trochonema* than of a *Pleurotomaria* in the general form of the shell and spire. There is but very indistinct evidence of the "deep notch" in the outer margin of the shell, and I cannot detect any revolving lines on the lower side of the last volution as stated.

Locality.—In the original paper the locality is given as Spergen Hill, but the card is marked Alton, and the specimen shows the lithological characters of the rock from that locality. Therefore I think it probable the locality has been wrongly stated by mistake.

Pleurotomaria Piasaensis, Hall; (*Trans. Alb. Inst., Vol. 4, p. 22.*) **Plate 9, Figs. 6 and 7.**

"Shell depressed, sub-globose; spire short and little elevated, consisting of about four volutions; volutions rapidly increasing in size, depressed-convex above, somewhat rounded below, and becoming sub-angular near the aperture; the periphery abruptly rounded and marked by a spiral groove or band; surface marked by about four strong spiral or revolving striæ on the upper side of the volution, between the periphery and suture, and four or five similar striæ on the lower side; transverse striæ scarcely distinct except in the spaces between the revolving striæ; umbilical depression rather broad, and margined by a strong angular elevation towards the aperture of the shell; aperture sub-quadrangular, the pillar side shorter; the outer side, from the periphery to the angle bordering the umbilical region, nearly straight, and equal to the space from the periphery to the suture.

"Diameter .17; height .10 to .11 of an inch."

The shells of this species are very variable in the form of the

volutions; some being round on the periphery, and others quite angular, that figured being of the latter group. Of course this sharpness on the edge gives a more obliquely flattened form to the upper and lower surface, destroying to a considerable extent the "sub-globose" form as mentioned in the original description. The number of bands and the strength of the transverse striæ also vary. On the angular specimens there is often a carinated band forming the margin, when it becomes difficult to distinguish the position of the slit which should characterize the genus to which it is referred.

Locality.—Piasa Creek, above Alton, Ill., the locality of the Alton bed.

Pleurotomaria conula, Hall; (*Pleurot,* (*Murchisonia ?*) *Conula,* Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 26.) **Plate 9, Fig. 17.**

"Shell conical, spire gradually and uniformly diminishing from the base; volutions six to eight, angular in the middle, and flattened above and below; sutures defined; surface marked by distinct, elevated, nearly vertical striæ both above and below the spiral band; spiral band occupying the periphery of the volution, and composed of three revolving minute carinations with narrow depressions between (sometimes only two elevated bands are visible); aperture sub-quadrate; columella extended below, perforate.

"Length from .08 to .18 of an inch."

The generic relations of this shell are rather obscure, as it seems to be intermediate between *Murchisonia* and *Pleurotomaria.* If it were not perforated it would form a very good *Murchisonia,* but the type of that genus has a solid axis, and all true species of the genus in the Devonian have, while this species is very distinctly umbilicated. The slit in the aperture is very narrow, and in the specimen figured is seen to be open for nearly an entire volution, becoming gradually narrower as it recedes from the aperture, and in closing finally forms the third carination of the band mentioned in the description.

Locality.—Spergen Hill, Ind.

Pleurotomaria elegantula, Hall sp.; (*Murchisonia elegantula,* Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 27—*Pleurotomaria Shumardi, M. and W.; Geol. Surv. Ill., Vol.* 2, *p.* 260, *Pl.* 18, *fig.* 6.) **Plate 9, Fig. 19.**

As the original description of this species was taken from a very

imperfect and immature specimen it is very incomplete, and I have thought best to substitute that given by Messrs. Meek & Worthen, *loc. cit.* which is much better. The shell is a very good *Pleurotomaria*, and does not in its complete form possess the features of the genus *Murchisonia.*

"Shell trochiform, of medium size, very thin ; spire moderately elevated, conical, somewhat attenuate at the apex. Volutions about seven, increasing rather rapidly in size, obliquely flattened above ; those of the spire somewhat angular near the lower side ; last one very prominent, and angular around the middle, moderately convex below, the immediate edge of the angle being truncated by the narrow spiral band. Band flat or slightly concave, and margined above and below by a small, smooth, slightly elevated line ; passing around a little above the suture on the whorls of the spire. Suture well defined ; umbilicus small ; aperture rhombic-sub-quadrate, wider than high. Surface ornamented by numerous transverse lines, which are very regular and closely arranged on the upper whorls, but become stronger, more distant, and less regular on the last turn. In crossing the upper, flattened, sloping sides of the whorls, these lines arch a little forward, and pass very obliquely backwards from the suture to the band ; on the under side of the body whorl, they are smaller or nearly obsolete, and crossed by obscure traces of fine revolving striæ. Length 0.70 inch, breadth 0.73 inch ; apical angle rather distinctly concave ; divergence 0.70."

Localities.—Bloomington, Ind., and Warsaw, Ill.

Genus MURCHISONIA, *D'Arch. & Vern.*

Murchisonia insculpta, Hall ; (*Trans. Alb. Inst., Vol.* 4, *p.* 26.) **Plate 9, Fig. 18.**

"Shell subulate-conical ; spire somewhat rapidly ascending, acute ; volutions six or seven, convex and rounded in the middle, appressed and sloping gradually above, and abruptly below, to the suture ; upper side of volutions marked by vertical elongate nodes, which are pointed above and gradually disappear in the surface below, or subdivide into distinct elevated striæ ; spiral band rather broad, margined by two distinct elevated lines with the intermediate space convex or concave ; last volution ventricose, extended below, and marked by an elevated line which is a continuation of the suture line ; aperture somewhat rounded, and extended in front ; columella extended below and imperforate.

"Length from .05 to .25 of an inch."

The species approaches more nearly to *Pleurotomaria conula*

1882.]

than to any other associated species, but can be readily distinguished by the more highly conical form, coarser markings, more extended aperture, more ventricose last volution which is longer on the lower side, and by not being umbilicated. The slit in the last volution extends from the margin of the aperture backwards for about one-fourth to one-third of a volution.

Localities.—Spergen Hill and Bloomington, Ind.

Murchisonia terebriformis, Hall; (*Trans. Alb. Inst.*, *Vol.* 4, *p.* 28.) **Plate 9, Figs. 15 and 16.**

"Shell extremely elongate, subulate-acute; volutions eight or nine, very convex, marked by a broad spiral band in the centre, last volution ventricose; suture deeply marked; surface ornamented on the upper side of the volutions by fine striæ, which extend obliquely backwards to the spiral band, below the band by one or two spiral elevated striæ, and on the last volution by four or five similar striæ; aperture unknown; umbilicus none.

"Length .33 of an inch."

This shell resembles in its general features *Pleurotomaria trilineata*, Hall, herein described, but is more elevated than the most slender forms of that species, and has a less ventricose volution as well as a greater number of whorls. The surface ornamentation is quite distinct as there are none of the fine revolving lines above the band on this one, the surface being marked by transverse striæ only, and the revolving lines below are raised, flattened, narrow bands instead of impressed lines as on that one. The shell is also imperforate.

Locality.—Bloomington, Ind.

Murchisonia vincta, (*Loxonema vincta*, Hall; *Trans. Alb. Inst.*, *Vol.* 4, *p.* 28.) **Plate 9, Fig. 14.**

"Shell extremely elongate, very gradually tapering from the base; volutions convex below, appressed above, banded just below the suture, and marked by transverse arching striæ; aperture ovate, wider below; umbilicus none.

"Length one inch."

The description given of this species is very incomplete, and the specimens are usually too imperfect to afford means for better. The volutions have been as much as ten or twelve in number, are very little convex, the upper half being depressed from the presence of a broad concave band just above the centre, which gives

them an obliquely flattened character, and throws the greatest convexity below the middle; often causing a slight angularity, and leaving a narrow flattened band below the suture line above the band. This form is so common a feature of the genus *Loxonema*, that it is very natural to make the wrong generic reference, especially as the surface markings are extremely fine and often obsolete. In the type specimen, however, they can be seen with a good glass, and show a decided recurving in crossing the depressed band, showing decidedly its generic affinities with *Murchisonia*. It is the largest shell of the form found in these beds, and is readily distinguished from any of the non-lirated species by its more slender form, and from those by its greater size and smooth volutions.

Locality.—All the specimens yet observed have been from Spergen Hill, Ind.

Murchisonia vermicula, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 27.) **Plate 9, Fig. 11.**

"Shell cylindrical, abruptly tapering at the apex; volutions from six to ten, moderately convex in the middle, and scarcely diminishing for the first four or five turns above the base, but becoming more abruptly contracted above; surface of each volution marked by two very prominent revolving striæ, having a space between them on the periphery, and a single finer line below and one above near the suture; the last volution not ventricose, and marked by a fifth revolving striation, which is a continuation of the suture line; aperture broadly oval, rounded below; columella imperforate. Shell minute.

"Length .14 of an inch."

This is the smallest gasteropod found in the Spergen Hill beds, and is extremely abundant in certain layers. The shell is nearly cylindrical for more than half its length in the larger specimens, the increase being mostly in the upper four or five volutions. The spiral bands are often nearly obsolete, or the upper and lower are indistinct, and the central ones very strongly marked. It is readily distinguished from the apical portion of *M. turritella* by its cylindrical form, that one being regularly tapering.

Localities.—Spergen Hill and Bloomington, Ind.

Murchisonia turritella, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 27.) **Plate 9, Fig. 12.**

"Shell subulate, elongate, gradually tapering to the apex; suture distinct; volutions about nine; equally rounded, the last one slightly ventricose; surface marked by closely arranged, rounded, revolving striæ, which are stronger on the middle of the volution; five revolving striæ on each volution of the spire, and about seven on the last volution; aperture sub-ovate; columella slightly extended, and curved around the aperture, imperforate.

"Length .18 to .50 of an inch."

The shells of this species are very variable in their rate of increase and in the comparative height of the volutions, as also in the strength of the revolving lines. These latter are often quite sharp or angular, or others are rounded as stated in the description above. The band marking the slit in the lip is situated above the middle of the volution, and is not well marked until the shell attains considerable size, when it becomes distinct. This feature gives a central or sub-central line, so that there are five lines exposed on each volution. There is but one associated species with which it will be readily confounded, namely, *M. attenuata*, under which species comparisons will be found.

Locality.—Spergen Hill, Ind.

Murchisonia attenuata, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 27.) **Plate 9, Fig. 13.**

"Shell subulate, elongate; spire very gradually tapering; volutions nine or more, flattened, scarcely convex in the middle, and marked by a spiral band which is margined on either side by a strong elevated line; suture bounded on each side by a sharp elevated line which is smaller than those bordering the spiral band; aperture transverse; umbilicus none."

There will always be considerable difficulty in distinguishing between this one and *M. turritella*, more especially so as no perfect specimens of this have been observed, so that the entire characters are unknown. It is probably a distinct species, but the only distinction that remains constant, even among the small number of individuals observed, (some five) consists of the number of revolving lines, which on this one is four, and on that five. As a pretty general thing they are sharper on this form, and those near the suture line less distinctly so than those bordering the band. This

feature destroys that roundness of the volutions so characteristic of *M. turritella.* The band is also situated nearer the middle of the volution, and the shell is perhaps a little more slender.

Locality—Spergen Hill, Ind.

HETEROPODA.

Genus BELLEROPHON, *Montf.*

Bellerophon sublævis, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 32;—*Geol. Iowa,* 1858, *p.* 666, *Pl.* 23, *fig.* 15.) **Plate 8, Figs. 6 and 7.**

"Shell sub-globose, inflated on the last volution; aperture transverse, arcuate, expanded, the lip thickened and much extended at the junction with the volution; umbilicus none; dorsum carinated by a narrow slightly elevated carina; surface ornamented by fine, regular striæ which bend abruptly and deeply backwards on the carina, denoting the depth of the emargination of the lip; striæ sometimes irregular from interrupted growth.

"Length from .062 to .875 of an inch."

This shell belongs to the non-umbilicated section of the genus, and in the adult shell the lip is much thickened over the umbilical area, so as to form a strong callus; while in the younger stages it is but slightly thickened, or in the very young is thin and scarcely enrolled. The volutions are strongly embracing, the last one so much so as to give a deeply reniform aperture. The dorsal keel is but slightly marked and very narrow, and in very many of the larger individuals becomes entirely obsolete, either from an external deposit or from a kind of erosion which has taken place before the shells were finally imbedded, and which has also obliterated the surface markings. Besides the broad emargination of the lip indicated by the transverse lines of growth, they sometimes show a deep slit of the width of the dorsal band extending an eighth of an inch or more from the margin of the lip. There is no described species from the lower carboniferous formations that approaches very near this one; *B. Stevensianus,* McChes., Pal. Foss. Pl. 2, fig. 18, from the coal measures of Illinois and the west, is as near as any, but is compressed laterally, more strongly marked and more distinctly carinate. Specimens measuring an

inch and one-eighth have been more recently obtained at Spergen Hill, and at Ellettsville, Ind.

Localities.—Spergen Hill, Bloomington, Paynter's Hill, and Ellettsville, Ind., and Alton, Ill.

Bellerophon textilis, Hall; (*Bellerophon textilis*, Hall; *Cat. Pal. Foss.* S. A. Miller, 1877;—*B. cancellatus*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 31.) **Plate 8, Figs. 4 and 5.**

"Shell sub-globose; aperture transversely oval, arcuate, with the lip reflexed at the sides; umbilicus small in young shells, and scarcely visible in the older specimens from the thickening of the lip; surface marked by fine longitudinal elevated striæ, of which about thirty may be counted on each side of the carina, increasing by implantation with the age of the shell; carina rather narrow and little elevated, very indistinctly marked by the longitudinal striæ. Transverse striæ in the direction of the lines of growth, irregular, sub-imbricate, more distant than the longitudinal striæ, bending backwards on the carina. At the crossing of the two sets of striæ the surface is slightly nodulose, in well preserved specimens.

"Length .125 to .75 of an inch or more."

This is the only cancellated form described from the carboniferous rocks of the Western States, and is a form more characteristic of the Devonian and Waverly formations than of this horizon. The shells which I have seen all have the appearance of immaturity, and there is an uncertainty as to whether the lip may or may not have been reflected in the adult stages, like those of the same type in the lower formations mentioned. If it were thin and unreflected as in the specimens known, this alone would be a distinguishing mark. But the even cancellation of the surface otherwise distinguishes it from all except *B. Leda*, Hall, from the Hamilton shales of New York, which always has a broader band, and is rather more decidedly umbilicate.

Localities.—Spergen Hill and Bloomington, Ind.

PTEROPODA.

Genus CONULARIA, *Miller.*

Conularia subulata, Hall ; (*Trans. Alb. Inst., Vol.* 4, *p.* 32.) **Plate 8, Fig. 3.**

"Shell quadrangular, the four sides nearly flat and converging at an angle of about 18° ; surface marked with a distinct longitudinal groove on each of the angles, and numerous regular, smooth, closely arranged, elevated, transverse striæ, which pass a little obliquely downwards towards the middle of each of the sides, where they meet at a very obtuse angle. A single sharp longitudinal line passes down the centre of each side, without interrupting the transverse striæ ; angles truncate or rounded towards the apex.

"Length .50 of an inch."

The striæ on this shell, so far as can be determined from the imperfect specimens in the collection are smooth, and have had no longitudinal striæ crossing them, cutting their surfaces into ornaments as is generally the case in this genus. They are very angular and occupy the entire space of the furrow. The number in a given distance varies with the distance from the apex of the shell, one counting eighteen in a tenth of an inch where the shell measures a twelfth of an inch in diameter, and another where the shell is a trifle less than a sixth of an inch in diamter there are only ten in the same distance. The specimens are too small and imperfect to afford means for comparison with other described forms.

Locality.—Alton, Ill.

CEPHALOPODA.

Genus ORTHOCERAS, *Breyn.*

Orthoceras epigrus, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 33.) **Plate 8, Fig. 2.**

"Shell sub-cylindrical, very gradually tapering ; section circular ; siphuncle small, sub-central ; septa slightly concave, separated by spaces equal to about one-third the diameter of the shell ; surface marked by distant, rather faint, longitudinal lines."

The only specimen of the species in the collection is a fragment retaining five chambers. The septa are remarkably flat. With a strong hand glass I fail to find any indications of the "rather

faint longitudinal lines" spoken of in the original description.

Locality.—Spergen Hill, Ind.

Genus NAUTILUS, *Breynius.*

Nautilus Clarkanus, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 32.) **Plate 8, Fig. 1.**

"Shell sub-discoidal, flattened on the dorsum, and angular at its lateral margin; umbilicus large, showing all the inner volutions; volutions (number unknown) rapidly diminishing, broader than high, not embracing; surface ornamented by a deep revolving groove round the dorso-lateral margin, between which and the umbilicus is a single row of indistinct nodes, and about five or six strong striæ, which are crossed by fine elevated striæ. Aperture transversely oval; septæ slightly concave, and separated by spaces about equal to one-fourth the greater diameter of the volutions.

"The specimen described is somewhat worn upon the dorsal side, which may have obliterated the fine transverse or longitudinal striæ, remaining upon the lateral edge of the shell."

The specimen used for the above description is a fragment of what was a much larger shell, and from its imperfect condition has led to a misconception of the characters of the species. There are three small fragments in the collection which show that the volutions were not flattened on the dorsum, but that portion which forms the flat surface, and the border of the "deep revolving groove round the dorso-lateral margin" of the volution, is only a portion of the inner surface of a succeeding volution which has been broken away, leaving the ventral portion attached to the present one. The dorsal surface has been broadly convex, and so far as seen on the fragments mentioned has been marked by revolving ridges, coarser and more distant than on the side of the volution. None of the specimens show the position of the siphon or afford means of comparison with other species.

Locality.—Spergen Hill, Ind.

ANNELIDA.

Genus SPIRORBIS, *Lamarck.*

Spirorbis annulatus, Hall; (*Trans. Alb. Inst., Vol.* 4, *p.* 34.) **Plate 9, Fig. 30.**

"Shell planorbicular, more or less ascending, irregularly spiral; spire composed of about three turns, which are contiguous or

more or less disconnected ; umbilical side more or less deep and regular according to the regularity of the spiral ; surface ornamented with strong annulations, with finer striæ between.

" Diameter from .062 .25 of an inch."

This species attains a rather larger size than is common with those of the genus. The coiling of the tube is very irregular, but is always dextrally ascending from a small base of attachment, although the specimens are invariably found free. The annulating striæ are strong, raised and lamellose, and form a very good distinguishing feature of the species.

Localities.—Spergen Hill and Bloomington, Ind., and at Alton, Ill.

Spirorbis nodulosus (*Spirorbis annulatus*, var. *nodulosus*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 34.) **Plate 9, Fig. 31.**

"Shell in form like the preceding ; last volution strongly deflected ; volutions sub-angular, marked by oblique striæ or ridges which become strongly nodulose on the umbilical side, and particularly towards the aperture."

The nodose character of this species is a strong distinguishing feature, and is entirely unlike the surface structure of the preceding one, being composed of oblique rows of thickened nodes, not capable of being formed by a modification of the distant, straight, encircling lines of the surface of that one, therefore I see no impropriety in classing it as a distinct species. It possesses about two or two and a half volutions, the latter part of the outer one being deflected to nearly an upright position and is free and cylindrical. Both these species in nearly every case show evidence of having been fixed to some foreign substance when living and young, but are always, so far as I am aware, found loose in the rock. It would seem probable that they had been attached during life to some perishable substance, as a plant, which on decomposing had freed the tubes and allowed them to fall to the bottom of the water in a free state

Locality.—Spergen Hill Ind.

OSTRACODA.

Genus LEPERDITIA, *Roualt.*

Leperditia carbonaria (*Cythere* carbonaria*, Hall; *Trans. Alb. Inst., Vol.* 4, *p.* 33.) **Plate 9, Figs. 24-27.**

"Shell oval or sub-ovate, gibbous; slightly compressed towards the margins; ventral [dorsal] margin straight, one-third less than the greatest length of the valves; extremities rounded, broader anteriorly; dorsal [ventral] margin forming a broad curve; surface smooth.

"This species does not exceed a single line in length. Compare with C. PUSILLA, McCoy."

The carapace of this species is broadly ovate, slightly narrowed anteriorly; hinge-line straight about half as long as the valves, which are compressed towards the dorsal line and become rapidly inflated toward the ventral; extremities of the hinge angular, so as to produce a slight feature at this point. Right valve considerably larger than the left, and overlaping it except on the dorsal margin, at which point the left projects above the right. Ocular spot not definitely determined. There is a small tubercle present on some individuals just behind or at the middle of the length, on the right valve, indicated on the figure, but which is very obscure and rarely seen. On the casts at this point a circular scar is also visible on each side, indicating the position of the muscular tubercle, but no evidence of the ocular tubercle has been observed. In the original description above quoted the terms dorsal and ventral are used reversed; the corrections in brackets are now added.

Localities.—Spergen Hill and Bloomington, Ind.

Genus CYTHERELLINA, *Jones & Holl.*

Cytherellina glandella, N. sp. **Plate 9, Figs. 28 and 29.**

Carapace minute, elongate ovate, a little wider at one (posterior?) end and also more ventricose, while being compressed gradually toward the anterior extremity, presenting a somewhat cuneate aspect in profile. Upper and lower margins nearly equally cur-

* Misprint for *Cytherina.*

ved ; ends neatly rounded, length about twice the width, and the width nearly twice the thickness of the middle of the valves. Valves nearly equal, scarcely overlaping at their edges even on the basal margin ; the hinge line scarcely distinguishable. Surface of the valves smooth under an ordinary magnifier, but with a faint sulcus crossing them just behind the middle, and a slight tubercle between it and the broader end.

There is some doubt as to the true generic relations of this species. It seems to be more nearly related to *Cytherellina* than to any other which I can find, although the slight inequality of the valves required under the diagnosis of that genus does not appear on any of the very few specimens which I have observed. There is some little variation in the form of the different specimens in their proportionate length and breadth, and also in the regularity of curvature. Length of the largest specimen about eight one hundredths of an inch.

Locality.—Spergen Hill, Ind.

The following species have been observed among the collections from Spergen Hill, Ind., in addition to those described in the foregoing paper.

Foraminiferous (?) bodies, spinose. Genus and species undet.

Palæacis cuneatus, M. & W.

Zaphrentis elliptica, White.

Zaphrentis spinulosa, Hall (?). Small form.

Zaphrentis, sp. undet.

Dichocrinus simplex, Shumard.

Platycrinus sp. Base and separate plates, resembling *P. Saræ*, Hall.

Platycrinus sp. ?. Two or more species represented by plates only.

Synbathocrinus Swallovi, Hall.

Batocrinus irregularis, Casseday.

Batocrinus icosidactylus, Casseday.

Batocrinus ? biturbinatus, Hall.

Barycrinus magister, Hall. Stems and plates.

Cyathocrinus. Several species represented by detached plates.

Scaphiocrinus sp. ?. Arms simple, formula $\frac{2}{4}\frac{4}{4}$

Forbesiocrinus Wortheni, Hall.

Pentremites (Tricoelacrinus) obliquatus Rœmer—*P. Woodmani*, M. & W.

Pentremites (Tricoelacrinus) obliquatus, M. & W., not of Rœmer.

Coscinium escharense, Prout.

Stictopora, sp. undet.

Fenestella hemitrypa, Prout.

Fenestella. Two or more undetermined species.

Paleschara tuberculata—*Fustra tuberculata*, Prout.

Streptorhynchus crinistriatum, King (?).

Productus vittatus, Hall.

Productus semireticulatus, Martin.

Spirifera tenuicostata, Hall.

Spirifera Leidyi, N. & P.

Spiriferina spinosa, N. & P. sp.

Aviculopecten, Indianensis, M. & W. This species is exactly a minature of the specimens from Crawfordsville, Ind.

Macrodon obsoletus. The specimen which I have identified with this species is much water worn, but so far as preserved retains features exactly identical with specimens from the coal measures of Ohio as given by F. B. Meek.

Dentalium or Coleus, sp. undet. The specimens of this shell are so universally fragmentary and eroded that I have not considered it describable.

Chiton carbonarius, Stevens.

Phillipsia bufo, M. & W. On close comparison of this species with examples from Crawfordsville, Ind., I can find no difference of importance.

Fish teeth, several species and genera are known from the beds at Spergen Hill.

In some specimens from a bed of white and ferruginous chert from Tuscumbia, Ala., I find the following Spergen Hill species represented, as casts principally.

Pentremites conoideus, Hall.

Pentremites Koninckana, Hall.

Spirifera Leidyi, N. & P.

Spiriferina spinosa, N. & P.

Athyris hirsuta, Hall.

Athyris trinucleata, Hall.
Eumetria Verneuiliana, Hall.
Rhynchonella Grosvenori, Hall.
Rhynchonella mutata, Hall.
Terebratula turgida, Hall.
Terebratula formosa, Hall.
Platyceras acutirostris, Hall.
Euomphalus Spergenensis, Hall.
Spirorbis annulatus, Hall.

EXPLANATION OF PLATE 6.

PAGE

Figs. 1–5. ORTHIS DUBIA, Hall. Fig. 1, dorsal view of a ventricose specimen from Bloomington, Ind. Figs. 2–4, three views of a larger specimen from Spergen Hill, Ind. Fig. 5, interior of ventral valve of a large individual from Paynter's Hill. 45

Figs. 6–7. PRODUCTUS INDIANENSIS, Hall. Profile and vertical views of the largest type specimen (2x). 47

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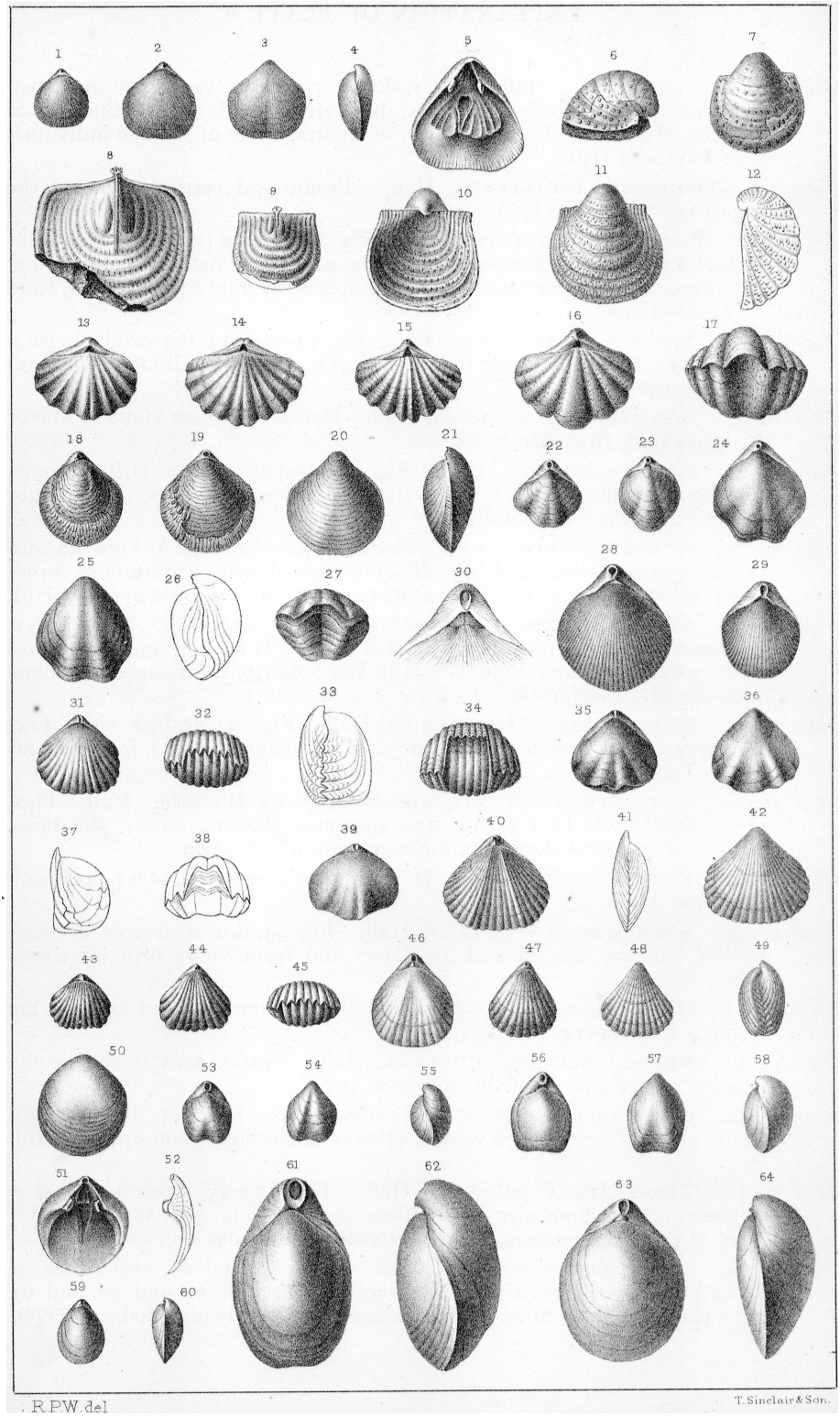
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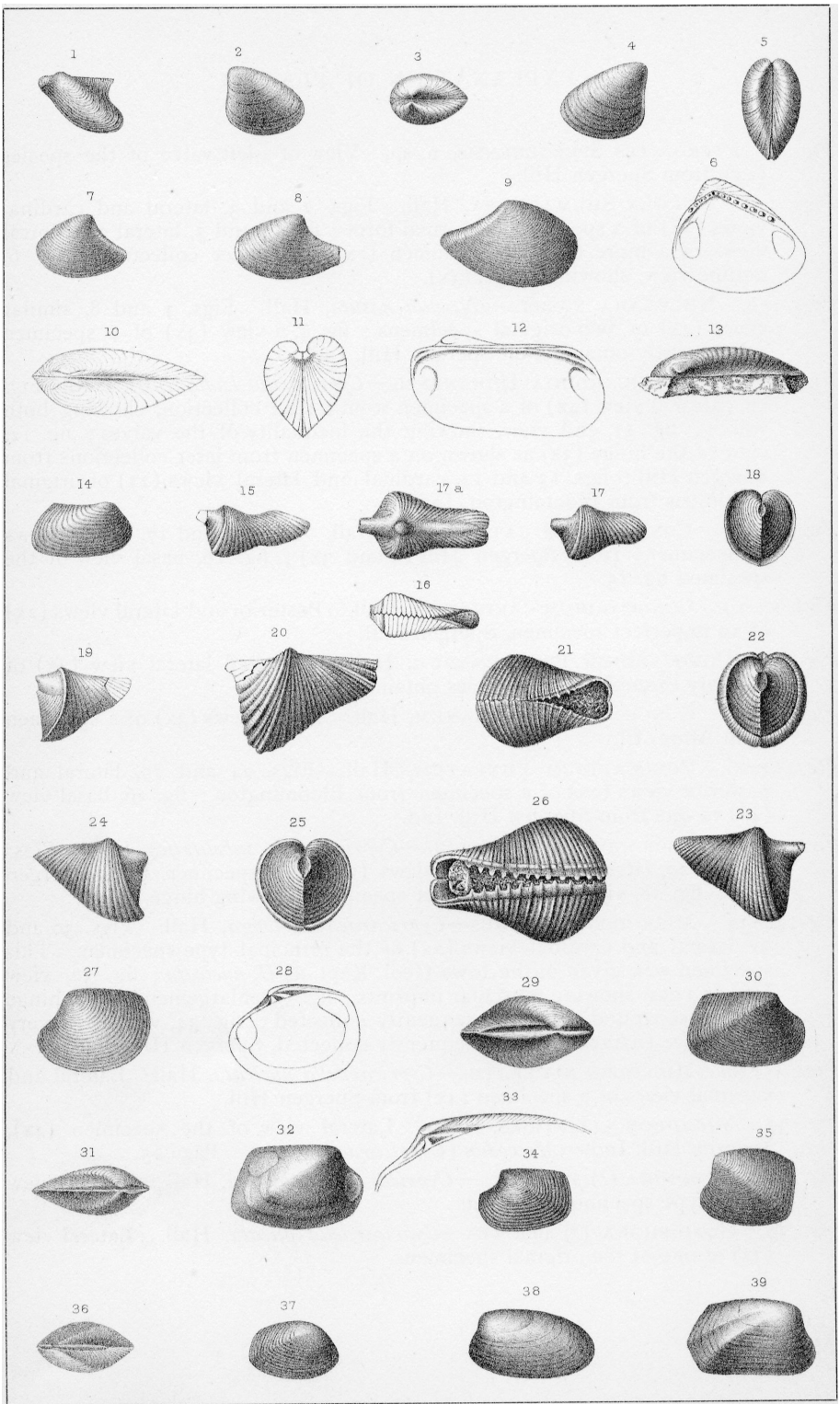
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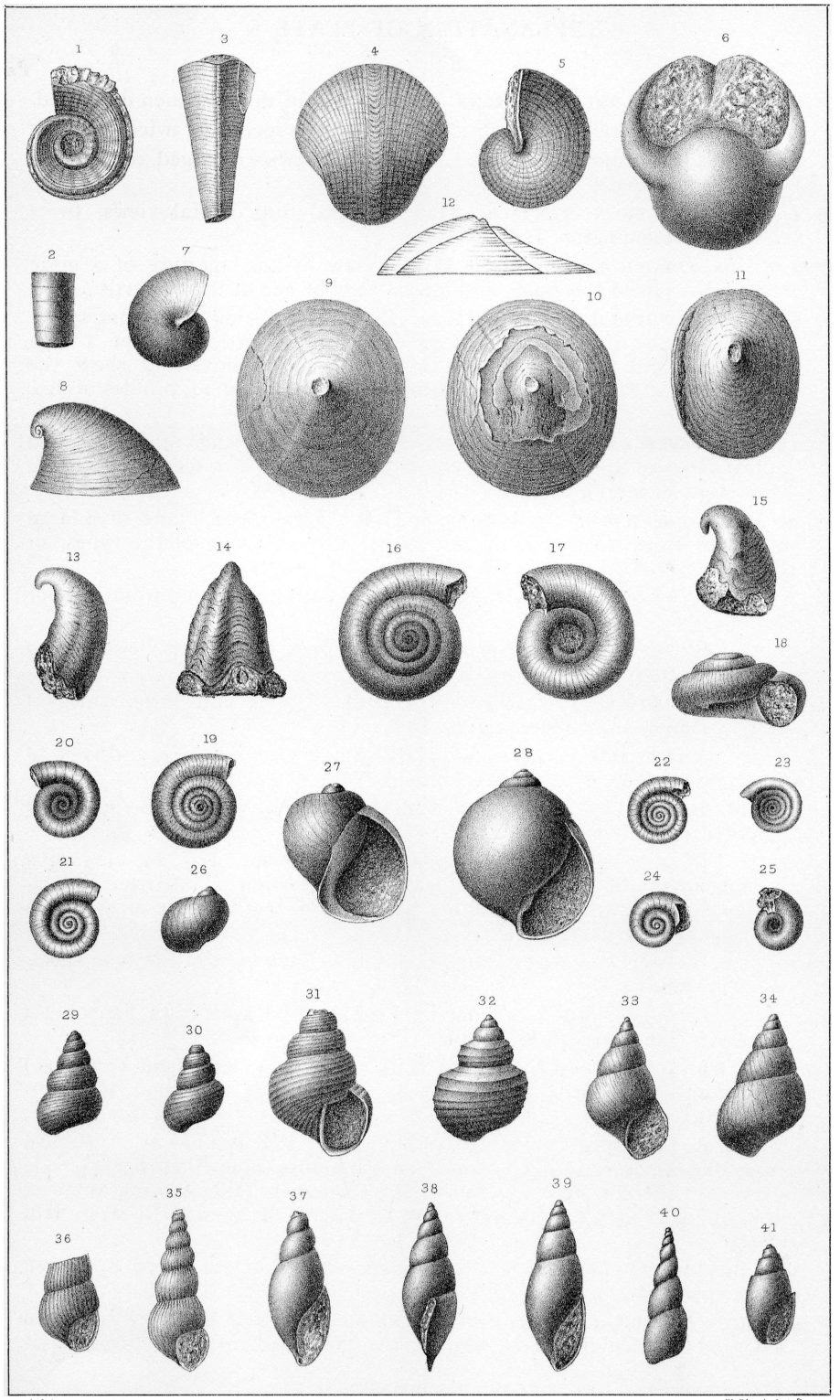
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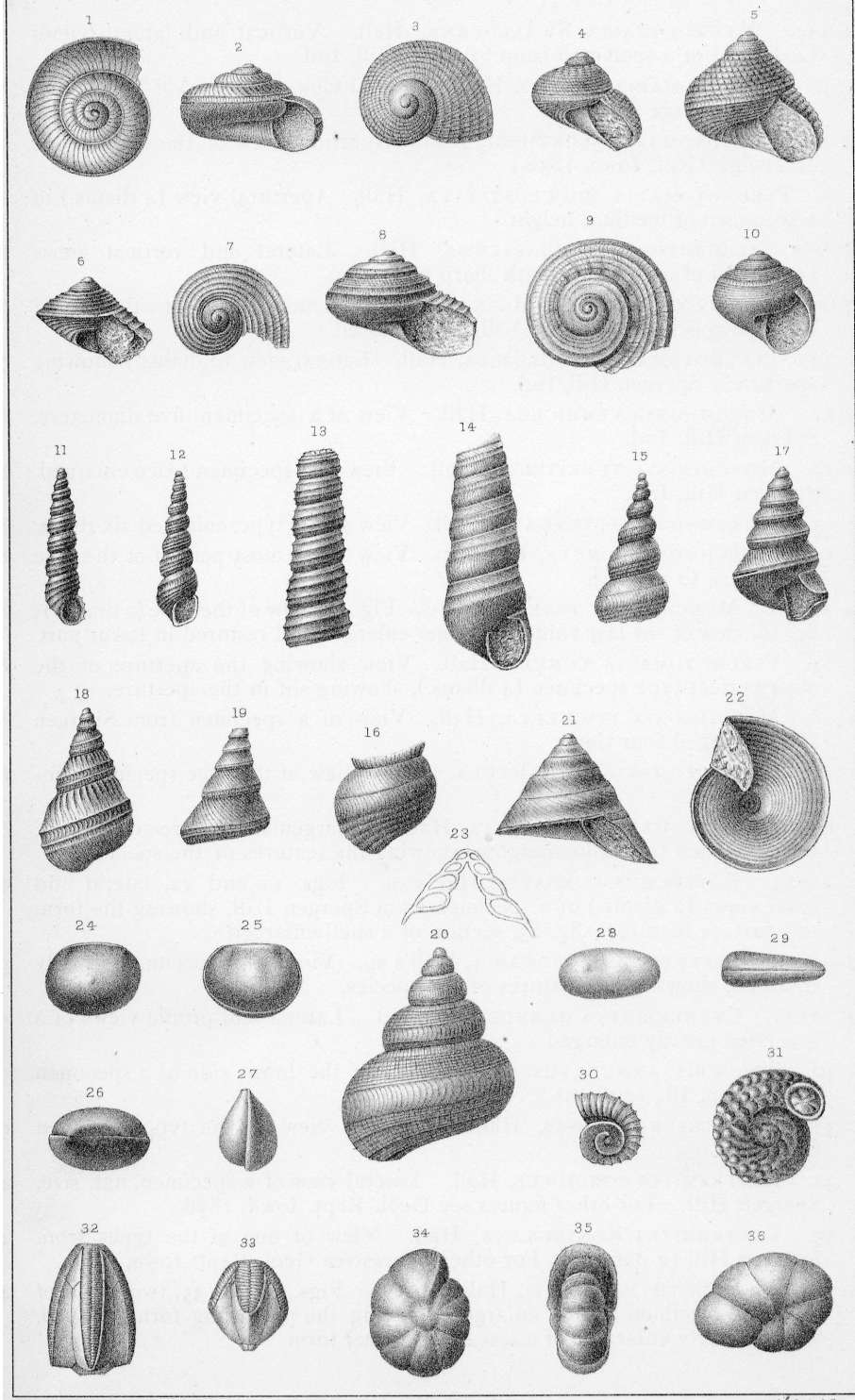
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