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XIII.—*Descriptions of New Species of Fossils from Ohio, with Remarks on some of the Geological Formations in which they occur.**

BY R. P. WHITFIELD.

Read January 16th, 1882.

Species from the Hydraulic Limestones of the Lower Helderberg Group.

BRACHIOPODA.

***Streptorhynchus hydraulicum*, n. sp.**

Pal. Ohio, Vol. III, Plate 1, Figs. 1—3.

Shell small to minute, the largest individuals yet observed not exceeding five-eighths of an inch in greatest diameter, while the most of those observed are not more than two-thirds as great. Valves depressed convex, or, more commonly, appearing very flat, as seen on the surface of the stone. Hinge-line straight, nearly as long as the width of the shell below, and the latter usually more than the length, frequently nearly once and a half as great. Ventral valve characterized by a very narrow and nearly vertical cardinal area, and a usually more or less twisted or otherwise distorted beak. Dorsal valve slightly more convex than the ventral, with a perceptible mesial depression extending from beak to base, becoming broad and undefined below the middle of the length. Surface of the shell marked by coarse and somewhat ridged radiating striæ, which are distinctly alternating in size; the principal ones proportionally very strong.

The small size of the shell, with the strong radiating and alternate striæ, are distinguishing features of the species. There is no species resembling it, to any degree, among the fossils of New York rocks of a corresponding age. It presents much more the features of forms of the genus from the Coal measures than any heretofore described from Silurian rocks of America, and will not be readily confounded with any known species.

Formation and Locality.—In the hydraulic beds of the Lower Helderberg group, at Belleville, Sandusky County, and at Green-

* These descriptions will be reprinted in the forthcoming Volume of the Palæontology of Ohio, and will be accompanied by Illustrations, to which the references by Plate and Figure, given in the present article, under each species, relate.

field, Ohio; associated with *Meristella bella*, *Nucleospira rotundata* and *Leperditia alta*, occurring sometimes in great numbers, almost covering the surfaces of slabs.

***Nucleospira rotundata*, n. sp.**

Pal. O., III, Plate I, Figs. 11—14.

Shell attaining a rather large size for the genus, being often more than half an inch in transverse diameter, and when of medium or large size, strongly ventricose or rotund. The younger individuals, however, are depressed-convex or lenticular in profile. Length of the shell as great or greater than the transverse diameter. Beaks small and incurved, not at all conspicuous. Valves marked by a slight depression along the median line, strongest on the ventral side.

This species, like all those of this formation yet obtained in Ohio, are mostly internal casts and impressions; consequently the true features of the shell are not readily obtained. The general features of the species, however, are preserved sufficiently for identification and comparison, when good individuals are selected. The shell bears much resemblance to *N. ventricosa*, Con., from the Lower Helderberg group of New York, in its general form, except the much greater size and more elongated form of the adult individuals. There is more difficulty in separating them satisfactorily from the casts of *Meristella bella*, Hall, with which they are associated. In fact, it is all but impossible to do this with certainty, unless they are in a good state of preservation, as the difference in the form of the muscular imprint of the ventral valve, and the more strongly incurved beaks, are the only features that can be relied upon.

Formation and Locality.—In the hydraulic limestone of the Lower Helderberg group, at Greenfield, Ohio.

***Rhynchonella hydraulica*, n. sp.**

Pal. O., III, Plate 1, Fig. 17.

Shell rather smaller than medium size, transversely oval in outline and ventricose in profile; the dorsal valve being highly convex, and the ventral somewhat depressed convex. Beaks small, not prominent or conspicuous; that of the ventral valve moderately incurved, and the other rather strongly incurved. Surface of the shell marked by from sixteen to eighteen simple plications, four of which are strongly elevated on the front half of the dorsal valve to form the mesial elevation, which does not extend beyond the mid-

dle of the valve, and six or seven may be counted on each side of the valve. The plications are but slightly elevated, are round on the summit, and do not extend beyond the middle of the shell, the upper part of which is smooth, and marked only by concentric lines of growth. The interior of the dorsal valve is marked by a moderately strong mesial septum, extending from the apex of the valve to about one-third of its length. The shell appears to have been also marked by fine concentric lines of growth, some of which form distinct varices.

This species belongs to the semi-plicated group of the genus, of which there are many species having close resemblance to it, but none in rocks of corresponding age or position having very close affinities to it.

Formation and Locality.—In the hydraulic limestone of the Lower Helderberg group, at Greenfield, Ohio.

***Pentamerus pes-ovis*, n. sp.**

Pal. O., III, Plate 1, Figs. 11—22.

Shell quite small, and of a somewhat broadly triangular form, with depressed convex valves, the ventral side being nearly twice as deep as the dorsal, and more elongated at the beak, giving it the triangular character; cardinal slopes straightened and rapidly diverging; front broadly rounded.

The species is known only in the condition of internal casts, and as thus seen, the ventral valve is deeply cleft along the median line by the removal of the central septum, the slit often extending more than three-fourths of the length of the valve. The filling of the spoon-shaped cavity is proportionally large, being long and narrow, and not strongly arched. Cast of the dorsal valve characterized by a proportionally large and broad cardinal plate, from which project two long and strongly divergent and distant crural processes, reaching far along the surface of the cast in some cases, while in others they are quite short. The surface of the valves has been destitute of plications, but is usually marked in the larger individuals by several strong varices of growth near the front margin, which give to the shell a prematurely old appearance for so small a species; the individuals seldom exceeds five-eighths of an inch in length on the ventral side.

The species is unlike any known form of a similar size, in the shallowness of the valves, in the erect character of the ventral beak, and in the deeply divided feature of the cast of this valve. The dorsal valve is much less marked, and is often destitute of any distinguishing feature.

Formation and Locality.—In the hydraulic limestone of the Lower Helderberg group, in Adams County, Ohio, occurring in

numbers densely packed together, but having the shelly substance entirely removed.

ARTICULATA.

Eurypterus Eriensis, n. sp.

Pal. O., Vol. III, Plate 1, Figs. 31, 32.

Among the fossils from the Hydraulic limestones of Beach Point, Put-in-Bay Island, Lake Erie, there are several detached cephalic shields and one body of a species of *Eurypterus*, which is so distinctly different from any of those described, that it seems necessary to class it as a separate species. The differences, so far as seen on the parts preserved, consist in the form of the cephalic plate, in the size and position of the eye-tubercles, and in the proportions of the body as compared with the known forms. There are undoubtedly other and more important differences in the appendages, but as these are not preserved on any of the individuals examined, comparison is impossible.

The cephalic shield is proportionally broader than that of *E. remipes* or *E. lacustris*, and is more regularly rounded or arched on the anterior border, lacking that subquadrate form characteristic of those species. The eyes are proportionally smaller, and situated nearer each other, and also farther forward, as well as being somewhat more oblique to the longitudinal axis of the body. The minute ocular points are somewhat larger than in *E. remipes*, are situated close together, and are nearly opposite the posterior end of the real eye tubercles; they consist of a pair of distinctly elevated rings surrounding rather deep, although minute, central depressions; the inner margins of the rings being almost in contact. The head does not show evidence of having been margined by an elevated or thickened rim, as in those species, but as the specimens are rather impressions of the inner surface of the external crust than actual external surfaces (being more properly internal casts, the substance of the carapace having been entirely removed), this feature may not be properly shown. The head-plate more closely resembles that of *E. microphthalmus*, Hall (Pal. N. Y., Vol. III, p. 407,* pl. 80 A, fig. 7), from the Tentaculite limestone near Cazenovia, N. Y., than of any other described species; it differs, however,

in being proportionally much shorter, which gives it a more semicircular form. The eye-tubercles are also more nearly of the size of those of that species and similarly situated.

The thorax closely resembles that of *E. remipes* in its general form, but the lower three of four segments are proportionally shorter, giving the posterior extremity a much more compact character. The principal distinction between the two species, as shown by the thorax, exists in a difference of the ornamentation of the surface, as seen on the specimen used. This consists in the minute spine-like pustules or pointed granules, marking the surface of the crust, being arranged in irregular transverse lines across the body, and parallel to the anterior and posterior margins of the segments, instead of being irregularly disposed, as in all other species described. No indication of the longitudinal rows of larger pustules, marking the median line of the thoracic segments, can be traced. Caudal spine not observed.

***Leperditia angulifera*, n. sp.**

Pal. O., Vol. III, Plate 1, Figs. 28—30.

Carapace of medium size, having a length, in adult individuals, of about three-eighths of an inch, by a height of one-fourth of an inch in the broadest part. General form of the outline broadly sub-ovate and widest posteriorly; hinge-line straight, equal in length to two-thirds that of the entire valve; anterior end a little the shortest, narrowly rounding into the broadly curved basal line; posterior end broadly rounded. Surface of the carapace highly elevated and prominent, forming a strong, somewhat angular, longitudinal node just within the basal margin, and near the middle of the length. From this point, the surface slopes somewhat gradually upward to the hinge-line, with a barely perceptible convexity, except on the anterior end, where it is more strongly convex, and characterized by a rather prominent and well-marked ocular tubercle. From the angular node near the lower margin, there is, on well-preserved individuals, a perceptible angulation, extending along the surface to the point of greatest length on the anterior end, and a similar one, but less strongly marked, on the posterior side. There is no perceptible difference in form between the right and left valves, each showing the features about equally developed. No appearance of striations radiating from the ocular tubercle can be detected, either on the internal casts or in the matrices; still the nature of the rock in which they are imbedded is such that very obscure markings would scarcely be preserved.

This species differs from *Leperditia alta*, Conrad, of the same formation, in its larger size, and in the larger and more distinct

eye-tubercle, as well as in its slightly different position; but most distinctly in the sub-angular ridge-like node, and greater convexity of the lower border of the valves. This projecting node being situated near the lower margin, and also being the most prominent point of the valve, causes the rock to adhere to the more abrupt sides when fractured, and gives to the valves as they appear upon the fractured surface a very decidedly triangular aspect, entirely unknown in *L. alta*.

Formation and Locality.—In the hydraulic limestone of the Lower Helderberg group, at Greenfield, Ohio, where it occurs in great numbers, forming distinct layers through the rock, as does the *L. alta* in the Tentaculite limestone of New York.

Species from the Limestones of the Upper Helderberg Group.

PROTOZOA.

Receptaculites Devonicus, n. sp.

Pal. O., Vol. III, Plate 2, Fig. 10.

A very decidedly marked and characteristic specimen of the genus *Receptaculites*, De France, has been obtained from the limestones of the Upper Helderberg group, by Mr. Ed. Hyatt, of the Ohio State University, from a quarry at Fishinger's mills, about eleven miles north of Columbus, Ohio. The specimen is about two and a half inches in diameter, is broadly concave across the disc, and slightly recurved at the outer margin. The concentric lines of pores or cells are strongly marked, and increase rapidly in size as they recede from the centre of the disc, but the surface has been so much weathered that the grooves left by the removal of the stolons at the foot of the cells are not distinguishable, so that the entire specific characters are not recognized; enough, however, remains to show the general form and proportions. It has much the appearance of specimens of a corresponding size of *R. Oweni*, Hall, from the lead-bearing limestones of the West, both in its general form and in the concavity of the disc, as well as in the proportions and rate of increase of the cell-openings as seen exposed on the surface of the limestone.

The occurrence of a species of this genus at this horizon, is a

rather unexpected feature in its history. The highest horizon of its occurrence hitherto recorded, is in the shaly limestone of the Lower Helderberg group of New York, from which the type of the species *Receptaculites infundibuliformis* (*Coscinium infundibuliformis*, Eaton; Geol. Text-book, 2d Ed., 1833, p. 132, fol. 5, figs. 64, 65) was derived. The figure and description, as given by Prof. Eaton, are both poor, but the specimen is still in the cabinet of the Rensselaer Polytechnic Institute, bearing the original label, and I have seen several specimens of the species from the same formation. *R. dactyloides* (*Dictyocrinus dactyloides*, Conrad) is also from about the same horizon. Both of these species, however, are in the Silurian, while the present species brings the genus up to the Devonian; so that we now know of its existence from the base of the Lower Silurian to the Lower Devonian.

RADIATA.

Stylasteria Anna, n. sp.*

Pal. O., Vol. III, Plate 2, Figs. 1—5.

Corallum compound, growing in irregular or more or less hemispherical masses of several inches in diameter, which are formed of a large number of closely aggregated polygonal cell-tubes or polyps, of rather small size, divided by intercellular walls of considerable thickness, as in most forms of the compound *Cyathophyllidæ*. Full-grown polyps, measuring about half an inch in diameter, but usually somewhat smaller; the prevailing size being about three-eighths of an inch. Calyces deep, abruptly declining from the intercellular walls to a depth nearly equalling the transverse diameter. Longitudinal septa or rays well developed, extending about one-third, or less, of the diameter of the tube from the outer wall, and averaging about forty in number in adult individuals; some containing thirty-six, and one large one counted gives forty-two. Crest of the rays strongly denticulate, the denticles being thickened and knot-like at their junction with the rays. Central chamber within the limits of the longitudinal rays, equal to one-third of the entire of the polyp, and divided by numerous distinct transverse tabulæ, which are variously bent or interrupted by contact with the adjoining ones, leaving irregular cavities of considerable size between them. Interseptal spaces occupied by a series of horizontal plates, which originate at the outer wall, and extend upward and inward with increased growth to the edge of the rays, where they form the denticulation of the crest. Between the latter plates, the spaces are occupied by the smaller irregular vesicular structure.

* Named in honor of Mrs. Orton, wife of President Orton, of the State University, Columbus, Ohio.

The species, in its general features, resembles *Cyathophyllum rugosum*, Hall, sp., from this formation, and may be easily mistaken for that one, in obscure or imperfect specimens; but where the internal structure is observable, especially in longitudinal sections of the polyps, can be very readily distinguished by the large central space in each polyp, and by the strongly developed transverse tabulæ; also by the rays not extending to the centre, as in that species and in those of the genus *Acervularia*. When the coral is weathered, or the substance becomes chalky, so that the polyps are readily separable from each other longitudinally, the appearance very closely resembles that of *Cyathophyllum rugosum* when in a similar condition, but the interruption of the rays before reaching the centre, and the great extent of the tabulæ, will then serve to distinguish them.

Formation and Locality.—In the Upper Helderberg group, in Paulding County, Ohio.

BRACHIOPODA.

***Streptorhynchus flabellum*, n. sp.**

Pal. O., Vol. III, Plate 2, Figs. 7 and 9.

Shell below a medium size, semi-circular or semi-ovate in outline, with a straight hinge-line of variable length; the lateral and front margins are somewhat regularly rounded and, in a profile view, irregularly bi-convex. Ventral valve depressed convex, with a more or less elevated and projecting but twisted or distorted beak, overhanging a nearly vertical cardinal area of irregular form and width, which is divided in the middle by a narrowly triangular convex deltidium. The dorsal valve is almost regularly semi-circular, very depressed convex, with a slightly more prominent umbo, and is destitute of cardinal area. Surface of the valves marked by from twenty-two to twenty-four strong, rather sharply elevated, radiating plications, which are entirely simple, and separated by broad, concave interspaces. The shell is also further marked by fine, regular, concentric striae of growth, which arch backward in crossing the radii, and may have been sub-lamellose on the external surface, but the examples seen are all exfoliated.

The species is of a somewhat unusual type, especially in Devonian rocks. The dorsal valve seen alone presents so much the appearance of a strongly-marked *Aviculopecten*, that when first observed it was thought to belong to that genus; but the ventral valve, similarly marked, and possessing the characteristically twisted cardinal area and beak with its covered fissure, at once

indicates its true position. It is entirely unlike any species hitherto described from American rocks, and will not easily be mistaken. It resembles, in the features of the dorsal valve, specimens of *Orthis flabellum* from the shales of the Niagara group of New York and elsewhere; but it is more coarsely marked, with wider and more deeply concave interspaces.

Formation and Locality.—In the limestones of the Upper Helderberg group, at Smith and Price's quarries, near Columbus, Ohio. Collected by Mr. Hyatt.

***Rhynchonella? raricosta*, n. sp.**

Pal. O., Vol. III, Plate 2, Fig. 6.

Shell of moderate size, and somewhat transversely sub-triangular in outline, when seen upon the ventral side. Ventral valve flattened and very shallow, with a short, obtuse, and not at all incurved beak; cardinal slopes incurved, and the margins straight from the beak to near the point of greatest width of the valve, the angle of divergence being nearly or quite 120 degrees. Front of the valve broadly curved, and marked by several deep indentations corresponding to the number of plications marking the surface. Middle of the valve marked by a broad, shallow, slightly angular mesial sinus, which is more than one-third as wide at the front of the valve as the length from beak to base. Surface of the valve marked, on each side of the sinus, by two low, angular, but distinct plications, besides those bordering the sinus; no other markings are traceable on the surface of the shell. The margin of the valve between the plications is extended, forming rounded projections similar to that of the mesial sinus, and probably corresponding to low rounded plications which have characterized the dorsal valve, which has not been observed.

The broad sub-triangular form of the shell, with the shallow ventral valve and the small number of low, angular plications, will readily distinguish this from any species hitherto known. There may possibly be some doubt as to the generic reference of the species; but this cannot be positively determined until more perfect individuals are obtained.

Formation and Locality.—In limestone of the Upper Helderberg group, at Smith and Price's quarries, near Columbus, Ohio. Collected by the Hyatt brothers, of the State University.

LAMELLIBRANCHIATA.

Genus *Mytilarca*, H. and W.

Prelim. Notice Lamellibranchiate Shells, Up. Held., Ham. and Chemung Groups, &c.
State Cab. Nat. Hist., Dec., 1869.

***Mytilarca percarinata*, n. sp.**

Pal. O., Vol. III, Plate 6, Figs. 1 and 2.

Shell less than medium size, the specimen used for description and illustration measuring but one and three-fourths inches in extreme height ; and the distance from the anterior to the posterior margins across the point of greatest diameter, only a trifle over one inch ; the depth of the valve being nearly half an inch. Form of the shell elongate triangular-ovate, rather acutely pointed at the beak, which is small and incurved ; anterior, or byssal, margin straight and absolutely vertical in the example mentioned ; basal margin broadly rounded from the anterior line nearly to the point of greatest length of the valve, where it is more rapidly curved, and finally passes abruptly into the rapidly ascending posterior margin ; the lower part of which is nearly parallel to the anterior side, but above inclines more rapidly toward the short and very oblique hinge-line. The surface of the valve is most elevated along the anterior umbonal ridge, where it is at right angles to the anterior surface, but slopes gently backward for two-thirds of the distance toward the posterior margin, and on the other third much more abruptly. Near the beak, the surface rounds rapidly from the anterior ridge to the posterior border. Surface of the shell marked by numerous concentric ridges, parallel to the margin of the valve, many of which are strongly marked and form varices of growth. On the anterior surface, these varices and the concentric striae are well marked. Cardinal area not observed.

The example used is a right valve, and bears evidence in its characters of being an adult shell. It is associated in the same layers of cherty material with *M. ponderosa*, H. & W. (Prelim. Notice Lamell. Shells, etc., p. 21), but may be readily distinguished by the vertical anterior surface and the angular umbonal ridge. From the young of that species, it is readily distinguished by these characters, as those are distinctly round and ventricose. The only known species approaching this in the angularity of the ridge, is *M. attenuata*, H. & W., of the Chemung group ; but this is quite distinct in other respects.

Formation and Locality.—In the white chalky chert-beds of the Upper Helderberg Group, near Dublin, Ohio.

GASTEROPODA.

***Platyceras squalodens*, n. sp.**

Pal. O., Vol. III, Plate 3, Figs. 6 and 8.

Shell small, sharply conical when viewed in a lateral direction, with the apex gently curved anteriorly ; but in a posterior view, the form is narrowly

lanceolate, with the dorsal portion rising into a thin, sharp crest or ridge ; anterior side rounded and the anterior slope concave. Aperture narrowly ovate, rounded on the anterior side, widest just above the middle, and extending backward into a narrow point. Surface of the shell marked by fine hair-like concentric lines of growth parallel to the margin of the aperture, which is a little bent down anteriorly and posteriorly, and also by a rather faintly marked, but still distinct sulcus, which passes from the apex on the left anterior slope, and over which the striæ are slightly undulated, indicating a slight notch in the margin at this point.

In the narrow and curved lanceolate form of the shell, this species differs very materially from any of the numerous species of this very monotonous genus, and may be readily distinguished by the sharp dorsal ridge.

Formation and Locality.—In the Upper Helderberg limestone, at Columbus, Ohio. Collection of Columbia College.

***Dentalium Martini*, n. sp.**

Pal. O., Vol. III, Plate 3, Fig. 10.

Shell somewhat larger than medium size, rather rapidly expanding from the apex to the aperture for a species of this genus, and moderately curving throughout the length ; cylindrico-conical in form, and circular in a transverse section. Surface marked only by encircling striæ, which form rather broad undulations on the shell, and are strongly arched forward on the inner side of the curvature, showing that the lip of the shell has been somewhat extended on this side of the aperture. Shell-substance thick.

The species attains a rather large size, and expands more rapidly than most species of the genus, reaching a diameter of one-fourth of an inch in a length of less than two inches. The curvature is also considerable, being deflected fully an eighth of an inch from a straight line within the length of the specimen when tested on the inner face. There is no species of similar character from rocks of Devonian age, so far as can be ascertained. On some of the internal casts, there occurs a longitudinal ridge, as if there had been a slit or interruption of some kind at that point, which gives rise to a supposition that it may have belonged to the genus *Coleoprion*, Sandberger, though no positive interruption of the striæ of the surface is seen on any specimen examined. This fact may suggest its belonging to the recently formed genus *Coleolus*, Hall, but its perfect resemblance to *Dentalium* more strongly indicates its affinities as in that relation, rather than with the Pteropoda. Nor does there appear any

sufficient reason among the species referred to *Coleolus* by its author, for a generic separation from *Dentalium*, other than their more strictly straight form. But there are straight or nearly straight *Dentalia*, and also curved forms which he has referred to the new genus. The generic feature "shells thick" would also be opposed to pteropodous affinities. In its more rapid taper and greater curvature, it is sufficiently distinct from described forms of that genus.

Formation and Locality.—In the cherty layers of the Upper Helderberg limestones, near Dublin, Ohio.

Macrocheilus priscus, n. sp.

Pal. O., Vol. III, Plate 3, Figs. 3 and 4.

Shell small and very ventricose, the height but little greater than the diameter of the body volution; the former in the figured example being three-eighths of an inch, and the latter only about one-sixteenth of an inch less. Shell composed of about four volutions, which are very ventricose and rapidly increase in diameter, the last one forming the great bulk of the shell, being fully two-thirds of the entire height. Suture-line distinct, but not strongly marked. Apical angle about eighty degrees. Aperture somewhat semilunate, strongly modified on the inner side by the body of the preceding volution, which occupies fully one half its height. Columella strong, straight and rounded, and the twisted ridge obsolete. Surface of the shell apparently smooth; at least no striæ are perceptible.

This pretty little species reminds one strongly of *M. ventricosus*, Hall, from the Coal-measures, but is somewhat shorter in the spire, although resembling it in most other respects. The substance of the shell is soft and chalky, and might not retain minute surface striæ if they had ever existed; but no remains of them are visible at present.

Formation and Locality.—In the white cherty layers of the Upper Helderberg group, near Dublin, Ohio.

Loxonema parvulum, n. sp.

Pal. O., Vol. III, Plate 3, Fig. 5.

Shell minute, scarcely exceeding a fourth of an inch in length, and proportionally slender, with a rapidly ascending spire, which is slightly more rapidly tapering in the upper than in the lower part. Volutions six or six and a half, moderately convex on the outer surface, and more strongly rounded on the lower part of the exposed portion than on the upper;

suture-line distinct, but not margined by a flattening of the upper edge of the succeeding volution. Aperture elongate, slightly angular at the base and pointed above. Surface of the volutions marked by a large number of distinct vertical striæ, which are more numerous and slightly finer on the body volution than above, and are so nearly destitute of sigmoid curvature as to appear vertical until closely examined.

The small size of the shell, the nearly vertical lines, and the unequally expanding volutions, are distinguishing features; the latter character, however, appears to vary a little in degree on some of the specimens. It will be readily distinguished from the young shells of *L. Hamiltoniæ*, which occurs in the same rock, by the number of volutions and the slender form.

Formation and Locality.—In the white cherty layers of the Upper Helderberg limestone, near Dublin, Ohio.

CEPHALOPODA.

Trematoceras, n. gen.

A straight, obconical, cephalopodous shell, presenting the characteristics of an *Orthoceras*, so far as the appearance of the tube, septa and siphuncle is concerned; but with the additional feature of a line of elongated, raised tubercles along one side of the shell, which have formed perforations at certain stages of growth, probably confined to the outer chamber as openings, which were closed as the animal extended the shell, and before the septa opposite them were formed. Type, *T. Ohioense*.

The shell for which the above generic name is proposed offers an entirely novel feature among the *Orthoceratidæ*. The line of nodes seen on the cast of the shell is entirely different from anything pertaining to the ornamentation of the shell, and presents the same appearance as would the partially filled perforations of a *Haliotis*, or like those shown on the back of species of *Bucania*, and those on which the genus *Tremanotus* was founded; neither is it a feature at all dependent upon the position of the siphon or directly connected with it; for in the specimen used the siphon is slightly excentric, on the opposite side of the tube from the nodes. Its position would thus indicate that it was a feature pertaining to the dorsal lip of the shell, corresponding to the sinus seen in the lip of many other genera. Taking this view of it, it would appear to indicate the existence of a deep, narrow notch, with raised margins, in the lip of the shell at stated periods, beyond which the shell was again united for a

time, leaving a perforation to be closed by a deposit of shell from the mantle as it approached the lower part of the chamber of habitation. Many species of *Orthoceras* have been observed, having a raised line, or rather markings, along the dorsal side; but none, so far as I am aware, presenting these evidences of a series of separate openings, which I consider a feature worthy of generic distinction.

***Trematoceras Ohioense*, n. sp.**

Pal. O., Vol. III, Plate 6, Figs. 3 and 4.

Shell of medium size, straight, and somewhat rapidly tapering from below upward; the rate of increase being equal to nearly one-sixth of the increase in length. Septa moderately concave, rather closely arranged; five of the chambers about equalling the diameter of the uppermost of the five counted. Siphon of moderate size, and in the specimen used slightly excentric. The surface of the shell, so far as can be determined from the internal cast, has been smooth. Perforations, or nodes representing them, large and elevated, two to three times as long as wide, and occurring at every third septum below and at every second in the upper part of the specimen.

Formation and Locality.—In limestone of the Upper Helderberg group, at Smith and Price's quarry, near Columbus, Ohio. The discovery and preservation of this peculiar specimen are due to the careful observation of Mr. Edward Hyatt, of the State University at Columbus, Ohio.

***Gomphoceras Hyatti*, n. sp.**

Pal. O., Vol. III, Plate 4, Fig. 1, and Plate 5, Fig. 1.

Shell large and robust, slightly arcuate throughout, but more strongly curved below than in the upper part; somewhat rapidly expanding from below upward to near the middle of the outer chamber, where it is suddenly contracted to the aperture, and on the lateral margins again slightly expanding. The rate of increase in diameter, as compared with the increased length, is about as one and two, when measured on the inside curvature. Transverse section of the shell obtusely subtriangular, flattened or but slightly convex on the inner surface, rounded on the lateral surfaces, and obtusely rounded on the back; the dorso-ventral and lateral diameters are about as four and five, and the triangular form is more perceptible in the earlier stages of growth, owing to the greater convexity of the inner face in the upper portion and on the outer chamber. Outer chamber comparatively short, being about two thirds as high as wide. Aperture large, irregularly tri-lobed, straight on the inner face, and about four-fifths

as wide as the entire width of the shell, and apparently about two-thirds as wide in a dorso-ventral direction as laterally. The exact form of the aperture on the outer side cannot be ascertained, owing to the imperfection of the specimen in this part. Septa moderately concave, very closely arranged in the lower part, but more distantly disposed above; the rate of increase in distance somewhat gradual to near the upper portion, where two or three of the septa are slightly more crowded. In the more distant portions, three chambers occupy the space of one inch, but in the lower part of the specimen, where the transverse diameter is a little more than one and a half inches, they are less than one-twelfth of an inch apart. Siphuncle of moderate size and sub-centrally situated. Surface of the shell unknown.

The specimen from which the description is taken is an internal cast, not retaining any portion of the shelly structure, but it appears to have been destitute of strong surface markings. It measures about seven inches in length by nearly four inches in transverse diameter at the widest part, which is near the lower part of the outer chamber. The lower end is imperfect, and measures one and a half inches in transverse diameter. It is with some hesitation that I place the species under the genus *Gomphoceras*, owing to the strong curvature of the shell and the structure of the aperture, which is reversed in its relation to the curvature of the shell as compared with most species of the genus; the widest portion being on the inside curvature, instead of on the outer side. The general triangular or trilobed form of the aperture, together with the greater lateral diameter, would seem to overbalance the fact of the curvature.

Formation and Locality.—In limestone of the Upper Helderberg group, at Smith and Price's quarries, near Columbus, Ohio. Named in honor of Mr. E. Hyatt, from whose collection it was obtained.

***Gomphoceras amphora*, n. sp.**

Pal. O., Vol. III, Plate 3, Fig. 9.

Shell of large size, elongate-ovate or short sub-fusiform, somewhat rapidly expanding from below upward to within a short distance of the base of the outer chamber; from which point it again contracts more rapidly to about one-half the height of the outer chamber, and is then drawn out into a narrow neck, resembling the neck of a bottle, of a width but little exceeding one-third of the diameter of the larger portion of the shell. Aperture not distinctly traced, but on the side figured, there is an appearance of a deep, rather narrow sinus, extending nearly one-half the depth of the outer

chamber. The shell bears the appearance, also, of having been curved, as indicated principally by the obliquity of the septa, which are numerous, rather deeply concave, and arranged at a distance of about one-fourth of an inch in the largest part of the specimen, and decreasing in distance below and above; while near the base of the outer chamber there are about six septa closely crowded together. Position of the siphuncle not determined.

The species resembles *G. eximium*, Hall, of the same formation, in the lower part of its length, although more rapidly expanding, but in the upper part, and especially near the aperture, differs entirely from any other species known.

Formation and Locality.—In the limestones of the Upper Helderberg group, in Marion Co., Ohio. Collection of Columbia College, N. Y.

***Gomphoceras Sciotense*, n. sp.**

Pal. O., Vol. III, Plate 4, Fig. 4; Pl. 5, Fig. 2; Pl. 6, Figs. 6 and 7.

Shell of medium size or smaller, short obconical in form, or rapidly expanding from the apex upward; slightly flattened in a dorso-ventral direction, giving a broadly oval transverse section, which is a little more flattened on the dorsal than on the opposite side, in the more perfect specimen, but may not be constantly so in all individuals. Septa shallow, arranged at nearly equal distances from each other in the larger parts, and numbering about seven in an inch, except near the outer chamber, where there are usually one or two more closely arranged. The outer chamber is proportionally short, and rapidly contracted in the upper part to about one-half the diameter below, to form the transversely sub-triangular or obscurely trilobed aperture, which is rounded at the lateral extremities, straightened on the dorsal side, and provided with a moderately deep but rather narrow sinus on the ventral margin. Siphuncle proportionally small, and situated close to the dorsal side.

Only two individuals have thus far been observed, and these show some slight variation in the form of the transverse section and in the proportional length of the outer chamber; the one retaining the chambers being shorter above, and more flattened on the dorsal side than the other. In this specimen, the septa are somewhat obliquely arranged, being highest on the dorsal side, which may, however, be owing to oblique compression in the matrix. The individuals, being both internal casts, have afforded no opportunity of observing the surface structure.

Formation and Locality.—In the limestone of the Upper

Helderberg group, at Smith and Price's quarries, near Columbus, Ohio. Collected by Mr. Hyatt.

***Cyrtoceras cretaceum*, n. sp.**

Pal. O., Vol. III, Plate 4, Figs. 2 and 3.

Shell of medium size, somewhat moderately expanding in its upward growth to the base of the outer chamber, from which point it again contracts to the aperture; the increase not always regular, but in some individuals more abruptly expanding above than below. Shell slightly curving throughout its length, appearing less arcuate in the upper portion, owing to the contraction of the outer chamber toward the aperture. Transverse section oval, widest in a lateral direction, and with the inner surface much less arcuate than the outer or dorsal surface. Outer chamber proportionally short, the length not exceeding the dorso-ventral diameter of the lower end; margin simple, so far as can be determined from any of the specimens, showing only a broad, shallow sinuosity on each side. Septa somewhat closely arranged and deeply concave, but slightly increasing in distance in the upper part, the average length of the chambers being about one-tenth of an inch, but somewhat more crowded just below the outer one. Siphuncle of moderate size, situated a little within the dorsal surface, and very slightly expanded within the chambers. Surface of the shell marked only by transverse lines of growth parallel to the margin of the aperture.

The shells are moderately abundant, and show slight variations in form among individuals, especially in the rate of increase in dimensions or in the regularity of the expansion, as well as in the comparative distance between the septa; a single individual showing a much greater distance between them in the upper part of its length. The shell would probably be considered by some as belonging to the genus *Oncoceras*, as the decrease in diameter in the upper part of the outer chamber gives to the shell, below, the peculiar bulging appearance supposed to be characteristic of that genus; but the transverse form and elliptical section, together with the form of the siphuncle and other features, present characters common to the genus *Cyrtoceras*. It is most nearly related, in general form, to *C. Conradi*, Hall, from the Marcellus Shales of New York, but attains a much greater size, has a shorter outer chamber, and is destitute of the small lip-like sinus on the ventral side, as seen in that one. The upper portion of *Gomphoceras oviforme*, Hall, from the limestone of the Marcellus Shale, bears considerable resemblance, except in the closing of the aperture, which constitutes a generic difference.

Formation and Locality.—In the cherty layers of the Upper Helderberg limestone, near Dublin, and at Bellenaris quarry at Georgesville, Franklin Co., Ohio.

Gyroceras Columbiense, n. sp.

Pal. O., Vol. III, Plate 6, Fig. 8.

Shell of about a medium size, often attaining a diameter across the disc of about six inches, although the majority of the specimens seen will not measure more than five. The shell is closely coiled, the volutions being in absolute contact and about one and a half or two in number. Volutions nearly circular in a transverse section, being a very little greater in the lateral direction than in the dorso-ventral, and the back of the volution barely perceptibly flattened on the outer portion of the larger one, but not perceptibly so on the inner portions. Septa deeply concave and distantly arranged; the chambers measuring about half an inch each, on the outer two-thirds of the body-volution of a specimen where the vertical, or largest, diameter of the disc is five inches. Position of the siphuncle not absolutely determined. Surface of the shell unknown.

All the individuals of this species observed are internal casts, and occur in a rather rotten limestone, under conditions very unfavorable for the preservation of the shelly substance; consequently the surface-characters have not been observed. It is an abundant species, but owing to the conditions of preservation, is not often found in collections. It will be readily distinguished from the other described species by the closely coiled volutions and the nearly circular section. It is perhaps more nearly related to *G. cyclops*, Hall, 15th Rept. N. Y. State Cab. Nat. Hist., than to any other described species; but it differs from that one in its smaller size, and more rapidly increasing as well as more closely coiled volutions, and does not appear to have been provided with the broadly expanding and foliated varices which are so characteristic of that species. It might be objected, that as the shell of this species is unknown, the determination of the absence of these foliated expansions is not well authenticated; but it may be answered, that as the two species are associated in the same layers in the quarries where they are both rather common, if they were really one and the same, the shell would be preserved on these as well as on the *G. cyclops*, and the expansions readily detected.

Formation and Locality.—In the limestones of the Upper

Helderberg group, near the lower part, at Smith and Price's, and at other quarries near Columbus, Ohio.

Gyroceras seminodosum, n. sp.

Pal. O., Vol. III, Plate 4, Fig. 5.

Shell small, compactly coiled, and consisting, in the specimen used, of a little more than two volutions, which increase rather rapidly in diameter with increased age; they are somewhat wider transversely than in a dorso-ventral direction, and are slightly triangularly elliptical in a transverse section; the greatest transverse diameter being very slightly outside of the middle of the dorso-ventral diameter. The inner one and a half coils are smooth on the exterior, but the outer volution, for a little more than the larger half, is ornamented by a single series of comparatively large, transverse, triangularly elliptical nodes on each lateral surface, having the angular side of the node placed anteriorly and the opposite side nearly straight. The nodes are placed at distances from each other about equal to one-half the dorso-ventral diameter of the tube at the node indicated. The septa are not clearly defined and cannot be given with certainty; but they appear to be distantly placed on the inner portions of the shell, while on the nodose portion they seem to be placed at about half the distance of the nodes apart. The siphuncle has not been observed. The surface of the shell, as seen on a fragment of the substance remaining on the dorsum of the outer volution, is marked with rather close, distinct, revolving lines or ridges, crossed by more closely arranged transverse lines, which make a shallow retral bend in crossing the back of the shell.

The specimen is probably an immature shell, but is a distinctly marked species, differing strongly in its form and nodose character from any of those associated with it. It most nearly resembles *G. (Hercoceras?) paucinodus*, Hall, from the Upper Helderberg group of New York (see *Illust. Dev. Foss.*, Pl. 55, Figs. 1 and 2), but is less distinctly triangular in a transverse section, that one being widest near the outer portion of the volution, with a nearly regular sloping surface on the side of the whorl to its junction with the preceding one, while this species is rounded. The form of the nodes is also different—those being situated near the dorsal margin. The triangular form of these nodes is peculiar in having the two short sides of the triangle directed forward. It also differs in having a greater number of volutions for a given diameter.

Formation and Locality.—In limestone of the Upper Helderberg group, near Dublin, Ohio. Collected by Mr. Hyatt, of the State University, at Columbus, Ohio.

Species from the Marcellus Shales.*

The following species occur in a highly bituminous brown shale, of but a few feet in thickness, and having intercalated beds of thin shaly limestone associated with it. The bed occurs near the upper part of the limestones heretofore referred to the Upper Helderberg group in Ohio, and below the layers known as the Delaware stone, characterized by an abundance of remains of Devonian fishes. These black or brown shales, so far as yet explored, contain only the following species, most of which are known forms, and some of them characteristic species of the Marcellus Shales of New York. The species *Lingula Manni*, Hall, occurs in the upper blue layers of the Delaware beds at Delaware, and in a corresponding position at other localities, but so far as yet known does not occur in the lower portions of the group. At one of the localities where the fossils were obtained from the brown shales, the layers immediately above these beds are thickly covered with specimens of *Tentaculites scalariformis*, Hall, and *Spirifer gregaria*, Clapp; and although both these species may be occasionally found at a lower horizon, they are never abundant except in the upper part of the group, and are unknown in the lower part. Judging from these circumstances, together with the lithological character of the shales and the known position of the species occurring in them, it would appear reasonable to consider these brown bituminous shales and limestones as being the western representatives of the Marcellus Shales of New York; while the beds above them, characterized by the presence of large numbers of *Tentaculites* and *Spirifer gregaria*, would appear to represent the Hamilton group of New York. In pursuance of this idea, several sections have been critically examined in Central Ohio, and it is found that the blue Delaware stone is followed by rapid repetitions of brown shale, and thin-bedded shaly limestones, and finally by soft, blue, muddy shales, resembling the Moscow shales of New York, which are followed by beds of thin fissile black shales, representing the Genesee slates of the New York series.

* In Vol. V, Pal. N. Y., on pp. 146 and 147, after speaking of the section of rocks at the Falls of the Ohio, and the probability that the hydraulic cement bed and the layers above it, up to the base of the Black Slates, are of the age of the Hamilton beds of New York, the au-

The species recognized and described as occurring in the shales above referred to are as follows; most of them being previously known. The species marked as new are described below.

Lingula Manni, Hall.

Lingula Ligea, Hall. ?

Discina minuta, Hall.

Discina Lodensis, Hall.

Chonetes scitula, Hall.

Chonetes reversa, n. sp.

Spirifera Maia, Billings' sp.

Leiorhynchus limitaris, Vanuxem's sp.

Aviculopecten equilatera, Hall's sp.

Pterinea similis, n. sp.

Chonetes reversa, n. sp.

Pal. O., Vol. III, Plate 7, Figs. 8 and 9.

Shell of about a medium size, semicircular in outline, with a long straight hinge-line exceeding the width of the shell below. Valves resupinate, or reversed in their curvature; the ventral being very slightly convex in the earlier stages of growth, and subsequently recurved so as to appear concave; the entire deflection from a plane being very little, so that the general appearance of this valve may be said to be nearly flat. Area linear. Hinge-line ornamented by four long, very slender spines on each side of the centre, which are projected from the hinge-line at an angle of about 65 degrees, measured on the outside, or 115 degrees as counted on the inside of the spine. Surface of the ventral valve marked by exceedingly fine striæ, which are slightly alternating in size; there being from two to five finer ones between the coarser kind. Interior of the valve characterized by fine pustules, arranged in indistinct lines, presenting the usual characteristics of the genus. Dorsal valve not positively known; but there is associated with it, in the same layers, a slightly convex valve with similar striæ, but more distinctly alternating, which may possibly represent this valve. Its form is similar, and the convexity correspondingly great.

This species is peculiar in its resupinate character, so far as

thor says: "In the State of Ohio similar conditions may be inferred, from the fact that certain species of Hamilton fossils are published in the Ohio Geol. Rept. as from the Corniferous group." By reference to the 28th Vol. of the Proc. of the Am. Association for the Advancement of Science, p. 297, it will be seen that, at the Saratoga meeting of the Association, I read a paper on the discovery of the Marcellus Shale in Ohio; in which it is stated that the rocks above that horizon (the Marcellus) would necessarily be Hamilton. This was in August, 1879. The volume above-mentioned is dated, in the letter of transmissal, Dec. 15th, 1879.

the genus is known in American Devonian rocks, and this character, together with its form, its fine striae, and its nearly erect slender spines, will readily distinguish it from any other species. The dorsal valve above spoken of was at first supposed to be the young of *Strophodonta perplana*, Conrad's sp., but the similarity in size and character of striae to this species renders it doubtful.

Formation and Locality.—In thin-bedded bituminous limestone, from above the "Bone-bed" at Smith and Price's quarries, near Columbus, Ohio.

***Pterinea similis*, n. sp.**

Pal. O., III, Plate 7, Fig. 15.

Shell small, oblique; the body, exclusive of the wings, being almost regularly although obliquely ovate in outline, the anterior part being the larger; hinge-line about two-thirds as long as the entire length of the valve; anterior wing small, distinctly rounded on the end, and separated from the body of the shell, on the left valve, by a distinct sulcus along the surface, and which constricts the margin of the shell; posterior wing one-third longer than the anterior side, pointed at the extremity and sinuate below. Body of the valve ventricose, strongly so on the umbone, with a strong tumid beak, which projects distinctly beyond the hinge. Surface of the left valve marked by distinct radii, which are plainly alternated in strength over the body of the valve, but less distinctly so toward and on the wings; also, by less strong concentric lines, and varices of growth. Right valve unknown.

The shell is of the type of *Pterinea decussata*, Hall, which occurs abundantly in the Hamilton group in New York, but is of extremely small size, and very ventricose; the proportionally strong varices of growth showing its adult character. The type is one represented in the Devonian rocks, from the Hamilton to the top of the Chemung, inclusive, in New York, by several distinct species, but which is seldom recognized below this horizon. We may, therefore, consider it as an additional evidence of the age of the beds in which it is found.

Formation and Locality.—In the thin shaly layers of bituminous limestones, from above the "Bone-bed" at Smith and Price's quarries, near Columbus, Ohio.

The following species are from the limestones above the "Bone-bed," which rest on the top of the Marcellus Shale, in the vicinity of Columbus, Ohio, and are not known to pass below that horizon at any locality in that region.

Gilbertsocrinus spiniferus—*Trematocrinus spinigerus*, Hall; 15th Rept. N. Y. State Cab., p. 128;—*Gilbertsocrinus* (*Trematocrinus*) *spinigerus*, Hall; Descr. of New Species of Crinoidea, from the Carbonif. Rock of the Miss. Valley, Plate 1, Fig. 9.

Spirifera ziczac, Hall.

Pterinea flabella, Conrad's sp.

Grammysia bisulcata, Conrad's sp.

Actinodesma subrecta, n. sp.

Pal. O., Vol. III, Plate 7, Fig. 20.

Shell of moderate size; the body of the shell, exclusive of the wings and hinge-extensions, ovate in outline, and slightly oblique to the cardinal line. Hinge-line extended in the form of strong auriculations or wings on the sides of the shell, the upper margin straight, or a little declining on each side of the beak; anterior wing short, triangular, and divided from the body of the shell by a deep and wide sub-triangular notch; posterior side long and sub-mucronate at the extremity, three to three and a half times as long as the anterior side, and its area much greater, extending along the body of the valve to nearly half its length from the beak. Body of the left valve more than moderately convex, and strongly arcuate or bent between the beak and base of the shell; so that when placed on a flat surface, the margin, especially on the posterior side, would be much elevated above the plane. Beak of the valve large, sub-tumid, and slightly extended above the cardinal line. Length of the body of the shell, from the cardinal line to the base, about one-fifth greater than across it in the opposite direction. Anterior border broadly rounded, the basal margin more sharply so, with a slight angularity at its junction with the nearly direct posterior border. Surface of the shell marked by irregular, concentric, strongly lamellose lines, resembling those of the oyster. Right valve not yet observed from Ohio.

The species is allied to *A. recta*—*Avicula recta*, Conrad, but is shorter, more ventricose on the left side, more arcuate or bent, and with less extended wings. It is not an uncommon species in the soft shales of the Hamilton group of New York, where it is readily recognized from *A. recta* by the above-mentioned characters. The *A. recta* is most common in the arena-

aceous beds of eastern New York, while this is the prevailing form among the soft shales farther west. The right valve is there recognized as being shorter than the left, concave instead of convex, with an appressed beak or umbo not extending beyond the cardinal line, and the valve is much thinner in its substance.

Formation and Locality.—In layers of brownish limestone above the "Bone-bed," at Fishinger's mill, Franklin Co., Ohio. Collected by the Hyatt brothers, of the State University at Columbus.

Genus **Nyassa**, H. & W. Prelim. Notice of Lamellib. Shells of the Upper Held., Hamilton and Chemung Groups, etc. N. Y. State Cab. Nat. Hist., Dec., 1869, page 28. [Generic description omitted. R. P. W.]*

Nyassa arguta,

Pal. O., Vol. III, Plate 7, Fig. 18.

Nyassa arguta H. and W. Prelim. Notice of the Lamellib. Shells of the Upper Held., Hamilton and Chemung Groups, etc., distributed without author's name, Dec., 1869, p. 28.

Shell of medium size, transversely sub-ovate or sub-trapezoidal, much longer than high. Valves moderately ventricose, most prominent along the umbonal ridge, which is rather strongly arcuate and sub-angular. Beaks rather small and appressed, slightly incurved, and situated near the anterior end. Surface of the valve generally declining from the umbonal ridge to the basal line, and with a slight sinus or sulcus below the ridge, which gradually widens toward the margin of the shell, where it causes a broad, but not marked, emargination in the border of the shell. Cardinal slope narrow and abrupt; hinge-line arcuate; posterior end of the shell narrowed; anterior end broad, rounded, and slightly excavated below the beaks.

Surface of the shell marked by concentric lines of growth parallel to the margin of the valve, and often forming rather strong, irregular varices, most distinctly marked on the anterior half of the shell.

The Ohio specimens, although preserved in an entirely different matrix, are yet such exact counterparts of the New York shells that no question can exist of their positive identity.

Formation and Locality.—In limestone above the Bone-bed in Tully township, Marion Co., Ohio. The specimen figured is from the State Cabinet at the State University, Columbus, Ohio.

Genus **Palaoneilo**, H. & W.

Preliminary Notice of Lamellib. Shells of the Upper Held., Hamilton and Chemung Groups, etc., N. Y. State Cab. Nat. Hist., Dec., 1869, p. 6.

* See note at the close of this article.

Palæoneilo similis, n. sp.

Pal. O., Vol. III, Plate 8, Figs. 4 and 5.

Shell oblong, with nearly equally rounded extremities, and almost parallel dorsal and ventral margins. Anterior end short, a little narrower than the body of the shell, resulting from the constriction below the beaks. Posterior end rounded, with a slight oblique truncation below the middle of the height, corresponding to the very shallow umbonal sulcus of the valves. Beaks situated within the anterior third of the length of the shell, small and enrolled. Valves ventricose, most prominent just below the umbones, and slightly sulcated along the posterior slope. The surface of the shell, so far as can be determined from the matrix, has been smooth or without visible markings. On the internal cast, the condition in which the specimens are found, the muscular imprints are faintly marked—the pedal muscles being the most distinct.

The species is closely related to *P. (Leda) Barrisi*, White and Whitf., Proc. Bost. Soc. Nat. Hist., Vol. 8, p. 298, (*Palæoneilo Barrisi* (W. and W.), H. & W., Prelim. notice of Lam. Shells of the Up. Held., Hamilton and Chemung groups, etc.), but has been somewhat more nearly parallel on the margins, and has a smoother shell.

Formation and Locality.—In the calcareous concretions of the Erie shale, at Leroy, Lake Co., Ohio, accompanying the fossil entomostracan from the same locality (next described).

CIRRIPEDIA.

Plumulites Newberryi, n. sp;

Pal. O., Vol. III, Plate 8, Figs. 6—11.

The specimens for which the above specific name is proposed, consist of several detached plates, and of one of several plates, irregularly folded together in such a manner as to be difficult of interpretation. The several plates vary considerably in form among themselves, and probably represent those from different parts of the body.

The general form of the plates is triangular, with the apex, or initial point of growth, a little inclined to one side; the base, or margin of accretion, is usually the longest side, but not in all cases. One set of plates has the shorter sides diverging at nearly right-angles. On this form, the basal line is convex for more than two-thirds its length, and concave on the remaining por-

tion, giving a sigmoidal outline; of the shorter sides, one is straight to near the apex, where it becomes rounded, and the other is slightly concave. Another form has the shorter sides diverging at an angle of about 105 degrees, one slightly convex and the other concave; while the basal margin is convex in two sections, with a constriction or interruption between the two sections, or at about one-third of its length from the straight margin. The plates of this and the preceding form have the surface regularly annulated transversely, parallel to the basal margin, the annulations very fine, and regularly increasing in size and strength from the apex to the base, except in aged specimens, where they are again crowded near the border: five undulations may be counted in an eighth of an inch, where strongest. These forms, also, have the straight margin often fractured and bent, as if they had been broken along that side; indicating that two such plates may have been united along this line; and on the only individual showing several plates together, this would appear to be the case. A third form of plate is narrowly triangular or conical, the basal border being the shortest, and simply convex; the other sides being slightly curved throughout, but more distinctly so near the apex, which is obtusely rounded; the lateral margins are of unequal length, and the annulations of the surface finer and more closely arranged than on the other forms.

The individual specimens are much too few in number to give any very satisfactory idea of the general form of the complete body, or of the number of ranges of plates of which it may have been composed. There appears to be no reason, however, to doubt the correctness of the reference of these plates to the genus *Plumulites*, Barrande, as their general form and surface structure is exactly like those given by Dr. Barrande, and also to those given in Vol. II, Pal. Ohio, Pl. 4, Figs. 1 and 2 (*P. Jamesi*), as occurring in the rocks of the Hudson River group, at Cincinnati; while some idea may be obtained of the probable form of the entire body from the outline figure of a European species, represented in Fig. 3 of the same plate. These Devonian specimens, however, have been of very much greater size than the above, as the plates here figured are all represented of natural

size, the larger individual plates being more than an inch in transverse diameter, while the species above referred to is minute. The occurrence of forms of this genus in rocks of Devonian age is also a new feature in its history; as those of Europe are confined to the Lower Silurian formations and the lower beds of the Upper Silurian; while these occur above the middle Devonian.

Formation and Locality.—In the Huron shale at Sheffield and Birmingham, Erie Co., Ohio; equivalents of the Genesee slates and Portage group of New York.

The following species are from the Maxville limestone of Maxville, Newtonville, and the neighboring parts of Ohio, equivalent to the Chester limestone, or Chester and St. Louis limestones, of the Mississippi Valley.

CRINOIDEA.

***Cyathocrinus inequidactylus*, n. sp.**

Pal. O., Vol. III, Plate 9, Figs. 5—8.

Body of rather small size. Calyx deep cyathiform, being nearly hemispherical in one example, and somewhat broad obconical in another, and composed of smooth plates, which have only the general convexity of the the body, or very slightly tuberoso. Basal plates minute to moderate size, higher than wide. Sub-radials large; height and width nearly equal; two of them heptagonal and the others hexagonal, the lower sides barely diverging from a straight line. First radials wider than high, and about two-thirds as high as the sub-radials. Anals visible, three in number; the first elongate pentagonal, nearly twice as high as wide, and situated a little obliquely on the right side of the area; the other two are small and pentangular. Second radials, or first arm-plates, smaller than the first radials and narrowing upward, wedge-formed above, and each supporting two arms. On the postero-lateral rays they are long and cylindrical, with the arms slender. On the anterior ray it is short and supports two slender arms; while on the antero-lateral rays they support a slender arm similar to those of the other rays on the anterior side, and on the outer side an arm several times larger and stronger than the others, and composed of larger and stronger plates.

Plates of the arms short and unequal-sided, and giving origin to jointed tentacula from the longer side of each plate, which is upon the alternate sides of the arm, or on the same side from every second plate. Surface of the plates smooth. Length of the arms and subsequent bifurcations not known. Column small, round, and composed of unequal-sized plates alternating with each other.

The slender arms are preserved on two individuals to the length of about

one inch, and the strong antero-lateral arm on one, to more than an inch ; but no evidence of bifurcation appears.

The inequality of the antero-lateral arms will be the distinctive feature of the species, as the form of the calyx is similar to many other species of the group.

Formation and Locality.—In the Maxville limestone (shaly portion), at Newtonville, Ohio.

BRYOZOA.

Synocladia rectistyla, n. sp.

Pal. O., Vol. III, Plate 9, Figs. 9 and 10.

Bryozoum growing in spreading funnel-formed fronds, rising from a rooted base and widely diverging in their upward growth ; the inner surface of the cup bearing pores. Rays straight and somewhat rigid in their upward direction, with frequent bifurcations, which are not abrupt with rapidly diverging branches, but rise gradually from a thickened space, and gradually diverge as slender but constantly thickening rays until the normal strength is attained.

The rays are slender, rather closely arranged ; about six of them occupying the space of a fourth of an inch in the widest parts, and from eleven to twelve may be counted in the same space in the most crowded parts.

Transverse dissepiments nearly as strong as the longitudinal rays, and often slightly arched upwards between them in the wider parts, but more frequently directed obliquely upward in passing from one ray to the next, and very often directed upward to the right from one side of a ray, and to the left on the opposite side ; but they are generally direct in the more crowded portions. The middle of the ray on the poriferous surface is elevated or roof-like, with a central crest or ridge bearing distant nodes ; a single row of large pores is arranged on each side, which are usually less than their own diameter apart, and more or less alternating with those of the opposite side. From two to three pores occupy each side of each fenestrule, and the pores are margined by an elevated lip, which on unworn spaces are very prominent. From one to three similar pores, although sometimes of smaller size, occupy the surface of each dissepiment. Non-poriferous surface not observed.

This species is somewhat similar to *S. biserialis*, Swallow (Trans. St. Louis Ac. Sci., Vol. I, p. 179), as identified and figured by Mr. F. B. Meek (Final Rept. of U. S. Geol. Surv. Neb., pl. 7, fig. 5), but differs in wanting the longitudinal nodose ridge between the pores of the dissepiments, and in having only a single row of pores on those parts occupying the

middle of the dissepiment, as well as in the more slender, finer and more direct, and much more crowded rays, also in having a larger number of somewhat smaller pores on the rays. Mr. Meek, *loc. cit.*, identifies the above species with *Synocladia Cestriensis* (*Septipora Cestriensis*, Prout, Trans. St. Louis Acad. Sci., Vol. I, p. 448, pl. 18, fig. 2), which differs from the Ohio specimens in the stronger and thicker, as well as more flexuose rays; in the rounded fenestrules, and smaller-sized pores, which are also more abundant, often showing three ranges on parts below bifurcations. On direct comparison of the Newtonville specimens with specimens from Chester, Ill., these differences, especially those pertaining to the mode of growth, are very marked and characteristic.

Formation and Locality.—In the Maxville limestone (Chester), at Newtonville, Ohio. Collected by Prof. E. B. Andrews.

LAMELLIBRANCHIATA.

***Pinna Maxvillensis*, n. sp.**

Pal. O., Vol. III, Plate 10, Fig. 5.

Shell of about a medium size, very acutely triangular in outline, with highly convex valves; the length along the hinge equal to nearly three times the greatest width. Hinge-line straight, not quite as long as the shell below; anterior end acute; basal margin very slightly arcuate, and the posterior extremity rather broadly rounded; the point of greatest length being at about one-third of the width below the hinge-line. Surface of the shell, except for a short distance within the basal margin, marked by moderately strong, simple radiating plications, about eighteen in number, as counted at the posterior end of the specimen figured, but increasing in number with increased growth; the additions being near the hinge. There are also numerous strong concentric lines of growth parallel to the margin, often forming undulations of the surface.

I find no American species described that closely resembles this one; but *P. flexicostata*, McCoy, from the English Carboniferous rocks (British Pal. Foss., p. 499, pl. 3, E, figs. 11—13), is very similar, but has slightly stronger radii, is somewhat broader, and differs in having a longitudinal depression just below the hinge-line, which this species does not possess.

Formation and Locality.—In the Maxville limestone, at Maxville, Ohio. Collection of Prof. E. B. Andrews.

Allorisma Andrewsii, n. sp.

Pal. O. Vol. III, Plate 10, Fig. 6.

Shell of medium size or smaller, transversely elliptical in outline; the length being about twice the height, and the thickness a little more than two-thirds the height. Valves ventricose, most rotund a little in advance of the middle and along the umbonal ridge, and wedge-shaped posteriorly, as seen in a cardinal view; beaks of moderate size, slightly projecting above the hinge-line, incurved, directed anteriorly, and situated at about one-sixth of the entire length from the anterior end. Cardinal line straight or appearing slightly concave, extending about three-fourths of the length of the shell from the beaks backward, and bordered by a proportionally large and wide escutcheon. Anterior end short, sloping forward from between the beaks, at about an angle of forty-five degrees to the hinge-line, to near the middle of the height of the shell, and then abruptly rounding backward into the somewhat regularly convex basal margin. Posterior end broadly rounded from the point of the umbonal ridge to the extremity of the cardinal line. Anterior end of the shell characterized by a very small lunule. Surface of the shell marked by several strong concentric undulations or folds, which are simple, and regularly increase in size and strength to near the full size of the shell; but near the outer margin of the valves, in the specimen figured, they are smaller and doubled by the interpolation of an intermediate rib. The undulations are crossed obliquely from the beak to the basal margin, just posterior to the middle, by a narrow, almost imperceptible sulcus, and along the crest of the umbonal ridge by a line of low-convex and faintly-marked nodes, one on the surface of each undulation; the posterior umbonal slope is also marked, immediately below the margin of the escutcheon, by a slightly concave sulcus, across which the undulations are more faintly marked than below.

The species is closely allied to *Allorisma clavata*, McChesney, and was at first supposed to be identical; but on comparison, it shows so many points of difference that it became necessary to consider it as a distinct species.

Formation and Locality.—In limestone of the age of the Chester group (or Chester and St. Louis combined), at Newtonville, Ohio. Collected by Prof. E. B. Andrews, to whom the species is dedicated.

Allorisma Maxvillensis, n. sp.

Pal. O., Vol. III, Plate 10, Figs. 7 and 8.

Shell small, the specimen used being a little less than one inch in length, and the height less than half the length. Form of the shell transversely

elongate, and cylindrically oval, the cardinal and basal margins parallel and very slightly curved, and the extremities very nearly equally rounded; beaks small, inrolled, barely projecting above the cardinal line, and situated at about one-fourth of the entire length from the anterior end. Body of the shell very evenly and highly rounded from the cardinal to the basal margins, and almost as convex posteriorly as in front. Umbonal ridge scarcely perceptible, and the umbonal slope convex; escutcheon and lunule not defined; anterior slope abruptly rounded. Surface of the shell marked by faint concentric undulations of unequal strength, but most strongly marked on the posterior end and on the umbonal slope.

The evenly convex and regularly cylindrical form of the shell, together with the inconspicuous beaks and the equal-sized anterior and posterior extremities, are distinguishing features of the species. The shell shows evidence in its form and curvature, in a profile view, of having been slightly gaping behind.

Formation and Locality.—In limestone of the age of the Chester group of Illinois, at Newtonville, Ohio.

GASTEROPODA.

***Naticopsis zic-zac*, n. sp.**

Pal. O., Vol. III, Plate 10, Figs. 15 and 16.

Shell small, the greatest diameter of the body-volution, in the only individual seen, being about nine-sixteenths of an inch; and the entire vertical height of the shell only half an inch. The shell is very obliquely ovate in form, and consists of about two and a half ventricose volutions, which increase somewhat rapidly in size to the last one, which forms nearly the entire bulk of the shell. The surface of the shell is ornamented by a series of strong and raised transverse lines, which, on the upper volutions, are simple as far as the suture below, and are directed strongly backward in their passage; but on the body-volution they appear more distant and conspicuous, and are directed strongly backward in their passage for about one-third the vertical diameter of the volution, where they are bent forward at an acute angle, and after continuing for a distance nearly equal to their length above, are again bent backward. Across the middle of the volution, they make two or more zig-zagging bends in vertical lines, forming a revolving band of vertical ridges on the periphery; below this band, the lines are directed forward obliquely, running nearly parallel to the base of the shell.

The peculiarity of this shell consists entirely in the structure of the surface ornamentation, as the general form of the species

is similar to that of many others, but the peculiar zig-zag feature of the ornamenting ridges will at once distinguish it from all other described species. Several ornamented forms of the genus are known from the Coal-measures, but their markings consist of nodes, either promiscuously scattered or arranged in patterns.

Formation and Locality.—In the limestone of the age of the St. Louis and Chester beds of Illinois (Maxville limestone), at Newtonville, Ohio.

***Holopea Newtonensis*, n. sp.**

Pal. O., Vol. III, Plate 10, Fig. 12.

Shell of medium size, ovate in outline and ventricose, with a moderately elevated spire and extremely ventricose volutions, which increase very rapidly in bulk from the apex. Volutions three and a half to four in number, with strongly rounded surfaces and moderate sutures. Apical angle about seventy degrees. Aperture broad ovate, modified on the inner side by the preceding volution, pointed at the upper end and broadly rounded at the base. Surface of the shell smooth and the substance very thin.

The form of the shell is much like that of a *Macrocheilus*, but the substance is much thinner than those usually are, and the base of the columella is not prolonged, nor is there a solid axis; but specimens show satisfactory evidence of having been distinctly and largely umbilicated.

Formation and Locality.—In the Maxville limestone (Chester), at Newtonville, Ohio. Collection of Columbia College, N. Y.

***Macrocheilus subcorpulentus*, n. sp.**

Pal. O., Vol. III, Plate 10, Fig. 14.

Shell small, the specimens observed not exceeding five-eighths of an inch in length, and the diameter rather exceeding half the length; spire conical, the apical angle being about fifty degrees. Volutions about three or three and a half, rapidly increasing in diameter and very ventricose, the last one forming more than half the length and much the greater bulk of the shell; suture deep and well marked. Aperture ovate, short and oblique. Surface of the shell smooth. Columella not seen.

This species is rather closely related to several forms which have been described from the Coal-measures of the Western States, but differs in the form of the volutions somewhat from

any, and in the more regular tapering spire,—those mostly having the body-volutions proportionally enlarged.

Formation and Locality.—In the Maxville limestone (Chester and St. Louis groups), at Newtonville, Ohio. Collected by Prof. E. B. Andrews.

***Polyphemopsis melanoides*, n. sp.**

Pal. O., Vol. III, Plate 10, Fig. 13.

Shell rather below a medium size, elongate-fusiform; the length nearly twice and a half the greatest diameter, when not compressed; spire elevated, pointed at the apex, the apical angle being about thirty-five degrees when uncompressed. The specimen figured gives on measurement thirty degrees in the line of compression, and forty degrees in the opposite direction. Volutions about five and a half, gradually increasing in size, moderately and evenly convex, with distinct sutures. Aperture elongate ovate, widest across the middle, rounded and effuse below and pointed above. Columella not observed. Surface apparently smooth.

The species is nearly of the form of *M. fusiforme*, Hall (Geol. Rept. Iowa, Vol. I, Part 2), from the Coal Measures of Iowa, but is considerably more slender. It is possible it may not properly belong to the genus, as the columella has not been closely observed; but so far as can be determined, it appears to be twisted.

Formation and Locality.—In the Maxville limestone, at Newtonville, Ohio. Collected by Prof. E. B. Andrews.

***Bellerophon alternodosus*, n. sp.**

Pal. O., Vol. III, Plate 10, Figs. 17—19.

Shell of about a medium size, and somewhat subglobose in general form, with an appearance of being slightly flattened on the dorsum in immature specimens; while on the adult forms, the dorsum is marked on the outer half of the body-volution by a double series of rounded nodes, those on one side of the centre alternating with those of the other side, and the inner margins of the two series interlocking with each other. Aperture broadly elliptical, strongly modified by the projection of the preceding volution, on the inner margin. Auriculations largely developed and slightly reflected. Axis very distinctly perforate. Inner lip somewhat callous on the protruding inner volution. Surface of the shell, so far as can be ascertained, marked only by lines of growth, beyond the nodes mentioned.

The species is somewhat similar in general form to *B. Montfortianus*, N. and P., from the Coal Measures, in its general form, but does not possess the strong transverse folds nor the

carina between the lines of nodes marking the dorsum. It also differs in the alternating positions of the nodes.

Formation and Locality.—In the Maxville limestone at Newtonville, Ohio. Collection of Columbia College, N. Y.

CEPHALOPODA.

***Nautilus pauper*, n. sp.**

Pal. O., Vol. III, Plate 10, Fig. 23.

Shell somewhat below the medium size, and consisting of about two and a half volutions, which increase rather rapidly in size, and are so coiled as to expose almost the entire diameter of the inner coils in the umbilical cavity; the outer one embracing only the dorsal surface of the inner volution. Volutions quadrangular in form, with the lateral diameter only about two-thirds as great as the dorso-ventral diameter; while the dorsal and ventral surfaces are nearly vertical to the plane of the sides, so far as can be determined from the specimen in hand; or possibly the dorsal surface may be slightly rounded. The sides of the shell are marked by a faint, narrow, revolving sulcus bordering the margin of the umbilicus, and by a correspondingly faint ridge close to the dorsal margin; while a much stronger rounded ridge occurs on the surface at about one-third of the width of the volution from the dorsal border. Internal features of the shell not known.

A single individual only of the species has been observed, and is altogether too imperfect to reveal all the features. It consists of the non-septate portion of the shell, in the condition of an internal cast, with the impression of one side of the entire shell; but gives no indications of the septa themselves. The only features indicating its cephalopodous nature, upon which one can rely, are its symmetrical form, and the evidences of a similar ornamentation on the opposite sides; otherwise it might have been supposed to represent a form of *Euomphalus*.

Formation and Locality.—In the Maxville limestone (Chester), near Rushville, Ohio. Collection of Prof. E. B. Andrews.

Fossils from the Coal Measures.

CRINOIDEA.

***Cyathocrinus Somersi*, n. sp.**

Pal. O., Vol. III, Plate 11, Figs. 4 and 5.

Calyx very shallow, being low and spreading; the extreme height to the top of the first radial plates not exceeding one-fourth of the diameter; the

sides, above the middle of the sub-radial plates, gradually and almost evenly curving. Centre of the calyx below deeply impressed, the cavity embracing the basal and inner half of the sub-radial plates. Basal plates very small, extending but little beyond the circumference of the proportionally small column, and forming by their union a somewhat regular pentagon. Sub-radial plates of medium size, four of them being equal, and pointed at their upper ends, the upper edges being convex; the fifth plate is larger than the others, and is truncated above by the very small first anal plate, which rests between the adjacent first radials, and has apparently joined three other plates above. The surface of this plate bears a single round granulose tubercle. First radial plates nearly twice as wide as high; their lateral faces being short and uniting with those of the adjacent plate, except on the anal side, where they are separated by the first anal plate. Articulating face for the second radials nearly straight, but deeply grooved. Second radial plates short; that of the anterior ray being cuneiform above, and has supported an arm-plate on each upper sloping surface. The second radials of the other rays have not been fully determined; but on the antero-lateral rays, where partially detached plates remain, they have been quadrangular, as if for the support of other radial plates in a direct series. Surface of the inner half of the sub-radial plates smooth, while the outer half and the entire surface of the other plates are covered with proportionally large, distinct, irregular tubercles, which are flattened on their surfaces and covered with numerous small, distinct granules. The granules also extend to parts of the intermediate surface. The upper margin of the first radial is bounded by an elevated transverse ridge, which is also granulose.

This species bears considerable resemblance in its general surface-markings to *Eupachyrcrinus tuberculatus*, M. and W. (Geol. Surv. Ills., Vol. V, Pl. 24, Figs. *a*, *b*), but the tubercles are very distinctly granulose. It, however, does not possess the structure of *Eupachyrcrinus*, having only one small anal plate, the upper end of which projects above the line of the first radials. The only specimen yet obtained of the species measures about three-fourths of an inch in diameter, and is about three-sixteenths of an inch high to the top of the first radial plates.

Formation and Locality.—In the Coal-measures at Carbon Hill, Hocking Co., Ohio. Collected by Mr. Somers, of Columbus, Ohio.

***Zeacrinus Mooresi*, n. sp.**

Pal. O., Vol. III, Plate 11, Figs. 6—10.

Form of entire body unknown. Calyx of moderate size and pentagonal in outline, very broadly cyathiform or shallow cup-shaped; the region of the basal plates being impressed, and the radials but moderately curving

upward at their outer edges. Basal plates small, forming by their combination a nearly regular pentagon. Sub-radials proportionally large, wider than high, four hexagonal and one on the anal side heptagonal. Sub-radials short, but not very broad, twice to twice and a half as wide as long; the cicatrix for the second radials very large and nearly straight. The anal plates, three of which are preserved, are longer than wide. Column small, round, composed near the calyx of alternately small and large plates, with very coarse radiating lines of articulation. Surface of calyx smooth, except a line of granules just within the margin of the sub-radial plates.

The second radial plates present the strong specific feature of the species, and are large and spine-bearing, as in *Zeacrinus mucrospinus*, McChes. The spines are long, much thickened and bulbous in the lower part, presenting in this respect a strong contrast with those of that species. The cicatrix for the attachment of the arm-plates is very large, showing that the plates above were of large size. Arms and dome unknown.

The species has been quite abundant, as the spines are found in great numbers, and vary considerably in size, according to the width of the first radial plates upon which they have rested. But all are thickened and bulbous, and many of them are more than an inch in length. They are seldom found attached to the calyx, but are scattered through the shale in the bed where found.

Formation and Locality.—In shale of the Coal-measures at Carbon Hill, Hocking Co., Ohio. Named in honor of H. Moores, Esq., of Columbus, Ohio, their discoverer.

BRACHIOPODA.

***Discina Meekana*, n. sp.**

Pal. O., Vol. III, Plate 11, Figs. 1—3.

Discina nitida? (Phil.) M. and W., Geol. Ills., Vol. V, p. 572, pl. 25, fig. 1;—not *D. nitida*, Phillips, Geol. Yorkshire, Vol. II, p. 221, pl. 11, figs. 10—13.

Shell of moderate size or larger, circular or sub-circular in outline. Dorsal valve convex, with an elevated beak which is directed backward and situated at about one-third of the length of the shell from the posterior margin. Posterior slope slightly concave just below the apex; anterior slope convex. Surface of the shell, when preserved, marked by fine, even, but elevated and regular concentric lines, with flattened interspaces; about ten or eleven of the elevated lines occupy a space of an eighth of an inch on the middle of a shell, being finer within and coarser beyond that point. On the partially exfoliated shell, fine radiating vascular lines are perceptible. Ventral

valve flat, discoidal, circular in outline, or perceptibly elongated in some cases ; the apex a little more than one-third the length of the shell from the posterior margin. Foramen small, elongate-elliptical, narrow, not extending more than one-fourth of the distance from the apex toward the margin, and the depression somewhat further. Surface marked as in the other valve.

This shell would appear to be identical with the one described and figured by Messrs. Meek and Worthen as *D. nitida*? under the supposition that it was the same as that figured by Prof. Phillips, in the Geol. Yorkshire Coast, Vol. II, pl. 11, figs. 10—13 ; but it differs very much in outline from those figures, as well as those given by other authors, in its circular form ; those being ovate, narrowed behind and widened in front ; also, in having the apex much more distant from the margin. They also cite *D. Missouriensis*, Shumard, as a synonym of the European species. That author indicates his shell as parabolic in outline ; from which statement I should consider it as distinct from the present species.

Formation and Locality.—In the Coal-measures at Carbon Hill and Flint Ridge, Ohio ; also in Illinois and Iowa.

***Crania carbonaria*, n. sp.**

Pal. O., Vol. III, Plate 11, Figs. 11 and 12.

Shell small, none of the specimens observed exceeding three-eighths of an inch in diameter ; sub-circular in outline, or varied in form by the outline of the object to which they are attached. Free valve depressed convex, marked by a few concentric lines of growth ; attached valve thin, but with a slightly thickened margin. Posterior muscular impressions large and sub-marginal, the others being nearly central and forming a small elevation just posterior to the middle of the valve.

The shells of this species are found attached to the spines of *Zeacrinus* and other bodies, one of those figured being upon the operculum of *Naticopsis*. They are very thin, and not easily detected in the roughened condition caused by the adhering material in which most of the fossils from these beds are found. Species of this genus are rather rare in the Coal-measures, but very few having been described. *Crania Permiana*, Shumard, from the white limestones of the Guadalupe Mts., Texas, is a large form, and probably not a *Crania*, according to the description given. *C. modesta*, White and St. John, from the Coal-

measures of Iowa, is described as "rather small, finely punctate, smooth, except somewhat strong concentric lines of growth toward the margins. Upper valve moderately convex, umbo oblique, nearly central. Lower valve moderately concave." There would appear to be some similarity between the upper valves of this and the Ohio species; but the remark concerning the lower valve being "moderately concave" throws considerable doubt on their identity, as the lower valve of this species is attached over its entire surface, while that one would appear to be free or partially free, if it is a *Crania*.

Formation and Locality.—In the Coal-measures of Carbon Hill, Hocking Co., Ohio. Collected by H. Moores, Esq., of Columbus, Ohio.

GASTEROPODA.

***Naticopsis Ortoni*, n. sp.**

Pal. O., Vol. III, Plate 12, Figs. 12 and 13.

Shell small, with a somewhat depressed conical spire, which forms an angle of about 105 degrees, and the two and a half to three volutions are obliquely flattened on their upper side, in the direction of the spire; the outer one being marked just below the suture by a barely perceptible concave channel of considerable width, which produces a very slight angularity of the upper part of the volution. Suture-line slightly grooved. Lower side of the volution rounded; umbilicus closed; callus slight; aperture obliquely ovate at the outer margin, but rounded within from the excessive thickening of the shell. Surface of the shell marked by fine, rather equal and somewhat regular transverse striae of growth, most distinctly marked on the lower half of the volution. On the outer half of the last volution, there occur lines of nodes, very faintly indicated, having a direction opposite to the growth-lines, and becoming fainter and finally imperceptible toward the lower side.

The species resembles *N. nana*, M. & W. (Geol. Rept. Ills., Vol. III, p. 365, pl. 32, fig. 4), in size and general form, but differs from it in the greater flattening of the volution in the direction of the spire, and in the faintly nodose surface.

Formation and Locality.—In a thin cherty band of the Coal-measures in the railroad cutting at Mrs. Banks' farm, Falls Township, Hocking Co., Ohio.

***Loxonema plicatum*, n. sp.**

Pal. O., Vol. III, Plate 11, Figs. 14 and 19.

Shell small and slender, spire elevated, presenting an apical angle of about fifteen degrees; composed of about eleven volutions, in the example used and illustrated, which are flattened on the surface in the direction of the spire, and marked by strong vertical plicæ, which are directed a little forward in their passage across the volution from above downward. The body or largest volution, counting from the lip backward, contains fifteen of these plications, and the volutions above contain nearly the same number; those of the several volutions being in line with those on the one below, but set enough back of it to be in line with the slope of the plication. This gives them a somewhat spiral arrangement on the shell, the whole having a twist of about one-fourth of one turn in the length of the shell. On the last volution the plicæ are not distinct much below the bulge of the whorl. Aperture elongate and pointed below. Suture distinct, but not grooved or banded. Columella straight, about half as long as the aperture, solid, and terebra-like; shell without umbilicus.

The species belongs to a group of the genus which has but few representatives in our Coal-measures; and even those that are nearest allied to it appear to differ in the form of the columella, which is somewhat peculiar; and if other species should appear presenting these same characters, it may be necessary to separate them generically from the true *Loxonema*.

Formation and Locality.—In the Coal-measures of Carbon Hill, Hocking Co., Ohio. Collected by H. Moores, Esq.

CEPHALOPODA.

***Nautilus Ortoni*, n. sp.**

Pal. O., Vol. III, Plate 12, Fig. 20.

Shell of medium size, and consisting of about two and a half or three closely coiled volutions, but which are not at all embracing; the outer one being simply in close contact with the medio-dorsal portion of the next within, and exposing nearly the entire dorso-ventral diameter of the shell. Volutions transversely sub-pentangular, being angularly convex on the back, strongly sub-angular on the sides, and concave on the abrupt umbilical slope, which forms a somewhat sigmoidal curve resembling an ogee moulding, while the slightly concave ventral surface is quite narrow, and forms a fifth surface. Lateral angles obtuse or round sub-angular, and ornamented by a series of nodes which are strong and very distinct on the inner coil, broad and rounded on the first part of the last volution, and become obsolete on the outer third. The substance of the shell has been very thick and strong, and the surface shows no evidence of growth-markings or striæ. Septa and other internal features unknown.

The shell resembles somewhat *N. spectabilis*, M. and W., but has a smaller number of coils in a shell of corresponding size, while the concavity of the umbilical slope and the sub-angular back are strong distinguishing features.

Formation and Locality.—In the Coal-measures at Springfield, Summit Co., Ohio. Cabinet of the School of Mines, N. Y. City.

***Nautilus (Gyroceras?) subquadrangularis*, n. sp.**

Pal. O., III, Plate 11, Fig. 16.

Shell of about a medium size, consisting of two volutions, as seen on the specimen used, which increase somewhat rapidly in size with increased length, and are closely coiled so as to bring them in close contact, but not to be in any degree embracing. The inner volution, however, is coiled in so large a circle that it leaves an opening within it of about one inch in diameter. The shell is at first circular in section, but before the completion of the first coil the form has become modified so as to produce a sub-quadrangular section, narrowest on the dorsal side, and the second volution becomes distinctly quadrangular, being nearly as wide on the dorsum as across the lateral face; but the angles are all distinctly rounded, and the inner or umbilical margins most particularly so. The inner part of the shell has a line of strong node-like undulations on each dorsal angle, which become obsolete at about the first third of the second volution. Margin of the aperture greatly extended on the sides beyond the line of the inner edge, and apparently sinuate on the back. Septa deeply concave and numerous; those at the base of the outer chamber showing about three chambers in the space of one inch, and gradually decreasing in distance toward the earlier part of the shell. On the quadrangular parts, they are deeply receding on the sides and back, and correspondingly advanced on the angles; a consequence of the quadrangular form on a deeply concave septum. Surface of the shell apparently smooth and the substance thin. Siphon unknown.

The species is peculiar in its quadrangular form, and in the wide opening through the centre; in these characters it differs from any previously described species. It is of a form that is with difficulty placed in the genus *Nautilus*,—its characters, so far as the external features are concerned, nearly resembling those of *Gyroceras*,—and in the absence of a knowledge of the position of the siphuncle, must remain doubtful.

Formation and Locality.—In limestone of the Coal-measures, at Canfield, Ohio. Collected by H. C. Bowman, and now in the cabinet of the School of Mines, New York City.

APPENDIX.

Leiorhynchus Newberryi.

LEIORHYNCHUS NEWBERRYI, H. & W., 23d Rept. State Cab., N. Y. In the description of this species it is correctly referred to the Chemung group, but improperly to the Waverley group on the plate.

Genus **Pholadella**, H. & W.

Preliminary notice of Lamellibranchiate Shells of the Upper Helderberg, Hamilton and Chemung groups, etc. (State Cab. Nat. Hist., Decem., 1869, p. 63). The name ("Hall, n. g.") incorrectly inserted without my knowledge.—R. P. W.

Pholadella Newberryi.

PHOLADELLA, NEWBERRYI, H. & W. Prelim. Notice, cited above, p. 65. *Allorisma* (*Sedgwickia*?) *pleuropistha*, Meek; Pal. Ohio, Vol. I, p. 309, Plate 13,
Figs. 4a and 4b.

Pleurotomaria Mississippensis.

PLEUROTOMARIA MISSISSIPPIENSIS, White & Whitf., Proc. Bost. Soc. Nat. Hist., 1862, p. 203, Vol. 8.

Pleurotomaria textiliger, Meek; Pal. Ohio, Vol. I, p. 314, Pl. 13, Figs. 7a and b.

Note on the Marcellus Shale and other Members of the Hamilton Group in Ohio, as determined from Palæontological Evidence.

During the early summer of 1878, Pres't Edward Orton wrote, asking if I could spend a few days with him in central and southern Ohio, in an effort to ascertain from palæontological evidence, the true horizon of certain layers of rock which had been somewhat of a difficulty to him; and in the month of August I spent several days with him for that purpose. While making

these somewhat hurried observations at a locality about six miles N. W. of Columbus, in Perry township, on the east bank of the Scioto River, we accidentally discovered a thin bed of dark brown shale, somewhat fissile and bituminous in character, in what Prof. Orton had considered as a representative of the Delaware limestone of Delaware, Ohio. The peculiar texture of the shales, occurring where I had expected only a light-colored limestone, excited my interest; and after a few minutes' examination, I discovered that they contain numerous flattened shells of *Leiorhynchus limitaris*, Vanuxem. I also obtained from them two specimens of *Discina minuta*, and examples of *Lingula Manni*, Hall; the two former being well-known and characteristic forms of the Marcellus shales of New York. On examination, we found that these shells, especially the *Leiorhynchus*, extended through a thickness of several feet of the rock, and that the peculiar bituminous character of the shale accompanied them, but with intercalations of thin layers of less bituminous and lighter-colored limestones. Subsequently, at a point nearly opposite Dublin, Ohio, some miles north of the above-mentioned locality, the same shale was again recognized in a corresponding horizon, accompanied by the same species, the *Leiorhynchus* being quite numerous. At a subsequent visit, Mr. Edward Hyatt obtained *Discina Lodensis*, Hall, another New York Marcellus species. At this second locality, immediately above the shale, and while the limestone layers retain much of the bituminous character, the layers become thicker and more calcareous, and their surfaces are covered with the shells of *Spirifera gregaria*, Clapp, and *Tentaculites scalariformis*, Hall, both of which are likewise common in the blue limestone layers at Delaware, Ohio.

A section of the rocks at the first-mentioned locality, six miles N. W. of Columbus, on the east bank of the Scioto, subsequently furnished by Prof. Orton, is as follows :

The lower bed, No. 1 of section, is a heavy-bedded limestone, about thirty feet thick, representing the Columbus quarries, including the coral beds and those containing the large cephalopods. (Lower Corniferous of the Ohio Geol. Rept.)

No. 2, a thin layer of limestone, four to six inches thick,

densely filled with teeth, plates and bones of fishes, locally known as the "Bone-bed."

No. 3, about thirty feet of thin-bedded shaly limestone, the "Delaware bed" of Prof. Orton. The upper part of this is supposed to represent the beds of similar character at Delaware, Ohio, which contain the large fish-remains.

No. 4, about fifteen feet of bluish, somewhat marly shales, the "Olentangy shales" of N. H. Winchell. This is followed above by the Huron shales, the supposed equivalents of the Genesee slates and Portage shales of New York.

Near the lower part of No. 3, only a few feet above the "Bone-bed," occurs the dark brown shale in question, with the peculiar fossils, which I have no hesitation in pronouncing the equivalent of the Marcellus shales of New York.. Admitting this—and there certainly appears to be no alternative—the rocks found above this limit should represent the Hamilton group of the New York system; and we ought to find some fossils here, characteristic of that formation, which would not pass below this line. To ascertain if this was so, I requested Mr. Edward Hyatt, who has collected carefully the fossils around Columbus, to furnish me a list* of the species known, with their horizons indicated; and also requested the use of specimens of species not known to occur below the horizon of the "Bone-bed,"—that being the most easily recognized limit, and the one most generally studied in connection with the vertical distribution. Contrary to my expectations, the species yet known not to pass below the "Bone-bed" are very few. These, with the exception of the *Tentaculites scalariformis*, have been illustrated on Plate 7, and are, with two exceptions, known Marcellus and Hamilton types,—one being a new species, and the other (*Spirifera Maia*, Bill.) occurring in the Upper Helderberg limestone in Canada. The examination of the upper layers for characteristic fossils was not carried far enough to make it perfect, owing to Mr. Hyatt's absence from Columbus; but the few forms found above these bituminous layers will readily be recognized as characteristic of the Hamilton group, and warrant one in considering the

* These lists will be found appended at the end of the present article.

Black Shales and other beds coming above these thin limestones in central Ohio, as equivalent to the Genesee Slates and succeeding formations of New York.*

The following lists, prepared by E. and H. Hyatt, of Columbus, Ohio, are from the limestones within 24 miles of that place. Those of the first list are from below the horizon of the "Bone-bed," and the next from above; *Strophomena rhomboidalis* being the only species fully recognized from both horizons. All species have been collected by them from known horizons, or have been seen from the beds by myself.

SPECIES FROM BELOW THE "BONE-BED."

PROTOZOA.

STROMATOPORA, De Blainville.

C. granulosa, Nich.

S. nodulata, Nich.

S. ponderosa, Nich.

S. Sanduskyensis, Rominger.

S. substriatella, Nich.

CANNOPORA, Phillips.

C. columnaris, Nich.

C. densa, Nich.

RECEPTACULITES, De France.

R. Devonicus, Whitf.

RADIATA.

FAVOSITES, Lamarck.

* Since writing the above remarks, Vol. 5 of the Palæont. of New York has been published. In it the author has, on page 139, some remarks on the limestones at the Falls of the Ohio, and their relations to the Hamilton group of New York. After showing that the Hydraulic-cement beds of the Falls of the Ohio are the equivalents of the Hamilton group of New York (which had already been stated in the Geol. Rept. Ind., 1875, pp. 147, 148, and also shown in sections on page 157), the author remarks, "In the State of Ohio, similar conditions may be inferred, from the fact that certain known species of Hamilton fossils are published in the Ohio Geological Reports as from the Corniferous group." At the meeting of the Am. Assoc. for the Advancement of Science, at Saratoga, August. 1879, I read a notice of the occurrence in Ohio of rocks representing the Marcellus shales of New York, in which it was shown that a considerable thickness of the limestones previously recognized as "Corniferous" in Ohio, were above the horizon of the beds which I had recognized, from palæontological and lithological evidence, as of the age of the Marcellus shale, and would be of necessity equivalents of the Hamilton group.

- F. basaltica*, Goldf.
- F. Gothlandica*, Lamarck. (?)
- F. hemispherica*, Yand. and Shumard.
- F. invaginata*, Nich.
- F. pleurodictyoides*, Nich.
- F. polymorpha*, Goldf.?
- F. turbinata*, Billings.

MICHELINA, De Koninck.

- M. convexa*, Emmons.
- M. maxima*, Troost.

EMMONSIA, Ed. and Haime.

- E. Emmonsii*, Hall.

TRACHYPORA, Ed. and Haime.

- T. elegantula*, Billings.

AULOPORA, Goldfuss.

- A. cornuta*, Bill.
- A. filiformis*, Bill.
- A. tubæformis*, Gold.?

SYRINGOPORA, Goldf.?

- S. Hesingeri*, Bill.
- S. Maclurei*, Bill.
- S. tabulata*, Ed. and Haime.

ERIDOPHYLLUM, Ed. and Haime.

- E. Simcoense*, Bill.
- E. strictum*, E. and H.
- E. Verneuillanum*, E. and H.

STYLASTREA, Lonsdale.

- S. Annae*, Whitf.

ZAPHRENTIS, Rafinesque.

- Z. cornicula*, Ed. and H.
- Z. Edwardsi*, Nich.
- Z. gigantea*, Ed. and H.
- Z. prolifica*, Bill.
- Z. Wortheni*, Nich.

CYATHOPHYLLUM, Goldf.

- C. rugosum*, Hall.
- C. Zenkeri*, Bill.

HADRIOPHYLLUM, Ed. and H.

- H. D'Orbigny*, Ed. and H.

HELIOPHYLLUM, Ed. and H.

H. confluens, Hall.

H. Halli, Ed. and H.

AULACOPHYLLUM, Ed. and H.

A. sulcatum, Ed. and H.

CYSTIPHYLLUM, Lonsdale.

C. Americanum, Ed. and H.

C. Ohioense, Nich.

CRINOIDEA.

MEGISTOCRINUS, O. and S.

M. spinulosus, Lyon.

DOLATOCRINUS, Lyon.

D. multiradiatus, Hall.

D. radiatus, Hall.

BLASTOIDEA.

NUCLEOCRINUS Conrad.

N. Verneuili, Troost.

CODASTER, McCoy.

C. pyramidatus, Shumard.

ANCYROCRINUS, Hall.

A. spinosus, Hall.

MOLLUSCA.

BRYOZOA, Emmerich.

STICTOPORA, Hall.

S. Gilberti, Meek.

LICHENALIA, Hall.

L. lichenoides, Meek.

BRACHIOPODA.

DISCINA, Lamarck.

D. grandis, Vanux.?

CRANIA, Retzius.

C. crenistriata, Hall.

C. Hamiltoniae, Hall.

ORTHIS, Dalman.

O. Livia, Bill.

O. propinqua, Hall.

O. Vanuxemi, Hall.

STREPTORHYNCHUS, King.

S. flabellum, Whitf.

S. Pandora, Bill.

STROPHODONTA, Hall.

S. ampla, Hall.

S. demissa, Conrad.

S. hemispherica, Hall.

S. inequiradiata, Hall.

S. nacrea, Hall.

S. Patersoni, Hall.

S. perplana, Conrad.

S. subdemissa, Hall. ??

STROPHOMENA, Rafinesque.

S. rhomboidalis, Wilck.

CHONETES, Fischer.

C. acutiradiata, Hall.

C. arcuata, Hall.

C. deflecta, Hall.

C. mucronata, Hall.?

C. Yandellana, Hall.

PRODUCTELLA, Hall.

P. spinulicosta, Hall.

SPIRIFERA, Sowerby.

S. acuminata, Con.

S. duodenaria, Hall.

S. euryteines, Owen.

S. fimbriata, Con.

S. gregaria, Clapp.

S. Greeri, Hall.

S. macra, Hall.

S. macrothyris, Hall.

S. Manni, Hall.

S. Marcyi, Hall.

S. Oweni, Hall.

S. segmenta, Hall.

S. varicosa, Hall.

SPIRIFERINA, D'Orb.

S. raricosta, (Conrad.)

CYRTINA, Davidson.

C. Hamiltonia, Hall.

MERISTELLA, Hall.

M. nasuta, (Conrad.)

M. scitula, (Hall.)

NUCLEOSPIRA, Hall.

N. concinna, Hall.

ATRYPA, Dalman.

A. reticularis, Linn.

RHYNCHONELLA, Fischer.

R. Billingsi, Hall.

R. Carolina, Hall.

R. Dotis, Hall.

R. Thetis, Billings.

R.? raricosta, Whitf.

PENTAMERELLA, Hall.

P. arata, Hall.

TEREBRATULA, Schlotheim.

T. Sullivanti, Hall.

TROPIDOLEPTUS, Hall.

T. carinatus, Conrad.

LAMELLIBRANCHIATA.

AVICULOPECTEN, McCoy.

A. crassicostata, H. and W.

A. paralis, Conrad.

PTERINEA, Goldf.

P. flabella, Conrad? The specimens referred to this species are very doubtfully identified. They are large coarse forms, very unlike any of those in the higher beds.

MYTILARCA, H. and W.

M. ponderosa, H. and W.

M. percarinata, Whitf.

CONOCARDIUM, Brown.

C. trigonale, Hall. *C. Ohioense*, Meek, is the young of the above.

GONIOPHORA, Phillips.

G. perangulata, H. and W.

PARACYCLAS, Hall.

P. lirata, Conrad.

P. occidentalis, H. and W. *P. Ohioensis*, Meek, is the same as *P. lirata*, Conrad.

MODIOMORPHA, H. and W.

M. elliptica?

M. perovata, Meek.

SANGUINOLITES, McCoy.

S. Sanduskyensis, Meek.

GASTEROPODA.

PLATYCERAS, Conrad.

P. attenuatum, Meek.

P. bucculentum, Hall.

P. carinatum, Hall.

P. conicum, Hall.

P. dumosum, Conrad.

P. multispinosum, Meek.

P. squalodens, Whitf.

PLATYOSTOMA, Conrad.

P. lichas, Hall.

EUOMPHALUS, Sowerby.

E. Decewi, Billings.

HOLOPEA, Hall.

H. rotundata, Hall, sp.

TURBO, Klein?

T. Kearneyi, Hall.

T. Shumardana, Yandell.

ISONEMA, M. and W.

I. bellatula, Hall.

I. depressa, H. and W.

I. humilis, Meek.

XENOPHORA, Fischer.

X. antiqua, Meek.

NATICOPSIS, McCoy.

N. æquistriata, Meek.

N. cretacea, H. and W.

N. levis, Meek.

LOXONEMA, Phillips.

L. Leda, Hall.

L. Hamiltoniæ, Hall.

L. parvulum, Whitf.

L. pexatum, Hall.

ORTHONEMA, M. and W.

O. Newberryi, Meek.

MACROCHEILUS, Phillips.

M. priscus, Whitf.

PLEUROTOMARIA, De France.

P. adjutor, Hall.

P. Doris, Hall.

P. Hebe, Hall.

P. Lucina, Hall.

MURCHISONIA, De Verneuil.

M. desiderata, Hall.

M. Maia, Hall.

M. obsoleta, Hall.

DENTALIUM, Linnæus.

D. Martini, Whitf.

BELLEROPHON, Montfort.

B. Newberryi, Meek.

B. Pelops, Hall.

B. propinqua, Meek.

PTEROPODA.

CONULARIA, Miller.

C. elegantula, Meek.

TENTACULITES, Schloth.

T. scicula, Hall.

CEPHALOPODA.

ORTHOCERAS, Breynius.

O. nuntium, Hall.

O. Ohioense, Hall.

O. profundum, Hall.

TREMATOCERAS, Whitf.

T. Ohioense, Whitf.

GOMPHOCERAS, Sowerby.

G. amphora, Whitf.

G. eximium, Hall.

G. Hyatti, Whitf.

G. Sciotense, Whitf.

CYRTOCERAS, Goldfuss.

C. cretaceum, Whitf.

C. Ohioense, Meek.

C. undulatum, Vanuxem ?

GYROCERAS, Meyer.

G. Columbiense, Whitf.

G. Cyclops, Hall.

G. inelegans, Meek.

G. Ohioense, Meek.

G. seminodosum, Whitf.

CRUSTACEA.

DALMANIA, Emmerich.

D. Calypso, Hall.

D. Helena, Hall.=*D. Ohioense*, Meek.

D. selenurus, Green.

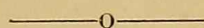
PHACOPS, Emmerich.

P. rana, Green.

PROETUS, Steininger.

P. crassimarginatus, Hall.

Species from above the Bone-Bed.



CRINOIDEA.

GONIASTEROIDOCRINUS, Lyon.

G. spinigera, Hall.

BRACHIOPODA.

LINGULA, Brugiere.

L. Manni, Hall.

L. ligea, Hall.

DISCINA, Lamarck.

D. Lodensis, Hall.

D. minuta, Hall.

STROPHOMENA, Rafinesque.

S. rhomboidalis, Wilck.

CHONETES, Fischer.

C. scitula, Hall.

C. reversa, Whitf.

SPIRIFERA, Sowerby.

S. Maia, Billings.

S. zic-zac, Hall.

LEIORHYNCHUS, Hall.

L. limitaris, Vanuxem.

LAMELLIBRANCHIATA.

AVICULOPECTEN, McCoy.

A. equilatera, Hall.

PTERINEA, Goldfuss.

P. similis, Whitf.

ACTINODESMA, Sandberger.

A. subrecta, Whitf.

GRAMMYSIA, De Vern.

G. bisulcata, Conrad.

NYASSA, H. and W.

N. arguta, H. and W.

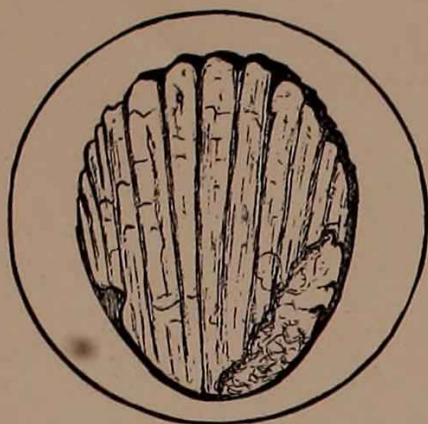
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[NOTE TO PAGE 216.]

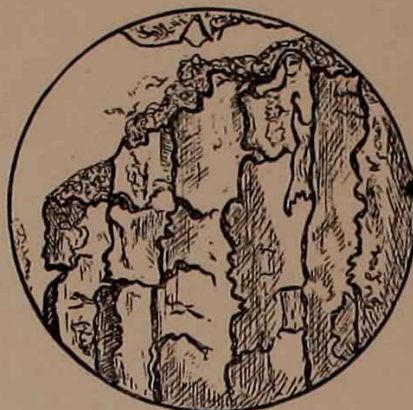
Genus **NYASSA**, H. and W.

Nyassa, H. & W., Prelim. Notice of the Lamellibranchiate Shells of the Upper Helderberg, Hamilton and Chemung Groups, &c. Albany, Dec., 1869, p. 28,

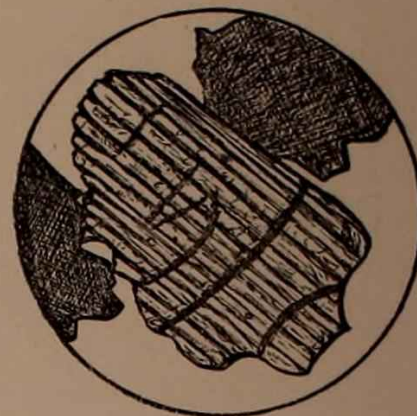
Shells bivalve, very oblique and transversely ovate in form. Posterior hinge-plate narrow, bearing from one to four long slender ridge-like teeth. Anterior plate broad, marked by numerous small point-like teeth with intermediate depressions, arranged somewhat radiating from the middle of its inner border. Adductor muscles two, one at each extremity. Pallial line entire. Ligament internal. Type, *N. arguta*. Name, mythological. Geological range, so far as known, Devonian. Family relations apparently near *Megalomus*, Hall, and *Megalodon*, Sowerby.



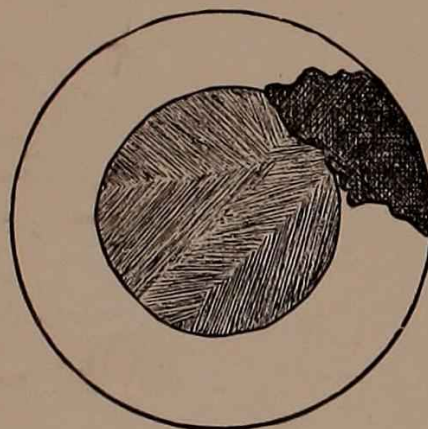
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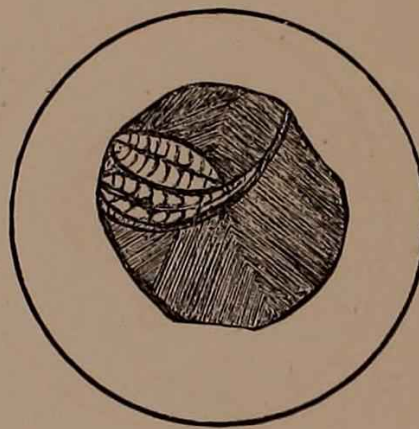
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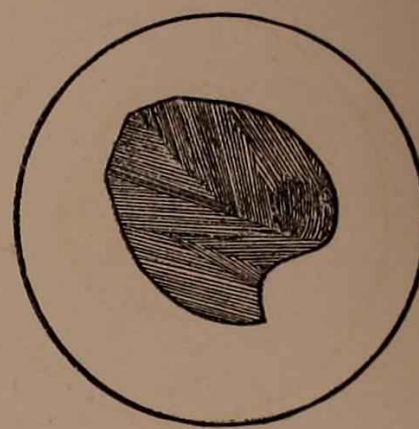
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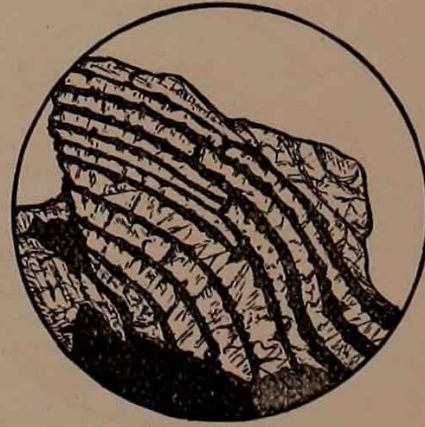
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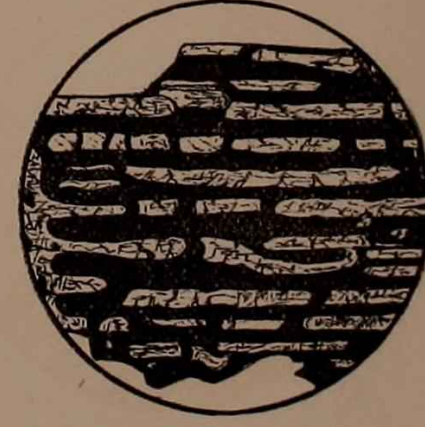
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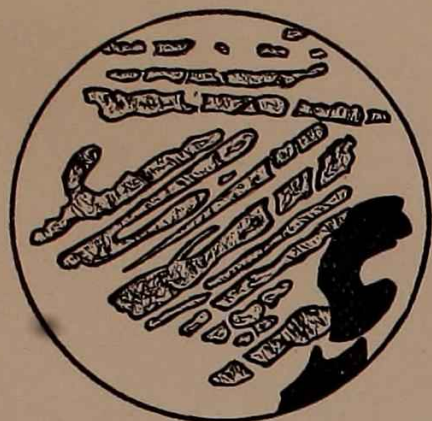
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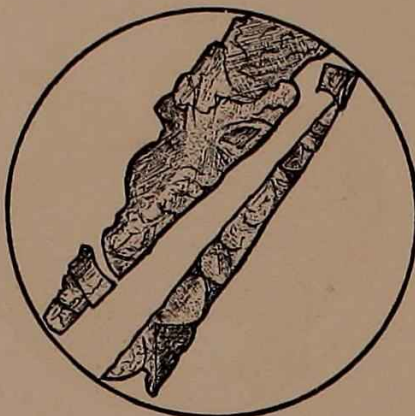
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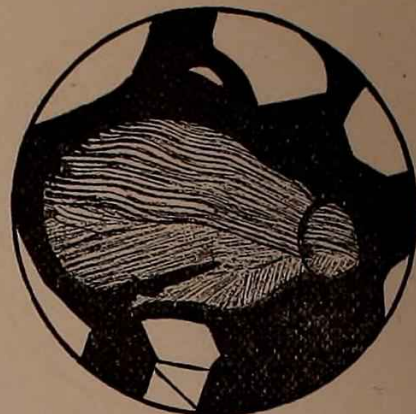
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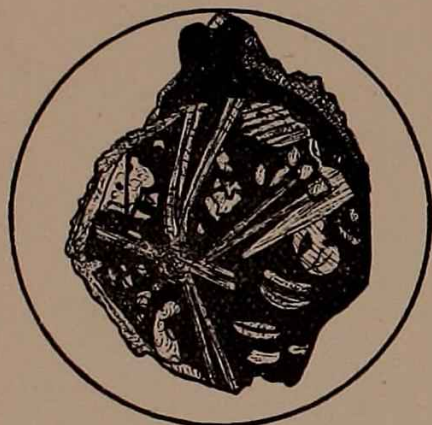
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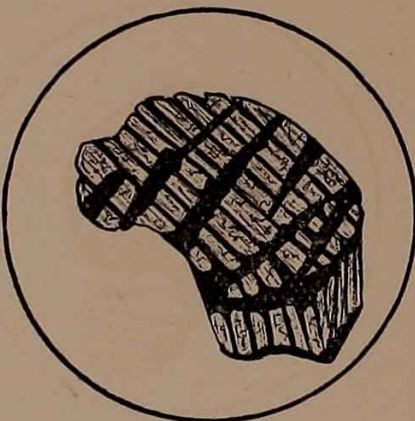
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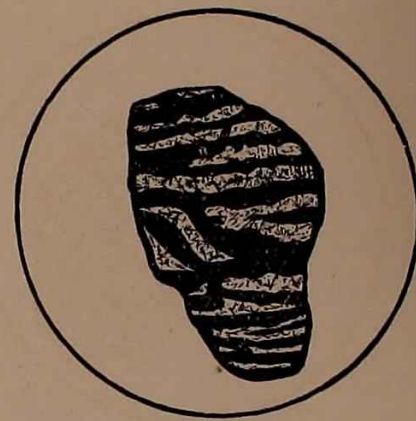
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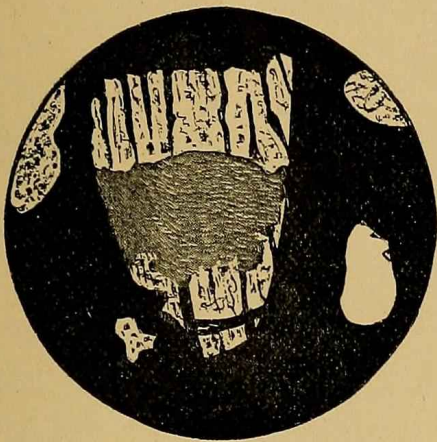
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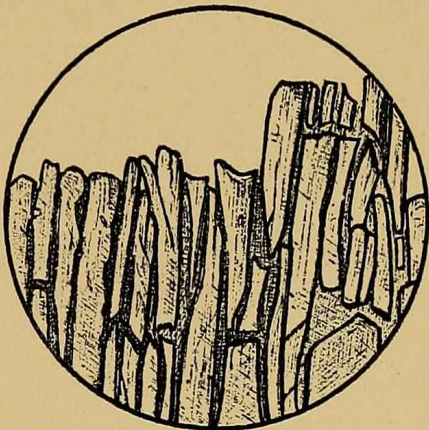
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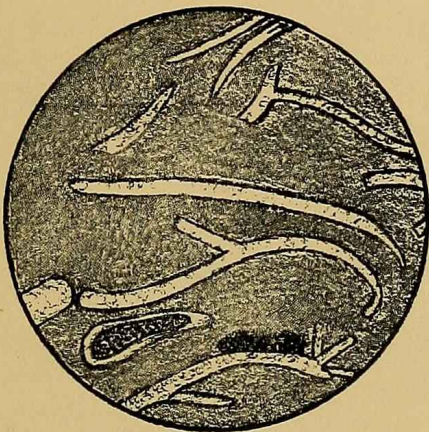
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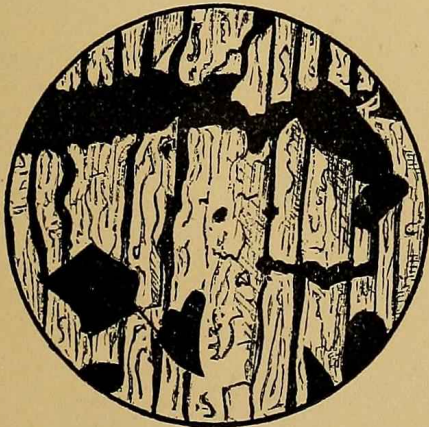


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