

ronously done, those species having the construction of *Dichoerinus*, and differing in every essential particular from *Pterotoerinus*. None of the species present any evidence of sculpture or ornamentation; nor do any of the many other fine Crinoids found associated with them. It might be supposed that this was the result of erosion, were it not for the fact that the many beautiful species of *Chaetetes*, *Polypora*, *Fistulipora*, *Septopora*, etc., associated with them, have all their most delicate structure perfectly preserved. It must then be inferred that the *Crinoidea* of this group were plain species. The true formula of the genus is as follows: Basals, 2; radials, 1st series, 5; radials, 2d series, 10; radials, 3d series, 20; brachials, 3 or 4, x 20; axillaries or interbrachial rays, 5; anal plate, 1 or more (?); arms, 20; column small and round; exterior without ornamentation. Geological position: upper half of the Kaskaskia Group of the Sub-carboniferous, in sandy shales, Pulaski Co., Ky. The wide variation exhibited in the form of the different species of this remarkable Crinoid; the inconstant character of its plates; the different arrangement of the vault pieces at the apex; the strange and widely varying forms of the rays, are each evidences of the impossibility of arranging a generic formula that shall include all cases; but that given is as near perfect as can be. The almost entire ankylosis of the first and second radials in old individuals may easily lead one astray who does not study sliced specimens; while the varying form of the rays found, and not yet referred to discovered species, shows that there are large numbers of forms as yet unknown. It is plain that its nearest alliance is with *Eucalyptocrinus*, which has four basals, or a second division of those of *Pterotoerinus* and *Dichoerinus*. I am satisfied, however, that all classification of the *Crinoidea*, based merely upon the arrangement of the pelvic plates, will soon be superseded by the more rational one of the relationship of internal structure.

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DESCRIPTIONS OF NEW GENERA AND SPECIES OF  
FOSSILS FROM THE LOWER SILURIAN  
ABOUT CINCINNATI.

BY E. O. ULRICH.

In giving the formations in which the following species occur, the terms Utica shale and Hudson River Group are used instead of Cincinnati Group. The term Cincinnati Group was mainly established by Messrs. Meek and Worthen, on account of the supposed absence, in the Cincinnati exposures, of the Utica shale. The rocks exposed at High Bridge, Lexington, and many other localities in Kentucky, are

undoubtedly of the age of the Trenton; and also, we believe, that the Black River limestone crops out at the Kentucky River, below High Bridge, Frankfort, and possibly at several other localities. The strata exposed at Cincinnati, from low water mark in the Ohio River to about seventy-five feet above that horizon, and which are considered by nearly all the geologists at Cincinnati to be referable to the Utica shale, differ from the strata above and below them lithologically, as well as in the fossils they contain. At least twenty-six species occur in them that are not known to have been found in the strata referred to the Trenton Group, nor in those of the Hudson River Group. These species are: *Buthotrephis ramulosa*, Miller; *Lockeia siliquaria*, James; *Chatetes briareus*, Nicholson; *Chatetes calicula*, James; *Dendrocrinus dyeri*, Meek; *Graptolithus tenuis*(?), Portlock; *Dicranograptus ramosus*, Hall; *Diplograptus whitfieldi*, Hall; *Diplograptus spinulosus*(?), Hall; *Leptobolus lepis*, Hall; *Modiolopsis cincinnatiensis*, Hall and Whitfield; *Leperditia byrnesi*, Miller; eight species described in this paper: *Heterocrinus geniculatus*, *Dendrocrinus*(?) *curtus*, *Palauster finei*, *Leptana plicatella*, *Cyrtolites nitidulus*, *Leperditia radiata*, *L. bicertes*, *L. unicornis*, and six undetermined species; two crinoids, probably new, a *Leperditia*, a graptolite, a fucoid, and an undescribed species of Crustacean, allied to *Euoploura*. Although there is some intermingling of the species occurring in this western exposure of the Lower Silurian, on the whole, we believe that there are sufficient reasons for re-instating the old terms by which its subdivisions were known.

#### Genus LEPERDITIA (Ronalt).

LEPERDITIA RADIATA, n. sp. (Plate VII., figs. 2, 2a, 2b.)

[Ety.--*Radiatus*, radiating.]

Length, 0.2; breadth, 0.17 inch.

Carapace from sub-quadrate to sub-reniform; dorsal margin straight, nearly as long as the length of the valve; anterior and posterior ends equal, either slightly truncate, or broadly rounded; ventral margin convex. Valves depressed convex, with a slightly defined, rather broad marginal rim. Tubercle situated near the middle of the valve, small, sub-oval, and not very prominent; substance of tubercle very thin, rarely preserved, the position of the tubercle usually being marked by a perforation in the valve. Surface minutely striate; striae radiating from four or five points on the valve; the striae composing the central group are the strongest, and radiate from the tubercle. In some specimens, the striae show through the valve on the interior; in

others, the interior is smooth. Ventral margin of the right valve overlapping that of the left, and on the interior thickened and grooved, to admit the ventral edge of the left valve. Substance of the valves thin.

The form of the valves and their radially striate surface, will serve to readily distinguish the species from any other species of the genus known to the writer.

Formation and locality: The specimens were found in the Utica shale, exposed below the banks of the Ohio River, in the First Ward of Cincinnati.

Collectors: J. Fine, H. E. Dickhaut, E. O. Ulrich.

LEPERDITIA CREPIFORMIS, n. sp. (Plate VII., figs. 3, 3a.)

[Ety.—*Crepis*, a horse-shoe; *formis*, form.]

Length, .02; breadth, .015 inch.

Carapace minute, broadly elliptical or reniform; dorsal margin straight or slightly convex, with hinge line much shorter than the entire length of the valve; anterior and posterior extremities subequal, rounded, the former end being sometimes slightly more obtuse than the latter; ventral margin uniformly rounded. Valves moderately convex. Tubercle or ridge arising abruptly, very prominent, and shaped like a horse-shoe, placed on the anterior half of the valve: the two sides of the "horse shoe" are rectangular to the dorsal margin, and extend from the same across the valve to the ventral margin: the anterior half of the ridge arises immediately from the anterior extremity: width of the ridge equal to about one fourth of the width of the valve: a deep sulcus, between the anterior and posterior halves of the ridge, extends from the dorsal margin to three fourths the distance across the valve. Surface smooth. Interior marked by a horse-shoe shaped depression corresponding to the ridge of that form on the exterior.

This species is too distinct to necessitate a comparison with other species of the genus.

Formation and locality: in the lower part of the Hudson River Group, at Covington, Ky.

Collector: E. O. Ulrich.

LEPERDITIA UNICORNIS, n. sp. (Plate VII., figs. 4, 4a, 4b.)

[Ety.—*Unicornis*, one-horned.]

Length, .035; breadth, .02 inch.

Carapace minute, sub-quadrate, or obtusely elliptical, rather narrow; anterior and posterior ends nearly equal, broadly rounded, valves very convex, with abruptly sloping margins, and cylindrical; dorsal edge

straight, nearly as long as the entire valve; tubercle near the anterior extremity prominent, pointed, directed anteriorly, and in some specimens to such an extent, as to project beyond the margin of the valve; the posterior third is sometimes tumid, and in that case there is a broad, slightly defined depression or sulcus, about in the middle of the valve. Surface smooth, or minutely pitted. Color, black. Substance of valves thick. There is an internal pit corresponding to the anterior tubercle.

*Leperditia (Isachilina) cylindrica*, Hall, bears some resemblance to this species. It is, however, comparatively longer, more uniformly convex, somewhat different in outline, and with the tubercle obsolete.

Numerous valves of this species were found associated with *Leperditia minutissima* and *cylindrica*, Hall; *L. byrnesi*, Miller; *L. biverter*, Ulrich; and *Leptobolus lepis*, Hall, in slabs of crystalline limestone, occurring within fifty feet of low water mark in the Ohio River, about one half a mile west of Covington, Ky.

Collectors: H. E. Dickhaut, E. O. Ulrich.

LEPERDITIA BIVERTEX, n. sp. (Plate VII., figs. 5, 5a.)

[Ety.—*Biverter*, with two peaks.]

Length, .04; breadth, .03 inch.

Carapace minute, sub-reniform: dorsal margin straight, over two thirds as long as the entire length of the valve; anterior and posterior extremities equal in width; ventral curve nearly uniform. Valves strongly convex. Tubercle at the anterior end, near the dorsal margin, large, rising abruptly, obtusely rounded, and slightly directed posteriorly. Posterior tubercle situated near the dorsal margin, and about half the length of the valve from the posterior extremity, less obtusely rounded, and more prominent than the anterior tubercle. Between the tubercles there is a deep sulcus, extending from the dorsal margin to one half the distance across the valve. Surface smooth. On the interior there is a corresponding pit for each tubercle, and a divisional ridge between them.

The species can be readily distinguished from *Leperditia byrnesi*, S. A. Miller, which it most resembles, by the form and relative positions of the tubercles. In that species the posterior tubercle is nearer the posterior margin, is much more prominent and pointed, and extends considerably beyond the dorsal margin. That species is also comparatively longer.

Formation, locality and collectors: same as the last.

## GENUS BEYRICHTIA (McCoy).

BEYRICHTIA PERSULCATA, n. sp. (Plate VII., fig. 6.)

[Ety. — *Persulcatus*, strongly sulcated.]

Length of large specimen, .02; breadth, .015 inch.

Carapace very minute, sub-reniform to semi-circular, longer than wide, the proportions being about as three to four; dorsal margin straight, as long as the valve; anterior and posterior extremities subequal; valve marked by three transverse furrows extending from the dorsal to the ventral margin, which are deeply and abruptly impressed, the central one being essentially central to the entire valve; anterior and posterior furrows at their ventral ends, curving slightly towards each other. The anterior, posterior, and posterior median lobes are nearly equal in size, the latter, however, is somewhat more prominent; the anterior median lobe is of the same general form and dimensions as the posterior median lobe, but is divided in the middle of its length into two nearly equal parts, by a narrow, deep, and very abrupt furrow. Surface smooth.

This is an exceedingly small and quite distinct species. It is probably most nearly related to *Beyrichtia regularis*, Emmons, from which it is distinguished by its comparatively stronger ridges or lobes, and much more abruptly depressed sulci, as well as by having the anterior median lobe divided into two parts, instead of entire, as is the case in that species.

Formation and locality: found associated with *Leperditia crepiformis*, at Covington, Ky.

Collector: E. O. Ulrich.

## GENUS CYRTOLITES (Conrad).

CYRTOLITES NITIDULUS, n. sp. (Plate VII., figs. 7, 7a.)

[Ety. — *Nitidulus*, neat, pretty.]

Shell below the medium size; volutions two or three, rapidly increasing in size, very slightly embracing; dorsum with a broad, flattened carina; sides strongly convex, rounding more abruptly into the umbilicus than to the periphery; umbilicus moderately wide and deep; aperture broadly cordate. Surface ornamented by rather fine, rounded, transverse striae, crossing the volutions from the umbilicus to the dorsum in a curved and obliquely backward direction; on the broad dorsal carina also the striae make a short backward curve.

Greatest diameter of an adult example, 0.38 inch; convexity at the aperture, 0.2 inch; number of transverse striae in the space of one tenth of an inch, near the aperture, from seven to nine.

This pretty little species is probably most nearly related to *C. carinatus*, Miller, but the strongly carinated sides of the volutions and the sharp keel in that species will distinguish them. The striae also are different.

Formation and locality: the specimens examined were found in the layer of dark blue limestone occurring in the Utica shale, and in which the *Modiolopsis Cincinnatiensis*, Hall and Whitfield, abounds.

Collectors: H. E. Dickhaut, E. O. Ulrich.

GENUS MICRO CERAS (Hall.)

MICRO CERAS MINUTISSIMUM, n. sp. (Plate VII., fig. 8.)

[Ety.—*Minutissimus*, very small.]

Shell exceedingly small, discoid; volutions from two to three, rounded, not embracing, the last one nearly separate, and increasing moderately in size; umbilicus shallow, about one and a half times as wide as the dorso-ventral diameter of the outer volution at the aperture; aperture rounded, approaching sub-ovate; surface smooth.

Greatest diameter, 0.02 inch; convexity less than 0.01 inch.

This shell can easily be separated from *M. inornatus*, Hall, the other species of the genus. In that form the volutions increase much more rapidly in size, and are quite angular on the periphery and sides, while in the one under consideration they are rounded. Hall's species is also about three times as large. Another difference, which however may not be constant, is, that the shell of *M. inornatus* always has a dark-brown or black color; while all the specimens observed of this species are yellowish white.

Formation and locality: found associated with *Cyclora minuta*, *C. depressa* and *M. inornatus*, at Hamilton, O., and near the tops of the hills at Cincinnati.

Collector: E. O. Ulrich.

GENUS CYCLORA (Hall).

CYCLORA DEPRESSA, n. sp. (Plate VII., figs. 9, 9a.)

[Ety.—*Depressus*, depressed.]

Shell very small, sub-lenticular, about twice as wide as high; spire much depressed; volutions two or three, angular a little below the middle, increasing moderately in size, and with a barely perceptible convexity on the upper side; sutures deeply impressed; umbilicus large; aperture rhombic oval; surface smooth.

Height of a specimen of the usual size, 0.02 inch; breadth, 0.04 inch.

This species differs from both *C. minuta* and *C. parvula*, Hall, in having a larger umbilicus, the spire much more depressed, and the whorls angular instead of rounded.

Formation and locality: found in great abundance in the Hudson River Group at Hamilton, Ohio.

#### Genus ZYGOSPIRA (Hall).

ZYGOSPIRA CONCENTRICA, n. sp. (Plate VII., figs. 10, 10a, 10b.)

[Ety.—*Concentricus*, concentric.]

Shell small, depressed, sub-equivalve, generally a little wider than long; posterior lateral margins straightened, and converging to the beaks at an obtuse angle; lateral margins rounded; front rounded or sometimes a little straightened. Dorsal valve with a shallow, undefined mesial sinus of moderate breadth at the front, but becomes obsolete before reaching the umbo; surface on the sides of the sinus gently convex, and sloping to the lateral margins; beak rather prominent and slightly incurved.

Ventral valve with a low mesial ridge, most prominent near the middle of the shell, on each side of the ridge the slopes are somewhat depressed; beak small, pointed, projecting beyond that of the other valve, and strongly incurved; foraminal aperture very small, round, and situated just under the apex.

Surface ornamented by rather distant but well-defined striae of growth; sometimes 6 or 8 very obscure radiating folds or plications are observed; in that case two occupy the mesial ridge and one the sinus.

Length of medium-sized specimen, 0.18 inch; width, 0.2 inch; greatest convexity, 0.12 inch.

The outlines of *Zygospira modesta*, Say, are quite similar to those of this shell; that species has, however, from 16 to 20 strong and angular radiating ridges, and only very rarely has the fine and crowded concentric lines preserved; but in this species there are generally no radiating plications (when any do exist, they are only rudimentary), while the concentric striae are well developed; besides, the posterior lateral margins are straighter, and the beak of the ventral valve is more pointed, than in that shell.

Formation and locality: found in the lower part of the Hudson River Group, on the hills about Cincinnati, at an elevation of from 300 to 350 feet above low water mark.

Collectors: W. Gault, W. E. Cook, E. O. Ulrich.

ORTHIS? SECTOSTRIATA, n. sp. (Plate VII., figs. 11, 11*a* and 11*b*.)

[Ety.—*Seco*, to cut, to divide.]

Shell attaining medium size, sub-circular; valves nearly equally convex. Dorsal valve convex, its greatest prominence being near the middle of the valve; a slight mesial ridge runs from the umbo to the anterior margin; beak short and incurved. Ventral valve with greatest convexity a little posterior to the middle; mesial sinus but slightly defined; beak very prominent, obtusely pointed, and quite strongly incurved upon that of the other valve. Surface ornamented with from thirty to thirty-five fine, even, radiating striae, all of which bifurcate once near the center of the valves, making the number at the anterior margin about seventy. On well preserved specimens, when viewed through a magnifier, the surface exhibits very fine and crowded concentric lines.

Length of a medium sized specimen.

The generic affinities of this species can not, at present, be positively determined, since its interior is as yet unknown. It is possible that it should be placed into the genus *Zyggospira*, Hall, as it externally much resembles *Zyggospira headi*, Billings. From *O. ella*, Hall, it is distinguished by its circular outline, much finer and bifurcated striae; the beak of the ventral valve is much more incurved upon that of the dorsal valve, than is the case in *O. ella*.

Formation and locality: the species is not common, and occurs in the Hudson River Group, on the hills back of Cincinnati, Ohio, at an elevation of about three hundred and seventy-five feet above low water mark in the Ohio River.

Collector: the specimen figured was found by Mr. Stange. A number of specimens have been found by other collectors.

Genus LEPTENA (Dalman).

LEPTENA PLICATELLA, n. sp. (Plate VII., figs. 12, 12*a*, 12*b* and 12*c*.)

[Ety.—*Plicatella*, a small plait or fold.]

Shell very small, semi-oval, approaching semi-circular, concavo-convex; hinge line sometimes only as long as the greatest breadth of the valves, but generally its length is greater than the breadth of the shell; lateral extremities varying from acutely angular to rectangular, and not reflexed; anterior and lateral margins forming together nearly a regular semi-circular curve.

Ventral valve rather strongly convex, being almost evenly arched along the middle from the beak to the front; beak very small, scarcely distinct from the cardinal margin; area moderately developed, twice as high as that of the other valve, inclined slightly backward; foramen

arched over, near the beak, by a small pseudo-detidium. Interior showing cardinal teeth to be small; muscular impressions undefined.

Dorsal valve concave, with deepest concavity near the middle, and following so nearly the curve of the ventral valve as to leave but a very thin visceral cavity within; beak not distinct from the cardinal margin; area very narrow, and ranging at right angles to the plane of the valves. Interior of this valve not observed. Surface of both valves marked by distinct, sub-angular, radiating plications, some of which bifurcate once or twice, at about the middle of their length. Near the free margins the striae number from eighteen to twenty-five.

Length of a mature specimen, 0.13 inch; breadth, 0.25 inch; convexity, 0.06 inch.

From young specimens of *L. (?) sericea*, Sowerby, this species is distinguished by having comparatively strong plications instead of the exceedingly fine striae of that species; and in having a greater convexity.

Formation and locality: in the Utica shale, associated with *Triarthrus becki*, at Cincinnati, O., and Covington, Ky.

HETEROCRINUS GENICULATUS, n. sp. (Plate VII, figs. 13, 13a, 13b, 13c.)

[Ety.—*Geniculatus*, jointed, geniculated.]

Body small, obconic, and slightly longer than wide. Basal pieces pentagonal, about as wide as high, or a little wider. First radial plates in four of the rays, convex, about as wide as high, and pentagonal in form: each supporting on its upper side a considerably larger sized second radial, that is quadrangular in outline, with a length and width about equal: in the right posterior ray, this piece is slightly truncated for its articulation with the first plate of the azygos or anal series; third radial in these rays a little smaller than the second, wider than long, and contracted at the upper end to about two thirds of the length of the lower side; these support a somewhat smaller, regularly pentagonal fourth radial, the two lateral edges of which are not parallel, but converge toward the inferior end; this is an axillary piece, and bears two arms on its upper sloping faces. First radial in the fifth or right lateral ray comparatively large, obscurely pentagonal in outline, and longer than wide, having a length that is nearly equal to the combined height of the first and second radial pieces in the other rays; this piece supports a second radial which in form and size is the same as the third radial in the other rays; above this is an axillary piece, which bears two arms on its superior sloping sides, and in form and size is similar to the axillary or fourth radial plates of the other series of primary radials. Arms, from their origin on the third and fourth radials, simple through-

out, rounded, rather slender, and composed of elongate, somewhat wedge-shaped joints; from which proceed strong, jointed pinules, from near the upper margin of their longer sides. These arm plates are much enlarged at the origin of the pinules which are alternate on the opposite sides of the arm, giving the rays a peculiarly roughened aspect and tortuous direction. The pinules appear first on the third and then on the sixth piece of the secondary radials, above which each succeeding plate is provided with one. In some specimens each second or third piece, above the sixth plate of the secondary radial series, appears to be divided into two; in that case the lower and smaller piece is without a pinule.

The first azygos inter radial, or anal piece, is wedge-shaped, with its base resting upon the superior lateral sloping side of the second radial of the right posterior ray. Above this there is a direct vertical range of pieces, much rounded on the outer side, and reaching nearly to the extremities of the arms. The ventral prolongation is formed by thin extensions of these pieces, which proceed from their sides. The width of these extensions is about one-sixteenth of an inch, more or less.

Column of medium size, round, tapering downward from the calyx, near which, and to one and a half inches below the same, it is composed of alternately thicker and thinner disks, the thicker ones being slightly prominent at the edges; the rest of the column, as far as observed, is nearly smooth, and composed of rather thin, subequal disks.

The peculiarly roughened and tortuous rays of this species, which in that respect remind one strongly of a number of sub-carboniferous species of *Poteroocrinus* and *Scaphioocrinus*, will serve to distinguish it from all the other species of the genus known to the writer. *H. laevis*, Hall, has this peculiarity developed in a small degree. Otherwise it differs from this species in having a proportionally longer and more angular body, and shorter arm pieces; while the armlets or pinules are proportionally stouter, much shorter, and are given off at longer intervals. The column and calyx of *H. simplex*, var. *grandis*, Meek, are much like those parts in this species, but the very different structure of the arms in the two forms, and the different outlines of the third and fourth primary radials, and the absence of a ventral prolongation in *H. simplex*, clearly show that they are distinct.

Formation and locality: the specimens used in the description were found in the Utica shale, at Cincinnati, O., within fifteen feet of low water mark in the Ohio River.

Collected by J. G. Fine, S. A. Miller, E. O. Ulrich.

## DENDROCRINUS (?) CURTUS, n. sp. (Plate VII., fig. 14.)

[Ety.—*Curtus*, short.]

Body truncate-obconic, short. Basal pieces very short, more than twice as wide as high. Sub-radial pieces moderately large, rather obscurely hexagonal, with a width equal to one and a half times the length. First radial pieces, in the three rays exposed, a little larger than the sub-radials, about as long as wide, and pentagonal. Right posterior ray with the second piece a little larger than those of the other rays, about as large as the sub-radials, nearly as long as wide, sub-pentagonal in outline, with the two superior sides sloping, so as to give the appearance of an axillary piece, but the right, shorter slope merely supports the first anal piece; while from the left continue the succeeding true radials, of which there are six, somewhat shorter, smaller pieces in direct succession, the sixth one being axillary, and supporting the first divisions of the arm. In the ray immediately to the right of the one just described, there are ten pieces (counting the first radial) in direct vertical succession, which, above the first radial, have a width that is nearly equal to twice the length; the tenth piece appears to have been an axillary, but this can not be satisfactorily determined, on account of the imperfect condition of the specimen at that point.

The left posterior ray presents six pieces, between the first bifurcation and the first radial, that are shorter than in the other rays. Arms moderately long and rather stout, acutely rounded on the dorsal side and concave on the inner side, giving off, alternately, on opposite sides, at rather distant intervals above the first bifurcation in each ray, from four to five, or more, scarcely diverging divisions, that are about half as stout as the main arm from which they spring, and composed of pieces that are about as wide as long, and prominent at the superior lateral angles; these armlets remain simple throughout; the first bifurcation of the rays is in all respects similar to the succeeding ones.

Azygos inter-radials or anal series, consisting of a direct vertical range of pieces, that are longer than wide, not so wide as the primary radials, very convex on the outer side, and rise from the right superior sloping side of the second radial of the right posterior ray, so as to present much the appearance of a branch of this ray; ventral prolongation and its connection with the anal series not observed.

Column large, round, nearly smooth, increasing very slightly in size downward, and composed of nearly equal, thin joints; the disks have a small, central and circular perforation, radiating from which there are fine striae.

The large columns of this species are quite abundant in the lower twenty-five feet of the Utica shale, as it is exposed on the banks of the Ohio River at Cincinnati. Much search has been made for the body, but without success, so far as the writer is aware, until the specimen used in the description, and figured, was found by Mr. J. G. Fine. Unfortunately, the specimen received a fracture, about one half an inch above the top of the column, when the piece of shale in which it occurs was opened, and now (above the fracture) only shows the inner portion of the arms of the anterior side. The column and body are considerably compressed, but the plates in the latter seem to retain their relative positions very well. The first radials appear to be free, but this appearance very likely has been produced by pressure. The second radial is almost certainly free, except in the right posterior ray, in which that piece articulates with the first anal plate. In that respect, it approaches very near to *Cyathocrinus*, in which the second radial is entirely free. This peculiarity, in connection with others, has induced me to place the species only provisionally under *Dendrocrinus*, until other specimens can be found which will better show the characteristics of the species.

In the form and structure of the calyx, below the radials, *D. (?) curtus* is somewhat like both *D. rusticus*, Billings, from the Trenton, of Canada, and *D. Oswegoensis*, Meek and Worthen, from the Cincinnati Group of Illinois, but in the form of the primary radials, in the structure of the arms, and in the position of the anal plates there is considerable difference. There is no species found in the vicinity of Cincinnati to which it is near enough related to necessitate comparisons.

Formation and locality, same as the last.

PALEASTER FINEI, n. sp. (Plate VII., figs. 15, 15a, 15b.)

Small; rays five, of medium length, rather broad, pointed, and narrower where they are attached to the much contracted body, than they are about the center of their length.

Dorsal side of rays composed of four rows of pieces, that are quite close fitting, as wide as long, from twelve to fourteen in each row, and increase in size inward to the disk, which is composed of irregularly shaped and prominent pieces, some of which are smaller and others larger than those composing the rays; the pieces in the marginal rows are more prominent than the two rows between them, and have a small pit in the center, probably for the articulation of a spine. Madreporiform body rather small, circular, very prominent, and marked by strong

striae, which become more numerous toward the margin by intercalation.

Marginal pieces on the ventral surface, convex, quite as long as wide, and numbering in different specimens on each side from eleven to twelve; the piece at the junction of the rays is three times as large as any other of the series, sub-circular, and very convex.

Adambulacral plates more prominent, slightly wider than long, and numbering, on each side, from nine to ten. Ambulacral pieces a little wider than long, not alternating with the adambulacral plates, and each provided with a rather sharp ridge across most of its width.

There are ten oral plates formed by the junction of the adambulacral rows, which in form and size are scarcely distinguishable from the other plates of those series.

Greatest breadth measuring between the opposite extremities of the rays, 0.7 inch; breadth of rays at their inner ends, .1 inch; length of same, 0.3 inch; diameter of madreporiform piece, 0.02 inch.

This species is related to *P. matulinus*, Hall, but has proportionally shorter rays, is smaller, and has four rows of pieces on the dorsal side of the rays instead of three. That species has a circle of stellately marked pieces on the dorsal side of the disk, which feature is not present in the species under consideration. The madreporiform body is also different. *P. incomptus*, Meek, has proportionally much shorter rays, larger disk, only three series of pieces on the dorsal side of the rays, and a much less convex madreporiform piece.

In the cabinet of the author there is a complete specimen with but four rays, which in all other respects is identical with the specimens used in the description.

Named in honor of the discoverer, Mr. J. G. Fine.

Formation and locality: in the Utica slate that is exposed near low water mark in the Ohio River, at Cincinnati, O.

## INCERTA SEDES.

### LEPIDOLITES, n. gen.

[Ety.—*Lepis*, a scale; *lithos*, a stone.]

This generic name is proposed for the reception of some very peculiar fossils, obtained by Mr. H. E. Dickhaut and the author, near Covington, Ky., on and in the shale immediately surrounding some of the hard clay nodules, which frequently occur in the shales of the lower part of the Hudson river group. They consist of much flattened, calcareous bodies, which in their original state must have had, in the type

species, a sub-spherical, and in the other species, a sub-cylindrical form. They are hollow, with a thin envelope of imbricating plates or scales. The lower end has an outside indentation similar to that borne by an apple for the reception of the stem, while the corresponding part of the interior is raised into a small cone. The interior of the sack appears to be lined with a very thin and delicate integument, to the outer surface of which the scales are attached. No openings of any kind can be detected.

Type: *L. dickhauti*.

In the imbricating plates some resemblance is presented to such genera of the PALECHONIDE, as *Lepidesthes*, but these fossils can scarcely be referred to the ECHINODERMATA, on account of the entire absence of openings, and of any series of plates that might be termed ambulacra. The genus seems, in certain characters, to be related to *Pusceolus*, which by some authorities is considered to be a Cystidean, while others place the genus with the PROTISTA. On account of the unique characters of the specimens on which the genus is founded, I have thought it advisable to describe them, provisionally, as fossils with uncertain affinities. However, I have no doubt, that when these characters are better understood, that the genus will be the type of a new family, if not indeed of a new order.

LEPIDOLITES DICKHAUTI, n. sp. (Plate VII., figs. 17, 17a, 17b).

All the specimens of this species examined are exceedingly flattened, but their original form undoubtedly was either sub-spherical or sub-pyriform, with the lower portion considerably indented. The envelope of scale-like plates is very thin, being little more than one-hundredth part of an inch in thickness, and appears to have been slightly flexible. The plates imbricate, with the exposed margin rounded, and arranged in concentric lines crossing each other in a quincuncial manner; they are much smaller about the indented portion, gradually becoming larger as the rows approach the upper portion. The appearance presented by a specimen that is flattened vertically, is very like that style of ornamental work on watch cases called "rose engine turning." In the largest plates observed, the exposed portion has a diameter that is not more than one thirty-secondth of an inch. Detached plates have a length that is equal to about three times the greatest breadth, and are somewhat cuneiform in outline, the widest end being that one which is exposed on the exterior of the sack. When the exceedingly delicate integument lining the interior of the sack, and to the outside of

which the plates are attached is removed, the lower ends of the plates are exposed; this side of the plates is provided with a slightly defined, longitudinal furrow.

Specimens of this species are usually coated with iron, which effectually destroys their minute characters. Fortunately, the author found some fragments that were entirely free of that troublesome substance, and from these the details of the above description were obtained.

Named in honor of the energetic collector, Mr. H. E. Dickhaut.

Formation and locality: the specimens were found in the shales of the lower part of the Hudson River Group, at Covington, Ky. Elevation, about one hundred and fifty feet above low water mark in the Ohio River.

LEPIDOLITES ELONGATUS, n. sp. (Plate VII., fig. 16).

(Ety.—*Elongatus*, elongated.)

This species differs from the type of the genus mainly in its different form. The form of *L. dickhauti* is sub-spherical, while that of the species under consideration is sub-cylindrical, with the ends usually somewhat truncated. The length is generally equal to about three and a half times the diameter or transverse measurement. The specimens are coated with iron, and for that reason I was unable to ascertain whether the plates differ from those of the type species. Their arrangement is very much the same.

This species seems to have attained a larger size than *L. dickhauti*. The largest specimen found, though defective at both ends, in its flattened condition is nearly two inches in length, by three-fourths of an inch in width.

Formation, locality and collectors: same as the last.

ORTHOESMA SUBOVALE, n. sp. (Plate VII., fig. 18).

[Ety.—*Sub*, somewhat; *ovale*, oval.]

Shell exceedingly thin, moderately elongate, subovate, the length equal to twice or twice and nearly a half the greatest height; cardinal and basal margins sub-parallel; cardinal line straight for one-half the length of the shell posterior to the beaks, beyond which point it gradually curves downward to near the posterior extremity, which is rather abruptly rounded or slightly truncate; anterior end short, equal to less than one fifth of the entire length of the shell, very slightly contracted beneath the beaks, and more regularly rounded than the posterior margin; beaks small and somewhat pointed. Surface of the valves

with a faint, scarcely perceptible umbonal ridge, anterior to which there is a broad, very shallow and undefined depression, crossing the valves from the beaks toward the basal line, and becoming obsolete before reaching it. Internal markings not preserved in the specimens examined.

Surface of the valves marked by fine concentric striae, and by some stronger undulations.

This shell is allied to *Orthodesma parallelum*, Hall, but that species has the anterior end more contracted, the shell proportionally longer, and the cardinal and basal margins are straight for a greater distance than in *O. suborale*.

Formation and locality: the specimens were found by me in the Hudson River Group, at Morrow, O.

#### GENUS TELLINOMYA, (Hall).

##### TELLINOMYA CINGULATA, n. sp. (Plate VII, figs. 19, 19a.)

(Ety.—*Cingulata*, encircled with lines.)

Shell of medium size, nearly circular, with a slight prolongation of the posterior end, thus giving a little obliquity to the shell; anterior and basal borders regularly rounded; posterior cardinal margin slightly rounded and sloping to point of greatest extension; beaks small, obtusely pointed, and not incurved; valves moderately convex, somewhat depressed just posterior to the beaks, and along the cardinal margin.

Hinge plate wide, regularly, and rather strongly arched, occupied by eight to ten teeth on each side of the middle, those at the extremities bent to about a right angle, becoming more and more straight toward the center.

Surface ornamented by from six to eight very fine concentric lines.

Muscular impressions and pallial line not observed.

Length, 0.72 inch; height, 0.68 inch; convexity, 0.22 inch.

This species is related to *T. pectunculoides*, Hall, but its more circular form, less prolonged posterior border, the fine concentric striae and its larger size, will serve to distinguish them externally, while its smaller number of teeth, wider hinge-plate, and more abrupt curvature of the same, will separate them internally.

Formation and locality: in the upper part of the Hudson River Gr. at Marble Hill, near Madison, Ind. The type specimens were found by Mr. H. Nettleroth, of Louisville, Ky.

## NUCULITES YOLDIAFORMIS, n. sp. (Plate VII., fig. 20).

Shell small, extremely elongate, about three times as long as high; hinge line straight; beaks small, not prominent, somewhat pointed, and situated about three-eighths of the length of the shell from the anterior extremity; posterior end acutely pointed; margin of anterior end, below its junction with the cardinal line, regularly rounded; basal line gently curved, slightly sinuate or straightened posterior to the middle of the shell; an undefined and very shallow sulcus crosses the shell obliquely from below the beaks toward the posterior basal margin, causing the straightening of the basal line; cardinal slope narrow, carrying two folds or ridges, which originate just behind the beaks, extending to the posterior extremity, and gradually becoming heavier until that point is reached.

A strong clavicle extends from the anterior cardinal line, just in front of the beaks, nearly to the anterior basal margin.

Surface marked with very fine concentric lines.

It is quite impossible to confound this species with any other lamelibranchiate shell found in the Hudson River Group.

Formation and locality: in the shales of the lower part of the Hudson River Group, at Covington, Ky.

Collectors: H. E. Dickhaut, E. O. Ulrich.

## PTERINEA MUCRONATA, n. sp. (Plate VII., fig. 21).

(Ety.—From *unitero*, a sharp point).

Shell small, broadly semi-cordate in outline, with hinge-line much longer than the body of the shell; greatest length generally nearly twice the breadth; anterior side gently and regularly convex, forming an angle of about seventy-five degrees with the hinge line; posterior side very slightly concave, or straight below the angle, and gently convex in the lower half, forming an angle of forty degrees with the hinge line; posterior wing compressed, extended into a rather long, acute point, and in most specimens is scarcely distinguishable from the rest of the posterior portion of the shell; there is no wing at the junction of the hinge with the anterior margin, the shell at that point usually being rounded or obtusely angulated; basal margin regularly rounded. Left valve moderately convex below and at the umbones; beak small, very slightly or not at all elevated above the hinge, and situated between one fourth and one fifth of the length of the hinge line from the anterior angle. Right valve not observed. In very young specimens the hinge line is comparatively shorter than in the adult examples.

Surface of the left valve marked by fine concentric lines, and at irregular intervals by rather strong furrows.

Length of large example, one half an inch; width, one quarter of an inch or a little more; convexity of left valve about one sixteenth of an inch.

The peculiar outline of this species will at once distinguish it from any other form known to the writer.

Formation and locality: in the soft shales of the lower fifty feet of the Hudson River Group, at Covington and Constance, Ky.

Collectors: H. E. Dickhaut, E. O. Ulrich.

*CLEIDOPHORUS ELLIPTICUS*, n. sp. (Plate VII., fig. 22).

Shell small elliptical, moderately and evenly convex; beaks a little more than two fifths of the length of the shell from the anterior end; umbones very little elevated; anterior and posterior margins regularly and evenly rounded; cardinal and basal lines both gently curved; clavicle slightly curved forward, and extending obliquely from in front of the beak to a point more than half the distance to the anterior basal margin.

Surface marked by very fine sub-equal concentric striae.

Height of medium sized specimen, 0.18 inch; length, 0.3 inch; convexity, 0.1 inch.

This species is allied to *C. suboratus*, Hall, described from the Arisaig Formation of Nova Scotia, but that shell is larger, has different striae, the beaks situated near the anterior extremity, and a shallow sinus.

Formation and locality: this species was found by Mr. Henry E. Dickhaut in the lower part of the Hudson River Group, at Covington, at an elevation of about one hundred and fifty feet above low water mark in the Ohio River.

*CLEIDOPHORUS MAJOR*, n. sp. (Plate VII., fig. 23).

(Ety.—*Major*, large).

Shell sub-ovate, ventricose, height and length respectively as  $5\frac{1}{2}$  to 10; umbones rounded and prominent; beaks elevated, sub acute about one-fourth the entire length of the shell from the anterior margin; posterior cardinal line nearly straight, with a strongly defined, sharp, umbonal ridge extending from the beaks and gradually becoming obsolete toward the posterior margin; the space between the ridge and cardinal line slightly depressed; anterior margin rounded; basa

margin broadly, but regularly rounded; posterior end rather narrowly rounded.

Surface unknown. The interior, as shown in casts, presents a deep triangular groove just anterior to the beaks, and passing, for a distance a little more than one third of the height of the shell, toward the anterior basal margin; the anterior muscular scar is distinctly defined, ovate, and situated immediately in advance of the groove; the posterior scar is rather large, sub-circular, and placed on the umbonal ridge (in the cast of the interior) about in the middle of the distance from the beaks to the posterior basal margin; pallial line obscure, simple, and running nearly parallel with, and considerably within, the basal border.

This is the largest species of the genus.

It is most nearly related to *C. elongatus*, Hall, from Nova Scotia. That shell however is sinuate, has the cardinal margin rounded and not straight, the beaks closer to the anterior margin, and has the clavicle bent and proportionally longer than in our species.

Formation and locality: Hudson River Group. Not rare on the hills back of Cincinnati, O.

## CRISIDÆ.

### ROPALONARIA, nov. gen.

[Ety.—From *ropalon*, a club.]

Polyzoary creeping, adnate, branched, and forming a close and delicate network. Branches linear; cells uniserial, elliptical, joined together at their contracted ends. This genus is related to *Hippothoa*, but in the form and arrangement of the cells they differ widely.

### ROPALONARIA VENOSA, n. sp. (Plate VII., figs. 24, 24a.)

[Ety.—*Venosus*, full of veins.]

Polyzoary creeping, adnate, branched, and forming a very delicate network. Branches linear, with a straight central stripe or series of cells, which has two branches springing, usually from every junction of the cells, though sometimes at that of the second with the third; these branches are again divided in a similar manner, and anastomose; this peculiar mode of growth gives the polyzoary very much the appearance of the venation in a leaf. Cells uniserial, long, acutely elliptical, and joined together at their contracted ends, length of cells somewhat variable, but generally about four occupy the space of two

lines. Cell mouths not clearly determined, but appear to be situated near the middle of the cell.

This form has only been observed, incrusting *Streptelasma corniculum*. On account of the great delicacy of the fossil, the fronds themselves are rarely found, but instead we find a series of impressions on the exterior coat of the *Streptelasma*, which very well represent the fronds and celis of the same.

Formation and locality: the type specimens were found in the upper part of the Hudson River Group, at Clarksville, Ohio.

Collectors: H. E. Dickhaut, E. O. Ulrich.

CILETETES COMPRESSUS, n. sp. (Plate VII., figs. 25, 25a, 25b).

[Ety.—*Compressus*, compressed.]

Polyzoary composed of small, very thin fronds, carrying the cell mouths on both sides; thickness of fronds varying from one half a line to one line.

Surface smooth. Tubes slightly oblique to the surface, opening by somewhat elongated apertures. Cell orifices nearly of equal size, circular to oval, and arranged in diagonal rows, eight to ten occupying the space of one line; occasionally a small septal tooth is developed in some of the tubes, projecting from the wall into the aperture. Inter-cellular space of variable thickness, apparently occupied by but few minute cells.

In longitudinal sections the tubes are short and approach the surface in a regular curve, a line drawn from the commencement of a tube to the aperture, forming an angle of about forty-five degrees with the surface: in the center of the frond the tubes are crossed by remote tabulae, but as they near the surface the diaphragms become much more numerous, and here they are placed one third tube diameter apart. A few of the tubes are divided into halves by a delicate, wavy, vertical septum; in one half of the tube the tabulae are always more or less curved, while in the other half they are straight.

The general aspect of this species is somewhat like that of small specimens of *C. parvata* and *C. decipiens*, but those species grow in double leaves, with a divisional lamina between them. In the shape and arrangement of the tubes they are also different. It is so easily distinguished from the other frondescent species of the genus, that no comparison with any of them is necessary.

Formation and locality: the specimen figured is from the cabinet of the author, and was found by Mr. J. Nicklas, at Cincinnati, Ohio.

FISTULIPORA FLABELLATA, n. sp. (Plate VII., figs. 26, 26*a*, 26*b*.)[Ety.—From *flabellum*, a fan.]

Polyzoary forming irregular, fan-like expansions, carrying cell mouths on both sides. Thickness usually varying from one to two lines. Surface sometimes raised into broad and inconspicuous monticules, carrying tubules of the ordinary size. Cells oval, with apertures a little arched, arranged in bent and rather irregular rows; about five cells occupying the space of one line, the distance between them being equal to a little more than their diameter.

Intertubular space occupied by a great number of minute cells, which are nearly equally distributed between all the tubes of larger or ordinary size.

Longitudinal sections show the tubules to be nearly vertical in the middle of the polyzoary, and then gradually bending outwards to the surface. Tabulæ are very sparingly developed. These sections clearly demonstrate that the interstitial tubuli observed on the surface, are not of the nature of a coenenchyma, but are only aborted cells. They are developed only near the surface. In the central portion of a transverse section, the tubes are angular, of unequal size and irregular form, with no minute tubuli between them.

Formation and locality: this species is found quite common at a height of 400 feet above low water mark, in the Ohio River, at the quarries back of Cincinnati, O.

INOCAULIS ARBUSCULA, n. sp. (Plate VII., figs. 27, 27*a*.)[Ety.—*Arbuscula*, a little shrub.]

FronD small, originating in a single stripe at the base, diffusely branched and spreading above; branches narrow, and varying somewhat in width, the strongest not exceeding two hundredths of an inch, with strong, projecting, prong-like processes rising from the sides at frequent, but variable intervals; bifurcations numerous, not at equal distances. Substance of the frond thin, carbonaceous; the surface is marked with faint, longitudinal, or slightly diverging corrugations, irregularly distributed over most parts of the branches; the free extremities of the branches are usually pointed.

The surface corrugations on this species are much like those seen on some species of *Dictyonema*, but the mode of growth and the entire absence of connecting filaments, will at once distinguish it from species of that genus. *Inocaulis bella*, Hall and Whitfield, from the Niagara Group, is closely related to this form; that species is, however, more

robust, and has the prongs projecting from the sides of the branches more numerous.

Formation and locality : in the soft shales of the lower portion of the Hudson River Group, at Covington.

Elevation of strata about one hundred and fifty feet above low water mark in the Ohio River.

Collectors : H. E. Dickhaut, E. O. Ulrich.

CRATERIPORA, nov. gen.

[Ety.—*Crater*, a bowl; *pore*, a pore.]

Attached to foreign substances, usually forming small, but sometimes quite large expansions, with a deep, cup-like depression in the central part ; the latter feature imparting to specimens of the species, much resemblance to erinoid bases or roots; and composed of minute canals radiating irregularly from the cup, and passing obliquely to the surface. Spiculae not observed.

Type : *Crateripora lineata*.

This genus includes several species, which occur in circular or expanded forms, presenting a minutely striated or pitted surface. Although I have examined a large number of good specimens, many of which were cut for examination with the microscope, we are not altogether certain that the genus should be referred to the sponges. It possesses characters entirely peculiar, and probably is a true Paleozoic type.

CRATERIPORA LINEATA, n. sp. (Plate VII., figs. 28, 28a.)

[Ety.—From *linea*, a line.]

Generally growing parasitically upon foreign bodies, but apparently was sometimes free, consisting of small patches, from two to four lines in diameter, usually circular, at other times with the outer margin irregular. The cup in the center is provided with a raised margin, and has a diameter one fourth that of the entire specimen. Radiating from the cup are very fine thread-like striae, the number of which is increased as the margin is approached by interpolation. Upon close examination, they prove to be elevated ridges separating the rows of canal apertures. In the cup the apertures are also placed between raised lines radiating in every direction from the middle. From fourteen to sixteen rows occupy the space of one line. Sections taken at a right angle with the surface show the canals in the middle of the expansions to proceed upwards from the base, and terminating in the cup, while the others take an obliquely-outward course to the surface.

Formation and locality : not an uncommon fossil in the lower three hundred feet of the Hudson River Group, as exposed at Cincinnati, O.

CRATERIPORA LINEATA, var. EXPANSA.

[Ety.—*Expansa*, expanded.]

The specimens upon which this variety is established are attached to an *Endoceras*, and form rather large expansions, the largest examined covering the *Endoceras* for the distance of two and a half inches. The cup-like depressions are from half an inch to an inch or more distant from each other, over one line in diameter and about one half a line in depth, with a secondary, very shallow depression surrounding them, having a diameter of two lines. The canal apertures are arranged between raised lines, the same as in the typical examples of *C. lineata*, but where the specimens are well preserved the ridges are ornamented with a row of small granules.

This form may be distinct from *C. lineata*, but the material at hand is not sufficient for a satisfactory determination of that point. At any rate it is an easily distinguished variety of that species.

Formation and locality: in the middle part of the Hudson River Group, at Hamilton, O.

Collector: E. O. Ulrich.

CRATERIPORA ERECTA, n. sp. (Plate VII., figs. 29, 29a.)

[Ety.—*Erecta*, erect.]

This species grows parasitically upon foreign substances (usually upon *Chonetes mammulatus*), and consists of small, circular, or somewhat irregular bodies, having much of the form of the type, *C. lineata*, excepting that the margin of the central depression is not raised. The cup has a diameter equaling one seventh of that of the entire specimen. The upper surface is covered with the openings of minute canals, of different sizes, irregular shapes and arrangement, apparently passing with but little obliquity from the lower or attached portion, to the upper surface. About fifteen canal apertures occupy the space of one line. Diameter of expansions from one to two and a half lines.

This species is distinguished from either of the preceding forms by its smaller size, comparatively smaller cup, its irregular arrangement of the canals, and in having the latter more erect in their course from the base to the upper surface.

Formation and locality : the type specimens were found in the Hudson River Group, at Cincinnati, O., at an elevation of four hundred feet above low water mark in the Ohio River.

Collectors : H. E. Dickhaut, E. O. Ulrich.