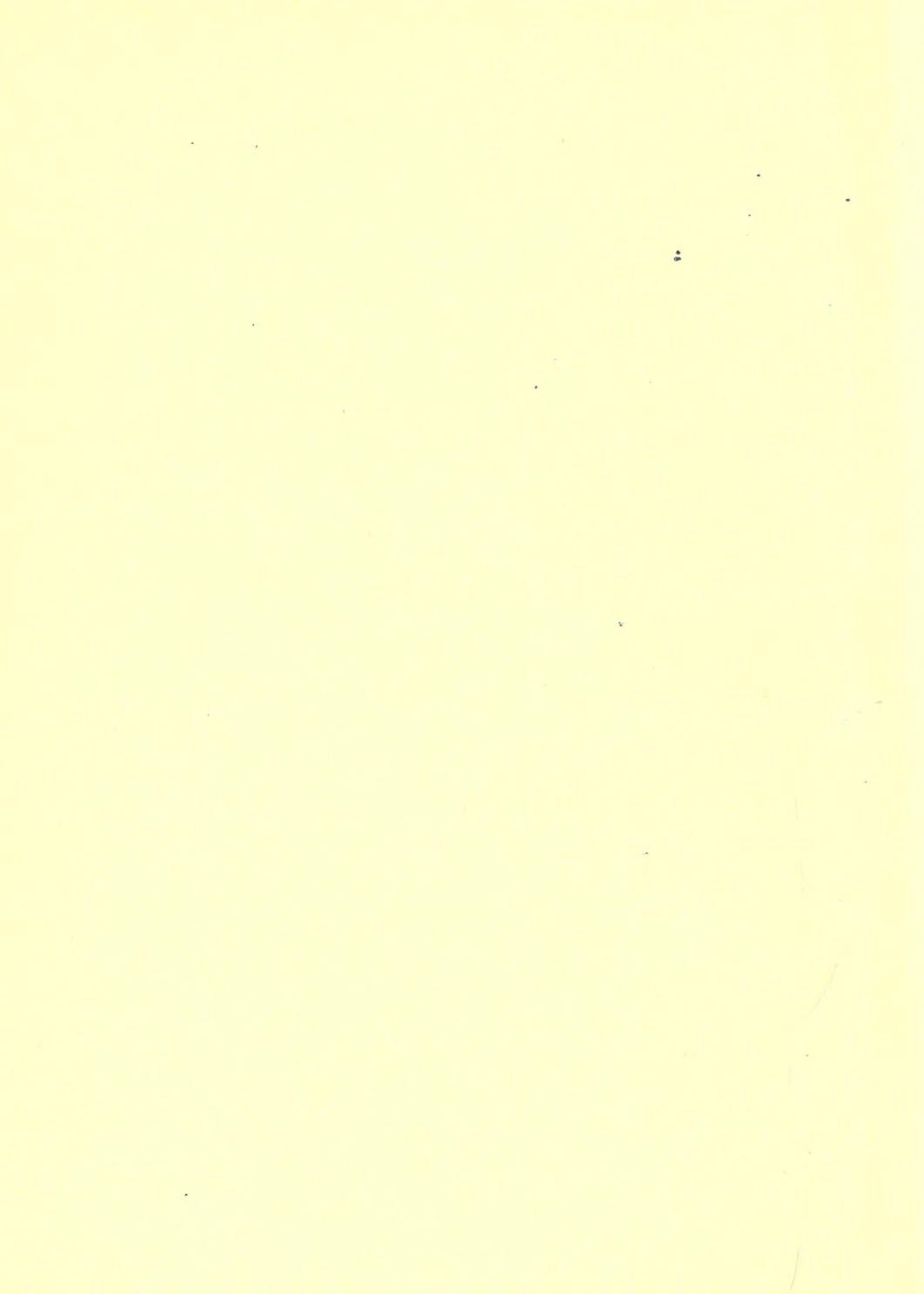


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GEORGE K. GREENE.

FEBRUARY, 1898 to SEPTEMBER, 1904.

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## PREFACE.

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With some reluctance I enter into the publication of these new forms of Fossils that I have in hands, knowing the many obstacles in the way of a new beginner. But I am offered the assistance and co-operation of some well known authors, and through their assistance and advice I hope to be able to offer to the student and collector some information that may be of interest to them.

I have material in hand sufficient for sixty plates. These will be issued in parts, three plates with the descriptions of figures, will constitute a part. These will be for sale at 25 cents each, a sum barely enough to pay for printing, engraving, etc. Each edition will be limited to 500 copies. After all have been issued, a thorough revision will be made of text and plates, and published in book form. The numbers on pages and on plates will follow in regular order, so that they can be separated and placed in position for binding.

The class, order and family, etc., will be omitted, for the reason that it would be a waste of space and expense, and would simply be repeated in every part.

The species described by other authors, in all these publications, will appear under their own name.



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**HELIOPHYLLUM OSCULATUM, N. Sp.**

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PLATE 1, FIG. 1 AND PLATE 2, FIGS. 1-2-3.

Corallum simple, or compound, rapidly increasing by calicular gemmation. Height varying in different examples from forty to eighty millimeters. Diameter of calyx from thirty to forty millimeters. Exterior with rough annulations and wrinkles, caused by intermittent growth. Tabulæ numerous and closely arranged, elevated in the center of the calyx, from five to eight millimeters or more. Number of lamellæ from seventy to eighty, alternating in length, rounded and uniform in size at the margin, for about ten millimeters nearly flat, then abruptly descends to the bottom of the calyx, where the short ones terminate: the longer ones continue coalescing, fasciculating and twisting into a rough prominence on the elevated tabulæ. Denticulations moderately coarse, ten in the space of seven millimeters. Fossette in some examples well defined, in others very obscure.

Found in the upper Devonian (Hamilton group), near Charlestown, and at the different cement quarries in Clark county, Indiana, and at Crab Orchard, Kentucky, now in the collection of the author.

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**HELIOPHYLLUM NANUM, N. Sp.**

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PLATE 1, FIGS. 2-3-4.

Corallum simple, oblique, with a broad scar at the base of attachment: rapidly increasing in diameter to the margin of the cup. Calyx broadly campanulate. Exterior with sharp annulations and constrictions caused by intermittent growth. Length varying in different individuals from fifteen to twenty millimeters. Diameter of calyx twenty to twenty-five millimeters, depth ten to fifteen millimeters. Number of lamellæ eighty, alternating in size and length, the short ones gradually disappear before reaching the bottom of the calyx, The longer ones become elevated and sharp as they gradually descend to the center of the calyx, where they abruptly terminate. In some examples they coalesce with the lamellæ on the opposite side, twisting, and slightly elevated, into a rough crest, Denticulations prominent in some places; others broken away or faintly indicated. Fossette well defined, consists of a deep depression at the edge of the elevated space in the bottom of the calyx and extends to the anterior margin. Situated in the fossette there is one conspicuous lamellæ, extending from the bottom of the fossette to the margin of the calyx, The adjacent lamellæ as they descend about one-third the distance from the margin coalesce, and again at about two-thirds the distance from the margin, and on reaching the bottom of the cup they coalesce the third time.

This species resembles somewhat *H. Tumidulum*, but differs in the coalescing of the lamellæ adjacent to the fossette, and the elevation in the bottom of the calyx is not so conspicuous.

Found in the Upper Devonian (Hamilton group) near Charlestown, Ind., now in the collection of the author.

### HELIOPHYLLUM TUMIDULUM, N. Sp.

#### PLATE 1, FIGS. 5-6-7.

Corallum small, simple, oblique, sub-turbinate, with a broad scar at the base of attachment, height twenty to twenty-five millimeters. Diameter twenty to twenty-five millimeters. Depth fifteen millimeters. Longitudinal striæ distinct. Exterior with constrictions and sharp annulations, caused by intermittent growth. Number of lamellæ eighty, alternating in size and length; the shorter ones gradually disappear before reaching the bottom of the cup. The longer ones are rounded at the margin, growing thinner as they approach the center of the calyx, coalescing and twisting into a small prominence, two or three millimeters in height. Denticulations coarse, slightly elevated above the lamellæ. Fossette well defined, consist of a deep depression at the base of the elevation in the bottom of the calyx, and continues to the anterior margin.

Found in the Upper Devonian (Hamilton Group), near Charlestown, Indiana. Now in the collection of the author.

### ZAPHRENTIS HUMILIS, N. Sp.

#### PLATE 1, FIGS. 8-9.

Corallum small, simple, turbinate, straight, or regularly curved, acute at the base of attachment, gradually expanding in diameter to the calyx. Exterior with sharp annulations and wrinkles caused by intermittent growth. Height twenty-five millimeters. Calyx bell-shaped, fifteen millimeters in diameter. Depth ten to twelve millimeters; a flat space in the bottom of the cup, occupied by the tabulæ, ten millimeters in diameter. Number of lamellæ seventy to seventy-six in the circumference of a calyx fifteen millimeters in diameter, thickened and rounded at the margin, growing thinner and elevated, as they gradually descend to the bottom of the calyx, where the short ones terminate. The longer ones continue to near the center of the cup, and abruptly end, leaving a flat space from two to five millimeters in diameter. On the posterior side there is one principal lamellæ elevated above the others that extends to the edge of the fossette. In some examples it does not extend so far, but abruptly ends in the center of the cup. Fossette conspicuous, consist of a

deep depression in the bottom of the calyx, and extends to the anterior margin. Situated in the fossette is one principal lamellæ, and two rudimentary ones.

The single elevated—lamellæ in the bottom of the calyx—makes this easily recognized from all other species.

Found in the Upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

### ZAPHRENTIS VARIANS, N. Sp.

PLATE 2, FIGS. 7—8.

Corallum simple, turbinate, straight or regularly curved, attenuate below, gradually or rapidly expanding in diameter to the calyx. Exterior with broad, irregular annulations and wrinkles, caused by intermittent growth. Height fifty millimeters. Calyx broadly bell-shaped, thirty millimeters in diameter. Depth twenty millimeters. A flat space in the bottom of the calyx occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ seventy, in the circumference of a cup twenty millimeters in diameter, alternating in length, rounded and thickened at the margin, gradually sloping to the flat space in the bottom of the calyx, here the short ones abruptly terminate. The longer ones become sharp and slightly elevated, and continue a short distance on the tabulæ, and gradually disappear, leaving a flat, smooth space in the bottom of the calyx, from three to five millimeters in diameter; in some other examples the long lamellæ continues to the center of the calyx, twisted and slightly elevated. Fossette consist of a deep depression in the bottom of the calyx, but disappears before reaching the margin of the cup; position variable.

Found in the Upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

### ZAPHRENTIS ACUTICORNIS, N. Sp.

PLATE 2, FIGS. 9—10.

Corallum simple, turbinate, straight, or slightly curved, acute at the base of attachment, gradually, or sometimes rapidly expanding to the calyx; longitudinal striæ fine, distinct. Exterior with broad, shallow annulations, caused by intermittent growth. Height from twenty to thirty millimeters, varying in different individuals. Diameter of calyx fifteen millimeters. Depth ten millimeters. A flat space in the bottom of the calyx, occupied by the tabulæ, six millimeters in diameter. Number of lamellæ fifty in the circumference of a calyx, twelve millimeters in diameter, alternating in length, sub-equal at the margin, abruptly sloping to the bottom of the calyx, where the short ones grad-

ually disappear. The longer ones are slightly elevated, growing thinner, continuing to near the center of the calyx, where they abruptly terminate, leaving a smooth, flat space in the center of the calyx from two to three millimeters in diameter. Fossette small, situated on the side of the longest curvature, of the coral.

Found in the Upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

ZAPHRENTIS LIMATUS, N. Sp.

PLATE 2, FIGS. 11, 12—13.

Corallum simple, oblique, regular or abruptly curved, acute at the base of attachment, rapidly expanding in diameter to the calyx, exterior with broad annulations and wrinkles, caused by intermittent growth. Height varying in different individuals from twenty to forty millimeters. Calyx broadly campanulate, from ten to thirty millimeters in diameter. Depth ten to fifteen millimeters, a flat space in the bottom of the calyx five millimeters in diameter. Number of lamellæ seventy in the circumference of a calyx twenty millimeters in diameter, alternating in length, equal in size at the margin, gradually sloping, to the flat space in the bottom of the calyx, where the short ones terminate. The longer ones continuing to the center of the calyx, and abruptly end. There is seven or eight lamellæ adjacent to the right and left lateral gaps, situated on the side next the shortest curvature of the coral, that converges to the gaps. Fossette consists of rather a wide, deep depression in the center of the calyx, grows narrower as it approaches the anterior margin.

Found in the Upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

FAVOSITES ROTUNDITUBA, N. Sp.

PLATE 3, FIGS. 1—2.

Corallum variable in form, discoid with a wrinkled epitheca on the under side. Globular or sub-pyriform or sub-ramose. Tubes unequal in size, rounded polygonal, from one to three millimeters or more in diameter. Diaphragms flat or oblique, and not very much crowded. Mural pores not closely arranged, round, rather large, with an elevated circular lip from one-fourth to one-half millimeter in height, one and two rows on a side,

The large round tubes, and the elevated circular lips of the mural pores, and the oblique diaphragms, distinguish this from all other species.

Found in the Lower Devonian (Corniferous group), Falls of the Ohio. Now in the collection of the author.

## FAVOSITES GLOBOSUS, N. Sp.

## PLATE 3, FIGS. 3-4-5.

Tubes rounded, polygonal, unequal in size, from one to three millimeters in diameter. Tube walls moderately stout. Longitudinal furrows not very conspicuous. Pores moderately large, from one to three rows on a side, situated below a spine like projection. Diaphragms stout, oblique, to suit the peculiar growth of the coral, not very much crowded, and not so complicated with squamæ as in some other species. Grows parasitic on crinoid stems, and sometimes found attached to fragments of other marine organisms. Globular or sub-pyriform in shape: varying in size from ten to sixty millimeters or more in diameter.

The large round tubes, the oblique diaphragms, not so complicated with squamæ as some other species, parasitic in habits, globular or sub-pyriform shape, makes this easily recognized from all other species.

Found in the upper Devonian (Hamilton group), one and a half miles North West of Charlestown, Indiana. Now in the collection of the author.

## DIPHYPHYLLUM UNICUM, N. Sp.

## PLATE 3, FIGS. 6-7-8-9-10.

Corallum simple, elongate turbinate, straight or gradually curved, distorted or geniculated. Acute at the base of attachment. Gradually or rapidly increasing in diameter to the calyx. Length varying in different individuals from twenty to forty millimeters or more. Calyx somewhat bell-shaped, from ten to fifteen millimeters in diameter. Depth ten to twelve millimeters. Number of lamellæ forty-eight, in the circumference of a calyx ten millimeters in diameter; alternating in length, rounded and equal in size at the margin, from three to four millimeters nearly flat, then abruptly slopes to the bottom of the calyx, where the short ones gradually terminate; the longer ones continue until they reach the vertical wall of the horse-shoe shaped area, situated in the center of the calyx. The smooth oblique space, inclosed in the vertical wall, is from one to three millimeters in diameter. Denticulations fine, distinct, ten in the space of five millimeters.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

## MICHELINIA MINUTA, N. Sp.

## PLATE 3, FIGS. 11-12.

Corallum small, composite, pyriform in shape, not exceeding fifteen milli-

meters in its greatest diameter. Having a stout, wrinkled, epithecal crust on the lower side. With a small scar at the base of attachment. Tubes unequal in size, quadrangular or pentagonal in outline, from two to four millimeters in diameter. Lineal furrows fine, distinct. Mural pores large, few in number, and irregularly distributed. The diaphragms are broken down in all the tubes, and only a faint impression is left on the walls. From these I would judge they were moderately stout, and not much crowded.

This is unlike any *Michelinia* that I am acquainted with, differing essentially in the form of the tubes, and the large pores, and few in number, with the wrinkled epitheca, makes it easily recognized from all other species.

Found in the upper Devonian (Hamilton group), near Gibson's Station, Clark county, Indiana. Now in the collection of the author.

#### DOLATOCRINUS DEPRESSUS, (S. A. Miller.)

##### PLATE 2, FIGS. 4-5-6.

Species medium or below medium in size. Calyx depressed, bowl-shaped; diameter about three times the height. Surface ornamented with radiating lines, ridges and nodes. Radial ridges small, rounded, and have a node at the center of each plate. Each interradial bears a central node, from which there are radiating ridges, and on some plates there are a few scattering nodes. Column about medium in size.

Basal plates almost covered by the column. First primary radials a little wider than long, bear an elongated central node from which there are small, radiating ridges. Second primary radials quadrangular, very little wider than long. Third primary radials a little larger than the second, wider than long, pentagonal, axillary, and, in the ray on each side of the azygous area, and in the one opposite thereto bears upon each upper sloping side, a single secondary radial, which is axillary and supports, on each upper sloping side, two tertiary radials which arrangement gives to each of these three rays four arms. In each of the two lateral rays, the third primary radial supports, on one upper sloping side, three secondary radials, and, upon the other, a single secondary radial, which is axillary and supports, on each superior sloping side, two tertiary radials, which gives to each of these rays three arms. There are, therefore, eighteen ambulacral openings to the vault in this species.

The first interradials are large, have nine sides, and bear a prominent central node from which there are radiating ridges of unequal size, the two larger ones being directed toward the adjoining secondary radials. These radiating ridges are more or less nodose. The second interradials are about two-thirds as large as the first, and each one bears two nodes that sometimes coalesce and form a transverse ridge. There are three small plates in the third range that

separate the last radials and unite with the plates of the vault. These plates are also more or less nodose.

The azygous area is well marked in this species by being wider than either of the other areas, and having the plates more nodose and deeper sculptured. The nodes on the adjacent radial series, disconnected with the radial ridges, are more prominent in this area than in either of the others, and form a conspicuous circle around the first azygous plate. The number of plates in the azygous area is the same as in each of the other areas.

The vault is depressed conical, though as seen from above the outline is sub-pentagonal. There is a small, short, sub-central proboscis. Each plate over the junction of the ambulacral canals bears a spine having a length about twice its diameter, and each plate surrounding the base of the proboscis, bears a similar spine. Each of the other plates on the vault bears a few small nodes. There are twenty ovarian pores, four to each radial series, that penetrate the plates at the base of the arms and not the vault between the arms as in many species.

This species most resembles *D. venustus*, with which it agrees in the number of ambulacral openings to the vault. It will be most readily distinguished by having comparatively a shorter calyx, which is due to the fact that there is one less plate in each tertiary radial series, and one less in each of two of the secondary radial series, in all making twenty plates less in the calyx of this species than are in *D. venustus*. The interradials in that species being necessarily proportionally longer than they are in this. The vaults and vault plates are also different in the two species. The surface ornamentation may also be sufficient in well preserved specimens to distinguish the species, but as there is some resemblance in this respect, probably it cannot be relied upon for a distinguishing feature. It is to be presumed that *D. venustus* possessed the same number of ovarian pores, probably arranged higher up on the plates, at the base of the arms, and so closely connected with the ambulacral openings that they were not distinguished by me when describing that species. There is no difficulty in distinguishing the ovarian pores in this species.

Found by G. K. Greene, in the Hamilton Group, near Charlestown, Ind., and now in his collection.



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**ZAPHRENTIS ISCHYPUS, N. Sp.**

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**PLATE 4. FIGS. 1, 2, 3.**

Corallum simple, turbinate, or elongate turbinate. Straight, regularly, or sometimes irregularly curved, with a broad scar at the base of attachment, occasionally an example is acute at the base. Gradually or sometimes rapidly expanding in diameter to the calix. Exterior with irregular annulations and constrictions, caused by intermittent growth. Height varying in different individuals, from three to five inches, in the longest examples observed. Calix broadly bell-shaped, thirty-five millimeters in diameter. Depth from twenty to thirty-five millimeters, with a flat convex space in the bottom of the calix, occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ, seventy in the circumference of a calix, thirty-five millimeters in diameter, equal in size and rounded at the margin, alternating below, gradually or sometimes rapidly sloping to the bottom of the calix, where the short ones gradually disappear, the longer ones are slightly elevated, becoming thinner as they approach the bottom of the cup, and extend a short distance on the tabulæ and disappear, leaving a smooth convex space in the bottom of the calix, ten or twelve millimeters in diameter. Fossette conspicuous, consists of a deep depression at the edge of the smooth space in the bottom of the calix, but does not extend on the side of the coral.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

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**ZAPHRENTIS COMIS, N. Sp.**

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**PLATE 4. FIGS. 4, 5, 6.**

Corallum simple, sub-turbinate, straight, or regularly curved, with a broad scar at the base of attachment. Height forty millimeters. Gradually, or sometimes more rapidly, expanding in diameter to the calix. Calix rather broad, somewhat shallow, thirty-five millimeters in diameter. Depth fifteen to twenty millimeters, with rather a smooth and slightly concave space in the bottom of the calix, occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ, sixty-four, in a calix thirty-five millimeters in diameter, equal in size, and sharp at the margin, slightly alternating below, gradually or sometimes more rapidly descend to the bottom of the calix. The short ones extend a few millimeters on the tabulæ, and abruptly terminate; the longer ones are slightly elevated near the bottom of the calix, and extend a short distance farther on the tabulæ, and gradually disappear, leaving a smooth, concave space in the bottom of the calix, ten millimeters in diameter. Fossette consists of a deep

depression at the edge of the flat space in the bottom of the calix, and in some examples extends to the anterior margin, in some others it does not extend so far, but always conspicuous.

This species resembles somewhat in external appearance *Z. ischypus*, but differing essentially, in having thin sharp lamellæ, and concave tabulæ; in that species the tabulæ is more numerous and flat.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### ZAPHRENTIS AMPLIATUS, N. Sp.

PLATE 4. FIGS. 7, 8.

Corallum simple, turbinate, straight, or slightly curved. A broad scar at the base of attachment, occasionally extending some distance on the side of the coral. Height thirty-five to sixty-five millimeters in the longest examples observed. Calix broadly campanulate, somewhat funnel-shaped, from twenty to thirty-five millimeters in diameter. Depth twenty millimeters. A flat space in the bottom of the cup, occupied by the tabulæ, from three to ten millimeters in diameter. Number of lamellæ seventy, in the circumference of a cup, thirty millimeters in diameter, alternating in length, rounded and sub-equal at the margin, gradually sloping to the bottom of the calix; the short ones terminate on reaching the flat space, the longer ones become elevated, sharp, slightly twisted, and continues to the center of the calix, and terminates, not elevated. Fossette consists of a deep depression on the side of the flat space in the bottom of the cup, and extends about half way to the anterior margin, and gradually disappears.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### CYATHAXONIA COMPRESSA, N. Sp.

PLATE 4. FIGS. 14, 15, 16, 17.

Corallum simple, turbinate, straight, or slightly curved. Acute at the base of attachment. Height fifteen millimeters, for about ten millimeters compressed, then gradually rounding to the margin of the cup. Exterior comparatively smooth, with a few shallow annulations and wrinkles caused by intermittent growth. Diameter of calix four millimeters. With vertical walls. Depth four millimeters. A flat space in the bottom of the calix two or three millimeters in diameter. Situated in the center of the calix, is a smooth convex cone, two millimeters in height. Number of lamellæ thirty, in a calix four

millimeters in diameter, alternating in length, sub-equal at the margin, growing thinner below; the short ones continuing to the flat space in the bottom of the cup and gradually disappears, the longer ones continues to the base of the convex cone in the center of the calix, and abruptly terminate. No fossette visible in any of the examples examined.

Found in the Warsaw division of the St. Louis group (Sub-carboniferous) at Georgetown, Floyd County, and at Lanesville, Harrison County, Indiana. Now in the collection of the author.

### BLOTHROPHYLLUM CINGULATUM, N. Sp.

PLATE 4. FIGS. 11, 12, 13.

Corallum simple, or composite, elongate turbinate, or sub-cylindrical, straight, or flexuous, increase by calicular gemmation. Acute at the base of attachment, gradually increasing in diameter to the calix. Height varying in different individuals, from thirty to eighty millimeters or more. Exterior with somewhat coarse irregular annulations and constriction, caused by intermittent growth; when decorticated, they have the decided appearance of a *Helio-phyllum*. Calix broadly bell-shaped, fifteen to twenty-five millimeters in diameter. Depth fifteen millimeters. A smooth convex space in the bottom of the calix, occupied by the tabulæ, ten millimeters in diameter. Number of lamellæ seventy-four in the circumference of a calix, twenty-five millimeters in diameter, alternating in length, rounded, and unequal in size at the margin: the short ones continue a short distance from the margin, becomes thinner, and gradually disappears before reaching the flat space in the bottom of the cup; the longer ones are slightly elevated and thinner, and continuous to the smooth convex space in the bottom of the calix and abruptly terminate. Fossette obscure, in a great many examples examined only a faint impression of a fossette is shown, on the side of the longest curvature of the coral.

Found in the Middle Devonian, (Upper Helderburg group) Falls of the Ohio. Now in the collection of the author.

### BLOTHROPHYLLUM FLEXOSUM, N. Sp.

PLATE 5. FIG. 6, 7, 8.

Corallum simple, turbinate, or elongate turbinate, gradually, or irregularly curved, or distorted. Acute at the base of attachment. Gradually, or at times rapidly increasing in diameter to the calix. Height varying in different individuals from forty to eighty millimeters. Calix broad, funnel-shaped, from fifteen to twenty millimeters in diameter. Depth ten to fifteen millimeters. Number of lamellæ sixty in the circumference of a calix, twenty millimeters in

diameter, thin and equal in size at the margin, alternating in length; the short ones abruptly slope to the bottom of the calix and terminate; the longer ones become flexuous and gradually slope to the center of the calix, meeting those of the opposite side, and abruptly end. Fossette consists of a shallow, narrow groove commencing in the bottom of the calix, extends a short distance on the side of the cup, and gradually disappears; position variable. Exterior with irregular annulations and sharp constrictions, caused by intermittent growth, when decorticated they have the appearance of a number of thin invaginated cups.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### CYSTIPHYLLUM CRASSATUM, N. Sp.

PLATE 5. FIGS. 9, 10.

Corallum simple, explanate. Composed of a series of thin, blistered, calycinal cups, with a strong wrinkled epithelial crust on the under side, and having a small flat scar at base of attachment. Diameter of corallum varies in different individuals, from thirty to forty millimeters, with a thickness from ten to twenty millimeters. Calix shallow, slightly concave, and strongly vesiculose, the largest cysts are near the bottom of the cup. Near the margin there is numerous fine striae, but gradually disappears before reaching the bottom of the calix.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### CYSTIPHYLLUM GEMMATUM, N. Sp.

PLATE 6. FIGS. 2, 3, 4.

Corallum simple, or compound, rapidly increasing by calicular, or lateral gemmation: in some examples they have a broad scar at the base of attachment, in this case some of them have rootlets that show evidence of being attached to some foreign body, and in some examples the base of attachment is acute. Height varying in different individuals from one to six inches. The exterior is very rugged and deeply constricted, and when decorticated appears as thin invaginated cups. The calix is so variable that in twenty examples no two would appear alike; when not interrupted by the new growth, it is somewhat bell-shaped, and has a depth of one inch, with numerous fine septa, eight in the space of ten millimeters. Small cysts appear near the margin of the cup, but are larger in the bottom; in some other examples, the cysts are large throughout the calix, entirely obscuring the septa.

This is the most remarkable form of this genus that I am acquainted with, differing from all heretofore described species, in the mode of growth, and the manner of budding. In the most common forms the parent cup seems to increase by prolific growth, and from the superior margin a number of buds appear, five or more sometimes sets forth closely connected, or, in some examples widely separated, and while this new process of budding is going on, a new growth springs up from the center of the calix, and continues a short distance and ceases; then new buds set forth from the margin on the opposite side from the former ones; this is not the case in all corallums, some examples after budding, set forth a new growth from the calix, and shows no signs of budding; in these examples, the calix is deep, with numerous coarse granulose septa, and the cyst are confined to the bottom of the calix.

Found in the Upper Devonian, (Hamilton group) two miles north-west of Charlestown, Indiana. Now in the collection of the author.

#### CYSTIPHYLLUM GEMMULA, N. Sp.

PLATE 6. FIGS. 8, 9.

Corallum simple, or composite, turbinate, straight or regularly curved. Acute at the base of attachment, gradually, and regularly expanding in diameter to the calix. Height, twenty millimeters. Diameter of calix ten millimeters. Depth, ten millimeters, somewhat funnel-shaped. Near the margin, and for a short distance below, the cysts are small and numerous, as they approach the bottom of the calix they become slightly larger, and are covered with fine, rather indistinct striae. Exterior with sharp constrictions and wrinkles, caused by periodical growth. When decorticated, the surface cysts appear somewhat larger than they do in the calix. From one cup, there are two corallites, equal the diameter of the parent cup, (not very high) from one of these, another small bud is attached.

The short corallum, and wide calix, and the short, broad corallites, make this easily recognized from all other species.

Found in the Upper Silurian. (Niagara group) at the Bear Grass Creek Quarries, near Louisville, Kentucky. Now in the collection of the author.

#### CYSTIPHYLLUM OSSICULUM, N. Sp.

PLATE 6. FIGS. 5, 6, 7.

Corallum simple, or composite, increasing by calicular gemmation, turbinate in the young state, but becoming cylindro-conical in the more mature growth. Height varying in different individuals from one to four and a half

inches. More or less curved, with a stout, wrinkled epitheca, and a broad scar at the base of attachment, but in some cases they are pointed. The exterior is rugged, undulated, and constricted, and presents an invaginated appearance. A specimen well preserved, and an inch in diameter, will have a calix, an inch, or more in depth, in the form of a conical cup; the cysts are large, though somewhat variable in size; they are as large internally as they are on the exterior. In some specimens, the corallum appears as a mass of cysts, without any evidence of septa, but in other specimens, when the cysts do not cover completely the interior of the calix, fine rudimentary septa can be plainly distinguished; in such cases there are from eighty to one hundred septa in a calix one inch in diameter.

This species is easily distinguished in the simple state by the epitheca, and the strongly marked base of attachment; it is also distinguished by the rugged, constricted, and invaginated appearance, and large cysts.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### CYSTIPHYLLUM LACINIATUM, N. Sp.

PLATE 6. FIGS. 10, 11, 12.

Corallum simple, turbinate, more or less curved. Acute at the base of attachment. Gradually, or at times rapidly expanding to the calix. Height varying in different individuals from three-fourths to three inches or more. The exterior is very rugged, and constricted, and appears as if composed of thin invaginated cups. The calix appears as a hemispherical cup, having a depth equal to one-half or more, of the diameter. The cysts are medium in size in the calix, but larger externally. The septa is thin and numerous; rudimentary septa may be distinguished in the calix of nearly all specimens.

This species differs essentially from *C. ossiculum* in its more rapidly expanding to the calix, and is not as rough externally, and the cysts are smaller, the cups are thinner in this species, than in that, and the calix is deeper.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### HELIOPHYLLUM BORDENI, N. Sp.

PLATE 4. FIGS. 9, 10.

Corallum simple, or compound, increasing by calicular gemmation. Exterior of parent cup with rough annulations, and wrinkles, caused by intermittent growth. Height varying from twenty to fifty millimeters. Acute at the base

of attachment, gradually expanding to the calix. Diameter of calix varying in different individuals from twenty-five to forty millimeters. Number of lamellæ eighteen in the space of ten millimeters, alternating in length, slightly unequal in size, and rounded at the margin, growing thinner below, for about five millimeters from the margin nearly flat, then abruptly sloping to the bottom of the calix, where the short ones terminate, the longer ones continuing to the center, where a few intimately connect, and in some cups they are slightly twisted, and elevated into a false calumella, one or two millimeters or more in height. Fossette consists of a deep depression in the bottom of the calix, but does not extend but a short distance on the side of the cup. Denticulations fine, ten in the space of six millimeters.

The specific name is in honor of Prof. W. W. Borden, of Borden Institute, Borden, Indiana.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### HELIOPHYLLUM AGASSIZI, N. Sp.

##### PLATE 5. FIG. 1.

Corallum simple, or compound. Increasing by calicular gemmation. Parent cup usually very much smaller than the increasing corallites, rarely exceeds one and one-half inches in diameter. Height about equal to the diameter of the calix. While the increasing corallites have a length from two and one-half to seven and one-half inches. Calix broad, bell-shaped, from sixty to eighty millimeters in diameter, varying in different individuals. Depth twenty millimeters. A flat space in the bottom of the calix, occupied by the tabulæ, twenty millimeters in diameter. Number of lamellæ eighty, in the circumference of a calix, eighty millimeters in diameter, somewhat thick, and equal in size at the margin, alternating in length, for ten or fifteen millimeters from the margin, flat, then abruptly slope to the bottom of the calix, where the short ones abruptly end, the longer ones continues, for six or seven millimeters, and abruptly terminate, leaving a smooth, slightly oblique space, in the bottom of the calix, from six to eight millimeters in diameter. Fossette consists of a deep depression, at the edge of the smooth, oblique space, in the bottom of the calix, extends a short distance on the side of the coral, and gradually disappears: position variable. Denticulations very coarse, seven or eight, in the space of ten millimeters.

Found in the Lower Devonian, (Corniferous group) at the Falls of the Ohio. The specific name, is given in honor of Prof. Alexander Agassiz, of Cambridge University, one who has contributed so largely to the advancement of science. Now in the collection of the author.

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 HELIOPHYLLUM NILESI, N. Sp.
 

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PLATE 5. FIGS. 2, 3.

Corallum simple, or composite, increasing by parietal budding. Attenuate at the base of attachment. A short distance above the base, short root-like processes sets out for attachment or support. Height of corallites forty millimeters. Diameter of calix twenty millimeters, and somewhat funnel-shaped. Depth fifteen millimeters. A smooth depressed space in the bottom of the calix, occupied by the tabulæ, four millimeters in diameter. Number of lamellæ sixty-four, in the circumference of a calix, twenty millimeters in diameter, thin, and slightly unequal in size at the margin, alternating below, gradually sloping, to within five or six millimeters of the smooth space in the bottom of the calix, where the short ones terminate, the longer ones coalesce, and continues to the smooth space, and abruptly ends, leaving a smooth depressed space in the bottom of the calix, four millimeters in diameter. Denticulations fine, conspicuous, nine in the space of five millimeters. Fossette consists of a narrow groove, commencing at the edge of the smooth space in the bottom of the calix, and continues to the margin of the cup; position variable. Exterior very rugged, when decorticated they have the appearance of thick invaginated cups. Base of the corallites, when not in contact with the parent cup, are smooth and round, appears as if turned in a lathe.

Found in the Lower Devonian, (Corniferous group) Falls of the Ohio. The specific name is in honor of Prof. Wm. H. Niles, professor of Geology in the Massachusetts School of Technology, Boston, Massachusetts. Now in the collection of the author.

 HELIOPHYLLUM TURGIDUM, N. Sp.
 

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PLATE 5. FIGS. 4, 5.

Corallum simple, broadly sub-turbinate, straight, or gradually curved. With a broad scar at the base of attachment, rarely acute at the base. Height thirty millimeters. Rapidly expanding in diameter to the calix. Exterior with a few strong annulations, and wrinkles caused by intermittent growth. Calix oblique, broadly campanulate, forty millimeters in diameter. Depth ten millimeters. A convex space, slightly elevated, in the bottom of the calix, occupied by the tabulæ, ten millimeters in diameter. Number of lamellæ, varying in different individuals, from one hundred and thirty to one hundred and fifty, in the circumference of a calix, forty millimeters in diameter, alternating in length, sub-equal at the margin, for about five millimeters nearly flat, then gradually slope to the bottom of the calix, where the short ones become thinner and gradually disappear, the longer ones continues to the convex elevation, slightly

twisted, and terminates, a few extend to the top of the elevation, and gives it the appearance of a rough cone. Fossette commences at the bottom of the calix, and continues to the anterior margin. Denticulations rather obscure, due to the weathered condition of the corallum.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

### HELIOPHYLLUM GURLEYI, N. Sp.

PLATE 6. FIG. 1.

Corallum simple, or compound, with a broad scar at the base of attachment, rapidly expanding in diameter to the margin of the calix. Exterior with coarse annulations and wrinkles, caused by intermittent growth. Height varying from fifteen millimeters to five inches; the longest examples are simple ones. Diameter of calix, varying in compound corallums, from fifteen to sixty-five millimeters. Depth twenty millimeters. A flat space in the bottom of the calix, occupied by the tabulae, from five to ten millimeters in diameter, in some of the cups, the flat space is smooth, in others, the ends of the lamellæ are broken up and gives to the bottom a rugose appearance. Number of lamellæ seventy-four in the circumference of a calix, thirty millimeters in diameter, sub-equal, rounded, and slightly flattened at the margin, for about ten millimeters nearly flat, then abruptly sloping to the bottom of the calix, where the short ones terminate, the longer ones are very much elevated, becomes sharper as they continue to the center of the calix. Fossette consists of a shallow narrow groove, commencing at the flat space in the bottom of the cup, and continuing about half way to the anterior margin. Denticulations coarse, well defined, from ten to fifteen in the space of ten millimeters.

The specific name is in honor of Prof. Wm. F. E. Gurley, ex-State Geologist of Illinois, an ardent collector, and a good Palæontologist.

Found in the Upper Devonian, (Hamilton group) near Charlestown, and at the different cement quarries, in Clark county, Indiana. Now in the collection of the author.



## HELIOPHYLLUM OBESUM, N. Sp.

PLATE 7, FIGS. 1-2-3-4.

Corallum simple, or compound, increasing by calicular gemmation, with a strong blunt base of attachment. Gradually, or at times, rapidly expanding in diameter to the calix. Height from forty to seventy millimeters. Usually straight. Diameter of calix from twenty to forty millimeters. Depth fifteen to twenty millimeters. Situated in the center of the calix, is a convex elevation formed by the elevated tabulæ, five millimeters in height, and from five to ten millimeters in diameter. Number of lamellæ, one hundred and ten, in the circumference of a calix, forty millimeters in diameter, unequal in size at the margin, alternating below, gradually sloping to near the bottom of the calix, where the short ones terminate, or coalesces with the longer ones. The longer ones continue, coalescing with the adjacent primary ones, and a few continue to the top of the elevated tabulæ, twisting, and giving to the convex elevation, a corrugated appearance. This feature is more strongly pronounced, in some examples, than in others. Exterior, when decorticated, has the appearance of a number of thin invaginated calices. Fossette well pronounced, it consists of a shallow depression in the bottom of the cup, near the convex elevation, and continues to the margin of the calix; position variable.

Found in the upper Devonian (Hamilton group) near Charlestown, and at the different cement quarries throughout Clark County, Indiana. Now in the collection of the author.

## HELIOPHYLLUM SEAMANI, N. Sp.

PLATE 7, FIG. 5.

Corallum simple, or compound. Usually straight, or slightly curved. Rather blunt at the base of attachment. With a few strong root-like processes, that served for attachment to other objects for support. Height of entire corallum, one hundred and twenty millimeters. Diameter of parent calix forty millimeters. Depth twenty-five millimeters, with steep walls. Number of lamellæ ninety-six, in the circumference of a calix, forty millimeters in diameter, unequal in size at the margin, alternating below, rapidly sloping to the bottom of the calix, where the short ones gradually disappear, the longer ones continue to within two or three millimeters of the center, coalescing, and abruptly terminate, leaving a smooth convex space in the bottom of the calix four or five millimeters in diameter. Exterior when decorticated very rugose. With numerous, sharp annulations, and constrictions, caused by periodical growth. Coral-

lites unequal in size. With the margins of their calix expanding, from twenty to twenty-five millimeters indiameter. Denticulations strong, one millimeter or more apart. Fossette consists of a shallow depression at the edge of the smooth space in the bottom of the calix, and continues to the anterior margin.

The specific name is in honor of Prof. A. E. Seaman, professor of Natural Science in the Michigan Mining School, Houghton, Michigan.

Found in the lower Devonian (Corniferous group), at the Falls of the Ohio. Now in the collection of the author.

#### HELIOPHYLLUM FLOS, N. Sp.

PLATE 7, FIGS. 6-7-8.

Corallum simple, or composite, increasing by calicular gemmation, straight or regularly curved. With rather a broad scar at the base of attachment, on the side of the coral, there is a number of slender root-like prolongations, that served for attachment to other objects for support. Height from ten to fifteen millimeters, calix broad, from eight to fifteen millimeters in diameter. Number of lamellæ twenty-two, in the space of eight millimeters, unequal in size at the margin, alternating below. Corallites slightly unequal in size, five millimeters in diameter. Depth three millimeters with a smooth space in the bottom of the calix two or three millimeters in diameter. Denticulations very fine, conspicuous, ten or twelve in the space of five millimeters. No fossette observed in any of the examples examined.

Found in the upper Silurian (Niagara group), at the Bear Grass Creek Quarries, near Louisville, Kentucky. Now in the collection of the author.

#### HELIOPHYLLUM PARTITUM, N. Sp.

PLATE 8, FIGS. 7-8.

Corallum composite, increase by calicular gemmation, corallites slightly unequal in size, somewhat quadrangular, with their margins intimately connected, and occupying the entire diameter of the parent cup. Number of lamellæ sixty to seventy or more, varying in different corallites. In some, the lamellæ is very thin, and the denticulations are distant, and fine. In others the lamellæ is numerous, coarse, and the denticulations are very much coarser, and more numerous. Acute at the base of attachment, rapidly expanding in diameter to the margin of the cup. Height twenty millimeters. Calix broadly bell-shaped, varying in different individuals from twenty to fifty millimeters in diameter. Exterior very rugged with deep constrictions, and wrinkles, caused by intermittent growth. No fossette observed in any of the corallites.

This differs in the manner of gemmation from all other composite forms of *Heliophyllums*, by the corallites being attached to the bottom of the calix, instead of growing from the superior margin of the parent cup, as in other species.

Found in the middle Devonian (upper Helderberg group), Falls of the Ohio. Now in the collection of the author.

### HELIOPHYLLUM BEECHERI, N. Sp.

#### PLATE 8, FIG. 9.

Corallum simple, or compound, rapidly increasing by calicular, and lateral gemmation. Corallum rugged. Corallites unequal in size, rounded, very much crowded, especially those springing from the calix. Parent cup rather large, very blunt at the base of attachment. Height ninety millimeters. Diameter of calix forty millimeters. Depth twenty-five millimeters, a flat space in the bottom of the calix, occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ, ten in the space of ten millimeters, slightly unequal in size at the margin, alternating below, the short ones extend to the bottom of the calix, and abruptly terminate, the longer ones continue on the tabulæ, gradually disappearing, and only faintly indicated on the bottom of the calix. Fosse, if any, very obscure.

The calix of the new corallites presents a different appearance from the parent cup. The lamellæ is unequal in size at the margin, alternating in length, the short ones extend to the bottom of the calix, and terminate, the longer ones continue to the center of the calix, coalescing, twisting, and is elevated into a false columella.

The specific name is in honor of Prof. Charles E. Beecher, of Yale College, New Haven, Conn.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

### MICHELINIA SPICULATA, N. Sp.

#### PLATE 7, FIGS. 11-12.

Corallum composite, small, eight millimeters in diameter, three millimeters in thickness. Tubes round, equal in size, two millimeters in diameter, margins slightly elevated, with spine-like elevations about one-half millimeter in height, situated at regular intervals. Tube walls vertical, pores small, irregularly dispersed, tabulæ convex, smooth. Surface of corallum convex, with a concave base covered with fine papulose structure.

The small spines at the margin of the cups, and smooth convex tabulae, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

*MICHELINIA PAPULOSA*, N. Sp.

PLATE 7, FIGS. 13-14-15.

Corallum, composite, small, not exceeding ten millimeters in its greatest diameter, three millimeters in thickness. Tubes rounded, unequal in size, two millimeters in diameter, with very thick walls, space between the margins one-fourth the diameter of the tubes, slightly elevated above the margin of the cups, finely notched, giving to the cup a fine crenulated appearance, lineal furrows fine, distinct, especially near the margin of the tubes. Mural pores small, rather few in number compared to other forms of *Michelinia*, dispersed without system; surface of corallum convex. With a concave base, covered with fine papulose secretion.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

*MICHELINIA NEGLECTA*, N. Sp.

PLATE 7, FIG. 16.

Corallum small, not exceeding five millimeters in its greatest diameter, slightly less than two millimeters in thickness, tubes polygonal, unequal in size, two millimeters or less in diameter; lineal furrows, fine, distinct. Tube walls thin. Mural pores numerous and irregularly dispersed. Tabulae smooth, slightly oval; surface of corallum convex, with a slightly concave base covered with a fine granulose structure.

The thin walls, and numerous mural pores, and the unequal polygonal tubes, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

*MICHELINIA LOUISVILLENSIS*, N. Sp.

PLATE 8, FIGS. 10-11-12.

Corallum small, thin, not exceeding ten millimeters in its greatest thickness, with a stout wrinkled epithecal crust on the under side. Acute at the point of attachment, diameter varying in different individuals from eight to twenty millimeters, the broadest examples observed. Tubes

polygonal, unequal in size, from one to three millimeters in diameter. Mural pores large, round, dispersed without any system, three rows is the greatest number observed on the sides of the largest tubes. Walls rather thick for the size of the corallum.

The small thin expansion and the strong wrinkled epithecal crust and thick walls makes this easily recognized from all other species.

Found in the upper Silurian (Niagara group) at the Bear Grass Creek Quarries, near Louisville, Ky. Now in the collection of the author.

MICHELINIA WILLIAMSI, N. Sp.

PLATE 8, FIG. 13.

Corallum small, not exceeding fifteen millimeters in its greatest diameter, with a wrinkled epithecal crust on the lower side. Tubes polygonal, unequal in size, from one-half to two millimeters in diameter. Walls very thin. Mural pores somewhat large, not exceeding three rows on the sides of the largest tubes. Lineal furrows faintly indicated on the margins of the best preserved tubes. This is growing upon a *Cystelasma Lanesvillense*, (S. A. Miller).

Found by Mr. Wm. N. Williams, in whose honor the specific name is given, in the Warsaw division, of the St. Louis group (Sub-Carboniferous), four miles southwest of Bridgeport, Harrison County, Indiana. Now in the collection of the author.

MICHELINIA TANTILLA, N. Sp.

PLATE 9, FIG. 12.

Corallum small, hemispherical, not exceeding one inch in its greatest diameter. Growing parasitical on a crinoid stem. Tubes rounded, slightly unequal in size, eight millimeters, or less, in diameter, slightly connected by their epithecal walls. Lineal furrows deep, conspicuous. Mural pores large, numerous, situated in the grooves. Tabulæ concave, and situated in the bottom of the tubes.

The large round tubes and thick walls, and numerous pores situated in the grooves, makes this easily recognized from all other species.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

ZAPHRENTIS SELLERSI, N. Sp.

PLATE 7, FIGS. 9-10.

Corallum simple, turbinate, straight, or regularly curved. Acute at the base of attachment. Rapidly expanding in diameter to the calix. Height

sixty millimeters. Calix broadly campanulate, thirty-five millimeters in diameter. Depth twenty millimeters. With a flat space in the bottom of the calix occupied by the tabulae, twenty millimeters in diameter. Number of lamellae sixty-two, in the circumference of calix, thirty-five millimeters in diameter, somewhat equal in size and broadly rounded at the margin, alternating below, for about five millimeters gradually, then rapidly slope to the bottom of the calix, where the short one terminate. The longer ones become slightly elevated and thinner as they approach the bottom of the calix. On reaching the bottom they abruptly become thinner and smaller and are only faintly indicated in the center of the calix, in some examples the lamellae does not extend to the center of the cup, leaving a smooth space in the bottom five or six millimeters in diameter. Exterior with shallow, distant annulations, and wrinkles, caused by intermittent growth. Fossette consists of a deep depression on the sinistral side of the tabulae, but does not extend on the side of the cup. On the dextral side of the calix there is one principal lamellae, slightly elevated above the others, that extends to the center of the calix, and in some examples it extends to the margin of the fossette, and abruptly ends.

Found by Mr. John Sellers, in whose honor the specific name is given, in the upper Devonian (Hamilton group), at Speed's Quarry, Clark County, Indiana. Now in the collection of the author.

### ZAPHRENTIS OBLIQUATUS, N. Sp.

PLATE 8, FIG. 1-2-3.

Corallum simple, elongate turbinate, regular or irregularly curved, or distorted. Acute at the base of attachment, gradually increasing in diameter to the calix. Height of an adult specimen ninety millimeters. Diameter of calix twenty-five millimeters. Depth twenty-five millimeters. Walls very thin and vertical. Number of lamellae, seventy in the circumference of a calix, twenty-five millimeters in diameter, unequal in size at the margin, alternating below, the short ones scarcely more than rudimentary, the longer ones continue to the bottom of the calix, and abruptly terminate. Tabulae oblique, very thin, occupies the entire diameter of the corallum. Fossette consists of a slight depression, at the dextral margin of the tabulae, but does not extend on the side of the coral. Exterior with deep constrictions, and wrinkles, caused by intermittent growth.

The very thin deep calix, and broad oblique tabulae, deep constrictions, and wrinkles, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

## ZAPHRENTIS HOBBSI, N. Sp.

PLATE 8, FIGS. 4-5-6.

Corallum simple, elongate turbinate, or conico cylindrical. Acute at the base, or in some examples there is a broad scar at the base of attachment. Gradually increasing in diameter to the calix, in some examples, the diameter is essentially the same throughout. Calix with thin vertical walls, twenty millimeters in diameter. Depth twenty to thirty millimeters. Tabulæ flat, occupies the entire diameter of the corallum. Number of lamellæ seventy to eighty, rounded and equal in size at the margin, alternating below, the short ones becoming thinner as they approach the bottom of the calix, but disappear before reaching the tabulæ, the longer ones are slightly elevated, and thinner, and continue to the tabulæ, and abruptly terminate, leaving the tabulæ smooth, and convex, slightly less than the diameter of the corallum. Exterior with smooth rounded annulations at somewhat regular intervals, and occasionally, a few shallow wrinkles, caused by intermittent growth. Fossette consists of a slight depression at the margin of the tabulæ; position variable.

The regular annulations, broad flat tabulæ, thin vertical walls, and deep calix, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

## CLADOPORA GURLEYI, N. Sp.

PLATE 9, FIG. 1.

Undose laminar expansions. With a central or sub-central attachment. Composed of slightly flattened radiating tubules, intimately joined at their margins. Forming a thin wrinkled epithecal crust, covering the entire under surface. Tubes near the base comparatively small, gradually expanding and becoming more flattened as they approach the surface, and open in oblique oblong orifices, from two to three millimeters wide, and from one to two millimeters in height. Tube walls rather thick. Pores large, not very numerous; one, very rarely two rows in a tube. Tabulæ, not very well pronounced, faint traces can be observed in some tubes near the margin.

The thin undose expansion, the large dilated orifices, and thick walls, and large pores, makes this easily recognized from all other species.

The specific name is in honor of Prof. Wm. F. E. Gurley, Ex-State Geologist of Illinois, an ardent collector, and a good Palæontologist.

Found in the lower Devonian (Corniferous group), at the Falls of the Ohio. Now in the collection of the author.

## CLADOPORA INTERMEDIA, N. Sp.

PLATE 9, FIG. 2.

Undose laminar expansion, composed of thin, slightly flattened, radiating tabules, intimately joined at their margins, forming a thin, wrinkled epithecal crust, covering the entire under surface. Tubes with moderately thick walls, smooth, oblique. With dilated orifices, from one to two millimeters wide, and one millimeter, more or less, in height. Pores very small, and not very numerous. Tabulæ not visible in any of the examples examined. Surface very nodose.

This is an intermediate species between *C. Gurleyi*, of the same plate, and *C. Winchellana*, of (S. A. Miller). The thin undose expansion, and nodose surface, with oblique, dilated orifices, makes this easily recognized from all other species.

Found in the lower Devonian (Corniferous group), at the Falls of the Ohio. Now in the collection of the author.

## BLOTHROPHYLLUM BUCCULENTUM, N. Sp.

PLATE 9, FIG. 3-4-5.

Corallum simple, elongate turbinate, or sub-cylindrical, straight, or slightly curved with sharp constrictions, and numerous annulations, caused by intermittent growth. Height varying in different individuals, from twenty-five to sixty millimeters, or more. Diameter of calix twenty millimeters. Depth ten millimeters. A flat space in the bottom of the calix, occupied by the tabulæ, eight or ten millimeters in diameter. Number of lamellæ seventy or eighty, alternating in size, and length, gradually sloping to the bottom of the calix, where the short ones terminate, the longer ones are elevated, sharp and extend to near the center of the calix, leaving a smooth flat space, from three to five millimeters in diameter. Fossette consists of a slight depression in the bottom of the cup, but disappears before reaching the margin of the calix.

Found in the upper Devonian (Hamilton group), two miles north-west of Charlestown, Indiana. Now in the collection of the author.

## BLOTHROPHYLLUM CONIGERUM, N. Sp.

PLATE 9, FIGS. 6-7-8.

Corallum simple, elongate, turbinate, or cylindrical, straight or curved. Acute at the base of attachment. Gradually expanding to the calix. Exterior with constrictions, and annulations, caused by intermittent growth. Height of longest corallum seventy-five millimeters. Depth eight millimeters. Number of

lamellæ sixty, in the circumference of a cup, thirteen millimeters in diameter, alternating in length, nearly equal in size at the margin, abruptly sloping to the bottom of the calix, where the short ones terminate, the longer ones become elevated, sharp, and continue on the bottom, coalescing and fasciculating, and is elevated into a sharp cone, from three to five millimeters in height. No fossette.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

### BLOTHROPHYLLUM INCULTUM, N. Sp.

#### PLATE 9, FIGS. 9-10.

Corallum simple, turbinate, or elongate turbinate. Straight, or regularly curved. Acute at the base of attachment. Gradually and regularly enlarging in diameter to the calix. Height, varying in different individuals, from forty-five to seventy-five millimeters. Calix broad, bell-shaped, twenty to twenty-five millimeters in diameter. Depth ten to fifteen millimeters. A flat convex space in the bottom of the calix, occupied by the tabulæ, ten or twelve millimeters in diameter. Number of lamellæ seventy, in the circumference of a cup, twenty millimeters in diameter, unequal in size, and slightly rounded at the margin, alternating below, gradually, or in some examples, rapidly sloping to the bottom of the calix, where the short ones abruptly terminate, the longer ones continue on the tabulæ, to the center of the calix, coalescing, and slightly twisting, and terminate; not elevated. Exterior, with numerous, rounded annulations, and sharp constrictions, and when decorticated the surface is covered with broad, shallow vesicles, and the numerous, sharp constrictions, gives to the corallum, the appearance of a series of thin invaginated calices. Fossette conspicuous; it consists of a deep, narrow pit, situated at the anterior margin of the tabulæ, but does not extend far on the side of the calix.

Found in the upper Devonian (Hamilton group) near Charlestown, and at the different cement quarries, throughout Clark County, Indiana. Now in the collection of the author.

### DIPHYPHYLLUM EXPANSUM, N. Sp.

#### PLATE 9, FIG. 11.

Corallum compound, increasing by lateral gemmation, corallites rarely in contact. Exterior with gentle undulations, and wrinkles, caused by periodical growth. Longitudinal striæ distinct. Height twenty millimeters. Diameter of corallites, varying, from ten to twenty millimeters. Depth fifteen millimeters. Number of lamellæ, from sixty to seventy, uniform in size at the margin, alternating in length, the short ones end abruptly, on reaching the bottom of the calix, the longer ones become elevated, and continues to the vertical wall of the internal area. Internal area smooth, three millimeters in diameter. Fossette obscure. Denticulations fine, eight in the space of five millimeters.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.



## DIPHYPHYLLUM WADSWORTHI, N. Sp.

## PLATE 10. FIG. 1.

Corallum composite, with a wrinkled, epithical crust at the base of attachment. Corallites never very much crowded, from twenty to fifty millimeters in length, rounded, unequal in size, from ten to twenty millimeters in diameter, one-third to one half larger at the calix than at the base. stems strongly annulated, caused by periodical swellings; frequently they are attached by the epithica at these swellings, rarely in contact their entire length. The calix in most of the stems is very shallow, caused by the calicular growth. Situated in the center of the calix is a smooth, horse-shoe shaped area, somewhat oblong, inclosed in a vertical wall, from one to two millimeters wide, and from two to three millimeters long. Number of lamella forty-eight, in the circumference of a calyx twenty millimeters in diameter, rounded and equal in size at the margin, alternating below, for about five millimeters flat, then gradually slope to the bottom of calix, where the short ones terminate; the longer ones continue to the margin of the vertical wall, in the center of the calyx, and abruptly end. Denticulations rather fine, ten in the space of five millimeters. Fossette consists of a slight depression at the edge of the smooth, horse-shoe shaped area, but does not continue on the side of the calix.

The specific name is in honor of Dr. Marshman E. Wadsworth, ex-President of the Michigan Mining School, Houghton, Michigan.

The short, rapidly enlarging stems, and the manner in which they attach themselves, and the peculiar calix, makes this easily recognized from all other species.

Found in the upper Devonian (Hamilton group) at the Clark County Cement quarries, Clark county, Indiana. Now in the collection of the author.

## DIPHYPHYLLUM LAXUM, N. Sp.

## PLATE 10. FIGS. 2-3.

Corallum composite, rather small, growing somewhat lax. Parent cup acute at the base of attachment. Rapidly increasing by lateral gemmation. tubes not exceeding thirty millimeters in length, unequal in size, from five to fifteen millimeters in diameter. Calix oblique, funnel shaped. Depth ten millimeters. A smooth space, horse-shoe shaped, situated in the bottom of the calyx, surrounded by a vertical wall, from one to two millimeters in diameter.

Number of lamellæ fifty-eight, in the circumference of a calix, fifteen millimeters in diameter, rounded and equal in size at the margin, alternating below, rapidly sloping to the bottom of the calix, where the short ones gradually terminate; the longer ones continue to the margin of the vertical wall in the bottom of the calix, and abruptly end. Denticulations fine, ten in the space of seven millimeters. Fossette in some of the cups obscure; when visible, it consists of a slight depression at the edge of the horse-shoe shaped area, but does not extend on the side of the calix.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

DIPHYPHYLLUM PROLATUM, N. Sp.

PLATE 11. FIG. 1.

Corallum composite, rapidly increasing, by both lateral, and calicular gemination, growing rather loose, corallites never very much crowded. There is a broad scar at the base of attachment of the parent cup. Height of the longest corallites two and one-half inches. Diameter of calyx from eight to eighteen millimeters. Depth five to ten millimeters, with a smooth, horse-shoe shaped area, surrounded by a vertical wall in the center of the calix, two millimeters in diameter. Number of lamellæ, forty-six, in the circumference of a calix fifteen millimeters in diameter, equal, or in some cups, slightly unequal at the margin, alternating below, for two or three millimeters from the margin, nearly flat, then abruptly slope to the bottom of the calix, where the short ones terminate. The longer ones continue to the vertical wall in the center of the calix, and abruptly end. Denticulations fine, sharp; seven in the space of four millimeters.

The loose spreading stems, and the lateral and calicular manner of increasing, makes this easily recognized from all other species.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

DIPHYPHYLLUM ADJUNCTUM, N. Sp.

PLATE 12. FIG. 1.

Corallum solid, rather large, composite, rapidly increasing by lateral gemination. Corallites unequal in size, from five to fifteen millimeters in diameter, intimately connected throughout their length. Calix broadly bell-shaped. Number of lamellæ, forty-five in a calix, fifteen millimeters in diameter. A

flat, convex space in the bottom of the calix, from five to seven millimeters in diameter. Situated in the center of the flat area, is a smooth space, horse-shoe shaped, with vertical walls, three millimeters in diameter. At the margin of the cups the lamellæ are equal in size, alternating below, the short ones extend to the bottom of the calix, and gradually disappears; the longer ones are slightly elevated, and continue on the bottom of the cup, to the vertical wall, in the center of the calix, and abruptly terminate.

In some of the corallites, they have the decided appearance of prolific gemmation. In a vertical section, the corallites have the appearance of thin, somewhat distant invaginated cups, caused by the contraction and expansion of the periodical growth.

Found in the Middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

PTYCHOPHYLLUM GEMMATUM, N. Sp.

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PLATE 12. FIGS. 2-3.

Corallum rather small, simple, or composite, increasing by lateral gemmation: base rather broad, having root-like processes for attachment to some foreign bodies. Height varying in different examples, from twenty to thirty millimeters. Exterior with sharp constrictions, and wrinkles, caused by intermittent growth. When decorticated, the longitudinal striæ is distinct, about one millimeter in thickness. Calix rather broad, bell-shaped, fifteen millimeters in diameter. Depth ten millimeters. Number of lamellæ, seventy-six in the circumference of a calix, fifteen millimeters in diameter, alternating in length, equal in size at the margin, the short ones not over five millimeters in length: the longer ones continue to the center of the calix, flexuous and slightly twisted, but not elevated. No fossette visible.

Found in the middle Devonian (upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

PTYCHOPHYLLUM BENEDICTI, N. Sp.

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PLATE 12. FIGS. 4-5-6.

Corallum simple, or composite, increasing by calicular gemmation, turbinate, straight or irregularly curved. Acute at the base of attachment. Gradually, or in some examples, more rapidly expanding in diameter to the calix. Height twenty-five millimeters. Calix broadly bell-shaped, twenty to thirty-

five millimeters in diameter. Depth five to ten millimeters, varying in different individuals. A flat convex space in the bottom of the calix, occupied by the tabulæ from five to ten millimeters in diameter. Number of lamellæ, eighty in the circumference of a calix, twenty-five millimeters in diameter, rounded and equal in size at the margin, alternating below, from five to ten millimeters from the margin flat, or slightly oval, then abruptly slope to the bottom of the calix, where they coalesce, and continue to the center of the calix, fasciculating, and twisting, but not elevated. In the example Fig. No. 5, the lamellæ does not coalesce, but the short ones, on reaching the bottom of the cup, abruptly end: the longer ones, continue slightly elevated, and near the center of the calix they coalesce with the adjacent ones, and terminate, not elevated. No fossette. The exterior is somewhat rugged with strong rough wrinkles and deep constrictions, caused by periodical growth.

The specific name is in honor of Mr. A. C. Benedict, of Indianapolis, Indiana.

Found in the Niagara group (upper Silurian) at the Beargrass creek quarries, near Louisville, Kentucky. Now in the collection of the author.

#### CYSTIPHYLLUM LAMELLATUM, N. Sp.

##### PLATE 10. FIGS. 4-5.

Corallum simple, turbinate or elongate turbinate, straight or regularly curved. Acute at the base of attachment. Gradually or rapidly increasing in diameter to the calix. Exterior rather rugged, with coarse, irregular annulations and constrictions, caused by intermittent growth. When decorticated they have the appearance of thin, invaginated cups. Height varying in different individuals from one to six inches or more. Calix somewhat bell-shaped, from fifteen to thirty millimeters in diameter. Depth twenty to thirty millimeters, with a concave space in the bottom of the calix, occupied by large cysts, from ten to fifteen millimeters in diameter. Number of septa one hundred in a calix twenty-five millimeters in diameter. Somewhat irregular in size. Abruptly slope to the edge of the concave area in the bottom of the calix, and terminate. The exterior shows numerous small cysts, not more than one-third to one-half as large as those situated in the bottom of the calix.

The concave bottom of the calix, covered with large cysts, the conspicuous septa free from cysts, and the small cysts on the exterior, with the appearance of thin invaginated cups, makes this easily recognized from all other species.

Found in the upper Devonian (Hamilton group), two miles northwest of Charlestown, Indiana. Now in the collection of the author.

## CYSTIPHYLLUM OSCULUM, N. Sp.

## PLATE 10. FIGS. 6-7-8.

Corallum simple, turbinate, or subturbinate. Gradually or sometimes irregularly curved. Acute at the base of attachment, gradually enlarging to the calix. Height varying in different individuals, from forty-five to sixty millimeters. Calix funnel-shaped, fifteen millimeters in diameter. Depth fifteen millimeters; sides regularly sloping to the bottom of the cup. A few rounded lamellæ appear near the margin of the calix, but rarely extend to the bottom of the calix. The vesicles in the calix appear as irregular swellings, giving to the calix a somewhat undulating appearance. Exterior with few distant shallow annulations and wrinkles; when decorticated the surface is covered with numerous fine cysts.

Found in the upper Devonian (Hamilton group), near Charlestown, and at the different cement quarries throughout Clark county, Indiana. Now in the collection of the author.

## CYSTIPHYLLUM CONSTRICTUM, N. Sp.

## PLATE 10. FIGS. 9-10-11-12.

Corallum simple, turbinate or subturbinate, straight or irregularly curved. Acute at the base, or in some examples there is a broad scar at the base of attachment. Height varying in different individuals, from forty to seventy millimeters; slightly enlarging towards the calix. Exterior with a thick, smooth epithelial crust, and strong rounded, irregular annulations, and deep constrictions, caused by intermittent growth. Calix shallow, oblique, twenty-five millimeters in diameter. Depth from five, to fifteen millimeters. There are numerous fine lamellæ near the margin of the calix, that extend five or ten millimeters from the margin of the cup, and gradually disappear. There are a few vesicles situated in the bottom of the calix. When the epitheca is preserved, there is no indication of cysts, but when decorticated, they are numerous, and the corallum has the appearance of a number of thin, distant, invaginated cups.

The thick, smooth, epithelial crust, and the strong rounded annulations, and deep constrictions, and the thin, invaginated cups, make this easily recognized from all other species.

Found in the lower Devonian (corniferous group), at the Falls of the Ohio. Now in the collection of the author.

## CYSTIPHYLLUM PARASITICUM, N. Sp.

PLATE 12. FIGS. 7-8-9.

Corallum simple, oblique, subturbinate, straight, or flexuous. With a broad scar at the base, or in some examples they are acute at the base of attachment. With root like processes that serve for attachment and support. Examples with broad bases, rarely exceed three or four millimeters in height on the anterior side, posterior side, from one to two millimeters. Diameter of some corallums is essentially the same throughout; in other examples, especially those having acute bases, are from two to five millimeters in height, rapidly expanding in diameter to the calix. Calix oblique, from two to five millimeters in diameter, varying in different individuals. Depth about equal the diameter in the same corallum. In the bottom of the calix, there is from one to five cysts somewhat large and oval, and in some others they are on the sides, and near the margin of the calix. Near the margin of the cup, when not interrupted by the cysts, fine septa, scarcely more than rudimentary, may be observed. Exterior of well preserved specimens have a strong wrinkled epitheca, and fine distinct longitudinal striae.

These are found single, or in great numbers, attached to Favosites Zaphrentis, and fragments of other marine organisms.

Found in the middle Devonian (upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

## CYSTIPHYLLUM INFUNDIBULIFORMIS, N. Sp.

PLATE 12. FIG. 10-11-12.

Corallum small, simple, turbinate, increasing by proliferous growth. Acute at the base of attachment. Usually straight, or slightly curved. Height varying in different individuals, from twenty to fifty millimeters. Calix oblique, from ten to fifteen millimeters in diameter. Depth ten millimeters. Exterior with sharp constriction. When decorticated it has the appearance of thin, invaginated funnel-shaped cups. At the margin of the cup, fine septa is observed, and the cysts are faintly indicated. As they approach the center of the calix, the cysts become larger, and more numerous, leaving no trace of septa. On the exterior the cysts are unequal in size, and not so large as those in the calix.

The thin, oblique, funnel-shaped, invaginated cups, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group), Falls of the Ohio. Now in the collection of the author.

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*ZAPHRENTIS NANUS*, N. Sp.

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PLATE 11. FIGS. 2-3-4-5-6.

Corallum simple, turbinate, straight or regularly curved. Acute at the base of attachment, gradually or at times more rapidly expanding in diameter, to the calix. Exterior with broad, irregular annulations, and shallow constrictions. Height twenty millimeters. Calix somewhat campanulate, ten millimeters in diameter. Depth five millimeters; with a flat space in the bottom of the cup, occupied by the tabulæ. Six millimeters in diameter. Number of lamellæ, fifty-two, in the circumference of a calix, ten millimeters in diameter; unequal in size at the margin, alternating in length, the short ones are scarcely more than rudimentary; the longer ones abruptly slope to within a short distance of the center, and terminate, leaving a smooth convex space in the bottom of the calix, from two to three millimeters in diameter. No fossette visible in any of the specimens examined.

Superficially this has some resemblance to *Z. Acuticornis* of Part 1, Plate 2, Figs. 9-10. But this species has no fossette, and the smooth convex space in the center of the calix, is more pronounced in this species than in that.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

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*HELIOPHYLLUM JACKSONI*; N. Sp.

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PLATE 11. FIGS. 7-8.

Corallum simple, or compound. Acute at the base of attachment, Rapidly increasing in diameter to the margin of the calix. Exterior with strong rounded annulations and constrictions. Height varying in different examples from twenty-five to forty millimeters. Calix broadly bell-shaped, from thirty to thirty-five millimeters in diameter. Depth fifteen millimeters, with a flat space in the bottom of the cup, occupied by the tabulæ, ten millimeters in diameter. Number of lamellæ, sixty in the circumference of a calix, thirty millimeters in diameter, unequal in size at the margin, alternating below, from three to four millimeters from the margin, flat or slightly oval, then gradually slope to the bottom of the calix, where the short ones terminate; the longer ones continue to the center of the calix, coalescing, and are slightly elevated, not twisted. Denticulations coarse, irregular in position, from one to two millimeters apart. Fossette conspicuous, commences near the center of the calix, and continues to the anterior margin.

The specific name, is in honor of Dr. R. T. Jackson, the eminent Palæontologist, of Harvard University.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

BLOTHROPHYLLUM BELLICINCTUM, N. Sp.

PLATE 11. FIGS. 9-10.

Corallum simple, elongate turbinate, straight or regularly curved. Acute at the base of attachment, gradually or at times, more rapidly expanding in diameter to the calix. Exterior with shallow annulations, and sharp constrictions, and wrinkles, caused by intermittent growth. Epithica thin; when denticated it has the appearance of a number of thin invaginated cups, with large oblong vesicles on the surface. Height varying in different individuals, from thirty to one hundred millimeters or more. Calix funnel-shaped, from twenty-five to forty millimeters in diameter. Depth twenty-five to thirty-five millimeters. Number of lamellæ seventy, in the circumference of a calix, thirty-five millimeters in diameter. Very unequal in size at the margin; alternating in length, the short ones scarcely more than rudimentary; the longer ones are somewhat thick at the margin, growing thinner as they gradually slope to the center of the calix, and terminate. Fossette consists of a deep depression in the center of the calix, but does not extend far on the side of the cup.

The thin wrinkled epithica, and the deep funnel-shaped calix, and the large oblong vesicles, on the exterior, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

## CYSTIPHYLLUM INVAGINATUM, N. Sp.

## PLATE 13. FIG. 1-2.

Corallum simple, large and somewhat rugged, turbinate, or elongate turbinate. Straight or irregularly curved, or geniculated. Acute at the point of attachment. Gradually, or in some examples, more rapidly expanding in diameter to the calix. Height varying in different individuals, from two and one half to seven inches or more. Calix broadly bell-shaped, from thirty to seventy millimeters in diameter. Depth thirty to fifty millimeters, and funnel-shaped. Situated in the calix is one or two, and in some examples three depressions, appearing like fossettes, but occupying different positions in the different corallums. In some cups these depressions are scarcely more than rudimentary; when they are strongly pronounced in the cup, there is a corresponding elevation on the exterior of the corallum. Septa numerous, in many places it appears as fine striæ, in other places it is more conspicuous, in these places there are fourteen in the space of ten millimeters. Near the margin of the calix, the vesicles are larger than they appear below, in some examples the large cysts are confined to the bottom of the calix, and smaller ones appear near the margin, always confined on the anterior side of the cup. In examples where the margin of the cup is broken away, large vesicles will appear on the broken surface. Exterior somewhat rugged, with numerous annulations, and sharp, shallow constrictions. When decorticated the corallum has the appearance of numerous thin invaginated cups with crenulated margins.

Found in the upper Devonian (Hamilton group), at Charlestown, and above the cement rock, at the different quarries, throughout Clark county, Indiana. Now in the collection of the author.

## HELIOPHYLLUM SHERZERI, N. Sp.

## PLATE 13. FIGS. 3-4-5-6.

Corallum simple, turbinate, or elongate turbinate. Straight, or regularly curved. Acute at the base, or in some examples there is a broad scar at the base of attachment. Height varying in different examples, from thirty to one hundred millimeters. The calix of some are very much contracted, while some others are broadly bell-shaped, varying in different individuals, from ten to twenty-five millimeters in diameter. Depth ten millimeters. In the bottom of the calix there is a flat space occupied by the tabulæ, from five to ten millimeters in diameter. Number of lamellæ eighty, equal in size, and sharp at the margin; alternating below, rapidly, or in some cups more gradually sloping to

the bottom of the calix, where the short ones gradually disappear; the longer ones continue, coalescing with the tabulæ, to within two or three millimeters of the center of the calix, and abruptly terminate, leaving a smooth, depressed space in the bottom of the calix, from four to six millimeters in diameter. Exterior with rough distant annulations, sharp, and deep constrictions, caused by periodical growth. Fossette consists of a deep depression at the margin of the smooth depressed space in the bottom of the calix, and extends to the anterior margin. Denticulations fine, but not closely arranged.

The specific name is in honor of Prof. Will H. Sherzer, Professor of Natural Science in the State Normal School, Ypsilanti, Michigan.

Found in the middle Devonian (upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

#### HELIOPHYLLUM MINUSCULUM, N. Sp.

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 PLATE 13. FIGS. 7-8.

Corallum simple, turbinate, straight or regularly curved, with a broad scar at the point of attachment. Gradually, or in some examples, more rapidly expanding in diameter to the calix. Height twenty-five millimeters. Diameter of calix twenty millimeters. Depth fifteen millimeters. With an oblique convex space in the bottom of the calix, occupied by the tabulæ, eight millimeters in diameter. Number of lamellæ ninety-four, in the circumference of a calix twenty millimeters in diameter; unequal in size, and sharp at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones terminate; the longer ones continue coalescing with the tabulæ; a few extend to the center of the cup, and abruptly end. There are two fossettes, situated on the posterior, and anterior sides, the principal one is situated on the anterior side; both of them commence at the margin of the concave space, and extend to the margin of the calix. Denticulations rather coarse, one millimeter apart. Exterior with irregular annulations, and shallow constrictions, caused by periodical growth.

Found in the middle Devonian (upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

#### HELIOPHYLLUM LEMONI, N. Sp.

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 PLATE 14. FIG. 17.

Corallum simple, or composite, increasing by calicular gemmation. Acute at the base of attachment. Rapidly increasing in diameter to the calix.

Height of entire corallum ninety millimeters. Exterior with numerous deep constrictions and wrinkles, caused by intermittent growth. Corallites when decorticated, have the appearance of a number of invaginated cups. Calix broad, bell-shaped, from thirty to thirty-five millimeters in diameter. Depth ten to fifteen millimeters; a flat space in the bottom of the cups, occupied by the tabulæ, from ten to twelve millimeters in diameter. Number of lamellæ seventy, in the circumference of a calix thirty millimeters in diameter, rounded and equal in size at the margin, alternating below for about five millimeters flat, then abruptly slope to the bottom of the calix, where the short ones gradually disappear. The longer ones continue to within three millimeters of the center of the cup, and abruptly terminate, leaving a smooth convex space in the bottom of the calix, six millimeters in diameter. Denticulations moderately coarse, eight in the space of five millimeters. Fossette consists of a slight depression at the margin of the tabulæ, but does not extend on the side of the calix. Position variable.

The specific name is in honor of Dr. John Lemon, of New Albany, Ind., an ardent collector and a good palaeontologist.

Found in the lower Devonian (Corniferous group), at the Falls of the Ohio. Now in the collection of the author.

ZAPHRENTIS GROSBACHI, N. Sp.

PLATE 13. FIGS. 9-10-11-12.

Corallum simple, rather below medium size, turbinate, straight or irregularly curved. Acute at the base of attachment, gradually expanding in diameter to the calix. Height varying in different examples, from fifteen to twenty-five millimeters. Diameter of calix from ten to fifteen millimeters. Depth five to seven millimeters, with a smooth, depressed, convex space in the bottom of the calix, occupied by the tabulæ, from five to seven millimeters in diameter. Exterior rather rough, with coarse annulations and constrictions, caused by intermittent growth. Number of lamellæ, fifty-four in the circumference of a calix fifteen millimeters in diameter; unequal in size at the margin, and rather sharp, alternating in length; the short ones abruptly slope to the bottom of the calix, and gradually disappear; the longer ones rapidly for a short distance, then gradually slope to the depressed convex space in the bottom of the calix, and abruptly terminate, leaving a smooth, depressed convex space in the bottom of the calix, about six millimeters in diameter. No fossette in any of the examples in my collection.

Found by Mr. Henry Grosbach, of Sellersburg, in whose honor the specific name is given, in the upper Devonian (Hamilton group), near Sellersburg, Clark county, Ind. Now in the collection of the author.

## ZAPHRENTIS OPPELTI, N. Sp.

PLATE 14. FIGS. 10-11-12-13.

Corallum simple, turbinate, straight or regularly curved. Acute at the base of attachment, gradually, and regularly expanding to the calix. Height varying in different individuals, from twenty to forty millimeters. Exterior with strong, rounded longitudinal striæ, ten in the space of eight millimeters; and numerous sharp constrictions and wrinkles, caused by intermittent growth. Diameter of calix, from ten to eighteen millimeters. Depth, twelve millimeters. A smooth, convex space in the bottom of the calix, six millimeters in diameter. Number of lamellæ, sixty-four, in the circumference of a calix, eighteen millimeters in diameter, slightly rounded, and very unequal in size at the margin, alternating below, the short ones merely rudimentary; the longer ones gradually slope to the smooth convex space in the bottom of the calix, and abruptly terminate. Fossette consists of a deep depression, at the anterior margin, of the smooth convex space in the bottom of the cup, and extends to the margin of the calix.

The specific name is in honor of Dr. Otto Oppelt, of New Albany, Ind., an expert chemist, and an ardent collector.

Found in the Knobstone group, (sub-carboniferous), at Stone's Farm, one and one-half miles east of Bridgeport, Clark county, Indiana. Now in the collection of the author.

## ZAPHRENTIS BREVICORNIS, N. Sp.

PLATE 15. FIGS. 7-8.

Corallium simple, turbinate, straight, or regularly curved. Acute at the base of attachment. Regularly expanding in diameter to the calix. Height on the side of the longest curvature, seventy millimeters; shortest side, thirty-five millimeters. Calix oblique, thirty-five millimeters in diameter. Depth thirty millimeters. A smooth convex space in the bottom of the calix, occupied by the tabulæ, eight millimeters in diameter. Number of lamellæ, one hundred in the circumference of a calix, thirty-five millimeters in diameter; unequal in size at the margin, alternating below; the short ones are twelve or fifteen millimeters in length, the longer ones continue to the smooth convex space in the center of the calix, and abruptly end. Exterior with a few broad, rounded annulations and deep constrictions, caused by intermittent growth. Fossette consists of a slight depression at the anterior margin of the convex space, in the bottom of the cup, and continues as a shallow groove to the margin of the calix.

Found in the upper Devonian (Hamilton group), near Charlestown, and in the strippings, above the cement rock, at the different quarries throughout Clark county, Indiana. Now in the collection of the author.

## ZAPHRENTIS ALBERSI, N. Sp.

## PLATE 15. FIGS. 9-10-11

Corallum simple, turbinate, majority of specimens slightly compressed, straight, or gradually curved. Acute at the point of attachment. Gradually increasing in diameter to the calix. Height varying in different individuals, from thirty to thirty-five millimeters. Calix somewhat compressed, twenty five millimeters in its longest diameter. Depth fifteen millimeters. A flat space in the bottom of the calix, occupied by the tabulæ, ten millimeters in diameter. Number of lamellæ, ninety, in the circumference of a calix, twenty-five millimeters in diameter, slightly unequal in size at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones terminate; the longer ones continue to within two millimeters of the center, and abruptly ends, leaving a convex space in the center of the calix, four millimeters in diameter. Fossette consists of a deep depression at the margin of the convex space in the center of the cup, and extends to the margin of the calix. Exterior with shallow, irregular annulations, and constrictions, caused by periodical growth; longitudinal striæ distinct, seven in the space of five millimeters.

The specific name is in honor of Mr. A. Albers, of Cincinnati, Ohio, the artist who engraved the figures on this plate.

Found in the Middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

## CYATHAXONIA BORDENI, N. Sp.

## PLATE 14. FIGS. 3-4-5-6.

Corallum simple, turbinate, regularly curved. Acute at the base of attachment, regularly, and gradually expanding in diameter to the calix. Height twenty to twenty-five millimeters. Diameter of calix eight millimeters. Depth five millimeters, with nearly vertical walls. A smooth conical elevation in the bottom of the calix, two millimeters in diameter at the base, and three millimeters in height. Number of lamellæ, thirty-six, in the circumference of a calix eight millimeters in diameter, broadly rounded, and equal in size at the margin, alternating below, rapidly sloping to the bottom of the calix, where the short ones terminate; the longer ones continue, to the margin of the smooth conical space, and abruptly end. No fossette visible in any of the examples examined.

This species is easily recognized from *Cyathaxonia Cynodon* of (Rafinesque and Clifford), by the absence of spines, and being more regularly curved.

Found by Prof. W. W. Borden, in whose honor the specific name is given, in the Knobstone group (Sub-carboniferous) at Stone's Farm, one and a half miles east of Bridgeport, Clark county, Indiana. Now in the collection of the author.

CYATHAXONIA PARVA, N. Sp.

PLATE 14. FIGS. 7-8-9.

Corallum simple, turbinate, regularly curved. Acute at the base of attachment, gradually, and regularly expanding in diameter to the calix. Exterior comparatively smooth, with a few shallow undulations of growth. Longitudinal striæ rather fine, distinct, ten in the space of five millimeters. Height thirty millimeters. Diameter of calix ten millimeters. Depth five millimeters. Walls nearly vertical. A smooth conical elevation in the center of the calix, two millimeters in diameter at the base, and three millimeters in height. Number of lamellæ fifty, in the circumference of a calix ten millimeters in diameter, unequal in size, and sharp at the margin, alternating below, rapidly descends to the bottom of the calix, where the short ones terminate; the longer ones continue to the margin of the conical area, in the bottom of the calix, and abruptly end, leaving the conical elevation smooth. No fossette visible in any of the examples examined.

The numerous sharp and unequal lamellæ, and more robust form, and somewhat larger calix, makes this easily recognized from all other species.

Found in the Knobstone group (sub-carboniferous), at Stone's Farm, one and a half miles east of Bridgeport, Clark county, Indiana. Now in the collection of the author.

PTYCHOPHYLLUM ROBUSTUM, N. Sp.

PLATE 14. FIGS. 1-2.

Corallum simple, turbinate, straight or regularly curved. Acute at the base of attachment. Gradually or in some examples rapidly increasing in diameter to the calix. Exterior with a thick, comparatively smooth epithecal crust, and rather distant, shallow annulations, more strongly pronounced on the anterior side. Height varying in different individuals, from seventy, to one hundred and twenty millimeters. Calix broad, bell-shaped, from thirty-

five to sixty millimeters in diameter. Depth from fifteen to thirty millimeters; a convex space in the bottom of the calix, occupied by the tabulæ, from fifteen to thirty millimeters in diameter, elevated in the center, with the margins slightly bending downward. Number of lamellæ, one hundred and forty-four, in the circumference of a calix, sixty millimeters in diameter, broadly rounded, and unequal in size at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones terminate; the longer ones continue for about five millimeters farther, coalescing with the adjacent longer ones, and are in some cases twisted, and terminates; a few continues blending with the tabulæ, and giving the bottom of the calix a rugose appearance. Fossette consists of a deep depression, some little to the right, of the posterior side of the tabulæ, but does not extend more than four or five millimeters on the side of the calix.

The measurements given are for the two examples illustrated; the variations are due to the difference in size of the two corallums.

Found in the lower Devonian (Corniferous group), at the Falls of the Ohio. Now in the collection of the author.

#### MICHELINIA BRIDGHAMI, N. Sp.

#### PLATE 14. FIGS. 14-15-16.

Corallum small, rarely ever exceeding two inches in diameter, more frequently less. Convex or globular. Composed of an aggregation of thin walled funnel-shaped tubes, with a strong epithecal crust on the basal side, frequently attached to fragments of crinoid columns. Tubes rounded, polygonal, unequal in size, from two to ten millimeters in diameter. Tubes decorated with numerous rows of longitudinal grooves. Pores large, round or oblong, very numerous, situated in the grooves. Tabulæ rarely observed.

The thin walls, and unequal sized tubes, the deep longitudinal grooves and the numerous large round, or oblong pores, make this easily recognized from all other species.

The specific name is in honor of Mr. Joseph Bridgham, of Providence, R. I., the artist who made the pen drawings for the photo engraving of this plate.

Found in the upper Devonian (Hamilton group), at Charlestown, and above the cement beds, at the different cement quarries, northwest of Silver Creek, in Clark county, Indiana. Now in the collection of the author.

## FAVOSITES CLAVATULUS, N. Sp.

PLATE 15. FIG. 1-2-3.

Corallum composite, from thirty millimeters, to eight inches or more in length. Diameter, nearly the same throughout the entire length, not exceeding thirty millimeters in its greatest width. Tubes rounded, polygonal, unequal in size, from one to two and one-half millimeters in diameter. Walls thin, and comparatively smooth, pores round, rather large, not closely arranged, one and two rows on a side; where there is two rows they are slightly alternating in position; tabulæ flat or slightly oblique. Between the tabulæ there are a few spine like projections, but do not extend to the center of the tubes.

There is no other species, in the Corniferous group, that could be mistaken for this one; the long, slender mode of growth, the thin walls, and the large pores, makes this easily recognized from all other species.

Found in the lower Devonian (Corniferous group) at the Falls of the Ohio. Now in the collection of the author.

## FAVOSITES ROTUNDUS, N. Sp.

PLATE 15. FIGS. 4-5-6.

Corallum composite, variable in size, from one to six inches in diameter, round or hemispherical, or sub-hemispherical; some examples, have a diameter of five or six inches, and a thickness not exceeding one inch. With a strong, wrinkled epithecal crust on the basal side. Tubes rounded, polygonal, unequal in size, from one to three millimeters in diameter, or slightly more in some tubes. Walls rather thick, somewhat smooth. Pores rather large, round, from one to three rows on a side. Tabulæ flat, or oblique, in some places very much crowded, in others more distant.

Some examples have the appearance of *Favosites Hemisphericus* (Yandell & Shumard) but on comparison, there is a marked difference in the variation, of the size of the tubes, and the number of rows of pores. From *Favosites Tuberosus* (Rominger) it differs in the mode of growth, and the number of pores, and the tubes are not so complicated with squamæ, as in *F. Tuberosus*.

Found in the lower Devonian (Corniferous group), at the Falls of the Ohio. Now in the collection of the author.

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**ZAPHRENTIS ALBUS, N. Sp.**

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**PLATE 16. FIGS. 11-12.**

Corallum simple, turbinate, irregularly curved, a small scar at the base of attachment. Height thirty millimeters, for about ten millimeters, rapidly, then gradually expanding in diameter to the calix. Exterior, with sharp annulations, and deep constrictions, and wrinkles, caused by intermittent growth. Calix very thin and somewhat campanulate, twenty millimeters in diameter, with nearly vertical walls. Depth twelve millimeters, tabulæ smooth, flat, occupying slightly less, than the entire diameter of the corallum. Number of lamellæ, sixty, in the circumference of a calix, thirty millimeters in diameter, somewhat sharp, and slightly unequal in size at the margin, alternating below, the short ones becoming thinner as they approach the bottom of the calix, and are faintly indicated on the margin of the tabulæ, the longer ones, are slightly elevated, growing thinner as they descend to the bottom of the calix, and abruptly end, leaving a smooth convex space in the bottom of the calix, ten millimeters in diameter. Fossette, consists of a shallow depression on the anterior side of the tabulæ, but does not extend on the side of the calix.

Found in the middle Devonian (upper Helderberg group) Falls of the Ohio. Now in the collection of the author.

**ZAPHRENTIS CURTUS, N. Sp.**

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**PLATE 16. FIGS. 13-14.**

Corallum simple, turbinate, straight or regularly curved. Acute at the base of attachment, rapidly expanding in diameter to the calix. Height forty-five millimeters. Calix broad, thirty-five millimeters in diameter. Depth fifteen millimeters. A convex space in the bottom of the calix, occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ, one hundred and thirty-eight, in the circumference of a calix, thirty millimeters in diameter, thin and sharp, and equal in size at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones terminate: the longer ones continue to within four or five millimeters of the center of the calix, and abruptly end leaving a smooth convex space in the center of the cup, from eight to ten millimeters in diameter. Fossette consists of deep depression, on the anterior side of the smooth convex area, but does not continue on the side of the calix. The lateral gaps, are represented by two small depressions,

but does not extend on the side of the calix. Exterior, with deep constrictions, and wrinkles, caused by periodical growth.

The thin numerous lamellæ, and the broad deep fossette; with the small depressions in the lateral gaps, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

ZAPHRENTIS INFLEXUS. N. Sp.

PLATE 16. FIGS. 15-16.

Corallum simple, turbinate, straight or regularly curved. Acute at the base of attachment, rapidly expanding in diameter to the calix. Height forty millimeters. Calix broadly campanulate thirty millimeters in diameter. Depth twenty millimeters, a convex space in the bottom of the calix, occupied by the tabulæ, ten millimeters in diameter. Number of lamellæ, eighty, rounded and slightly unequal in size at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones terminate, the longer ones continues to the bottom of the calix, coalescing, and slightly twisting, but not elevated, giving to the lamellæ in the bottom of the calix, a zig zag appearance. Fossette, consists of a deep depression, on the posterior side of the tabulæ, but does not extend on the side of the calix.

The manner of coalescing of the lamellæ and the zig zag appearance in the bottom of the calix, makes this easily recognized from all other species.

Found in the middle Devonian (upper Helderberg group) Falls of the Ohio. Now in the collection of the author.

ZAPHRENTIS PUSILLUS. N. Sp.

PLATE 16. FIGS. 17-18-19.

Corallum simple, rather small, turbinate, straight or slightly curved. A small scar at the base of attachment. Rapidly expanding in diameter to the calix. Height varying in different individuals, from twenty to thirty millimeters. Calix broad, from ten to thirty millimeters, in diameter. Depth ten millimeters. Exterior somewhat rough, with shallow annulations, and wrinkles, caused by intermittent growth, longitudinal striæ conspicuous, fourteen in the space of ten millimeters, number of lamellæ, ninety-four, in the circumference of a calix twenty-five millimeters in diameter, unequal in size at the margin, the short ones merely rudimentary, the longer ones gradually slope to near the

center of the calix, coalescing, and abruptly terminate, leaving a smooth flat space, from two to four millimeters in diameter, in some examples the lamellæ continues until it meets those on the opposite side, and abruptly end, leaving the bottom of the calix flat. Fossette consists of a slight depression near the center of the calix, and continues to the anterior margin.

Found in the middle Devonian (upper Helderberg group) Falls of the Ohio. Now in the collection of the author.

ZAPHRENTIS LAMASTERI. N. Sp.

PLATE 17. FIGS. 4-5.

Corallum simple, turbinate, straight or regularly curved. Acute at the base of attachment. Height sixty-five millimeters. Calix slightly or broadly bell-shaped, thirty millimeters in diameter. Depth twenty millimeters. Walls nearly vertical. A convex space in the bottom of the calix, occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ, eighty in the circumference of a calix, thirty millimeters in diameter, equal in size, and broadly rounded at the margin, getting thinner, and alternating below, abruptly sloping to the bottom of the calix, where the short ones terminate, the longer ones continue, to within two or three millimeters of the center of the calix, and abruptly end, leaving a flat smooth convex space in the bottom of the calix, five or six millimeters in diameter. Exterior with numerous irregular annulations, and shallow constrictions, and wrinkles, caused by intermittent growth. Fossette consists of a deep depression, on the sinistral side of the tabulæ but does not extend on the side of the calix.

Found in the upper Devonian (Hamilton group) by Mr. Thomas J. Lamaster, of Speed, in whose honor, the specific name is given, at the Clark county cement quarries, Clark county, Indiana. Now in the collection of the author.

ZAPHRENTIS INSOLENS. N. Sp.

PLATE 18. FIGS. 1-2.

Corallum simple, turbinate, or elongate turbinate, straight or curved, attenuate at the base of attachment, gradually or sometimes more rapidly expanding in diameter to the calix. Height from sixty to one hundred millimeters, or more, varying in different individuals. Exterior with broad shallow annulations, and occasionally, a few deep constrictions. Calix oblique, rather deep, with the extreme margins slightly contracted, with a diameter of forty

millimeters. Depth thirty millimeters, with a smooth oblique, concave space in the bottom of the calix, occupied by the tabulæ, ten millimeters in diameter. Number of lamellæ, one hundred, to one hundred and ten, in the circumference of a calix, forty millimeters in diameter, very thin, and sharp, equal in size at the margin, alternating below, gradually or sometimes rapidly sloping to the edge of the smooth concave space, in the bottom of the calix, where the short ones abruptly terminate, the longer ones extend a short distance further, and blends with the tabulæ, and disappears, leaving a concave space, in the bottom of the calix, from six to eight millimeters wide. Fossette consists of a deep depression, situated at the edge of the concave space in the bottom of the cup, and extends to the anterior margin.

Found in the upper Devonian (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

CYSTIPHYLLUM LOUISVILLENSIS. N. Sp.

PLATE 16. FIGS. 7-8-9-10.

Corallum simple, turbinate, or broadly subturbinate, usually straight. Acute at the base of attachment, near the base there is slender, root like, prolongations, which served as attachment to other objects for support. Height varying in different individuals from fifteen to fifty millimeters. Calix broad, shallow, from twenty to forty millimeters in diameter. Depth ten millimeters. The entire surface of the calix, is covered with moderately large, somewhat uniform sized cysts. When the calix is fairly preserved, the cysts are covered with fine striæ, but is not so strongly pronounced, as to appear as lamellæ. Exterior when decorticated shows the vesicles to be oblong in shape, and irregular in size, the large ones being more concave than the smaller ones, occasionally from two to four course elevated lines can be observed in the large oblong concave vesicles.

Found in the upper Silurian (Niagara group) at the Bear-grass creek quarries, near Louisville, Ky. Now in the collection of the author.

CYSTIPHYLLUM EXPANSUM. N. Sp.

PLATE 17. FIGS. 6-7-8.

Corallum simple, broadly sub-turbinate. Acute or slightly thickened at the point of attachment. Rapidly expanding into a broad shallow cup. Length on anterior side, fifty-five millimeters, Length of posterior side, twelve milli-

meters. Exterior with a strong epithecal crust, with numerous fine longitudinal striæ, and shallow constrictions, and wrinkles, caused by periodical growth. In decorticated examples, they exhibit numerous shallow oblong cysts, occasionally, having traces of fine striæ, in the concave spaces. Calix very broad, oblique, varying in different individuals, from twenty to forty millimeters in diameter, near the margin of the cup, there is a few vesicles, but the bottom of the calix is perfectly smooth, the corallum appears to be composed of thin invaginated cups.

Found in the middle Devonian (upper Helderberg group), Falls of the Ohio. Now in the collection of the author.

### CYSTIPHYLLUM DIVERSUM. N. Sp.

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#### PLATE 17. FIGS. 9-10.

Corallum simple turbinate, straight or regularly curved, with a broad scar at the base of attachment. Gradually expanding in diameter to the calix. Height twenty-five millimeters. Calix broad, oblique, with spreading margins forty millimeters in diameter. Depth twenty millimeters. The bottom of the calix, is covered with numerous vesicles, larger than those on the sides, and near the margin of the cup. There is numerous, rather coarse Septa, that seems to interfere with the vesicles, and the two blend together, giving to the calix, a peculiar rugose appearance. Exterior when decorticated, exhibits numerous somewhat coarse vesicles, a few shallow constrictions, and wrinkles, caused by periodical growth.

Found in the upper Devonian (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

### BLOTHROPHYLLUM CONIFERUM. N. Sp.

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#### PLATE 16. FIGS. 2-3-4-5-6.

Corallum simple, elongate turbinate, or conico-cylindrical, straight or gradually or sometimes irregularly curved. Acute at the base of attachment, in some examples there is short root like processes near the base which served as attachments to some foreign objects for support. Gradually, or at times more rapidly expanding in diameter to the calix. Height varying in different individuals, from thirty to one hundred millimeters or more. Calix broad, bell-shaped, thirty millimeters in diameter. Depth twenty-five millimeters. A convex space in the bottom of the calix occupied by the tabulæ twelve millimeters

in diameter. Situated in the center of the calix is an elevation, formed by the elevated tabulæ, five millimeters in height. Number of lamellæ sixty, in the circumference of a calix, thirty millimeters in diameter, unequal in size at the margin, and alternating in length, for about ten millimeters, gradually, then rapidly slope to the bottom of the calix, where the short ones terminate, the longer ones become elevated, and thinner, as they continue to the bottom of the calix. Coalescing and twisting into a sharp crest on the elevated tabulæ.

In a great number of examples examined, I have failed to discover any trace of a fossette.

Found in the middle Devonian (upper Helderberg group), Falls of the Ohio. Now in the collection of the author.

### HELIOPHYLLUM ROWLEYI, N. Sp.

#### PLATE 16. FIG. 1.

Corallum simple, elongate turbinate, or conico-cylindrical, straight or irregularly curved, or distorted. Acute, or in some examples, they have a broad scar, at the base of attachment, and occasionally, an example will have slender root-like processes near the base, for attachment, to foreign objects for support. Gradually, or at times, rapidly expanding in diameter to the calix. Height varying in different individuals, from six to fourteen inches or more. Calix broadly bell-shaped, thirty millimeters in diameter. Depth twenty-five millimeters, a smooth convex space in the bottom of the calix occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ ninety, in the circumference of a calix, thirty millimeters in diameter, alternating in size, the small ones merely rudimentary; the longer ones for about ten millimeters, gradually slope, then abruptly turn down, and continue until they reach the tabulæ, leaving a smooth convex space in the bottom of the calix, ten millimeters in diameter. Exterior when decorticated has a very rugose appearance. Situated at somewhat regular intervals, there are funnel-shaped expansions, giving to the corallum, somewhat the appearance of a number of invaginated funnels. The lamellæ on these funnel-shaped expansions, are uniform in size, and length, and the denticulations are much finer than those in the calix. Fossette consists of a slight depression on the anterior side of the tabulæ, but disappears before reaching the margin of the calix.

The specific name is in honor of Prof. R. R. Rowley, of Louisiana, Mo.

Found in the lower Devonian (Corniferous group), at the Falls of the Ohio. Now in the collection of the author.

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**ACROPHYLLUM RUGOSUM, N. Sp.**

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**PLATE 17. FIGS. 1-2-3.**

Corallum simple, turbinate, or sub-turbinate, or sometimes conico-cylindrical, straight or irregularly curved. Acute at the base of attachment. Height varying in different individuals, from forty millimeters in small compressed examples, to seven inches in long horn-shaped or conico-cylindrical forms. The smaller examples, are usually in a better state of preservation, and exhibit numerous small spines near the point of attachment, and frequently extend for one or two inches above the base. Exterior, with more or less strong, rounded annulations, and deep constrictions, and wrinkles, caused by periodical growth. Calix somewhat expanding, rarely, though sometimes are circular, in this case, they have steep side walls. In the examples with expanded calix, the walls gradually slope to the bottom of the cup. Diameter of calix, varies from twenty to thirty-five millimeters, in the broadest examples observed. Depth from ten to twenty millimeters. Situated in the bottom of the calix, is a conical elevation, five millimeters broad at the base, and five millimeters in height, caused by the elevation of the tabulæ. Number of lamellæ, ninety, in the circumference of a calix, thirty millimeters in diameter, equal in size, and sharp at the margin, alternating below, gradually, or in some examples, rapidly sloping to the bottom of the calix, where the short ones disappear, or coalesces with the longer ones, then continues a short distance, and coalesces again, and a few continues coalescing with the elevated tabulæ. Fossette consists of a deep depression at the base of the conical elevation, and continues to the margin of the calix. Position variable.

Found in a silicified condition in the lower Devonian (Corniferous group) at the Falls of the Ohio. Now in the collection of the author.

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**CHONOPHYLLUM TYPICUM, N. Sp.**

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**PLATE 18. FIGS. 3-4-5.**

Corallum simple, turbinate, straight or curved, with a broad sear at the base of attachment. This peculiarity is more strongly marked in some examples than in others; occasionally the scars extend a short distance on the side of the coral; in these examples, small root-like processes set out, having the appearance of being attached to some foreign object. Regularly expanding in diameter to the calix. Height varying from ten to fifty millimeters. Exterior covered with a strong, wrinkled, epithecal crust, with a few broad, rounded annulations and

wrinkles. Diameter of calix thirty millimeters. Depth twenty millimeters. Number of lamellæ sixty, in the circumference of a calix thirty millimeters in diameter, equal and broadly rounded at the margin, slightly alternating below, gradually sloping to within five or six millimeters of the center of the calix, where the short ones abruptly ends; the longer ones continue to the center, and either ends, or is slightly twisted, not elevated. No fossette visible in any of the examples examined.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

### CHONOPHYLLUM INFUNDIBULUM, N. Sp.

PLATE 18. FIGS. 6-7-8-9-10.

Corrallum simple, turbinate, or elongate turbinate, straight or irregular curved. With a broad scar at the base of attachment, and sometimes continuing a short distance on the side of the coral. Exterior somewhat rugged, with coarse annulations and deep constrictions, caused by intermittent growth. Gradually and sometimes more rapidly expanding in diameter to the calix. Height varying in different examples from ten to eighty-five millimeters in the largest examples observed. Calix broad, somewhat funnel-shaped, from ten to forty millimeters in diameter. Depth ten to fifteen millimeters, with a deep convex space in the center of the calix, six or seven millimeters in depth, and four millimeters in diameter. Number of lamellæ, sixty-four in the circumference of a calix, thirty millimeters in diameter, thin, sharp, and equal in size at the margin, alternating below, gradually sloping to the edge of the deep convex space in the bottom of the calix, where the short ones gradually terminate; the longer ones continue and abruptly turns down the sides of the convex depression, and continue to the bottom, and gradually disappears. The deep convex space in the center of the cup gives to the calix the decided funnel-shaped appearance. No fossette. In appearance this may be mistaken for *C. Typicum*, but the thin, sharp lamellæ, and funnel-shaped calix, makes this easily recognized from all other species.

Found in the upper Devonian (Hamilton group), near Charlestown, Indiana. Now in the collection of the author.

## MONILOPORA BEECHERI Grabau

## PLATE 19. FIGS. 20, 21.

*Monilopora beecheri*, Grabau — (1899, Proc. Bost. Soc. Nat. Hist. vol. 28, p. 411, pl. 1, figs. 2-3, and pl. 2, figs. 1-5.)

Corallum regularly branching or forming a confused mass of intergrown tubes, which branch and repeatedly unite; the calices opening in all directions. Tubes expanding rapidly towards the calyx, below which they give off one or more lateral buds. Adjoining corallites frequently united by their walls.

Walls thick, especially in the lower portions of the corallite, consisting of numerous concentric lamellæ. These at intervals are separated so as to leave sub-equal lacunæ, which are traversed by numerous fine transverse bars or trabeculæ, rather irregularly disposed.

Visceral chamber of corallites open throughout, as in all the species of this genus. Corallites connected with their parent basally, except in old individuals where they have become constricted off, and the pores covered by a layer of sclerenchyma.

OBSERVATIONS.—In the two specimens figured there is a total absence of regularity of budding, the calices opening in all directions, and the individuals freely uniting. This indicates that the specimens were supported.

Specimen figure 21 is attached to one side of a crushed calyx and arms of *Platyerinus* (not drawn in the figure), but it is impossible to determine whether this attachment was accomplished before or after the death of the crinoid. The latter was probably the case.

Faint septal ridges are shown in a number of specimens, in some becoming quite strongly marked, and rather broad.

Specimen figure 20, probably encircled a crinoid stem, but the other specimen figured is too massive and seems to have grown in a suspended manner. Colonies encircling crinoid stems are not at all uncommon. Many merely surround the stem without seeming to affect it in any way, and in such cases the calices open in all directions. Others, however, have become imbedded in the substance of the crinoid stem, which has become enlarged, as is the case so generally with the European *M. crassa*. In some specimens observed, the crinoid stem has grown to such an extent as to completely bury the coral in its substance, only the calices remaining slightly raised above the surface of the stem. In such cases aside from the enlargement there seems to be no modification of the characters of the stem.

In a well preserved specimen from Edwardsville, Indiana, fine thread-like, but prominent, and slightly wavy encircling striæ were seen covering the cor-

allites. These striæ are irregular, and generally more than their width apart. They have the appearance of being minutely cancellated. This is the only surface ornamentation observed, all the other specimens seen having a smooth surface, or only showing faint costal striations.

HORIZON AND LOCALITIES.—In the Keokuk group of the Lower Carbonian of Crawfordsville and Edwardsville, Indiana, specimens figured with others in the collection of Mr. G. K. Greene.

CERATOPORA AGGLOMERATA. N. Sp. (Grabau.)

PLATE 19. FIGS. 22-25.

Corallum compound, consisting of agglomerate masses, unattached except basally. Corallites auloporoid, slightly curved, and gradually enlarging towards the aperture which is circular. A short distance below the termination of the corallite, one or two buds are given off, diverging at various angles; sometimes extending acutely upward; frequently at right angles to the parent, or occasionally extending downward. The buds themselves give off other buds which may extend in all directions. Corallites frequently joined by epithecal prolongations. Interior with circumferential cysts. Cysts rather sparingly developed, but usually of fair size. Septal spines small, short and comparatively stout; in numerous vertical rows.

OBSERVATIONS —This species is readily recognized by its singular branching corallites which form a confusedly agglomerate mass. The frequent rectangular divergence of the buds from the parent, gives rise to masses in which corallites of the third generation, may grow in a diametrically opposite direction from that taken by corallites of the first generation. Sometimes from crowding, a bud may grow in such a direction as to form a complete loop with its parent corallite. Not infrequently a number of corallites, budding one from the other, appear to form a ring around a corallite of an earlier generation which occupies the center.

No case has been observed in which there are more than two buds given off at the same level, this being the usual number. In this respect the species is like *C. dichotoma*, Grabau, but the buds are irregular as in *C. distorta*, Grabau. In some corallites, however, a second series of buds is given off at a higher level, and these, rebudding again, greatly increase the complexity of the whole corallum. In some cases, however, the corallites grow to a considerable length after giving off their first pair of buds, without producing a second series. While the buds are most frequently given off in pairs, the two are not always given off at precisely the same level, there being often a slight discrep-

ancy between them. This feature is occasionally seen in *C. dichotoma*, the most regular species of the genus, and is common in *C. distorta*.

When the corallites are united by the epithecal prolongations, a rugose surface is produced from the wrinkled character of the epitheca. Otherwise the surface is smooth, showing only fine concentric growth lines. When the corallites grow close together, they generally become inseparably united, and not infrequently the original circular section of the tube will be variously modified or distorted, and often become concave on the side of contact.

The less frequent development, in this species, of the cysts, is a characteristic feature. They are best visible in the calicinal portions, for as the known specimens of this species are all silicified, the interior structure has become more or less modified, and some of the cysts have been filled. There is, as in all the species of the genus, a complete absence of tabulæ, the corallites remaining open throughout, and united to their parent basally at least during the greater part of life. In many individuals the connecting pore is probably never closed, in others a sort of partition is formed over it by the extensive growth of spines. When the daughter corallite becomes separated from the mother tube, the pore may be covered by the formation of a cyst wall over it. Occasionally adjoining corallites have been found to be traversed by a single pore, this undoubtedly being a case of aborted budding. The septal spines appear generally much shorter than in the Devonian species, in this respect, and in the diminution of the cysts, approaching *Monilopora*. In a few cases, however, spines comparable to those of *C. dichotoma* and *C. distorta* have been observed. In some cases the interior of the wall appears perfectly smooth, the fine papillose spines being probably destroyed during the process of crystallization.

This species is closely related to *C. distorta*, Grabau, but I do not think that the two are identical. The profusely branching specimen figured on plate 3, fig. 7, Vol. 28, No. 16, Boston Soc. Nat. Hist. Proceedings, and referred to *C. distorta*, has many characters of the present species, and forms a connecting link between the two. Though parallelisms in form occur, the structure of the two species is sufficiently distinct. The present species is also somewhat smaller than the prevailing forms of *C. distorta*.

HORIZON AND LOCALITIES.—In the Warsaw division of the St. Louis group, Lower Carbonian; Lanesville, Harrison county, Indiana.

Types in the collection of Mr. G. K. Greene.

#### ROMINGERIA CYSTOIDES, N. Sp. (Grabau.)

PLATE 20. FIGS. 19-23.

Corallum compound, erect, free except basally, consisting of numerous

more or less closely crowded corallites, which generally proceed in an umbelliferous manner from a parent corallite. Corallites elongate-conical to sub-cylindrical, widening at first rapidly, then more slowly, and finally retaining almost the same diameter throughout. Calicinal portion not infrequently inflated.

Corallites closely adnate for the greater part of their length, and connected by mural pores. Septa absent so far as known. Interior traversed by irregular lamellæ which extend across the cavity and frequently join each other, dividing the visceral cavity into a number of unequal cysts.

OBSERVATIONS.—This species is readily recognized by its rather coarse, though not large corallites, the mural pores and the irregular diaphragms which take the place of tabulæ. The corallites bud off from the parent in verticils of three or more, and they grow upward closely adhering to the old corallites, which also continue to grow and to embrace each other. They are closely united by the epitheca, which in some cases extends across several corallites, and in others effects the junction merely by root-like proliferations. The epitheca is wrinkled and the growth lines are strong, and this with the frequent irregular constrictions of the corallites, gives them a very rough and wrinkled appearance. The direction of growth is upward in most cases, but in some colonies (fig. 22) it is more irregular, the corallites growing loosely. In such cases the umbelliferous habit of growth is generally lost sight of.

When the head is a dense umbel, small corallites generally occupy the spaces between the larger ones, all being united by the epitheca direct, or by epithecal proliferations. When the corallites are closely joined by their walls, they are generally pierced by the mural pores, which put the corallites into communication with each other. These pores have been observed in a few specimens only (fig. 19), but they are undoubtedly present in most cases. In size they are such as would be made by a fine pin or needle. They are quite numerous, but irregularly disposed, and they are best developed where the neighboring corallites are closely adnate for their entire length.

The interior appears entirely smooth, not even septal spines having been observed. The diaphragms are very coarse and can hardly be classed as tabulæ, since they are too irregular and partake more of the nature of horizontal or slightly inclined cyst walls.

These diaphragms, together with the absence of septal spines, and general rugose character of the corallum, separate this species from the others of the genus, and may make it desirable to place it in a distinct genus. These features closely ally the present species to *CYSTELEMA*, S. A. Miller, of which the type *C. lanesvillense* occurs in the Warsaw group of Indiana. This genus, however, is stated to be simple, while the present species has the compound mode of growth and the mural pores of *Romingeria*. Under this genus it will be left for the present, until better preserved material allows the making of sections for the closer study of the internal structure.

The young corallites are early cut off from their parent, and the connecting pore closed by sclerenchyma.

HORIZON AND LOCALITY.—Warsaw division of the St. Louis group Lower Carbonian at Lanesville, Harrison county, and at Georgetown, Floyd county, Ind. Types in the collection of G. K. Greene.

## ENALLOPHYLLUM, N. Gen.

(Ety Enallos, changed; and Phyllon, a leaf.)

Corallum having tabulate area with vertical walls, resembling *Diphyphyllum*, and having a well developed fossette. Lamellæ occurs single or in pairs, not extending farther than the vertical wall in the center of the calix. Type *E. Grabaui*:

## ENALLOPHYLLUM, GRABAU, N. Sp.

## PLATE 20. FIGS. 8-18.

Corallum simple, or composite, increasing by gemmation from the superior margin of the parent cup, turbinate, straight or slightly curved. Acute at the point of attachment. Some examples have a broad scar at the base, some corallums have root-like prolongations that served for attachment and support. Exterior, when well preserved, exhibits numerous fine spines, distributed without any regularity, and frequently extends some distance on the side of the coral. Height varying in different individuals from ten to twenty millimeters or more in some examples. Calyx somewhat expanded, from eight to ten millimeters in diameter. Depth seven or eight millimeters, walls nearly vertical. Situated in the center of the calyx is a vertical wall occupying one-third or slightly more than the diameter of the corallum at that point. The tabulæ is smooth and strongly oblique, occupying the entire inner area. Number of lamellæ fifty-four, in the circumference of a calyx seven millimeters in diameter. Equal in size, and somewhat rounded at the margin, occurring in pairs except a single one that marks the continuation of the fossette, and three single ones on the opposite side to the fossette. Sometimes these three lamellæ coalesce, and in some examples where the cup is well preserved they are not united, the lamellæ extends to the vertical wall in the center of the calix, and abruptly terminates. The fossette consists of a deep depression at the margin of the smooth, oblique space in the center of the calix, and continues some distance on the side of the coral, the position of the fossette is variable. I have examples with the fossette on the anterior, and others having it on the posterior side.

Found in the Warsaw division of the St. Louis group (Sub-Carb.) at Lanesville, Indiana.

The specific name is in honor of Dr. Amadeus W. Grabau, Professor of Paleontology in the Rensselaer Polytechnic Institute of Troy, New York, now in the collection of the author.

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 HELIOPHYLLUM, COLLATUM. N. Sp.
 

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PLATE 20. FIGS. 4-5-6-7.

Corallum simple, or composite, increasing by lateral gemmation. In some examples the tubes are round, the margins free, or slightly in contact by their epithelial walls. In some other corallumns the cup margins are intimately connected in polygonal outlines. Diameter of corallites varies in different examples, and even in the same corallum, from five to fifteen millimeters. Depth from five to ten millimeters. Situated in the center of the calix is a smooth concave space, occupied by the tabulæ, five millimeters in diameter. Number of lamellæ forty-eight, in the circumference of a calix ten millimeters in diameter, equal in size at the margin, alternating below; gradually, or at times rapidly sloping to near the bottom of the calix, where the short ones gradually disappear; the longer ones continue to the margin of the smooth, concave space, and abruptly terminate. Denticulations fine, ten in the space of three millimeters. Exterior of corallites somewhat rugged, with annulations and wrinkles, and coarse, longitudinal striæ. No fossette observed in any of the cups.

Found in the middle Devonian (Upper Helderberg group) at the Falls of the Ohio, now in the collection of the author.

 HELIOPHYLLUM, HAMMELLI. N. Sp.
 

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PLATE 20. FIGS. 1-2-3.

Corallum composite, rapidly increasing, by calicular or lateral gemmation. Tubes rounded or polygonal, unequal in size, from five to seventeen millimeters in diameter. Depth seven to ten millimeters. Situated in the bottom of the calix is a smooth flat, or sometimes a concave space, occupied by the tabulæ, from five to seven millimeters wide. Stems rather lax in some places; in this case they are rounded, in other portions they are more intimately connected, and the ends of the tubes are joined in polygonal outline. Number of lamellæ sixty, in the circumference of a calix, seventeen millimeters in diameter; equal in size at the margin, alternating below, for about five millimeters from the margin, flat or slightly oval, then abruptly slope to the bottom of the calix, where the short ones gradually terminate, the longer ones continue to the margin of the smooth space in the center of the calix, and abruptly ends, leaving a smooth space in the center of the calix, from five to seven millimeters in diameter. Denticulations fine, ten in the space of six millimeters. No fossette visible in any of the cups.

The specific name is in honor of Mr. John Hammell, of Madison, Indiana.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

## HELIOPHYLLUM, SPICULATUM. N. Sp.

## PLATE 19. FIG. 1.

Corallum simple, broadly turbinate, a portion of the base is broken off, but was acute at the point of attachment when perfect. Rapidly increasing in diameter to the calix. Height five inches; diameter of calix three and one-fourth inches. Depth fifteen millimeters. Situated in the center of the calix, is a broad space occupied by the tabulæ twenty millimeters in diameter, somewhat undulating with a few spine like projections scattered over the surface. There is fifteen lamellæ in the space of fifteen millimeters, very thin and sharp at the margins, and in some places wider apart than in others, alternating below, the short lamellæ does not reach to the undulating tabulæ. The long lamellæ is thin and sharp and in some places is not denticulated; they reach to the undulating tabulæ, coalescing with two or three of the adjacent lamellæ and twisting, giving to this portion of the calix a very rugose appearance. In that part of the corallum where the lamellæ is broad and distant the sides are decorated with numerous spines, these appear more or less promiscuous throughout the corallum. Exterior when decorticated has the appearance of a series of thin invaginated cups with their margins crenulated. Denticulations moderately large, more strongly pronounced on the shorter lamellæ, than on the longer ones. Fossette consists of a deep depression on the side of the shortest curvature of the coral, and extends to the margin of the cup.

Found in the middle Devonian (upper Helderberg group) at Straw's mill, Clark county, Indiana. Now in the collection of the author.

## CYSTELASMA, SEPTATA. N. Sp.

## PLATE 19. FIGS. 10-19.

Corallum simple, turbinate, straight or slightly curved. Acute at the point of attachment. Some examples have a broad scar at the base, and occasionally one has root like prolongations that served for attachment and support. Height varying in different individuals from ten to twenty millimeters. Gradually enlarging in diameter to the calix. Diameter of calix from five to eight millimeters. The internal portion of the corallum is divided into three, four and sometimes five compartments, by vertical walls, extending the entire length of the coral. The tabulæ is well developed in each of these compartments, flat, oblique or funnel-shaped, closely arranged, or some little distance apart. All these features may be observed in a single corallum. No septa observed in any of the examples in my collection.

Found in the Warsaw division of the St. Louis group (Sub-carboniferous) at Lanesville, Harrison county, and at Spergen Hill in Washington county, Indiana. Now in the collection of the author.

## BORDENIA, N. Gen.

(Ety proper name.)

Corallum simple or composite, resembling Zaphrentis. Tabulæ complete with the central portion being smooth. Fossette well pronounced or scarcely more than rudimentary. Primary lamellæ well defined. Secondary lamellæ rudimentary or indicated by fine striæ. Type B. Zaphrentiformis.

## BORDENIA, ZAPHRENTIFORMIS. N. Sp.

PLATE 19. FIGS. 2-9.

Corallum simple or composite, turbinate, or sub-cylindrical, slightly curved, usually having a broad scar at the base of attachment, and some examples have root-like prolongations that served for attachment and support. Slightly enlarging in diameter to the calix. Height from ten to forty millimeters, varying in different individuals. Calix oblique, somewhat campanulate, from ten to twenty millimeters in diameter. Depth from three to ten millimeters, with vertical walls. In the bottom of the calix there is a flat oblique space occupied by the tabulæ, occupying the entire diameter of the corallum at that point. Number of lamellæ, fifty-two, in the circumference of a calix, fifteen millimeters in diameter, the short ones scarcely more than rudimentary; the longer ones are sharp, slightly elevated, rapidly descend to the bottom of the calix, and extend a short distance on the tabulæ, and gradually disappear, leaving a smooth, oblique space in the bottom of the calix, from five to six millimeters in diameter. This feature is only in corallums that have no buds; when there is buds the number of lamellæ cannot be made out. The exterior appears somewhat rugged, from the strong oblique wrinkles, and constrictions. The fossette is not well defined: it consists of a small depression on the side of the tabulæ, more strongly pronounced on the reversed side.

This coral has been labelled *Amplexus Coralloides* (Sowerby) Mineral Conchology; by many collectors. Mr. Sowerby supposed his specimen was a cephalopod shell and described it as such. If the genus *Amplexus* should be applied to corals, this coral would not be placed in that genus.

Mr. G. B. Sowerby, Jr., in *Conchological Manual*, second edition, 1842, page 64, says that *Amplexus*, a generic name proposed by Captain Brown for *Helix Pulchella*. Drop. 112, Tab. 107, page 134.

Found in the Warsaw division of the St. Louis group (sub-carb.) in Harrison, Floyd and Washington counties, Indiana. Now in the collection of the author.

## GOMPHOCERAS STRIATUM, N. Sp. (Rowley.)

PLATE 21. FIGS. 1-2-3-4.

The shell, as a whole, is pyriform and the tapering position is probably short. The outer surface is preserved and crossed by numerous fine striae, along the middle of the ventral side, by changing and rechanging direction, form a line of angles pointing backward but without any elevation of the surface beyond the general contour. The septa or chamber walls are unknown, except the last one, which is but slightly convex on the outer surface.

The siphuncle is located on the left side and is moderately large. The aperture is not large, with an elliptical top to a low "t." The shell is but slightly dorso-ventrally elliptical and with a slight curvature toward the dorsum.

A creeping Aulopora-like coral covers much of the surface. The type specimen is nearly three centimeters long, two and one-eighth in greatest breadth, by two in lesser diameter.

The shape of the aperture, the character of the striae, and the lateral position of the siphuncle, will readily serve to identify this species.

It comes from the Hamilton division of the Devonian, at Charlestown, Ind., and the type specimen is in the collection of Mr. G. K. Greene.

## GOMPHOCERAS BELLATULUM, N. Sp. (Rowley.)

PLATE 21. FIGS. 5-6-7-8.

The body is short, club-shaped, somewhat flattened dorso-ventrally. Surface quite smooth with very faint striae, passing circularly around the shell. The septa are moderately close together. The living chamber is shallow. The aperture is "t" shaped with rather a deep stem to the "t."

The inflated part of the shell passes gradually into the posterior position, not as abruptly as in the previous species. Length of specimen (Figs. 7 and 8) over three centimeters, the greater diameter (latteral)  $2\frac{1}{2}$  c. m., the lesser (dorso-ventral)  $1\frac{1}{4}$  c. m.

The specimens from which the description has been made were collected from the Hamilton beds of the Devonian at Charlestown, Ind., and are now in the collection of Mr. Geo. K. Greene, of New Albany, Ind.

## GOMPHOCERAS FACETUM, N. Sp. (Rowley.)

PLATE 21. FIGS. 9-10-11-12.

The body is pear-shaped, the front being greatly inflated. The aperture is almost a round-cornered triangle. The living chamber is not deep. The septa

(chamber walls) rather close, there being about nine on the specimen (Figs. 10 and 11). The shell is but slightly elliptical in cross section (laterally). The surface is crossed by fine lines of growth running circularly around the shell. The siphuncle is small and located ventrally. Length of figured specimen (Figs. 10, 11 and 12)  $3\frac{1}{8}$  centimeters, greatest thickness (laterally)  $2\frac{1}{2}$  c. m., dorso-ventral diameter  $2\frac{1}{4}$  c. m.

The shape of the aperture, ornamentation, position of the siphuncle, and greatly inflated body will readily distinguish this species.

Found in Hamilton division of the Devonian at Charlestown, Ind.

The types are in the collection of Mr. G. K. Greene.

GOMPHOCERAS OVIFORME, Hall Sp. Rowley.

PLATE 21. FIGS. 13-14.

It is elongate club-shaped and consists of portions of eight septal segments behind the living chamber. The condition of preservation is such that the siphuncle can not be located.

It is from the cherty layers of the Upper Helderberg Group at the Falls of the Ohio, and the specimen figured is the property of Mr. G. K. Greene.

CRANOCERAS? ELLIPTICUM, N. Sp. (Rowley.)

PLATE 21. FIGS. 15-16.

There is some doubt about the generic relation of this specimen. It consists of nine chambers, probably near the anterior portion of the shell. The sutures are straight and the siphuncle is small and near the ventral side. It is a portion of a shell that is accurate, and expands rather rapidly toward the front. Nothing is known of the living chamber, nor of the real shell surface as the type specimen is an internal cast. We are aware that *Cranoceras* is a Silurian genus while our type comes from the Hamilton (Devonian) beds near Charlestown, Ind. Collection of G. K. Greene.

TEMNOCHILUS? Sp.

PLATE 21. FIG. 17.

Is a drawing of a specimen broken across the whorls and still imbedded in the matrix. Where the septa are jagged they have been restored, but no attempt has been made to fill out the missing partitions and lost partitions of the siphuncle.

This beautiful specimen has been broken across in such a way as to show well the internal character of the shell. The siphuncle is a little nearer the outer than the inner side of the fossil. The septa are saucer shaped.

The figured specimen is from the collection of Mr. G. K. Greene, and was found three miles north of Lanesville, Ind., in Warsaw chert.

TEMNOCHILUS COXANUM, M. and W. Sp. Rowley.

PLATE 21. FIGS. 18-19-20.

The specimen consists of four chambers, injured on one side, and is a natural cast. A faint raised line extends down the middle of the outer side, while latterly there is a large node to every second chamber. The specimen is apparently part of an individual larger than the type specimen of *Temnochilus Coxanum* but from the same horizon.

It is from the Warsaw Limestone, three miles north of Lanesville, Ind., and the figured specimen is in the cabinet of Mr. G. K. Greene.

GRAMMYSIA IMBRICATA. Rowley.

PLATE 21. FIGS. 21-22.

This little Pelecypod seems to agree well with the above species, despite the horizon.

The original type came from the Lower Burlington Limestone, at Louisiana, Mo., but the author has seen it from the Chouteau, Upper Burlington and Cherty Keokuk beds of Missouri. It is interesting to note the occurrence of this shell in the Keokuk of Indiana. Now in the collection of G. K. Greene.

The species was originally figured and described in *The American Geologist*, vol. xxv., May, 1900.

CRANIA MODESTA, W. and St. J. Sp. Rowley.

PLATE 21. FIGS. 23-24.

This specimen is from the Upper Coal Measures of Hooser, Cowley County, Kansas, and belongs to the collection of Geo. K. Greene.

CRANIA DELICATA, N. Sp. (Rowley.)

PLATE 21. FIG. 25.

Two specimens only of this little crania have been seen by the author and both are undervalves, attached to the pedicel valve of *Productus tenuicostus*.

The specimens are circular in outline, devoid of markings, save the subcentral elevation, the perimeter appearing as a mere raised line. The plications of the Productus show plainly through the crania. The color is a little browner than that of the Productus.

The horizon is the St. Louis Group and the locality, Georgetown, Ind.  
Types in the collection of G. K. Greene.

CRANIA ? LEMONI, N. Sp. (Rowley.)

PLATE 21. FIG. 26.

There is considerable doubt in the author's mind as to the correctness of the generic reference.

The shells are parasitic, white and seem to be made up, for the most part, of a central elevation surrounded by a circular depression, outside of which is a circular ridge or elevation. They vary much in size but all are noticeably small. There seem to be no striæ or other ornamentation. The shape is circular.

The specific name is in honor of the discoverer, Dr. John Lemon, of New Albany, Ind.

Found in the Keokuk Group, at Edwardsville, Ind. The types are in Mr. G. K. Greene's collection.

SCAPHIOCRINUS ? LONGITENTACULATUS, N. Sp. (Rowley)

PLATE 21. FIG. 27.

The body of this crinoid has been so badly injured that nothing can be definitely determined as to the arrangement of the calix plates. However, striking peculiarities in the arms and ventral tube induce the writer to give a name to this very odd crinoid.

The arms are long, branched and of single pieces, alternately long and short, the former giving off the pinules which are composed of very elongate pieces. The outline of the plates of the ventral sack or tube can not be made out satisfactorily, but the tube itself is apparently coiled (recalling some of Angelin's Gotland crinoids) and consists of an outer rim with a double row of very small elongate elevations forming a middle zone or ridge, and one inner rim. The little elongate elevations of the middle zone seem to be pitted and the zone itself is elevated above the rims and traversed by a median toothed or broken ridge.

The long, strong arms, elongate pinules with their long segments and the coiled ventral tube will suffice to identify the species.

It was found in the Kaskaskia Group of the Subcarboniferous on White River below the shoals, Martin county, Indiana. The type is in the collection of Mr. G. K. Greene.

## HELIOPHYLLUM, AMPLIATUM, N. Sp.

## PLATE 22. FIGS. 1-2.

Corallum simple, turbinate or subturbinate, straight, or regularly curved. Acute at the base of attachment. Gradually enlarging in diameter to the calix. Height varying in different individuals from forty to one hundred millimeters or more. Exterior very rugged, with deep constrictions and wrinkles, caused by intermittent growth. When decorticated, it has the appearance of a number of thick invaginated cups. Calix broad, slightly oblique, forty-five millimeters in diameter. Depth twenty millimeters. A flat space in the bottom of the calix, occupied by the tabulæ, twenty-five millimeters in diameter. Number of lamellæ ninety, in the circumference of a calix forty-five millimeters in diameter, equal in size at the margin, alternating below for about five millimeters from the margin, they are flat or slightly oval; then gradually slope to the bottom of the calix, where the short ones gradually disappear; the larger ones are slightly elevated and sharp, and continue on the tabulæ to near the center of the calix, and abruptly end, leaving a narrow groove in continuation of the fossette. Fossette consists of a deep depression at the anterior side of the tabulæ, gets narrower and thinner, and disappears before reaching the margin of the calix. Denticulations very coarse, from one to one and a half millimeters apart.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

## HELIOPHYLLUM CONIGERUM, N. Sp.

## PLATE 22. FIGS. 3-4.

Corallum simple, turbinate, or elongate turbinate. Straight or slightly curved. Acute at the base of attachment. Height seventy millimeters. Gradually enlarging in diameter to the calix. Exterior with distant, shallow constrictions and wrinkles, caused by intermittent growth. Calix somewhat bell-shaped, thirty-five millimeters in diameter. Depth twenty-five millimeters. Situated in the bottom of the calix, is a convex elevation, caused by the elevation of the tabulæ, ten millimeters in diameter, and five millimeters in height. Number of lamellæ, one hundred and twelve, slightly unequal in size at the margin, alternating below, for about five millimeters gradually, then rapidly slope to the bottom of the calix, where the short ones terminate, the longer ones continues to the conical elevation in the center of the ca-

lix and gradually disappear; a few continues to the summit of the cone and abruptly ends, giving the surface of the cone a rugose appearance. Fossette consists of a deep narrow groove, commencing on the anterior side of the elevated tabulæ, and continues to the margin of the calix. Denticulations fine, ten in the space of six millimeters.

Found in the Upper Devonian (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

CYSTIPHYLLUM MULTICRENATUM, N. Sp.

PLATE 22. FIGS. 5, 6-7.

Corallum simple, turbinate, straight or slightly curved. Acute at the base of attachment, height varying in different examples, from forty to sixty millimeters. Exterior with numerous annulations, and sharp constrictions, caused by periodical growth. When decorticated, they have the appearance of a number of thin, invaginated cups, with fine crenulated margins. Calix broadly campanulate, from thirty-five to fifty millimeters in diameter. Depth twenty-five millimeters; the bottom of the calix is comparatively smooth, with a thin silicious coating of a white appearance. The lamellæ is very numerous and well defined. Equal in size and broadly rounded at the margin, growing narrower and thinner, and gradually disappears on reaching the smooth space in the bottom of the calix. The vesicles in the calix have the appearance of slight swellings, variable in size, those on the surface, when decorticated, are more numerous and well defined.

The broad rounded lamellæ and the appearance of the crenulations on the margins of the invaginated cups, gives it the decided appearance of a Chonophyllum.

Found in the middle Devonian (Upper Helderberg group) at the Falls of the Ohio, now in the collection of the author.

ZAPHRENTIS OBSCURUS, N. Sp.

PLATE 22. FIGS. 8-9-10.

Corallum simple, turbinate, straight or regularly curved. Acute at the base of attachment. Height varying in different individuals, from forty to sixty millimeters, regularly expanding in diameter to the calix. Exterior with distant rounded annulations, and wrinkles, caused by intermittent growth. Calix somewhat campanulate, from thirty to thirty-five millimeters in diameter. Depth twenty millimeters. A convex space in the bottom of the calix, occupied

by the tabulæ, twenty millimeters in diameter. Number of lamellæ eighty-six, in the circumference of a calix twenty-five millimeters in diameter, unequal in size at the margin, abruptly sloping to the bottom of the calix, where the short ones terminate, the longer ones continue, coalescing with the adjacent ones, and abruptly end on reaching the center of the cup. Fossette consists of a very slight depression on the anterior side of the tabulæ, but does not extend on the sides of the calix.

Found in the middle Devonian (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

PENTREMITES ALTUS, N. Sp. (Rowley.)

PLATE 23. FIGS. 1, 2(?)—3(?).

The basal region of this blastoid is quite convex and from the expanded character of the body at the tips of the ambulacra, the cup formed by the basal plates is rather large.

The radials are over half the length of the body, while interradials are nearly a fourth.

The ambulacra are about five-eighths the entire length of the body, moderately broad and scarcely sunken below the radial lips. The four spiracles are each doubled just within the external opening, by the sharp upper edge of the interradial plate, the latter thus extending near to the central summit opening. The anal opening is somewhat larger than a spiracle. A slight groove starts from the lower point of the interradial and extends to the tip of the ambulacrum, making with the lower interradial sutures an X in each interambulacral area. This feature recalls a similar one on *Lophoblastus*. On the weathered portion of the type, may be seen the outer side plates and pores, and below the ambulacrum itself the tips of the hydrospires.

This blastoid is much more contracted at the summit and expanded at the ambulacral points than *P. Pyriformis*. The shape of the body outside of the basal region is worn like, that of *P. Conoideus*.

The description is made out from figure 1, a specimen obtained at Newman's Ridge, East Tennessee. Fig. 2 is from near Bowling Green, Ky., and is apparently of the same species, differing in one or two minor features.

Both are from the Kaskaskia Group, and are in the collection of Mr. G. K. Greene.

## AOROCRINUS CASSEDAYI. Lyon. Rowley.

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 PLATE 23. FIGS. 4-5.

The broad disk is greatly expanded in this crinoid, recalling the rim in some species of *Eretmoerinus* and some of the larger *Dorycrini*.

All of the plates of the calix are strongly nodose and deeply pitted at the angles by the radiate arrangement of the sculpturing. The arm lobes are strong and separated by deep valleys, especially in a ventral view. There are four arm bases to the lobe or twenty in all. The anal opening is located laterally and on a distinct fold in the broad and deep depression above the anal interradial area, strongly recalling a similar feature in the *Dorycrini*. The plates of the vault are small, convex and the central one and the one at the junction of the ambulacral ridges in each of the five radial series are highly nodose, almost spinose. Wachsmuth and Springer who have given the only drawings of complete bodies of this crinoid make no mention of these ray spines, neither do they figure them.

Hamilton group near Charlestown, Ind. Collection of Mr. G. K. Greene.

AOROCRINUS CASSEDAYI Var. CHARLESTOWNENSIS,  
N. Var. (Rowley)

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 PLATE 23. FIG. 6.

Outside of the peculiar fluted appearance of the continued basal rim and the more complete channeling of the calix plates by the radiate sculpturing, this specimen, a calix only, differs little from our figures 4 and 5 of the plate. However, a complete body necessitate an entire specific separation.

From the Hamilton group near Charlestown, Ind., and in the collection of Mr. G. K. Greene.

## AOROCRINUS DEPRESSUS, N. Sp. (Rowley.)

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 PLATE 23. FIG. 7.

The small basals, only seen a dorsal view of the calix, form a small hexagon. The first radials are large and strongly nodose, with short ridges extending to the second radials and the first interradials. The second radials small, quadrangular, blunt, spinose. The bifurcated third radial, five sided and forming a sharp elevated ridge. The double series of radials above this latter consists of two plates each (higher plates being wanting in the specimen) and so expanded as to leave but narrow interradial spaces, suggesting an almost

complete calix in the type specimen. The first interradials, except the first anal plate, are larger than the first radials, ten sided, nodose and with short ridges to the surrounding plates. Above each of these are two very small nodose plates, apparently filling the entire upper part of each interradial area. The first anal plate is in the ring of the first radials, a little smaller, seven-sided, nodose. Above this plate are three smaller nodose plates, and above these three others much smaller, the specimen preserving three others yet higher in the area. The ventral disk is unknown to the writer.

The type is in the collection of Mr. G. K. Greene, who found it in the Hamilton Group, near Charlestown, Ind.

### STROPHOSTYLUS AMPLUS, N. Sp., (Rowley).

PLATE 23. FIG. 8.

This handsome shell in the height of the spire, and in the less rapidly expanding volution differs even more widely than *S. Cyclostomus* from the typical species of the genus.

Little can be seen of the aperture from the presence of the adhering stony material and the crushed condition of the lip, but it is probably nearly round. The cross lines of growth are finer than those on *S. Cyclostomus*, while the longitudinal strictions can hardly be seen without the aid of a glass.

Shell, subglobose; volution five, the last an outer one quite ventricose: testa thin.

In general outline our shell is nearer *Cyclonema* than *Strophostylus*, but wants the strong revolving ridge-like striae of the former. The ornamentation is nearer that of *Platystoma* than *Strophostylus*, wanting entirely the lamelle character of the latter.

The type is in the collection of Mr. G. K. Greene, and was found in the Niagara formation at Waldron, Ind.

### NATICOPSIS DUBIA, N. Sp., (Rowley).

PLATE 23. FIGS. 9, 10-11.

Shell rather large, rounded. Volution about five and expanding somewhat rapidly, the outer whirl being more than three-fourths of the height of the shell, round and ventricose.

Aperture more or less rounded or elliptical.

Foreign, silicious matter adheres to the under side of the shell in such a

way as to make uncertain the presence or absence of an umbilicus. Its presence would remove our shell from *Naticopsis*.

Transverse lines of growth cross the volutions, but apparently no other surface ornamentation.

This fine shell comes from the Keokuk Group of Pitcher's Point, Salt River, Ky., and the type specimen is the property of Mr. G. K. Greene.

PLATYSTOMA NIAGARENSE, Hall. Rowley.

PLATE 23. FIG. 12.

We give here the side view of a specimen from the Niagara Group of Waldron, Ind., with the outer volution free from the rest of the shell, and directed downward. This shell exhibits the most extravagant form of the species, and might well be given a varietal name were it not that extensive collections at the type locality show all grades of form from the lax to the closely coiled.

The specimen illustrated is from the Niagara Group, Waldron, Ind., and is the property of Mr. G. K. Greene.

SPIRIFERINA HORIZONTALIS, N. Sp. (Rowley.)

PLATE 23. FIGS. 13-14-15-36.

Valves unequal in length, the pedicel being quite one-third longer than the brachial. The greatest convexity in either valve is nearer the anterior than the posterior part of the shell and the greatest thickness at the middle of the pedicel valve.

A slight depression traverses the mesial fold, making it appear to be a double plication. Ten simple plications either side of the mesial fold.

A very indistinct elevation down the middle of the sinus. Ten plications on either side of the sinus.

The shell is crossed with crowded lamellose lines of growth. Cardinal extremities pointed but not acute. Cardinal area the greatest width of the shell and forms a low, broad triangle, confined entirely to the pedicel valve.

The horizontal position of the cardinal area where the shell rests on the middle of either valve, is the chief character of this little brachiopod. The character is constant, being shown by all the specimens before us, three double and two separate valves.

To the flattening of the pedicel valve immediately over the cardinal area is due this character.

The specimens were collected from the Warsaw limestone at Lanesville, Ind., and now in the collection of Mr. G. K. Greene.

## BLOTHROPHYLLUM GREENEI, N. Sp. (Rowley.)

PLATE 23. FIGS. 16-17-18-19-20.

This coral is extremely variable in form, sometimes elongate like *Amplexus* and at other times short like *Zaphrentis*, all the specimens being more or less tortuous.

The calix apparently not very deep but the rim is partly broken away in all the specimens examined.

The primary septa are very thin and do not reach the center, a portion of the uppermost tabulum appearing at the bottom of the oblique cup. A deep septal fossette is near one side at the bottom of the calix.

Secondary lamellæ occur as mere denticulations near the top of the cup rim. One calix is somewhat elliptical while another is quite round, conforming in general to the tortuous or irregular growth of the coral stem. There are, probably, not far from fifty primary lamellæ, but in the two specimens showing the calix they are greatly broken up in places, owing to their thinness.

The tabulæ extend throughout the length of the corallum, perhaps, and are seen along the side of broken and weather worn specimens, being slightly concave on the upper middle portion.

The blister-like plates of the outer zone are also to be seen on decorticated specimens.

The epithica is thin and through it may be seen the longitudinal striations corresponding to the septa.

Lines of growth are present.

One specimen only is entire at the base and is pointed, with a scar of attachment just above the twisted point as if the coral had actually half surrounded the stem of some object to which it had been attached.

Many of the specimens display numerous crowded lines of growth.

This interesting coral is named specifically for the collector, Mr. George K. Greene, of New Albany, Ind., in whose collection the specimens now are.

This species occurs one and one half miles east of Bridgeport, Clark county, Ind., in the Knobstone group.

## SPIRIFER LATERALIS, Var. DELICATUS, N. Var. (Rowley)

PLATE 23. FIGS. 21, 22-23.

The several specimen's of this shell differ much from Hall's figures and descriptions of *Spirifer Lateralis*. They are much smaller and have very much

finer plications, sharper in outline. The differences are hardly more than of varietal significance, however.

The figured specimens were collected from the Warsaw Limestone at Lanesville, Ind., and form a part of the collection of Mr. G. K. Greene.

ORBICULOIDEA PARVA, N. Sp., (Rowley).

PLATE 23. FIGS. 24-25.

The upper valve of this little shell is low, conical and circular. Apex elevated, eccentric (almost central in the largest or type specimen). Ventral valve unknown.

The shell is very thin and marked by very fine, closely arranged, concentric striae.

The specimens examined vary in size from minute ones to those as large as the type, and all came from the same nodule or coprolite, collected in the Knobstone shales at New Albany, Ind., by George K. Greene.

CRANIA ROBUSTA, N. Sp., (Rowley).

PLATE 23. FIGS. 26-27.

Shell depressed, conical. Beak of the convex valve sub-central, slightly curved toward the nearest side or border and fronting an ill-defined, triangular area. Surface apparently smooth, save concentric lines of growth.

The specimen figured is from the Knobstone Group, three miles west of New Albany, Ind., and is in the cabinet of Mr. G. K. Greene.

CRANIA DEPRESSA, N. Sp., (Rowley).

PLATE 23. FIGS. 28-29.

This shell is very much depressed, and has the beak very near the front, but hardly defined.

A few concentric lines of growth are present, but the surface is otherwise smooth. The general outline is roughly quadrangular.

The lower valve is unknown. The concave side of the upper valve as figured, shows the muscular scars.

The type specimen is from the Middle Devonian (upper Helderberg Group) Falls of the Ohio River. Collection of Mr. Geo. K. Greene.

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**PRODUCTUS PARVICOSTATUS, N. Sp. (Rowley).**

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**PLATE 23. FIGS. 30-31.**

Shell rather small, finely plicate. Ventral valve very gibbous. Length greater than the width. The ventral valve incurved and rounded at the cardinal line. The rapid convex growth or bending of the ventral valve throws the side of the shell, near the hinge line, into folds or crumples, crossing the plications a little obliquely. Irregularities of growth, may be due to injury, and change the direction of the plications at such places, but spines are apparently entirely wanting.

The dorsal valve is greatly concave and has the same fine striae. Lateral folds, and is devoid of spines.

This little *Productus* belongs to a well defined group of shells of varying sizes, and occurring from the base to the top of the Carboniferous.

A beautiful form occurs at Louisiana, Mo., in the Burlington Limestone, of larger size and of greater proportional length.

*Productus Parvicostatus* occurs in the Knobstone Group, 3 miles west of New Albany, Ind., and the types are in the collection of Mr. G. K. Greene.

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**PLATYCERAS CIRCULARIS, N. Sp. (Rowley.)**

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**PLATE 23. FIGS. 32-33.**

Shell ventricose. Spire slightly inrolled: the body of the shell rather rapidly expanding to the almost perfectly circular aperture. The concentric striae almost obliterated in the silicification of the shell.

The circular outline of the aperture and the slightly curved spire make it easy to identify this species.

The type comes from the Warsaw group at Lanesville, Ind., and is in the collection of Mr. G. K. Greene.

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**LEPETOPSIS LEVETTEI, White. Rowley.**

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**PLATE 23. FIGS. 34-35.**

This specimen is figured here, merely to call attention to the fact that the species is not confined to the Warsaw group from which the type specimen came, but is also found in the Keokuk limestone.

It is one of a number of species of fossils common to the two groups and

leaves little doubt in the writer's mind that the Warsaw beds are the top of the Keokuk group and not the bottom of the St. Louis limestone as usually considered.

The specimen figured was obtained from the Keokuk group at Edwardsville, Ind., by G. K. Greene, and is now in his collection.

MEGISTOCRINUS CORNIGER, N. Sp. (Rowley.)

PLATE 24. FIGS. 1-2-3-4.

Dorsal cup hardly as deep as the ventral cup with a width about three times the depth.

The concavity involving the basals and first radials and the flattened zone outside, even the middle of the third radials, give to the dorsal cup a decided basin shape.

The three basal plates form a hexagon. The first radials are hexagonal. The second radials of about the same size and likewise hexagonal. The third radials are bifurcating plates of seven sides and a little larger than either the second or first radials. The first interradials (interbrachials of W. and S.) are hexagonal and a little smaller than the first and second radials, being a little longer than wide. Two slightly smaller hexagonal plates rest on each of these first interradials.

The first anal plate is in line with the first radials and hardly less than they are in size.

Above this latter plate are three somewhat smaller anal interradials, higher plates can hardly be made out on the specimen, but are such as in other species of the genus. There are sixteen arm-bases and apparently thirty-two respiratory pores, two to each arm opening. Owing to the character of preservation these pores can be made out in one or two places only.

The plates of the ventral disk are small, but the sutures are indistinct.

The anal opening is eccentric, rather large and somewhat elevated. The plate at the junction of the ambulacral furrows and the central dome plate, each bear a short, strong spine, six in all.

The calix plates, apparently flat, or very slightly convex in places, and are ornamented by low, fine concentric lines. This species is a little higher, less spreading, and less lobes at the arm bases, than *Megistocrinus Expansus* of Miller and Gurley, and with much greater vault spines. The plate ornamentation is also apparently different.

The type came from the upper Devonian beds, near Charlestown, Ind., and belongs to the cabinet of Mr. G. K. Greene.

MEGISTOCRINUS EXPANSUS. Var. INFLATUS.  
N. var. (Rowley).

PLATE 24. FIGS. 5, 6-7.

The calix of this handsome *Megistocrinus* is low bowl shape. The basal plates and first radials are involved in the dorsal concavity which, however, is shallow, but broad.

The second radials and first interradials, form a more or less flattened zone surrounding the concavity.

The plates of the calix are of the normal number and arrangement, slightly concave and ornamented by fine radiate lines and granules. The ventral disk is somewhat inflated and made up of numerous small plates, flat or insensibly convex, apparently smooth. There are sixteen arm bases, grouped as follows: Beginning with the ray to the right of the anal region and going to the right, 4, 2, 4, 2, 4. The central dome plate bears a low spine and the plate at the junction of the ambulacral furrows, either side of the anal opening are similarly spinous, but the spines (three in number) are of much less size than those on *M. Corniger*.

The groups of arm bases are separated by depressions, as also the ray divisions to a less extent.

The anal opening is eccentric and apparently large.

One of the second interradials has a smooth, round hole through it, as if bored by some marine worm or other aquatic organism, and portions of both the calix and dome have barnacle-like shells attached, but all of these have been omitted in the drawing.

This fossil is near to Miller and Gurley's *M. Expansus*, but seems to differ sufficiently for the separation as a variety.

It was found in the upper Devonian beds near Charlestown, Ind., and belongs to the private collection of Mr. G. K. Greene.

MEGISTOCRINUS CIRCULUS. N. Sp. (Rowley).

PLATE 24. FIGS. 8, 9-10.

This unique crinoid has a low calix, expanding toward the circle of arm bases from the region of the second radials. The basals, first radials and parts of the second radials form a decided concavity, much more so than in the species above noticed. The usual arrangements and number of calix plates, modified to some extent to conform to the shape of the cup, flat or slightly concave, with low, fine linear ornamentation, apparently without definite arrangement.

The calix has a peculiar pinched look between the arm bases, the fold thus formed being thrown into sharp cross ridges.

There are sixteen arm bases, but the groups are not separated by noticeable depressions, the pinched appearance of the inter-arm areas giving an almost unbroken rim-like appearance to the peripheral region.

The vault is low, convex and rounded, made up of small, slightly tumid plates, without apparent surface ornamentation. The central dome plate has a small node, as also a plate above each arm group to the right and left of the anal region. The anal opening is eccentric, but the vault is broken in about it, rendering further description impossible.

The respiratory pores are two to the arm opening and are small slits.

This species belongs to the *Depressus* group, but may be readily recognized by the ornamentation, continuous peripheral rim, low, almost smooth dome, short, expanding calix, and the strong ornamentation of the small plates between the arm bases.

It is from the upper Devonian beds near Charlestown, Ind., and the type is in the collection of Mr. G. K. Greene.

#### MAGISTOCRINUS UNICORNIS, N. Sp., (Rowley).

PLATE 24. FIGS. 11, 12-13.

The region of the basals, first radials and parts of the second radials form a shallow concavity, bordered by a rounded zone. The calix is low and expanding rapidly to the arm region. The number and arrangement of the calix plates much as in the others already described, and nearly related species and varieties.

Arm bases of strongly lobed groups, the openings being sixteen in number, and slightly directed upward.

The ornamentation of the calix is quite obliterated in silicification, but probably consisted of low radiate lines. Plates flat. The vault is low, somewhat inflated at the center, but depressed at the arm lobes. Plates numerous, small, hardly convex near the center, but more pronounced about the ambulacral ridges.

The central dome plate spinose, and the eccentric anal opening looks like the base of a short proboscis, or is something more than a mere opening through the test.

The low, rapidly expanding calix, strongly lobed arm groups, single central dome spine and strongly defined anal opening will readily serve to identify this little species.

From the upper Devonian, near Charlestown, Ind., and the type is in Mr. G. K. Greene's collection.

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MEGISTOCRINUS EXPANSUS, Miller and Gurley. Rowley.

PLATE 24. FIGS. 14, 15-16

This little crinoid has a flat basal region, slightly concave about the columnar base and beyond the rounded plane, rapidly expanding to the arm region.

The calix plates are ornamented by radiate low lines, apparently breaking up into granules.

The arm arrangement is as in other species of this genus, usually sixteen openings. The arm lobes are strong.

The dome plates are smooth, a few about the ambulacral ridges being finely spinose. The central dome plate is acutely spinose.

The anal opening is eccentric.

From the Upper Devonian near Charlestown, Ind., and the specimen figured is the property of Mr. G. K. Greene.



## FAVOSITES SEAMANI, N. Sp.

## PLATE 25. FIG. 1.

Corallum ramose, with short, cylindrical, nodose stems, with a hollow central axis, when free from foreign substance. Tubes rounded, unequal in size, from one to two millimeters in diameter. Tabulæ flat or oblique, in places closely arranged, and complicated with squamæ, in other places more distant. Pores rather large, round, one and two rows on a side.

Some corallums, have broad thin basal expansions, and others are found attached to and completely covering the end of a stem of another coralla, and by its weight have broken the stem, and become free, or these may have been broken off by waves or currents.

The nodose character of the stems, and the hollow central axis, will readily distinguish this from all other species of the ramose type.

The specific name is in honor of Prof. A. E. Seaman, Professor of Natural Science in the Michigan Mining School, Houghton, Michigan.

Found in the Lower Devonian (Corniferous group) at the Falls of the Ohio. Now in the collection of the author.

## CERATOPORA FLABELLATA, N. Sp.

## PLATE 25. FIGS. 2, 3-4.

Corallum rapidly increasing by lateral gemmation, with closely aggregated tubules, spreading in fan-like expansions in more than one direction. Corallites closely connected more or less throughout their entire length, gradually enlarging in diameter to the margin of the calyx. Diameter of tubes varies in the same corallum from two to four millimeters, and occasionally there is a tube much larger. When the walls are in contact with each other, large rounded pores may be observed. The spines in the tubes are not well defined, but the bases can be seen in all well preserved tubes. Exterior with numerous annular lines of growth, more strongly pronounced near the margin of the tubes.

The Fan-like growth of the corallum, and the closely aggregated corallites, and their oblique dilated orifices, will distinguish this from all other species.

Found in the Upper Devonian (Hamilton group) in a cut on the B. and O. R. R., one and a half miles northeast of Jeffersonville, Indiana. Now in the collection of the author.

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 CERATOPORA SEPARATA, N. Sp.
 

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## PLATE 25. FIGS. 5-6

Corallum growing somewhat loose, rapidly increasing by lateral gemmation. Corallites short, cylindrical, more or less flexuous, with numerous broad, rounded annulations, and shallow constrictions, occasionally the walls are in contact their entire length; in other portions of the same corallum, the stems are free and in some places they are distant a tube diameter. The bases of the tubes rarely ever exceed two millimeters in diameter, gradually enlarging to the calyx. Diameter of calyx from three to five millimeters. Tabulæ funnel-shaped, and from the highly silicified condition of the coral, they appear like the vesicles in the cup of a *Cystiphyllum*. The spines or trabeculæ have been destroyed through silicification.

This is so unlike any other species of *Ceratopora*, found in the Hamilton group, that a comparison is unnecessary.

Found in the Upper Devonian (Hamilton group) at Charlestown, and in the strippings above the Cement rock, throughout Clark county, Ind. Now in the collection of the author.

 CERATOPORA NANUS, N. Sp.
 

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## PLATE 25. FIGS. 7, 8, 9-10.

Corallum small, increasing by lateral gemmation from the basal portion of the parent tubes. Basal portion of all the corallites broad, with a strong wrinkled epithecal crust. Tubes rounded, with numerous strong rounded annulations, and rough wrinkles, caused by periodical growth. The length of the corallites varies in different corallums, even in the same corallum, from four to eleven millimeters in length, in the longest tubes observed. Diameter of tubes from four to five millimeters. In some examples the tubes are connected throughout their entire length, while in others, after leaving the parent tube, they are free: this is the case sometimes in the entire corallum. Tabulæ when present, is concave or oblique; but in many tubes it is so intimately connected with the basal portion, that it can not be determined. The walls of the tubes when well preserved, are decorated with numerous fine longitudinal granulose lines, instead of spinules, as shown in other forms of *Ceratopora*.

Found in the Upper Devonian (Hamilton group), at Charlestown, and in the strippings above the cement beds, throughout Clark county, Indiana. Now in the collection of the author.

## CERATOPORA CONGLOMERATA, N. Sp

PLATE 25. FIGS. 11, 12-13.

Corallum medium in size, closely aggregated, or a promiscuous mass of tubes, or explanate when attached to other objects. Tubes nearly uniform in diameter throughout. Diameter of tubes one and a half to two millimeters: in well preserved tubes from five to seven rows of spines can be observed: in some places the long slender ones reach nearly to the opposite wall. The exterior is comparatively smooth, more especially when the tubes become free near the ends; in the attached portion they are more or less wrinkled and become distorted by pressure.

All the examples in my collection are attached to other corals, showing their habits to be parasitic.

Found in the Middle Devonian (Upper Helderberg group), at the Falls of the Ohio. Now in the collection of the author.

## NUCLEOCRINUS CUCULLATUS, N. Sp. (Rowley.)

PLATE 26. FIGS. 1-2.

The type specimen is almost spherical. Base concave, small.

Basal plates 3, covered by the upper stem joint.

The radial plates hardly visible on a side view.

Interradials almost the entire body length.

The ambulacra are narrow and slightly above the general surface.

The summit is slightly concave, and has a "tucked in" appearance.

The central summit opening is covered by small plates, whose number we have failed to make out.

The plate intercalated in the anal area, sulcate below, but above the surface from the middle of the specimen upward, projecting extravagantly above the ventral surface and forming a kind of hood over the anal opening.

The elongate triangular areas along the interradial sutures not very pronounced, except near the base, where they become quite concave. Nearly half way from the base to the summit in each interambulacral area, a double "M"-shaped depression crosses the triangular area like plate sutures, but merely a freak of ornamentation. The ornamentation is lines that pass from the ambulacra to the triangular area, and cross that area parallel to the radio-interradial sutures.

This handsome species is from the Middle Devonian beds at the Falls of the Ohio, and is in the collection of Mr. G. K. Greene.

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 NUCLEOCRINUS VERNEUILI, Var. Inflatus, N. Var. (Rowley)

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 PLATE 26. FIGS. 3, 4-5.

This variety is characterized by its full interambulacral areas, almost or quite smooth plates and rather broad base, due to the ventricose character of the body.

The anal plate is rather prominent, rising above the general contour and more or less produced at the summit. The ventral side of this form is covered over by a roof of plates, as in the illustration and the basal concavity is rather large, due to the shape of the body.

The ambulacra are rather narrow and the surface markings, though indistinct, differ little from typical *verneული*.

From the middle division of the Devonian at the Falls of the Ohio, and the figured specimens belong to the collection of Mr. G. K. Greene.

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 NUCLEOCRINUS VERNEUILI, Var. Sulcatus. N. Var. (Rowley.)

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 PLATE 26. FIGS. 6, 7-8.

This variety is chiefly characterized by the very distinct grooves or sulcations occupying about one-fourth of the width of the interambulacral areas and extending from base to summit, being quite deep between the ambulacral tips. These sulci divide the body into distinct, flattened lobes and give to the areas between them a canoe shape, the centers of which is occupied by the ambulacra.

The ornamentation of the interambulacral areas, bordering the ambulacra, are both cross lines and linear elevations, passing to the sulci a little obliquely.

The ornamentation of the depressed areas or sulci is cross, wavy or M-shaped lines.

The special anal plate is furrowed down the middle, and but little elevated above the general surface.

Its ornamentation is very similar to that of the other sulci.

The ambulacra are broader than in variety *Inflatus* and give room below for a less basal cavity.

The summit is covered by small plates as in *Verneული*, and there are ten spiracles as usual in the genus.

The radials bear the same proportion in length to the interradials as they do in *Verneული*.

Horizon, locality and collection same as last.

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NUCLEOCRINUS VERNEUILI. Var. Pomum (?) Etheridge & Carpenter, Rowley.

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PLATE 26. Figs. 16-17.

We refer doubtfully figures 16 and 17 to this variety. The form is more or less rotund and plump. The anal plate is outlined by strong sutures, but not elevated above the general surface. The radial plates are hardly visible on a side view in figure 16, being very short.

Figure 17 is a well preserved, more or less globose specimen, but more contracted at the base. The surface markings are rather peculiar as in the illustration, looking somewhat like plate sutures along the middle of the interambulacral areas. The transverse and longitudinal lines show beautifully under the lens. The basal cavity is a triangular pit, but the sutures of the basal plates are apparently obliterated.

Locality, horizon and collection same as the last.

NUCLEOCRINUS VERNEUILI, Troost, Rowley.

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PLATE 26. Figs. 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21-22.

PLATE 27. Figs. 17, 18, 19, 20, 21, 22, 23.

Figure 9, Plate 26, is an elongate form, hardly sulcate interambulacrally. Base rather deeply concave, contracted.

Ambulacra areas broad as in variety *Subvatus*. Anal plate flat except near the anal opening, where it is a little protuberant. Radial plates of the usual proportional length. Basal plates hidden in the basal concavity, three and small. Ornamentation as usual, cross and longitudinal lines.

Fig. 10, plate 26, is an anal side view of a less elongate specimen with scarcely any interambulacral sulcation.

The ventral covering of this specimen is beautifully preserved and presents the appearance of a five pointed star with the points toward the ambulacra.

The little plates themselves are covered with granular prominences. The anal plate is hardly elevated above the surface. The ambulacra are rather broad for *Verneuili*.

Fig. 11, plate 26, is a side view of a specimen that is almost flat interambulacrally and elongate, narrow base and usual ornamentation.

This flattening and tendency toward angular ambulacral ridges is an approach to *N. Angularis*. Outside of this the separation of the species is very great.

Fig. 12, plate 26, is an anal side view of another elongate specimen with flattened areas as in Fig. 11. This specimen shows the spiracles and anal opening free from foreign matter.

Fig. 13, plate 26, is drawn to show the unusually large size of the specimen. It is a veritable giant. The ambulacrum on the right is covered nearly half its length below by the adjacent edge of the interradiial plate, due perhaps to pressure, as the specimen is not symmetrical, being flattened somewhat laterally, and shorter on one side than on the other.

Figs. 14 and 15, plate 26, are summit and side views of a handsome small specimen of the elongate type. The anal plate on this is quite prominent, and all the interradiial plates, as well as the anal, are somewhat sulcate. The ventral roof of small plates is present and the spiracles are exposed.

Hidden in the small basal cavity of this specimen is the top stem joint as in figure 21.

Fig. 18, plate 26, is a finely preserved, elongate specimen, but somewhat mutilated on one side. The interambulacral fields are convex except near the top and the base, where they become a little sulcate. The ambulacra are of medium width and a little above the general surface. The anal plate is above the surface only near the top. The radials are about one-seventh the length of the body. The cross and longitudinal surface lines show well on the specimen.

Fig. 19, plate 26, is a side view of a slightly elongate specimen, showing rather strong ornamentation. The interambulacral areas are full, giving to a cross section an almost perfectly circular outline. The basal cavity is clean in this specimen, and the ventral covering in perfect condition, the little plates having a granular surface appearance.

Fig. 20, plate 26, is a side view of an elongate specimen with the interambulacral areas hardly convex, presenting much the appearance of figures 11 and 12. Only the top of the anal plate is above the general surface, and the base and summit present the usual appearances seen on well preserved specimens.

Fig. 21, plate 26, is a basal view of an imperfect, elongate specimen. The upper stem joint, with its round central perforation, occupies the center of the basal concavity. In this specimen the anal plate is not only sulcate, but above the general surface for over half its length.

Fig. 22, plate 26, is a side view of a small elongate specimen of almost circular cross section, the ambulacra being a little above the general surface, and the anal plate even more pronounced than in figure 21.

Fig. 17, plate 27, is an elongate specimen, almost circular in cross section, the anal plate arising but little above the general surface. The summit plates have been removed by weathering, and five little pits with sharp division walls (sutures) indicate their former presence. The spiracles and usual opening also show well on this specimen.

Figs. 18 and 19, plate 27, is an elongate specimen with but four ambulacra, the place of the fifth being represented by a line only. The base, however, is quite regular in outline. The central summit opening is closed by four large plates and a double series of smaller plates extend outward for a little distance over the ambulacra.

Fig. 20, plate 27. In this specimen the anal plate is bounded on either side by an extra, elongate, triangular plate, shorter on the left side, the whole forming an irregular protuberance above. Thus we have in this specimen, three anal plates. The central summit opening in Fig. 20 is closed by a roof of small plates.

Fig. 21, plate 27, is a basal view of a very elongated specimen, showing a beautifully preserved basal cavity with the top stem joint and its minute central perforation.

The outer sutures of the basal plates show in the pit, but could not be reproduced in the drawing.

The ornamentation of the radial and interradial plates is beautifully preserved in the specimen, and the folding of the radials about the lower ends of the ambulacra, form five little foot like projections.

Fig. 22, plate 27, is a side view of a plump specimen, in which again the anal plate is burdened on either side by what seems to be elongate triangular plates, but unlike figure 20, in that the triangles have their acute angles above, and their broadest part below. It is nearly impossible to determine, from the silicified character of the specimen, whether these are real plates or folds.

Fig. 23, plate 27, is a summit view of a specimen, in which the ventral surface is covered by a roof of granular plates, and the spade like ends of the interradials concave and granular.

In this specimen the anal plate is considerably elevated above the surface, near the summit, and the bounding edges of the interradials form elevated rims about the spiracles.

The base of this specimen is clean, and shows the sutures of the basal plates, and the anal plate is bounded, either side, by an apparent elongated triangular plate as in figure 22.

Horizon, locality and collection same as the last.

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 NUCLEOCRINUS ANGULARIS, Lyon, Rowley.
 

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## PLATE 27. FIG. 1, 2, 3-4.

The radial plates of this blastoid are short, the interradials occupying more than nine-tenths of the body length. The basals are three in number and rather small, extending but little beyond the upper stem joint.

The column is round, medium in size and with a small, round canal. The base is flat or but slightly concave. The interradial areas have the mid-triangular space hardly traceable, except in the anal field, where it is bilobed and with a central sulcus.

The ambulacra are narrow and with the upturned edges of the bounding interradials form five ridges with interambulacral valleys between.

The summit is slightly concave and the central opening is covered by a roof of small pieces.

The spiracles are elliptical, ten in number, and somewhat roofed over by the edge of the interradials. The anal opening is elongate oval. The anal area is noticeably wider than the other areas.

The ornamentation is faint, longitudinal lines, apparently nearly parallel with the ambulacra.

The three specimens figured are from the Upper Devonian beds near Charlestown, Ind., and form part of the collection of Mr. G. K. Greene.

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 NUCLEOCRINUS VENUSTUS, M. & G., Rowley.
 

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## PLATE 27. FIGS. 5, 6, 7-8.

This little blastoid evidently belongs to the Angularis group. Compared with *N. Angularis*, it is smaller, more elongate, less sharply five lobed, the interambulacral areas being less depressed. The mid-interambulacral triangles more sharply defined and giving to the ambulacral areas a lobed instead of angular appearance.

The base is flat or slightly concave. The basals are small and so is the column.

The plate ornamentation is like that of *Angularis*. The ambulacra are narrow. Spiracles and anal openings as in *Angularis*.

The central summit opening is covered by a roof of small plates.

The anal area is wider than the other interradial areas.

The radial plates seem to be a little longer in proportion to the interradials than in *Angularis*.

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From the Upper Devonian beds near Charlestown, Ind. Collection of Mr. G. K. Greene.

NUCLEOCRINUS GREENEI, M. & G., Rowley.

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PLATE 27. FIGS. 12, 13, 14-15.

This blastoid is very variable in size, some specimens of which are even larger than *N. Angularis*.

In a general way it is somewhat longer in proportion to the width than *N. Angularis*, but otherwise very closely resembles it. A cross section shows it quite as pentangular as the former.

The base is probably never concave, being flat or slightly convex.

The anal interradiar area is wider than the other four areas and the triangular areas are more pronounced than in *Angularis*.

The ventral side is flat, but probably never concave.

The spiracles and anal openings are not otherwise than in *N. Venustus* and *N. Angularis*.

The ambulacra stand out on sharp ridges.

Upper Devonian beds near Charlestown, Ind. Collection of Mr. G. K. Greene.

NUCLEOCRINUS STICHTERI, N. Sp. (Rowley).

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PLATE 27. FIGS. 9, 10-11.

Body elongate, somewhat contracted at the lower ends of the ambulacra and more inflated toward the summit.

A cross section would give an outline circular as in typical *Vernoni*.

The base is concave and the little foot-like projections in which the lower ends of the ambulacra rest, point outward and are quite prominent.

The radial plates are about one-sixth of the entire body length.

The ambulacra are narrow and hardly above the general convexity. The interambulacral triangles are hardly outlined.

The anal plate is but little above the surface, even near the summit.

The anal opening is more or less round, and there are ten spiracles.

The interradiar plates are about five-sixths of the body length.

The silicified condition of the specimens and their badly weathered character forbid further description.

This form is somewhat like *N. Obovatus* of Barris, but differing in many particulars, being much smaller.

It is much larger and longer than *N. Elegans*, with which it has little affinity beyond that of generic characters.

The specific name is for our co worker, the artist, Mr. Fred D. Stichter.

Upper Devonian beds near Charlestown, Ind. Collection of Mr. G. K. Greene.

#### NUCLEOCRINUS IMITATOR, N. Sp., (Rowley.)

PLATE 27. FIGS. 24, 25, 26, 27-28.

At a hasty glance this blastoid looks strikingly like *Orbitremites Norwoodi*, in shape and general outline.

The base is hardly concave, small. The basal plates are mostly hidden beneath the top stem joint.

The ambulacral "feet" point downward and the body is greatly lobed at that place.

The mid-interambulacral triangles form sulcations; otherwise the interradials would be flat, merely.

A cross section is pentagonal, but not nearly so strong as in *Angularis*. The length and width of body are about equal. The radials are about one-tenth the body length. The ambulacra stand out above the interradial lips and are quite broad for *Nucleocrinus*. The anal plate is but little above the surface near the top.

There are ten spiracles and a more or less round anal opening.

The ventral surface is flat and the central summit opening is covered by small plates.

The stem is small, as shown by the upper joint and the perforation is minute.

The ornamentation is lines more or less parallel with the ambulacra. The ambulacral areas are more rounded in this species than in *N. Angularis*.

From the Upper Devonian beds near Charlestown, Ind. Collection of Mr. Geo. K. Greene.

## HELIOPHYLLUM IGNOTUM, N. Sp.

PLATE 28, FIGS. 1-2.

Corallum simple, turbinate, or elongate turbinate, straight or curved, sometimes distorted or geniculated. In some examples the point of attachment is sharp, and in others there is a small scar that extends a short distance above the base. No root-like processes has been discovered on any of the specimens in my collection. Rapidly increasing in diameter to the calix. Height five inches; diameter of calix from two to two and one-half inches. Depth twenty-five millimeters. Number of lamellæ one hundred and twenty, in a calix fifty millimeters in diameter, unequal in size at the margin, alternating below, abruptly sloping to the bottom of the calix, where the short ones terminate, or coalesce with the longer ones, and continue to the center of the calix, for the last five or six millimeters, very faintly indicated on the tabulæ, fossette in some cups is strongly defined, in others it is interrupted by the coalescing and twisting of the lamellæ at that point; the position depends upon the curviture of the corallum; it is usually situated on the side of the longest curviture of the coral. Exterior with strong rounded annulations, and deep constrictions caused by periodical growth, denticulations coarse, about one millimeter apart.

Found in the Upper Devonian (Hamilton group) near Charlestown, Indiana, now in the collection of the author.

## HELIOPHYLLUM, ADNASCENS, N. Sp.

PLATE 28. FIGS. 3, 4-5.

Corallum simple or composite, increasing by calicular gemmation. Acute at the base of attachment. Sometimes there is a broad scar on the side, near the base of the corallum. Gradually and in some examples more rapidly expanding in diameter to the calix. Height from twenty to sixty millimeters. Calix broad, bell-shaped, from thirty to sixty millimeters in diameter. Number of lamellæ one hundred and four, in the circumference of a cup sixty millimeters in diameter, alternating in length, equal in size and rounded at the margin, becoming sharp as they descend to the bottom of the calix, where the short ones abruptly end; the longer ones continue coalescing, twisting, and is elevated into a convex cone, five millimeters in height. Fossette consists of a shallow depression in the bottom of the calix, continuing a short distance on the side of the cup, and disappears. Denticulations rather strong, sharp, ten in the space of eight millimeters,

Found in the Upper Devonian (Hamilton group) near Charlestown, Indiana, now in the collection of the author.

## ZAPHRENTIS AMPLEXIFORMIS, N. Sp.

PLATE 28. FIGS. 6, 7-8.

Corallum simple, elongate turbinate, straight or curved. Attenuate at the base of attachment, and in some examples there is a broad scar at the base, and extends a short distance on the side of the coral. Height varying in different specimens, from thirty to seventy-five millimeters, the longest example observed, gradually expanding to the calix. Diameter of calix twenty millimeters, depth twenty-five millimeters, with vertical walls, with a flat space at the bottom of the calix, occupying the entire inner diameter of the corallum at that point. Number of lamellæ seventy, in the circumference of a calix twenty millimeters in diameter; alternating in length, equal and rounded near the margins, in some examples continuing in this manner until they reach the bottom of the cup. In other corallums as they descend to the bottom they become sharp, and slightly elevated; on reaching the bottom of the calix the short ones terminate, the longer ones continuing to the center of the tabulæ, not elevated. Fossette not developed in all specimens; when it is, it consists of a slight depression at the margin of the tabulæ, not visible on the sides of the calix.

The broad tabulæ, the high vertical walls, and the flat, rounded lamellæ, makes this easily recognized from all other species.

Found in the Upper Devonian (Hamilton group), near Charlestown, Indiana, now in the collection of the author.

## ORBITREMITES OPPELTI, N. Sp., (Rowley).

PLATE 29. FIGS. 15, 16, 17, 18, 19-20.

Body subglobose, apparently slightly concave at the summit, and with a more or less shallow concavity at the base.

Interradials from one-fourth to one-third the entire length of the body, and flat or a little convex.

The radials are from two-thirds to three-fourths the entire body length, and slope from the ambulacra to the lateral sutures, giving a quite well defined five lobed appearance to the fossil from a basal view.

Basals hidden in the dorsal concavity, and unknown to the writer. Probably much as in *Orbitremites norwoodi*.

Ambulacra narrow, and composed of many side pieces, bordered on either side by a row of granules, otherwise the ambulacra would stand out above the general surface. As it is, they are even with the tops of the granules.

Of the character of the anal opening, spiracles and central opening nothing is known from the condition of the specimen.

The ornamentation of the deltoids is rows of heavy granules, often more or less confluent, parallel with the lower sutures or broadly V-shaped.

The radials are ornamented by strong rows of more or less confluent granules, parallel with the radio-deltoid and radial sutures or L-shaped inverted. Along the radio-interradial sutures, there is a sunken band or zone of small granules, and a groove along the radial sutures, broadest above.

This is a handsome species and might be mistaken for *O. granulatus*, but differs from that species in its strongly lobed character, longer deltoids, definite arrangement of the granules and in the depressed radio-interradial zone. Moreover it comes from a much lower horizon.

The specific name is for Dr. Otto Oppelt, of New Albany, Ind.

The type specimens came from the Knobstone group, two miles north of New Albany, Ind., and are in the collection of Mr. G. K. Greene.

Figures 18, 19, 20 are restored views of the species.

#### PENTREMITES, CONOIDEUS, Hall, Rowley.

##### PLATE 29. FIGS. 28, 29, 30, 31, 32, 33, 34.

This very abundant blastoid shows great diversity in both size and outline. Two forms deserve particular notice, differing so far from the typical *conoideus* as to be entitled to varietal names. For one of these we propose:

#### PENTREMITES CONOIDEUS, var. *Perlongus*, n. var. (Rowley.)

##### PLATE 29. FIG. 28.

The greatest lateral diameter of the body is above the tips of the ambulacra, so that the form is almost barrel-shape, but with the greater end diameter at the base. Like the typical form, this variety is strongly lobed: while from its extremely elongate shape, the plates are proportionally greater in length and less in width than in the broader forms. In outline this form is much like *Pentremites elongatus* from the Burlington limestone.

In the author's collection is a specimen from near Flag Pond, Va., so contracted at the base as to give a truly elongate elliptical outline on side view.

The type of this variety is from the Warsaw limestone at Lanesville, Ind., and now in the collection of Mr. G. K. Greene.

For the other form we offer the name.

PENTREMITES CONOIDEUS, var. *Amplus*, n. var. (Rowley).

## PLATE 29. FIGS. 31, 32, 33-34.

The width of these specimens is quite as great as the length and the greatest lateral diameter is midway of the body, giving a granatocrinoid form to the fossil.

There is quite as much difference in form, size and relative proportion of plate length and width between this variety and typical *conoideus* as there is between *P. godoni* and *P. pyriformis*, yet these latter two are regarded as distinct species. Perhaps the intermediate forms in the *conoideus* group more closely unite typical *conoideus* with variety *amplus* than variations in the *godoni* series connect *pyriformis* and *godoni*. Yet figures in "The Catalogue of the Blastoids in the British Museum," by Etheridge and Carpenter fail to show this fact.

Accepting, as these authors do, the validity of *pyriformis* and *godoni*, they unhesitatingly unite *conoideus* and *koninkanus*, forms as diverse as the former and as easily separated by American collectors.

Locality and horizon the same as variety *perlongus*, and the types in Mr. G. K. Greene's collection.

Figure 41 is a specimen of *Pentremites conoideus*, to show the great thickness of the test just above the base, where the cast of the visceral cavity is exposed to view. At the summit the shell is rather thin. It will also be seen from this figure that the hydrospire folds are imbedded in the thickened test below for nearly half their length, instead of hanging free in the cavity as they do near the summit.

This is probably a constant character of *Pentremites*, and is also noticeable in some of the granatocrinoids. In *Orbitremites norwoodi* and *Cryptoblastus melo*, however, the hydrospires are exposed internally, full length.

Figure 38 is a view of the cavity of a *conoideus* showing the place at which the hydrospires enter the thickened test.

Compare this height with the tips of the ambulacra, either side of the figure.

Figure 40 is a specimen from which the hydrospires have been removed, exposing the double row of pores piercing the test, beneath each ambulacrum; also showing the broken ends of the hydrospire tubes at the summit.

Figure 37 (x2) is a good view of the hydrospires as seen from the base, the tips being exposed inside the thickened ends of the radials.

Figure 39 (x2) is a similar drawing, side view, but with the ambulacral tubes broken away in part, the central perforation being exposed at the summit. The anal opening and ventral area are shown as openings through the test.

## PENTREMITES PYRIFORMIS, Say, Rowley.

## PLATE 29. FIGS. 21, 22-23.

Side and basal views of a malformed specimen. By the introduction of a narrow sixth radial, the slender ambulacrum to the left has quite crowded out the interradial on its right, and more or less deformed the adjoining ambulacrum.

Figure 22 shows this extra radial, which has no groove for the reception of an ambulacrum, but an indistinct longitudinal flattening instead.

Figure 23 is a basal view of the same specimen showing the hexagonal outline and the broad concave field between the two pairs of crowded ambulacra.

The summit has the usual four spiracles and the anal opening, but the perforation between the crowded ambulacra is smaller than the rest.

Figure 12 is a side view of a specimen that has been crushed by a weight on the tip of one ambulacrum, and the injury repaired by the secretion of successive longitudinal bands of stony material, giving the injured radial a peculiar linear and banded appearance, much like regular plate sutures.

All of these specimens of *P. pyriformis* are from the Kaskaskia limestone near Bowling Green, Ky., and belong to the collection of Mr. G. K. Greene.

## PENTREMITES GODONI. DeFrance, Rowley.

## PLATE 29. FIGS. 1, 2, 3, 7, 8.

Figures 1 and 2 are views of a specimen with six radials, giving to the base the appearance of a six-rayed star. The place in the extra plate that should be the tip of an ambulacrum is slightly grooved.

Figures 3 and 4 are ventral and side views of a specimen with a pyramid covering the region about the anal opening and the spiracles. It is a five-lobed structure, the lobes being interradial in position. The spiracles and anal opening are not covered over, however, but appear as small perforations at the top of the pyramid, uncovered, perhaps by the action of water or weather. There passes down the middle of each ambulacrum, for a little distance from the pyramid a low roof-like covering, but the nature of the pyramid and the covering can not be determined on account of the silicified character of the specimen. This strange feature can hardly be due, however, to the overlapping of proximal pinules into a pyramid, as in Etheridge and Carpenter's figure in "The Catalogue of Blastoidea," or similar in construction to the ventral pyramid described by Shuman, and afterwards observed by Hambach. It is more probably a structure composed of small plates.

Figures 7 and 8 illustrate a peculiar deformity. A similar specimen is figured by Etheridge and Carpenter on Plate 2, Figs. 8-9 in "The Catalogue of the Blastoidea."

There are five radial plates, but one is narrow and without an ambulacrum, being imperceptibly grooved. One of the four ambulacral fields (the one on the right of the deformed radial) is broader than the other three, a ridge passing down the middle of it. As this ridge is composed on each lateral face of side plates, we have here in this abnormal ambulacral area two ambulacra with their abutting edges pushed up into a ridge-like fold.

The specimens of *Pentremites godoni*, here figured, are from near Bowling Green, Ky., and are the property of Mr. G. K. Greene.

#### PENTREMITES KONINCKANUS, Hall, Rowley.

##### PLATE 29. FIGS. 5, 6, 9, 10, 10a, 11, 13, 14.

Figs. 9, 10a, 11 are illustrations of a tetraradiate specimen, but with one ambulacral field broader than the rest and the medial groove occupied by a broad, rounded ridge, composed of a double row of side pieces, the whole forming a double ambulacrum. The abnormality of this specimen differs from that of the *Pyriiformis*, Figs. 7 and 8, in the absence of the fifth radial.

Figures 13 and 14 represent a symmetrical tetraradiate specimen. There are two such in the collection.

The specimen represented by figures 5 and 6 preserves a part of the mid-ventral pyramid, but more poorly preserved than the same structure in Figures 3 and 4.

All these specimens of *Koninckanus* are enlarged to two diameters.

They were collected from the Warsaw group at Lanesville, Ind. So also were all of the figured specimens of *P. conoideus*, and are a part of the collection of Mr. G. K. Greene.

#### TRICCELOCRINUS WOODMANI, M. and W., Rowley.

##### PLATE 29. FIGS. 35, 36, 42, 43.

The figures represent a badly decorticated specimen, restored in plate surface by the artist. It is figured here merely to show the base of the triangular column and its minute central perforation. It would be interesting to know if triangular columns occur in the Warsaw beds, where this blastoid is found, and it is probable that all species of this genus have, at least, the bases of their columns triangular,

Figures 42 and 43 show the portion of column attached to a larger, but

even more poorly preserved specimen of *woodmani*. The propriety of separating *Tricelocrinus bipyramidalis* and *wortheni* from *woodmani* and placing them in another genus is not apparent to the writer.

*Metablastus* may be a good genus and include *lineatus* and such very elongate forms, but the distinctive characters of *Tricelocrinus* are possessed by *wortheni* and *bipyramidalis*.

From an examination of a large series of these last mentioned species from Boonville, Mo., the writer is inclined to doubt that specific differences exist between *wortheni* and *bipyramidalis*, a complete series of intermediate forms, making it quite impossible to define the limits of the two species. However, forms that the writer takes to be *bipyramidalis* occur in the Warsaw beds of Indiana, associated with *woodmani* while no typical *wortheni* has yet been brought to his notice from that particular section.

The figured specimens of *T. woodmani* were collected from the Warsaw beds, two miles west of Bridgeport, Harrison county, Ind., and are now in the G. K. Greene collection.

#### TALAROCRINUS SIMPLEX, Shumard, Rowley.

##### PLATE 29. FIGS. 24, 25, 26-27.

Figure 24 shows a specimen with an extra plate between one of the radials and the basal plate below it, and encroaching on two other radials at their lower angles. This plate is pentagonal and wider than long.

Another specimen of this same species, figures 25, 26, has an extra plate in the anal area, below the usual anal plate, and cutting off the lower radial to the right. This is rather a small quadrangular plate, wider than long. The same specimen, figure 26, has a large extra quadrangular plate between a radial and a basal plate.

These two abnormal specimens are from Lanesville, Ind., Warsaw group, and the normal specimen, figure 27, from the Keokuk Limestone of Edwardsville, Ind. All belong to the G. K. Greene collection.

#### ELEUTHEROCRINUS CASSEYI, Shumard & Yandell, Rowley.

##### PLATE 30. FIGS. 1, 2, 3-4.

This very peculiar blastoid, viewed from its anterior side, bears a striking resemblance to the associated species of *Pentameritidea*, but there the likeness ends.

The abbreviated fifth ambulacrum, the short and broad posterior radial, and the narrow, elongate bases upon which the latter plate rests, widely sepa-

rate this from all other blastoids. The absence of the stem facet is a still more striking feature.

The small basal plate, pushed toward the anterior side, supports two elongated radials above, and on the other side is half enveloped by the two elongate radials of the posterior side. These paired radials are half the length of the body and support on their long sides two elongated radials of abnormal shape, and a short broad radial on their curved upper edges. This posterior radial resembles the radial plate of a *Platycrinus*. The normal interradials are rather short, and the two adjoining the short ambulacrum are somewhat narrower.

The little projections at the lower ends of the normal ambulacra, are extravagantly extended outward.

The normal ambulacra are about four-fifths the entire length of the body, and somewhat below the incised edges of the supporting radials. The two lateral ambulacra are somewhat longer, with hardly noticeable projections below, and not sunken below the general surface, except near the summit.

The azygos ambulacrum is quadrangular and confined to the summit of the calyx.

The central opening is small, and there are apparently eight spiracles, but this observation is not quite satisfactory, as all of the specimens seem to be injured somewhat at the top.

The specimen shown in figure 3 is much larger than the others.

They come from the Upper Devonian, near Charlestown, Ind., and all the figured specimens are in the collection of Mr. G. K. Greene.

#### PENTREMITIDEA (?) DUBIA, N. Sp. (Rowley).

#### PLATE 30. FIGS. 5, 6, 7, 11.

The three basal plates of this little blastoid form a sharp triangular pyramid which is more than a fourth of the entire body in depth. The radial plates are nearly three-fourths of the entire body length. The interradials are not visible on a side view, being minute and confined to the summit. Sharp radial projections receive the distal ends of the ambulacra and extend horizontally outward.

The ambulacra are rather narrow and are but little below the edges of the grooves in which they lie.

Outside of the basal pyramid, the body is somewhat elliptical and circular in cross section, the interambulacral spaces being convex, and the whole having a plump appearance.

The columnar scar is round and small.

The upper ends of the radials project upward distinctly.

The anal spiracle is of moderate size and round.

There are eight other spiracles which would seem to indicate that our species is not *Pentremitidea*, but otherwise the resemblance is close, and there isn't sufficient excuse for referring it to any other genus or erecting a new genus for its reception. The minute interradians hardly distinguishable in the specimens, save the anal piece, are unmistakable Pentremitidean characters. It is widely separated from any subcarboniferous genus as *Schizoblastus*, to which there is a superficial resemblance.

Horizon, locality and collection same as the last.

PENTREMITIDEA? APPROXIMATA, N. Sp. (Rowley).

PLATE 30. FIG. 8.

The specimen here figured is somewhat injured about the base, but is sufficiently well preserved to show that the basal plates form a less pronounced convexity.

The body in side view is elongate elliptical and the radials are almost as long as the entire body. The interradians except the anal plate, are not visible on a side view, and are probably confined to the summit.

The ambulacra are somewhat wider in proportion than in the last described species, and extend above the grooves that hold them, thus differing widely from *P. dubia*.

The upper ends of the radials are depressed and a cross section of the body is decidedly pentangular. (Compare with figure 6 of *P. dubia*). Our specimen is not unlike *Pentremitidea leda*, but has double spiracles instead of single in that species. The anal opening is round and there are eight spiracles.

The horizon, locality and collection same as the last.

PENTREMITIDEA LEDA? Var. magna, N. Var. (Rowley).

PLATE 30. FIGS. 9-10. 32-33?

There is some doubt about the reference of this specimen to Hall's species.

The three basal plates form a low convexity and the columnar facet is small.

The radial plates are little less than the entire body length. The interradians are small, but apparently visible on a side view. The ambulacra are of moderate width and quite as long as the radial plates, and forming with the upturned lips of the grooves, low, rounded ridges. The ambulacra are not at all sunken.

The central opening of the vault is star-shaped and there are five round spiracular openings of which the anal opening is the largest.

A cross section of the body is pentagonal, but not sharply so, the middle of the interambulacral areas being slightly convex.

Horizon, locality and collection same as the last.

CODASTER ATTENUATUS, Var. robustus. N. Var. (Rowley.)

PLATE 30. FIGS. 12, 13, 16, 17.

The basal plates form a cone. The radial plates are narrow-elongate, forming nearly two-thirds of the entire length of the fossil. The ambulacra are short and narrow and hardly seen on a side view. Crossing the four interradial plates and the upper edges of the radials are, on either side of an ambulacrum, six or seven hydrospire slits starting from the interradial ridge and running parallel with the ambulacra.

The central opening is round and rather small.

The anal opening is round and much larger than the central opening. The ends of the interradial ridges are broken, thus giving the appearance of openings.

The specimen is too badly preserved to show surface markings.

The shape of this fossil, the short, narrow ambulacra and the rounded, upper edges of the radials, together with the almost circular cross section separates it at least as a variety from *C. attenuatus*. It will probably prove to be a good species.

Upper Devonian, Clark county Cement quarry, Clark county, Ind. Collection of Mr. G. K. Greene.

CODASTER ATTENUATUS? Lyon, Rowley.

PLATE 30, FIGS. 14-15.

This little blastoid differs somewhat from *C. attenuatus*, but hardly enough even to separate it from that species as a variety. The radials are so tucked in above that the interradial spaces are small and the respiratory slits seem to be few. The basal plates form a cone of half the body length, longer proportionally than in *C. attenuatus*. The entire body is conical in shape. A section at the ends of the ambulacra gives a pentagonal outline. The ambulacra stands up sharply, while the interradial ridges are inconspicuous. Again the horizon of this specimen is higher than that of *C. attenuatus*.

Horizon, locality middle Devonian upper Helderburg group, Falls of Ohio. Collection of G. K. Greene.

## CODASTER PYRAMIDATUS, Shumard, Rowley.

PLATE 30. FIGS. 18, 19, 24, 25, 22-23.

The three basal plates form the frustum of an elongated triangular pyramid. The radial plates in the larger specimens are a little more than one-half the body length and form five strong lobes.

The interradial plates are confined to the summit and either side of the interradial ridge are cut by from five to seven hydrosphere clefts.

The ambulacra are narrow, and but little above the interradial plates. The central opening is five-pointed, and the anal aperture round. The body in cross section, is stellate, due to the lobed character of the radials.

The ornamentation is longitudinal lines.

The first or basal joints of the column are probably triangular and the perforation is minute.

Middle Devonian, Columbus, Ohio. Collection of Mr. G. K. Greene.

## CODASTER ATTENUATUS, Lyon, Rowley.

PLATE 30. FIGS. 20-21.

This species, while quite as large as *C. pyramidatus*, is never so strongly lobed. The whole specimen is conical in shape and the basal plates form over a third of the entire height of body. The radials are narrow, elongate and their upper edges are tucked in toward the summit.

The interradials are confined to the summit.

The ambulacra are narrow and hardly above the interradial areas. The hydrosphere slits are from 6 to 8 between the interradial ridge and adjacent ambulacrum. The central opening is stellate and small. The anal opening is round.

A cross section varies from round to pentagonal. The surface is ornamented by longitudinal lines.

Formation, locality middle Devonian, Falls of the Ohio. Collection of Mr. G. K. Greene.

## CODASTER Sp?

PLATE 30. FIGS. 26-27x2.

These pretty little *Codasters* are unfortunately too poorly preserved for identification.

They are conical in shape and the basal plates are half the body length.

The radial plates are but slightly lobed above, and the interradials can not be made out as the summit of each of the three specimens before me is injured or poorly preserved. The ambulacra are narrow and but little elevated.

It is almost certain that these fossils are not *Codaster attenuatus* nor *C. pyramidatus*, but until the hydrospire slits can be seen there is no absolute certainty that they are even *Codasters*.

Upper Devonian, Charlestown, Ind. Collection of G. K. Greene.

#### METABLASTUS BIPYRAMIDALIS?, Hall, Rowley.

PLATE 30. FIGS. 28, 29, 30-31.

The basal plates form a low, but strongly triangular pyramid. The radial plates are long and with a strong central ridge from the distal ends of the ambulacra to the basal plates.

The interradial plates are found at the extreme upper ends of the interambulacral areas and only visible on a side view in the top of the excavated grooves. The interambulacral areas slope toward the summit from the lower ends of the ambulacra, and thus form the second pyramid, as implied in the name. The ambulacra are elongate, narrow and about two-fifths of the body length; deeply sunken in the radial sinuses, especially at the summit.

The anal opening perforates the end of one of the interambulacral areas, but no spiracles are visible on the specimen before us.

The surface ornamentation is not preserved.

In the center of the triangular excavation at the base is the small columnar facet.

This fossil comes from the Warsaw beds at Lanesville, Ind., and the figured specimen is the property of Mr. G. K. Greene.

#### ORBITREMITES GRANDIS, N. Sp., (Rowley.)

PLATE 30. FIGS. 34-35.

The specimen from which this description is made out is a natural cast of the visceral cavity and nothing but the great size of the specimen and its unique plate arrangement could induce us to describe a species from such material. The fossil is a giant of its kind, subglobose with a very large and probably somewhat concave base.

The radials are but little more than half the length of the body, while the interradials are a little less than half the entire body length. The ambulacra, from very narrow at their distal ends, increase in width upward toward the summit. They were probably a little sunken below, but above the surface outline above.

A cross section would hardly be round, the mid-interambulaeral areas being slightly concave.

The anal opening is apparently small. Spiracles unknown. The broad base, the great length of the deltoids and the large size of the fossil itself will serve to identify it.

It is not unlike an upper Burlington form and somewhat near to *Gedatocrinus granulatus*, but much larger than either form.

Keokuk group, Greene county, Ky. Collection of Mr. G. K. Greene.

PENTREMITES GODONI, DeFrance, Rowley.

PLATE 30. FIGS. 36, 39.

In figure 36, a ground specimen, the position of the hydrospire tubes is shown, the dark spots being the central opening and anal aperture. The sub-ambulaeral canal is shown in the figure just over the middle of two hydrospire groups. There seem to be but three hydrospire tubes to the group.

Figure 39 is a specimen to which 5 or 6 stem joints are attached. The column is small and the joints are thin.

Both specimens are from the Kaskaskia limestone of Warren county, Ky., and belong to the collection of Mr. G. K. Greene.

PENTREMITES PYRIFORMIS, Say, Rowley.

PLATE 30. FIGS. 37, 38, 40, 41, 42, 43, 44, 45.

This series of specimens gives most of the variation in size and outline noticed in the species.

Figure 37 is a specimen from Warren county, Ky., and represents an extreme in form, approaching somewhat *P. godoni*.

Figure 38 is a beautiful specimen from Newman's Ridge, Tenn., in which the radial sinuses are deep. A single stem joint is attached.

Figures 40 and 41 are from Warren county, Ky., and have stem joints attached.

The appearance of folds about the basal plates is somewhat odd and suggests conditions in growth.

The specimen shown in figures 42 and 43 is a Kentucky specimen and represents the very elongate variety, and is near the form known as *P. symmetricus*, about five stem joints are attached to this specimen.

Figs. 44, 45 is a young specimen from Crittenden county, Ky. The ambulaera are short and broad, occupying not over one-third of the body length.

If it is true, as appears, that the deltoids are not visible on a side view, but very small and confined to the ventral surface, this little blastoid may represent a new species.

All these specimens are from the Kaskaskia limestone, and belong to the collection of Mr. G. K. Greene.



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**ERIDOPHYLLUM LOUISVILLENSIS, N. Sp.**

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**PLATE 31. FIG. 1.**

Corallum composite, rapidly increasing by calicular gemmation. Corallites more or less distant, from two to five or more millimeters apart. Attached by strong root-like processes growing from their sides. Tubes rounded, unequal in size, from five to fifteen millimeters in diameter. The entire corallum does not exceed forty millimeters in height, and eighty millimeters in diameter. Number of lamellæ seventy, in a calix fifteen millimeters in diameter, uniform in size, and slightly rounded at the margin, alternating below, for two or three millimeters from the margin flat, or slightly oval, then abruptly slope to the bottom of the calix, where the short ones terminate, the longer ones continue, coalescing with the adjacent primary ones, and fasciculating and twisting into a small prominence in the center of the calix. No fossette observed in any of the cups.

Found in the Upper Silurian (Niagara group) at the Work House Quarry, Beargrass Creek, near Louisville, Kentucky, now in the collection of the author.

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**DIPHYPHYLLUM BILLINGSI, N. Sp.**

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**PLATE 31. FIG. 2, 3.**

Corallum composite, rapidly increasing by calicular and lateral gemmation. Stems rounded, unequal in size, five to fifteen millimeters in diameter. Exterior of corallites with numerous annulations and sharp constrictions, giving to the stems the appearance of a number of thin invaginated cups. Height varying from twenty to forty millimeters. Diameter of calix, from five to fifteen millimeters. Depth five millimeters. Situated in the center of the calix is a smooth convex area, inclosed in a vertical wall, two millimeters in diameter. Number of lamellæ sixty, in the circumference of a calix twelve millimeters in diameter, equal in size at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones abruptly end, the longer ones continue to the vertical wall in the center of the calix, and terminate. Denticulations appear as small granules. Fossette consists of a small groove, commencing at the edge of the vertical wall and continuing to the margin of the calix.

The short, rapidly increasing corallites, and the invaginated appearance of the stems, makes this easily recognized from all other species.

The specific name is in honor of Mr. Walter R. Billings, of Ottawa, Canada.

Found in the Upper Silurian (Niagara group) at the Work House Quarry, on Beargrass Creek, near Louisville, Kentucky, now in the collection of the author.

## BORDENIA KNAPPI.

PLATE 31. FIGS. 4, 5, 6, 7, 8, 9, 10, 11.

*Zaphrentis deformis*, Hall, Twelfth Annual Report of the Indiana Geological Survey, 1882, page 290, plate 20, figures 9-10.

*Zaphrentis Knappi*, Hall, Thirty-fifth Annual Report of the State of New York, page 438, 1884.

As the descriptions for both species are the same, I prefer the specific name *Knappi*, as this was intended as a compliment by Prof. Hall, to his old friend Dr. James Knapp, of Louisville, Ky.

Corallum simple, or composite, and sometime growing socially, two or more together, with a broad sear at the point of attachment. Gradually, or sometimes more rapidly, expanding in diameter to the calix. Height varying in different individuals, from fifteen to forty millimeters. Diameter of calix, from ten to twenty-five millimeters. Depth, five to ten millimeters, with a smooth space in the center of the calix, occupied by the tabulæ, from ten to twelve millimeters in diameter. Number of lamellæ, from thirty to thirty-two, in the circumference of a calix, twenty-five millimeters in diameter. When well preserved they are unequal in size, and sharp at the margin, gradually descends to the smooth space in the center of the calix, and abruptly terminates, leaving a smooth space in the center of the cup, ten or twelve millimeters in diameter. Secondary lamellæ rudimentary. Fossette consists of a slight depression at the margin of the smooth space in the center of the calix, but does not extend on the side of the coral. Exterior with numerous strong rounded annulations and wrinkles, caused by periodical growth.

Found in the Upper Devonian (Hamilton group) at Charlestown, and in the strippings above the different cement quarries, throughout Clark County, Indiana, now in my collection.

## GENNÆOCRINUS, FACETUS, N. Sp., (Rowley).

PLATE 32. FIGS 1, 2, 3, 4, 5, 6.

The body is low, basket shape, the ventral disk being hardly convex.

The basals are three in number, and extend horizontally outward beyond the column base as three sharp ridges or tripartite rim.

The first radials are hexagonal, each with a strong central tubercular prominence, sharp and angular, extending outward almost horizontally and overshadowing the basals.

A sharp ridge extends upward from this tubercular prominence, forking on the third primary radial and each branch again dividing on a second

axillary plate, a third division occurring on each inner branch. From the tubercle extends outward on each side to the center of each adjacent first radial, and each first interradial a low, sharp ridge.

The second primary radial plate is about as long as wide and hexagonal and sends outward from its center a low, sharp ridge, to the first interradial on each side.

The third primary radial is apparently pentagonal and axillary. Each of the radials resting on the upper, sloping sides of the third primary radial, are axillary, and the plate resting on the inner side of this second axillary plate is also a bifurcating plate, the whole supporting above, around the periphery, thirty arms, six to the ray.

Above the third primary radial, the radial ridges become much stronger and round instead of sharp or angular.

The first interradial (of the four series) is seven sided and supports above three smaller interradials.

Above the latter are apparently two other plates in the calyx. The first anal interradial is in the first radial ring, and of the same size as the first radials, seven-sided, supporting above three smaller plates.

Above these latter are five little plates, and still above these five very small plates.

Between the arm bases in the anal interradius are still other five little plates.

The interradial plates of the anal area have central tubercles, so also have the plates in the other four interradial areas, the center of each first interradial giving off six, low, sharp ridges to the contiguous plates. There is apparently but one minute interaxillary plate to the ray.

In the depressed triangles formed by the radial ridges and the low, sharp interradial ridges are three small granular tubercles.

The column is round and the canal small.

The plates of the ventral disk are ornamented by small tubercles, most numerous along the ambulacral ridges and about the anal opening.

The central dome plate has a larger wart-like tubercle. On each ambulacral ridge, just over the arm openings is a long slender spine, directed a little obliquely outward.

The body is deeply lobed at the arm bases.

The arm openings are directed a little upward.

The anal opening is located laterally, as in *Aeroerinus*, and on a warty prominence.

Nothing is known of the arms or pinules of this species.

From *G. kentuckiensis* this species differs in the number of arms, (thirty instead of forty) the less number of radiating ridges on the calyx plates, and the strong nodose character of the first radials.

The specimens figured come from the Upper Devonian beds near Charlestown, Ind., and are the property of Mr. G. K. Greene.

AOROCRINUS CASSEDAI, Lyon, Rowley.

PLATE 32. FIGS. 7, 8, 9.

The three basal plates form a wide, thin, continuous rim below the radials, the body being constricted above.

The first radials are hexagonal, the second hexagonal, the third pentagonal.

There are two radials of the second series (secondary brachials). Each ray of the third radial series is composed of two plates.

The first interradial is hexagonal with two plates above and two other very small ones above the latter.

The first anal plate is seven-sided and as large as the first radial.

Above this plate are three tuberculose plates, five smaller tuberculose plates above the latter, and four or five yet higher up.

All the calyx plates are highly convex and are made stellate by short, radiating ridges, extending to the sutures.

The arm lobes are strong, the column is small, the canal minute.

The ventral disk is somewhat elevated, but less so than the dorsal cup.

The plates are small and convex or warty.

The food grooves are covered by a double row of small, warty plates.

Over each pair of arm openings is a quite strong, low, warty-like tubercle.

The central dome plate supports a short, heavy, spine-like tubercle.

The anal opening is lateral, directed outward and on a flattened ridge.

The arm openings are directed a little upward and twenty-two in number, the right anterior lobe bearing six against four for each of the other lobes.

This beautiful fossil comes from the Upper Devonian, near Charlestown, Ind., and the specimen figured is the property of Mr. G. K. Greene.

A study of the figures of *Gennæocrinus facetus* and *Aoroerinus casedayi*, on our plate, will fail to bring out the great differences between the two genera, as seen by Wachsmuth and Springer. The anal opening in *Gennæocrinus* is much nearer the periphery than described and from a mere opening through the vault, is really, when well preserved, on a wart-like protuberance. There is also a large central node on the dome, corresponding to the spiniferous node on

*Aeroerinus*. The only differences of much note are the inflated character of the dorsal cup in *Gemmaerinus*, the flat ventral disk, greater number of arms, less extended basal rim and surface ornamentation.

**DOLATOCRINUS**, Sp?

PLATE 32—FIGS. 10, 11, 12.

This little *Dolatoerinus* has but four arm groups, the place of the fifth looking like an anal interradius. The base is flat and a slight rim surrounds the column. The radial plates possess strong nodes, connected by a strong ridge.

The large interradials have each a strong central node from which radiate eight or more ridges.

The body is constricted below the arm bases.

There are nine arms, arranged as follows, 3, 2, 2, 2.

The ventral disk is convex and the ornamentation is numerous short radiating lines and granule-like tubercles.

The anal opening is medium in size.

From the Upper Devonian beds, near Charlestown, Ind., and in the collection of Mr. G. K. Greene.

**MEGISTOCRINUS RUGOSUS**, var. *Spinuliferus*, N. var. (Rowley)

PLATE 32. FIGS. 13, 14, 15.

A specimen of this variety is figured in Wachsmuth and Springer's great work on the Crinoidea Camerata as the young of *M. rugosus*. Our type has all the appearance of an adult form. It has an almost central proboscis, elongate tubercles or spines on the vault, greatly nodose calyx plates above the first radials, fiat basal and first radial plates, these latter forming a flat area, hardly concave, even at the stem base.

The vault spines are along the ambulacral ridges and on the proboscis (ventral tube).

There are sixteen arm openings and apparently two respiratory pores to the arm.

The specimen figured is from the Upper Devonian beds, near Charlestown, Ind., and now in the collection of Mr. G. K. Greene.

**DOLATOCRINUS ASPRATILIS**, M. & G., Rowley.

PLATE 32. FIGS. 16, 17, 18.

A rather deep funnel occupies the base of this fossil, to the centers of the first radials, bounded above by a pentagonal rim formed by strong ridges, connecting the central tubercles of the first radial plates.

The radial nodes are connected by a strong rounded ridge, forking on the third radial.

The first interradials are not larger than the first radials, convex, and with a strong central node from which radiate to adjoining plates six to eight ridges.

The second interradial has a tuberculose node.

The ventral disk is contracted and with no ornamentation preserved, the plates however, being a little convex.

The base of the proboscis is strong and nearly central. There are but ten arms, two to the ray.

The anal interradial on this specimen, has a stronger node on the second interradial plate, than on the same plate in the other interradial areas.

There are two respiratory pores to the arm group or ten in all.

This fossil is scarcely wider than long.

Miller and Gurley's type of this species had eleven arms.

. Horizon, locality and collection same as the last.

MEGISTOCRINUS EXPANSUS, var. Magniventrus,  
N. var. (Rowley).

PLATE 32. FIGS. 19, 20, 21.

The general appearance of this fossil is like an overgrown Aorocrinus parvus, such as we sometimes find in the Burlington limestone.

The region of the arm bases presents the greatest width of the fossil.

The arm openings are directed obliquely upward. The ventral disk is tumid at the center, apparently smooth, with two or three hardly outlined nodes.

There are sixteen arm bases, 4, 2, 4, 2, 4.

The plates of the calyx are a little depressed.

The base is almost flat and beyond this area the calyx rapidly expands to the spreading arm bases, giving the appearance of a broad pan.

The respiratory pores are very small.

The ornamentation of the calyx is wavy radiate lines.

Horizon, locality and collection same as the last.

STEPHANOCRINUS, DEFORMIS, N. Sp. (Rowley).

PLATE 32. FIGS. 22, 23.

This is the most elongate form of the genus we have yet seen. It is deep, obconical and with a trigonal base. Column small, round.

The plate sutures can not be made out on the specimen owing to the crystalline character of the test. The interradial processes are strong and project obliquely upward, but are not entire.

The ventral star formed by the radial grooves is shown in the illustration.

The anal opening and spiracular canals pierce the processes as seen in figure 23.

From the Niagara group on Big Creek, near Big Creek P. O., Jefferson County, Ind. Collection of G. K. Greene.

STEPHANOCRINUS GEMMIFORMIS, Hall, Rowley.

PLATE 32. FIGS. 24, 25.

Unlike most of the other species of this genus, *gemmaformis* is subglobose and mimics Pisocrinus.

The three basal plates are broad and so are the radials. The interradial processes are short.

The plate ornamentation seems to be fine, radiate lines. The radial grooves remind one of the ambulacra of blastoids.

The stem base is almost minute.

From the Niagara group at Waldron, Indiana. Collection of G. K. Greene.

STEPHANOCRINUS OSGOODENSIS, Miller, Rowley.

PLATE 32. FIGS. 26, 27.

This is almost an ellipsoid in outline. The interradial processes are directed upward. The plate outlines are obliterated by the crystalline structure.

The base is triangular and the columnar scar, round. The radial depressions and central pit are well shown in the drawing.

Found by Mr. John Hammell of Madison, Ind., in the Niagara group, on Big Creek, near Big Creek P. O., Jefferson County, Indiana. Now in the collection of G. K. Greene.

STEPHANOCRINUS, HAMMELLI, Miller, Rowley.

PLATE 32. FIGS. 28, 29, 30.

This form is rounded with a handle-like base.

The interradial processes are apparently short.

The ornamentation is fine longitudinal lines.

The basal plates are fully half the height of the fossil.

The five radials are of equal size in perfect bodies.

The ventral opening is small and perfectly round.

The radial depressions are broad and the anal opening is rather small.

Found by Mr. John Hammell of Madison, Indiana.

Horizon, locality and collection, same as the last.

STEPHANOCRINUS QUINQUEPARTITUS, N. Sp., (Rowley)

PLATE 32. FIGS. 31, 32, 33.

This pretty little crinoid has a triangular base.

The place for the attachment of the small column is a little excavated.

The basals are three and hardly of equal size and about half the height of the body to the base of the interradial processes.

These latter are directed almost straight upward and absolutely perfect in the specimen figured.

The anal process is shorter than the rest and is pierced above by the anal opening.

There is an apparent minute perforation in the top of each of the other processes.

The central opening and radial grooves are covered, but the nature of the plates can not be made out by the aid of a hand glass.

The general form of the entire body is obconical.

Found by Mr. John Hammell, of Madison, Indiana.

Horizon, locality and collection, same as the last.

GENNÆOCRINUS COMPTUS, N. Sp., (Rowley.)

PLATE 33. FIGS. 1, 2, 3.

This beautiful crinoid has a slightly inflated dorsal cup, strongly lobed arm-base-groups and low convex ventral disk with a stout, short central spine.

The three basal plates form a low expansion, broken at the inter-suture lines by distinct clefts. As in some other species of this genus, the cross ridge-like elevations or central nodes of the first radial plates are more conspicuous than the basal nodes, while the reverse is the case in the associated species of *Aorocrinus* with their greatly developed unbroken basal rim.

The central radial ridge is low and rounded, but becomes more prominent above, forking on the axillary plates till it reaches the bases of the free arms.

Two of the first radials are heptagonal and three are hexagonal, all a little wider than long. All of the second radials are hexagonal and a little wider than long, hardly smaller than the first radials. The third radials are pentagonal, axillary, a little wider than long and smaller than the second radial plates. The first and only plate of the secondary radial series is axillary while the inner one only of the third radial series is bifurcating, giving rise to six arm bases to each brachial lobe or thirty free arms to the specimen, the characteristic number, apparently, of the genus.

The first anal interradial plate is in the ring of the first radial plates and heptagonal in outline, supporting above three hardly smaller hexagonal plates, the latter in turn, supporting upon their upper edges five smaller plates.

The plates above can not be made out.

The first or lower plate in the four regular interradial areas is heptagonal and little less in size than the second radial but is of equal length and breadth.

This plate supports above, three smaller plates and above the latter are three still smaller plates.

Each interradial plate has a hardly perceptible central node from which radiate low ridges in groups of threes and twos, terminating on the radials near the central radial ridge. Parallel with the radial ridge and on either side of it is a low rounded supplementary ridge.

The column occupies about one half of the width of the basal cup and has an apparently rounded central perforation.

The arm lobes are constricted where they leave the body and have a broad paddle-like expression.

The thirty arm openings are directed slightly upward and, on each lobe, are separated into two groups, by a cleft, of three openings each, a slighter cleft separating the outer one from the inner two bases.

The ambulacral ridges are not very strong from the base of the arm lobes to the center, having at the fork a low, inconspicuous node. The ventral plates in general are hardly convex.

The anal opening is small and located about half way from the central spine to the periphery.

This species differs from *Gennæocrinus kentuckiensis* in having a less inflated dorsal cup, very much stronger first radial nodes, less defined radiating lines of ornamentation, stronger arm-base lobes, smooth ventral plates against acutely nodose plates in the former, and in the possession of a central spine, apparently absent in the former.

From *G. faretus* it differs in its larger size, stronger ventral convexity,

smooth instead of nodose ventral plates, stronger central spine and shorter ambulacral spines, and less strong dorsal ornamentation.

From Upper Devonian beds, near Charlestown, Ind. Collection of Mr. G. K. Greene.

G E N N Æ O C R I N U S S C U L P T U S , N. Sp., (Rowley.)

PLATE 33. FIGS. 4, 5, 6.

In this fine species the length and width of the dorsal plates are about equal and the first and second radials and the first interradials are about of the same size. In the interradial to the right of the azygous area there are but two plates in the second series, three in the third and four in the fourth. In the other series there are three above the first and four in the third. The three basal plates form a very low tripartite rim while the first radial nodes are sharply elevated and produced outward.

The mid-radial ridge is low and sharp to the middle of the third radial where it becomes stronger, and rounded.

The plate ornamentation is low, sharp, radiating ridges.

The ventral disk is low, almost flat, covered by small, slightly convex plates. There are no ambulacral ridges inside of the arm lobes. The latter are rounded, not constricted below and less prominent than on the preceding species.

The ventral spaces between the arm lobes are depressed and there are short spines over the groups of arm bases, with probably a low one at the dome-center.

All the plates on the ambulacra are inclined to be tuberculous.

The specimen is broken-in about the anal opening.

Unlike the preceding species, this form has a very greatly inflated dorsal cup and a slight constriction at the periphery and much stronger ornamentation.

Like *G. comptus* and *G. facetus*, it has thirty arm bases, while *G. kentuckiensis* has forty according to Wachsmuth and Springer.

Locality, horizon and collection, same as the last.

G E N N Æ O C R I N U S C O M P T U S , Var. Spiniferus, N. Var. (Rowley.)

PLATE 33. FIGS. 7, 8, 9.

This fossil agrees well with *G. comptus* in general outlines, character of ornamentation, paddle-shaped arm-base lobes; smooth, flat ventral plates and central spine and in having thirty arms and excentric anus.

It differs in the possession of five ambulacral spines quite as strong as the central dome spine and a more convex ventral disk. The dorsal cup is very little deeper and slightly more inflated, while the ambulacral ridges on the ventral disk are a little better pronounced, the whole tegmen having somewhat the appearance of a low, broad pentagonal pyramid. The central spine is directed a little backward and the five ambulacral spines slightly outward.

Horizon, collection and locality same as the last.

GENNÆOCRINUS KENTUCKIENSIS? Shumard? Rowley.

PLATE 33. FIGS. 10, 11, 12.

This specimen seems to agree quite well with the species to which it is above referred, save that it has but thirty arms, while Wachsmuth and Springer state that Shumard's species has forty. We suspect the authors were in error as to the number.

This is the largest form we have yet seen. The dorsal cup is moderately inflated and the basal plates form a low tripartite rim, but the first radials want the strong node so conspicuous on the other species described in this series of papers. The radial ridge is less strong, but the radiating lines from the plate centers are sharply defined and numerous. The plates of the upper part of the anal interradius are provided with short spine-like central nodes, while all of the ambulacral plates are similarly surmounted, giving the ventral disk a decidedly burr-like aspect. The interambulacral plates are less spinose and those around the anal opening are hardly more than smooth. There is no central spine, and from the condition of preservation of the specimen, the presence or absence of a strong spine at the ambulacral fork is a matter of conjecture. The ventral disk is hardly convex and the arm lobes are quite strong.

Upper Devonian beds, Falls of the Ohio. Collection of Mr. G. K. Greene.

AOROCRINUS CASSEDAYI, Lyon, Rowley.

PLATE 33. FIGS. 13, 14, 15.

The specimen before us seems to be the form figured by Wachsmuth and Springer in the Revision of the Paleocrinoidea as *A. casedayi*, differing from the usual form in its greater width of body and almost flat ventral disk.

Upper Devonian, near Charlestown, Ind. Collection of G. K. Greene.

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*DOLATOCRINUS PULCHELLUS*, M. & G., Rowley.

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PLATE 33. FIGS. 16, 17, 18.

This little crinoid seems to be the form described by Miller and Gurley as *D. pulchellus*, but agrees quite as well with *D. aspratilis*, having one less arm-base, however.

Each radial and the first interradial plate have strong central spine-like nodes and the few radiating lines are strong. That part of the dorsal surface as far outward from the stem as the middle of the first radials is a smooth pentagonal figure for the most part a wide funnel-shaped area. There seems to be but one interradial above the first plate of that area.

Horizon, locality and collection, same as the last.

There is little doubt in the author's mind that *D. bulbaceus*, *D. pulchellus*, *D. argutus* and *D. aspratilis* of M. & G. are one and the same species, despite an extra arm-base in one and the slight variations in sculpture.

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**HELIOPHYLLUM MIRUM, N. Sp.**

PLATE 34. FIGS. 1, 2.

Corallum simple, turbinate, straight or curved. Attenuate at the base of attachment, rapidly expanding in diameter to the calix. Exterior with gentle undulations and wrinkles, caused by intermittent growth. Length of corallum on anterior side eighty millimeters; on the posterior side twenty-five millimeters. Calix oblique and broadly campanulate, fifty millimeters in diameter. Depth fifteen millimeters. A flat space in the bottom of the calix occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ one hundred and fifty in the circumference of a calix fifty millimeters in diameter, alternating in length, unequal in size at the margin, the short ones continue for ten or fifteen millimeters, and coalesce with the longer ones, or disappear, the longer ones are slightly elevated, sharp, and gradually slope to the flat space in the bottom of the calix, and abruptly terminate. Fossette conspicuous, consists of a deep groove commencing at the margin of the flat space in the bottom of the calix, and continuing to the anterior margin. Denticulations obscure, due to the weathered condition of the corallum, but in well preserved examples they are elevated and sharp, and about one millimeter apart.

Found in the Upper Devonian (Hamilton group) two miles north-west of Charlestown, Indiana. Now in the collection of the author.

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**HELIOPHYLLUM DISPANSUM, N. Sp.**

PLATE 34. FIGS. 3, 4.

Corallum simple, turbinate, straight or curved. Attenuate at the base of attachment, rapidly expanding in diameter to the calix. Exterior surface with annulations and wrinkles caused by intermittent growth. Length of corallum seventy millimeters on the anterior side, thirty-five millimeters on the posterior side. Calix broadly campanulate, forty-five millimeters in diameter. Depth fifteen millimeters. A flat space in the bottom of the calix, occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ, one hundred and fifty, in the circumference of a calix forty-five millimeters in diameter, alternating in length, equal in size at the margin, gradually sloping to the flat space in the bottom of the calix, where the short ones terminate, the longer ones continuing to the center, twisting, and slightly elevated. Fossette conspicuous, consists of a deep groove commencing at the bottom of the calix, and continuing to the anterior margin. Denticulations on preserved portions of the lamellæ well defined, much finer than in the former species.

Found in the Upper Devonian (Hamilton group) two miles north-west of Charlestown, Indiana. Now in the collection of the author.

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 HELIOPHYLLUM CROTALUM, N. Sp.
 

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## PLATE 34. FIGS. 5, 6.

Corallum simple, turbinate, straight or curved. Attenuate at the base of attachment, rapidly expanding in diameter to the calix. Length of corallum on the side of the longest curvature, seventy-five millimeters; length on the posterior side, thirty-five millimeters. Exterior with undulations and wrinkles, caused by intermittent growth. Calix broadly campanulate, forty-five millimeters in diameter. A flat space in the bottom of the calix, occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ, one hundred and thirty-six, in the circumference of a calix forty-five millimeters in diameter, alternating in length, subequal at the margin, gradually sloping to the flat space in the bottom of the calix, where the short ones terminate, the longer ones continue, coalescing and fasciculating and is slightly elevated in the center of the calix. Fossette conspicuous, consists of a deep groove at the bottom of the calix, and continues to the anterior margin. Denticulations rather obscure, though in protected places they are more pronounced.

Found in the Upper Devonian (Hamilton group) two miles north-west of Charlestown, Indiana. Now in the collection of the author.

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 ZAPHRENTIS WEBERI, N. Sp.
 

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## PLATE 34. FIGS. 7, 8, 9, 10, 11.

Corallum simple, turbinate, straight or regularly curved, usually with a broad scar at the base of attachment, while some examples are acute at the point of attachment. Height from thirty to sixty millimeters, varying in different individuals. Gradually, or at times, rapidly increasing in diameter to the calix. Exterior with rough, rounded annulations, and wrinkles. Longitudinal striæ coarse, distinct, six in the space of five millimeters. Calix usually slightly oblique, twenty to thirty millimeters in diameter. Depth ten to twenty millimeters. Situated in the center of the calix, is an oblique concave space, occupied by the tabulæ, from five to ten millimeters in diameter. Number of lamellæ, ninety-six in the circumference of a calix, twenty-five millimeters in diameter, sharp, and unequal in size at the margin, alternating below, the short ones scarcely more than rudimentary; the longer ones gradually slope to the smooth, oblique space in the bottom of the calix, and abruptly terminate, leaving a smooth, oblique, concave space, in the bottom of the calix, from five to ten millimeters in diameter. Fossette rather obscure; when visible it is situated on the side of the longest curvature of the coral.

The specific name is in honor of Mr. George Weber, of Louisville, Kentucky.

Found in the Middle Devonian (Upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

**STRIATOPORA BELLISTRIATA, N. Sp.**

PLATE 34. FIG. 12.

*Córalium* romose, composed of irregular sized cylindrical stems, varying from ten to fifteen millimeters in diameter, varying in different examples. Tubes rounded, unequal in size, from one half to two and one half millimeters in diameter, opening oblique to the surface, with expanded margins. The inner portion of the tubes are beautifully striated with longitudinal grooves, pores round, rather large, situated in the grooves.

The large sized stems, and the unequal size tubes, and the tubes opening oblique, with wide spreading margins, makes this easily recognized from all other species.

Found in the Middle Devonian (Upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

**DOLATOCRINUS EXCAVATUS, var. Incarinatus, new var.**  
(Rowley).

PLATE 35. FIGS. 1, 2, 3.

The dorsal cup of this crinoid is low, flattened below the first radials of the second series, and with a deep basal funnel. The body is broadest where the flattening begins and a little contracted just below the arm bases. The ventral disk is high for *Dolatocrinus*, being low conical.

The basal plates, as usual, are hidden by the top stem joints, lying at the bottom of an excavation as deep as the long first radials, and as high as the arm bases.

The stem is of moderate size and with a medium sized five lobed columnar canal.

The first radials are six and seven sided, much longer than wide. The second radials are nearly twice as wide as long and, as usual, four-sided. The third or axillary radials are broader than long and five-sided. Each upper sloping side of this latter plate supports four plates of the second radial series, all broader than long, and the first being larger than the axillary plate, itself.

The first interradial plate is longer than broad, ten sided, and supports

above two smaller plates which rest below two still smaller pieces. Above these and between the arm lobes are four or five elongate small plates.

The plates of the ventral disk are slightly convex, and the anal opening or base of anal tube, is nearly central and rather strong. The ventral portion of the fossil is badly weathered, and surface features may be obliterated.

There are ten large arm bases (two to the group). Lobes not distinct. From six to seven slits pierce the plates between the arm groups, just at the periphery, and from four to five between the arm bases of the same group.

The dorsal cup of the specimen is beautifully preserved and, unlike either *D. marshi* or *D. escaratus* has no keeled radial ridge, the entire surface being ornamented by numerous, low sharp lines radiating from the centers of all the plates and with short, connecting ridges, giving a delicate pitted or reticulate appearance to the test, with but the merest indication of a radial ridge. The dorsal plates are wholly without central nodes.

The great height of the ventral disk of this form and the non-keeled character of the radial rays separate it from *D. escaratus*, which Wachsmuth and Springer describe as strongly keeled and with a depressed ventral side.

The handsome specimen figured is from the middle Devonian, Thompson's Bend, on Silver Creek, Clark county, Indiana, and belongs to the collection of Mr. G. K. Greene.

#### DOLATOCRINUS PERNODOSUS, N. Sp. (Rowley.)

##### PLATE 35. FIGS. 4, 5, 6.

The dorsal cup of this fine crinoid is concave below the first interradial plates, broadly but much less deeply than in the preceding species. The outline of the pentagonal basal disk is seen at the bottom of the broad, shallow concavity. The first radials are about as wide as long and convex, with low, sharp ridges radiating from the center to the centers of adjoining plates. The second and third radials are much wider than long and strongly convex or nodose. As in the first radials, sharp radiating lines pass to adjacent plates. The first plates of the second series of radials are each axillary and quite as large as the radial plates below them, strongly convex and giving rise to sharp radiating ridges. Each plate of the third series supports above two plates, making three times four plates to the third radial series.

The first interradial plate is the largest plate in the body, as wide as long, strongly tumid with radiating ridges from the center to the centers of neighboring plates. Above the first interradial is a large, tumid second interradial above which is a smaller plate supporting above two still smaller plates. All of the dorsal plates are strongly tumid and with sharp radiating lines from center to center of adjoining plates.

The body is broadest near the region of the second interradials and slightly contracted below the arm bases.

One radial ray has four plates in the first series.

There are four slits between the arm lobes and two between individual arms. The arm formula is 3, 4, 3, 4, 3, or 17 in all.

The anal tube is nearly central but not strong.

The plates of the ventral side are nearly flat, grooved at the sutures and ornamented with low, granular like nodes.

Compare with *D. amplus*, M. & G., a twenty armed species.

From the Upper Devonian (Hamilton group) near Charlestown, Ind. Collection of Mr. G. K. Greene.

### CALCEOCRINUS GRANULIFERUS, N. Sp. (Rowley.)

PLATE 35. FIGS. 7, 8, 9.

Body subquadrate, broadest below. The basal plate seems to be made up of three anchylosed pieces, the whole triangular and more than twice as wide as long, grooved along the entire upper edge. Scar for attachment of column hardly round, excavated.

Lower dorsal plate broadly triangular, more than twice as broad as long and deeply grooved along its lower edge. Upper dorsal plate triangular, three times as broad as long and grooved along the front of the upper edge.

The dorso lateral plates are longer than wide, and constricted a little at the middle of the outer edge,

All of the plates are somewhat convex and depressed, almost grooved, along the sutures.

Surface ornamentation granular.

Arms and column unknown.

Knobstone group, Button Knobs, near Louisville, Ky. Collection of Mr. G. K. Greene.

Our species belongs to the division of Calceocrinus, called Deltacrinus by Mr. E. O. Ulrich, and should this latter name hold in a full generic sense, our species would become *Deltacrinus granuliferus*.

### PLATYCRINUS DEVONICUS, N. Sp., (Rowley).

PLATE 35. FIGS. 10, 11.

The base *only* of this fossil is known, but its characters are quite marked

enough to deserve a name, coming from a horizon that has yielded little of such material.

The base is pentagonal and quite large, forming a low cup or bowl.

A row of more or less coalescing nodes passes from the stem base to each angle of the pentagon and within the five triangles thus formed, four rows of coalescing nodes run parallel to the baso-radial sutures (sides of the pentagon). The nodes are strong and sharp. There is a break in the test at the base so that the stem cicatrix can not be determined as to shape and depth.

Middle Devonian, Falls of the Ohio. Collection of Mr. G. K. Greene.

### PENTREMITES OBESUS, Lyon, Rowley.

PLATE 36. FIGS. 1, 2-3.

The specimen represented on our plate by figures 1, 2, 3, though somewhat inferior in size to Lyon's type specimen, is a fine individual, and preserved in such a way that every plate suture can be readily made out.

It differs from the drawings in the old Kentucky report, mainly in the shape of the body above the ambulacral tips, where the greatest width occurs, thus giving little curvature to the lateral outline.

Below the ambulacral tips the body has less height, and the lateral bounding lines curve inward instead of being straight as in the specimen with which we are making the comparison.

The chief characters of *P. obesus* seem to be its great size, rather strongly convex base, strongly lobed character of the fork pieces, the deeply sunken ambulacra, themselves trough-shaped; the great height of the bounding edges of the fork and deltoid pieces above the ambulacra, and the high, acute upper points of the deltoids, extending much above the ventral surface. The deltoids themselves are rather large and separated below from the fork pieces by curved sutures. The central opening (uncovered ventral region) is small, and the four spiracles and anal opening are but medium in size. A long triangular depression with the radio-deltoid suture as a base, has its vertical angle below the middle of the radial edge, bounding the ambulacrum. The two of these triangles in an interambulacral space, together with the deltoid at their bases, form a slightly depressed inverted v-shaped area. This character is common to many blastoids and not confined to the genus *Pentremites*. In *Lophoblastus inopinatus* it is sometimes so strong as to give rise to a spine-like elevation in the fork pieces at the union of the radial and radio-interradial sutures.

The edges of the fork pieces bounding the ambulacra are often irregular, fluted or thrown into folds and depressions, giving rise to spine-like processes as in Dr. Hambach's species *P. spinosus*, and doubtless to the nodosities in

*P. nodosus*. See our figures 4, 5, 6, for the tendency toward extravagance in this kind of development. Thus a variation in surface feature reaching extravagance in development and becoming permanent, assumes a character of specific importance.

The diameter of a column of a very large *P. obesus* is about three-sixteenths of an inch, judging from the columnar scar on the basal plates.

The side pieces, pores and lancet plates will not be discussed in this connection.

The surface ornamentation is, doubtless fine lines, parallel with the plate sutures as in other species of the genus, but the character of the surface preservation in our specimen is not such as to show this.

The specimen, figures 1, 2, 3, is from the Kaskaskia Limestone of Grayson Springs, Ky., and was kindly presented to Mr. G. K. Greene by Dr. John E. Younglove, of Bowling Green, Ky.

#### PENTREMITES SULCATUS? Roemer, Rowley.

##### PLATE 36. FIGS. 4-5.

The specimens figured are fragments of large Pentremites, exhibiting many of the characters of *P. obesus*, but disagreeing in the less convexity of the base, approaching more nearly to *P. sulcatus* in this particular.

Figure 4 is a view of the visceral cavity, by the removal of one of the fork pieces and the half of another adjoining.

The interambulacral space is seen to be traversed longitudinally by two folds that are received into a lunular pocket above, and the thickening of the substance of the test below the middle of the body and the union of the sides of opposite folds form deep pits beneath the ambulacra, to their distal ends, along the lateral margins of the ambulacra may be seen the lines of pores.

The proportionate thickness of the test is also shown.

Figure 5 shows the great depth of the ambulacral sulcus and the fluted and folded character of the radial edges bounding the sulcus.

Both specimens are from the Kaskaskia Limestone of Big Clifty, Hardin county, Ky., and were collected by Mr. Charles Very, of New Albany, Ind. They now belong to the cabinet of Mr. G. K. Greene.

#### PENTREMITES CHEROKEUS? Troost, Rowley.

##### PLATE 36. FIG. 6.

Following Hall's description and figure in the old Iowa Report, we refer

this form to *P. cherokeus*, but not without some doubt, however, as to the validity of the species.

There seem to be few differences of no importance, between *P. cherokeus* and *P. sulcatus*, if Hall and others have correctly identified them. There is a larger form than either from Tennessee, and said to occur in the St. Louis Limestone, which may, after all, be the form originally referred to *P. cherokeus* by Troost.

The specimen under consideration has a strongly convex base, with an almost straight edge from the distal end of the ambulacrum to the columnar base. The deltoid is less than one-fourth as long as the ambulacrum, and projects upward into a spine-like process. The ambulacra form broad troughs, bordered by the rather deep, sharp edges of the fork pieces, the latter being crimped as mentioned in the description of *P. obesus*. The ambulacral fields form strong folds below, or the body is strongly five-lobed at the ambulacral tips.

The central ventral opening is a small five-pointed star. The spiracles are almost round, while the anal opening is somewhat elliptical.

Collected from the Kaskaskia Limestone at Clifty Station, <sup>Johnson</sup> Grayson county, Ky. Collection of Mr. G. K. Greene.

#### PENTREMITES CHESTERENSIS, Hambach, Rowley.

#### PLATE 36. FIGS. 7, 8, 9, 10-11.

The specimen figures 7 and 8 differs in some minor details from Dr. Hambach's description of the type, the basal portion of the body to the lower ends of the ambulacra being proportionally much greater in depth in our specimen, the basal cup itself being deeper, and that part of the fork piece below the tip of the ambulacrum sloping strongly toward the basal cup instead of being nearly horizontal as in *P. chesterensis*.

The ambulacra are rather medium in width, nearly flat, and but little below the interambulacral surface.

The entire specimen has a somewhat double conical shape, the interambulacral fields being nearly flat and the greatest width of body being at the distal ends of the ambulacra.

The deltoids are a little more than one-third of the length of the ambulacra, but their proximal ends do not extend quite to the summit, while in *P. chesterensis* they extend above.

The test is rather thin. No surface ornamentation is visible on our specimen.

Horizon: Kaskaskia Limestone. Locality: Big Clifty, Hardin county, Ky.  
 Collector: Charles Very, of New Albany, Ind. Collection of G. K. Greene.

The specimen, figures 9, 10, 11, also differs somewhat from typical *P. chesterensis*, the inter-ambulaeral spaces forming shallow troughs, thus giving a lobed appearance to the body. In fact, the whole specimen to the distal ends of the ambulaera has a strongly *P. godoni* look and could be easily referred to that species were it not for the protuberant base.

To the basal plates, the body is sub-ellipsoidal, instead of conical in *P. chesterensis*. The deltoids are more than a third as long as the ambulaera, but do not project above the ventral surface. The ambulaera are nearly flat, moderately wide and but little sunken beneath the bounding radial lips.

The openings on the ventral side are medium in size.

Surface ornamentation unknown.

Horizon: Kaskaskia Limestone. Locality: five miles northwest of Bowling Green, Ky. Collection of G. K. Greene.

#### PENTREMITES ROBUSTUS. Lyon, Rowley.

PLATE 36. FIG. 12.

Our specimen differs little from Lyon's type, except in size. The basal plates form a low conical cup and the line from the top of the basal cup to the distal end of the ambulaerum is a little oblique. The inter-ambulaeral spaces form troughs and so throw the ambulaera into lobes. The fork pieces are hardly more than half the body length while the deltoids are more than a third the ambulaeral length, but do not extend upward to the spiracles. The ambulaera are rather wide, almost flat, and but little below the bounding edges of the radials and deltoids. Here again we have a specimen strongly like *P. godoni* above the ambulaeral ends.

From the Kaskaskia Limestone of Newman's Ridge, East Tennessee. Collection of G. K. Greene.

The various species of the genus *Pentremites* may be referred to a few simple groups of closely related forms, *P. chesterensis*, *P. robustus*, *P. hemisphericus* falling in naturally with *P. godoni*, while *P. symmetricus*, *P. elegans*, *P. calycinus*, and perhaps *P. clavatus*, range themselves with *P. pyri-formis*.

The *sulcatus* group would include *P. obesus*, *P. cherokeeus*, *P. sulcatus*, *P. angularis*, *P. spinosus*, *P. broadheadi* and *P. basilaris*. *P. conoideus*, *P. koninckanus* and *P. benedicti* would form a group of kindred species.

*Pentremites burlingtonensis* and *P. elongatus* have affinities with both the *godoni* and *conoideus* groups.

The *P. cervinus* group seems to connect the *P. sulcatus* and *P. godoni* series and embraces *P. cervinus* and *P. nodosus*.

*Pentremites altus* seems to belong to the *Pyriiformis* group, while *P. gemmiformis* is perhaps a synonym of *P. calycinus*.

*P. abbreviatus* is hardly distinct from *P. godoni*.

Of *P. globosus*, *P. missouriensis* and *P. troosti* little seems to be known, while other species as *P. truncatus*, *P. subconoides*, *P. longicostalis* and *P. decussatus* probably do not belong to the genus.

*P. laternitiformis* is the internal cast of some large species of Pentremites.

#### PENTREMITES Sp.?

PLATE 36. FIG. 13.

We are unable to refer this form to any species with which we are acquainted. It evidently belongs to the *P. pyriiformis* type, and, although it bears a superficial resemblance to *P. angularis*, it cannot be placed there as that is within the realm of the *sulcatus* group. We hardly care to found a species on the evidence of one fossil but should future research prove the constancy of these characters in other specimens, we would suggest the name *Pentremites speciosus*.

The body is doubly conical, the part below the distal ends of the ambulacra being much deeper than the part above.

The large basal plates form a strong conical cup and are quite one third of the body in height. The radial pieces are but little more than half the entire body height. The deltoids are quite one third the ambulacral length but do not quite reach the summit. The ambulacra are of moderate width, almost flat, lying but little below the bounding radial and interradial edges and less than half the body in length.

The inter-ambulacral spaces are flat and the outline boundary from the ambulacral tip to the stem base is an oblique line, almost straight. The ventral or top surface is quite broad, spiracles round and but little smaller than the anal opening and the uncovered central space is a small, symmetrical, five pointed star.

The number of pore pieces on one side of an ambulacrum is about thirty-five, or seventy to the whole area.

The column was quite strong.

On account of the poorly preserved character of the surface nothing can be determined as to the external ornamentation.

From the Kaskaskia group of Crittenden county, Kentucky, and the collection of G. K. Greene.

## PENTREMITES PYRIFORMIS, Say, Rowley.

## PLATE 36. FIG. 14.

The specimen figured is the largest we have yet seen and is not a typical example. The greatest width is at the ambulacral ends, at the middle of the length. The body is doubly conical. Inter-ambulacral areas flat. Ambulacra quite flat and but slightly sunken below the bounding plates and rather narrow.

Deltoids but little more than one-fourth the ambulacral length and not reaching the summit. The basal plates are one-fourth the entire body length, forming an inverted cone. The fork pieces are more than half the body length. The ventral area is much contracted. Spiracles and anal opening small.

Greatest length of the specimen, one and a half inches: greatest width, one inch.

From the Kaskaskia group of Crittenden county, Kentucky. Collection of Mr. G. K. Greene.

## PENTREMITES PYRIFORMIS, Say, Rowley.

## PLATE 36. FIG. 15.

Figure 15 is a side view of a very elongate young example in which the depth of the basal cup is more than one-third of the body length. The lower half of the basal cup is a slender neck formed by the consolidation or ankylosis of stem joints. The radial plates are long, while the deltoids are minute and do not nearly reach the summit. The ambulacra are broad and sunken below the bounding plate edges. Body slightly lobed.

Kaskaskia group, Wolf Creek, Breckinridge county, Kentucky. Collection of G. K. Greene.

## PENTREMITES PYRIFORMIS, Say, Rowley.

## PLATE 36. FIGS. 16, 17.

The specimen here figured is normal as to the five ambulacra, but one of the inter-ambulacral spaces is pushed out above, forming a strong central ridge, occupied by an elongate five-sided extra plate. Below the ambulacral ends the specimen is again normal. This extra plate is a sixth radial.

The ventral surface is somewhat worn, showing the double character of the spiracles.

Horizon: Kaskaskia group. Locality: Five miles northwest of Bowling Green, Ky. Mr. G. K. Greene's collection.

## PENTREMITES GODONI, De France, Rowley.

PLATE 36. FIGS. 18, 19, 20, 21, 22, 23, 24, 25.

Figure 18 exhibits the worn ventral surface of a very flat specimen, perhaps Dr. Hambach's *P. abbreviatus*. The spiracles that usually reach the surface as four rounded openings are here shown to be eight paired holes. In well preserved (perfect) specimens where the spiracular openings are free of rock material, the knife-blade-like partition wall may be seen just within the spiracle, separating it into two canals. The least weathering develops both canals as is shown in the figure.

Figure 19 is an end view of an abnormal specimen in which the fifth ambulacrum is wanting, its place being occupied by an elongate, protuberant plate of radial length, a single broad deltoid filling the space above. There are three spiracles, and a rather large anal opening opposite the abortive fifth ambulacrum.

Another specimen in our hands, larger, but of like abnormality, has a simple spiracle, not unlike the other two, opposite the wanting ambulacrum, the anal opening of usual size opposite a normal deltoid plate.

Kaskaskia group, near Bowling Green, Ky. Collection of Mr. G. K. Greene.

Figure 20 is a small Godoni with ambulacra of different lengths, due to an injury and subsequent growth.

The specimen is considerably flattened on one side, where the ambulacrum is much less than half the length of the two normal ones and of less width. The two adjacent ambulacra are also shortened and somewhat distorted.

Figure 21 is a specimen quite normal in outline but having one ambulacrum doubled two-thirds of the distance up from its distal extremity: rather, having a ridge inserted along the lancet plate as in the illustration. This ridge is ribbed along its sides as ambulacral areas are and pierced along the top by pores, showing plainly the doubled character of the ambulacrum.

Specimens with a ridge the entire length of the ambulacrum are occasionally found and the presence of the ridge can be explained by supposing two ambulacra to be contiguous (an abnormality) and the later tendency of the blastoid in growth to become normal, pushing the two fields into the space of one, by doubling upward the inner halves of each field into a longitudinal elevation. For an illustration see figure 37.

Both 20 and 21 are from the Kaskaskia group, of Bowling Green, Ky., and the property of G. K. Greene.

Figure 22 is a basal view of a specimen, normal in the relative widths of the ambulacral and inter-ambulacral fields, but with one of the latter filled by an

extra plate pushed into a ridge and forming a spine-like process between the distal ends of two ambulacra. From the ambulacral tips to the base of the column, the specimen is normal. This inter-ambulacral plate is a sixth fork piece, having an indistinct rounded longitudinal prominence down its center instead of an ambulacrum. Above this inserted radial is but one deltoid, being scarcely wider than the other four but not quite so concave.

This specimen is from the Kaskaskia group, of Breckinridge county, Kentucky.

Figures 23 and 24 are side and summit views of two internal casts of *P. godoni*.

The longitudinal slender ridges on either side of a broader ridge are the casts of the hydrospire sacks, the broader ridge being a cast of the open space just beneath the lancet plate and formed by the median hydrospire folds.

Notice the great similarity between the ventral view of this cast of *Pentremites* and a like view of the test of a *Codaster*. The resemblance is striking, the difference being mainly in the greater number of the slits in an ambulacral field of the latter. Breaks in the fields of the specimens before us show the depths of the folds.

The same and other features may be seen in the natural casts of the visceral cavity of *Schizoblastus sayi* and *Orbitremites norwoodi*.

These two specimens (Figs. 23 and 24) are from the Kaskaskia group of Kentucky, and the property of G. K. Greene.

Figure 25 is a side view of a specimen from which two ambulacra and the inter-ambulacral plates have been removed, showing the cast of the visceral cavity. Along the edges of the fork and deltoid pieces may be seen the pores that communicate with the hydrospires beneath. The relative thickness of the various parts of the test is also shown.

From the Kaskaskia group, of Bowling Green, Ky.

#### PENTREMITES GODONI, De France, Rowley.

PLATE 36. FIGS. 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36.

Figure 26 is a view of the inner surface of a fragment showing two groups of hydrospires. As is usual in this species there are eight tubes to the group.

The shape of a series is in a general way like that of the ambulacrum, broadest at the top of the fork pieces. The tip is received below into a pocket so that the full length is not seen in the illustration. The relative thickness of the test is also exhibited.

Figure 27 is a side view of a specimen, preserving the pinules in the left half of one ambulacrum, the right half of the same and parts of two other am-

bulacra being covered by pinule joints. From the condition of preservation, little else can be made out by the use of an ordinary hand lense, nothing in fact as to the manner of attachment to the pore pieces.

Figure 28 is a view where the top has been ground off, down to the point of greatest width of the ambulacra, hardly half the length of the deltoids. The hydrospire folds and the pores are exhibited, as well as the shape of the lancet piece in cross section. One ambulacrum has been removed.

The specimen figure 29 has been ground down about the same depth but is better preserved internally and shows well the groups of hydrospires, the ambulacral pores and the lancet canal.

If there is a closed under-lancet canal it can not be made out in this specimen unless the walls of the inner hydrospire sacks of a paired group are in contact which does not appear to be the case. The lancet tube appears as a minute dot and smaller than in *Orbitremites norwoodi* where the writer first learned of its presence. In breaking Burlington cherts for casts of this latter species, after removing the beautiful mold of the visceral cavity, delicate curved rods were seen free in the cavity in the matrix, broken away from the east by the jar of the hammer. Delicate as these acicular rods are, occasionally they remain in place on the fossil.

Figure 30 is an enlarged view of a paired group of hydrospires as they lie beneath the ambulacrum. The inner, adjacent folds are separated too far in picture.

Kaskaskia group, Breckenridge county Kentucky.

Figures 31 and 32 are different views of a specimen whose ventral surface is covered by a pyramid, the character of which is rather obscure.

This much can be said of it with certainty that it is a five lobed elevation, the lobes facing the deltoid plates and covering the spiracles and presumably the anal opening, but an apparent injury occurs at that particular place and the opening itself is seen but filled by what appears to be the collapsed lobe of the pyramid. Between the bases of the lobes the ambulacral grooves enter the pyramid as tunnels, but at one of these re-entrant angles a low roofing over the groove passes a short distance down the ambulacrum, the edges of it being seen further down where the roof itself has been broken in.

Kaskaskia group, near Bowling Green, Ky.

Figures 33, 34 and 35 are different views of a specimen in which the pyramid has been mostly broken away but showing well the inner character of the structure. It seems to be a two-story affair, or in other words, a double covering, the inner or lower one, rather flat and of sufficient area to overspread the central stellate opening and pass outward down the middle of the ambulacrum as a slender low roof over the ambulacral groove. The outer or upper covering is a five lobed pyramidal structure surrounding the spiracles and, doubtless, the

anal opening, closing in above the lower covering. Both the outer and inner integuments are very delicate structures, thin as the thinnest sheet of writing paper. At the re-entrant angles are inner knife-edge-like strengthening, upright partitions that may or may not extend to the center, separating the inner continuation of the spiracles. Thus the pyramid seems to cover a stellate space of five radiating tunnels, extensions of the spiracles and anal opening. Whether they unite at the center, can not be definitely determined, neither can it be learned whether there is any communication between this chamber and the outside or any perforations through the lower integument. The direct communication between the visceral cavity and the outside by means of the tunnels leading to the ambulacral grooves can be plainly seen.

The outside surface of the pyramid shows evidences, apparently, of being made up of small plates, but we can not say positively. When one takes into consideration the great difficulty even in tracing the sutures of the radials and deltoids in well preserved, silicified *Pentremites* from the Kaskaskia Limestone, there is no wonder that the structure of these delicate ventral integuments should escape him.

Why the spiracles or the anal opening or both should be cut off from external communication is not apparent, but if it is so, as appears almost certain, we should accept the fact whether it is consistent with our conclusions as to the "eternal fitness" of things or not. Too, our conclusions may be based on erroneous reasoning, after all. Again, that specimens preserving these ventral coverings should be so scarce is not at all surprising taking into account their very delicate character. In a score of years collecting from the Burlington Limestone here at Louisiana, during which time several hundred specimens of *Dichocrinus* have passed through our hands, we have yet the first one to find with the ventral covering intact, despite the fact it has been seen and figured, time and again. Should we reason from *our* experience we could assert that the ventral side of *Dichocrinus* is never closed by a disk of covering plates and yet we would be in error.

Strange as it may seem, in the very same locality where a perfect body of *Dichocrinus* has never yet been found, a very large per cent of the specimens of *Schizoblastus sayi* preserve the delicate ventral covering and, in this connection, we may say it is unlike that of *Pentremites golomi* in that it is not double, corresponding to the inner roofing in that species and yet covering the spiracles, but never the anal opening so far as we have been able to see in the study of dozens of well preserved specimens.

In a single beautifully preserved individual of *Orophocrinus stelliformis* from the same place, the narrow rounded ridges of minute plates that cover the ambulacral grooves, extend some distance down four of the ambulacra and to the very distal end of the fifth.

The specimen numbered 33, 34 and 35 is from the Kaskaskia Limestone, near Bowling Green, Ky.

The structure over the ventral side of figure 36 can not well be determined. It has the appearance of aggregate pinules but may be something wholly foreign to the fossil. At any rate, enveloped in this mass, above one ambulacrum, may be seen a part of the outer pyramidal ventral covering, the sutures of whose minute plates at its base may be plainly seen.

Locality: Bowling Green, Ky., Kaskaskia group.

PENTREMITES GODONI, De France, Rowley.

PLATE 36. FIGS. 37, 38.

Side and ventral views of a four sided specimen in which two ambulacra have been crowded into the space of one, the contiguous halves of the two being pushed up into a ridge.

The fossil has but four radials, four deltoids, three spiracles and the anal opening, the latter being above the deltoid to the left of the abnormal ambulacrum.

From the Kaskaskia group, near Bowling Green, Ky.

PENTREMITES CALYCINUS, Lyon, Rowley.

PLATE 36. FIGS. 39, 40.

In general outline neither of our specimens agrees well with Lyon's figure of the type nor yet with Dr. Hambach's drawings of Calycinus. There is little doubt of the identity, however. The basil plates form a low cup with a rounded handle-like base. The fork pieces are more than half the length of the body, while the deltoids are hardly more than a fourth the length of the ambulacra and do not extend to the summit.

The inter-ambulacral spaces are but little depressed, while the ambulacra are broad and slightly trough shaped, and lying but little below the bounding edges of the radial and deltoids. The spiracles are round, as is also the anal opening.

All our specimens are badly weathered.

The general aspect of the fossil is much like that of *P. pyriformis*, but less in length and more robust than the young of that species.

The specimens figured are from the Kaskaskia Limestone of Clifty Station, Hardin county, Ky.

## PENTREMITES CONOIDEUS, Hall, Rowley.

PLATE 36. FIGS. 41, 42, 43, 44.

Figure 41 is a specimen with five radial plates, but only four ambulacra, the fifth radial being somewhat shorter than the rest, narrower and merely creased down the middle, where the ambulacrum should be. There seems to be but one deltoid above this abnormal fork piece and that too, is creased in like manner and has the outline of a double piece.

The abortive radial is directly opposite the anal opening.

The summit openings are but four.

Figure 42 is a ventral view of another so-called four-sided specimen, differing in no wise from the above specimen except that the anal opening is directly above the crease in the double deltoid.

Figure 43 is a deformed specimen in which two of the ambulacra are little more than half the length of the other three.

Figure 44 is a side view of a much smaller, normal specimen with some stem joints attached to the base.

The chief character of *P. conoideus* are the cone shape of the body, the strongly lobed character of the ambulacral region, the narrowness and convexity of the ambulacra themselves, the relatively long deltoids that do not reach the summit. The large, mature specimens usually have a flat base, but smaller examples often have the base quite convex, approaching in this particular, *P. koninckanus*, which Etheridge and Carpenter make a variety of the former.

Warsaw limestone, Lanesville, Ind.

## PENTREMITES KONINCKANUS, Hall, Rowley.

PLATE 36. FIG. 45.

Our figure is of an elegant little specimen, preserving some of the stem joints in place.

The main differences between this and *P. conoideus* is in the proportionate length of the ambulacra, which in *koninckanus* are not more than half the length of the body, while in adult *P. conoideus* they are full body length. In narrowness and convexity of the ambulacra the two species agree. In *koninckanus* the bounding edges of the fork pieces and deltoids are more sharply outlined above the ambulacra. As in *conoideus* the body is strongly lobed. The anchylosis of the basal stem joints in these little blastoids explains well the presence of the so-called *basal* plates of Lyon. There is yet a better illustration of that in *Orophocrinus stelliformis*.

The specimen illustrated (Fig. 45) is from the Warsaw limestone of Lanesville, Ind.

## CARPENTEROBLASTUS VERYI, N. Sp. (Rowley).

PLATE 36. FIGS. 46, 47, 48.

The three basal plates form a shallow cup or low inverted frustum of a cone. The fork pieces are about three-fourths of the body height, The deltoids are nearly a fourth of an inch long on the type specimen, but confined mostly to the flattened summit. The ventral region is considerably sunken as in all the known species of this genus.

The spiracles are apparently minute, while the anal opening is of average size and with the tip of the deltoid a little swollen above it. The ambulacra are very narrow and somewhat below the bounding edges of the radial and deltoids.

The radial lips with the inclosed ambulacrum form a rather steep ridge that assumes considerable elevation at the distal end of the ambulacrum so that a basal view of the blastoid is very noticeably stellate, recalling *Orophocrinus*. The inter-ambulacral area is almost flat from ambulacral ridge to ambulacral ridge. The distal end of the ambulacrum droops below the inferior surface of the radial, and the outline from that point to the stem base is an incurved arc. The plate sutures are so strong as to appear to be grooved.

The stem base is quite large.

No surface ornamentation is preserved since the specimens are silicified.

Length of the larger of the two specimens and the one figured, one-half an inch, width eleven-sixteenths.

This species differs from *C. magnibasis* in its strong, stellate outline, greater elevation of the ambulacral ridges, nearly flat inter-ambulacral spaces, greater size of the deltoids and the shape of the dorsal side. In *C. magnibasis* the lower portion of the radials and the basal plates form a low rounded convexity, while in *C. veryi* the basal plates alone enter into the formation of a low inverted frustum of a cone. *C. veryi* bears a stronger resemblance to the cast of the visceral cavity of *C. magnibasis* than it does to the real fossil, in the projection of the distal ends of the ambulacra, it approaches somewhat *C. stella* but is a much larger species. In fact it is larger than *C. magnibasis*.

The finding of this fossil in Kentucky and the probability that its horizon is Keokuk, are very interesting pieces of information. *Carpenteroblastus* has not been found beyond the limits of northeast Missouri till the present specimens came to light, and not beyond the limit of the basal one foot of the upper Burlington limestone.

The specific name is in honor of the collector, Mr. Charles Very, of New Albany, Ind.

From the supposed horizon of the Keokuk it was collected, on the top of a

hill seven miles north of Burksville, on the Burksville and Columbia Road, Cumberland county, Kentucky. Collection of Mr. G. K. Greene.

METABLASTUS NITIDULUS, M. & G., Rowley.

PLATE 36. FIG. 49.

This little blastoid is elongate and narrowing but little toward the base where an end view is strongly triangular.

The ambulacra are deeply sunken between the radial lips, very narrow and less than one-third the length of the body.

The deltoids are not visible on a side view.

If this fossil were found at Boonville, Mo., it would be the young of *M. wortheni*.

Warsaw Limestone, Lanesville, Ind. Collection of G. K. Greene.

CODASTER ATTENUATUS, Lyon, Rowley.

PLATE 36. FIGS. 50, 51.

We give summit and side views, respectively, of a deformed specimen: one in which the fifth ambulacrum is wanting. The ventral portion of the fossil is not well preserved, the slit areas having been removed.

Middle Devonian, Columbus, Ohio.

NUCLEOCRINUS VERNEULI, Troost, Rowley.

PLATE 36. FIGS. 52, 53, 54, 55, 56.

Figure 52 is a summit view of a specimen showing the roof of ventral plates whose surface is finely papulose. The relative position and relation of the spiracles and anal opening and the passage of the ambulacral grooves under the ventral disk, as tunnels, are shown in the figure.

Figure 53 is a side view of a smaller specimen in which the anal plate is greatly produced beyond the normal shape of the body, especially near the summit.

The specimen, also, has the mid ventral area covered by a low roof of small papulose plates.

Figure 54 is a side view of a specimen in which the covering of a ventral surface is shown at "a" the entrance of the ambulacral groove under the

ventral roof as a tunnel. It will be observed that *Nucleocrinus* has a ventral disk as in *Schizoblastus* but wanting the outer pyramid of *Pentremites*.

Figure 55 is a ventral view of a melon-shaped specimen, whose ambulacra traverse low, canoe-shaped elevations and stand out beyond the surface of those areas.

The surface ornamentation is beautifully preserved and the ventral covering plates in place.

This specimen varies enough from the typical *N. verneuili* to be considered specifically distinct, if its characters were constant in a series of specimens; but the gradual passage of typical *verneuili* into this form through intermediate varieties can be traced in a series of *Nucleocrinus* from the Falls. Our specimen may be identical with Barris' *N. meloniiformis*.

Figure 56 is an enlarged view of a group of hydrospires beneath an ambulacrum. The characteristic number is four. The side plates and the lancet plate are outlined just over the hydrospires, while parts of two inter-ambulacral areas are shown.

All of these specimens of *N. verneuili* are from the Middle Devonian beds at the Falls of the Ohio.

#### NUCLEOCRINUS GREENEI, M. & G. Rowley.

PLATE 36. FIG. 57.

We give here an inverted basal view of a specimen to show the slightly elevated basal cup.

Upper Devonian beds near Charlestown, Ind.

All specimens figured on the accompanying plate belong to the collection of Mr. G. K. Greene.

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MICHELINIA WARDI, N. Sp.

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PLATE 37. FIGS. 1, 2, 3.

Corallum composite, somewhat thin, often attaining a diameter of seven or eight inches, and a thickness from one to two inches, or slightly more. Examples are occasionally found somewhat convex, or discoid, or sub-hemispherical. With diverging prostrate tubes, intimately connected by their epithecal walls, forming a strong, wrinkled epithecal crust, on the under basal side. Tubes rounded-polygonal from two to three millimeters in diameter. In examples with rounded tubes they become free a short distance from the margin: the free ends have numerous fine but conspicuous annular rings, and numerous fine longitudinal striæ; many of the tubes are contracted at the ends, giving to the corallum the appearance of a syringopora. Examples with tubes joining in polygonal outline, have dilated orifices. Pores moderately small, not numerous, dispersed without any system of regularity. Tabulæ flat, concave, or oblique, very numerous and closely arranged. Lineal furrows fine, and numerous, not so strongly pronounced as in other forms of *Michelinia*.

The specific name is in honor of Prof. Henry A. Ward, the well known collector and Palæontologist, of Rochester, New York.

Found in the Upper Devonian (Hamilton group) in the strippings above the cement beds, throughout Clark county, Indiana. Now in the collection of the author.

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CHONOPHYLLUM PYGMÆUM, N. Sp.

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PLATE 37. FIG. 4.

Corallum small, simple, turbinate, straight or regularly curved. Acute at the base of attachment. Height thirty-five millimeters. Calix shallow, twenty-five millimeters in diameter. Depth ten millimeters. Number of lamellæ, one hundred, in the circumference of a calix twenty-five millimeters in diameter, thin and equal in size at the margin, alternating below, the short ones about five millimeters long, the longer ones continue to the center of the calix, coalescing, and intimately touching those from the opposite side, and abruptly terminate. A portion of the exterior has a thin, smooth, epithecal crust, with numerous wrinkles and sharp constrictions, giving to the corallum the appearance of a series of thin invaginated cups. No fossette.

Found in the Lower Devonian (Corniferous group) at the Falls of the Ohio. Now in the collection of the author.

## ZAPHRENTIS TRISINUATUS, N. Sp.

PLATE 37. FIGS. 5, 6, 7.

Corallum simple, turbinate, straight or regularly curved. Acute, or with a broad scar at the base of attachment. Gradually expanding in diameter to the calix. Height varying in different individuals, from seventy-five to one hundred millimeters. Calix, funnel shaped, from twenty-five to forty-five millimeters in diameter. Depth forty-five millimeters. Number of lamellæ, eighty-four in the circumference of a calix, twenty-five millimeters in diameter, unequal in size, and very sharp at the margin, alternating below, the short ones scarcely more than rudimentary, the longer ones abruptly slope to within two or three millimeters of the center, two, three, or more of them coalescing, and gradually terminate, leaving a depressed convex space in the bottom of the calix, from four to six millimeters in diameter. There are three fossettes, the principal one is situated on the anterior side of the corallum, and consists of a deep depression, commencing at the margin of the depressed convex space in the bottom of the calix, but gradually disappears a short distance from the bottom, but its continuation is marked by one principal lamellæ continuing to the anterior margin. The two lateral fossettes are situated on the sides at right angles to the principal fossette: neither of these extend to the margin of the calix.

Found in the Lower Devonian (Corniferous group) Falls of the Ohio. Now in the collection of the author.

## STRIATOPORA BELLISTRIATA, N. Sp.

PLATE 37. FIG. 8.

*Striatopora bellistriata* see CONTRIBUTION TO INDIANA PALEONTOLOGY, Part 12, Page 112, Plate xxxvii, Fig. 12, July 18, 1903, for description and explanation.

## MEGISTOCRINUS RUGOSUS, L. &amp; C., Rowley.

PLATE 38. FIGS. 1, 2, 3, 4, 5, 6, 11.

The fine specimen figured, 1 and 2 differs in some features from Lyon & Cassedy's type, but the differences are of no great importance. The region of the basals and first radials is hardly concave. The column covers most of the basal ring of plates, occupying a hardly perceptible concavity, the uncovered portion of the basal plates appearing as a low ring-like elevation. The columnar canal is quite large and round. Each of the first radials is granulose and very slightly concave about the center. The next ring of plates (second radials and first interradials) are quite convex and rendered very rugose by sharp ridges.

The plates of the next ring above are still more sharply convex and hardly less rough. The succeeding rows of plates are more tubercular and strongly defined.

The plates of the ventral disk are small, convex and somewhat rugose with irregular distributed larger spinose plates. There are sixteen arm bases.

The specimen, represented by figures 3 and 4, has a more convex base and the basal, first radial and the greater part of the next ring of plates are flat and granular. The next ring of plates, however, are very convex and strongly rugose. All other dorsal plates are quite nodose, almost spinose. The plates of the ventral disk are nodose and rugose, but there are apparently no strong spinose plates as in the preceding specimen. The concentric or irregular arrangement of the granular ornamentation of the basal region of these fossils is of no consequence and the confinement of it to the basal and first radials or the invasion of the second radials and first interradials is of no significance whatever beyond growth or development.

Figure 5 represents a form where-in the basals, first radials, and three of the first interradials (save a single strong node) and portions of several second radials are ornamented by irregular granular lines. The plates above are convex and crossed by strong radiating ridges. The plate ornamentation on this specimen is very strong and the basal region (basal plates, first radials and part of the second radials) is concave, but not deeply so.

Specimen figure 6 is quite concave in the basal region and the granulo-linear ornamentation of the flat basals, first radials and parts of the next ring of plates above is concentric in arrangement. The rest of the dorsal plates are convex and with very strong radiate ridges or strongly nodose, as the smaller upper plates.

Figure 11 is a smaller and younger individual in which the ornamentation of the basals, first radials and parts of the ring of plates above appears to be numerous intersecting granular ridges giving the surface a pitted appearance. The center of each of these plates is a low, indistinct elevation. The rest of the dorsal plates are strongly nodose, the third radials, however, being invaded by illy defined radiating ridges.

All these specimens come from the Upper Devonian beds at the Falls of the Ohio and are the property of Mr. G. K. Greene, of New Albany, Ind.

#### DOLATOCRINUS ARROSUS? M. & G., Rowley.

#### PLATE 38. FIGS. 9, 10.

The body of this little crinoid is basket shaped with a flat basal region, strong nodes on the first, second and third radial plates and the first interradial:

with low radiating ridges about the nodes, nineteen arm bases and tubercular ventral plates.

The width of the body is about once and a half the depth.

The ventral tube is small and tuberculous about the base.

The worn condition of the specimen precludes further description. It differs from *D. arrosus* in the possession of three more arm bases, but its close resemblance otherwise does not warrant its specific separation.

Upper Devonian beds, near Charlestown, Ind. Collection of Mr. G. K. Greene.

### STEMMATOCRINUS? VERYI, N. Sp. (Rowley)

#### PLATE 38. FIGS. 7, 8.

Body hemispherical. Plates very thick and heavy as in *Barycrinus*. The underbasals form a solid pentagonal disk, not flat as in Prof. Trautschold's species, but decidedly convex.

Owing to the worn condition of our type specimen, the columnar scar is obliterated but the small pentagonal? canal is present surrounded by a narrow ring of silicious material as if the deposition of calcareous matter about a minute stem had incorporated it in the plate substance.

The basals are large and pentagonal, two of them being somewhat larger than the other three. The upper angle of one of these two larger plates extends somewhat higher than that of the other.

The first radials are nearly twice as broad as long, pentagonal and with a concave articular facet quite the full width of the plate and directed upward. This is contrary to the straight articulating line of *S. cernuus*.

The plates are apparently smooth. There is no anal plate.

The only other described species of this genus is from the Subcarboniferous of Russia.

Our species comes from the Subcarboniferous (probably Keokuk group) of Cumberland county, Kentucky, and was found by Mr. Charles Very, of New Albany, Ind.

The specific name is for the discoverer.

In the great thickness of the plates, concave articular facets of the primary radials and the convex basal region, our species differs from *Stemmatocrinus* and in the same respects even more so from *Erisocrinus* a genus with hexagonal basal plates.

The type is in the collection of Mr. G. K. Greene.

## DOLATOCRINUS FUNGIFERUS, N. Sp. (Rowley)

## PLATE 39. FIGS. 1, 2, 3.

The body of this crinoid is depressed, being nearly twice as wide as long.

The basal plates occupy the sides and bottom of a funnel, with a bounding circular rim above.

The columnar canal is pentalobate where it pierces the bottom of the funnel.

The first and second radials form a flattened zone, the former being hexagonal and broader than long; the latter, quadrangular and nearly twice as wide as long.

The third radials are pentagonal and wider than long.

The first plates of the second radial series are axillary and support on each upper sloping side a series of about three plates.

The first interradial is apparently nine sided and the largest plate in the body.

Above this, there is one more plate in the anal interradius of the dorsal side.

There is rather a strong node in the center of each dorsal plate and those of the radial series are connected by a ridge. From these nodes radiate in all directions nodular lines, fully twenty of which arise from the first interradial tubercle.

There are nineteen arm bases, one ray having but three.

The ventral side is ornamented by very small granular prominences and large mushroom-shaped tubercles, unlike the ornamentation of any other species of Dolatocrinus with which we are acquainted.

There are two respiratory pores to each arm base.

The anal opening is moderately large and slightly excentric.

This elegant crinoid is from the Middle Devonian, Falls of the Ohio, and the type is the property of Mr. G. K. Greene. Compare with *D. greenei*, M. & G.

## DOLATOCRINUS EXCAVATUS, W. &amp; S., Rowley.

## PLATE 39. FIG. 4.

The specimen, only a part of the dorsal cup, is most beautifully preserved.

The basal funnel is quite deep and the radial ridges, although quite sharp are prominent only on the first radial plates, decreasing upward and reaching the arm bases as mere lines.

The plate sutures are beveled and every plate outline can be seen at a glance.

There are no central nodes on the interradials but fifty or sixty sharp radiating lines pass from the center of the first interradial to the adjoining plates.

Similar sharp lines also leave the center of the other calyx plates.

Middle Devonian, Falls of the Ohio. Collection of Mr. G. K. Greene.

MEGISTOCRINUS OPPELTI, N. Sp., (Rowley)

PLATE 39. FIG. 5.

The type specimen preserves only a part of the calyx but it is so different from all other described species that we feel warranted in giving it a specific name.

The basal plates form a convex hexagon. The central area occupied by the column is broken through in the specimen here described.

The first radials are large, and hexagonal, the length and width being equal.

The second radials are likewise hexagonal and with equal dimensions.

The third radial is heptagonal and axillary, supporting on each upper sloping side a somewhat smaller plate.

The first anal plate is in the first radial ring and of about the same size as these plates.

Higher plates of the anal area can not be determined.

The first interradials are nearly as large as the first radials, of equal length and width, hexagonal.

In the second line of interradials are two quite large plates resting on the first interradial, one is six and the other seven sided, the length and breadth being equal.

Above these two plates are four hexagonal plates, much smaller. Higher plates are not present in the specimen.

The ventral disk is unknown, also the number of arms.

Each plate is convex with a spinous ventral node from which radiate to adjacent plates, numerous strong raised lines. The convexity of the plates make the plate sutures very plain.

The ornamentation of this species is so different from all other species that a comparison is not at all possible.

The specific name is for the finder, Dr. Otto Oppelt, of New Albany, Ind. Horizon, locality and collection, same as the last.

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**DOLATOCRINUS APLATUS, M. & G., Rowley.****PLATE 39. FIGS. 6, 7, 8.**

The whole of the calyx as far out as the top of the second radials and the middle of the first interradials is involved in the deep funnel-shaped basal concavity.

The sharp ridges connecting the nodes near the tops of the first radials form boundaries for the smooth pentagonal funnel.

Sharp, distinct ridges pass up through the middle of the radial plates, becoming stronger and more rounded above and slightly keeled at the centers of the plates.

Strong raised lines or ridges radiate outward from the first interradial centers with an occasional node between two lines.

The interradial plates have no central node but a small bare place not reached by the ridges, like a miniature valley among hills or mountains.

Cross raised lines and nodes occupy the second interradials.

Strong nodes occur between the branches of the radial ridges. There are fifteen arm openings, three to the ray.

The first radials are hexagonal and involved in the concavity.

The second radials are quadrangular while the third are pentagonal.

Of the first plates of the second series, one is an axillary plate while the other supports but one plate above, making three arms to the ray.

The first interradial plate is nine sided and but little larger than the plate above it.

The ventral disk is about as high as the dorsal cup and with a central proboscis, forming a low, broad cone with no noticeable depression between the arm groups.

The ventral plates are granular-nodose.

There are from two to three respiratory slits between each group of arm bases and an equal number between each two arm bases in the group, making quite forty slits in all.

The proboscis is small.

The depth of the basal funnel is about equal to the depth of the dorsal cup.

This beautiful little crinoid is found in the Upper Devonian, near Charlestown, Ind., and the figured specimen is in the G. K. Greene collection.

**DOLATOCRINUS SPRINGERI, N. Sp., (Rowley)****PLATE 39. FIGS. 9, 10, 11.**

The calyx is somewhat flat about the basal region, there being no concavity save the stem cicatrix.

The first radials are hexagonal and broader than long.

The second are quadrangular and wider than long.

The third are pentagonal and broader than long.

The first radial of the second series is axillary.

Two of the rays have one axillary plate in the third series.

The first interradial is nine sided and a little larger than the first radial.

The second interradial is smaller than the first.

The basal plates form a low rim about the column base.

The body is depressed and somewhat constricted just below the arm bases, the latter being strongly lobed.

The arm openings are twenty-two, 5, 4, 4, 5, 4.

The plates of the ventral surface are ornamented, especially in the depressions between the arm lobes, by granular nodes and by strong spine-like tubercles about the central small proboscis and along the ambulacral ridges.

The calyx plates have central strong nodes, connected on the radials by a low ridge and giving off lines of nodes on the interradials.

The basal portions of this specimen have been injured and have been so represented in the picture.

The specific name is in honor of Mr. Frank Springer, of Las Vegas, N. M., one of America's best workers in Crinoids.

From the same horizon, locality and collection as the last.

#### DOLATOCRINUS ARROSUS, Var. Cognatus, N. Var., (Rowley)

##### PLATE 39. FIGS. 12, 13, 14.

There is but little basal flattening. A stem joint is attached to the base.

The radial plates have central nodes connected by sharp ridges. The first interradial has a central node and a few radiating lines. Similar lines leave the radial centers. The plates are of unusual shape and number in the calyx, the first radials being hexagonal; the second, quadrangular; the third, pentagonal, while the first interradial is nine sided and supporting above a second but smaller interradial. There are nineteen arm bases.

The ventral disk is convex and ornamented by spinose tubercles.

The anal tube is excentric.

The arm groups form distinct lobes,

Horizon, locality and collection the same as the last.

This form may be compared with both *D. calatus* and *D. arrosus*, species of sixteen arm bases.

## ALVEOLITES DISPANSA. N. Sp.

## PLATE 40. FIGS. 1, 2, 3.

Corallum below medium size. Thin undose, discoid expansions. With a strong wrinkled epithecal crust on the under basal side. When decorticated the prostrate tubes may be seen radiating from a central axis. Orifices oblique, from one to two millimeters wide, and slightly more in some tubes, and one millimeter in height, varying somewhat in different corallums, and sometimes in the same example. Pores large, round, in one and two rows, situated near the angles of the tubes. Spinulose crest strongly pronounced, from two to four rows in a tube. Tabulæ flat or oblique, well defined, not very much crowded.

The thin undose expansion, and the strong wrinkled epithecal crust, and the broad oblique orifices, will readily distinguish this from all other species in the Hamilton group.

Found in the Upper Devonian (Hamilton group) near Charlestown, and in the strippings above the cement rock, throughout Clark county, Indiana. Now in the collection of the author.

## ALVEOLITES SUBANGULARIS. N. Sp.

## PLATE 40. FIGS. 4, 5, 6.

Corallum variable in size, from thin undose, discoid expansions, to large convex or sub-hemispherical masses. With a thin imperfectly developed epitheca on the under side. Orifices opening oblique, from one to one and a half millimeters in width, and one millimeter in height, and frequently the width and height are the same, giving to the tubes a somewhat angular appearance. The spinulose crests are strongly developed in some corallums, appearing as small spikes, while in some others they are only faintly indicated, or are entirely absent. Pores small, round, one and rarely two rows, situated near the angles of the tubes. Diaphragms numerous, and closely arranged.

The sub-angular tubes, and the numerous and closely arranged diaphragms will distinguish this from all other species in the Hamilton group.

Found in the Upper Devonian (Hamilton group) near Charlestown, and in the strippings above the cement rock, throughout Clark county, Indiana. Now in the collection of the author.

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 HELIOPHYLLUM CONVERGENS.
 

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PLATE 40. FIGS 8, 9, 10, 11, 12, 13.

*Aulacophyllum Convergens*, Hall. Thirty-fifth annual report of the New York State Museum of Natural History, advance sheets, page 22, August, 1882.

*Aulacophyllum Convergens*, Hall. Indiana Geological report, page 281, plate 17, figures 1 and 2, 1882.

HALL'S DESCRIPTION: Corallum simple, broadly sub-turbinate, regularly curved. Exterior comparatively smooth with concentric wrinkles and striations; longitudinal striæ fine, distinct; specimens of the same height have a diameter at the calix varying from twenty-five to forty-five millimeters; in one example the height is ten millimeters; length of posterior side, twelve millimeters; of anterior side, twenty-five millimeters; diameter of calix, twenty millimeters, for a distance of five millimeters from the margin nearly flat, then the posterior portion is nearly verticle, the anterior portion concave; fossette narrow, deep, extending from the bottom of the calix to the anterior margin; lamellæ varying from 80 to 120 in number according to the diameter of the calix, alternating in size, thin denticulated; convergence of lamellæ to the fossette very distinct.

Formation and locality, corniferous limestone. Falls of the Ohio, and Clark county, indiana.

This is misleading, this species is not found in the corniferous group at the Falls of the Ohio, but is found in the Upper Devonian (Hamilton group) near Charlestown, and in the strippings above the cement rock, throughout Clark county, Indiana. All the specimens illustrated on plate 40 are in my collection.

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 HELIOPHYLLUM ZENKERI.
 

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PLATE 40. FIGS. 14, 15, 16, 17, 18.

*Cyathophyllum Zenkeri*, Billings, Canadian Journal, new series, volume 5, page 262, 1860.

*Cyathophyllum Zenkeri*, Nicholson, Palæontology of Ontario, page 76, 1875.

*Cyathophyllum Zenkeri*, Lambe, Contribution to Canadian Palæontology, volume 4, part 2, plate 12, page 138, 1900.

Corallum simple, turbinate, regularly curved, with blunt points of attachment. Height varying in different individuals, from twenty millimeters to four inches or slightly more. Calix oval, oblique, broadly bell-shaped, from fifteen to fifty millimeters in diameter. Depth from fifteen to twenty-five millimeters. Number of lamellæ, one hundred and thirty, in the circumference of a calix,

thirty millimeters in diameter, very fine, and equal in size at the margin, alternating below, the short ones continue to the bottom of the cup, and gradually disappear, the longer ones continue to the center of the calix, coalescing with the adjacent ones, and terminates, leaving the bottom flat. Fossette consists of a deep depression near the center of the calix, and continues to the anterior margin. Denticulations are very fine, they are not seen in only well preserved examples. The exterior is strongly marked with annular lines of growth. The epitheca is strong, and comparatively smooth.

Found in the Upper Devonian (Hamilton group) in the strippings above the cement rock, at the different cement quarries throughout Clark county, Indiana. The examples illustrated are in my collection.

DOLATOCRINUS NODULIFERUS, N. Sp., (Rowley)

PLATE 41. FIGS. 1, 2, 3.

The region of the basal plate is a little concave.

The upper stem joints fill the funnel with scarcely an appearance of a rim.

The hexagonal first radials have a strong central wart-like node each or a cluster of smaller tubercles.

The quadrangular second radials have each a strong central node. The third radials have either a single node or a cluster of nodes. The higher radials have clusters of tubercles.

A radial ridge begins at the node on the second radial plate and passes upward to the arm bases, forking twice. This ridge is not strong.

The large first interradians have each either a cluster of small tubercular nodes or a large node surrounded by smaller ones. The two or more higher interradians have groups of nodes. From the centers of two of the first interradians radiating lines pass to the sides of adjacent plates.

There are apparently sixteen arm bases, one ray being injured. Three to the ray except in one, which has four.

The arm lobes are strong. The anal tube is nearly central and strong. The ornamentation of the ventral disk is tubercular nodes, small and sparingly scattered over the whole surface.

The ambulacral ridges or folds are strong.

The peculiar mixed ornamentation will serve to distinguish this species.

From the Upper Devonian, near Charlestown, Ind.

Collection of Mr. G. K. Greene.

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 MEGISTOCRINUS EXPANSUS, Var. Magniventrus? Rowley.
 

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## PLATE 41. FIGS. 4, 5, 6.

This fine specimen is referred doubtfully to variety magniventrus, differing from that form in the slender elongated spines of the ventral disk and fifteen arm bases instead of sixteen.

The ventral tube is at the highest part of the dome, but located latterally.

The basal and first radial plates form a shallow concavity. The arm bases form strong lobes.

The ambulacral fold or ridge to the left of the anal tube is without a spine, all of the other folds possessing one each and with one at the center of the vault.

This specimen is figured mainly to show its spinose character and the tendency toward ventral spines in these smooth forms.

It comes from the same horizon, locality and collection as the last specimen.

 DOLATOCRINUS MULTIBRACHIATUS, N. Sp., (Rowley)
 

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## PLATE 41. FIG. 7.

This fine specimen preserves only the dorsal cup and that even is incomplete on one side.

The calyx is greatly depressed, the concave basal area extending beyond the third primary radial.

The radial ridges are greatly elevated or keeled on the first radials and angular.

The first, second and third radials are much wider than long. Each plate of the second radial series is an axillary plate, so is each of the third and in one of the rays or divisions even a fourth series plate is axillary. The whole giving rise to eight arm bases to the ray (one has nine), making forty-one arms in all, if the missing part of the dorsal cup was normal. The ventral disk is unknown.

The first interradial plate is large and above it is a second interradial.

From a hardly noticeable central node on each interradial plate, numerous fine raised lines radiate outward to the centers of adjoining plates.

Similar raised lines radiate outward from the radial plates.

This species seems to belong to the Excavatus section of Dolatoerinus but may be readily identified by its great number of arm bases.

The ornamentation of this species is most beautiful.

Middle Devonian, Falls of the Ohio.

Collection of Mr. G. K. Greene.

AOROCRINUS CASSEDAYI, Var. Charlestownensis, Rowley.

PLATE 41. FIGS. 8, 9, 10, 11, 12, 13.

This variety was figured and described in Part VIII of this publication from a detached dorsal cup. As better specimens are now in our hands, we re-figure and complete the description.

The plates of the dorsal cup are strongly convex and present the appearance of stellate nodes, the sutures being hidden in the deep interspaces.

The rim formed by the basal plates is less expanded than in *A. casedayi* and is strongly fluted, whereas it is smooth in *Casedayi*.

The first radial plates being as deep as the basal rim and their nodes almost meeting the folds in the rim and the equal depths of the rest of the calyx plates, render the rim inconspicuous.

The plate nodes all have a very crowded look.

The third primary radials are much smaller than the first and second and above them the two radials of the second series and the three of the third are prominent and rounded, looking not unlike the pieces of free arms.

The interradials are one large first, two large second and three small third series pieces, the latter lying between the arm lobes.

The anal plates are one, three, five. Above the anal fold or ridge is smooth and further plates can not be made out.

The anal opening is located latterly and one a distinct fold which extends to the central dome spine.

The plates of the ventral cup are small and quite strongly convex on the ambulacral folds, those directly over the pairs of arm bases being spinose.

There are twenty free arms and the openings are directed upward.

The central dome spine is strong but short.

The groups of arm bases are strongly lobed.

In the drawings of the young specimen, figures 8, 9, 10, the artist has failed to show the fluted character of the basal rim.

The differences between the variety *Charlestownensis* and the species *Casedayi*, herein pointed out, are doubtless enough to separate the two forms specifically. If so, our crinoid will become *Aorocrinus Charlestownensis*.

Upper Devonian beds, near Charlestown, Ind.

Collection of Mr. G. K. Greene.

## DOLATOCRINUS WELLERI, N. Sp., (Rowley)

## PLATE 41. FIG. 14.

The ornamentation of this species and its general appearance are much like *Stereocrinus* and from the fact that one of its radial rays has but two primary radials, the kinship becomes closer.

The basal funnel is bounded above by a strong rounded ridge or ring. The basal flattening extends out to the center of the second primary radials.

The first radials are hexagonal and of equal length and width.

The second radials are quadrangular and wider than long.

The third are pentagonal and a little wider than long.

There are probably two plates above the bifurcation to the arm base.

The first interradials are nine sided and large. There is apparently but one plate above the first interradial.

The ornamentation of the dorsal cup is nodes and ridges.

The radial ridges are broken but strong at the plate centers.

The interradial plates have small central nodes with six or seven broken radiating ridges. From the centers of the radial plates, short ridges or lines of nodes pass out to the plate sutures.

The ventral disk is unknown. The entire body was probably much compressed, dorso-ventrally.

There were probably twenty arms, as there appear to be four to the ray.

The specific name is for Prof. Stuart Weller, of the Chicago University.

Upper Devonian, Falls of the Ohio.

Collection of Mr. G. K. Greene.

## DOLATOCRINUS CURRIEI, N. Sp., (Rowley)

## PLATE 42. FIGS. 1, 2, 3, 4, 5, 6.

The width of the calyx is nearly twice the length.

The basal plates form a deep funnel, nearly half the calyx depth. The columnar canal is five lobed. There is no rim about the funnel. There is little difference in the size of the three primary radials and the first secondary radial. All are broader than long. Higher radials smaller.

The first interradial is large and eleven sided, supporting above a six sided

plate a little longer than broad. Above this are three very small elongate pieces.

An interrupted ridge crosses the first and second radial plates, being most pronounced at the center of each plate and passing up the higher radials as a mere central convexity.

Numerous fine lines radiate from the center of each plate to that of the adjoining plate and by cross connecting lines give a fine pitted appearance to the surface, in places, not unlike the ornamentation of *D. excavatus*. W. & Sp.

The suture lines are quite distinctly grooved so that no difficulty is experienced in tracing the plate outlines.

The plates of the vault have the same pitted surface ornamentation as the calyx and those along the ambulacral ridges and surrounding the base of the anal tube have strong central spine-like nodes.

There are twenty arm bases, four to the ray.

This species may be compared with *D. excavatus* which has but two arm bases to the ray and no ventral spines; *D. major*. W. & Sp., and *D. Spinosus*. M. & G., both smooth species, the latter, however, having twenty arms and vault spines.

The specific name is meant as a compliment to the Rev. H. Currie, of Thedford, Ontario, an excellent collector in the Devonian of Canada.

The type is from the Middle Devonian of the Falls of the Ohio and belongs to the collection of Mr. G. K. Greene.

Figure 3 is apparently of the same species, somewhat larger, with the same number of arms but without the ventral disk in place. The basal funnel is larger and deeper and the width of the calyx was, probably, greater in proportion to the depth than in the type specimen.

Figures 4 and 5 are of the same species but with greater depth in proportion to the width, stronger ornamentation and deeper grooved suture lines.

Two of the primary interradials are ten sided; two, eleven sided and one of a doubtful number.

The ornamentation, instead of radiate lines, seems to be pits and short, ever changing, fine ridges.

Figure 6 is a rather robust form in which two of the primary interradials have ten sides and one, eleven.

The ornamentation is injured in the weathered condition of the specimen, but enough shows to indicate that it does not differ from the above described specimens. It has twenty arms.

The specimens represented by figures 1, 2, 3, 4, 5, 6, are all from the Middle Devonian at the Falls of the Ohio, and are the property of Mr. G. K. Greene.

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 DOLATOCRINUS EXCAVATUS? W. & Sp. Rowley.
 

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## PLATE 42. FIG. 7.

This fossil is referred with some hesitation to Wachsmuth & Springer's species. It probably had ten arms but this can not be certainly determined from the condition of the specimen. The basal funnel is large and deep and the radial ridges much stronger than in *D. curriei*.

The plate ornamentation is closely like that of both *D. excavatus* and *D. curriei*. On a side view, nothing below the third radial is seen, the plates hidden, being involved in a concavity. The plate sutures are channeled. Each primary interradial is probably ten sided.

Horizon, locality and collection same as the last.

 MEGISTOCRINUS CORNIGER, Rowley.
 

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## PLATE 42. FIGS. 8, 10, 11, 12.

This little crinoid has the shape of *M. corniger* but apparently smaller spines. The base is not so concave and the central dome spine seems to be entirely wanting.

The stem base is attached to the dorsal cup. The plate ornamentation can not be determined.

Figures 10, 11, 12 represent a smaller and more depressed specimen, but apparently of the same species. The base is a little more concave but no surface ornamentation can be discerned.

Both specimens are from the Upper Devonian beds near Charlestown, Ind., and in the collection of Mr. G. K. Greene, of New Albany, Ind.

 MEGISTOCRINUS HEMISPHERICUS? M. & G., Rowley.
 

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## PLATE 42. FIG. 9.

With some doubt we refer this specimen to Miller & Gurley's species, as it differs in some respects from that form, the dorsal cup being less abruptly elevated and the height being less in proportion to the width. The arm bases form quite strong lobes and there is an entire absence of spines on the ventral surface. Our specimen has the normal number of arms (16) while *M. hemisphericus* has but fourteen.

Horizon, locality and collection same as the last.

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HELIOPHYLLUM CONGLOMERATUM, N. Sp.

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PLATE 43. UPPER FIGURE.

Corallum composite, globular, or hemispherical. Rapidly increasing by calicular gemmation. Corallites varying from ten to thirty millimeters in diameter, broadly campanulate, intimately united at their superior margins. Depth from ten to fifteen millimeters. A convex space in the bottom of the calix, occupied by the tabulæ, from five to ten millimeters in diameter; in some cups the tabulæ is smooth, and flat; in some others, it is slightly elevated in the center of the calix. Number of lamellæ from eighty to ninety, equal in size and rounded at the margin, alternating below, gradually or sometimes rapidly sloping to the bottom of the calix where the short ones abruptly terminate, the longer ones continue in some cups to within two or three millimeters of the center, and, abruptly end, leaving a smooth space, in the center of the calix, from four to six millimeters in diameter; in these cups the tabulæ is usually flat; in the cups that have elevated tabulæ, the long lamellæ extends to the center, twisting, into a small crest, on the elevated tabulæ. Denticulations moderately large, eight in the space of five millimeters. Fossette consists of a slight depression in the bottom of the calix, but gradually disappears before reaching the margin of the cups. Position variable.

Found in the Middle Devonian (Upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

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HELIOPHYLLUM CONGREGATUM, N. Sp

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PLATE 43. LOWER FIGURE.

Corallum simple or compound, rapidly increasing by calicular gemmation. Corallites very much crowded at the margin of the parent cup, separating as they increase in height. The free portions are surrounded by a strong, rough epithelial crust, occasionally they intimately connect by their epithelial walls. Exterior with irregular, strong, rounded annulations, and deep constrictions, caused by periodical growth. Varying in height from thirty to forty millimeters. Calix somewhat campanulate, varying in diameter from ten to thirty millimeters. Depth fifteen millimeters, with a flat space in the bottom of the calix, occupied by the tabulæ, from ten to fifteen millimeters wide. Number of lamellæ sixty to seventy, equal in size at the margin, alternating below, for about five millimeters from the margin flat or slightly oval, then gradually or in some cups rapidly slope to the bottom of the calix, where the short ones gradually disappear, the longer ones continue to the center, coalescing, fasciculating,

and twisting into a false calumella; in some cups the larger lamellæ does not fasciculate and twist into an elevation, but continues after coalescing to the center of the calix, and gradually disappears, leaving a flat space in the center of the cup from six to eight millimeters in diameter. Fossette well defined, it consists of a deep depression at the edge of the flat space in the bottom of the calix, and extends to the anterior margin. Denticulations not so prominent in all the cups, ten in the space of seven millimeters.

Found in the Middle Devonian (Upper Helderberg group) (near Gibson's Station, Clark County, Indiana. Now in the collection of the author.

DOLATOCRINUS MULTINODOSUS, N. Sp., (Rowley)

PLATE 44. FIGS. 1, 2, 3.

Dorsal cup much broader than long, slightly constricted below the arm bases.

The flattening of the base extends outward to the second radials. The center of each plate of the radial series contains a conspicuous tubercle, and from the second radial up these tubercles are connected by a low indistinct ridge.

Each radial tubercle is the center of a series of low ridges that pass outward toward the plate perimeter, becoming obsolete there. These ridges either connect with the tubercles or are barely disconnected.

The center of each large interradial plate is occupied by from one to three tubercles that give off in all directions ridge-like rays which become obsolete at the plate sutures. These ridges, as in the case of the radials, are sometimes connected with the tubercles and again slightly disconnected.

The tubercles of the first and second radial plates and the first radial and basal plates are not noticeably connected by ridges. The tubercles of the first radials are the largest on the body.

The second interradials have each a central broad node surrounded by node-like ridges.

The upper edges of the basal plates form a circular ridge about the basal concavity.

The plates of the ventral surface have small central tubercles surrounded by still smaller nodes.

The proboscis is subcentral and small.

There are eighteen arm openings arranged as follows: 4, 4, 4, 3, 3.

The basal concavity is rather large as is also the star-shaped canal.

The first radials are hexagonal; the second, quadrangular; the third, pentagonal and axillary, supporting on each upper sloping edge a second axillary plate. Each upper edge of this latter supports a series of three or four plates to the arm bases.

The first interradial is nine sided and the largest plate on the body. The second interradial is quite large and apparently hexagonal.

The plates of the ventral side are rather large and arranged as usual in the species of this genus.

This form may be compared with Wachsmuth and Springer's species *D. tuberculatus* which was described from a fragmentary dorsal cup: and Miller and Gurley's *D. cælatus*, a much smaller species and with two less arms.

The type specimen is from the Upper Devonian beds, near Charlestown, Indiana, and belongs to the G. K. Greene collection.

DOLATOCRINUS CORPOROSUS, Var. Concinnus, N. Var.,  
(Rowley)

PLATE 44. FIGS. 4, 5, 6.

This crinoid differs in a few minor details from Miller and Gurley's species, principally in the more elaborate sculpturing, the much less size of the basal concavity, smaller basal canal and the ornamentation of the ventral surface. In the latter respect, it agrees well with Wachsmuth and Springer's *D. icosidactylus*, a species with a much greater convexity of vault.

Radial ridges pass up the middle of the radial series of plates from the base to the arm openings but become almost obsolete between the first and second radials, growing stronger as they approach the periphery.

The central nodes of the plates are much smaller than on *D. multinodosus* and those on the interradial plates are quite small. The first radial nodes connect with the low basal rim by one or two sharp ridges each and the space between these nodes is filled by from four to seven transverse ridges, not connected with the nodes, however.

The central node of the very large first interradial is the center from which radiate about thirty-six knotty ridges that pass to the nodes of the radial series and that of the second interradial plate, four to each. Some of these ridges coalesce with the interradial node and some do not. None of them, however, are connected with the radial nodes or ridges.

Small tubercular nodes stand at the ends of some of the ridges, near the central-radial and interradial nodes.

The ventral surface is ornamented with low rounded elevations, minute spine-like tubercles and strong nodes at the junction of the ambulacral ridges.

The basal funnel is rather small and completely filled by the column. The columnar canal is five lobed and smaller than in *D. corporosus*. The basal flattening hardly extends beyond the first radial plates.

The dorsal cup is somewhat constricted below the arm bases.

Between two of the arm groups is a contusion-like elevation in the dorsal cup and to the left of it in the edge of the next interradial area, another abnormal elevation with a crater-like top.

The vault is hardly more than convex, with strong radial ridges and corresponding deep valleys between them.

The base of the anal tube is sub-central and rather small.

There are two respiratory pores to each arm opening, or forty in all.

The plate arrangement is the same as in other Dolatocrini, differing from that of *D. corporosus* only in the proportional length and breadth of the several plates.

This species comes from the same geological horizon and locality as the last and is a part of the same collection.

DOLATOCRINUS CORPOROSUS, Var. Decoratus, N. Var.  
(Rowley)

PLATE 44. FIGS. 7, 8, 9.

The body of this beautiful crinoid is more compressed than either of the above described species, the ventral disk being almost flat.

The radial ridges are continuous and the central nodes not conspicuous.

The mid-interradial nodes are hardly more than centers for the numerous sharply elevated radiating ridges. These ridges are sharp and strong and break up into nodes or are toothed in places.

The ornamentation is much stronger on this than on the preceding species, except as to the central plate-nodes.

As in the preceding species, the radiating ridges are in part continuous with the central node of the first interradial but disconnected with the radial nodes.

The ornamentation of the ventral surface is short lines of confluent granules, giving a toothed appearance.

The basal funnel is rather large and surrounded by a low ridge.

The columnar canal is quite large and of the usual shape. A shallow depression involves the greater part of the first radials.

The body is considerably constricted below the arm bases.

There are sixteen arms arranged thus: 4, 4, 3, 2, 3, and there are two respiratory pores to the arm.

The anal tube is small and nearly central. The arm lobes are strongly separated by the depth of the inter-ambulacral areas.

The plates of the dorsal cup are as usual in the genus, as to number, varying in proportional width and length to conform to the shape of the body.

The arm openings are directed strongly upward.

Locality and geological horizon, same as the last.

Collection of Mr. G. K. Greene.

#### DOLATOCRINUS ELEGANTULUS, N. Sp., (Rowley)

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#### PLATE 44. FIGS. 10, 11, 12.

Body broader than high, hardly constricted below the arm bases.

A distinct and continuous rim bounds the basal, funnel-shaped cavity. The funnel as well as the stellate canal are large.

The nodes at the center of the radial and interradial plates are rather strong and the radial ridges are very pronounced. The nodes or tubercles on the first radial plates are connected by rather strong transverse ridges, doubled in two areas and giving a pentagonal outline to the basal region. From the mid-interradial node there radiate outward toward the radial nodes from nine to twelve toothed ridges with a few small elongate nodes between the ridges. The center of the second interradial is occupied by a strong, elongate, cross node.

The plate sutures of the dorsal cup are grooved.

The plates of the ventral disk are ornamented by small and larger tubercular nodes.

The anal tube is strong and sub-central. The inter-ambulacral depressions are rather strong.

There are eighteen arm openings arranged thus: 4, 4, 3, 4, 3 and probably two respiratory pores to the arm.

The first radials are six sided and a little wider than long. The second ra-

dials four sided and wider than long. The third radial is pentagonal and nearly twice as wide as long. This latter plate supports on each upper sloping side a second axillary plate each of whose upper edges supports a series of two plates to the arm bases.

The first interradial plate is the largest plate on the body and nine sided. The second interradial plate is smaller and six sided. Above this latter plate three smaller ones lying in the depression between the arm lobes.

The plates of the vault can only be made out in part.

The basal pentagon is a shallow depression.

The locality and horizon, same as the last.

The type belongs to Mr. G. K. Greene's collection.

#### DOLATOCRINUS CORBULIFORMIS, N. Sp., (Rowley)

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PLATE 44. FIGS. 13, 14, 15.

The centers of the plates are occupied by rather strong tubercles, connected by short, sharp ridges.

The center of the interradial plates is occupied by a tubercle from which radiate toothed lines and lines of nodes.

The base is flat but hardly concave.

In this species there is but one interradial plate on the dorsal cup. The arm groups are strongly lobed and there are apparently eighteen arm openings, 4, 4, 3, 3, 4.

The ventral side is somewhat injured, but the part preserved is ornamented by small spine-like tubercles, larger on the ambulacral ridges.

The whole appearance of this pretty little crinoid is that of a low, ornamental basket.

The first radial plates are hexagonal and wider than long. The second radial is quadrangular and wider than long. The third radial is pentagonal and supports on each of its two upper sloping sides an axillary plate. Above each of these second bifurcating plates are two rows of two plates each to the arm bases.

The first interradial plate is very large and seems to fill the entire interradial area on the dorsal cup.

Locality and horizon, the same as the last.

Collection of Mr. G. K. Greene.

## DOLATOCRINUS PRECIOSUS, M. &amp; G., Rowley.

## PLATE 45. FIGS. 1, 2, 3.

Body depressed. Dorsal cup flattened to the middle of the first interradians but with no concavity except about the stem base and that is insignificant.

A rim surrounds the columnar cicatrix. The columnar canal is medium in size and pentalobate. Column rather large. The first radials are wider than long, with a strong central tubercular node from which radiate out to the plate margins lines of small nodes and short acute ridges, the latter between first radial centers only and three in number. (The drawing shows but two.)

The second and third radials are wider than long, with central tubercular nodes and radiating lines of smaller nodes or short ridges.

Of the two plates resting on the upper edges of the third radial, one is bifurcating and supporting above a series of two or three plates to the arm bases. All of these radial plates have the strong central node and radiating ridges or confluent nodes, the central tubercles of all the radial plates being connected by a low sharp ridge.

The first interradian plates are about as wide as long and eight sided, with a strong central node from which radiate outward to the sutures numerous lines of smaller nodes and ridges. The second interradian is smaller than the first and supports above a still smaller plate, all being ornamented alike, the entire series being 1, 1, 1, except the anal, which is 1, 1, 3. The second plate of the anal interradian is smaller than the same plate in the other interradian areas, while the three plates above are quite small and lie between the arm lobes.

The ventral disk is but little elevated, the inter-ambulacral spaces depressed, making the arm lobes strong and distinct. The anal tube is rather slender and located sub-centrally, its plates being strongly nodose or tubercular. The central dome plate and the base of the proboscis are surrounded by a ring of seven plates, the anterior four being much the larger. Two of these latter being located ambulacrally and two inter-ambulacrally. Of the three smaller plates of this ring, two are ambulacrally placed and the one inter-ambulacrally situated is in the anal depression.

The next ring of plates is composed of paired, elongate, inter-ambulacral pieces, separated by a single ambulacral plate followed below by three other smaller ambulacral pieces.

The elongate inter-ambulacral pieces, largest and longest in the two anterior depressions, fill the valleys below the first ring of plates, except in the anal area where there are three or four small plates.

The two large anterior plates of the first ring which we stated as located inter-ambulacrally meet along a suture, mid-ambulacrally.

The centers of the first ring of plates and each ambulacral plate is occupied by a node and these nodes on the ambulacral plates are connected by indistinct ridges. Otherwise the vault plates are thickly set by granular-like nodes.

The ornamentation of this fossil is sharper than on any *Dolatocrinus* we have yet seen.

The arms are fifteen in number. No respiratory slits.

This specimen differs from Miller and Gurley's species *D. preciosus* only in stronger ornamentation and different arm arrangement, agreeing in number of arms.

This species comes from the Upper Devonian beds, near Charlestown, Ind., and the specimen figured belongs to the collection of Mr. G. K. Greene.

#### DOLATOCRINUS PRECIOSUS, M. & G., Rowley.

PLATE 45. FIGS. 4, 5, 6.

The specimen here figured is somewhat larger than the preceeding form, hardly less depressed, with a very shallow basal funnel and strongly elevated ambulacral areas.

It differs from *D. preciosus* in arm number and formula, and the character of the dorsal ornamentation.

The radiating lines of nodes, so prominent on *D. preciosus*, here become lines of confluent nodes about the base but differing a little higher up.

The arms are sixteen in number and have the arrangement, 3, 3, 4, 3, 3, beginning at the anal area and passing around the periphery toward the right, the lobe with four bases being the anterior one. No respiratory pores.

Anal tube as in the preceeding form.

Horizon, locality and collection, same as the last.

#### DOLATOCRINUS CHARLESTOWNENSIS, M. & G., Rowley.

PLATE 45. FIGS. 7, 8, 9

This crinoid is depressed as usual in the genus, the basal flattening beginning with the top of the second radial plates.

A rim surrounds the stem base and a rounded ridge passes up the middle

of the radial plates to the arm bases, hardly noded at the plate centers. Low, rounded radiating lines pass from plate center to the sutures, being most prominent near the base. All of the radial plates are wider than long, and the same is true of the interradial pieces, except the first, which is of equal dimensions. The interradial plate arrangement is 1, 1, 1, except the anal area which is 1, 1, 3.

Most of the plates of the ventral disk, especially those located ambulacrally, have rather strong central nodes. The poor preservation of the ventral surface prevents further diagnosis.

The anal tube is nearly central and the inter-ambulacral areas are depressed, making the arm lobes distinct.

The arm formula is 2, 4, 3, 3, 3, or fifteen in all.

No respiratory pores (slits).

The form is probably identical with M. & G.'s *D. charlestownensis*, differing mainly in its greater size and stronger ventral nodes.

The artist has made the dorsal ornamentation in Figure 7 too much like lines of nodes when in fact it is low, rounded radiating ridges.

It is probable this form should be placed under *D. preciosus* as a variety, since *D. charlestownensis* is hardly entitled to specific distinction.

Horizon, locality and collection, same as the last.

#### DOLATOCRINUS AMPLUS? M. & G., Rowley.

#### PLATE 45. FIGS. 10, 11, 12.

This is a very depressed form, a broad concavity involving the dorsal plates to the bottom of the third primary radials and the middle of the first interradials. The columnar or basal funnel shallow. Stem rather small.

All of the dorsal plates are strongly tumid, except the basals and first radials. Rather strong, sharp radiating ridges pass from plate center to plate center.

Each of the plates in the second series of radials is axillary. The first radials are about as long as broad, the second and third wider than long.

The first interradials are scarcely longer than wide.

The ventral disk elevated but little.

Plates flat and ornamented by nodes or granules.

Inter-ambulacral areas scarcely depressed.

Anal tube rather small and sub-centrally located.

There are from three to four respiratory slits between the arm lobes, two to four between the arm divisions and two between individual arm bases of each division.

There are twenty arms, the same as in *D. amplus*, M. & G., from which species the form before us, differs mainly in its greater depressed form, sharper tumid character of dorsal plates and greater basal concavity. In this latter feature it agrees well with *D. lyoni*, W. & Sp., but differs in its width, depressed form and number of arms.

It is not without some hesitation that we refer our specimen to *D. amplus*. Horizon, locality and collection same as the last.

## BLOTHROPHYLLUM HOUGHTONI.

## PLATE 46. FIGS. 1, 2, 3, 4.

Example *Cyathophyllum houghtoni*, Rominger. Fossil Corals, 1876, Page 104, Plate 36, upper tier of figures.

*Cyathophyllum houghtoni*, Hall. Illustration of Devonian Corals, Plate 30, Figs 1, 2. 1876.

Corallum simple, turbinate, or elongate turbinate, or conico-cylindrical. The point of attachment in some examples are pointed, in some there is a broad scar at the base of attachment, and some have strong, root-like prolongations that serve for attachment and support. Height varying in different individuals, from three to five inches or more. Diameter of calix from twenty-five to forty-five millimeters. Depth ten to twenty-five millimeters. A flat space in the center of the calix occupied by the tabulæ, from ten to twenty millimeters, varying in different specimens. Number of lamellæ ninety-four in the circumference of a calix thirty-five millimeters in diameter, rounded and equal in size at the margin, alternating below, the short ones terminate before reaching the bottom of the cup, the longer ones continue a short distance on the tabulæ and gradually disappear, leaving a smooth oblique space in the bottom of the calix eight or ten millimeters in diameter. Fossette consists of a deep depression at the margin of the smooth space, but does not extend far on the side of the calix. The epitheca is very thin, and does not conceal the longitudinal striæ. Where the epitheca is weathered away the corallum has the appearance of a series of thin invaginated cups.

Found in the Upper Devonian (Hamilton group) in the strippings above the cement rock throughout Clark county, Indiana, and in the same horizon at Crab Orchard, Kentucky, and in the Hamilton group at Pavillion Center, Genessee county, New York, and at Little Traverse Bay, Michigan. The specimens illustrated are in my collection.

## ZAPHRENTIS PROLIXUS, N. Sp.

## PLATE 46. FIGS. 5, 6.

Corallum simple, turbinate, or elongate turbinate, straight or regularly curved. Acute at the point of attachment. Length on anterior side eighty-five millimeters; length of posterior side thirty-five millimeters. Calix oblique and broadly bell-shaped, and very thin near the margin, forty millimeters in diameter. Depth twenty-five millimeters. Number of lamellæ one hundred and eight, somewhat rounded, and slightly unequal in size at the margin, alternating below, gradually sloping to the bottom of the calix where the short ones terminate, the longer ones converge to the center, coalescing, and slightly deflected when meeting the opposite lamellæ, but not elevated or connected. There

are three septal fossettes, the principal one is situated on the anterior side; the two secondary ones are at right angles to the primary one. Situated in the principal fossette is one large lamellæ, extending from the bottom of the calix to the anterior margin. Situated on either side of the single large lamellæ is three shorter ones. The surface is comparatively smooth, with a few wrinkles and shallow constrictions. Longitudinal striæ fine, distinct.

Found in the Middle Devonian (Upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

### HELIOPHYLLUM VESICULATUM.

PLATE 46. FIGS. 7, 8, 9, 10, 11, 12.

Example *Cyathophyllum vesiculatum*, Hall. Thirty-fifth Annual Report of the New York State Museum of Natural History. Advance sheets, August, 1882.

*Cyathophyllum vesiculatum*, Hall. Indiana Geological Report Page 297, Plate 23, Figure 6, 1882.

Corallum, simple, turbinate, straight, or slightly curved, usually having a small scar at the point of attachment. Height varying in different individuals, from ten to thirty millimeters. Calix thin and broadly bell-shaped, from fifteen to twenty-five millimeters in diameter. Depth fifteen millimeters. Number of lamellæ sixty, in the circumference of a calix twenty millimeters in diameter, unequal in size at the margin, alternating below, for about five millimeters gradually then they rapidly slope to the bottom of the calix, giving the calix somewhat of a funnel-shaped appearance. Fossette consists of a slight depression in the bottom of the calix but does not extend on the side of the cup. Denticulations well defined, in well preserved examples.

Found in the Middle Devonian (Upper Helderberg group) at the Falls of the Ohio. The examples illustrated are in my collection.

### DOLATOCRINUS CORPOROSUS? M. & G., Rowley.

PLATE 47. FIGS. 1, 2, 3.

The specimen before us differs some from *D. corporosus* in ornamentation, but still more in the number of arms, having but ~~ten~~<sup>13</sup> against twenty in that species, a difference partly accounted for in the absence of one entire arm group in our specimen.

The four-rayed character of this fossil gives rise to broad and deep ventral inter-ambulacral areas and a strongly lobed ventral aspect.

On the dorsal side this same irregularity so disturbs the usual plate arrangement that a large, well defined anal area exists, the first plate of which

supports above three larger plates, the third series being composed of four smaller ones, the two on the right directly below two arm bases.

Here then are two arms that do not rest on a radial series, but shall we say on interradial plates?

This crinoid is not unsymmetrical so far as appearance goes. There is no indication of injury that would have produced the anomalous character above noticed, even in long continued growth.

Directly above the anal ? area and below the base of the subcentral anal tube is a slight protuberance, probably all that is left of an abortive ray.

The radial series to the right of the abortive ray consists of four plates to the bifurcation.

All of the dorsal plates have distinct central tubercles except the uppermost of the interradial series. The radial nodes are connected by a low, sharp ridge, and from node to node of the radial and interradial plates pass numerous toothed lines and strings of small tubercles. A circular rounded elevation surrounds the basal excavation. The ventral plates have central node-like tubercles and small granular elevations.

The character of the dorsal flattening is well shown in the illustration.

The respiratory pores are not more than two to the arm base.

The specimen is from the Upper Devonian, Speed's Cement Quarry, Clark county, Indiana.

#### DOLATOCRINUS GREENEI, M. & G., Rowley.

##### PLATE 47. FIGS. 4, 5, 6, 25.

Miller & Gurley described the species with nineteen arms, as one of the chief characters. The specimen under examination has but thirteen and yet it can hardly be considered a new species. How unreliable even the number of arms becomes as a specific character. The basal plates form a flat pentagon with a central columnar pit.

Three of the radial series have but one costal each, the remaining ones having the normal two. In one of these abnormal rays, the bifurcating radial supports on the right above, an interradial plate, making three plates to that interradial series.

A smaller radial plate rests on the left upper edge of this bifurcating first costal and is itself a bifurcating plate.

Perhaps our interpretation of this ray as a one-costalled series would not meet the approval of some crinoid specialists. See figure 25.

The absence of second costals in three of the rays, recalls Barris' genus

Stereocrinus. In fact, the ornamentation of the specimen before us is somewhat like that of *Stereocrinus*, a genus founded upon a permanently abnormal species in which each ray has lost its second costal, the shortening and flattening of the body being due to this fact. Other features of *Stereocrinus* are not wanting in our specimen, small plates above the second interradianal being present in some of the series on the dorsal cup.

The ornamentation is somewhat like that of *D. corporosus*, but stronger, and the radiating lines of nodes fewer in number. The respiratory pores are two to the arm base. The anal tube is central.

An examination of a large and fine series of *Dolatocrinus* of quite a number of species from Southern Indiana has forced us to the belief that the number of arms is not always a safe guide in the identification of species.

The separation of forms, differing little or not at all in shape and ornamentation, merely upon the possession or lack of an arm or two is hardly pardonable even in hasty work.

Palaeontologists allow for considerable variation in individuals of species in other orders of fossils and that such variation does exist in outline, ornamentation, etc., is well known to every extensive collector.

Similar results of growth should be expected among crinoids as in brachiopods or other fossils, but, perhaps, to a less noticeable extent from the peculiar shape of the body.

If each extra arm base is a sufficient character upon which to establish a species. I believe Mr. Greene has in his possession individuals with from 12 or 13 to 20 arms in each group of like ornamentation, omitting the two or more groups of ten armed species.

The specimen of *D. greenei* is from the Upper Devonian beds near Charlestown, Ind.

#### DOLATOCRINUS MARSHI, Lyon, Rowley.

#### PLATE 47. FIGS. 7, 8.

There is little doubt of the correct reference of this specimen to Lyon's species.

It is a ten-armed form and with a series of six slits between each two arm bases on the vault. The basal plates and the greater part of the first radials occupy a deep inverted frustum of a pentagonal pyramid, the stem having been comparatively small and with a pentagonal canal.

Strong carina extend from the base of the frustum near the top of the first radial to the center of the second costal where it forks, sending a low, sharp ridge to each arm base.

The plate sutures are grooved both on the ventral disc and dorsal cup and the ornamentation of the dorsal plates is low, radiating ridges, so crossing the plate sutures as to give a pitted appearance between. The deep basal concavity extending upward to the level of the arm bases is apparently smooth. The ornamentation of the ventral plates is a toothed ridge bordering the suture groove.

The proboscis is sub central and small

From the Middle Devonian at the Falls of the Ohio.

DOLATOCRINUS VENUSTUS, M. & G., Rowley.

PLATE 47. FIGS. 9, 10.

To this little crinoid at a younger stage an auloporoid coral attached itself and flourished to the inconvenience of its host. Surrounding one arm group it has prevented the development of all but one arm and the crinoid, in its growth, has partially surrounded and imbedded its guest in a calcareous secretion.

The surface about the imbedded tubes, where the secretion thickened, the test is smooth, while the rest of the dorsal surface is highly ornamented with ridges and nodes.

The specimen has fifteen arm bases, arranged as follows: 3, 3, 4, 4, 1.

The sub-central proboscis is bent sidewise by the retarded growth of the vault near it. Each dorsal plate center is occupied by a strong node and radiating lines or ridges traverse the plates from node to node. A low rim surrounds the basal concavity.

The specimen illustrates the fact that arm growth may be retarded or destroyed by injury and yet the animal live on; but this lessening of the normal number of arms does not create a new species.

Upper Devonian, Speed's Quarry, Clark county, Ind.

MEGISTOCRINUS EXPANSUS, M. & G., Rowley.

PLATE 47. FIGS. 11, 12, 13.

Our drawing is of a young specimen but it agrees well with the description of Miller & Gurley's species, even to the number of arms. The anal tube is ex-centric and the central dome plate is crowned with a spine. A node is over each arm group.

The plate ornamentation is indistinct, broken and continuous, radiating or concentric lines.

Upper Devonian, Clark county, Ind.

## CERIOCRINUS? PRISCUS, N. Sp., (Rowley.)

## PLATE 47. FIGS. 14, 15, 16, 26.

The typespecimen differs in several respects from Ceriocrinus (Delocrinus of Miller) and may have to be removed, but it differs even more from Eupachyerinus and Ulocrinus, with both of which it has affinities.

The infrabasals are five in number and concealed by the top stem joint but visible from the inner side. They are probably quadrangular.

The basals are five in number and pentaloid, three of them being almost surrounded externally by the radials. The bottom of each radial is much too broad in our figures.

Three of the radials are irregularly seven sided, while the two adjacent to the anal area are eight sided.

The articular line for the attachment of the costal is the entire width of the upper edge of the radial.

A rather large five sided interradial rests between two radials and upon the truncated basal. This interradial supports above two plates, each of which rests against a radial.

The infrabasals lie at the bottom of a deep pit in which the lower portions of both basals and radials are involved. See the shaded area in figure 26.

The dorsal cup is low, without surface ornamentation, and composed of very heavy plates.

The stem was round and with a small circular canal.

The type specimen is from the Kaskaskia Group, of Newman's Ridge, East Tennessee.

## ELEUTHEROCRINUS CASSEDAYI, Y. &amp; S., Rowley.

## PLATE 47. FIGS. 17, 18, 19, 20.

Our figures are of a very large and fine specimen, one and one-sixteenth of an inch long by nearly three-quarters of an inch broad.

To the bottom of one ambulacrum is attached a little slender coral.

Figure 17 is a view of the two normal ambulacra, while figure 18 is of the abnormal side of the specimen showing the plate sutures.

Figure 19 is a basal view showing the usual features and figure 20 is a ventral view showing well the abnormal ambulacrum.

This fine specimen is from the Upper Devonian, near Charlestown, Ind.

METABLASTUS BIPYRAMIDALIS. Hall, Rowley.

PLATE 47. FIGS. 21, 22, 23, 24.

The specimen is much larger than the average example from Boonville, Mo., the place from which the type of the species came.

In the width of the cup below the ends of the ambulacra the specimen approaches Mr. Gurley's species *M. wachsmuthi*.

The ambulacra are narrow and less than half the body length, the radials being excavated quite deeply for their reception.

The interradials are small.

The specimen is so perfectly free of the matrix that the paired spiracles are easily seen but unfortunately the tops of the radials about the anal opening have been broken away.

Small perforations are visible in the ends of the deltoids, but this is due to the condition of silicious replacement and the breaking in of the outside surface.

The column of this fossil was round and almost minute as shown by the cicatrice for attachment. We have a specimen of *M. lineatus* lying upon a slab with a portion of the stem just separated from the base, a slender thread-like rod.

The stem of Tricoelocrinus is triangular at the base but probably not so throughout.

From the Warsaw Limestone of Lanesville, Ind.

All of the fossils described in this paper are from the collection of Mr. G. K. Greene.

NOTE—In Dr. Hambach's new paper, entitled "Review of the Blastoidæ with a proposed new Classification and Description of New Species," the two genera Tricoelocrinus and Metablastus have both been discarded and the euphonious name Saccoblastus offered in lieu thereof. What possible reason he could have had to rob others of their labors it would be difficult to imagine unless to enrich himself. Perhaps it would be better for science if his already vastly superior cabinet contained the types of all genera of blastoids as it now holds such an array of "scientific specimens (pathologic and abnormal developments and specimens illustrating morphology)" but not one individual showing a roofing of small plates over the so-called "central orifice." Our modest little cabinet of less than ten thousand specimens and collected in less than fifty years contains many specimens showing this latter feature and the roofing is not composed of "little scales or particles of broken pinulæ" for, beneath this arch, over every ambulacrum is a tunnel.

In connection with his figures 6 and 7 in the text to show the presence of a "small proboscis" he makes this startling statement: "To my knowledge it is the first time that such a body has been observed on a Blastoid." (This is a correct copy even to the *capital* in blastoid). In the October, 1900, number of the American Geologist, under the subject "Notes on the Fauna of the Burlington Limestone at Louisiana, Mo.," I called attention to such a structure in these

words, "One specimen has the anal opening at the top of a short proboscis, composed of small pieces." The specimen referred to was *Schizoblastus* (not *Crioblastus* of this newly proposed classification) *Sayi* and I can now make the number two. I might also add that both specimens have the "central orifice" neatly roofed over by minute plates. In the June, 1901, number of the same publication I figured the above mentioned specimen on Plate xxviii in a paper entitled "Two new Genera and some new Species of Fossils from the Upper Paleozoic Rocks of Missouri."

The Dr.'s eyes were not open or he would have seen these mentions unless my descriptions and illustrations were too insufficient to be recognized.

There are many other points upon which we would take issue with the learned Dr. but our space is limited here and we shall have to beg leave to continue the discussion at another time. As to the insufficiency of the descriptions and illustrations of our specimens we might say, in a passing way, that the verdict of this scientific Solomon does not disturb us in the least. If we thought his condemnation of them would result as disastrously as the verdict of the scientific world will with his proposed classification we would feel miserable indeed. By the way, it might not be out of place to state here that Dr. Hambach has never seen a type of ours, and what is just as certain, never will. It is this fact that rankles in his bosom.

By way of a short review, we condemn every one of his new genera to oblivion since they were erected upon already valid names.

Of his eighteen new species, fifteen at least are synonyms of older species and we add to these, of his previously described species *Pentremites abbreviatus*, *Pentremites gemmiformis*, *Pentremites sampsoni*, *Pentremites potteri*, *P. broadheadi*, *P. spinosus*, *P. basilaris*, *P. nodosus*, *Codonites campanulatus*. The first of these is a synonym of *Pentremites godoni*, the second of *Pentremites calycinus*; the third, fifth, sixth, seventh and eighth of *Pentremites sulcatus*. The fourth is a synonym of *Schizoblastus sayi*.

*Pentremites tulipaformis* is a synonym for *P. cervinus*.

*P. obtusus* and *P. angustus* are mere varieties of *P. conoideus* as will be recognized by any one that ever collected at Boonville, where a handful of the specimens will show every gradation between the two forms. *P. turbinatus* is the young of some larger form. *P. Bradleyi*—*P. godoni*, *P. serratus* is an extravagant form of *P. sulcatus*. Serrations less numerous and less regular occur on many of the specimens of *Sulcatus* from Kentucky, *Crioblastus incisus*—*Granatoerinus projectus*. *Cidaroblastus parvus* was described from insufficient material and unreconizable. *Crioblastus verrucosus*—*Schizoblastus sayi*, *Crioblastus tenuistriatus*—*Lophoblastus inopinatus*, *C. Schucherti* is a synonym of *Granatoerinus spinuliferus*, Rowley.

*Saccoblastus ventricosus*—*Metablastus bipyramidalis*, *Globoblastus magnificus*—*Orbitremites norwoodi*, *Globoblastus ornatus* and *G. Spathatus*—*Lophoblastus aplatatus* so far as can be made out from the insufficient drawings and descriptions, *C. tenuis*—*G. roemeri*.

## DOLATOCRINUS NODOSUS, M. & G., Rowley.

### PLATE 48. FIGS. 1, 2, 3.

The beautiful specimen we have illustrated agrees well with Miller & Gurley's type, save that the radial ray to the right of the anal area has but one costal.

The number of arms is the same but two respiratory pores to each arm base are visible on our specimen. The sutures of the three basal plates are shown. The body is flattened but hardly concave save the slightly excavated column

base. An almost circular rim surrounds the stem cicatrice. The columnar canal is pentalobate. The radials and costals have each a strong central tubercle, connected in the same ray by a more or less indistinct thread-like ridge.

The centers of the interradians are occupied by a strong node from which radiate sharp, more or less toothed ridges, passing to adjacent radial and interradial centers. The ridges are interrupted at the sutures. The ornamentation of the higher radials or distichals is a stellate arrangement of elongate nodes.

The distichals of the one-costalled ray are bifurcating plates, supporting palmars above as in other rays.

The interbrachials of four interradial rays are three in number while the anal interradius has but two.

In the ventral disk the lower interradial (inter-ambulacral) plates are two elongate pieces to each of the four areas, supporting above one or two plates. In the anal area there are two short plates below, supporting three plates above. The anal tube is sub-central and small. The ventral plates are ornamented by small spine-like nodes except near the proboscis where the number is fewer and the size larger.

There are two respiratory pores to each arm base.

This beautiful specimen is from the Upper Devonian, near Charlestown, Ind.

#### DOLATOCRINUS SPINOSUS, M. & G., Rowley.

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#### PLATE 48. FIG. 4.

Our drawing is of a symmetrical four-rayed dorsal cup. The basal concavity is round and quite deep as in the Marshi group.

The radials to the middle of the second costal are traversed by an extravagantly strong keel. The plates are without central nodes. The ornamentation is fine radiating lines.

The specimen furnishes strong evidence against the erection of species upon the number of arms alone.

It probably had sixteen arms.

Miller & Gurley's figure is without ornamentation but they do not state that fact in the description. As our specimen does not preserve the vault, there is some doubt of the correctness of the reference. It might be placed with Wachs-muth & Springer's *D. excavatus*, but that species is probably a synonym of *D. spinosus*, M. & G.

The specimen is from the Falls of the Ohio and the Middle Devonian beds.

## HADROCRINUS PLENISSIMUS, Lyon, Rowley.

## PLATE 48. FIGS. 5, 6.

Hadrocrinus in many particulars is much like an over-grown Dolatocrinus or as Wachsmuth & Springer assert, like Stereocrinus, in the possession of but one costal.

The greater depth of the basal concavity involving the plates to the top of the palmars or even higher, the greater width of the calyx and the greater number of dorsal plates, separate Hadrocrinus from both of the above genera. The plates are without tubercles and the radiating linear ornamentation is not strong.

The columnar funnel is surrounded by a low rounded rim which does not cover the basal plates. The latter are five in number, apparently, but ankylosed. Wachsmuth & Springer would not commit themselves on the number of basals, but their figure of *H. discus* shows five sutures, while that of *H. plenissimus* shows but three. It is hardly supposable that the number varies in the same genus except in abnormal specimens. From the fragmentary condition of our specimen, nothing further can be ascertained.

Middle Devonian, Falls of the Ohio.

## DOLATOCRINUS CAELATUS, M. &amp; G., Rowley.

## PLATE 48. FIGS. 10, 11, 12.

The calyx of this crinoid is basket shape with strong radial ridges knotted in the middle of the plates. There is a large basal pentagon outlined by strong ridges connecting the centers of the first radials. Unlike either *D. caelatus* or *D. arrosus* (the latter is a synonym of the former in our opinion) there are no distinct nodes at the interradial centers.

A few strong raised lines or ridges including between them nodes and toothed lines, pass from the centers of the interbrachials to the centers of adjoining plates.

The ornamentation of the ventral disk is large and minute tubercles, the former being near the anal tube and over the arm lobes.

The specimen is slightly deformed in the region of one arm lobe giving but three arms there and leaving the anal tube excentric.

Four of the rays support four arms each or nineteen in all. Here then, is a twenty-armed species with nineteen arms.

Upper Devonian beds, Speed's Cement Quarry, Clark county, Ind

## MEGISTOCRINUS EXPANSUS, M. &amp; G., Rowley.

PLATE 48. FIGS 7, 8, 9, 13, 14, 15.

The larger of our two specimens is a fine one and shows well the plate sutures. It differs somewhat from Miller & Gurley's species in that the dorsal plates are slightly concave against flat in that species and the periphery between the arm lobes and especially in the anal region has the appearance of having been pinched into a ridge. The same feature is seen on figures 8, 9, 10, plate xxiv, part viii, Contribution to Indiana Palæontology.

The five ventral spines are well developed on this specimen. Anal tube rather strong and excentric.

There are sixteen arms and the peculiar fine linear ornamentation characteristic of the *M. depressus* group.

The small specimen figured is hardly concave at the base, has sixteen arms, five ventral spines and with the lines of ornamentation beautifully preserved. Contrary to the larger specimen the plates are flat (not concave) or slightly convex in the radial ring.

The ornamentation consists of short parallel lines crossing the sutures and extending toward the plate centers, which latter are covered by short lines or granules. Toward the periphery the lines become more or less distorted. This ornamentation is almost microscopic, and we venture to say here, that every species of flat and so-called smooth-plated Megistocrinus from the Upper Devonian beds of Indiana, possess this ornamentation when well preserved. We have seen it on several so-called species. It will be also noticed that the lateral diameter passing through the anal region, is longer than any other lateral diameter in the sixteen armed, smooth (?) species.

There is something suggestive in these observations that might be used profitably in a needed revision of the genus.

Both of our specimens are from the Upper Devonian beds of Clark county, Indiana.

HOLOCYSTIS<sup>tes</sup> PAPULOSUS? M. & G., Rowley.

PLATE 48. FIGS. 16, 17, 18.

Our specimen seems to have some affinity with the above species. It seems to have six large and two small plates in the first row, the second row having seven, the third has eight, the fourth eight, the fifth eight. The sixth row has the same number, four of which bear elliptical scars for the attachment of spines, perhaps, and a fifth has a rather large quadrangular hole at its lower suture, from the standpoint of crinoids, an anal opening. The top row seems

to be composed of six small plates surrounding an elongate rectangular opening, the mouth perhaps.

The specimen is laterally flattened as is usually the case with specimens of this genus.

The base has no scar for stem attachment and the specimen was probably sessile.

The plates are all a little convex especially noticeable at the center. On some plates there are nodes and warty prominences. Pores are scattered rather thickly over the plates. In outline our specimen differs from all described species, as well as in the number of plates, but here is a genus with no definite number of plate rows nor plates in a row. Even rows can not sometimes be traced and disorder is often occasioned by the intercalation of small plates between the larger ones. The base has a stem or nothing but a flat face for attachment, roots (S. A. Miller) or the base is rounded.

In other words, some of the species are attached by stems, others by roots, still others are sessile or free floating.

Some species have scars for the attachment of arms? or spines, usually four in number, while others have no indication of such appendages.

It would be hard to state upon what characters this genus is founded and what would be good specific characters.

A slight change in form, as lengthening or shortening the longitudinal diameter, increases or decreases the number of rows of plates and plates in a row, and these things furnish the palæontologist an excuse for the creation of many species. Of the thirty odd species of the genus, perhaps over half came from practically the same locality, and it would be safe to say that eight or ten species could be made to include the whole thirty-five or more.

In a genus of such variation, should we not expect considerable variation in specimens of the same species?

Niagara group, Big Creek, near Dupont, Jefferson county, Ind. All of the fossils figured on this plate and described in this paper are the property of Mr. G. K. Greene.

## FAVOSITES CLAUSUS, Rominger.

## PLATE 49. UPPER FIGURE.

Favosites Clausus, Rominger, Geological Survey of Michigan, page 37, plate xiv, upper left hand figure, 1876.

Rominger's description: Clustered, rapidly branching and anastomosing stems, varying from one-half to one centimeter in thickness. Tubes unequal, larger ones circular, measuring in different specimens from one-half to one and a half millimeters in diameter; the smaller tubes filling the interstices between the larger ones are subangular. Orifices at the ends of the branches all open, on the sides of the stems most of them are found closed by opercula. Opercula flat or convex, some of them decorated with twelve marginal carinæ radiating towards the center. Diaphragms partly simple and regular, but largely intermingled with irregular partial septa, formed by the development of lateral squamæ analagous to the vertical rows of leaflets in other species of Favosites. Pores numerous.

The specimen illustrated on Plate 49, upper figure, is from the Upper Devonian (Hamilton group) at Speed's cement quarry, Clark county, Ind., now in my collection.

## LITHODRUMUS, N. Gen.

(Ety. lithos, a stone; drumos, a bush or thicket).

Corallum compound. Tubes rounded-polygonal, unequal in size. Tabulæ flat and closely arranged, occupying more than half the diameter of the corallite. Septa alternating in size and length, not strongly developed. Fosse well defined in some cups; in some others only faintly indicated: and occasionally a cup may have two fosses. Interseptal area vesicular. Type *L. Veryi*.

## LITHODRUMUS VERYI, N. Sp.

## PLAT 49. LOWER FIGURE.

Corallum composite, rapidly increasing by lateral gemmation. Corallites rounded-polygonal, unequal in size, surrounded by their own epithical wall, intimately connected periodically by the expansion of the epithica, or they may not connect only at the superior margin of the cup. Calyx broadly bell-shaped, from ten to thirty millimeters in diameter, or slightly more in some cups. Depth from five to fifteen millimeters. A flat space in the bottom of the calix occupied by the tabulæ, from five to fifteen millimeters in diameter. Tabulæ

flat or slightly oval, and closely arranged. Number of lamellæ, sixty to seventy, alternating in size, the shorter ones scarcely more than rudimentary; the longer ones at the margin rather obscure. For about five or ten millimeters they gradually slope, and at this point they become elevated and sharp, and abruptly descend to the bottom of the calix, and extend a short distance on the tabulæ, and abruptly terminate, leaving a smooth, convex space in the bottom of the calix, from five to fifteen millimeters in diameter. Interseptal area vesicular. Fossette conspicuous, consists of a deep depression at the edge of the smooth convex space in the bottom of the calix, but does not extend on the side of the cup. A specimen in my collection shows in some of the corallites two well defined fossettes situated opposite to each other.

Found in the St. Louis group, (sub-carboniferous) four miles south-east of Mammoth Cave, Kentucky. Now in the collection of the author. The specific name is in honor of Mr. Charles Very, of New Albany, Indiana.

#### PROTOPORA, N. Gen.

(Ety. Protos, first; and Pora, a pore).

Corallum composite, increasing by lateral and calicular gemmation. Corallites frequently connected by their epithelial walls, and having numerous transverse and oblique diaphragms which divide the tubes into coarse cysts somewhat like *Cystelasma*, but differing from *Cystelasma* in having mural pores in the adjoining corallites as in *Romingeria*. Type *P. Cystoides*.

#### PROTOPORA CYSTOIDES

Example, *Romingeria Cystoides*, Grabau, contribution to Indiana Palaeontology, Part VII, page 52, plate 20, figures 19 to 23, May 23, 1901.

#### CYSTIPHYLLUM FULCRATUM, N. Sp.

PLATE 50. FIG. 1.

Corallum simple, turbinate or elongate turbinate or cylindrical. Straight or slightly curved. Very blunt and rugged at the base of attachment. Frequently strong, root-like prolongations set out near the base, that serve for attachment and support. For about three inches rapidly enlarging, then the diameter is essentially the same to the margin of the calix. Height seven inches. Calix very shallow and oblique. Sixty millimeters in diameter. Exterior very rugged; when decorticated it has the appearance of a series of thin invaginated cups, with numerous spines covering the spaces between the cups, commencing on the surface of one cup and reaching to the bottom of the succeeding one.

Near the margin of the calix, there are numerous small cysts: many of these appearing as short, thick spines; but these spine-like cysts disappear as they approach the bottom of the calix, and are replaced with large, irregular vesicles. The vesicles on the exterior are very irregular in size, but very numerous and shallow, and somewhat long.

I have one corallum in my collection that agrees with this in diameter at the calix, and has a more symmetrical form, that measures nineteen inches in length.

The broad, shallow, oblique calix, and the numerous thin invaginated spinulose cups, make this easily recognized from all other species.

Found in the Lower Devonian (Corniferous group) at the Falls of the Ohio. Now in the collection of the author.

#### CYSTIPHYLLUM CLAVATUM, N. Sp.

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PLATE 50. FIG. 2.

Corallum simple, turbinate, or elongate turbinate or cylindrical, straight or regularly curved. Acute at the base of attachment. Gradually and regularly expanding in diameter to the calix. Height of entire corallum fifteen inches: only seven inches is illustrated. Diameter of corallum at the height of seven inches, sixty-five millimeters: then very slightly enlarging to the calix. Exterior very rugged, and has the appearance of being composed of numerous thin invaginated cups. When decorticated, the surface is covered with numerous shallow and somewhat broad cysts. The calix is covered with much larger vesicles than those on the exterior, and near the margin of the cup fine striæ appears more or less on the surface of the cysts.

The large size and large vesicles in the calix, and fine striæ on the surface of those near the margin, and the numerous broad shallow cysts on the exterior, and the appearance of numerous thin invaginated cups, makes this easily recognized from all other species.

Found in the Lower Devonian (Corniferous group) at the Falls of the Ohio. Now in the collection of the author.

#### BATOCRINUS MAGNIROSTRIS, N. Sp., (Rowley.)

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PLATE 51. FIG. 1, 2, 3.

In this species the ventral disk is deeper than the dorsal cup and the base of the ventral tube is very strong.

The calyx rapidly expands from the basal plates and forms a low cone. The three basal plates form a distinct rim. The columnar canal is round.

The ornamentation of the plates of the dorsal cup consists of fine, indistinct radial lines and low radiating ridges.

The final radial is broader than long and has a slight cross ridge. The second radial is quadrangular, broader than long, and has a low cross ridge. The third radial is pentagonal, broader than long, and has a cross ridge as in the first and second plates. There is another bifurcation above the third primary radial. A slender thread-like line traverses the radial series from the base to the arms. The first interradial plate sends off indistinct radiating ridges from the center. Above this latter plate are one or two smaller plates. There are eighteen arm bases, four to the ray, except the one opposite to the anal area, which has but two. To each group there are two large respiratory pores or ten in all.

The plates of the ventral disk are strongly nodose and the nodes are sharp.

The ornamentation of the dorsal cup reminds one of delicate ripples. The proboscis (ventral tube) is stout, long and nodose.

The plates are rather thick.

This crinoid comes from the Warsaw Limestone of Lanesville, Ind., and the specimen figured belongs to the G. K. Greene collection.

#### BATOCRINUS IRREGULARIS, Casseday, Rowley.

PLATE 51. FIGS. 4, 5, 6.

The columnar canal is large. The basal plates form a slight rim. All of the radial plates are much wider than long, and each with a prominent cross ridge or convexity; an almost absolute line connects the convexities and passes to the arm bases. The first interradial is nine or ten sided and convex or wart-like, with one or two small interradials above it.

Resting upon the first azygous interradial are five smaller anal plates. Above these latter is another series of several plates. As in the preceding species there are eighteen arm openings and with the same arrangement of respiratory pores, but smaller.

The plates of the ventral disk are convex, three of them just over each arm group are nodose, except over the two armed ray, where but a single node occurs. The anal tube is nearly central and strong. Probably nodose.

Horizon, locality and collection same as the last.

#### BATOCRINUS DAVISI, Rowley.

PLATE 51. FIGS. 7, 8, 9.

This is another 18-armed form, with convex calix plates, the latter orna-

mented by short, irregular raised lines and pits of a most delicate character. A slight raised line connects the radial plates.

The radials are wider than long, and there are two bifurcations to the ray in four radial rays.

The first interradiation is larger and supports two smaller plates above.

The basal plates form a rim. The column is rather large and the perforation round.

The ventral disk is as deep as the dorsal cup, and the plates are nodose-spinose.

The anal tube is central and strong and probably nodose.

The first plate of the anal interradius supports three plates above, and above them are three others.

Horizon, locality and collection same as last.

This specimen was originally described from the Kaskaskian limestone.

#### BATOCRINUS CRASSITESTUS, N. Sp., (Rowley.)

PLATE 51. FIGS. 10, 11, 12.

This crinoid is subglobose, with a deeper ventral disk than dorsal cup.

The broad plates form a distinct rim and, as in the preceding forms, the radial plates are convex and wider than long and slightly connected by a low line. There are two bifurcations to the ray except in the anterior ray.

The large first interradiation plate is nine or ten sided, convex, with indistinct lines radiating from its center. Above it are one or two smaller convex plates.

The first anal interradiation is twice as wide as long, and supports three larger convex plates above. Upon these three plates rest two other plates of nearly equal size. A small plate lies above these two.

There are eighteen arm bases in five groups, with two respiratory pores to the group, or ten in all.

The plates of the ventral disk are strongly nodose, almost spinose, but with no definite arrangement to the nodes.

The proboscis or ventral tube is subcentral and very strong, also nodose. The body plates are all thick.

Horizon, locality and collection same as the last.

#### BATOCRINUS DAVISI, Var. Lanesvillensis, N. Var. (Rowley.)

PLATE 51. FIGS. 13, 14, 15.

In this crinoid the depth of the dorsal cup and the ventral disk are about the same.

The basal plates form a slight rim. The stem is rather large and the perforation round.

All of the radial plates are somewhat wider than long, a very little convex and all connected by a slight line.

The first interradiial plate is the largest plate on the dorsal cup and about as long as wide, a little convex and with the slightest appearance of radiating ridges. Above this plate are two smaller ones, and two yet smaller above the latter two.

There are nineteen arm bases with two pairs of respiratory pores for each arm group or twenty in all.

The arm groups are somewhat lobed in this form, unlike the previously described forms.

The plates of the ventral disk are convex and each with a small central nipple like spine.

The anal tube is only moderately strong, and with convex plates bearing central nodes.

The first plate of the anal area is a little longer than the first radial plate, and supports above three rather large plates. Above these latter, appear to be two smaller plates.

Horizon, locality and collection same as the last.

#### BATOCRINUS ICOSIDACTYLUS, Casseday, Rowley.

#### PLATE 51. FIGS. 16, 17, 18.

The three basal plates of this species form rather a strong rim. The column is not large and the perforation small. Outside of the basal plates the dorsal cup forms the frustum of a very low cone. All of the calyx plates are convex merely and all of the radial plates much wider than long. In each radial ray there are two bifurcations, making twenty arm bases in all.

Above the second bifurcation are three plates to the periphery.

The interradiial plates are one large one below, two smaller ones above and a yet smaller one above the two.

The arm bases form a continuous rim.

There are apparently two respiratory pores to the arm base.

The ventral disk is deeper than the dorsal cup and the plates are convex, some of them bearing short, stout spines. The arrangement of these spines seems to be three in a triangular form above each arm group and one above the anal area, with a semicircle of large ones above, on the anterior side of the vault.

There are six plates in the anal area of the dorsal cup, a large one below, supporting three above, which in turn support two smaller ones upon their upper edges.

The anal tube is nearly central, very strong and composed of convex plates, often spinose. All of the plates are very thick.

Horizon, locality and collection, same as the last.

*BATOCRINUS ICOSIDACTYLUS*, Casseday, Rowley.

PLATE 51. FIGS. 19, 20, 21.

This little specimen has the upper stem joint in place and the same arrangement of spines on the vault as in the preceding specimen, twenty arm bases and nearly half an inch of a spine-bearing proboscis.

Horizon, locality and collection, same as the last.

*BATOCRINUS DAVISI*, Var. *Sculptus*, N. Var. (Rowley).

PLATE 51. FIGS. 22, 23.

The dorsal and ventral cups are of equal depth.

The colum rather large and the basal plates forming a low rim.

All of the calyx plates are a little convex with fine radiate-line sculpture, a delicate ridge traversing the radial plates. The fine radiating ridges are often broken up and on some plates display no definite arrangement, crossing some of the radial plates entirely.

The radial plates are wider than long and the radial series embraces three orders of plates.

The interradiial series contains four plates, 1, 2, 1, the lower one being the largest plate in the dorsal cup.

The anal area has eight plates, 1, 3, 3, 1.

The plates of the ventral disk are smooth and convex, some of them having a low, nipple-like central node.

The anal tube is not very strong and located near the center.

There are eighteen arm bases, the anterior ray having but two.

The ornamentation of the dorsal cup of this form will readily distinguish it.

Horizon, locality and collection, same as the last.

*BATOCRINUS ICOSIDACTYLUS*, Casseday, Rowley.

PLATE 51. FIGS. 24, 25, 26, 27, 28.

Figure 24 is, perhaps, nearly a full length proboscis or anal tube of this

species and shows well the spinose character of the appendage. Figure 25 is a portion of another tube with stronger but less numerous spines.

Figure 26 is the ventral disk of a specimen with half an inch of the anal tube. The spinose character of the plates is shown beautifully and their arrangement above the arm bases is the same as in figures 16 and 17.

Figures 27 and 28 are basal and lateral views of a beautiful dorsal cup of this species. There are but three plates in the anal interradius and the basal rim is very strong.

Horizon, locality and collection, same as the last.

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**ZAPHRENTIS STRIGATUS, N. Sp.**

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**PLATE 52. FIGS. 1, 2, 3.**

Corallum simple, turbinate, straight, or regularly curved. Acute at the point of attachment. Rapidly expanding in diameter to the calix. Height varying in different individuals, from thirty to fifty millimeters, the longest examples observed. Calix oblique, broadly campanulate, thirty millimeters in diameter. Depth ten to fifteen millimeters. A deep, broad, concave space in the center of the calix, occupied by the tabulæ, from five to eight millimeters deep, and ten millimeters broad. Number of lamellæ, one hundred and twelve in the circumference of a calix thirty millimeters in diameter, the short ones merely rudimentary, the longer ones gradually slope to the margin of the concave area, and abruptly terminate. Fossette consists of a deep depression in the center of the concave space, and continues as a deep broad groove to the anterior margin. Situated in the center of the fossette is one large lamellæ, commencing in the bottom of the calix, and continues to the anterior margin.

The broad, deep concave space, and the long lamellæ, situated in the fossette, makes this easily recognized from all other species.

Found in the Upper Devonian (Hamilton group) near Charlestown, and at the different cement quarries throughout Clark county, Indiana. Now in the collection of the author.

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**ZAPHRENTIS INVAGINATUS, N. Sp.**

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**PLATE 52. FIGS. 4, 5.**

Corallum, simple, turbinate or elongate turbinate, straight or regularly curved. Acute at the point of attachment. Gradually enlarging in diameter to the calix. Height varying in different individuals from fifty to eighty-five millimeters. Diameter of calix twenty-five millimeters. Depth fifteen millimeters, with a smooth oblique space in the bottom of the calix occupied by the tabulæ, fifteen millimeters in diameter. Number of lamellæ seventy in the circumference of a calix twenty-five millimeters in diameter, equal in size and slightly rounded at the margin, alternating below, rapidly sloping to the bottom of the calix where the short ones gradually terminate, the longer ones continue a short distance on the tabulæ and abruptly end, leaving a smooth, oblique space in the center of the calix, from six to ten millimeters in diameter. Fossette consists of a slight depression in the center of the calix, gets deeper and broader as it approaches the posterior side of the cup, but does not extend on the side of the calix. Exterior with numerous shallow annulations and wrinkles caused by intermittent growth.

Found in the Upper Devonian (Hamilton group) at Charlestown and at the different cement quarries throughout Clark county, Indiana. Now in the collection of the author.

ZAPHRENTIS ALBACORNIS, N. Sp.

PLATE 52. FIGS. 6, 7.

Corallum, simple, turbinate, straight or regularly curved. Acute at the point of attachment. Rapidly expanding in diameter to the calix. Height from thirty to fifty millimeters. Calix oblique, broadly campanulate, thirty millimeters in diameter. Depth twenty millimeters. Number of lamellæ one hundred, in the circumference of a calix thirty millimeters in diameter, somewhat rounded and slightly unequal in size at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones gradually terminate, the longer ones continue to within two millimeters of the center of the calix and abruptly end, leaving a smooth, convex space in the bottom of the calix, four millimeters in diameter. Exterior comparatively smooth, a few shallow, distant annulations and wrinkles, caused by intermittent growth. Fossette consists of a shallow depression at the anterior margin of the convex space in the bottom of the cup, but does not extend on the side of the calix.

Found in the Upper Devonian (Hamilton group) at Charlestown, and at the different cement quarries in Clark county, Indiana. Now in the collection of the author.

ZAPHRENTIS COMPRESSA. Milne Edwards.

PLATE 52. FIGS. 8, 9, 10, 11.

Zaphrentis Compressa, Milne Edwards, Histoire Naturelle Des Coralliaires, page 342, plate 61, figures 3 a, 3 b, 1860.

Zaphrentis lanceolata, Worthen, Geological Survey of Illinois, Volume VIII, page 76, plate 10, figures 4, 4 a, 4 b, 1890.

WORTHEN'S DESCRIPTION: Corallum small, pointed at the lower extremity, compressed, lanceolate widening regularly from the pointed extremity to the upper margin of the cup. Septal fossette well developed and ranged in direction with the greatest diameter of the cup. Lamellæ twenty-two to twenty-four, all reaching to the border of the septal fossette.

Length of an average size specimen 13-16 inch; breadth across the greatest diameter of the cup 6-16 inch. The broadest specimen seen measured in length 10-16 inch, breadth of cup across its greatest diameter 9-16 inch, in the opposite direction 5-16.

Found in the Warsaw division of the St. Louis group (sub-carb.) at Spengen Hill, Washington county, and at Georgetown, Floyd county, and at Lanesville, Harrison county, Indiana. The specimens illustrated are in my collection.

ZAPHRENTIS CASSEDAYI. Milne Edwards.

PLATE 52. FIGS. 12, 13, 14, 15, 16, 17, 18.

Zaphrentis Cassedayi, Milne Edwards, Histoire Naturelle Des Coralliaires, page 341, plate 61, figure 2 a, 2 b, 2 c. / 860

Zaphrentis Calcariformis, Hall, Thirty-fifth Annual Report of the New York State Museum of Natural History, p 33, 1882.

Zaphrentis Calcariformis, Hall, Indiana Geological Report, page 293, plate 21, figures 10, 11, 1882.

Zaphrentis Calcariformis, Hall, Worthen, Geological Survey, Illinois, volume VIII, page 74, plate 10, figures 2, 2 a, 1890.

Zaphrentis Spengenensis, Worthen, Geological Survey of Illinois, volume VIII, page 77, plate 10, figures 8, 8 a, 1890.

Zaphrentis Ulrichi, Worthen, Geological Survey of Illinois, volume VIII, page 76, plate 10, figures 10, 10 a, 1890.

HALL'S DESCRIPTION: Corallum simple, narrowly turbinate, regularly curved, diameter of calices in individuals of the same height varying from ten to fifteen millimeters. Height twenty-five millimeters. Exterior with frequent undulations and low rounded annulations. Fossette narrow, very deep, commencing at the center and continuing to the posterior margin, the lamellæ extends to the margin, coalescing and forming vertical walls. Number of lamellæ fifty, alternating in size, at a distance of two millimeters from the margin, the smaller lamellæ coalesce with the others.

Found in the Warsaw division of the St. Louis group (sub-carb.) at Spengen Hill, Washington county, and at Georgetown, Floyd county, and at Lanesville, Harrison county, Indiana. The specimens illustrated are in my collection.

ZAPHRENTIS ALVEOLATUS, N. Sp.

PLATE 53. FIGS. 1, 2.

Corallum simple, turbinate, or elongate turbinate, straight or regularly curved, or distorted. Acute at the point of attachment. Gradually, or in some examples rapidly increasing in diameter to the calix. Height varying in different individuals, from fifty to one hundred millimeters. Calix broad, deep, forty-five millimeters in diameter. Tabulæ funnel-shaped. Number of lamellæ one hundred and ten, in the circumference of a cup forty-five millimeters in diameter, slightly unequal in size at the margin, alternating below, the short ones terminate before reaching the bottom of the calix, the longer ones continue to the margin of the smooth space in the bottom of the calix, and abruptly termi-

nate, leaving a broad, deep concave space in the bottom of the cup, twenty millimeters in diameter. Fossette consists of a deep depression at the margin of the concave area, and continues as a deep groove to the anterior margin.

Found in the Upper Devonian (Hamilton group) in the strippings above the cement rock throughout Clark county, Indiana. Now in the collection of the author.

ZAPHRENTIS HALLI, E. & H.

PLATE 53. FIGS. 3, 4.

Corallum simple, turbinate, or elongate turbinate. Acute at the point of attachment, rapidly expanding in diameter to the calix. Height varying in different individuals from sixty to one hundred millimeters or more. Calix broad, bell-shaped, forty millimeters in diameter. Depth twenty-five millimeters. Tabulæ flat or slightly depressed in the center of the cup, twenty-five millimeters in diameter. Number of lamellæ one hundred and six in the circumference of a calix forty millimeters in diameter, sharp and unequal in size at the margin, alternating below, rapidly slope to the bottom of the calix, and extend a short distance on the tabulæ, where the short ones abruptly terminate, the longer ones continue to within seven or eight millimeters of the center of the calix, and abruptly end, leaving a flat, smooth space in the center of the calix fifteen millimeters in diameter. Fossette deep and broad, situated at the margin of the smooth space in the bottom of the cup, and continues to the anterior margin. The exterior is usually rough, with numerous rough wrinkles and strong annulations of growth.

Found in the Upper Devonian (Hamilton group) near Charlestown, and in the strippings above the different cement quarries, throughout Clark county, Indiana. Now in my collection.

ZAPHRENTIS INTORTUS, N. Sp.

PLATE 53. FIGS. 5, 6.

Corallum simple, turbinate, straight, or regularly curved. Acute at the point of attachment, regularly expanding in diameter to the calix. Height varying in different examples, from fifty to one hundred and twenty millimeters, or slightly more in matured specimens. Calix broadly campanulate, sixty millimeters in diameter. Tabulæ oblique, thin and closely arranged, twenty-five millimeters in diameter. Number of lamellæ one hundred and twenty-eight, in the circumference of a calix sixty millimeters in diameter, sharp and unequal in size at the margin, alternating below, the shorter ones continue to the tab-

ulæ and gradually disappear, the longer ones continue on the tabulæ to the center of the calix; for the last three or four millimeters they become flexuous, and in some cups they fasciculate, and sometimes the ends of the lamellæ is broken up and gives to the bottom of the cup a rugose appearance. Fossette consists of a broad, deep depression at the margin of the tabulæ, but gradually disappears before reaching the margin of the calix, position on the longest side of the curvature of the coral.

Found in the Upper Devonian (Hamilton group) near Charlestown, and in the strippings above the cement rock at the different cement quarries throughout Clark county, Indiana. Now in the collection of the author.

#### HELIOPHYLLUM PARVULUM. N. Sp.

##### PLATE 53. FIGS. 7, 8, 9.

Corallum simple, turbinate, straight or regularly curved, with a broad scar at the point of attachment. Height varying in different examples from fifteen to thirty millimeters. Exterior frequently very rugged with rough irregular annulations, and deep constrictions, and rough wrinkles, caused by intermittent growth. Calix in some examples badly constricted, in some others broadly bell-shaped. Diameter from twenty to thirty millimeters. Depth fifteen millimeters, an oblique convex space in the bottom of the calix occupied by the tabulæ, from ten to fifteen millimeters in diameter. Number of lamellæ, eighty in the circumference of a calix, twenty-five millimeters in diameter, sharp and unequal in size at the margin, alternating below, gradually, or in some examples rapidly sloping to the bottom of the calix, where the short ones gradually disappear, the longer ones continue to within three or four millimeters of the center, and abruptly ends, leaving a smooth concave space in the bottom of the calix, from six to eight millimeters in diameter. Fossette consists of a slight depression at the margin of the tabulæ, but gradually disappears before reaching the anterior margin. Denticulations moderately fine, twelve in the space of eight millimeters.

Found in the Upper Devonian (Hamilton group) at Charlestown, and at the different cement quarries, throughout Clark county, Indiana. Now in the collection of the author.

#### ARACHNOCRINUS EXTENSUS, W. & Sp., Rowley.

##### PLATE 54. FIG. 1.

The specimen we have figured, although somewhat weathered, preserves the arms to near their distal ends. The whole lies upon a slab with the calyx imbedded in the matrix.

We doubt if *A. extensus* is specifically distinct from *A. bulbosus*, but as our specimen is, doubtless, the form described by W. & Sp., we refer it to their species.

The arms are massive and composed of moderately thick joints, the rays tapering but little to their extremities.

The left posterior ray is preserved to the fifth brachial which is not a bifurcating plate. The right posterior ray divides on the third brachial, so also the right anterior, while the left anterior bifurcates on the second brachial, the anterior itself dividing on the thirteenth. Wachsmuth & Springer in their diagnosis of this species assert that all the arms bifurcate on the second brachial, except the anterior ray which divides on the fourteenth or fifteenth plate. As to the number of times the rays branch, there seems to be nothing fixed. It appears to be from five to six. The differences we have pointed out are of little consequence.

The arm groove is scarcely half the width of the ray.

The calyx plates are but moderately thick, the articular facet occupying the greater part of the upper edge of the radial.

The fossil figured came from the Upper Helderberg group, at the Falls of the Ohio, the horizon, doubtless, of W. & Sp.'s type, though they give "Hamilton group below Hydraulic beds" (Encrinal Limestone, Hall).

Collection of G. K. Greene.

### MEGISTOCRINUS CIRCULUS?, Rowley.

PLATE 54. FIGS. 2, 3, 4.

This large crinoid agrees well with the above species in some respects, but differs quite as much in others.

It is a very depressed form but with a shallow concavity extending scarcely beyond the first radials.

The ventral disk is but little convex, the calyx contracted below the arm bases and all the calyx plates distinctly concave, the plate edges being ridges. The anterior and two posterior rays have four arm bases each while the two lateral have but two (each). There are ten spines on the vault, one located centrally and one above each ray while a smaller one is at the junction of two ambulacral ridges. This would give twelve but there is one each wanting on the anterior and left posterior rays. The surface of the ventral plates and, doubtless, so of the calyx plates, is granulose.

The base of the ventral tube is of moderate size. The periphery has a pinched appearance between the arm bases.

The specimen comes from the Hamilton group at Isaac Perry's farm, near Slate Cut, Clark county, Indiana. Collection of G. K. Greene.

## MEGISTOCRINUS SPINOSULUS, Lyon, Rowley.

## PLATE 54. FIGS. 5, 6.

Our specimen is much depressed, the ventral disk being scarcely convex, but little more than half of it preserved. The basals and first radials are involved in a shallow concavity and without nodes, while the rest of the calyx plates below the distichals have strong central spines.

The vault appears to have had six nodes or spines but from the weathered condition of this part of the fossil, the statement can not be positively made.

Some specimens in our hands, however, have longer ventral than dorsal spines and the smaller the specimen the more convex the vault. See plate 32, figure 14 for *M. rugosus*. This species has very strong spines on the ventral surface, while the dorsal plates above the first radials are only strongly convex or warty. Even the smooth-plated species of *Megistocrinus* generally have ventral spines, some times extravagant ones. See plate 24, figures 2, 3, 4. Again, the tendency in the flat-plated species in large individuals is to have concave calyx plates. See figures 3 and 4 on the accompanying plate.

The specimen figured is from the Upper Helderberg limestone at the Falls of the Ohio. Collection of G. K. Greene.

## STEREOCRINUS? INDIANENSIS, M. &amp; G., Rowley.

## PLATE 54. FIGS. 7, 8.

The two specimens figured on our plate represent the form for which Miller & Gurley proposed the above name.

It is doubtful whether this species belongs to the genus *Stereocrinus*. It is true it possesses but one costal but the specimen, figure 8, on our plate, has a greater number of distichals to the calyx periphery.

The basal plates are three in number and extend beyond the column base. The first radials are hexagonal and the largest plates in the calyx. The second radial or costal is pentagonal, of much smaller size and axillary.

Resting on each bifurcating costal are double rows of distichals, *eight* or more to the row in the imperfect dorsal cups figured, against *two* mentioned by Wachsmuth & Springer in their diagnosis of the genus.

The first interradial (interbrachial) is quite as large as the first radial, eleven sided and longer than broad.

Three much smaller plates rest on the upper edges of this first interradial and above these are others but they can not be made out on our specimens.

The entire dorsal cup as preserved is flat or even concave. The basal plates on figure 7 occupy a shallow concavity while the rest of the calyx is flat.

Starting near the baso-radial suture a strong rounded ridge traverses the radial plates to the periphery, bifurcating on the costals and growing stronger outward.

The number and shape of the interdistichal plates can not be determined, but such plates are present.

The column was not large, but round, with a pentagonal canal.

From the smaller specimen it would seem that the arms leave the calyx horizontally, the interbrachials between the radial ridges turning up a little.

The ventral disk, arms and anal tube unknown.

The specimen No. 7 came from the Hamilton group at Speed's Quarry, Clark county, Indiana, and No. 8, is from the Upper Helderberg group at the Falls of the Ohio. Collection of G. K. Greene.

#### GENNÆOCRINUS SIMULANS, N. Sp., (Rowley).

#### PLATE 54. FIGS. 9, 10, 11.

This species is founded on three calyces, more or less imperfect above.

In the greater prominence of the basal plates our species resembles *Aoro-crinus*.

The radial series is traversed by a rounded ridge that bifurcates on the axillary plates and passes to the arm bases. Two of these radial ridges fork at the middle of the first radial and meet the basal expansion as an inverted v.

The calicular areas between these ridges are flat, relieved only by small central nodes from which radiate to adjoining plates, low fine ridges, as in the drawings.

Each plate of the interbrachial series has this delicate central tubercle with the small radiating ridges.

The column is medium and round. Columnar canal small and pentagonal. The basal plates are three, expanding outward as in *Aoro-crinus*, into a cleft rim. Two of the basal expansions are slightly bilobed. The first radial is about as broad as long and hexagonal, its length being as great as both the second and third radials. The second radial is hexagonal and a little broader than long. The third radial is pentagonal and wider than long. The second distichal is an axillary plate, the second palmer of one division being also a bifurcating plate and making thirty arms in all.

The lowest interbrachial is hexagonal, a little larger than the second radial

and a little wider than long. Above this plate are two hexagonal plates. Three smaller plates are above the two, and three still smaller ones above the latter, three very small ones finishing out the series, or twelve in all. There are two small interdistichal plates, the one above the other.

Ventral disk and arms unknown.

Hamilton group, Charlestown, Ind. Collection of G. K. Greene.

**BOTRYOCRINUS AMERICANUS. N. Sp., (Rowley).**

**PLATE 54. FIGS. 12, 13, 14.**

The infra-basals are five in number, rather large, quadrangular convex and spread out horizontally to more than half the width of the calyx. There is a shallow excavation for the reception of the column. The columnar canal is pentagonal.

The basals are five in number, width and length equal, sharply convex or wart-like, the two posterior being seven sided, the remaining three, six sided. The wart-like nodes on these plates are not central but near the bottom of the plate giving the calyx, in a basal view, a pentagonal outline. The anterior and the adjoining lateral radials are pentagonal, wider than long and with scars for arm attachment more than half their width. These three plates are most protuberant at the middle of the scar. The two posterior radials are five sided but somewhat smaller in size. Lying between the two posterior basals but not reaching the infra-basals, is a quadrangular interradiial plate, a little larger than an infra-basal, hardly convex. Above and to the left of this plate is another and larger interradial, five sided and with its top suture on a line with the top of the radials. This plate rests between a basal, the first interradiial, and two radials. Plates all rather thick. Shallow pits mark the junction of sutures. Ventral parts and arms unknown. This fossil agrees with the Silurian genus *Botryocrinus* in the number and arrangement of its plates, but, despite the presence of two interradials, the body is quite symmetrical in shape. *Botryocrinus* has previously been found only in the Silurian of Europe.

From the Hamilton group near Charlestown, Ind. Collection of G. K. Greene.

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 NOTE—In my correspondence with Mr. Springer, in regard to the geological position of his species, *Arachnoerinus extensus*, he requests me to say that he is satisfied that his specimen is from the Upper Helderberg group, at the Falls of the Ohio, and that Dr. Wachsmuth was misled by the collector from whom he obtained his specimen.



## HELIOPHYLLUM SULCATUM.

PLATE 55. FIGS. 1, 2, 3, 4, 5, 6.

*Caninia Sulcata* D'orbigny. . Prodr. d, Palæontology, T. 1, P. 105, 1850.

*Aulacophyllum Sulcatum*, E. & H. Polypiers Fossiles, des Terr. Palæoz., page 355, plate 6, figure 2, 1851.

*Aulacophyllum Sulcatum*, Hall. Indiana Geological Survey, Page, 279, Plate 17, Figures 7 to 10, 1882.

Corallum simple, turbinate, or elongate turbinate, acute at the point of attachment. Gradually enlarging in diameter to the calyx. Height of the longest example seven inches. Calix oblique, three inches in diameter. Depth forty-five millimeters. Number of lamellæ, one hundred and seventy, very fine and equal in size at the margin, alternating below, gradually sloping to the bottom of the calix where the short ones terminate, the longer ones continue, coalescing and fasciculating and abruptly end before reaching the center of the calix, leaving a smooth depressed oblique space in the bottom of the cup, ten millimeters wide and twenty-five millimeters long. Denticulations are very fine, and can only be seen in places where the lamellæ has been protected from weathering. Fossette conspicuous, consists of a deep depression at the margin of the smooth space in the bottom of the calix, and continues as a deep broad groove to the anterior margin of the cup, when the long smooth space in the bottom of the calix is absent, by decay or otherwise it makes the fossette appear like one long deep groove, extending almost the entire diameter of the corallum.

Found in the Middle Devonian (Upper Helderberg group) at the Falls of the Ohio. All the specimens illustrated are in my collection.

## HELIOPHYLLUM GRADATUM, N. Sp.

PLATE 56. FIG. 1.

Corallum composite, rapidly increasing by calicular gemmation. Stems growing loose, never in contact for any distance. Corallites are deeply constricted, somewhat regularly, giving them the appearance of rough circular swellings, or strong rounded annulations. Each cup puts forth four or five buds, they again bud and a repetition of gemmation is often repeated. Buds at the margin of the parent cup have a diameter of five millimeters, gradually enlarging to the calix. Height from one cup to another varies in the same corallum from twenty to forty millimeters. Diameter of the calix ten to fifteen millimeters. Depth five to eight millimeters. A smooth convex space in the bottom of the calix, occupied by the tabulæ, four millimeters in diameter. Number of lamellæ fifty in the circumference of a calix ten millimeters in diameter, equal in size at the margin, alternating below,

abruptly slope to the bottom of the calix, where the short ones gradually disappear, the longer ones continue to the smooth convex space and abruptly terminate. Denticulations fine, ten in the space of five millimeters. Fossette consists of a slight depression at the margin of the smooth convex space in the bottom of the calix and extends to the margin of the cup; position variable.

Found in the Lower Devonian (Corniferous group) at the Falls of the Ohio. Now in the collection of the author.

### FAVOSITES LOUISVILLENSIS, N. Sp.

PLATE 56. FIGS. 2.

Corallum composed of a thin convex disk. With a thin wrinkled epithecal crust on the lower side. Tubes polygonal, unequal in size, from one to three millimeters in diameter. Tube walls decorated with numerous longitudinal rows of spines. Pores large, round from two to three rows on a side. Tabulæ flat or slightly oblique, in some places closely arranged, in other places more distant apart. When the surface of the corallum is weathered the tubes have the appearance of being quadrangular or pentagonal in outline, and where the diaphragms come to the surface they appear pitted in the angles of the tubes as seen in *Favosites favosus*.

Found in the Upper Silurian (Niagara group) at the Work House Quarry, on Beargrass Creek, near Louisville, Ky. Now in the collection of the author.

### ZAPHRENTIS SUBCENTRALIS, N. Sp.

PLATE 56. FIGS. 3, 4, 5.

Corallum simple, turbinate, straight or slightly curved. Acute at the point of attachment. Height twenty-five millimeters. Gradually enlarging in diameter to the calix. Exterior with numerous shallow annulations and wrinkles, caused by intermittent growth. Calix rounded, somewhat campanulate, twenty millimeters in diameter. Depth ten millimeters. Number of lamellæ fifty-two, in the circumference of a calix twenty millimeters in diameter, sharp and unequal in size at the margin, alternating below, the short ones reach to the bottom of the calix and terminate, the longer ones continue to within one and a half millimeters of the center and abruptly end, leaving a smooth, oblique, concave space in the center of the calix three millimeters in diameter. Fossette consists of a deep groove, commencing at the margin of the smooth oblique space, and continues to the posterior margin.

Found in the Upper Devonian (Hamilton group) at Speed's Quarries, Clark county, Indiana. Now in the collection of the author.

## ZAPHRENTIS CLINATUS, N. Sp.

PLATE 56. FIGS. 6, 7, 8, 9.

Corallum simple, rather small, compressed, turbinate, regularly curved. Acute at the point of attachment. Height from ten to twenty millimeters. Calix oblique, from ten to fifteen millimeters in diameter. Depth five millimeters. A flat space in the bottom of the calix, occupied by the tabulæ, five millimeters in diameter. Number of lamellæ sixty-six in the circumference of a calix, twenty millimeters in diameter, unequal in size at the margin, alternating below, gradually sloping to the bottom of the calix, where the short ones terminate, the longer ones continue to within two millimeters of the center of the calix and abruptly end, leaving a smooth concave space four millimeters in diameter. Fossette consists of a deep depression in the center of the calix, and continues to the posterior margin. Exterior with moderately fine longitudinal striæ, ten in the space of five millimeters. Surface comparatively smooth.

Found in the Warsaw division of the St. Louis group (Sub-carboniferous) at Edwardsville, Indiana. Now in the collection of the author.

## CYATHAXONIA VENUSTA.

PLATE 56. FIGS. 10, 11, 12, 13, 14.

*Cyathaxonia compressa*, G. K. Greene, Contribution to Indiana Palæontology. Part 2, page 9, plate 4, figures 14, 15, 16, 17, January, 1899.

*Cyathaxonia compressa*, Thompson, in a paper on some new species of Corals, read before the Philosophical Society of Glasgow, Scotland, December 19, 1877.

ACTINOCRINUS MULTIRAMOSUS, Var. Altidorsatus, N. Var.  
(Rowley)

PLATE 57. FIGS. 1, 2.

The dorsal cup of this crinoid is hardly as wide as high and all the plates are strongly nodose. Instead of radiating ridges, the top of each node is occupied by a cross lunulate depression. A low, delicate, rounded ridge passes from plate to plate in the radial series. The arms apparently spring from small distichals resting upon the second costals; in other words the arms are free above the first distichals. There are three interbrachials to the interradial series.

The anal interradials as far as can be made out are one, three and proba-

bly three. Shortly after becoming free, one arm bifurcates making six arms to the series or thirty in all, perhaps. At half their height the arms bifurcate again. The basal plates form a rim about the column, the three upper joints of which are strongly ridged.

The ventral disk is quite as deep as the dorsal cup and the plates are conspicuously nodose, but without ornamentation.

The ventral tube, three-fourths of an inch of which is preserved on the type specimen, is hardly strong with nodose and spinose plates. The pinules are rather long.

The whole body is somewhat flattened or crushed in at the anal interradius in the calyx and extending along the vault nearly to the anal tube base.

We should be glad to place this crinoid under one or the other of Wachsmuth & Springer's species *A. multiramosus* or *A. magnificus*, but it differs from both in so many details that we are constrained to erect a new variety for its reception. First, it differs from both in plate ornamentation; second, from *A. multiramosus* in the much greater height of the ventral disk, that of the latter species being from one-fourth to one-third the height of the calyx, while in our species it is fully as high as the dorsal cup. From *A. magnificus* it differs in its shallower dorsal cup and the basal rim wanting in the latter species. From both species it differs in the much greater height of the free arm bifurcation.

With both, it agrees in the number of arms and lack of lobed character of arm bases.

This beautiful crinoid comes from the Keokuk Limestone of Washington, county, Ind., and belongs to the cabinet of Mr. G. K. Greene.

#### BATOCRINUS SPERGENENSIS, Miller, Rowley.

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#### PLATE 57. FIGS. 3, 4.

The specimen we have figured is not quite so much depressed as Miller's type but preserves the plate ornamentation which consists of low irregularly arranged elevations and depressions hardly noticeable to the eye, presenting a somewhat pitted appearance. The outer edges of the basal plates are raised into a rounded ring-like elevation.

The ventral disk is composed of numerous convex plates.

The proboscis is not strong and excentrically located.

There are four arm bases to the ray or twenty arms in all.

A delicate thread-like elevation traverses the radial series, bifurcating on the second costal and again on the second distichal. A slight basal concavity involves the plates to the top of the radials (first radials).

The specimen is from the Warsaw Limestone of Edwardsville, Ind., and is the property of Mr. G. K. Greene.

TRICÆLOCINUS WOODMANI? M. & W., Rowley.

PLATE 57. FIGS. 5, 6, 7, 8.

There is some doubt of the correctness of this reference, but it is the same form referred to that species by Etheridge & Carpenter in the "Catalogue of the Blastoidea in the British Museum," plate XIX, figures 13, 14, 15, 16.

There is no doubt that this form is Roemer's *T. obliquatus* and that a well preserved specimen of that form, as indicated by the great plates occasionally found would be as large as Meek & Worthen's type of *T. woodmani*, but *T. obliquatus* described from detached plates alone must give way to M. & W.'s species. In our opinion Etheridge & Carpenter's *T. meeki* is a young individual of the form we have here figured, and the species is not valid.

Our figure 9 is a medium size specimen of *Tricælocrinus (Metablastus) bipyramidalis* from the type locality for comparison with *T. woodmani*. It is quite evident that the forms can not be separated generically. The three basal depressions are present on both forms and the only apparent difference is in the expansion of body below the ambulaeral tips. Large, well preserved specimens of *Metablastus? wortheni* differ not more from *bipyramidalis* than the latter from *woodmani*.

Keyes has figured on plate XVIII of the "Missouri Geological Survey," volume IV, two adult forms from Booneville, which he identifies as *M. wortheni* and *M. bipyramidalis*. No collector who has seen a set of the Booneville fossils can separate the forms, as there are scarcely any two of them with the same ambulaeral length and, moreover, all the young specimens are elongate and not unlike *M. lineatus* of the Burlington. Unless *lineatus* is sufficiently distinct, *Metablastus* will have to be abandoned.

Such forms as *Troostocrinus nitidulus* and *Tricælocrinus varsouviensis* are but the young of *bipyramidalis*, *wortheni* or *woodmani*.

Meek & Worthen's *Tricælocrinus obliquatus* as figured in the VII volume,

Illinois Geological Survey, plate 31, is an undersized *T. woodmani*, the form described by Etheridge & Carpenter as *T. meeki*.

The figures of our specimens will give an idea of the size and proportion of the fossil. The greatest width of the fossil is at the distal ends of the ambulacra.

The three basal hollows give a strong triangular appearance to the bottom. The stem base is triangular also. The basal plates are quite large and can be plainly seen on a side view of the fossil.

The horizon of our specimen is Warsaw Limestone, and the locality Greenville, Ind. Collection of Mr. G. K. Greene.

PENTREMITES KONINCKANUS, Hall, Rowley.

PLATE 57. FIGS. 10, 11 (x 2).

Our specimen shows a small radial plate between one of the fork pieces and the basals. The deformity is not due to a break in the fork piece, but, as figure 10 shows, a plate inserted, perhaps from abnormal growth as the fossil is flattened in that direction. It is a very interesting feature to say the least.

The locality is Lanesville, Ind., Warsaw group. Collection of Mr. G. K. Greene.

NUCLEOCRINUS ANGULARIS, Lyon, Rowley.

PLATE 57. FIG. 12.

The specimen figured seems to have an abortive sixth radial or fork piece, much narrower than the other five and without a groove for the reception of an ambulacrum.

The interradial area in which the ridge is inserted is somewhat wider than the three normal areas, about the same width, in fact, as the anal interradius.

Such a feature as we have here illustrated, while it is occasionally observed in true Pentremites and other sub-carboniferous blastoids, is rare in Nucleocrinus.

Hamilton group, Speed's Cement Quarry, Clark county, Ind. Collection of Mr. G. K. Greene.

NUCLEOCRINUS IMITATOR, Rowley.

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## PLATE 57. FIGS. 13, 14, 15.

This very interesting blastoid was figured and described in, No. 9 of this series of bulletins. Herewith we figure another specimen showing well the features of the species. The chief characters of *N. imitator* are its greater width than depth, concave basal region; narrow, depressed interradian sinuses and boat-shaped elevations about the ambulacra. The ambulacra are narrow and the ventral region a little concave.

Specimens of this species in a casual way strongly remind one of *Orbitremites norwoodi*.

The distal ends of the ambulacra are received into little foot-like folds that project obliquely outward.

Hamilton group, Speed's Cement Quarry, Clark county, Ind. Collection of Mr. G. K. Greene.

DOLATOCRINUS EXCAVATUS, W. & Sp., Rowley.

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## PLATE 57. FIGS. 16, 17, 18.

Figure 16 is a specimen that has but one costal in one of the radial rays. It will be observed that while this one costal is somewhat longer than the second costal, in the other four rays it is not as deep as both costals in those rays, but the distichals are a little larger.

Figure 17 is a somewhat larger specimen with unbroken radial ridges and two rays with single costals, perhaps three rays. A disarrangement of plates about the latter ray leaves us in doubt as to whether it has two or three plates in the first series. If three, then the two costals have much less depth than in the two rays that do have three primary plates.

We have seen other specimens of this same species with but two plates in the first radial series and yet species have been founded upon characters of less importance.

In a great series of specimens of this species with the tendency to reduce the number of primary radials, doubtless specimens can be found with but a single costal to each of the five rays. Could such specimens belong to *Stereocrinus*?

Number 18 has a small but distinct piece lying between the second costal

and the superimposed distichal. The sutures about this little plate are very distinct. It would be idle to conjecture the possible origin of this little plate, and yet, one can't help thinking it was due to an injury, despite the fact the body gives no evidence of this.

All three of the specimens of the above species here figured are from the Upper Helderberg group, Falls of the Ohio. Collection of Mr. G. K. Greene.

### NUCLEOCRINUS LUCINA, Hall, Rowley.

PLATE 57. FIGS. 19, 20.

The little blastoid here figured seems to belong to the above species. It is longer than wide and distinctly lobed. The interrarial sulcus is shallow, but broader than the raised ambulacral area, from the middle of the body to the base. The base is convex and the distal ends of the ambulacra are received into little feet-like projections that are directed outward. The ornamentation of the narrow, elongate areas bordering the ambulacra are rather strong raised lines directed a little obliquely downward. The sulci are traversed longitudinally by smaller lines.

The summit is not unlike that of other Nucleocrini.

Hamilton group, Speed's Cement Quarry, Clark county, Ind. Collection of G. K. Greene.

## A REVIEW OF DR. G. HAMBACH'S

"Revision of the Blastoidæ, with a Proposed New Classification and Description of New Species."

BY R. R. ROWLEY.

After stating a necessity for a revision of the Blastoidæ, growing out of the accumulation of new material, principally his own collection, Dr. Hambach proceeds to inform us that his revision is based mainly upon three forms, namely: *Pentremites sulcatus*, *florealis* and *conoideus*,

not because of their great abundance, but from the excellent preservation of the first named species. To strengthen this foundation he adds, "I think it is not unreasonable to suppose that similar conditions in structure must have existed in other species belonging to this family."

With such a statement in the beginning and a source so narrow from which to draw the information to be used in the diagnosis of a family of organisms, including several genera and many species, the reviewer could hardly hope the acceptance of his new classification.

A worse mistake was made by the author when, without excuse, he set aside valid generic names and substituted therefor new names of his own creation, thus ignoring the law of priority. Objectionable as blastoid names ending in *crinus* certainly are, yet who has the authority to change them? We really expected the Doctor to make all generic endings *blastus* but he seemed to have forgotten his own plans and retained a few *ites*.

He mentions no type species under his new genera and he did wisely, from the heterogeneous character of the species grouped under the new generic names.

In speaking of the construction of the body of a *Pentremite*, and we suppose it is to answer for all blastoids, he says it is a most perfect dicyclical body and then calls the reader's attention to the fact that he does not use the word dicyclical in the same sense as in *Crinoidea*. Why then use it at all since its employment can not be otherwise than misleading? His conception of the growth of the two circles of pieces is a very curious one and at the same time very doubtful.

It is equally doubtful that any but an abnormal specimen ever has five basal plates.

It is difficult to understand why the base portion of the deltoid piece is the most important part of the calyx and the writer does not tell us why.

That the central lancet canal and the pentagonal ring of which it forms a part, served as a lodgement for the nervous system admits of doubt, as well as the so called genital openings of this author. Until such a time as proof is given that these ventral openings were for the passage of ova, we shall continue to speak of them as spiracles.

Regarding the fork pieces as radials, the deltoids are located interradially and the blastoid is monocyclic.

There is absolutely no excuse for insisting that the outer surface of the ambulacrum "is covered by an organic and elastic integument." If the peculiarly ornamental character of the surface of the ambulacrum were an integument, there is no reason why it could not be readily removed, but such is not the case and why not conceive that the substance of the ambulacrum is thrown into minute elevations and depressions of peculiar pattern to serve some useful purpose to the animal? Doubtless the position that Dr. Hambach has taken on the ventral covering in *Pentremites* gives him a good excuse to hold on tenaciously to his "zig-zag plicated integument" theory, thereby obtaining scales with which to form the "cone-shaped body observed on the summit of many species."

After illustrating the ventral tube of *Pentremites conoideus*, he makes the following statement: "To my knowledge it is the first time that such a body has been observed on a Blastoid." overlooking or ignoring the fact that the writer of this paper mentioned such an appendage on a specimen of *Schizoblastus sayi* in the October, 1900, number of *The American Geologist*, page 247, and in the June, 1901, number of the same publication, we illustrated the specimen on plate

xxviii, figures 15 and 16, both papers antedating the learned professor's publication by several years.

Dr. F. A. Bather in "The Record of and Index to the Literature of Echinodermata" for the year 1900, at the bottom of page 49, mentions our discovery of the blastoid anal tube.

It seems to us that the figures on plate I of Dr. Hambach's paper, show merely the results of injury to the ambulacra, just what one would expect to see in some specimens, but carrying no evidences of a flexible membrane.

With a persistence that is remarkable and with almost all of the most accurate observers against him, the Doctor still denies the existence of a roof of small plates covering the central opening of Pentremites and allied forms, arguing that it "is only logical to suppose that, if nature provided an opening it should remain open or that the covering is a flexible one and not formed by additional plates inserted into the openings as intimated by all authors who adopted the first statement of Shumard," and yet in his diagnosis of the genus *Olivianites*, he says "Center of the summit closed by additional pieces" (See page 49 of his paper). Did nature so far forget herself as to make a central summit opening in *Nucleocrinus* and then roof it over with a covering of plates?

I have seen dozens of specimens of *Nucleocrinus verneuili* with the ventral covering in place. In fact most of the specimens found at the Falls of the Ohio are in that condition as I infer from the material of Mr. G. K. Greene that has passed through my hands. Not *verneuili* alone, either, as I have seen the covering also on *angularis*, *greenei* and *venustus*.

The statement that "every one disregards the fact that all casts of the interior of a calyx exhibit on the summit a cast of the summit opening" is a great mistake of the Doctor's if he includes *Schizoblastus sayi* in the statement and I am led to believe he does, since in his diagnosis of *Cribroblastus* he uses these words, "Central opening never closed except by ambulacral in-tegument."

There is little doubt that his vast collection is deficient in structural material outside of Pentremites or he would not commit himself to such a statement.

I have collected hundreds of casts of *sayi* and a vast majority of them are specimens with a closed summit.

Of my specimens of the same species preserving the test, and I have fifty or more from Louisiana alone, less than one tenth are without the ventral covering or roof of small plates over the central area that Dr. Hambach would leave uncovered in deference to nature.

Of the rare species *Lophoblastus inopinatus* we have two specimens preserving the ventral covering, two of *L. apertus*, one of *L. marginulus* and several among other species.

In one specimen of *Orophocrinus stelliformis* in our collection not only the ventral covering is in place but a roofing of small plates has extended down each ambulacrum, broken in more or less, in four of the ambulacra, but preserved to the distal end of the fifth.

These coverings that we have seen are made up of small plates not foreign matter or ovulum-like bodies drifted into the orifice and mistaken for plates, for where the roofing extends over the ambulacrum there is a neatly arched canal beneath.

That a pyramidal covering is occasionally found over the central orifice of Pentremites can

not be doubted and its origin is not due to an elastic integument, even though the latter may be capable of a good deal of stretching. We have seen it on specimens of *Pentremites godoni* from Kentucky and Tennessee, and Etheridge and Carpenter figure a specimen of *P. sulcatus* showing a ventral covering on plate I, in the "Catalogue of the Blastoidæ." These same authors on plates III and VI have drawings of specimens of *Schizoblastus sayi*, and on VI and VII of *Orbitremites norwoodi* showing closed summits. On plate XV of the same work are similar figures of *Orophocrinus stelliformis*.

Meek and Worthen in the Fifth Illinois Report also figure the latter species with a ventral covering.

Try as hard as Dr. Hambach and others have done to separate the Blastoids and Crinoids as far as possible, the fact is patent to the unbiased observer that they have many homologous parts. Both were stalked, both had basals, radials, interradials, covered ventral disks, (the latter reduced to a minimum in blastoids) pinulæ and arms, if the ambulacra of the Blastoidæ represent recumbent arms, respiratory pores around the arm bases and an anal opening through the test or on the end of a proboscis. The Doctor may be in error when he says he believes organs similar to the anal tube of *Pentremites conoideus* existed in all typical species, for we might rush to the same conclusion on beholding for the first time the proboscis of *Actinocrinus*. We imagine similar conditions will be found to occur in the genera of Blastoids. Some will have probosces and others mere openings through the test.

It would be much safer to say, and we are willing to make the unqualified statement, that all blastoids in life had a ventral covering of small plates.

Dr. Hambach's statement that his hypothetical water vascular duct in a state of collapse has given rise to the assertion that there is an under lancet piece, and his further statement that "his much doubted tentacles, protruding through the poral openings" have formed in their collapsed condition "the supplementary poral pieces of Dr. Roemer or outer side plates of later authors" are not any nearer acceptance than they were years ago, for his present paper is little more than a rehash of the earlier one.

To put beyond dispute the character of certain small tubes lying between the hydrospiral folds, our reviewer has actually found petrified ova in them. It only remains to establish beyond question the function of certain other vessels by the discovery of petrified water in the ducts. It is reasonable to suppose now that the little ovulum-like bodies that Dr. Hambach found resting in the central summit orifice were not drifted in by the water but were actually fresh laid eggs.

After reviewing the earlier classification and pointing out its inadequacy to present need in view of the increased knowledge of the subject and the better understanding of the relationship of the parts, the author proposes a new classification based upon the summit openings, development of the deltoids and the aspect of the outer surface, remarking, "Nor can we attribute any more than specific value to the hydrospiral tubes, or plications, on account of the variability often observed in one and the same specimen, a fact sufficiently recognized by the very authors who regard them as being of importance for classification," and we are actually treated to views of three specimens of as many species with deformed hydrospires, but the author neglected to tell us how many specimens with the normal number of folds he examined before he found the abnormal ones.

Does he know that there is some variation even in the spiracles of a single individual? Etheridge & Carpenter on plate VII of "The Catalogue of the Blastoidæ" in figure 12 show a double spiracle in one of the deltoids of *O. norwoodi*.

Double spiracles are not uncommon in *Pentremites elongatus* as Dr. Hambach can but know. On plate I, of Etheridge & Carpenter's great work are figures of two specimens of *P. elongatus* one with five spiracles and the other with ten (five divided), and the authors say on page 161 "Spiracles oval but often in pairs and separated by strong septa."

In his concluding remarks on the new classification the author seems to hurry as the following remarks show: "I also wish to remark that this classification embraces only our American species, although most of the European species, I believe (judging from my small collection of European specimens), will fit into one or another of these genera, with the exception of aberrant forms, like some of our American ones, of which it is still doubtful whether they should be regarded as Blastoids or Cystoids, for the reception of which a separate class should be established. This class may include all doubtful specimens and those insufficiently described and doubtfully illustrated because of the fragmentary condition of the material."

He seemed to have wearied of the genus making and took up the European material in job lots and shoveled them into corners where they seemed to fit.

Then the odds and ends are placed together and a suggestion is made that a separate class be created for their reception apparently based on their differences from one another and every thing else. What a grand finale this is to a classification and what name would the learned author suggest? Not *Irregulares* for he has already used that.

We have spoken elsewhere of the substitution of new names for old as well as established genera.

The author arranges two families under the order *Regulares* and two under the order *Irregulares* without any definition of families whatever, placing *Codonites* under *Pentremitidæ*, while *Codaster* stands alone under *Codasteridæ*. Of his species of *Pentremites*, *P. abbreviatus*, *P. bradleyi*, *P. florealis*, probably *P. tulipaformis* and *P. rusticus* are synonyms or mere varieties of *P. godoni*. *P. basilaris*, *P. broadheadi*, *P. nodosus*, *P. spinosus* and *P. serratus* are synonyms of *P. sulcatus*, *P. clavatus* and *P. gemmiformis* mere varieties of *P. calycinus*, *P. obtusus* and *P. angustus* are merely extreme forms of *P. conoideus* and, if varieties, would be synonyms of my varieties *P. conoideus* var. *amplus* and *P. conoideus* var. *perlongus*, described in Part X, Contribution to Indiana Palæontology, September 4th, 1902, on pages 87, 88 and figured on plate 29.

The definition of the proposed genus *Crioblastus* is founded upon an erroneous assumption and is invalid even if it were lawful to propose it instead of a prior name. The author gives as its chief character "Central opening never closed except by ambulacral integument," a statement which is untrue. He ranges under this genus a heterogenous group of species of which *C. potteri* and *C. verrucosus* are synonyms of *Schizoblastus sayi*, *C. incisus* of *Cryptoblastus melo*; *C. tenuis* of *Lophoblastus roemeri*; *C. sampsoni* of *L. roemeri*.

The proposed genus *Saccoblastus* embraces *Tricælocrinus*, *Metablastus* and *Troostocrinus* and is invalid as it is meant to supplant valid prior names. *Tricælocrinus obliquatus* formerly described from fragments, is here figured as a whole, but the specimen is a typical *T. woodmani*, *S. meekianus* is a synonym of *T. woodmani*, *S. ventricosus*, *N. Sp.* is a synonym of *Metablastus bipyramidalis*, coming from the same horizon and locality where there is a great variation in *bipyramidalis* suggesting that it is probable that even the form from there recognized by some collectors as *M. wortheni* is after all the same species. We do not mean the *M. wortheni* from the Keokuk Limestone.

*Cidaroblastus* is offered for *Pentremitidea* and *Troostocrinus reinwardti*. A strange idea to associate in the same genus such forms as *Pentremitidea americana* and *Troostocrinus reinwardti*, *Mesoblastus*, E. & C. is retained and made to receive *M. Glaber*. *Cidaroblastus* is offered for *Granatocrinus*, the latter name being objectionable on account of its ending.

Two species are recognized *C. granulatus* and *C. parvus*, *N. Sp.*, the latter said to be from cherty rock of the St. Louis age in South-western Missouri. We doubt the horizon and hardly think the species could be identified from the figure and description, and await evidence that the granules were for the reception of little spines.

*Globoblastus* is a synonym for *Orbitremites* and is defective in diagnosis by reason of the statement "Central opening never closed except by ambulacral integument," a very erroneous character since the ventral covering has been seen and figured. *Orbitremites norwoodi* and the following new (†) species are placed under the spurious genus: *G. magnificus* a synonym of *O. norwoodi*; *G. ornatus*, *G. spathus*, both probably mere varieties of *O. norwoodi*, but non-recognizable from the descriptions and drawings.

Under *Cribroblastus* I omitted his two new (†) species, *C. tenuistriatus* a synonym of *Lophoblastus inopinatus* and *C. selucherti* a synonym of *Granatocrinus spinuliferus*, Rowley. He retains the genus *Codonites*. His *C. campanulatus* is a synonym of *C. stelliformis*. In his diagnosis of *Codonites*, he says "Central opening very small and usually covered by the ambulacral integument." It is usually covered by small plates.

The author does not disturb the name *Codaster*, which he retains as a genus. He should have objected to the use of this word, as it would be more appropriate for a star fish.

For *Nucleocrinus* or *Elæacrinus* he proposes to resuscitate the name *Olivanites*. He places M. & G.'s species *Nucleocrinus venustus* as a synonym under *N. elegans* a much smaller form.

The genus *Eleutherocrinus* is converted into *Eleutheroblastus* and two species recognized, *E. cassedayi* and *E. whitfieldi*. The latter is an undoubted synonym of the former.



## ZAPHRENTIS CALLOSUS, N. Sp.

PLATE 58. FIGS. 1, 2.

Corallum simple, turbinate, straight, or slightly curved. Acute at the point of attachment, gradually enlarging in diameter to the calix. Height one hundred and forty-five millimeters. Diameter of calix sixty millimeters. Depth varying in different examples from forty to sixty millimeters. Number of lamellæ one hundred and forty in the circumference of a calix, forty-five millimeters in diameter, unequal in size at the margin, alternating below. The short ones scarcely more than rudimentary, the longer ones gradually descend to the bottom of the calix, four or more coalescing, appearing like a letter V, and extends a short distance on the tabulæ and abruptly ends, leaving a flat smooth space in the center of the calix, from four to six millimeters in diameter. In some examples a few lamellæ extends to the center of the cup, but they do not connect. There are two fossettes situated on the anterior and posterior sides, and two lateral gaps situated at right angles to the primary fossette, which is situated on the anterior side, and is very shallow and narrow at the margin of the tabulæ, but gets broader as it approaches the margin of the cup. The secondary fossette is situated on the shortest side of the curvature of the coral, but is not so strongly pronounced as the anterior one. The epitheca is thin and comparatively smooth. There are a few swellings, and strong rounded annular lines of growth.

Found in the Middle Devonian, (Upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

## HAIMEOPHYLLUM ORDINATUM. Billings.

PLATE 58. FIGS. 7, 8.

*Haimeophyllum ordinatum*, Billings. Fossil corals of the rocks of Canada West. Page 43, figure 29, 1859.

*Chonostegites Ordinatium*, S. A. Miller. North American Geology and Palæontology, page 178, figure, 151, 1889.

BILLING'S DESCRIPTION: Corallum forming large sub-globular or flat hemispheric masses; average diameter of the corallites in the constricted portions one line and a half to two lines, and of the expansions two and a half to three and a half lines. The epitheca, where it can be seen between the expansions, is more or less distinctly marked with the longitudinal septal striæ. There appears to be about forty internal striæ. The expansions which connect the corallites are periodical, or occur at the same level in all the individuals at distances of from one to three lines.

There are some specimens in which the expansions occur at intervals of less than one line, and they are even so close together that the coral appears at first sight to be a large sub-globular mass of concentric laminae. I do not at present think these can be separated as a distinct species from those with expansions one or two lines distant.

Locality and formation, Township of Walpole, corniferous limestone.

The specimen illustrated on plate 58 is from the Middle Devonian, (Upper Helderberg group) at the Falls of the Ohio. Now in my collection.

#### HELIOPHYLLUM CONDITUM, N. Sp.

PLATE 58. FIGS. 3, 4, 5, 6.

Corallum simple, or compound, turbinate, straight or slightly curved. Increase by calicular gemmation. Acute at the base of attachment. Height varying from ten to forty millimeters. Exterior with fine annulations and constrictions, caused by intermittent growth. Diameter of corallites varying from fifteen to thirty millimeters. Depth ten to fifteen millimeters. Number of lamellæ seventy-four in the circumference of a calix twenty-five millimeters in diameter, slightly unequal in size at the margin, alternating below, for about three millimeters, nearly flat, then abruptly slope to the bottom of the calix, where the short ones terminate, the longer ones continue, coalescing, fasciculating and twisting into an elevated labyrinthine mass in the center of the calix, giving to the calix a sponge-like appearance. Denticulations moderately fine, twelve in the space of eight millimeters. Fossette consists of a slight depression at the anterior side of the tabulæ, and extends for a short distance on the side of the calix.

Found in the Upper Devonian, (Hamilton group) near Charlestown, Indiana. Now in the collection of the author.

#### DIPHYPHYLLUM DILATUM, N. Sp.

PLATE 58. FIGS. 9, 10, 11, 12.

Corallum simple, turbinate, straight or slightly curved, acute at the point of attachment, occasionally a specimen has root-like prolongations near the base that served as attachment for support. Height varying in different examples, from ten to twenty-five millimeters, the largest example I have seen has a height of twenty-five millimeters. Diameter of calix twenty-five millimeters. Depth ten millimeters. The center of the calix is occupied by a horseshoe-shape area with slightly elevated margins, central portion smooth three millimeters

in diameter. Number of lamellæ seventy in the circumference of a calix twenty-five millimeters in diameter, slightly unequal in size at the margin, alternating below; the short ones descends to the bottom of the cup and gradually disappear, the longer ones continue to the margin of the horseshoe-shaped area in the center of the calix and abruptly end. Exterior rugged with sharp constrictions and strong rounded annular lines of growth, denticulations moderately coarse, four in the space of two millimeters.

Found in the Upper Devonian, (Hamilton group) at Speed's cement quarry and in the strippings above the cement beds throughout Clark county, Ind. Now in the collection of the author.

### HELIOPHYLLUM INFLEXUM, N. Sp.

PLATE 59. FIGS. 1, 2, 3, 4.

Corallum simple, turbinate, straight or regularly curved. Acute, or sometimes there is a broad scar at the base of attachment. Height varying in different examples, from fifteen to sixty millimeters or more in some corallums. Calix oblique, circular or broadly oval, from twenty to thirty millimeters in diameter. Depth ten to fifteen millimeters. The bottom of the calix is oblique, more strongly pronounced in some cups than in others. Number of lamellæ ninety-two in the circumference of a cup twenty-five millimeters in diameter, thin and somewhat sharp, and alternating in size at the margin, getting thinner and alternating in length, gradually sloping to the bottom of the calix where the short ones terminate; the longer ones continue to the bottom of the calix, and from five to eight of the principal ones extend across the bottom of the cup connecting with the opposite ones, generally at right angles, or slightly oblique to the principal fossette. The intermediate lamellæ converge to those that extend across the bottom of the cup. There are two lateral fossettes situated on either side of the principal one; the position of these is variable, and occasionally there is one that is poorly defined. The exterior is very rugose, with numerous sharp constrictions giving to the corallum the appearance of a series of invaginated calices. The denticulation are absent in worn or weathered specimens, but they are well defined in well preserved examples.

This species is common in the Middle Devonian, (upper Helderberg group) Falls of the Ohio. Now in the collection of the author.

### HELIOPHYLLUM OBLIQUUM, N. Sp.

PLATE 59. FIGS. 5, 6, 7.

Corallum simple, turbinate, or elongate turbinate, straight or regularly

curved, or sometimes geniculated. Acute at the point of attachment, or some examples have a broad scar at the base. Height varying in different examples from thirty to seventy millimeters. Diameter of calix thirty to forty millimeters. Depth twenty millimeters. Number of lamellæ one hundred in the circumference of a calix twenty millimeters in diameter, thin and sharp, and slightly unequal in size at the margin, growing thinner and alternating below, abruptly sloping to the bottom of the calix, where the primary ones coalesce and blends with the tabulæ and terminate, leaving a smooth oblique space in the bottom of the calix twelve or fifteen millimeters wide. The secondary lamellæ is confined to the wall and scarcely ever exceed twelve or fifteen millimeters in length. The exterior, when decorticated, is very rugose, having the appearance of close, or in places of distant invaginated calices. The primary fossette is situated on the side of the longest curvature of the coral, commencing at the margin of the smooth oblique space in the bottom of the calix and extends to the anterior margin. There are two rudimentary fossettes, situated at right angles to the principal one, but neither of these extends to the margin of the calix. Denticulations rather fine, frequently they are destroyed by the weathering of the coral.

Found in the Middle Devonian, (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

#### ZAPHRENTIS CALIGULUS, N. Sp.

PLATE 59. FIGS. 8, 9, 10, 11.

Corallum simple, turbinate, straight or slightly curved, acute at the point of attachment. Height sixty millimeters, for about half the length compressed and slightly curved, then abruptly rounding to the margin of the calix, in some examples instead of rounding to the margin they become somewhat quadrilateral. Exterior with broad, shallow, rounded annulations and wrinkles, caused by intermittent growth. Calix broadly bell-shaped, or quadrilateral, forty-five millimeters in diameter. Depth twenty millimeters. An elevated space in the bottom of the calix, occupied by the tabulæ, thirty millimeters long and twenty millimeters wide in a calix forty-five millimeters in diameter. Number of lamellæ one hundred and fourteen in the circumference of a calix forty millimeters in diameter, equal in size and rounded at the margin, alternating and growing thinner below, gradually sloping to the bottom of the calix, where the short ones terminate; the longer ones continue for a short distance and abruptly turns upwards for four or five millimeters, then turn toward the center of the calix, coalescing and fasciculating, and abruptly ends, leaving a smooth depressed space in the center of the calix, two millimeters wide and four or five millimeters long. Fossette consists of a deep depression at the margin of the

elevated space in the bottom of the calix, situated sometimes on the sinistral side and again it may be situated on the dextral side of the tabulæ, this may be due to the curvature of the coral.

Found in the Middle Devonian, (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

CYSTIPHYLLUM VESICULOSUM. Phillips.

PLATE 60. FIGS. 1, 2.

*Cyathophyllum Vesiculosum*, Goldfuss, *Germ Petref.*, page 58. plate 17, figure 5 and plate 18, figure 1, 1826.

*Cystiphyllum Vesiculosum*, Phillips, *palæozoic fossils*, 1841.

*Cystiphyllum Vesiculosum*, De Vermeil and Jules Haime, *Bull. Society Geology of France*, second series, volume VII, page 162, 1850.

*Cystiphyllum Secundum and Vesiculosum* D. orbigny, *Prod. de Pal.*, volume 1, page 106, 1850.

*Cystiphyllum Vesiculosum*, Milne Edwards and Jules Haime, *Pal. Foss. des Terr. Palæozoic.*, page 462, 1851.

*Cystiphyllum Vesiculosum*, Edwards and Haime, *British Fossil Coral.*, page 243, plate 56, figures 1, 1a, 1b, 1853.

*Cystiphyllum Vesiculosum*, McCoy, *British Palæ. Foss.*, 1851.

EDWARDS AND HAIME'S DESCRIPTION: Corallum simple, very long, slightly bent, subcylindrical, provided with a very strong epitheca, and presenting rather strong subhorizontal circular wrinkles. Calicular cavity rather deep, the septal striæ, when visible, more distinct towards the outer part of the calice. Vesicles unequal in size, the largest occupying the center of the visceral cavity, and about one line in length. Height of the coral in general about three or four inches. We have seen in the collection of Mr. Pengelly a specimen that measured one foot in length and one and a half inches in diameter.

The British specimens submitted to our examination were found at Lorguay, Plymouth and Meedstone Bay. Prof. Phillips has met with the same species at Babbacombe, and Prof. McCoy at Newton Bushel. It exists also in Spain at Millar, in the Province of Leon; in Germany, in the Eifel mountains: and in America at Corn Island, Falls of the Ohio.

The illustrated specimens were collected in the upper Helderberg group, on Goose Island, at the Falls of the Ohio. Now in my collection.

CYSTIPHYLLUM GEMMIFERUM. N. Sp.

PLATE 60. FIGS. 3, 4, 5.

Corallum simple, or composite, increasing by calicular and lateral gemmation, with a rough wrinkled scar at the base of attachment. Height forty millimeters. Corallites unequal in size, from twenty to forty millimeters in diameter. Calix oblique, very shallow, not exceeding five millimeters in depth. The

surface of the calix is covered with coarse vesicles, varying in size from one to three millimeters in diameter. The exterior is very rugged and when decorticated appears as coarse invaginated cups. The surface cysts are not so large as those in the calix, and are not so deeply pitted, and are somewhat oblong. The margins of the corallites when in contact are very much elevated, and appear as sharp ridges.

The coarse rugged appearance of the corallum, its composite form, and the large round vesicles in the calix, and the elevated margins of the corallites where in contact, makes this easily recognized from all other species.

Found in the Middle Devonian, (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

### CYSTIPHYLLUM CONSPICUUM, N. Sp.

PLATE 60. FIGS. 6, 7, 8.

Corallum simple, or composite. Acute at the point of attachment. Some examples have root-like prolongations near the base, that served as attachment for support. Height varying in different examples, from twenty to seventy millimeters. The margin of the calix is generally very thin and bell-shaped, from ten to forty millimeters in diameter. Depth from twenty to fifty millimeters. In some examples there is a strong silicified coating, from one and a half to two millimeters in thickness, covering the entire calix, when this silicified coating is very thick, the cysts appear as swellings or nodes, but when the coating is thin or weathered away, numerous cysts appear somewhat small at the margin of the cups, but getting larger as they approach the center of the calix. Corallites in composite examples vary in size from twenty to forty millimeters in diameter. Depth from ten to twenty millimeters. Exterior when decorticated is somewhat rugged and has the appearance of being composed of a series of thick invaginated vesicles, with their upper margins broken off.

Found in the Middle Devonian, (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

### CYSTIPHYLLUM CRENATUM, N. Sp.

PLATE 59. FIGS. 12, 13, 14, 15, 16, 17, 18, 19, 20.

Corallum simple, turbinate, or subturbinate. With a broad scar at the base of attachment. Height from five to forty millimeters, varying in different individuals. Diameter of calix ten to twenty millimeters. Depth ten to fifteen millimeters. Exterior rather rough, having the appearance of a number of thin invaginated cups with crenulated margins. Diameter of calix from fif-

teen to twenty millimeters. Depth five to ten millimeters. Near the margin of the cups there is numerous rounded and well defined striæ, eight in the space of five millimeters; they disappear before reaching the bottom of the calix. The vesicles do not interfere with the striæ; usually they are large and confined to the bottom of the cup. The vesicles on the exterior of decorticated specimens are very numerous and small.

The small corallum, with the broad base and thin invaginated calices, with their margins crenulated, makes this easily recognized from all other species.

Found in the Middle Devonian, (upper Helderberg group) at the Falls of the Ohio. Now in the collection of the author.

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- Part 7. May 23, 1901.
- Part 8. August 14, 1901.
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- Part 10. September 4, 1902.
- Part 11. February 3, 1903.
- Part 12. July 18, 1903.
- Part 13. August 27, 1903.
- Part 14. September 24, 1903.
- Part 15. October 22, 1903.
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- Part 17. May 9, 1904.
- Part 18. June 22, 1904.
- Part 19. July 20, 1904.
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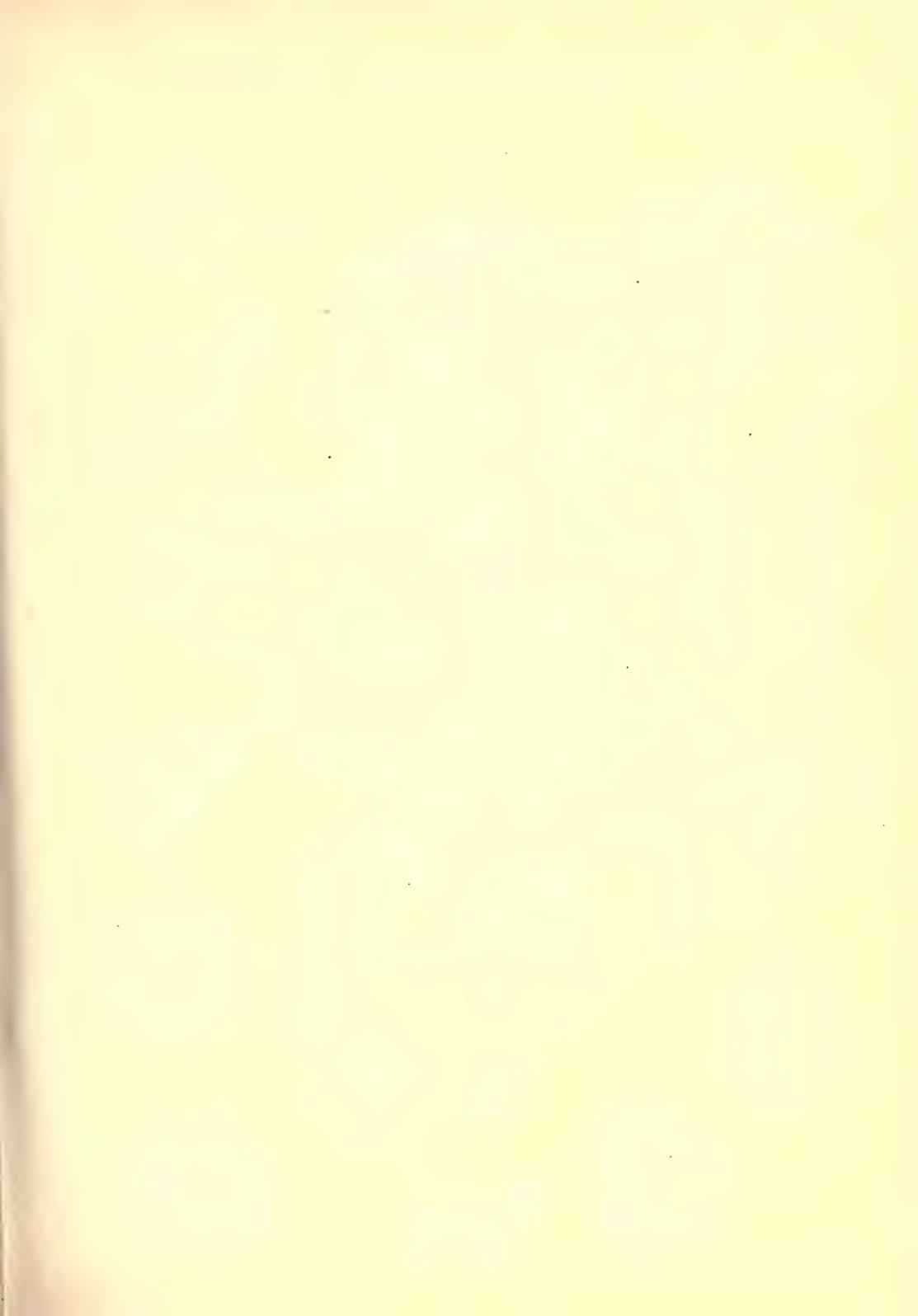
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# EXPLANATION OF PLATES.

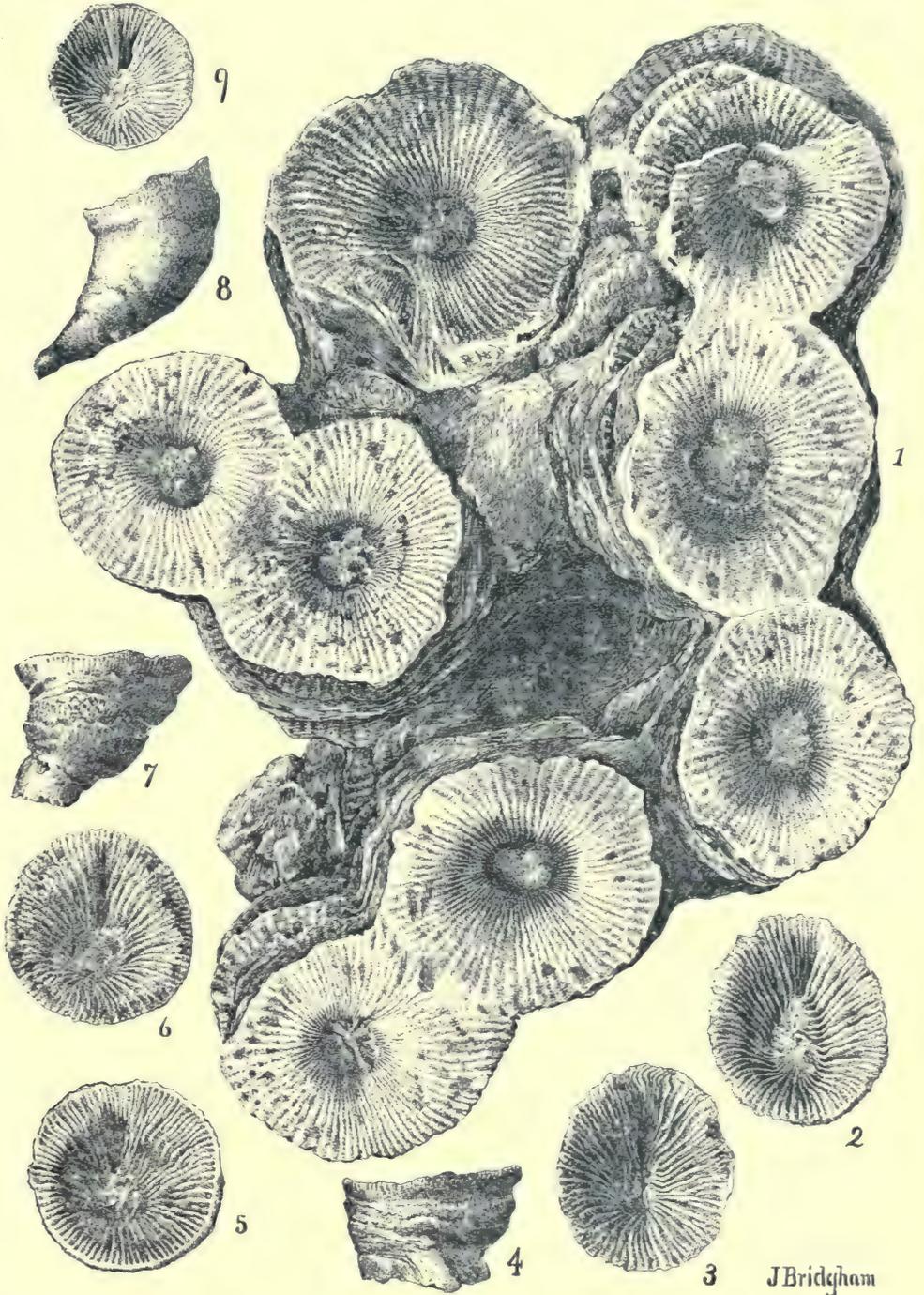
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CONTRIBUTION TO INDIANA PALAEOLOGY.

Part 1.

Pl. I.



J. Bridgman





# EXPLANATION OF PLATES.

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CONTRIBUTION TO INDIANA PALAEOZOOLOGY.

Part 1.

Pl. II.



1



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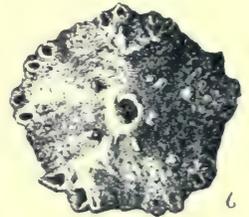
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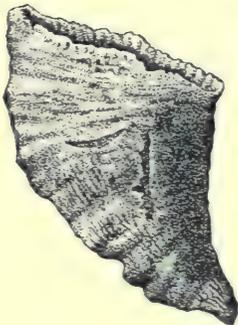


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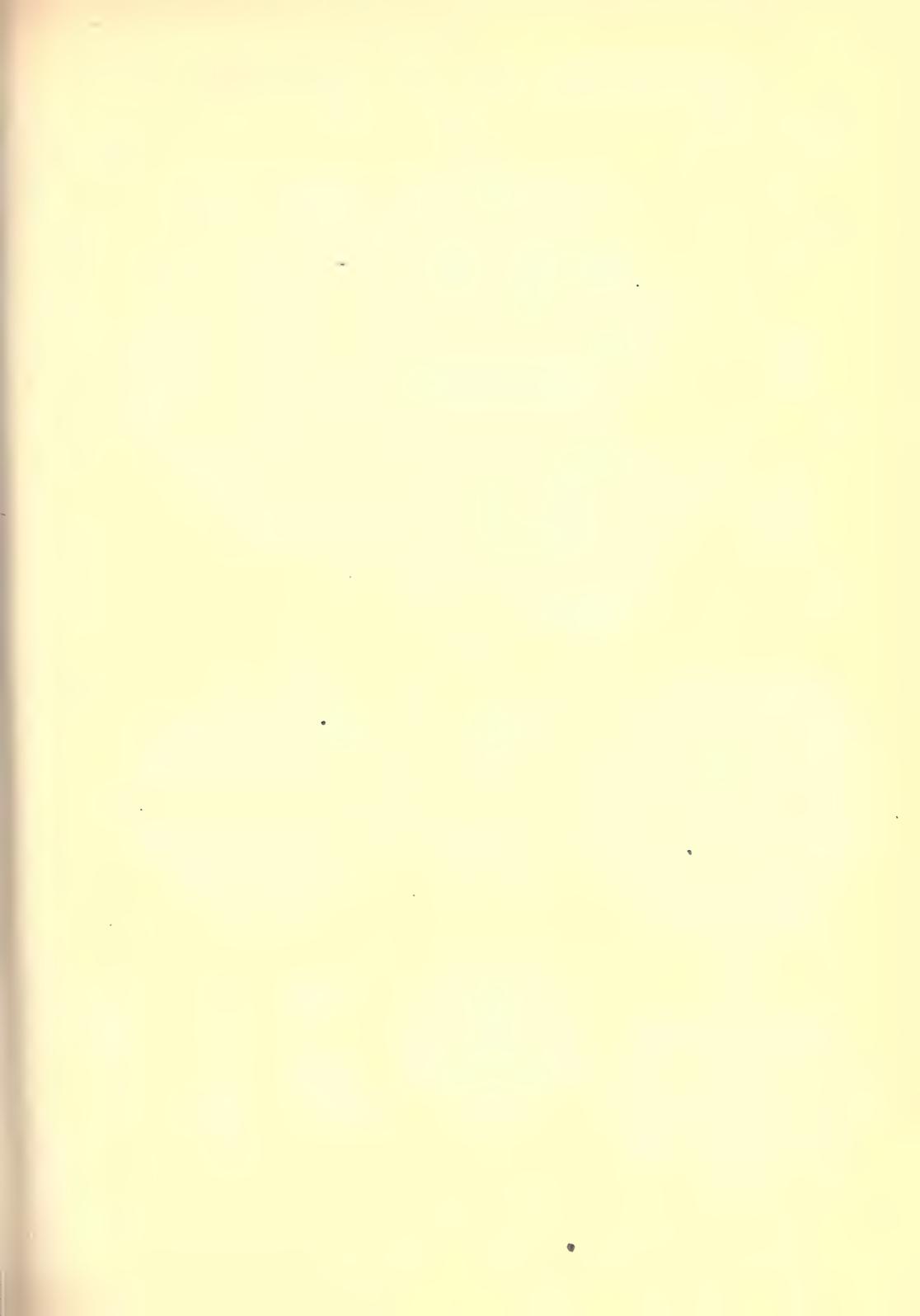


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# EXPLANATION OF PLATES.

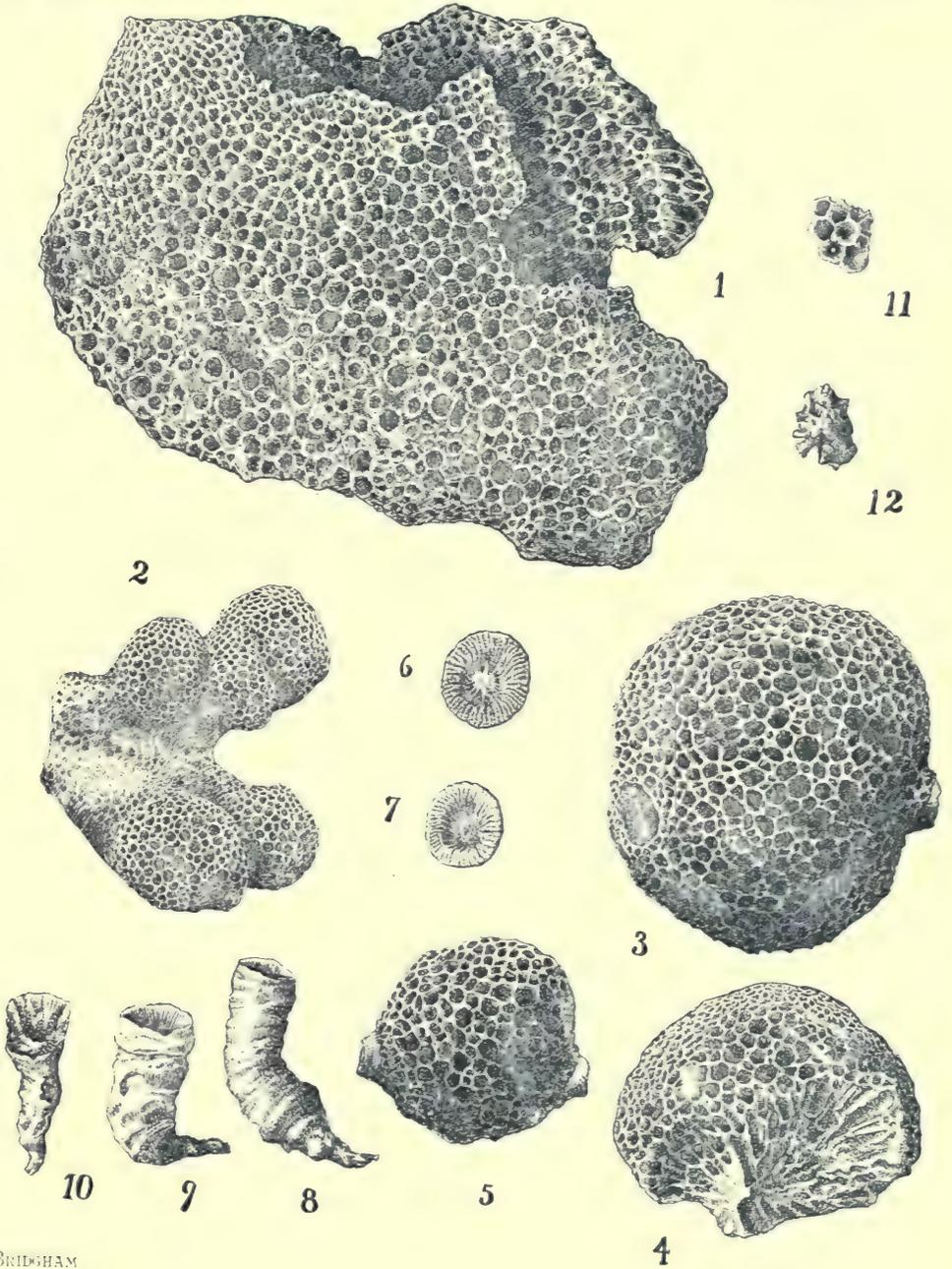
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	PLATE 3.	PAGE
	FAVOSITES ROTUNDITUBA, N. Sp.	4
FIG. 1.	—Upper view of a specimen.	
FIG. 2.	—Lateral view of another individual.	
	FAVOSITES GLOBOSUS, N. Sp.	5
FIG. 3.	—Surface view of a large example.	
FIG. 4.	—Surface view of another individual.	
FIG. 5.	—View of another example showing the surface and a vertical section.	
	DIPHYPHYLLUM UNICUM, N. Sp.	5
FIG. 6.	—Calyx view.	
FIG. 7.	—Calyx view of another individual.	
FIG. 8.	—Lateral view of another example.	
FIG. 9.	—Lateral view of another specimen.	
FIG. 10.	—Posterior view of another individual with portion of the cup broken away to show the lamellæ.	
	MICHELINIA MINUTA, N. Sp.	5
FIG. 11.	—Surface view.	
FIG. 12.	—Basal view of the same specimen.	

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Part I.

Pl. III.







# EXPLANATION OF PLATES.

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## PLATE 4.

PAGE

### ZAPHRENTIS ISCHYPUS, N. Sp.

---

8

- FIG. 1—Lateral view of a large example.  
FIG. 2—View of the calix of another individual.  
FIG. 3—Longitudinal section of another specimen showing the tabulæ.
- 

### ZAPHRENTIS COMIS, N. Sp.

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8

- FIG. 4—Posterior view showing the calix.  
FIG. 5—Longitudinal section of another example showing the tabulæ and calix.  
FIG. 6—Calix view of another individual.
- 

### ZAPHRENTIS AMPLIATUS, N. Sp.

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9

- FIG. 7—Lateral view.  
FIG. 8—Calix view of another example.
- 

### HELIOPHYLLUM BORDENI, N. Sp.

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13

- FIG. 9—Lateral view.  
FIG. 10—Calix view of another example.
- 

### BLOTHROPHYLLUM CINGULATUM, N. Sp.

---

10

- FIG. 11—Lateral view.  
FIG. 12—Lateral view of another example.  
FIG. 13—Calix view of another individual.
- 

### CYATHAXONIA COMPRESSA, N. Sp.

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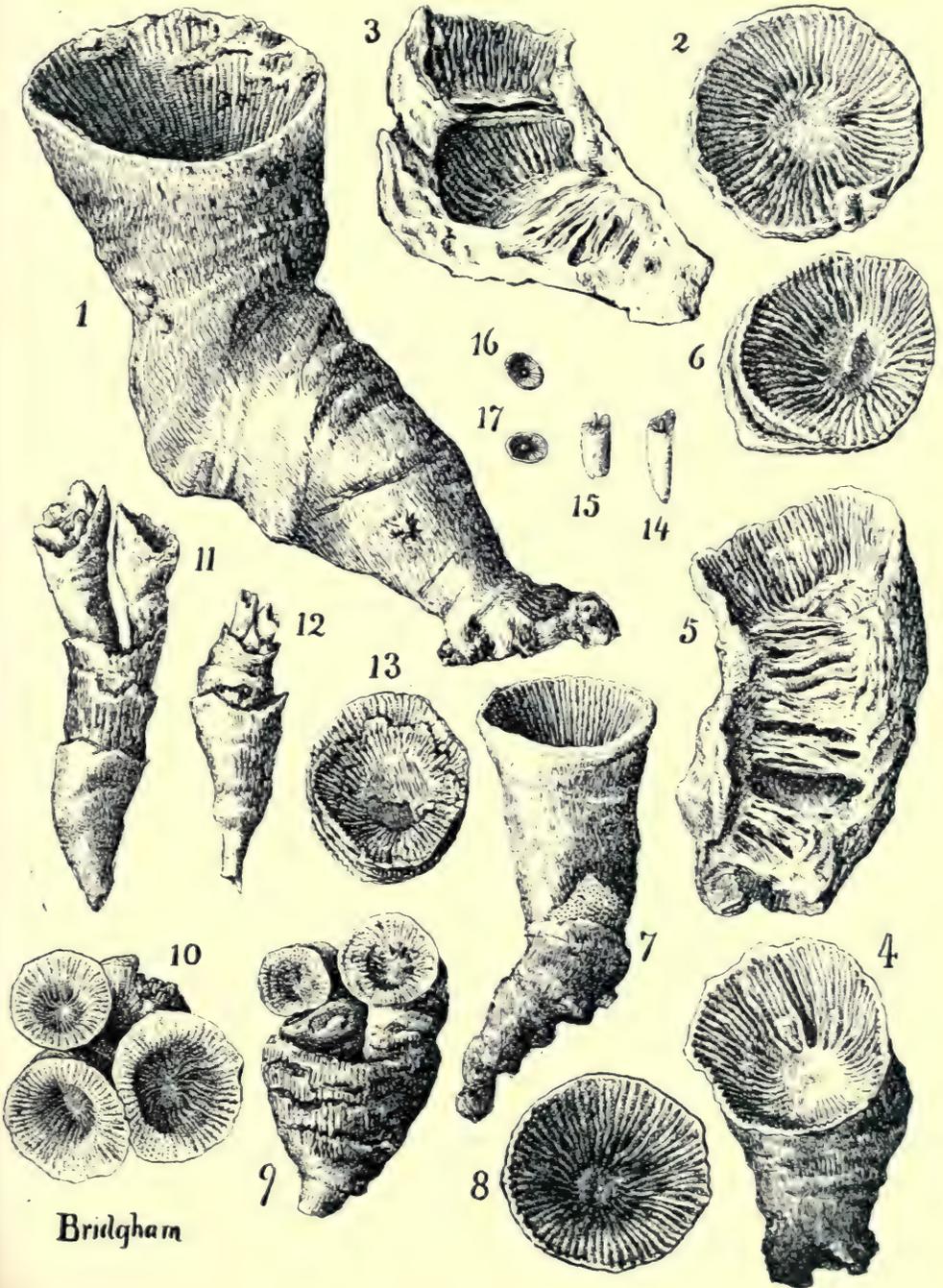
9

- FIG. 14—Lateral view.  
FIG. 15—Lateral view of another example.  
FIG. 16—Calix view of another specimen.  
FIG. 17—Calix view of another individual.

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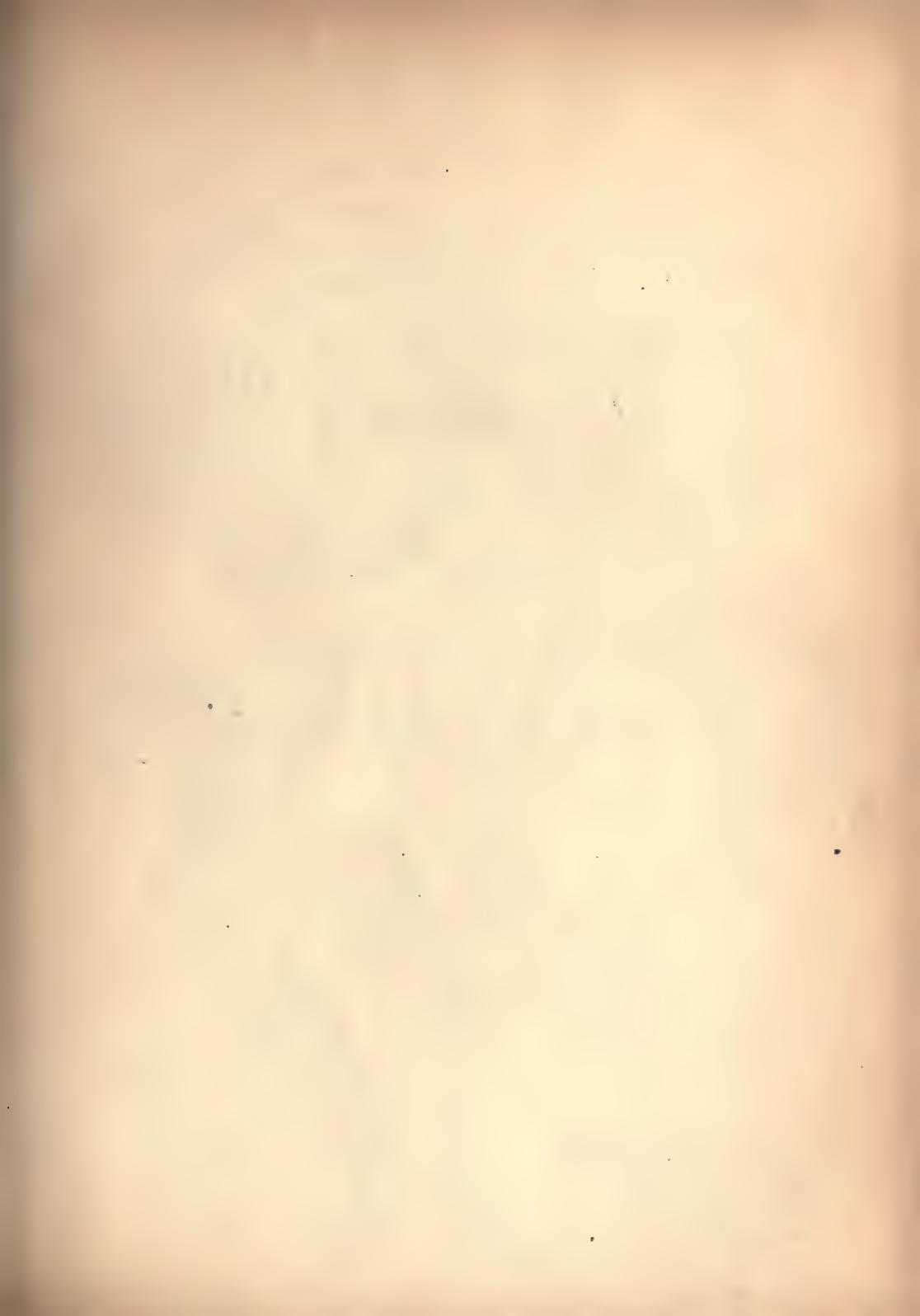
PART 2.

PL. IV.



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# EXPLANATION OF PLATES.

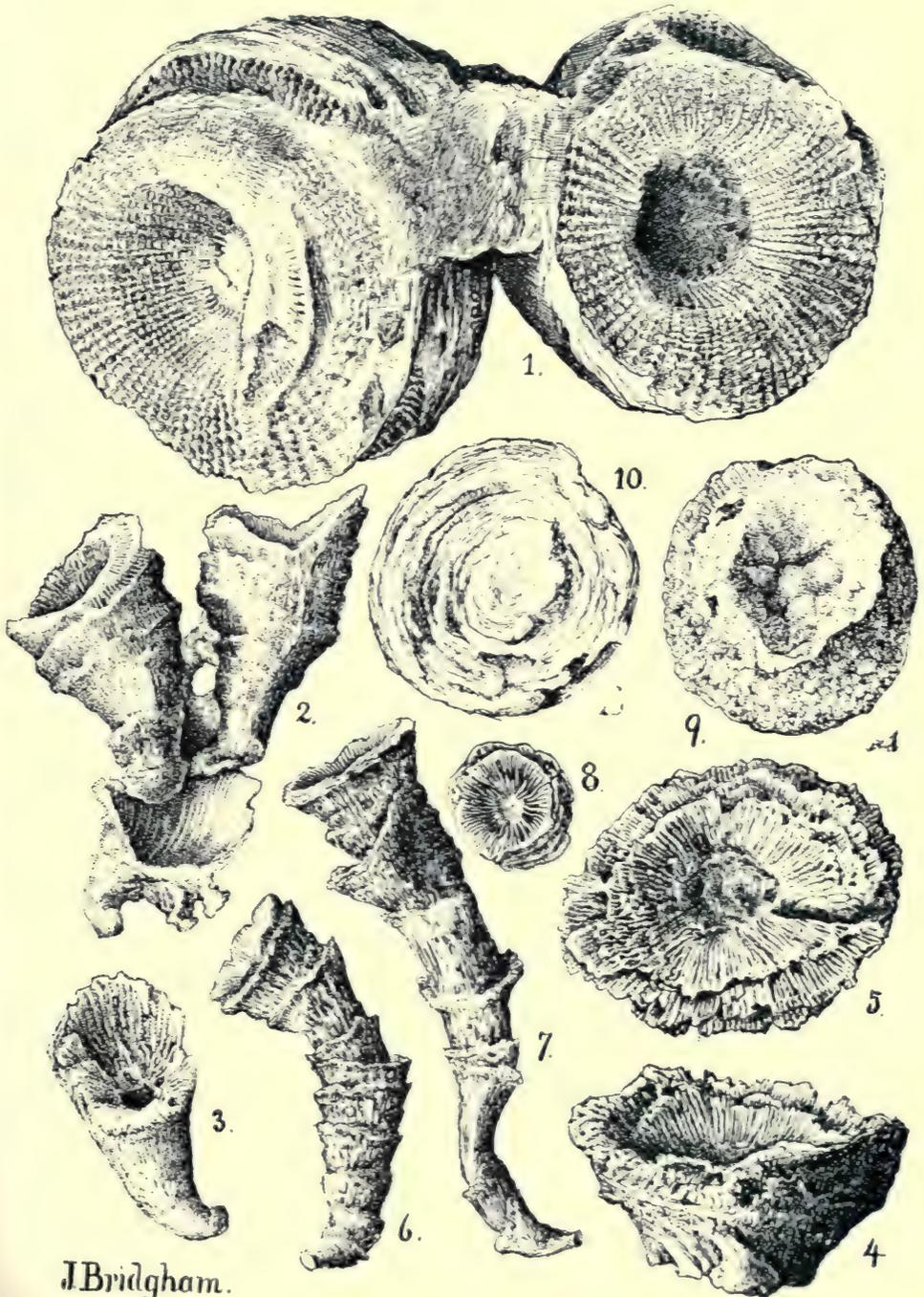
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	PLATE 5.	PAGE
	HELIOPHYLLUM AGASSIZI, N. Sp.	14
FIG. 1—	Calix view of a compound example.	
	HELIOPHYLLUM NILESI, N. Sp.	15
FIG. 2—	Lateral view of a compound example.	
FIG. 3—	Lateral view of another individual.	
	HELIOPHYLLUM TURGIDUM, N. Sp.	15
FIG. 4—	Lateral view.	
FIG. 5—	Calix view of another example.	
	BLOTHROPHYLLUM FLEXUOSUM, N. Sp.	10
FIG. 6—	Lateral view.	
FIG. 7—	Lateral view of another large example.	
FIG. 8—	Calix view of another individual.	
	CYSTIPHYLLUM CRASSATUM, N. Sp.	11
FIG. 9—	Calix view.	
FIG. 10—	Basal view showing epithecal crust.	

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PART 2.

PL. V.



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# EXPLANATION OF PLATES.

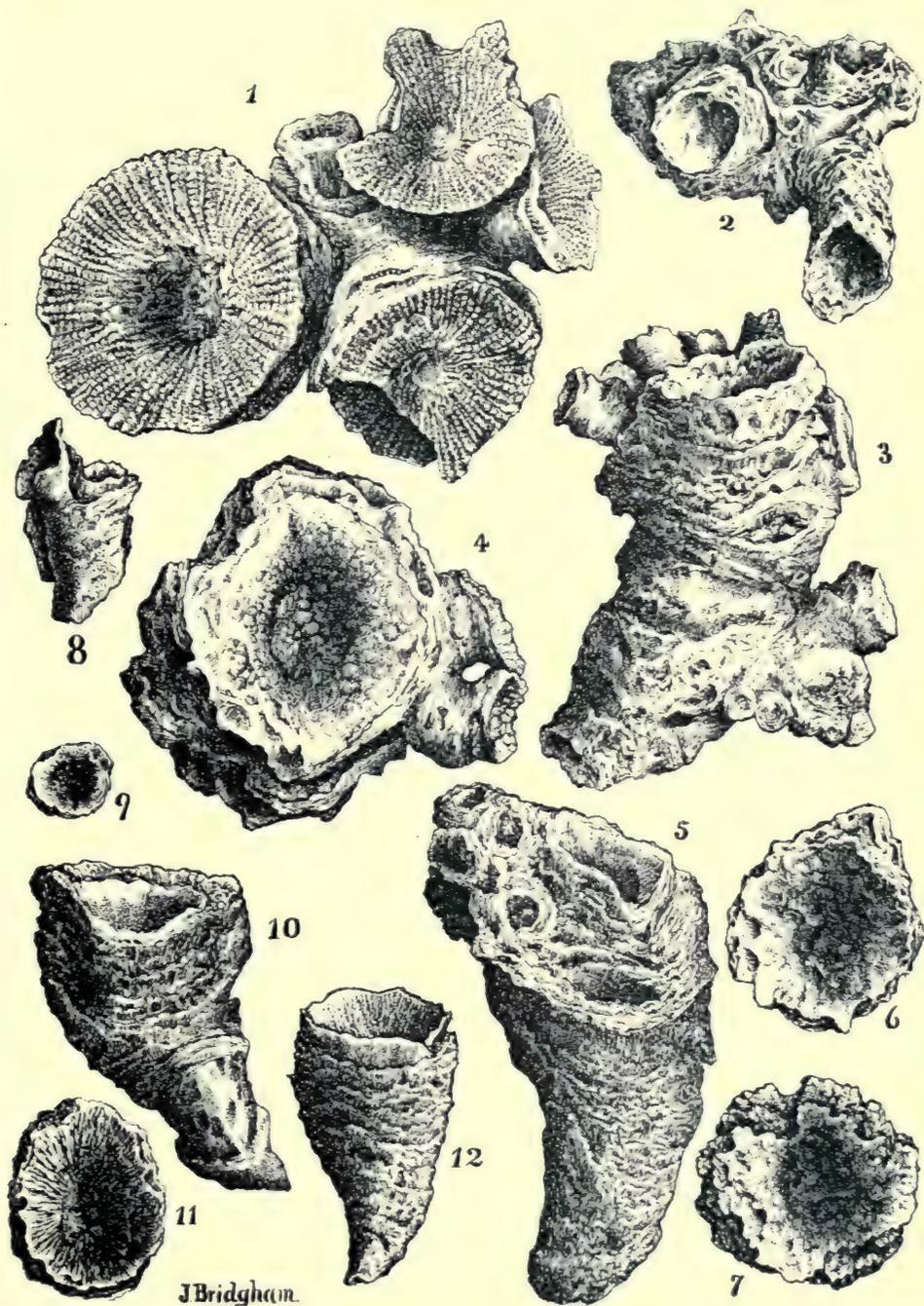
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	PAGE
PLATE 6.	
HELIOPHYLLUM GURLEYI, N. Sp.	
FIG. 1—Calix view of a compound example.	16
CYSTIPHYLLUM GEMMATUM, N. Sp.	
FIG. 2—Calix view of a compound example.	11
FIG. 3—Lateral view of another compound specimen.	
FIG. 4—Calix view of another compound example.	
CYSTIPHYLLUM OSSICULUM, N. Sp.	
FIG. 5—Lateral view showing parietal budding.	12
FIG. 6—View of the calix of a simple example.	
FIG. 7—View of the calix of another individual.	
CYSTIPHYLLUM GEMMULA, N. Sp.	
FIG. 8—Lateral view showing calycinal budding.	12
FIG. 9—View of the calix of a simple example.	
CYSTIPHYLLUM LACINIATUM, N. Sp.	
FIG. 10—Lateral view with a portion of the cup broken away to show the invaginated appearance.	13
FIG. 11—Calix view of another individual.	
FIG. 12—Posterior view of another example.	

CONTRIBUTION TO INDIANA PALÆONTOLOGY.

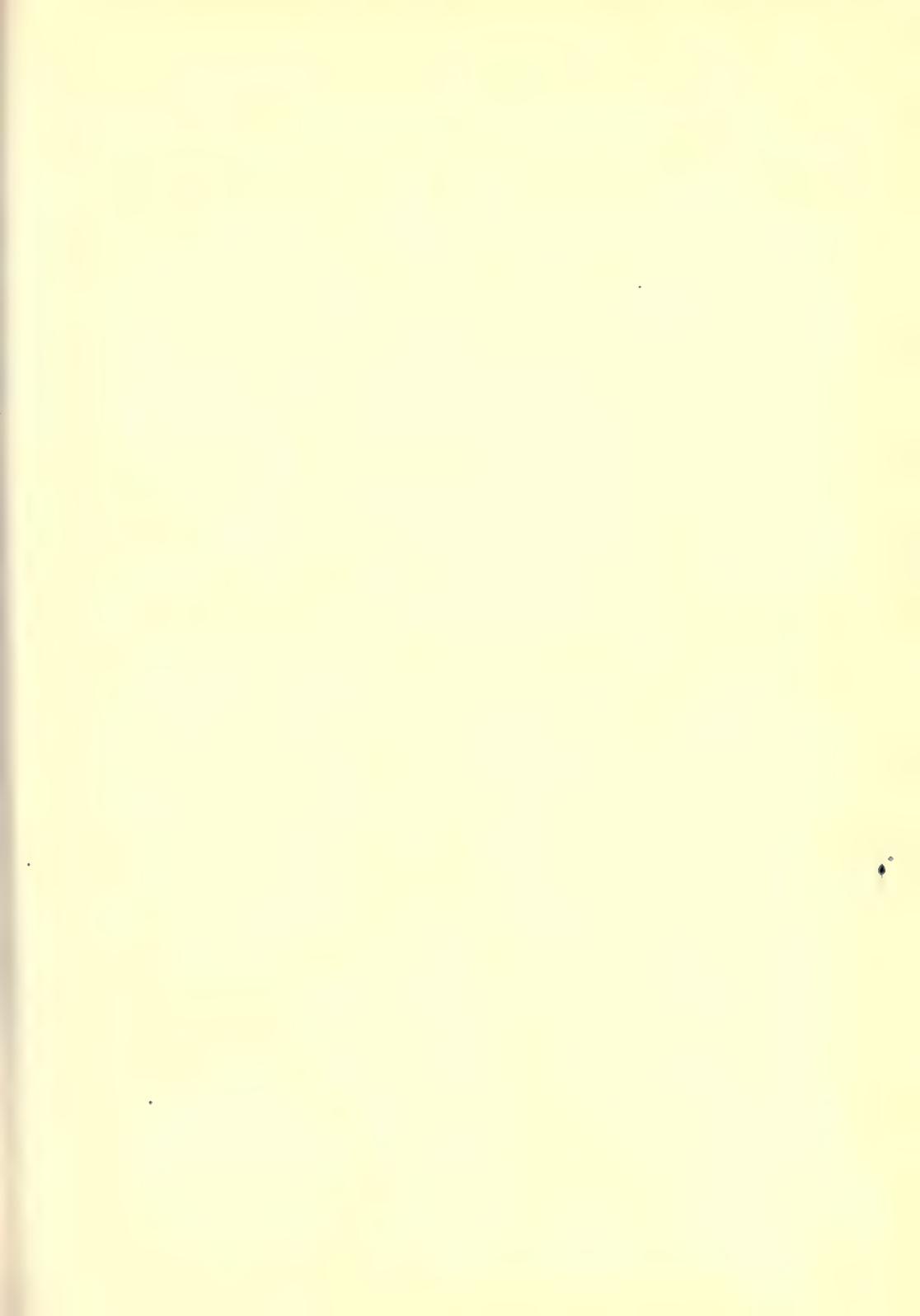
PART 2.

PL. VI.



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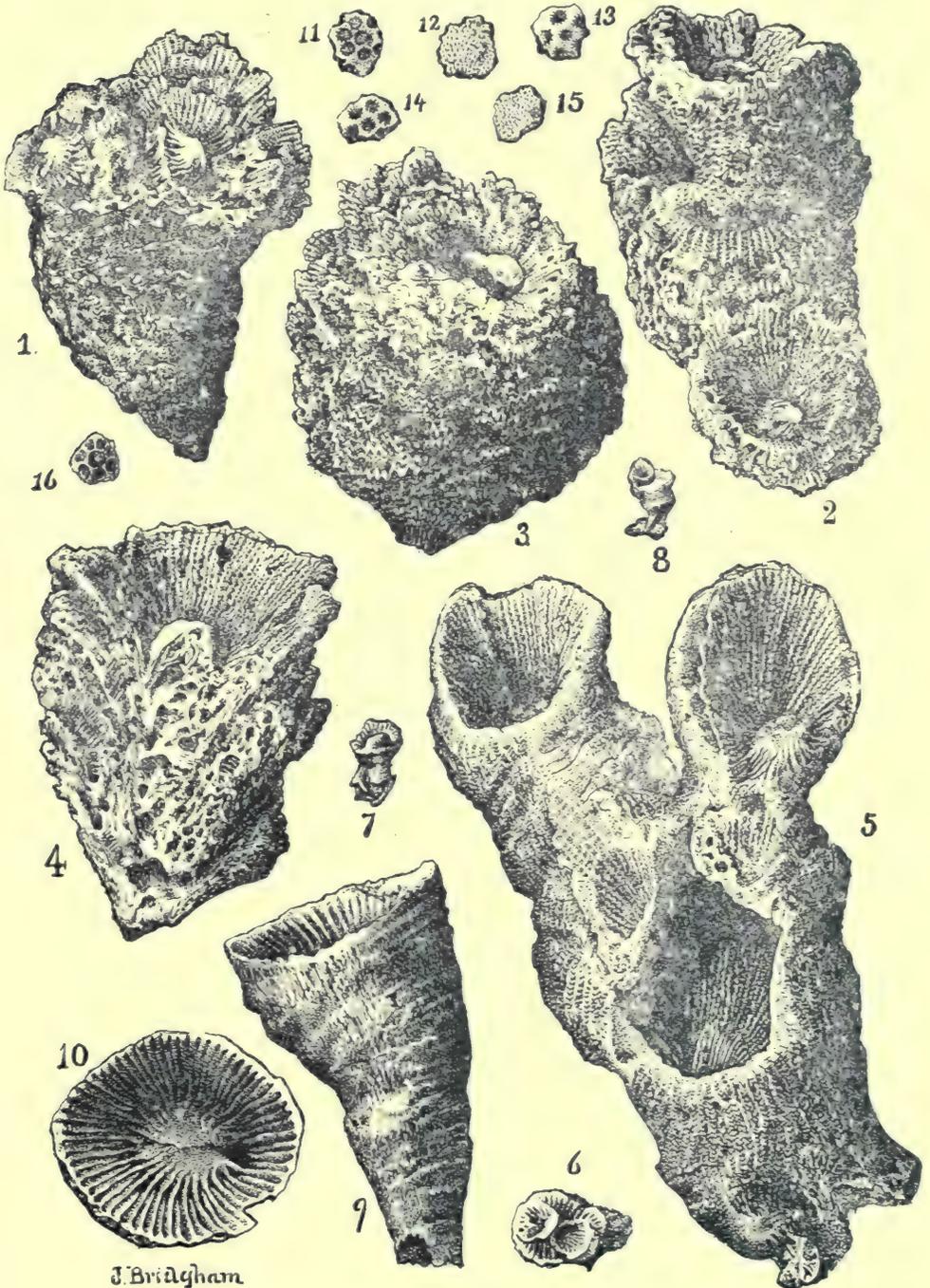
# EXPLANATION OF PLATES.

	PLATE 7.	PAGE
	<b>HELIOPHYLLUM OBESUM, N. Sp.</b>	17
FIG. 1.	—Posterior view of a composite corallum.	
FIG. 2.	—Posterior view of another composite example.	
FIG. 3.	—Posterior view of a simple individual.	
FIG. 4.	—Longitudinal view, with a portion of the calix broken away, showing the elevated tabulæ. and the vesiculose structure.	
	<b>HELIOPHYLLUM SEAMANI, N. Sp.</b>	17
FIG. 5.	—Posterior view of a composite example.	
	<b>HELIOPHYLLUM FLOS, N. Sp.</b>	18
FIG. 6.	—Calix view of a large example.	
FIG. 7.	—Posterior view of a small specimen.	
FIG. 8.	—Lateral view of another individual.	
	<b>ZAPHRENTIS SELLERSI, N. Sp.</b>	21
FIG. 9.	—Lateral view.	
FIG. 10.	—Calix view of another example.	
	<b>MICHELINIA SPICULATA, N. Sp.</b>	19
FIG. 11.	—Surface view.	
FIG. 12.	—Basal view of another example.	
	<b>MICHELINIA PAPULOSA, N. Sp.</b>	20
FIG. 13.	—Ventral view.	
FIG. 14.	—Ventral view of another example.	
FIG. 15.	—Basal view of another individual.	
	<b>MICHELINIA NEGLECTA, N. Sp.</b>	20
FIG. 16.	—Ventral View.	

CONTRIBUTION TO INDIANA PALEONTOLOGY.

Part 3.

Pl. VII.



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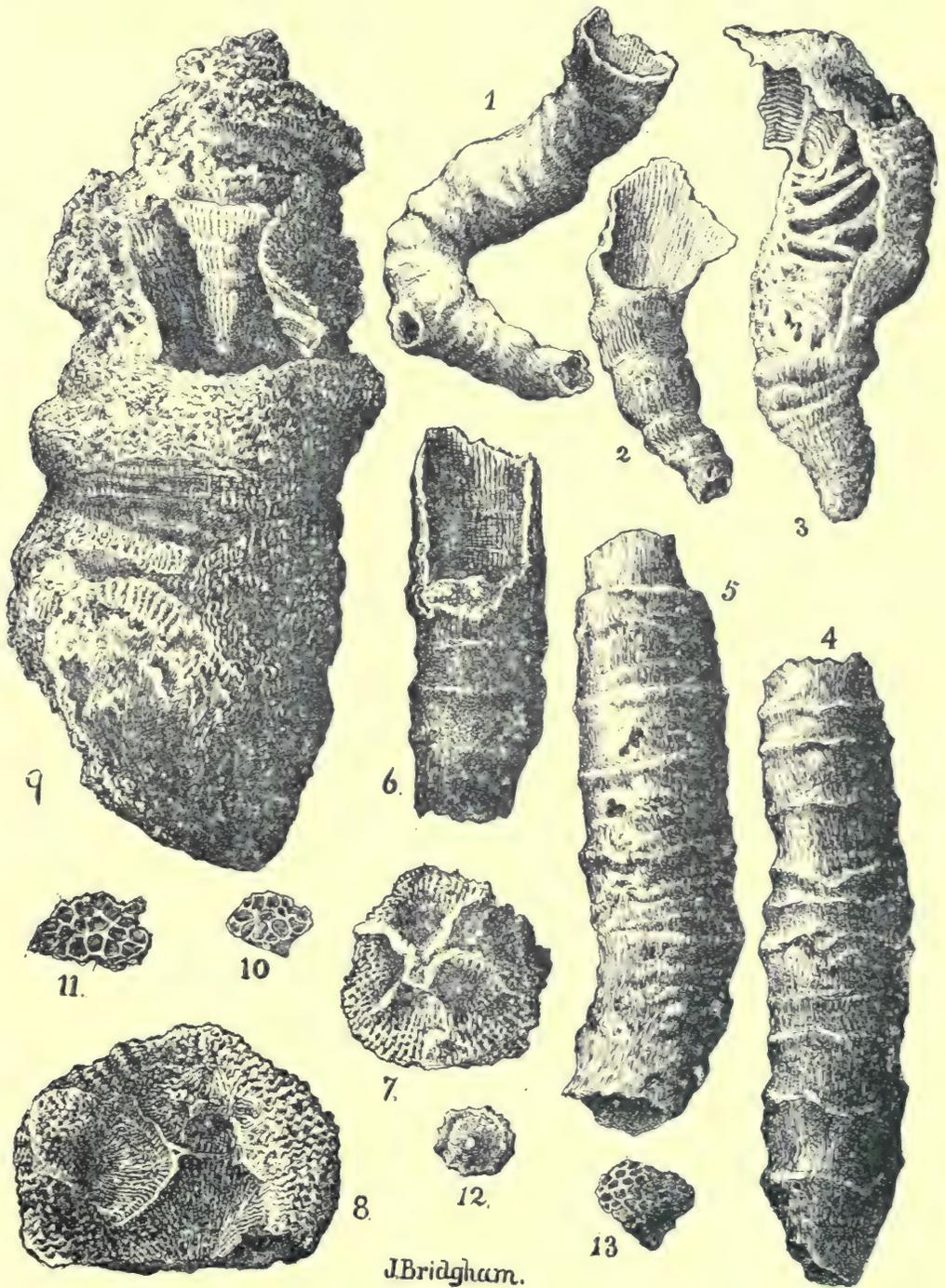
# EXPLANATION OF PLATES.

	PLATE 8.	PAGE
	ZAPHRENTIS OBLIQUATUS, N. Sp.	22
F I G. 1.	—Lateral view.	
F I G. 2.	—Lateral view of another example.	
F I G. 3.	—Lateral view with a portion of side broken away to show the oblique tabulæ.	
	ZAPHRENTIS HOBBSI, N. Sp.	23
F I G. 4.	—Lateral view.	
F I G. 5.	—Lateral view of another specimen.	
F I G. 6.	—Lateral view of another example, with a portion of the calix broken away, to show the lamellæ, steep wall and broad tabulæ.	
	HELIOPHYLLUM PARTITUM, N. Sp.	18
F I G. 7.	—Ventral view of a small example.	
F I G. 8.	—Ventral view of another specimen.	
	HELIOPHYLLUM BEECHERI, N. Sp.	19
F I G. 9.	—Lateral view of a large corallum.	
	MICHELINIA LOUISVILLENSIS, N. Sp.	20
F I G. 10.	—Ventral view of a small example.	
F I G. 11.	—Ventral view of a large specimen.	
F I G. 12.	—Basal view of another individual.	
	MICHELINIA WILLIAMSII, N. Sp.	21
F I G. 13.	—Ventral View.	

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Part 3.

Pl. VIII.



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# EXPLANATION OF PLATES.

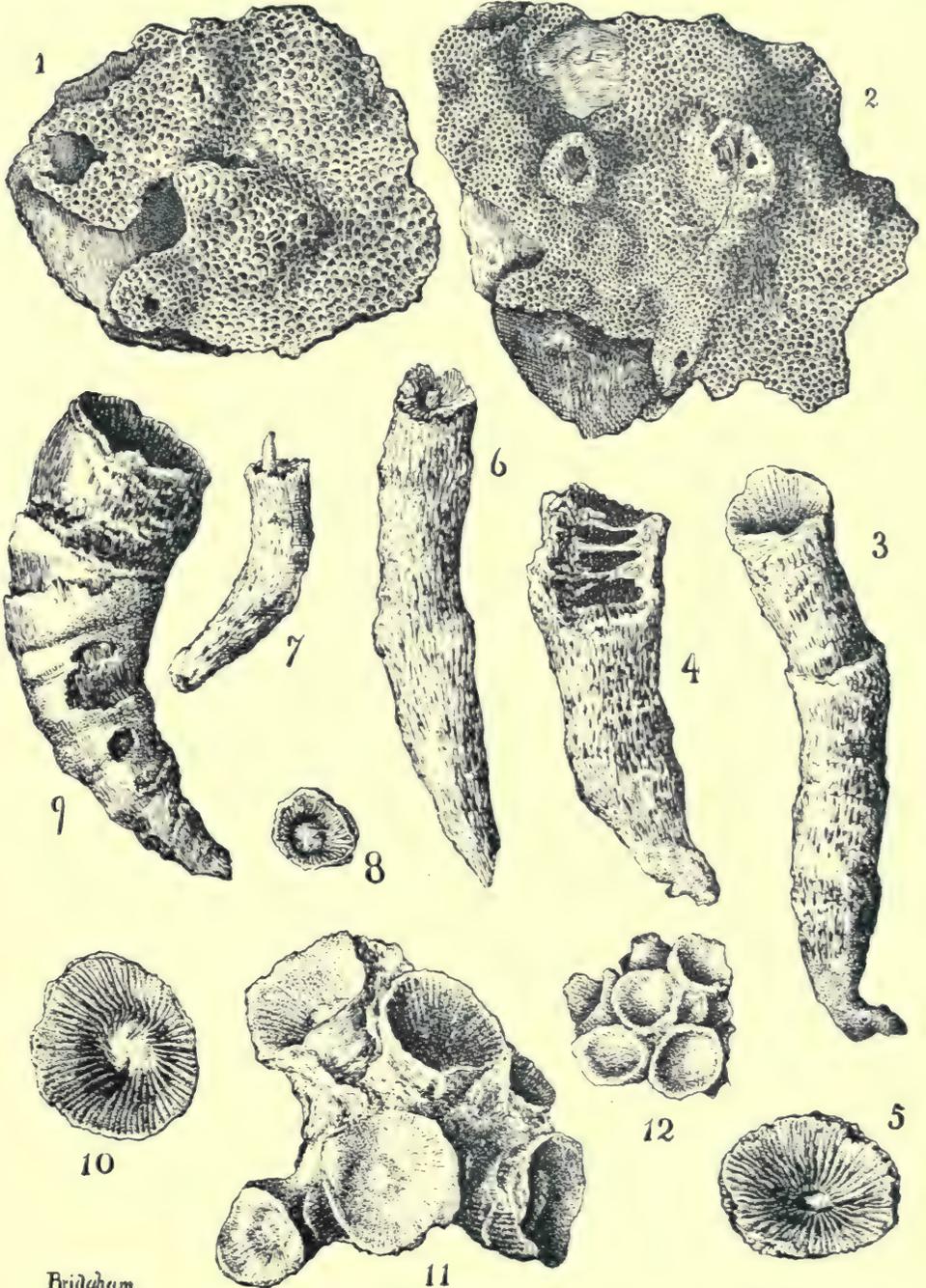
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	PLATE 9.	PAGE
	<b>CLADOPORA GURLEYI, N. Sp.</b>	23
F I G. 1.—Ventral view of a small corallum.		
	<b>CLADOPORA INTERMEDIA, N. Sp.</b>	24
F I G. 2.—Ventral view of a small corallum.		
	<b>BLOTHROPHYLLUM BUCCULENTUM, N. Sp.</b>	24
F I G. 3.—Lateral view of rather a long specimen.		
F I G. 4.—Lateral view of another example, with a portion of the side broken away, to show the tabulæ.		
F I G. 5.—View of the calix of another individual.		
	<b>BLOTHROPHYLLUM CONIGERUM, N. Sp.</b>	24
F I G. 6.—Lateral view of a decorticated example.		
F I G. 7.—Lateral view of another specimen with the calix broken away to show the conical projection.		
F I G. 8.—View of the calix of another individual.		
	<b>BLOTHROPHYLLUM INCULTUM, N. Sp.</b>	25
F I G. 9.—Lateral view of a well preserved specimen.		
F I G. 10.—Calix view of another individual.		
	<b>DIPHYPHYLLUM EXPANSUM, N. Sp.</b>	25
F I G. 11.—Ventral view of a perfect corallum.		
	<b>MICHELINIA TANTILLA, N. Sp.</b>	21
F I G. 12.—Ventral view of a perfect corallum.		

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Part 3.

Pl. IX.



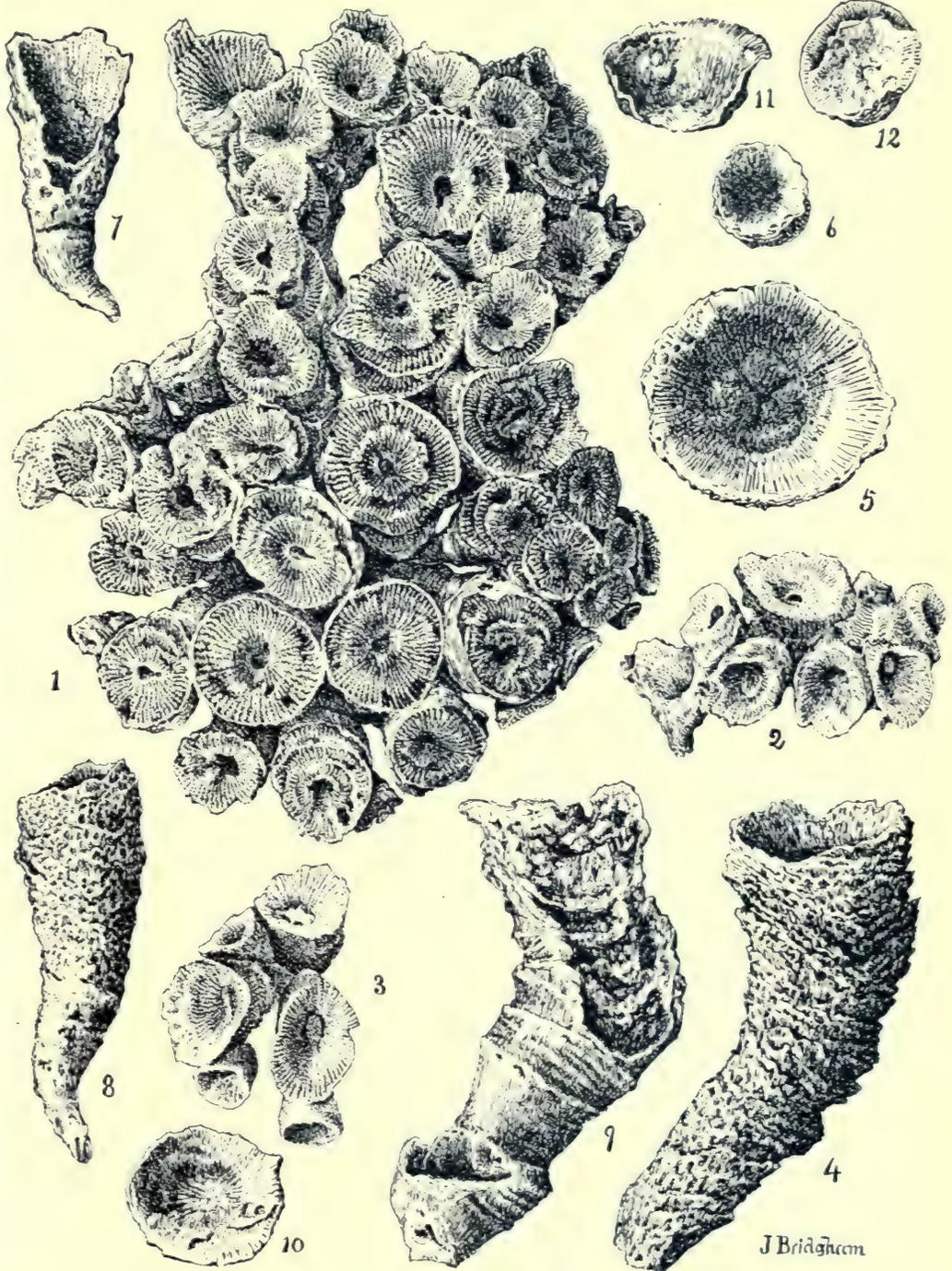




# EXPLANATION OF PLATES.

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	PLATE 10.	PAGE
	DIPHYPHYLLUM WADSWORTHI, N. Sp.	26
—		
FIG. 1.	—Ventral view of a large corallum.	
—		
	DIPHYPHYLLUM LAXUM, N. Sp.	26
—		
FIG. 2.	—Ventral view of a medium-sized corallum.	
FIG. 3.	—Ventral view of another small-sized corallum.	
—		
	CYSTIPHYLLUM LAMELLATUM, N. Sp.	29
—		
FIG. 4.	—Lateral view of a small corallum.	
FIG. 5.	—Calix view of another example.	
—		
	CYSTIPHYLLUM OSCULUM, N. Sp.	30
—		
FIG. 6.	—Calix view of a small specimen.	
FIG. 7.	—Lateral view of another example, with a portion of the calix broken away, to show the septa.	
FIG. 8.	—Lateral view of another individual.	
—		
	CYSTIPHYLLUM CONSTRICTUM, N. Sp.	30
—		
FIG. 9.	—Lateral view of a mature specimen, with a portion of the side broken away, to show the vesicles on the invaginated cups.	
FIG. 10.	—Calix view of another example.	
FIG. 11.	—View of one-half of the calix of another specimen.	
FIG. 12.	—Calix view of another individual.	







# EXPLANATION OF PLATES.

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## PLATE II.

PAGE

### DIPHYPHYLLUM PROLATUM, N. Sp.

27

FIG. 1.—Ventral view of a large corallum.

### ZAPHRENTIS NANUS, N. Sp.

32

FIGS. 2-3-4.—Views of the posterior sides, showing the proliferous growth.

FIG. 5-6.—View of the calix showing the proliferous growth. This feature is shown in one-third of all the specimens in my collection. All figures are from different examples.

### HELIOPHYLLUM JACKSONI, N. Sp.

32

FIG. 7.—Lateral view of a composite example, showing a portion of the calix of each corallite.

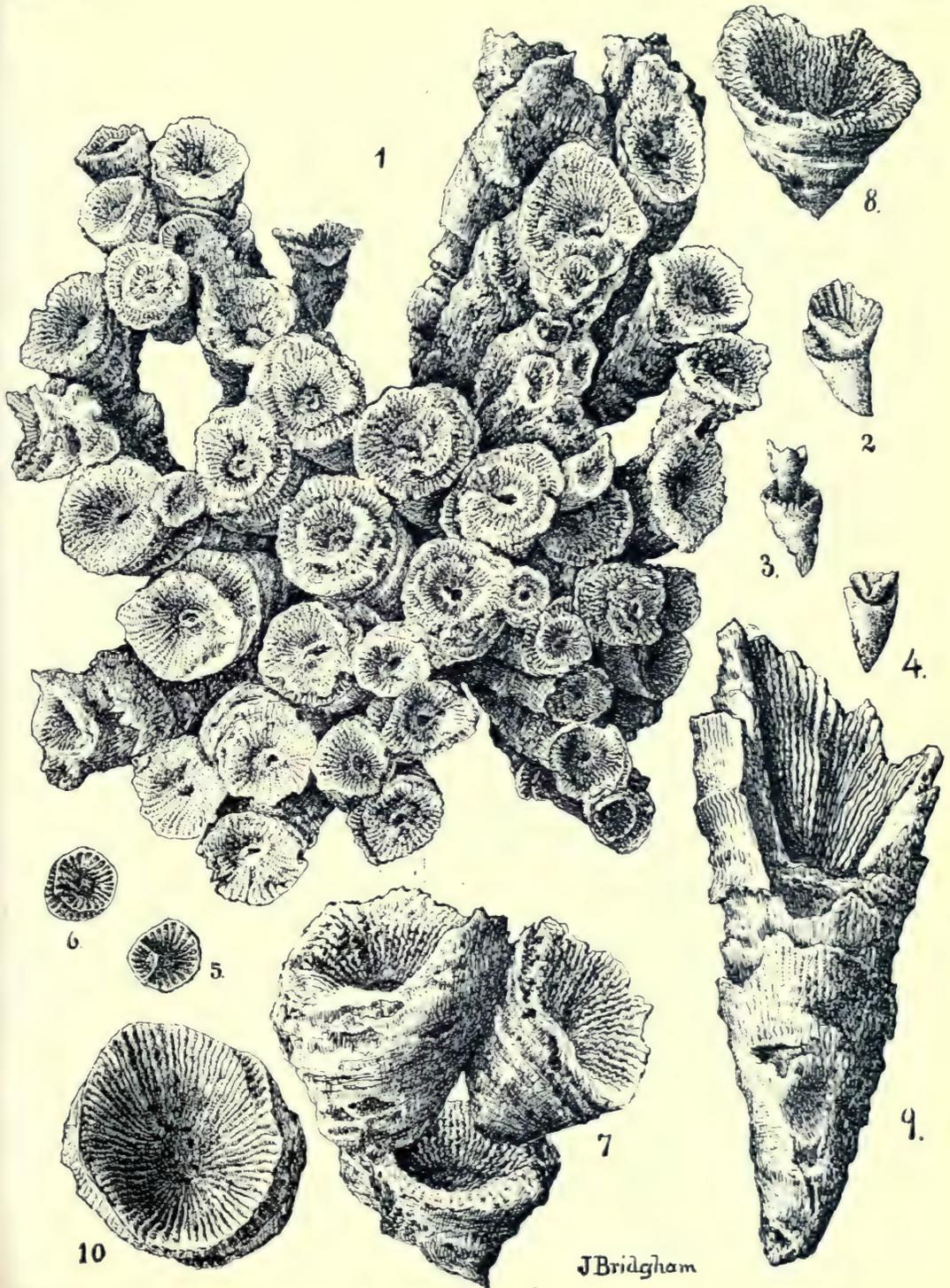
FIG. 8.—Posterior view of another simple example, showing a portion of the calix.

### BLOTHROPHYLLUM BELLICINCTUM, N. Sp.

33

FIG. 9.—Posterior view of a well preserved example, with a portion of the cup, broken away to show the lamellæ.

FIG. 10.—Calix view of another example.



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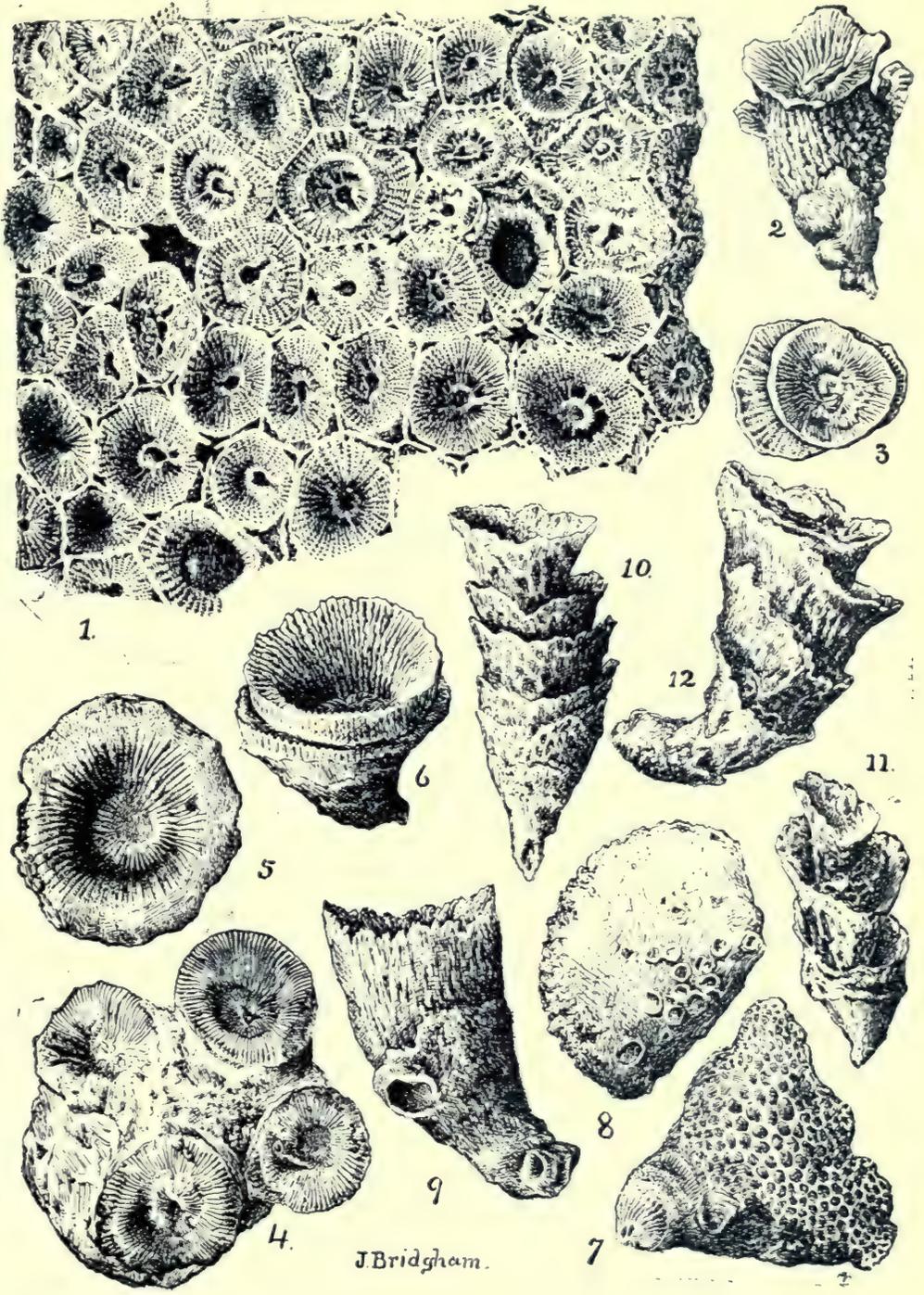




## EXPLANATION OF PLATES.

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	PLATE 12.	PAGE
	DIPHYPHYLLUM ADJUNCTUM, N. Sp.	27
FIG. 1.	—Ventral view of a portion of a large corallum.	
	PTYCHOPHYLLUM GEMMATUM, N. Sp.	28
FIG. 2.	—Posterior view showing the lateral buds and a portion of the calix.	
FIG. 3.	—View of the calix of another specimen.	
	PTYCHOPHYLLUM BENEDICTI, N. Sp.	28
FIG. 4.	—Ventral view of a composite example.	
FIG. 5.	—Calix view of another simple individual.	
FIG. 6.	—Oblique lateral view, showing a portion of the calix of another specimen.	
	CYSTIPHYLLUM PARASITICUM, N. Sp.	31
FIG. 7.	—View of the calix of a large specimen attached to a Heliophyllum at the lower portion of a Favosite, also attached to the Heliophyllum.	
FIG. 8.	—A large number attached to the epitheca of Favosites Hemisphericus (Yandell & Shumard.)	
FIG. 9.	—A large example attached to a worn and weathered Heliophyllum.	
	CYSTIPHYLLUM INFUNDIBULIFORMIS, N. Sp.	31
FIGS. 10-11.	—Posterior view, showing the invaginated calyces.	
FIG. 12.	—Lateral view of another example.	



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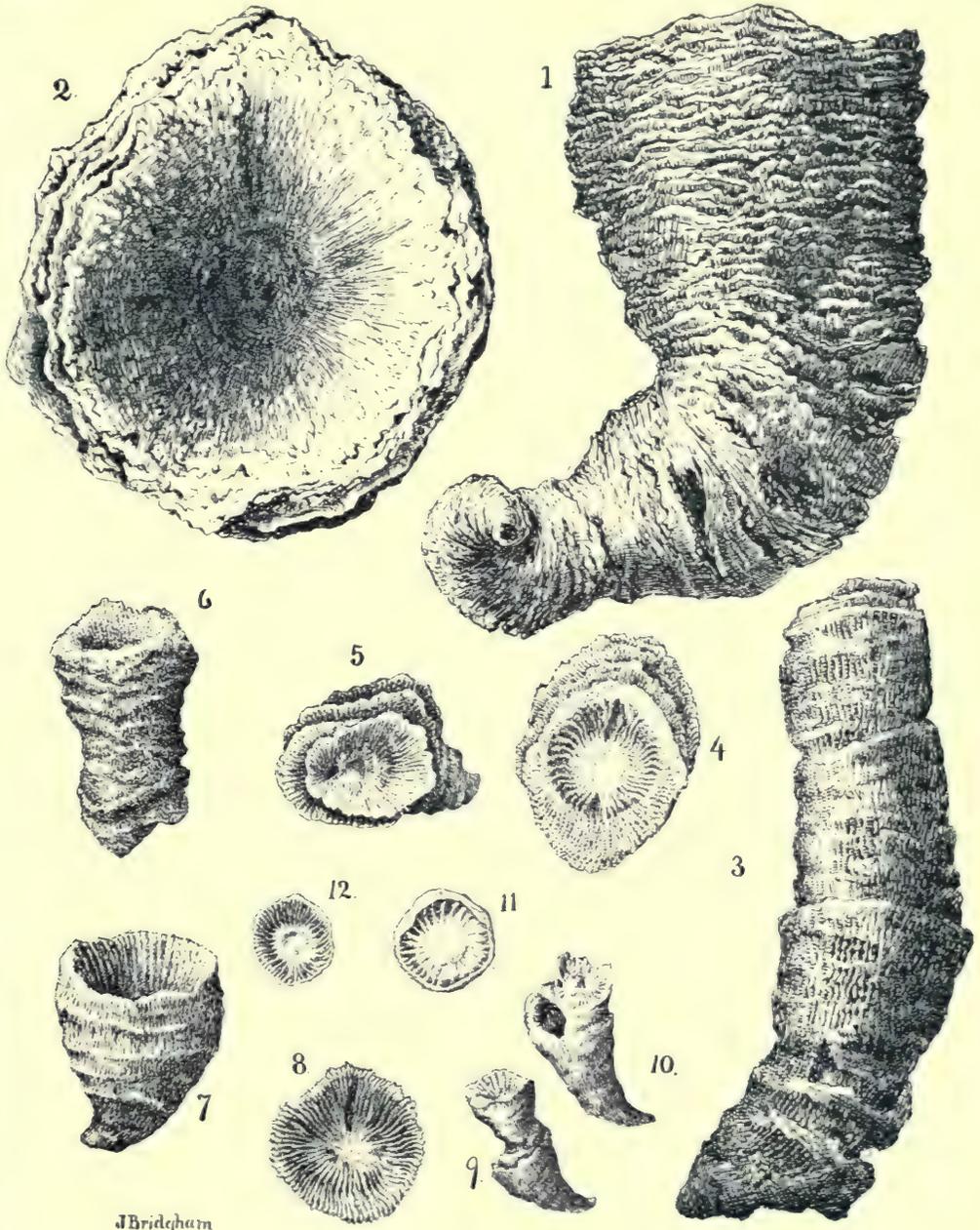




## EXPLANATION OF PLATES.

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	PLATE 13.	PAGE
	CYSTIPHYLLUM INVAGINATUM, N. Sp.	34
<hr/>		
FIG. 1.	—Lateral view of a large specimen.	
FIG. 2.	—Calix view of another example.	
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	HELIOPHYLLUM SHERZERI, N. Sp.	34
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FIG. 3.	—Lateral view of a large specimen.	
FIG. 4.	—Calix view of another large example.	
FIG. 5.	—Calix view of another smaller individual.	
FIG. 6.	—Lateral view of another smaller specimen.	
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	HELIOPHYLLUM MINUSCULUM, N. Sp.	35
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FIG. 7.	—Posterior view.	
FIG. 8.	—Calix view of another individual.	
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	ZAPHRENTIS GROSBACHI, N. Sp.	36
<hr/>		
FIGS. 9-10.	—Lateral views of different individuals showing the proliferous growth.	
FIGS. 11-12.	—Calix views, of two different examples, showing the smooth, convex space, in the center of the calix.	



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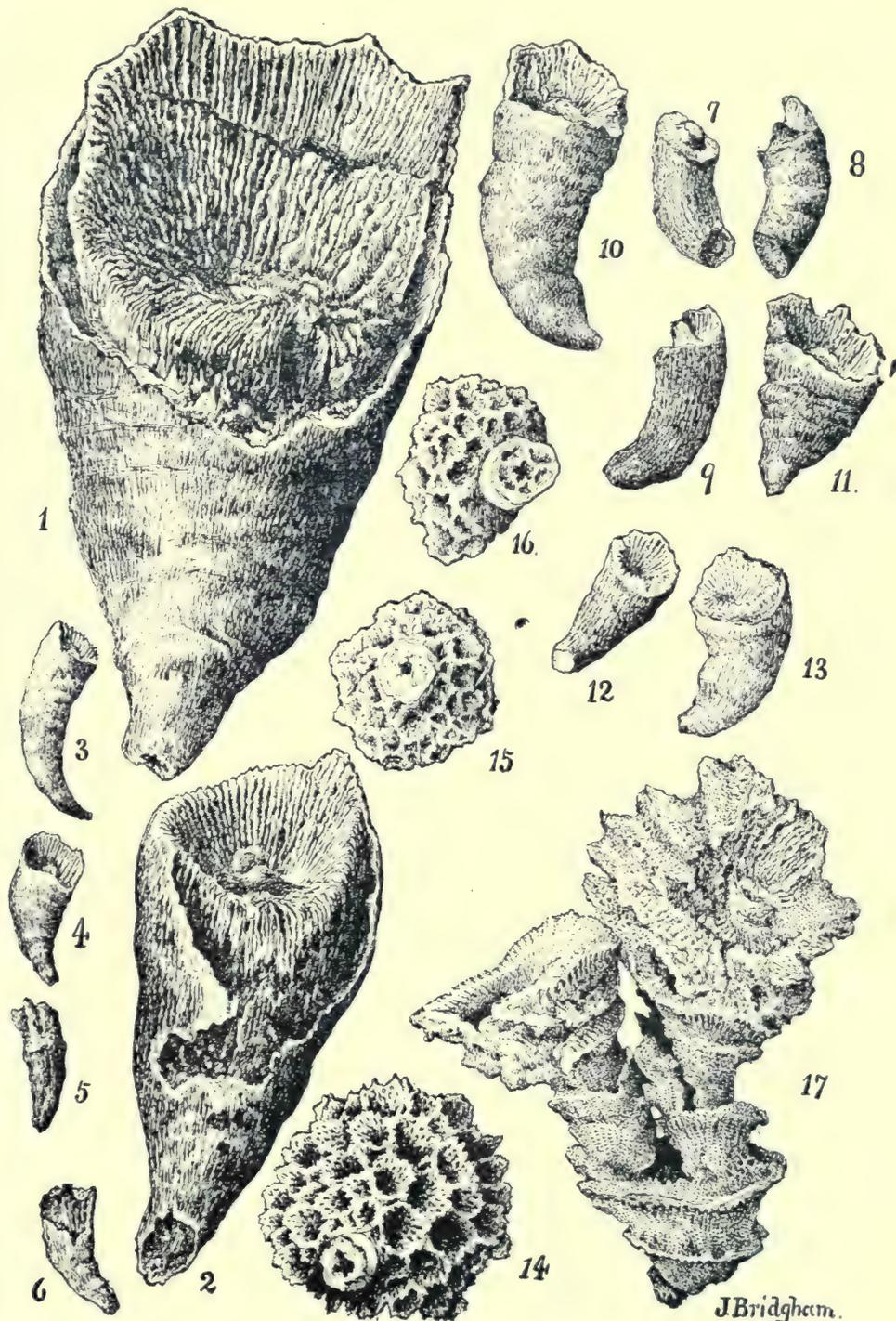
## EXPLANATION OF PLATES.

	PLATE 14.	PAGE
	<u>PTYCOPHYLLUM ROBUSTUM, N. Sp.</u>	39
FIG. 1.	—Posterior view of a large specimen.	
FIG. 2.	—Posterior view of another smaller example.	
	<u>CYATHAXONIA BORDENI, N. Sp.</u>	38
FIG. 3.	—Lateral view of an adult specimen.	
FIG. 4.	—Lateral view of another example, showing the point of the cone, and the ends of the lamellæ.	
FIG. 5.	—Lateral view, of an other individual, with the side broken away, to show the central cone.	
FIG. 6.	—Lateral view of another example, with a portion of the calix broken away, to show the central cone.	
	<u>CYATHAXONIA PARVA, N. Sp.</u>	39
FIG. 7.	—Lateral view, with the calix broken away, to show the central cone.	
FIG. 8.	—Lateral view of another individual.	
FIG. 9.	—Lateral view, of another example, with a portion of the calix broken away, to show the central cone.	
	<u>ZAPHRENTIS OPPELTI, N. Sp.</u>	37
FIG. 10.	—Lateral view of a mature specimen.	
FIG. 11.	—Posterior view of another individual.	
FIG. 12.	—Posterior view of another example.	
FIG. 13.	—Lateral view of another specimen.	
	<u>MICHELINIA BRIDGHAMI, N. Sp.</u>	40
FIGS. 14-15-16.	—Three views showing the expanded cups, and the attachment to crinoid columns.	
	<u>HELIOPHYLLUM LEMONI N. Sp.</u>	35
FIG. 17.	—Lateral view, of a composite example.	

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PART 5.

PL. XIV.



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## EXPLANATION OF PLATES.

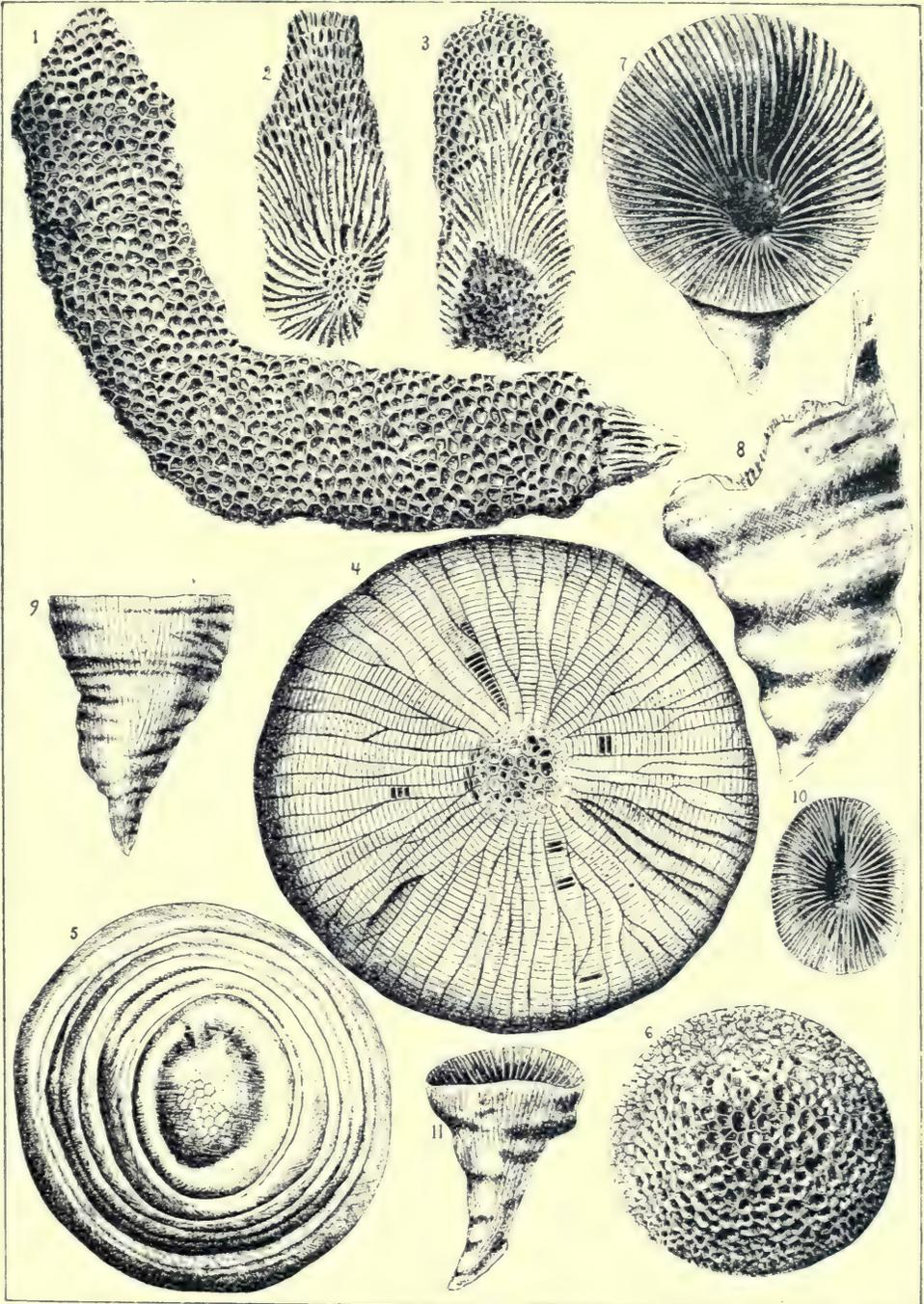
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	PLATE 15.	PAGE
	<b>FAVOSITES CLAVATULUS, N. Sp.</b>	41
<hr/>		
FIGS. 1-2.	—Lateral views, with a portion of the walls of the tubes broken away, showing the large pores.	
FIG. 3.	—Lateral view of another example.	
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	<b>FAVOSITES ROTUNDUS, N. Sp.</b>	41
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FIG. 4.	—Ventral view, with a portion of upper surface worn away, showing the fissiparous mode of growth.	
FIG. 5.	—Basal view, of another specimen, showing the strong wrinkled epithical crust.	
FIG. 6.	—Ventral view of another individual.	
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	<b>ZAPHRENTIS BREVICORNIS, N. Sp.</b>	37
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FIG. 7.	—Posterior view, showing the interior of the calix.	
FIG. 8.	—Lateral view, of another specimen.	
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	<b>ZAPHRENTIS ALBERSI, N. Sp.</b>	38
<hr/>		
FIG. 9.	—Posterior view.	
FIG. 10.	—Calix view, of another specimen.	
FIG. 11.	—Lateral view, of another example.	

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PART 5.

PL. XV.







# EXPLANATION OF PLATES.

	PLATE 16.	PAGE
	<b>HELIOPHYLLUM ROWLEYI, N. Sp.</b>	47
FIG. 1.	Lateral view with portion of the calix broken away to show the lamellæ.	
	<b>BLOTHROPHYLLUM CONIFERUM, N. Sp.</b>	46
FIG. 2.	Posterior view.	
FIG. 3.	Lateral view of another specimen.	
FIG. 4.	Lateral view of another example.	
FIG. 5.	Longitudinal section of a specimen showing conical elevation and the lamellæ.	
FIG. 6.	Longitudinal section of another individual the showing the vesiculose structure.	
	<b>CYSTIPYPHLLUM LOUISVILLENSIS, N. Sp.</b>	45
FIGS. 7-10.	Oblique views showing the calix and the root-like processes that served for attachment.	
FIG. 8.	View of the exterior of another example showing the large concave vesicles.	
FIG. 9.	Calix view of another specimen.	
	<b>ZAPHRENTIS ALBUS, N. Sp.</b>	42
FIG. 11.	View of the calix from the posterior side.	
FIG. 12.	View of the calix of another example.	
	<b>ZAPHRENTIS CURTUS, N. Sp.</b>	42
FIG. 13.	Lateral view.	
FIG. 14.	Calix view of another specimen.	
	<b>ZAPHRENTIS INFLEXUS, N. Sp.</b>	43
FIG. 15.	Lateral view with a portion of the calix broken away to show the side of the cup.	
FIG. 16.	Calix view of another individual.	
	<b>ZAPHRENTIS PUSILLUS, N. Sp.</b>	43
FIG. 17.	Posterior view giving portion of the fossette.	
FIG. 18.	Lateral view of another example.	
FIG. 19.	Calix view of another specimen.	

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PART 6.

PL. XVI.



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## EXPLANATION OF PLATES.

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### PLATE 17.

PAGE

#### ACROPHYLLUM RUGOSUM, N. Sp.

48

FIG. 1.—Lateral view of a mature specimen with a portion of the calix broken away to show the conical elevation.

FIG. 2.—Lateral view of another matured example.

FIG. 3.—Lateral view of another individual with a portion of the calix broken away to show the conical elevation and the lamellæ.

---

#### ZAPHRENTIS LAMASTERI, N. Sp.

44

FIG. 4.—Posterior view showing the smooth flat space in the center of the cup and the lamellæ.

FIG. 5.—Oblique posterior view of another example exhibiting the smooth tabulæ and the fossette.

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#### CYSTIPHYLLUM EXPANSUM, N. Sp.

45

FIGS. 6-7-8.—All three views of the calix from different specimens.

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#### CYSTIPHYLLUM DIVERSUM, N. Sp.

46

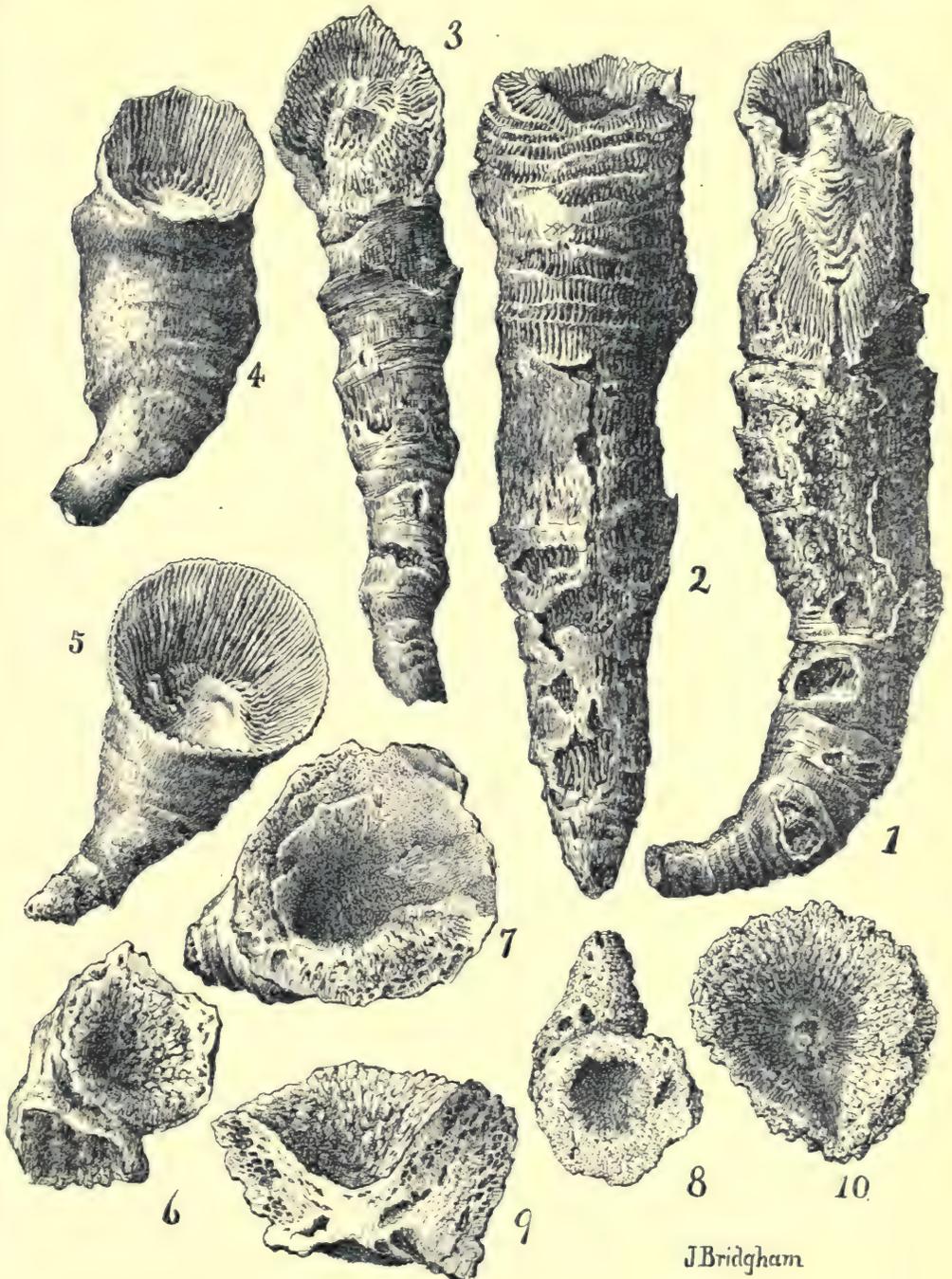
FIG. 9.—View of a longitudinal section of a matured specimen.

FIG. 10.—Calix view of another example.

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PART 6.

PL. XVII.



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## EXPLANATION OF PLATES.

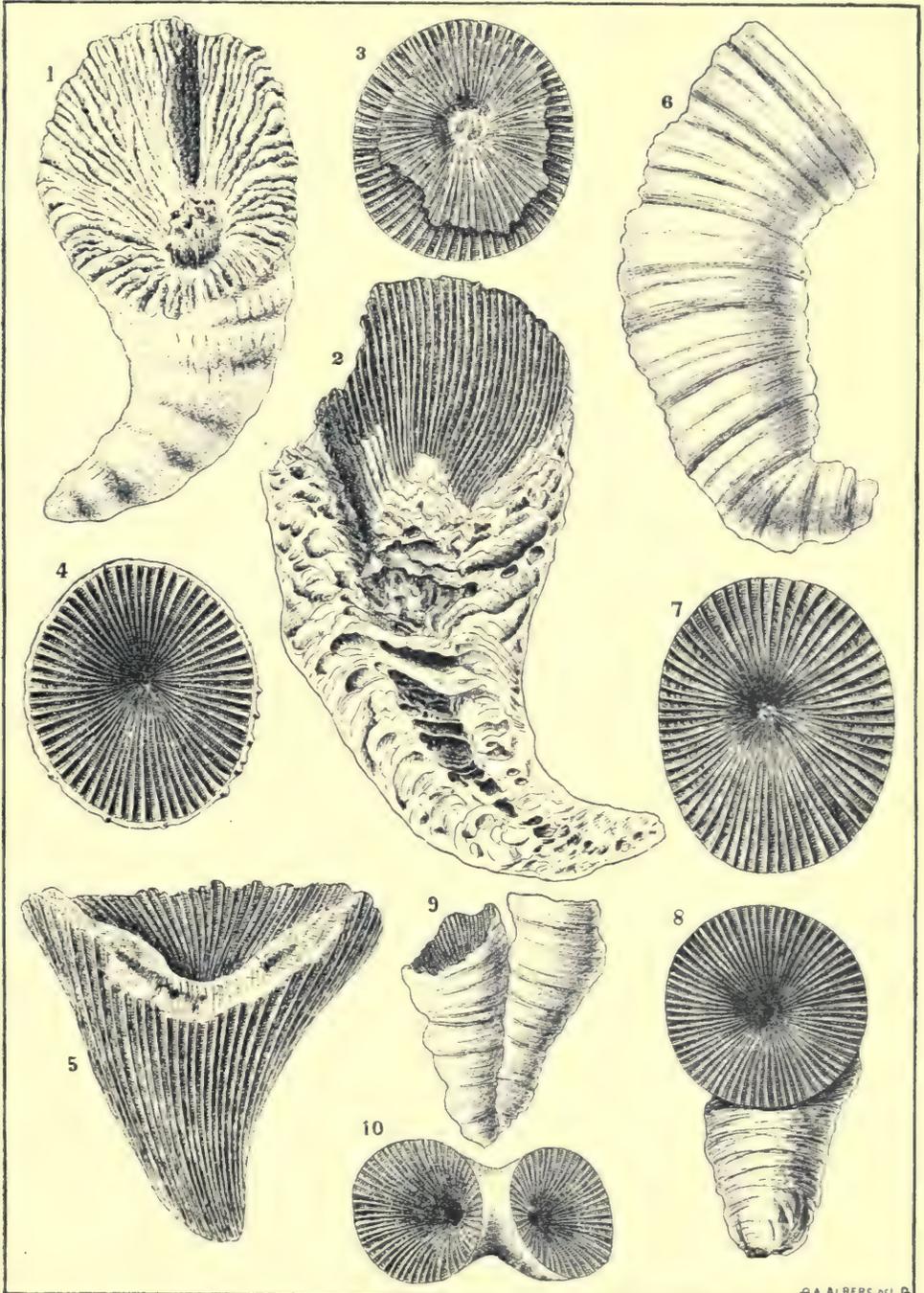
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- |            | PLATE 18.  | PAGE |
|------------|--|------|
|            | ZAPHRENTIS INSOLENS, N. Sp.  | 44   |
| <hr/>      |  |      |
| FIG. 1.    | —Posterior view showing the oblique tabulæ and the fossette.         |      |
| FIG. 2.    | —Longitudinal section showing the oblique tabulæ and the lamellæ.    |      |
| <hr/>      |  |      |
|            | CHONOPHYLLUM TYPICUM, N. Sp.   | 48   |
| <hr/>      |  |      |
| FIGS. 3-4. | —Views of the calix of two different individuals.                    |      |
| FIG. 5.    | —Lateral view of another example.                                    |      |
| <hr/>      |  |      |
|            | CHONOPHYLLUM INFUNDIBULUM, N. Sp.                                    | 49   |
| <hr/>      |  |      |
| FIG. 6.    | —Lateral view of a matured example.                                  |      |
| FIG. 7.    | —Calix view of another individual.                                   |      |
| FIG. 8.    | —Posterior view of a specimen and exhibiting the calix.              |      |
| FIG. 9.    | —Lateral views of two specimens attached by their epithecal walls.   |      |
| FIG. 10.   | —Calix views of two more examples attached by their epithecal walls. |      |

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PART 6.

PL. XVIII.

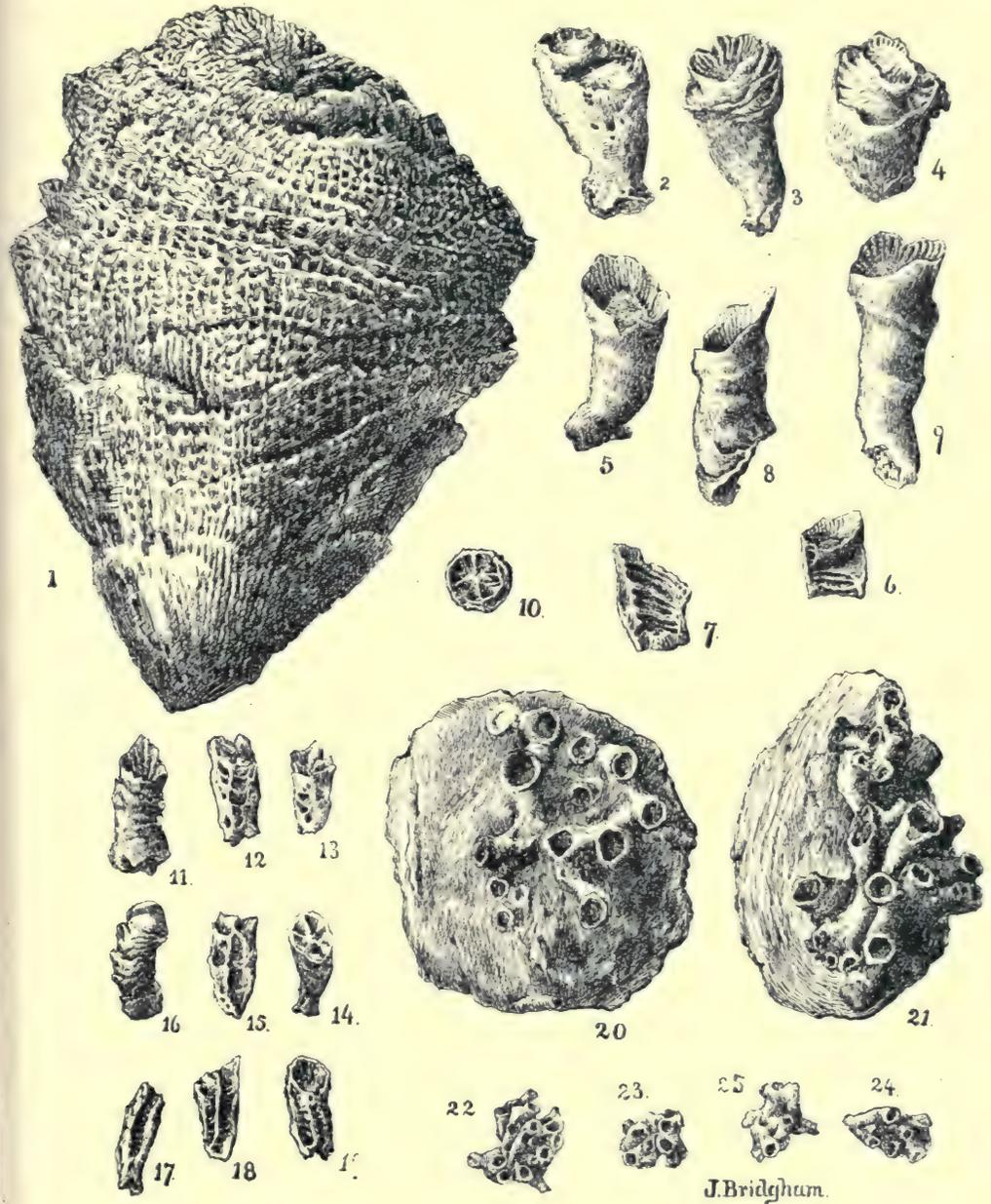






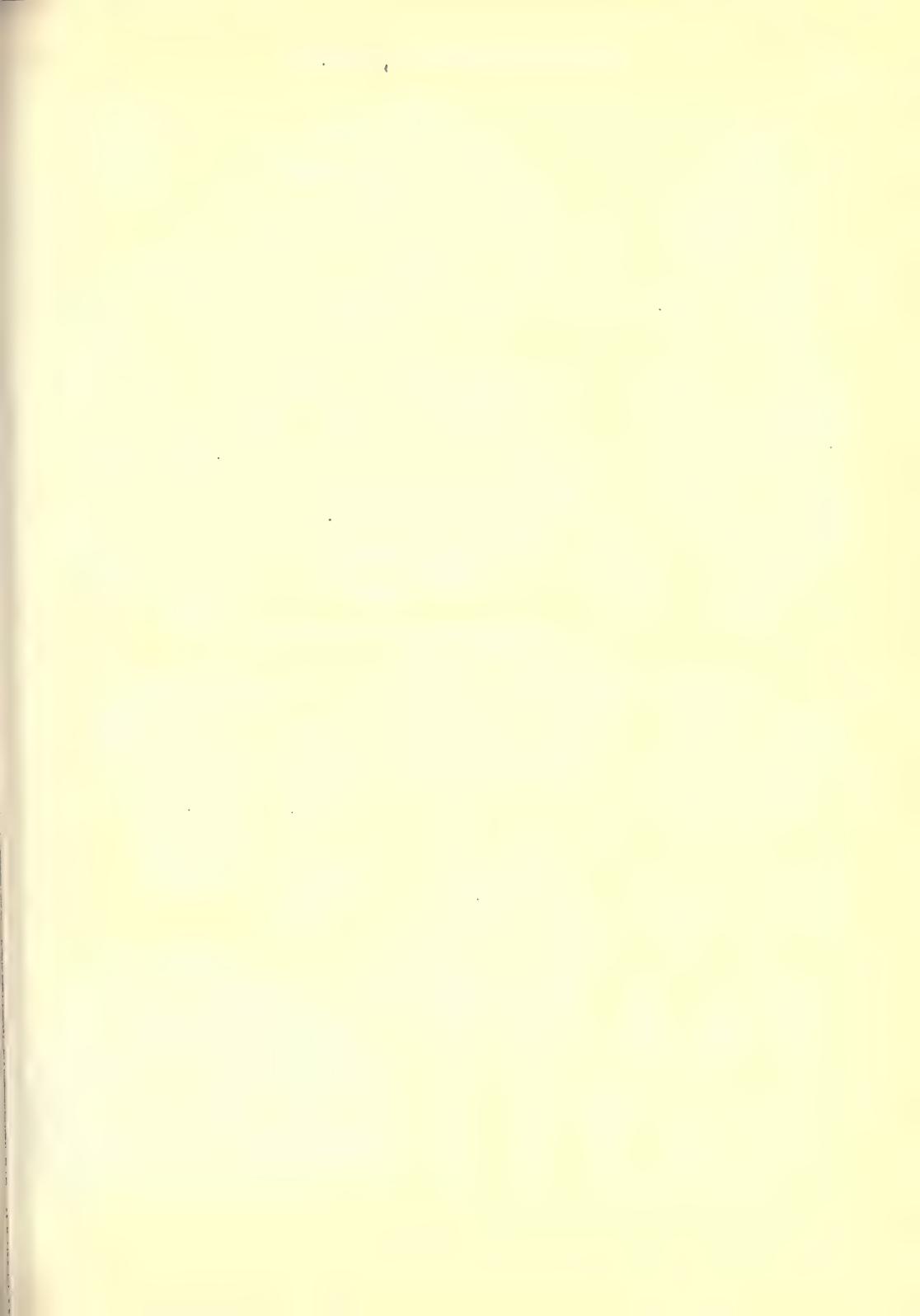
# EXPLANATION OF PLATES.

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	<i>HELIOPHYLLUM SPICULATUM</i> , N. Sp.	56
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	<i>CERATOPORA AGGLOMERATA</i> , N. Sp. (Grabau.)	51
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FIG. 24.	—Oblique view of another example exhibiting the stems.	



J. Bridgman.





# EXPLANATION OF PLATES.

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## PLATE 20.

PAGE

### HELIOPHYLLUM HAMMELLI, N. Sp.

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55

- FIG. 1.—Ventral view of a large corallum.  
FIG. 2.—Longitudinal section of a single corallite of No. 1.  
FIG. 3.—Ventral view of another smaller corallum.
- 

### HELIOPHYLLUM COLLATUM, N. Sp.

---

55

- FIG. 4-6.—Ventral views of two different examples exhibiting the rounded tubes.  
FIG. 5.—Lateral view of another corallum.  
FIG. 7.—Ventral view exhibiting the margin of the tubes joined in polygonal outline.
- 

### ENALLOPHYLLUM GRABAU, N. Sp.

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54

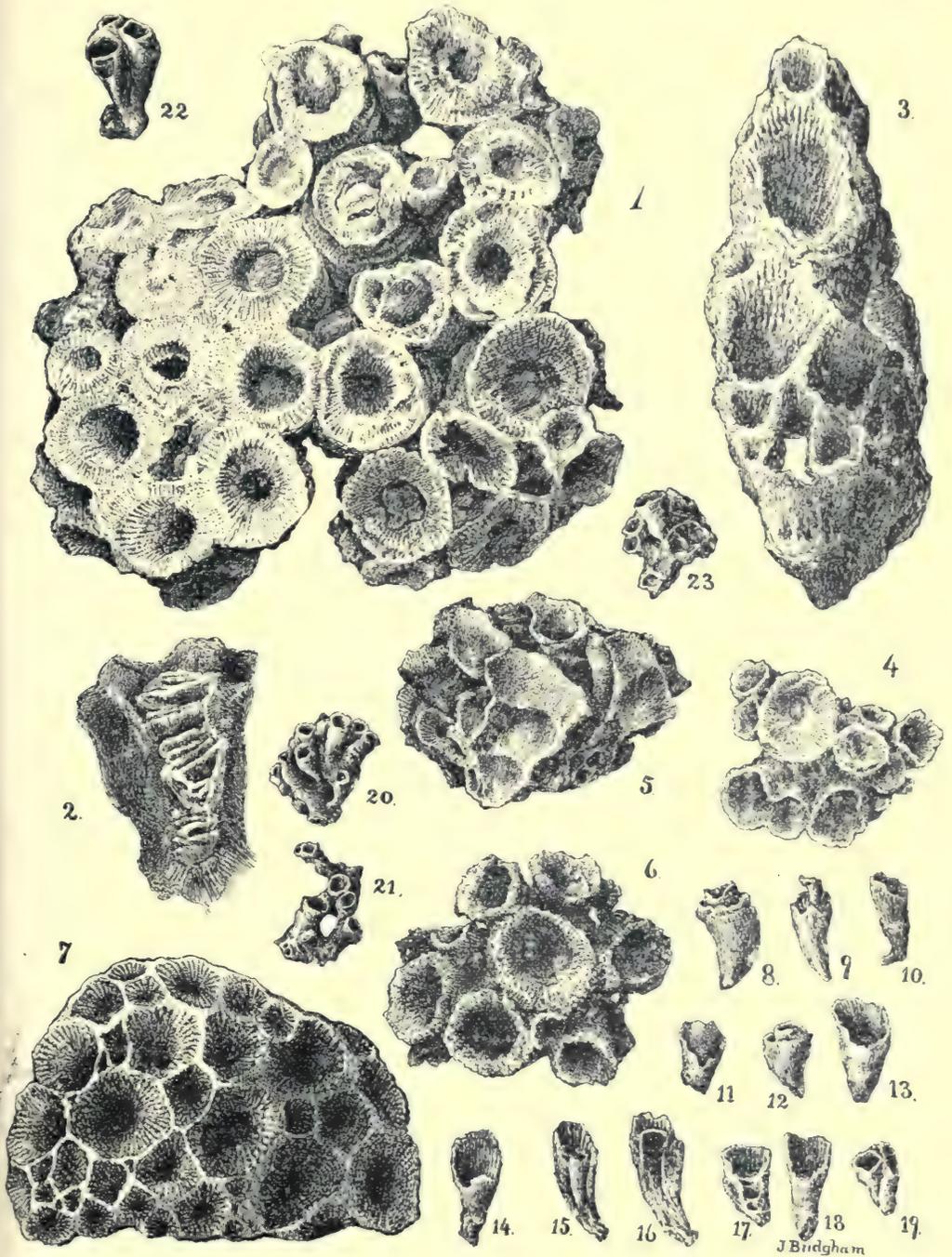
- FIGS. 8-9-12.—Lateral views of three examples exhibiting the calicular budding.  
FIG. 10.—Lateral view of a small corallum, exhibiting the broad scar at the point of attachment.  
FIGS. 11-13-14-18.—Anterior views of different corallums.  
FIGS. 15-16-17.—Lateral views of three corallums, where the sides are broken away to show the tabulate area.
- 

### ROMINGERIA CYSTOIDES, N. Sp. (Grabau.)

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- FIGS. 19-22.—Lateral views of different corallums.  
FIGS. 20-21-23.—Ventral views of three examples exhibiting the different modes of growth.



J. B. Bidgham



# EXPLANATION OF PLATES.

## PLATE 21.

PAGE

### GOMPHOCERAS STRIATUM, N. Sp. (Rowley.)

58

- FIG. 1.—Front view of the aperture.  
FIG. 2.—Ventral side view of same specimen.  
FIG. 3.—Dorsal side view of same individual.  
FIG. 4.—End view of the last septum preserved, showing the lateral position of the siphuncle, same specimen.

### GOMPHOCERAS BELLATULUM, N. Sp. (Rowley.)

58

- FIG. 5.—Front view to show the size and shape of the aperture.  
FIG. 6.—Outer surface of the first chamber wall of another specimen, showing the ventral position of the siphuncle.  
FIGS. 7-8.—Dorsal and ventral views respectively of another specimen.

### GOMPHOCERAS FACETUM, N. Sp. (Rowley.)

58

- FIG. 9.—Front view of the large, almost V-shaped, aperture.  
FIGS. 10-11.—Ventral and dorsal views of another specimen.  
FIG. 12.—Posterior end view of the same, showing the position of the siphuncle.

### GOMPHOCERAS OVIFORME? Hall Sp. Rowley.

59

- FIG. 13.—Lateral view of an internal cast from chert.  
FIG. 14.—Cross section to show elliptical outline.

### CRANOCERAS? ELLIPTICUM, N. Sp. (Rowley.)

59

- FIG. 15.—Side view of an internal cast.  
FIG. 16.—End view of the same.

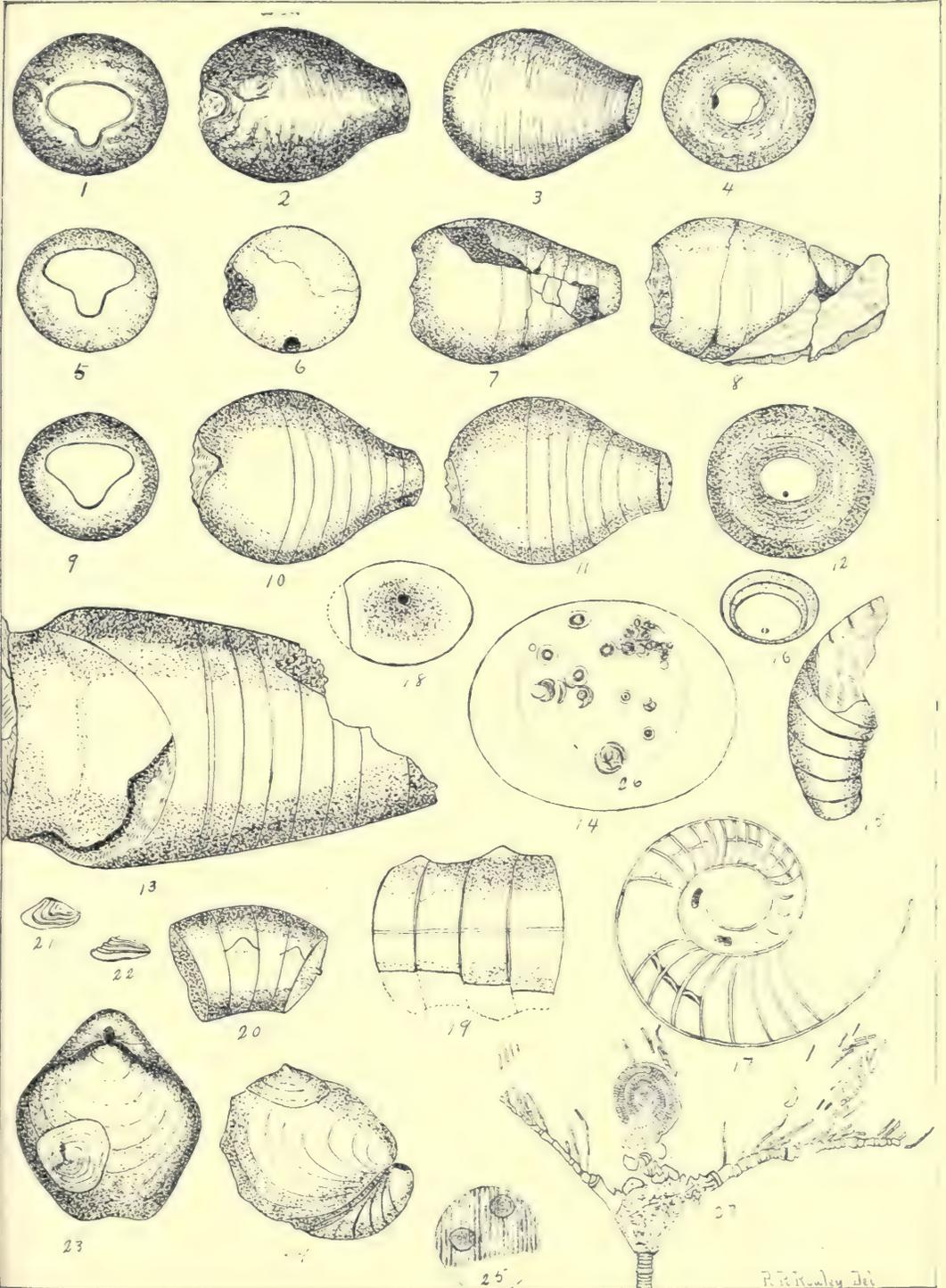
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# EXPLANATION OF PLATES.

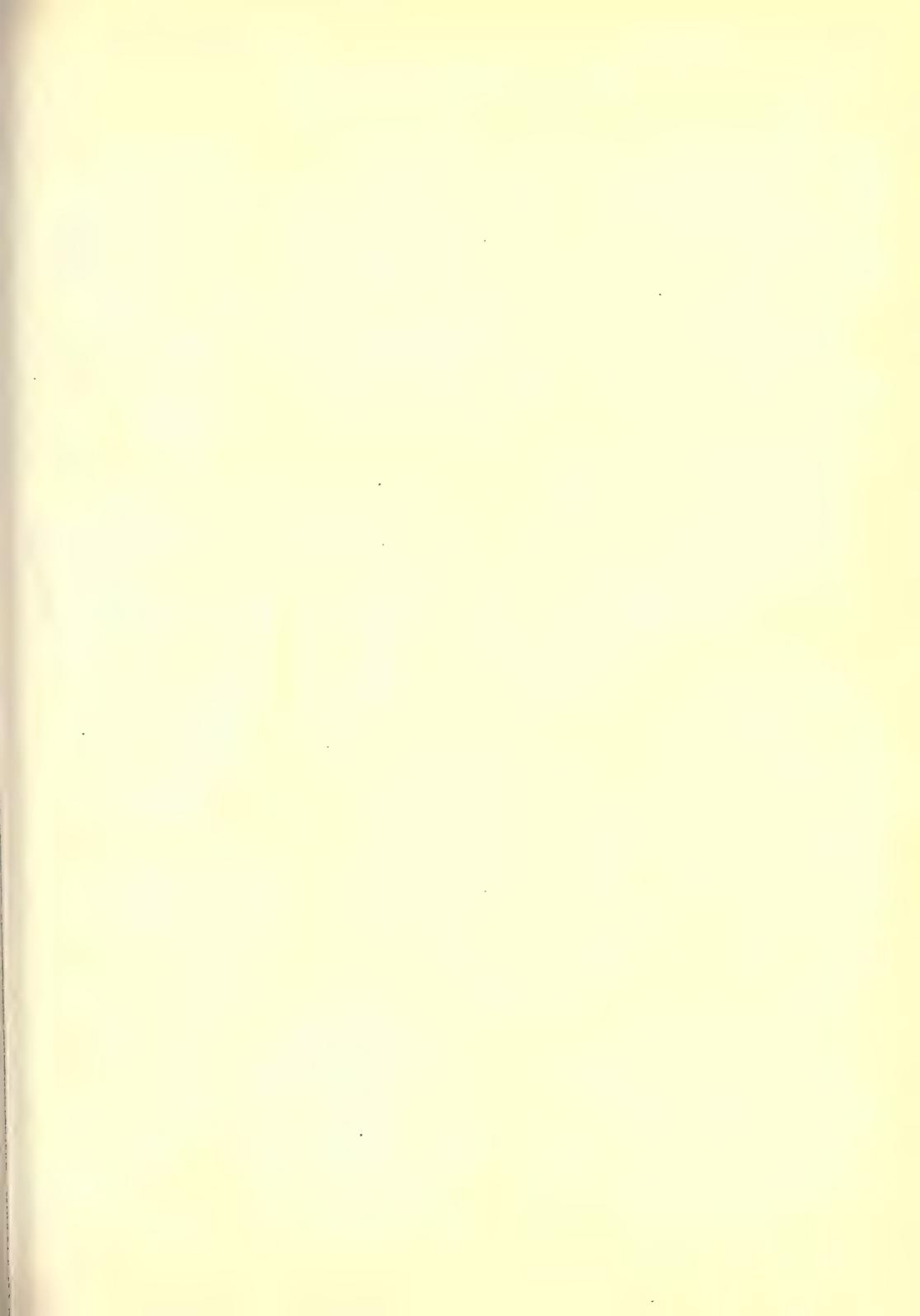
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PLATE 21. (CONTINUED.)	PAGE
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FIG. 27.—View of the type specimen as seen on the slab.	

All the figures on this plate are drawn natural size, except 26, which is two diameters.







# EXPLANATION OF PLATES.

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## PLATE 22.

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### HELIOPHYLLUM AMPLIATUM, N. Sp.

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- FIG. 1.—Lateral view of a matured example.  
FIG. 2.—Calix view of another individual.
- 

### HELIOPHYLLUM CONIGERUM, N. Sp.

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62

- FIG. 3.—Lateral view of a well preserved example.  
FIG. 4.—Calix view of another specimen.
- 

### CYSTIPHYLLUM MULTICRENATUM, N. Sp.

---

63

- FIG. 5.—Calix view showing the vesiculose structure in the bottom of the cup, and the invaginated appearance.  
FIG. 6.—Oblique posterior view of another specimen, showing the well developed lamellæ, and exhibiting a bud in the bottom of the cup.  
FIG. 7.—Lateral view of a decorticated specimen, exhibiting the fine vesiculose structure.
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### ZAPHRENTIS OBSCURUS, N. Sp.

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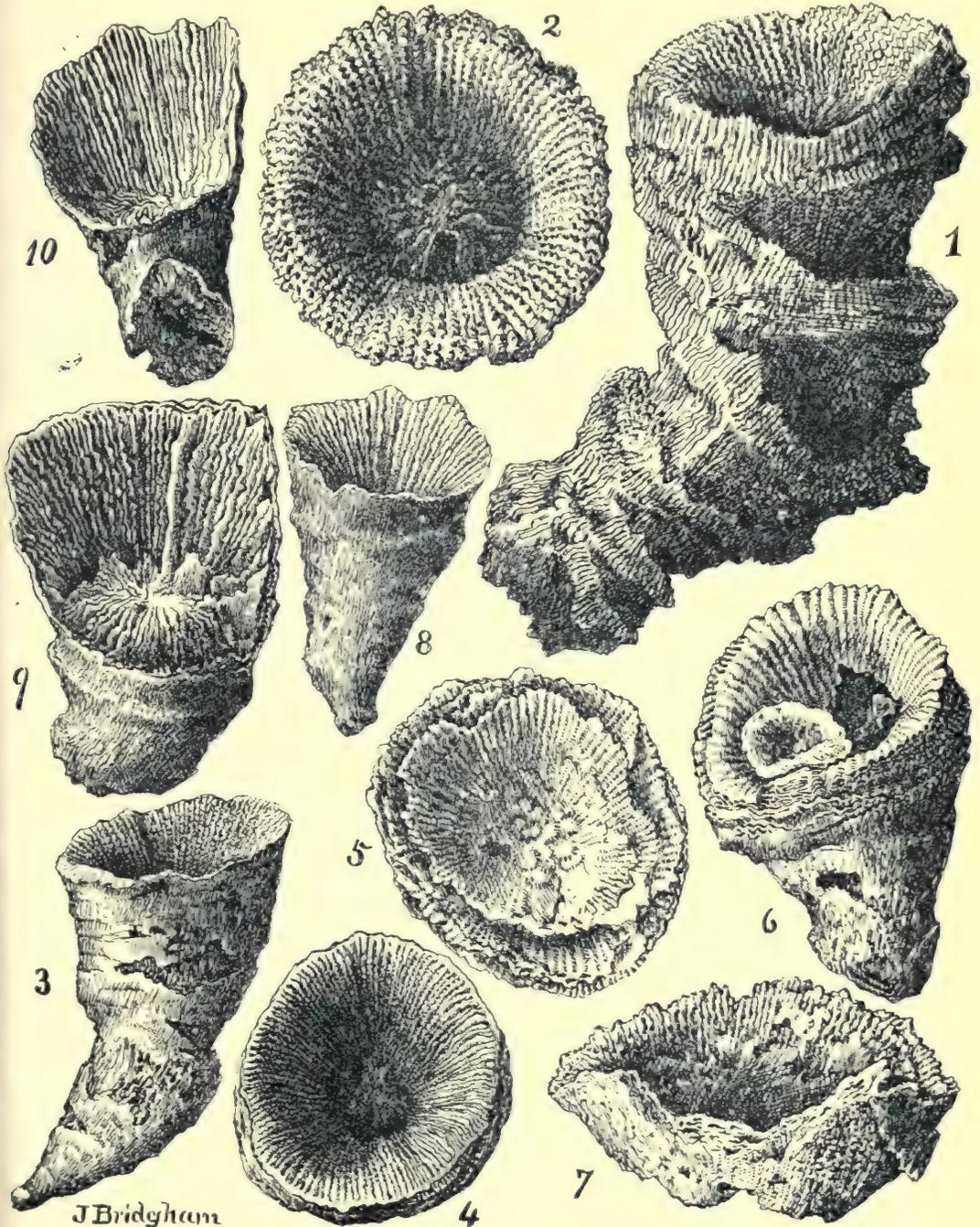
63

- FIG. 8.—Posterior view of a small example.  
FIG. 9.—Lateral view of another specimen with a portion of the cup broken away to exhibit the bottom of the calix and the lamellæ.  
FIG. 10.—Oblique posterior view of another individual exhibiting the lamellæ.

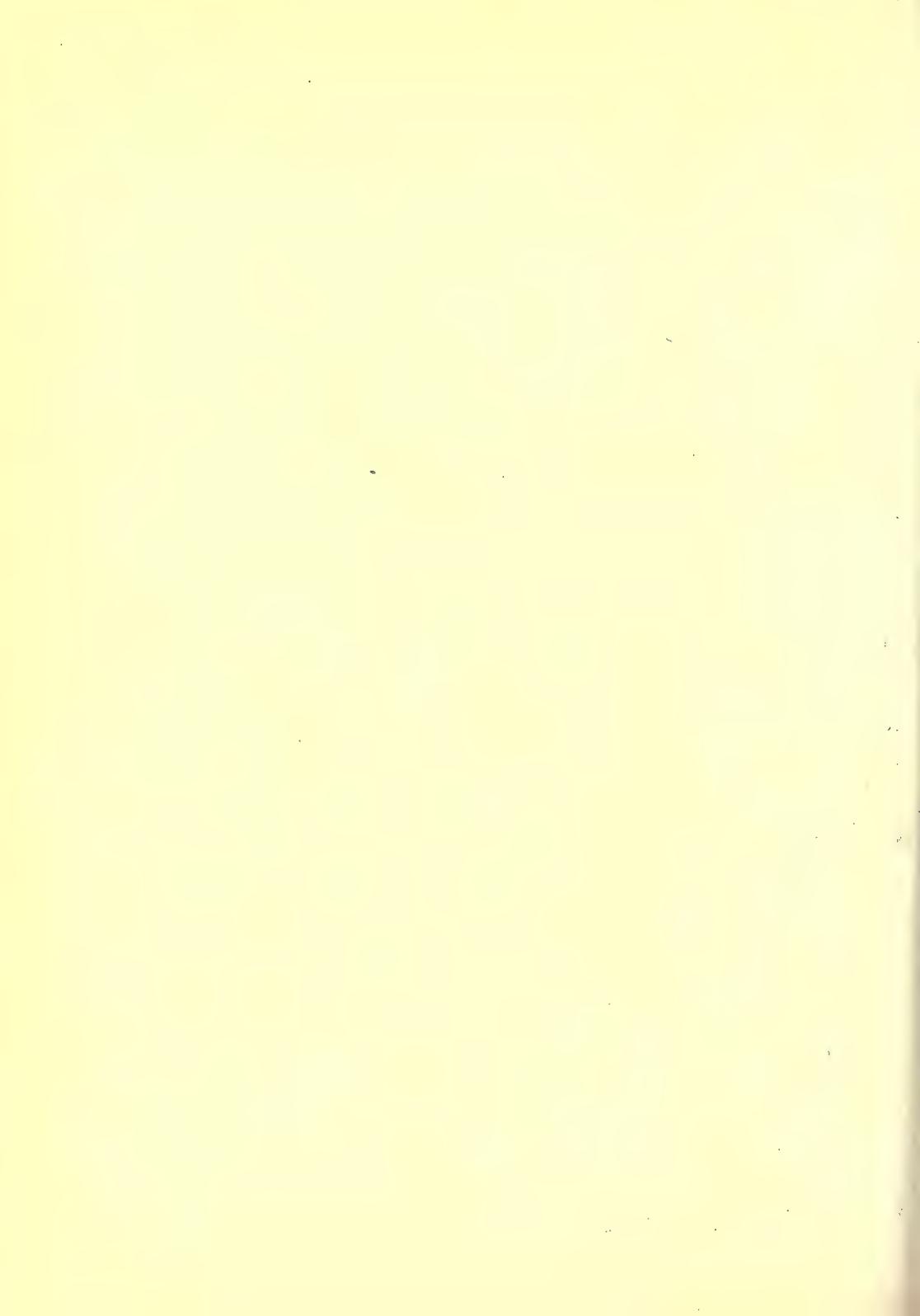
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PL. XXII.



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# EXPLANATION OF PLATES.

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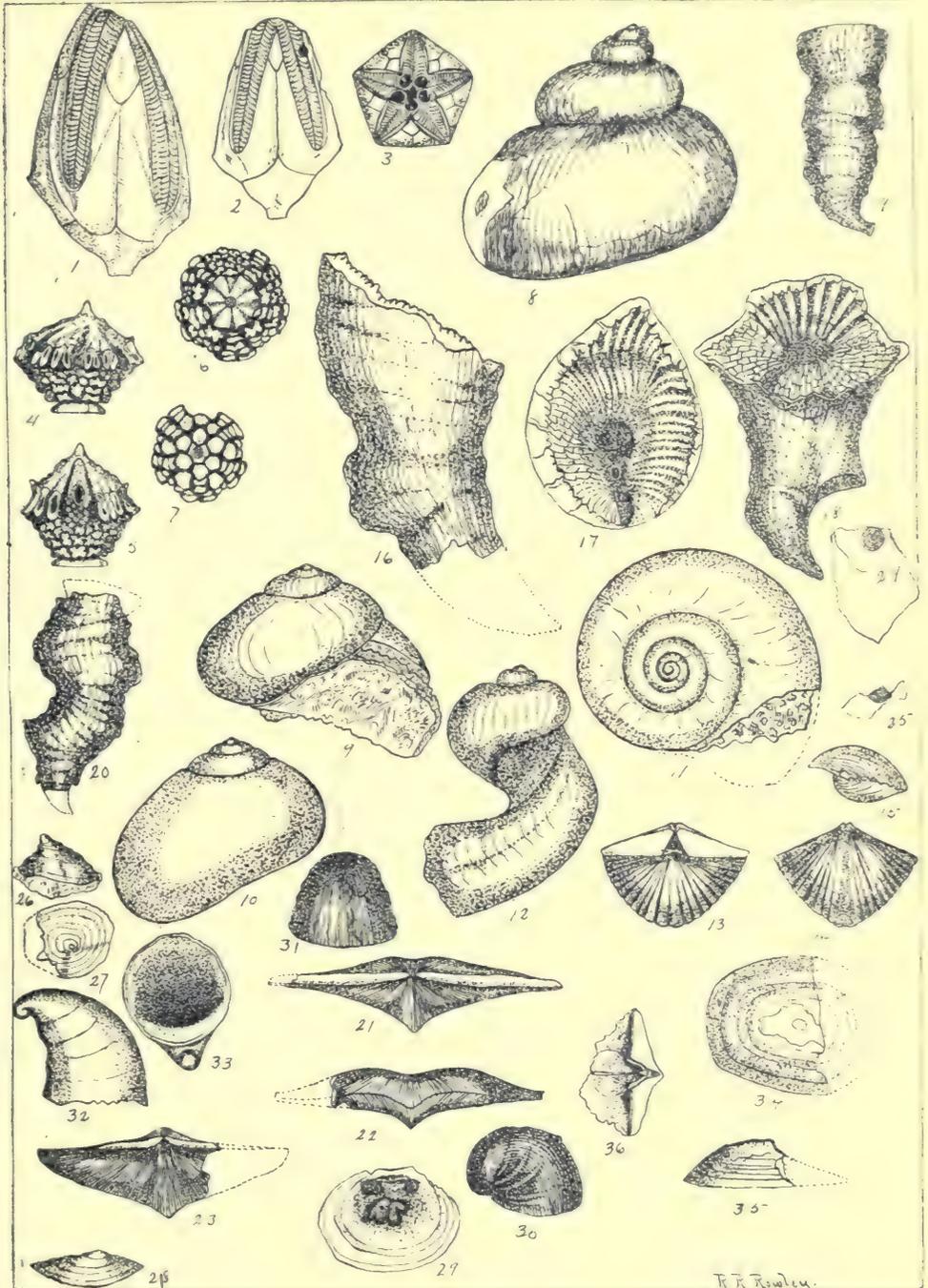
# EXPLANATION OF PLATES.

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# EXPLANATION OF PLATES.

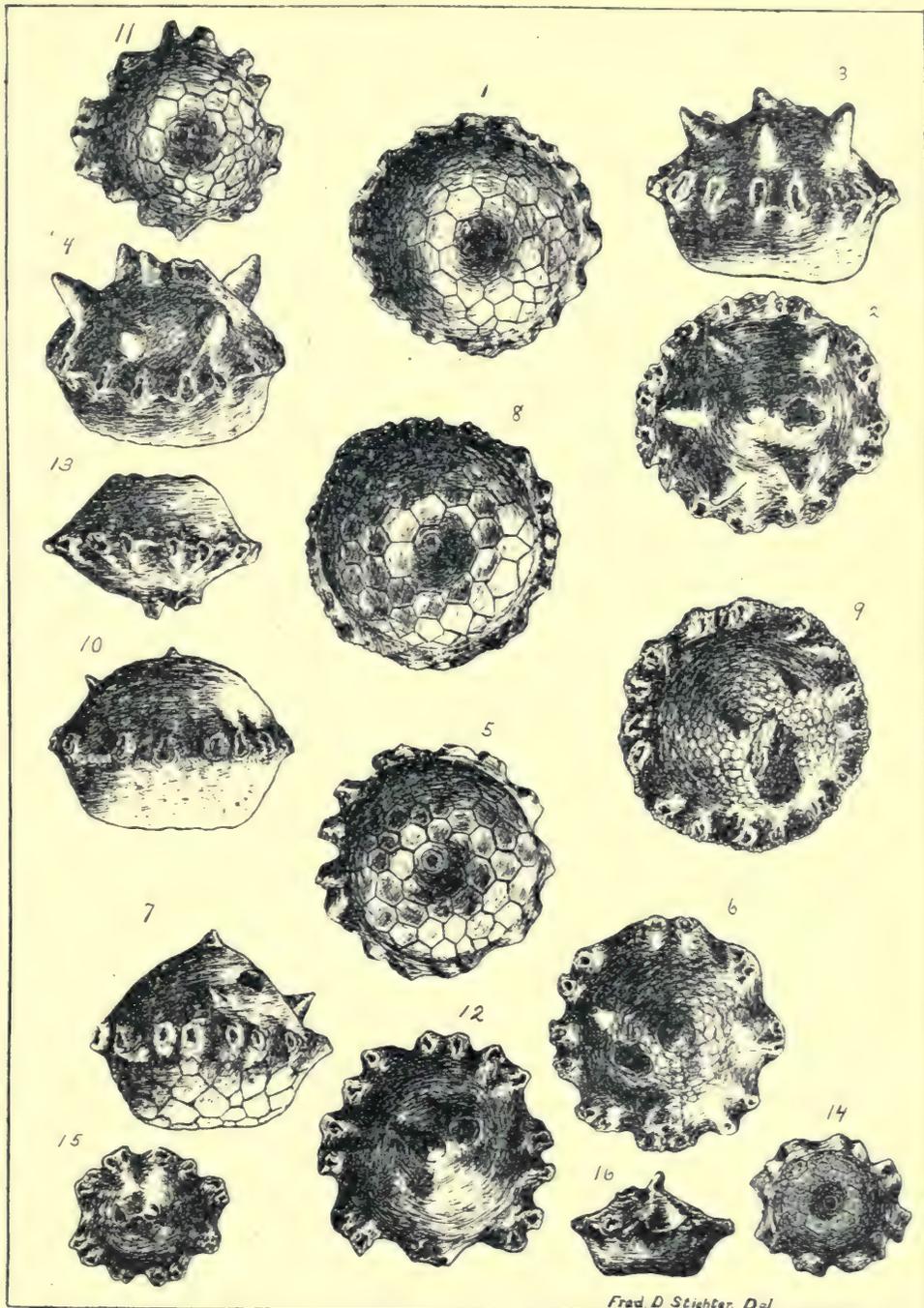
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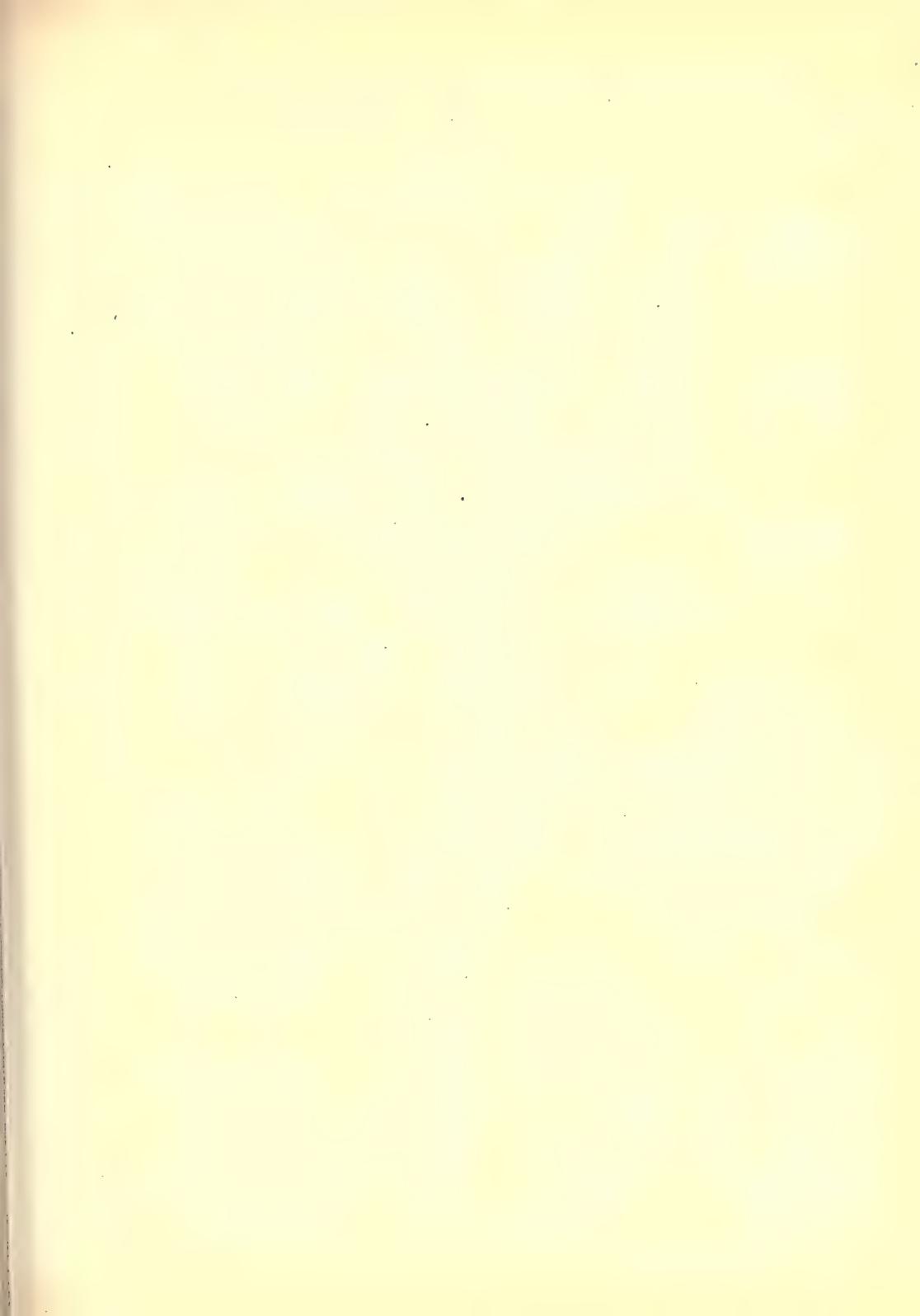
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Frad. D. Stiehr. Del.





# EXPLANATION OF PLATES.

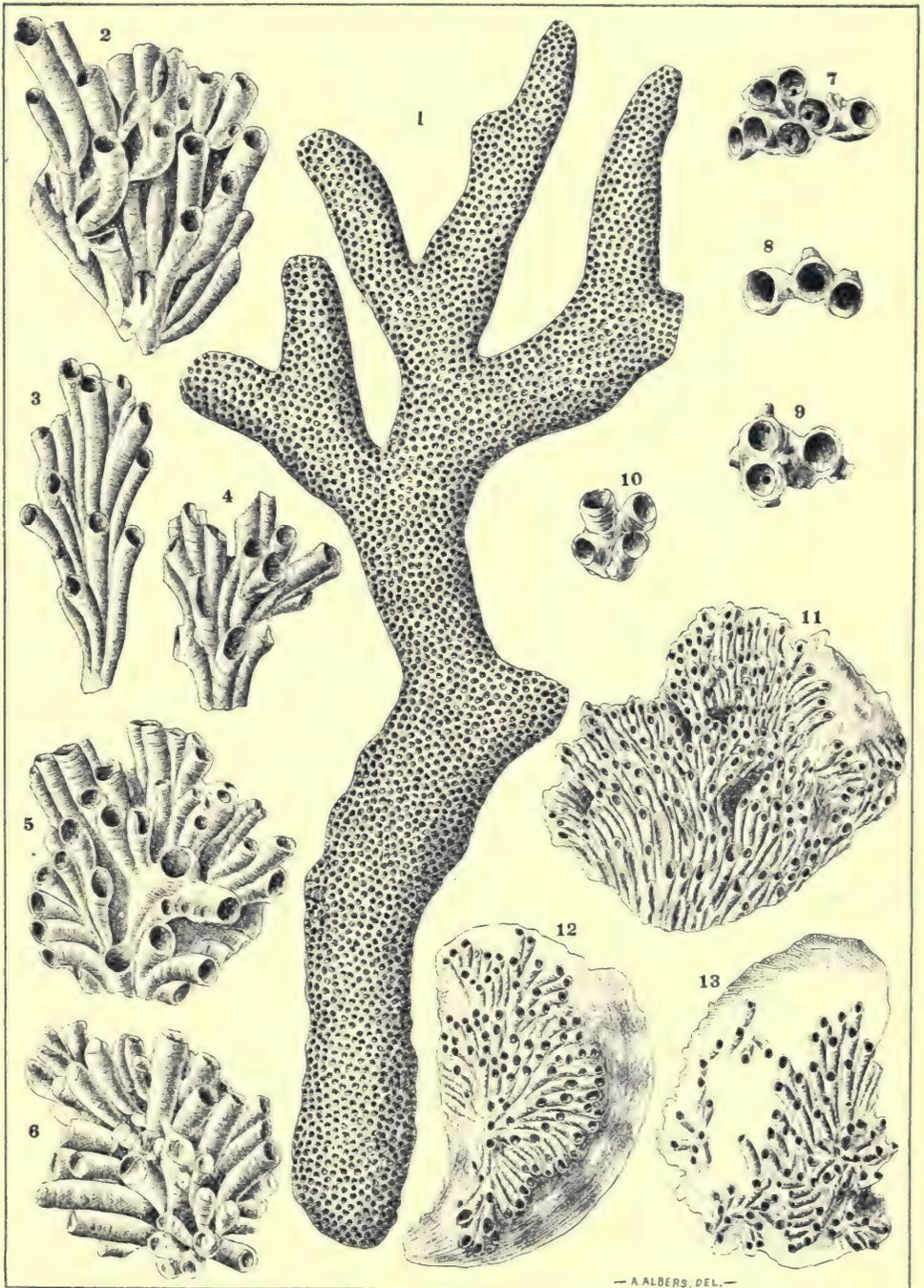
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FIG. 1.—Lateral view of a large corallum.	
—	
CERATOPORA FLABELLATA, N. Sp.	75
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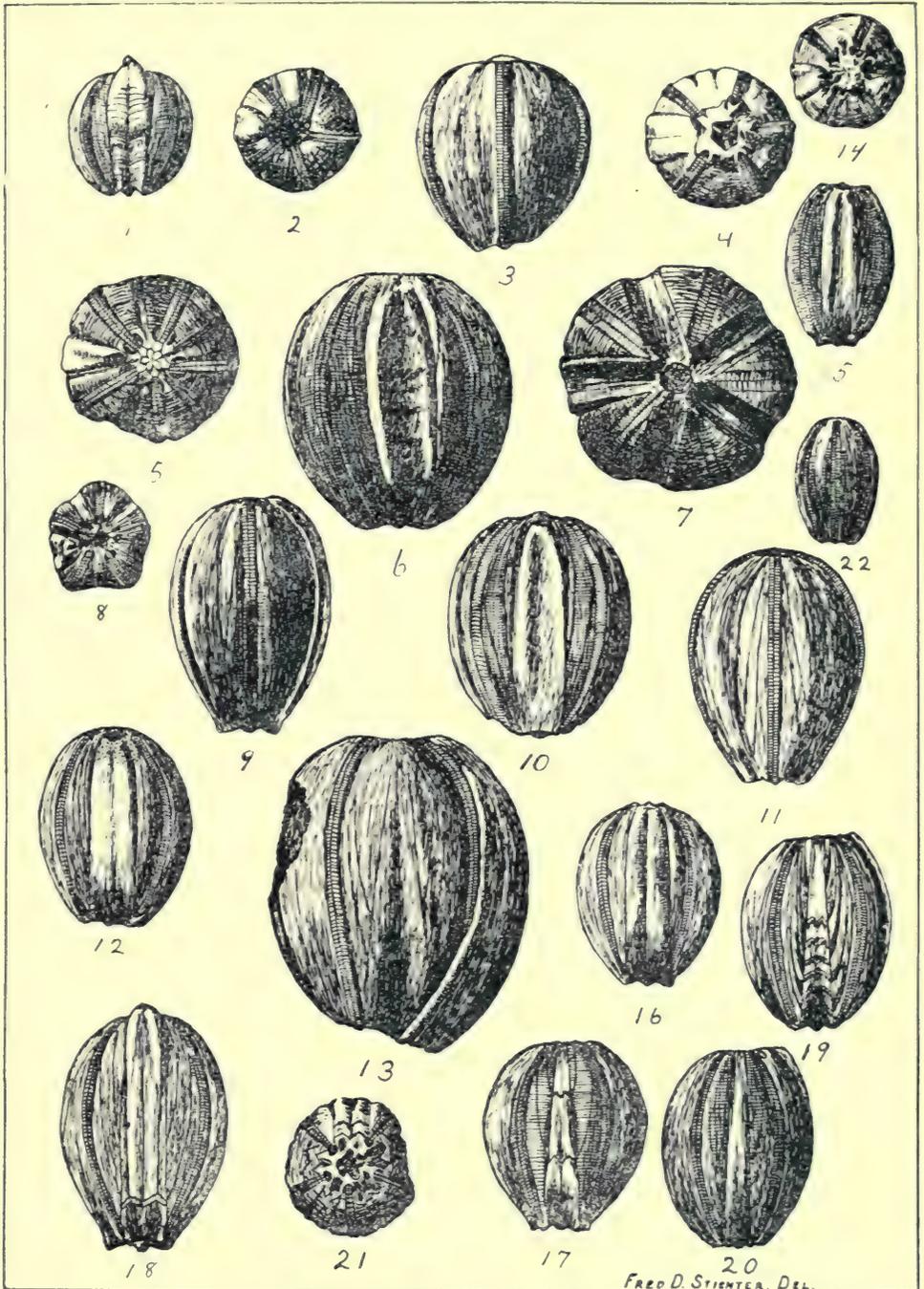
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FIG. 21.—End view of an imperfect elongate specimen. (Base.)	
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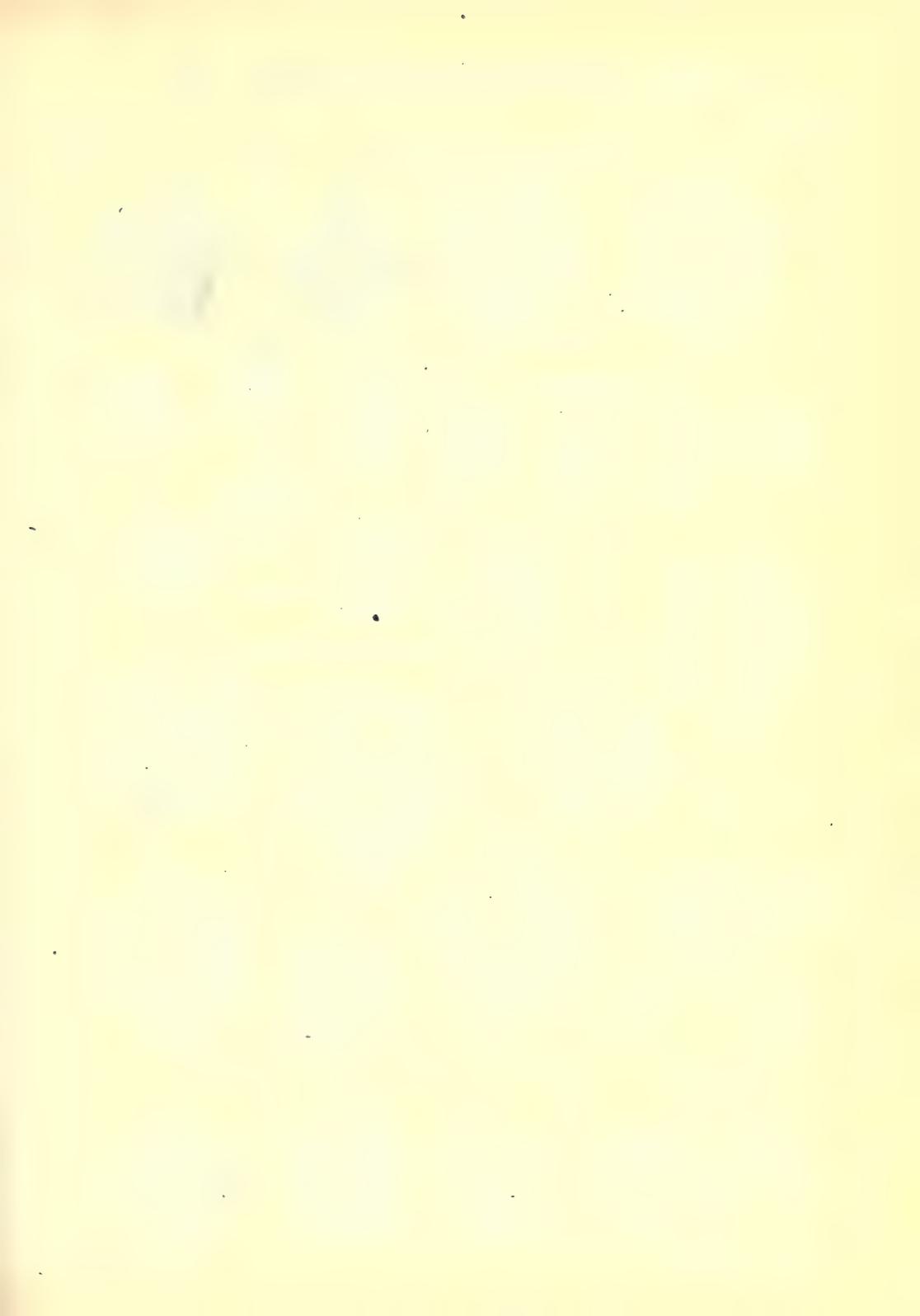
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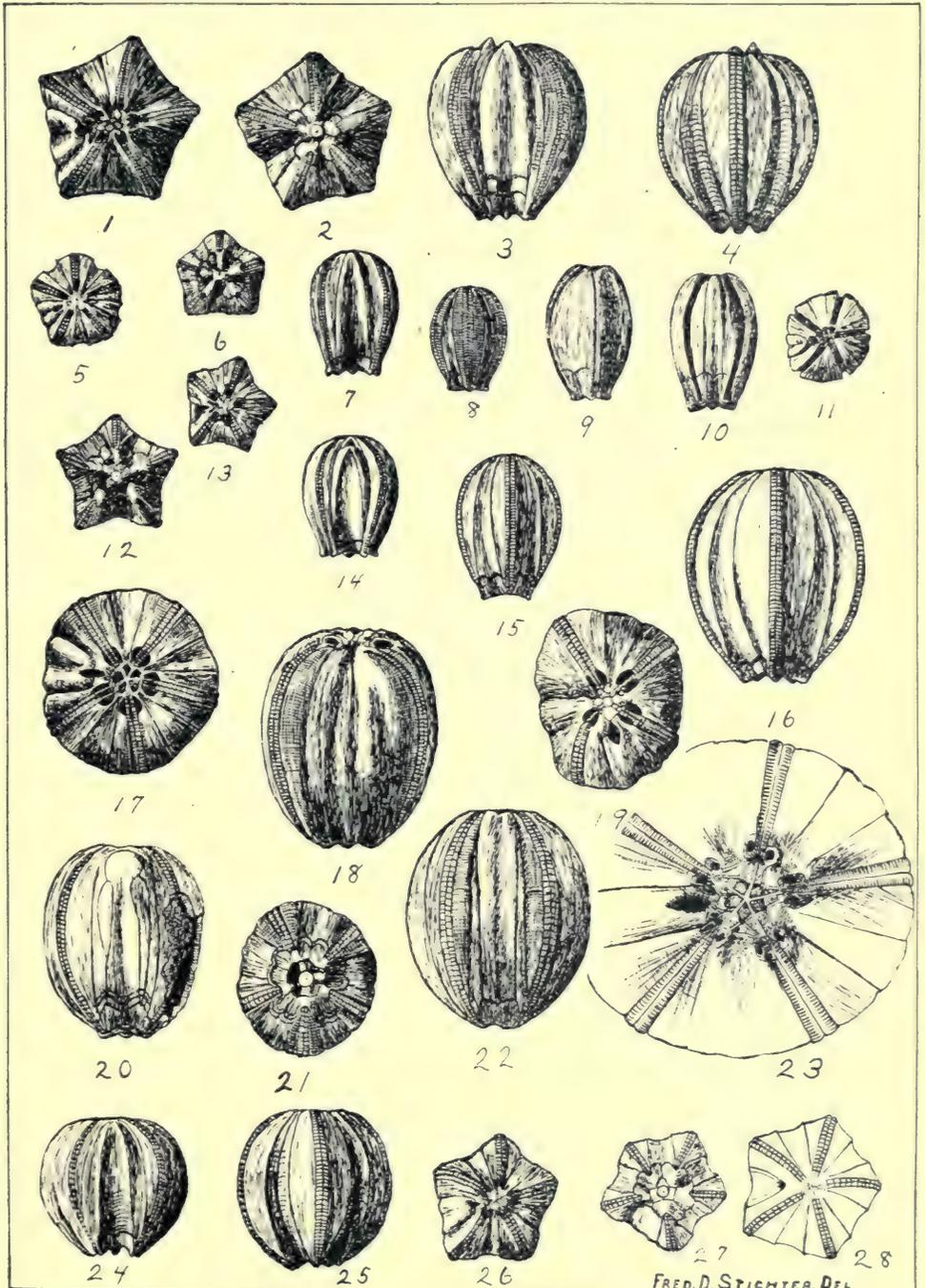
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FIG. 28.—Ventral view of figure 24.	

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# EXPLANATION OF PLATES.

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## PLATE 28.

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### HELIOPHYLLUM IGNOTUM. N. Sp.

85

- FIG. 1.—Lateral view of a matured specimen, exhibiting the strong annulations and constrictions.
- FIG. 2.—Posterior and calix view of another example, exhibiting the coalescing, and twisting of the lamellæ in the bottom of the calix.

### HELIOPHYLLUM ADNASCENS. N. Sp.

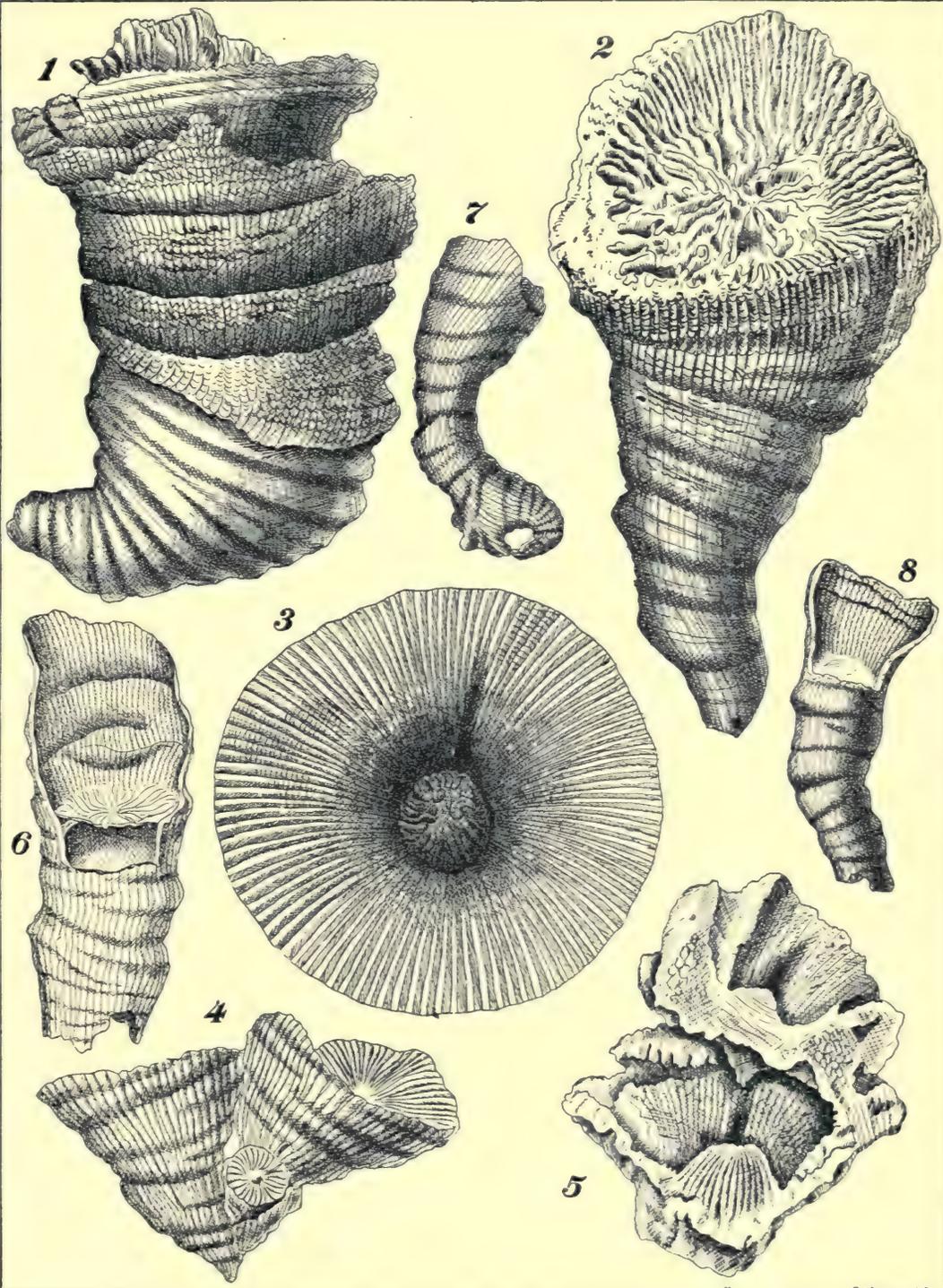
85

- FIG. 3.—Calix view of a simple corallum, a portion of the calix is broken away, but the artist has failed to indicate this.
- FIG. 4.—Lateral view of a perfect composite corallum, natural size.
- FIG. 5.—View of a longitudinal section of a composite example, exhibiting the elevated lamellæ in the bottom of the calix, and exhibiting the interlamellar vesiculose space, natural size.

### ZAPHRENTIS AMPLEXIFORMIS. N. Sp.

86

- FIGS. 6-8.—Lateral views of two examples, where a portion of the cup has been removed to exhibit the broad tabulæ, and the deep calix, and flattened lamellæ.
- FIG. 7.—Lateral view of another individual, exhibiting the curved point of attachment, and the root-like processes, that served for support.





# EXPLANATION OF PLATES.

## PLATE 29.

PAGE

### PENTREMITES GODONI, De France. Rowley.

89

- FIGS. 1-2.—Basal and side views of a six-rayed specimen, figure 2 showing the size and shape of the extra radial.
- FIGS. 3-4.—Summit and side views of a specimen with a pyramid covering the ventral openings and a low arching integument extending a short distance downward over each ambulacrum.
- FIGS. 7-8.—Summit and side views of a specimen with but four ambulacral fields, the fifth radial being narrow and indistinctly grooved along the middle. A strong rounded fold extends down the middle of one of the four ambulacral areas.

### PENTREMITES PYRIFORMIS, Say, Rowley.

89

- FIG. 12.—Side view of a specimen that has been injured in life and repaired by the secretion of stony material along the lines of fracture or crushing.
- FIGS. 21-22-23.—Side and basal views of a six-rayed specimen, figure 22 showing the extra non-ambulacral bearing radial plate and figure 23, the irregularity in outline due to the crowding of two ambulacra.

### PENTREMITES KONINCKANUS, Hall, Rowley.

90

- FIGS. 5-6.—Side and summit views of a specimen showing the summit pyramid, x 2.
- FIGS. 9, 10a-11.—Basal, summit and side views of a tetraradiate specimen, the central part of one ambulacral area being occupied by a strong fold, x 2.
- FIG. 10.—Is a faulty drawing corrected in 10a, x 2.
- FIGS. 13-14.—Side and basal views of a symmetrical four-rayed specimen, x 2.

### PENTREMITES CONOIDEUS, Hall, Rowley.

87

- FIGS. 29-30.—Side views of two different specimens to show outline.
- FIG. 37.—Interior of a specimen, broken across, showing the hydrospire folds, x 2.
- FIG. 38.—Similar view of another specimen, showing one hydrospire area.
- FIG. 39.—An interior view of a specimen showing the anal opening, mouth and broken hydrospire tubes, x 2.

# EXPLANATION OF PLATES.

## PLATE 29.—Continued.

PAGE

FIG. 40.—Interior view of a specimen showing the ambulacral pores beneath the hydrospire folds, the latter broken away.

FIG. 41.—A specimen with the test broken away below, exposing the cast of the cavity and the thickness of the test at the ambulacral tips.

### PENTREMITES CONOIDEUS, Var. Perlongus, N. Var. (Rowley.)

87

FIG. 28.—Side view of type, showing outline.

### PENTREMITES CONOIDEUS, Var. Amplus, N. Var. (Rowley.)

88

FIGS. 31, 32, 33-34.—Side views of different individuals, showing outline.

### TRICOELOCRINUS WOODMANI, M. & W., Rowley.

90

FIGS. 35-36.—Side and basal views of a specimen, showing the triangular column and the minute columnar perforation.

FIGS. 42-43.—Side and basal views of the triangular column of another specimen.

### ORBITREMITES OPPELTI, N. Sp. (Rowley.)

86

FIGS. 15-16.—Side and ventral views of the type specimen.

FIG. 17.—Another specimen consisting of an entire ambulacrum.

FIGS. 18, 19-20.—Side and summit views of this species in restoration.

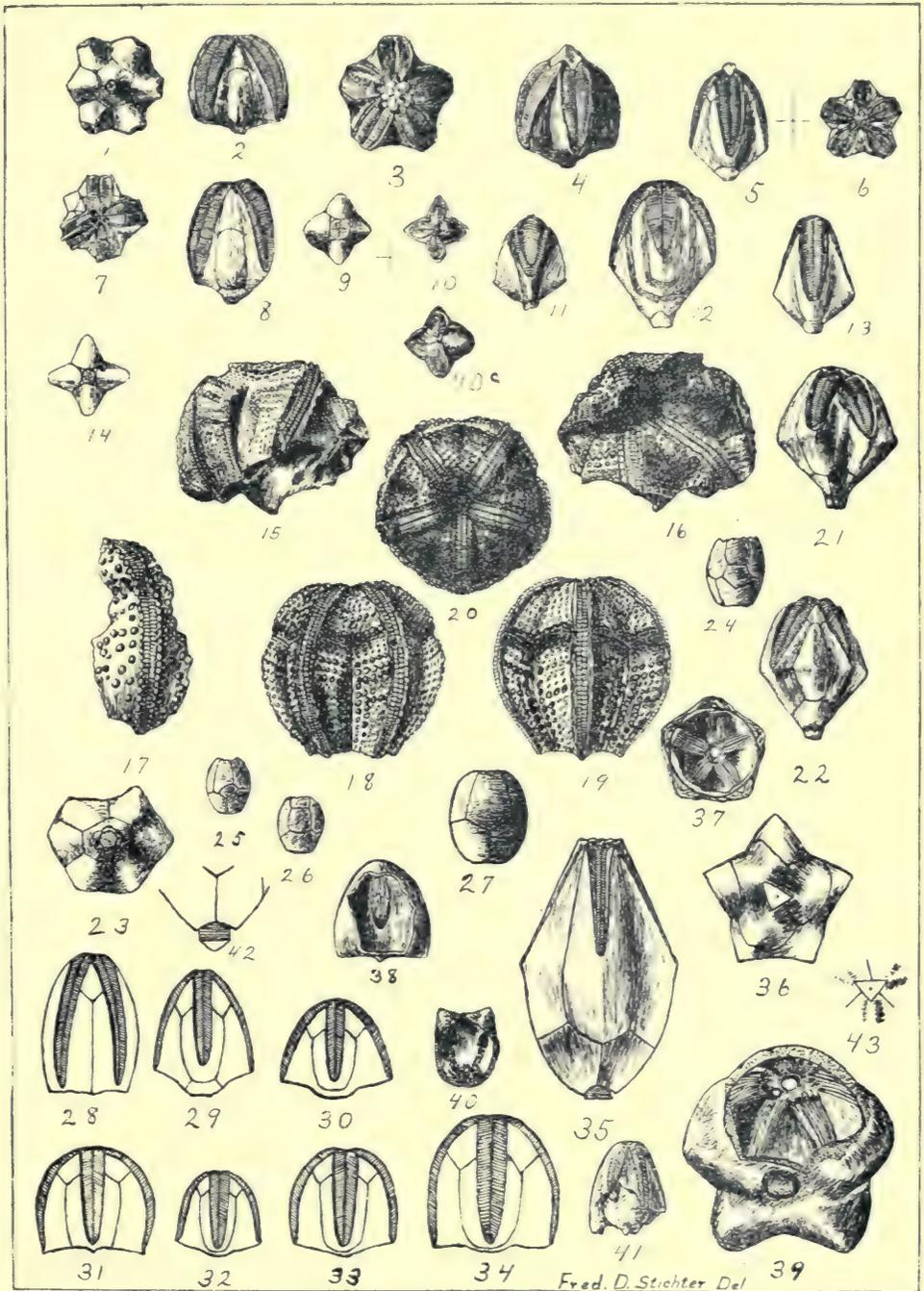
### TALAROCRINUS SIMPLEX, Shumard, Rowley.

91

FIG. 24.—Side view of a specimen with an extra calyx plate.

FIGS. 25-26.—Side views of another specimen, having two extra calyx plates.

FIG. 27.—A normal specimen from the Keokuk limestone.



Fred. D. Stichter Del



# EXPLANATION OF PLATES.

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FIGS. 14-15.—Summit and side views of a specimen. (Fig. 14 is incorrectly drawn.)	
<u>CODASTER PYRAMIDATUS</u> , Shumard, Rowley.	95
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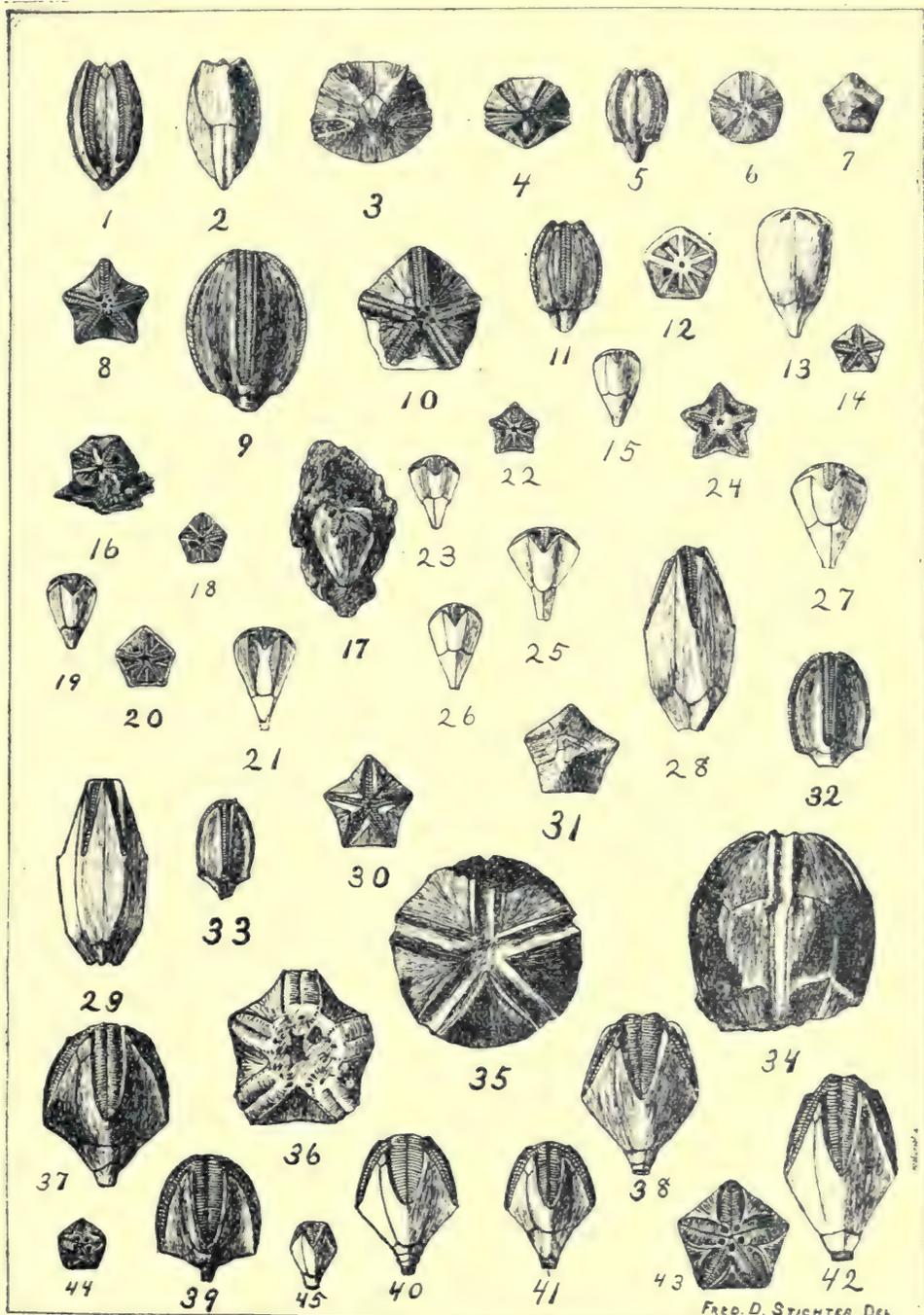
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CONTRIBUTION TO INDIANA PALEONTOLOGY.

PART 10.

PL. XXX.



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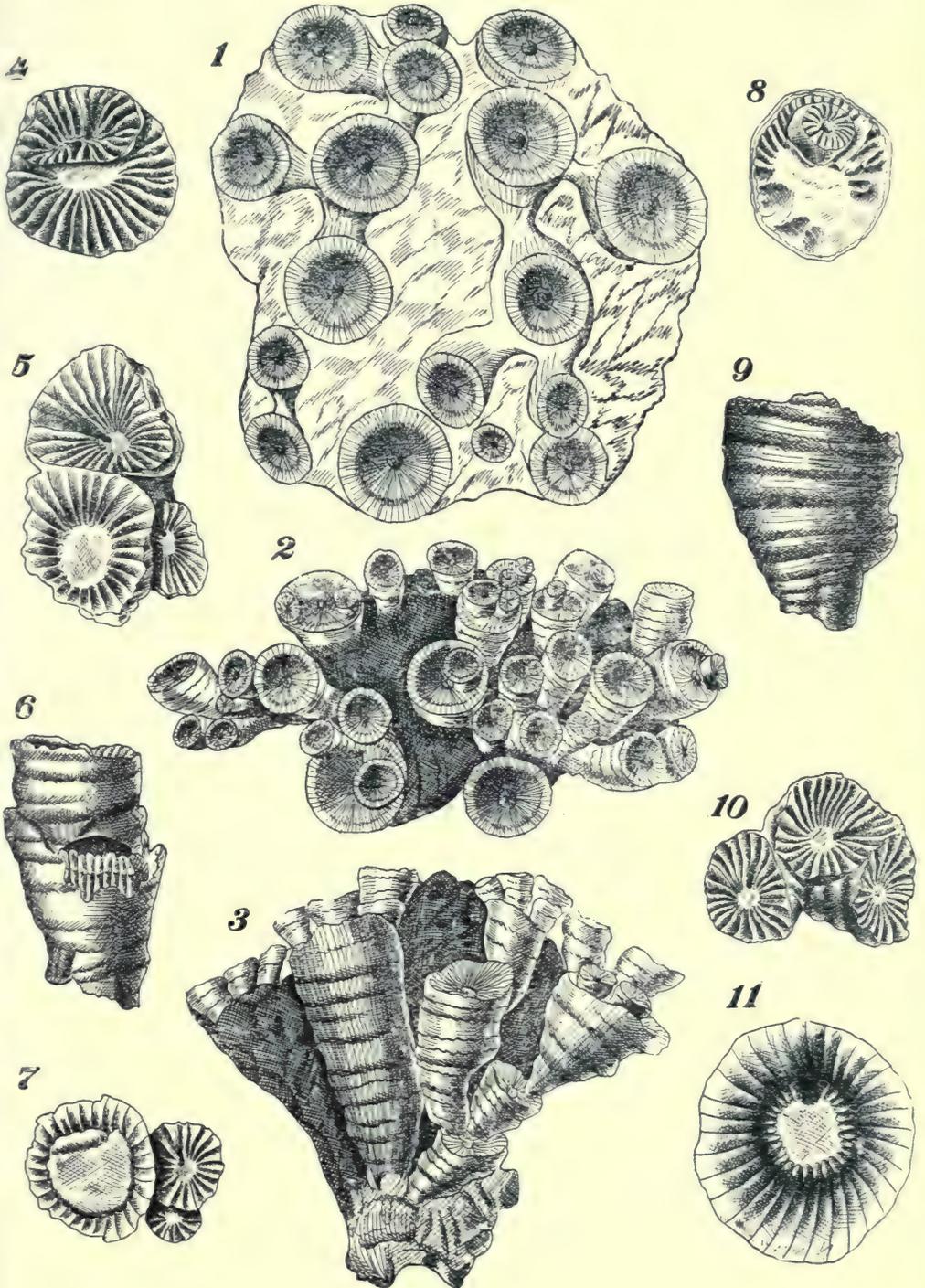




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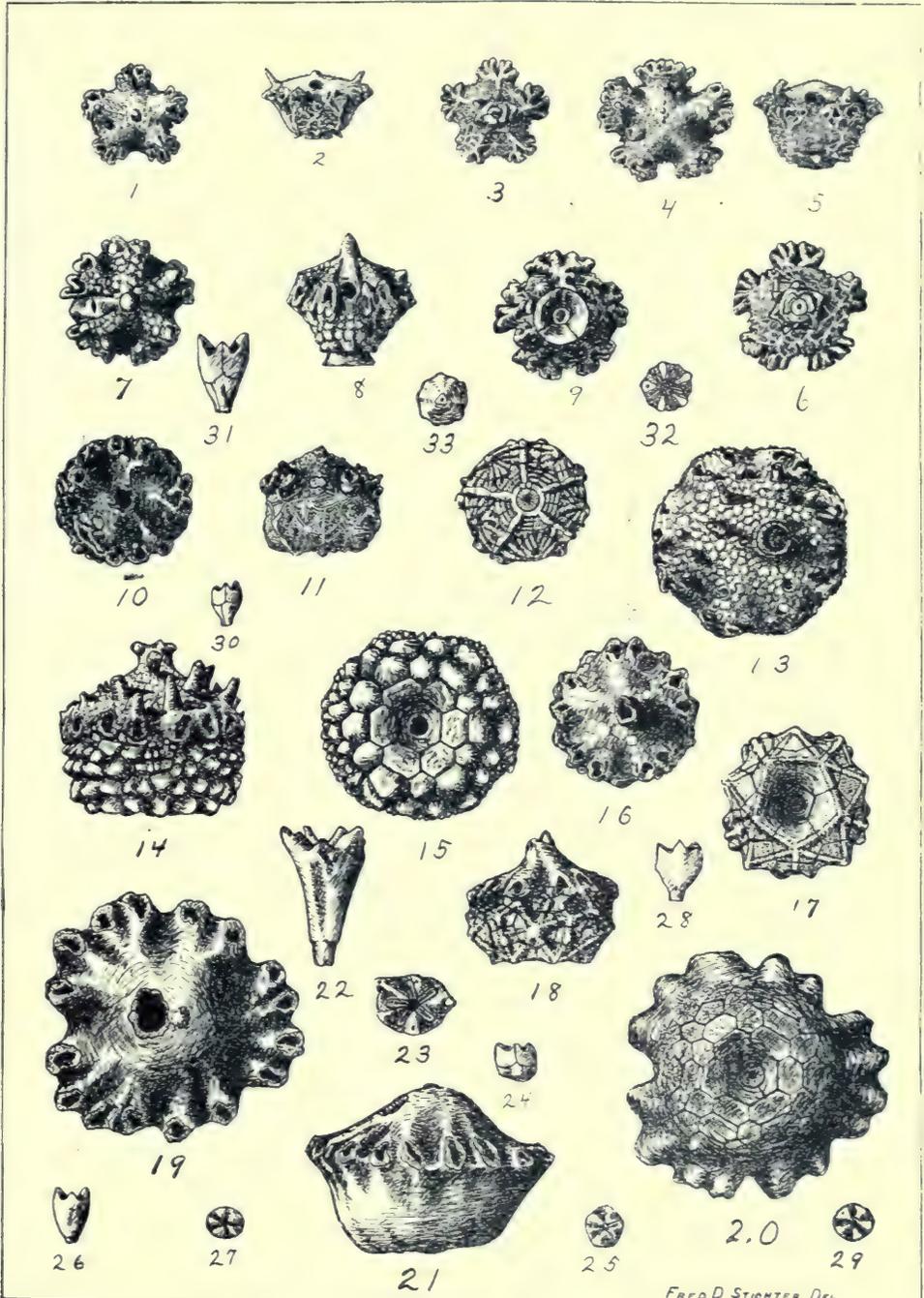
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CONTRIBUTION TO INDIANA PALÆONTOLOGY.

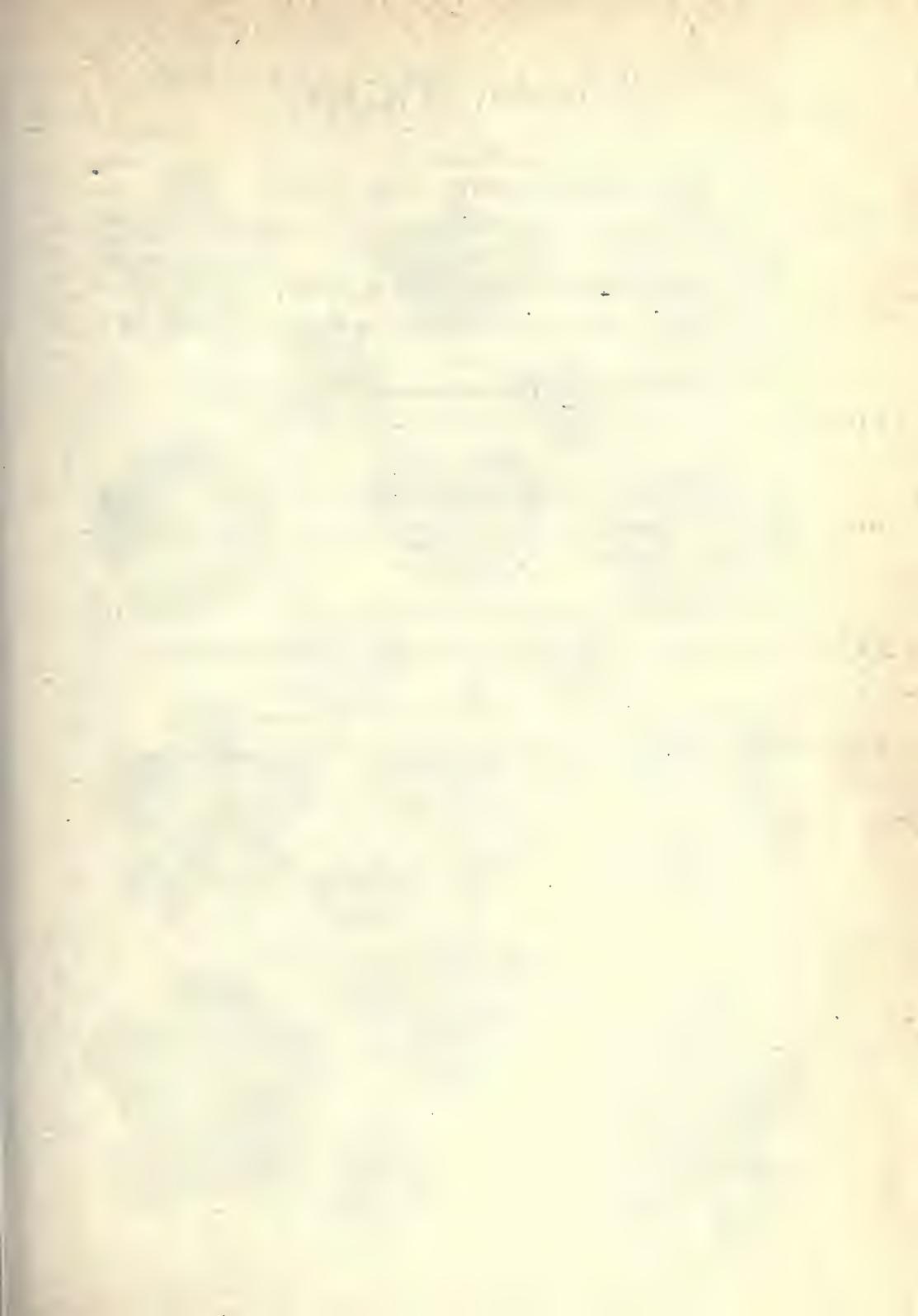
PART 11.

PL. XXXII.



FRED D. STIGHTER DEL.





## EXPLANATION OF PLATES.

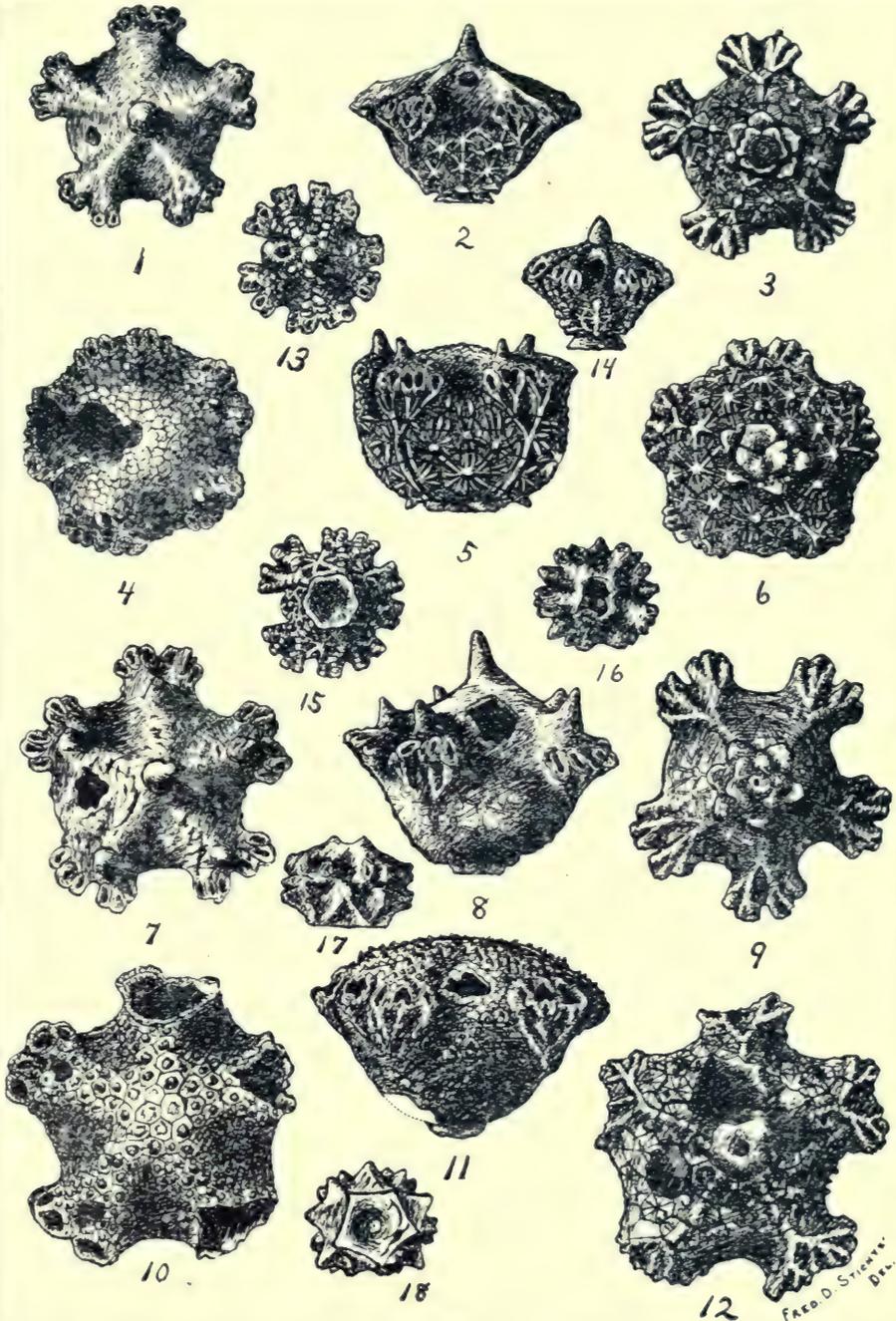
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CONTRIBUTION TO INDIANA PALÆONTOLOGY.

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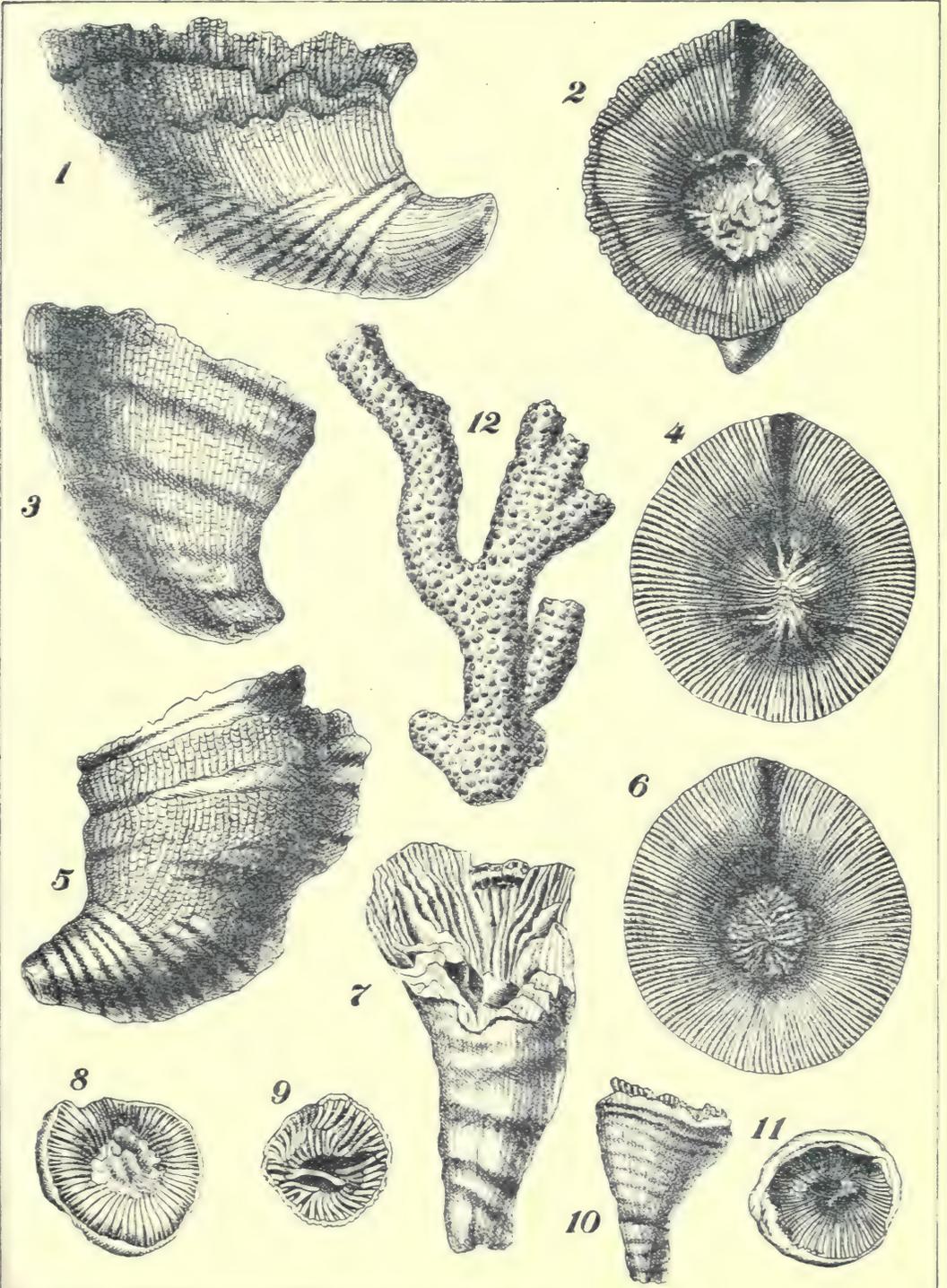
# EXPLANATION OF PLATES.

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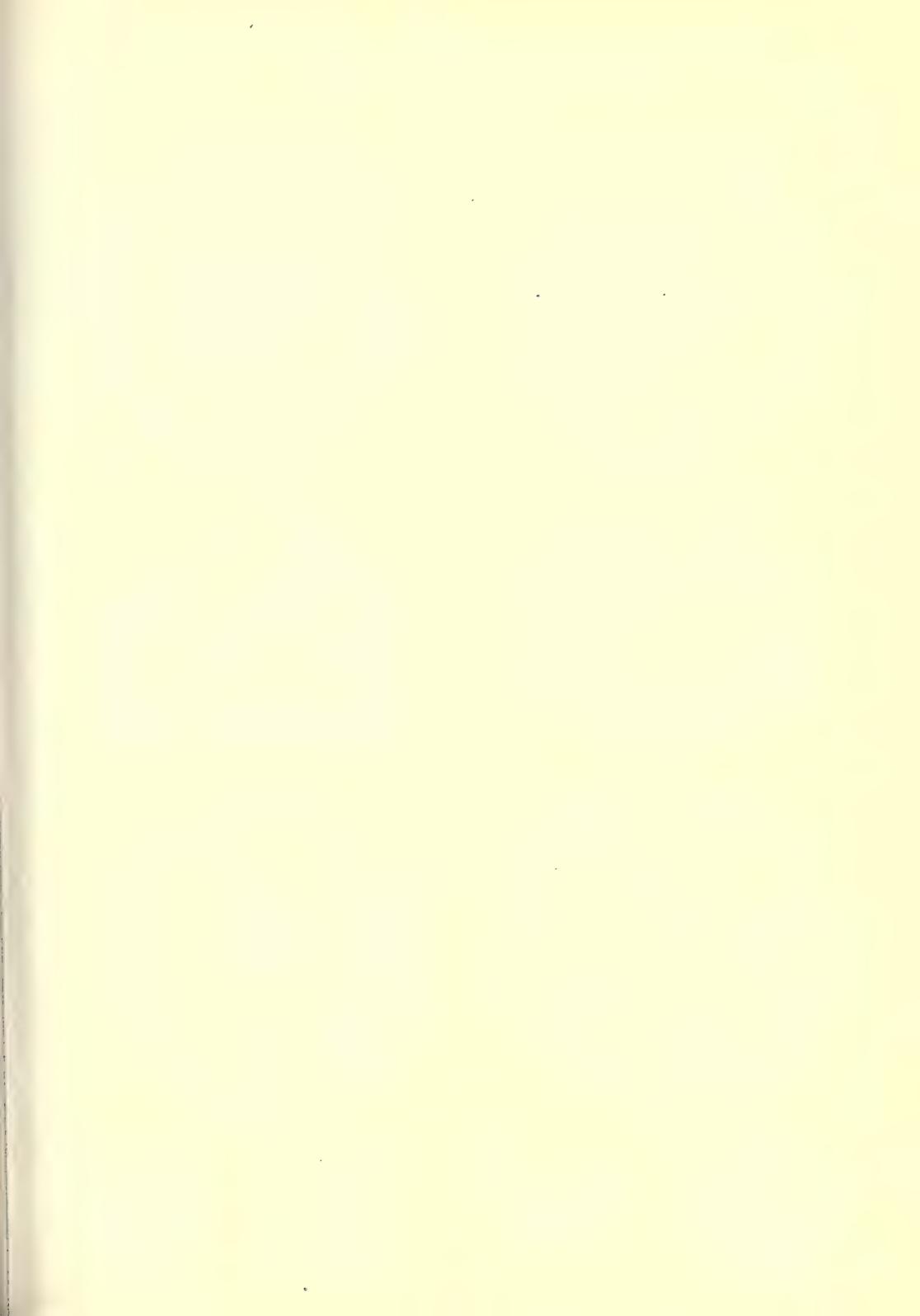
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 This drawing is not satisfactory, and will appear again in a later number.





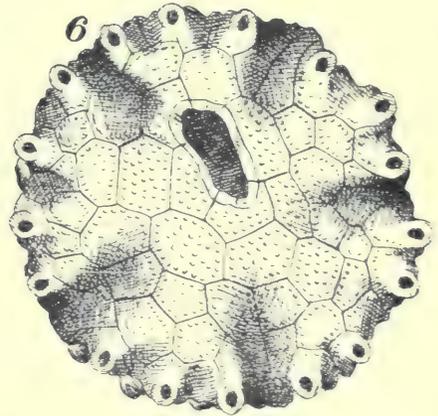
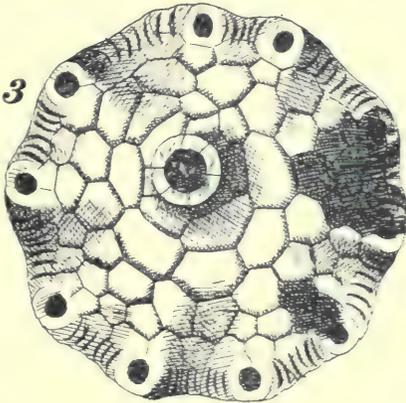
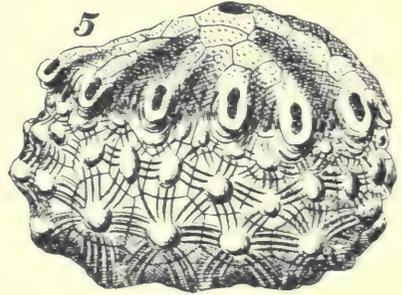
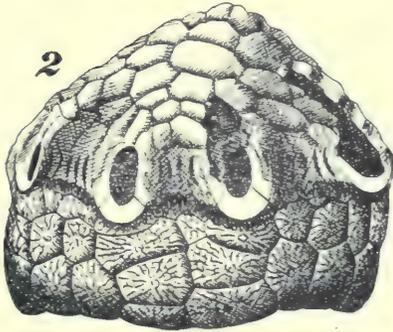
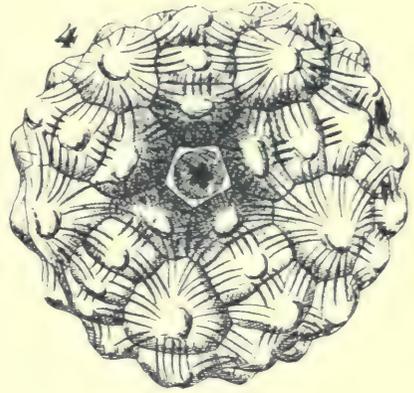
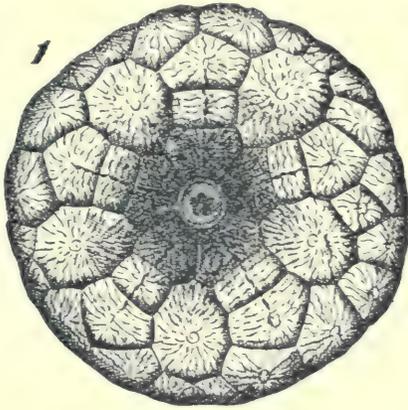


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### PENTREMITES CALYCINUS, Lyon, Rowley.

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### PENTREMITES CONOIDEUS, Hall, Rowley.

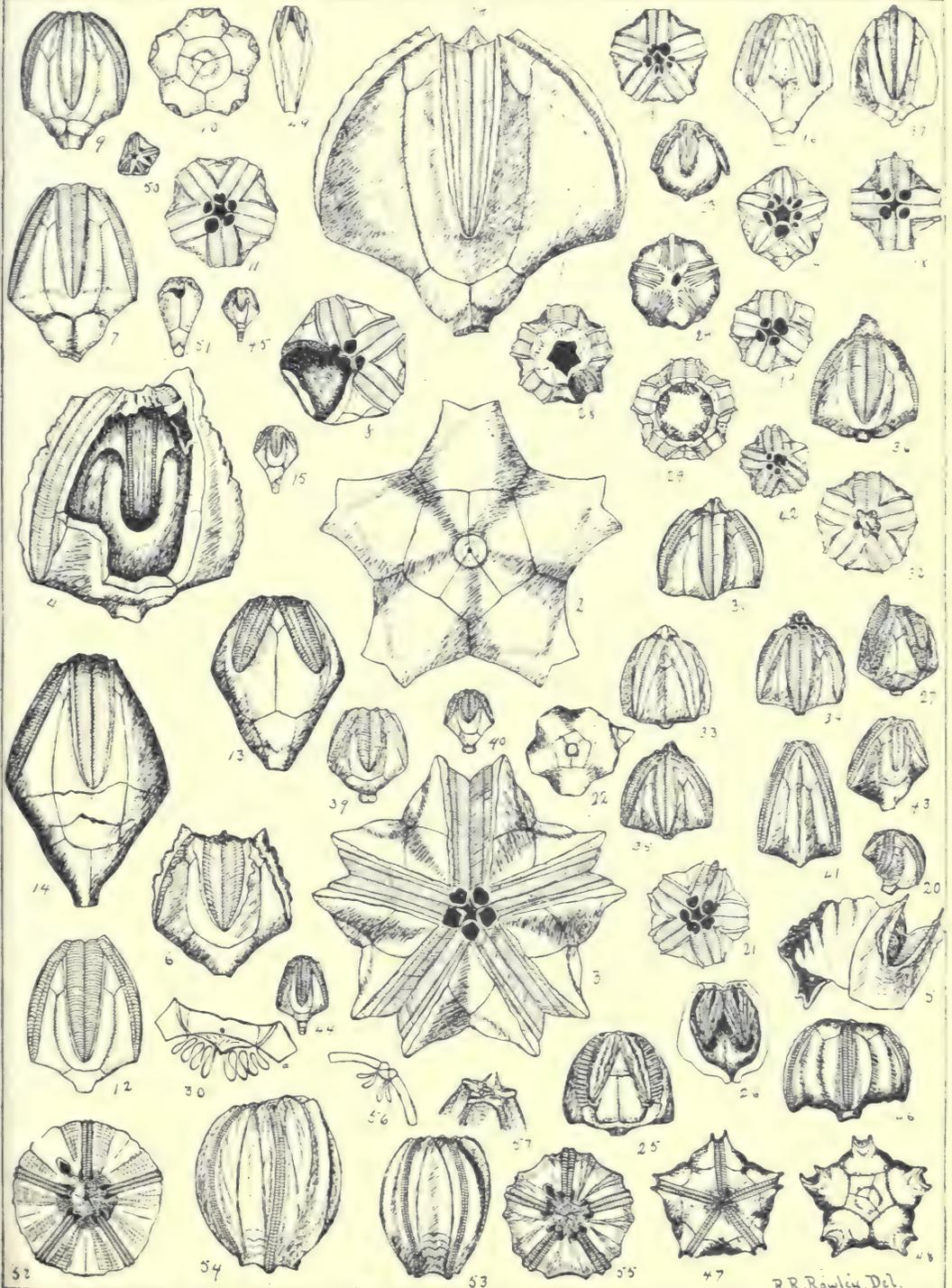
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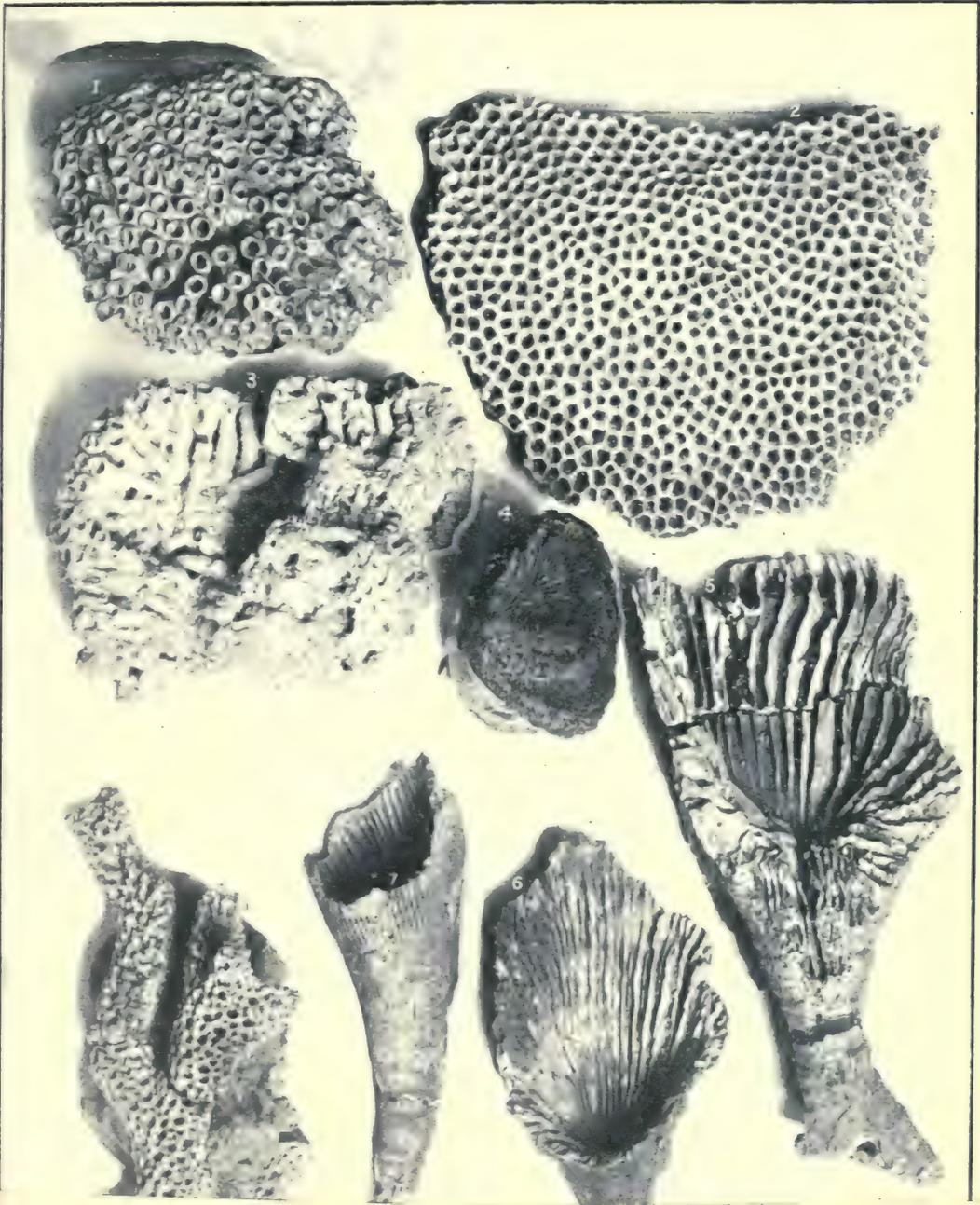
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### MEGISTOCRINUS RUGOSUS, L. & C. Rowley.

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FIGS. 1-2—Basal and side views of a fine specimen.

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FIG. 6—Dorsal view of a large imperfect calyx.

FIG. 11—Basal view of a smaller crushed specimen showing a concave basal region.

---

### DOLATOCRINUS ARROSUS? M. & G. Rowley.

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FIGS. 9-10—Dorsal and side views of a small specimen.

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### STEMMATOCRINUS? VERYI, N. Sp. (Rowley)

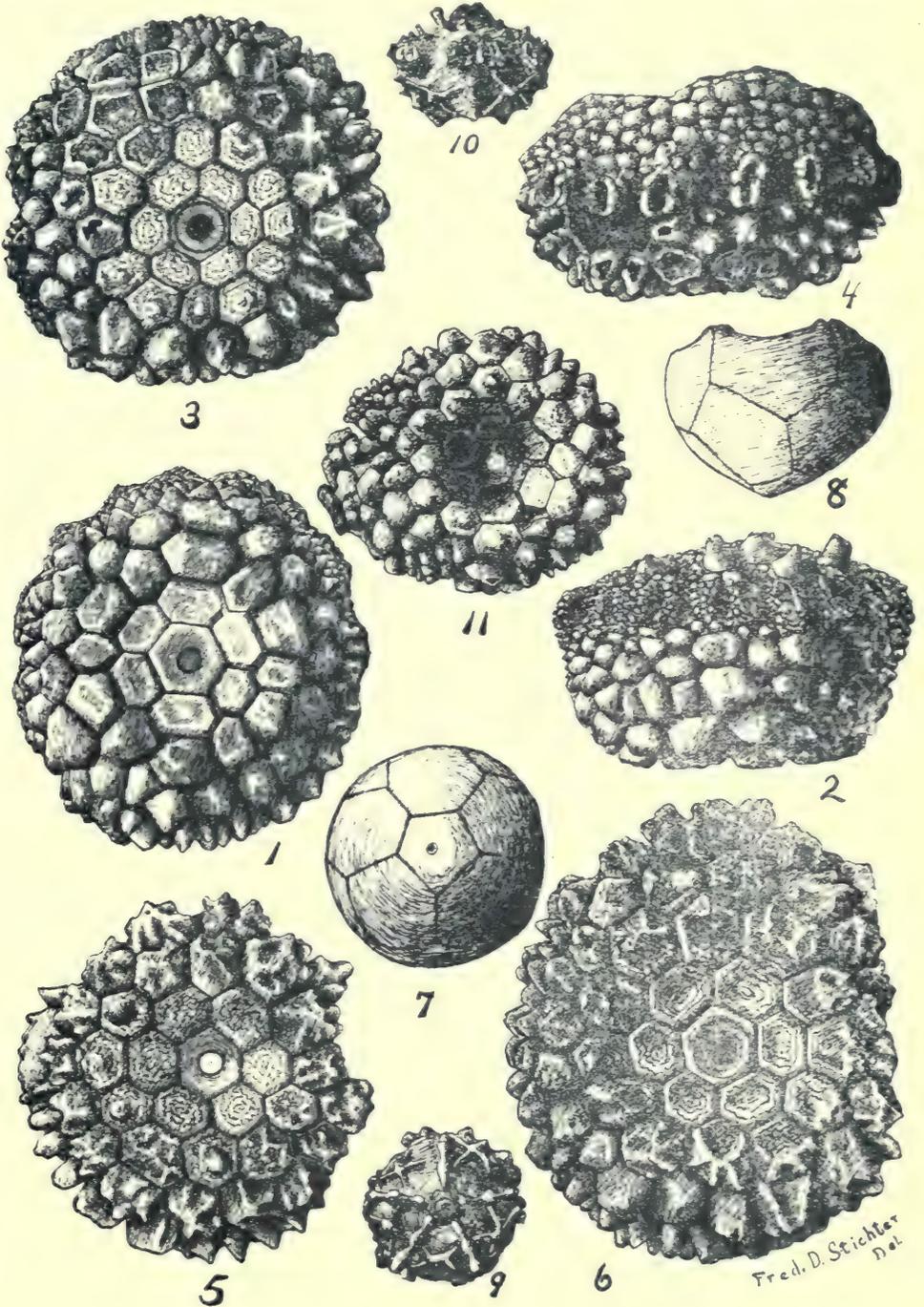
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Del.





# EXPLANATION OF PLATES.

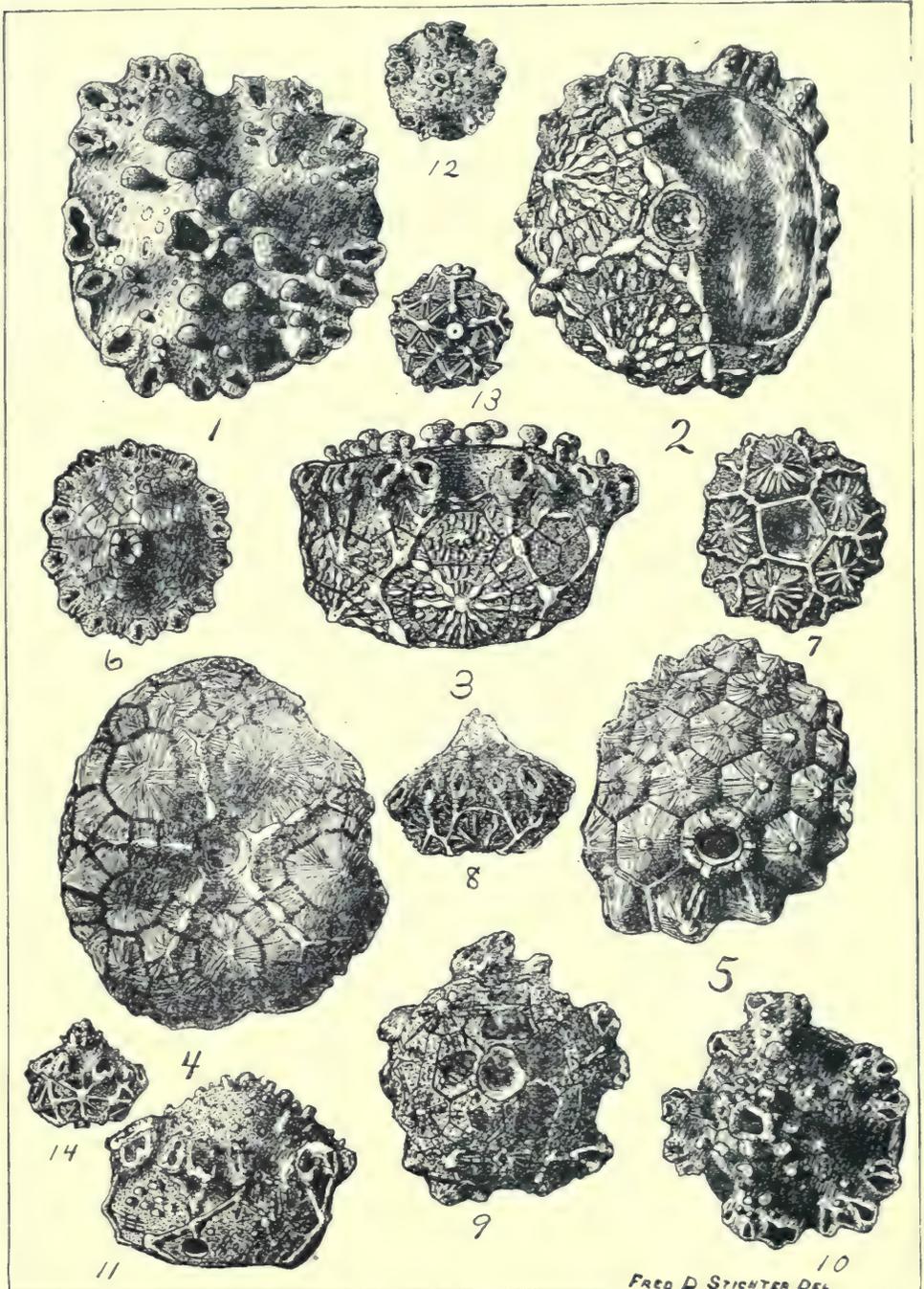
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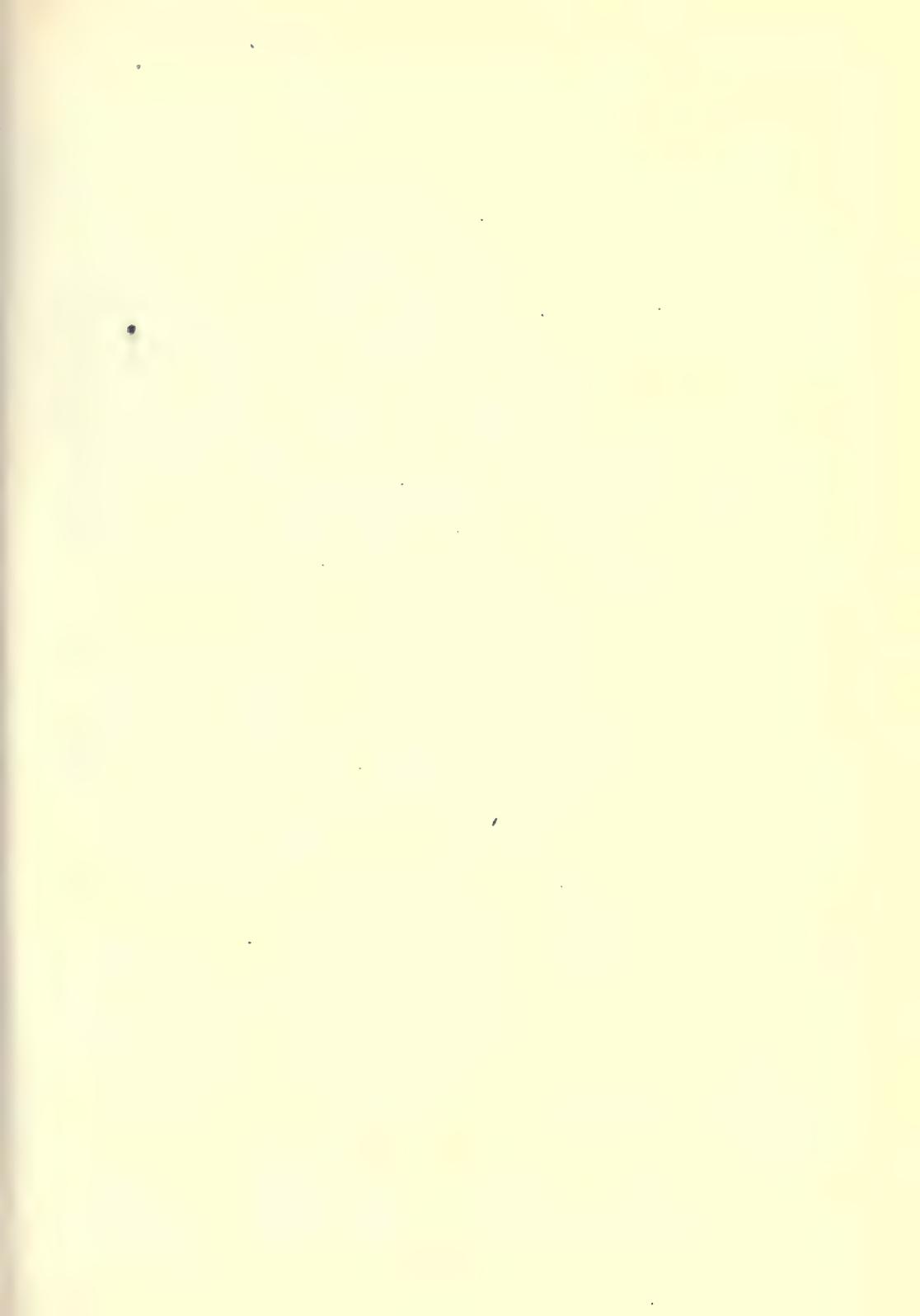
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# EXPLANATION OF PLATES.

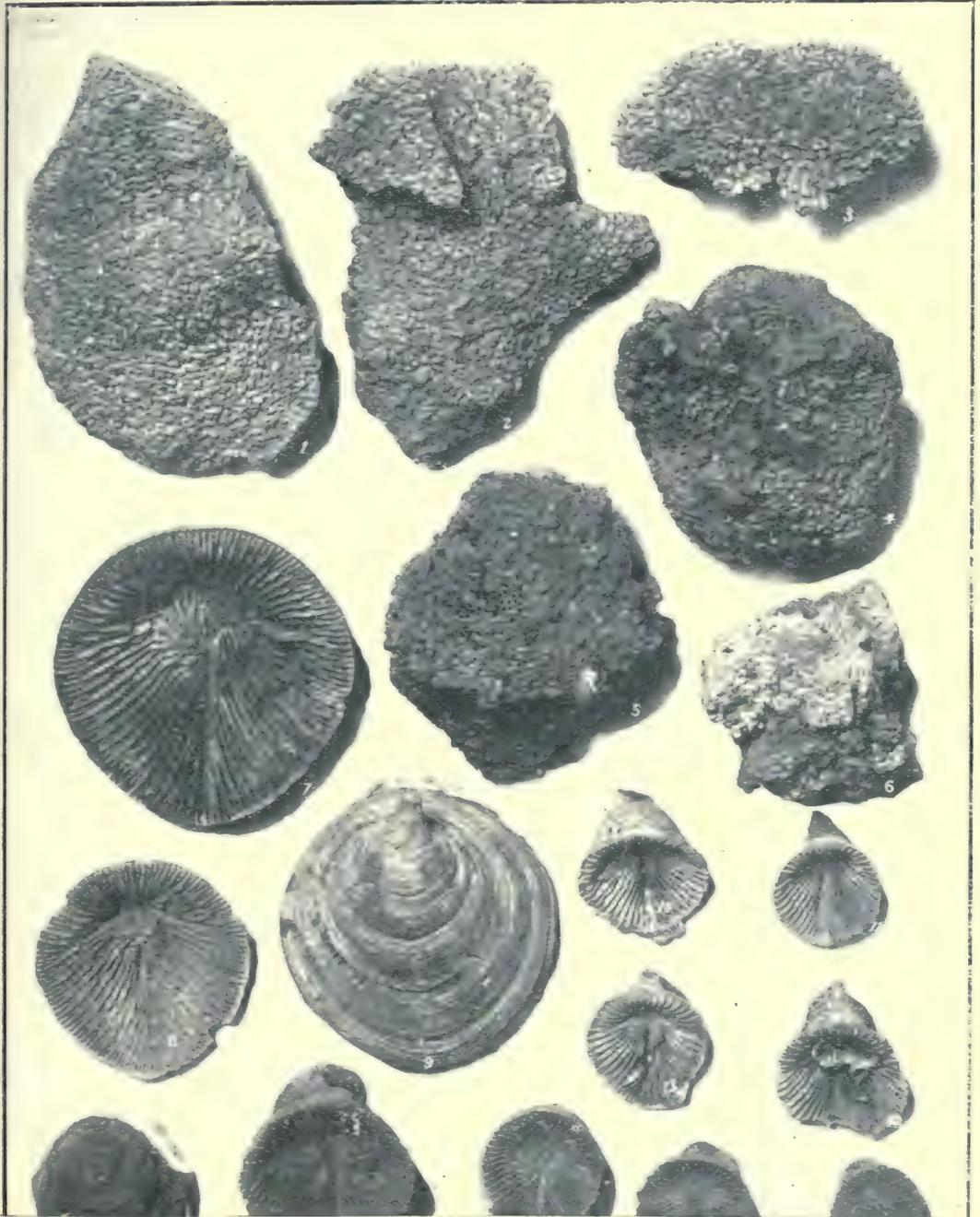
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PL. XL.







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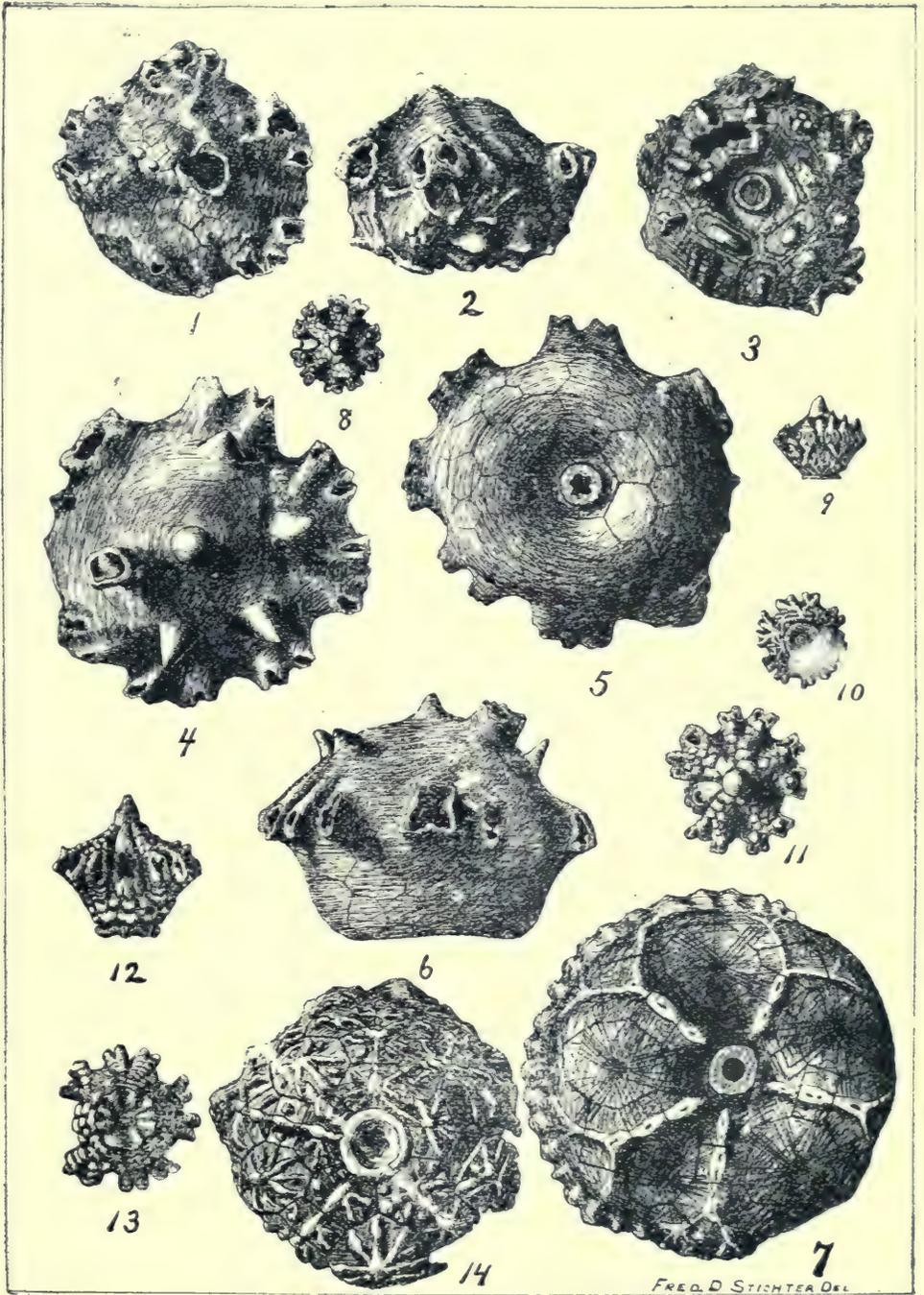
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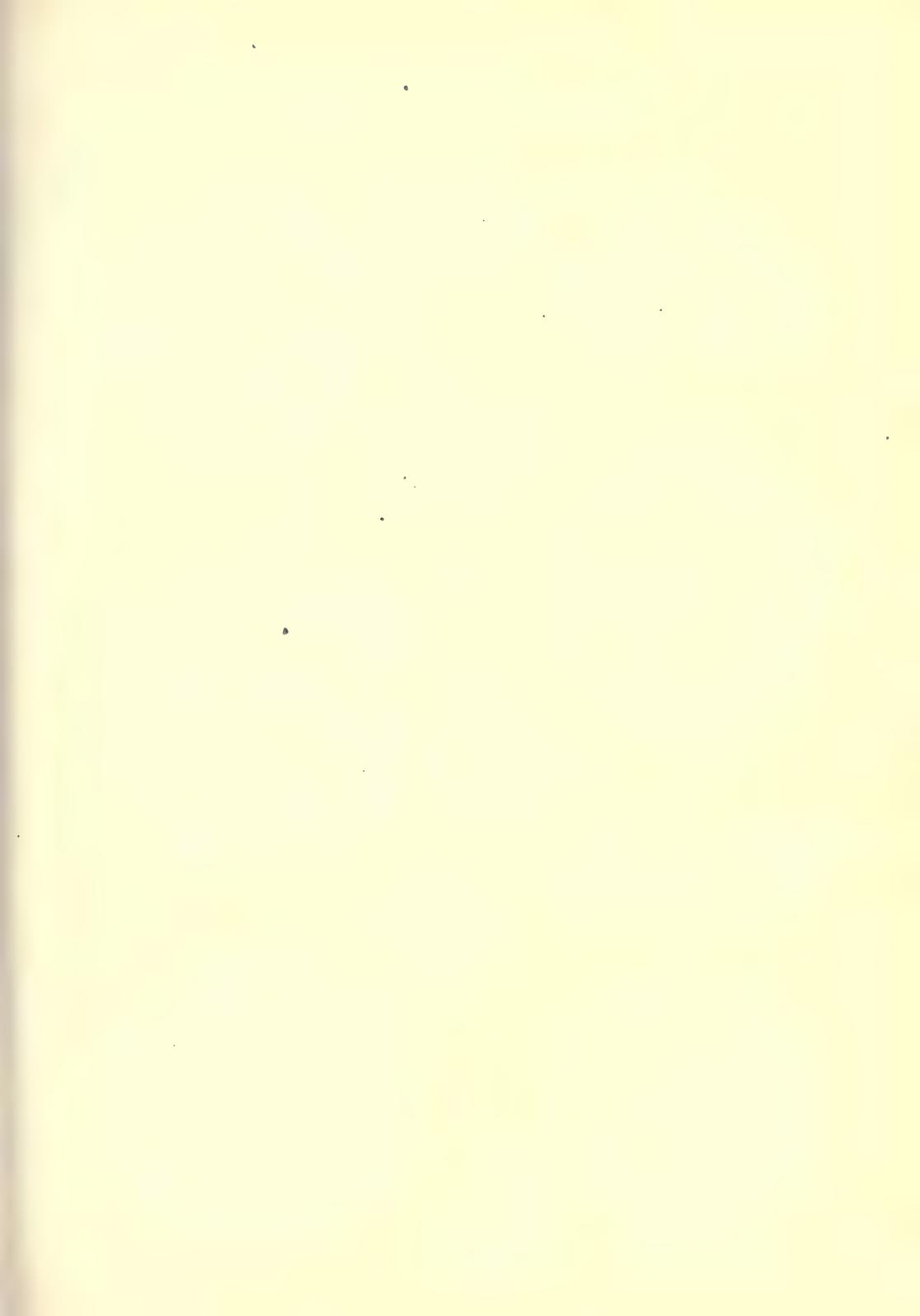
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PL. XLI.



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## EXPLANATION OF PLATES.

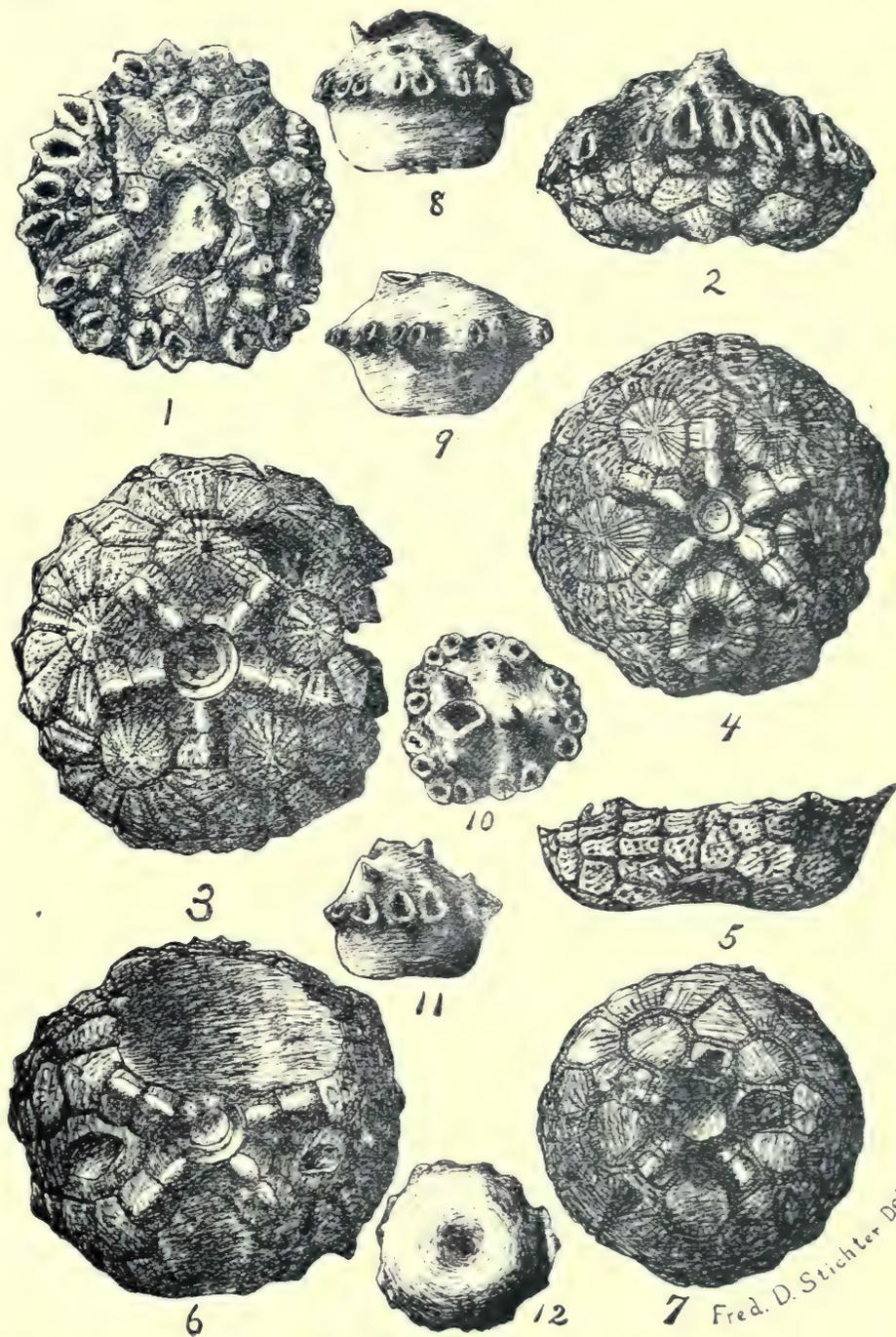
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PLATE 43.

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HELIOPHYLLUM CONGLOMERATUM, N. Sp.

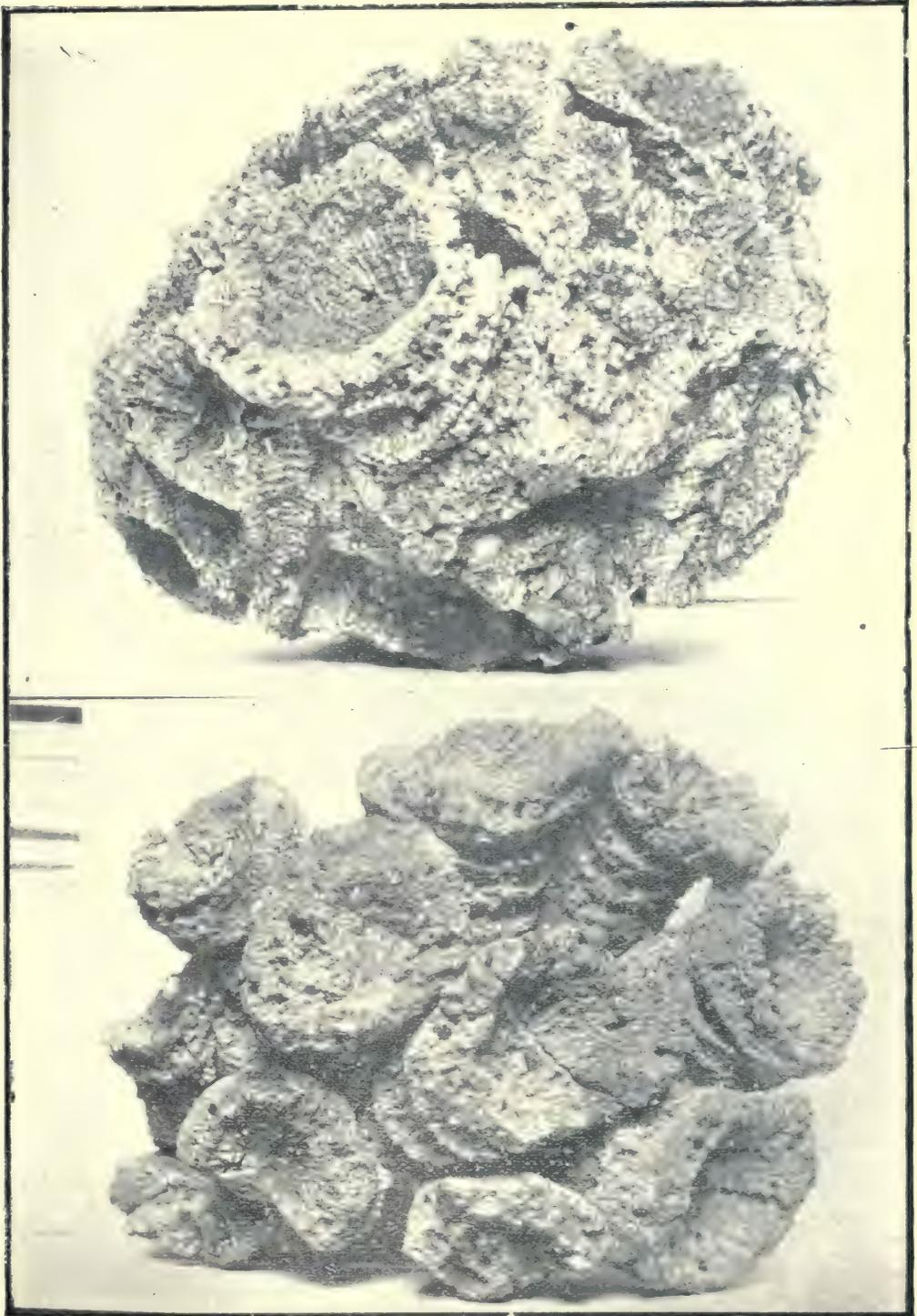
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—  
UPPER FIGURE—Ventral view of a large corallum.

—  
HELIOPHYLLUM CONGREGATUM, N. Sp.

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—  
LOWER FIGURE—Ventral view of a large corallum.







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### DOLATOCRINUS MULTINODOSUS, N. Sp. (Rowley)

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FIG. 1—Basal view of the type specimen.

FIG. 2—Ventral view of the same specimen.

FIG. 3—Side view of the same.

### DOLATOCRINUS CORPOROSUS, Var. *Concinnus*, N. Var. (Rowley)

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FIG. 4—Basal view of the specimen described.

FIG. 5—Ventral view of the same.

FIG. 6—Side view of the same.

### DOLATOCRINUS CORPOROSUS, Var. *Decoratus*, N. Var. (Rowley)

149

FIG. 7—Basal view of the specimen described.

FIG. 8—Ventral view of the same specimen.

FIG. 9—Same, side view.

### DOLATOCRINUS ELEGANTULUS, N. Sp. (Rowley)

150

FIG. 10—Basal view of the type specimen.

FIG. 11—Ventral view of the same.

FIG. 12—Side view of the same.

### DOLATOCRINUS CORBULIFORMIS, N. Sp. (Rowley)

151

FIG. 13—Basal view of type specimen.

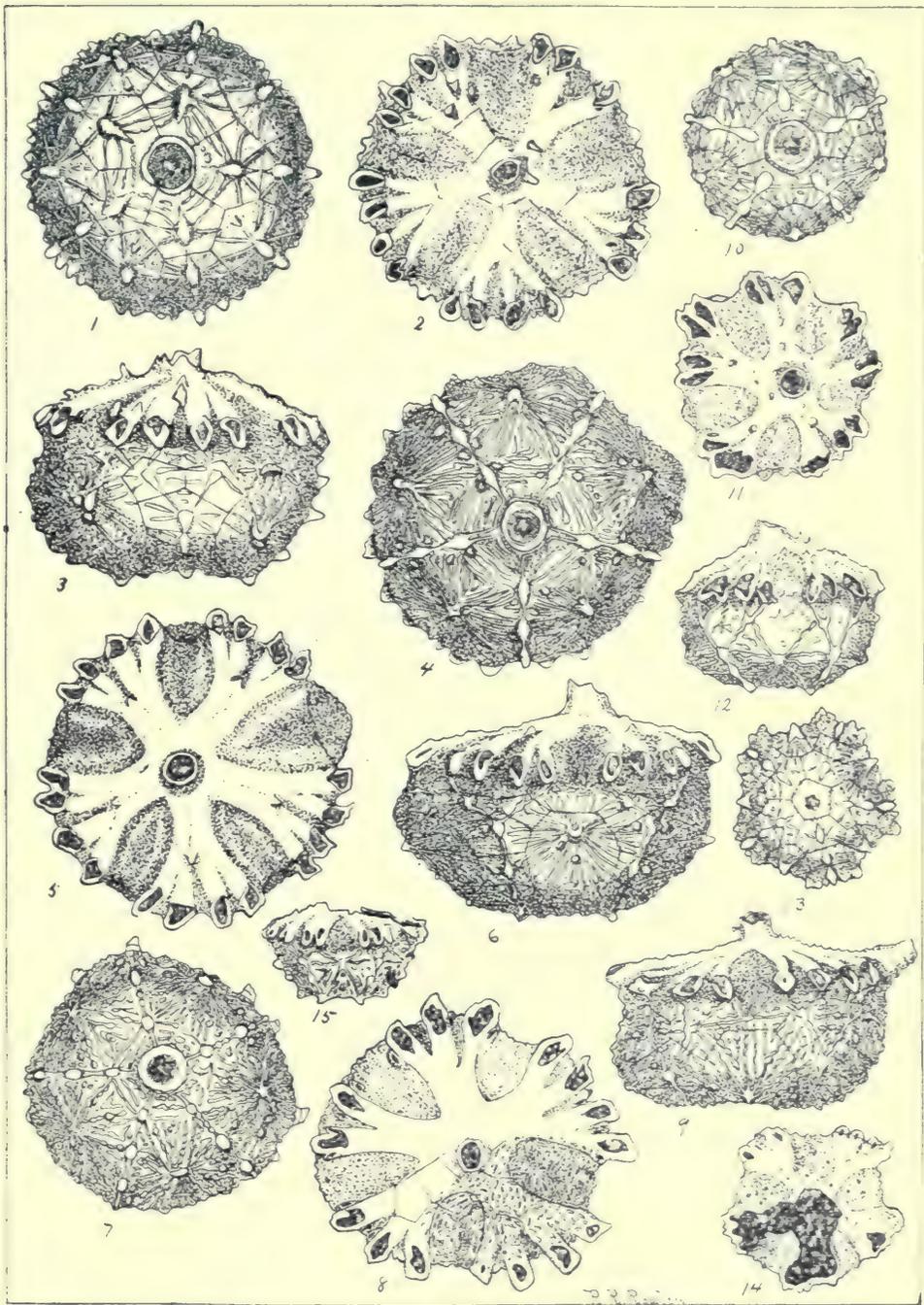
FIG. 14—Ventral view of same.

FIG. 15—Side view of the same.

CONTRIBUTION TO INDIANA PALÆONTOLOGY.

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DOLATOCRINUS PRECIOSUS, M. & G. Rowley.

152 and 153

—  
FIGS. 1-2-3—Dorsal, side and ventral views of a splendid specimen.

FIGS. 4-5-6—Similar views of a larger, 16 armed specimen.

—  
DOLATOCRINUS CHARLESTOWNENSIS, M. & G. Rowley.

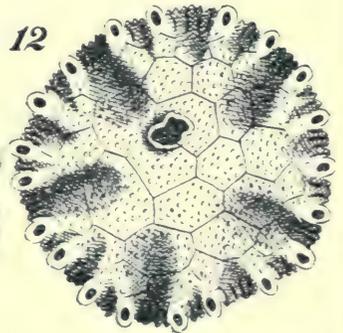
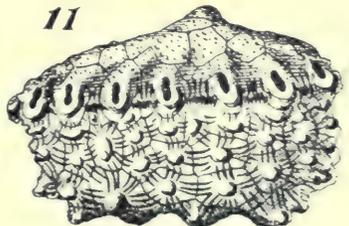
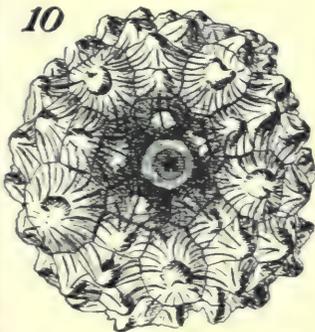
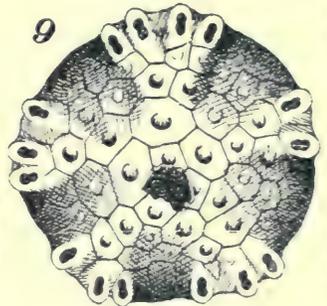
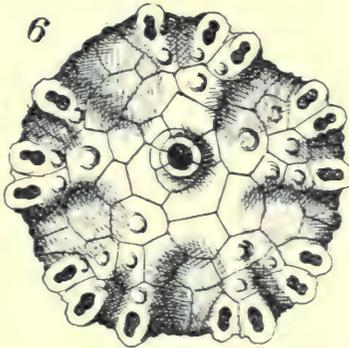
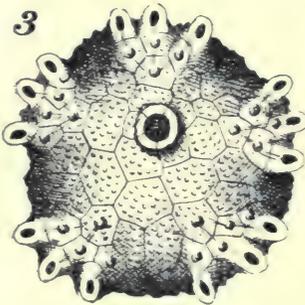
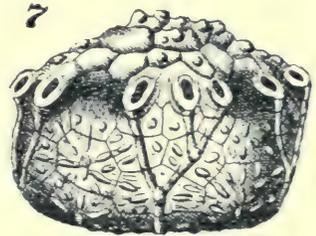
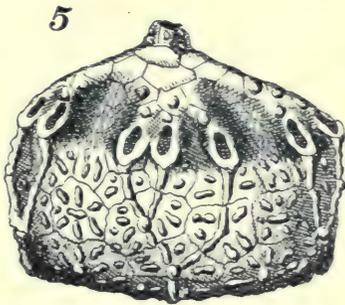
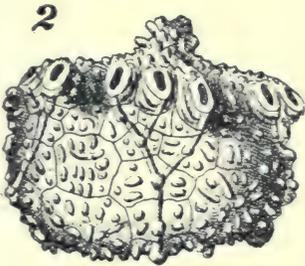
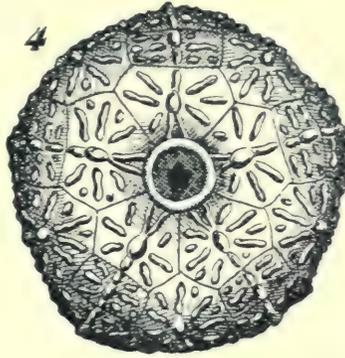
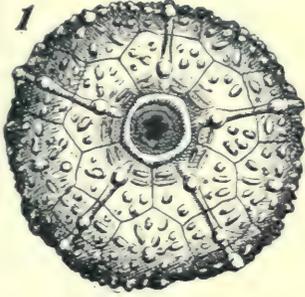
153

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FIGS. 7-8-9—Side, dorsal and ventral views of a specimen.

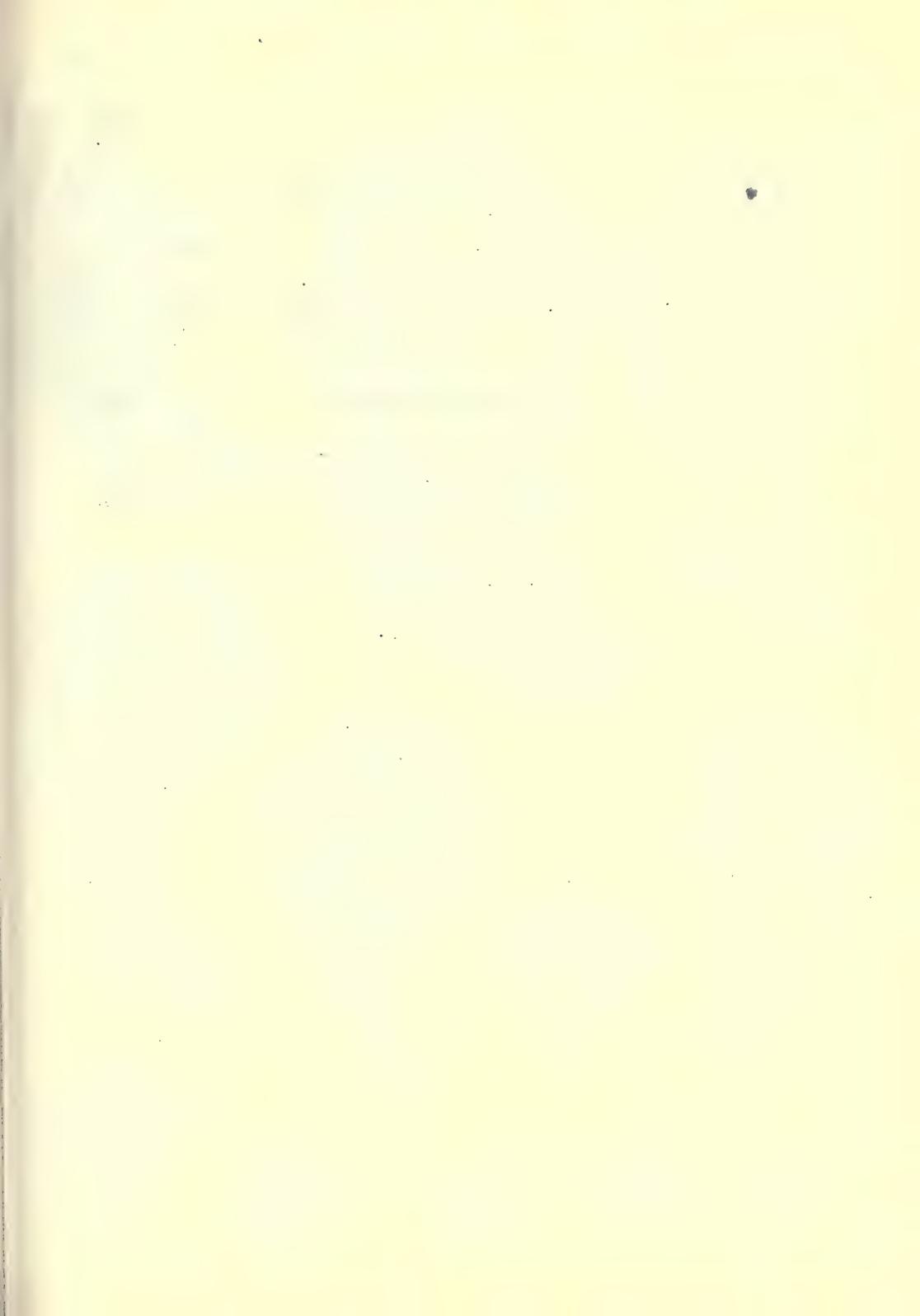
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DOLATOCRINUS AMPLUS? M. & G. Rowley.

154

—  
FIGS. 10-11-12—Dorsal, side and ventral views of a fine specimen.







# EXPLANATION OF PLATES.

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## PLATE 46.

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### BLOTHROPHYLLUM HOUGHTONI.

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FIG. 1—Lateral view of a large corallum, from the Hamilton group of Genessee county, New York.

FIGS. 2-3—Lateral views of two specimens, from the Hamilton group, of Clark county, Indiana.

FIG. 4—Anterior view of a small corallum, from the Hamilton group, of Crab Orchard, Kentucky.

### ZAPHRENTIS PROLIXUS, N. Sp.

156

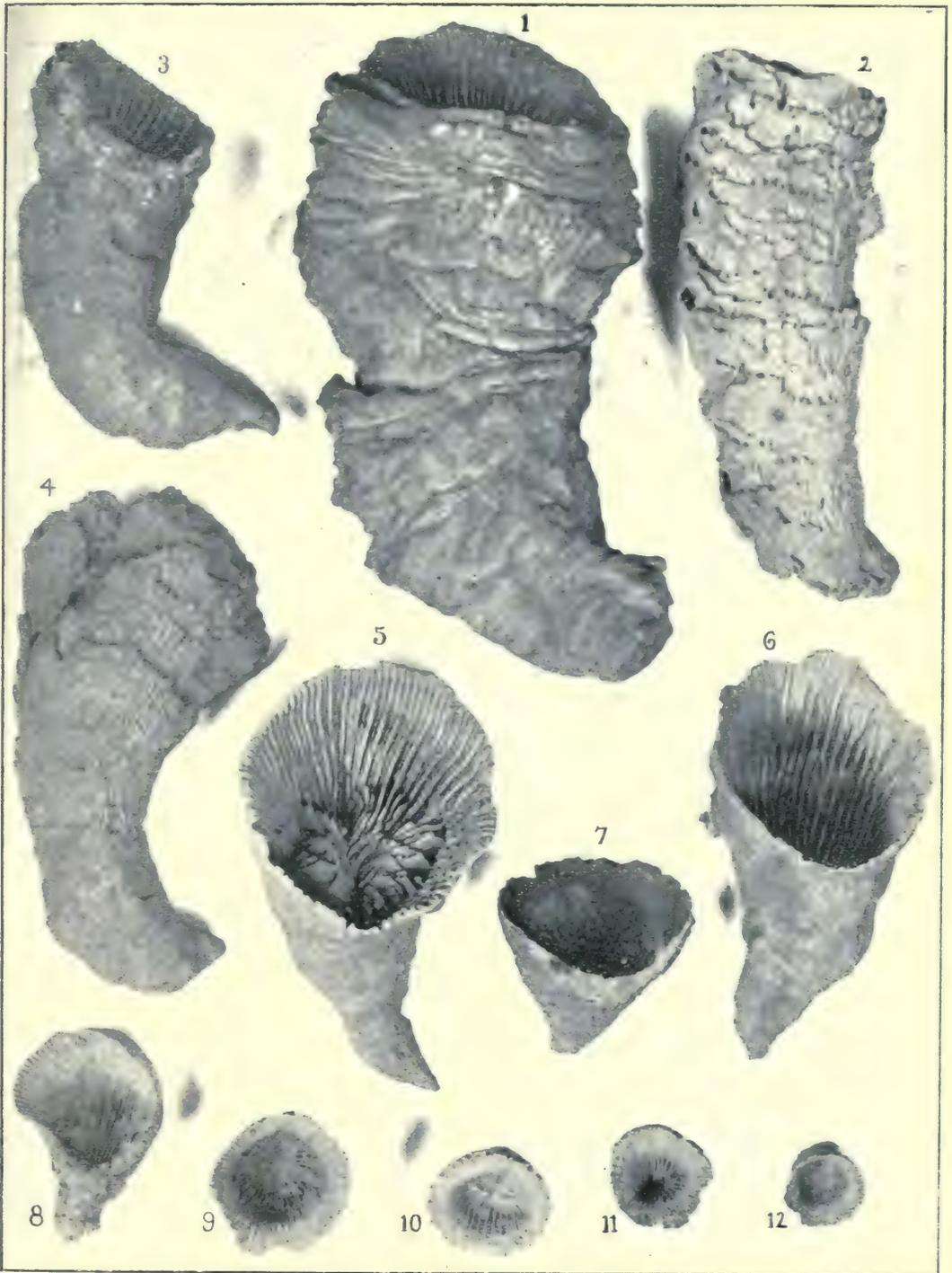
FIGS. 5-6—Posterior views of two corallums. Natural size.

### HELIOPHYLLUM VESICULATUM.

157

FIGS. 7-8—Posterior views exhibiting the calix.

FIGS. 9-10-11-12—Views of the calix of four different corallums.

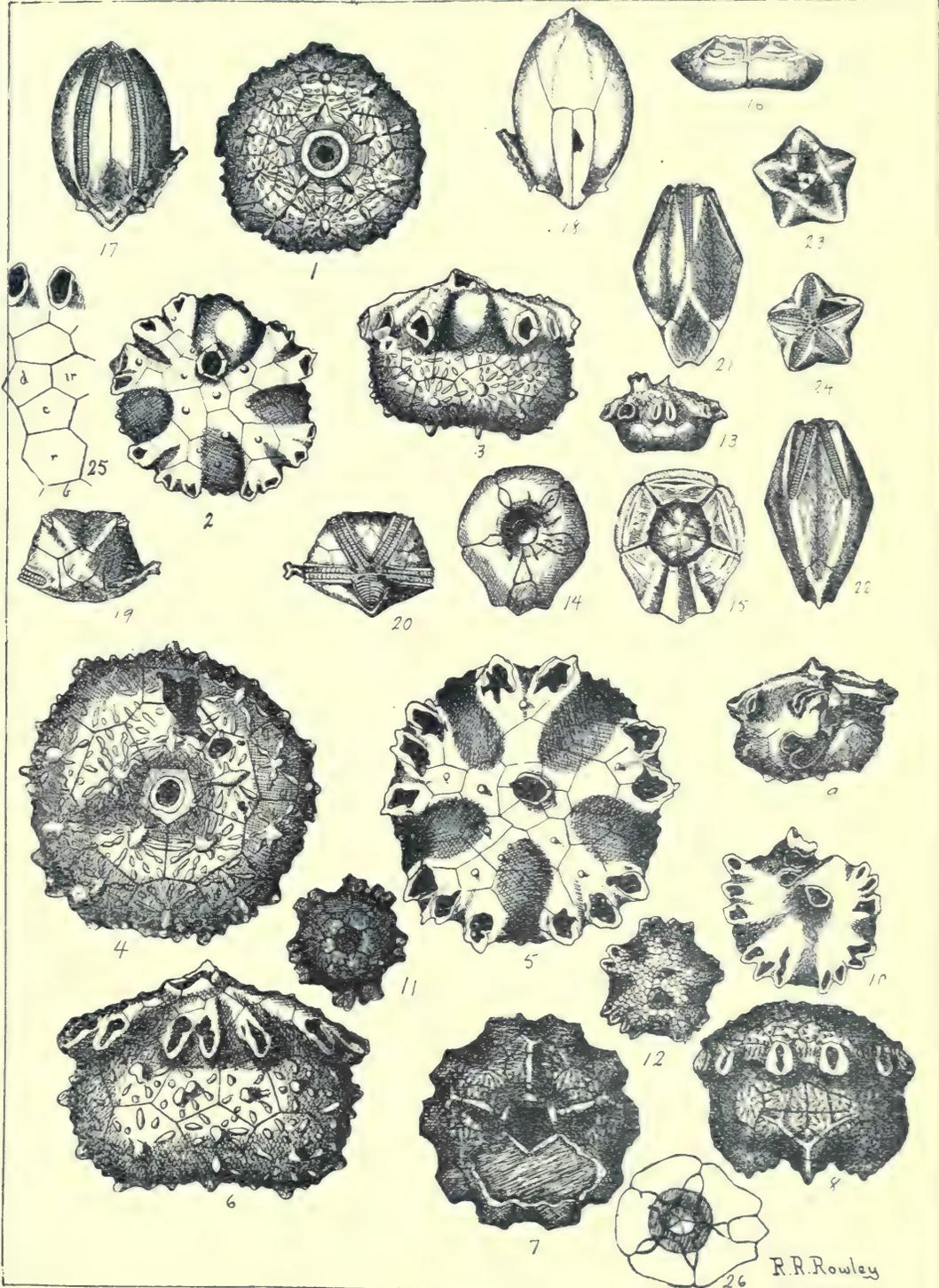






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DOLATOCRINUS NODOSUS, M. & G., Rowley.

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FIGS. 1-2-3—Dorsal, side and ventral views of the same specimen.

DOLATOCRINUS SPINOSUS, M. & G., Rowley.

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FIG. 4—Dorsal view of a four-rayed specimen.

HADROCRINUS PLENISSIMUS, Lyon, Rowley.

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FIGS. 5-6—Inside and outside views of the deeply concave basal region.

DOLATOCRINUS CAELATUS, M. & G., Rowley.

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FIGS. 10-11-12—Dorsal, ventral and side views of a slightly malformed specimen.

MEGISTOCRINUS EXPANSUS, M. & G., Rowley.

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FIGS. 7-8-9—Dorsal, ventral and side views of a large, fine specimen.

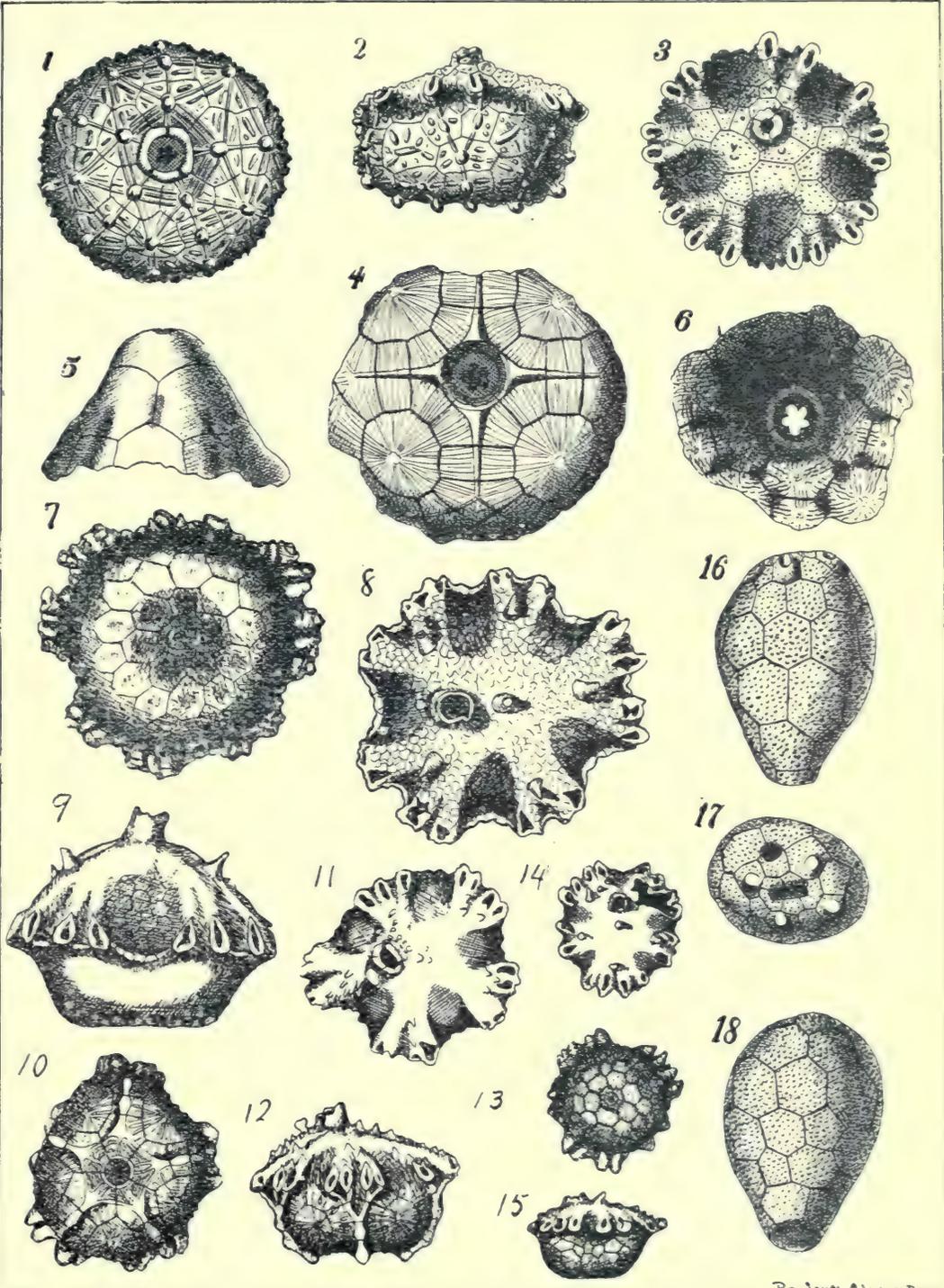
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HOLOCYSTIS <sup>to</sup>PAPULOSUS? M. & G., Rowley.

166

FIGS. 16-17-18—Side and summit views of a fine specimen.

All figures on this plate are of natural size.







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FAVOSITES CLAUSUS, Rominger.

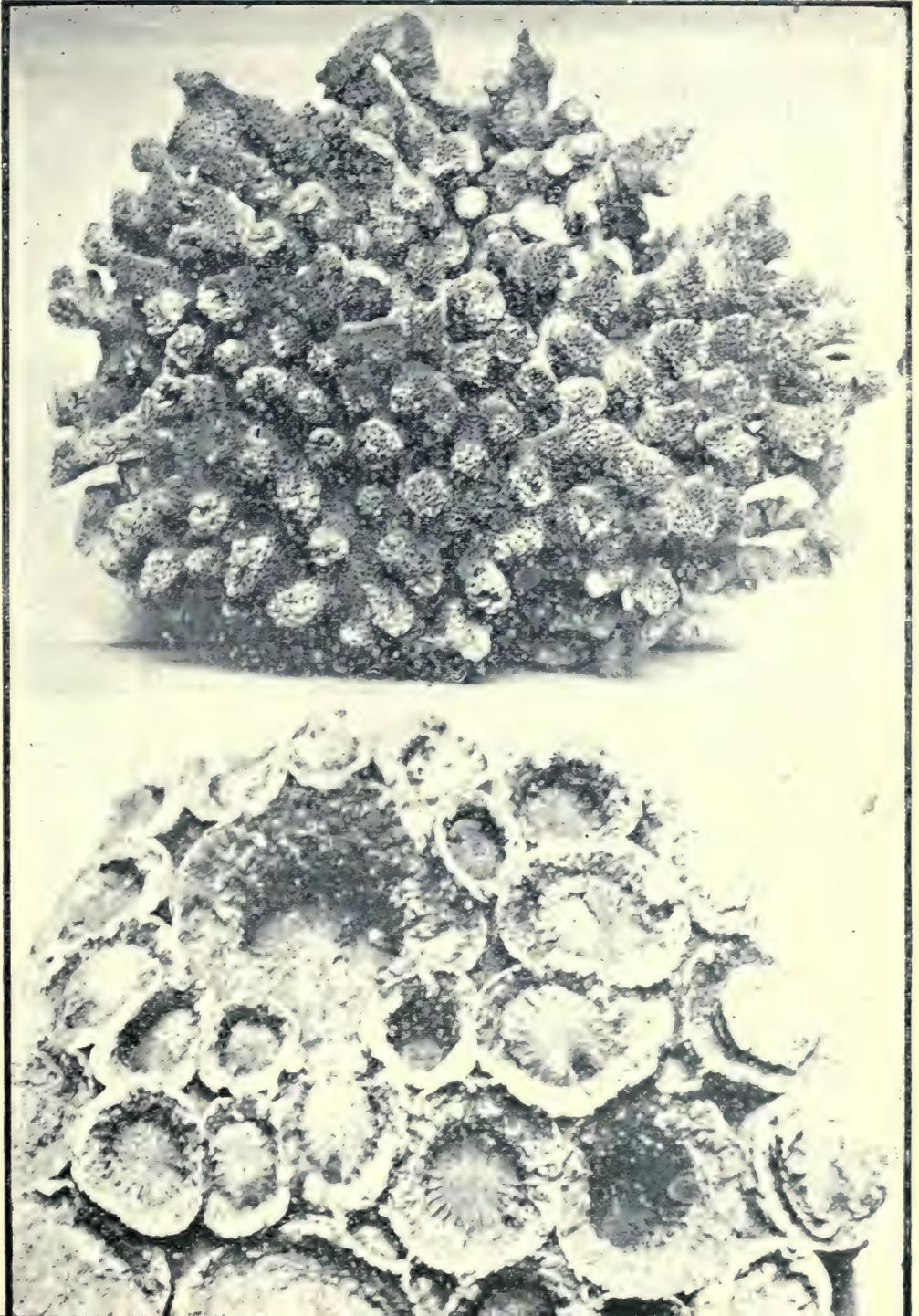
168

—  
Upper figure, ventral view of a large corallum.

—  
LITHODRUMUS VERYI, N. Sp.

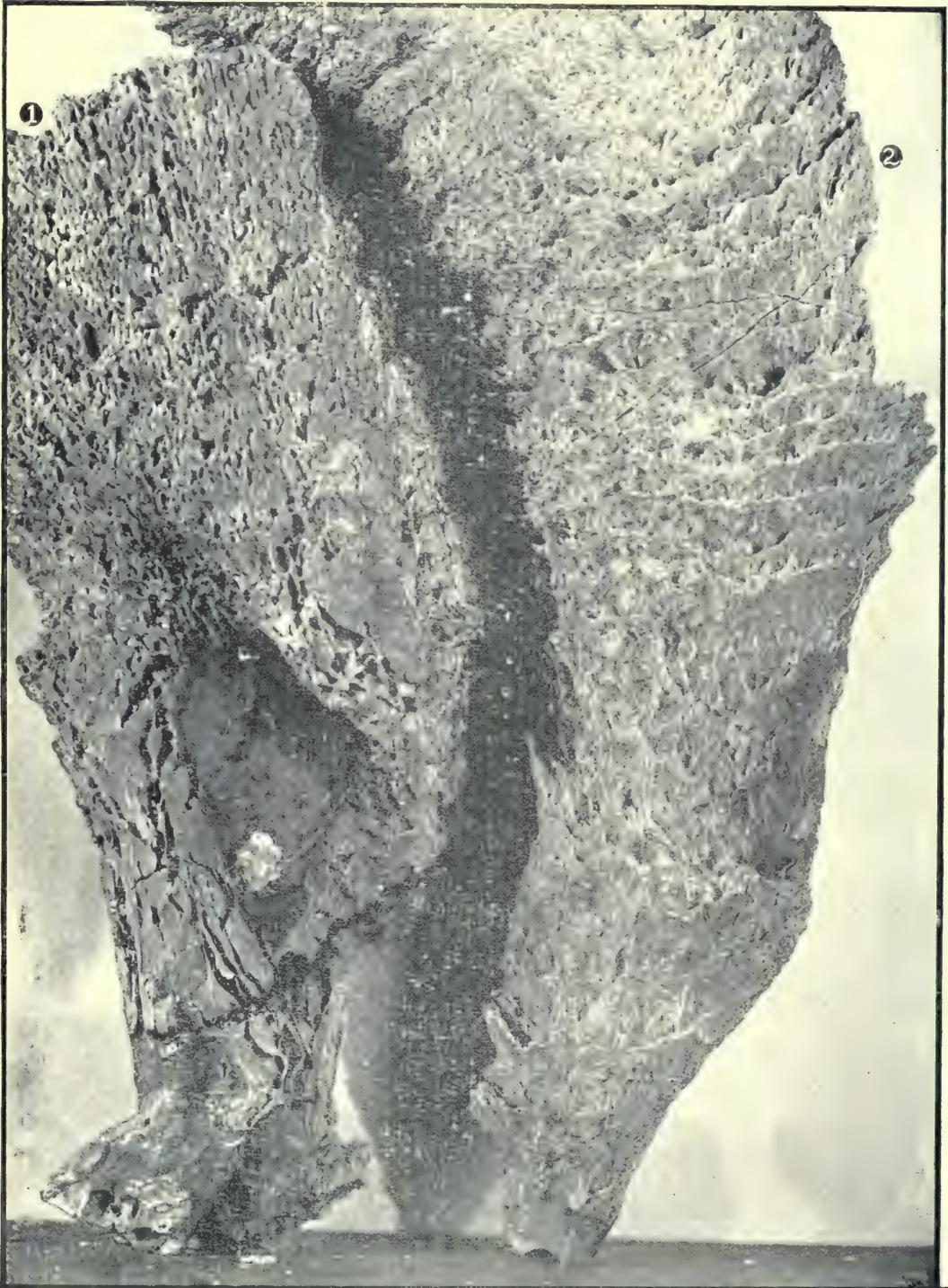
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—  
Lower figure, ventral view of the type specimen.









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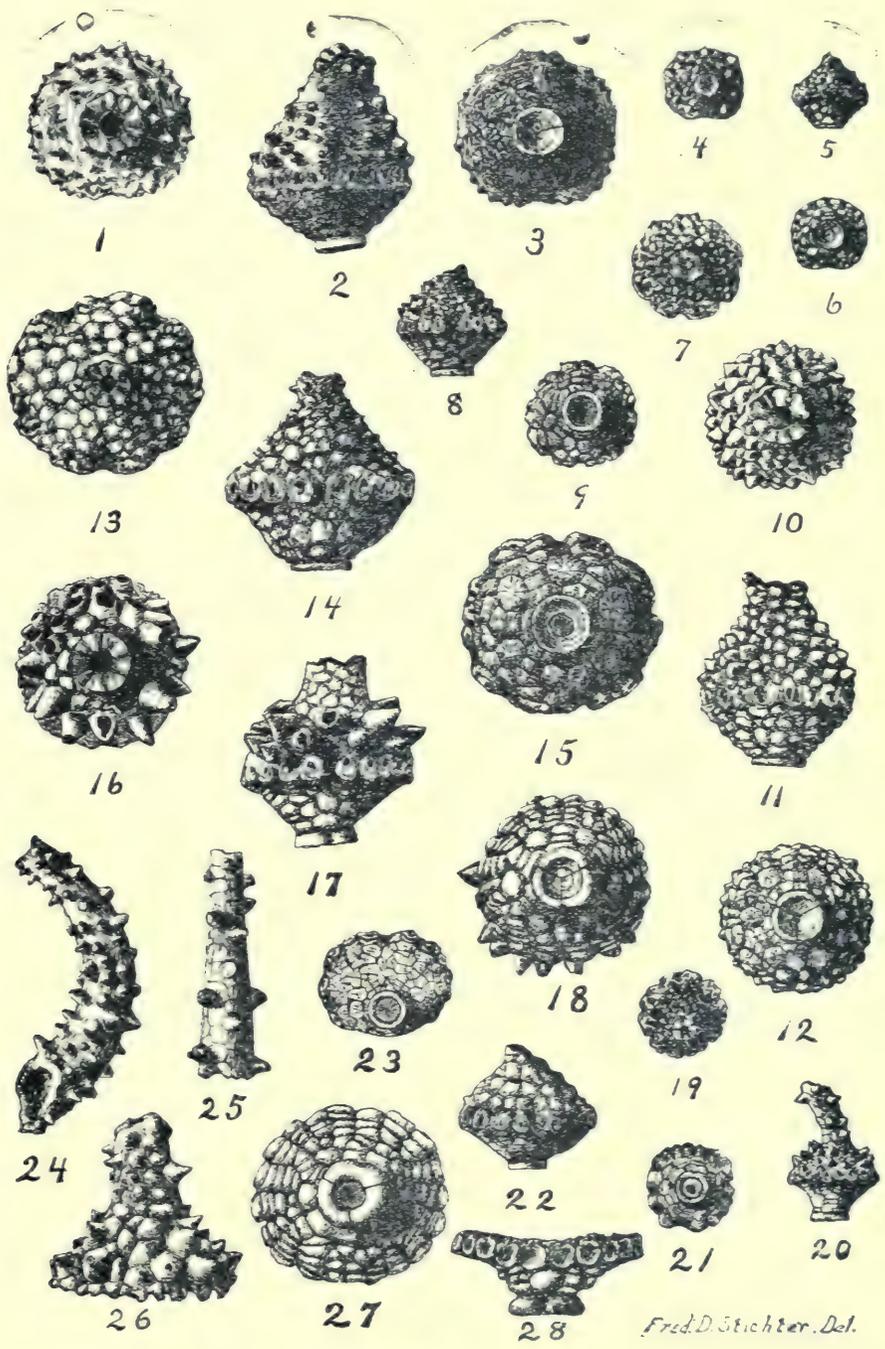
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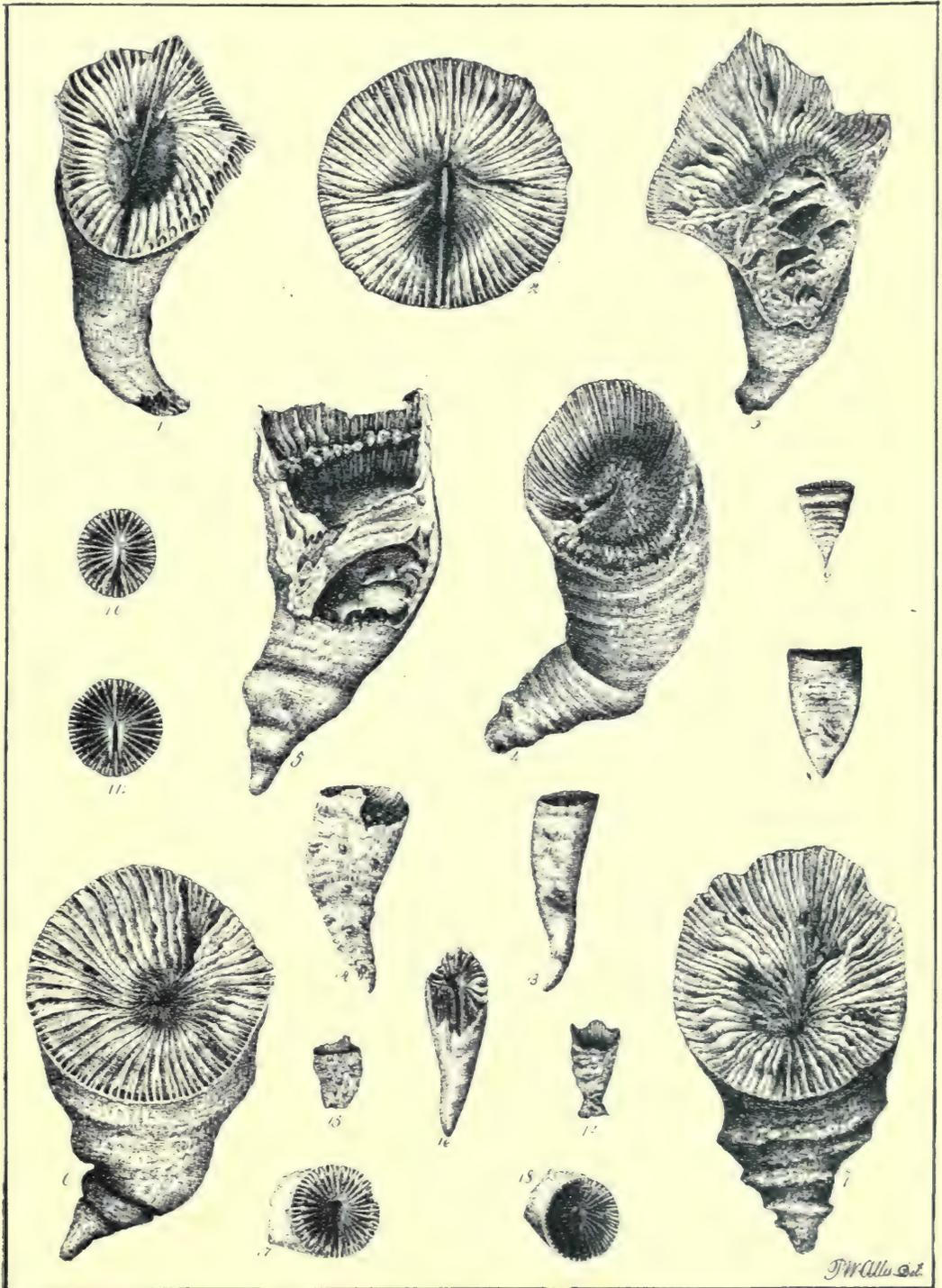
Fred. D. Stichter, Del.





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# EXPLANATION OF PLATES.

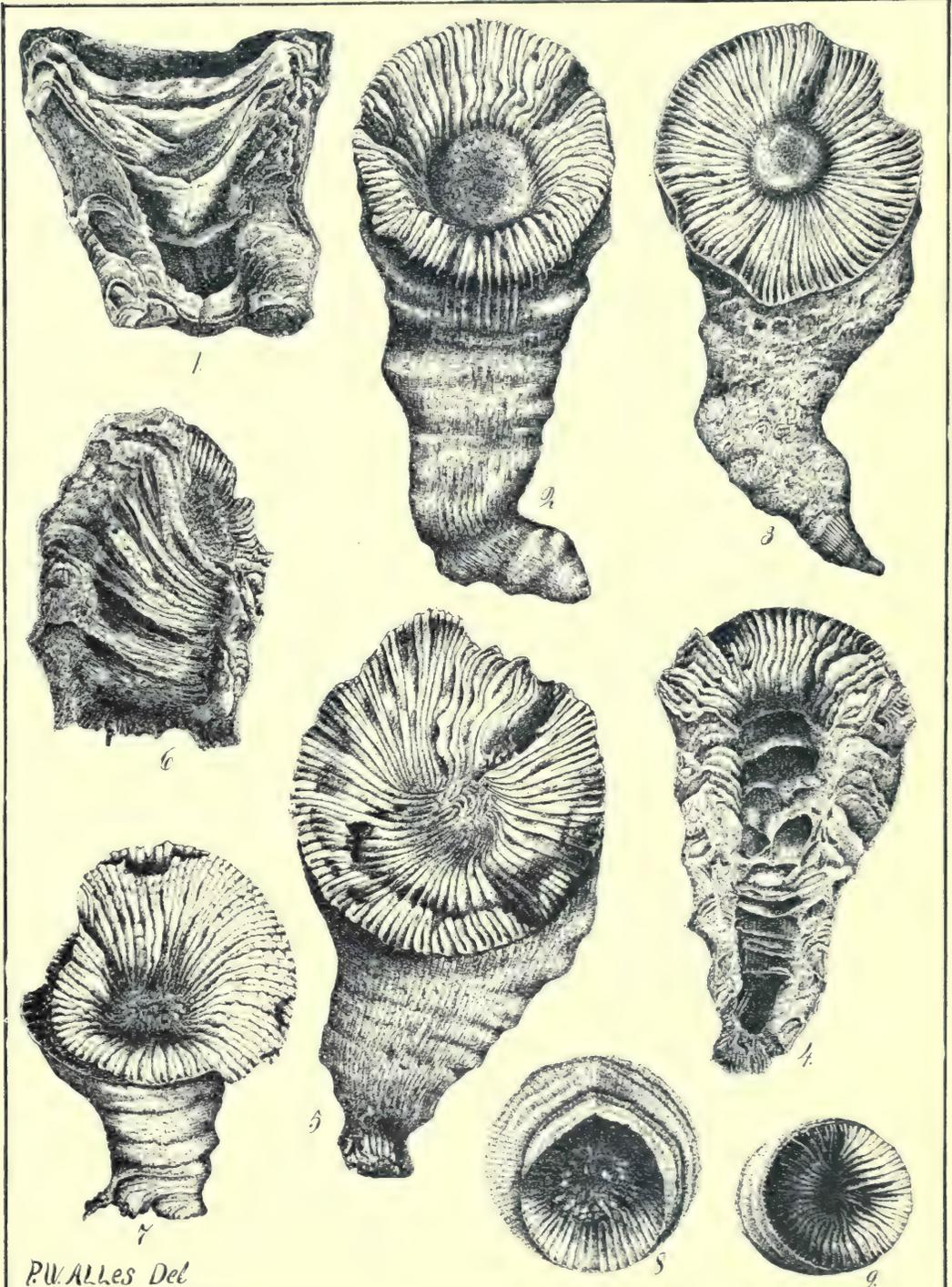
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ARACHNOCRINUS EXTENSUS, W. & Sp. Rowley.

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FIG. 1—View of a calyx imbedded in the rock with its arms spread out on the surface of the slab.

MEGISTOCRINUS CIRCULUS? Rowley.

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FIGS. 2-3-4—Side, dorsal and ventral views of a large specimen with concave plates.

MEGISTOCRINUS SPINOSULUS. Lyon. Rowley.

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FIGS. 5-6—Basal and side view of a specimen from the Falls of the Ohio.

STEREOCRINUS? INDIANENSIS, M. & G., Rowley.

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FIG. 7—Basal view of a small imperfect calyx from the Hamilton group at Speed's cement quarry, Clark county, Ind.

FIG. 8—Similar view of a somewhat larger, imperfect calyx, from the Upper Helderberg group at the Falls of the Ohio.

GENNAEOCRINUS SIMULANS, N. Sp. (Rowley.)

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FIGS. 9-11—Side and basal views of a nearly perfect dorsal cup.

FIG. 10—Basal view of another specimen, showing the same features as in figure 11.

BOTRYOCRINUS AMERICANUS, N. Sp. (Rowley.)

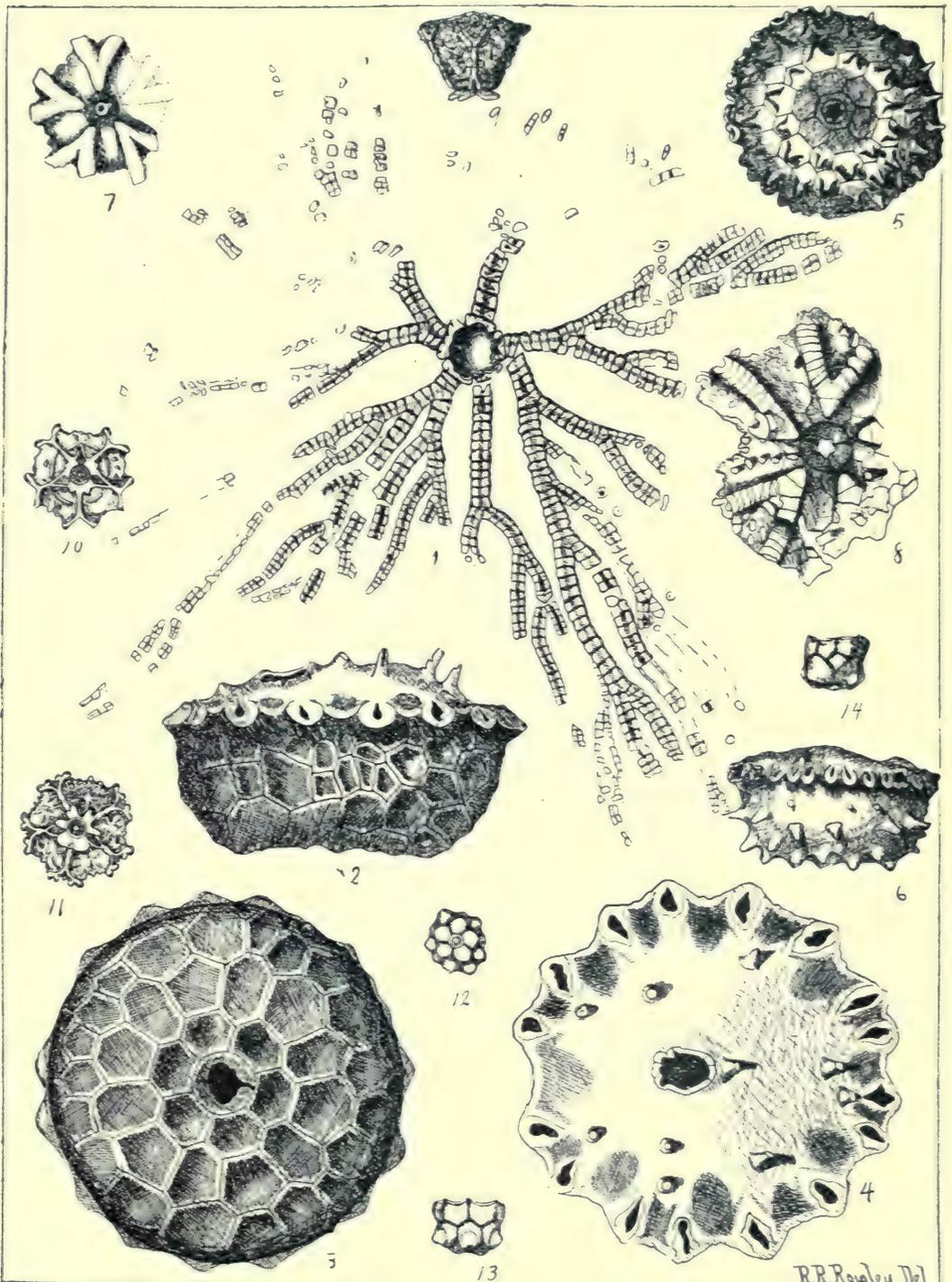
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FIGS. 12-13-14—Basal, anterior and posterior side views of the type specimen.

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PL. LIV.







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HELIOPHYLLUM SULCATUM.

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—

FIG. 1—Lateral view of a large corallum.

FIG. 2—Lateral view of a weathered specimen showing the vesicular structure.

FIGS. 3-4—Calix views of two different examples, showing the long fossette.

FIG. 5—Lateral view of a specimen exhibiting the vesicular structure and the deep cup.

FIG. 6—Calix view of another individual.



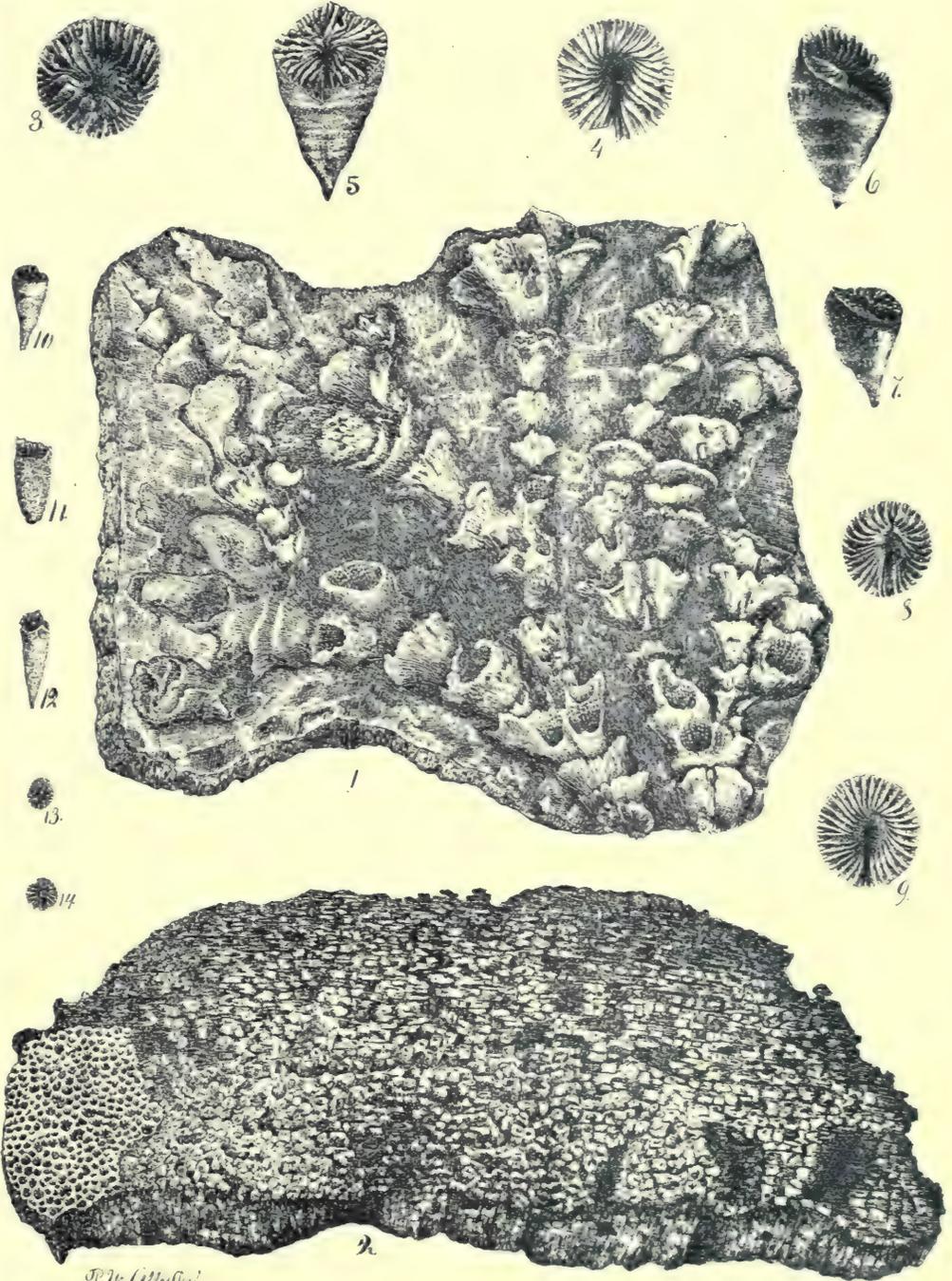




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FIGS. 10-11-12—	Lateral views of three different specimens.	
FIGS. 13-14—	Calix views of two different examples. For further illustration and description see Contribution to Indiana Palæontology, Part II, page 9, plate IV, figures 14, 15, 16, 17, January 20, 1899.	

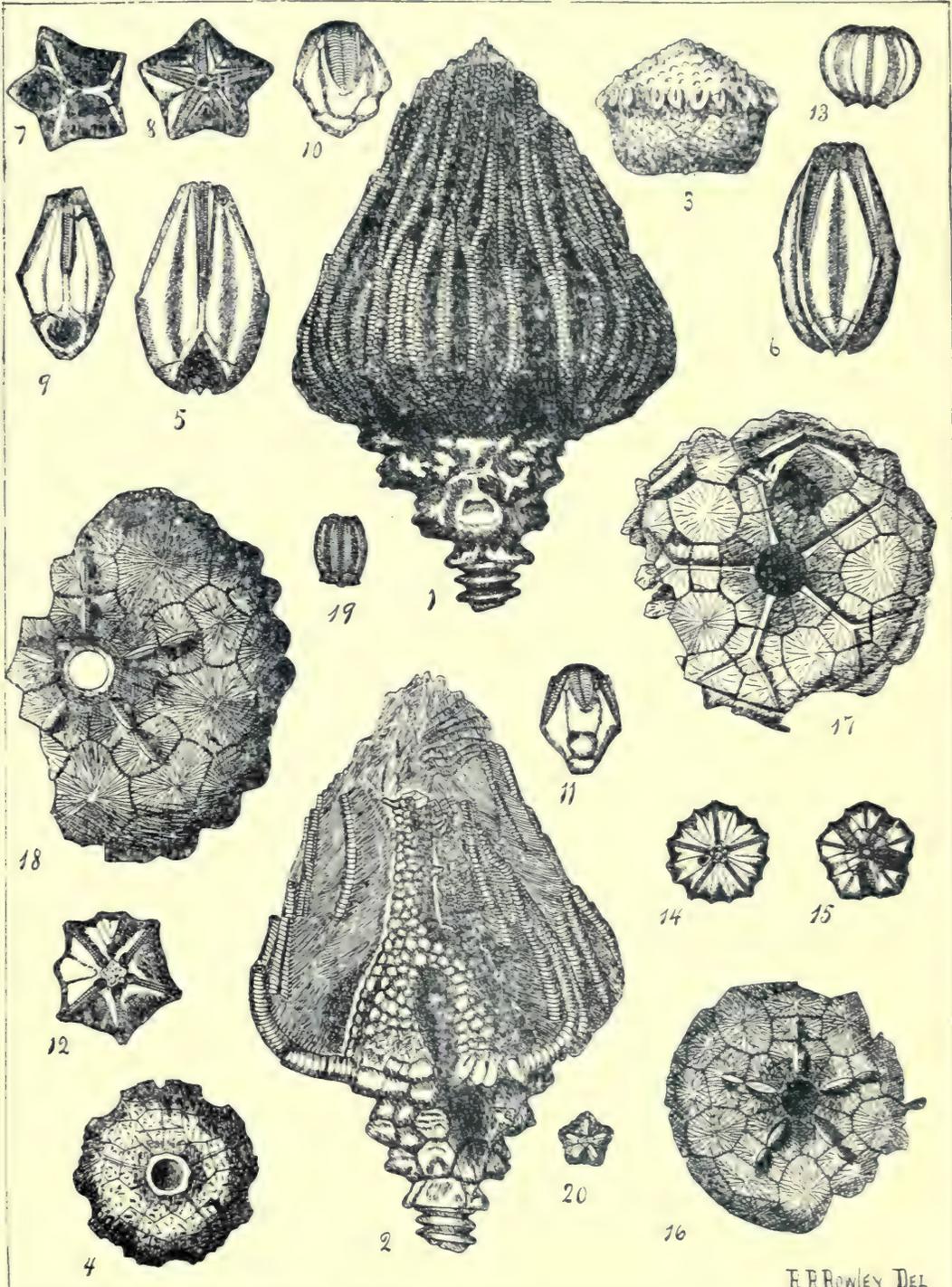






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# EXPLANATION OF PLATES.

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## PLATE 58.

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### ZAPHRENTIS CALLOSUS, N. Sp.

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FIGS. 1, 2—Posterior views of two different examples, part of the cup is broken away from each to show the lamellæ and tabulæ.

---

### HELIOPHYLLUM CONDITUM, N. Sp.

199

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FIG. 3—Lateral view of a simple example.

FIGS. 4, 5—Ventral views of two different examples.

FIG. 6—Lateral view of another individual, showing the elevated tabulæ in the center of the calix.

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### HAIMEOPHYLLUM ORDINATUM. Billings.

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FIG. 7—Lateral view of a fragment showing the contraction and expansion of the corallites.

FIG. 8—Ventral view of the same.

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### DIPHYPHYLLUM DILATUM, N. Sp.

199

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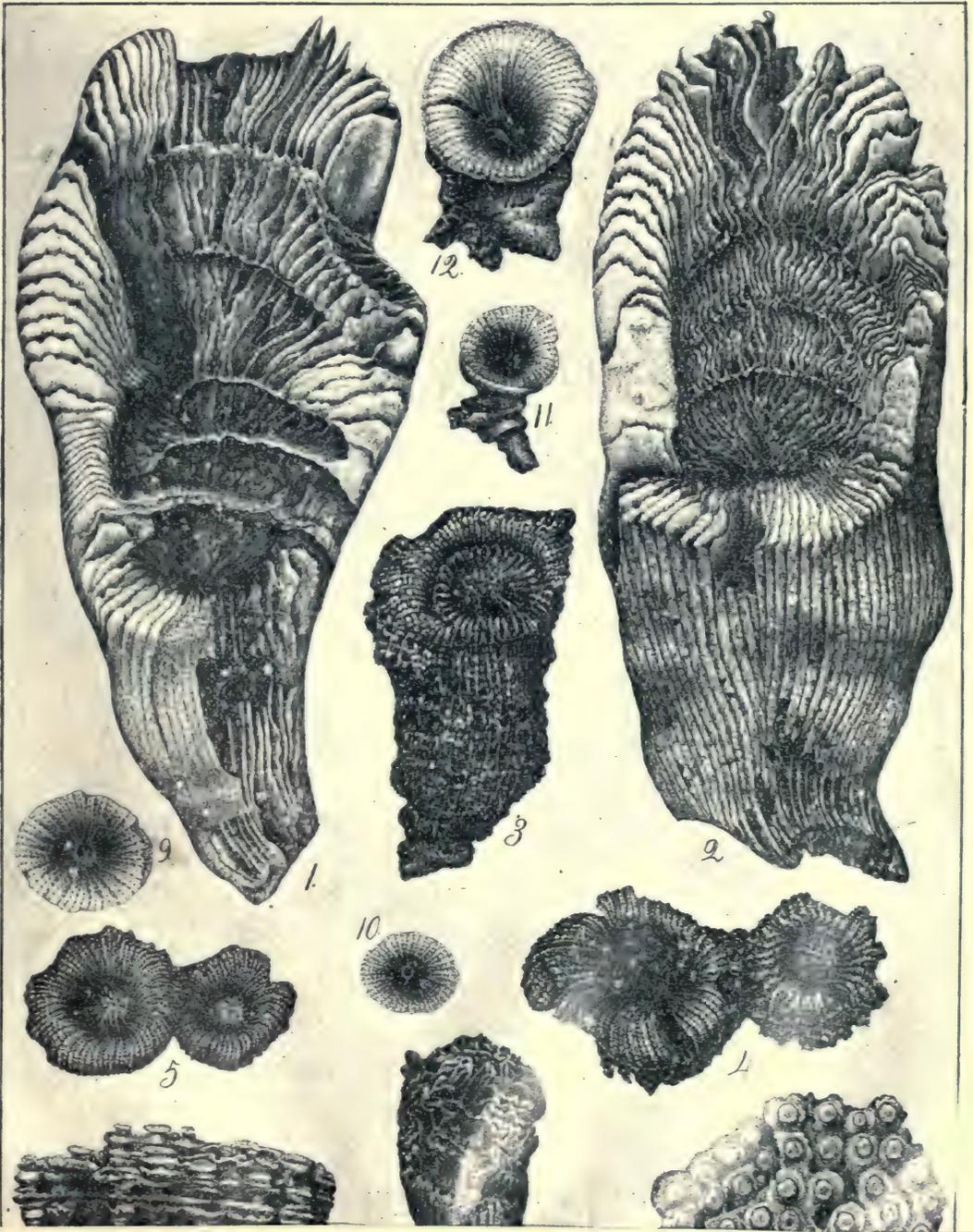
FIGS. 9, 10—Calix view of two different individuals.

FIGS. 11, 12—Postero-lateral views of two different examples.

CONTRIBUTION TO INDIANA PALÆONTOLOGY.

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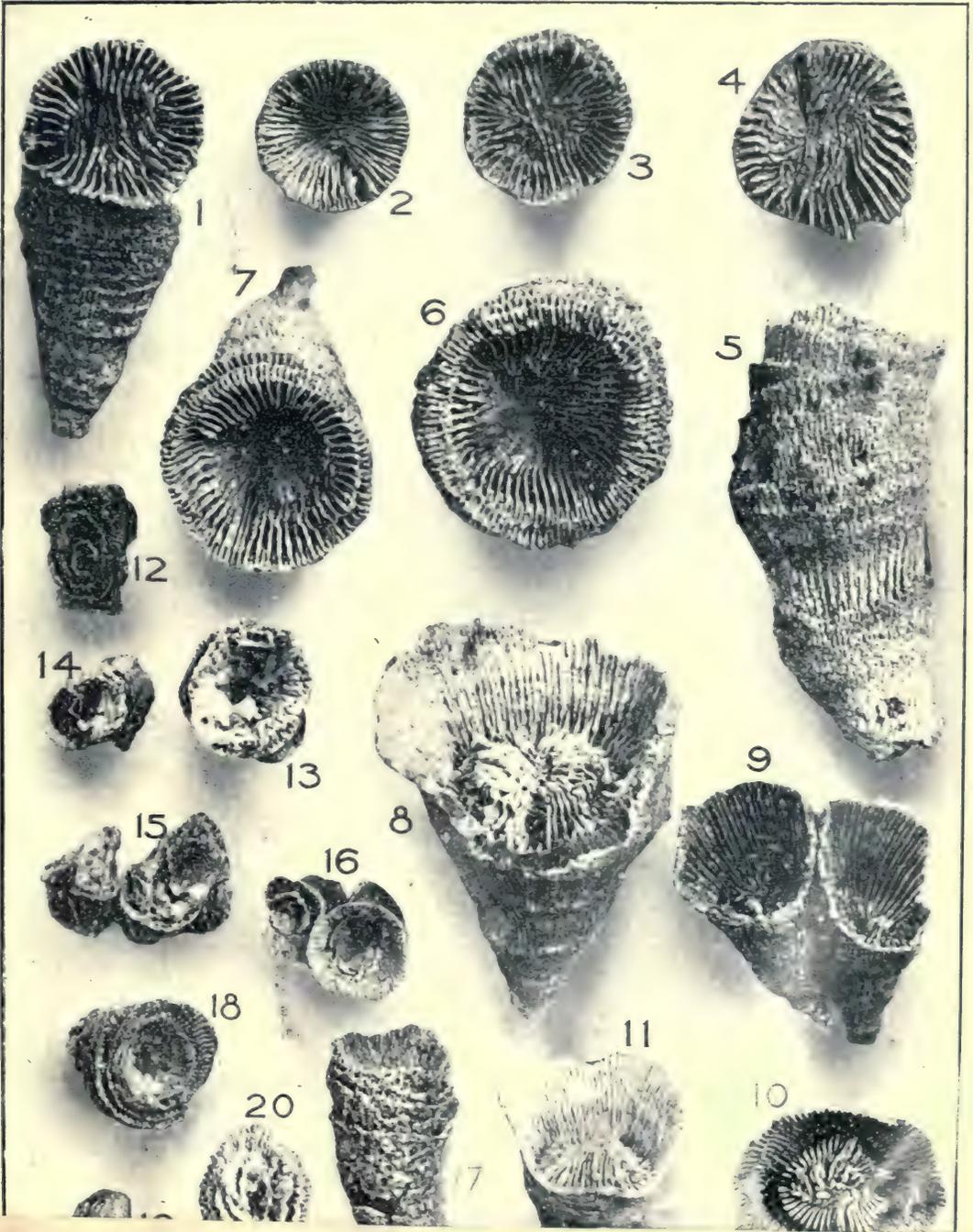
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<hr/>	
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PL. LVIX.







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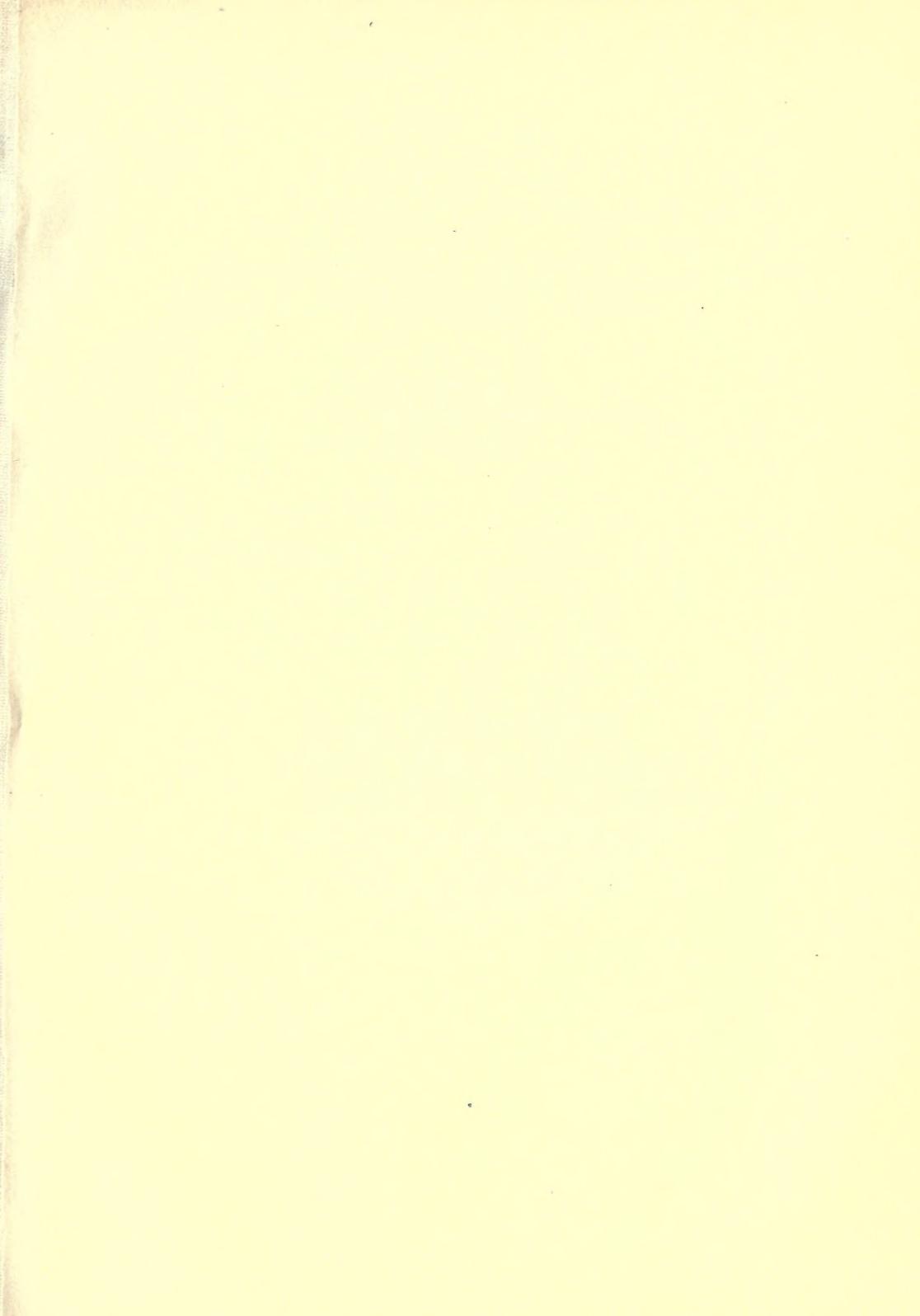
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<hr/>		
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