

MEMOIRS  
OF THE  
American Museum of Natural  
History.

VOLUME I, PART I.

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REPUBLICATION OF DESCRIPTIONS OF LOWER CARBONIFEROUS CRINOIDEA  
FROM THE HALL COLLECTION NOW IN THE AMERICAN MUSEUM OF  
NATURAL HISTORY, WITH ILLUSTRATIONS OF THE ORIGINAL TYPE  
SPECIMENS NOT HERETOFORE FIGURED.

By R. P. WHITFIELD.

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September 15, 1893.







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PLATES I-III.

Among the collections obtained by the Museum from Prof. James Hall are many of the original type specimens of that author which have never been illustrated. It has been the purpose of the Museum to have all such specimens figured and the illustrations published whenever circumstances should permit, giving with them the original description as published by the author, together with such additional information as may be known, or such comments as may be necessary at the time. In furtherance of this object a 'Bulletin' was issued in October of 1882<sup>1</sup> on the 'Fauna of the Lower Carboniferous Limestones of Spergen Hill, Indiana,' with illustrations of the type series of fossils used in the preparation of the original paper, and in the following pages are given several species of Lower Carboniferous Crinoidea from the same collection, the illustrations being drawn from the specimens used when the descriptions were first given. Many other species of other groups still remain to be illustrated, and will be given when the opportunity occurs.

In republishing these species the original description is copied entire, and in the comments made on them the same system of nomenclature is used as in the original description, in order to avoid confusion, and for the purpose of uniformity. Some of these species have been published under other names by subsequent writers, a circumstance which is always liable to occur where illus-

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<sup>1</sup> Bull. Am. Mus. Nat. Hist., Vol. I, No. 1.

trations are not given. It is for the purpose of reclaiming for the Museum specimens the name, and preserving the authenticity and value of the types, that they are now illustrated.

In referring the species to other genera than those under which they were originally published, I have followed Messrs. Wachsmuth and Springer, as shown in their 'Revision of the Palæocrinidæ.' A single new species is now described, simply because it had been figured under the impression that it belonged to one of those previously described with which it had always been associated in the collection. A few of the figures now given were photographed many years ago, and a few copies distributed by Prof. Hall, but perhaps not enough to properly constitute publication. Those made from Museum specimens have been repeated here, that there may be no question regarding the species in future. Prof. Hall has kindly loaned these drawings for use, and also the cuts of the diagrams used in the text, as in that of the original descriptions now copied.

## CRINOIDEA.

### Family PLATYCRINIDÆ.

#### *Platycrinus clytis*.

PLATE III, FIG. 6.

*Platycrinus clytis* HALL, Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 285, Photo-plate ii, fig. 4.  
*Platycrinus scobina* (M. & W.) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 75. (Not *Platycrinus scobina* M. & W. Geol. Ills. Vol. III, Pl. xvi, fig. 9.)

"Body small, broadly cup-shaped. Basal plates proportionally large, forming about one-third the height of the cup. Radial plates quadrangular, height and width nearly equal; articulating scar small, occupying about one-half the diameter of the plate, and extending but a short distance upon the body of the plate. Second radial or sub-brachial plates small, subpentagonal, giving origin to an arm on each of the two upper sides; one of these is simple, and one bifurcates on the second plate above, giving three arms to the ray.

"Arms composed of a single series of plates at base, becoming gradually double towards the upper part. Tentacula long, composed of long and comparatively strong joints. Surface of plates entirely covered with small elevated pustules. Column strong, composed of unequal, somewhat angularly elliptical plates, so arranged as to give the column a twisted appearance.

"The form of the radial plates and the surface markings distinguish this species from every other in these rocks.

"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 285.



Messrs. Wachsmuth and Springer have cited this species in their 'Revision of the Palæocrinidæ' as a synonym of *P. scobina* M. & W. (Proc. Acad. Nat. Sci. Phil., 1861, p. 129 ; Geol. Ills., Vol. III, p. 466, Pl. xvi, Fig. 9). A very slight inspection of the figures given of that species and of the figure of this one will show that the structure of the arms at once place them under two distinct groups of the genus *Platycrinus*, this one having very slender arms composed of a single series of wedge-shaped plates, with tentaculæ rising from the alternate plates, while in *P. scobina* the arms are stronger and composed of a double row of short plates uniting on the back of the arm, and from which tentaculæ originate on each plate.

### **Platycrinus elegans.**

PLATE III, FIG. 1.

*Platycrinus elegans* HALL, Desc. New Sp. Crin. 1861, p. 4 ; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 285, Photoplate ii, fig. 15.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 71.

"Body small, narrowly subturbinate. Basal plates a little constricted near the middle, the lower sides slightly projecting ; the small plate is nearly twice as long as its greatest width. Radial plates long and narrow, quadrangular, very gradually increasing in width upwards, once and a half as long as wide. The articulating scar for the attachment of the arms small, little more than one-third the width of the plate, and scarcely extending below the top. Arms bifurcating on the second plate above the first radial, and each branch again dividing on the third or fourth plate above, composed of a single series of plates, alternately longer and shorter on the opposite sides ; those in the upper part of the arms larger and somewhat squamous, the upper edge projecting.

"Tentacula arising from the longest side, apparently short and strong. Surface of plates smooth. Column small, round, composed of unequal plates.

"This small and beautiful species resembles, in the appearance of the calyx, specimens of the genus *Dichocrinus* ; but the base being distinctly divided into three parts places it in the genus *Platycrinus*.

"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 285.

### **Platycrinus excavatus.**

PLATE III, FIG. 5.

*Platycrinus excavatus* HALL, Desc. New Sp. Crin. 1861, p. 4 ; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 286. *Platycrinus discoideus* (O. & SH.) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 71.

"Body discoid to the arm bases. Basal plates deeply impressed, forming a conical or funnel-shaped cavity. First radial plates subquadrangular, rapidly expanding to their upper edges, which are more than twice as wide as the lower.



Articulating scar extending less than half the width of the plate, occupied by the small, subtriangular, subbrachial plate, and the first arm plate on each side.

"Summit and arms unknown.

"The suture lines of the first radial plates are profoundly grooved or channelled, with an elevated, thickened ridge extending along the lateral and basal margins, while the intermediate space is slightly concave, without other surface markings.

"The surface characters of this species are so peculiar that they distinguish it from every other species known to me.

"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 286.

Had Messrs. Wachsmuth and Springer seen the type specimen of this species, I do not think they would have placed it as a synonym of *P. discoideus* of Owen and Shumard. The sculpturing is so entirely different from that indicated by their figures that there can be no mistaking them.

### **Platycrinus striobrachiatus.**

PLATE III, FIGS. 2-4.

*Platycrinus striobrachiatus* HALL, Desc. New Sp. Crin. 1861, p. 4; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 287; Photo-plate ii, figs. 2 and 3.

*Platycrinus corrugatus* (O. & SH.) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 71.

"Body discoid to the arm bases; dome highly elevated, hemispherical. Basal plates occupying little more than one-third the width of the disc, depressed in the centre around the top of the column. First radial plates expanding laterally from the base to near the middle, where they are abruptly bent upwards, the upper part forming the sides of the cup, broadly and deeply notched above, truncated on the upper lateral angles by the large interrarial and anal plates. The articulating scar occupies about one-half the width of the plate, and is of an elongate, horseshoe form, broadest at the lower end, with a slightly elevated border around the lower margin; it is occupied by the clavate subbrachial plate and the outer ends of the first arm plates.

"Arms bifurcating on the subbrachial plate, each main division again dividing on the second plate above, the inner branch again dividing on the succeeding second plate, and the middle branch again dividing on the second plate above the last, giving four arms to each main division and eight to the ray. The arms are elongate fusiform, composed of a double series of very short plates, wedge-form at the interlocking edges. Surface of arms marked by fine, interrupted, longitudinal striæ, visible only on well-preserved specimens. Surface of body plates covered by short, confluent, setiform spines,



which sometimes form lines parallel to the sides of the plate; in some individuals these spines are less developed. Suture lines distinct and impressed.

"This species is closely related to *P. Shumardianus* (Iowa Geol. Rept. Pl. viii, Fig. 5); it differs in the narrow radial plate, and in having two more arms to each ray.

"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 287.

I do not think this species should be identified with Owen and Shumard's *P. corrugatus*; or if so, their *P. discoideus* certainly must be included. In the features of the calyx plates it is much more nearly like Hall's types. But in the surface ornamentation and the features of the arms, I think this is distinct from both.

#### Family ACTINOCRINIDÆ.

#### *Actinocrinus limabrachiatus*.

PLATE I, FIGS. 8 AND 9.

*Actinocrinus limabrachiatus* HALL, Desc. New Sp. Crin. 1861, p. 2; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 268; M. & W. Geol. Rep. Ills. Vol. V, p. 341.—WASHSM. & SPRINGER, Revis. Palæocrin. Pt. II, p. 144.

"Body turbinate below the arms, narrowly truncate at base, somewhat excavated for the attachment of the column; arm bases slightly projecting; summit unknown. Basal plates short, angularly thickened at the lower margin. First radial plates of medium size, height and width nearly equal. Second radial plates quadrangular, upper and lower margins convex. Third radial plates heptagonal, much larger than the second, wedge-form above, supporting on each side a large, supraradial, bifurcating plate; each of these supports on the outer margin a series of brachial plates, and on the inner margin a small supraradial plate of the second order, each of which gives origin to two arms, making three arms to each division of the ray or six to the ray.

"First interradianal plate octagonal, supporting two smaller plates in the second range, two in the third, and one in the fourth range. Anal series consisting of about twelve plates: the first hexagonal, smaller than the first radial plates, supporting two in the second range nearly equal in size, one seven-sided and the other eight-sided; four smaller plates in the third range; with the remaining plates irregularly placed above. Surface of plates traversed by a single set of ridges, which passing from plate to plate meet at the centres and form sharp nodes.



"Arms long, slender, simple, composed near their base of a single series of wedge-form plates, and above of a double series of short interlocking plates, each of which has a sharp elevated ridge near and parallel to its upper margin; the edge of this ridge is directed upwards, and has the appearance of the teeth of a file. The tentacula are long and slender, composed of numerous joints, each of which has, on its outer edge, a strong, sharp, curved spine, inclined obliquely outwards and upwards. Column composed near the body of alternately thicker and thinner joints, every fourth of which is larger, and projects beyond the others as a carinated ring.

"In the specimen examined only the lateral rays are determinable; but the peculiar character of the arms is sufficient to distinguish this from every other described species.

"This species most resembles *A. spinotentaculus*, but differs in the number of arms to the ray, the teeth-like ridges of the arm-plates, and the single series of plates near the arm-bases. The arms of several other specimens are known.

"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 268.

No examples of the calyx of this species are in the Museum collection, but there are two sets of the arms, both of which were used in the original description, and one of them is now figured. The structure of these is so peculiar that they are readily distinguished from all other forms.

### **Actinocrinus thetis.**

PLATE I, FIG. 10.

*Actinocrinus thetis* HALL, Desc. New Sp. Crin. 1861, p. 11.  
*Actinocrinus sexarmatus* (HALL) WACHSM. & SPRINGER, Revis. Palæocrin. Pt. II, p. 145.

"Body below the arms calyculate, and broadly spreading at the arm-bases, wider than high. Basal plates short and squarely truncate below. Plates of the radial series scarcely wider than high. Interradial series consisting of five or six and sometimes seven plates; anal series, of nine plates. Arms six from each ray, of moderate length, rounded on the back, with the surface finely granulose. Plates of body angulated with transverse ridges.

"Approaches *A. opusculus*; but the arms are less crowded at their bases, and the plates of the body less sharply carinated; while the arms are rounded on the back, and not nodose or subspinose on the margins. Height from base to extremities of arms, varying from one and a half to three inches or more. Burlington limestone."—Desc. New Sp. Crin., 1861, p. 11.



Messrs. Wachsmuth and Springer consider this as identical with *A. sexarmatus* and *A. securis* Hall. The arm formula is the same, and the structure of the calyx much alike. The arms of the type specimen of this species are, however, much more robust than those of any specimens of *A. sexarmatus* seen. Beyond this the divisions of the arms do not take place until the margin of the calyx has spread out laterally to such an extent that where the calyx only was preserved there would appear to be only four arms to the ray.

*Locality and position.*—In the Yellow beds of the Burlington limestone, at Burlington, Iowa.

### **Actinocrinus quarternarius.**

PLATE I, FIGS. 1-3.

*Actinocrinus quarternarius* HALL, Supp. Geol. Surv. Iowa, 1860, p. 22.

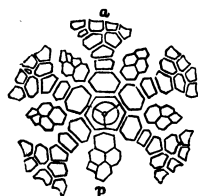
*Actinocrinus proboscidioides* (HALL) WACHSM. & SPRINGER, Revis. Palæocrin. Pt. II, p. 145.

“Body biturbinate, small, rather higher than wide, greatest diameter central, ridged below and spinose above. Base concave for the reception of the column.

“Basal plates very short, and projecting in a scarcely thickened rim below the attachment of the column; divided by a broad and deep notch at the line of junction.

“First radials proportionally large, wider than high. Second radials small, short, pentagonal and hexagonal. Third radials small, pentagonal and hexagonal, supporting upon their upper sloping edges supraradials in single series; upon these rest the brachial plates, apparently one only to each arm. This arrangement gives to each ray four arms :  $\frac{4}{4} \frac{4}{4} = 20$  in all.

“The interradians are four in number, except a small intercalated plate in one series; the first one largest, hexagonal or heptagonal, supporting two smaller ones side by side, with a small one between them above, which allows the brachial plates of the adjacent rays to rest against each other. Anal plates five; the first large, hexagonal, as high as wide, supporting two smaller in the second and two in the third series.



*Actinocrinus  
quaternarius.*

“The plates of the calyx are all traversed by sharp ridges, those which pass along the ray being the most conspicuous: these ridges meet on the plates, and form angular nodes or transverse ridges. The plates of the summit are produced into short obtuse spines: proboscis central, large.

“This species bears considerable resemblance to *A. multi-brachiatus* (Geol. Rep. of Iowa, Pl. xi, Fig. 10), but is more nearly allied to Fig. 13 of the same plate, and differs from the first in the number of arms, and from the last in the form of the body and surface markings; the plates

of the calyx being more strongly and deeply ridged and the plates of the summit more distinctly spinose, while the body is proportionally broader, and the parts above and below the arms more nearly equal.

"*Geological position and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Surv. Iowa, 1860, p. 22.

Messrs. Wachsmuth and Springer consider this as a synonym of *A. proboscidualis* Hall, and also place it with *A. lagina*, *A. quarternarius* var. *spiniferus*, and *A. themis* Hall. There is excellent reason for considering *A. quarternarius* as the same as *A. proboscidualis*, though the cup is comparatively much broader than those of the typical form of the species.

### Actinocrinus clarus.

PLATE I, FIGS. 4 AND 5.

*Actinocrinus clarus* HALL, Desc. New Crin. p. 2; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 277, Photo-plate iii, figs. 24 and 25; M. & W. Geol. Surv. Ill. Vol. V, p. 341.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 142.

The description from the Boston Journal is given below. One of the figures is repeated from Hall's photographic plate, and an additional figure is given from another calyx in the Hall collection at the Museum.

"Body very broadly subturbinate, spreading more rapidly above the third radial plates, truncate at base. Basal plates short, scarcely thickened at the lower margins, projecting but little beyond the column. First radial plates of moderate size. Second radial plates varying from quadrangular to hexagonal. Third radial plates usually larger than the second, varying from pentagonal to heptagonal, wedge-form above, and supporting on each upper side a bifurcating supraradial plate, on the outer side of which rests a series of brachial plates, and on the inner side a supraradial of the second order; this supports brachial plates on each side, making the brachial formula  $\frac{6}{6}-\frac{6}{6}=30$ .

"Interradial series consisting of four or five plates each, the first large, seven-sided, supporting two smaller plates in the second range, one seven-sided and one six-sided, with one or two small plates above. The anal series consists of seven or eight plates; the first hexagonal, little smaller than the first radial plates, supporting two in the second range, little smaller than the first interradial plates; three in the third range; with the others irregularly placed above. Dome and arms unknown. Surface of body plates elevated into strong angular nodes, sometimes marked by low ridges in the lower part; the nodes of the upper part connected by a strong angular ridge.

"This species is of the type of *A. multibrachiatus* (Iowa Geol. Rep., Pl. x, Fig. 10), but differs in its spreading form and angular nodes.



"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 277.

### **Actinocrinus opusculus.**

PLATE I, FIGS. 6 AND 7.

*Actinocrinus opusculus* HALL, Supp. Geol. Surv. Iowa, 1860, Explanation of Pl. ii and fig. 6 of same plate; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 264.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 144.

"Body broadly caliculate, height little more than half the width, the brachial plates spreading around the circumference of the cup in the form of a rim; base truncate, and largely excavated for the attachment of the column. Basal plates short, thickened at the outer margins, and indented at the suture lines. First radial plates wider than high, with long upper lateral sides. Second radial plates quadrangular and pentangular, wider than high. Third radials larger than the second, varying from pentagonal to hexagonal and heptagonal, very obtusely wedge-form above, and supporting on each upper sloping edge a large bifurcating supraradial plate; these each support upon the outer edge a series of brachial plates, and upon the inner edge a supraradial plate of the second order, which gives origin to two arms, making six arms to each ray, and thirty arms to the whole.

"Interradial series consisting of four or five plates each, the first one seven or eight sided, supporting two in the second range, one six and the other seven sided, and one or two small plates in the third range. First anal plate hexagonal, about equal to the first radial, supporting two or three slightly smaller plates in the second range, with two to four irregularly placed above. The interradial and anal spaces are enclosed or arched over by the brachial plates. Surface of plates strongly convex, traversed by distinct ridges, which, passing from the centre of the plates, unite at the edges with those of the adjoining ones.

"Arms proportionally strong, round at the base, and becoming somewhat flattened above; composed of a double series of interlocking plates, armed at their outer edges with short, spine-like nodes. Proboscis strong, composed of small plates. Column of medium size, composed of short, alternately thicker and thinner plates, ornamented on the margins.

"This species is of the type of *A. multibrachiatus*; but differs from that and all other described species in the ornaments of the surface, the crowded horizontal brachial plates, and flattened arms. In this latter character it resembles *A. clio*, but differs materially in form of body and arm formula.

"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 264.

**Actinocrinus rusticus.**

PLATE I, FIG. 13.

*Actinocrinus rusticus* HALL, 1861, Desc. New Species Crin. p. 2; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 267.  
*Actinocrinus scitulus* M. & W. (by typographical error *A. scilutulus*), Proc. Acad. Nat. Sci. Phil. 1860, p. 386; Geol. Rept. Ills. Vol. II, p. 202, Pl. 15, fig. 7, and Vol. V, p. 341.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 145.  
*Actinocrinus sillimani* M. & W. Proc. Acad. Nat. Sci. Phil. 1861, p. 134; Geol. Surv. Ills. Vol. II, p. 202.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 145.  
*Actinocrinus wachsmuthi* (WHITE) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 145.

We have not given Hall's description of this species, as Meek and Worthen's name *A. scitulus* has priority over Hall's name. We have figured one of the best of several specimens from the Hall Collection in order to demonstrate the authenticity of the identification.

**Actinocrinus glans.**

PLATE I, FIGS. 11 AND 12.

*Actinocrinus glans* HALL, Supp. Geol. Rept. Iowa, 1860, p. 16.—WACHSM. & SPRINGER, Revis. Palæocrinidæ, Part II, p. 143.

In his supplement to the Geological Survey of Iowa, Prof. Hall gives a full description of this species, and a diagram from a specimen borrowed. The figures now given are from a second individual, in the Hall Collection, used in description. It does not differ in any essential feature from that used in making the diagram.

The species is from the Upper Burlington limestone, at Burlington, Iowa.

Messrs. Wachsmuth and Springer, in their 'Revision of the Palæocrinidæ,' cite Hall's *A. tholus* and *A. eryx* as synonyms of this species, considering them as only differing in the surface features of the plates. By reference to the figure of *A. eryx* given on Hall's Photo-plate iv, Figs. 5 and 6, it will be seen that this species has a much shorter calyx with the interradian series depressed between the arm bases, while in *A. glans* the rim of arm bases is continuous. Five other individuals, in the Museum collection, show this to be a constant character.

"Body symmetrically urnshaped below, regularly convex above, and terminated in a medium-sized central proboscis. Basal plates large, massive, convex in the centre, and having a large concave cicatrix for the articulation of the column.

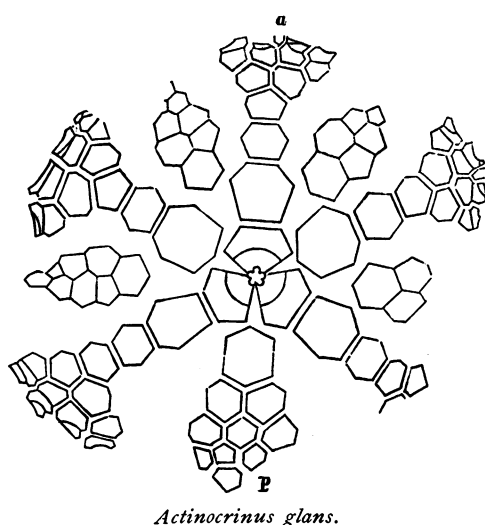
"First radial plates large, about as high as wide, hexagonal and heptagonal. Second radials distinctly hexagonal. Third radials as large as the second, pentagonal and hexagonal, and supporting on each of their upper sloping edges a supraradial of large size, which in turn support on each side brachials in



double series ; completing the rim of the cup, and giving four arms to each ray :  $\frac{4}{4} \times 4 = 20$  arms opening upwards.

"First interradians regularly hexagonal, each supporting on its upper edge two smaller plates varying in form from five to seven-sided ; these are again surmounted by two still smaller plates in the third series and one in the fourth, making in all six plates in each group. First anal plate large, hexagonal ; supporting two smaller hexagonal plates in the second, three in the third series, with several smaller polygonal plates above.

"Surface of plates regularly convex. Column large, central ; perforation pentalobate.



*Actinocrinus glans.*

"This species, although greatly resembling *Actinocrinus longirostris* (Geol. Report of Iowa, Pl. ii, Fig. 2), is nevertheless a very distinct species, having a greater number of arms, plates of different form, and differently arranged. The arm-openings in this species are directed upwards, while in *A. longirostris* they are lateral : the body is also of a more elongated form. It is very distinct from the *A. urna* of Troost.

"*Geological position and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Rept. Iowa, 1860, p. 16.

### **Batocrinus æquibrachiatus var. alatus.**

PLATE I, FIG. 14.

*Actinocrinus æquibrachiatus* MCCHESNEY, var. *alatus* HALL, New Sp. of Crin. 1861, p. 1 ; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 263 ; Photo-plate iii, figs. 21-23.  
*Batocrinus æquibrachiatus* (MCCHESNEY) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 165.

"Body variable in form, sometimes broadly turbinate, the depth below the arms equal to half the transverse diameter, and sometimes so short as to appear scarcely more than a stellate disc ; the dome above the arm bases is usually nearly equal in height to the body below the arm bases. In some specimens the interbrachial and anal spaces are constricted half the depth from the periphery to the centre, giving a deeply pentalobate form, while in others they are scarcely depressed.

"This species has the same arm formula and general structure as *A. æquibrachiatus* McChesney, and the deep constrictions between the rays give it a

stellate or pentalobate form, not noticed in typical specimens of the species. This variety differs from *A. sinuosus* (which it resembles in the sinuosities or constrictions between the rays) in having nodose plates of body and dome, and in the important distinction of having four arms to each ray, instead of five in the postero-lateral rays, as in that species.

“*Geological formation and locality.*—Burlington limestone, Burlington, Iowa.”—Jour. Bost. Soc. Nat. Hist., VII, p. 263.

Messrs. Wachsmuth and Springer do not consider this as more than a variety of the species *æquibrachiatus* McChesney. It is, however, a rather common and extravagant variety, and seems to be as well worthy a name as many others which are recognized. Another of the types of extreme form originally used is figured on the plate. *B. asteriscus* M. & W., Geol. Ills., Vol. II, is the same form, although not as extravagant.

### Batocrinus oblatius.

PLATE I, FIGS. 21 AND 22.

*Actinocrinus oblatius* HALL, Supp. Geol. Surv. Iowa, 1860, p. 38.

*Batocrinus rotundus* (Y. & S.) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 168.

The following is a copy of Hall's original description and diagram, but as stated by Wachsmuth and Springer it only differs from *B. rotundus* in having twenty-two arms :

“Body depressed globose ; height to the summit of the dome a little more than two-thirds the width, the height of the dome being greater than that of the body below the bases of the arms. Basal plates small, and scarcely projecting beyond the general curve of the lower side of the body.

“First radials short and broad, as wide again as high, concave on their upper margins. Second radials quadrangular, as wide again as high, about two-thirds as large as the first radials. Third radials hexagonal and heptagonal, about as large as the first radials, much wider than high, supporting on each of their upper sloping edges a double range of supraradial plates, which are very large in proportion to the plates below ; the upper ones being larger than the third radials, and are bifurcating plates, supporting on each of their upper sloping edges two brachial plates, giving four arms to each ray :  $\frac{4}{4} \times \frac{4}{4} = 20$ .

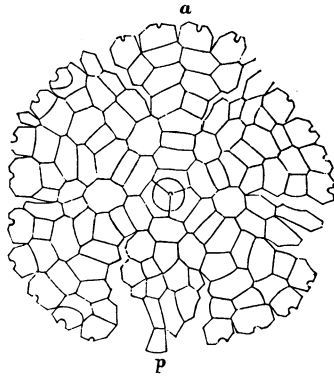
“First interrarial plates of medium size and irregular in form, being eight-, nine- and ten-sided ; supporting two smaller elongated plates in the second range and two in the third, the latter being usually much elongated, reaching as high as the upper fixed brachial plate.

“First anal plate heptagonal, higher but not as wide as the first radials, supporting three slightly smaller plates in the second range ; the central one



hexagonal (being slightly truncated above), the others octagonal. Above these are ten irregularly shaped plates in about three ranges, the upper ones being elongated.

"This species is of the type of *A. rotundus* of Yandell and Shumard. In this species, however, the number of interrarial and anal plates is much greater, giving a greater width to the body, which is more flattened below than in true *A. rotundus*. In that species the interrarial series is one and two, above which come the brachial plates of adjacent rays; while in the one here described the arm-bases are separated by one or two plates. In the *A. rotundus* the proboscis is more strongly marked, rising from the centre of an elevated dome; while the dome of *A. oblatius* is less elevated, and the proboscis, if existing at all, has been much smaller.



*Actinocrinus oblatius.*

"The number of arms given in the original description of *A. rotundus* is twenty-one, which is not a regular number; and we suppose the arm-formula to be  $\frac{4}{5}-\frac{4}{5}$ , as we have found in well-marked forms of that type which have the other characters of the species as given by its authors."—Supp. Geol. Surv. Iowa, 1860, p. 38.

The type specimen here figured came from the Burlington limestone at Rocheford, Missouri.

### **Batocrinus bisbrachiatus, n. sp.**

PLATE II, FIGS. 4 AND 5.

Body below the arms turbinate, rather broadly spreading from a very narrow base, and distinctly lobed on and below the periphery by the constrictions at the interrarial and anal series. Basal plates proportionally high, forming an obconical cup more than half as high as wide. First radial and anal plates large, about as high as their greatest width; second and third radials of medium size; supraradials one or two on each side, but always giving origin to two divisions of the ray on each side, producing so far as can be seen, four brachial plates to each ray. Anal series consisting of ten plates in the type specimen, the first large, seven-sided, with three arches above consisting of three plates each. Interrarial plates four in the series, with a single interbrachial above between the brachial plates. Arms two from each brachial plate, composed from their origin of minute plates, without intervention of medium sized plates; there being a single small pentagonal

plate in the centre upon which the arms divide. Arms slender, not very long, round on the back, and composed of a double row of very short plates interlocking on the back. Vault composed of small smooth plates, and surmounted by a strong subcentral proboscis of moderately large size; the surface of the vault, between the base of the proboscis and the margin, concavo-conical. Plates of the calyx smooth, and flattened to the general form of the cup.

This species in the body closely resembles *B. sinuosus* McChesney, in the narrowness of the base and the lobing of the margin at the arm bases. But differs entirely in the arm structure by having two arms from each brachial plate, whereas other specimens having all the features of that species in the calyx have only a single arm from each brachial plate. This I deem a good and sufficient specific character.

A specimen closely resembling this one in the arms, is figured by Meek & Worthen in Vol. V of the Ill. Geol. Rept. on Plate v, Fig. 4a, as *Batocrinus christyi*, and it may be a small individual of this species, but the edge is not lobed as is this one.

In the Burlington limestone at Burlington, Iowa.

### **Batocrinus discoideus.**

PLATE I, FIGS. 19 AND 20.

*Actinocrinus discoideus* HALL, Geol. Rept. Iowa, Pt. II, p. 594.

*Actinocrinus (Batocrinus) discoideus* M. & W. Geol. Rept. Ills. Vol. II, p. 150.

*Batocrinus discoideus* M. & W. Geol. Rept. Ills. Vol. V, p. 367.—WACHSM. & SPRINGER, Revis. Palæocrin. II, p. 166.

“Body extremely short, spreading, discoid; base distinctly hexagonal; dome depressed-convex, with a subcentral proboscis. Basal plates short, projecting in a somewhat rounded rim. First radial plates prominent, much wider than long, transversely tubercular. Second radial plates very short, quadrangular, and sometimes nearly obsolete. Third radials small, pentagonal, supporting on each oblique upper side a range of two or three diverging supradials which are succeeded by brachial plates in first and second series, from each of which arise a series of arm-plates; giving four arms from the anterior and each antero-lateral ray, while each postero-lateral ray is modified so as to support five arms, making altogether  $\frac{4}{5-5} = 22$  arms.

“Interradial plates large, ten- or twelve-sided; sides below flanked by the second and third radials, and above by the first and second supradials; no second interradians. First anal plate and second range of three plates large, prominent; third range of three plates holding the position of subbrachial plates, and supporting the arm-joints. Dome composed of numerous subangularly tuberculous plates, and the proboscis of similar plates.



"Surface granulose or granulose-striate, with a plain slightly elevated band along the margins of the larger plates.

"This species resembles in some degree the *A. æqualis*; but it is more depressed, with a smaller number of arms and a single series of interrarial plates. The discoid form is characteristic.

"*Geological formation and locality*.—In the Burlington limestone, Burlington, Iowa."—Geol. Rept. Iowa, Part II, p. 594.

This species bears much resemblance to *B. cassedayanus* M. & W., Geol. Surv. Ills., Vol. V, p. 370, Pl. v, Fig. 1, but differs in the arm formula, having twenty-two arm openings while that one has only seventeen. Among the specimens used in the description of *A. discoideus*, at least now with the type and marked as such, is one having only seventeen arms; while Meek and Worthen figure one having twenty-four arms under the name *B. quasillus*, on the same plate with *B. cassedayanus*, which is still more nearly related to the present species, but recognized by Messrs. Wachsmuth and Springer as a valid species.

### Batocrinus inornatus.

PLATE II, FIGS. 1-3.

*Actinocrinus inornatus* HALL, Supp. Geol. Surv. Iowa, 1860, p. 24.

*Batocrinus inornatus* (HALL) M. & W. Geol. Surv. Ills. Vol. V, p. 367.

*Batocrinus clypeatus* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 166.

Messrs. Wachsmuth and Springer include not only this form under the synonyms of *B. clypeatus*, but also Hall's *A. papillatus*; which in general appearance is so very distinct. It is possible that by studying a large series of individuals they may be gradually merged into each other, but I think it quite doubtful. Below we give Mr. Hall's description of this species.

"Body depressed-turbinate, widely spreading at the arm-bases and abruptly contracted below the basal portion, protruding so as to leave a concavity below a line drawn from the arm-bases to the edge of the basal plates. Dome depressed convex, with a small subcentral proboscis.

"Basal plates slightly convex, extending little below the base of the first radials, depressed in the centre, the lower edges not extending downwards.

"First radials large, height and width nearly equal. Second radials small, wider than high, quadrangular. Third radials a little longer than the second, pentangular, supporting a double series of supraradials, which support a double series of brachial plates above, the last brachial plate being protuberant. Arm-formula :  $\frac{4}{4}-\frac{4}{4} = 20$  arms, composed of a double series of minute interlocking plates. Surface finely granulose.

"A worn specimen in Mr. Worthen's collection, and one with arms in Mr. White's collection, correspond to the following description :

"First interrarial plate large, nine- or ten-sided, supporting two in the second range, with sometimes one in the third range. First anal plate large, heptagonal, a little higher than the first radials ; three plates in the second range and three in the third range ; or sometimes two irregular ranges above the second, with two each with a single one above these.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Surv. Iowa, 1860, p. 24.

### Batocrinus lepidus.

PLATE I, FIGS. 17 AND 18.

*Actinocrinus lepidus* HALL, Supp. Geol. Surv. Iowa, 1860, p. 32.

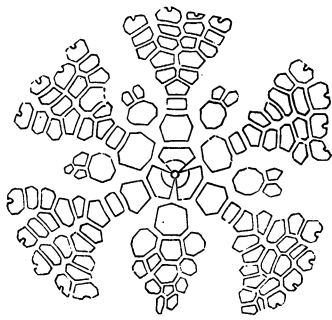
*Batocrinus lepidus* (HALL) M. & W. Geol. Rept. Ills. Vol. V. p. 367.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 167.

The following description and diagram is from Hall's Supplement to the Geological Survey of Iowa, as cited above. The specimen figured on our plate is that used both for the description and diagram.

"Body broadly subtrubinate, abruptly spreading above the third radial plates ; summit depressed-convex, with a central proboscis rising abruptly from the dome. Basal plates short, thickened at the lower margins, and slightly excavated for the attachment of the column.

"First radial plates of medium size, a little wider than high. Second radials small, quadrangular. Third radial small, pentagonal, supporting on each upper oblique side a brachial plate, which is succeeded by a second one, on the sloping sides of which succeed three brachial plates, except on the anal side of the postero-lateral ray, where the upper supraradial sustains two supraradials of the second order, the last one a bifurcating plate supporting two brachial plates, and giving one more arm to this ray ; making the brachial formula  $\frac{4}{5}\frac{4}{5} = 22$  arms.

"First interrarial ten-sided, supporting two smaller ones in the second range, which are arched above by the brachial plates of the adjacent arms. First anal plates heptagonal, about equal to the first radial plates, supporting three small plates in the second range, which are respectively six-, seven- and eight-sided ; three plates in the third range, with an intercalated plate between the two ranges ; three small plates in the fourth range, and two small elongated plates extending upwards and separating the brachial plates of the postero-lateral rays. Plates of the body very slightly convex, becoming more convex towards the bases of the arms ; plates of the summit tuberculous. Column comparatively large.

*Batocrinus lepidus.*

"This species, in its general form, resembles *A. æqualis*; but the plates of the body are not tuberculous, the summit less elevated, and the arm-formula very different. In the arm-formula it resembles *A. turbinatus*, var. *elegans*, but differs in form of body and in the less elevated summit, while it has one more range of brachial plates forming part of the body. In this species, a right line from the base of the dome to the bases of the arms shows the outline of the body to be below it, or concave; while in *A. turbinatus*, the outline is straight or slightly convex.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Surv. Iowa, 1860, p. 32.

### **Batocrinus laura.**

PLATE I, FIGS. 15 AND 16.

*Actinocrinus laura* HALL, Desc. New Sp. of Crinoids, 1861, p. 15.  
*Batocrinus laura* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 167.

Hall's original description cited above is here quoted.

"Body biturbinate, the height above and below the arms equal; the sides of the calyx slightly contracted at the middle and rapidly expanding near the arm-bases, which are somewhat lobed. Basal plates short, rounded below, and excavated for the column-attachment. First radials proportionally large, wider than high; second radials small, quadrangular; third radials broadly pentagonal, supporting on each upper sloping side a series of two supraradial plates, the upper one bifurcating and supporting a double series of brachial plates, giving an arm-formula  $\frac{4}{4}-\frac{4}{4}=20$ .

"Interradial plates four in each series, in ranges of one, two and one. Anal plates five; the first heptagonal, a little smaller than the first radials, supporting three in the second range, with one larger resting on their upper sides, and one elongate plate above between the arm-plates of the adjacent rays. Plates of the calyx smooth; those of the dome depressed convex. Proboscis of moderate size, central. Arm-openings placed at the edge of the dome, directed upwards.

"This species, in general form and number of arms, somewhat resembles *A. equibrachiatus* (McChesney); but is much higher in proportion to its width, less spreading at the arm-bases, and has a smaller number of interradians and anal plates; the arm-bases are never so distinctly lobed, as in specimens of that species. Burlington limestone."—Desc. New Sp. Crin., 1861, p. 15.

From the brown beds of the Burlington limestone at Burlington, Iowa.



**Eretmocrinus attenuatus.**

PLATE I, FIGS. 23 AND 24.

*Actinocrinus matuta* var. *attenuata* HALL, Desc. New Sp. Crinoids, 1861, p. 14.  
*Eretmocrinus attenuatus* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 172.

This species was not fully described originally, but only given as a variety of *A. matuta*, with a comparison with that species. The type is not in a very good state of preservation, and bears evidence of immaturity. The form is narrowly obconical below the arm bases, and highly dome-shaped above and has been surmounted by a small proboscis much nearer the anal side than the anterior. There are four arm-openings to each ray except the anterior one, where there are only three, the right hand side having the single one. The supraradials are two everywhere, and the brachial series two except on the single ray of the anterior side, where there is but one. The anal series is one below, with an arch of three above it, and then two, with possibly a single one above between the brachial plates of the adjacent post-lateral rays. Interradial series, one, large, with probably two above, and possibly a minute one between the brachials. Vault composed of strongly nodose plates. Calyx marked by an angular ridge traversing the rays and their ramifications, quite strongly marked; while the plates of the anal series, as well as the principal plate of each interradial series, are marked with ridges passing from the centre to the adjoining plates.

The following comparison is that given under the original publication :  
 "A specimen of the same general form as *A. matuta*, with a more attenuate body; a truncate base; the first radials but slightly nodose; the radial series less strongly ridged; the dome higher, with three or four ranges of strongly nodose plates between the arms and base of proboscis; and proboscis excentric."

The specimen is from the Burlington limestone, at Burlington, Iowa, and is entirely silicified from excessive weathering. Probably from the brown bed.

**Dorycrinus pendens.**

PLATE II, FIG. 9.

*Actinocrinus pendens* HALL, Supp. Geol. Surv. Iowa, 1860, p. 31.  
*Dorycrinus unicornis* (O. & S.) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 354.

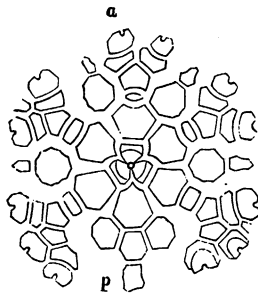
This is probably only an extravagant form of *Actinocrinus* (*Dorycrinus*) *unicornis*, as stated by Wachsmuth and Springer, but in the condition of preservation, with the calyx only, it certainly presents a remarkable variation from the usual form of that species. Hall's original description is given below, as is also his diagram of the specimen now figured :

"Body cup-shaped, subhemispheric below the arms ; base depressed. Basal plates small, short, forming a narrow interrupted rim around the summit of the column ; the continuity of the rim broken at the sutures by two of the radials and the first anal plate, the bases of which project within the area of the column.

"First radials large, wider than high ; upper margins concave. Second radials quadrangular except in the anterior ray, very short ; upper and lower margins convex ; the anterior ray becomes elliptical, by the meeting of the angles of the first and third radials. Third radials much larger than the second, pentangular, supporting on each of their upper sloping edges brachial plates, except on the anal side of the postero-lateral rays, where they support bifurcating supraradial plates, which, on each side, support brachial plates, giving three arms to each of these rays and two to each of the others ; making the arm-formula  $\frac{2}{3}-\frac{2}{3}=12$ .

"First interradial plates large, eight-, nine- and eleven-sided, supporting a single smaller elongate plate above.

"First anal plate large, heptagonal, supporting three smaller plates in the second range, the second one of which is hexagonal and the other two heptagonal ; and above this a single quadrangular plate lies between the bases of the arms.



*Dorycrinus pendens.*

"Column round, rather small ; canal pentagonal or pentalobate.

"Surface of plates strongly nodose ; the nodes of the first radials and first anal plate elongate and subclavate, being contracted in the middle and swelling out at the extremities, extending considerably below the plane of the summit of the column ; nodes of the first brachial plates subcrescentform. This is a very distinct and beautiful species, readily recognized by the very prominent character of the nodes.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Geol. Surv. Iowa, 1860, p. 31.

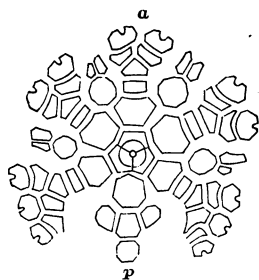
### ***Dorycrinus tricornis.***

PLATE II, FIGS. 6-8.

*Actinocrinus tricornis* HALL, Geol. Rept. Iowa, Vol. I, Pt. II, p. 569.  
*Dorycrinus unicornis* (O. & S.), WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 180.

This is another of the *B. unicornis* type, and although presenting strong individual differences may readily be conceived to be identical with *B. unicornis*, as classed by Wachsmuth and Springer. Below is the original description from the Geological Report of Iowa.

"Body subglobose, truncate at base and spiniferous at the summit. Basal plates concave in the centre, with projecting margins, and broadly notched at the sutures ; with edges between the sutures emarginate in the middle, but less deeply than at the sutures. First radial plates thick, turgid, tuberculiform, and abruptly truncated on the upper sides ; width about once and a half the length. Second radials very short, more than twice as wide as long. Third radials short, pentagonal, each side with a simple plate on the upper oblique side, which supports a brachial plate ; those adjoining the anal side supporting two brachial plates. First interradial plate ten-sided, presenting the form of an angular tubercle, resting on the upper sloping edges of the first radials, and supported on the sides by the second and third radials ; its supralateral edges supporting the supraradial plates, and its superior plates supporting two narrow second interradials which lie between the brachial plates. First anal plate large, tuberculiform ; second range consisting of three plates, the middle one largest ; above this a prominent line of three successive plates, the lateral ones of each series concealed in a deep groove between the anal ridge and the prominent arm-plates ; above these are three series of small plates, the last one surrounding the aperture, which lies against the subcentral apical spine. A prominent spiniferous tubercle, on each side of the anal opening, projects obliquely upwards. Arms three from each ray adjoining the anal area, and two from each of the other rays, making twelve altogether.



*Dorycrinus tricornis.*

"This species differs conspicuously from *A. unicornis* in the outline of the basal plates, and the greater prominence and angularity of the other plates, as well as in the character of the spines. The plates of the summit, also, are more pointed ; while the plates above each pair of arms, and more especially those above the triple arms, are distinctly spiniform.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Geol. Surv. Iowa, Part II, p. 569.

### **Teleocrinus ægilops.**

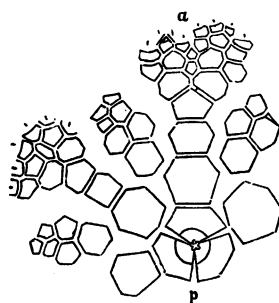
PLATE II, FIGS. 27 AND 28.

*Actinocrinus ægilops* HALL, Supp. Geol. Iowa, 1860, p. 5.  
*Strotocrinus ægilops* (HALL) M. & W. Geol. Surv. Ills. Vol. V, p. 349.  
*Teleocrinus ægilops* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 148.  
 ? *Teleocrinus umbrosus* (HALL) WACHSM. & SPRINGER, *ibid.*

"Body urnshaped below, spreading, high, domeshaped above, composed of polygonal nodose plates, and terminating in a strong subcentral proboscis : base slightly excavated.



"Basal plates large, thick, projecting below the point of attachment for the column in a bipartite node. First radial plates slightly wider than high, narrower at base than above. Second radials pentagonal or hexagonal. Third radials pentagonal, as large as the second, and supporting on their upper oblique sides large heptagonal supraradial plates; these support, upon their outer oblique sides, brachial plates in double series, and upon their inner sides they sustain supraradial plates of the second order; these again sustain brachials and supraradials of the third order, in reversed positions: the last supraradials support two brachial plates, giving eight arms to each ray, or forty arms to the whole brachial series. Resting upon the first supraradials and lying between the second, are two pentagonal inter-supraradial plates, the first three times the size of the second.



*Teleocrinus agilops.*

"First interrarial plate hexagonal, sustaining on its upper sides two smaller plates, hexagonal and heptagonal, with from two to four small plates above. First anal plate as large as the first radials, heptagonal, supporting three smaller plates: the remaining anal plates have not been determined.

"Surface traversed by low ridges, which pass from plate to plate, meeting in a transverse lanceolate node on the centre of each plate, except the first radials, which are marked by irregular confluent nodes.

"*Geological position and locality.*—In the Burlington limestone, Quincy, Illinois."—Supp. Geol. Surv. Iowa, 1860, p. 5.

### **Amphoracrinus divergens.**

PLATE II, FIGS. 12 AND 13.

*Actinocrinus divergens* HALL, Supp. Geol. Iowa, 1860, p. 36.  
*Amphoracrinus divergens* (HALL) M. & W. Geol. Ills. Vol. V, p. 388, pl. vi, fig. 6.  
*Amphoracrinus divergens* var. *multiramosus* M. & W. *ibid.* p. 389.  
*Amphoracrinus divergens* (HALL) and var. *multiramosus* M. & W.  
*Actinocrinus planobasilis* (HALL) and *A. quadrispinus* (WHITE) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 155.

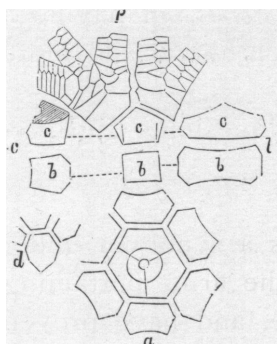
"Body depressed, subdiscoid below. Dome elevated and surmounted by central and lateral spines, the lateral ones being nodose and bifurcate. Basal plates forming a protruding hexagonal disc; the area for the attachment of the column large, slightly depressed.

"First radial plates hexagonal from the straightness of the lower margin, about once and half as wide as high. Second radials short and wide, hexagonal and heptagonal, spreading horizontally or at right angles to the direction of the axis. Third radials heptagonal, much wider than high: the lateral margins of these, and of the second radials, are strongly inflected. The third radials support on their upper sloping edges a pair of large supraradial plates,

which, in one of the postero-lateral rays, give origin to two arms on one side, and, on the side adjacent to the anal area, to three arms, making five arms from one of the postero-lateral rays; the arm-formula being probably  $\frac{4}{5}-\frac{4}{5}$ . The arms differ, at their origin, from most of the forms of *Actinocrinus*; being composed of a double series of interlocking plates below the last bifurcation, giving the arm altogether the appearance of the arm of *Platycrinus*.

"Interradial plates consisting of two ranges, the lower one of a single seven-sided plate supporting three plates in the second range. First anal plate smaller than the first radial plate, seven-sided, supporting three larger plates in the second range.

"This species has a very remarkable form for an *Actinocrinus*: the body consists of a shallow cup; the rays diverge from the second radial plates rectangulary, these plates and the third radials being broadly and deeply excavated on their inner sides, and probably occupied by the viscera of the animal as far as the first bifurcation. The arms are long and spreading, and, in the specimen examined, are curved in a horizontal direction. The dome is broken, and the form and arrangement of plates cannot be fully determined. It is clear, however, that the summit was crowned by a central strong spine, which was surrounded by others (probably five) without intervening plates, two of which still remain; these latter are divided at their summits, and tuberculous on their sides. There have been several ranges of plates between the bases of the outer spines and the axils of the arms.



*Amphoracrinus divergens.*

"The diagram illustrates the structure of the base and first radials *a*, and one ray continued to the arm-bases *b c*, while *b c* on the right show the form of these plates if spread out, and *b c* on the left are sections of the same; *d* being the interradian series as far as seen in that specimen.

"Since this diagram was made, several other specimens have been seen, consisting of the base, first and second radials, interradian and anal series. The general aspect of the species is that of *Cyathocrinus*.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Surv. Iowa, 1860, p. 36.

### ***Amphoracrinus inflatus.***

PLATE II, FIGS. 10 AND 11.

*Actinocrinus inflatus* HALL, Supp. Geol. Iowa, 1860, p. 20.

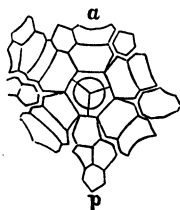
*Amphoracrinus spinobrachiatus* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 155.—M. & W. Geol. Surv. Ills. Vol. V, p. 388.

"Body flattened, or very moderately convex below. Dome high and inflated, terminating in a large subcentral proboscis, which is composed at base of large spinose plates: proboscis nearest the anal side.

"Basal plates of medium size, hexagonal, without reëntering angles at the suture lines : base very slightly concave, and margins of plates not produced.

"First radial plates large, once and a half as wide as high, straight below. Second radials short and wide, hexagonal. Third radials smaller than the second, hexagonal, twice as wide as high, sustaining on their upper oblique edges brachial plates on the only arm where they remain ; the number of arms undeterminable, on account of the imperfection of the specimen.

"In the interrarial series there is but one hexagonal plate in each division, which can properly be called an interrarial plate, the two plates above being more properly interbrachials. The anal series consists of one hexagonal plate below, smaller than the first radials, and two in the second range ; above these, the number and arrangement cannot be determined. The interbrachial spaces are much depressed, forming deep grooves in the body ; the constriction extending to the upper angles of the first radial plates, giving a peculiar stellate form to the crinoid when viewed from the base.



*Amphoracrinus inflatus.*

"The plates of the body of the crinoids of this type are very thin and fragile, and the specimens consequently much distorted and broken.

"This species differs from *A. planobasilis*, in having a more convex calyx, in the dome being much higher and more inflated, as well as in the proportional size of the plates.

"*Geological position and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Surv. Iowa, 1860, p. 20.

Messrs. Wachsmuth and Springer cite this species as a synonym under *Amphoracrinus spinobrachiatus* Hall. I have not seen the arms pertaining to this variety, so far as I know, but I presume they have, and have proved their observation. The type here figured does not possess the sculpturing on the plates of the calyx shown on those of *A. spinobrachiatus*, as shown in the Illinois Geological Report, Vol. V, Plate 6, Figs. 5 and 5a.

### **Agaricocrinus pyramidatus.**

PLATE II, FIGS. 23-25.

*Actinocrinus pyramidatus* HALL, Geol. Surv. Iowa, Vol. I, Pt. II, p. 565.

*Agaricocrinus pyramidatus* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 112.

We give below Hall's original description of the species, and figure the two type specimens, one quite young, the other probably fully grown. Wachsmuth and Springer cite as a synonym of this species Hall's *A. corrugatus*, Journal Boston Society of Natural History, 1861, p. 283. Our recollection of that species is that it is very distinct, but not having specimens cannot feel sure.



"Body depressed pyramidal, with the apex terminating in a short acute spine. Basal plates not visible beyond the circumference of the column. First radial plates much longer than wide, deeply concave towards the column, the outer margins thickened and prominent, and, together with the thickened second radials, forming the plane of rest where the body is deprived of the column. Second radials short, quadrangular. Third radials pentagonal, each one supporting on its upper sloping sides two succeeding simple brachial plates, which are in turn succeeded by a double series of arm-plates, making one pair of arms at the base from each radial. Interradial plates in general form ovate, resting on the upper sloping edges of the adjacent radials: each one is supported on its sides by the second and third radial, and on its upper slopes by the two simple brachial plates; its upper short side supports a narrow second interradial or interbrachial plate. First anal plate much longer than the first radial plates: second, third and fourth ranges consisting of three plates each; and above this, two or three ranges of small plates surrounding the aperture which lies just below the base of the apical plate. The centre of the entire anal area, from the first plate to the apex, is elevated in a distinct rounded ridge.

"Summit short pyramidal: a range of two or three prominent tuberculous plates extends from the upper side of the arms to the apical plate; those from the anterior pair of arms being surmounted by two plates, making six tuberculiform plates surrounding the apical spiniferous plate. Arms two at their origin from each ray. Surface somewhat coarsely granuliferous.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Geol. Rept. Iowa, Part II, p. 565.

### **Agaricocrinus ornotrema.**

PLATE II, FIGS. 19-22.

*Agaricocrinus ornotrema* HALL, New Sp. of Crin. 1861, p. 3.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 112.

We have figured the best preserved individuals of this species known at the time of the original description. They are highly imperfect, the larger one preserving less than half of the body, while the second one, although retaining all the parts of the body, is so badly weathered that it is difficult to trace the structure. A third specimen, not figured, is quite immature, but presents the same features around the anal opening. Hall's original description is given below.

"Body flat below the arm-bases, pyramidal above; the central terminal plate of the dome raised in a strong rounded tubercle, rarely tapering above; the surrounding plates much stronger than the other plates of the dome,

except those directly above the arms. The plates surrounding the aperture extend into strong clavate nodes, which feature is characteristic of the species. Burlington limestone."—Desc. New Sp. Crin., 1861, p. 3.

The two smaller specimens vary from the above description in being quite convex on the base instead of being flat, as there stated.

### **Agaricocrinus pentagonus.**

PLATE II, FIGS. 17 AND 18.

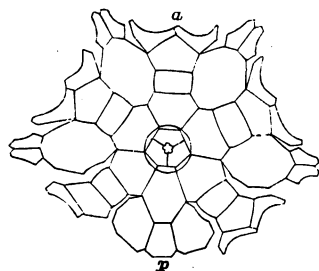
*Agaricocrinus pentagonus* HALL, Supp. Geol. Surv. Iowa, 1860, p. 57.—M. & W. Geol. Rep. Ills. Vol. II, p. 210.—WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 112.

"Base of specimen nearly flat from the edge of the last joint of the column to the junction of the second and third radial plates, at which point it becomes deflected upwards: the interrarial and anal spaces are at right angles to the plane of the base, while the rays themselves are a little more protruding, giving to the outline of the body a pentagonal form. Basal plates very small, entirely concealed by the column, and depressed beneath the general level of the base.

"First radial plates hexagonal from the straightness of their lower margins, once and a half as wide as high; their lower margins very narrow. Second radials of moderate size, quadrangular; upper and lower margins straight, with convex lateral faces. Third radials pentangular, much wider than high, and supporting on their upper oblique edges short wide brachial plates, which are somewhat triangular in outline, with upper edge concave.

"First interrarial plates very large, double the size of the first radials and of an elongated form, supporting on their upper oblique edges two small elongated plates in the second range, which reach to the top of the arm-bases. First anal plate extremely elongated, supporting three other irregularly formed plates in the second range, the central one being the smallest.

"Dome elevated, three-fourths as high as the width at the base of the specimen, composed of convex and tuberculiform plates, the central one being elevated into an obtuse spine; and a single plate in the axil of each pair of arms is very strongly tuberculose, while the central one is surrounded, except on the anal side, by a row of tuberculous plates.



*Agaricocrinus pentagonus.*

"This species may be readily distinguished from any other of this genus yet described, by the relative proportions of the plates; the first interradians being nearly double the size of any other species, in comparison with the size of the specimen, while all the other plates vary in proportion from those of other species.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Surv. Iowa, 1860, p. 57.

### **Agaricocrinus excavatus.**

PLATE II, FIGS. 14-16.

*Agaricocrinus excavatus* HALL, Desc. New Sp. Crin. 1861, p. 3; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 282.  
*Agaricocrinus americanus* (ROEMER) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 112.

"Body pentagonal, flat below, with the centre abruptly depressed or excavated, pyramidal above; height equal to two-thirds the width. The depression of the base consists of a deep, circular cavity, the bottom of which includes the plates of the body as far as the middle of the second radial plates, while the upper part of these and the lower part of the third radials form the sides of the cavity; the space between this and the arm-bases is somewhat rounded. Basal plates small, forming a pentagon. First radials hexagonal, wider than long; second radial plates wider and not so high, five- and seven-sided; third radial plates proportionally very large, pentagonal, obtusely wedge-form above, supporting on each upper side a series of short, broad plates, on which rest the arm plates proper.

"First interradial plates hexagonal in the antero-lateral spaces, succeeded by two very narrow and much elongated plates in the second range, which reach from the inner margin of the cavity to the arm openings. In the postero-lateral spaces, the first interradial plates are elongate, reaching to the top of the third radial plate, or higher. First anal plate sub-hexagonal, somewhat elongate, supporting three larger elongate plates in the second range, with numerous small polygonal plates above. The anal area is somewhat protruding, and situated about midway between the arm-bases and the top of the dome. Dome composed of variously sized plates, the large ones tuberculose and regularly arranged, one over the centre of each ray, and the largest at the top is sub-globose and surrounded by a circle of smaller plates. The plates of the flattened base are slightly convex; surface of all the body plates granulose or striato-granulose.

"This species differs from all others in the abrupt depression in the base.

"*Geological formation and locality.*—In cherty layers in the upper part of the Burlington limestone, Brush Creek and Flint River, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 282.

Messrs. Wachsmuth and Springer cite this as a synonym of *Agaricocrinus americanus* Roemer (= *A. tuberosus* Troost), and also include *A. bullatus* Hall, and *A. nodosus* M. & W. as being the same. In regard to this species it appears to me they cannot be correct. It is not only in the deeply sunken

base that it differs, but also very materially in the structure, as instead of having the first interrarial plates elongated so as to reach up among the arm plates or above the first supraradials; in this form they are very short and allow the second interradials to reach to and often abut against the corners of the second radials. If this is not of specific importance, it is difficult to tell what would be.

### **Periechocrinus whitei.**

PLATE II, FIG. 29.

*Actinocrinus* (*Megistocrinus*) *olliculus* HALL, Desc. New Sp. Crin. 1861, p. 2.  
*Actinocrinus* (*Megistocrinus*) *whitei* HALL, Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 271.  
*Megistocrinus* (*Saccocrinus*) *whitei* M. & W. Geol. Surv. Ills. Vol. V, p. 395, pl. vi, fig. 1.  
*Periechocrinus whitei* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 133.

“Body pocilliform, the height and greatest breadth nearly equal; dome flattened or depressed-convex. Basal plates of medium size, spreading almost horizontally from the top of the column. First radial plates moderately large, height and width sub-equal, superior lateral sides nearly equal to the lower. Second radial plates proportionally large, hexagonal. Third radial plates pentagonal, sometimes hexagonal, smaller than the second radials, wedge-form above, and supporting on each upper side a short hexagonal plate, upon which rest the first arm plates.

“First interrarial plate hexagonal, as large as the second radials or larger, supporting two smaller heptagonal plates in the second range, with three in the third, and three or four in the fourth; and above these are still smaller plates, which unite with the plates of the dome. First anal plate heptagonal, as large as the first radial plates, supporting three smaller plates in the second range, with four in the third range, above which are ten to fifteen smaller, irregular plates.

“Arms two from each ray, bifurcating soon after becoming free; the branches, strongly diverging and curving upwards, again bifurcate, and still strongly divergent. The arm-plates are a single series of obtusely wedge-form plates near the base, becoming double from the fourth or fifth plate, after which they continue in double series. At each bifurcation the arms gradually diminish in size.

“Surface smooth, with an incipient ridge passing along the middle of the radial series. Column round, of moderate strength, composed of very short plates.

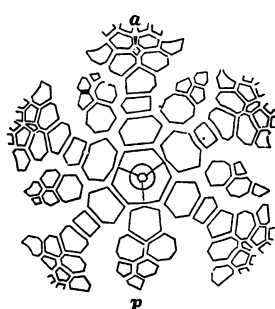
“This is a very distinct and well-marked form, though the bifurcations of the arms vary in different individuals.

“*Geological formation and locality.*—Burlington limestone, Burlington, Iowa.”—Jour. Bost. Soc. Nat. Hist., VII, p. 271.

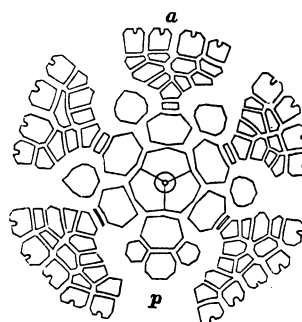


There is a slight difficulty in regard to the identification of this species, owing to a mistake in the numbering of figures on Hall's Photo-plate, where Figs. 4 to 6 are referred to it under the name *A. olliculus*, instead of only Fig. 4, while Figs. 5 and 6 should have been referred to *A. eryx*. (See remarks under *Actinocrinus glans*.) The specimen here figured as *P. whitci* is one used in the original description and appears to have been originally obtained from Dr. C. A. White.

The following cuts of two species of the Family Actinocrinidæ were accidentally omitted in their proper places.



*Actinocrinus opusculus.*  
(See p. 9.)



*Batocrinus discoideus.*  
(See p. 14.)

### Family CYATHOCRINIDÆ.

#### *Cyathocrinus viminalis.*

PLATE III, FIG. 7.

*Cyathocrinus viminalis* HALL, Desc. New Sp. Crin. 1861, p. 5; Jour. Bost. Soc. Nat. Hist. 1861, p. 299.  
*Cyathocrinus iowensis* (O. & SH.) WACHSM. & SPRINGER, Proc. Acad. Nat. Sci. Phil. 1877, p. 256.

"Body small, depressed-subglobose, nearly twice as wide as high; the greatest diameter at the top of the subradial plates. Basal plates small, pentangular. Subradial plates proportionally large, height and breadth nearly equal, hexagonal, except one on the anal side, which is pentagonal and larger. First radial plates subheptagonal, about equal to the subradials, slightly inflected at the upper lateral margins; articulating scar for the attachment of the arm small, less than one-half the width of the plate, moderately impressed.

"First anal plate hexagonal, with very small upper lateral faces, supporting three plates, the middle one much the larger; form and number of plates above undeterminable. The anal area extends above in the form of a short proboscis, reaching nearly half an inch above the arm-bases.

"Arms composed of a single series of short plates below and longer ones above, bifurcating on the second or third plate above the first radial plate; the second and third bifurcations are on the second or third plate

above the preceding. One of the armlets on each main division of the ray bifurcates at some distance above its origin. The branches of the arms at their bifurcations are strongly diverging. Column very small, round, and composed, at a distance from the body, of strong, thick plates of equal size.

"This species differs from *C. divaricatus* (Geol. Rep. Iowa, Pl. x, Fig. 5) in its much larger subradial plates, and less strongly diverging arms, which also are composed of more numerous plates.

"*Geological formation and locality*.—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 299.

Messrs. Wachsmuth and Springer have shown in their remarks on this species (Proc. Acad. Nat. Sci. Phil., 1878, p. 256), that several described forms of this type are apparently identical when large numbers of individuals are examined. They consider that *C. viminalis*, *C. malvaceus* and *C. divaricatus* Hall, are all identical with *C. iowensis* O. & Sh., figured in the Geol. Surv. Iowa, Wis. and Minn., Plate Va, Figs. 11, *a*, *b*, *c*. It is difficult for one without the series of specimens examined by these authors to imagine the connection, but still it may exist.

### **Barycrinus sculptilis.**

PLATE III, FIG. 12.

*Cyathocrinus sculptilis* HALL, Supp. Geol. Surv. Iowa, 1860, p. 59.

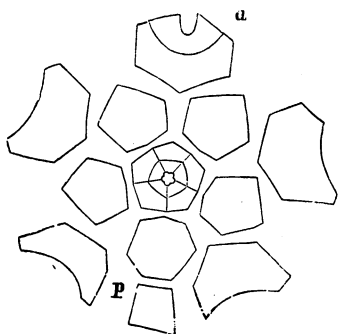
*Barycrinus sculptilis* (HALL) M. & W. Proc. Acad. Nat. Sci. Phil. 1868, p. 340.—WACHSM. & SPRINGER, Palæocrin. Pt. I, p. 103.

"Body broadly basin-shaped; height to the summit of the first radial plates equal to two-thirds the diameter: base truncate, and the summit of the column deeply inserted. Basal plates short, spreading, regularly pentagonal in form, the apices bent inwards. Subradial plates hexagonal; height and breadth nearly equal. First radial plates large, more than twice as wide as high, three of them heptagonal and two hexagonal: the articulating faces very large, occupying the greater part of the width of the plate. First anal plate nearly as large as the subradials, heptagonal: second anal plate smaller, quadrangular, its upper margin being on a line with the summits of the adjacent radials.

"Surface of the plates marked by broad strong ridges, which occupy the greater portion of the area. The basal plates are marked by a ridge on each side, which, uniting at the suture with corresponding elevations on the subradial plate, coalesce in one broad elevation near the base of that plate, and again subdivide above the middle, sending one division to each of the lower adjacent radial plates.

"A short ridge extends from the lateral face of each of the radial plates, uniting at the suture with those of the adjacent plates. The direction of these

ridges gives a series of lozenge-shaped depressions, which occupy the apex of the basal plate the lateral margins of the adjacent subradials, and the lower angle at the centre of the base of the first radial plates ; and a series



*Barycrinus sculptilis.*

of subtriangular depressions occupy the apices of the subradials, and lower lateral angles of the adjacent radial plates. The ridges, in well-preserved specimens, are marked by a set of sharp striæ parallel to their direction, while the depressions are finely granulose.

“This species would appear to bear a close resemblance to the *Poteriocrinus rhombiferus* of Owen and Shumard ; but the basal plates are always visible beyond the margin of the column, and are regularly pentagonal, while the second series are distinctly hexagonal, with the exception of the anal plate which is heptagonal. The first radial plates are much wider in proportion to their height : the faces joining the adjacent radials and subradials are four ; the summit has a broader articulating face for the second radial, and the upper adjacent angles are truncated by the interrarial plates, except those joining the anal plate.

“*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa.”—Supp. Geol. Surv. Iowa, 1860, p. 59.

Messrs. Wachsmuth and Springer cite *Cyathocrinus latus* Hall (Jour. Bost. Soc. Nat. Hist., Vol. VII, 1861, p. 292) and *C. scitulus* M. & W. (Proc. Acad. Nat. Sci. Phil., 1863, p. 393), as synonyms of this species. Meek and Worthen also cite their *C. scitulus* as a synonym in Vol. II, Geol. Surv. Ills., p. 178.

### **Eupachyrcrinus orbicularis.**

PLATE III, FIGS. 8 AND 9.

*Scaphiocrinus orbicularis* HALL, Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 311, Photo-plate v, figs. 7-9.  
*Eupachyrcrinus orbicularis* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. I, p. 138 ; Geol. Ills. Vol. VIII, p. 97, at which place they copy Hall's original description.

“Body below the arms very broadly basin-shaped, or depressed-hemispheric, with the upper margins slightly inflected ; articular scar for the column attachment sharply impressed, extending one-half or two-thirds the diameter of the basal plates. Basal plates pentagonal, obtusely angular above, forming by their union a pentagon with scarcely concave margins. Subradial plates exceedingly large, extending from the edge of the column to near the top of the first radial plates, three subpentagonal and two heptagonal (or hexagonal from the straightness of the lower sides), length some-

what greater than breadth. First radial plates proportionally small, subtriangular; the lateral edges of the adjacent plates slightly truncating each other. First anal plate large and massive, pentagonal, resting between the two heptagonal subradials, and supporting one side of the adjoining first radial plate. The two remaining anal plates (all which are seen in the specimen) are smaller and hexagonal.

"Arms and column unknown. Surface of plates depressed-convex, sutures distinctly marked. The body plates are very massive, the internal cavity being less than half the whole diameter.

"This species differs remarkably from any known species in the sub-carboniferous rocks of this country. Its nearest relations are with *Cyathocrinus pentalobus*, (Iowa Geol. Rep., Pl. xxv, Fig. 5) = *Graphiocrinus quatuordecim-brachialis* of Lyon, (Kentucky Geol. Rep., Pl. i, Fig. 2;) from which it differs in the greater disproportion in the size of the plates, which are not produced in nodes or tubercles.

"*Geological formation and locality.*—Keokuk limestone, Keokuk, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 311.

### **Poteriocrinus (Scaphiocrinus) carinatus.**

PLATE III, FIGS. 13 AND 14.

*Scaphiocrinus carinatus* HALL, Desc. New Sp. Crin. 1861, p. 8; Jour. Bost. Soc. Nat. Hist. Vol. VII, 1861, p. 310. *Poteriocrinus (Scaphio.) carinatus* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. I, p. 114. Not *Poteriocrinus carinatus* M. & W. Geol. Surv. Ills. Vol. III. pl. 17, fig. 1.

"Body small, basal plates entirely covered by the column. Subradials three pentagonal and two hexagonal, the one on the anal side larger. Radial plates three in each series: the first of moderate size, subpentangular, a little wider than long; the second quadrangular, height nearly as great as the width; the third short, pentangular, acutely wedge-form above, supporting the first arm-plates. Arms two from each ray, bifurcating on the eighth or tenth plate, and in the anterior ray, and at least one of these branches from each arm again bifurcating; and a similar bifurcation is seen on one of the antero-lateral rays.

"First anal plate elongate, pentagonal, resting on two of the subradials, and supporting one of the first radials; second anal plate larger than the first, hexagonal; the third of the same form and smaller; above these are ten or twelve plates, marked by stelliform ridges, forming the lower part of proboscis. Surface of body plates marked by strong radiating ridges, giving a stelliform aspect. Arms composed of a single series of plates, short, and concave on the shorter side, the longer side marked by a protuberance, below which it is concave; from this protuberance the tentacula proceed.

These plates are traversed longitudinally by sets of ridges, the central one more prominent and sharply carinate, the lateral ones less distinct. Column proportionally strong, distinctly pentangular, composed of equal plates with thin projecting edges.

"This species differs from the two preceding in the proportional size of the column, which conceals the basal plates, in having three radials in each series, in the smaller first radials, the more numerous bifurcations of the arms, and the sharply carinated plates.

"*Geological formation and locality.*—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 310.

The specimen now figured is one of those used in the original description. The plates of the arms are so displaced and disjointed that it is impossible to give a very satisfactory figure of it. The enlargement of a part of the right antero-lateral ray, however, will give a fair idea of the character of the plates.

### Graphiocrinus tortuosus.

PLATE III, FIGS. 15-17.

*Scaphiocrinus tortuosus* HALL, Desc. New Sp. Crin. 1861, p. 7; Jour. Bost. Soc. Nat. Hist. 1861, p. 309.  
*Graphiocrinus tortuosus* (HALL) WASHSM. & SPRINGER, Palæocrin. Pt. I, p. 123.

"General form and proportions of body similar to the preceding, the basal plates being somewhat larger, the subradials and first radials are of nearly the same form and proportions; second radials a little shorter and broader in the upper part, single in the antero-lateral and postero-lateral rays, while in the anterior ray there are two plates in this position, the length of both but little greater than the one in the other rays, and of less width.

"Arms simple throughout their entire length; the plates short, concave on the short side and strongly angular on the longer side from the projecting bases for the attachment of the tentacula. Surface of calyx plates marked by a series of ridges radiating from the centres of the subradial plates and uniting with those of the adjoining plates at the sutures; these ridges form a star on each subradial plate, the figures on the others varied according to the size and shape of the plates.

"In general aspect this species is like the preceding. The stelliform ridges of the body plates are strongly distinctive, and the angular ridges or projections on the arm plates give a more directly transverse aspect to these parts, and produce a more abruptly tortuous or zigzag appearance than in the preceding species, while the spiral aspect is not observable.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 309.



**Coeliocrinus dilatatus.**

PLATE III, FIG. 18.

*Poteriocrinus dilatatus* HALL, Desc. New Sp. Crin. 1861, p. 6; Bost. Jour. Soc. Nat. Hist. 1861, p. 300.  
*Coeliocrinus dilatatus* (HALL) C. A. WHITE, Jour. Bost. Soc. Nat. Hist. 1863, p. 501.—WACHSM. & SPRINGER, Palæocrin. Pt. I, p. 133.

"Cup of body very small, broadly expanding. Basal plates minute, pentangular, slightly projecting beyond the column. Subradial plates small, hexagonal, except one on the anal side which is heptagonal, length and breadth about equal. First radial plates irregularly pentagonal, having one of the upper lateral angles slightly truncated by the second radial plate of the adjacent ray. Second radial plates nearly twice as large as the first radials, the plates of the adjacent rays joining at their lateral margins, very obtusely wedge-form above, supporting the plates of the arms on the sloping upper sides. Anal plates small, four seen in specimen, form not determined.

"Arms two from each ray, bifurcating on the sixth plate from the base, and the outer divisions again bifurcating at the sixth plate above the first division, and again at irregular distances above. Surface of plates of the lower part of the body depressed-convex, becoming inflected at the sides as they approach the arm bases.

"Proboscis large and inflated, rising from the top of the small cup, and extending nearly as high as the extremities of the arms; small and constricted near its base, and rapidly expanding until it becomes three times as large in diameter as the calyx, and terminating above in a highly convex dome, the lines of junction between the upper and lower parts being strongly angular; the lower part is composed of several series of small elongated polygonal plates, which gradually increase in size towards the inflated portion; each series of plates is traversed longitudinally by a sharp, angular, elevated ridge, which terminates on the plate on the widest part of the inflation in a lanceolate or pointed node. The plates composing the dome of the proboscis are comparatively large and elevated, each marked by lines which form a star, the rays equalling in number the sides of the plate, across which they join those of the adjacent plates.

"*Geological formation and locality.*—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 300.

The specimen here figured shows the calyx and proboscis of the same individual, which is one of the largest seen up to the time of the description of the species. The parts are separated now, but were found together in the rock. The arms are entirely absent. It is labeled as from the white limestone at Burlington, Iowa. The figure is enlarged to twice its natural size.

***Zeacrinus scoparius.***

PLATE III, FIGS. 19 AND 20.

*Zeacrinus scoparius* HALL, Desc. New Sp. Crin. 1861, p. 8; Jour. Bost. Soc. Nat. Hist. 1861, p. 305.  
*Zeacrinus troostanus* M. & W. Geol. Surv. Ills. Vol. II, p. 186.—WACHSM. & SPRINGER, Palæocrin. Pt. I, p. 129.

"Body small, broadly cup-shaped. Basal plates small, scarcely reaching beyond the circumference of the column, forming by their union a pentagon. Subradials small, height and breadth nearly equal, three pentagonal and two heptagonal, (apparently hexagonal from the straightness of the lower sides). Radial plates four in the anterior ray and two in each of the others. First radials pentagonal, proportionally large, width twice the height. Second radial in the anterior ray quadrangular, width and height sub-equal; the third very short, quadrangular; the fourth pentagonal, like the second in the other rays, but not so high. The last radials support on their upper faces the arms, two from each ray. The arms bifurcate on the sixth or eighth plate above, in the postero-lateral and antero-lateral rays. The outer branch of each division again bifurcates at about half the length. In the anterior ray the arms bifurcate on the eleventh or twelfth plate, apparently simple above. First anal plate pentagonal, slightly elongated; second and third hexagonal; Form of fourth and fifth not determined. Column round, slender, composed in the upper part of short, equal plates, below often throwing out branches from larger and thicker plates than the intervening ones. Surface smooth or very finely granulose.

"This species resembles *Zeacrinus elegans* and *Z. ramosus*, (Iowa Geol. Rep., Pl. ix, Figs. 2 and 3,) but differs very materially from either in the mode of growth and bifurcation of the arms.

"*Geological formation and locality.*—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 305.

It will be seen by the citations above that both Meek and Worthen, and Wachsmuth and Springer, place this species as a synonym of *Z. troostanus* of the former authors. The two certainly have great similarity, but in the details of the arms they differ widely, if Meek and Worthen's figure can be relied on. The second division of the lateral arms, in Meek and Worthen's species, takes place on the eighth, ninth and tenth plates; while in this one it is on the fifth, sixth and seventh plates. There are other discrepancies in the number of plates higher on the arms. Considering these points of difference, I think this is entitled to a distinctive name.

**Taxocrinus juvenis.**

PLATE III, FIGS. 21 AND 22.

*Forbesiocrinus juvenis* HALL, Jour. Bost. Soc. Nat. Hist. 1861, p. 319.*Taxocrinus juvenis* (HALL) M. & W. Geol. Surv. Ills. Vol. II, p. 271.—WACHSM. & SPRINGER, Paleocrin. Pt. I, p. 49.

“Body small, sub-globose, truncated at base rather largely. Basal plates short, showing only as a thin edge of a disc outside of the column. Sub-radials of medium size, pentagonal and hexagonal, wider than high, obtusely pointed above. Radial plates four in each series: the first largest, sub-heptagonal, once and a half wider than high; second and third radials short and broad; fourth radial very broad in proportion to its height, obtusely pointed above, and supporting an arm on each side. Arms dividing on the fourth plate above, and again dividing once more at least; strong and rounded on the back, composed of a single series of short, strong plates, rapidly diminishing in size at each bifurcation. Interradial and anal series consisting of one plate each, resting upon the edges of the first radials and between the second radials of the adjacent rays, the rays becoming free above the second radial plate. The small patelloid plates are indicated by the strong curvature of the suture lines of the radial plates, becoming more distinct in the arm plates. Surface apparently smooth. Column proportionally large, rapidly tapering below, composed of thin, equal plates, with a large central perforation.

“This small species is easily distinguished by the arms becoming free within the limits of the radial series, the single interrarial and anal plate, and the simplicity of the arm structure.

“*Geological formation and locality.*—Burlington limestone, Burlington, Iowa.”—Jour. Bost. Soc. Nat. Hist., VII, p. 319.

**Ichthyocrinus burlingtonensis.**

PLATE III, FIG. 24.

*Ichthyocrinus burlingtonensis* HALL, Geol. Rept. Iowa, Vol. I, Pt. 2, p. 557.—WACHSM. & SPRINGER, Palæocrin. Pt. I, p. 34.

“Base regularly and broadly convex: column small. Basal plates very minute, showing a triangular form beyond the margin of the column. First radial plates very irregularly six-sided, the upper side concave: second radials very wide, irregularly six-sided, the lateral angles being truncated: third radials five-, six- or seven-sided, depending on the truncation of the

lateral angles. Arm-plates quadrangular, resting on the upper sloping sides of the third radials. Structure beyond the first arm-plates unknown.



*Ichthyocrinus  
burlingtonensis.*

"This species is noticed here for the purpose of calling attention to the occurrence of the genus in Carboniferous rocks, the only species hitherto known being in rocks of Silurian age.

"The accompanying figure illustrates the form and proportions of the plates remaining in this specimen, affording the means of comparison with the other known species.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Geol. Surv. Iowa, Vol. I, p. 557.

### Ollacrinus papillatus.

PLATE III, FIG. 23.

*Trematocrinus papillatus* HALL, Supp. Geol. Iowa, 1860, p. 76.  
*Ollacrinus tuberculosus* (HALL) WACHSM. & SPRINGER, Palæocrin. Pt. II, p. 219.

"Body robust, spreading above: the subradials, first and second radials and interradials large, abruptly convex; the upper ones produced into a papilliform node in the middle, and the subradials into short rounded spines.

"The plates of this species are larger than in the two preceding forms; the spines are never produced as in *T. typus*, and the central apical node or subspine gives a distinctive feature when compared with *T. tuberculatus*.

"*Geological formation and locality.*—In the Burlington limestone, Burlington, Iowa."—Supp. Geol. Surv. Iowa, 1860, p. 76.

## BLASTOIDEA.

### Orophocrinus whitei.

PLATE III, FIGS. 25-28.

*Codaster whitei* HALL, Desc. New Sp. Crin. 1861, p. 10; Jour. Bost. Soc. Nat. Hist. 1861, p. 327; Miller's Catal.  
*Orophocrinus conicus* WACHSM. & SPRINGER, Geol. Ills. Vol. VIII, 1890, p. 201, pl. xv, figs. 1, 2, 3.

"Body ovoid, a little more obtuse above than below, base obtuse; the length of basal plate, from the central perforation to the top, is equal to the space between the base of the radial and the base of the pseudo-ambulacral areas; and the distance from the base of the pseudo-ambulacral area to the

point of the plate, measuring the sloping face, is a little greater than the preceding measurements. The radial plates are as wide at the base as the length from the base to the pseudo-ambulacral areas, while at the top they are once and a half as wide as at the lower margin ; the entire length, measuring along the suture line to the summit, (interradials not distinguished) is equal to the width at the top of the plate.

"The pseudo-ambulacral fields are narrow and strongly elevated, with a central sulcus, which is quite distinct above, but becomes obsolete towards the lower part ; composed of a double series of plates on each side, those of the inner range or ambulacral ossicula are smaller than those of the outer ranges. Towards the base the area is contracted, and the inner faces of the outer ranges of plates come in contact ; the number of poral pieces in a single inner range is about twenty-three or twenty-four.

"The inter-ambulacral spaces are divided by a sharply defined ridge extending from the apex of the radial plates to the summit ; and between this and the pseudo-ambulacral field, the surface is marked by strong, rounded striæ, separated by deep, narrow grooves, which in the lower part are parallel to the sides of the pseudo-ambulacral field, but in the upper part diverge from this direction, and converge to the summit of the central ridge.

"These striated surfaces appear to be composed of separated linear plates, like the pectinated rhombs of Cystideans ; and in one place, where broken through, they are seen to be disconnected almost to the inner face of the substance, giving the appearance of numerous thin parallel laminæ. The mouth is visible in the centre of the summit ; but the anal opening is undetermined, (though visible,) from imperfection in the specimen.

"*Geological formation and locality.*—Burlington limestone, Burlington, Iowa."—Jour. Bost. Soc. Nat. Hist., VII, p. 327.

There can be no doubt that the *Orophocrinus conicus* W. & Sp. is the same as Hall's *Codaster whitei*. Hall's description states that it is from the Burlington limestone, but at the time the description was made the Yellow Sandstone at Burlington, which contained so many of the Crinoids, were, I think, usually referred to the Burlington horizon. *O. conicus* appears to have come from the Kenderhook beds at Le Grand, Iowa, which would probably be the same horizon.



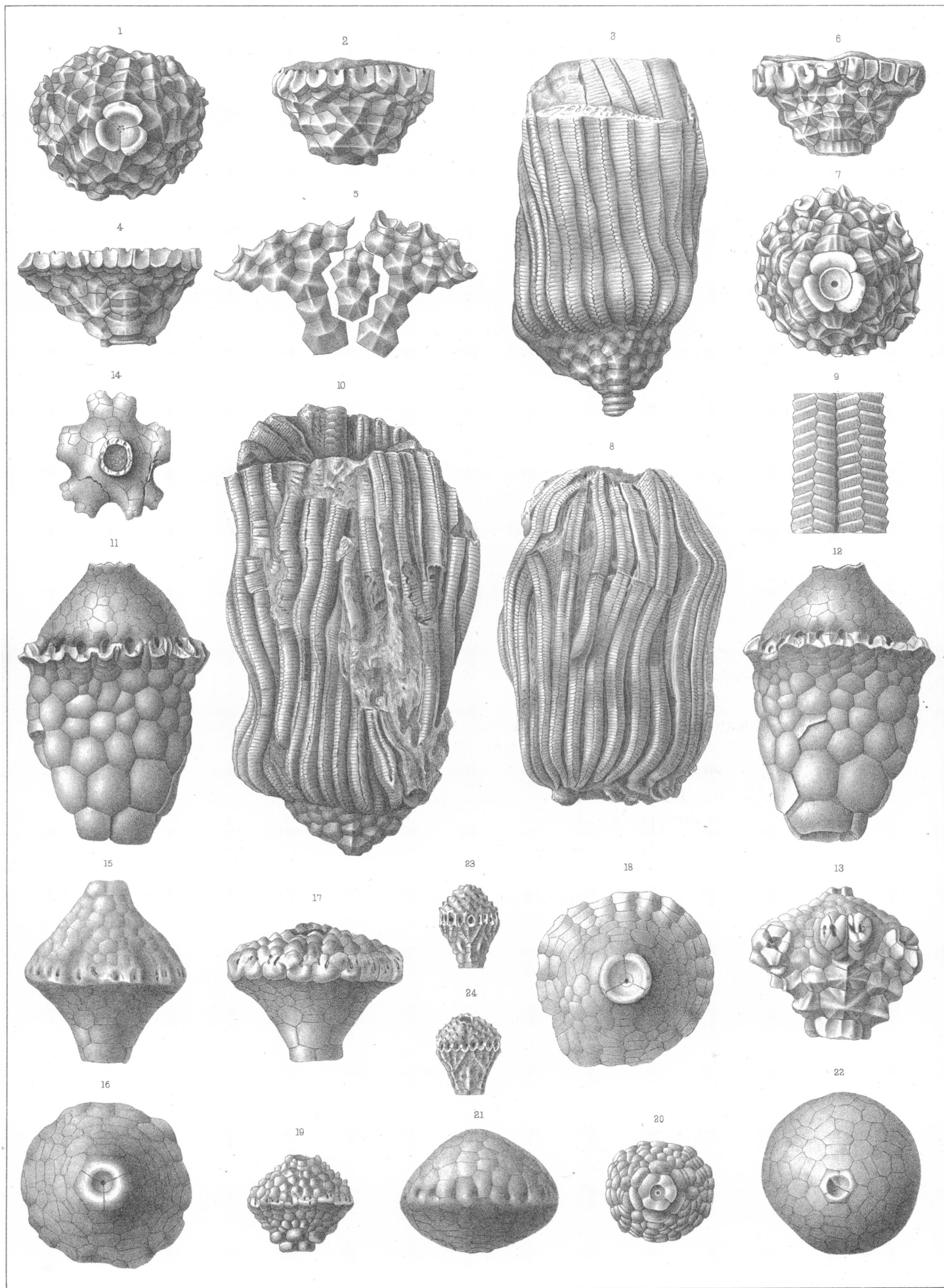




## EXPLANATION OF PLATE I.

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- Figs. 1-3.—**Actinocrinus quaternarius** Hall. Figs. 1 and 2, basal and lateral views of a calyx,  $1\frac{1}{2}$  diameters; the lateral view showing the left postero-lateral interradials. Fig. 3, view of a specimen showing the arms.
- Figs. 4 and 5.—**Actinocrinus clarus** Hall. Right postero-lateral view of a calyx and view of a part of a crushed rim of a calyx. The latter from Prof. Hall's Photo-plate.
- Figs. 6 and 7.—**Actinocrinus opusculus** Hall. The anterior and basal views of the calyx described.  $1\frac{1}{2}$  diameters.
- Figs. 8 and 9.—**Actinocrinus limabrachiatus** Hall. View of one of the sets of arms, and an enlargement of a fragment.
- Fig. 10.—**Actinocrinus thetis** Hall. View of the specimen described by Hall. It shows part of the calyx, the arms, and a fragment of the proboscis.
- Figs. 11 and 12.—**Actinocrinus glans** Hall. Anal and anterior views of one of the type specimens, natural size.
- Fig. 13.—**Actinocrinus rusticus** Hall (= *A. scitulus* M. & W.). Anterior view of Hall's type,  $1\frac{1}{2}$  diameters.
- Fig. 14.—**Batocrinus æquibrachiatus** var. **alatus**. (*Actinoc. æquibrachiatus* var. *alatus* Hall.) View of the lower side of another of the types, not figured on Hall's Photo-plate.
- Figs. 15 and 16.—**Batocrinus laura**. (*Actinoc. laura* Hall.) Anterior and basal views of the type,  $1\frac{1}{2}$  diameters.
- Figs. 17 and 18.—**Batocrinus lepidus**. (*Actinoc. lepidus* Hall.) Anterior and basal views of one of the types,  $1\frac{1}{2}$  diameters.
- Figs. 19 and 20.—**Batocrinus discoideus**. (*Actinoc. discoideus* Hall.) Anal and basal views of one of the types, natural size. The second specimen is a trifle more elongated than this one.
- Figs. 21 and 22.—**Batocrinus oblatus**. (*Actinoc. oblatus* Hall.) Anterior and basal views of the type.
- Figs. 23 and 24.—**Eretmocrinus attenuata**. (*Actinoc. mutata*, var. *attenuata* Hall.) Anterior and anal views of the type.





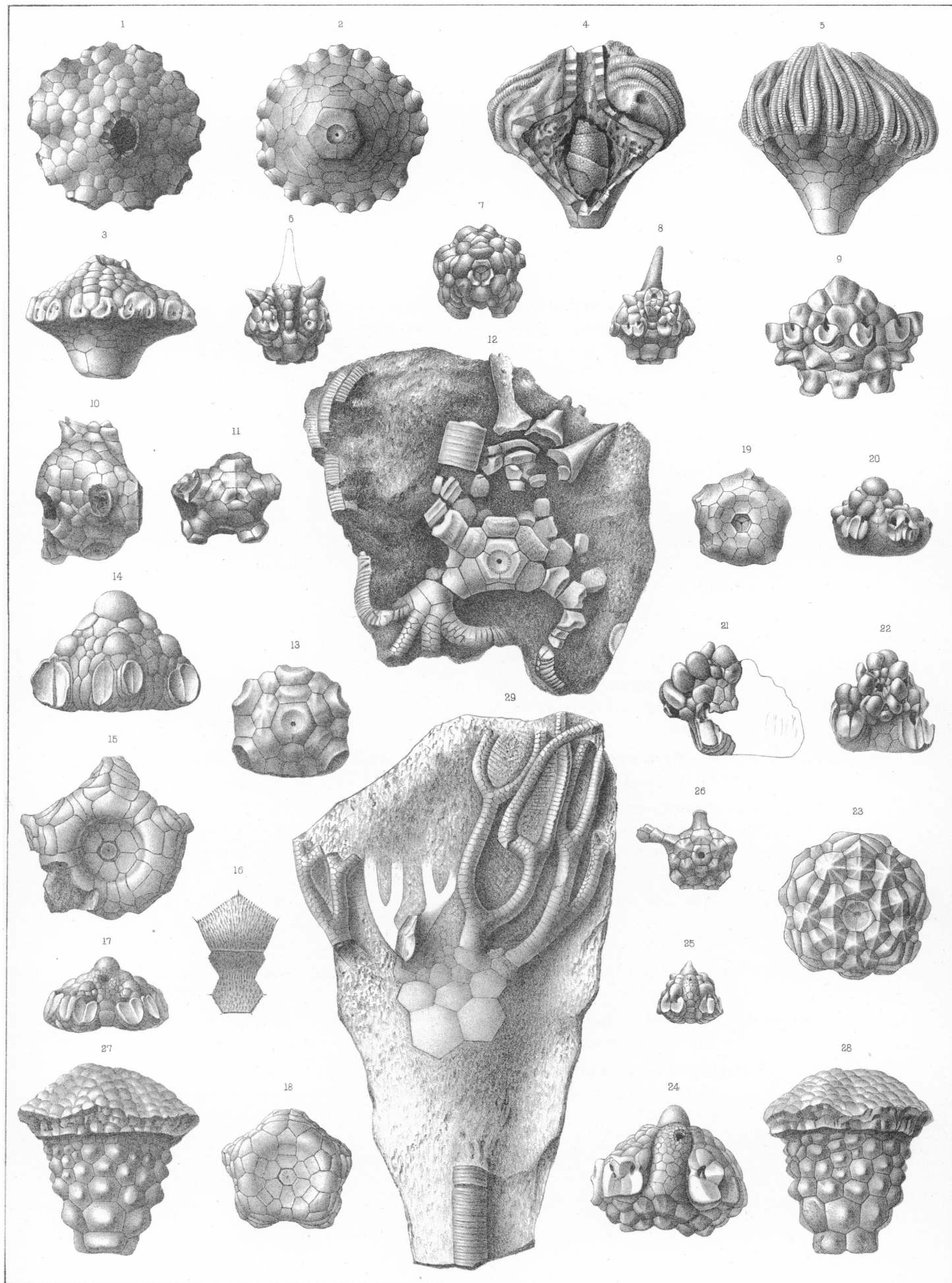




## EXPLANATION OF PLATE II.

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- Figs. 1 and 3.—**Batocrinus inornatus**. (*Actinoc. inornatus* Hall.) Summit, basal and anterior views of Hall's type.
- Figs. 4 and 5.—**Batocrinus bisbrachiatus**, n. sp. Fig. 4 is a view of the fractured face of the specimen showing the stomach plate inclosed. Fig. 5 shows the anal side of the specimen a little to the right of the center. The arms are represented a little too thick.
- Figs. 6–8.—**Dorycrinus tricornis**. (*Actinoc. tricornis* Hall.) Figs. 6 and 7 are ventral and basal views of the same specimen, and Fig. 8 the ventral side of a second individual.
- Fig. 9.—**Dorycrinus pendens**. (*Actinoc. pendens* Hall.) Lateral view of the type,  $1\frac{1}{2}$  diameters, with the right antero-lateral ray in front. A few of the dome plates are in place.
- Figs. 10 and 11.—**Amphoracrinus inflatus**. (*Actinoc. inflatus* Hall.) Lateral and basal views of the type. The specimen is slightly crushed, bringing the base into view in Fig. 10.
- Figs. 12 and 13.—**Amphoracrinus divergens**. (*Actinoc. divergens* Hall.) Fig. 12, view of a specimen showing part of the arms and summit plates, but badly displaced. Fig. 13, basal view of a separate calyx.
- Figs. 14–16.—**Agaricocrinus excavatus** Hall. Lateral and basal views of one of the types, and enlargement of the radial plates showing the striated surface texture.
- Figs. 17 and 18.—**Agaricocrinus pentagonus** Hall. Anal and basal views of one of the type specimens.
- Figs. 19–22.—**Agaricocrinus ornatrema** Hall. Figs. 19 and 20, basal and lateral views of a small entire body. Figs. 21 and 22, lateral and anal views of a fragment of a large specimen, showing the tuberosc plates around the anal opening.
- Figs. 23–25.—**Agaricocrinus pyramidatus**. (*Actinoc. pyramidatus* Hall.) Basal and anal views of the larger type specimen,  $1\frac{1}{2}$  diameters, and an anal view of the smallest one, natural size.
- Fig. 26.—**Steganocrinus pentagonus** Hall sp. One of the type specimens (young) of this species which agrees with *S. arancolus* M. & W. sp.
- Figs. 27 and 28.—**Teleocrinus ægilops**. (*Actinoc. ægilops* Hall.) Anterior and anal views of one of the type specimens.
- Fig. 29.—**Periecochrinus whitei**. (*Actinoc. [Megistocrinus] whitei* Hall.) View of one of the type specimens which shows the arms attached to a few of the calyx plates, and also what was probably the column of the same.









### EXPLANATION OF PLATE III.

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- Fig. 1.—**Platycrinus elegans** Hall. View of the type specimen. The figure is the same used on Hall's Photo-plate.
- Figs. 2-4.—**Platycrinus striæbrachiatus** Hall. Fig. 2, the calyx and base of the arms from Hall's Photo-plate; Fig. 3, opposite side of the same specimen showing the arms, and Fig. 4 an enlargement from one of the arms.
- Fig. 5.—**Platycrinus excavatus** Hall. View of the calyx and radial plates as far as preserved. From Hall's Photo-plate.
- Fig. 6.—**Platycrinus clytis** Hall. View of the specimen. The figure is the same one used on Hall's Photo-plate.
- Fig. 7.—**Cyathocrinus viminalis** Hall. View of the specimen used, enlarged two diameters.
- Figs. 8 and 9.—**Eupachycrinus orbicularis**. (*Scaphiocrinus orbicularis* Hall.) Basal and anal views of a second individual used in the original description of the species.
- Figs. 10-12.—**Barycrinus sculptilis**. (*Cyathocrinus sculptilis* Hall.) Figs. 10 and 11, anterior and basal views of the calyx. Fig. 12, enlargement of the plates of the anterior side to show sculpturing.
- Figs. 13 and 14.—**Poteriocrinus (Scaphiocrinus) carinatus**. (*Scaphiocrinus carinatus* Hall.) The best side of the specimen, two diameters, and a further enlargement of one of the right lateral rays to above the second bifurcation to show the carinate character of the plates.
- Figs. 15-17.—**Graphiocrinus tortuosus**. (*Scaphiocrinus tortuosus* Hall.) Fig. 15, view of the specimen, natural size. Fig. 16, the calyx enlarged. Fig. 17, enlargement of a part of one of the arms and tentaculæ.
- Fig. 18. **Cœliocrinus dilatatus**. (*Poteriocrinus dilatatus* Hall.) Enlarged view of the specimen described.
- Figs. 19 and 20.—**Zeacrinus scoparius** Hall. Anterior and anal views of the type specimen, two diameters.
- Figs. 21 and 22.—**Taxocrinus juvenus**. (*Forbesiocrinus juvenus* Hall.) Opposite sides of the specimen, natural size.
- Fig. 23.—**Ollacrinus papillatus**. (*Trematocrinus papillatus* Hall.) View of the fragment from which the description was drawn.
- Figs. 24.—**Ichthyocrinus burlingtonensis** Hall. Basal view of the fragment used, two diameters.
- Figs. 25-28.—**Orophocrinus whitei**. (*Codaster whitei* Hall.) Figs. 25 and 26, lateral and summit views of the specimen which preserves the test. Figs. 27 and 28, lateral and summit views of an internal cast of the species, all enlarged two diameters.

