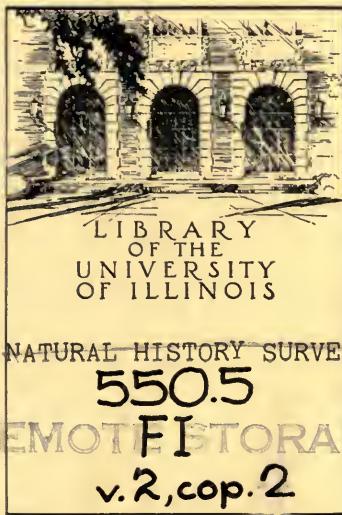




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## NEW CRINOIDS FROM THE CHICAGO AREA.

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## NEW CRINOIDS FROM THE CHICAGO AREA.

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BY ARTHUR WARE SLOCOM

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In the fall of 1905 the attention of the writer was called to the fact that fossils were being found at a quarry operated by the Illinois Steel Company for limestone for flux, at Romeo, Illinois. Upon visiting the quarry it was found that not only was the limestone itself fossiliferous, but that silicified fossils were abundant near the bottom of large clay pockets which were exposed at various places in the quarry. These clay pockets occupy large, irregular shaped cavities in the limestone. The larger ones are 15 or more feet deep and their width is often greater than their depth. In some instances several are connected, their connections following the jointing of the limestone. These cavities, or "pot-holes" as they are sometimes called, often associated with furrows, are to be seen in many places along the Chicago Drainage Canal where the surface of the rock is exposed. The cavities vary in size from a fraction of an inch in depth to those mentioned above. These cavities or pot-holes must have been in part subjected to the action of running water since their sides are smooth. They are frequently broader at the base than above and may even be cone-shaped, with the apex of the cone above. Their filling is for the most part a blue homogeneous clay. This contains small silicified fossils of Niagaran age, small, modern, fresh-water shells and fragments of pyritized and charred wood. No large boulders or pebbles occur in the clay, although these frequently form a capping of the pockets. The question of the origin of the filling of the pockets is a matter of no little interest. The clay could not be of preglacial origin because of its content of wood and modern shells. If of postglacial origin, the presence of the Niagaran fossils is difficult to account for. A wall of the quarry showing typical pockets is represented in Plate LXXXII. A single one in more detail is represented in Plate LXXXIII.

During the fall of 1905 and the spring and summer of the following year, over 400 fossils representing 38 species were collected by the writer from these clay pockets. These fossils were divided as follows:

Corals.....	293 specimens, 15 species;
Sponges.....	20 specimens, 3 species;
Bryozoans.....	12 specimens, 4 species;

Crinoids.....	21 specimens,	7 species;
Brachiopods.....	96 specimens,	9 species;
Trilobite.....	1 fragment.	

Of this material the corals, sponges and crinoids showed a great similarity to those found at St. Paul, Indiana, and Perry county, Tennessee, and a number of species described from those localities were recognized. It was found that the manner of preservation of the clay pocket fossils differed from that usual to those of the limestones of the Chicago Area in that the latter are natural casts and molds, while the clay-pocket fossils are silicified. Search in the surrounding limestone at Romeo failed to show similarly preserved fossils in place there and only a few of the clay-pocket species were discovered. The spoil heaps of the Chicago Drainage Canal were then studied and near Lemont, Illinois, the species found in the clay began to appear, until all the brachiopods and part of the corals were found. Many of these were in a similar state of preservation to those of the clay pockets. Of the seven species of crinoids occurring in the clay three were found in the Lemont limestone and three more were represented by species of the same genera. Over 400 fossils, representing 76 species, were collected at this locality, divided as follows:

Sponges.....	3 specimens,	1 species;
Corals.....	40 specimens,	6 species;
Cystoids.....	62 specimens,	6 species;
Crinoids.....	149 specimens,	32 species;
Bryozoans.....	10 specimens,	6 species;
Brachiopods.....	62 specimens,	11 species;
Mulluscs.....	9 specimens,	5 species;
Trilobites.....	82 specimens,	9 species;

The finding of these silicified corals and brachiopods at Lemont identical with those occurring in the clay pockets, left little room for doubt that the clay and fossils found in it were residual from the Niagaran limestone, and that they had been transported to Romeo from the Lemont Area. The Romeo quarry is distant about five miles in a southwesterly direction from the point near Lemont where the corresponding fossils were found. Both localities are in the valley known as the Chicago Outlet, through which the waters which occupied the basin of Lake Michigan at the close of the glacial period discharged into the Mississippi River. The flow of these waters would have been sufficient to transport material like that described from Lemont to Romeo, although the period and exact circumstances of this deposition have not as yet been determined. The silt-like nature of the deposit in the clay pockets shows that it occurred in quiet waters.

Among the crinoids collected in this work several proved to be either hitherto undescribed or new to the Area. Of these five had been described from other localities and nine were new species. Of three species previously described by other authors, additional characters, which are here given, were obtained from specimens found by the writer. The nine new species are here described and five species previously described from other localities are here re-described. A total of seventeen species of crinoids is therefore described in the present paper.

#### CLASSIFICATION AND TERMINOLOGY

The classification here used is that prepared by Wachsmuth and Springer and is substantially that given in the English edition of Zittel's Text-book of Paleontology. The terminology of Wachsmuth and Springer is also adhered to. It may be briefly stated as follows:

*Crinoid*: A normal crinoid consists of a crown attached by its dorsal extremity or base to a stem or column which is fixed to some solid body by a root.

*Crown*: All of the crinoid above the stem. It includes the calyx and the arms.

*Calyx*: The body of the crinoid without the free arms or stem. It includes the dorsal cup and ventral disc or tegmen, and within it are enclosed the more important organs of the body.

*Dorsal Cup*: That part of the calyx below the point of attachment of the free arms. It is usually more or less cup-shaped and is composed of two or more rows of plates having a more or less complete pentamericous symmetry.

*Ventral Disc, Tegmen, Dome, etc.*: That part of the calyx above the point of attachment of the free arms. It is made up of plates more or less regularly arranged and contains the mouth and usually the anal opening.

*Base*: That part of the dorsal cup lying between the radial plates and the stem. It consists of a single row of plates, the basals, in a monocyclic base, and of two rows of plates, the basals and infrabasals, in a dicyclic base.

*Rays or Brachials*: The series of plates which rests upon the basals and extends up to and forms the arms. The first plate of the series is always a part of the dorsal cup, the others may or may not be a part of the cup. There are five of these rays, except in the Zophocrinidæ, and they are designated as follows: (Figs. 1 and 2) (1) right posterior ray, (2) right anterior ray, (3) anterior ray, (4) left anterior ray, and (5) left posterior ray.

*Interbrachial areas* (I Br.\*): The plates in camerate crinoids situated between the rays.

*Anal or posterior interradius* (X. a. a.): The area situated between the right and left posterior rays and leading up to the anal opening.

*Basals* (B): The circle of plates directly below the radials and alternating with them. In a monocyclic base they join the column.

*Infrabasals* (I B): The first row of plates in a dicyclic base. They separate the basals from the column and are radial in position.

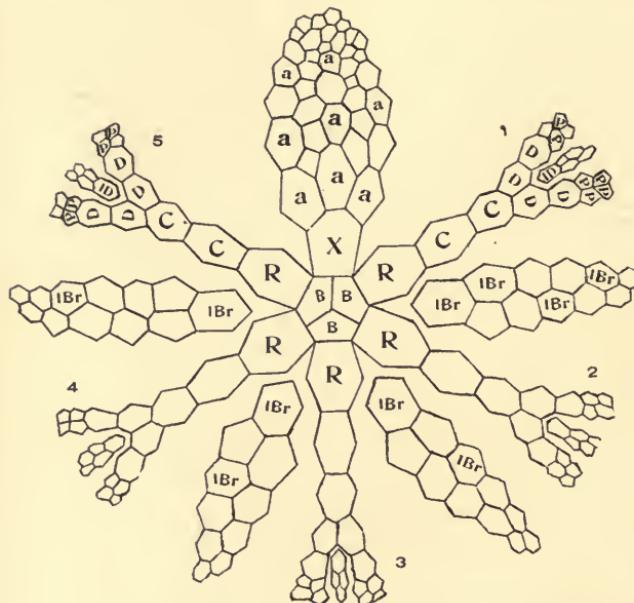


Fig. 1. Diagram of a Monocyclic, Camerate Crinoid.

*Radials* (R): The first plate of each ray, usually resting on the basals. In some families part of the radials are divided horizontally. The parts of these plates are called *superradials* (Rs) and *inferradials* (Ri), respectively.

*Costals* (C): Those plates of each ray extending from the radials, on which they rest, up to the first bifurcation.

*Distichals* (D): All plates of each ray between the first and second bifurcation.

*Palmers* (P): All plates of each ray between the second and third bifurcation. Any plates of a higher order than these are called *post-palmers*.

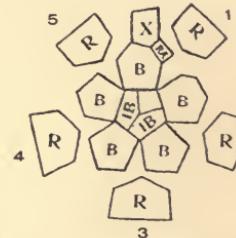


Fig. 2. Diagram of a Dicyclic Crinoid.

\* The letters in parenthesis refer to those of Figs. 1 and 2.

*Interdistichals* (I D): Any plates situated between the distichals.

*Anal Plate* (X): First plate of the anal interradius. It often rests upon the posterior basal and is in line with radials or nearly so.

*Interbrachials* or *interradials* (I Br): Any plates of the interbrachial areas.

*Radianal* (RA): A plate resting within the angle formed by two basals and below the right posterior radial plate. It joins the anal plate on the left and occupies the position of an inferradial.

*Distal*: Farthest from the stem.

*Proximal*: Nearest to the stem.

*Lateral*: Pertaining to the side.

Authors differ widely in the use of the terms "mold," "cast" and "impression," but as used in this paper they may be defined as follows:

*Natural mold*: A matrix or cavity in the rock, formed, by natural causes, around an organism when the rock was plastic. The external form of the organism is thus preserved.

*Natural cast*: The rock filling of the internal or visceral cavity of an organism, the shell of the organism having served as a mold. In many cases (see Plate LXXXIV, Figs, 3 and 10) the shell is afterwards dissolved out, leaving the mold and cast in position. In such cases the space between the two indicates the thickness of the shell.

*Impression*: An artificial cast, made in a natural mold, which shows the external features of the organism.

In the following descriptions three materials are referred to as being used for making impressions, viz.: plaster, roller composition, referred to as "composition," and vulcanized rubber, referred to as "rubber." The methods of making impressions from the two latter substances have been previously described by the writer.\* In addition to the details there given it may be remarked that in many cases the shape and position of the mold in the rock is such that it is difficult to keep the rubber in place while vulcanizing. In such cases it is necessary to build a retaining wall of plaster, or to cement a metal ring around the opening of the mold; this prevents the rubber from spreading when the pressure is applied with the clamp, and a perfect impression is assured.

\* Science, 1907, N. S. Vol. XXV, p. 591.

## DESCRIPTION OF GENERA AND SPECIES.

## Order I. LARVIFORMIA.

## Family PISOCRINIDÆ.

## PISOCRINUS De Konik.

No members of this genus have hitherto been reported from this Area. Representatives of three species, *P. benedicti*, *P. gemmiformis* and *P. quinquelobus* were found by the writer. The generic characters

are as follows: Calyx small, globular, subconical or subcylindrical. Facets for the attachment of the arms wide, angular and projecting limbs of the radials short.

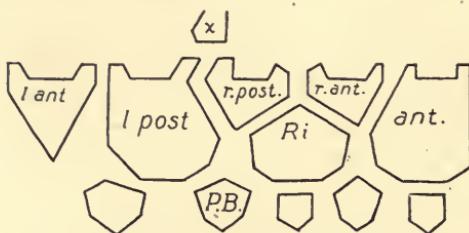


Fig. 3. Diagram of *Pisocrinus*. (After Bather).

Basals five, forming a triangle. The three plates situated at the angles larger than the other two. Radials

five, extremely irregular, only the left posterior and anterior radials in contact with the basals. These are more than twice the size of the other radials. The left anterior radial is angular below, resting on the lateral edges of the two large radials. The right posterior and right anterior radials rest upon a large inferradial which separates them from the basal plates. Notwithstanding the great difference in size of the radials, their distal edges are about equal. Anal plate rests on the processes of the posterior radials.

Arms neither branched nor pinnulate.

PISOCRINUS GEMMIFORMIS S. A. Miller, Plate LXXXIV, Figs. 1-4.

1879. *P. gemmiformis* S. A. M., Jour. Cincin. Soc. Nat. Hist. Vol. 2, p. 113, Pl. 9, Figs. 6 a-c, Osgood, Ind.

1886. *P. gemmiformis* Wachsmuth & Springer, Rev. Palæocr. Pt. III, p. 184.

1892. *P. gemmiformis* S. A. M., 17th Rept. Geol. Surv. Ind. p. 636, Pl. VI, Figs. 10-12, Madison, Ind.

Calyx globular, depressed at the base: plates thick, sutures indistinct, surface smooth or finely granular.

Basal plates five, forming a nearly equilateral triangle and curving

into the basal cavity. The three plates at the angles are larger than the other two. The basal triangle is followed by three large plates which comprise the principal part of the calyx. These are the anterior and left posterior radials and an inferradial plate. The left posterior radial rests upon two basals, the other two plates rest upon three. The other three radials are small, angular below and are not in contact with the basals; the left anterior radial rests upon the sloping sides of the adjoining radials, and the right posterior and right anterior radials each rest, one side upon the inferradial and one side upon the adjoining radial. The distal edges of the radials are provided with short processes at their juncture with the lateral edges which form a wide, shallow, angular excavation for the attachment of the arms.

Arms not preserved.

Owing to the thickness of the plates, the natural casts of this genus bear little resemblance to the exterior of the calyces. The natural casts of this species are in the form of a triangular pyramid, truncated by a cylinder. The base of the pyramid is nearly flat and is formed by the inner surfaces of the basal plates. One face of the pyramid is formed by the inferradial plate and the other two by the lower part of the large radials. The cylinder is formed by the three small radials together with the upper part of the two larger ones.

The distinguishing characteristics of the exterior of the calyx of this species are its globular form, with its depressed base, gradually curving into the facet for the attachment of the stem. The casts are distinguished by the triangular pyramid at its base.

Locality: This species is comparatively abundant in the clay pockets in the limestone at Romeo, Illinois, where it occurs as silicified specimens which appear to be identical with those of the type locality. In the spoil heaps along the Chicago Drainage Canal near Lemont, Illinois, it is one of the most abundant crinoids in the form of natural molds and casts, and a single silicified specimen was found there.

PISOCRINUS BENEDICTI S. A. Miller, Plate LXXXIV, Figures 8-11.

1892. *P. benedicti* S. A. M., 17th Rept. Geol. Surv. Ind., p. 639,  
Pl. VI, Figs. 3-16.

Calyx deeply cup-shaped, moderately expanding to the upper third, rounded at the base and slightly constricted at the top; plates thick, surface smooth or finely granular.

The plates of the calyx are the same in number and position as in *P. gemmiformis*, but the basals are larger than in that species, so as

to be visible in a side view of the calyx, and the two large radials and the inferradials are longer in proportion to their width, making the calyx higher than wide. The rounder base is provided with a deep basal cavity whose sides are subparallel.

The natural casts are subcylindrical, moderately expanding to the arm bases. The base is flat, having three slight protuberances which give it a subtriangular appearance from below.

The specimens here described appear to be more cup-shaped than Miller's original figures indicate, and no mention is made by him of the abrupt margin of the basal cavity. Examination of several hundred specimens of this species, from the type locality, shows these features to be characteristic and those which most easily distinguish this species from *P. gemmiformis*.

**Locality:** The specimens (Mus. No. P 8481), consisting of natural molds and casts on which the above description is based, were collected by the writer in the spoil heaps of the Chicago Drainage Canal near Lemont, Illinois. A single incomplete individual from the clay pockets at Romeo, Illinois, is doubtfully referred to this species.

#### PISOCRINUS QUINQUELOBUS Bather, Plate LXXXIV, Figures 5-7.

1893. *P. quinquelobus* Bather, Crinoidea of Gotland, Part I, p. 27.

1895. *P. milligani* Miller & Gurley, Bull. 7 Ills. St. Mus. p. 80, Pl. V, Figs. 27, 28.

1896. *P. quinquelobus* Bather, Am. Geol., Vol. XVII, p. 184.

Bather's description is as follows: "Dorsal cup low; pentagonal as seen from ventral surface, the angles of the pentagon being radial in position; the radial facets are very narrow, the radial processes correspondingly broad, forming the concave sides of the pentagon; basals hidden in the concavity of the stem." To which may be added: surface of plates smooth; sutures very obscure, only visible with the aid of a magnifier; stem round. The form and arrangement of the plates is similar to the two preceding species. No plates of the ventral disc present.

The species is closely related to *P. gorbyi* S. A. M.\* but is distinguished from that species by its shorter cup and the position of the basal plates, which in *P. gorbyi* are visible from a side view and in this species are concealed in the basal cavity.

**Locality:** The species is represented in the collections of this Museum by four specimens, P 8414 and P 8827, which were collected by the writer in the clay pockets of the Niagaran limestone at Romeo, Illinois. These specimens are silicified and in a good state of preserva-

\* 17th Rept. Geol. Ind., p. 640, Pl. VI, Figs. 17-20.

tion. There seems to be no reason to doubt that they are specifically identical with the specimens from Tennessee on which the original description was based.

### Family STEPHANOCRINIDÆ.

#### STEPHANOCRINUS Conrad.

Only one species of this genus has heretofore been recognized in the Chicago Area. Two new species have been collected by the writer and are here described. The generic characters are as follows: Basals three, about equal in size, two pentangular, one quadrangular. Radials five, equal, resembling the forked plates of some Blastoids. These prongs form interradial processes, and between them are situated the ambulacral grooves leading to the arms, which rise from a single axillary costal plate situated at the end of the sinus. Oral plates five, interradial in position and forming most of the ventral disc. They are not visible in a side view of the calyx. They join the inner surface of the radial plates and extend to the top of the interradial processes. Their lateral edges are in contact below the ambulacral grooves, but a space is left for the mouth at the center of the ventral disc. The anus is situated between the posterior oral plate and the adjoining process.

This genus has been referred to the Cystoids and Blastoids by some writers, and while it undoubtedly has some characters similar to both it has been shown to be a Crinoid by Wachsmuth and Springer on account of its brachial plates.

#### STEPHANOCRINUS OBCONICUS sp. nov. Plate LXXXIV, Figs. 12, 13.

The dorsal cup is obconical, truncated at the base, sides slightly convex, forming an angle of about 30 degrees. The surface of the plates is apparently smooth or finely granulose, following the curve of the calyx except near the proximal end of the basal plates, where they develop a median ridge giving a triangular form to the base. This ridge is most prominent at the base and rapidly diminishes, disappearing

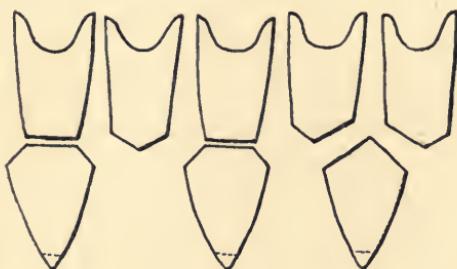


Fig. 4. Diagram of *Stephanocrinus*.

altogether before the center of the plate is reached. Sutures obscure, not marked by grooves.

Basal plates three, about equal in size. Two are pentangular and one is quadrangular. Together they form an obconical cup comprising about half the height of the calyx, triangular at the base and circular at the top. There is a slight circular depression in the center of the base for the reception of the column. Radial plates five, equal in size with the lateral edges produced into interradial processes. Height, aside from the processes, about equal to that of the basals. The characters of the vault are quite obscure, but appear to correspond with the description of the genus.

This species is based on a single silicified specimen (Mus. No. P 8416) in a fairly good state of preservation. Its obconical form renders it so unlike all other species of the genus that comparison with them seems to be superfluous. The following measurements, in millimeters, taken from the type specimen, may be of use for comparison in case other specimens are found.

Diameter at base,.....	2.3	mm
Diameter at top of basals,.....	5.5	"
Diameter at top of calyx,.....	6.4	"
Height of radials aside from spines,.....	4.6	"
Height of basals,.....	5.0	"
Height of calyx,.....	9.6	"
Length of spines,.....	1.6	"

Locality: Collected by the writer in the fall of 1905 in the clay pockets of the Niagaran limestone at Romeo, Illinois.

#### STEPHANOCRINUS SKIFFI, sp. nov. Plate LXXXIV, Figures 16-20.

The calyx has a small triangular base. It expands rapidly to the top of the basals and moderately from that point on. The distal edges of the radial plates are excavated for the reception of the arms, thus forming five interradial processes. The plates of the dorsal cup are ornamented with a series of acute prominent striae. These striae are oblique at and below the upper lateral angles of the radials, longitudinal on the middle of the radials and basals and transverse on the lower part of the basals. Sutures are obscure and do not interrupt the striae.

Basal plates three, about equal in size, one quadrangular, two pentangular. Together they form a funnel-shaped cup, triangular at the base and expanding very rapidly to the top. An acute angular ridge extends from the base to the center of each plate where it becomes lost in the longitudinal striae. The basal cup comprises about half the

height of the calyx. Radials five, equal, sides slightly converging towards the base; moderately convex longitudinally, so that the ventral view of the calyx is subpentangular. A semicircular excavation occupies nearly the entire distal edge of the radials, and the processes thus formed are rather short for the genus. The costals are not preserved in the type or any of the specimens at hand. The interradials or orals are large and are not visible in a side view; they comprise the greater part of the ventral disc. They extend to the top of the radial processes, and rest against their inner faces. Laterally they connect with each other, but leave a comparatively large round opening for the peristome in the center of the disc. The deflected lateral edges form the ambulacral groove extending from the arm bases to the central opening. The anal opening is situated at the juncture of the posterior interradial with the processes of the two posterior radials. None of the plates which covered the peristome, ambulacral grooves or anal opening is preserved.

The natural casts are similar in form to the exteriors, but slightly constricted at the arm bases and somewhat shorter in proportion to their diameter. The interradial processes are indicated by five rather stout protuberances between which the dorsal cup curves gradually into the convex ventral disc. A large circular protuberance in the center of the disc indicates the size and position of the peristome, and a small one rising out of the posterior interradial process indicates the anal opening.

Dimensions of the type are as follows:

Natural mold		Natural cast	
Height of calyx,	6.7 mm.	Height of calyx,	4.5 mm.
Height of basals,	3.3 "	Height of basals,	1.3 "
Height of radials,	2.4 "	Height of radials,	2.4 "
Height of processes,	1.0 "	Height of processes,	0.8 "
Diameter at arm bases,	5.0 "	Diameter at arm bases,	2.9 "
Diameter at top of basals,	4.1 "	Diameter at top of basals,	3.0 "

As to size, form and pattern of ornamentation, this species approaches *S. hammelli* S. A. M.\* and from the original description and figures it would hardly be safe to separate them. Upon comparison, however, with the types of *S. hammelli*, which are in the paleontological collections of the University of Chicago, the ornamentation of the plates was found to be so much more prominent in the specimens here described as to warrant specific distinction. The striations in both species are so grouped as to form geometric figures. For instance, the longitudinal striae on the right posterior radial and the basal on which

\* 17th Rept. Geol. Ind., p. 635, Pl. VI, Figs. 7-9.

it rests, are in the form of a rhomb, with its transverse axis equal to the width of the radial plate. In *S. skiffii* the rhomb consists of nine striae, but in *S. hammelli* there are more than three times that number. In *S. hammelli* moreover the curvature of the rhomb conforms to the general curvature of the calyx, but in *S. skiffii* it is decidedly convex transversely and moderately so longitudinally (Pl. LXXXIV, Fig. 16).

The type specimen (Mus. No. P 8479) consists of a natural cast and more than half the accompanying mold, both in an excellent state of preservation. Several other individuals of this species are in the collections.

The specific name is proposed in honor of Mr. Frederick J. V. Skiff, Director of the Museum.

Locality: Niagaran limestone of the spoil heaps of the Chicago Drainage Canal near Lemont, Illinois.

#### Family ZOPHOCRINIDÆ.

##### ZOPHOCRINUS S. A. Miller.

Two new species belonging to this genus were collected by the writer and are here described. This genus differs from all other crinoids in that the calyx contains but four radial plates; the quadrangular one is somewhat larger than the others and is probably made up of the right and left posterior radials fused, as the tetramerism affects the dorsal cup only; the dome and arms are pentameral.

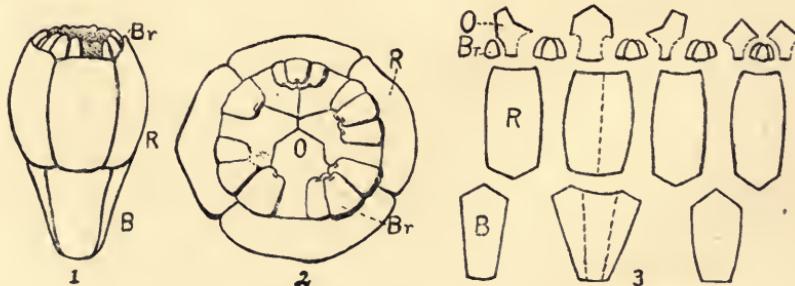


Fig. 5. Outline of the (1) Posterior and (2) Ventral Views of the Genotype and (3) Diagram of *Zophocrinus*. (After Bather.)

The plates are as follows: Basals three, two equal, one larger; radials four, three equal, one larger. The ventral disc is composed of five orals, the posterior oral is the largest and the two anterior orals

are the smallest and are not in contact with the posterior one; anus unknown; five groups of arms are situated where the interoral sutures meet the radials. The distal edges of the radials are thickened on their inner side and are pierced by pores. The presence of these pores has been taken by some writers to indicate that the genus might belong to the cystoids, but for the present it is considered to be a crinoid.

**ZOPHOCRINUS GLOBOSUS** sp. nov. Plate LXXXV, Figures 15-19.

The calyx is small, in the form of a prolate spheroid, truncated at the top. The natural casts are subspherical, slightly flattened on six sides, approaching a rounded hexahedron. The plates are rather thick and smooth or possibly finely granulose, convex, slightly sloping towards the sutures, so that their shape and arrangement is easily studied.

Basal plates three, much thicker than the radials; two are quadrangular and about equal in size; the other is pentangular and larger; together they form a shallow rounded cup with a slight triangulation at the base and a circular depression for the reception of the column. Radials four, height and width about equal; three are pentangular, the other is quadrangular; their sides are subparallel, slightly contracted at either end. These plates have a decided thickening of the inner margin of their distal ends, which is shown by a deep groove on the natural casts. The ventral disc is not preserved on any of the specimens studied.

The species differs from the other species of the genus in its globose form, its relatively short radial plates and its rounded base, as compared with the pear-shaped body and attenuate obconical base of the other species. These characters are stated in more detail on a later page.

Locality: Niagaran limestone of the spoil heaps along the Drainage Canal, about a mile and a half east of Lemont, Illinois.

This species, while it cannot be said to be abundant in this Area, is by no means rare. Four specimens were collected by the writer in the fall of 1905 and a like number in the spring of 1906. The specimens consist of natural casts with more or less of the accompanying molds. The Museum number of the type specimen is P 8480.

**ZOPHOCRINUS PYRIFORMIS** sp. nov. Plate LXXXV, Figures 12-14.

The calyx is broadly pear-shaped, truncated at the top, expanding rapidly from the base to about the middle of the radials, from which point it contracts to the arm bases. The surface of the plates is finely granulose and moderately convex, sloping towards the sutures; this shallow depression indicates the position of the sutures.

The basal plates are three in number. Together they form an obconical cup comprising about one-third the height of the calyx. Two are quadrangular and equal in size, the other is pentangular and larger. The proximal end of each plate is provided with a decided median ridge, giving a triangular base to the cup in which is a circular depression for the reception of the stem. The radial plates are four, about equal in size, three pentangular and one quadrangular; the distal margins are thickened and beveled towards the interior. The beveled edge of each plate is pierced by pores, the exact number of which cannot be determined from this specimen.

This species is founded on a single silicified specimen (Mus. No. P 8415), having the dorsal cup complete and in a good state of preservation, but the dome is missing. In form it appears to occupy a position between that of *Z. howardi* and *Z. globosus*. The description of *Z. howardi*\* is as follows: "Body subovate or pear-shaped, greatest diameter at the upper third, pointed below, length more than twice the diameter; base subhexahedral." *Z. pyriformis* is distinguished from *Z. howardi* by being much shorter in proportion to its greatest diameter and by the form of the base; also the opening formed by the distal edges of the radial plates is much larger. From *Z. globosus*, which it resembles in general proportions, it differs in the form of the base and general outline of the calyx.

The comparative characters of the three species may be shown in tabular form as follows:

	Ratio of diameter to height	Form of base	Form of basal cup	Position of greatest diameter
<i>Z. globosus</i>	6:7	Hemispherical	Wider than high	Near middle
<i>Z. pyriformis</i>	3:4	Short triangular	Wider than high	Near middle
<i>Z. howardi</i>	1:2	Long hexagonal	Higher than wide	Upper third

Locality: The type specimen (Mus. No. P 8415) was collected by the writer in the clay pockets in the Niagaran limestone at Romeo, Illinois.

Examination of a large series of specimens of *Z. howardi* from St. Paul, Indiana, showed two individuals of *Z. pyriformis*.

\* 17th Rept. Geol. Surv. Indiana, p. 643.

## Order II. FISTULATA.

## Family GASTEROCOMIDÆ.

## ACHRADOCRINUS Schultze.

This genus was originally proposed by Schultze, to receive a species from the Devonian rocks of the Eifel, Germany. The species collected by the writer and here described is the first American species to be referred to the genus. The original description\* of the genus is as follows: "The composition of the calyx is as follows: Basalia (infrabasals) five, equal, pentagonal; Parabasalia (basals) five, four equal, pentagonal, the fifth hexagonal; Radalia (radials) five, pentagonal, alternating with parabasalia (basals); Interradials (anal plate) one, resting on the horizontal, truncated edge of the hexagonal parabasal (basal) directly beneath the anal opening.

Ventral dome, arms and column unknown. The base is pierced by a single circular canal."

Genotype *Achradocrinus ventrosus*.

To the above description of the radial plates may be added the following, as the characters are generic: Radials five, shield-shaped; three regular and equal, the two posterior ones irregular, deeply excavated for the reception of the anal plate which they enclose on three sides by meeting above. A prominent articular facet occupies the outer side of the radials near their distal edges. The facets are provided with a ventral groove and are pierced by a small canal located at some distance from the groove.

In referring *Achradocrinus* to the Gasterocomidae Schultze compares it with *Gasterocoma*, which it resembles in general arrangement of the plates and position of the anal interradius, but from which it differs in the form of the basal canal. In *Gasterocoma* the base is pierced by a quadrilobate canal and in *Achradocrinus* by a circular, central canal.

So far as is known to the writer, all genera heretofore referred to the Gasterocomidae have been of Devonian age.

\* Monographie der Echinodermen des Eifler Kalkes, p. 101.

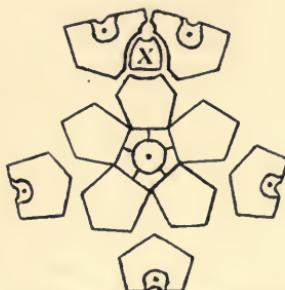


Fig. 6. Diagram of *Achradocrinus*.  
(After Schultze).

## ACHRADOCRINUS PATULUS sp. nov. Plate LXXXV, Figures 1-4.

Dorsal cup depressed, obconical, truncated at the base, somewhat inflated on the posterior side so that the symmetry is bilateral. Surface of the plates granulose and moderately convex, forming shallow grooves in which the sutures are situated.

Infrabasals small, forming a disc which barely extends beyond the circumference of the column. The disc is provided with a central, circular canal, and the plates appear to be fused as the sutures are not visible. Basals five, four equal in size and shape, angular above, the posterior larger and truncated to support the anal plate. Radials five, three shield-shaped and equal, the two posterior radials deeply excavated for the reception of the anal plate which they enclose on three sides by meeting above. The distal edges of the radials are sharply inflected towards the center of the vault. A prominent, semicircular, articular facet, directed outward, occupies more than half the width of the radials. There is an axial canal situated at about the center of the facet and a wide, shallow ventral groove extends from the facet across the inflected edge of the radials. The anal plate is small, subquadrangular, its lateral edges arched and its distal edge excavated for the anal opening. It rests upon the posterior basal and between the posterior radials. The anal opening is situated in line with the arm facets directly above the anal plate and below the lateral extension of the adjoining radials. The opening is directed horizontally and is surrounded by a number of small plates. Arms unknown, but judging from the articular facets they appear to be widely divergent or possibly recumbent. Tegmen not preserved. Column circular with central canal.

The species here described is referred to the above genus, although differences from the genotype occur. These differences, however, are not considered to be of generic importance. Schultze's original figures are reproduced for comparison, Pl. LXXXV, Figs. 5-8.

With *A. ventrosus*, *A. patulus* compares as follows: In form and arrangement of the plates the two species are similar, likewise in the character of the stem and the articular facets with their ventral grooves and axial canals. In *A. ventrosus*, however, the five infrabasals are distinct and form a shallow cup visible in a side view of the calyx, but in *A. patulus* the infrabasals appear to be fused into a disc and inconspicuous. The type specimen of *A. patulus* is, however, silicified and it is quite probable that the basal sutures have been obliterated in the process of silicification. The anal opening in both species is situated between the distal edge of the anal plate and the lateral extensions of the posterior radials; but in the genotype the opening is directed

vertically and is not visible in a side view of the calyx. In *A. patulus*, however, the opening is in line with the center of the arm facets, directed horizontally and visible only in a side view of the calyx.

Locality: The type specimen, Mus. No. P 8417, is a silicified dorsal cup in a good state of preservation. It was collected by the writer in the clay pockets of the Niagaran limestone at Romeo, in the fall of 1905.

### Family CYATHOCRINIDÆ.

#### HOMOCRINUS Hall.

No members of this genus have been heretofore reported from this area, but two species, *H. ancilla* and *H. cylindricus*, were collected by the writer and are here described. The generic description is as follows: Calyx dicyclic, subcylindrical to turbinate. Infrabasals five; basals five; radials five, separated on the posterior side by an anal plate. The radianal plate is situated below the right posterior radial and between the right anterior radial and the anal plate; ventral sac long and large; arms bifurcating, without pinnules; stem round. Distinguished from *Dendrocrinus* by the proportionally larger infrabasals and from *Poteriocrinus* by the arrangement of the azygous plates.

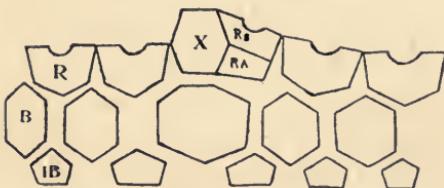


Fig. 7. Diagram of *Homocrinus*. (After Bather).

#### HOMOCRINUS ANCILLA Hall, Plate LXXXV, Figures 9-11.

- 1879 *Dendrocrinus ancilla* Hall, Trans. Alb. Inst., Vol. X, p. 9.  
 1882 *Dendrocrinus ancilla* Hall, 11th Geol. Rept. Ind., p. 271.  
 1886 *Homocrinus ancilla* W. & Sp., Revis. Paleocrinoidea, Pt. III,  
 p. 220.

Hall's description of this species is as follows: "Body narrowly turbinated, width and height above as ten to twelve or ten to thirteen; contracted between the arm bases; upper part of the column closely adhering to the body, the five minute basal plates (infrabasals) scarcely distinguishable from the segments of the column at its summit; subradial plates (basals) obscurely angular on the lower face, about three-fourths as wide as long, very gradually expanding in width from the base, and supporting on their upper adjacent sloping faces a large

hexagonal interradial plate, and this supporting a single radial, from which the arms take their origin. Arms unknown."

A detailed description of specimens from the Chicago Area is as follows: Calyx narrowly turbinated or trumpet-shaped; arm bases prominent with constrictions between; surface of the plates smooth; sutures situated in small, but well-defined furrows; base dicyclic.

Infrabasal plates five, equal in size, pentagonal, higher than wide. Basals five; height and width about as 4:3; four are hexagonal and the posterior one is heptagonal, being truncated to support the anal plate on its distal edge. The infrabasals and basal plates together form a deep cup, its base apparently about the size of the upper joints of the column. It expands very moderately until the middle of the basals is reached, from which point the expansion is quite rapid to the arm bases. Radial plates five, very much thickened in the middle of their distal edges to form the prominent facets for the attachment of the arms; these facets occupy about half the width of the plate. The right posterior radial is smaller than the others, on account of the radianal plate being interposed between the anal plate and the right anterior radial; it rests on two of the basals and supports the right posterior radial; it is quadrangular in form. The anal plate is situated in line with the radials and rests on the truncated distal side of the posterior basal; it joins the left posterior radial on one side and the right posterior radial and the radianal on the other.

The natural casts conform in a general way with the outline of the outside of the plates, with the exception of the base, which terminates in a point, and the region of the arm bases, which is quite constricted on account of the thickening of the distal portions of the radial plates. The greatest diameter of the natural casts is at the middle of the radials, but that of the outside of the plates is at the arm bases.

This species was originally described from the Niagaran shales at Waldron, Indiana, and while the Chicago specimens do not agree in all respects with the original description, there seems to be little doubt that they should be referred to this species. In regard to the size of the infrabasals Hall's description and figure do not agree. Moreover, many characters, some of which, such as the size and position of the anal plates, are of generic importance, are incompletely described or are omitted altogether by Hall.

Locality: The specimens from the vicinity of Chicago consist of natural casts with the accompanying molds. The species was collected by the author in the spoil heaps along the Chicago Drainage Canal near Lemont, Illinois. The specimen used for the illustration

is said to have been collected at Joliet, Illinois, and is in the collection of the Joliet High School.

HOMOCRINUS CYLINDRICUS Hall, Plate LXXXIV, Figures 14, 15.

1852 *H. cylindricus* Hall, Pal. N. Y., Vol. II, p. 186, Pl. XLI,  
Figs. 2 and 3.

1859 *Poteriocrinus cylindricus* Hall, Correct List of N. Y. Fossils.

1879 *H. cylindricus* W. & Sp., Revision Paleocrinoidea, Pt.  
I, p. 78. Pt. III, p. 220.

Calyx subcylindrical, gradually enlarging to the top of the infrabasals and slightly constricted at the arm bases. Surface of the plates smooth and conforming to the general curve of the calyx, except the radials which are longitudinally convex at the arm facets, giving a lobed appearance to the upper part of the calyx; lobes thick. Infrabasals five, equal, pentagonal, higher than wide, forming a cup whose height and width are about equal. Basals four, higher than wide, the largest plates of the calyx. The posterior basal is heptagonal, being truncated distally for the support of the anal plate. It is somewhat larger than the other four which are hexagonal and equal in size. Radials five, wider than high, somewhat smaller than the infrabasals. The articulating facets for the arms occupy nearly the entire distal edge of the plate. The right posterior radial is smaller than the others, on account of the proximal end being displaced by the radianal plate. The radial symmetry is disturbed by the presence of an anal plate situated between the two posterior radials and resting on the posterior basal, and a radianal plate is situated at the right of the anal, resting on the posterior and right lateral basal plates and carrying on its distal side the right posterior radial.

The species occurs in this locality in the form of natural casts and molds. Owing to the comparative thickness of the plates the casts are quite different in shape from the molds. The infrabasal cup is in the form of a rapidly expanding pyramid. Owing to the convexity of the inner surface of the basal plates there is a noticeable constriction a little above the middle of the cast and another at the arm bases. These features are well shown in Pl. LXXXIV, Fig. 15. Hall's original description\* of this species is brief, and, judging from his figures, his specimens were not very well preserved. There seems to be little doubt, however, that this specimen should be referred to this species. The species was described from the Niagaran shale at Lockport, New York, and, so far as is known to the writer, has never been reported from any other locality.

\* Pal. N. Y., Vol. II, p. 186.

Locality: Collected by the writer in the spoil heaps along the Chicago Drainage Canal about  $1\frac{1}{2}$  miles east of Lemont, Illinois. (Mus. No. P 8887.)

### Family CROTALOCRINIDÆ.

#### CROTALOCRINUS Austin.

CROTALOCRINUS CORA Hall, Plate LXXXVI, Figs. 3 and 4.

1868 *Cyathocrinus cora* Hall, 20th Rept. N. Y. St. Mus., p. 324, Pl. XI, Figs. 13, 14.

1870 *Cyathocrinus cora* Hall, 20th Rept. N. Y. St. Mus. (Rev. Ed.), p. 366, Pl. XI, Figs. 13, 14.

1879 *Cyathocrinus cora* W. & Sp., Rev. Paleocrin., Pt. I, p. 85.

1881 *Cyathocrinus cora* S. A. M., Jour. Cin. Soc. Nat. Hist., Vol. IV, p. 171.

1900 *Cyathocrinus cora* Weller, Bull. 4, Nat. Hist. Surv. Chicago Acad. Sci., p. 62, Pl. XIV, Figs. 6-10.

1900 *Crotalocrinus americanus* Weller, ibid. p. 143, Pl. XIV, Fig. 1.

1902 *Crotalocrinus cora* Weller, Jour. Geol., Vol. X, p. 532, Pl. III.

This species is abundant at various localities in the vicinity of Chicago and at Racine, Wisconsin, in the form of natural casts, but it is rarely found with the brachial plates preserved. The specimen here figured (Mus. No. P 8809) shows the anterior and right anterior rays, complete to the fourth bifurcation of the brachials, and part of the left anterior and right posterior rays. This is probably the most complete specimen of this species yet discovered. The specimen consists of a natural cast with more than half the accompanying mold. Fig. 3 is drawn from a "composition" impression taken from the natural mold. Collected by the writer in the upper layers of the Hawthorne Quarry, Chicago, May, 1906.

### Order III. CAMERATA.

#### Family PLATYCRINIDÆ.

#### PLATYCRINUS Miller.

PLATYCRINUS AUGUSTA sp. nov. Plate LXXXVI, Figures 5-7.

Dorsal cup subhemispherical, sharply constricted above, with the base produced into a circular facet for the attachment of the column. Pentangular in transverse section at the arm bases, circular below. Plates thin, without ornamentation, conforming to the curvature of the calyx; sutures not in furrows, inconspicuous.

The natural cast is similar in form and proportions to the outside of the calyx without the radial and basal facets. The transverse ridge near the arm bases is more prominent and the inner surface of the plates is slightly beveled towards the edges, so that the position of the sutures is indicated on the casts by indistinct ridges.

Basals three, two pentangular and equal, the other smaller, quadrangular. Together they form a cup wider than high and with a small circular base. Radials five, about equal in size, three pentangular, two quadrangular. The radials are inflected on a line with the lower part of the articular facet forming an obtuse angular transverse ridge. The articular facets are small, occupying about one-third the width of the plates. They are circular in outline with a deep ventral groove. One axillary costal is attached to each articular facet. Column, as indicated by the basal facet, round with a central circular canal. Arms and ventral disc not preserved.

The type specimen (Mus. No. P 8895) consists of a natural cast of the dorsal cup and the associated natural mold nearly complete. Figures 5 and 6, Plate LXXXVI, are drawn from a rubber impression of the natural mold. This species is so different in its general form from any other species of this genus that comparison seems superfluous. The specific name is proposed in honor of the wife of the writer.

Locality: Collected by the writer in the Niagaran limestone of the spoil heaps along the Chicago Drainage Canal near Lemont, Illinois.

### Family BATOCRINIDÆ.

#### HABROCRINUS Angelin.

Calyx obconical to urn-shaped; composed of thick, more or less ornamented plates. Arms, two to each ray; uniserial, long, heavy and simple throughout. Base monocyclic.

Basals three, equal. Radials five, each followed by two costals. Distichals two to six to each ray leading up to the arms. First anal plate large, situated between the two posterior lateral radials. It is followed by three plates in the second row and five in the third. The anal interradius is much wider than the other interbrachial areas.

The genus *Habrocrinus* together with *Pionocrinus* was created in

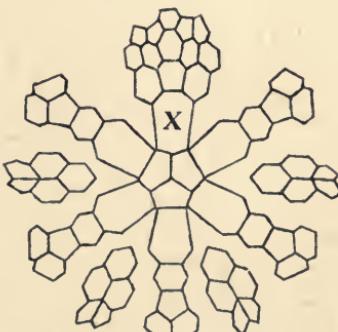


Fig. 8. Diagram of *Habrocrinus*.

1878 by Angelin\* to receive a number of species from the Silurian rocks of Gotland, Sweden. It has been recognized in the Wenlock limestone in England, and Wachsmuth and Springer described two species from Indiana which they referred to the subgenus *Acacocrinus*. The differences between *Habrocrinus* and *Pionocrinus* are as follows: In *Habrocrinus* the interbrachial areas consist of one plate resting on the superior lateral edges of the radials, followed by two plates in each of the succeeding rows; in *Pionocrinus* the first interbrachial plate is large, occupying the space between the two rays from the superior lateral edges of the radials to the inferior edges of the first distichals. This plate is followed by a single narrow plate. The first costals in *Habrocrinus* are hexangular, while those of *Pionocrinus* are quadrangular. These differences are not considered to be of generic importance, so that Bather and Wachsmuth & Springer place the species originally referred to *Pionocrinus* in the genus *Habrocrinus*.

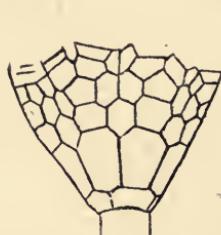


Fig. 9. Outline of *Habrocrinus ornatus* Ang. Lateral and Posterior Views. (After Angelin).

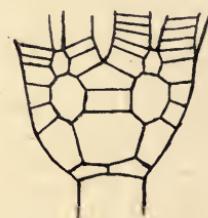
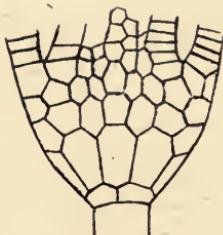


Fig. 10. Outline of *Pionocrinus jactus* Ang. Lateral View. (After Angelin).

*Habrocrinus* differs from *Periechocrinus* in character and ornamentation of the plates of the dorsal cup; in the former the plates are thick, more or less sculptured, sutures situated in deep furrows; in the latter the plates are thin, edges not beveled and position of sutures not well defined. In *Habrocrinus* the arms are strong and simple; in *Periechocrinus* they are slender and branching. In the former the palmers are not present in the dorsal cup; in the latter they are present. In the former the number of arms is two to each ray, in the latter it is four or more to each ray.

Of the fourteen American species referred to *Periechocrinus*, four species, *P. benedicti* S. A. M., *P. chicagoensis* Weller, *P. howardi* S. A. M. and *P. ornatus* Hall, possess characters which appear to necessitate their removal from that genus to *Habrocrinus*. The characters referred to are as follows: The absence of the palmers in the dorsal cup, reducing the number of arm bases from four to two in each ray, and the

\* *Iconographia crinoideorum*, p. 3.

thick, more or less sculptured plates with edges beveled forming furrows in which the sutures are situated. As none of these species has been found with the arms preserved, it is not possible to state whether they are simple or branched, but the number of the arm bases and the thickness and ornamentation of the plates indicate their affinity with *Habrocrinus*. In the new species described herewith both the typical form of *Habrocrinus* and the form referred to *Pionocrinus* are found.

**HABROCRINUS BENEDICTI** S. A. Miller, Plate LXXXVII, Figs. 6-7.

1892 *Saccocrinus benedicti* S. A. M., Adv. Sheets, 18th Rept. Geol. Surv. Ind., p. 28, Pl. V, Figs. 1-2.

1894 *Saccocrinus benedicti* S. A. M., 18th Rept. Geol. Surv. Ind., p. 283, Pl. V, Figs. 1-2.

1902 *Periechocrinus chicagoensis* Weller, Bull. 4, Nat. Hist. Surv., Chicago Acad. Sci., p. 131, Pl. XIII, Figs. 7-8.

The specimens described by S. A. Miller as *Saccocrinus benedicti* had the plates preserved, so that their form and ornamentations were well shown. The specimens were from St Paul, Indiana. *Periechocrinus chicagoensis* was described by Weller from natural casts from Chicago, no specimens showing the ornamentation of the plates having at the time been reported.

In the summer of 1906 the writer was fortunate enough to find a natural cast of *P. chicagoensis* accompanied by a large part of the natural mold. Upon taking an impression of this mold a great similarity with *P. benedicti* was at once apparent, and upon further study of the two forms there appeared little reason to doubt that they were specifically identical. As Miller's species has about ten years priority, *P. chicagoensis* Weller will thus become a synonym. Wachsmuth & Springer consider *H. benedicti* to be a synonym of *H. ornatus*. This view is not held by many other authors and a comparison of the type of *H. benedicti* with the drawings of *H. ornatus* would seem to leave little room to doubt that they are distinct.

Locality: Niagaran limestone of the spoil heaps along the Chicago Drainage Canal near Lemont, Illinois. The specimen here figured has the Museum number P 8893.

The bibliography of the two other species transferred to *Habrocrinus* is here given, although they have not been reported from this Area.

**HABROCRINUS HOWARDI** S. A. Miller.

1892 *Saccocrinus howardi* S. A. M., Adv. Sheets, 18th Rept. Geol. Surv. Ind., p. 29, Pl. V, Figs. 3-5.

1894 *Saccocrinus howardi* S. A. M., 18th Rept. Geol. Surv. Ind., p. 284, Pl. V, Figs. 3-5.

1897 *Periechocrinus howardi* W. & Sp., N. Am. Crin. Cam., Vol. II, p. 529.

Niagara Group, St. Paul, Indiana.

#### HABROCRINUS ORNATUS Hall.

1875 *Saccocrinus ornatus* Hall, Pal. Ohio, Vol. II, p. 126, Pl. VI, Figs. 7-9.

1881 *Periechocrinus ornatus* Wachsmuth & Springer, Rev. Palaeocr., Pt. II, p. 132.

1897 *Periechocrinus ornatus* Wachsmuth & Springer, N. Am. Crin. Cam., Vol. II, p. 527, Pl. L, Figs. 3a-b, and Pl. LI, Fig. 7.

Niagara group, Yellow Springs, Ohio.

#### HABROCRINUS FARRINGTONI sp. nov. Plate LXXXVII, Figs. 1-5.

The calyx is urn-shaped, with an expanded hexagonal base. The dome is not preserved. The plates of the dorsal cup are thick, depressed in the center, with low nodes near the angles. The sutures are situated in deep furrows formed by the beveled edges of the plates. No radial ridges are found. The natural casts have a pronounced tubercle near the center of the radial and first anal plates, indicating a depression on the inner side of the plates, but no corresponding elevation, on the exterior of the plates, is shown in the natural mold. The natural casts are pyriform, pointed below and truncated above, somewhat constricted between the prominent arm bases. Arms, judging from the arm bases, two to each ray.

Basals three, equal, forming a shallow hexagonal cup. Radials five, height and width about equal; the two anterior laterals heptagonal, the others hexagonal. First costals hexagonal, about half the size of the radials; second costals smaller than the first, pentagonal, axillary, bearing the distichals upon their superior edges. First distichals about twice as high as wide. Higher plates of the rays not known. First interbrachials hexagonal, equal in size or slightly larger than the first costals; they are followed by two somewhat smaller plates, and these by two still smaller which join with the plates of the dome. No interdistichal plates visible. The anal interradius has nearly the combined width of one of the rays and two interbrachial areas. The first anal plate is situated between the two posterior radials, resting on the basals. It is heptagonal in form and from its superior edge extends

a row of three or more plates, gradually diminishing in size; these anal plates are similar in size to the corresponding radial, costal and distichal plates; on either side of the anal plates is a series of plates similar to, but slightly smaller than, those of the interbrachial areas, with the exception that there are three in the third row instead of two.

This species somewhat resembles *H. benedicti* S. A. M. in general appearance, but it is distinguished from that species by having a more shallow and expanded basal cup. The diameter of the calyx is greater in proportion to its height in *H. farringtoni* than in *H. benedicti*, and both the constriction below the arm bases and the second and third distichals are wanting in *H. farringtoni*. In the form of the calyx and the ornamentation of the plates *H. farringtoni* resembles *H. lemontensis*, but they are distinguished by the shape of their first costals and by the number and shape of the plates in the interbrachial areas.

The type specimen of *H. farringtoni*, on which this description is based, consists of a natural cast of the dorsal cup accompanied by a portion of the natural mold. The sutures are well defined on both cast and mold. The mold comprises two rays, one interbrachial area and more than half the anal interradius. An impression taken from this mold gives the external form of the calyx and the surface markings of the plates. As the basal plates are missing from this mold, the impression of a mold in the collection of the University of Chicago is also figured, Plate LXXXVII, Figs. 1 and 2. The type is somewhat crushed, thus giving a wider appearance in proportion to its height than is natural.

The specific name is proposed in honor of Dr. O. C. Farrington, Curator of the Department of Geology of the Museum.

Locality: This species is represented in the Museum collections by the type specimen P 8474, and a natural cast, P 8949. These were collected by the writer in the Niagaran limestone of the spoil heaps along the Chicago Drainage Canal about a mile east of Lemont, Illinois, one in the fall of 1905 and one in the spring of 1906. The specimen in the collection of the University of Chicago is from the same locality.

**HABROCRINUS LEMONTENSIS sp. nov. Plate LXXXVII, Figs. 8-10.**

The calyx is urn-shaped with an expanded hexagonal base; moderately constricted between the prominent arm bases, giving a pentagonal section to the dorsal cup. The dome is not preserved. The plates of the dorsal cup are thick and depressed with nodes near the angles of the plates. The sutures are situated in deep furrows formed

by the beveled edges of the plates. No radial ridges are observed. The natural cast is turbinate, pointed below and truncated above, with prominent arm bases. Arms, judging from the arm bases, two to each ray.

Basals three, equal in size, forming a shallow cup with an hexagonal outline. Radials five, height and width about equal, the two anterior laterals heptagonal, the others hexagonal, in-contact except at the posterior side where they are separated by the first anal plate. First costals quadrangular, height and width about equal, much smaller than the radials. Second costals about the size of the first, wider than high, pentangular, axillary, supporting the distichals upon their sloping edges. Distichals comparatively large, two or more to each ray. The first interbrachial plate is intermediate in size between the radials and the first costals; it is nine-sided and occupies the space from the sloping superior edges of the radials to the inferior edges of the distichals; it supports a narrow plate upon its upper edge. No interdistichals are observed. The anal interradius is considerably wider than the interbrachial areas. The first anal plate is heptagonal, resting on the basals between the posterior lateral radials. It is followed by three plates in the second row and by five in the two succeeding rows.

In the arrangement and relative size of the plates this species closely resembles *H. (Pionocrinus) farctus* Angelin \* (See Fig. 10), but that is a very small species and the plates are moderately convex and without sculpturing. The distinguishing characters between this species and *H. farringtoni* are discussed under that species.

The type specimen (Mus. No. P 9628) consists of a somewhat weathered natural cast with a portion of the accompanying natural mold. The mold comprises the basal cup in good condition, three radials and the first anal plate practically complete and the lower half of the other two radials; in two of the rays the costals and one of the distichals are preserved with the enclosed interbrachial area. The impression from this mold gives the general form of the exterior of the dorsal cup and the ornamentation of the plates. The form of more than half of the plates can be traced on the natural cast, so that the characters of the species can be ascertained. The pits on the basal and radial plates, shown in Pl. LXXXVII, Figs. 8 and 9, are caused by protuberances in the natural mold. These protuberances appear to be carbonate of lime deposited after the original crinoid had been dissolved out, and probably have no connection with the ornamentation of the plates.

\* *Iconographia Crinoideorum*, p. 5, Pl. XVI, Fig. 23.

Locality: The species is represented by a single individual collected by the writer in the fall of 1905, in the Niagaran limestone in the spoil heaps along the Chicago Drainage Canal, about one mile east of Lemont, Illinois.

### Family THYSANOCRINIDÆ.

#### THYSANOCRINUS Hall.

Weller's description\* of this genus is as follows:—

"Calyx subglobose, urn or bell-shaped, the rays marked by more or less conspicuous ridges; the surface of the plates smooth, or variously ornamented. Infrabasals five small, barely extending beyond the column, or entirely hidden by it. Basals five, four of them equal and angular above; the fifth truncated and supporting a large anal plate. Radials considerably larger than the costals, their proximal sides distinctly angular, the lateral faces comparatively short. Costals two. Distichals two or three in each series. In some cases palmers are also present, the axillary distichal giving rise on the interradial side to an armlet for the most part included in the calyx and on the other side of the main arm. Four of the first interbrachials large, angular below, resting upon the sloping upper corners of the two radials and against the costals; two plates in the second row, often followed by smaller ones above which connect with the plates of the disc. The anal side considerably wider, the first plate large, hexagonal, resting upon the truncated posterior basal, three plates in the second row and smaller ones above. In some species an uninterrupted row of anal plates extends to the anal opening. Interdistichals generally represented and rather large. Column round or obtusely pentangular."

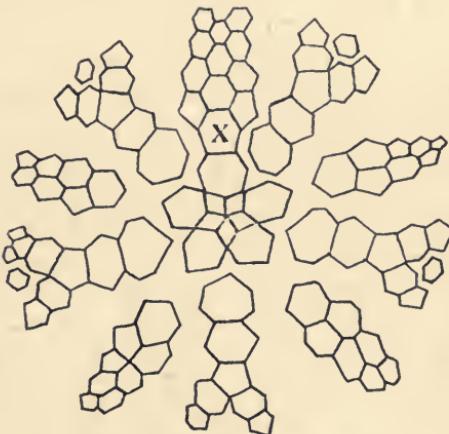


Fig. 11. Diagram of *Thysanocrinus*.

THYSANOCRINUS CAMPANULATUS sp. nov. Plate LXXXV, Figs. 20–23.

The calyx is bell-shaped, expanding very rapidly above the top of

\* Bull. IV, Pt. I, Nat. Hist. Surv., Chicago Acad. Sci., p. 70.

the radial plates. The diameter of the dorsal cup at the arm bases is about one-half greater than the height of the cup. The dorsal cup is ornamented with series of prominent rounded ridges. The ridges begin near the middle of the lower margins of the basal plates at the juncture with the column and extend to the center of the plate. At this point they bifurcate and pass to the center of the radials where they join the ridges from the basals on either side. From the center of the radials the ridges follow the median line of the radials and costals to the middle of the axillary costal where they again bifurcate and follow the distichals up to the arm bases. Another, less conspicuous ridge connects the centers of the posterior lateral radials crossing the first anal plate. Surface of all plates, not ornamented with the ridges, smooth and moderately convex. Sutures not situated in grooves. In the natural casts the dorsal cup is broad and flat at the base and curves abruptly upward at about the middle of the basal plates; it expands moderately up to the middle of the radials, where a slight constriction occurs, and above this constriction the expansion is very rapid until at the arm bases the plates are nearly at right angles to the axis of the calyx. Ventral disc not preserved.

Infrabasals five, small, scarcely extending beyond the columnar facet. Basals five, large, forming with the infrabasals a shallow cup; the posterior basal is heptagonal and larger than the others which are hexagonal. Radials five, larger than the basals; the two posterior laterals are hexagonal and the rest are heptagonal. First costals hexagonal, less than half the size of the radials. Second costals axillary, pentagonal or hexagonal. In some cases the interdistichal appears to join the axillary costal. Distichals two or more in each series. First interbrachials are hexagonal, intermediate in size between the radials and first costals; they are followed by three or more rows of two plates each, diminishing in size upward. Interdistichals present, but in the specimens at hand only the first plate is preserved; this appears to be hexagonal or heptagonal. The anal interradius is wider than the interbrachial areas. The first anal plate is hexagonal, smaller than the radials; it rests on the distal edge of the posterior basal and separates the posterior lateral radials; it supports on its distal edge a row of plates, diminishing in size, which lead up to the vault; the space between this row of plates and the posterior lateral rays is filled with smaller plates.

In its general form and proportions this species is so unlike all other species of this genus that it will be easily recognized.

The type specimen, P 8891, was collected by the writer in the spring of 1906. It consists of a nearly perfect natural cast of the dorsal

cup accompanied by a natural mold of which a part of the base is missing.

Locality: Niagaran limestone of the spoil heaps along the Chicago Drainage Canal near Lemont, Illinois.

### Family CALYPTOCRINIDÆ.

#### EUCALYPTOCRINUS Goldfuss.

EUCALYPTOCRINUS OBCONICUS Hall, Plate LXXXVI, Figures 1-2.

1867 *E. obconicus* Hall, 20th Rept. N. Y. St. Mus., p. 323, Pl. XI, Fig. 1.

1870 *E. obconicus* Hall, 20th Rept. N. Y. St. Mus., Rev. Ed., p. 365, Pl. XI, Fig. 1.

1885 *E. obconicus* Wachsmuth & Sp., Rev. Palæocr. Pt. III, p. 133.

1897 *E. obconicus* Wachsmuth & Sp., N. Am. Crin. Cam., Vol. I., p. 353, Pl. LXXXIII, Fig. 13.

1900 *E. obconicus* Weller, Bull. 4, Nat. Hist. Surv., Chicago Acad. Sci., p. 109, Pl. VII, Fig. 8.

Dorsal cup obconical, truncated at the base by the attachment for the column; height nearly twice its diameter at the arm bases; gradually and regularly expanding from the size of the column at its base to the arm bases where it attains its greatest diameter. The plates are thicker in the central portion than at the edges, so that both their inner and outer surfaces are convex. The outer surface of the plates is smooth and slopes gently towards the sutures. The natural cast is similar in outline to the exterior of the dorsal cup, but it is pointed at the base. The position of the sutures is indicated by low angular ridges which are formed by the convexity of the inner surface of the plates.

Basals four, three pentagonal, one hexagonal, long and narrow. Together they form a cup, height and width about equal. Radials five, the largest plates in the calyx; four heptagonal, the other hexagonal, about equal in size and nearly twice as high as wide. First costals quadrangular, higher than wide, proximal and lateral edges arched, distal edges much narrower than the proximal ones. Second or axial costals are in the form of a regular pentagon, somewhat smaller than the first costals. Distichals four to each ray. The first pair hexagonal, in contact with each other and about the size of the second costals upon which they rest. The second pair is very small. First interbrachials ten-sided, about twice as high as wide and next to the radials in size. These are followed by two long narrow plates, with their longest edges in contact. Interdistichals small, angular below and

resting upon the short, sloping edges of the first distichals and between the second distichals.

Arms and ventral disc not preserved.

The following dimensions are given for comparison. Those of the type are taken from the cut, those of this specimen from the cast.

	This specimen	Type specimen
Length of dorsal cup,	37.5 mm.	19.0
Diameter at arm bases,	18.2	13.5
Diameter at top of radials,	11.1	8.0
Height of radials,	12.5	5.2
Height of basals,	7.7	2.5

Owing to the fact that this specimen is somewhat distorted, the dimensions of the diameters as given are estimated. The actual measurements are as follows:

The longer and shorter diameters at arm bases are 22.15 and 14.3 respectively.

The longer and shorter diameters at top of radials are 12.9 and 9.3 respectively.

The specimen here described (Mus. No. P 8879) consists of a practically complete natural cast accompanied by a portion of the mold. The mold comprises one complete ray, a portion of two others and part of three interbrachial areas. So far as known to the writer, this is the first specimen of this species in which the external characters of the plates have been described or figured. This specimen differs from the type as figured by Hall in several particulars, and if other specimens should be found showing these characters to be constant, it may be advisable to consider this a new species. This specimen is about twice the length of the type and somewhat more slender. The basals, radials, first costals and first interbrachials are much higher in proportion to their width. In the type the sutures between the first costals and first interbrachials are straight, but in this specimen they are arched, with the convex side towards the interbrachial.

This species is distinguished from all other species of the genus by the absence of a basal cavity.

Locality: Niagaran limestone of the spoil heaps along the Chicago Drainage Canal near Lemont, Illinois.

Previous to the present publication there have been described from the Chicago Area a total of 62 species of crinoids divided among 26 genera. A complete list of these was given by Weller in 1900.\* Two years later Weller obtained a specimen which showed that *Cyathocrinus cora* Hall and *Crotalocrinus americanus* Weller were one and should be known as *Crotalocrinus cora* Hall, † thus making the number of species 61. The species obtained by the present writer increase the total number of species of crinoids known from the Chicago Area to 75 and that of the genera to 30. A full list of these follows. In addition it may be noted that several specimens which were associated with those here described and which are evidently new species proved too fragmentary for description. Should better specimens of these be obtained, three or more new species and at least one new genus may be added to the list.

\* Bull. 4, Nat. Hist. Surv., Chicago Acad. Sci., Pt. I.

† Jour. Geol., Vol. X, pp. 532-4.

## LIST OF CRINOIDS OF THE CHICAGO AREA.

### Order I. LARVIFORMIA.

#### Family PISOCRINIDÆ.

*Pisocrinus benedicti*, S. A. M.; *P. gemmiformis*, S. A. M.; *P. quinquelobus*, Bather.

#### Family STEPHANOCRINIDÆ.

*Stephanocrinus obconicus*, Slocom; *S. osgoodensis*, S. A. M.; *S. skiffi*, Slocom.

#### Family ZOPHOCRINIDÆ.

*Zophocrinus howardi*, S. A. M.; *Z. globosus*, Slocom; *Z. pyriformis*, Slocom.

#### Family HETEROCRINIDÆ.

*Myelodactylus bridgeportensis*, S. A. M.

### Order II. FISTULATA.

#### Family GASTEROCOMIDÆ.

*Achradocrinus patulus*, Slocom.

#### Family CYATHOCRINIDÆ.

*Homocrinus ancilla*, Hall; *H. cylindricus*, Hall.

*Cyathocrinus turbinatus*, Weller; *C. vanhorni*, S. A. M.

*Botryocrinus polyxo*, Hall.

*Ampheristocrinus dubius*, Weller.

#### Family CROTALOCRINIDÆ.

*Crotalocrinus cora*, Hall.

### Order III. CAMERATA.

#### Family PLATYCRINIDÆ.

*Platycrinus augusta*, Slocom; *P. dubius*, Weller.

*Marsupiocrinus chicagoensis*, Weller.

## Family BATOCRINIDÆ.

*Habrocrinus benedicti*, S. A. M.; *H. farringtoni*, Slocom; *H. lemontensis* Slocom.

*Periechocrinus egani*, S. A. M.; *P. infelix*, W. & M.; *P. marcouanus*, W. & M.; *P. necis*, W. & M.; *P. urniformis*, S. A. M.

## Family THYSANOCRINIDÆ.

*Thysanocrinus campanulatus*, Slocom; *T. egani*, S. A. M.; *T. occidentalis*, Hall; *T. pentangularis*, Hall.

*Cyphocrinus chicagoensis*, Weller.

*Gazacrinus major*, Weller; *G. minor*, Weller.

*Lampterocrinus dubius*, Weller; *L. inflatus*, Hall; *L. robustus*, Weller; *L. subglobosus*, Weller.

*Siphonocrinus nobilis*, Hall.

## Family RHODOCRINIDÆ.

*Archæocrinus depressus*, Weller.

*Lyriocrinus melissa*, Hall.

## Family MELOCRINIDÆ.

*Macrostylocrinus obconicus*, Weller; *M. semiradiatus* Hall; *M. striatus*, Hall; *M. subglobosus*, Weller.

*Melocrinus obpyramidalis*, W. & M.

*Corymbocrinus chicagoensis*, Weller; *C. niagarensis*, Weller.

## Family CALYPTOCRINIDÆ.

*Eucalyptocrinus asper*, Weller; *E. crassus*, Hall; *E. depressus*, S. A. M.; *E. egani*, S. A. M.; *E. inornatus*, Weller; *E. magnus*, Worthen; *E. nodulosus*, Weller.; *E. obconicus*, Hall; *E. ornatus*, Hall; *E. rotundus*, S. A. M.; *E. turbinatus*, S. A. M.

*Callicrinus biforcatus*, Weller; *C. bilobus*, Weller; *C. cornutus*, Hall; *C. corrugatus*, Weller; *C. desideratus*, Weller, *C. digitatus*, Weller;

*C. hydei*, Weller; *C. longispinus*, Weller; *C. pentangularis*, Weller.

*Chicagocrinus inornatus*, Weller; *C. ornatus*, Weller.

## Order IV. ARTICULATA.

## Family ICHTHYOCRINIDÆ.

*Ichthyocrinus subangularis*, Hall.

*Lecanocrinus waukoma*, Hall.

*Pycnosaccus americanus*, Weller.

## ACKNOWLEDGMENTS.

The writer is indebted to the publications of Wachsmuth & Springer, F. A. Bather and Stuart Weller for most of the generic descriptions used in this paper, but, as they have been rearranged and adapted more or less, they have not been treated as quotations. In any cases where descriptions have been copied due credit has been given.

The writer is also under obligations to Professor Weller of the University of Chicago for the use of publications, types and other specimens from the collections of Walker Museum, which have materially aided in the preparation of this paper.

The drawings illustrating the paper were made by Mr. Leon L. Pray of the Museum.



VIEW OF WALL OF QUARRY AT ROMEO, ILLINOIS SHOWING CLAY POCKETS.





NEAR VIEW OF CLAY POCKET, ROMEO, ILLINOIS. THE SIDE WALLS ARE NIAGARAN LIMESTONE. THE POCKET  
CAPPED BY WATERWORN PEBBLES.





#### EXPLANATION OF PLATE LXXXIV.

*PISOCRINUS GEMMIFORMIS* S. A. Miller, page 278.

Figs. 1, 2. Posterior and basal views of the type specimen, (after Miller).  $\times 2$ .

Figs. 3, 4. Lateral and basal views of a natural mold with natural cast in position.  $\times 2$ .

*PISOCRINUS QUINQUELOBUS* Bather, page 280.

Fig. 5. Basal view of a specimen from Tennessee (after S. A. Miller).  $\times 2$ .

Figs. 6, 7. Posterior and ventral views of a specimen from Romeo, Illinois.  $\times 2$ .

*PISOCRINUS BENEDICTI*, S. A. Miller, page 279.

Fig. 8. Lateral view of a rubber impression of a natural mold.  $\times 2$ .

Fig. 9. Basal view of a rubber impression of another natural mold.  $\times 2$ .

Figs. 10, 11. Basal and lateral views of a natural mold with the natural cast in position.  $\times 2$ .

*STEPHANOCRINUS OBCONICUS* sp. nov., page 281.

Figs. 12, 13. Posterior and basal views of the type specimen.  $\times 2$ .

*HOMOCRINUS CYLINDRICUS* Hall, page 291.

Fig. 14. Lateral view of a rubber impression of the natural mold.  $\times 2$ .

Fig. 15. Posterior view of the natural cast of the same individual.  $\times 2$ .

*STEPHANOCRINUS SKIFFI* sp. nov. page 282.

Figs. 16, 17. Lateral and ventral views of a rubber impression of the natural mold of the type specimen.  $\times 2$ .

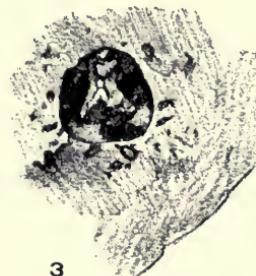
Figs. 18-20. Lateral, anterior and ventral views of the natural cast of the same individual.  $\times 2$ .



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EXPLANATION OF PLATE LXXXV.

*ACHRADOCRINUS PATULUS* sp. nov., page 288.

Figs. 1-4. Posterior, lateral, basal and ventral views of the type specimen.  
X 2.

*ACHRADOCRINUS VENTROSUS* Schultze, page 288.

Figs. 5-8. Posterior, lateral, basal and ventral views of the genotype from the Devonian of Eifel, Germany (after Schultze), reduced one-half for comparison with above.

*HOMOCRINUS ANCILLA* Hall, page 289.

Fig. 9. Lateral view of a plaster impression of a natural mold. X 1.

Figs. 10, 11. Posterior and anterior views of a natural cast of the same individual. X 1.

*ZOPHOCRINUS PYRIFORMIS* sp. nov., page 285.

Figs. 12-14. Posterior, lateral and basal views of the type specimen. X 2.

*ZOPHOCRINUS GLOBOSUS* sp. nov., page 285.

Fig. 15. Lateral view of a rubber impression of the natural mold of the type specimen. X 2.

Fig. 16. Lateral view of the natural cast of the same individual. X 2.

Fig. 17. Outline showing size and position of the natural cast and mold. X 2.

Figs. 18, 19. Basal and lateral views of another natural cast. X 2.

*THYSANOCRINUS CAMPANULATUS* sp. nov., page 299.

Figs. 20, 21. Lateral and posterior views of a composition impression of the natural mold of the type specimen. Somewhat restored at the base. X 1.

Figs. 22, 23. Posterior and basal views of the natural cast, same individual. X 1.



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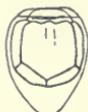
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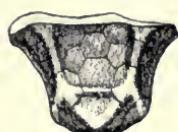
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EXPLANATION OF PLATE LXXXVI.

*EUCALYPTOCRINUS OBCONICUS* Hall, page 301.

Fig. 1. Natural mold with the natural cast in position.  $\times 1$ .

Fig. 2. Lateral view of a plaster impression of the natural mold.  $\times 1$ .

*CROTALOCRINUS CORA* Hall, page 292.

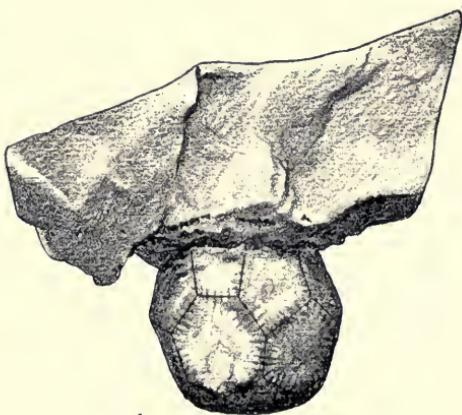
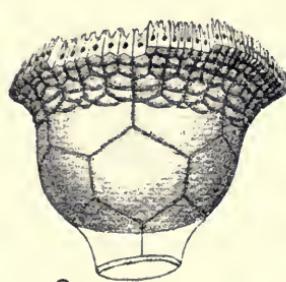
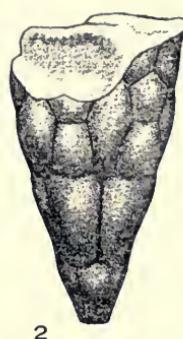
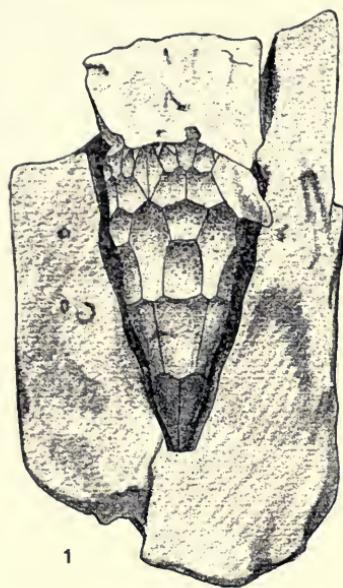
Fig. 3. Anterior view of a composition impression of the natural mold.  $\times 1$ .

Fig. 4. Posterior view of the natural cast of the same individual.  $\times 1$ .

*PLATYCRINUS AUGUSTA* sp. nov., page 292.

Figs. 5, 6. Lateral and basal views of a rubber impression of the natural mold of the type specimen.  $\times 2$ .

Fig. 7. Lateral view of the natural cast of the same individual.  $\times 2$ .







EXPLANATION OF PLATE LXXXVII.

*HABROCRINUS FARRINGTONI* sp. nov., page 296.

Fig. 1. Oblique view from below showing base and right posterior ray of a composition impression of a natural mold in the collection of Walker Museum, University of Chicago.  $\times 1$ .

Fig. 2. Posterior view of the same.  $\times 1$ .

Fig. 3. Lateral view of a composition impression of the natural mold of the type specimen.  $\times 1$ .

Figs. 4, 5. Lateral and posterior views of the natural cast of the type specimen.  $\times 1$ .

*HABROCRINUS BENEDICTI* S. A. Miller, page 295.

Fig. 6. Lateral view of the natural cast.  $\times 1$ .

Fig. 7. Lateral view of a rubber impression of a part of the natural mold of the same individual, showing the ornamentation of the plates.  $\times 1$ .

*HABROCRINUS LEMONTENSIS* sp. nov., page 297.

Figs. 8, 9. Basal and lateral views of a composition impression of the natural mold of the type.  $\times 1$ .

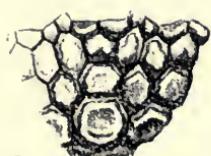
Fig. 10. Posterior view of the natural cast of the same individual.  $\times 1$ .



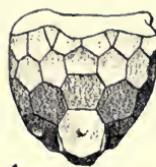
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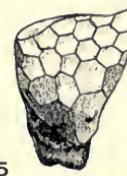
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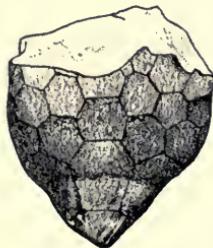
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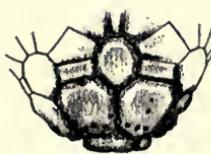
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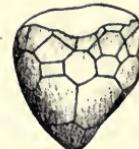
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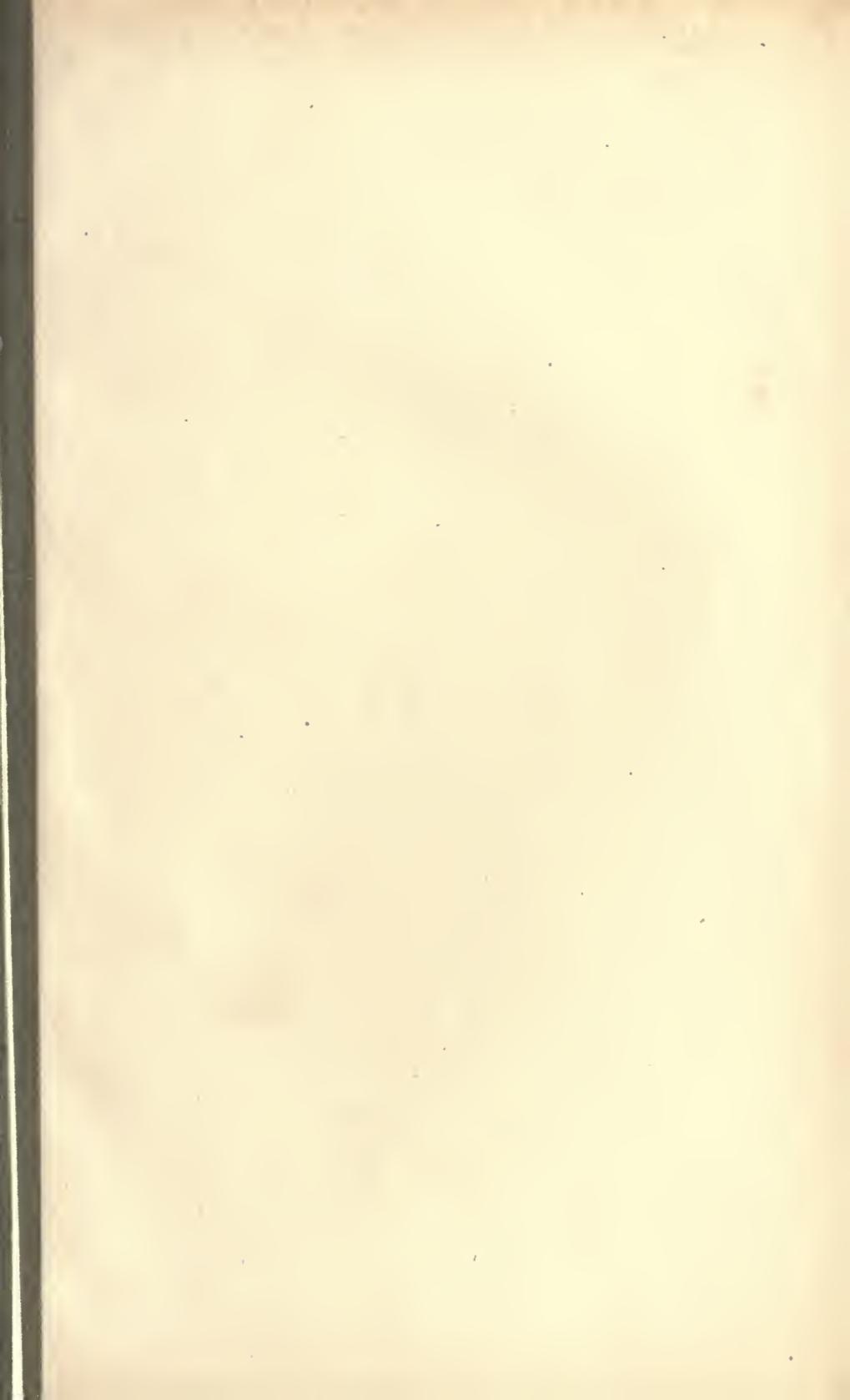


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