OKLAHOMA GEOLOGICAL SURVEY
CARL C. BRANSON, *Director*

CIRCULAR 55

THE GENUS PARAGASSIZOCRINUS IN OKLAHOMA

by

HARRELL L. STRIMPLE

The University of Oklahoma
Norman
1960

CONTENTS

ILLUSTRATIONS

PART I
THE GENUS PARAGASSIZOCRINUS IN OKLAHOMA

HARRELL L. STRIMPLE

ABSTRACT

The fused infrabasal cones of the crinoid *Paragassizocrinus* are preserved in greater numbers than hard parts of many fossils. Differences in the shape of the conical cup and in the upper facets of the infrabasal plates permit differentiation of species. Ten species, eight of which are new, occur in the Pennsylvanian rocks of Oklahoma, and these species are useful in determining geologic age of the beds in which they occur.

INTRODUCTION

It was originally the intent of this study to present a new species of *Paragassizocrinus* from the Atoka formation, found by J. G. Blythe while doing graduate work at The University of Oklahoma. In comparing the species with other forms it became increasingly apparent that much other unpublished data need to be recorded. The fused infrabasal cones appear at many horizons over a wide area and it is clear that the present study will by no means cover all of the species; but future studies will be somewhat enhanced by the information presented herein. There is also a strong possibility that the forms may eventually prove to be of sound stratigraphic value.

Previously described species belonging to the genus are:

Agassizocrinus carbonarius Worthen, 1873
Agassizocrinus conicus Owen and Shumard, of Morgan, 1924
Agassizocrinus magnus Moore and Plummer, 1938
Agassizocrinus caliculus Moore and Plummer, 1938
*Agassizocrinus tarri** Strimple, 1938
Henanobasis coffeyvillensis Moore, 1938
Agassizocrinus mcgüirei Strimple, 1939

* Genotype species

Presently described species are:

Paragassizocrinus deltoideus Strimple, n. sp.
Paragassizocrinus asymmetricus Strimple, n. sp.
Paragassizocrinus turris Strimple, n. sp.
Paragassizocrinus elongatus Strimple, n. sp.
Paragassizocrinus disculus Strimple, n. sp.
Paragassizocrinus springeri Strimple, n. sp.
Paragassizocrinus hoodi Strimple, n. sp.
Paragassizocrinus atoka Strimple and Blythe, n. sp.

Considerable field work has been done by the author and others since the desirability of more information became apparent. The collections at The University of Oklahoma were searched for additional material and the results have been gratifying.

There has been a surprisingly small number of dorsal cups found. The two originally figured syntypes of *Paragassizocrinus tarri* are partial cups. One hypotype from the Stanton limestone of Kansas, figured by Moore and Plummer (1940), is an almost complete cup and those authors figured a cup that had been restored from disarticulated segments from the Graford formation of Texas. In the present collections are one complete cup and two nearly complete cups of *P. tarri* from the Nellie Bly formation southwest of Tulsa, Oklahoma; one complete cup of *P. deltoideus* from the Wapanucka formation of the Stonewall quadrangle in southeastern Oklahoma; one complete cup and one partial cup of *P. atoka* from the Atoka formation of Cherokee County; and one complete cup of *P. mcguirei* from the Checkerboard formation of Okfuskee County. A dorsal cup of *P. tarri* from the Nellie Bly formation has been restored from disarticulated segments (OU No. 3580) to obtain measurements of the cup height and width in an undistorted specimen.

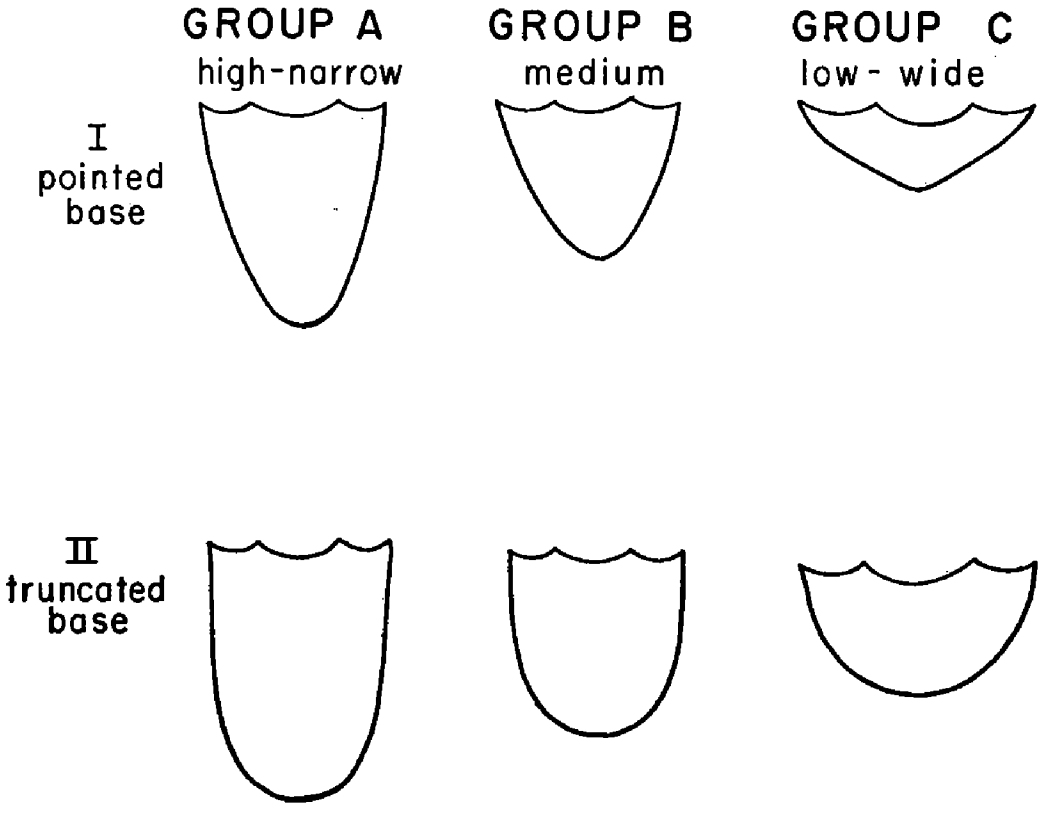
Infrabasal cones are from too many localities to list here, but will be noted under the systematic descriptions. There is a great variation in shape and size of the infrabasal cones, even within a given species. Even so, a norm can be established that is distinctive enough for practical comparative purposes. It is to be expected that the extremes of one species will agree with the norm of another species.

One of the more interesting facts disclosed by this study is the existence of two distinct kinds of *Paragassizocrinus,* based on characteristics of the upper facets of the infrabasal cone. *P. tarri* is a

typical representative of the one kind in which the upper articulating facets of the cone are directed outward and are smooth except for shallow ligament furrows and occasional fine crenulations. In the other kind, the cone is normally more or less bullet-shaped and the upper facets are subhorizontally directed with strong projections marking the interbasal positions. A typical representative of this group is *P. turris.*

The general contour of the infrabasal cone has been found to be significant and text-figure 1 illustrates the present usage of this characteristic. It is to be noted that the shape of the cone has not been used alone in any of the specific determinations. Other factors, such as height-to-width ratio, structure of the upper articulating facets, and size and structure of the body cavity are of equal importance.

Acknowledgments for those who have assisted in a work of this scope are inadequate. I am particularly indebted to Dr. Carl C. Branson, Oklahoma Geological Survey, Norman, Oklahoma; Drs. G. A. Cooper and Porter Kier, U. S. National Museum, Washington, D.C.; Mr. Audd Dailey, formerly of Holdenville, Oklahoma, present



TEXT-FIGURE 1. Classification of contours of infrabasal cones of *Paragassizocrinus.*

location unknown; Mr. Jack Hood, Mr. E. L. Gilmore, and Mrs. Melba L. Strimple, of Tulsa, Oklahoma.

A great number of measurements have been taken, but it must be remembered that measurements are only indicative, not final evidence. The late Dr. Edwin Kirk once told the author that he took his measurements four times and then took the average. I did not measure every plate and there are some variations involved. In addition different workers use slightly different methods in taking their measurements. The present methods were simplified. The width or length of a plate is the distance from one side to the other regardless of surface curvature. The length of the infrabasal cone is taken to the uppermost extremity, externally. The length of the upper facets of the cone was taken in midsection, which is normally shorter than the areas in interbasal position.

SYSTEMATIC DESCRIPTIONS

Subclass INADUNATA Wachsmuth and Springer
Suborder DENDROCRINOIDEA Bather
Family AGASSIZOCRINIDAE Miller
Genus PARAGASSIZOCRINUS Moore and Plummer

PARAGASSIZOCRINUS TARRI (Strimple), 1938
Plate II, figures 4, 5, 12, 13.

The original description (Strimple, 1938) of this species was based on an infrabasal cone with the articulated basal plates, a partial dorsal cup composed of articulated basal, radial and anal plates, with several first brachials retained in place, and several infrabasal cones. In 1940, Moore and Plummer designated the species as genotype of the genus *Paragassizocrinus* and presented additional data for the species. At that time the known range of the species was Stanton formation of Kansas, Graford formation of Texas, and Wann formation of Oklahoma. The author has verified its presence in the clay above the Willow Point limestone, Graford formation, near Bridgeport, Texas, but has not found specimens in Kansas. Moore and Plummer noted that the dorsal cup from Kansas was not as close to the syntypes in the measurements of basal and radial plates as to the disarticulated plates found in Texas. This difference may eventually be found to have special significance.

For comparative purposes, the infrabasal cone of *P. tarri* is of medium height and width, and conical with a pointed base. It therefore belongs under Group B-I as shown in text-figure 1.

A new occurrence of the species was called to my attention by Mr. E. L. Gilmore, owner of T-Town Rock Shop, Tulsa, Oklahoma. He has donated a nearly complete dorsal cup to The University of Oklahoma and was kind enough to take me to the exposure. Numerous infrabasal cones, isolated plates and one complete dorsal cup were eventually collected and used in the present study. The exposure is in SW¼ sec. 17, T. 19 N., R. 11 E., southwest of Sand Springs, Tulsa County. The horizon is given as Nellie Bly formation, Skiatook group, Missouri series by the geologic map of Tulsa County (Oakes, 1952). The fauna is dominantly molluscan and envelopment in limonite concretions appears to be at least partially responsible for the preservation of the crinoids.

The semi-elliptical nature of the infrabasal cones is readily apparent from measurements but not so quickly noticed in casual observation. Some specimens have a shallow ligament groove in each upper facet, and may have fine crenulations along the outer perimeter of the facets. The facets are directed slightly outward.

Measurements of several infrabasal cones (plesiotypes), in millimeters, are as follows:

	OU No. 3581					
	900	*901*	*902*	*903*	*904*	*906*
Height of cone	8.0	7.4	8.2	7.7	6.0	6.8
Width of cone						
maximum	10.7	14.1	11.2	12.1	9.8	9.9
minimum	10.0	13.5	10.7	11.5	9.0	9.3
Ratio of height to maximum width	0.747	0.524	0.732	0.636	0.612	0.686
Thickness of facet	3.1	3.1	3.5	3.3	2.1	2.6
Ratio of facet thickness to maximum cone width	0.289	0.219	0.312	0.272	0.214	0.263
Width of cavity (max.)	6.1	9.2	6.6	7.5	6.0	5.5

Measurements of dorsal cups, in millimeters, are as follows:

	Restored	*Partial*	*Complete*
Height of dorsal cup	17.6	17.7	20.1
Width of dorsal cup			
maximum	15.4	13.0e	18.7e
minimum	14.5		
Ratio of height to maximum width of cup	1.142		
Length of basal	7.5	8.2	9.1
Width of basal	7.8	6.3	8.1
Length of radial	5.1	4.8	5.2
Width of radial	7.8	7.3	9.2
Length of anal			5.5
Width of anal			4.2
Height of cone	8.0	8.1	8.8
Width of cone			
maximum	11.7	10.4	12.7
minimum	10.5	9.4*	11.1*
Ratio of height to maximum width of cone	0.683	0.778	0.692

e Estimated.
* Posterior to anterior orientation.

The anal plate in the large plesiotype is fundamentally five sided. Its upper edge provides two facets for the reception of two tube plates. In the original description of the species it was reported that the anal plate had six facets, but I am now certain the extra facet was in contact with the lateral side of a primibrach rather than with an extra tube plate.

It is of interest to note that the minimum diameter of the infra-

basal cones is from posterior to anterior as shown by the dorsal cups. The cones of the dorsal cups fall well into the norm for the species with respect to ratio of height to width.

The next specimens referred to the species are two infrabasal cones collected in the upper part of the exposure of the middle part of the Nellie Bly formation near the center of sec. 1, T. 17 N., R. 10 E., 11 miles from the Tulsa entry to the Turner Turnpike (OU No. 3582). Measurements, in millimeters, are as follows:

	OU No. 3582	
Height of cone	8.2	7.2
Width of cone		
maximum	9.3	9.8
minimum	9.0	9.2
Ratio of height to maximum width	0.881	0.734
Thickness of facet	1.7	1.9
Ratio of facet thickness to maximum cone width	0.182	0.193
Width of cavity (max.)	5.7	6.9

The ratio of height to width for the cones falls within the range for the species. The thickness of the upper facets is less than normal and therefore the cavity is larger than normal. The ligament furrows are shallow but well defined and the outer edge of each facet is crenulated. The thin upper walls and wide cavity are characteristics of *Paragassizocrinus carbonarius* and indicate close relationship. Additional material may make it desirable to establish a separate species for this form.

One small infrabasal cone that is similar to those from the Nellie Bly formation, discussed above, was found by Mr. Jack Hood in NE¼ SW¼ sec. 11, T. 19 N., R. 10 E., Tulsa County, southwest of Sand Springs, on the Keystone road (OU No. 3583). The horizon is just above the Iola limestone of Oakes' geologic map (1952) and is therefore the base of the Wann formation, Ochelata group, Missouri series. Measurements, in millimeters, are as follows:

	OU No. 3583
Height of cone	6.7
Width of cone	
maximum	9.8
minimum	9.5
Ratio of height to maximum width	0.683
Thickness of facet	2.0
Ratio of facet thickness to maximum cone width	0.204
Width of cavity (max.)	6.3

A single infrabasal cone has been found in the Iola formation, Ochelata group, Missouri series, in SW¼ SE¼ sec. 24, T. 29 N., R. 13 E., Washington County (OU No. 3584). This is a natural exposure in a stream bank. A dense limestone of unknown thickness forms the bed of the stream and part of the bank. This is overlain by about two feet of shale, from which the cone was collected. The shale is overlain by about two feet of weak limestone. Measurements of the cone, in millimeters, are as follows:

	OU No. 3584
Height of cone	9.0
Width of cone	
maximum	11.9
minimum	11.3
Ratio of height to maximum width	0.756
Thickness of facet	3.0
Ratio of facet thickness to maximum cone width	0.252
Width of cavity (max.)	7.4

In SE¼ sec. 20 and NE¼ sec. 29, T. 23 N., R. 13 E., 3.1 miles west of Vera, Washington County, there is a small road-metal quarry in strata just below the Dewey limestone and therefore in uppermost Nellie Bly formation, Skiatook group, Missouri series. Some thirty-eight infrabasal cones and seven basal plates which are assignable to *P. tarri,* have been collected at this exposure. The specimens are in most cases covered in part by secondary deposition of calcite and are difficult to study closely without a great amount of preparation. Four specimens (OU No. 3585) were selected on the basis of minimum preparation requirements and measurements, in millimeters, are given below:

	OU No. 3585			
	907a	*907b*	*907c*	*907d*
Height of cone	11.5	9.6	8.2	9.0
Width of cone				
maximum	13.7	13.1	12.3	11.5
minimum	12.5	13.1	11.8	10.2
Ratio of height to maximum width	0.839	0.732	0.666	0.782
Thickness of facet	2.8	2.2	2.7	2.3
Ratio of facet thickness of maximum cone width	0.204	0.168	0.219	0.200
Width of cavity (max.)	7.8	7.3	7.0	7.2

The cones discussed above are more rugged appearing than typical representatives of the species.

One specimen was found at the base of the Dewey limestone in NW¼ sec. 33, T. 25 N., R. 13 E., Washington County (OU No. 3586). At this particular exposure the blue-gray shale, that marks the base of the Dewey limestone at the type locality and most exposures in the northern part of the county, is missing. The specimen is from a yellowish clay shale, comparable to the occurrence given above, in secs. 20 and 29, T. 23 N., R. 13 E. The clay shale is considered to be uppermost Nellie Bly formation. Measurements of the cone confirm close affinity with the cones found in sections 20 and 29, which are somewhat deeper than is typical of the species. Measurements, in millimeters, are:

	OU No. 3586
Height of cone	10.1
Width of cone	
maximum	11.5
minimum	10.5
Ratio of height to maximum width	0.878
Thickness of facet	2.7
Width of cavity (max.)	6.0

Occurrence and horizon: Wann formation, Ochelata group, Missouri series, Washington, Tulsa, and Creek Counties, Oklahoma. Nellie Bly formation, Skiatook group, Missouri series, Washington, Tulsa, and Creek Counties, Oklahoma. Inola formation, Ochelata group, Missouri series, Washington County, Oklahoma. Eudora shale member, Stanton formation, Missouri series, Montgomery County, Kansas. Clay above the Willow Point limestone, Graford formation, Canyon series (Missouri series), Wise County, Texas. Graford formation, Canyon series (Missouri series), Palo Pinto County, Texas.

PARAGASSIZOCRINUS MCGUIREI (Strimple), 1939
Plate II, figures 3, 8-11.

Three infrabasal cones from the type locality were selected for measurement in order to give a better understanding of the species. As originally described, it is similar to *P. tarri* from which it differs in having a proportionaly longer cone. The ratio of height to width of the holotype was 1.02; however, most subsequently discovered specimens are proportionately a bit wider. The body cavity is normally narrower in *P. mcguirei* than in *P. tarri*. In text-figure

1, the species falls under Group A-I. Measurements, in millimeters, are as follows:

	OU No. 3587		
	S 897	S 898	S 899
Height of cone	9.6	9.0	7.2
Width of cone			
maximum	11.3	11.0	8.9
minimum	10.0	10.1	7.0
Ratio of height to maximum width	0.849	0.818	0.809
Thickness of facet	3.0	2.7	2.3
Ratio of facet thickness to maximum cone width	0.265	0.245	0.253
Width of cavity (max.)	5.3	5.1	4.1

These specimens come from the flanks of a small bioherm of the Hogshooter formation, Skiatook group, Missouri series (OU No. 3587). The zone is a shale just above the basal limestone layer which is also the type locality for the rare blastoid, *Paracodaster dotti* Moore and Strimple (1942). The legal description is SW¼ NE¼ sec. 28, T. 24 N., R. 13 E., just north of Ramona, Washington County.

Six infrabasal cones and one complete dorsal cup (OU Nos. 3282, 3576), collected by Ries from the Checkerboard limestone formation, Skiatook group, Missouri series, 0.3 mile west of SE cor. sec. 30, T. 12 N., R. 10 E., Okfuskee County, are assigned to the species. The upper facets are narrower than normal for the species, and, in fact, are similar to those of the specimens from the Nellie Bly formation that have been assigned to *P. tarri*. The present specimens are proportionately longer than those and the upper facets are slightly thicker. Measurements, in millimeters, are as follows:

	OU No. 3576	
Height of dorsal cup	15.7	
Width of dorsal cup	16.0*	
Length of basal	6.2	
Width of basal	6.5	
Length of radial	4.0	
Width of radial	7.0	
Length of anal	3.5	
Width of anal	3.7	
Height of cone	7.2	11.3
Width of cone		
maximum	8.7	13.0
minimum	7.5	12.6
Ratio of height to maximum width of cone	0.827	0.869
Width of cavity in cone		8.3
Thickness of upper facets of cone		2.7

* Distorted.

The anal plate in the only observed dorsal cup is seven sided. It rests solidly upon the truncated upper edge of the posterior basal and is adjoined to the right and left by radial plates. Extra facets provide for reception of first primibrachials. There are two facets above for the reception of two tube plates, but the division is so mild that it is hardly noticeable in side view of the cup.

Five infrabasal cones collected by Waters from the Hoxbar formation in sec. 10, T. 5 S., R. 1 E., Murray County (OU. Nos. 3561, 3562, 3563), are referred to the species. Only one of the specimens is adequately preserved for critical comparison. Measurements, in millimeters, are as follows:

Height of cone	7.9	9.0
Width of cone		
maximum	10.5	10.5
minimum	9.8	9.9
Ratio of height to maximum width	0.752	0.857
Thickness of facet	2.8	3.2
Width of cavity (max.)	5.1	4.6

Two infrabasal cones have been found recently in the Seminole formation, NE¼ SE¼ sec. 3, T. 16 N., R. 12 E., Tulsa County, by Mr. E. L. Gilmore of Tulsa. Considerable interest has been aroused in this area by the recent report of Dr. C. C. Branson (1960) on a fauna collected by me from a zone just above the Dawson coal. The present specimens came from a zone below the Dawson coal. One specimen was firmly embedded in a thin, highly fossiliferous limestone and the other was free. The larger specimen has been donated by Mr. Gilmore to The University of Oklahoma where it is deposited in the Paleontological Collections (No. 3588). Measurements, in millimeters, of the larger specimen are:

	OU No. 3588
Height of cone	13.9
Width of cone	
maximum	14.3
minimum	13.7
Ratio of height to maximum width	0.972
Thickness of facet	3.7
Width of cavity (max.)	6.5

PARAGASSIZOCRINUS ASYMMETRICUS, n. sp.

Plate I, figures 1-5.

The species is based on thirteen infrabasal cones, one basal plate, and one radial plate. Although the form is long and thick, the

fusion of infrabasal plates is not so thorough as one would expect. In several slightly weathered specimens one or more sutures are visible and at least four specimens have been found that are broken along sutural planes. The broken specimens also disclose the existence of an atrophied column that extends almost to the exterior. Moore and Plummer (1937, p. 253) mention the existence of somewhat similar features in *P. caliculus,* particularly in young representatives.

P. asymmetricus is considered to be closely related to *P. magnus* Moore and Plummer, from which it differs in the height-to-width ratio of the cone and in having more prominent extensions in interbasal position.

Some isolated basal plates are obviously of posterior position in that the upper extremity is truncated for the reception of one anal plate. The lower articulation facet shows them to belong to the present species. It is therefore safe to assume that the species is properly assigned to *Paragassizocrinus.*

The upper facets of the cone are unequal in width, and one interbasal extension is more pronounced than the other four. There are five radiating ridges that converge toward the center where there is a relatively deep cavity. A narrow ligament area is left between the ridges. The processes on the upper facets of the cone are met by complimentary ridges and depressions on the lower facets of the basal plates. Fundamentally there are well-defined depressions just inside each lower corner of the basal. When articulated, this specialized condition is not visible from the exterior.

On the interiors of the basal plates there are five heavy, wide ridges (six in the posterior) that radiate from the midportion of the plate. They differ from similar rays in *P. atoka* in that they enter the articulating facets. The depressed areas of the articulating facets are sharply impressed and must have housed rather large ligaments. Some weathered specimens show what appear to be traces of canals within the raised ridges.

Only one radial plate that appears to belong to this species is at hand. Internally it shows five broad rays that radiate from the center of the upper portion of the plate. The rays continue onto the facets (rather than onto the arm-articulating facet) where they have a knob-like appearance. The projected areas of the facets are crenulated. The intervening space between projections is sharply exca-

vated, as was observed in the basal plates. The arm-articulating facet is shorter than the greatest thickness of the plate and is somewhat weathered in this particular specimen. There is a strong transverse ridge. The outer ligamental area is well defined and deeply excavated. It does not occupy the full width of the plate. The inner area slopes slightly inward. There are two narrow well-defined lateral furrows just behind the transverse ridge, one on each side of the facet. Muscle areas are shallowly depressed and there is no well-defined intermuscular notch.

Measurements of type specimens, in millimeters, are as follows:

			OU No. 3571		
	S 373	*S 356*	*S 364*	*909*	*910*
Height of cone	11.0	8.2	12.1		
Width of cone					
maximum	10.0	8.1	12.1		
minimum	9.2	7.7	11.1		
Ratio of height to maximum width	1.100	1.012	1.000		
Thickness of facet	3.0	2.0	3.5		
Width of cavity (max.)	3.6	3.2	4.7		
Length of basal				10.8	
Width of basal				8.5	
Length of radial					12.3
Width of radial					12.7

The internal radiating rays of the radial plates are somewhat similar to, though not so sharply defined as, those of the radial plate described as *Bunarthrum septatum* Moore (Moore, 1938, pl. 3, fig. 1).

It seems probable that the asymmetrical form described as *Henanobasis coffeyvillensis* Moore (Moore, 1938, p. 206) from the Checkerboard limestone of Kansas is related to the present species, though more closely to the form described below as *Paragassizocrinus elongatus* from the Hogshooter formation of Oklahoma.

The form assigned to *Agassizocrinus conicus* Owen and Shumard by Morgan (1924) is most certain to be conspecific with *Paragassizocrinus asymmetricus.* Although I have been unable to examine Morgan's specimen, it is from the same exposure as the type locality of the present species, and most decidedly is not conspecific with *Agassizocrinus conicus.*

The general contour of the infrabasal cone of *Paragassizocrinus asymmetricus* is shown under Group A-I of text-figure 1.

Occurrence and horizon: Wapanucka formation, Morrow series, Pennsylvanian; 900 feet north of SE cor. sec. 8, T. 1 N.,

R. 7 E., near Canyon Creek, Stonewall quadrangle, southeastern Oklahoma. According to Morgan (1924), this is near the base of the formation. The crinoids come from a zone about three feet thick composed of shale and thin lentils of limestone that rest on a dense limestone about one foot thick.

Types: Holotype (infrabasal cone) and three paratypes (one infrabasal cone, one basal plate, and one radial plate) are deposited in the Paleontological Collections of The University of Oklahoma (OU Nos. 3571, 3572). Two paratypes (infrabasal cones) are deposited in the Springer Collection, U. S. National Museum, Washington, D. C.

PARAGASSIZOCRINUS ELONGATUS, n. sp.
Plate II, figures 1, 2.

Among the numerous cones found in the Hogshooter formation near Ramona, Oklahoma, a few unusually elongate, slightly tapered forms stand out from the others. Examination of the upper facets discloses the protruded interbasal areas that are typical of *Paragassizocrinus asymmetricus.* The contour of the cone is also comparable; that is, it falls under Group A-I of text-figure 1. One specimen is very well preserved and the measurements indicate that the Hogshooter forms are proportionately longer, and that the ligamental facets are more pronounced. There is a well-defined ridge bordering the inner edge of the depressed ligament facet that is notched in midsection.

Cones of the same type have been found in the uppermost part of the Nellie Bly formation west of Vera, Oklahoma, in association with *P. tarri;* however, they are not proportionately quite as long as the Hogshooter specimens.

Measurements of the type specimens from Ramona, in millimeters, are as follows:

	OU No. 3567	*OU No. 3589*
Height of cone	12.2	10.8
Width of cone		
maximum	9.9	9.5
minimum	9.9	8.5
Ratio of height to maximum width	1.232	1.136
Thickness of facet	2.4	3.1
Width of cavity (max.)	4.6	3.9

Occurrence and horizon: Hogshooter formation, Skiatook group, Missouri series, Pennsylvanian; SW¼ NE¼ sec. 28, T. 24

N., R. 13 E., just north of Ramona, Washington County, Oklahoma.

Types: Holotypes (OU No. 3567) and one paratype (OU No. 3589) are deposited in the Paleontological Collections of The University of Oklahoma, Norman, Oklahoma.

PARAGASSIZOCRINUS TURRIS, n. sp.
Plate I, figures 6-8.

This species is unquestionably closely related to *Paragassizocrinus asymmetricus* and superficially resembles the species. Careful examination discloses several significant differences between the two forms. The base of *P. turris* is broad and nearly flat (Group A-II, text-fig. 1), and the greatest width of the cone is just below its midheight. This is quite different from the slowly tapering cone of *P. asymmetricus* (Group A-I, text-fig. 1). Most specimens of the present species have a small depression marking the position of the atrophied column in the middle of the lower extremity of the cone. In the upper facetal portion of the cone, there are broad projections in interbasal position, as in *P. asymmetricus,* but in addition there is a smaller pronounced projection midway between at the interinfrabasal position. This gives the upper edge of the cone a highly scalloped appearance, strikingly similar to the crennelles of a medieval castle. *P. turris* is unquestionably ancestral to *P. hoodi* from the slightly younger Savanna formation, which form has five prominent projections on the upper surface of the cone.

Basal and radial plates have not been positively identified for this species. The depressions and projections on the basal plates are not so well defined or easily interpreted in relation to those of the cone facets.

The sutures between infrabasal plates have been observed in several specimens and do not reflect any specialized divergencies or inequalities such as those found by Moore and Plummer (1937, text-figs. 11a-d) for *P. magnus.*

Measurements of type specimens, in millimeters, are as follows:

	OU No. 3564	*OU No. 3565*
Height of cone	9.0	6.7
Width of cone		
maximum	8.0	7.8
minimum	7.6	7.6
Ratio of height to maximum width	1.125	0.858

Occurrence and horizon: Wapanucka formation, Morrow series, Pennsylvanian; 900 feet north of SE cor. sec. 8, T. 1 N., R. 7 E., Stonewall quadrangle, southeastern Oklahoma.

Types: Holotype (OU No. 3564) and two paratypes (OU Nos. 3565, 3566) are deposited in the Paleontological Collections, The University of Oklahoma, Norman, Oklahoma. Two paratypes are deposited in the Springer Collection, U. S. National Museum, Washington, D. C.

PARAGASSIZOCRINUS DELTOIDEUS, n. sp.
Plate I, figures 11-17.

Of this small species we have one complete dorsal cup and numerous infrabasal cones. The pointed base and low infrabasal cone are distinctive and come under Group C-I of text-figure 1.

Considering the isolated infrabasal cones, the upper facets are marked by five radiating, sharp-crested ridges that slope outwardly at a strong angle. A small pit is present in the midsection of the interior. It is so restricted in size that it could hardly be considered as a part of the body cavity. In young specimens, there is a sharp angle at the position of the infrabasal sutures, which sutures may or may not be present, and the angulation is normally present even in fully mature forms. This condition gives the lower edge of each basal an angular appearance, a feature which is not typical of the genus. The basal plates are wider than long, another departure from characteristics found in the genotype species, *P. tarri*. The radial plates are twice as wide as long, which ratio is normal for the genus. The single anal plate rests squarely upon the straight upper surface of the posterior basal. It is five sided, extending slightly above the upper limits of the cup. There are facets for the reception of two tube plates.

The arm-articulating facets of the radials are no longer than the normal thickness of the plates. There is a strong transverse ridge with a well-developed outer ligamental furrow directed slightly outward. There are long, narrow ligament furrows back of the transverse ridge and short muscle areas. The intermuscular notch is broad. The inner part of the facet slopes gently inward.

Measurements of the holotype, in millimeters, are as follows:

	OU No. 3569
Height of dorsal cup	10.1
Width of dorsal cup	
maximum	8.4
minimum	8.2
Length of basal	4.2
Width of basal	5.1
Length of radial	2.7
Width of radial	5.3
Length of anal	2.8
Width of anal	3.0
Height of cone	5.1
Width of cone	
maximum	8.4
minimum*	8.2
Ratio of height to maximum width of cone	0.607

* Posterior to anterior.

Measurements of infrabasal cones, in millimeters, are as follows:

	OU No. 3573	*OU No. 3590*				
		360	*349a*	*345*	*346*	*348*
Height of cone	6.3	7.0	6.6	4.3	5.4	5.5
Width of cone						
maximum	9.8	11.6	10.3	7.2	8.8	10.0
minimum	9.3	10.7	10.0	6.2	8.2	9.2
Ratio of height to maximum width	0.642	0.603	0.640	0.597	0.613	0.550

P. deltoideus is somewhat comparable in size and height-to-width ratio of cone to *P. caliculus* Moore and Plummer. I have not studied the type material of that species and do not have any specimens of the species from northeastern Oklahoma and Arkansas for comparison. However, Moore and Plummer were very explicit in ascribing a flatly rounded base to the species which is supported by their illustrations. This places the species under Group C-II of text-figure 1 whereas *P. deltoideus* has a pointed base (Group C-I of text-fig. 1). Illustrations of *P. caliculus* show a different type of ridge on the upper face of the cone. That is, the ridges are gently rounded. In the present species the ridges are sharp-crested.

Comparison with *P. tarri* discloses that the dorsal cup of *P. deltoideus* is not so long as it is in the genotype species. Considering the ratio of height to width of the numerous infrabasal cones, that of *P. deltoideus* is lower. The low, wide structure of the radial plates and the lack of a true central cavity in the infrabasal cone of *P. deltoideus* are two characteristics that readily differentiate the species from other known forms.

Occurrence and horizon: Wapanucka formation, Morrow series, Lower Pennsylvanian; 900 feet north of SE cor. sec. 8, T. 1 N., R. 7 E., Stonewall quadrangle, south of Canyon Creek, Oklahoma.

All but one specimen came from the same exposure as *Paragassizocrinus asymmetricus*. This is also the type locality for *Allocatillocrinus morrowensis* (Strimple) and *Lasanocrinus daileyi* (Strimple). The crinoid fauna is more varied than that found in the Canyon Creek exposure to the north, where *Paragassizocrinus* is a rarity.

One specimen assignable to the species has been collected by Cooksey and Hollingsworth in association with the new species, *P. disculus,* in NE¼ sec. 33, T. 3 N., R. 7 E., Pontotoc County, Wapanucka formation, Morrow series, Pennsylvanian.

Types: Holotype, measured paratypes from section 8, and a specimen from section 33 are deposited in the Paleontological Collections of The University of Oklahoma, Norman, Oklahoma. Three paratypes are deposited in the Springer Collection, U. S. National Museum, Washington, D. C.

PARAGASSIZOCRINUS HOODI, n. sp.

Plate I, figures 9, 10.

This small species appears to be closer to *P. turris* than to other known forms. The contour of the cone places it under Group B-II of text-figure 1. Only one infrabasal cone is available for study but crinoids from this horizon are so rare that it is deemed advisable to describe the form for comparative purposes. The base is broad and only slightly convex. There is a proximal columnal in place, extending below the cone. It is not placed solidly but is at an angle. It is larger than one would expect, is circular in outline and is scalloped about the perimeter. The lumen is indistinct but it is small and appears to be pentalobate. Many specimens of the genus having a depression at the point for normal columnar attachment have been found, but the only other specimen having a columnal visible is that described by Moore as *Henanobasis coffeyvillensis.*

There is no swelling of the cone at midheight. There are strong, flattened protrusions at interbasal positions but no additional protrusion between these points. The ligament pits are well defined.

The presence of a columnal is not considered to be a specific characteristic. Additional specimens of the species very likely will not have such a feature. The form is distinct enough, on the basis of other factors, to be separated from other known species.

Measurements of the holotype, in millimeters, are as follows:

	OU No. 3570
Height of cone	5.8
Width of cone	
maximum	6.1
minimum	6.0
Ratio of height to maximum width	0.950

Occurrence and horizon: The specimen was found by Mr. Jack Hood on a field trip with the author in the fall of 1959. The zone is a red, concretionary, weak limestone in the Sam Creek member, Savanna formation, Middle Pennsylvanian; about two miles south of Wagoner, Oklahoma, on U. S. Highway 69.

Holotype: Deposited in the Paleontological Collections, The University of Oklahoma, Norman, Oklahoma (OU No. 3570).

PARAGASSIZOCRINUS DISCULUS, n. sp.
Plate 3, figures 1-3.

This species is based on three infrabasal cones from the Wapanucka formation and one from the Atoka formation. The general contour of the cone is under Group C-I of text-figure 1. In this regard it is close to *P. deltoideus;* however, it is proportionately wider and has a definite, wide body cavity. The articulating facets occupy almost the entire upper surface of the cone in *P. deltoideus.* The nearest affinity is with *P. atoka,* which species has a higher cone and a well-rounded, deep base.

The articulating facets are divided by sharp-crested ridges and are directed outwardly. They are broad, shallowly impressed and bordered on the interior by a fine ridge. The five facetal ridges divide as they approach the cavity and are met by raised rays that continue to the sharply depressed area at the bottom of the cavity. This same general type of structure is found in *P. atoka* and is discussed in detail under its specific description.

Measurements of the holotype, in millimeters, are as follows:

	OU No. 3578
Height of cone	7.8
Width of cone	
maximum	16.6
minimum	16.6
Ratio of height to maximum width	0.469
Thickness of facet	3.9
Width of cavity (max.)	9.1

Occurrence and horizon: The holotype and two paratypes are from the Wapanucka formation, Morrow series, Pennsylvanian: NE¼ sec. 33, T. 3 N., R. 7 E., Pontotoc County, Oklahoma. One hypotype is from the Atoka formation, NW¼ sec. 10, T. 17 N., R. 19 E., Cherokee County, Oklahoma.

Types: The holotype (OU No. 3578) and two paratypes (OU No. 3577) collected by Cooksey and Hollingsworth and the hypotype (OU No. 3568) collected by Blythe are deposited in the Paleontological Collections, The University of Oklahoma, Norman Oklahoma.

PARAGASSIZOCRINUS SPRINGERI, n. sp.

Plate II, figures 6, 7.

This species is based on a single infrabasal cone from the Ardmore basin. It is the longest form known to date, has a pointed base, greatest width at two-thirds of the height, a scalloped upper surface and a slight twist. It falls under Group A-I in contour and the appearance of crenelles in the facetal region associates it with the forms typified by *P. turris.* In addition to strong projections in interbasal positions, there are smaller swollen areas dividing each facet into two equal sections. These secondary projections are not so pronounced as those found in *P. turris* but they are more prominent than those found in *P. assymmetricus.* Near the inner edge of each facet, in midsection, there is a separate small node.

Measurements of the holotype, in millimeters, are as follows:

	OU No. 3423
Height of cone	21.0
Width of cone	
maximum	16.4
minimum	16.0
Ratio of height to maximum width	1.280
Thickness of facet	4.5

Occurrence and horizon: Pumpkin Creek limestone member, Big Branch formation, Des Moines series, Pennsylvanian; 5½ miles north of Ardmore on east side of Highway 77, near Springer, Oklahoma.

Holotype: Collected by Mr. Allen Graffham, Ardmore, Oklahoma, and deposited in the Paleontological Collections, The University of Oklahoma, Norman, Oklahoma (OU No. 3423).

PART II
PARAGASSIZOCRINUS IN THE ATOKA OF NORTHEASTERN OKLAHOMA

H. L. STRIMPLE AND J. G. BLYTHE

INTRODUCTION

Several years ago the junior author found several specimens of *Paragassizocrinus* in a marine zone of the Atoka formation while doing field work toward his master's degree at The University of Oklahoma. The senior author has subsequently collected several specimens from the same locality so that we now have the following material:

One dorsal cup with small portions of the arms attached, one partial cup consisting of the infrabasal cone and all of the basal plates, thirteen infrabasal cones and six isolated basal plates.

The species proves to be distinct from other described forms and is presented below as *Paragassizocrinus atoka,* n. sp.

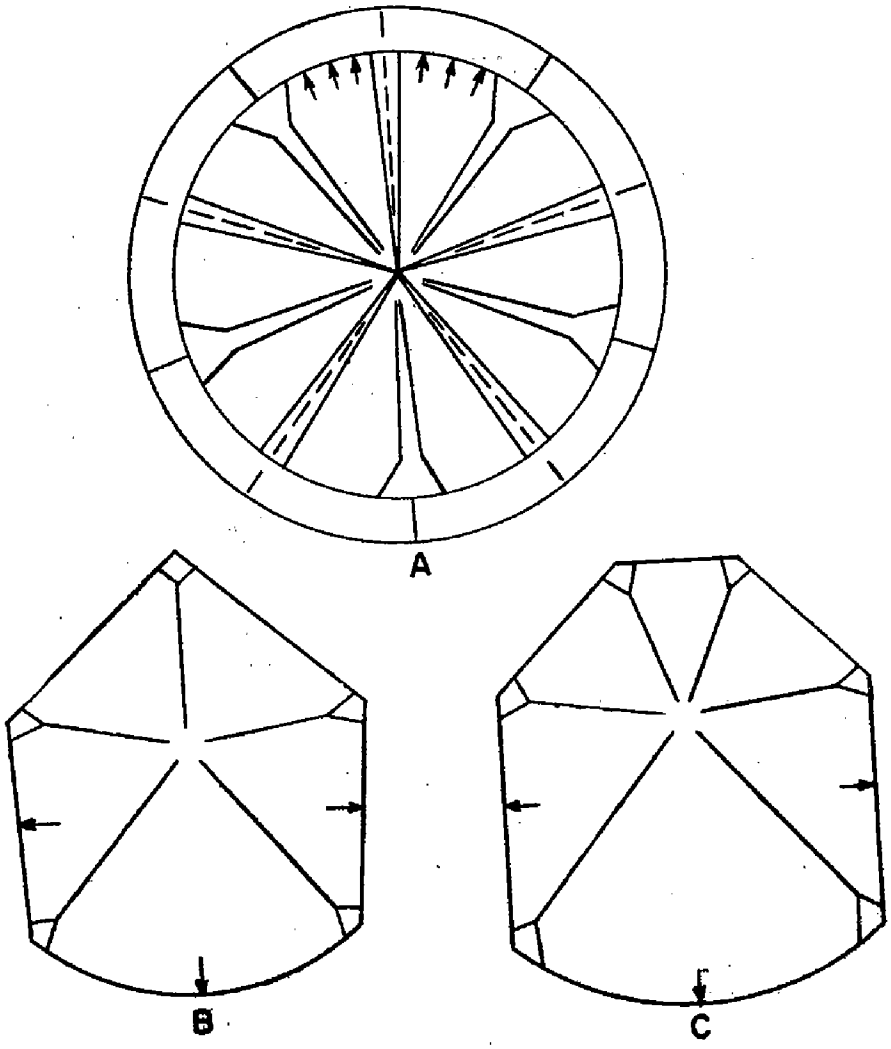
SYSTEMATIC DESCRIPTION

PARAGASSIZOCRINUS ATOKA, n. sp.
Plate III, figures 4-9; text-figure 2.

Dorsal cup is elongate, conical, approximately 1.35 times as long as wide. Infrabasal plates are completely fused to form a low, wide, evenly rounded cone. One weathered cone shows the five infrabasal sutures. The cones are distinct enough to provide specific determination without knowledge of the other cup elements.

The basal plates (with the exception of the posterior basal) are pentagonal. They are higher than wide (about 1.238 times). The lower extremity is curved rather than angular as in most inadunate crinoids. The posterior basal is truncated for the reception of one large anal plate. The facets of the basal plates slope inward and are strongly excavated for most of their lengths. No doubt ligaments occupied the grooves. Faint crenulations, which we believe acted as

locking, or non-skid devices, usually mark the areas that are not depressed. On the inner side there are five ridges (six in the posterior) that extend from the corners of the plate to the slightly elevated midsection (text-fig. 2).



TEXT-FIGURE 2. Diagrammatic views of interior of infrabasal cone (A) and basal plates (B, C) of *Paragassizocrinus atoka*. Dashed lines show position that would be occupied by infrabasal sutures, if present. Heavy lines show ridges, and arrows show positions of grooves.

Radial plates are almost twice as wide as high. The anterior radial is as wide as any other plate of the circlet and those of the right and left posterior are not quite as wide as the other three. Isolated plates have not been observed so that the structure of the inner side and the nature of the facets, other than arm articulation, are not known. They probably agree with the other calyx elements in fundamental structure. The arm-articulating facets are divided

into two parts by a low, wide transverse ridge. The outer ligament pit is rather short but is deep and well defined. The inner ligament area slopes slightly inward, carries two shallow muscle scars, and is short. Faint crenulae mark the transverse ridge and outer edges of the inner area.

The single anal plate is slightly elongate and at first glance appears to be six-sided; however, there are seven facets. The plate rests upon the truncated upper surface of the posterior basal, well below the summit of the cup. It is adjoined to the right and left by the lateral sides of radial plates and the first primibrachs of the arms. There are sculptured facets for the reception of two tube plates above.

The first primibrachs are low, wide and quadrangular. The second primibrachs are low, axillary and pentagonal.

Some variability is exhibited by the isolated infrabasal cones; that is, some are more or less elliptical in outline, the internal cavity is more pronounced in some than in others, and one or two are more pointed than normal. This is to be expected in a normal species concept. The majority of the specimens, including the dorsal cups, have a low, evenly rounded cone with a circular outline. The inner cavity is broad, rather deep, and a small sharply depressed area is found in the midsection. In one specimen a well-defined pentalobate lumen is present at the bottom of the central pit. In well-weathered specimens the concentric growth lines are well shown, demonstrating the secondary growth that fused the infrabasals. In one weathered specimen the infrabasal sutures are visible, showing five fundamentally equal plates.

Of most interest are the ridges and grooves found internally in the cones. A pair of confluent ridges originates about the perimeter of the basal pit and extends the length of the infrabasal to the upper facet. The ridges divide just before reaching the facet, forming a triangular depressed area. A ridge is also present on the facet in interbasal position, but it is rather sharp crested and does not appear to have any functional connection with the internal ridges. On the other hand, under similar conditions in *P. disculus,* it was found that the interbasal ridges divided at their inner edges. The two species are obviously closely related. In *P. atoka* a finer pair of faint ridges originates in the pit itself and marks the positions of the infrabasal sutures. The ridges do not pass onto the upper facets but are met by faint ridges or grooves on the basal plates. These ridges are shown

in text-figure 2. Some other faint grooves have been observed but they are not clear enough for careful study.

The above features are remarkably similar to the nervous system for *Calceolispongia* (Teichert, 1949, p. 15) and for *Marsupites* (Sieverts, 1927, p. 17). It is unfortunate that the present material is not better preserved so that a more detailed study of the grooves and ridges could be made.

There is no evidence of the existence of a column other than the substellate lumen observed in the internal central pit of one infrabasal cone.

Measurements, in millimeters, are as follows:

	Holotype OU No. 3127	*Figured paratype* OU No. 3128	*Figured paratype* OU No. 1269
Height of dorsal cup	22.7		
Width of dorsal cup	21.5	23.7	
Length of basal (anterior)	12.8		
Width of basal (anterior)	12.0		
Length of radial	7.5		
Width of radial	13.1		
Length of anal	7.1		
Width of anal	5.2		
Length of first primibrach	4.6		
Width of first primibrach	11.8		
Length of second primibrach	4.7		
at lateral sides	3.9		
Width of second primibrach	10.2		
Height of cone	9.3	14.1	10.6
Width of cone	16.6	19.8	22.5
Width of cavity in cone			15.5
Depth of cavity in cone			3.5
Thickness of upper facets of cone			4.1

DISCUSSION

The largest infrabasal cone of the present species has a width of 22.5 mm, which is nearly the size of the Morrowan *Paragassizocrinus magnus,* the holotype of which is an elliptical infrabasal cone with a maximum width of 23 mm. Comparison of the height of 20 mm for *P. magnus* against a height of 10.6 mm for *P. atoka* most readily dispells any serious consideration of conspecific affinity.

Paragassizocrinus caliculus is yet another Morrowan species with a cone somewhat similar in outline to *P. atoka* but it is a much smaller form and the inner structure of the infrabasal cone is quite different from that of the present species.

Detailed comparison with all other known species of the genus would take too much space and actually there are only two

forms known to us that are closely comparable. One is a single specimen from the Wapanucka formation, collected by the senior author from the type locality of *P. turris, P. asymmetricus* and *P. deltoideus.* The upper facets of this cone, and the cavity, are not well preserved, but we are reasonably certain the structure is similar to that of *P. atoka.* The contour of the cone is almost identical. The specimen is designated as a hypotype of the species.

The other comparable form is *P. disculus,* based on the nature of the upper facets of the cone and the common existence of five pairs of radiating ridges in the cavity of the cone. *P. disculus* has a proportionately wider cone with a pointed base. It is a Morrowan species.

Occurrence and horizon: Black shale about fifteen feet above the base of the Atoka formation, Middle Pennsylvanian; NW¼ sec. 10, T. 17 N., R. 19 E., road cut on Oklahoma State Highway 51 east of Wagoner in Cherokee County, Oklahoma. Hypotype from the Wapanucka formation, Morrow series, Lower Pennsylvanian: 900 feet north of SE cor. sec. 8, T. 1 N., R. 7 E., Stonewall quadrangle, southeastern Oklahoma.

Types: The complete dorsal cup, collected by C. C. Branson, is the holotype (OU No. 3127) which, together with ten paratypes (OU Nos. 1269, 3128, 3129, 3579) and the one hypotype (OU No. 3560), are deposited in the Paleontological Collections of The University of Oklahoma, Norman. One paratype is deposited in the Springer Collection, U. S. National Museum, Washington, D. C. The figured paratypes are OU Nos. 1269, 3128, and 3579.

REFERENCES

Blythe, J. G., 1959, Atoka formation on the north side of the McAlester basin: Okla. Geol. Survey, Cir. 47, 74 p.

Branson, C. C., 1960, Local fossil assemblage in the Seminole formation: Okla. Geol. Survey, Okla. Geology Notes, vol. 20, no. 1, p. 16-17.

Morgan, G. D., 1924, Geology of the Stonewall quadrangle Oklahoma: Bureau of Geology, Norman, Okla., Bull. 2, 248 p., 53 pls.

Moore, R. C., 1938, The use of fragmentary crinoidal remains in stratigraphic paleontology: Denison Univ., Jour. Sci. Lab., vol. 33, p. 165-250, 4 pls.

————, 1940, Crinoids from the Upper Carboniferous and Permian strata in Texas: Texas, Univ., Publ. 3945, p. 9-468, 21 pls.

Moore, R. C., and Laudon, L. R., 1943, Evolution and classification of Paleozoic crinoids: Geol. Soc. America, Special Paper 46, 167 p., 14 pls.

Moore, R. C., and Plummer, F. B., 1937, Upper Carboniferous crinoids from the Morrow subseries of Arkansas, Oklahoma and Texas: Denison Univ., Jour. Sci. Lab., vol. 32, p. 209-313, pls. 12-16.

Moore, R. C., and Strimple, H. L., 1942, Blastoids from Middle Pennsylvanian rocks of Oklahoma: Denison Univ., Jour. Sci. Lab., vol. 37, p. 85-91, fig. 1.

Oakes, M. C., 1940, Geology and mineral resources of Washington County, Oklahoma: Okla. Geol. Survey, Bull. 62, 208 p.

————, 1952, Geology and mineral resources of Tulsa County, Oklahoma: Okla. Geol Survey, Bull. 69, 234 p.

Sieverts, Hertha, 1927, Ueber die Chinoidengattung *Marsupites*, Preuss. geol. Landesanstalt, Abh., new series, vol. 108, 73 p., 5 pls.

Strimple, H. L., 1938, A group of crinoids from the Pennsylvanian of northeastern Oklahoma: private publ., 12 p., 2 pl.

————, 1939, A group of Pennsylvanian crinoids from the vicinity of Bartlesville, Oklahoma: Bull. Amer. Paleontology, vol. 24, no. 87, p. 18, pl. 2, figs. 9, 10.

————, 1940, Some new crinoid species from the Morrow subseries: Bull. Amer. Paleontology, vol. 25, no. 91, 10 p., 1 pl.

————, 1959, Crinoids from the Missourian near Bartlesville, Oklahoma: Okla. Geol. Survey, Okla. Geol. Notes, vol. 19, p. 115-127, 2 pls.

Teichert, Curt, 1949, Permian crinoid *Calceolispongia*: Geol. Soc. America, Mem. 34, 132 p., 25 pls.

ILLUSTRATIONS OF FOSSILS

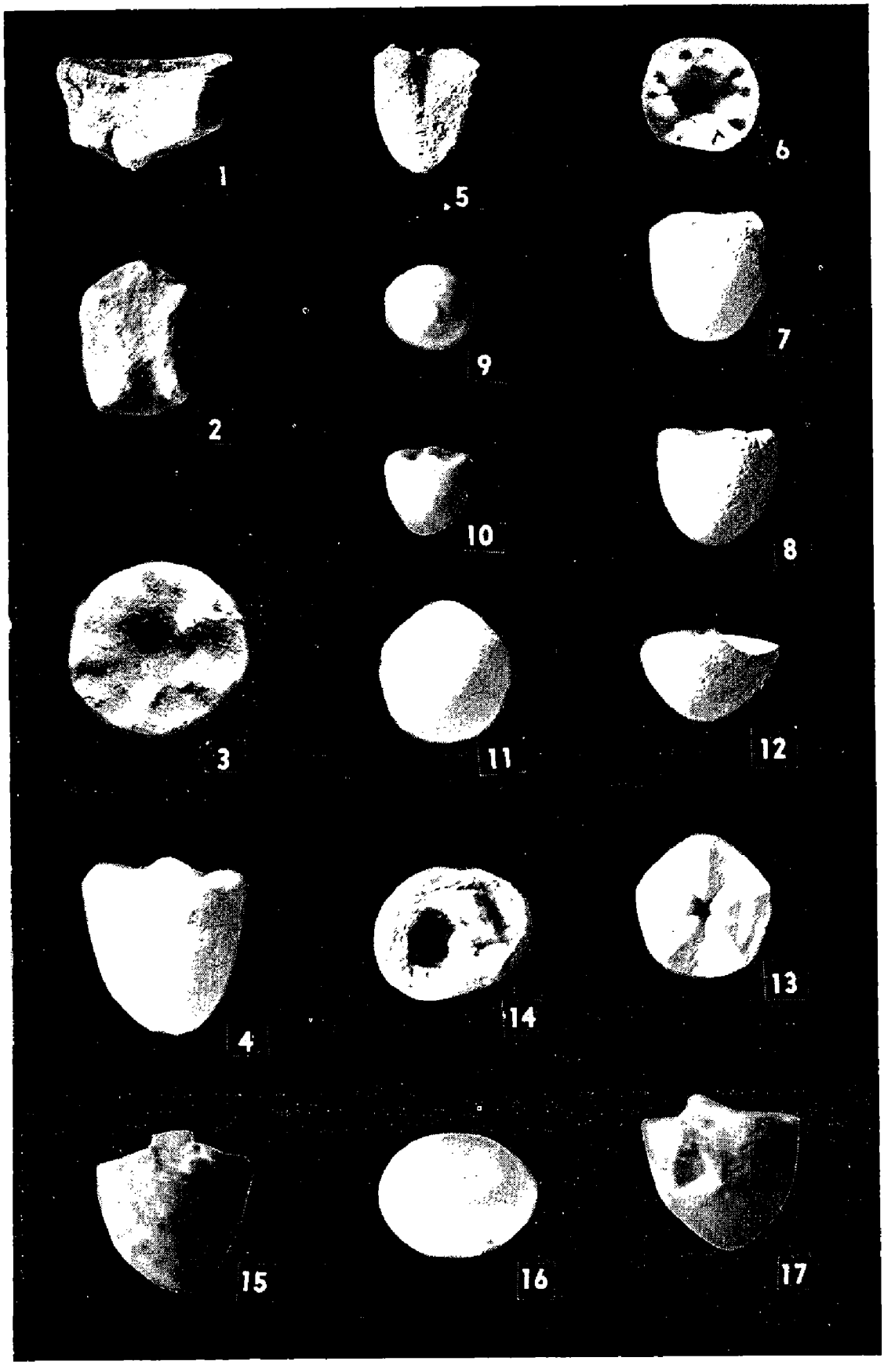
Paragassizocrinus asymmetricus n. sp.	Plate I, figures 1-5
Paragassizocrinus atoka Strimple and Blythe n. sp.	Plate III, figures 4-9
Paragassizocrinus deltoideus n. sp.	Plate I, figures 11-17
Paragassizocrinus disculus n. sp.	Plate III, figures 1-3
Paragassizocrinus elongatus n. sp.	Plate II, figures 1, 2
Paragassizocrinus hoodi n. sp.	Plate I, figures 9, 10
Paragassizocrinus mcguirei (Strimple)	Plate II, figures 3, 8-11
Paragassizocrinus springeri n. sp.	Plate II, figures 6, 7
Paragassizocrinus tarri (Strimple)	Plate II, figures 4, 5, 12, 13
Paragassizocrinus turris n. sp.	Plate I, figures 6-8

Explanation of Plate I

(All figures x2)

		Page
Paragassizocrinus asymmetricus n. sp.		15
Figure 1.	Paratype, internal view of disarticulated radial plate. OU No. 3571.	
Figure 2.	Paratype, internal view of disarticulated basal plate. OU No. 3571.	
Figures 3, 4.	Holotype, infrabasal cone viewed from above and from side. OU No. 3571.	
Figure 5.	Paratype, natural sectioned infrabasal cone showing rudimentary remains of columnal within cone. OU No. 3572.	
Paragassizocrinus turris n. sp.		19
Figures 6, 7.	Holotype, infrabasal cone viewed from above and from side. OU No. 3564.	
Figure 8.	Paratype, side view of infrabasal cone showing faint sutures between plates. OU No. 3566.	
Paragassizocrinus hoodi n. sp.		22
Figures 9, 10.	Holotype, infrabasal cone viewed from below and from side. OU No. 3570.	
Paragassizocrinus deltoideus n. sp.		20
Figures 11-13.	Paratype, infrabasal cone viewed from below, side, and above. OU No. 3573.	
Figures 14-17.	Holotype, dorsal cup viewed from above, posterior, below, and anterior. OU No. 3569.	

PLATE I

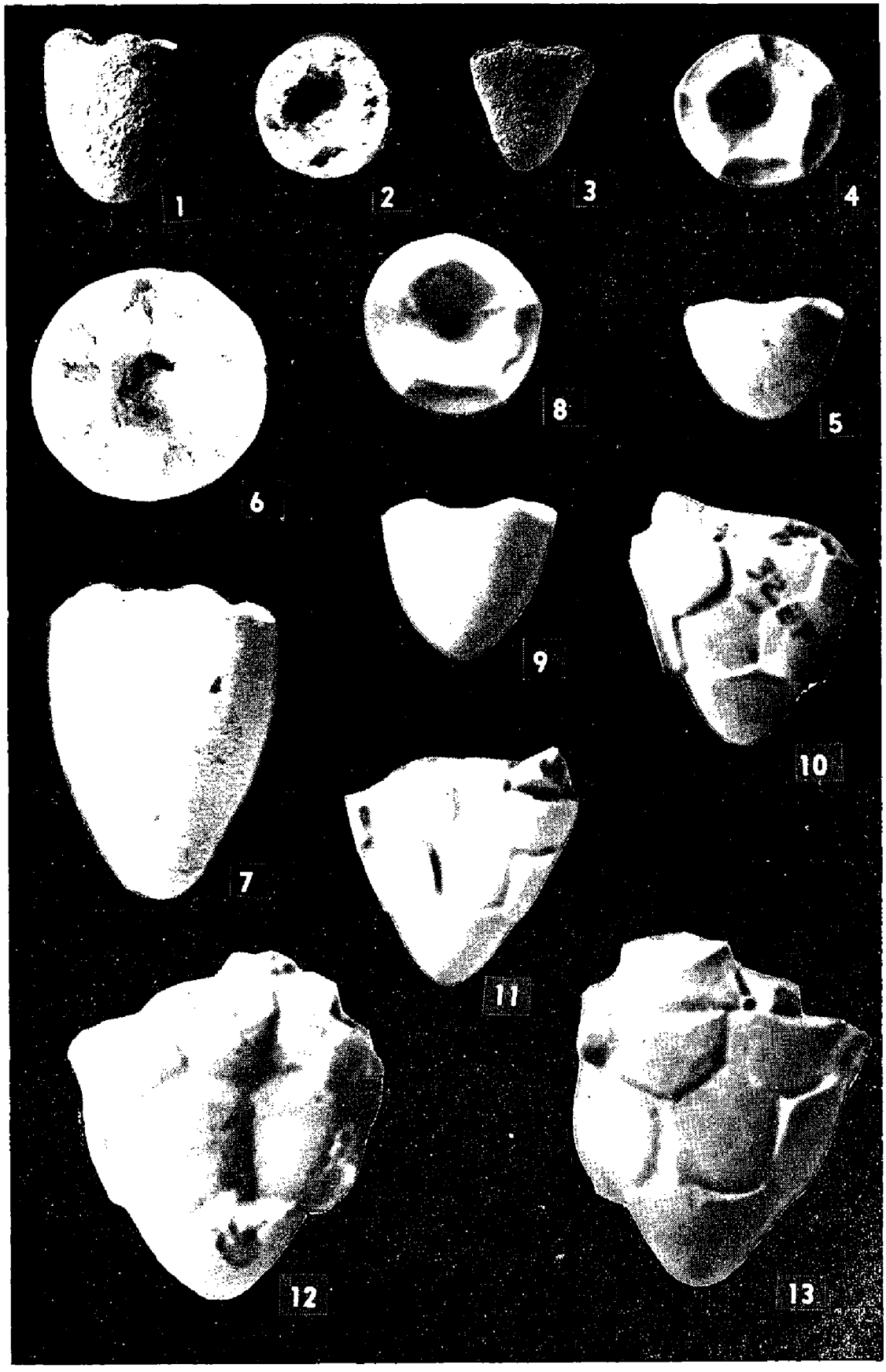


Explanation of Plate II

(All figures x2)

		Page
Paragassizocrinus elongatus n. sp.		18
Figures 1, 2.	Holotype, side and summit view of infrabasal cone. OU No. 3567.	
Paragassizocrinus mcguirei (Strimple)		13
Figure 3.	Holotype, side view of infrabasal cone. (New illustration courtesy of the U.S. National Museum).	
Paragassizocrinus tarri (Strimple)		9
Figures 4, 5.	Plesiotype, view from above and side of infrabasal cone from Nellie Bly formation. OU No. 3574.	
Paragassizocrinus springeri n. sp.		24
Figures 6, 7.	Holotype, view from above and side of infrabasal cone. OU No. 3423.	
Paragassizocrinus mcguirei (Strimple)		13
Figures 8, 9.	Plesiotype, view from above and side of infrabasal cone from the Checkerboard formation. OU No. 3576.	
Figures 10, 11.	Plesiotype, view from anterior and posterior of dorsal cup from the Checkerboard formation. OU No. 3576.	
Paragassizocrinus tarri (Strimple)		9
Figures 12, 13.	Plesiotype, view from left posterior and anterior of dorsal cup from the Nellie Bly formation. OU No. 3575.	

PLATE II



Explanation of Plate III

(All figures x2)

		Page
Paragassizocrinus disculus n. sp.		23
Figures 1-3.	Holotype, infrabasal cone viewed from summit, side, and below. OU No. 3578.	
Paragassizocrinus atoka Strimple and Blythe, n. sp.		25
Figure 4.	Paratype, internal view of isolated basal plate. OU No. 3579	
Figures 5, 6.	Paratype, infrabasal cone viewed from side and summit. OU No. 1269.	
Figures 7, 8.	Holotype. dorsal cup viewed from anterior and posterior. OU No. 3127.	
Figure 9.	Paratype, partial dorsal cup viewed from anterior. OU No. 3128.	

PLATE III