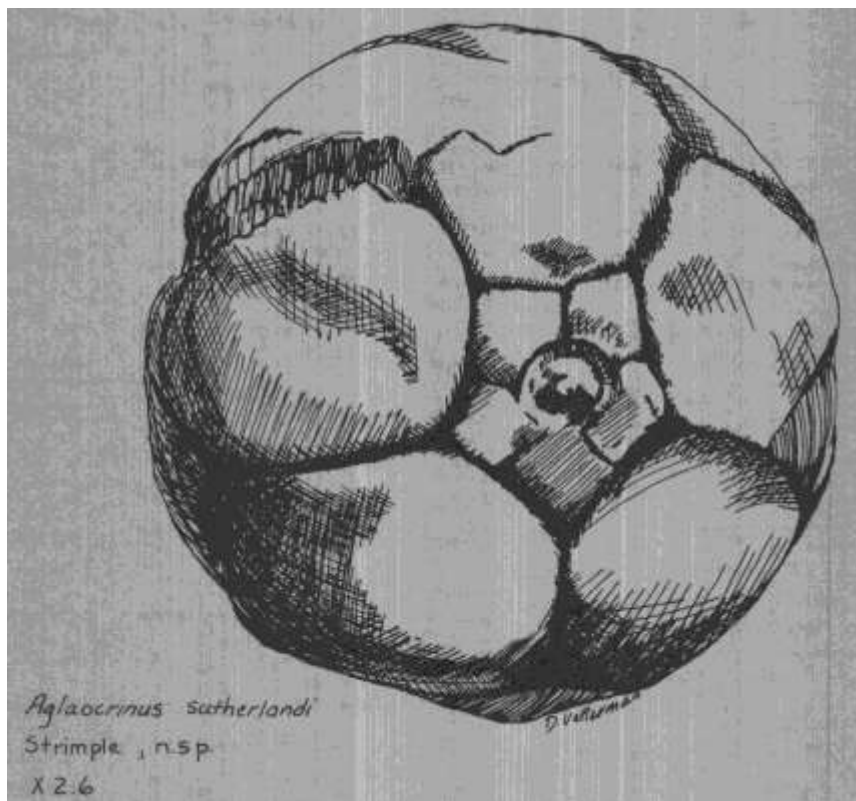


*Pennsylvanian crinoids from
Sangre de Cristo and Sacramento Mountains
of New Mexico*

by Harrell L. Strimple



New Mexico Bureau of Mines & Mineral Resources

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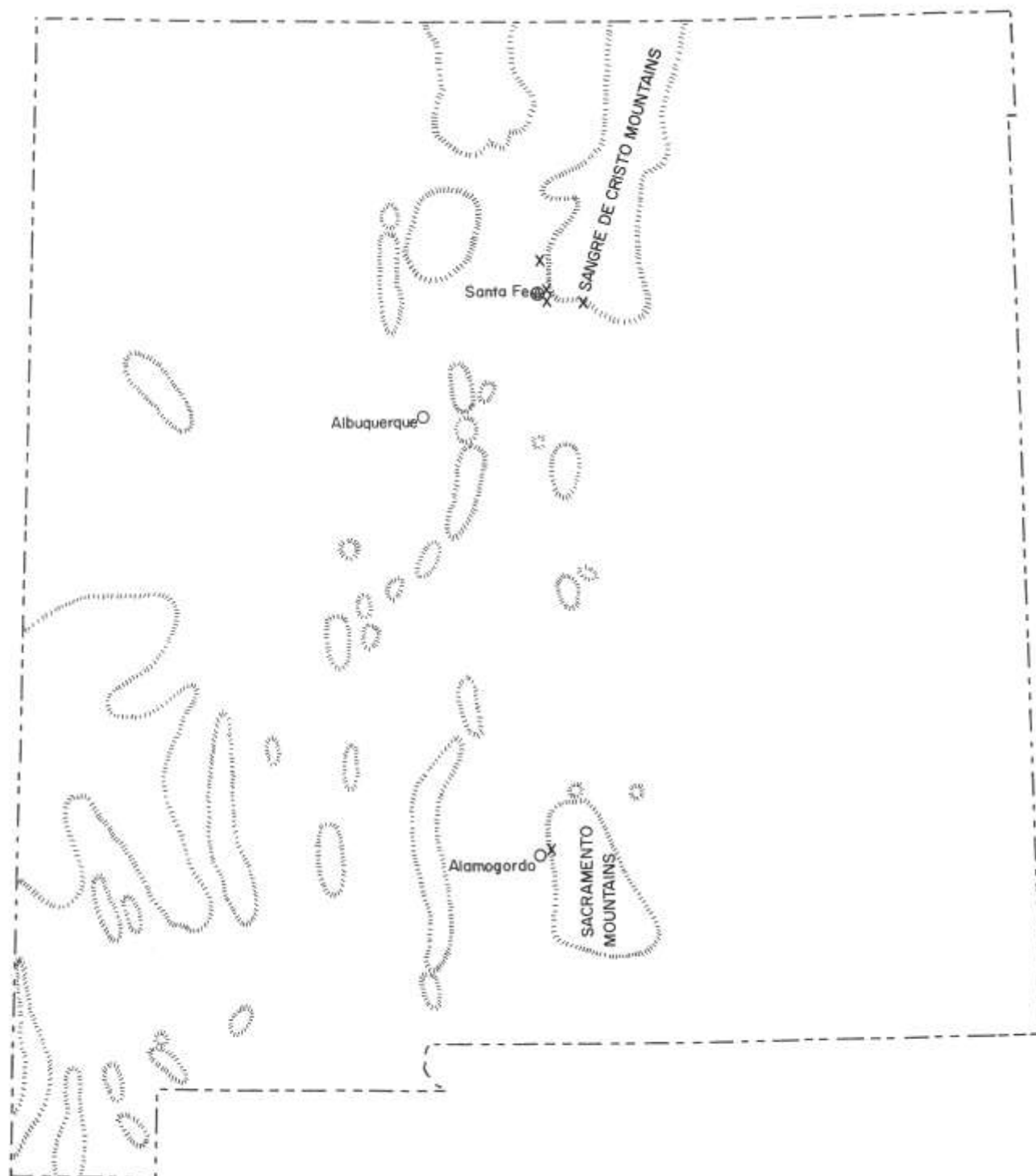


FIGURE 1—LOCATION MAP OF NEW MEXICO SHOWING SITES (X) described in locality register (table 1).

Abstract

Twelve species representing eight genera of inadunate crinoids are reported from Lower and Middle Pennsylvanian strata of New Mexico. Two new species are proposed: *Diphuicrinus santafeensis* n. sp. and *Aglaocrinus sutherlandi* n. sp. Three taxa are not identified to species and six are ascribed to previously described species from the midcontinental United States and one from the southern Appalachian Mountains. Three species are from the Gobbler Formation (Morrowan), eight from the La Pasada Formation (Atokan), and one from the Alamitos Formation (Desmoinesian).

Introduction

Crinoids preserved as cups or crowns are seldom found because of the multiplated nature of the endoskeleton which is subject to rapid disarticulation upon demise of the animal unless quickly entombed in a soft matrix. Even when such specimens are preserved, tectonic stresses may distort them beyond recognition. Although the number of specimens is rather small, cups and some crowns are being found and recorded from Pennsylvanian strata of the southwestern and western United States. The specimens have affinities with some previously known crinoid faunas from the midcontinental United States and the southern Appalachian Mountains.

Most of the material in the present study was collected by P. K. Sutherland and F. H. Harlow in the Sangre de Cristo Mountains of New Mexico (table 1 and fig. 1). A specimen was collected by C. C. Branson from near Alamogordo in the Sacramento Mountains; specimens collected from the same locality by W. M. Furnish, Becky Furnish, Christina Strimple, and the author

are also included. All specimens are Early or Middle Pennsylvanian in age.

Twelve species are recognized, although one *Paragassizocrinus*, one *Plaxocrinus*, and one *Metacromyocrinus* are not identified to species (table 2). Seven of the species have been previously described from other geographic areas. Eight genera are involved, all belonging to the subclass Inadunata. Locality references for specimens from the Sangre de Cristo Mountains are those used by Sutherland and Harlow (1973). Detailed information on localities is given in the locality register (table 1).

Although limited in numbers as well as geographic distribution, the material can be compared stratigraphically with somewhat better known faunas. *Palmeroocrinus profundus* Moore and Strimple is known from the Wapanucka Formation (Morrowan) of southern Oklahoma and the Quivirrah Formation (Morrowan) of Utah. *Paragassizocrinus caliculus* (Moore and Plummer) has been reported from Bloydian (Morrowan)

TABLE 1—LOCALITY REGISTER FOR SANGRE DE CRISTO AND SACRAMENTO MOUNTAINS.

Locality, section, and units	Description
Dalton Bluff Section 36 Units 133, 146, 147, and 149	Bluff is on west side of Pecos River, 6.6 mi by road north of the highway junction in the town of Pecos. The units herein were measured in the largest draw on the cliff face, located west of a point on the road 0.15 mi south of the bridge over the Pecos River at the Dalton Campground (Miller and others, 1963, p. 56). Unit 133 is in the Alamitos Formation, Lower Desmoinesian (Fusulinid Zone III). Units 146 and 147 are in the Alamitos Formation in the lower part of the Middle Desmoinesian (Fusulinid Zone IV) (Sutherland and Harlow, 1973, p. 105).
Nambe Falls Section 41 Unit 42	Located 4 mi southeast from Nambe Pueblo, up the Nambe River valley, NW' SW' sec. 29, T. 19 N., R. 10 E. This section exposes only the lower part of the La Pasada Formation (Morrowan) (Sutherland and Harlow, 1973, p. 111).
Santa Fe Quarries Section 61 Unit 11	Located 1 mi southeast of Santa Fe Plaza and adjacent to Gonzales Road. Only the lower part of the La Pasada Formation (Morrowan-Atokan) is exposed in the quarries (Sutherland and Harlow, 1973, p. 118).
Santa Fe Quarries Section 62 Units 17 and 18	Same location, but entirely Atokan in age (Sutherland and Harlow, 1973, p. 121).
Santa Fe Quarries—North Locality 64	Possibly correlative with Unit 30 of Section 62 above; Atokan in age (Sutherland and Harlow, 1973, p. 122).
Santa Fe Quarries—South Locality 68	Isolated locality in southernmost part of the Santa Fe Quarries, located 150 ft northeast of dirt road near 3 houses. Low ridge of limestone and shale in the lower part of the La Pasada Formation, Morrowan in age and equivalent to lower part of Section 61, 400 ft to the northeast (Sutherland and Harlow, 1973, p. 127).
Santa Fe River, Cerro Gordo Road Unit 2	A short section including only the lowest part of the La Pasada Formation (Morrowan) at an exposure in a small arroyo on the north side of the Santa Fe River valley, a short distance east of Santa Fe. Located immediately south of where Cerro Gordo Road crosses a small valley, 1.2 mi east of the junction of this road with Gonzales Road (Sutherland and Harlow, 1973, p. 128).
Horse Ridge	Located 3 mi northeast of Alamogordo, Otero County, NW 1/4 sec. 10, T. 16 S., R. 10 E. Gobbler Formation of Morrowan age (Pray, 1961, p. 74).

TABLE 2—LISTING OF SPECIES SHOWING FORMATION NAME, STAGE, AND LOCALITY.

Species	Formation	Stage	Locality
<i>Palmerocrinus profundus</i> Moore and Strimple, 1973	lower part of La Pasada	Morrowan	Santa Fe Quarries—South, Section 68
<i>Paragassizocrinus</i> sp. aff. <i>P. kendrickensis</i> Strimple and Knapp, 1966	Gobbler	Morrowan?	Horse Ridge
<i>Paragassizocrinus</i> sp. aff. <i>P. asymmetricus</i> Strimple, 1960	Gobbler	Morrowan?	Horse Ridge
<i>?Paragassizocrinus</i> sp.	lower part of La Pasada	Morrowan	Santa Fe Quarries, Section 61
<i>Paragassizocrinus</i> sp. cf. <i>P. caliculus</i> (Moore and Plummer, 1937)	lowest part of La Pasada	Morrowan	Santa Fe River—Cerro Gordo Road, Section 90
<i>Anchicrinus planulatus</i> Moore and Strimple, 1973	lower part of La Pasada	Morrowan	Nambe Falls, Section 41
<i>Plaxocrinus</i> sp.	lower part of La Pasada	Morrowan	Nambe Falls, Section 41
<i>Lecythiocrinus</i> sp. cf. <i>L. optimus</i> Strimple, 1951	Gobbler	Morrowan?	Horse Ridge
<i>Diphuicrinus santafeensis</i> n. sp.	La Pasada	Atokan	Santa Fe Quarries, Section 62
<i>Diphuicrinus coalensis</i> (Strimple and Moore, 1971)	La Pasada	Atokan	Santa Fe Quarries, Section 62
<i>Metacromyocrinus</i> sp.	La Pasada	Atokan	Santa Fe Quarries, Locality 64
<i>Aglaocrinus sutherlandi</i> n. sp.	Alamitos	Desmoinesian	Dalton Bluff, Section 36

strata in northeast Oklahoma, northwest Arkansas, and southern Oklahoma. *Diphuicrinus coalensis* Strimple and Moore occurs in the Atoka Formation (Atokan) in Coal County, Oklahoma; *D. santafeensis* n. sp. is closely related to similar species in Atokan or lower Desmoinesian strata in Oklahoma. *Anchicrinus planulatus* Moore and Strimple is known from Bloydian rocks in northeast Oklahoma and northwest Arkansas. Although considered a discrete species, *Aglaocrinus sutherlandi* n. sp. has the same general appearance as *A. keyti* Strimple and Moore from the McCoy Formation of Colorado and other species of the genus in the Dornick Hills Formation (Desmoinesian) of the Ardmore Basin in southern Oklahoma (Strimple and Moore, 1973). *Metacromyocrinus* sp. shows close affinity with *M. gillumi* Strimple from the Morrowan of Arkansas and *M. holdenvillensis* Strimple of the Holdenville Formation (Desmoinesian) of Oklahoma.

The horizon exposed along Horse Ridge in the Sacramento Mountains was identified as Atokan by C. C. Branson; however, species of *Paragassizocrinus* found

there show strong affinity to those found in Morrowan rocks elsewhere. *Paragassizocrinus kendrickensis* occurs in the Breathitt Formation (Morrowan) of eastern Kentucky. *P. asymmetricus* is found in the Wapanucka Formation (Morrowan) of southern Oklahoma and the associated (and closely related) *P. turris* has also been reported from the Breathitt Formation. *Lecythiocrinus* sp. cf. *L. optimus* does not appear to be closely related to *L. asymmetricus* from Bloydian rocks of Oklahoma and has been provisionally assigned to a species of Desmoinesian age.

REPOSITORIES—All specimens described in this report are repositied as follows: the University of Oklahoma, Museum of Invertebrate Paleontology, Norman, Oklahoma, prefix OU; the University of Iowa, Geology Department Repository, Iowa City, Iowa, prefix SUI.

ACKNOWLEDGMENTS—Most of the material used in the present study was made available by P. K. Sutherland and C. C. Branson. A few specimens were collected by W. M. and Becky Furnish as well as Christina C. Strimple.

Systematic descriptions

Subclass INADUNATA Wachsmuth
and Springer, 1855

Order CLADIDA Moore and Laudon,
1943

Suborder CYATHOCRININA
Bather, 1899

Superfamily CODIACRINACEA
Bather, 1890

Family CODIACRINIDAE
Bather, 1890

Subfamily CODIACRININAE
Bather, 1890

Genus *LECYTHIOCRINUS* White, 1879

Lecythiocrinus sp. cf. *L. optimus*

Strimple, 1951

Pl. 1, fig. 8

DISCUSSION—Morphologic changes through time among various species of *Lecythiocrinus* are not well enough understood at present to evaluate. In addition, the present specimens are crushed and poorly preserved. However, the similarity to *Lecythiocrinus optimus* Strimple, 1951, warrants tentative assignment to that species. *L. optimus* has previously been known only from the Oologah Limestone (Desmoinesian) exposed east of Tulsa, Oklahoma (Strimple, 1962). The pitted surface of cup plates, which could have been accentuated by desert weathering conditions, is more pronounced than that observed in other species of the genus. *L. asymmetricus* Moore and Strimple, 1973, has a more slender cup with decidedly upflared infrabasals and possesses a very large anal opening, or periproct, in the side of the cup. *L. asymmetricus* is found in the Brentwood interval, Bloyd Formation (Morrowan), near Ft. Gibson, Oklahoma.

Approximate height of the illustrated cup is 9.0 mm, width 9.4 mm.

FIGURED SPECIMEN —SUI 42160, unfigured specimen—SUI 42161.

OCCURRENCE —Gobbler Formation (Morrowan, Pennsylvanian), Horse Ridge (table 1).

Suborder POTERIOCRININA
Jaekel, 1918

Superfamily ERISOCRINACEA
Wachsmuth and Springer, 1886

Family CATACRINIDAE Knapp, 1969

Genus *PALMEROCRINUS* Knapp, 1969

Palmerocrinus profundus Moore
and Strimple, 1973

Pl. 1, figs. 1-3

DISCUSSION —A single cup is available for study in which the B radial and most of the A radial are missing—a fortuitous occurrence that exposes the

lateral suture facets of two radials as well as the upper suture facets of two basals. These facets are smooth, showing no pit for a ligament or denticulation such as that reported for *Delocrinus subhemisphericus* by Strimple and Moore (1971, fig. 1, 3-7). It is also possible to measure the plate thickness, which is 3.4 mm at the cup summit and 2.5 mm at the common distal juncture of basals. The cup width is 19.0 mm and the height at the transverse ridge of the radial plates is 6.1 mm.

The anal plate of the holotype and that of the New Mexico specimen are different. In the holotype, the anal plate slopes very slightly inward and the outer face terminates with an apex, although there is a large upper facet with a smaller facet in the inner right corner. In the New Mexico specimen, the anal plate has a broad, horizontal distal edge and the upper facet is large with a quadrangular outline. The facet is weathered in such a manner as to obliterate any evidence of a small separate facet, if one was indeed present, in the right corner. If the arms were present, primaxils in C and D rays would meet over the anal plate of the holotype; however, in the New Mexico specimen those elements would probably meet over a small triangular anal-tube plate in series with the anal X.

A deep cup with shagreen surface ornamentation and a deep basal invagination are characters of the New Mexico specimen shared by *Palmerocrinus profundus*, which is typically from the Wapanucka Formation in southeast Oklahoma. The Wapanucka Formation is considered to be post-Brentwood (Bloydian) in age.

Palmerocrinus kesslerensis Moore and Strimple, 1973, shares the character of a pointed anal plate with *P. profundus* but has a very shallow cup. The anal plate of *Endelocrinus matheri* (Moore and Plummer, 1938) is more like that of the New Mexico specimen but the cup is shallow, the basal invagination is shallow, and there are mild depressions at the angles of the plates above the infrabasal circlet.

P. profundus is also known from the Bridal Veil Falls Member, Oquirrh Formation (Morrowan), west side of Slide Canyon in Provo Canyon, Utah (Moore and Strimple, 1973, p. 66, 67).

HYPOTYPE—OU 8669.

OCCURRENCE —La Pasada Formation (Morrowan), Santa Fe Quarries, Section 68 (table 1).

Family DIPHUICRINIDAE Strimple
and Knapp, 1966

Genus *DIPHUICRINUS* Moore and
Plummer, 1938

Diphuicrinus santafeensis Strimple,
new species

Pl. 1, figs. 9-11

DESCRIPTION—The dorsal cup is shallow and bowl shaped with pronounced surface ornamentation in the form of small pustules. The base of the cup is broadly

and deeply invaginated with sharply downflared infrabasals. These basals are large and kite shaped. Radials are pentagonal with proximal tips well above the basal plane of the cup. Anal X is long and slender, and the distal portion slopes inward.

Measurements of the holotype in millimeters are: height of cup 8.6, width of cup (anterior-posterior) 20.0, width of cup (maximum) 20.9, width of **IBB** circlet 4.0, diameter of stem 2.3, length of AB basal 8.4, width of AB basal 8.5, length of A radial 6.2, and width of A radial **11.5**.

DISCUSSION—*Diphuicrinus dovelyensis* has faint surface ornamentation, a relatively shallow basal concavity with mildly downflared infrabasals, and proximal tips of radials that reach the basal plane. The cup is evenly rounded as in *D. santafeensis* but in other respects the New Mexico specimen differs. Ornamentation is pronounced in *D. santafeensis* including numerous small pustules on basals and radials, infrabasals sharply downflared, and proximal tips of radials well above the basal plane of the cup.

D. coalensis is readily distinguished by the broad basal concavity, subhorizontal infrabasals, large pointed pustules, and proximal ends of radials curved into the basal plane.

HOLOTYPE —OU 8670.

OCCURRENCE —La Pasada Formation (Atokan), Santa Fe Quarries, Section 62, units 17 and 18 (table 1).

Diphuicrinus coalensis Strimple
and Moore, 1971 Pl. 1,
figs. 12-14

DISCUSSION —The specimen has a low cup with downflared infrabasals. Radials extend into the basal plane with distal ends flexed inward to form a fore facet and anal X is elongated and narrow. The surface is nodose, particularly in the distal portions. The New Mexico specimen is very similar to type specimens of *D. coalensis* from the Atoka Formation of Oklahoma.

Measurements of the hypotype in millimeters are: cup height 5.9, width 20.5.

HYPOTYPE —OU 8671

OCCURRENCE —La Pasada Formation (Atokan), Santa Fe Quarries, Section 62, unit 18 (table 1).

Superfamily CROMYOCRINACEA
Bather, 1890
Family CROMYOCRINIDAE Bather,
1890

Genus *AGLAOCRINUS* Strimple, 1961
Aglaocrinus sutherlandi Strimple,
new species
Pl. 2, figs. 8-10

DESCRIPTION —The dorsal cup is bowl shaped, with a planate or shallowly concave base, and sutures are located in deep grooves that result in a hemstitched ap

pearance. The infrabasal circlet is rather large and planate with distal tips upflared and basals are very large. Radials are wide plates with a pronounced shelf beyond the outer ligament area. Two anal plates, the radialian placed obliquely with a very wide proximal end and a relatively narrow distal end and the anal X, which is elongate and narrow but extends only slightly above the cup summit, are present on the specimen.

Measurements of the holotype in millimeters are: height of cup 17.9, width of cup (minimum) 34.3, width of cup (posterior-anterior) 35.7, width of **IBB** circlet 12.2, width of stem facet 5.3, length of AB basal 15.7, width of AB basal 18.3, length of A radial 11.4, width of A radial 19.3, height of proximal tip of A radial above basal plane 6.2.

DISCUSSION—*Aglaocrinus sutherlandi* is closely related to *A. keytei* Strimple and Moore, 1973, from the McCoy Formation of Colorado and to *A. magnus* (Strimple, 1949), type species of the genus. *A. magnus* has a pronounced though shallow basal concavity and the infrabasals are slightly downflared. *A. keytei* has proportionately larger proximal columnals than *A. sutherlandi* and the infrabasals of the latter species are more prominent.

TYPES —Holotype OU 8672, paratypes OU 8673, 8679.

OCCURRENCE—Alamitos Formation (Middle Desmoinesian), Dalton Bluff, Section 36, units 146, 147 (holotype), 133 and 149 (paratypes) (table 1).

Genus *METACROMYOCRINUS* Strimple, 1961
Metacromyocrinus sp. Pl. 2,
figs. 5-7

DISCUSSION —The cup is globose and has a convex base; infrabasals are large and slightly upflared. Anal plates and arms are unknown. The stem is round and little differentiation between nodals and internodals is present. Ornamentation consists of raised nodes at the juncture of the infrabasals and a rim circumscribing the columnar cicatrix, as well as low ridges marked by occasional nodes that pass from basal to basal and from basals to radials. The infrabasal circlet is partially fused with only traces of interinfrabasal sutures remaining.

The partially fused infrabasal circlet and stem were discovered together with five basal plates and five radial plates apparently belonging to the same specimen. However, one of the radial plates shows different ornamentation, and posterior (CD) as well as right posterior (BC) basals are missing. The latter two plates have distinctive distal facets for reception of anal X and radialian plates that are also missing from the material at hand.

The contour of the infrabasal circlet and cup ornamentation are sufficient characteristics to align the species with *Metacromyocrinus*, and the five nodes placed in interinfrabasal position about the columnar impression serve to distinguish the species from other

described forms. The tall globose cup is like *M. gillumi* Strimple, 1966, which, however, has profuse nodose ornamentation, and *M. holdenvillensis* Strimple, 1961, which has three coarse riblike ridges on each infrabasal and coarse tubercles on basals and radials. Proximal columnals of *M. holdenvillensis* do not fill the impressed area in the infrabasal circlet but they do fill the columnar cicatrix in *Metacromyocrinus* sp.

Measurements of the reconstructed specimen in millimeters are: height of cup 16.0, width of cup 21.8, width of infrabasal circlet 11.0.

ILLUSTRATED SPECIMEN —OU 8674.

OCCURRENCE —La Pasada Formation (Atokan), Santa Fe Quarries, Locality 64 (table 1).

Superfamily LOPHOCRINACEA

Bather, 1899

Family LAUDONOCRINIDEA Moore and Strimple, 1973

Genus *ANCHICRINUS* Strimple and Watkins, 1969

Anchicrinus planulatus Moore and

Strimple, 1973

Pl. 1, figs. 15-18

DISCUSSION—The cup is low and bowl shaped with a shallow basal concavity, granular surface, and hexagonal outline when viewed from above or below. Infrabasals are gently downflared except for a circular, sharply impressed columnar cicatrix. Basals are moderately large and slightly tumid and flex into the short lateral walls of the cup. Radials are wide with a pronounced node in the mid-portion of each plate; inter-radial areas are deeply impressed and a sharp concavity is present at the meeting with the distal apex of each basal plate. Three anal plates are in normal (primitive) arrangement and have sharp depressions at all plate angles.

The small New Mexico specimen is closely comparable to the small paratype (SUI 32777) of *Anchicrinus planulatus* illustrated by Moore and Strimple (1973, pl. 6, figs. 2a-d). *A. planulatus* is typically from beds of the Brentwood interval, Bloyd Formation (Bloydian), in northeast Oklahoma and northwest Arkansas.

Measurement of the hypotype in millimeters are: cup height to transverse ridge 3.4, anteroposterior width 9.1, maximum width 10.2.

HYPOTYPE—OU 8675.

OCCURRENCE —La Pasada Formation (Morrowan), Nambe Falls, Section 41, units 36-42 (table 1).

Superfamily PIRASOCRINACEA

Moore and Laudon, 1943

Family PIRASOCRINIDAE Moore and Laudon, 1943

Genus *PLAXOCRINUS* Moore and

Plummer, 1938

Plaxocrinus sp.

Pl. 2, figs. 1-3

DISCUSSION —This single spinose axillary primibrach 1 has some features in common with a similar ossicle reported by Strimple (1949, fig. 2) as probably belonging to *Plaxocrinus dornickensis* Strimple (1949). The bulge on the underside of the New Mexico specimen is more pronounced and the spinose end (not preserved) is directed upward at a sharper angle than in *P. dornickensis*. There is no evidence of ornamentation on the outer surface of the ossicle. Maximum width is 11 mm and height is 7.5 mm.

FIGURED SPECIMEN —OU 8680.

OCCURRENCE —La Pasada Formation (Morrowan), Nambe Falls, Section 41, unit 42 (table 1).

Superfamily AGASSIZOCRINACEA

S. A. Miller, 1890

Family AMPELOCRINIDAE Kirk, 1942

Subfamily PARAGASSIZOCRININAE

Strimple and Watkins, 1969

Genus *PARAGASSIZOCRINUS* Moore and

Plummer, 1940

Type species: Agassizocrinus tarri

Strimple, 1938

Although the fused infrabasal cones of *Paragassizocrinus* are very simple structures, several distinctive characteristics, aside from the gross shape, can be used to separate them into certain types or groups. The magnitude of the central cavity, which houses the lower portion of the visceral mass, varies considerably among species and also may be expressed by the length of the summit facets of the infrabasals. In general terms, such species of *P. caliculus* and *P. deltoideus*, both of Morrowan age, have very small central cavities. The long superior facets are matched by basal plates with thickened proximal portions, further reducing the proximal portion of the body cavity and in turn reducing the gross size of the visceral mass. At the opposite extreme are species such as *P. atoka*, which possess a wide, deep central cavity with short summit facets (relatively thin basals) allowing for a relatively large coelomic mass. Such species also have a broad, low infrabasal cone. Somewhat intermediate between the two previous groups are species such as *P. tarri* of Missourian age.

Further division may be made on the sharp or blunt nature of the distal apices of the infrabasals. Whenever sharp, a fine ridge extends the length of the facet, but whenever blunt a rounded ridge is matched by uneven lower facets of basals. The Morrowan species *P. turris* is an example of the latter group.

Differentiation between species is relatively simple when all of the above-mentioned factors are taken into account and the specimens are well preserved. Ettensohn (personal communication) has reviewed the genus *Paragassizocrinus* and has synonymized many of the previously described species. Much of his approach to the matter is at variance with previously accepted concepts and, in my opinion, requires further study.

RANGE—Pennsylvanian, North American.

Paragassizocrinus sp.

Fig. 2, E

DISCUSSION—The distinctive infrabasal cone, which is strongly flared in the distal portion, is unlike any known species. If additional specimens are found speciation may be warranted.

The species apparently lived on a very soft substrate and the cone flared to prevent the cup from sinking too deeply. Some species, for example, *Paragassizocrinus atoka* Strimple and Blythe, 1960, form a broad basinlike infrabasal cone probably in response to a soft substrate.

Measurements of the figured specimen in millimeters are: height of cone 17.7, width of cone 15.0, diameter of central cavity (est.) 10.0.

FIGURED SPECIMEN—OU 8676.

OCCURRENCE—La Pasada Formation (Morrowan), Santa Fe Quarries, Section 61, unit 11 (table 1).

Paragassizocrinus sp. cf. *P. caliculus*

Moore and Plummer, 1937

Fig. 2, A-B, Pl. 2, fig. 4

DISCUSSION—The fused infrabasal cone is wider than long with a very small central cavity and sharp ridges at the apices of the infrabasals. The base of the cone is broader than that found in *P. deltoideus*. Sutural faces slope slightly outward. The height/width ratio is 0.66.

Paragassizocrinus caliculus is commonly found in the Brentwood interval of the Bloyd Formation in northeast Oklahoma and northwest Arkansas.

Measurements of the figured specimen in millimeters are: height of cone 5.8; width of cone, maximum 8.8, minimum 7.5; diameter of central cavity 1.4.

FIGURED SPECIMEN—OU 8677.

OCCURRENCE—La Pasada Formation (Morrowan), Santa Fe River-Cerro Gordo Road, Section 90, unit 2 (table 1).

Paragassizocrinus sp. aff. .

P. kendrickensis Strimple and

Knapp, 1966

Fig. 2, D

DISCUSSION—The fused infrabasal cone falls in the category of Group B (medium) I (pointed base), (Strimple, 1960, text fig. 1). Upper facets are narrow (body cavity relatively wide) and are directed outward. The height/width ratio is 0.84.

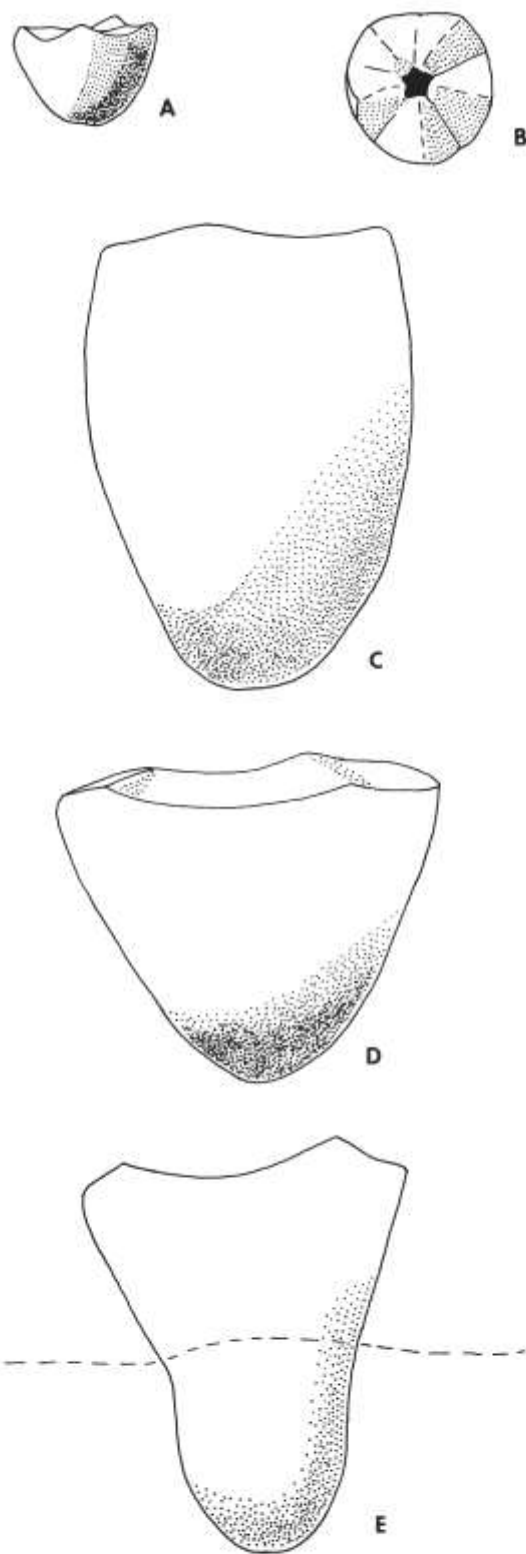


FIGURE 2—CAMERA LUCIDA DRAWINGS OF *Paragassizocrinus* FROM NEW MEXICO, $\times 3$.

A, B—*Paragassizocrinus* sp. cf. *P. caliculus* Moore and Plummer, figured specimen (OU 8677), infrabasal cone from side and summit; C—*Paragassizocrinus* sp. aff. *P. asymmetricus* Strimple, figured specimen (SUI 42159), infrabasal cone from side; D—*Paragassizocrinus* sp. aff. *P. kendrickensis* Strimple and Knapp, figured specimen (SUI 42158), infrabasal cone from side; E—*Paragassizocrinus* sp., figured specimen (OU 8676), infrabasal cone from side, dotted line representing surface of inferred substrate.

In closer comparison with *P. kendrickensis*, the New Mexico specimen has a more pointed base and the upper facets have more of an outwardly directed slant; that is, they are more exposed in a side view of the cone. The ratio of height over width of a paratype of *P. kendrickensis* (SUI 11898) is identical with that of the New Mexico specimen.

P. kendrickensis is typically from Kendrick beds, Breathitt Formation (Morrowan), roadcut on State Highway 460, near Phyllis at the left fork of Grapevine Creek, Pike County, Kentucky.

Measurements of the figured specimen in millimeters are: cone height 14.3; cone width, maximum, 16.9, minimum 16.6; diameter of central cavity 8.7.

FIGURED SPECIMEN-SUI 42158.

OCCURRENCE-Gobbler Formation (?Morrowan), Horse Ridge (table 1).

Paragassizocrinus sp. aff.

P. asymmetricus Strimple, 1960

Fig. 2, C; Pl. 1, figs. 4-7

DISCUSSION-The fused infrabasal cone is bullet-shaped, falling in the category of Group A (high-narrow). The base of the cone could be called I (pointed base) or II (truncated base), which might be interpreted to mean the New Mexico species could be assigned to *P. turris* as readily as to *P. asymmetricus*. Unfortunately, none of the New Mexico specimens have the distal facets preserved well enough to study other than to observe that they are unlike the sharply defined surfaces found in *P. kendrickensis*, the group exemplified by *P. tarri* (Strimple, 1938).

P. asymmetricus is typically from the Wapanucka Formation (Morrowan), exposed near Canyon Creek, Stonewall quadrangle, southern Oklahoma.

Measurements of the figured specimen (SUI 43159) in millimeters are: cone height 19.6, cone width 14.0.

FIGURED SPECIMEN -SUI 43159 (additional specimens OU 8678 a-b).

OCCURRENCE-Gobbler Formation (?Morrowan), Horse Ridge; La Pasada Formation (Morrowan) (table 1).

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Plates

PLATES 1-2

PLATE 1

Figures

- 1-3 *Palmerocrinus profundus* Moore and Strimple, Morrowan, Lower Pennsylvanian, x 2. Locality 68 (table 1). Hypotype (OU 8669) cup viewed from posterior, summit, and anterior.
- 4-6 *Paragassizocrinus* sp. aff. *P. asymmetricus*, Morrowan, Lower Pennsylvanian, x 1.1. Section 61 (table 1). Figured specimen (OU 8678a) infrabasal circlet viewed from side, summit, and base with latter view showing small central depression where stereom has failed to totally cover the former position of the stem.
- 7 *Paragassizocrinus* sp. aff. *P. asymmetricus*, Morrowan, Lower Pennsylvanian, x 1.1. Section 61 (table 1). Figured specimen (OU 8678b), infrabasal cone viewed from side.
- 8 *Lecythiocrinus* sp. cf. *L. optimus* Strimple, Atokan, Middle Pennsylvanian, x 3. Horse Ridge (table 1). Figured specimen (SUI 42160) cup viewed obliquely with periproct (aperture in CD interray) to the right of center.
- 9-11 *Di phuicrinus santafeensis* n. sp., Atokan, Middle Pennsylvanian, x 2. Section 62 (table 1). Holotype (OU 8679) cup viewed from base, anterior, and posterior.
- 12-14 *Di phuicrinus coalensis* (Strimple and Moore), Atokan, Middle Pennsylvanian, x 2. Section 62 (table 1). Hypotype (OU 8671) viewed from summit, anterior, and base.
- 15-18 *Anchicrinus planulatus* Moore and Strimple, Morrowan, Lower Pennsylvanian, x 4. Section 41 (table 1). Hypotype (OU 8675) cup viewed from anterior, base, posterior, and summit.

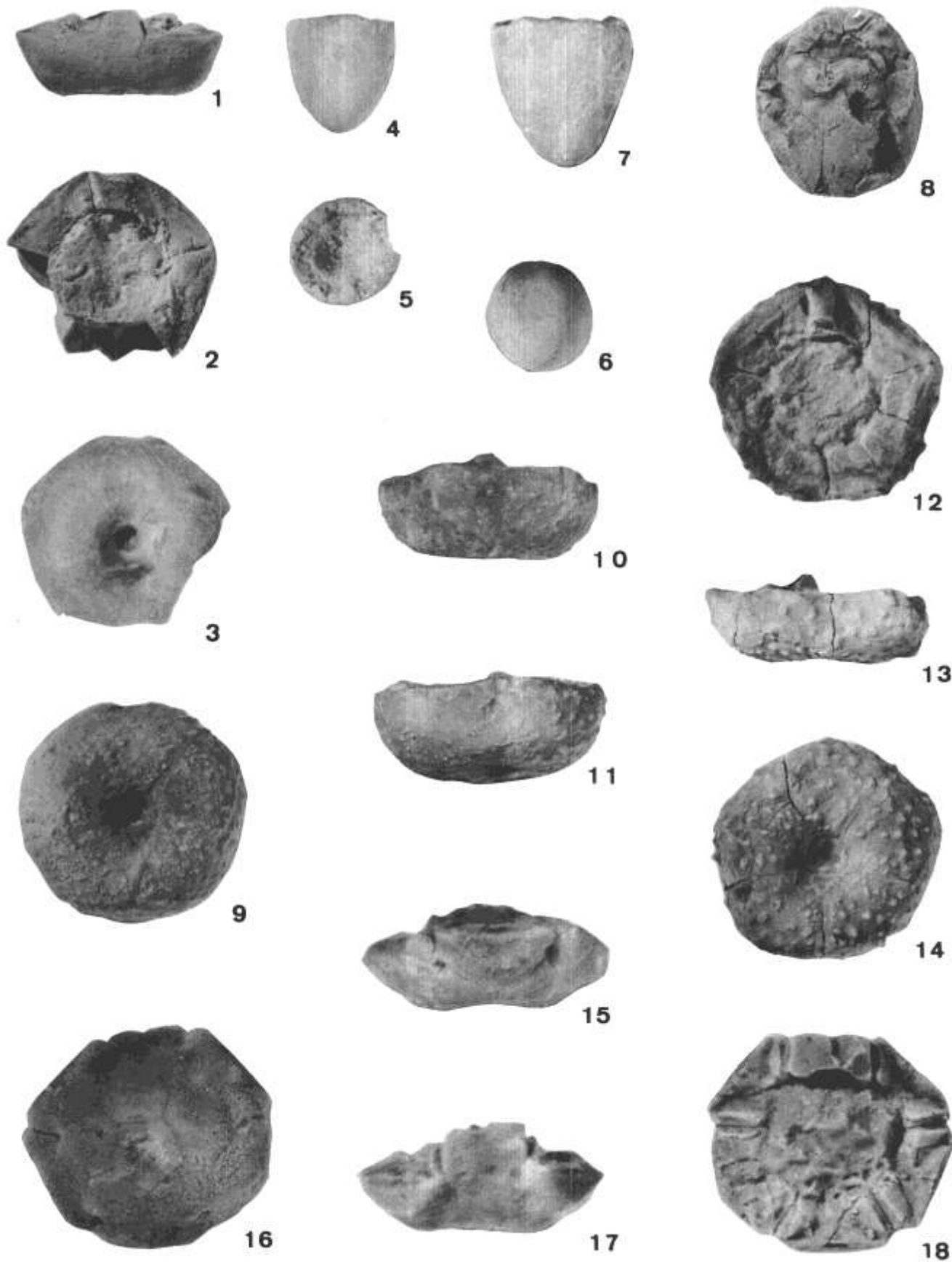
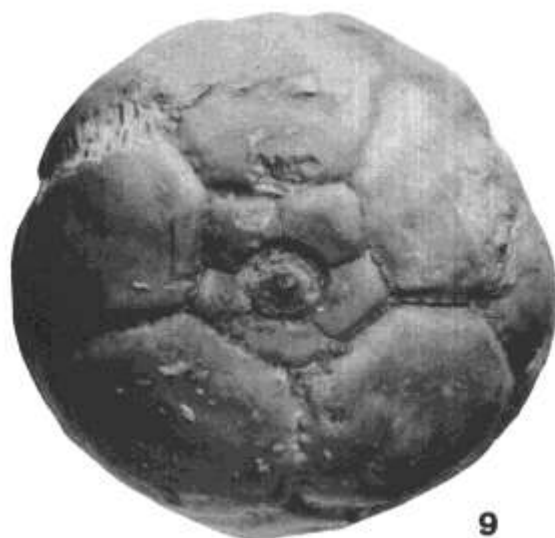


PLATE 2

Figures

- 1-3 *Plaxocrinus* sp., Morrowan, Lower Pennsylvanian, x 4.5. Section 41 (table 1). Figured specimen (OU 8680), axillary primibrach 1 viewed from side, end, and summit.
- 4 *Paragassizocrinus* sp. cf. *P. caliculus* Moore and Plummer, Morrowan, Lower Pennsylvanian, x 4. Section 90 (table 1). Figured specimen (OU 8677), infrabasal circlet viewed from side.
- 5-7 *Metacromyocrinus* sp., Atokan, Middle Pennsylvanian, x 2. Locality 64 (table 1). Figured specimen (OU 8674) cup restored from closely associated plates together with associated cirriferous stem, viewed from side and base.
- 8-10 *Aglaocrinus sutherlandi* n. sp., Desmoinesian, Middle Pennsylvanian, x 2. Section 36 (table 1). Holotype (OU 8672) cup viewed from posterior, base, and anterior.



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