OKLAHOMA
GEOLOGICAL
SURVEY

BULLETIN 96

Pennsylvanian Cephalopods of Oklahoma

A. G. UNKLESBAY

1962

OKLAHOMA GEOLOGICAL SURVEY

CARL C. BRANSON, *Director*

BULLETIN 96

Pennsylvanian Cephalopods of Oklahoma

by A. G. UNKLESBAY

The University of Oklahoma

Norman

January 1962

CONTENTS

ILLUSTRATIONS

TABLES

PENNSYLVANIAN CEPHALOPODS OF OKLAHOMA

A. G. UNKLESBAY*

ABSTRACT

The known cephalopod fauna of the Pennsylvanian rocks of Oklahoma comprises 15 genera and 28 species of nautiloids and 29 genera and 52 species of ammonoids. Of these, three nautiloid species and three ammonoid species are new. Cephalopods have been found in all Pennsylvanian units older than the Wabaunsee group except the Hartshorne, Thurman, and Tallant formations and their equivalents. None has been reported from the Wabaunsee group. The most prolific fauna, comprising 34 species, is that of the Wewoka formation. *Pseudorthoceras knoxense* is the most wide-ranging species, having been reported from 16 Pennsylvanian formations.

New species described are *Michelinoceras directum, Liroceras patulum, Coelogasteroceras planum, Wewokites newelli,* and *Eoasianites subdiscus.* One specimen of a new species of *Proshumardites* is described but not named. *Eudissoceras collinsvillense* Miller and Owen, 1937, is now recognized to be an immature form of *Gonioglyphioceras gracile* (Girty), 1911.

INTRODUCTION

Pennsylvanian cephalopods of Oklahoma have been studied by many authors. These studies have been made on collections representing limited stratigraphic intervals or only one locality, and the reports have been published in diverse places. Thus a person concerned with this group of fossils has been compelled to search for information in many publications.

The aim of the present publication is to bring together the data already known and to supplement them with additional studies of newer collections, and to present an up-to-date evaluation of the current knowledge of the Pennsylvanian cephalopods of Oklahoma.

Particularly important among the previous works have been those of Girty (1911, 1915a, 1915b), and the many papers of A. K. Miller and associates (1930 to 1958). Other studies of importance are the early reports of F. B. Meek, A. H. Worthen, and J. P. Smith. Many of the county and regional reports of the Oklahoma Geological Survey have included lists of cephalopod

*Department of Geology, University of Missouri.

occurrences, and where these could be verified they have been included in this report. Unverified listings are not included.

Large collections of Oklahoma Pennsylvanian cephalopods are preserved at the University of Oklahoma, and at the State University of Iowa. Others are in the collections at the U. S. National Museum, Oklahoma State University, and the University of Tulsa.

ACKNOWLEDGMENTS

During the preparation of this report I have been greatly aided by W. M. Furnish, of the State University of Iowa, who made their collections available to me, and who also spent much time in discussion of matters of taxonomy and stratigraphic distribution. This help is greatly appreciated. Appreciation should also be expressed to C. C. Branson of the Oklahoma Geological Survey for encouragement, and support.

For the loan of specimens I am indebted to John Naff of Oklahoma State University, Floyd Beghtel of the State University of Iowa, and M. E. Hopkins of Tulsa University. George Carini of the University of Missouri contributed several specimens from his personal collection.

Special thanks are also due to Neville M. Curtis, Jr., for invaluable help in photography, and to Alex. Nicholson in matters editorial.

Stratigraphic Distribution

Nautiloids and ammonoids range through a considerable part of the Pennsylvanian of Oklahoma and occur in abundance in various units from the Morrowan Union Valley upward to the Vamoosa formation of the Virgil.

Nautiloids

The nautiloids, although relatively abundant and widespread, are not particularly valuable as stratigraphic markers because most of them are simple in structure and relatively plain in ornamentation. They do not vary significantly from bed to bed. Also many of the nautiloids are long-ranging forms.

Morrow Group.—The Morrowan beds have yielded only a few nautiloids. The Union Valley formation has yielded *Liroceras patulum* n. sp. and a poorly preserved specimen of *Mooreoceras normale* Miller, Dunbar, and Condra. The Wapanucka formation has produced *Pseudorthoceras knoxense* (McChesney), an ubiquitous species, and a fragmental specimen that might be referred to *Liroceras patulum.*

Atoka Group.—The Atoka group has yielded *Liroceras liratum* (Girty) and *Mooreoceras normale* Miller, Dunbar, and Condra, both of which are long-ranging forms.

Krebs Group.—In the Krebs group the Boggy formation and the Buckhorn asphalt have yielded numerous nautiloids. From the Boggy formation there are known:

Brachycycloceras crebricinctum (Girty)
Pseudorthoceras knoxense (McChesney)
Mooreoceras normale Miller, Dunbar, and Condra
M. tuba (Girty)
Metacoceras cornutum Girty
M. perelegans Girty
M. sinuosum Girty
Liroceras liratum (Girty)
Ephippioceras ferratum (Cox)

and from the Buckhorn asphalt the following:

Michelinoceras directum n. sp.
Pseudorthoceras knoxense (McChesney)
Mooreoceras normale Miller, Dunbar, and Condra

Metacoceras sinuosum Girty
Domatoceras williamsi Miller and Owen
Liroceras liratum (Girty)
Ephippioceras ferratum (Cox)

The Pumpkin Creek formation has yielded *Pseudorthoceras knoxense* (McChesney) and *Liroceras liratum* (Girty).

Cabaniss Group.—In the Cabaniss group the Stuart formation has produced almost all the nautiloids found, and the following species are known:

Pseudorthoceras knoxense (McChesney)
Mooreoceras tuba (Girty)
Metacoceras cornutum Girty
Liroceras liratum (Girty)

The Senora formation has yielded *Liroceras liratum.*

Marmaton Group.—The Marmaton group has yielded large numbers of nautiloids and they are especially abundant in the Wetumka, Wewoka, and Holdenville formations. The lowermost nautiloids of the Marmaton are from the Fort Scott, which contains *Pseudorthoceras knoxense* (McChesney), *Mooreoceras normale* Miller, Dunbar, and Condra, *Metacoceras cornutum* Girty, and *M. sinuosum* Girty.

In the Wetumka there have been found:

Brachycycloceras crebricinctum (Girty)
Pseudorthoceras knoxense (McChesney)
Mooreoceras normale Miller, Dunbar, and Condra
M. tuba (Girty)
Foordiceras bellatulum (Miller and Owen)
Domatoceras sculptile (Girty)
Liroceras liratum (Girty)

The Wewoka contains all the above Wetumka species and in addition:

Brachycycloceras normale Miller, Dunbar, and Condra
B. longulum Miller and Owen
Euloxoceras greenei Miller, Dunbar, and Condra
Poterioceras curtum? (Meek and Worthen)
Metacoceras cornutum Girty
M. perelegans Girty
M. sinuosum Girty
M. carinatum Girty
Solenochilus missouriensis Miller, Lane, and Unklesbay

Only one nautiloid, *Pseudorthoceras knoxense* (McChes-

ney), has been reported from the Nowata, and the Lenapah has yielded only *Metacoceras sinuosum* Girty.

The Holdenville nautiloid fauna is similar to that of the Wewoka formation and the following species are common to both:

Brachycycloceras normale Miller, Dunbar, and Condra
Pseudorthoceras knoxense (McChesney)
Euloxoceras greenei Miller, Dunbar, and Condra
Mooreoceras normale Miller, Dunbar, and Condra
M. tuba (Girty)
Foordiceras bellatulum (Miller and Owen)

				Michelinoceras directum	Brachycycloceras normale	B. crebricinctum	B. longulum	Pseudorthoceras knoxense	Euloxoceras greenei	Mooreoceras normale	M. tuba	Poterioceras curtum	Tainoceras monilifer	T. murrayi	Foordiceras bellatulum	Metacoceras cornutum	M. perelegans	M. sinuosum	M. vagans	M. carinatum	Domatoceras sculptile	D. williamsi	Solenochilus missourlensis	Liroceras liratum	L. reticulatum	L. patulum	Coelogasteroceras planum	Ephippioceras ferratum
VIRGILIAN	Wabaunsee	Brownville																										
		Emporia	Vanoss																									
		Pony Creek	Ada																									
		Wakarusa																										
		Hallett																										
		Bird Creek																										
		Severy shale																										
	Shawnee-Douglas	Pawhuska						X																				
		Vamoosa						X		X	X		X	X				X					X					
MISSOURIAN	Ochelata	Tallant																										
		Barnsdall																										
		Wann										X												X				
		Iola	Hilltop					X																				
		Chanute						X		X																		
	Skiatook	Dewey	Belle City		X																							
		Nellie Bly						X	X	X						X					X			X				
		Hogshooter	Francis		X			X	X							X												X
		Coffeyville			X			X	X		X					X	X	X			X							
		Checkerboard	DeNay			X										X												
		Seminole								X						X			X					X				
DESMOINESIAN	Marmaton	Holdenville			X			X	X	X	X				X	X	X	X		X	X			X			X	
		Lenapah																X										
		Nowata						X																				
		Oologah	Wewoka		X	X	X	X	X	X	X	X	?			X	X	X	X		X	X		X	X			
		Labette	Wetumka			X		X		X	X					X					X			X				
		Ft. Scott	Calvin					X		X							X		X									
	Cabaniss	Senora																						X				
		Stuart						X			X					X									X				
		Thurman																										
	Krebs	Boggy		*		x		**		**	x					x	x	**				*		**				**
		Savanna																										
		McAlester	Pumpkin Creek					X																X				
		Hartshorne	Frensley																									
Atoka		Atoka								X														X				
Morrow		Wapanucka	Bloyd					X																		?		
		Union Valley	Hale							?																X		

TABLE 1.—DISTRIBUTION OF PENNSYLVANIAN NAUTILOIDS IN OKLAHOMA

(Pawhuska includes Lecompton, Vamoosa includes Kanwaka, Holdenville includes Sasakwa, Boggy includes Buckhorn asphalt. Buckhorn asphalt occurrences are indicated by asterisks.)

Metacoceras cornutum Girty
M. perelegans Girty
M. sinuosum Girty
M. carinatum Girty
Domatoceras sculptile (Girty)
Liroceras liratum (Girty)

Coelogasteroceras planum n. sp. is known only from the Holdenville.

Skiatook Group.—Nautiloids are scattered in the Skiatook group.

The Seminole formation contains:
Mooreoceras normale Miller, Dunbar, and Condra
Metacoceras cornutum Girty
M. vagans Miller and Owen
Liroceras reticulatum (Miller and Owen)

The Checkerboard has yielded:
Brachycycloceras crebricinctum (Girty)
Metacoceras cornutum Girty

The Coffeyville has yielded:
Brachycycloceras normale Miller, Dunbar, and Condra
Pseudorthoceras knoxense (McChesney)
Euloxoceras greenei Miller, Dunbar, and Condra
Mooreoceras tuba (Girty)
Metacoceras cornutum Girty
M. perelegans Girty
M. sinuosum Girty
Domatoceras sculptile (Girty)

The Francis formation has yielded:
Brachycycloceras normale Miller, Dunbar, and Condra
Pseudorthoceras knoxense (McChesney)
Euloxoceras greenei Miller, Dunbar, and Condra
Metacoceras cornutum Girty
Ephippioceras ferratum (Cox)

The Nellie Bly has yielded:
Pseudorthoceras knoxense (McChesney)
Euloxoceras greenei Miller, Dunbar, and Condra
Mooreoceras normale Miller, Dunbar, and Condra
Metacoceras cornutum Girty
Domatoceras sculptile (Girty)
Liroceras liratum (Girty)

The Dewey formation has yielded only *Brachycycloceras normale* Miller, Dunbar, and Condra.

Ochelata Group.—The beds of the Ochelata contain few nautiloids. The Chanute has yielded *Pseudorthoceras knoxense* (McChesney) and *Mooreoceras normale* Miller, Dunbar, and Condra; the Iola has yielded only *Pseudorthoceras knoxense* (McChesney); and the Wann formation has produced only *Poterioceras curtum* (Meek and Worthen) and *Liroceras liratum* (Girty).

Shawnee-Douglas.—In the Shawnee-Douglas portion of the Oklahoma section the Vamoosa has produced:

Pseudorthoceras knoxense (McChesney)
Mooreoceras normale Miller, Dunbar, and Condra
M. tuba (Girty)
Tainoceras monilifer Miller, Dunbar, and Condra
T. murrayi Miller and Unklesbay
Metacoceras sinuosum Girty
Liroceras liratum (Girty)

The Pawhuska has yielded only the ubiquitous *Pseudorthoceras knoxense* (McChesney).

Ammonoids

Ammonoids, with their intricate and distinctive suture patterns, are excellent index fossils for the Late Paleozoic. They are especially abundant and well preserved in the Pennsylvanian rocks of Oklahoma, and have been a subject of investigation for many years. These forms range from the Morrowan Union Valley formation upward into the Vamoosa formation with various degrees of abundance at different stratigraphic levels. Unlike the nautiloids, the ammonoids develop distinctive characteristics at certain levels and many species have short stratigraphic ranges.

Morrow Group.—For the most part the Morrowan ammonoids are short-ranging forms. Three species,

Cravenoceras? morrowense Miller and Moore
Gastrioceras branneri Smith
Eoasianites globulosus (Meek and Worthen),

occur at both Union Valley and Wapanucka horizons (and their equivalents). Others occurring in the Union Valley are:

Gastrioceras adaense Miller and Owen
G. fittsi Miller and Owen
Eoasianites oblatus (Miller and Moore)
Pseudoparalegoceras kesslerense (Mather)
Pronorites arkansasensis Smith

Two species, *Bisatoceras secundum* Miller and Moore and *Axinolobus modulus* Gordon, occur only at the Wapanucka-Bloyd level. *Eoasianites globulosus* (Meek and Worthen) and *Pronorites arkansasensis* Smith occur in the Morrowan and also at higher levels. A new species of *Proshumardites* is also known from the Morrowan and it is similar to a form described by Delépine from the Namurian of North Africa.

Atoka Group.—The Atokan ammonoids are rather distinct. Only four species, *Eoasianites globulosus* (Meek and Worthen), *Pseudoparalegoceras kesslerense* (Mather), *Pronorites arkansasensis* Smith, and *Gastrioceras adaense* Miller and Owen, occur in older strata. Only five forms, *Pronorites arkansasensis* Smith, *Boesites girtyi* (Plummer and Scott), *Paralegoceras iowense* (Meek and Worthen), *P. texanum* (Shumard), and *Eoasianites globulosus* (Meek and Worthen), are known to occur also in younger beds. Those species distinctive of the Atokan in Oklahoma are *Pseudoparalegoceras compressum* (Hyatt), *P. williamsi* Miller and Downs, and *Diaboloceras varicostatum* Miller and Furnish.

Krebs Group.—In the Krebs group the Boggy formation and the Buckhorn asphalt are the only units containing ammonoids. The faunas of the two have some similarity but also some differences. The species common to both are *Pseudoparalegoceras brazoense* Plummer and Scott and *Paralegoceras iowense* (Meek and Worthen). Others in the Boggy are:

Gordonites oklahomensis (Miller and Owen)
Paralegoceras texanum (Shumard)
Dimorphoceras politum (Shumard)

Those in the Buckhorn are:

Bisatoceras primum Miller and Owen
Gonioloboceras goniolobum (Meek)
Eoasianites subdiscus n. sp.
Wellerites mohri Plummer and Scott
Pronorites arkansasensis Smith
Prouddenites primus Miller

Cabaniss Group.—No ammonoids are known from the rocks of the Cabaniss group.

Marmaton Group.—The Marmaton group has produced most of the ammonoids in Oklahoma, with the Wetumka, Wewoka, and Holdenville formations being especially prolific. The Fort Scott limestone has produced only a few specimens of *Eoasianites angulatus* (Girty).

Series	Group	Formation		Gastrioceras fittsi	Eoasianites oblatus	Cravenoceras? morrowense	Gastrioceras branneri	Bisatoceras secundum	Axinolobus modulus	Pseudoparalegoceras compressum	P. williamsi	P. kesslerense	Gastrioceras adaense	Eoasianites globulosus	Diaboloceras varicostatum	Paralegoceras iowense	P. texanum	Boesites girtyi	Pronorites arkansasensis	Gordonites oklahomensis	Eoasianites subdiscus	Pseudoparalegoceras brazoense	Bisatoceras primum	Gonioloboceras goniolobum	Wellerites mohri	Dimorphoceras politum	Prouddenites primus	Eoasianites angulatus	E. excelsus	E. hyattianus	Gastrioceras prone	Gonioglyphioceras gracile	Eoasianites kansasensis	Maximites cherokeensis	Bisatoceras greenei	Wewokites venatus	W. newelli	Pintoceras postvenatum	Neodimorphoceras texanum	N. lenticulare	N. oklahomae	Owenoceras retiferum	Pintoceras unicum	Eothalassoceras inexpectans	Eoasianites anguloumbilicatus	Eupleuroceras bellulum	Proshumardites senex	Schistoceras missouriense	S. hildrethi	Eoasianites welleri
VIRGILIAN	Wabaunsee	Brownville																																																
		Emporia	Vanoss																																															
		Pony Creek	Ada																																															
		Wakarusa																																																
		Hallett																																																
		Bird Creek																																																
		Severy shale																																																
	Shawnee-Douglas	Pawhuska																																																
		Vamoosa																				X				X											X									X	X	X
MISSOURIAN	Ochelata	Tallant																																																
		Barnsdall																																																
		Wann																							X		X																			X	X	
		Iola	Hilltop																																															
		Chanute																																									X					
	Skiatook	Dewey	Belle City																																															
		Nellie Bly																				X			X	X																		X	X	X		
		Hogshooter	Francis																																															
		Coffeyville											X															X															X					
		Checkerboard	DeNay																																															
		Seminole																				X						X		X	X		X								X	X	X						
DESMOINESIAN	Marmaton	Holdenville																					X				X	X	X		X																		
		Lenapah																																									X					
		Nowata																																																
		Oologah	Wewoka											X				X					X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X									
		Labette	Wetumka											X										X				X	X	X		X	X																	
		Ft. Scott	Calvin																									X																						
	Cabaniss	Senora																																																
		Stuart																																																
		Thurman																																																
	Krebs	Boggy														*X	x		*	x	*	*X	*	*	*	x	*																							
		Savanna																																																
		McAlester	Pumpkin Creek																																															
		Hartshorne	Frensley																																															
	Atoka	Atoka								X	X	X	X	X	X	X	X	X	X																															
	Morrow	Wapanucka	Bloyd			X	X	X	X					X																																				
		Union Valley	Hale	X	X	X	X					X	X	X					X																															

TABLE 2.—DISTRIBUTION OF PENNSYLVANIAN AMMONOIDS IN OKLAHOMA

(Pawhuska includes Lecompton, Vamoosa includes Kanwaka, Holdenville includes Sasakwa, Boggy includes Buckhorn asphalt. Buckhorn asphalt

The Wetumka, in addition to its good nautiloid fauna, has also produced:

Gonioloboceras goniolobum (Meek)
Gonioglyphiaceras gracile (Girty)
Eoasianites angulatus (Girty)
E. excelsus (Meek)
E. hyattianus (Girty)
E. globulosus (Meek and Worthen)
E. kansasensis (Miller and Gurley)

Each of these species also occurs in the Wewoka formation, and in addition the Wewoka has yielded the following:

Maximites cherokeensis (Miller and Owen)
Agathiceras cf. *A. ciscoense* Smith
Bisatoceras primum Miller and Owen
B. greenei Miller and Owen
Wewokites venatus (Girty)
W. newelli n. sp.
Pintoceras postvenatum (Plummer and Scott)
Wellerites mohri Plummer and Scott
Dimorphoceras politum (Shumard)
Neodimorphoceras texanum (Smith)
N. lenticulare (Girty)
N. oklahomae (Girty)
Boesites girtyi (Plummer and Scott)

This fauna is probably the most prolific goniatite fauna in the Midcontinent region. Since Girty's description of these fossils in 1911 and 1915 many collections have been made from the Wewoka and literally hundreds of goniatites have been collected. It is remarkable that the Wewoka has also yielded many nautiloids.

The Lenapah formation has yielded only one species, *Eoasianites anguloumbilicatus* (Plummer and Scott).

The Holdenville, which is also rich in nautiloids, has yielded the following ammonoids:

Goniolobocerας goniolobum (Meek)
Gonioglyphioceras gracile (Girty)
Eoasianites angulatus (Girty)
E. excelsus (Meek)
E. hyattianus (Girty)

All of these also occur in the Wewoka and two of them, *Gonioglyphioceras gracile*, and *Eoasianites angulatus*, are also present in the higher Seminole formation.

Skiatook Group.—In the Skiatook group ammonoids are abundant in the Seminole and Nellie Bly formations, but only one species, *Eoasianites angulatus* (Girty), is common to both.

The fauna of the Seminole was described by Miller and Owen in 1937 from beds above the Dawson coal in a strip pit in S½ sec. 32, T. 22 N., R. 14 E., near Collinsville, Tulsa County. These beds were then referred to the Coffeyville formation.

As now known the fauna of the Seminole contains the following species:

Maximites cherokeensis (Miller and Owen)
Bisatoceras primum Miller and Owen
Gonioglyphioceras gracile (Girty)
Gastrioceras prone Miller and Owen
Eoasianites excelsus (Meek)
Owenoceras retiferum (Miller and Owen)
Pintoceras unicum (Miller and Owen)
Eothalassoceras inexpectans (Miller and Owen)

The Coffeyville formation has yielded only:

Eoasianites anguloumbilicatus (Plummer and Scott)
E. hyattianus (Girty)
E. globulosus (Meek and Worthen)

A Nellie Bly fauna from 6½ miles west of Sand Springs, Tulsa County, was described by Miller and Cline in 1934. A few other specimens from this unit are now known from scattered localities in the same general area, and as now known the Nellie Bly fauna is as follows:

?Imitoceras grahamense (Plummer and Scott)
Proshumardites senex (Miller and Cline)
Gonioloboceras goniolobum (Meek)
Eoasianites angulatus (Girty)
Eupleuroceras bellulum Miller and Cline
Schistoceras missouriense (Miller and Faber)
Prouddenites primus Miller

Ochelata Group.—A few specimens in the State University of Iowa collections are labeled as having come from the "Ochelata formation, 12 mi. W. of Skiatook." Others are labeled "Wildhorse locality," and others "the Wildhorse member of the Nelagoney, at Wildhorse." These are all apparently from the same general area, and the same stratigraphic position, and should be properly referred to the Wann formation of the Ochelata group. The following species are represented:

Imitoceras grahamense (Plummer and Scott)
Eoasianites excelsus (Meek)
Schistoceras missouriense (Miller and Faber)
S. hildrethi (Morton)
Prouddenites primus Miller

One other Ochelata formation, the Chanute, has yielded *Eoasianites anguloumbilicatus* (Plummer and Scott).

Shawnee-Douglas.—The Vamoosa formation, in addition to an abundant nautiloid fauna, has also yielded a variety of ammonoids as follows:

Gonioloboceras goniolobum (Meek)
Eoasianites angulatus (Girty)
E. welleri (Smith)
Schistoceras missouriense (Miller and Faber)
S. hildrethi (Morton)
Neodimorphoceras texanum (Smith)

The specimen of *Imitoceras grahamense* referred to Niles zone in a well in Caddo County by Miller and Downs (1950, p. 194) is probably from a Shawnee horizon.

Systematic Descriptions—Nautiloidea

Order MICHELINOCERATIDA Flower, 1950
Family Michelinoceratidae Flower, 1950

Genus *Michelinoceras* Foerste, 1932
Michelinoceras directum new species
Plate 1, figures 1-3

The Buckhorn asphalt pit of Oklahoma has yielded many well-preserved orthoconic cephalopods. Especially numerous among them is a form which seems closely similar to the types of *Michelinoceras* illustrated by Barrande in 1874. As pointed out by Miller and Youngquist (1949), other forms which possess the essential features of his types are of world-wide occurrence, and of wide stratigraphic range. The specimens from the Buckhorn locality fit nicely into his generic diagnosis and, although they may not be genetically related, there are no satisfactory criteria for separating them.

These specimens of *Michelinoceras directum* are straight, slender, slowly expanded orad, and have circular cross sections. The sides of the conch are nearly parallel, diverging at an angle slightly less than 2 degrees. The specimens available range from 4 mm to 21 mm in diameter. Large and small ones maintain approximately the same relative proportions.

The septa are simple saucers, moderately convex apicad. They are directly transverse and therefore the sutures are straight. They are evenly spaced so that the distance between them is approximately equal to the diameter of the shell. The siphuncle is orthochoanitic and exactly central in position. Where it passes through the septa its diameter is about one-sixth the diameter of the shell. It does not enlarge within the camerae, hence it forms a straight cylindrical structure.

The shell is preserved on many specimens. It is thin and fragile, and its surface is marked by fine transverse lirae. In the smaller portions of the shell there are about 20 lirae in a length of 1 mm. This ornamentation is correspondingly coarser in the larger specimens. Because of the delicacy of the shell, and the mode of preservation, the specimens are delicate and most of them are molds of individual camerae.

Remarks.— *M. directum* is clearly distinguished by its slight rate of expansion, the convexity of the septa, the length of the

camerae, and the transverse ornamentation. The specific name is given because of the straight slender shape of the conch.

Occurrence.—Known only in the Buckhorn asphalt pit, Boggy formation. The specimens described here came from sec. 26, T. 1 S., R. 3 E., about 3 miles south of Sulphur, Murray County.

Repository.—The University of Oklahoma. Six syntypes, OU 3900, paratypes, OU 3899.

Genus *Brachycycloceras* Miller, Dunbar, and Condra, 1933

Brachycycloceras normale Miller, Dunbar, and Condra, 1933

Plate 1, figure 6

1915. *Protocycloceras? rushense?* Girty, U. S. Geol. Survey, Bull. 544, p. 235-236, pl. 27, figs. 9-10b.

1921. *Protocycloceras? rushense?* Plummer and Moore, Univ. Texas, Bull. 2132, p. 151, pl. 22, figs. 4, 5.

1924. *Protocycloceras? rushense* Morgan, [Okla.] Bur. Geology, Bull. 2, p. 236, pl. 53, fig. 6.

1933. *Brachycycloceras normale* Miller, Dunbar, and Condra, Nebr. Geol. Survey, Bull. 2, 2d ser., p. 107-109, pl. 3, figs. 3-5.

1944. *Brachycycloceras normale* Shimer and Shrock, Index Fossils N. America, p. 539, pl. 220, fig. 5.

Conch straight, rapidly expanded orad, and nearly circular in cross section. The largest specimen of *Brachycycloceras normale* currently available is 21 mm long, 9.5 mm wide at the adapical end and 19 mm wide at the adoral end. It is incomplete on both ends. The surface is strongly annulate with widely spaced, prominent ridges separated by broadly rounded furrows. There are seven of these ridges on the large specimen mentioned. The surface of the shell is also marked by fine lirae parallel to the annulations.

The nature of the siphuncle and septa is not shown in the material available.

Remarks.—*B. normale* can be separated from others of this genus by its more rapidly expanding conch and stronger annulations.

Occurrence.—Girty's specimens are from the Wewoka formation in the Wewoka quadrangle. Others have been reported by Ries from the Coffeyville, Hogshooter, Dewey, and Holdenville formations. The illustrated specimen is from the Coffeyville formation, in the SE corner sec. 36, T. 12 N., R. 9 E. Okfuskee County.

Repository.—Holotype, Yale Peabody Museum, 13,976. Other specimens, The University of Oklahoma, OU 169.

Brachycycloceras crebricinctum (Girty), 1911
Plate 1, figures 4, 5

1911. *Protocycloceras? rushense* var. *crebricinctum* Girty. New York Acad. Sci., Annals, vol. 21, p. 144.
1915. *Protocycloceras? rushense* var. *crebricinctum* Girty, U. S. Geol. Survey, Bull. 544, p. 236-237, pl. 27, figs. 11-11b.
1933. *Brachycycloceras crebricinctum* Miller, Dunbar and Condra, Nebr. Geol. Survey, Bull. 9, 2d. ser., p. 109-110, pl. 3, figs. 6-8.

Brachycycloceras crebricinctum is represented in the collections being studied by nine specimens, all of which closely resemble Girty's original illustration. They are straight, moderately expanded orad, and elliptical in cross section. The largest specimen is 28 mm long. It is 7 mm wide at the adapical end, and 11.5 mm wide at the adoral end.

The surface is marked by narrow rounded annulations which form low broadly rounded ventral and dorsal saddles. These annulations are evenly spaced and, on the several specimens available, there are six or seven in the space of 10 mm. On the best specimen the surface of the test is marked by fine transverse lirae parallel to the annulations.

The sutures are not well defined on these specimens but the apical end of one is formed by a septum which is moderately convex apicad, and directly transverse; hence the sutures are straight. The siphuncle is small and ventrad of the center. Where one specimen is 5.63 mm wide the siphuncle is 0.7 mm in diameter.

Remarks.—B. crebricinctum can be differentiated from other species of this genus by the smaller annulations and less rapidly expanding conch.

Occurrence.—Girty's types came from the Wewoka formation in the Wewoka quadrangle. Additional Oklahoma specimens are now known from the Wewoka in sec. 1, T. 10 N., R. 10 E., Okfuskee County; NE¼ sec. 2, T. 14 N., R. 12 E., Okmulgee County; and S½ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County. From the Wetumka in the NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E., Pontotoc County; the Boggy in sec. 27, T. 3 N., R. 7 E., Pontotoc County; and from just below the Coffeyville formation, NE¼ sec. 33, T. 6 N., R. 7 E., Seminole County.

Repository.—Syntypes illustrated by Girty are in the U. S. National Museum. Other specimens, The University of Oklahoma, OU 407, 408, 411, 423, 3660, 3662, 3663.

Brachycycloceras longulum Miller and Owen, 1934
Plate 1, figure 7

1934. *Brachycycloceras longulum* Miller and Owen, Univ. Iowa. Studies, vol. 16, no. 3, p. 208, pl. 8, figs. 1-4.

Only one specimen of *Brachycycloceras longulum* is in The University of Oklahoma collections. This specimen is long, slender, straight, rather gradually expanded orad, and circular in cross section. It is 35 mm long and expands from a diameter of 7.4 mm at the adapical end to 15.8 mm at the adoral end. It is an internal mold of a living chamber and the adapical end is a mold of the ultimate septum.

The surface of the adapical portion is marked by well-defined annulations about 1 mm apart, but the adoral portion is smooth. Small bits of the test adhering to the specimen bear fine lirae parallel to the annulations.

The septa are directly transverse and rather deeply convex apicad. The siphuncle is small and is ventral but not marginal in position.

Remarks.—*B. longulum* can be differentiated from *B. normale* in that it is smaller, tapers more slowly, and has smaller annulations. It differs from *B. crebricinctum* in that that species has more closely spaced annulations.

Occurrence.—The only specimen available from Oklahoma is from the Wewoka formation in sec. 10, T. 13 N., R. 12 E., Okmulgee County. The types are from the Cherokee of Iowa.

Repository.—The syntypes were in the private collection of John Britts Owen, and are now at the State University of Iowa. The specimen described here is at the University of Oklahoma, OU 3661.

Genus *Pseudorthoceras* Flower and Caster, 1935

Pseudorthoceras knoxense (McChesney), 1860
Plate 1, figures 10, 11

1949. *Pseudorthoceras knoxense* Miller and Youngquist, Geol. Soc. America, Mem. 41, p. 18-22, pl. 2, figs. 1-7; pl. 3, figs. 2-8, pl. 55, figs. 15-17. (this reference contains complete synonymy to that date).

Pseudorthoceras knoxense is abundantly represented in the Pennsylvanian of Oklahoma, and is probably reported from more localities and stratigraphic units than any other cephalopod species. It has been the object of much study by many

paleontologists, especially Miller, Dunbar, and Condra (1933); Flower (1939); and Miller and Youngquist (1949).

Typically the species has a long, straight, slender conch which expands gradually toward the adoral end. The cross section is normally circular, but some specimens are depressed slightly to an elliptical section. In a few specimens in which the adapical portion is preserved there is a slight curvature and, in the extreme adapical region, the conch is somewhat asymmetrical and the apex is bluntly rounded.

All known specimens are chambered throughout, hence nothing is known of the living chamber. The test is smooth. The septa are simple saucer-like partitions, moderately convex apicad. They are evenly spaced in most specimens, but the spacing may differ slightly from one individual to another. In general the length of the camerae is about one-fifth the diameter of the shell.

The siphuncle is central in position. It is small where it passes through the septum, but the septal necks are short and recurved, and the siphuncle expands within the camerae. The siphonal segments are nearly cylindrical in the early part of the shell but become subspherical in the larger, more mature portions.

The camerae are lined with lamellar calcareous deposits which extend from the outer walls along the surface of the septa toward the center. These differ somewhat from specimen to specimen yet are remarkably similar. They are commonly thicker along the ventral side, and are more strongly developed in the adapical chambers.

Remarks.—The Oklahoma specimens of *P. knoxense* available for study range in size from the small initial portions of the conch, to some with diameters of nearly 20 mm.

Occurrence.—This ubiquitous species is probably the most widely known of all nautiloids. It ranges in age from Early Pennsylvanian to Middle Permian. Geographically it is known from North America, Europe, Russia, and Australia. In Oklahoma it ranges from the Morrow to the Virgil, and is reported from many localities.

Repository.—The location of the type specimens for *P. knoxense* is not known. The specimens studied by Flower are at the Paleontological Research Institution, nos. 5859-5864. Those described by Miller and Youngquist are at the U.S.N.M. and the State University of Iowa, SUI 1147, 1148, 1467-1469. At

the University of Oklahoma there are many specimens, numbered OU 108-110, 153, 303, 318, 382-385, 391, 394, 396, 402, 425, 426, 692, 693, 809, 852, 3666-3692. Almost every university and college collection in the United States contains some specimens of this common species.

Genus *Euloxoceras* Miller, Dunbar, and Condra, 1933

Euloxoceras greenei Miller, Dunbar, and Condra, 1933

Plate 1, figures 8, 9

1933. *Euloxoceras greenei* Miller, Dunbar, and Condra, Nebr. Geol. Survey, Bull. 9, 2d. ser., p. 99-101, pl. 1, figs. 12-15.

1944. *Euloxoceras greenei* Shimer and Shrock, Index Fossils N. America, p. 553, pl. 227, figs. 2, 3.

Euloxoceras greenei is represented in the available collections by 15 specimens all of which are fragments of internal molds of phragmocones. Typically they are straight, slender, and gradually expanded orad. The sides diverge at an angle of approximately 8 degrees. All are somewhat compressed laterally with flattened lateral zones, and in the adoral portions of larger specimens the cross section is subquadrate. Some are slightly more compressed than others. The available specimens range in height from 2 mm to 10 mm. Small fragments of the shell adhere to some specimens but there is no indication of ornamentation.

The sutures are sinuous and slightly oblique, sloping orad as they cross from the venter to the dorsum. Each forms broad, shallow, lateral lobes, and rounded dorsal and ventral saddles. The septa are moderately concave orad. The siphuncle is ventrad of the center, more strongly so in the more immature portions. Its diameter is approximately one-eighth of the height of the shell. The siphuncle expands within the camerae and is cylindrical.

The type is described by Miller, Dunbar, and Condra as having lamellar deposits along the connecting rings, but these are not well preserved in the material currently being studied.

Remarks.—E. greenei is easily differentiated from other orthoconic forms, with which it commonly occurs, by its lateral compression, elliptical to subquadrate cross section, and sinuous oblique sutures.

Occurrence.—The holotype is reported by Miller, Dunbar, and Condra to have come from "the basal part of the Kansas City group in the northwest quarter of sec. 29, T. 13 N., R. 10 E., Okfuskee County, Oklahoma." This is within the Hogshooter lime-

stone of current usage. They also reported specimens from the Wewoka and Francis formations of Oklahoma, and from the Bend and Cisco of Texas. Specimens are now available from the Francis shale, in NE¼ sec. 33, T. 6 N., R. 7 E.; the lower Nellie Bly formation in NW¼ sec. 9, T. 5 N., R. 7 E., the Coffeyville formation in the NE¼ sec. 33, T. 6 N., R. 7 E., and from the Holdenville shale above the Sasakwa limestone in SW¼ sec. 18, T. 6 N., R. 8 E., all in Seminole County.

Repository.—Holotype and topoparatypes, Yale Peabody Museum 13964. Heteroparatypes, Yale Peabody Museum, 13965-13974. Nebraska Geological Survey. Specimens described here, the University of Oklahoma, OU 694, 698, 3664, 3665.

Genus *Mooreoceras* Miller, Dunbar, and Condra, 1933
Mooreoceras normale Miller, Dunbar, and Condra, 1933
Plate 1, figures 14, 15

1931. *Orthoceras colletti* Morse [not S. A. Miller], Kentucky Geol. Survey, ser. 6, vol. 36, p. 300, 325-326, pl. 54, figs. 1, 2.
1933. *Mooreoceras normale* Miller, Dunbar, and Condra, Nebr. Geol. Survey, Bull. 9, 2d. ser., p. 87-89, pl. 2, figs. 5-7.
1934. *Mooreoceras normale* Miller and Owen, Univ. of Iowa, Studies in Nat. Hist., vol. 16, no. 3, p. 203-204, pl. 11, figs. 1-6.
1939. *Mooreoceras normale* Flower, Paleontographica Americana, vol. 2, no. 10, p. 146, 152.
1944. *Mooreoceras normale* Shimer and Shrock, Index Fossils N. America, p. 553, p. 226, figs. 14-15.
1946. *Mooreoceras normale* Sturgeon, Jour. Paleontology, vol. 20, p. 14, pl. 3, figs. 10-12.
1958. *Mooreoceras normale* Unklesbay and Palmer, Jour. Paleontology, vol. 32, p. 1072, pl. 138, fig. 14, 15.
1961. *Mooreoceras normale* Unklesbay, Okla. Geology Notes, vol. 21, p. 108-110, fig. 1.

The collections being studied contain numerous representatives of *Mooreoceras normale*. They are straight, gradually expanded orad, and circular to subcircular in cross section; most of them are slightly depressed. They are fragments of internal molds of the phragmocone, ranging in diameter from 4.5 to 80 mm.

The shell appears to have been moderately thick, and smooth. The septa are moderately convex apicad, and are simple saucer-like partitions. They are directly transverse to the long axis and the sutures are essentially straight. The space between the septa averages about one-fourth the diameter of the shell.

The siphuncle is subcentral, being slightly closer to the venter. Where it goes through the septa it is small, but the septal necks are recurved and the siphuncle expands greatly within the camerae.

An unusually large specimen from the Fort Scott limestone deserves special attention. This specimen is exceptionally well preserved. It consists of an internal mold of all the living chamber and much of the phragmocone. It is 455 mm long and, when theoretically reconstructed at the adapical end, it seems to have been nearly 700 mm when complete. The mold is essentially circular in cross section and expands rather gradually orad from the apical end to a position about 50 mm behind the apical end of the living chamber. From here forward the rate of expansion is reduced for about half the length of the living chamber. The adoral half of the living chamber is rather abruptly constricted and then expands orad at a slow rate. At the adapical end of this specimen the diameter is 38 mm. At the position mentioned above, 50 mm behind the living chamber, the diameter is 75 mm. At the mid-length of the living chamber, which is the adapical end of the constriction, the diameter is 80 mm. At the deepest part of the constriction, which is 15 mm anterior to the last measurement, the diameter is reduced to 70 mm and at the extreme adoral end, which appears to represent the aperture, the diameter is 74 mm. Whether this constriction represents a decrease in the outside diameter of the shell, or a thickening of the shell which reduced only the inside diameter, cannot be ascertained.

Only small bits of the test adhere to part of the specimen and they are not well enough preserved to give any information regarding the nature of the shell. The only ornamentation visible is the ventral ridge, which is common on many orthoconic nautiloids. In this specimen this ridge is straight, low, and inconspicuous. It is about 1.5 mm wide.

The septa are simple and saucer-shaped, and directly transverse. In the adapical part of the specimen they are about 7 mm apart. Near the middle of the phragmocone they are about 10 mm apart, but the last few, just apicad of the living chamber, are more closely spaced, indicating that this is a gerontic individual. The sutures are essentially straight.

The siphuncle is small, circular in cross section, and located ventrad of the center. Where the mold is 42.5 mm in diameter, the siphuncle is 3.5 mm in diameter and its center is 16.4 mm inside the ventral wall.

Remarks.—M. normale is usually not well preserved, and most specimens consist of fragments. Many of them are only internal molds of a single camera. The large specimen described here is one of the largest and most complete Pennsylvanian orthocones in North America. Miller and Owen, in 1934, described a specimen from the Cherokee of Henry County, Iowa, which was about 400 mm long, and which was completely septate.

Occurrence.—M. normale is rather widely distributed stratigraphically as well as geographically. It is known from the Morrowan to the Upper Pennsylvanian, and in the United States it has been reported from Ohio, Kentucky, Illinois, Missouri, Arkansas, Oklahoma, and Colorado. In Oklahoma it is known from the Altamont limestone in NW¼ sec. 9, T. 27 N., R. 16 E., Nowata County; the Boggy formation in sec. 27, T. 3 N., R. 7 E., Pontotoc County; the Seminole formation in NW¼ NW¼ NW¼ sec. 23, T. 17 N., R. 12 E., Tulsa County; the Holdenville shale at the southeast edge of Fittstown, T. 2 N., R. 6 E., Pontotoc County; the Chanute formation about 10 feet below the Iola limestone in SE¼ SE¼ sec. 9, T. 19 N., R. 10 E., Tulsa County; the shale below the Elgin sandstone, SE¼ sec. 17, T. 21 N., R. 8 E., Pawnee County; Atoka formation, NW¼ sec. 10, T. 17 N., R. 19 E., Cherokee County; the Nellie Bly formation in Creek County; the Buckhorn asphalt pit, Boggy formation, sec. 26, T. 1 S., R. 3 E., 3 miles south of Sulphur, Murray County; and the Wewoka formation in sec. 10, T. 13 N., R. 12 E., Okmulgee County. The large specimen described is from the Fort Scott limestone, probably the Blackjack Creek member, east of Tulsa, Oklahoma.

Repository.—Most collections of Pennsylvanian cephalopods in this country contain specimens of this species. They are common in the collections at the State University of Iowa, University of Missouri, and the University of Oklahoma. The large specimen described above is in the collection of the University of Tulsa. The holotype of the species is at Yale Peabody Museum, 13956. Specimens at the University of Oklahoma are OU 219, 409, 696, 3646-3654, 3946.

Mooreoceras tuba (Girty), 1911
Plate 1, figures 12, 13

1911. *Orthoceras tuba* Girty, New York Acad. Sciences, Annals, vol. 21, p. 142-143.

1915. *Orthoceras tuba* Girty, U. S. Geol. Survey, Bull. 544, p. 224-225, pl. 26, figs. 1-4.
(?)1924. *Orthoceras tuba* Morgan, [Okla.] Bur. of Geology, Bull. 2, pl. 53, fig. 3.
1933. *Mooreoceras tuba* Miller, Dunbar, and Condra, Nebr. Geol. Survey, Bull. 9, 2d. ser., p. 90-92, pl. 2, figs. 2-4.

Typically the conch of *Mooreoceras tuba* is slender, straight, and has a circular cross section. In some specimens there is a slight dorsoventral depression. The adapical portions of the shell taper rather gradually and evenly, but near the adoral end the rate of expansion is accelerated so that the shell flares abruptly. In some specimens this flare affects only the living chamber, but in others it affects the chambered portion of the shell.

The test is thin, and in some specimens shows transverse ornamentation.

The septa are like those of other species of *Mooreoceras* and the sutures are straight and directly transverse. The camerae are short, there being about four in a length equal to the diameter of the specimen.

The siphuncle is excentric, being ventrad of the center, and it expands rather greatly in the camerae. The septal necks are short and recurved. Cameral or septal deposits are not evident.

Remarks.—*M. tuba* is distinguished by the rapid expansion of the adoral end. Also it is generally smaller and the camerae slightly shorter than in *M. normale*.

Occurrence.—Girty's specimens came from the Wewoka formation in Wewoka and Coalgate quadrangles of Oklahoma. Miller, Dunbar and Condra report a specimen from the Iola (?) limestone near Bartlesville, Oklahoma. Other Oklahoma specimens are known from the Coffeyville formation in sec. 30 and SE¼ sec. 36, T. 12 N., R. 9 E., Okfuskee County; the Lecompton limestone in sec. 23, T. 21 N., R. 7 E., Pawnee County; the Stuart formation, C north line sec. 3, T. 3 N., R. 9 E., Coal County; the Holdenville, at Fittstown T. 2 N., R. 6 E., Pontotoc County; the Boggy in sec. 7, T. 3 N., R. 8 E., Pontotoc County; the upper Wetumka in sec. 18, T. 3 N., R. 7 E., Pontotoc County; and the Wewoka in sec. 33, T. 5 N., R. 8 E., Pontotoc County.

Repository.—Girty's types are at the U. S. National Museum. The University of Oklahoma specimens are OU 386, 387, 393, 3655-3659, 3923.

Order ONCOCERATIDA Flower, 1950
Family ACLEISTOCERATIDAE Flower, 1950

Genus *Poterioceras* M'Coy, 1844
Poterioceras sp.
Plate 5, figure 9; plate 6, figure 4

Poterioceras is represented in the Oklahoma collections by only one relatively poor specimen. It is an internal mold of a living chamber with fragments of the shell still attached. It is slightly curved, short, broad, and slightly depressed. It is 85 mm long and the maximum height and width are 56 mm and 67 mm respectively.

The adapical end is not well preserved and the nature of the septa is not discernible. The adoral end however is fairly well preserved and seems to represent the original aperture. In general the apertural margin is oblique, sloping apicad from the venter, hence the specimen is shorter on the dorsal side. On the ventral side the margin of the aperture extends forward into a short "rostrum" from which it curves sinuously across the lateral zones.

The shell preserved is about 1 mm thick. Externally it bears numerous fine transverse growth lines which are nearly parallel to the margin. The internal mold is smooth.

As this specimen bears no part of the phragmocone, nothing is known of the septa, sutures, or siphuncle.

Occurrence.—Wewoka formation on the north side of Oklahoma Highway 56, approximately 0.1 mile east of the Canadian River Bridge, west of Okmulgee, SE¼ SW¼ sec. 10, T. 13 N., R. 12 E., Okmulgee County.

Repository.—The University of Oklahoma, 4202.

Poterioceras curtum (Meek and Worthen), 1860

1860. *Cyrtoceras curtum* Meek and Worthen, Phila. Acad. Nat. Sciences, Proc., p. 468.

1860. *Cyrtoceras? dilatatum* Meek and Worthen, Phila. Acad. Nat. Sciences, Proc., p. 468.

1861. *Cyrtoceras (Aploceras) curtum* Meek and Worthen, Phila. Acad. Nat. Sciences, Proc., p. 148.

1866. *Cyrtoceras (Aploceras) curtum* Meek and Worthen, Illinois Geol. Survey, vol. 2, p. 388-389, pl. 30, figs. 1a-1c.

1866. *Cyrtoceras? dilatatum* Meek and Worthen, Illinois Geol. Survey, vol. 2, p. 389, pl. 29, fig. 2.

1910. *"Cyrtoceras" curtum* Raymond, Carnegie Museum, Annals, vol. 7, p. 156, pl. 25, fig. 6, pl. 26, fig. 8.
1911. *"Cyrtoceras" curtum* Raymond, Pennsylvania Topog. and Geol. Survey Comm., Rept. 1908-1910, p. 86, 87, 96, pl. 4, figs. 3, 4.
1911. *Cyrtoceras peculiare* Girty, New York Acad. Sciences, Annals, vol. 21, p. 149.
(?)1915. *Cyrtoceras??* sp. Girty, U. S. Geol. Survey, Bull. 544, p. 247, pl. 32, figs. 4-5a.
1915. *Cyrtoceras peculiare* Girty, U. S. Geol. Survey, Bull. 544, p. 246-247, pl. 28, figs. 1-16.
(?)1924. *Cyrtoceras* sp. Morgan [Okla.] Bur. Geology, Bull. 2, pl. 51, figs. 5, 5a.
1942. *Cyrtoceras curtum* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, p. 133-135, pl. 2, figs. 1-3, pl. 5, fig. 1.

An Oklahoma specimen of *Poterioceras curtum* was illustrated and described by Miller and Unklesbay as follows:

> . . . It represents the adoral part of the phragmacone and the adapical part of the living chamber of what appears to be a mature individual. It is about 75 mm. long and the portion of the conch it represents is straight. In cross section it is circular, and at its adapical end it is about 50 mm. in diameter. Its sides diverge adorally at an angle of some 40 degrees. Near the adoral end of this specimen the test is is about 2½ mm. thick. Its surface is marked by very distinct transverse striae, which appear to be confined to a surface layer of the test. Near the adapical end of the specimen these striae are less than 1 mm. apart, whereas on the adoral portion the distance between successive striae measures as much as 2½ mm. As in the holotype, the striae are sinuous and are not directly transverse. However, both their obliquity and their sinuosity may be the result of distortion during preservation for neither is symmetrical with respect to the siphuncular side of the conch. The siphuncle is small and is located fairly close to the venter; at the adapical end of the specimen under consideration, the siphuncle is about 2 mm. in diameter at its passage through a septum and its center is about 10 mm. from the venter.

The Wewoka specimen illustrated by Girty and described as *Cyrtoceras??* sp., and the one which Morgan illustrated as *Cyrtoceras* sp. may very well be conspecific with the one described above, but it is difficult to ascertain their relationships from the published data.

Girty's other Wewoka specimen, which he called *Cyrtoceras peculiare* may also be conspecific.

Occurrence.—The specimen described by Miller and Un-

klesbay is from the Lansing (Eudora shale) 4 miles north and 2 miles east of Copan, Washington County.

Repository.—State University of Iowa, SUI 3116.

Order RUTOCERATIDA Flower, 1950
Family KONINCKIOCERATIDAE Hyatt, 1893

Genus *Endolobus* Meek and Worthen, 1865
Endolobus sp.

The genus *Endolobus* is represented in the Oklahoma collection by two poorly preserved specimens which do not merit illustration, and which provide only meager basis for description. The smaller specimen is the better. It is entirely septate and represents an individual which was at least 100 mm in diameter and whose conch was at least 70 mm in maximum width and 35 mm high. The cross section of the whorl is broadly elliptical with the venter being broadly rounded, the lateral zones narrowly rounded, and the dorsal zone slightly impressed. The siphuncle is slightly ventrad of the center and where the whorl height is 26 mm the siphuncle is 3 mm in diameter. The umbilicus is large and open. The sutures form a broad, rounded, shallow ventral lobe.

The larger specimen is less well preserved, but it represents an individual that reached a maximum diameter of at least 200 mm.

Miller, Dunbar, and Condra (1933) mentioned a small fragmentary specimen of this genus from "some unrecorded horizon and locality in the Pennsylvanian of Osage County, Oklahoma."

Occurrence.—These two specimens are from the Hale formation, 3 miles north of Webbers Falls, in Muskogee County.

Repository.—The University of Oklahoma, OU 3897.

Family TAINOCERATIDAE Hyatt, 1883

Genus *Tainoceras* Hyatt, 1883
Tainoceras monilifer Miller, Dunbar, and Condra, 1933
Plate 2, figure 10

(?)1871. *Nautilus occidentalis* Meek [not Swallow], West Virginia Univ., Board of Regents, 3d Ann. Rept., p. 71.

1872. *Nautilus occidentalis* Meek [not Swallow], Final Rept. U. S. Geol. Survey Nebraska . . . (U. S. 42d. Cong., 1st. sess., House Ex. Doc. 19) p. 234-236, pl. 11, fig. 17.

(?)1903. *Nautilus occidentalis* Meek [not Swallow], West Virginia Geol. Survey, vol. 2, p. 258 but probably not p. 325.
1910. *Tainoceras occidentale* Raymond [not Swallow], Carnegie Museum Annals, vol. 7, p. 147, 148, 149, 156, pl. 27, fig. 7.
1911. *Tainoceras occidentale* Raymond [not Swallow], Pennsylvania Topog. and Geol. Survey Comm., Rept. 1908-1910, p. 90, 92, 93, 96, pl. 6, fig. 7.
1912. *Tainoceras occidentale* Mark [not Swallow], Ohio Geol. Survey, Bull. 17, 4th ser., p. 279, 281, 299.
1933. *Tainoceras monilifer* Miller, Dunbar, and Condra, Nebraska Geol. Survey, Bull. 9, 2d ser., p. 148-151, pl. 10, figs. 1-5.
1942. *Tainoceras monilifer* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, p. 142-143, pl. 4, figs. 1-3.
1947. *Tainoceras monilifer* Miller and Unklesbay, Carnegie Museum, Annals, vol. 30, art. 18, p. 322.

This rather distinctive species, *Tainoceras monilifer*, is represented in the collections being studied by only two specimens from the same horizon and locality. They are poorly preserved fragments of internal molds, and each bears part of the phragmocone and living chamber. They can be readily identified by the characteristic ventrolateral nodes.

The larger specimen represents more than one volution and has a maximum diameter of 60 mm. The maximum width of the venter, between distal ends of the nodes, is 40 mm. The venter bears a pronounced groove down the center and on either side of it there is a row of nodes. Also preserved are prominent ventrolateral nodes on each side of the specimen.

The other specimen is similar. It shows the nature of the suture on the umbilical wall and on the lateral zone where it forms a rounded lobe. The umbilical shoulder also bears a row of nodes.

Remarks.—Despite the poor state of preservation these specimens retain the essential characteristics of the species.

Occurrence.—The genus *Tainoceras* is abundantly represented in the Pennsylvanian and Lower Permian of the United States, and it occurs also in the Pennsylvanian of Russia, and probably the Permian of Italy.

T. monilifer is known in the Cisco of Texas; the Lawrence shale, the Kereford limestone, and the Burlingame limestone of Kansas; the Iatan limestone of Nebraska; and the Conemaugh of Pennsylvania. The specimens described here are from the Vamoosa formation about 2 miles south-southwest of Wynona is Osage County.

Repository.—Miller, Dunbar, and Condra described a holotype but did not indicate the repository. Specimens described

by Miller and Unklesbay are in the Carnegie Museum, 705, 149, 10434, 22299. The two specimens described here are at the University of Oklahoma, OU 3695, 3696.

Tainoceras murrayi Miller and Unklesbay, 1942
Plate 2, figures 11, 12

1942. *Tainoceras murrayi* Miller and Unklesbay, Jour. Paleontology, vol. 16, p. 729, pl. 114, figs. 2, 3.

This species was established and described by Miller and Unklesbay for three specimens from Osage County. These are still the only known representatives of the species.

T. murrayi differs from *T. monilifer* in having a smooth umbilical shoulder.

T. murrayi is similar to *T. monilifer* in most respects, but can be differentiated by the lack of nodes on its umbilical shoulder.

Occurrence.—These specimens came from a "yellow shaly calcareous sandstone about 6.1 feet above the Lecompton limestone (which therefore may be upper Lecompton or basal Tecumseh) near the junction of sec. 32 and sec. 33, T. 28 N., R. 9 E., Osage County, Oklahoma."

Repository.—State University of Iowa 2123, holotype; and University of Tulsa, paratypes.

Genus *Foordiceras* Hyatt, 1893
Foordiceras bellatulum (Miller and Owen), 1934
Plate 2, figures 13, 14

1934. *Parametacoceras bellatulum* Miller and Owen, Univ. Iowa Studies, vol. 16, no. 3, p. 233, pl. 15, figs. 1-5.
1949. *Foordiceras bellatulum* Miller and Youngquist, Geol. Soc. America, Mem. 41, p. 96-97.

Eleven specimens of *Foordiceras bellatulum* from the Pennsylvanian of Oklahoma are conspecific with those described by Miller and Owen.

The conch in this species is thickly sub-discoidal to globose, and is nautiliconic. It has a rectangular cross section in the more mature portions, but this develops gradually out of an elliptical section in the earlier whorls. The venter is relatively wide and nearly flat, being weakly convex. The lateral zones are convex outward to nearly flat, and the ventral-lateral zones are rounded. The umbilical wall is steep and forms a rounded shoulder with

the lateral zones. The dorsal zone bears a shallow impressed zone. The lateral zones bear transverse ribs which are slightly oblique to the long axis. The septa are convex apicad and the sutures form a broad, shallow ventral lobe and shallow lateral lobes. The siphuncle is small and slightly ventrad of the center. Where a typical specimen is 12.5 mm wide the siphuncle is only 1 mm in diameter.

The surface of the test is ornamented with fine, closely spaced growth lines, which form broadly rounded ventral sinuses and are nearly straight across the lateral zones. The ventral sinus in this form is not as deep as it is in species of *Metacoceras*.

Remarks.—Miller and Youngquist (1949) pointed out that this genus had been overlooked in American studies because Hyatt's original description is poor and because he included in it at that time only species from Europe and Asia. It now seems clear that there are typical American representatives of this genus and that some of them have been referred to *Metacoceras*. Miller and Youngquist suppressed Miller and Owen's *Parametacoceras* as a synonym of *Foordiceras*.

Occurrence.—Miller and Owen's types are from the Cherokee of Henry County, Missouri. The Oklahoma specimens are from the Wewoka in sec. 33, T. 5 N., R. 8 E., and the NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E.; the Wetumka shale in sec. 18 southeast of Ada, and the Holdenville 5 miles northeast of Ada, all in Pontotoc County.

Repository.—The holotype and eleven paratypes were in the private collection of John Britts Owen, and are at the State University of Iowa. Those mentioned here are at the University of Oklahoma 372, 401, 697, 3732, 3733.

Genus *Metacoceras* Hyatt, 1883
Metacoceras carinatum Girty, 1911
Plate 3, figures 1-4

1911. *Metacoceras cornutum* var. *carinatum* Girty, New York Acad. Science, Annals, vol. 21, p. 146.

1915. *Metacoceras cornutum* var. *carinatum* Girty, U. S. Geol. Survey, Bull. 544, p. 243, pl. 30, figs. 3-4c.

1933. *Metacoceras carinatum* Miller, Dunbar, and Condra, Nebraska Geol. Survey, Bull. 9, 2d ser., p. 167.

Metacoceras carinatum, a rather distinctive species first recognized by Girty as a variety of *M. cornutum*, is represented in the collections by 20 specimens. All are closely alike in physiognomy, and all are fragmental internal molds of phragmocones

and living chambers. They are nautiliconic with low, broad, elliptical cross section. The ventral zones are rounded and convex and the lateral zones are narrowly rounded into the umbilicus without a sharply defined umbilical zone. On some of them the carina along the umbilicus, mentioned by Girty, is well defined. The dorsal zone is impressed except on the immature portions of the small specimens. A medium-sized specimen has a maximum width of 10 mm and a height of 6 mm. The lateral zones bear transverse, closely spaced nodes along the widest part of the conch.

The septa are not closely spaced, and are directly transverse. The sutures form broad ventral and dorsal lobes, and narrowly rounded lateral lobes. The siphuncle is small and nearly central in position.

Remarks.—M. carinatum is easily distinguished by its low broad cross section, and by the prominent nodes along the lateral zones.

Occurrence.—Girty's type came from the Wewoka of the Wewoka and Coalgate quadrangles. We now have specimens from the Wewoka in the S½ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County; and sec. 24, T. 5 N., R. 8 E., Seminole County; also from the Holdenville in the SE¼ sec. 36, T. 11 N., R. 9 E., and sec. 12, T. 10 N., R. 9 E., Okfuskee County.

Repository.—Girty's types are at the U. S. National Museum. The specimens described here are at the University of Oklahoma, OU 142, 3702, 3706, 3707, 3710, 3720.

Metacoceras cornutum Girty, 1911
Plate 2, figures 1-9

1910. *Temnocheilus winslowi* Raymond [not Meek and Worthen], Carnegie Museum, Annals, vol. 7, p. 156.
1911. *Temnocheilus winslowi* Raymond [not Meek and Worthen], Pennsylvania Topog. and Geol. Survey Comm., Rept. 1908-1910, p. 86, 88, 90, 96.
1911. *Metacoceras cornutum*, Girty, New York Acad. Sciences, Annals, vol. 21, p. 145-146.
1915. *Metacoceras cornutum* Girty, U. S. Geol. Survey, Bull. 544, p. 240-242, pl. 29, figs. 4-5b.
1924. *Metacoceras cornutum* Morgan, [Okla.] Bur. Geology, Bull. 2, p. 83, 118, pl. 53, figs. 1, 1a.
1942. *Metacoceras cornutum* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, art. 5, p. 139-141, pl. 3, figs. 1-5.
1947. *Metacoceras cornutum* Miller and Unklesbay, Carnegie Museum, Annals, vol. 30, art. 18, p. 322, pl. 1, figs. 9, 10.

1948. *Metacoceras cornutum* Sturgeon and Miller, Jour. Paleontology, vol. 22, p. 77.

This abundant species was recognized first in the Wewoka by Girty and is represented in the collection being studied by about 60 specimens. Unfortunately none of them is complete, but collectively they show the significant features of the species.

The conch of *Metacoceras cornutum* is subdiscoidal and nautiliconic, but only slightly involute. The whorls are gradually expanded orad and are subrectangular in cross section, being wider than high. The dorsum is slightly impressed. The umbilical shoulder is steep and abruptly set off from the lateral zone. The lateral zones are slightly rounded and diverge ventrad. The ventral zone is convex and rounded. In the immature portion of the shell the lateral zone has prominent transverse ribs which, with maturity, become shorter and in mature forms the ventrolateral shoulders bear rounded subconical nodes. The nodes are not so prominent on the internal molds as they are on testiferous specimens. The umbilicus is large and open.

The surface of the test bears closely spaced growth lines which form deep, rounded to subacute ventral sinuses and on the lateral zones they are sigmoidal forming a salient next to the ventrolateral shoulder and a sinus across the umbilical wall. The test is thicker over the umbilical shoulder, accenting the abruptness. This is especially true in this species.

The sutures are an expression of the shape of the conch and form broad, shallow ventral, lateral, and dorsal lobes. The siphuncle is small and is slightly ventrad of the center.

At the mid-length of the living chamber a typical specimen has the following dimensions in millimeters:

Ventral width between distal ends of nodes	25
Dorsoventral height	15
Width at umbilical shoulder	19.5
Width of impressed zone	7
Spacing of nodes	6.5

Remarks.—*M. cornutum* is distinctive in having a sharp non-nodose umbilical shoulder and subconical nodes along the ventrolateral zones. It resembles the type species, *M. sangamonense*, rather closely, but that species has slightly concave lateral zones and steep umbilical walls.

Occurrence.—The types of this species came from the Wewoka, and we now also have specimens from the Boggy, Francis, Calvin, Stuart, Holdenville, Nellie Bly, and from the shale under

the Wildhorse. Also this species has been reported from the Boggy (Morgan, 1924, Weaver, 1954, Ries, 1954); the Coffeyville (Ries, 1954, Tanner, 1956); the Holdenville and Checkerboard (Ries, 1954); and the Seminole, Stuart, Calvin, and Wewoka (Weaver, 1954). The species is also known from the Conemaugh of Pennsylvania and Ohio.

Repository.—Types, U. S. National Museum. Those described and mentioned by Miller and Unklesbay, State University of Iowa, SUI 3118, 3120-3123, 13636, 13637; Carnegie Museum. Specimens described here, The University of Oklahoma, OU 363, 370, 375, 403, 406, 410, 424, 690, 3711-3719, 3722-3724.

Metacoceras perelegans Girty, 1911
Plate 3, figures 6, 7

1858. *Nautilus decoratus* Rogers [not Cox], The geology of Pennsylsylvania, a government survey, vol. 2, pt. 2, p. 833, fig. 692.
1910. *Temnocheilus crassus* Raymond [not Hyatt], Carnegie Museum, Annals, vol. 7, p. 156.
1911. *Temnocheilus crassus* Raymond [not Hyatt], Pennsylvania Topog. and Geol. Survey Comm., Rept. 1908-1910, p. 86, 88, 90, 96.
1911. *Metacoceras perelegans* Girty, New York Acad. Sciences, Annals, vol. 21, p. 147-148.
1915. *Metacoceras perelegans* Girty, U. S. Geol. Survey, Bull. 544, p. 244-245, pl. 30, figs. 5-6.
1933. *Metacoceras perelegans* Miller, Dunbar, and Condra, Nebraska Geol. Survey, Bull. 9, 2d ser., p. 167.
1942. *Metacoceras perelegans* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, art. 5, p. 141-142, pl. 1, figs. 8-10; pl. 3, figs. 6-8.
1946. *Metacoceras perelegans* Sturgeon, Jour. Paleontology, vol. 20, p. 25-26, pl. 6, figs, 3, 4.
1947. *Metacoceras perelegans* Miller and Unklesbay, Carnegie Museum, Annals, vol. 30, art. 18, p. 322.

Metacoceras perelegans is not abundant in the collections at hand, and we have only four specimens. These are not well preserved, but they seem to exhibit the essential features of the species. The immature forms bear transverse lateral ribs with slightly prominent pilae at the ends. In the mature forms these ribs have become modified so that the terminal pilae become nodes along the ventrolateral and umbilicolateral zones. In most other respects the species is similar to *M. cornutum.*

Occurrence.—M. perelegans was first described from the Wewoka by Girty from his stations 2001, 2004, 2005, 2006, and 7193. We now have specimens from the Boggy in sec. 17, T. 2 N.,

R. 7 E., Pontotoc County; the Coffeyville in NE¼ sec. 33, T. 6 N., R. 7 E., Seminole County; SE cor. sec. 36, T. 11 N., R. 9 E., Okfuskee County, and the Holdenville northwest of Beggs, Okmulgee County. It has also been reported from the Wewoka by Ries (1954) and from the Coffeyville by Tanner (1956).

Repository.—Types, U. S. National Museum. Those described by Miller and Unklesbay, Carnegie Museum, 22295, 22296; State University of Iowa, SUI 3124-3127, 13638. Specimens described here are at the University of Oklahoma, OU 413, 691, 3703, 3704.

Metacoceras sinuosum Girty, 1911
Plate 3, figures 8, 9

1911. *Metacoceras cornutum* var. *sinuosum* Girty, New York Acad. Sciences, Annals, vol. 21, p. 146.
1915. *Metacoceras cornutum* var. *sinuosum* Girty, U. S. Geol. Survey, Bull. 544, p. 242, pl. 30, figs. 1-1b.
1933. *Metacoceras sinuosum* Miller, Dunbar, and Condra, Nebraska Geol. Survey, Bull. 9, 2d ser., p. 167.
(?)1934. *Metacoceras* aff. *M. sinuosum* Miller and Cline, Jour. Paleontology, vol. 8, p. 175.

Metacoceras sinuosum was originally mentioned by Girty as a variety of *M. cornutum*, and was based on a single specimen. However, we now have some 30 specimens which exhibit the features which Girty regarded as significant.

These specimens are all subdiscoidal, gradually expanded internal molds of parts of the phragmocone and living chamber. All have a subquadrate cross section. The venter in immature specimens is convex but gradually becomes flattened. The lateral zones are convex, and they form a fairly abrupt ventrolateral shoulder which curves into the broadly rounded, sloping umbilical wall. The umbilicus is large and open. The most complete specimen available represents most of the phragmocone and living chamber. It has a maximum diameter of 91 mm and the umbilicus is 37 mm across. At the adoral end it has a whorl width of 35 mm, not including nodes. The maximum dorsoventral height is 32 mm.

The septa are strongly convex apicad and directly transverse. Near the adoral end of the phragmocone they are 6.5 mm apart. The sutures form a deep rounded ventral lobe, high subangular ventrolateral saddles, and broad shallow lateral lobes.

Part of the specimen is testiferous and the surface bears fine, closely spaced growth lines which form a deep narrowly

rounded ventral sinus, a high, rounded ventrolateral salient, broad, shallow lateral sinus, then curve sinuously forward over the umbilical wall.

Immature portions of the conch bear elongate transverse ribs which, as the shell develops, become shorter and in the mature portions become rounded conical nodes along the ventrolateral shoulder. In well-preserved specimens these are high enough to be considered as short spines. Near the adoral end of the large specimen the nodes are about 8 mm apart.

The siphuncle is slightly ventrad of the center and is small.

Remarks.—This species can be readily distinguished from others of this genus by its convex smoothly rounded umbilicolateral zones.

Occurrence.—Girty's type came from the Wewoka formation. We now have specimens from the Holdenville in SE¼ sec. 36, T. 11 N., R. 9 E.; sec. 12, T. 10 N., R. 9 E.; Okfuskee County; and sec. 18, T. 6 N., R. 18 E., Seminole County; from the Vamoosa formation 2 miles south-southwest of Wynona in Osage County; from the Wewoka 2.4 miles west of Okmulgee, Okmulgee County; from the Calvin sandstone in sec. 23, T. 9 N., R. 11 E., Hughes County; from the Coffeyville in sec. 36, T. 12 N., R. 9 E., Okfuskee County; and NE¼ sec. 33, T. 6 N., R. 7 E., Seminole County; from the Boggy in sec. 17, T. 2 N., R. 7 E., Pontotoc County; from the "Buckhorn asphalt" in sec. 26, T. 1 S., R. 3 E., Murray County; and from the Lenapah limestone 1½ miles north of Lenapah, Nowata County.

Repository.—Holotype: U. S. National Museum. Specimens described here: the University of Oklahoma, OU 142, 428, 643, 1252, 3220, 3708, 3721, 3725-3731, 3748.

Metacoceras vagans Miller and Owen, 1937
Plate 3, figures 10, 11

1937. *Metacoceras vagans* Miller and Owen, Jour. Paleontology, vol. 11, p. 407-408, pl. 50, figs. 1-5.

One specimen of *Metacoceras vagans*, from the same horizon and locality as the holotype of this species, is now available for study. It is a testiferous internal mold of one and a half volutions of which all but the last fifth is phragmocone. It has a maximum diameter of 22.2 mm and a maximum whorl height of 9 mm. Although this specimen is embedded in hard black limestone, and is too delicate to permit complete removal, its visible features agree closely with the description of the holotype.

Occurrence.—Seminole formation, just above the Dawson coal, near Collinsville, Tulsa County.

Repository.—The holotype was in the private collection of John Britts Owen, and is now at the State University of Iowa. The specimen described here is a topotype and is at the University of Oklahoma, OU 3709.

Order CENTROCERATIDA Flower, 1950
Family DOMATOCERATIDAE Miller and Youngquist, 1949

Genus *Domatoceras* Hyatt, 1891
Domatoceras sculptile (Girty), 1911
Plate 5, figures 1, 2

1911. *Metacoceras sculptile* Girty, New York Acad. Sciences, Annals, vol. 21, p. 148.
1915. *Metacoceras sculptile* Girty, U. S. Geol. Survey, Bull. 544, p. 245-246, pl. 31, figs. 1-2a.
(?)1919. *Metacoceras sculptile* var. nov. Price, Geol. Soc. America, Bull., vol. 30, p. 578.
(?)1922. *Metacoceras sculptile* Plummer and Moore, Univ. Texas, Bull. 2132, p. 220.
(?)1931. *Metacoceras sculptile* Morse, Kentucky Geol. Survey, ser. 6, vol. 36, p. 300.
1933. *Pseudometacoceras sculptile* Miller, Dunbar, and Condra, Nebraska Geol. Survey, Bull. 9, 2d ser., p. 226-228, pl. 6, figs. 9-12.
1944. *Pseudometacoceras sculptile* Shimer and Shrock, Index Fossils N. America, p. 547, pl. 224, figs. 7, 8.
1949. *Domatoceras sculptile* Miller and Youngquist, Geol. Soc. America, Mem. 41, p. 41-42, pl. 9, figs. 2-5.

Fifteen specimens representing *Domatoceras sculptile* are available for study. They are all testiferous internal molds of living chambers and a few of them have a mold of the last camera attached. Each one represents about one-fourth of a volution, which is apparently the length of the living chamber. All are about the same size, the largest being 55 mm along the venter and the smallest 25 mm.

They are nautilicones with a rather shallow dorsal impressed zone. The cross section is subquadrate with the ventral and lateral zones being flattened and sharply demarcated at the ventral shoulder. The sides are nearly parallel and are nearly at right angles to the venter. The umbilical shoulder is well defined, and the umbilical wall is steep, making an angle of

slightly more than 90 degrees with the lateral zone. The impressed zone is not deep. A typical specimen has the following dimensions: ventral length, 14 mm; ventral width near mid-length, 14 mm; height of lateral zone, 11 mm; width of umbilical wall, 5.5 mm; width of dorsal impressed zone, 6.4 mm; depth of impressed zone, 1.5 mm. The ventrolateral shoulder bears a row of nodes which are slightly elongate longitudinally. The umbilical shoulder is not nodose. The umbilicus is relatively large.

The septa are slightly oblique, sloping apicad as they cross from the dorsum to the venter. Consequently the sutures form asymmetrical broad shallow lateral lobes, narrow ventrolateral saddles and a broad shallow ventral lobe. The siphuncle is dorsad of the center and is small. Where one specimen has a maximum width of 14 mm, the siphuncle is 10 mm in diameter.

The surface ornamentation of the test is similar to that of *Metacoceras*. It consists of closely spaced, fine growth lines which form a broadly rounded, deep ventral sinus, high ventrolateral salients, and shallow, rounded lateral sinuses.

Remarks.—D. sculptile was for several years regarded as the type species for the genus *Pseudometacoceras* because of the absence of ventrolateral nodes in the immature stages and the development of these nodes in the more mature portions of the conch. Miller and Youngquist (1949), however, make it clear that this habit is characteristic of many species of *Domatoceras*. Hence, they chose to suppress *Pseudometacoceras*.

Occurrence.—The types of this species are from the Wewoka formation in the Wewoka quadrangle, and others are known from the Holdenville, in sec. 36, T. 11 N., R. 9 E., and sec. 12, T. 10 N., R. 9 E., Okfuskee County; from the Wetumka in sec. 18, T. 3 N., R. 7 E., Pontotoc County; from the Coffeyville in sec. 36, T. 12 N., R. 9 E., Okfuskee County, and from the Wewoka in sections 21 and 28, T. 7 N., R. 9 E., Hughes County. Also one other specimen is known from the Nellie Bly, 5.8 miles west of the south end of Sand Springs Bridge, Tulsa County. In other areas this species is believed to occur in the Ames limestone of Maryland, the Kendrick shale of Kentucky, and the Graham shale of Texas.

Repository.—Girty's types are in the U. S. National Museum. The specimens described here are at the University of Oklahoma, OU 376, 390, 399, 3698-3700, 4203.

Domatoceras williamsi Miller and Owen, 1934
Plate 4, figure 7

1934. *Domatoceras williamsi* Miller and Owen, Iowa University Studies Nat. Hist. n. s., no. 280, vol. 16, no. 3, p. 246-250, pl. 16, fig. 4; pl. 17, fig. 1-4; pl. 18, fig. 1.

1948. *Domatoceras williamsi* Sturgeon and Miller, Jour. Paleontology, vol. 22, p. 77-78, pl. 18, fig. 1.

Several fragmentary specimens from the Buckhorn asphalt locality in the Boggy formation represent *Domatoceras williamsi* in the Oklahoma collections. Only one of these merits much attention. It is a somewhat crushed and distorted septate internal mold of part of four tarphyceraconic volutions. At the end of the first volution the whorl is 8 mm high, at the second it is 22 mm, at the third 60 mm, and the fourth is broken but was in excess of 75 mm. Only the left side of the specimen is visible, and it has been worn so that the precise nature of the lateral zones is not known. Also there is no evidence of the shell ornamentation except for a faint suggestion of nodes along the venter as illustrated in Miller and Owen's specimen.

Remarks.—Despite the poor preservation of this specimen, it seems to display the same specific characteristics as the types.

Occurrence.—Miller and Owen's specimens are from the Cherokee of Henry and Vernon Counties, Missouri. The specimen described here is from the Buckhorn asphalt locality, Boggy formation, sec. 26, T. 1 S., R. 3 E., Murray County, Oklahoma.

Repository.—State University of Iowa; the University of Oklahoma, OU 3771.

Domatoceras spp.
Plate 4, figures 1, 2

There are available three fragmentary specimens of *Domatoceras* which are different from previously established species, but which do not in themselves provide sufficient basis for establishment of a new species.

Two specimens are much alike, and are from the Wewoka. One is an internal mold of a portion of a phragmocone and the other of a living chamber. The whorls in these specimens have a nearly flat ventral surface, sharp ventrolateral shoulders and nearly flat sides which diverge toward the umbilicus where they are rounded to a fairly abrupt umbilical shoulder. The dorsal zone is impressed. The umbilicus is large and the walls are steep.

The larger specimen has a maximum width, at mid-length, of 25.5 mm. Here the height of the lateral zone is 24.8 mm and the ventral width is 17 mm. The test bears fine growth lines which form a broadly rounded ventral sinus from which they curve forward over the ventrolateral shoulder across the lateral zone in a broad lateral salient.

The septa are almost directly transverse, and the sutures form deep broadly rounded lateral lobes, high subangular ventrolateral saddles and a broad shallow lateral lobe. The siphuncle is small and is slightly ventrad of the center.

The third specimen is similar in most respects to the others except that it is relatively broader, and has a concave venter with prominent subacute ventrolateral shoulders.

Remarks.—These specimens are in many respects similar to described species of *Domatoceras*. They differ from *D. kleihegei* in having the siphuncle nearly central; from *D. umbilicatum* in having more strongly flattened sides; and from *D. williamsi* in having a narrower ventral zone. Also these specimens do not bear ventrolateral nodes as do some species of this genus.

Occurrence.—The two specimens first mentioned are from the Wewoka, in Okfuskee County, and the other (OU 361) is from the Wetumka in Pontotoc County.

Repository.—The University of Oklahoma, OU 361 and 392.

Order SOLENOCHILIDA Flower, 1950
Family SOLENOCHILIDAE Hyatt, 1893

Genus *Solenochilus* Meek and Worthen, 1870
Solenochilus missouriensis Miller, Lane, and Unklesbay, 1947
Plate 4, figures 4, 5

(?) 1910. *Solenochilus collectus* Raymond, Carnegie Museum, Annals, vol. 7, p. 156.

(?) 1911. *Solenochilus collectus* Raymond, Pennsylvania Topog. and Geol. Survey Comm., Rept. 1908-1910, p. 86, 88, 96.

1942. *Solenochilus brammeri?* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, p. 128, 130, 144-145, pl. 6, figs. 1, 2, pl. 7, figs. 3-6.

1947. *Solenochilus missouriensis* Miller, Lane, and Unklesbay, Univ. Kansas, Paleont. Contrib., Mollusca, art. 2, p. 10, pl. 4, figs. 3, 4.

In the collections being studied there is only one specimen of the genus *Solenochilus*, and it appears to be conspecific with the holotype of this species. It is a well-preserved internal mold of the adapical ten camerae and constitutes slightly more than half a volution. The apical end consists of the first camera. It is blunt, asymmetrical, and somewhat patellate in shape. From there the whorl expands rapidly and begins to coil. At the adoral end of the fifth camera the mold is 12 mm wide and 10.5 mm high. In the next five camerae it widens to 22 mm and the height increases to 15 mm. An umbilical plug on the side of the specimen indicates that before it was broken this specimen had at least one more volution, and was approximately 70 mm in diameter.

The whorl is broadly rounded over the venter, slightly flattened laterally, and has an abrupt and steep umbilical wall. The umbilicus is small.

Small bits of test adhere to the mold, and they seem to be smooth and show no surface ornamentation.

The camerae are moderately long. The ten occupy a length of 45 mm measured along the venter. Each suture forms a pronounced but small ventral lobe. On each side of the lobe there is a flat lateral saddle which extends to the ventrolateral region. On the lateral zones the suture curves orad to form a broad, shallow lateral lobe.

The siphuncle is small, and was in contact with the ventral wall of the conch. The septal necks are essentially straight and about half as long as the camerae. Near the mid-length of the specimen it is less than 1 mm in diameter. There seems to have been no significant expansion within the camerae.

Remarks.—*S. missouriensis* is distinct from other species of *Solenochilus* in having sinuous sutures and relatively flat lateral zones.

Occurrence.—This species, which is widespread in Europe and North America, ranges from Lower Mississippian to Lower Permian. However, only one other Oklahoma occurrence has been reported (Newell, 1937). The specimen described here is from the Wewoka formation 2.5 miles west of Okmulgee.

Repository.—Holotype, University of Kansas, 577. Specimen described here, The University of Oklahoma, OU 3697.

Order NAUTILIDA Spath, 1927
Family LIROCERATIDAE Miller and Youngquist, 1949

Genus *Liroceras* Teichert, 1940
Liroceras liratum (Girty), 1911
Plate 5, figures 6-8; plate 6, figures 5, 6
text-figure 1

1911. *Coloceras liratum* Girty, New York Acad. Sciences, Annals, vol. 21, p. 144.
1911. *Coloceras liratum* var. *obsoletum* Girty, New York Acad. Sciences, Annals, vol. 21, p. 145.
1915. *Coloceras liratum* Girty, U. S. Geol. Survey, Bull. 544, p. 237-238, pl. 28, figs. 2-6a.
1915. *Coloceras liratum* var. *obsoletum* Girty, U. S. Geol. Survey, Bull. 544, p. 238-239, pl. 29, figs. 1-3a.
1922. *Coloceras liratum* Plummer and Moore, Univ. Texas, Bull. 2132, p. 219.
1924. *Coloceras liratum* Morgan, [Okla.] Bureau Geology, Bull. 2, p. 232, pl. 51, fig. 4.
1933. *Coloceras liratum* Miller, Dunbar, and Condra, Nebr. Geol. Survey, Bull. 9, 2d ser., p. 132-134, pl. 6, figs. 1-8.
1933. *Coloceras obsoletum* Miller, Dunbar, and Condra, Nebr. Geol. Survey, Bull. 9, 2d. ser., p. 134-136, pl. 7, figs. 4-7.
1934. *Coloceras liratum?* Miller and Cline, Jour. Paleontology, vol. 8, p. 173-175, pl. 28, figs. 24-26.
1940. *Liroceras liratum* Teichert, Jour. Paleontology, vol. 14, p. 590.
1944. *Liroceras liratum* Shimer and Shrock, Index Fossils N. America, p. 545, pl. 223, figs. 8-10.
1946. *Liroceras liratum* Sturgeon, Jour. Paleontology, vol. 20, p. 19-20, pl. 4, figs. 6-9.
1949. *Liroceras liratum* Miller and Youngquist, Geol. Soc. America, Mem. 41, p. 120, pl. 53, figs. 3-6.
1958. *Liroceras liratum* Unklesbay and Palmer, Jour. Paleontology, vol. 32, p. 1073, pl. 138, figs. 1-3.

Liroceras liratum, recognized by Girty in 1911, is represented in the current collections by some 40 specimens, all of which are closely similar. All are internal molds and they vary considerably in quality of preservation. Most of them consist of less than one volution. All are nautiliconic and subglobose with rounded ventral and lateral zones, and impressed dorsal zones, which give them a reniform cross section. The umbilical shoulders are not sharply demarcated and the umbilicus is rather small and deep. In the larger, more mature specimens the venter becomes slightly flattened. The largest specimen available is 40 mm wide at the adoral end.

Some of the specimens are testiferous and these bear well-

defined lirae. In the smaller portions there are transverse lirae crossed by longitudinal ones which gives the shell a reticulate pattern. However, in the larger and more mature portions this pattern is not present. Here the shell is ornamented by fairly prominent, closely spaced growth lines which form a deep ventral sinus from which they curve sinuously over the lateral zones.

The septa are widely spaced, being about 6 to 7 mm apart in mature specimens. The sutures are essentially straight across the ventral and lateral zones but form a sharp dorsal lobe on the impressed zone. The siphuncle is nearly central, but in a few specimens it is slightly dorsad. It is small, being only about 1 mm or less in diameter in most of the specimens in which it is exposed.

Remarks.—Girty established a variety of this species which he called var. *obsoletum*, and Miller, Dunbar, and Condra recognized this variety as a species. However, a study of the larger number of specimens now available indicates that there is gradation between *L. liratum* and *L. obsoletum* and that the two are not sufficiently distinct to merit separation. Hence it is desirable to suppress *L. obsoletum*.

The ornamentation for which *L. liratum* is named is not always preserved, but the species can usually be recognized by the rate of expansion, the characteristic reniform cross section, and general physiognomy of the conch.

Occurrence.—This species was originally described from the Wewoka, but has since been found in many other Pennsylvanian formations. In Texas it is known from the Jacksboro and Graham and in Kansas from the Weston shale. In Oklahoma it has been reported from the Nellie Bly (Miller and Cline, 1934), the Senora (Ries, 1954; Weaver, 1954) Wewoka (Girty, 1911, 1915a; Ries, 1954; Weaver, 1954), the Boggy (Morgan, 1924), Wetumka (Miller, Dunbar, and Condra, 1933; Weaver, 1954), Holdenville (Ries, 1954; Weaver, 1954), Wann (Miller, Dunbar, and Condra, 1933). In addition, the present collections contain specimens from the Wewoka in secs. 3 and 24 and 33, T. 5 N., R. 8 E., sec. 18, T. 3 N., R. 7 E., Pontotoc County; sec. 10, T. 3 N., R., 12 E., Okmulgee County; the Holdenville in sec. 14, T. 7 N., R. 8 E., Hughes County; sec. 36, T. 11 N., R. 9 E., Okfuskee County; and at the southeast edge of Fittstown, Pontotoc County; the Wetumka in sec. 18, T. 3 N., R. 7 E., Pontotoc County; the Kanwaka in sec. 32, T. 24 N., R. 9 E., Osage County; the Vamoosa near Wynona, Osage County; the Boggy in sec. 17,

T. 2 N., R. 7 E., Pontotoc County; the Pumpkin Creek in sec. 9, T. 3 S., R. 2 E., and a locality labeled "Glenn formation in sec. 31, T. 3 S., R. 2 E.", Carter County; the "Buckhorn asphalt" in sec. 26, T. 1 S., R. 3 E., Murray County; the Stuart in sec. 7, T. 3 N., R. 9 E., Coal County; and the Atoka at Fort Gibson Dam, Muskogee County.

Repository.—Types, U. S. National Museum. Other specimens at many places. Those described here are at The University of Oklahoma, OU 192, 364, 417, 593, 3734, 3747, 3749-3753, 3924.

Liroceras reticulatum (Miller and Owen), 1937
Plate 3, figure 5; plate 4, figure 6

1937. *Coloceras reticulatum* Miller and Owen, Jour. Paleontology, vol. 11, p. 405-406, pl. 50, figs. 15-18.

Liroceras reticulatum was established in 1937 by Miller and Owen for six specimens. We now have another specimen from the same horizon and locality. It consists of an internal mold of part of the phragmocone, and is partially testiferous.

The conch is small and subglobular. The early part of it is nearly circular in cross section but it becomes subelliptical within the first volution, and an impressed zone develops in the dorsum. The venter is broadly rounded and the lateral zones are narrowly so. The umbilicus is moderately large for the genus. This specimen has a maximum diameter of 27 mm. At mid-length it is 15 mm wide. The umbilicus is 7 mm in diameter. The surface of the shell is reticulate with longitudinal and transverse lirae.

The sutures are essentially straight and directly transverse across the ventral and lateral zones. Camerae are moderate in length, there being about 15 in one volution.

Remarks.—L. reticulatum seems to differ from other congeneric forms in having a more slender conch, and a somewhat more reticulate ornamentation.

Occurrence.—The types of this species and the specimen described here came from the Seminole formation, just above the Dawson coal near Collinsville, Tulsa County.

Repository.—Topotype, The University of Oklahoma, OU 3168. Syntypes are at State University of Iowa.

Liroceras patulum new species
Plate 6, figures 1-3

1944. *Liroceras* cf. *L. liratum* Miller and Owen, Jour. Paleontology, vol. 18, p. 419-420, pl. 64, figs. 1-3.

The Union Valley has yielded five incomplete specimens which seem to represent an undescribed species, here named *Liroceras patulum*. Three of these were described by Miller and Owen in 1944 and now two more are available. These resemble the type species of *Liroceras* but they have relatively wider and lower whorls, and a larger umbilicus. The lateral zones, as noted by Miller and Owen, are more narrowly rounded and the larger umbilicus is more sharply demarcated. Also the conch is more rapidly expanded than in *L. liratum*.

The largest specimen at hand, the holotype, is an internal mold of the living chamber which was at least 60 mm wide at its adoral end. The whorl height at this position is only 25 mm. The impressed zone is deeper and wider than in other species. Near mid-length of the holotype it is 19 mm wide and 6 mm deep. No shell features are known.

The sutures form a broad, shallow ventral lobe, a low ventrolateral saddle, and a narrow lateral lobe. The siphuncle is small. Where the holotype is 40 mm wide the siphuncle is 2.5 mm in diameter.

Remarks.—Liroceras patulum can be differentiated from other species of this genus by the lower profile of the whorl and by the narrowly rounded lateral zones. The translation of the specific name is broad, or wide open.

Occurrence.—All of the specimens now included in this species are from the Union Valley formation near Lovelady in Pontotoc County. A few specimens which may be conspecific have been collected from the Brentwood limestone in sec. 9, T. 15 N., R. 24 E., Adair County.

Repository.—The University of Oklahoma, holotype, OU 3754; and one paratype, OU 3754a. State University of Iowa, SUI 13939-13941.

Genus *Coelogasteroceras* Hyatt, 1893

Type species: *Nautilus canaliculatus* Cox, 1857

Coelogasteroceras has not been previously recognized in Oklahoma, and now is known only from the Holdenville formation. It seems that in prior studies it has been overlooked because of the similarity to *Liroceras*. However, a close look at the two genera make it clear that they should not be confused.

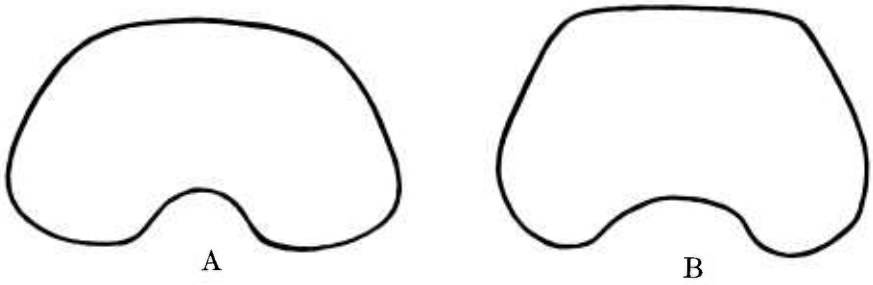
In *Coelogasteroceras* the conch is nautiliconic and subglobular. It has a slightly depressed cross section with flattened lateral zones, flattened ventral zones, and moderately small

umbilici. In the more mature portions the ventral area bears a broad shallow groove. The flattened lateral zones converge toward the venter and the maximum width of the conch is just outside the umbilical shoulders. The sutures form ventral and lateral lobes, and small ventrolateral saddles.

Coelogasteroceras planum new species
Plate 5, figures 3-5; text-figure 1

Coelogasteroceras planum is based on 23 specimens. All are internal molds of the living chamber except two which are septate. All are approximately the same size. One specimen which shows most of the essential features of the species is designated as the holotype.

This holotype, an internal mold of a living chamber, has the ultimate camera attached to it, and represents about one-fourth volution. It is nautiliconic, subglobular, and rapidly expanded orad. In a length (along the venter) of 35 mm it increases in width from 18 mm to 28 mm. The cross section is subquadrate with the lateral zones flattened and converging toward the venter, but gradually rounding into the broad slightly flattened ventral surface. In the adoral end of the specimen the ventral surface bears a shallow groove. The dorsum is deeply impressed with the ventral profile of the preceding whorl, which was rounded. The greatest width is near the umbilical shoulder, and, at the mid-length of this specimen, it is 21.5 mm. The umbilicus is small and deep. The shoulder is rather abrupt and the wall makes an angle of less than 90 degrees with the lateral zone.



TEXT-FIGURE 1. Whorl cross sections of A) typical mature *Liroceras liratum* (Girty), and B) typical mature *Coelogasteroceras planum* n. sp. Both x1.

Several specimens bear remnants of the test. These indicate that it was relatively thin and marked by growth lines which form deep rounded ventral sinuses then curve forward into broad salients across the lateral zones.

The septa are moderate in length. Where the conch has a maximum width of 28 mm the septa are about 3 mm apart in the ventrolateral zone. The sutures are somewhat sinuous, forming broad ventral lobes, low ventrolateral saddles, and low lateral lobes. They are nearly straight across the umbilical wall and the dorsum. The siphuncle is small and slightly dorsad of the center. Where the dorsoventral height of the conch of the holotype is 11 mm the diameter of the siphuncle is 1.5 mm.

Remarks.—Specimens here referred to *Coelogasteroceras planum* seem to have been previously put with *Liroceras liratum*. They can be clearly separated from that species, however, by their higher subquadrate profile with distinctly flattened lateral zones, and in the larger specimens, by having a shallow groove on the venter. The flattened lateral zones are the basis for the specific name.

Occurrence.—This species is known only from the Holdenville formation in sec. 14, T. 7 N., R. 8 E., Hughes County; sec. 12, T. 10 N., R. 9 E., and sec. 36, T. 11 N., R. 9 E., Okfuskee County; and sec. 10, T. 6 N., R. 8 E., Seminole County.

Repository.—The University of Oklahoma, holotype OU 373, paratypes OU 117, 366, 420, 3701, 3705.

Family EPHIPPIOCERATIDAE Hyatt, 1884

Genus *Ephippioceras* Hyatt, 1884

Ephippioceras ferratum (Cox), 1857

Plate 4, figure 3

1857. *Nautilus ferratus* Cox, Kentucky Geol. Survey, Rept. 3, p. 574-575, pl. 10, figs. 2, 2a.

(?) 1867. *Nautilus divisus* White and St. John, Chicago Acad. Sciences, Trans., vol. 1, p. 124.

1883. *Ephippioceras ferratum* Hyatt, Boston Soc. Nat. History, Proc., vol. 22, p. 290.

1891. *Ephippioceras clitellarium?* [part] Foord, Cat. Foss. Ceph. British Mus., pt. 2, p. 101-103.

1891. *Ephippioceras (Nautilus) ferratum* Hyatt, Texas Geol. Survey, Ann. Rept. 2, p. 352.

1894. *Ephippioceras ferratum* Hyatt, Amer. Philos. Soc., Proc., vol. 32, p. 539, pl. 10, figs. 23-26.

1924. *Ephippioceras ferratum* Morgan, [Okla.] Bur. Geology, Bull. 2, pl. 51, fig. 7.
1929. *Ephippioceras ferratus* Schmidt, Tierische Leitfossilien des Karbon, p. 60.
1930. *Ephippioceras divisum?* Sayre, Univ. Kansas, Sci. Bull., pt. 2, vol. 19, p. 82, 153-154, pl. 20, figs. 1-2a.
1933. *Ephippioceras ferratum* Miller, Dunbar, and Condra, Nebr. Geol. Survey, Bull. 9, 2d. ser., p. 112, 113, 114-118, pl. 3, figs. 14-17.
1934. *Ephippioceras ferratum* Miller and Owen, Univ. Iowa, Studies Nat. History, vol. 16, p. 194, 195, 209-211, 213, pl. 12, figs. 3, 4.
1942. *Ephippioceras ferratum* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, p. 128, 129, 130, 136, pl. 1, figs. 14, 15.
1944. *Ephippioceras ferratum* Shimer and Shrock, Index Fossils N. America, p. 545, pl. 223, fig. 4, 5.
1946. *Ephippioceras ferratum* Sturgeon, Jour. Paleontology, vol. 20, p. 11, 12, 18-19, pl. 4, figs. 2-4.
1947. *Ephippioceras ferratum* Miller and Unklesbay, Carnegie Museum, Annals, vol. 30, p. 320, pl. 1, figs. 7, 8.
1947. *Ephippioceras ferratum* Miller, Lane, and Unklesbay, Univ. Kansas, Paleont. Contrib., Mollusca, art. 2, p. 6, pl. 2, figs. 7-10.
1949. *Ephippioceras ferratum* Miller and Youngquist, Geol. Soc. America, Mem. 41, p. 129, pl. 53, figs. 7, 8.

Ephippioceras ferratum is represented in the collections being studied by only one specimen. It is an internal mold of approximately half a volution, of which nearly two-thirds is phragmocone and one-third living chamber. This specimen has the characteristic subglobular, rapidly expanding conch, small umbilicus, and reniform cross section. It is broadly rounded ventrally and laterally with fairly steep umbilical walls, and an impressed dorsal zone. The maximum width of the specimen is 31 mm and the height is 22.6 mm. The dorsal impressed zone at this width is 5 mm deep, and 7.5 mm wide.

Much of the specimen is testiferous but weathering has removed any trace of shell ornamentation. There is, however, a prominent ventral ridge on the internal mold.

The chambered portion of the specimen is somewhat crushed, but there appear to be six camerae preserved in a length of 33 mm. The sutures are typical for the species. They are strongly sinuous and each one forms a broad deep subacute ventral saddle and broad shallow lateral lobes. The umbilical and dorsal portions of the suture are not exposed. The nature and position of the siphuncle cannot be observed on this specimen.

Remarks.—The most distinguishing feature of *E. ferratum* is the subacute ventral saddle of the suture.

Occurrence.—The species is widely known in the Pennsylvanian of the United States. It ranges geographically from Pennsylvania to Texas, and stratigraphically from the Atoka to the Lansing. In Oklahoma it has been reported from the Francis shale, the Boggy formation, and the Buckhorn asphalt locality.

Repository.—Specimen figured by Miller, Dunbar, and Condra, Yale Peabody Museum 13978. Specimens figured by Miller and Unklesbay, Carnegie Museum 25,788 (and some unnumbered); and State University of Iowa 3128. Specimen described here is at The University of Oklahoma, OU 416.

SYSTEMATIC DESCRIPTIONS—AMMONOIDEA

Order AMMONOIDEA Zittel, 1884
Family BACTRITIDAE* Hyatt, 1884

Genus *Bactrites* Sandberger, 1843
Bactrites sp.
Plate 1, figure 16

Three specimens of *Bactrites*, each consisting of only an internal mold of one camera, seem to belong to this genus but specific assignment cannot be made with certainty.

This genus is diagnosed as being straight, long, slender, and circular or nearly so in cross section; and with a marginal siphuncle. The specimens at hand meet this diagnosis. The largest is 17 mm in diameter and 19 mm long. The septa are moderately convex apicad, and directly transverse. The siphuncle is marginal and was in contact with the shell wall. It is small, being only 1.7 mm in diameter in the largest specimen.

Remarks.—Miller and Owen (1934) described a specimen from the Cherokee of Iowa which they referred with question to *Bactrites*. Miller, Lane, and Unklesbay (1947) also did the same with a specimen from the Winterset of western Missouri. These specimens, and the ones at hand, all seem to be congeneric, but not conspecific.

Occurrence.—One specimen came from the Vamoosa formation about 2 miles south-southwest of Wynona, in Osage County; the others are from the Wewoka formation in the NE¼ NE¼ sec. 2, T. 14 N., R. 12 E.

Repository.—The University of Oklahoma, OU 3693, 3694.

Family CHEILOCERATIDAE Frech, 1897

Genus *Maximites* Miller and Furnish, 1957
Maximites cherokeensis (Miller and Owen), 1939
Plate 17, figures 4, 5; text-figure 2

1939. *Imitoceras cherokeensis* Miller and Owen, Jour. Paleontology, vol. 13, p. 145-147, pl. 20, figs. 18-20, text-fig. 146.

---

*Although the bactritids have generally been treated as ammonoids, they are omitted from the ammonoid volume, Part L of the Treatise on Invertebrate Paleontology, and will be included in the nautiloid volume, Part K.

1957. *Maximites cherokeensis* Miller and Furnish, Jour. Paleontology, vol. 31, p. 1045-1047, text-figs. 1A, 3C.

The Oklahoma collection contains 10 specimens of this rather uncommon species. All are limonite internal molds of moderately complete individuals ranging in diameter from 3.7 mm to 9 mm in diameter. The largest specimen is the most complete. It has a maximum width of 4.8 mm.

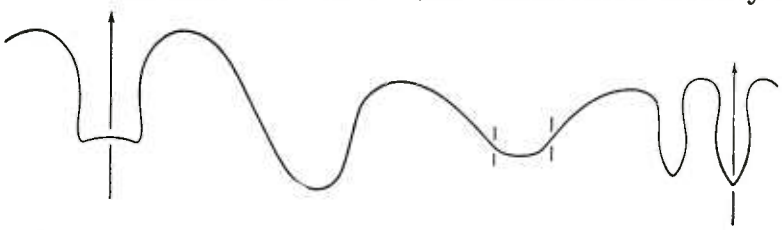
The conch of *Maximites cherokeensis* is small and subglobular to lenticular. The whorls are helmet-shaped in cross section as they are rounded ventrally, slightly flattened but weakly convex laterally, and impressed dorsally. The umbilicus is small and nearly closed. The umbilical shoulder is abrupt.

No shell material is retained on these specimens but the molds bear sinuous growth lines which form a shallow, broadly rounded ventral sinus, smaller low, rounded ventrolateral salients, a similar lateral sinus, and a small umbilicolateral salient.

The sutures are distinctive. They form a deep ventral lobe which is narrow and straight-sided, with the sides being parallel. The adapical end of the lobe is slightly concave adapically and this may represent incipient bifid division. The septa are so closely spaced that the adapical end of one ventral lobe extends into the adoral end of the next adjacent one, giving the appearance of two parallel lines along the venter. On either side of the ventral lobe there is a broadly rounded, slightly asymmetrical, U-shaped first lateral saddle; a broadly rounded first lateral lobe; and a low, asymmetrically rounded second lateral saddle which extends into the umbilicus. None of the specimens being studied shows the internal suture.

The siphuncle is not in contact with the ventral wall, and this fact explains the nature of the ventral lobe of the suture.

Remarks.—Despite their small size these specimens seem to be mature and to represent a small species. One evidence for this is the close spacing of the septa. Another is that they do



TEXT-FIGURE 2. Late mature suture of *Maximites cherokeensis* (Miller and Owen), x17.5, (from Miller and Owen, 1939).

not seem to be closely similar to the infant stages of other known species.

The unique shape of the ventral lobe of the suture in this species serves to differentiate it from others. *Neoaganides grahamensis* Plummer and Scott (1937) may be congeneric, but that species has more widely spaced septa, and the suture pattern illustrated by Plummer and Scott shows the first lateral lobe, and the first lateral saddle to be symmetrical. This is not true of *Maximites cherokeensis.*

Occurrence.—The syntypes of this species are from "just above the Mulky coal member of the Cherokee formation" in Henry County, Missouri. The specimens described here are from the Wewoka formation in the NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., Okmulgee County. Other specimens at the State University of Iowa are from the Wewoka near Holdenville in Hughes County, and from the Seminole near Collinsville, Tulsa County.

Repository.—The syntypes are now at the State University of Iowa, SUI 13484. Another Wewoka specimen there is numbered 8790. The specimens described here are at The University of Oklahoma, OU 3782.

Genus *Imitoceras* Schindewolf, 1923
Imitoceras grahamense (Plummer and Scott), 1937

1936 *Aganides?* sp. Elias, Internat. Geol. Cong., Rept. 16th Sess., vol. 1, p. 695.
1937. *Neoaganides grahamensis* Plummer and Scott, Texas Univ., Bull. 3701, p. 18, 350-351, 390, 502, text-fig. 88, pl. 40, figs. 4-9.
1939. *Imitoceras grahamense* Miller and Owen, Jour. Paleontology, vol. 13, p. 146-147, text-fig. 2, pl. 20, figs. 18-20.
1943. *Imitoceras grahamense* Miller and Unklesbay, Jour. Paleontology, vol. 17, p. 11-12.
1944. *Imitoceras grahamense* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 234, figs. 18, 19.
1950. *Imitoceras grahamense* Miller and Downs, Jour. Paleontology, vol. 27, p. 193-194, pl. 32, figs. 1-4.
1957. *Imitoceras grahamense* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. 149, 150, fig. 56.

Imitoceras grahamense, which was discussed at length by Miller and Downs (1950), is not well represented in Oklahoma. However these authors report it as follows:

> . . . one crushed questionable representative of the species from the Nellie Bly about 6½ miles due west of Sand Springs, Tulsa County, Oklahoma.

and another specimen from a depth of 7210 feet in a
sandstone and shale sequence believed to be the Niles 'formation' (about lower Shawnee).

This specimen came from the Superior No. 33-18 Cogdill well in the Anadarko basin, NW¼ SE¼ NW¼ sec. 18, T. 8 N., R. 11 W., Caddo County.

The Iowa collections also contain several small specimens, which may belong in this species, from the Ochelata formation about 12 miles west of Skiatook.

Family AGATHICERATIDAE Arthaber, 1911

Genus *Agathiceras* Gemmellaro, 1887
Agathiceras cf. *A. ciscoense* Smith, 1903

The collections at the State University of Iowa contain one specimen of *Agathiceras ciscoense* from Oklahoma which seems to represent this species. It is slightly crushed and somewhat weathered. It is 14.8 mm in maximum diameter but the later part of it is crushed. Where it is 10.8 mm in diameter, the width is 7.0 mm, and the height is 7.1 mm. The conch is subglobular, with broadly rounded venter, flat, nearly parallel sides, and slightly impressed dorsum. This specimen bears no trace of growth lines or constrictions.

Suture has nine lobes and nine saddles. All are spatulate and more or less constricted. Ventral lobe is broad and deep and divided into three parts by notched ventral saddles.

Occurrence.—This specimen came from the vicinity of Holdenville. It is probably from the Wewoka, but may be from lower in the section.

Repository.—State University of Iowa, SUI 9791.

Family SHUMARDITIDAE Plummer and Scott, 1937

Genus *Proshumardites* Rauser, 1928
Proshumardites senex (Miller and Cline), 1934
Plate 7, figure 11

1934. *Shumardites senex* Miller and Cline, Jour. Paleontology, vol. 8, p. 184-185, pl. 28, figs. 31-36.
1954. *Parashumardites senex* Unklesbay, Jour. Paleontology, vol. 28, p. 86.

This species was established by Miller and Cline (1934) for two incomplete internal molds.

They are subglobose in shape, with a maximum diameter of about 48 mm. The whorls are helmet-shaped in cross section. The umbilicus is large and deep, with subangular shoulders and steep walls. Each suture consists of twelve primary lobes and an equal number of primary saddles with distinct shumarditid features.

Occurrence.—These specimens came from the Nellie Bly formation 6½ miles west of Sand Springs, Tulsa County.

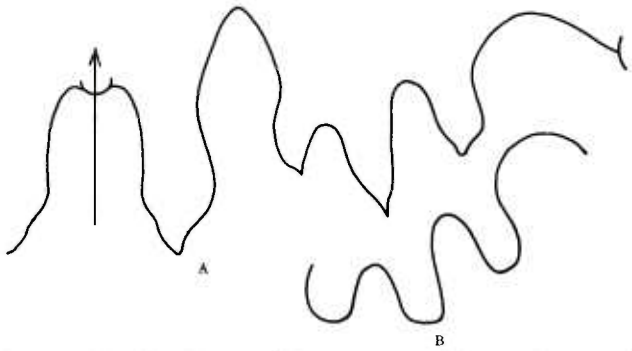
Cotypes.—State University of Iowa, SUI 641.

Proshumardites new species
Plate 7, figures 1, 2; text-figure 3

The Oklahoma collection contains one specimen of *Proshumardites* from the Morrow which represents a new species.

This specimen is a completely septate internal mold composed of calcite with numerous cleavage planes. The conch was globose and ammoniticonic and slightly compressed laterally. The ventral and ventrolateral surface is broadly rounded and the lateral zones are slightly flattended. The umbilical shoulder is smoothly and broadly rounded. The umbilicus is very small and is closed. The impression of the dorsal zone is deep and broadly rounded. The maximum diameter of the specimen is 13.5 mm and its width is 9 mm. At the adoral end of the last volution the dorsoventral height of the whorl is 3.1 mm.

The specimen has no trace of the shell, hence nothing can be learned of its surface ornamentation. The mold is marked



TEXT-FIGURE 3. *Proshumardites* n. sp. Two suture patterns one volution apart.

A. is at adoral end of outer volution where ventral-umbilical distance is 8.8 mm.

B. is one volution earlier where ventral-umbilical distance is 7.4 mm. Note change in detail of lobes in one volution. Both x8.

by transverse constrictions spaced about a quarter volution apart. These are shallow and are straight across. The sutures are not well preserved, except near the adapical and the adoral ends of the last volution. At the adapical end the external suture forms a bifid ventral lobe with sinuously hastate prongs separated by a relatively high, equal-sized ventral saddle with a small, rounded siphonal lobe. On either side of the ventral lobe there is a high, spatulate first lateral saddle which is narrowly rounded at the adoral end. The first lateral lobe is broad and trifid, being divided into three adventitious lobes which are small and have bluntly rounded adapical ends and are separated by bluntly rounded saddles. The second lateral saddle is broad and asymmetrically rounded into the umbilicus. In less than a volution the suture becomes modified so that the middle of the three adventitious lobes becomes narrower and attenuate, and the two on either side of it develop slightly attenuate points on the side next to it (text-figure 3).

Remarks.—This specimen seems to represent a previously undescribed species. However, in view of the fact that only one specimen is known, and that its preservation leaves much to be desired, it is not being used as the basis for a new species. It is somewhat similar to the type of *Subshumardites fornicatus* (Plummer and Scott) but has a much smaller umbilicus, and its suture lacks the small umbilical lobe of that species. Also its first lateral saddle is higher and narrower. Also its umbilicus is much smaller than that of *Proshumardites senex* (Miller and Cline). It is, of course, possible that this specimen represents only the inner whorls of an individual species of *Proshumardites*, but this remains to be demonstrated.

Occurrence.—Morrow formation, 4 miles northwest of Webbers Falls, sec. 3, T. 12 N., R. 20 E., Muskogee County, Oklahoma. A similar form has been described from the Namurian of North Africa by Delépine (1941).

Repository.—The University of Oklahoma, OU 3172.

Family POPANOCERATIDAE Hyatt, 1900

Genus *Peritrochia* Girty, 1908
Peritrochia sp.
Plate 7, figures 8, 9

1934. *Marathonites* sp. Miller and Cline, Jour. Paleontology, vol. 8, p. 182, pl. 28, figs. 12, 13.

Miller and Cline (1934) described a poorly preserved specimen from the Nellie Bly as belonging in the genus *Marathonites*, but because of its poor preservation they declined to assign it to a particular species.

In the Treatise on Invertebrate Paleontology the genus *Marathonites* is regarded as a synonym of *Peritrochia* hence this specimen is now listed under that genus. No other specimens of the genus *Peritrochia* have been found in Oklahoma.

Occurrence.—The specimen represented above is from the Nellie Bly, 6½ miles west of Sand Springs, Tulsa County.

Repository.—State University of Iowa, SUI 640.

Family GONIATITIDAE de Haan, 1825

Genus *Cravenoceras* Bisat, 1928

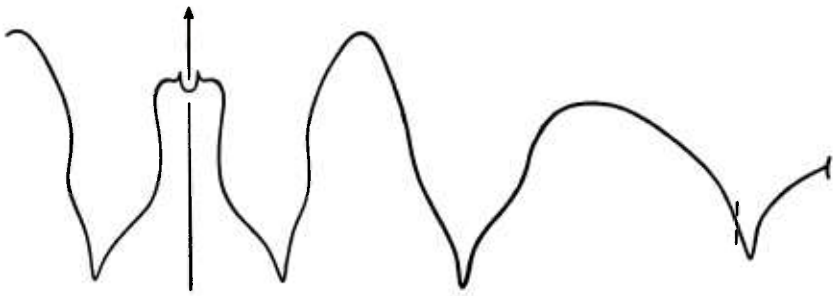
Cravenoceras? morrowense Miller and Moore, 1938

Plate 8, figures 8, 9; text-figure 4

1938. *Cravenoceras? morrowense* Miller and Moore, Jour. Paleontology, vol. 12, p. 346-347, pl. 43, figs. 1-3.

1944. *Cravenoceras? morrowense* Miller and Owen, Jour. Paleontology, vol. 18, p. 421-422, pl. 65, figs. 3, 4, pl. 66, figs. 3, 4, text-fig. 2B.

The conch of *Cravenoceras? morrowense* is moderately large, subglobular, and ammoniticonic. It is known only from internal molds of phragmocones, hence the nature of its living chamber is not known. The ventral zone is rather broadly rounded, and the lateral zones are more so. The lateral zones are slightly compressed and weakly flattened in the umbilicolateral areas. The umbilical shoulder is abrupt and the wall is



TEXT-FIGURE 4. Mature suture of *Cravenoceras? morrowense* Miller and Moore, x2.5, based on a specimen from the Union Valley, (from Miller and Owen, 1944).

steep. The dorsum is impressed to nearly half the whorl height. In a typical specimen the diameter is 57 mm, the maximum width 30 mm, the depth of impressed zone 14.5 mm, and the umbilicus is 10.5 mm across. In the specimens presently available there is no trace of shell material, although Miller and Moore stated that a specimen from the Morrowan of Arkansas shows transverse sinuous growth lines. Also some specimens are marked by transverse constrictions.

The suture pattern (fig. 4) shows that each external suture forms a large, moderately narrow, bifid ventral lobe whose prongs are hastate. On either side of this lobe is a first lateral saddle which is relatively high and narrow, a broad, asymmetrical second lateral saddle, and a second lateral lobe which is broadly V-shaped and centers on the umbilical wall. The lobes of the sutures become more acuminate and the saddles more narrowly rounded with maturity.

Remarks.—As explained by Miller and Moore, and by Miller and Owen, this form is more or less intermediate between *Homoceras* and *Cravenoceras*, but some uncertainty exists regarding the type of *Homoceras*. Hence these specimens are referred to *Cravenoceras* with slight uncertainty. One exceptionally large specimen has the same relative proportions and suture pattern as the others (OU 3823) and is also referred to this species. It is 142 mm in diameter, 70 mm wide, and the umbilicus is 27 mm across.

Occurrence.—Miller and Moore described the types from the Hale formation near Harrison, Arkansas, and also reported one from the Morrowan on Greenleaf Creek 3.5 miles southeast of Braggs, Muskogee County, Oklahoma. Miller and Owen described some 20 specimens from the Union Valley formation near Lovelady in Pontotoc County, Oklahoma. There are now available additional specimens from the Union Valey at Lovelady Switch, on the MKT railroad about two miles northwest of Stonewall, Pontotoc County, the same general area which yielded Miller and Owen's specimens. Another specimen is available from the Brentwood limestone in the bluffs on the east side of the Grand River, in Cherokee County, Oklahoma, and one from the uppermost Bloyd in SE¼ sec. 22, T. 17 N., R. 19 E., Cherokee County.

Repository.—State University of Iowa, SUI 1979-1981, 13947-13950. The University of Oklahoma, OU 3821-3823, 3896, 4208.

Genus *Gordonites* Miller and Furnish, 1958
Gordonites oklahomensis (Miller and Owen), 1939
Plate 7, figure 10

1934. *Gastrioceras angulatum* Morgan [part], [Oklahoma] Bureau Geology, Bull. 2, p. 83, pl. 51, fig. 8 not 8a.
1939. *Anthracoceras oklahomense* Miller and Owen, Jour. Paleontology, vol. 13, p. 149, pl. 17, fig. 4, 5.
1958. *Gordonites oklahomense* Miller and Furnish, Jour. Paleontology, vol. 32, p. 685.

Gordonites oklahomensis was first described by Miller and Owen from a small specimen, but it is now represented by a larger but not exceptionally well preserved one. This specimen is an internal mold of a broken specimen whose outer part consists of the living chamber, but in the broken area the inner whorls can be seen, and there are traces of the last septum. This specimen is lenticular in form, being widest near the umbilicus, and having weakly convex lateral zones which converge toward a rounded venter. The dorsum is deeply impressed. The maximum diameter of this specimen is 30 mm. Its maximum width is 13 mm, and the diameter of the umbilicus is only 5 mm. The umbilical shoulder is small and deep.

The surface of the mold bears fine growth lines which form shallow lateral sinuses, low ventral-lateral salients and a ventral sinus.

The suture is not well preserved but can be seen at the adapical end of the specimen. It forms a rounded first lateral saddle, a V-shaped first lateral lobe, a low, asymmetrical second lateral saddle, and a small umbilical lobe which centers just outside the shoulder.

Remarks.—*G. oklahomensis* is similar to *G. missouriensis* but its umbilicus is slightly deeper.

Occurrence.—The type was described from the middle part of the Boggy shale in the NE¼ sec. 22, T. 3 N., R. 7 E., Pontotoc County. The specimen described here is from the Boggy in sec. 27 of the same township.

Repository.—Holotype, Columbia University, 18459. The University of Oklahoma, OU 412.

Genus *Bisatoceras* Miller and Owen, 1937
Bisatoceras primum Miller and Owen, 1937
Plate 8, figures 2-7

1937. *Bisatoceras primum* Miller and Owen, Jour. Paleontology, vol. 11, p. 417-418, pl. 50, figs. 6-14.

1944. *Bisatoceras primum* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, figs. 3, 4.
1957. *Bisatoceras primum* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L60, text-fig. 78.

The conch of *Bisatoceras primum* is ammoniticonic. At maturity it is subdiscoidal, but in more immature stages it is nearly globular. Twenty-two small internal molds of phragmocones are now available for study. The largest of these is 18 mm in diameter and 11.5 mm wide. This specimen is smooth, and has rounded ventral and lateral zones and a fairly abrupt umbilical shoulder. The umbilicus is small and is closed. Another smaller specimen with a diameter of 5.8 mm is closely similar, except that it bears four transverse constrictions spaced equally at each quarter volution. None of these specimens gives any indication of the test or of its ornamentation.

The sutures form a bifid ventral lobe with a U-shaped first lateral saddle, and an acuminate broad first lateral lobe. The second lateral saddle is low and broadly rounded and grades into a broad, shallow, rounded lobe which centers just outside the umbilical wall. The siphuncle is small and is marginal on the venter.

Remarks.—The suture pattern of *B. primum* is similar to that of some species of *Eoasianites*, but the species can be distinguished by its having a small, closed umbilicus.

Occurrence.—The types of this species are from the Seminole formation just south of Collinsville, Tulsa County, and one topotype is in the Oklahoma collection (OU 3947). All the ones mentioned here are from the Wewoka. Sixteen are from along Highways 169 and 75 near Preston, NE¼ NE¼ sec. 2, T. 14 N., R. 12 E.; two are from sec. 10, T. 13 N., R. 12 E.; two from the same formation in a road cut 2.4 miles west of Okmulgee on Highway 56, all from Okmulgee County; two are from the S½ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County, and one from sec. 33, T. 5 N., R. 8 E., Pontotoc County. The State University of Iowa Collection also contains specimens from the Buckhorn asphalt near Sulphur, Murray County.

Repository.—The specimens described by Miller and Owen are now at State University of Iowa where four unfigured syntypes are numbered 1998. The specimens described here are in the collections at The University of Oklahoma, OU 369, 398, 3783-3785, 3794, 3947, 4205.

Bisatoceras cf. *B. secundum* Miller and Moore, 1938

One poorly preserved specimen seems to be very much like the types of this species in size and general physiognomy, except that it does not have the longitudinal lirate ornamentation characteristic of the types. This specimen is about 15 mm in diameter and 9.7 mm wide. It is subglobular and ammoniticonic in coiling, and has a small, closed umbilicus. The suture pattern is almost identical to that of the holotype.

Occurrence.—The types of the species are from the lower Morrow (Hale) near Harrison, Arkansas. The Oklahoma specimen is from the Morrow, 4 miles northwest of Webbers Falls, Muskogee County.

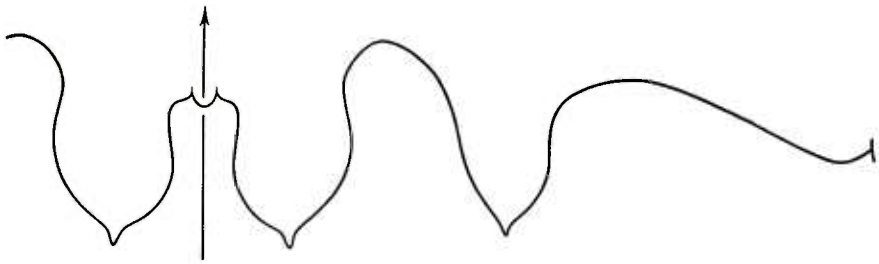
Repository.—The University of Oklahoma, OU 3173.

Bisatoceras greenei Miller and Owen, 1939
Plate 7, figure 7; text-figure 5

1939. *Bisatoceras greenei* Miller and Owen, Jour. Paleontology, vol. 13, p. 155-156, pl. 20, figs. 1-7.
1943. *Bisatoceras greenei* Miller and Unklesbay, Jour. Paleontology, vol. 17, p. 15, text-fig. 3B.

Three immature and one nearly mature specimens of *Bisatoceras greenei* are available for study. They are small internal molds of phragmocones. They are subglobular and ammonitic in growth pattern. The ventral and lateral zones are rounded and the umbilicus is small and closed. The umbilical shoulders are inconspicuous. The largest and most mature is about 10 mm in diameter and 6.5 mm wide.

These specimens retain no test, but the mold indicates that the test was marked by transverse sinuous growth lines. Each line formed a ventral sinus, and broad shallow lateral sinuses.



TEXT-FIGURE 5. A mature suture of *Bisatoceras greenei* Miller and Owen x7.5, (from Miller and Owen, 1939).

The suture has a bifid ventral lobe, and on either side of it is a high, slightly asymmetrical, rounded first lateral saddle, and a first lateral lobe which is asymmetrical and acuminate. The second lateral saddle is broad and low and grades into a shallow lobe on the umbilical shoulder. In the larger specimen the prongs of the lateral lobe are wider and rounder than in the smaller ones. The internal sutures are not visible on these specimens.

Remarks.—Although these specimens of *B. greenei* are small and fragmentary, their essential characteristics of suture pattern and shell ornamentation agree closely with the types of this species.

Occurrence.—The types of this species came from the Cherokee formation in Henry County, Missouri. The three small specimens described here are from the Wewoka in sec. 10, T. 13 N., R. 12 E., and the larger one is from the same formation in the NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., both in Okmulgee County.

Repository.—State University of Iowa paratypes SUI 13521, 13523, hypotypes SUI 8801. Holotypes not known—were in personal collection of J. B. Owen but apparently lost. The University of Oklahoma, OU 395, 3766.

Genus *Wewokites* Furnish and Beghtel, 1961

Type species: *Gastrioceras venatum* Girty, 1911

The Wewoka formation in Oklahoma contains an abundance of small goniatites. Among them is a common form which Girty recognized as a species of *Gastrioceras* which he called *G. venatum*. However, close study of this form reveals that it is not a *Gastrioceras*, and that it should be treated as a separate genus. This fact was recognized by Furnish and Beghtel who studied some 350 specimens, and who suggested the name *Wewokites* for the genus with *W. venatus* as the type.

The genus is diagnosed as follows: Conch small, subglobular to thickly lenticular, and ammoniticonic. Umbilicus is small in immature specimens but becomes relatively larger with maturity. Umbilical shoulders nodose and in some specimens the nodes extend as low ridges toward the venter. Each suture forms a deep, bifid ventral lobe with deep, narrow, rounded prongs which are separated by a relatively high, notched ventral saddle. On either side of the ventral lobe there is a high, rounded first lateral saddle; a broad, rounded, but fairly deep, first lateral

lobe; a low, rounded, asymmetrical second lateral saddle; and a small umbilicolateral lobe. The siphuncle is ventral in position.

Wewokites seems to be related to *Pennoceras* and *Bisatoceras*. It has a larger umbilicus than *Pennoceras* and has less prominent ornamentation in the ventral area. The sutures of the two are similar, except that in *Pennoceras* the saddles have more nearly parallel sides, and the lateral lobe is more narrowly rounded. *Bisatoceras* has a smaller umbilicus than *Wewokites* and has nearly straight, rather than sinuous, growth lines.

It seems possible that these small specimens may be immature individuals of a larger genus; however, they occur in great abundance in association with larger forms, but do not correspond with the immature whorls of the larger ones. Furthermore many specimens retain the living chamber, and in some of them the last few septa are closely spaced, another possible indication of maturity.

Wewokites venatus (Girty), 1911
Plate 9, figures 5, 6

1911. *Gastrioceras venatum* Girty, New York Acad. Sciences, Annals, vol. 21, p. 149.
1915. *Gastrioceras venatum* Girty, U. S. Geol. Survey, Bull. 544, p. 254, pl. 32, figs. 1-3b.
1937. *Gastrioceras venatum* Plummer and Scott, Texas Univ., Bull. 3701, p. 246, 382, 385, 386, 399.
1954. *Eudissoceras venatum* Unklesbay, Jour. Paleontology, vol. 28, p. 86.
1961. *Wewokites venatus* Furnish and Beghtel, Okla. Geology Notes, vol. 21, p. 289-293, fig. 1.

The conch of *Wewokites venatus* is small and subglobular to sublenticular, increasing in lenticularity with growth. The maximum diameter ranges from about 1 mm to as much as 16 mm. The whorl section is rounded ventrally and laterally. The umbilical shoulders are not abrupt and bear nodes or transverse ridges. In the larger specimens the transverse ridges extend well up on the lateral zones more than half-way to the venter. The umbilicus is small. In many specimens there is a narrow, shallow ventral furrow, or trough, which has steep sides and a broad, shallow bottom. This may extend along part of the phragmocone but does not affect more than the adapical half of the living chamber. In some specimens it is discontinuous, and in others it is absent. It is rarely developed in specimens smaller

than 5 mm. The living chamber is commonly as much as a volution in length. Some specimens are marked by transverse constrictions but others are not. Testate specimens bear growth lines which are slightly sinuous. These growth lines are also weakly shown by the internal molds.

The suture is characterized by having rounded lobes and saddles. Each suture forms a deep, bifid ventral lobe with deep, narrow, rounded prongs. These are separated by a relatively high, notched ventral saddle. The first lateral saddle is high and rounded, and the first lateral lobe is deep and rounded. The second lateral saddle is low and asymmetrical.

Remarks.—This species can be distinguished by its rounded lobes and saddles, and by the relatively great height of the ventral saddle.

Occurrence.—This species is very abundant in the Wewoka, in a road cut 2.4 miles west of Okmulgee, Okmulgee County; in sec. 10, T. 13 N., R. 12 E., Okmulgee County; sec. 24, T. 5 N., R. 8 E., Pontotoc County; and sec. 12, T. 4 N., R. 11 E., Hughes County.

Repository.—The collections at the State University of Iowa contain some 350 specimens, SUI 8826. The University of Oklahoma has more than 100, OU 368, 3835-3840. The holotype is at the U. S. National Museum.

Wewokites newelli new species
Plate 9, figures 1-4

1961. *Wewokites* n. sp. Furnish and Beghtel, Okla. Geology Notes, vol. 21, p. 289.

Some of the larger specimens of this genus develop characters which seem to be sufficiently different from those of *W. venatus* to justify another species. However, the smaller forms do not seem separable.

These larger forms are about 12-15 mm in diameter and in general physiognomy are similar to *W. venatus*. However they differ in ornamentation and suture pattern. In *W. newelli* the umbilicus is broader and deeper and has steeper sides. The umbilical shoulder is marked by nodes whose slopes expand from the dorsal and ventral ends to a sharp crest which parallels and overlies the umbilical shoulder. The ventral furrow described for *W. venatus* is also present in this species and its middle is marked by longitudinal fine lirae.

The suture is similar to *W. venatus* but the ventral saddle

is larger and more prominent, and the sides of the adjacent ventral prongs are more nearly parallel. The first lateral saddle is not so broad, and has steeper sides than in *W. venatus*. The outer whorls of *W. newelli* superficially resemble small specimens of *Gastrioceras* but the lobes of *Wewokites* are rounded whereas those of *Gastrioceras* become acuminate and angular.

Remarks.—This species was recognized by Beghtel who described it in an unpublished master's thesis, and who suggested the name *newelli* in honor of Dr. N. D. Newell.

Occurrence.—This species occurs in the Wewoka in Pontotoc, Hughes, and Okmulgee Counties. The holotype is from a road cut 2.4 miles west of Okmulgee, Okmulgee County. The University of Oklahoma collections contain other specimens from the Wewoka in sec. 10, T. 13 N., R. 12 E., Okmulgee County; from a road cut 2.4 miles west of Okmulgee, Okmulgee County; sec. 33, T. 5 N., R. 8 E., Pontotoc County; and NE¼ sec. 26, T. 11 N., R. 10 E., Okfuskee County.

Repository.—The University of Oklahoma, OU 3830-34, holotype 4206. State University of Iowa, SUI 8828, 8829.

Genus *Gonioloboceras* Hyatt, 1900
Gonioloboceras goniolobum (Meek), 1877
Plate 7, figure 12

1877. *Goniatites goniolobus* Meek, U. S. Geol. Exploration Fortieth Parallel (King), vol. 4, p. 98-99, pl. 9, figs. 5-5b.

1950. *Gonioloboceras goniolobum* Miller and Downs, Jour. Paleontology, vol. 24, p. 199-200, pl. 31, fig. 9; pl. 32, figs. 5-9. (This report contains an extensive synonymy to this date.)

Gonioloboceras goniolobum is represented in the Oklahoma collection by five specimens, all of which are septate internal molds with no trace of living chamber. All are subdiscoidal and ammoniticonic. The whorls are compressed laterally, with the slightly convex lateral zones converging toward the venter. The venter is rather narrow and rounded, and in two of the specimens there is a narrow, flattened area along the venter. The umbilical shoulder is rather abrupt but the umbilical wall is low, and the umbilicus is small. The dorsum is impressed to about one-third the whorl height. A typical specimen has a maximum diameter of 52.5 mm; a maximum width of 22.2 mm; a whorl height of 32 mm; and an umbilical diameter of 4.5 mm. One larger, but poorer specimen has a maximum diameter of 72.5 mm. None of these specimens has any trace of the test.

The sutures are typical of the species, and are essentially identical with that illustrated by Miller and Downs (1950, fig. 3A). Each external suture has a large bifid ventral lobe, and on either side of it an acute, slightly sigmoidal first lateral saddle, a similar acuminate first lateral lobe, a small, low, broadly rounded, asymmetrical second lateral saddle which extends into the umbilicus.

Remarks.—*G. goniolobum* has been the subject of intense study by Elias (1938) and by Miller and Downs (1950). The later study concludes with the opinion that most of the described congeneric species should actually be regarded as synonyms. Much of the confusion seems to have arisen from species being established for specimens in different stages of development, and different states of preservation. These specimens might be referred to *Gonioglyphioceras* but they do not have the retuse venter which is characteristic of that genus.

Occurrence.—Miller and Downs reported that this species is widespread in southwestern and midwestern United States and that it has a long stratigraphic range in Middle and Upper Pennsylvanian. The specimens described here are from the Wewoka in Pontotoc County; the Vamoosa in Osage County, the Buckhorn asphalt locality in Murray County, sec. 23, T. 1 S., R. 3 E., and the shale above the Lecompton limestone in sec. 5, T. 23 N., R. 8 E., Osage County. Other reported occurrences are: Wewoka (Girty, 1915a); Wewoka (Morgan, 1924); Nellie Bly (Miller and Cline, 1934); Wetumka (Morgan, 1924); and Holdenville (Weaver, 1954).

Repository.—The University of Oklahoma, OU 344, 3789, 3799, 3800. State University of Iowa, SUI 10443.

Genus *Gonioglyphioceras* Plummer and Scott, 1937
Gonioglyphioceras gracile (Girty), 1911
Plate 7, figures 3-6

1911. *Gonioloboceras welleri gracile* Girty, New York Acad. Sciences, Annals, vol. 21, p. 153.
1915. *Gonioloboceras welleri gracile* Girty, U. S. Geol. Survey, Bull. 544, p. 263-264, pl. 35, figs. 3-5b.
1932. *Gurleyoceras gracile* Miller, Jour. Paleontology, vol. 6, p. 76.
1937. *Eudissoceras collinsvillense* Miller and Owen, Jour. Paleontology, vol. 11, p. 408-410.
1937. *Gonioglyphioceras gracile* Plummer and Scott, Texas Univ., Bull. 3701, p. 334, 336, 337.
1938. *Gonioglyphioceras gracile* Elias, Jour. Paleontology, vol. 12, p. 99, 100, pl. 20, figs. 7a, 7b, text-fig. 1 N-O.

1946. *Gonioglyphioceras gracile* Miller and Sturgeon, Jour. Paleontology, vol. 20, p. 385.
1957. *Gonioglyphioceras gracile* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L60.

The conch of *Gonioglyphioceras gracile* varies somewhat in shape during development. At maturity it is discoidal and ammoniticonic. The sides are weakly convex and converge ventrad. The venter is narrow, and is marked by a longitudinal groove which lies between two thin, angular ridges. This groove is best observed on testiferous specimens. Two fragments from the Wewoka have had the shell completely removed and they have an acute venter without the groove or the ridges. However, a section cut through a testiferous specimen demonstrates that this should not be surprising. The umbilicus is small and closed, and the umbilical wall is abrupt but not high. In a typical specimen the maximum diameter is 40 mm; the maximum width is 14 mm; and the maximum whorl height is 24 mm. The umbilicus is 4 mm in diameter. The smaller and earlier whorls are broader and more nearly globose. On the specimens now under consideration there is no trace of the test, but Girty reported that the surface of his specimens were ". . . marked by obscure, incremental lirae, the direction of which indicates a deep, broad, hyponomic sinus."

The external suture forms a broad ventral lobe which is divided by a rounded, notched, ventral saddle. On either side of this lobe is: 1) a high, blunt first lateral saddle which is asymmetrical, and leans somewhat toward the umbilicus; 2) a first lateral lobe which is long, fairly broad, asymmetrical, and rounded; and 3) a broad, low, rounded, second lateral saddle across the umbilicolateral zone. The sutures are closely spaced, being approximately 1 mm apart.

Immature specimens are subglobose, have a fairly large umbilicus, and bear transverse ridges along the umbilical shoulder. The suture in the immature forms is much simpler than in the adult. These immature forms were once illustrated by Miller and Owen as *Eudissoceras collinsvillense*.

Remarks.—Six mature, one adolescent, and 26 early immature specimens are in The University of Oklahoma collections. Two of the immature ones are from the same locality as the types of *Eudissoceras collinsvillense* which is here listed as conspecific with *G. gracile*.

This species is easily confused with *Goniolobocerasgoniolobum*. However, that species does not have a ventral groove as its venter may be rounded or very slightly flattened. Also *G. goniolobum* has more angular lobes and saddles.

Occurrence.—Girty's types came from the Wewoka formation in the Wewoka and Coalgate quadrangles. Specimens are now known from the Wewoka in the NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., Okmulgee County, 2 miles west of Okmulgee on Highway 56, Okmulgee County, and 10.2 miles south of Tulsa County line on Highway 75, Okmulgee County; and from sec. 10, T. 13 N., R. 12 E., also Okmulgee County; from the Wewoka in S½ SE¼ sec. 28, T. 7 N., R. 9 E., Hughes County, and sec. 33, T. 5 N., R. 8 E., Pontotoc County; from the Holdenville in sec. 33, T. 11 N., R. 10 E., and sec. 36, T. 11 N., R. 9 E., Okfuskee County, and one locality in Hughes County; from the Wetumka in the NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E., Pontotoc County. Two immature specimens are also known from the Seminole near Collinsville in Tulsa County. The specimen reported by Miller and Sturgeon is from the Allegheny of Ohio.

Repository.—Girty's types are at the U. S. National Museum. The specimens mentioned here are in The University of Oklahoma collections, OU 194, 404, 3795-3798, 3801-3805, 4204. The State University of Iowa collections contain specimens numbered 8811-8815, and 13852.

Family NEOICOCERATIDAE Hyatt, 1900

Genus *Gastrioceras* Hyatt, 1884

Gastrioceras adaense Miller and Owen, 1944

Plate 7, figures 13, 14; text-figure 6A

1944. *Gastrioceras adaense* Miller and Owen, Jour. Paleontology, vol. 18, p. 423, pl. 64, fig. 4-6, text-fig. 3A.

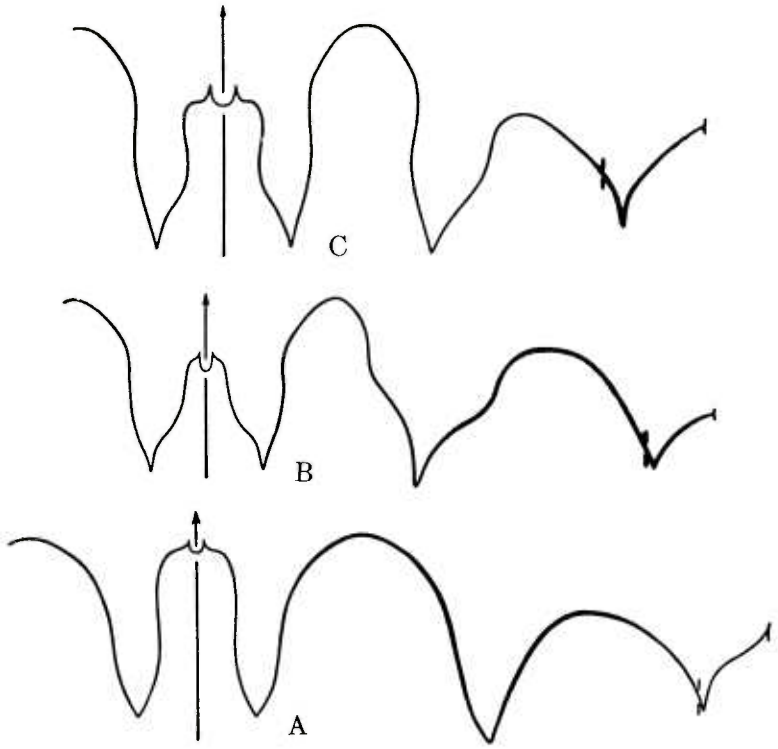
Gastrioceras adaense was originally based on ten specimens from the Union Valley. We now have another dozen from this formation and one from the Atoka. The Union Valley specimens are all relatively poor, septate internal molds of phragmocones which indicate that the conch of the species reached a maximum diameter of at least 150 mm. All are slightly compressed laterally so that the whorls are weakly flattened laterally, narrowly rounded ventrally, and impressed dorsally. The ventrolateral zones are not differentiated, but the umbilical shoulder is sharp and the umbilical wall is straight and steep.

The umbilicus is 23 mm in diameter in a specimen whose maximum diameter is 56 mm. The umbilical shoulder bears a single row of small distinct nodes.

The external suture forms a deeply divided ventral lobe with narrow prongs, a broadly rounded first lateral saddle, a V-shaped first lateral lobe, and an asymmetrical second lateral saddle which reaches the umbilical shoulder.

The Atoka specimen is smaller and less well preserved. It is about 20 mm in diameter, and it has a small umbilicus. However, the general physiognomy of the conch, and the umbilical nodes seem to be good evidence of its identity.

Remarks.—The umbilicus of *G. adaense* is smaller than in



TEXT-FIGURE 6.

A. Mature suture of *Gastrioceras adaense* Miller and Owen, based on the holotype where the diameter is about 95 mm, x1.5.

B. Mature suture of *Eoasianites oblatus* (Miller and Moore), based on specimen with diameter of about 30 mm, x3.25.

C. Mature suture of *Gastrioceras branneri* Smith, based on specimen with diameter of about 70 mm, x2.

All specimens from the Union Valley (all from Miller and Owen, 1944).

most congeneric forms, and the coiling is more involute than in *Gastrioceras branneri.*

Occurrence.—The Union Valley specimens described here are from Lovelady Switch, on the MKT Railroad about two miles northwest of Stonewall, and from SE cor. sec. 7, T. 3 N., R. 8 E., Pontotoc County. The Atoka specimen is from Barnett Hill, near Clarita, Coal County. The only other known members of this species are from the Union Valley formation along Buck Creek just north of the Midland Valley Railroad, near Lovelady, SE¼ NE¼ NE¼ sec. 29, T. 3 N., R. 7 E., 7 miles southeast of Ada, Pontotoc County.

Repository.—The types of this species are at the State University of Iowa, 13956 (holotype), 13957 and 13958 (paratypes). The specimens described here are in the collections of The University of Oklahoma, OU 3811-3815, 3817, 3851, 3852.

Gastrioceras branneri Smith, 1896

Plate 8, figures 10, 11; plate 10, figure 4; text-figure 6C

1896. *Gastrioceras branneri* Smith, Amer. Philos. Soc., Proc., vol. 35, p. 257-258, pl. 23, figs. 1-6.
1900. *Goniatites branneri* Williams, Arkansas Geol. Survey, Ann. Rept. 1892, vol. 5, p. 359.
1903. *Gastrioceras branneri* Smith, U. S. Geol. Survey, Mon. 42, p. 83, 84, pl. 11, figs. 8-13.
1915. *Gastrioceras branneri* Mather, Denison Univ., Bull., Jour. Sci. Labs., vol. 18, p. 242, pl. 16, figs. 12-12a.
1930. *Gastrioceras branneri* Croneis, Arkansas Geol. Survey, Bull. 3, p. 81.
1934. *Gastrioceras listeri* Hollingsworth, Geol. Soc. America, Proc. 1933, p. 364.
1937. *Branneroceras branneri* Plummer and Scott, Texas Univ., Bull. 3701, p. 218-221, pl. 11, figs. 1-7.
1938. *Branneroceras branneri branneri* Miller and Moore, Jour. Paleontology, vol. 12, p. 348-350, pl. 44, figs. 5-12, text-fig. 3B.
1944. *Gastrioceras branneri branneri* Miller and Owen, Jour. Paleontology, vol. 18, p. 422-423, pl. 63, figs. 1, 2; pl. 65, figs. 1, 2; text-fig. 3C.
1944. *Gastrioceras branneri* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, figs. 6-8.
1948. *Gastrioceras branneri branneri* Miller and Downs, Jour. Paleontology, vol. 22, p. 680, pl. 103, figs. 10, 11.
1957. *Gastrioceras branneri* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L61, fig. 81C.

The conch of *Gastrioceras branneri* is rather evolute for ammonoids, is rather gradually expanded orad, and is subdis-

coidal. The whorls are semilunate in cross section, being broadly rounded ventrally, more narrowly so laterally, and slightly impressed dorsally. The dorsal zone is impressed only to a depth of about one-fifth the whorl height. The umbilical shoulders are rounded and indefinite, and in mature specimens the umbilicus is rather large. In a typical specimen in the Oklahoma collection the maximum diameter of the conch is 107 mm, the maximum width of the whorl is 40 mm, and the diameter of the umbilicus is 59 mm. This specimen is septate throughout. Another much poorer specimen is 130 mm in maximum diameter. A well-preserved small specimen has maximum diameter of 22 mm, a maximum whorl width of 10 mm, and the umbilicus is 14 mm across. The umbilicolateral zones in this species bear prominent transverse ribs, from the early volutions to the adult.

The surface of the test is strongly reticulate with transverse growth lines being crossed by fine longitudinal lirae. The growth lines form a pronounced, shallow, rounded hyponomic sinus and sinuous ventrolateral saddles. The lirae are more strongly developed in the ventral zone, especially in the more mature specimens.

The external suture forms a bifid ventral lobe with narrow attenuate prongs; high, slightly asymmetrical, rounded first lateral saddles; broad, acuminate first lateral lobes; and low, asymmetrically rounded second lateral saddles which extend to the umbilicus. There is a narrow V-shaped lobe on the umbilical wall. The internal suture is not exposed on the specimens at hand, but the pattern has been illustrated by Miller and Moore (1938).

Remarks.—The distinctiveness of *G. branneri* was long ago recognized by Smith. It can be separated from other congeners by its slow rate of expansion, its relatively evolute coiling, and the presence of ribs on the umbilicolateral zones.

Plummer and Scott used this species as the basis for a separate genus, called *Branneroceras.* However, as explained by Miller and Owen (1944), this species differs from the type species of *Gastrioceras* only in having a slightly lower whorl. This, they believe, is not a valid basis for generic differentiation.

The Oklahoma collection contains fifteen specimens which range greatly in size as indicated in the dimensions given above.

Occurrence.—Smith's holotype came from the Hale formation in Carroll County, Arkansas. Other specimens are known from the Morrowan near Harrison and Fayetteville (Miller and

Moore, 1938) and from the Bend Group, probably the Smithwick formation, near Bend, Texas. Specimens in The University of Oklahoma collections are from the Bloyd formation, SE¼ sec. 7, T. 14 N., R. 25 E.; the Brentwood formation at the Spillway of Greenleaf Lake near Braggs, Muskogee County; the Morrowan 4 miles northwest of Webbers Falls, Muskogee County, and at Keough Quarry 2 miles north of Gibson; the Union Valley at Lovelady Switch on the MKT Railroad, 2 miles northwest of Stonewall, Pontotoc County, and along Buck Creek just north of Midland Valley Railroad near Lovelady, SE¼ NE¼ NE¼ sec. 29, T. 3 N., R. 7 E., 7 miles southeast of Ada, Pontotoc County.

Repository.—Holotype, U. S. National Museum, 26439. Others, Walker Museum 16124; University of Texas T-12548; State University of Iowa, SUI 1975-1977, 13453-13955; The University of Oklahoma, OU 3171, 3755-3758, 3760-3762.

Gastrioceras fittsi Miller and Owen, 1944
Plate 10, figure 3; plate 11, figures 1, 2

(?)1924. *Gastrioceras listeri* Morgan, [Okla.] Bur. Geology, Bull. 2, p. 55.
1944. *Gastrioceras fittsi* Miller and Owen, Jour. Paleontology, vol. 18, p. 424-425, pl. 68, figs. 1, 2.
1944. *Gastrioceras grileyi* Miller and Owen, Jour. Paleontology, vol. 18, p. 425, pl. 67, figs. 4-8, text-fig. 4.

Gastrioceras fittsi is a large species, represented in the Oklahoma collections by three large specimens of about the same magnitude as the holotype. The largest has a diameter of 200 mm. Also there are three smaller specimens which represent inner volutions.

The whorls in this species are low and broad. The ventral area is low and broadly rounded, and the umbilical walls are nearly straight, high, and steep. The shoulders are abrupt and the umbilical diameter is about three-fifths of the diameter of the conch. The umbilical shoulders bear a row of prominent rounded nodes from the inner whorls to the adult. The dorsal zone is impressed rather deeply.

The sutures are typically gastrioceran. The external ones form a prominently divided ventral lobe with narrow spear-shaped prongs. The first lateral saddle is broad and U-shaped and the umbilical saddle is broad, low, and asymmetrical. The first lateral lobe is narrowly V-shaped and the lobe on the um-

bilical wall is pointed. The internal sutures are not exposed on these specimens.

Remarks.—*G. fittsi* was established for a single specimen, and those now available are similar to the type. This species is distinguished by its large size. However, in the smaller specimens the characteristic broad low whorl section and prominent umbilical nodes serve to distinguish the species from others. The umbilical nodes also serve to distinguish this species from *Eoasianites excelsus* which also reaches large size. With more material available for study it seems that the specimens Miller and Owen ascribed to *G. grileyi* are adolescent representatives of *G. fittsi.* Accordingly, they are here listed as synonyms.

Occurrence.—All known specimens seem to have come from about the same locality. The locality of the holotype is described in the Union Valley formation, near Lovelady, in the SE¼ NE¼ NE¼ sec. 29, T. 3 N., R. 7 E., Pontotoc County. The specimens at hand are from the same formation at Lovelady Switch on the MKT railroad about 2 miles northwest of Stonewall, Pontotoc County. Another specimen in the collection of John Naff is from the same formation in the SE¼ NE¼ sec. 29, T. 3 N., R. 7 E., Pontotoc County.

Repository.—The holotype is at the State University of Iowa, SUI 13959; others are at The University of Oklahoma, OU 3809, 3816, 3854, 3855, and another large specimen is in the collection of John Naff. Specimens described by Miller and Owen as *G. grileyi* are at State University of Iowa, SUI 13960-13964.

Gastrioceras prone Miller and Owen, 1937
Plate 10, figures 1, 2

1937. *Gastrioceras prone* Miller and Owen, Jour. Paleontology, vol. 11, p. 415, pl. 52, figs. 1-3.

Gastrioceras prone is a small species, represented in the current collections by a single topotype which is essentially identical with the holotype described by Miller and Owen. The conch is subdiscoidal and ammoniticonic. It is 9 mm in maximum diameter, and about 5 mm wide at the adoral end. The whorls are wider than high. They are broadly rounded ventrally, narrowly rounded laterally, and slightly impressed dorsally. The ventrolateral and umbilicolateral zones are rounded. The living chamber is almost a volution in length. The umbilicus is large and open, but not perforate. The protoconch is exposed in the umbilicus and is small.

The lateral zones of the conch are somewhat nodose or ribbed, and the ribs grade into growth lines which cross the venter. The whorls also bear two widely spaced, narrow constrictions which are oblique and slope orad toward the venter.

The sutures are not well exposed on this specimen but they seem to be like those described by Miller and Owen.

Remarks.—As discussed by Miller and Owen, *G. prone* is not well understood. They compared it with other species of *Gastrioceras* all of which are now regarded as belonging in *Eoasianites*. However the presence of ribs along the lateral zones of these specimens seems sufficient reason to leave them in *Gastrioceras*.

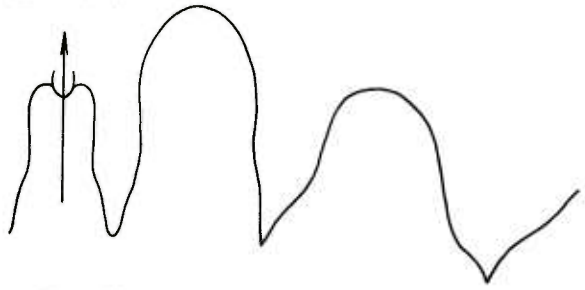
It is likely that these specimens represent the infants of some other species, but until this relationship can be observed and demonstrated it is better to treat them as a distinct species.

Occurrence.—Black limestone concretions in the Seminole formation, just above the Dawson coal, T. 22 N., R. 14 E., near Collinsville, Tulsa County.

Repository.—The holotype is at the State University of Iowa. The topotype described here is at The University of Oklahoma, OU 3818.

Genus *Eoasianites* Ruzhencev, 1933
Eoasianites angulatus (Girty), 1911
Plate 12, figures 7-11; text-figure 7

1911. *Gastrioceras angulatum* Girty, New York Acad. Sciences, Annals, vol. 21, p. 151.
1915. *Gastrioceras angulatum* Girty, U. S. Geol. Survey, Bull. 544, p. 256-258, pl. 34, figs. 1-3.
1924. *Gastrioceras angulatum* Morgan, [Okla.] Bur. Geology, Bull. 2, pl. 51, fig. 8.



TEXT-FIGURE 7. Mature suture pattern of *Eoasianites angulatus* (Girty), x8, based on specimen from the Wewoka in sec. 4, T. 3 N., R. 7 E., Pontotoc County, OU 388.

1937. *Glaphyrites angulatus* Plummer and Scott, Texas Univ., Bull. 3701, p. 269-271, pl. 16, figs. 1-9.
1937. *Gastrioceras clinei warei* Miller and Owen, Jour. Paleontology, vol. 11, p. 412-413, pl. 51, figs. 6-9, 12, 13, text-figs. 2A, 2E.
1939. *Glaphyrites welleri* Miller and Owen [part] Jour. Paleontology, vol. 13, p. 149-153, pl. 18, figs. 8-13, not 6, 7, 15, 16.
1944. *Eoasianites angulatus* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, figs. 20, 21.

The conch of *Eoasianites angulatus* is subglobular, ammoniticonic, and gradually expanded orad. The whorl section is helmet-shaped, being broadly rounded ventrally and ventrolaterally, but with abrupt umbilical shoulders which make an acute angle with the lateral zone. The ventral and dorsal surfaces are essentialy parallel. The whorls are low, and are much wider than high. The umbilicus is large, open, and deep. In smaller specimens the umbilical wall of each volution coincides with that of the preceding one so that the umbilical opening is essentially an inverted cone. However as the shell becomes larger the volutions progressively develop a larger radius of curvature so that the walls no longer coincide at the shoulder, but each volution leaves a small part of the lateral zone of the preceding one exposed. As this happens the shoulders also develop a somewhat keeled nature and the shell thickens over the crest. Because of incomplete cleaning of the umbilici, some authors have been known to interpret different-sized specimens as different species. This species ranges in size from a few millimeters to as much as 60 mm and the variation in shell construction mentioned can be traced easily. One very well-preserved specimen from the Seminole formation has a diameter of 56 mm, a width of 34 mm and an umbilical diameter of 30 mm.

The shell ornamentation is very poorly known because most specimens do not bear shell material. Girty described some of his as having a "cancellate" ornamentation.

The suture is typically gastrioceran. Each external suture forms a bifid ventral lobe with hastate prongs separated by a ventral saddle which is slightly wider than the prongs, and which is weakly constricted near mid-height. The first lateral saddles are broadly rounded and asymmetrical; the first lateral lobe is broadly V-shaped with slightly sinuous sides; the second lateral saddle is low and asymmetrically rounded; and the umbilical lobe is broad and shallow and centers on the umbilical wall. The internal suture has a deep narrowly hastate dorsal

lobe, two narrow, high, rounded second internal saddles, two narrowly hastate first lateral lobes, and two broadly rounded first lateral saddles.

In fully mature specimens the septa become more closely spaced, and the last suture is weakly developed. The prongs of the ventral lobe are short; the lateral lobes are broadly V-shaped, and the saddles are low and broadly rounded. The features are well shown in a specimen at hand and in the one illustrated by Miller and Owen (1937, pl. 51, figs. 8, 9).

Remarks.—The real nature of Girty's specimens has apparently been overlooked by subsequent authors because a few of the species proposed do not differ appreciably from his specimens. These species should more properly be considered as synonyms. In fact the concept of this species seems to have varied considerably from Girty's original and the illustrations used in Shimer and Shrock (1944) and by Miller and Furnish in the Treatise of Invertebrate Paleontology are not typical of the species as proposed.

The distinguishing characteristics of this species are the low broad whorls, the angular profile of the umbilical shoulder, the low rate of lateral expansion orad, and the relatively great width of the conch. The inner whorls of some of the recently proposed species are essentially identical with Girty's types.

Miller and Owen in 1937 recognized a group of specimens with a relatively large umbilicus and primitive gastrioceran sutures, and it seems that these properly belong in *E. angulatus*.

Occurrence.—This species is abundant in the Pennsylvanian of Oklahoma, and in some other areas of Pennsylvanian. Girty's types are from the Wewoka in sec. 2 and 5, T. 6 N., R. 9 E., and sec. 32, T. 7 N., R. 9 E., Hughes County. Miller and Owen's specimens came from the Seminole formation in Tulsa County. Other localities from which this species is known are:

The Wewoka formation in sec. 10, T. 13 N., R. 12 E.; NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., and from 2.4 miles west of Okmulgee, all in Okmulgee County; in the SE¼ sec. 1, T. 10 N., R. 10 E., Okfuskee County; in the S½ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County; and sec. 4, T. 3 N., R. 7 E., Pontotoc County; the Vamoosa formation about two miles south-southwest of Wynona, Osage County; the Holdenville near Fittstown in Pontotoc County, and in sec. 6, T. 10 N., R. 10 E. Okfuskee County; the Kanwaka in the NE¼ sec. 32, T. 24 N., R. 9 E., Osage County and in the S½ sec. 7, T. 21 N., R. 8 E., Pawnee

County; Nellie Bly formation in sec. 1, T. 17 N., R. 10 E., Creek County; Wetumka in the NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E., Pontotoc County; and the Excello shale in secs. 23, 24, 25, and 36, T. 24 N., R 16 E., and sec. 3, T. 23 N., R. 17 E., Rogers County; from the shale below the Elgin sandstone, SE¼ sec. 17, T. 12 N., R. 8 E., Pawnee County; and from a shale above the Bird Creek limestone in NW¼ sec. 18, T. 25 N., R. 8 E., Osage County.

Repository.—Girty's types are presumably at the U. S. National Museum. Those described by Miller and associates are at the State University of Iowa, and others are at The University of Oklahoma, OU 6, 107, 193, 299, 330, 343, 362, 381, 388, 419, 421, 846, 3828, 3829, 3841-3850, 3859-3862.

Eoasianites anguloumbilicatus (Plummer and Scott), 1937
Plate 12, figures 1-3

1937. *Glaphyrites anguloumbilicatus* Plummer and Scott, Texas Univ., Bull. 3701, p. 271-273, pl. 15, fig. 9, pl. 17, figs. 14-20.
1950. *Eoasianities anguloumbilicatus* Miller and Downs, Jour. Paleontology, vol. 24, p. 203-204, pl. 31, figs. 7, 8.
1954. *Eoasianites anguloumbilicatus* Unklesbay, Jour. Paleontology, vol. 28, p. 86.

The conch of *Eoasianites anguloumbilicatus* is globose and ammoniticonic. It is slightly compressed so that the lateral zones are somewhat flattened and the venter is broadly rounded. The umbilical shoulder is abrupt and sharp, and the umbilical wall is steep, making an angle near 85 degrees with the lateral zone. The umbilicus is medium-sized. In a typical specimen the maximum diameter is 29 mm, the width 16 mm, and the umbilical diameter is 11 mm. The living chamber is greater than one volution in length.

In well-preserved specimens the surface is ornamented with fine striae and revolving lirae. However, on most specimens these are preserved only in the area adjacent to the umbilicus. The mold, even in moderately large specimens, bears shallow transverse constrictions about every quarter volution.

The sutures are not well shown on the specimens at hand, but those of the type are typically gastrioceran.

Remarks.—E. anguloumbilicatus is similar to *E. welleri* except that its umbilical wall is steeper and it is somewhat more compressed laterally. It is also similar to *E. globulosus* but is also more compressed than that species. In some respects it is

similar to *E. hyattianus* but it has a larger umbilicus. This species is represented in the Oklahoma collections by six specimens.

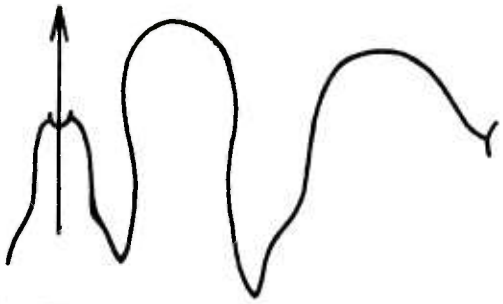
Occurrence.—The types of the species are from the Graford formation in Palo Pinto and Wise Counties, Texas. The Oklahoma specimens are from the Lenapah limestone 2 miles north of Lenapah in Nowata County; the top of the Chanute formation 4.2 miles west of the railroad crossing in Skiatook, Osage County; and from the Coffeyville formation in sec. 36, T. 12 N., R. 9 E., Okfuskee County.

Repository.—The types are in the collections at the Texas Bureau of Economic Geology. The Oklahoma specimens are at The University of Oklahoma, OU 3877, 3878, 3895.

Eoasianites excelsus (Meek), 1876, new combination
Plate 12, figure 14; plate 13, figure 4; text-figure 8

1876. *Goniatites globulosus* var. *excelsum* Meek, U. S. Geog. and Geol. Survey Terr., Bull. vol. 1, 2d ser., p. 445.
1896. *Gastrioceras excelsum* Smith, Amer. Philos. Soc., Proc., vol. 35, p. 260, pl. 17, figs. 1a-c.
1903. *Gastrioceras excelsum* Smith, U. S. Geol. Survey, Mon. 42, p. 88, pl. 16, fig. 2, pls. 28, 29.
1915. *Gastrioceras excelsum* Girty, U. S. Geol. Survey, Bull. 544, p. 258, pl. 34, fig. 4.
1924. *Gastrioceras excelsum* Morgan, [Okla.] Bur. Geology, Bull. 2, p. 100, 232, pl. 51, fig. 9.
1937. *Gastrioceras jonesi* Miller and Owen, Jour. Paleontology, vol. 11, p. 413-415, pl. 51, figs. 1-3, 10; text-figs. 2C, 3.

The conch of *Eoasianites excelsus* is large, globular, and ammoniticonic. The whorls have a helmet-shaped cross section



TEXT-FIGURE 8. Mature suture of moderate-sized *Eoasianites excelsus* (Meek), x1, where the specimen is 110 mm in diameter. Based on specimen from the Seminole formation south of Collinsville, Tulsa County, OU 3898.

and are broadly rounded ventrolaterally, and laterally. The umbilical wall is abrupt, but not rounded, and steep. The dorsal zone is impressed deeply so that the ventral and dorsal walls are nearly parallel. A typical moderate-sized specimen is 82 mm in diameter, 68 mm wide, and has an umbilical diameter of 34 mm.

The largest specimen currently available is a fragment consisting of about one-third volution of a phragmocone, representing about four camerae. It is unusually large, being 110 mm wide with a whorl height of 32 mm. The whorl cross section is low, and the ventral and lateral areas are smoothly rounded. The umbilical shoulder is abrupt and subangular. The umbilical wall is steep and makes an acute angle with the lateral zone. The wall is 25 mm wide. The specimen is somewhat weathered.

The test in the species is thin for the most part, but it thickens over the shoulder. Some specimens bear transverse constrictions which are more prominent on the early volutions, and may not appear at all on the larger whorls. These constrictions are shallow and broad, and form a slight ventral sinus and broad lateral salients. The specimens at hand show no shell ornamentation.

The suture pattern is shown in figure 4 on plate 13 and in text-figure 8. Each external suture forms a large, bifid ventral lobe with narrowly hastate prongs; first lateral saddles which are broadly rounded and faintly constricted at mid-height; V-shaped, asymmetrically attenuate first lateral lobes; and broad, shallow, asymmetrical second lateral saddles which grade into a small lobe centered on or just inside the umbilical shoulder.

Remarks.—E. excelus is one of the largest goniatite species. It can usually be distinguished by its relatively large proportions, and by the low whorl height. It is similar to *E. angulatus* in general form, except that it has a slightly larger umbilicus, and the sides of the first lateral saddle are more nearly parallel.

The designation of the type has been somewhat confusing. Girty, in 1915, explained that Smith regarded as the type the specimen in the U. S. National Museum which was the subject of an incomplete memorandum by Meek in 1876.

E. jonesi Miller and Owen was established for specimens much like *E. excelsus* because they thought their specimens had a smaller umbilicus, different proportions, and "there is no good reason to believe that its conch attains the large size characteristic of mature representatives of that species." However, we now have a large specimen (maximum diameter 118 mm, max-

imum width 88 mm) from the same horizon and locality as their types, and it shows clearly that as the conch increases in size the umbilicus becomes relatively larger and the width-height ratio changes slightly. This large specimen cannot be clearly differentiated from either the type of *excelsus* or *jonesi*. In view of this evidence it seems advisable to consider them conspecific.

Occurrence.—The type of the species came from the "Upper Coal Measures of eastern Kansas at Osage." Another specimen was reported by Smith from the middle Coal Measures of Pope County, Arkansas. Girty's specimen came from the Wewoka formation in T. 5 N., R. 8 E., Coal County, Oklahoma. The large specimen first described above is from the Wetumka formation in sec. 20, T. 2 N., R. 8 E., also in Coal County. Two of the moderate-sized specimens are from the Wewoka, one from sec. 33, T. 5 N., R. 8 E., Pontotoc County, the other from SE¼ sec 1, T. 10 N., R. 10 E., Okfuskee County. Another is from the Wann formation in "NE¼ SW¼ sec. (1?), T. 25 N., R. 12 E.," Washington County. Two poor specimens are also known from the Holdenville in NE¼ sec. 24, T. 15 N., R. 11 E., Okmulgee County. Miller and Owen's types, the large specimen mentioned in the remarks above, and four small specimens are from the Seminole formation just south of Collinsville, Oklahoma.

Repository.—Meek's type specimen is at the U. S. National Museum. Smith's specimen is at the Walker Museum (6226). Miller and Owen's specimens are at the State University of Iowa, SUI 1900 and 1989. The other specimens are at The University of Oklahoma, OU 103, 397, 3787, 3806, 3807, 3898.

Eoasianites globulosus (Meek and Worthen), 1860
Plate 12, figures 12, 13

1860. *Goniatites globulosus* Meek and Worthen, Phila. Acad. Nat. Sciences, Proc. 1860, p. 471.
1866. *Goniatites globulosus* Meek and Worthen, Ill. Geol. Survey, vol. 2, p. 39, pl. 30, fig. 2.
1884. *Gastrioceras globulosum* Hyatt, Boston Soc. Nat. History, Proc., vol. 22, p. 327.
1896. *Gastrioceras globulosum* Smith, Amer. Philos. Soc., vol. 35, p. 258, pl. 18, figs. 1-6.
1898. *Glyphioceras globulosum* Haug, Geol. Soc. France, Mem., vol. 7, no. 18, p. 26.
1903. *Gastrioceras globulosum* Smith, U. S. Geol. Survey, Mon. 42, p. 89-90, pl. 6, fig. 1, pl. 21, figs. 7-9.
1937. *Glaphyrites globulosus* Plummer and Scott, Texas Univ., Bull. 3701, p. 276-279, pl. 15, figs. 1-8.

1944. *Eoasianites globulosus* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, figs. 15-17.

The conch of *Eoasianites globulosus* is globose and ammoniticonic. The whorls are semilunate in cross section, being much wider than high and impressed by the preceding whorls so that the dorsal and ventral surfaces are nearly parallel except where they converge in the umbilical region. The venter is broadly rounded and in small specimens slightly flattened. The lateral zones are rounded to the umbilical shoulders, which are abrupt. The umbilicus is moderately large and open, but in some specimens which retain the living chamber the shell seems to widen and to nearly close the umbilicus. The living chamber is more than one volution in length. The shell when preserved is marked by faint transverse sinuous growth lines.

The external sutures form a bifid ventral lobe with a well-developed ventral saddle; the first lateral lobes are broad and bulbous with weakly attenuate ends; the first lateral saddle is broadly rounded, and the second lateral saddles are rounded and asymmetrical.

Remarks.—*E. globulosus* can be distinguished from other congeners by its globosity, and by the relatively low whorl in comparison to the width. The umbilicus is smaller than in *E. angulatus* but larger than in *E. hyattianus.*

Occurrence.—Smith reported this species from the Middle Coal Measures of Scott County, Arkansas; the Upper Coal Measures at Springfield, Illinois; and the Upper Coal Measures of Texas. Plummer and Scott report it from the Graham and Gaptank formations of the Upper Pennsylvanian. In Oklahoma it is known in the Union Valley limestone at Lovelady Switch near Stonewall, Pontotoc County; in the Atoka formation on Barnett Hill near Clarita, Coal County; in the Wewoka in sec. 33, T. 5 N., R. 8 E., Pontotoc County; in the Wapanucka in sec. 33, T. 3 N., R. 7 E., Pontotoc County; the Wetumka in sec. 3, T. 5 N., R. 9 E., Hughes County; and in the Coffeyville in sec. 36, T. 12 N., R. 9 E., Okfuskee County.

Repository.—Smith deposited his material in the U. S. National Museum. Plummer and Scott's material is at the Bureau of Economic Geology, University of Texas, and at Texas Christian University. The material currently being studied is at The University of Oklahoma, OU 367, 378, 400, 3880, 3888-3891.

Eoasianites hyattianus (Girty), 1911, new combination
Plate 14, figures 8-11

1911. *Gastrioceras hyattianum* Girty, New York Acad. Sciences, Annals, vol. 21, p. 150.
1915. *Gastrioceras hyattianum* Girty, U. S. Geol. Survey Bull. 544, p. 254, pl. 32, fig. 6; pl. 33, fig. 1-4.
1937. *Glaphyrites hyattianus* Plummer and Scott, Texas Univ. Bull. 3701, p. 268, pl. 16, fig. 14-17.
1954. *Owenoceras hyattianus* Unklesbay, Jour. Paleontology, v. 28, p. 86, 92.

The conch of *Eoasianites hyattianus* is subglobular to thickly lenticular and reaches its greatest width near the umbilicus. The smaller specimens are more globular and the larger more lenticular. The cross section of the whorl is helmet-shaped with the ventral and lateral sides being continuously and smoothly rounded. In large specimens there is a slight flattening near the umbilicus. The umbilical shoulder is abrupt, but narrowly rounded. The umbilicus is small, and deep, and its walls are steep. The living chamber is preserved on many specimens and is more than a volution in length. This species ranges in size from immature forms to mature individuals as large as 77 mm in diameter. One specimen of this large size is 45 mm wide, and its umbilicus is 22 mm in diameter. If large numbers of specimens are measured the ratio between their various dimensions varies somewhat, but there seems to be gradation and apparently these differences are not of taxonomic significance.

Only a few specimens bear shell fragments and some of these show faint longitudinal lirae in the umbilical region; others show both transverse and longitudinal lirae. Small specimens are strongly marked with transverse constrictions. In some specimens these constrictions may number 5 or 6 per volution, and in others they are fewer. They are sinuous on most specimens.

The external suture is typically gastrioceran. It consists of a bifid ventral lobe with symmetrically hastate prongs, and a ventral saddle, which is approximately half as high as the lobe is deep; two first lateral saddles which are rounded and slightly constricted at mid-height and spatulate in form; two first lateral lobes which are V-shaped with sinuous sides and briefly attenuate apical ends; two second lateral saddles which are moderately high and asymmetrically rounded. The umbilical lobe is broadly V-shaped and centers on the umbilical wall.

Remarks.—*E. hyattianus* is abundant in the Pennsylvanian of Oklahoma. The present collection contains approximately 200 specimens. The species differs from *E. angulatus* in having a smaller umbilicus and rounded umbilical shoulders, and its rate of lateral expansion is slightly greater. Some of Girty's illustrations show that some of his smaller specimens bear longitudinal lirae, however not all of them do. In his description he explains that, "When mature the shell seems to have had a perfectly smooth surface without lirae of either sort, except possibly a few revolving ones on the umbilical shoulder." In view of this statement it seems unwise to consider this species in the genus *Owenoceras* which is differentiated from *Eoasianites* solely on the basis of longitudinal lirae.

Occurrence.—Girty's specimens came from the Wewoka formation in the Wewoka and Coalgate quadrangles, at several locations in T. 6 N., R. 9 E., and in T. 5 N., R. 8 E., Hughes County. Those described by Plummer and Scott are from the Mineral Wells and Millsap Lake formations in Texas. Present collections contain specimens from the Coffeyville in sec. 36, T. 12 N., R. 9 E., Okfuskee County; the Wetumka in NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E., Pontotoc County; the Holdenville in sec. 36, T. 11 N., R. 9 E., and sec. 12, T. 10 N., R. 9 E., Okfuskee County; and from the Wewoka at the following localities: NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., secs. 8 and 10, T. 13 N., R. 12 E., a road cut 2.4 miles west of Okmulgee and at the spillway at Lake Okmulgee, all in Okmulgee County; in sec. 4, T. 3 N., R. 7 E., and secs. 23, 24, and 33, T. 5 N., R. 8 E., and sec. 32, T. 5 N., R. 9 E., Pontotoc County; sec. 32, T. 7 N., R. 9 E., and sec. 5, T. 9 N., R. 10 E., Hughes County; and SE¼ sec. 1, T. 10 N., R. 10 E., Okfuskee County.

Repository.—Girty's types are in the U. S. National Museum. Plummer and Scott's material is in the Bureau of Economic Geology, University of Texas. Other material is at the State University of Iowa, and The University of Oklahoma, OU 106, 173, 374, 389, 405, 414, 415, 422, 3863-3876, 3881-3887.

Eoasianites kansasensis (Miller and Gurley), 1896
Plate 12, figures 4-6

1896. *Goniatites kansasensis* Miller and Gurley, Illinois State Mus. Nat. History, Bull. 11, p. 43, pl. 5, figs. 9-11.
1903. *Gastrioceras kansasense* Smith, U. S. Geol. Survey, Mon. 42, p. 91, pl. 17, figs. 9-11.

1903. *Gastrioceras subcavum* Smith, U. S. Geol. Survey, Mon. 42, p. 97, pl. 17, figs. 15-17.
1937. *Glaphyrites kansasensis* Plummer and Scott, Texas Univ., Bull. 3701, p. 274-276, pl. 17, figs. 1-13.
1939. *Glaphyrites welleri* Miller and Owen [part], Jour. Paleontology, vol. 13, p. 149-153, pl. 18, figs. 15, 16 [not 6-14].

Four specimens in the collections at Oklahoma University are closer to *Eoasianites kansasensis* than to any other. Three of them are small and immature, but they seem to be closely similar to the large one. The small ones range from 6 to 9 mm in diameter. The large specimen is a completely septate, limonitic internal mold of a phragmocone which is sublenticular in shape, being slightly compressed. It is 27 mm in diameter, 17 mm wide, and the umbilicus is 8 mm in diameter. The whorl is smoothly rounded from side to side, but the venter is more narrowly rounded than are the lateral zones. The umbilical shoulder is sharp and abrupt and the shoulders, which are steep, make an angle with the lateral zone of about 90 degrees. The dorsum is impressed with the impressed zone being broadly rounded. Where the whorl height is 10.5 mm, the impressed zone is 11 mm wide and 5 mm deep. At this place the whorl width is 17 mm and the height of the umbilical wall is 3 mm.

These specimens bear no shell material so the surface of the test is not known. In all specimens the mold is marked by transverse constrictions which are shallow, and slightly sinuous across the lateral and ventral zones. In the larger specimen these are spaced at the quarter-volution position, but in the smaller ones they are more numerous.

The sutures are typically gastrioceran. They form: a bifid ventral lobe with hastate prongs divided by a high, equal-sized ventral saddle; broadly rounded first lateral saddles; broadly V-shaped, attenuate first lateral lobes; and low, asymmetrical, rounded second lateral saddles. There is also a V-shaped umbilical lobe centering on the umbilical wall.

Remarks.—These specimens, especially the larger one, are well preserved. Plummer and Scott called this species a "common upper Pennsylvanian species" and reported specimens from the Graham and Gaptank formations. Smith in 1903 reported his type from the Missourian stage at Kansas City. However, a specimen reported by Miller and Owen in 1939 appears to be conspecific and it came from just above the Mulky coal in Henry County, Missouri. Therefore, it is not necessary to restrict this form to the Upper Pennsylvanian.

E. kansasensis can be distinguished from other species of the genus by the size of its umbilicus, and by the lesser width of the conch.

Occurrence.—This species is known from the Graham and Gaptank formations in Texas; the Missourian (Mulky coal) at Kansas City; and the Cherokee of Henry County, Missouri. The presently described specimens are from the Wewoka of Oklahoma. Two of the smaller ones are from a road cut 2.4 miles west of Okmulgee on Highway 56, one is from sec. 33, T. 5 N., R. 8 E., Pontotoc County, and the other large one is from the Wetumka in the SW¼ sec. 10, T. 15 N., R. 13 E., Okmulgee County.

Repository.—Walker Museum, holotype. Texas Bureau of Economic Geology, Plummer and Scott's material. The University of Oklahoma, the presently described specimens, OU 774, 3893, 3894.

Eoasianites oblatus (Miller and Moore), 1938
Plate 13, figures 1-3; text-figure 6B

1924. *Gastrioceras kansasense* Morgan, [Okla.] Bur. Geology, Bull. 2, p. 55.
1938. *Glaphyrites oblatus* Miller and Moore, Jour. Paleontology, vol. 12, p. 352-353, pl. 43, figs. 10, 11.
1944. *Eoasianites oblatus* Miller and Owen, Jour. Paleontology, vol. 18, p. 425-427, pl. 66, figs. 5-13, text-fig. 4C.
1956. *Eoasianites oblatus* Elias, Amer. Assoc. Petroleum Geologists, Petrol. Geol. S. Okla., vol. 1, p. 97.

The conch of *Eoasianites oblatus* is subglobular, ammoniticonic, and large. Ordinary specimens reach diameters of 40 to 50 mm. The whorls are helmet-shaped in cross section, being rounded ventrally and laterally, with the ventral area being more narrowly rounded. The dorsal zone is impressed. The umbilical shoulders are abrupt and the umbilical wall is steep. The umbilicus is moderate in size but becomes relatively larger with maturity. Some specimens bear transverse constrictions.

Mature external sutures form: a low, broad, prominently bifid ventral lobe with hastate prongs on either side; a rather broad, rounded first lateral saddle; a wide, V-shaped, acuminate first lateral lobe; an asymmetrical, relatively low second lateral saddle; and an umbilical lobe which centers on the umbilical wall. The internal suture has a deep, hastate ventral lobe on either side of which is a broad, rounded saddle and a hastate first lateral lobe.

Remarks.—*E. oblatus* is probably the most abundant goniatite in the Morrowan beds of Oklahoma. It can be distinguished by its relatively narrow umbilicus and its conch is relatively narrower than those of other species of *Eoasianites*. *Cravenoceras*? *morrowense* occurs in association with this species, and can be confused with it. However, *C.*? *morrowense* has an even smaller umbilicus.

Occurrence.—This species is abundant in the Morrowan near Harrison, Arkansas, and in the Union Valley of Pontotoc County, Oklahoma. The latter region yielded the specimens described by Miller and Owen from Buck Creek, near Lovelady; and the present ones are from the Lovelady Switch on the MKT Railroad 2 miles northwest of Stonewall and from SE¼ sec. 33, T. 3 N., R. 7 E., Pontotoc County. Elias (1956) reported this species from the Primrose in SE¼ sec. 1, T. 3 S., R. 2 E.; also Miller and Moore reported this species from the Morrowan on Greenleaf Creek, 3.5 miles southeast of Braggs, Muskogee County.

Repository.—State University of Iowa, holotype, SUI 1972, others, SUI 1970, 1971, 13951, 13952. The University of Oklahoma, OU 371, 3824-3827, 4211.

Eoasianites welleri (Smith), 1903, new combination

1903. *Gastrioceras welleri* Smith, U. S. Geol. Survey, Mon. 42, p. 98-99, pl. 24, figs. 13-20.
1915. *Gastrioceras welleri* Girty, Missouri Bur. Geology and Mines, 2d ser., vol. 13, p. 270, 364.
1927. *Gastrioceras welleri* Smith, U. S. Geol. Survey, Prof. Paper 141, pl. 20, figs. 14-17.
1932. *Gastrioceras welleri* Smith, U. S. Geol. Survey, Prof. Paper 167, p. 24, pl. 43, figs. 14-17.
1937. *Glaphyrites welleri* Plummer and Scott, Texas Univ., Bull. 3701, p. 267-268, pl. 15, figs. 13-21.
1939. *Glaphyrites welleri* Miller and Owen [part], Jour. Paleontology, vol. 13, p. 149-153, pl. 18, fig. 6, [not 8-16].

Eoasianites welleri is represented in the current collection by only two specimens, neither of which merits illustration. Both are internal molds which display the same general form and physiognomy as the type, but are different in size. The small specimen is about 9 mm wide and 12 mm in diameter. The large one is 20 mm wide and 45 mm in diameter. In both of these the ventral and lateral zones are broadly rounded, the umbilical shoulder is sharp and subangular, and the umbilicus is relatively large. Neither specimen retains test fragments and

neither shows the nature of the suture clearly. From what can be seen of the suture, it seems to be typically gastrioceran.

Remarks.—*E. welleri* can be distinguished from *E. globulosus* in having a wider umbilicus, and from the other species of the genus by being wider and lower.

Occurrence.—This species is reported from the Cherokee of Henry County, Missouri, the Millsap Lake formation of Texas, and the Middle Pennsylvanian of Montgomery County, Illinois. The two specimens described here are from the Kanwaka shale in SE¼ sec. 11, T. 25 N., R. 9 E., Osage County; and SE¼ SE¼ sec. 9, T. 19 N., R. 10 E., Tulsa County.

Repository.—The types are at the Walker Museum. Other specimens are at the Texas Bureau of Economic Geology, the State University of Iowa, and at The University of Oklahoma, OU 3879, 3892.

Eoasianites subdiscus, new species
Plate 9, figure 7

Eoasianites subdiscus is based on two specimens from the Buckhorn asphalt pit. The better one, the holotype, is an unusually large goniatite which is septate throughout. The maximum diameter is 310 mm, the maximum whorl height is 123 mm, and the maximum width is 65 mm. At the adoral end of the specimen, where these measurements were made, the depth of the dorsal impressed zone is 40 mm.

The conch is subdiscoidal, laterally compressed, and ammoniticonic. The whorls are broadly rounded laterally, narrowly rounded ventrally, and deeply impressed dorsally. The umbilicus is moderately large, being about one-fifth of the diameter. The umbilical walls are fairly steep.

The external sutures are typically gastrioceran, and consist of: a deeply divided ventral lobe; an asymmetrical, high, and broadly rounded first lateral saddle; a slightly asymmetrical, V-shaped first lateral lobe; and a broad, asymmetrical second lateral saddle which extends to the umbilical shoulder where there is a narrow V-shaped lobe. The internal part of the suture cannot be observed.

The septa are widely spaced. On the mature part of the mold the longitudinal distance between saddles is about 70 mm.

Some shell fragments are preserved on the adoral portion of this specimen and they retain the nacreous layer. However,

not enough shell is present to give any hint of ornamentation or thickness of the shell wall.

The other specimen of this species is a fragment of an internal mold of a phragmocone. It is 183 mm long and has a dorsoventral height of 80 mm. It is strongly compressed laterally with a narrowly rounded venter, weakly convex sides, and a deeply impressed dorsal zone.

Remarks.—E. subdiscus can be distinguished from other species of this genus on the basis of its large size, and compressed conch. In lateral view it resembles *E. moorei* Miller and Owen, but that species is wider than high.

Because of its size and subdiscoidal shape, this species might possibly represent another genus. However, its suture pattern is so close to that of *Eoasianites* that it does not seem wise to establish a new genus without more supporting evidence. The specific name is given because of the subdiscoidal shape.

Occurrence.—The holotype and paratype are from the Buckhorn asphalt pit, about 3 miles south of Sulphur, sec. 26, T. 1 S., R. 3 E., Murray County.

Repository.—The University of Oklahoma; holotype 3945, paratype 3768.

Genus *Owenoceras* Miller and Furnish, 1954
Owenoceras retiferum (Miller and Owen), 1937
Plate 14, figures 5-7

1937. *Gastrioceras retiferum* Miller and Owen, Jour. Paleontology, vol. 11, p. 416-417, pl. 52, figs. 8-11.
1939. *"Gastrioceras" retiferum* Miller and Owen, Jour. Paleontology, vol. 13, p. 154.
1940. *"Gastrioceras" retiferum* Miller and Furnish, Jour. Paleontology, vol. 14, p. 359.
1954. *Owenoceras retiferum* Miller and Furnish, Jour. Paleontology, vol. 28, p. 86.

Owenoceras retiferum was established in 1937 by Miller and Owen for specimens from the Seminole formation.

It was first identified with the genus *Gastrioceras* but was later separated from this genus because it does not have the characteristic nodose umbilical shoulders. With *Neoglyphioceras bellilineatum* Miller and Owen it was placed in *Owenoceras.* This genus is distinguished from other gastrioceran forms, and especially from *Eoasianites,* by having numerous, prominent longitudinal lirae.

The species is subglobular, ammoniticonic, and moderately

large. The whorls are wider than high, and the umbilical shoulders are abruptly rounded. The umbilicus is large and open. The suture is typically gastrioceran.

Occurrence.—*O. retiferum* was reported by Miller and Owen as being rare in concretions in the Seminole formation, just above the Dawson coal, about three-quarters of a mile south of Collinsville, Tulsa County.

Repository.—Syntypes are at the State University of Iowa.

Genus *Eupleuroceras* Miller and Cline, 1934
Eupleuroceras bellulum Miller and Cline, 1934
Plate 15, figures 7, 8

1934. *Eupleuroceras bellulum* Miller and Cline, Jour. Paleontology, vol. 8, p. 179-181, pl. 28, figs. 19-23.
1954. *Eupleuroceras bellulum* Unklesbay, Jour. Paleontology, vol. 28, p. 86.
1957. *Eupleuroceras bellulum* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L63.

Eupleuroceras bellulum was established in 1934 by Miller and Cline for some small distinctive ammonoids. They are subdiscoidal with shells not tightly coiled and bearing prominent subangular ribs and a distinct subangular ventral keel. The cross section is pentagonal with a concave dorsal side, slightly convex lateral zones, and nearly flat ventrolateral zones. The umbilicus is large and exposes the lateral zones of all volutions. The suture is composed of eight primary lobes, and eight primary saddles.

Remarks.—*E. bellulum* is clearly distinct from all other described forms.

Occurrence.—The only known representatives of this species are those described by Miller and Cline (1934) from the Nellie Bly formation, 6½ miles due west of Sand Springs, Tulsa County.

Repository.—Cotypes, State University of Iowa, SUI 638.

Genus *Pseudoparalegoceras* Miller, 1934
Pseudoparalegoceras compressum (Hyatt), 1891
Plate 15, figure 10

1891. *Gastrioceras compressum* Hyatt, Geol. Survey Texas, Second Ann. Rept., p. 355, p. 57, 58, 59.
1903. *Gastrioceras compressum* Smith, U. S. Geol. Survey, Mon. 42, p. 86, pl. 9, figs. 1-3.

1940. *Pseudoparalegoceras compressum* Miller and Furnish, Jour. Paleontology, vol. 14, p. 531, text-fig. 3B.
1960. *Pseudoparalegoceras compressum* Murray, Furnish, and Carilla, Jour. Paleontology, vol. 34, p. 733, 734.

The lower part of the Atoka in east-central Oklahoma has yielded two specimens representing *Pseudoparalegoceras compressum*. Both are sandstone internal molds of phragmocones which, although they leave much to be desired, are moderately well preserved. Both are subdiscoidal ammoniticones with narrowly rounded venters, and broadly rounded, though slightly flattened, lateral zones. The dorsal zone is strongly impressed. The umbilical shoulder is distinct, but is rounded, and the umbilical wall is steep. Both specimens have the same general proportions. The larger one, which consists of at least eight volutions, has a maximum diameter of 108 mm, and a maximum whorl height of 35 mm. The umbilicus is large, diameter 46 mm, and open, though not perforate. It reveals much of the inner whorls and where the diameter given above was measured the umbilicus is 20 mm deep.

Neither of these specimens bears shell material and the internal mold bears no evidence of ornamentation.

The sutures are not well preserved, but the smaller specimen indicates that they form: a bifid ventral lobe with hastate prongs; a high, rounded, U-shaped first lateral saddle; a broad, acuminate first lateral lobe; a rounded, slightly asymmetrical second lateral saddle; and a wide, V-shaped second lateral lobe which centers on the umbilical shoulder. It should be mentioned that this specimen is badly worn and that the extremities of the lobes and saddles were narrower in their original condition.

Remarks.—*P. compressum* was used as the type species of *Phaneroceras* by Plummer and Scott. However, as pointed out in the discussion of *Pseudoparalegoceras williamsi*, their genus is not valid. Moreover, the specimens which they referred to *Phaneroceras compressum* are not conspecific with the holotype.

Occurrence.—The holotype of *P. compressum* is from the Bend formation in San Saba County, Texas. Miller and Furnish (1940) reported one from the Atoka near Winslow, Arkansas. The two described here are from the Atoka; one from the SW¼ SE¼ NW¼ sec. 7, T. 13 N., R. 23 E., and the other from Salt Hollow, both in Sequoyah County.

Repository.—Smith (1903) reported that the holotype is in the National Museum. Plummer and Scott (1937) said it is

in the Department of Geology, University of Texas. The specimen mentioned by Miller and Furnish is at the State University of Iowa, SUI 13991. The two described here are at The University of Oklahoma, OU 3617 (smaller), 3595 (larger).

Pseudoparalegoceras brazoense Plummer and Scott, 1937
Plate 15, figure 9

1935. *Strawnoceras brazoense* Plummer and Scott, *nomen nudum*, Texas Univ., Bull. 3534, p. 20.
1937. *Pseudoparalegoceras brazoense* Plummer and Scott, Texas Univ., Bull. 3701, p. 15, 16, 192, 196-197, pl. 10, figs. 10-14.
1940. *Pseudoparalegoceras brazoense* Miller and Furnish, Jour. Paleontology, vol. 14, p. 529-531, pl. 62, fig. 8; pl. 63, fig. 13-14, text-fig. 3.
1944. *Pseudoparalegoceras brazoense* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, fig. 5.

Two small fragments of the right half of about 3 camerae seem to represent *Pseudoparalegoceras brazoense*. One has a whorl height of 23 mm. The suture pattern is typical of the species in that the second lateral lobe is slightly ventrad of the umbilical shoulder, and the second lateral saddle is markedly asymmetrical. Also the umbilical wall and the lateral zone of the whorl make an acute angle instead of being nearly perpendicular as in *P. williamsi*.

Occurrence.—The types of *P. brazoense* are from near the base of the Millsap Lake formation in northern Hood County, Texas. Miller and Furnish (1940) had specimens from the Boggy formation east of Ada, Oklahoma, and from Magdalena formation in San Miguel County, New Mexico. They also reported a specimen, which may be conspecific, from the Buckhorn asphalt pit in Murray County, Oklahoma. The fragments described above are from the Boggy formation in sec. 27, T. 3 N., R. 7 E., southeast of Ada, Pontotoc County.

Repository.—The holotype is in the Geological Museum at Texas Christian University. Paratypes are at the Texas Bureau of Economic Geology. Other specimens are at the State University of Iowa, and The University of Oklahoma, OU 3774.

Pseudoparalegoceras kesslerense (Mather), 1915
Plate 15, figure 1

1915. *Gastrioceras kesslerense* Mather, Denison Univ., Bull. Sci. Labs., vol. 18, p. 242-243, pl. 16, figs. 10-10b.
1930. *Gastrioceras kesslerense* Croneis, Arkansas Geol. Survey, Bull. 3, p. 87, pl. 22, figs. 3-5.

1938. *Phaneroceras kesslerense* Miller and Moore, Jour. Paleontology, vol. 12, p. 351-352, pl. 44, figs. 1, 2.

Pseudoparalegoceras kesslerense is represented in the current collection by one very poor specimen. It is subdiscoidal, and ammoniticonic, and, despite poor preservation, seems to meet the specific characteristics of this species. This specimen has a maximum diameter of 85 mm, a maximum whorl height of 32 mm, a maximum width of 42 mm, and the umbilicus is 34 mm across. The whorl cross section is helmet-shaped with the ventrolateral surface being rounded, but more narrowly so over the venter. The umbilical shoulder is abrupt, and the umbilical wall is steep. The depth of the impressed zone is approximately one-third the whorl height. The umbilicus is large and the coiling is such that the volutions leave about one-half of the height of the preceding whorl exposed. There is no trace of shell on the specimen.

The sutures are not well preserved because of the weathered surface of the specimen, but it can be seen that they form a bifid ventral lobe with deep, pointed prongs with parallel sides; a high, rounded first lateral saddle with nearly parallel sides; and a V-shaped first lateral lobe. The nature of the second lateral saddle is not clearly discernible, but it appears to have been asymmetrical and relatively low.

Remarks.—Although this specimen is much larger than the holotype, its subdiscoidal shape, large umbilicus, and suture pattern seem to fit the specific features of *P. kesslerense*.

Occurrence.—The type came from the Kessler limestone near Fayetteville, Arkansas. Mather also reported a specimen from along Brush Creek, near Chouteau, Mayes County, Oklahoma. The present specimen is from the Union Valley formation at Lovelady Switch on the MKT railroad 2 miles northwest of Stonewall, Pontotoc County. The State University of Iowa collection contains many specimens from the Atoka at Barnett Hill, near Clarita, Coal County.

Repository.—The holotype is at the State University of Iowa. The presently described specimen is at The University of Oklahoma, OU 3772.

Pseudoparalegoceras williamsi Miller and Downs, 1948
Plate 16, figures 1, 2

1937. *Phaneroceras compressum* Plummer and Scott [part], Texas Univ., Bull. 3701, p. 15, 16, 30, 33, 191-193, 194, 220, 281; pl. 9, figs. 4-10; pl. 11, fig. 13.

1948. *Pseudoparalegoceras williamsi* Miller and Downs, Jour. Paleontology, vol. 22, p. 672, 673, 677-678; pl. 101, fig. 5; pl. 102, figs. 1-5; pl. 103, figs. 6-9; text-fig. 2.
1957. *Pseudoparalegoceras williamsi* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. 161-162, text-fig. 85.
1958. *Pseudoparalegoceras williamsi* Unklesbay and Palmer, Jour. Paleontology, vol. 32, p. 1074; pl. 138, fig. 8-11; text-figs. 1-2.
1959. *Pseudoparalegoceras williamsi* Blythe, Okla. Geol. Survey, Circ. 47, p. 44, text-fig. 23.

Pseudoparalegoceras williamsi is represented in the Oklahoma collection by one excellent specimen and many fragmentary ones. All are septate internal molds of phragmocones in various states of preservation. The one excellent specimen is subglobose and ammoniticonic. It has a maximum diameter of 85 mm, a maximum width of 39 mm, and a maximum height of 36 mm. The umbilicus is 26 mm across and the width of the umbilical wall at the end of the outer whorl is 9.5 mm. The whorl has a helmet-shaped cross section. It is rounded ventrally and ventrolaterally, slightly flattened laterally, and somewhat compressed. The umbilical shoulder is abrupt and the wall makes an angle of more than ninety degrees with the lateral zone. The dorsum is deeply impressed to about half the height of the whorl.

None of these specimens retains shell material, hence there is no evidence of ornamentation. The mold is smooth and shows no sign of nodes or ridges.

The sutures are typical for the species and some fragments show the complete suture from the venter to the dorsum. The suture has a bifid ventral lobe with fairly broad hastate prongs and first lateral saddles which are high and narrowly rounded, and have sinuous flanks. The first lateral lobes are wide and attenuate, and the second lateral saddles are asymmetrical and narrowly rounded with the ventral side being more sinuous than the umbilical side. The second lateral lobe is on the umbilical wall, and is V-shaped and attenuate. From this lobe the suture continues into the dorsum with a broad rounded saddle, a narrow hastate internal first lateral lobe, a narrow spatulate internal first lateral saddle, and a deep, narrow, attenuate dorsal lobe.

Remarks.—P. williamsi was established by Miller and Downs for about 75 specimens from the "Winslow" formation at Winslow, Arkansas. It is similar to *P. compressum* except that it has a smaller umbilicus which exposes less of the internal

whorls. Plummer and Scott used *P. compressum* as the type species for *Phaneroceras* on the basis of its second lateral lobe being centered outside the umbilicus. However, Miller and Furnish (1940) point out that the position of this lobe is dependent upon the shape of the shell and that it may be different in early and late whorls. It is their opinion that *Phaneroceras* should be regarded as a synonym of *Pseudoparalegoceras*.

Occurrence.—The types of Miller and Downs are from the "Winslow" formation at Winslow, Arkansas. Specimens in the University of Oklahoma collection are mostly from the Atoka at: (1) Barnett Hill, near Clarita, Coal County; (2) sec. 32, T. 14 N., R. 24 E., Adair County; (3) NW¼ sec. 26, T. 18 N., R. 19 E., Wagoner County; and (4) east end of bridge on Oklahoma Highway 51, SE¼ sec. 22, T. 17 N., R. 19 E., Cherokee County. Three specimens are from the Frensley in the NW¼ SE¼ sec. 32, T. 5 S., R. 2 E., Carter County.

Repository.—The types of the species are at the U. S. National Museum. Other specimens are in the collections at the State University of Iowa, and at The University of Oklahoma, OU 3160, 3596, 3769, 3770, 3773, 3776-3780, 3853.

Family SCHISTOCERATIDAE Schmidt, 1929

Genus *Schistoceras* Hyatt, 1889

Schistoceras missouriense (Miller and Faber), 1892

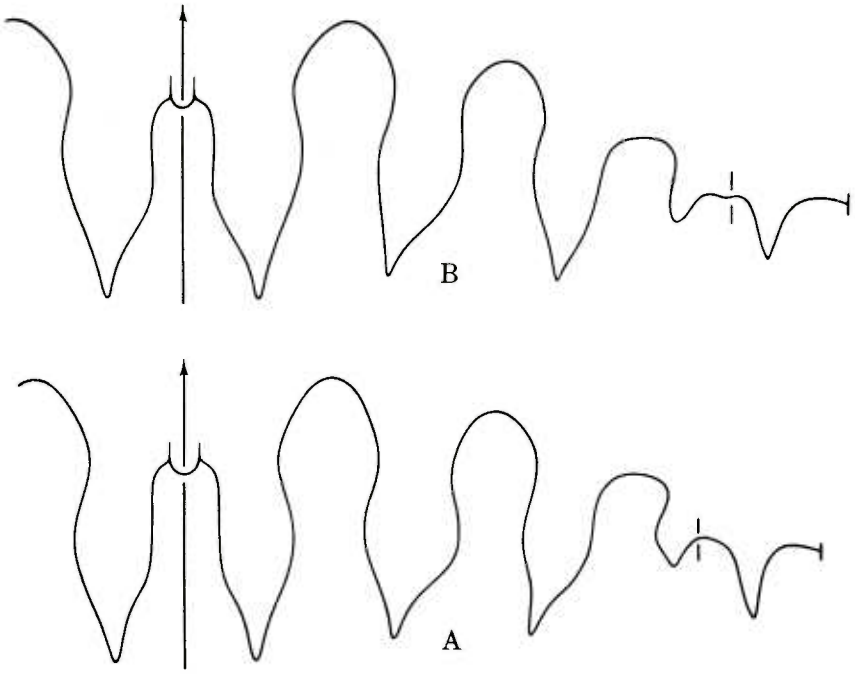
Plate 16, figure 5; text-figure 9B

1892. *Goniatites missouriensis* Miller and Faber, Cincinnati Soc. Nat. History, Jour., vol. 14, p. 164-165, pl. 6, fig. 1.
1940. *Schistoceras missouriense* Miller and Furnish, Jour. Paleontology, vol. 14, p. 540-541, pl. 65, figs. 6-9. (This report contains an extensive synonymy to this date).
1942. *Schistoceras missouriense* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, p. 153-158, pl. 8, figs. 4, 5; text-fig. 3.
1944. *Schistoceras missouriense* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, figs. 9, 10.
1950. *Schistoceras missouriense* Miller and Downs, Jour. Paleontology, vol. 24, p. 206-207, pl. 34, fig. 7-9.
1954. *Schistoceras missouriense* Unklesbay, Jour. Paleontology, vol. 28, p. 86-87.
1957. *Schistoceras missouriense* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L65, text-figs. 92C-D, 93.
1958. *Schistoceras hyatti* Miller and Furnish, Jour. Paleontology, vol. 32, p. 259, 260, 261, 263, 264, pl. 34, fig. 9, text-figs. 4, 5, 6.

Ten septate fragments of internal molds represent *Schistoceras missouriense* in the Oklahoma collection. All but two are poorly preserved, but all seem to possess the significant features of the species. The largest is about half a volution, and has a maximum diameter of 69 mm. It has been about 30 mm wide, and the umbilicus is 14 mm in diameter. The other of the two better specimens is about the same size, and displays clearly the typical suture pattern of the species (fig. 5 on pl. 16).

Remarks.—The poor preservation of these specimens of *S. missouriense* provides little basis for description. However, when these fragments are compared with the many published descriptions and illustrations of the species there is little doubt as to their identity.

There have been many species of *Schistoceras* named and described. However, in 1940, Miller and Furnish decided that only two of these, *S. hildrethi* and *S. missouriense*, were valid



TEXT-FIGURE 9. *Schistoceras.*

A. Mature external suture of *S. hildrethi* (Morton), x6, based on specimen about 25 mm in diameter.

B. Mature external suture of *S. missouriense* (Miller and Faber), x4, based on specimen about 35 mm in diameter (both from Miller and Furnish, 1940).

and they published extensive synonymies which included even some forms which had been used as bases for new genera. In 1958 Miller and Furnish published a revision of their ideas in which they recognized that part of their 1940 synonymy was not valid. In this paper they use the name of *S. hyatti* for the same specimen which Miller and Downs (1950) had called *S. missouriense*. However there is no explanation of this change, and they do not explain how *S. hyatti* can be differentiated from *S. missouriense*.

Occurrence.—This species is widely distributed in the upper half of the Pennsylvanian of United States. It is known from western Pennsylvania (Conemaugh), eastern Ohio (Conemaugh), Illinois (McLeansboro), eastern Kansas and western Missouri (Kansas City group), north-central Texas (Graford and Graham formations), and western Texas (Gaptank). In Oklahoma *S. missouriense* has been reported from the Nellie Bly of Seminole County (Miller and Furnish, 1940) and the presently described material is from the Vamoosa formation about 2 miles south-southwest of Wynona, Osage County. Fragmental specimens in the State University of Iowa collections are from the "Eudora shale," 6 miles northeast of Copan, Washington County.

Repository.—The holotype of this species is at the Walker Museum, 8756. Other specimens are at the State University of Iowa, SUI 1059, 1437, 13988; Yale Peabody Museum; Carnegie Museum at Pittsburgh; Columbia University; and The University of Oklahoma, OU 3786, 3808.

Schistoceras hildrethi (Morton), 1836
Plate 16, figure 4; text-figure 9A

1836. *Ammonites hildrethi* Morton, Amer. Jour. Science, vol. 29, p. 40, 149, pl. 1, fig. 1; probably not p. 137, pl. 28, figs. 48, 50, 53, 54.
1889. *Goniatites hildrethi* Miller, North American Geology and Paleontology, p. 439.
1898. *Agathiceras hildrethi* Haug, Soc. Geol. France, Mem., Paleont., no. 18, p. 33, 105-107, pl. 1, figs. 40a-c.
1903. *Schistoceras hildrethi* Smith, U. S. Geol. Survey, Mon. 42, p. 107-108, pl. 3, figs. 1, 2.
1930. *Schistoceras reticulatum* Miller, Jour. Paleontology, vol. 4, p. 403-406, pl. 39, figs. 6-9.
1937. *Paraschistoceras hildrethi* Plummer and Scott, Texas Univ., Bull. 3701, p. 17, 18, 22, 30, 33, 207, 240, 244, 247, 248, 250-251, 253, 255, 257, 379, 380, 387, 389, 390, pl. 14, figs. 1-14.

1937. *Paraschistoceras reticulatum* Plummer and Scott, Texas Univ., Bull. 3701, p. 16, 17, 21, 22, 34, 246, 247, 253-255, 380, 382, 387, 388, 394, 399, pl. 14, figs. 15-18.
1937. *Paraschistoceras costiferum* Plummer and Scott, Texas Univ., Bull. 3701, p. 17, 252-253, 255, pl. 14, figs. 19-21.
1940. *Schistoceras hildrethi* Miller and Furnish, Jour. Paleontology, vol. 14, p. 538, 539-540, pl. 65, figs. 10-11, text-fig. 6.
1944. *Schistoceras hildrethi* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, figs. 11, 12.
1947. *Schistoceras hildrethi* Miller and Unklesbay, Carnegie Museum, Annals, vol. 29, p. 151-154, pl. 8, figs. 1-3.
1954. *Schistoceras hildrethi* Unklesbay, Jour. Paleontology, vol. 28, p. 86-87.
1957. *Schistoceras hildrethi* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L65, text-figs. 92A-B.
1958. *Schistoceras hildrethi* Miller and Furnish, Jour. Paleontology, vol. 32, p. 258-263.

Schistoceras hildrethi is not well represented in the Oklahoma collection, there being only two relatively poor internal molds of phragmocones. Both however are subglobose ammoniticones. The better one has had a maximum diameter of at least 45 mm and a width of about 30 mm. The ventral and lateral zones are convex and are not differentiated, but the umbilical shoulder is abrupt and the wall is steep. The dorsum is deeply and broadly impressed. The cross section of the whorl is somewhat helmet-shaped. The umbilical shoulders bear short, low, transverse nodes and the umbilicus is moderately large, being 13.7 mm in diameter. Fragments of the test adhere to the mold but they are badly worn and show no ornamentation.

The sutures are typical of the species. The prongs of the ventral lobes are long, narrow, and attenuate, as are the first and second lateral lobes. The third lateral lobe is ventrad of the umbilicus and is slightly asymmetrical, relatively shallow, and blunt. The first and second lateral saddles are contracted near their mid-height and are rounded at the adoral end. The third lateral saddle is strongly asymmetrical.

Remarks.—*S. hildrethi* can be differentiated from other species of this genus by the size of the umbilicus, by a slightly more globose shape, and by having nodes along the umbilical shoulders.

Occurrence.—This species ranges rather widely. It is known in western Pennsylvania, eastern Ohio, Illinois, western Missouri, eastern Kansas, northeastern Oklahoma, and north-

central and west Texas. Stratigraphically it ranges from the upper Desmoinesian to the middle Virgil.

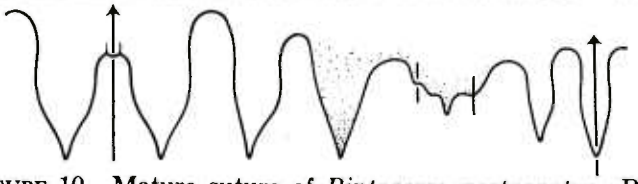
The specimens described here are from the Kanwaka member of the Vamoosa formation in NE¼ sec. 32, T. 24 N., R. 9 E., Osage County, Oklahoma. Miller and Furnish (1940) report it from the "Seminole and Nellie Bly formations of Tulsa County, Oklahoma; the Nelagoney formation of Osage County, Oklahoma." However, the Seminole and Nellie Bly specimens should be referred to *Pintoceras unicum*. The Nelagoney referred to here is probably the equivalent of the present Wann formation.

Repository.—The specimens described here are in The University of Oklahoma collections, OU 591. Others of this species are at Yale Peabody Museum; Carnegie Museum at Pittsburgh; University of Kansas; and State University of Iowa, SUI 1897, 3114, 3115, 5966.

Genus *Pintoceras* Plummer and Scott, 1937
Pintoceras postvenatum Plummer and Scott, 1937
Plate 8, figure 1; text-figure 10

1937. *Pintoceras postvenatum* Plummer and Scott, Texas Univ. Bull. 3701, p. 246, text-fig. 52c.
1937. *Paraschistoceras strawnense* Plummer and Scott, Texas Univ., Bull. 3701, p. 248-249, pl. 14, figs. 22, 23, text-fig. 52d.
1940. *Schistoceras hildrethi* Miller and Furnish [part], Jour. Paleontology, vol. 14, p. 539.
1957. *Pintoceras postvenatum* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L65.
1958. *Pintoceras postvenatum* Miller and Furnish, Jour. Paleontology, vol. 32, p. 258, 259, 261, 263, pl. 34, figs. 1-4, text-fig. 4D.

Pintoceras postvenatum was established by Plummer and Scott in 1937 and they said, "The type specimen unfortunately is only a fragment and no measurements or adequate illustration can be offered until better material is available." They did



TEXT-FIGURE 10. Mature suture of *Pintoceras postvenatum* Plummer and Scott, x1, based on a specimen from the Wewoka of Hughes County, SUI 1962 (from Miller and Furnish, 1958).

publish a suture pattern. Subsequently other material became available and Miller and Furnish in 1958 described a homeotype. At the same time they stated that *Paraschistoceras strawnense* Plummer and Scott should be considered conspecific. They also described and illustrated a specimen from the Wewoka of Hughes County, Oklahoma, and said that they had three specimens from this formation in Hughes, Pontotoc, and Okmulgee Counties.

Repository.—Specimens of this species are in the collections at the Texas Bureau of Economic Geology, P8586; at Texas Christian University (holotype of *P. strawnense*); and State University of Iowa, SUI 1962-1964, 8804.

Pintoceras unicum (Miller and Owen), 1937
Plate 17, figures 1-3

1937. *Schistoceras unicum* Miller and Owen, Jour. Paleontology, vol. 11, p. 420-422, pl. 52, figs. 16, 17, text-fig. 5.
1940. *Schistoceras hildrethi* Miller and Furnish [part], Jour. Paleontology, vol. 14, p. 539.
1958. *Pintoceras unicum* Miller and Furnish, Jour. Paleontology, vol. 32, p. 258, 259, 261, 263, pl. 33, figs. 1-4, text-fig. 4D.

The Oklahoma collection contains an excellent topotype of *Pintoceras unicum*. It is an internal mold of a large portion of the phragmocone, preserved in black limestone. It is subglobose and ammoniticonic. It is 40 mm in diameter and 25 mm wide. The maximum height of the whorl is 13 mm at the adoral end, and the umbilicus is 13 mm in diameter. The whorl is broadly rounded ventrally, more narrowly so laterally, and impressed dorsally. The umbilical walls are rounded but are fairly distinct. The umbilicolateral area is marked by low rounded transverse ribs spaced about 2 mm apart.

The test of this specimen is marked by subdued growth lines which form a shallow, broadly rounded, hyponomic sinus along the venter, on either side of which is a rounded, slightly asymmetrical salient whose umbilical portion swings strongly toward the apex.

The prongs of the ventral lobes of the suture are relatively wide but are attenuate apicad. The first and second lateral saddles are high and rounded and are slightly constricted near the mid-length so they have a spatulate shape. The third lateral lobe is lower and extends to the umbilicus.

The siphuncle is visible and is small. Where it can be seen along the venter it is less than 1 mm in diameter.

Remarks.—*P. unicum* was first regarded by Miller and Owen as a primitive *Schistoceras*, and as such it would be the oldest representative of that genus. In 1940 Miller and Furnish included it in synonmy with *Schistoceras hildrethi.* However, in 1958, Miller and Furnish recognized that it is congeneric with *Pintoceras postvenatum* Plummer and Scott, which has been accepted as the type species of *Pintoceras.* Accordingly in their 1958 paper Miller and Furnish recognize *Pintoceras unicum* as a valid species.

Occurrence.—All known specimens of *P. unicum* are from the Seminole formation just south of Collinsville, Tulsa County, Oklahoma.

Repository.—The holotype is at State University of Iowa. Topotypes are at Iowa (SUI 1961) and at The University of Oklahoma, OU 3167.

Genus *Paralegoceras* Hyatt, 1884
Paralegoceras iowense (Meek and Worthen), 1860
Plate 17, figure 6

1860. *Goniatites iowensis* Meek and Worthen, Philadelphia Acad. Nat. Sciences, Proc. 1860, p. 471.
1866. *Goniatites iowensis* Meek and Worthen, Ill. Geol. Survey, vol. 2, p. 392-393, pl. 30, figs. 3a-c.
1884. *Paralegoceras iowense* Hyatt, Boston Soc. Nat. History, Proc., vol. 22, p. 327.
1896. *Paralegoceras iowense* Smith, Amer. Philos. Soc., Proc., vol. 35, p. 263-265, pl. 19, figs. 1-3b.
1903. *Paralegoceras iowense* Smith [part], U. S. Geol. Survey, Mon. 42, p. 100-101, pl. 4, figs. 12-14 [not pl. 9, figs. 4-7].
1904. *Paralegoceras newsomi* Smith, U. S. Geol. Survey, Mon. 42, p. 101-104, pl. 12, figs. 4-9.
1919. *Paralegoceras iowense* Girty [part], Amer. Assoc. Petroleum Geologists, vol. 3, p. 72.
1930. *Paralegoceras* sp. Croneis [part], Science, n.s., vol. 72, p. 534.
1932. *Paralegoceras iowense* Sellards, Texas. Geol. Survey, Bull. 3232, pl. 6, figs. 17-18.
1937. *Paralegoceras iowense* Plummer and Scott, Texas Univ., Bull. 3701, p. 195, 198, 199-200, 211, pl. 18, figs. 8, 9.
1937. *Bendoceras texanum* Plummer and Scott [part], Texas Univ., Bull. 3701, p. 210-215 [not pl. 12, figs. 1-7].
1940. *Paralegoceras iowense* Miller and Furnish, Jour. Paleontology, vol. 14, p. 523, 524-526, pl. 62, figs. 1-3, text-fig. 1C.

1944. *Paralegoceras iowense* Shimer and Shrock, Index Fossils N. America, p. 573, pl. 235, figs. 24, 25.
1949. *Paralegoceras iowense* Miller, Iowa Acad. Science, Proc. vol. 56, p. 225.
1957. *Paralegoceras iowense* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L65, text-figs. 95, 96.
1958. *Paralegoceras iowense* Miller and Furnish, Jour. Paleontology, vol. 32, p. 259, 262-263, pl. 33, fig. 11, text-fig. 4C.

The Oklahoma collection contains one large septate internal mold with no trace of living chamber and two small, incomplete, immature forms of *Paralegoceras iowense*. The maximum diameter of the large specimen is 112 mm. Its width has been at least 25 mm, and the diameter of the umbilicus about 16 mm. It is discoidal and ammoniticonic. The lateral zones are slightly convex and converge ventrad. The ventral portion of the specimen is not well preserved but appears to have been rounded. The umbilical shoulder is rounded and moderately abrupt. The dorsum is impressed to a depth of nearly one-third the whorl height. The inner volutions are not exposed. This specimen is somewhat worn and weathered so that no shell material is preserved.

The suture pattern is shown in figure 6 on plate 17. The ventral lobe is not well preserved but it can be seen that its prongs are long and attenuate as are the first and second lateral lobes. The position of the second lateral lobe ventrad of the umbilicus is a characteristic of this genus. The first and second lateral saddles are high, narrow, and rounded, and the third is lower, asymmetrical, and broadly rounded. It lies just ventrad of the umbilicus.

Remarks.—*P. iowense* is close to *P. texanum* (Shumard) with which it sometimes occurs in association. However, *P. texanum* has a wider umbilicus and much stronger shell ornamentation. Only three species are included in this genus. Besides the two mentioned here, there is *P. nopcsai* (Rakusz) from the upper Namurian of Slovakia. It is closer to *P. texanum* than to *P. iowense*.

Occurrence.—The holotype of *P. iowense* came from Wapello County, Iowa, presumably from the lower Cherokee. The specimen described here is from the Buckhorn asphalt pit in NE¼ sec. 26, T. 1 S., R. 3 E., Murray County. The smaller ones are from the Boggy in sec. 27, T. 3 N., R. 7 E., Pontotoc County. Other conspecific specimens are known from the Atoka just

north of Clarita, Coal County, Oklahoma, the Smithwick shale in McCulloch County, Texas, and from the lower Atoka in Conway County, Arkansas.

Repository.—Holotype, University of Illinois, 11098. State University of Iowa, SUI 1414, 13999. The University of Oklahoma, OU 3810, 4209.

Paralegoceras texanum (Shumard), 1863
Plate 14, figures 1-4; text-figure 11

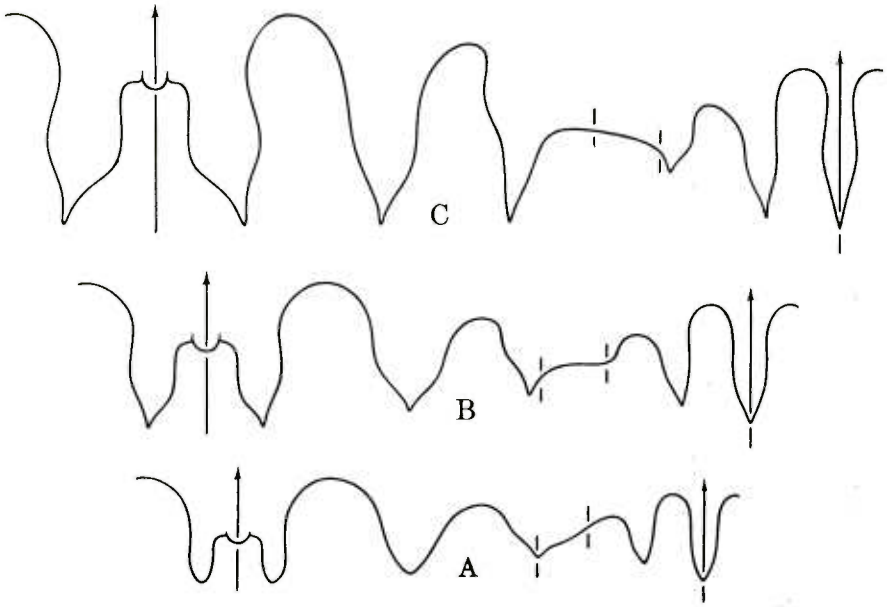
1863. *Goniatites texanus* Shumard, St. Louis Acad. Science, Trans., vol. 12, p. 109.
1893. *Paralegoceras iowense* Hyatt, Texas Geol. Survey, Ann. Rept. 4, p. 474.
1903. *Paralegoceras iowense* Smith [part], U. S. Geol. Survey, Mon. 42, p. 100-101, pl. 9, figs. 4-7 [not pl. 4, figs. 12-14].
1903. *Paralegoceras texanum* Smith, U. S. Geol. Survey, Mon. 42, p. 104.
1919. *Paralegoceras iowense* Girty [part], Amer. Assoc. Petroleum Geologists, Bull., vol. 3, p. 72.
1921. *Paralegoceras* sp. Plummer and Moore, Texas Univ., Bull. 2132, p. 58.
1930. *Paralegoceras* sp. Croneis [part], Science, n. s., vol. 72, p. 534.
1937. *Bendoceras texanum* Plummer and Scott [part], Texas Univ., Bull. 3701, p. 15, 29, 30, 33, 209, 210-215, pl. 12, figs. 1-7.
1937. *Bendoceras shumardi* Plummer and Scott, Texas Univ., Bull. 3701, p. 15, 209, 215-216, pl. 11, figs. 14-16.
1937. *Paralegoceras hyatti* Moore in Plummer and Scott, Texas Univ., Bull. 3701, p. 210.
1937. *Bendoceras* n. sp. Plummer and Scott, Texas Univ., Bull. 3701, p. 213, pl. 12, fig. 8.
1940. *Paralegoceras texanum* Miller and Furnish, Jour. Paleontology, vol. 14, p. 526-527, pl. 62, figs. 4-7, text-fig. 2.
1957. *Paralegoceras texanum* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L65, text-figs. 95A-C.
1958. *Paralegoceras texanum* Miller and Furnish, Jour. Paleontology, vol. 32, p. 256, 260, 261, 262, text-figs. 5, 6.

Paralegoceras texanum is represented in the Oklahoma collection by three small internal molds of the early triangularly coiled volutions. One of them is somewhat crushed so that the whorls are somewhat flattened and the angles of the triangle are rather sharp. All these specimens are small, the largest being about 12 mm in greatest diameter and 8 mm wide. The whorls are low and broad, and somewhat impressed dorsally. The venter is convex. The umbilicus is large and the umbilical shoulders bear transverse ribs spaced a little less than one mm apart. The

test bears transverse sinuous lirae which, on the venter, form a central sinus between two outer salients. As the lirae near the lateral zone they coalesce into the ribs. The crests of the lirae are finely granular suggesting that there may have been longitudinal lirae crossing them.

Remarks.—The uncrushed specimen is essentially identical to the specimen illustrated by Miller and Furnish (1940, pl. 62, fig. 4, and 1958, text-fig. 2E), which came from the lower Atoka formation near Clarita, Oklahoma.

Occurrence.—The uncrushed specimen is from the Boggy formation in sec. 17, T. 2 N., R. 7 E., Pontotoc County. The others are from the Atoka at Barnett Hill near Clarita, Coal County. The species has also been reported from near Clarita and from about 3 miles southeast of Jessie, Oklahoma, by Miller and Furnish. Outside Oklahoma it is known from the Smithwick shale in San Saba (holotype) and McCulloch Counties, Texas; and questionably from the Atoka near Fayetteville,



TEXT-FIGURE 11. Ontogenetic development of sutures of *Paralegoceras texanum* (Shumard).

A. Where specimen is about 8 mm in diameter, x12.
B. Where specimen is about 15 mm in diameter, x7.
C. Full maturity, where specimen is about 60 mm in diameter, x3.

Based on three specimens from the Atoka near Clarita, Oklahoma, SUI 13995, 13998 (from Miller and Furnish, 1940).

Arkansas. Miller and Furnish also report a specimen from a black shale 4,850 feet below the surface in a well in sec. 27, T. 2 N., R. 8 E., Coal County, Oklahoma.

Repository.—The holotype of this species is presumed lost, but there is a specimen in the collection at the University of Texas which may be it. Hyatt's plesiotype is also there. Plummer and Scott's neoholotype is at the Walker Museum, no. 31803, and at the same museum the neoparatypes are numbered 25582. Specimens at State University of Iowa are numbered 13994-13998. The specimens described here are in The University of Oklahoma collection, OU 3759, 3790.

Genus *Diaboloceras* Miller and Furnish, 1940
Diaboloceras varicostatum Miller and Furnish, 1940
Plate 16, figure 6; plate 18, figures 5, 6

1932. *Bendoceras texanum* Plummer, Amer. Assoc. Petroleum Geologists, Bull., vol. 16, p. 486.
1937. *Bendoceras shumardi* Plummer and Scott [part], Texas Univ., Bull. 3701, p. 215-216, pl. 11, figs. 8, 9. [not 10-12].
1940. *Diaboloceras varicostatum* Miller and Furnish, Jour. Paleontology, vol. 14, p. 527-529, pl. 63, figs. 6-10.
1957. *Diaboloceras varicostatum* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L65, text-figs. 94B, 97.
1958. *Diaboloceras varicostatum* Miller and Furnish, Jour. Paleontology, vol. 32, p. 259, 264, pl. 34, fig. 10, text-fig. 4B.

The conch of *Diaboloceras varicostatum* is large. The only specimen at hand is 64 mm from the center of the umbilicus to the venter of the last preserved whorl, and this is still within the phragmocone. The umbilicoventral height of this last whorl is 43 mm. The umbilicus is large, being approximately one-third the diameter of the specimen. The whorls are compressed laterally with a narrowly rounded venter and broadly convex lateral zones. The umbilical shoulder is abrupt and the wall is steep and narrow. The dorsal zone is deeply impressed to nearly half the height of the whorl, and in the umbilicus approximately two-thirds of each whorl is left uncovered by the succeeding whorl.

The surface of the test is prominently reticulate as it bears both longitudinal and transverse striae. The longitudinal lirae are essentially parallel to the coiling, but the transverse ones are sinuous. The early whorls have small nodes along the umbilical shoulder, but these are not present on the larger and later whorls.

The specimen at hand is not well enough preserved to per-

mit preparation of a suture pattern, but the suture appears to be like that illustrated by Miller and Furnish for this species.

Remarks.—Although only one relatively poor specimen of *D. varicostatum* is available, it exhibits the essential features of the species. The most distinctive of these are the suture pattern and the surface ornamentation.

Occurrence.—The specimen at hand is from the Atoka formation in NW¼ sec 10, T. 17 N., R. 19 E., Cherokee County. Miller and Furnish report specimens from the Coody sandstone member of the Atoka at Braggs Mountain in Muskogee County. They also report this species from the Smithwick in Culberson County, Texas.

Repository.—The University of Oklahoma, OU 3767.

Genus *Wellerites* Plummer and Scott, 1937
Wellerites mohri Plummer and Scott, 1937
Plate 18, figures 2-4

1937. *Wellerites mohri* Plummer and Scott, Texas Univ., Bull. 3701, p. 376, 377-378, pl. 38, figs. 13-16.
1938. *Wellerites mohri* Plummer and Scott, Geol. Soc. America, Bull., vol. 49, p. 1920.
1938. *Walkerites mohri* Smith, The cephalopod fauna of the Buckhorn asphalt, p. 32.
1938. *Walkerites plummeri* Smith, The cephalopod fauna of the Buckhorn asphalt, p. 32-33, pl. 2, figs. 22-23.
1938. *Walkerites vulgaris* Smith, The cephalopod fauna of the Buckhorn asphalt, p. 31-32, pl. 2, fig. 24, 25.
1944. *Wellerites mohri* Shimer and Shrock, Index Fossils N. America, p. 575, pl. 236, figs. 7, 8.
1946. *Wellerites* sp. Miller and Sturgeon, Jour. Paleontology, vol. 20, p. 387-389, pl. 56, figs. 6-9.
(?)1952. *Wellerites russiensis* Ruzhencev, Akad. Nauk. SSSR, Doklady, t. 84, p. 133-134.
1947. *Wellerites mohri* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L Mollusca 4, Paleozoic Ammonoidea, p. L66, text-figs. 99, 100.
1958. *Wellerites mohri* Miller and Furnish, Jour. Paleontology, vol. 32, p. 264, 265-267, pl. 33, figs. 5-9, text-figs. 7, 8.

One large fragment of a septate internal mold represents *Wellerites mohri* in the Oklahoma collection. It represents nearly half a volution of a specimen which must have had a diameter of at least 125 mm. Near the mid-length of this specimen the whorl height is 50 mm and the width is 18 mm. It represents a conch that has been discoidal and ammoniticonic. The lateral

zones are essentially flat and the venter is narrowly rounded. The umbilical shoulder is abruptly rounded and the umbilical wall is steep. The dorsal zone is impressed to a depth of about one-third the whorl height. The impressed zone is deep and narrow, and has nearly parallel walls. Where the whorl width is 17 mm the width of the impressed zone is 5 mm. This specimen bears no trace of shell material.

The sutures are fairly well preserved, except in the ventral area. The first lateral lobe is narrow, deep, and attenuate; and the succeeding three lateral lobes are narrow and acuminate but shorter. The lateral saddles are rounded and high, and the two nearest the umbilicus are narrow. The nature of the suture can be seen in figure 4 on plate 18.

Remarks.—Despite the rather poor and incomplete state of preservation, this specimen exhibits clearly the significant features of the species. These are the suture pattern and the discoidal shape. This is a relatively rare genus.

Occurrence.—This specimen is from the Buckhorn asphalt pit, NE¼ sec. 26, T. 1 S., R. 3 E., in Murray County, Oklahoma. Other Oklahoma specimens were described from the Buckhorn by Smith (1938). Miller and Furnish (1958) reported the species from the Wewoka in the McAlester basin. Plummer and Scott (1938) reported it from the Millsap Lake group of north-central Texas, and Miller and Sturgeon (1946) described two specimens from the Allegheny of Ohio. Ruzhencev (1952) illustrated a specimen from the Ural Region which seems to be conspecific.

Repository.—The University of Oklahoma, OU 3788.

Genus *Axinolobus* Gordon, 1960
Axinolobus modulus Gordon, 1960
Text-figure 12

1960. *Axinolobus modulus* Gordon, Jour. Paleontology, vol. 34, p. 142, 143, 149-150.

Gordon in 1960 established this species, and the genus, for one specimen. It is discoidal and moderately evolute. The whorls are compressed with a narrow vertex, and with strongly rounded umbilical and ventrolateral shoulders. The maximum diameter is at least 75 mm.

The suture is composed of 10 lobes which have straight, nearly parallel sides and sharply angular points. The saddle is

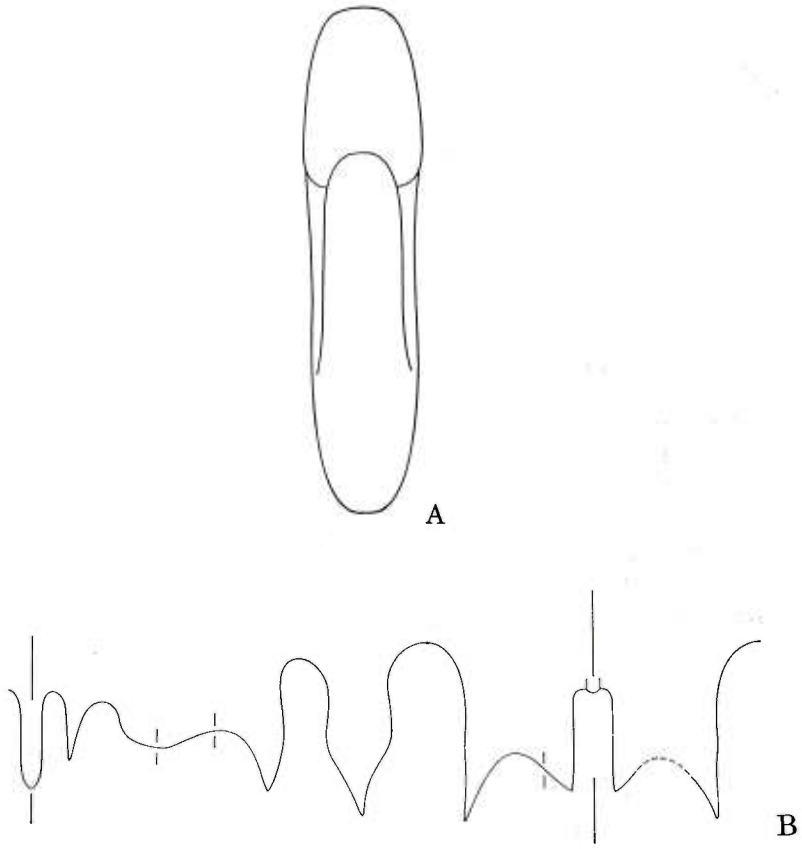
spatulate, except for the third lateral one which is broad and asymmetric.

Remarks.—*A. modulus* is distinguished from others by Gordon by "the unique ventral lobe of its suture, which is somewhat reminiscent of certain archaic types of axelike weapons, hence the generic name."

No other specimens are known.

Occurrence.—Morrow series, upper part, U. S. G. S. location 2000, SE¼ sec. 35, T. 13 N., R. 20 E., Muskogee County.

Repository.—Holotype, U. S. National Museum, 119684.



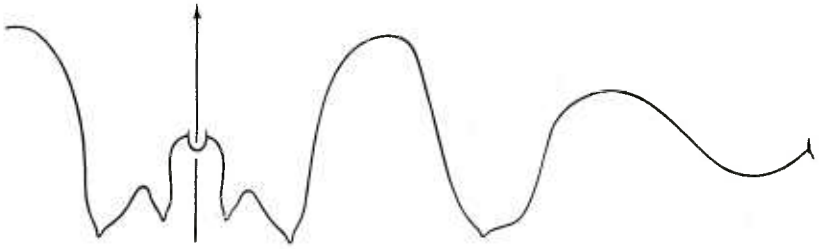
TEXT-FIGURE 12. *Axinolobus modulus* Gordon.
A. Front view in outline of the holotype, USNM 119684, natural size.
B. Suture from the holotype at a conch diameter of 71 mm, x2.
(both figures from Gordon, 1960).

Family DIMORPHOCERATIDAE Hyatt, 1884

Genus *Dimorphoceras* Hyatt, 1884
Dimorphoceras politum (Shumard), 1858
Plate 15, figure 6; text-figure 13

1858. *Goniatites politus* Shumard, St. Louis Acad. Science, Trans., vol. 1, p. 199.
1873. *Goniatites politus* Broadhead, Missouri Geol. Survey, Prelim. Rept., Iron Ores and Coal Fields 1872, pt. 2, p. 61.
1894. *Goniatites politus* Keyes, Missouri Geol. Survey, vol. 5, p. 221.
1898. *Goniatites politus* Weller, U. S. Geol. Survey, Bull. 153, p. 295.
1903. *Goniatites? politus* Smith, U. S. Geol. Survey, Mon. 42, p. 142.
1915. *Goniloboceras parrishi?* Girty, Missouri Bur. Geology and Mines, 2d ser., vol. 13, p. 270, 364.
1931. *Homoceratoides jacksoni* Bisat, Duncan, and Moore [part], Yorkshire Geol. Soc., Proc., n. ser., vol. 22, p. 1-8 [probably not text-figs. 1, 2], pl. 1, figs. 1a-1c [probably not 2a-3].
1937. *Homoceratoides jacksoni* Moore, Comptes rendus Deuxième Congrès pour l'avancement des études de stratigraphie carbonifère, Heerlen 1935, p. 666.
1937. *Homoceratoides jacksoni* Moore and Elias, Comtes rendus Deuxième Congrès pour l'avancement des études de stratigraphie carbonifère, Heerlen 1935, p. 679.
1937. *Dimorphoceras politum* Plummer and Scott, Texas Univ., Bull. 3701, p. 339-340, pl. 40, figs. 10-14.
1939. *Dimorphoceras politum* Miller and Owen, Jour. Paleontology, vol. 13, p. 158-161, pl. 20, figs. 10-17, text-fig. 8.
1944. *Dimorphoceras politum* Shimer and Shrock, Index Fossils N. America, p. 575, pl. 236, figs. 3, 4.

The conch of *Dimorphoceras politum* varies from subglobular in infant stages to sublenticular in adolescence and maturity. A typical small specimen in the collections at hand is



TEXT-FIGURE 13. Suture of late mature specimen of *Dimorphoceras politum* (Shumard) where specimen is about 16.5 mm in diameter, x6, (from Miller and Owen, 1939).

13.5 mm in maximum diameter and 4 mm in width, and the maximum whorl height is 5 mm. The umbilicus is 2.5 mm in diameter. The venter is narrowly rounded. The lateral zones are flattened but are slightly convex and converge ventrad. The umbilical shoulder is abrupt but rounded, and the umbilical wall is steep. The maximum width of the conch is just ventrad of the umbilical shoulder. The dorsum is deeply impressed, the amount of the impression being greater in more mature parts of the shell. The living chamber in these specimens is slightly more than half a volution, but is crushed and not completely preserved.

The several specimens available are all internal molds, but all are strongly marked with sinuous transverse growth lines which form a rather deep ventral sinus on either side of which is a fairly prominent ventrolateral salient, a shallow lateral sinus, and a low dorsolateral salient.

The sutures are typical for this species. Each forms a fairly broad bifid ventral lobe which is divided by a relatively low ventral saddle. Each prong of the lobe is also subdivided by a low asymmetrical saddle so that two adventitious lobes are formed with the ventrad one being the smaller. Outside the ventral lobe, on each side of the conch, there is a broadly rounded, slightly asymmetrical first lateral saddle; a broad, V-shaped first lateral lobe; a low, rounded second lateral saddle; and a shallow umbilical lobe which centers on the umbilical wall. The internal portion of the suture is not exposed.

Remarks.—*D. politum* is readily recognized by its strong growth-line ornamentation, and by the subdivisions of the prongs of the ventral lobe of the suture. Miller and Owen (1939) discussed its relationships at great length.

Occurrence.—The types of this species came from near Lexington, Missouri, presumably from the Cherokee. The species has been reported from many localities in Henry County, Missouri, and Fulton County, Illinois (Miller and Owen, 1939). Broadhead reported it from just above the Mulky coal in Carroll County, Missouri, and Plummer and Scott reported it from the Smithwick shale in McCulloch County, Texas. The several specimens referred to above are from the Wewoka formation in the NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., Okmulgee County, and two more are available from the Boggy in NW¼ sec. 27, T. 3 N., R. 7 E., Pontotoc County.

Repository.—The holotype is presumably lost. A topotype

is in the Walker Museum with some plesiotypes. Other plesiotypes are at the Texas Bureau of Economic Geology. Other specimens, including a neoholotype, are at the State University of Iowa. Specimens at The University of Oklahoma are OU 3763 and 4210.

Genus *Neodimorphoceras* Schmidt, 1925
Neodimorphoceras lenticulare (Girty), 1911
Plate 15, figure 5; text-figure 14

1911. *Dimorphoceras lenticulare* Girty, New York Acad. Sciences, Annals, vol. 21, p. 152.
1915. *Dimorphoceras lenticulare* Girty, U. S. Geol. Survey, Bull. 544, p. 259, pl. 35, figs. 1-1b.
1937. *Neodimorphoceras lenticulare* Plummer and Scott, Texas Univ., Bull. 3701, p. 345-347, pl. 35, figs. 9-11.
1950. *Neodimorphoceras lenticulare* Miller and Downs, Jour. Paleontology, vol. 24, p. 201.

Neodimorphoceras lenticulare is represented in the present collection by two immature specimens. They are subdiscoidal and ammoniticonic. Both are internal molds and are about the same size, being 8 mm in diameter and 4 mm wide. The venter is narrowly rounded and convex. The lateral zones are gently convex and converge ventrad. The umbilical shoulder is fairly abrupt and the umbilicus is small. The dorsal zone is deeply impressed to about half the height of the whorl. The whorl has a trigonal cross-section.

One of the specimens is testiferous and the shell ornamentation is well preserved. This ornamentation consists of strong transverse ridges, apparently growth lines, which form a shallow,

TEXT-FIGURE 14. *Neodimorphoceras lenticulare* (Girty). Immature suture where specimen is 8 mm in diameter, based on specimen from the Wewoka 2.5 miles west of Okmulgee, Okmulgee County, OU 3781.

rounded ventral sinus; a broadly rounded, asymmetrical ventrolateral salient; a deep, rounded lateral sinus; and a broad umbilicolateral salient. In the umbilicolateral area two ridges converge into one, or to say it another way, one ridge of the umbilical area bifurcates into two which go across the lateral area. This ornamentation affects the entire shell thickness and is prominent on the nontestiferous internal mold.

The sutures form a bifid ventral lobe two parts of which are also subdivided by adventitious lobes with the one nearer the venter being smaller. The first lateral saddle is high, slightly asymmetrical, and subacuminate. The first lateral lobe is deep and narrowly rounded, and the umbilicolateral saddle is broadly rounded. The internal suture is not exposed.

Remarks.—These two specimens are immature, but they exhibit the significant features of *N. lenticulare* very clearly.

Occurrence.—Girty's types are from the Wewoka formation in the Wewoka quadrangle. The two specimens described here are from the Wewoka, 2.5 miles west of Okmulgee in Okmulgee County. Other specimens in the State University of Iowa collection came from the Wewoka near Lovelady School in Pontotoc County. Plummer and Scott referred to this species a specimen from the Mineral Wells formation in Palo Pinto County, Texas.

Repository.—The University of Oklahoma, OU 3781, 4207.

Neodimorphoceras oklahomae (Girty), 1911
Plate 18, figure 7

1911. *Dimorphoceras oklahomae* Girty, New York Acad. Sciences, Annals, vol. 21, p. 152.
1915. *Dimorphoceras oklahomae* Girty, U. S. Geol. Survey, Bull. 544, p. 260, pl. 35, figs. 2-2b.
1924. *Dimorphoceras texanum* Morgan, [Okla.] Bur. Geology, Bull. 2, p. 100, pl. 51, fig. 6.
1937. *Neodimorphoceras oklahomae* Plummer and Scott, Texas Univ., Bull. 3701, p. 342, 347, 348, pl. 34, figs. 9-11.
1950. *Neodimorphoceras oklahomae* Miller and Downs, Jour. Paleontology, vol. 24, p. 201.

Three specimens representing *Neodimorphoceras oklahomae* are available for study. All are internal molds of phragmocones. The conch of this species is thickly subdiscoidal and ammoniticonic. The whorl cross section is subtriangular with the venter being rounded and the lateral zones weakly convex and convergent ventrad. The dorsum is impressed to about

one-third the height of the whorl. The umbilical wall is not abrupt and the umbilicus is small and closed.

The best of the three specimens has a whorl height of 35 mm where the width is 22.5 mm. The maximum width is just ventrad of the umbilical shoulder. A larger, but less well preserved, specimen has a whorl height of approximately 42 mm.

One specimen is testiferous and shows very clearly the shell ornamentation. In the immature and adolescent portions of the shell this ornamentation consists of sinuous ridges with alternating grooves. The ridges are flat, wide, and low. The intervening grooves are shallow, wide, and flat-bottomed. These ridges and grooves form a ventral sinus, which is fairly deep, narrow, and rounded. This is followed on either side by a broadly rounded, low outer lateral salient; a shallow, rounded mediolateral sinus; and an asymmetrical inner lateral salient which reaches the umbilicus. Along the venter there are about two ridges and two grooves per millimeter. This ornamentation affects also the internal mold. On the mature portions of the shell the ornamentation becomes weaker and the grooves are finer and closer together.

The suture pattern in this species is distinctive. Externally it consists of a wide ventral lobe, a sharp first lateral lobe and two lateral saddles of which the first is high and acute, whereas the second is lower and is rounded. The ventral lobe is complicated by having adventitious subdivisions. There are three adventitious saddles within the lobe. The ventral one is higher than the others, and is separated from them by an asymmetrical small but deep lobe. The two other saddles are high and are rounded. The first lateral saddle is high. Its ventral side is sigmoidal and is oblique to the venter. Its dorsal side is linear and is essentially parallel to the venter. The septa are about one mm apart except at the apicad ends of the lobes where they almost touch. The internal part of the suture is not exposed on these specimens.

Remarks.—N. oklahomae was first recognized by Girty. His material was not well preserved. The sutures of the specimens now available are slightly more acute in the saddles and lobes but they are more mature than his, and somewhat larger. The sutures are slightly different than in *N. texanum.* In that species the septa touch at the apicad ends of the lobes. Also *N. texanum* is somewhat wider than *N. oklahomae.*

It is possible that the specimens described here should be

referred to *Shuichengoceras* Yin. That genus is like *Neodimorphoceras* except that the venter is rounded rather than subacute or retuse. However, in all other respects it is so similar to *Neodimorphoceras* that it should be regarded only as a subgenus.

Occurrence.—Girty's types are from the Wewoka in the Wewoka quadrangle. Others are also known from the Wewoka in Hughes, Okmulgee, and Pontotoc Counties. Those described here are from the middle Wewoka in S½ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County.

Repository.—Girty's types are at the U. S. National Museum. Those described here are at The University of Oklahoma, OU 3791-3793. Others are at State University of Iowa, SUI 8806, 8808, 8809, and 17054.

Neodimorphoceras texanum (Smith), 1903
Plate 18, figure 8

1903. *Dimorphoceras texanum* Smith, U. S. Geol. Survey, Mon. 42, p. 16, 126-127, 138, 146, pl. 20, figs. 12-15.
1950. *Neodimorphoceras texanum* Miller and Downs, Jour. Paleontology, vol. 24, p. 200-202, pl. 32, figs, 10, 11; pl. 33, figs. 1-13. (This report contains an extensive synonymy to this date).
1957. *Neodimorphoceras texanum* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L68, text-figs. 106, 107, 108.

Two specimens represent *Neodimorphoceras texanum* in the Oklahoma collections. Both are fragments of internal molds of phragmocones. The better of the two represents about one-fourth volution and its right side is well preserved. The other is preserved in hematite but its cross-section shape and sutures are clearly discernible.

Both specimens are discoidal and ammoniticonic. The venter is narrowly rounded and the lateral zones are nearly flat but faintly convex and convergent toward the venter. The cross section of the whorl is narrowly trigonal. Where the better specimen has a whorl height of 26 mm its width has been about 13 mm. There is no trace of the test nor any shell ornamentation.

The suture pattern is identical with specimens of this species illustrated by Plummer and Scott (1937, pl. 35, fig. 8) and by Miller and Downs (1950, fig. 3b). The external suture consists of a large, bifid, ventral lobe; two narrow, acuminate lateral lobes; two high, subangular first lateral saddles; and two broad, low umbilicolateral saddles. Within the ventral lobe are three small adventitious saddles. The ventral one is broader

than the others, and is notched at the position of the siphuncle. The other two are slightly asymmetrical with sigmoidal sides. The adventitious lobes of this area are narrow and acuminate. The suture pattern is characterized by the close contact of the septa near the adapical extremities of the lobes, with the result being an apparent pair of concentric lateral ridges parallel to the venter.

Remarks.—Although Miller and Downs state that this species has not been definitely known outside of Texas, there is little doubt that the specimens described here are conspecific. Although they do not bear a ventral groove, the suture pattern is unmistakable. Miller and Downs also point out that in some specimens the groove does not develop until the whorl height reaches 30 mm.

Occurrence.—Miller and Downs, and Plummer and Scott, report this species from the Graham formation of north-central Texas. The specimens described here are from the Wewoka, sec. 24, T. 5 N., R. 8 E., Pontotoc County, and from the shale below the Elgin sandstone in the SE¼ sec. 17, T. 21 N., R. 8 E., Pawnee County.

Repository.—The University of Oklahoma, OU 102, 418.

Family THALASSOCERATIDAE Hyatt, 1900

Genus *Eothalassoceras* Miller and Furnish, 1940

Eothalassoceras inexpectans (Miller and Owen), 1937

Plate 15, figures 2-4; text-figure 15

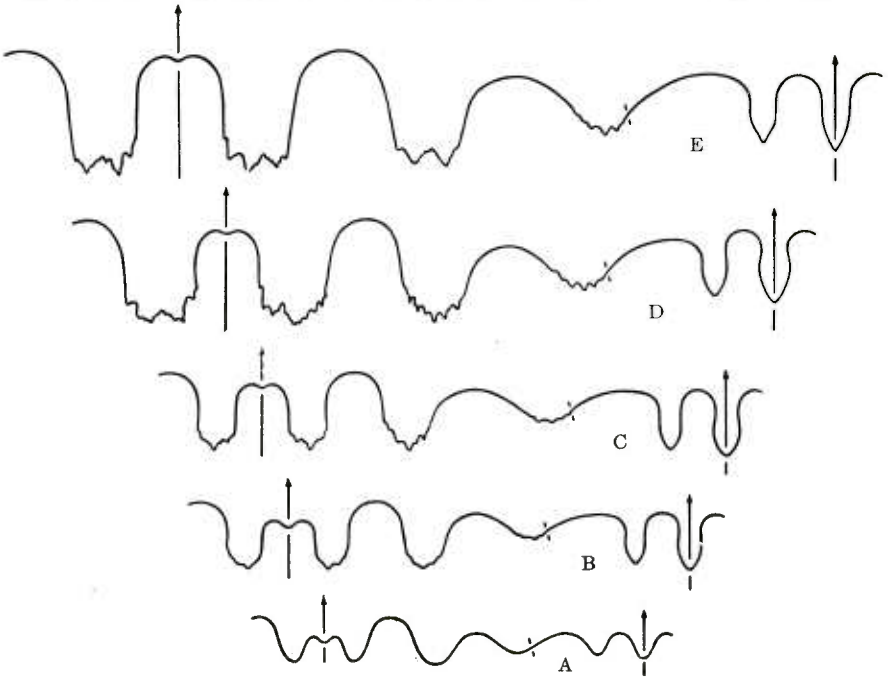
1937. *Prothalassoceras inexpectans* Miller and Owen, Jour. Paleontology, vol. 11, p. 418-420, pl. 52, figs. 12-15, text-fig. 4.
1940. *Eothalassoceras inexpectans* Miller and Furnish, Geol. Soc. America, Spec. Paper 26, p. 105-107, text-fig. 27A.
1943. *Eothalassoceras inexpectans* Miller and Unklesbay, Jour. Paleontology, vol. 17, p. 18, 20, pl. 1, fig. 6.
1957. *Eothalassoceras inexpectans* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L69, text-fig. 109A.

Eothalassoceras inexpectans was described in great detail by Miller and Owen in 1937. The conch is subglobular and ammoniticonic and moderately large. A specimen now available has a maximum diameter of 35 mm which is slightly smaller than Miller and Owen's largest specimen. In immature specimens the whorls are wider than high, but the more mature whorls

become higher so that the height and width become nearly equal. The umbilicus is small, being less than one-fourth the diameter of the specimen. The umbilical shoulders are fairly distinct but are low and gently rounded. In the specimen at hand the living chamber is more than half a volution in length.

The test is thin. Its surface and the surface of the internal mold are marked by growth lines which form a rounded ventral sinus, low rounded ventrolateral salients and broadly rounded lateral sinuses. At the umbilical shoulder these growth lines form a small rather prominent salient.

The sutures of this species were studied in detail by Miller and Owen and their illustration is reproduced here (text-fig. 15). A distinctive feature of this species is the development of digitation in the lobes of the external suture. This digitation does not have a well-established pattern and may differ from specimen to specimen and from suture to suture on the same speci-



TEXT-FIGURE 15. *Eothalassoceras inexpectans* (Miller and Owen). Representations of sutures at succesive stages of development. A at diameter of 1.8 mm, B at 4.2 mm, C at 8.7 mm, D at 15 mm, E at 21 mm. Magnification—A x16.5; B x10; C x7; D x4; E x3.5. Based on specimens from the Seminole formation about 0.75 mile south of Collinsville, Tulsa County (from Miller and Owen, 1937).

men. The septa are closely spaced, being about 1.5 mm apart on a mature individual. The siphuncle is small and is ventral and marginal.

Remarks.—*E. inexpectans* was first described by Miller and Owen from the Seminole of Oklahoma. They then considered it a primitive *Prothalassoceras*. However, in 1940, Miller and Furnish decided that the genus *Prothalassoceras*, as it had been established by Böse, was not valid and should be considered as a synonym of *Thalassoceras*. They thought, however, that this species was distinct enough to be separated from that genus. Hence it was made the type species of *Eothalassoceras*.

Occurrence.—This species is known only from the Seminole formation, just above the Dawson coal near Collinsville. Other specimens congeneric with these but of uncertain specific affinities are in State University of Iowa collections. They are from the Nellie Bly 6½ miles west of Sand Springs, Tulsa County, and the Vamoosa near Wynona, Osage County.

Repository.—The syntypes of Miller and Owen are at the State University of Iowa, SUI 1995, 1996. Others, said by them to be in Owen's private collection, are now also at the State University of Iowa, 1759; the Wynona specimen is 10440. The University of Oklahoma collection contains two specimens, OU 3616, 3765.

Suborder PROLECANITINA Miller and Furnish, 1954
Family DARAELITIDAE Tchernov, 1907

Genus *Boesites* Miller and Furnish, 1940
Boesites girtyi (Plummer and Scott), 1937
Plate 18, figure 1

1915. *Pronorites*?? sp. Girty, U. S. Geol. Survey, Bull. 544, p. 247-248, pl. 34, figs. 5-5c.
1930. *Daraelites* sp. Miller, Jour. Paleontology, vol. 4, p. 391.
1937. *Daraelites girtyi* Plummer and Scott, Texas Univ., Bull. 3701, p. 101.
1940. *Boesites girtyi* Miller and Furnish, Jour. Paleontology, vol. 14, p. 372.
1954. *Boesites girtyi* Unklesbay, Jour. Paleontology, vol. 28, p. 86, 93.

The small specimen figured by Girty in 1915 has apparently not been duplicated by later Wewoka collectors, and to date his

specimen is the only one of *Boesites girtyi* known from this formation.

Miller, in 1930, recognized the daraelitid affinities of this specimen. Plummer and Scott, in 1937, referred it to the genus *Daraelites* and made it the holotype of a new species named for Girty. In 1940, Miller and Furnish recognized that there should be a generic or subgeneric step between *Epicanites* and *Daraelites* and that *D. girtyi* represented that step. Hence, they designated *D. girtyi* as the type species for *Boesites*.

Another small and poorly preserved specimen is now available from the Atoka formation and is being referred to this species with some question. It is a small internal mold of phragmocone with a maximum whorl height of 5 mm. The lateral zones are distinctly flattened, and the venter is narrowly rounded. The dorsum is impressed but the outer volution does not cover all of the preceding one. Unfortunately this specimen is not good enough to add much to the understanding of the species.

Occurrence.—Girty's specimen came from the Wewoka in the Wewoka quadrangle. The specimen described here is from the Atoka on Barnett Hill, near Clarita, Coal County.

Repository.—The specimen which Girty had is probably in the U. S. National Museum. The specimen mentioned here is at The University of Oklahoma, OU 3764.

Family PRONORITIDAE Frech, 1901

Genus *Pronorites* Mojsisovics, 1882

Pronorites arkansasensis Smith, 1896

Plate 19, figures 1-4; text-figure 16

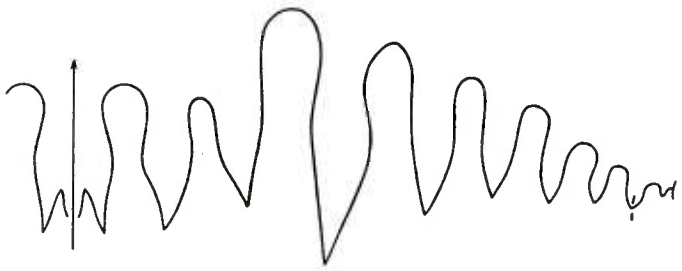
1896. *Pronorites cyclolobus arkansasensis* Smith, Amer. Philos. Soc., vol. 35, p. 267-270, pl. 24, figs. 1-4.
1900. *Goniatites cyclolobus* Williams [not Phillips], Arkansas Geol. Survey, Ann. Rept. 1892, vol. 5, p. 359.
1903. *Pronorites cyclolobus arkansasensis* Smith, U. S. Geol. Survey, Mon. 42, p. 43-46, pl. 12, figs. 12-15.
1913. *Pronorites arkansasensis* Smith, Zittel-Eastman Textbook of Paleontology, vol. 1, ed. 2, p. 633, text-fig. 1183.
1930. *Pronorites arkansasensis* Miller, Jour. Paleontology, vol. 4, p. 394.
1937. *Pronorites arkansasensis* Plummer and Scott, Texas Univ., Bull. 3701, p. 57-59, pl. 2, figs. 1-4.
1938. *Pronorites arkansasensis* Miller and Moore, Jour. Paleontology, vol. 12, p. 345-346, pl. 43, figs. 8, 9.

1944. *Pronorites arkansasensis* Miller and Owen, Jour. Paleontology, vol. 18, p. 420, pl. 63, figs. 3, 4, text-fig. 1.
1944. *Pronorites arkansasensis* Shimer and Shrock, Index Fossils N. America, p. 567, pl. 232, figs. 1, 2.
1957. *Pronorites arkansasensis* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L71, text-figs. 10A, 117.

Pronorites arkansasensis is represented in the Oklahoma collection by a dozen specimens of various sizes and quality. All are fragmental internal molds of phragmocones and all are discoidal with flattened sides and rounded venters. These are essentially parallel. Where it is preserved the umbilicus is small, and distinctly set off by abrupt, low shoulders. The smallest specimen is 24.5 mm in diameter and has a maximum width of 7 mm. The next larger one is 30.5 mm in diameter, and 15 mm in thickness. Its umbilicus is only 4 mm across. One of the largest specimens is a fragment representing a small portion along the venter but it has a maximum width of 28 mm. Another specimen with a maximum diameter of 78 mm has a maximum width of 19 mm. The last mentioned specimen retains some of the test but the ornamentation is not well preserved. The suture pattern of these specimens is typical of the species (text-fig. 16).

Remarks.—This species can be rather easily recognized by its discoidal shape, and distinctive suture pattern.

Occurrence.—The holotype of *P. arkansasensis* is from the Hale formation in Carroll County, Arkansas (Miller and Moore, 1938). It is known from the Morrowan of Arkansas; and the Smithwick shale of McCulloch County, Texas. Miller and Owen (1944) reported it from the Union Valley in Pontotoc County, Oklahoma. The specimens at hand are from the Union Valley,



TEXT-FIGURE 16. A mature suture of *Pronorites arkansasensis* Smith, x2, based on a specimen with a conch height of about 40 mm, from the Union Valley formation (from Miller and Owen, 1944).

NE¼ sec. 29, T. 3 N., R. 7 E., and from Lovelady Switch 2 miles northwest of Stonewall, and from SE¼ sec. 7, T. 3 N., R. 8 E., all in Pontotoc County; and the Atoka sandstone near Clarita, Coal County. It also occurs in the Buckhorn asphalt, near Sulphur, Murray County.

Repository.—The holotype is presumably at Stanford University. Other specimens are at the State University of Iowa, SUI 1982, 1983, 13942-13944; Texas Bureau of Economic Geology; and The University of Oklahoma, OU 3819, 3820, 3856, 3857, 3858.

Family MEDLICOTTIIDAE Karpinsky, 1889

Genus *Prouddenites* Miller, 1930
Prouddenites primus Miller, 1930
Plate 19, figures 5-10; plate 16, fig. 3

1930. *Prouddenites primus* Miller, Jour. Paleontology, vol. 4, p. 397-400, pl. 38, figs. 3-10.
1934. *Prouddenites primus* Miller and Cline, Jour. Paleontology, vol. 8, p. 177, pl. 28, figs. 1-3.
1937. *Prouddenites primus* Plummer and Scott, Texas Univ., Bull. 3701, p. 34, 61, 62.
1937. *Prouddenites boesei* Plummer and Scott [part], Texas Univ., Bull. 3701, p. 17, 22, 34, 61, 62-63, 64, 387, pl. 2, figs. 9, 10.
1937. *Prouddenites grafordensis* Plummer and Scott, Texas Univ., Bull. 3701, p. 63-64, pl. 2, figs. 11-15.
1937. *Pronorites grafordensis* Plummer and Scott, Texas Univ., Bull. 3701, p. 380.
1940. *Prouddenites primus* Miller and Furnish, Geol. Soc. America, Spec. Paper 26, p. 12, 35, 38.
1940. *Prouddenites primus* Miller and Furnish, Jour. Paleontology, vol. 14, p. 533-537, pl. 64, figs. 1-12.
1943. *Prouddenites primus* Miller and Unklesbay, Jour. Paleontology, vol. 17, p. 5, 7.
1954. *Prouddenites primus* Unklesbay, Jour. Paleontology, vol. 28, p. 86, 93.
1957. *Prouddenites primus* Miller, Furnish, and Schindewolf, Treatise Invert. Paleontology, Pt. L, Mollusca 4, Paleozoic Ammonoidea, p. L73, fig. 119.

Prouddenites primus is generally characterized as being discoidal with the whorls flattened laterally and ventrally, with the lateral zones being nearly parallel. Typical specimens have maximum diameters of about 65 mm and widths of about 17 mm. The living chamber, when preserved, is about two-thirds of a

volution in length. The umbilicus is moderately small and the shoulders are abrupt.

The external sutures consist of a deep trifid ventral lobe with a broad subdivided first lateral lobe which is typically trifid. The subdivisions of this lobe are also secondarily subdivided. The second lateral lobe is narrow and spatulate, and beyond this there usually are six rounded lobes. The saddles are all narrow and rounded. The internal sutures consist of a bifid dorsal lobe with several smaller, undivided lobes.

Remarks.—*P. primus* was discussed extensively by Miller and Furnish in 1940 and they recognized three varieties. Two of these *P. primus kleihegei* and *P. primus clinei* are recognized from Oklahoma. Except for the specimens they described, no others are known.

Occurrence.—The typical variety of the species, *P. primus primus* is from the Gaptank in Brewster County, Texas, and a few other specimens are known from the Winterset at Kansas City, Missouri, and in the Graford shale in Wise County, Texas. The holotypes of *P. primus clinei* came from the Nellie Bly formation 6.5 miles west of Sand Springs, Tulsa County, Oklahoma. The types of other specimens of *P. primus kleihegei* are from the Muncie Creek shale at Kansas City, Missouri, and four specimens of the variety are from the Wildhorse member of the Nelagoney formation at Wild Horse, 12 miles west of Skiatook in Osage County, Oklahoma.

Miller and Furnish also reported that the Buckhorn asphalt pit near Sulphur, Murray County, Oklahoma, has yielded many fragments belonging to this genus.

No new specimens have been found.

Repository.—The syntypes of the species are at Yale Peabody Museum, 12932, 12942. Others are at the State University of Iowa, SUI 634, 1422-1430, 2039, 13989, and 13990.

REFERENCES

BARRANDE, JOACHIM, 1874, Système Silurien du centre de la Bohême, Ière partie: Recherches Paléontologiques, Vol. II, Classe des Mollusques, Ordre des Céphalopodes, Text, Troisième partie, Description des formes du genre *Orthoceras*: Prague, p. 1-804.

BLYTHE, JACK G., 1959, Atoka formation on the north side of the McAlester Basin: Okla. Geol. Survey, Circ. 47.

COX, E. T., 1857, Palaeontological report of Coal Measure Mollusca: Kentucky Geol. Survey, Rept. 3, p. 557-576. [Plates issued in brochure titled *Maps and illustrations referred to in vols. II and III of the Report of the Geological Survey of Kentucky, 1857*].

CRONEIS, CAREY G., 1930, Geology of the Arkansas Paleozoic area, with special reference to oil and gas possibilities: Arkansas Geol. Survey, Bull. 3.

DELÉPINE, GASTON, 1941, Les goniatites du Carbonifere du Maroc et des confins Algéro-Moracains du sud (Dinantian-Westphalien): Protect. État Fr. Marcc, Direction gén. Trav. publ., Div. Mines et Géol., Serv. géol., Notes et Mém., no. 56, p. 1-111, pl. 1-8.

ELIAS, M. K., 1938, Studies of Late Paleozoic ammonoids: Jour. Geology, vol. 12, p. 86-105.

ELIAS, MAXIM K., 1956, Upper Mississippian and Lower Pennsylvanian formations of south-central Oklahoma: *in* Vol. 1, *of* Ardmore Geol. Soc., Petroleum Geology of southern Oklahoma—a symposium, p. 56-134. Published by Amer. Assoc. Petrol. Geologists.

FLOWER, ROSSEAU, 1939, Study of the Pseudorthoceratidae: Palaeontographica Americana, v. 2, no. 10.

————KUMMEL, BERNHARD, JR., 1950, A classification of the Nautiloidea: Jour. Paleontology, v. 24, p. 604-616.

FOORD, A. H., 1891, Catalog of the fossil Cephalopoda in the British Museum (Natural History), Part 2, Containing the remainder of the suborder Nautiloidea, consisting of the families Lituitidae, Trochoceratidae, and Nautilidae, with a supplement, London, p. 1-407.

GIRTY, GEO. H., 1911, On some new genera and species of Pennsylvanian fossils from the Wewoka formation of Oklahoma: New York Academy Sci., Ann. vol. 21, p. 119-156.

———— 1915a, Fauna of the Wewoka formation of Oklahoma: U. S. Geol. Survey, Bull. 544.

———— 1915b, Invertebrate paleontology of the Pennsylvanian of Missouri: Missouri Bur. Geology and Mines, 2d. ser. v. 13, p. 263-376.

GORDON, MACKENZIE, JR., 1960, Some American midcontinent Carboniferous cephalopods: Jour. Paleontology, v. 34, p. 133-151.

GREIG, PAUL B., 1959, Geology of Pawnee County, Oklahoma: Oklahoma Geol. Survey, Bull. 83.

HAUG, EMIL, 1894, Les ammonites du Permien et du Trias; remarques sur leur classification: Bull. Soc. geol. France, ser 3, v. 22, p. 385-412.

HYATT, ALPHEUS, 1883-1884, Genera of fossil cephalopods: Boston Soc. Nat. Hist., Pr. vol. 22, p. 253-338 [p. 253-272 were issued in Dec., 1883; 273-338 in Jan., 1884].

HYATT, ALPHEUS, 1891, Carboniferous cephalopods: Texas Geol. Survey, Ann. Rept. 2, p. 327-356.

KEYES, CHAS. R., 1894, Paleontology of Missouri, Pt. II: Missouri Geol. Survey, v. 5.

MARK, CLARA GOULD, 1912, The fossils of the Conemaugh formation in Ohio: Ohio Geol. Survey, Bull. 17, p. 261-318.

MATHER, KIRTLEY F., 1915, The fauna of the Morrow Group of Arkansas and Oklahoma: Denison Univ., Bull. Sci. Labs., vol. 18, p. 59-284.

——— 1917, Pottsville formations of Arkansas and Oklahoma: Amer. Jour. Sci., ser. 4, vol. 193, p. 133-139.

MEEK, F. B., 1871, Lists of Carboniferous fossils from West Virginia; descriptions of new species: W. Va. Univ. Bd. Reg., 3d Ann. Rpt., p. 68-73.

——— 1872, Report on the paleontology of eastern Nebraska with some remarks on the Carboniferous rocks of that district: *In* Hayden, F. V., Final report of the U. S. Geol. Survey of Nebraska, U. S. 42d Cong., 1st sess., H. Exec. Doc. 19, p. 83-239.

——— WORTHEN, A. H., 1860, Descriptions of new Carboniferous fossils from Illinois and other western states: Phila. Acad. Nat. Sci. Proc. 1860, p. 447-472.

——— WORTHEN, A. H., 1866, Descriptions of invertebrates from the Carboniferous System: Illinois Geol. Survey, vol. 2, p. 145-423.

MILLER, A. K., 1930, A new ammonoid fauna of Late Paleozoic age from western Texas: Jour. Paleontology, v. 4, p. 383-412.

——— 1932, A Pennsylvanian cephalopod fauna from south central New Mexico: Jour. Paleontology, v. 6, p. 59-93.

——— 1934, *Pseudoparalegoceras*, a new genus of Carboniferous ammonoids: Jour. Paleontology, v. 8, p. 18-20.

——— CLINE, L. M., 1934, The cephalopod fauna of the Pennsylvanian Nellie Bly formation of Oklahoma: Jour. Paleontology, v. 8, p. 171-185.

——— DOWNS, R. H., 1948, A cephalopod fauna from the type section of the Pennsylvanian "Winslow formation" of Arkansas: Jour. Paleontology, vol. 22, p. 672-680.

——— 1950, Ammonoids of the Pennsylvanian Finis shale of Texas: Jour. Paleontology, v. 24, p. 185-218.

——— DUNBAR, C. O., and CONDRA, G. E., 1933, The nautiloid cephalopods of the Pennsylvanian system in the mid-continent region: Nebraska Geol. Survey, Bull. 9, 2d. ser.

——— FURNISH, W. M., 1940a, Permian ammonoids of the Guadalupe Mountain Region and adjacent areas: Geol. Soc. America, Special Paper 26.

——— 1940b, Studies of Carboniferous ammonoids: Parts 1-4: Jour. Paleontology, v. 14, p. 356-377.

——— 1940c, Studies of Carboniferous ammonoids: Parts 5-7: Jour. Paleontology, vol. 14, p. 521-543.

——— 1954, The classification of the Paleozoic ammonoids: Jour. Paleontology, v. 28, p. 685-692.

——— 1958, Middle Pennsylvanian Schistoceratidae (Ammonoidea): Jour. Paleontology, v. 32, p. 253-274.

——————— 1958, The goniatite genus *Anthracoceras*: Jour. Paleontology, v. 32, p. 682-683.
——————— SCHINDEWOLF, O. H., 1957, Paleozoic Ammonoidea: *in* Treatise on Invertebrate Paleontology, Part L Mollusca 4, Cephalopoda, Ammonoidea. Geol. Soc. America, and University of Kansas Press.
——— GARNER, H. F., 1953, Upper Carboniferous goniatites from Argentina: Jour. Paleontology, v. 27, p. 814-816.
——— LANE, J. H., JR., and UNKLESBAY, A. G., 1947, A nautiloid fauna from the Pennsylvanian Winterset limestone of Jackson County, Missouri: Kansas Univ., Paleontological Contrib., Mollusca, Art. 2, p. 1-11.
——— MOORE, CARL A., 1938, Cephalopods from the Carboniferous Morrow Group of northern Arkansas and Oklahoma: Jour. Paleontology, v. 12, p. 341-354.
——— OWEN, J. B., 1934, Cherokee nautiloids of the northern Mid-Continent region: Iowa University Studies in Natural History, n. ser. no. 280, v. 16, p. 185-272.
——————— 1937, A new Pennsylvanian cephalopod fauna from Oklahoma: Jour. Paleontology, vol. 11, p. 403-422.
——————— 1939, An ammonoid fauna from the Lower Pennsylvanian Cherokee formation of Missouri: Jour. Paleontology, v. 13, p. 141-162.
——————— 1944, The cephalopod fauna of the Pennsylvanian Union Valley formation of Oklahoma: Jour. Paleontology, v. 18, p. 417-428.
——— STURGEON, MYRON T., 1946, Allegheny fossil invertebrates from eastern Ohio—Ammonoidea: Jour. Paleontology, v. 20, p. 384-390.
——— UNKLESBAY, A. G., 1942, The cephalopod fauna of the Conemaugh series in western Pennsylvania: Carnegie Mus. Annals, vol. 29, p. 127-174.
——————— 1943, The siphuncle of late Paleozoic ammonoids: Jour. Paleontology, v. 17, p. 1-25.
——————— 1947, The cephalopod fauna of the Conemaugh Series in western Pennsylvania: Supplement: Carnegie Mus. Annals, vol. 30, p. 319-330.
——— YOUNGQUIST, W. L., 1949, American Permian nautiloids: Geol. Soc. America, Mem. 41.
MILLER, S. A., 1889, North American geology and paleontology: Cincinnati, 1889.
——— FABER, C., 1896, Description of some Subcarboniferous and Carboniferous Cephalopoda: Cincinnati Soc. Nat. Hist., Jour., vol. 14, p. 164-168.
———GURLEY, W. F. E., 1896, New species of Paleozoic invertebrates from Illinois and other states: Illinois Mus. Nat. Hist., Bull. 11.
MORGAN, GEO. D., 1924, Geology of the Stonewall Quadrangle, Oklahoma: [Oklahoma] Bureau of Geology, Bull. 2.
MORTON, S. G., 1836, Notice and description of organic remains [valley of the Ohio]: American Jour. Sci., v. 29, p. 149-154.

NEWELL, N. D. *in* WILSON, C. W., JR., 1937, Geology of the Muskogee-Porum District, Muskogee and McIntosh Counties, Oklahoma: Oklahoma Geol. Survey, Bull. 57.

PLUMMER, F. B. and MOORE, R. C., 1922 (1921), Stratigraphy of the Pennsylvanian formations of north-central Texas: Texas Univ. Bull. 2132.

———— SCOTT, GAYLE, 1937, Upper Paleozoic ammonites in Texas: Texas Univ. Bull. 3701.

RAYMOND, P. E., 1910, A preliminary list of the faunas of the Allegheny and Conemaugh Series of western Pennsylvania: Carnegie Mus. Ann., vol. 7, p. 144-158.

———— 1911, A preliminary list of the faunas of the Allegheny and Conemaugh Series of western Pennsylvania: Pennsylvania Topog. and Geol. Survey Comm., Rept. 1908-1910, p. 81-98.

RIES, EDW. RICHARD, 1954, Geology and mineral resources of Okfuskee County, Oklahoma: Oklahoma Geol. Survey, Bull. 71.

SAYRE, A. N., 1930, The fauna of the Drum limestone of Kansas and western Missouri: Univ. Kansas Science Bull., v. 19, pt. 2, p. 75-203. (Reprinted as Kansas Geol. Survey Bull. 17).

SCHMIDT, HERMANN, 1929, Tierische Leitfossilien des Karbon: Gürichs *Leitfossilien,* Lief. 6, Berlin.

SHIMER, HERVEY W. and SHROCK, ROBERT R., 1944, Index Fossils of North America: John Wiley and Sons, New York.

SHUMARD, B. F. and SWALLOW, G. C., 1858, Descriptions of new fossils from the Coal Measures of Missouri and Kansas: St. Louis Acad. Sci. Trans., v. 1, p. 198-227.

SMITH, HOMER JAMES, 1938, The cephalopod fauna of the Buckhorn Asphalt: Private Edition, University of Chicago Libraries, Chicago, Ill.

SMITH, JAMES PERRIN, 1896, Marine fossils from the Coal Measures of Arkansas: Am. Philos. Soc., Proc. v. 35, p. 213-285.

———— 1903, The Carboniferous ammonoids of America: U. S. Geol. Survey, Monograph 42.

STURGEON, MYRON T., 1946, Allegheny fossil invertebrates from eastern Ohio—Nautiloidea: Jour. Paleontology, v. 20, p. 8-37.

TANNER, WM. F., 1956, Geology of Seminole County, Oklahoma: Oklahoma Geol. Survey, Bull. 74.

WEAVER, O. D., JR., 1954, Geology and mineral resources of Hughes County, Oklahoma: Oklahoma Geol. Survey, Bull. 70.

WHITE, C. A., and ST. JOHN, O. H., 1867, Descriptions of new Subcarboniferous and Coal Measure fossils collected upon the Geological Survey of Iowa; together with a notice of new generic character observed in two species of brachiopods: Chicago Acad. Sci., Trans., vol. 1, p. 115-127.

WILLIAMS, H. S., 1900, The Paleozoic fauna of northern Arkansas: Arkansas Geol. Survey, Ann. Rpt. 1892, p. 268-362.

UNKLESBAY, A. G., 1954, Distribution of American Pennsylvanian cephalopods: Jour. Paleontology, v. 28, p. 84-95.

———— PALMER, E. J., 1958, Cephalopods from the Burgner formation of Missouri: Jour. Paleontology, v. 32, p. 1071-1075.

PENNSYLVANIAN CEPHALOPODS OF OKLAHOMA

PLATES 1 TO 19

INDEX TO PLATES

PLATE 1

Figure *Page*

1-3. *Michelinoceras directum* new species. Lateral views of two syntypes, x1, and cross-section diagram of a larger syntype, x1, showing central position of siphuncle. All from the Buckhorn asphalt pit, in sec. 26, T. 1 S., R. 3 E., Murray County, OU 3900. 19

4, 5. *Brachycycloceras crebricinctum* (Girty). Lateral views of a specimen from the Wetumka in NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E., Pontotoc County, OU 408, and another from the Wewoka in S½ SW¼ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County, OU 3662. Both x1. 21

6. *Brachycycloceras normale* Miller, Dunbar, and Condra. Lateral view, x1, of a specimen from the Coffeyville, SE cor. sec. 36, T. 12 N., R. 9 E., Okfuskee County, OU 169. 20

7. *Brachycycloceras longulum* Miller and Owen. Lateral view, x1, of specimen from the Wewoka, sec. 10, T. 13 N., R. 12 E., Okmulgee County, OU 3661. 22

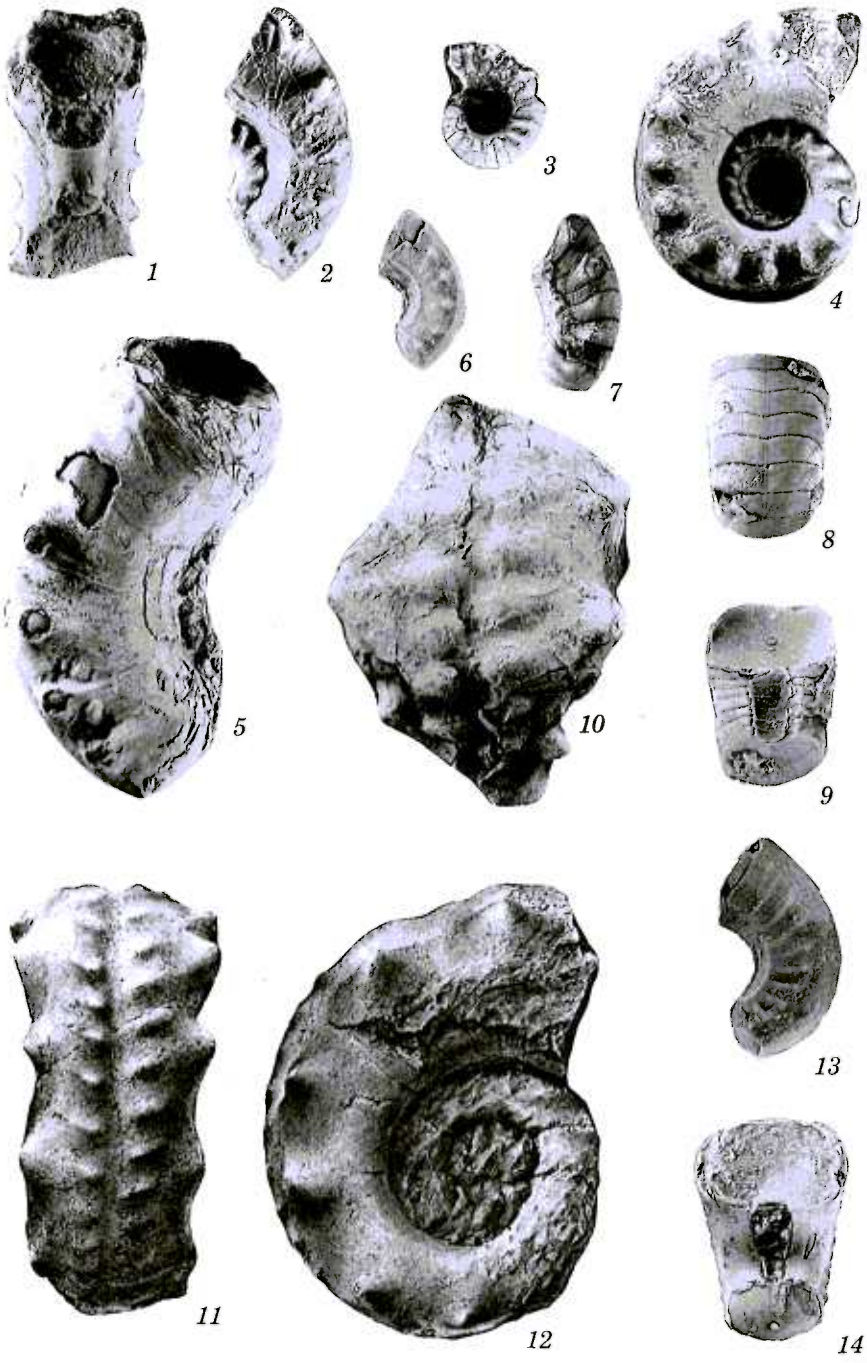
8, 9. *Euloxoceras greenei* Miller, Dunbar, and Condra. Lateral and septal views, x2.5, of specimens from the Holdenville, SW¼ sec. 18, T. 6 N., R. 8 E., Seminole County, OU 694. 24

10, 11. *Pseudorthoceras knoxense* (McChesney). Lateral view of small tip end of specimen from the Nellie Bly along Turner Turnpike, 11.1 miles from Tulsa entrance, Creek County, OU 3677, and ventral view of slightly crushed specimen from same location, OU 3676. Both x2. 22

12, 13. *Mooreoceras tuba* (Girty). Dorsal and lateral views, x1, of specimen from the Stuart formation, north center sec. 3, T. 3 N., R. 9 E., Coal County, OU 3923. 27

14, 15. *Mooreoceras normale* Miller, Dunbar, and Condra. Dorsal view, x1, of typical specimen from the Chanute formation, SE¼ SE¼, sec. 9, T. 19 N., R. 10 E., Tulsa County, OU 3649, and lateral view, x0.4, of exceptionally large specimen from the Fort Scott limestone east of Tulsa., University of Tulsa. 25

16. *Bactrites* sp. Septal view, x1, of specimen from the Vamoosa formation, about 2 miles south-southwest of Wynona, Osage County, OU 3694. 53


1
2
3
4
5
6
7
8
9
10
11
12
13
14

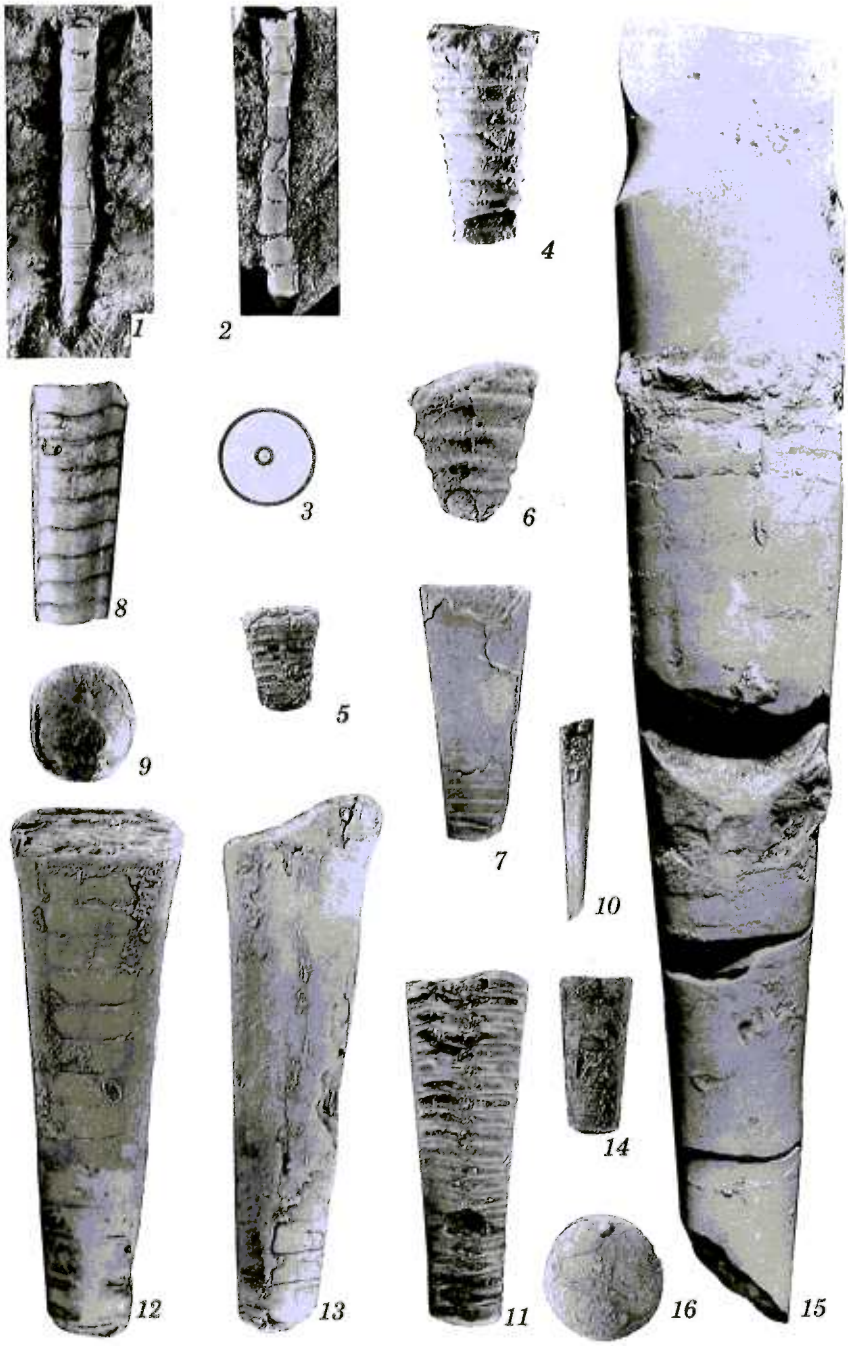

1
2
4
3
6
8
5
9
7
10
12
13
11
14
16
15

PLATE 2

Figure *Page*

1-9. *Metacoceras cornutum* Girty. All views x1.
1, 2. Dorsal and lateral views of specimen from the Coffeyville formation, SE¼ sec. 36, T. 12 N., R. 9 E., Okfuskee County, OU 424.
3. A small specimen from the caprock of the Bluejacket coal, SE¼ SW¼ NW¼ sec. 8, T. 25 N., R. 19 E., Rogers County, OU 3724.
4. Lateral view of a specimen from the Coffeyville, S center sec. 6, T. 6 N., R. 7 E., Seminole County, OU 690.
5. Lateral view of large fragment from same locality as 1 and 2, OU 424.
6. Lateral view of specimen from Boggy formation, sec. 17, T. 2 N., R. 7 E., OU 410.
7-9. Three views of specimen from same locality as 3, OU 3724. 35

10. *Tainoceras monilifer* Miller, Dunbar, and Condra. Ventral view, x1, of fragment from the Kanwaka shale, Vamoosa formation, about 2 miles south-southwest of Wynona, Osage County, OU 3695. 31

11, 12. *Tainoceras murrayi* Miller and Unklesbay. Ventral and lateral views, x1, of the holotype, from the upper part of the Lecompton limestone in northern Osage County, SUI 2123 (from Miller and Unklesbay, 1942). 32

13. 14. *Foordiceras bellatulum* (Miller and Owen). Lateral and dorsal views, x1, of specimen from the Wewoka, sec. 33, T. 5 N., R. 8 E., Pontotoc County, OU 401. 33

PLATE 3

Figure *Page*

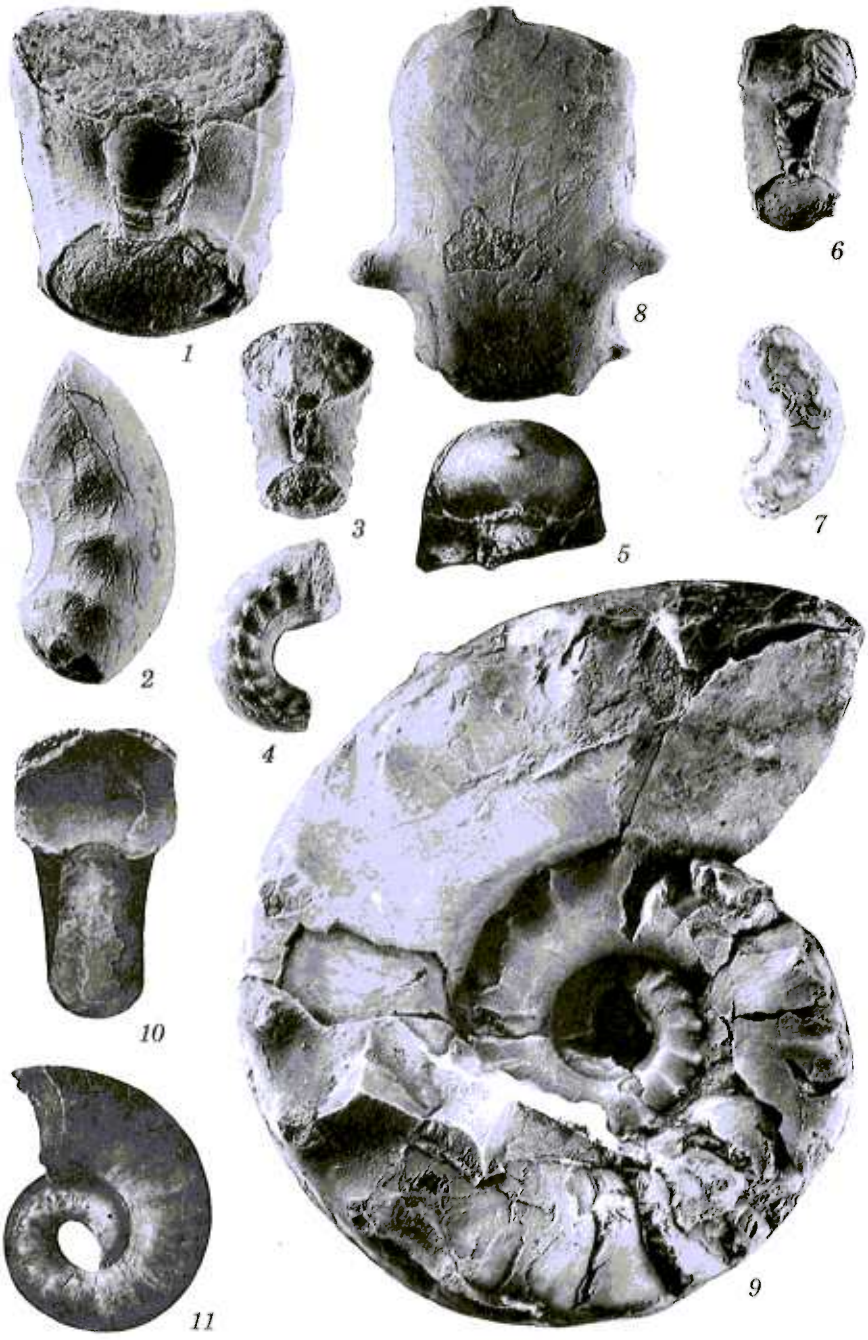
1-4. *Metacoceras carinatum* Girty.
1, 2. Dorsal and lateral views, x1, of specimen from the Holdenville, SE¼ sec. 36, T. 11 N., R. 9 E., Okfuskee County, OU 3720.
3, 4. Dorsal and lateral views, x1, of smaller specimen from the middle of the Wewoka S½ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County, OU 3707. 34

5. *Liroceras reticulatum* (Miller and Owen). Septal view of a syntype, x1.5, from the Seminole formation south of Collinsville, Tulsa County, SUI 2000 (from Miller and Owen, 1937) (see also pl. 4, fig. 6). 47

6, 7. *Metacoceras perelegans* Girty. Dorsal and lateral views, x1, of a specimen from the Boggy formation, sec. 17, T. 2 N., R. 7 E., Pontotoc County, OU 413. 37

8, 9. *Metacoceras sinuosum* Girty. Ventral view of large fragment and lateral view of a nearly complete specimen, both x1, from the Seminole formation, 0.75 mile south of Collinsville, Tulsa County, OU 3220. 38

10, 11. *Metacoceras vagans* Miller and Owen. Two views, x1.5, of the holotype, from the Seminole formation 0.75 mile south of Collinsville, Tulsa County, SUI (from Miller and Owen, 1937). 39


1
2
3
4
5
6
7
8
9
10
11

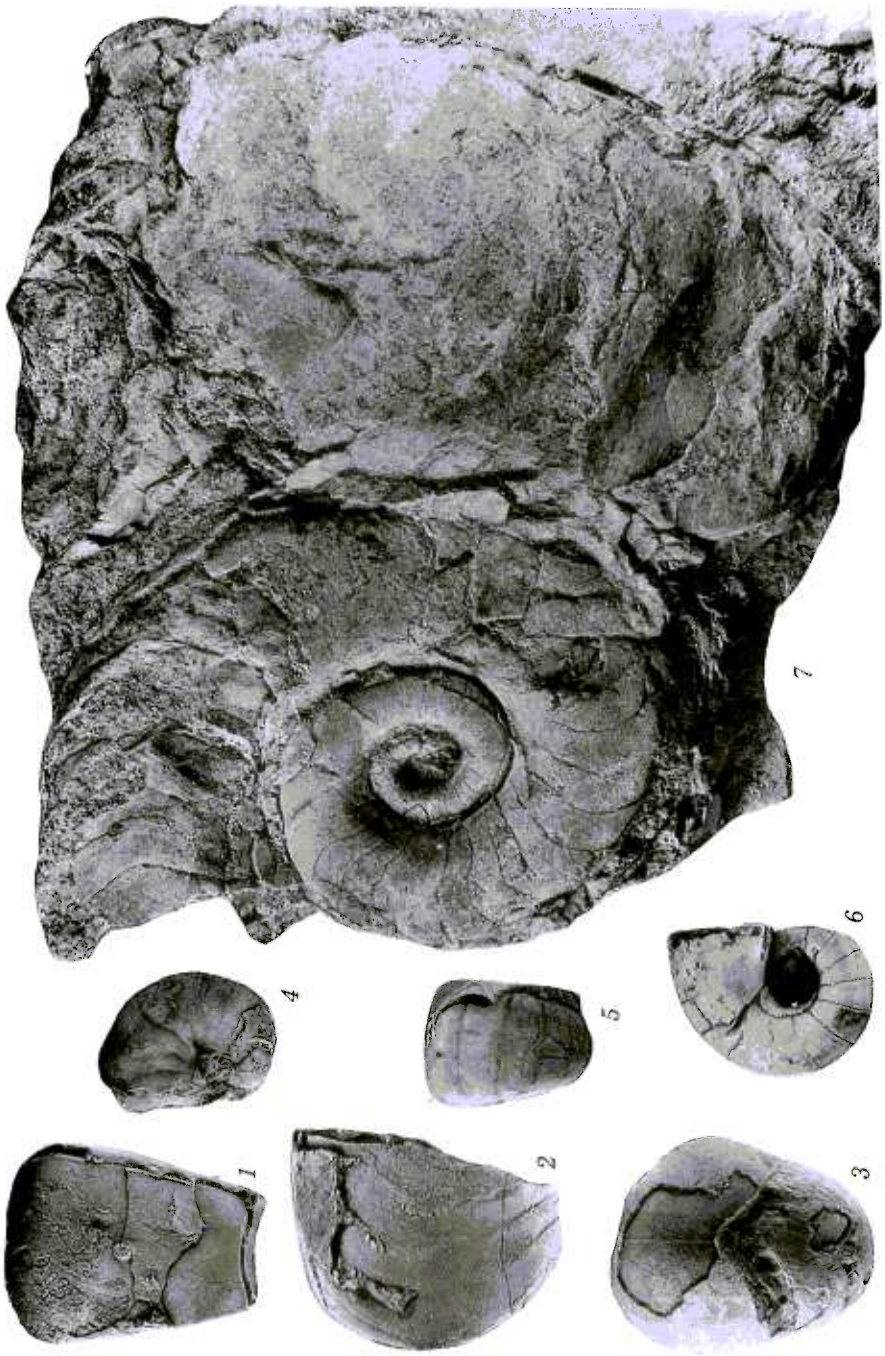

7
6
4
5
1
2
3

PLATE 4

Figure *Page*

1, 2. *Domatoceras* spp. Septal and lateral views, x1, of specimen from the Wetumka formation, NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E., Pontotoc County, OU 361. 42

3. *Ephippioceras ferratum* (Cox). Ventral view, x1, of specimen from the Boggy formation, sec. 27, T. 3 N., R. 7 E, OU 416. 50

4, 5. *Solenochilus missouriensis* Miller, Lane, and Unklesbay. Lateral and ventral views, x1, of specimen from the Wewoka formation, road cut 2.4 miles west of Okmulgee, Okmulgee County, OU 3697. 43

6. *Liroceras reticulatum* (Miller and Owen). Lateral view of topotype, x1, from the Seminole formation, 0.75 mile south of Collinsville, Tulsa County, OU 3168 (see also pl. 3, fig. 5). 47

7. *Domatoceras williamsi* Miller and Owen. Lateral view, x1, of large specimen from the "Buckhorn asphalt," in sec. 26, T. 1 S., R. 3 E., OU 3771. 42

PLATE 5

Figure *Page*

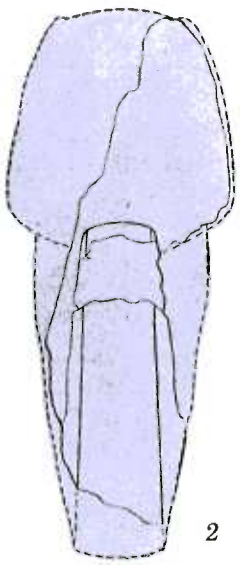
1, 2. *Domatoceras sculptile* (Girty). Lateral view and septal sketch, both x1, of specimen from Wewoka formation at Girty's locality 2005. (from Girty, 1915). 40

3-5. *Coelogasteroceras planum* Unklesbay, new species. Ventral, dorsal, and lateral views, all x1, of the holotype from the Holdenville, sec. 10, T. 6 N., R. 8 E., Seminole County, OU 373. 49

6-8. *Liroceras liratum* (Girty).
6. Lateral view of specimen from the Wewoka in sec. 10, T. 12 N., R. 12 E., Okmulgee County, OU 3744.
7, 8. Lateral and ventral views of specimen from the Wewoka, NW¼ NW¼ NE¼ sec. 18, T. 3 N., R. 7 E., Pontotoc County, OU 3753. All x1 (see also pl. 6, figs. 5, 6). 45

9. *Poterioceras* sp. Lateral view, x1, of specimen from the Wewoka, SE¼ SW¼ sec. 10, T. 13 N., R. 12 E., Okmulgee County, OU 4202. Note constriction caused by thickened shell (see also pl. 6, fig. 4). 29


1


2


3


6


9


4


7


5


8

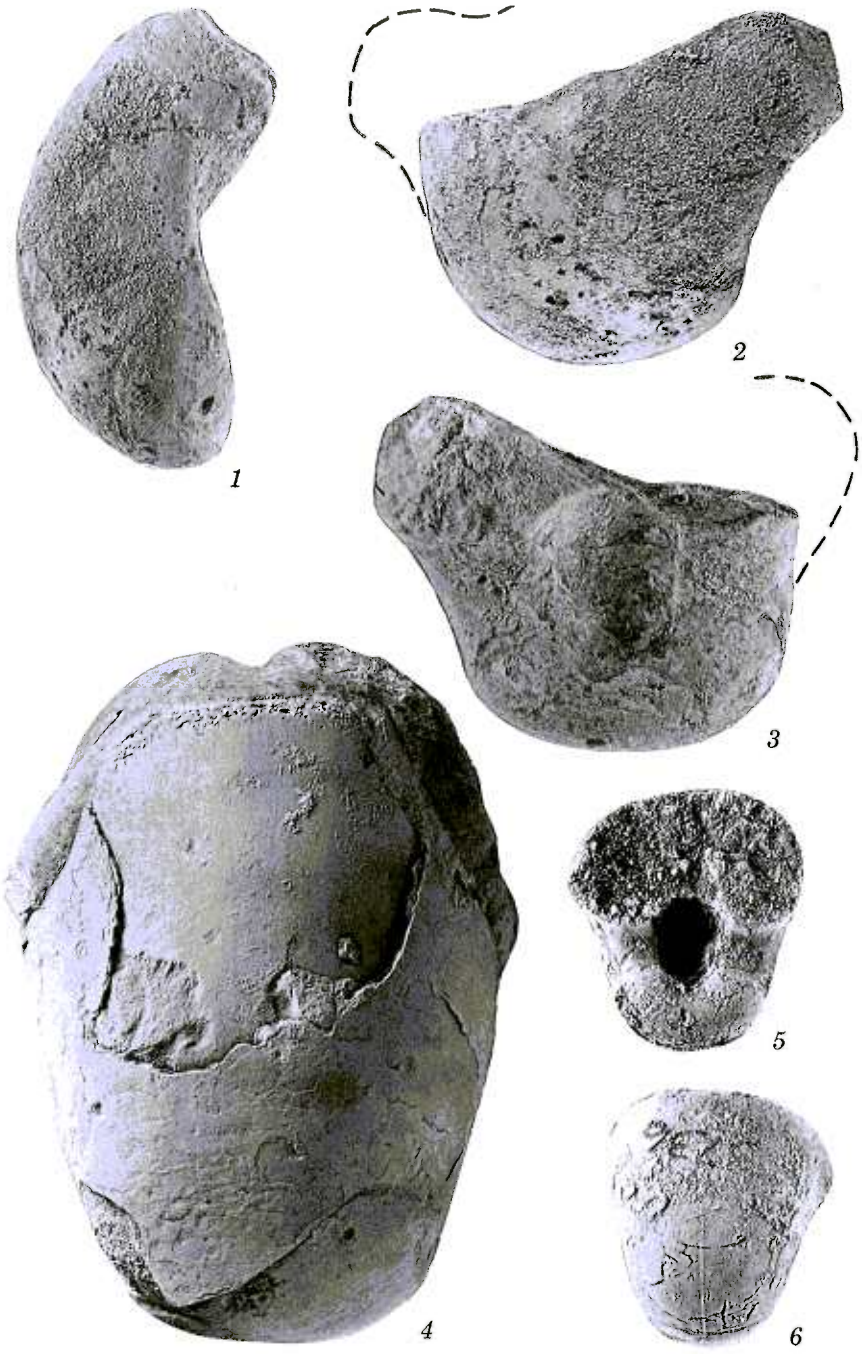

1
2
3
4
5
6

PLATE 6

Figure *Page*

1-3. *Liroceras patulum*, new species. Lateral, ventral, and dorsal views, x1, of the holotype, from the Union Valley formation at Lovelady Switch, Pontotoc County, OU 3754. 47

4. *Poterioceras* sp. Ventral view, x1, of specimen from the Wewoka formation, SE¼ SW¼ sec. 10, T. 13 N., R. 12 E., Okmulgee County, OU 4202 (see also pl. 5, fig. 9). 29

5, 6. *Liroceras liratum* (Girty). Dorsal and ventral views, x1, of specimen from the Atoka formation at east end of Fort Gibson Dam, Cherokee County, OU 3736 (see also pl. 5, figs. 6-8). 45

PLATE 7

Figure *Page*

1, 2. *Proshumardites,* new species. Ventral and lateral views, x2.5, of small specimen from the Morrow (Brentwood) 4 miles northwest of Webbers Falls, Muskogee County, OU 3172. 57

3-6. *Gonioglyphioceras gracile* (Girty).
3. Lateral view, x1, of immature specimen from the Wewoka in sec. 33, T. 5 N., R. 8 E., Pontotoc County, OU 3797.
4, 5. Apertural and lateral views, x1, of mature specimen from the Holdenville formation in Hughes County, OU 3795.
6. Lateral view, x3, of infant specimen from the Wewoka, 2 miles west of Okmulgee, Okmulgee County, OU 3802. 68

7. *Bisatoceras greenei* Miller and Owen. Lateral view, x2, of specimen from the middle Wewoka, NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., Okmulgee County, OU 3766. 63

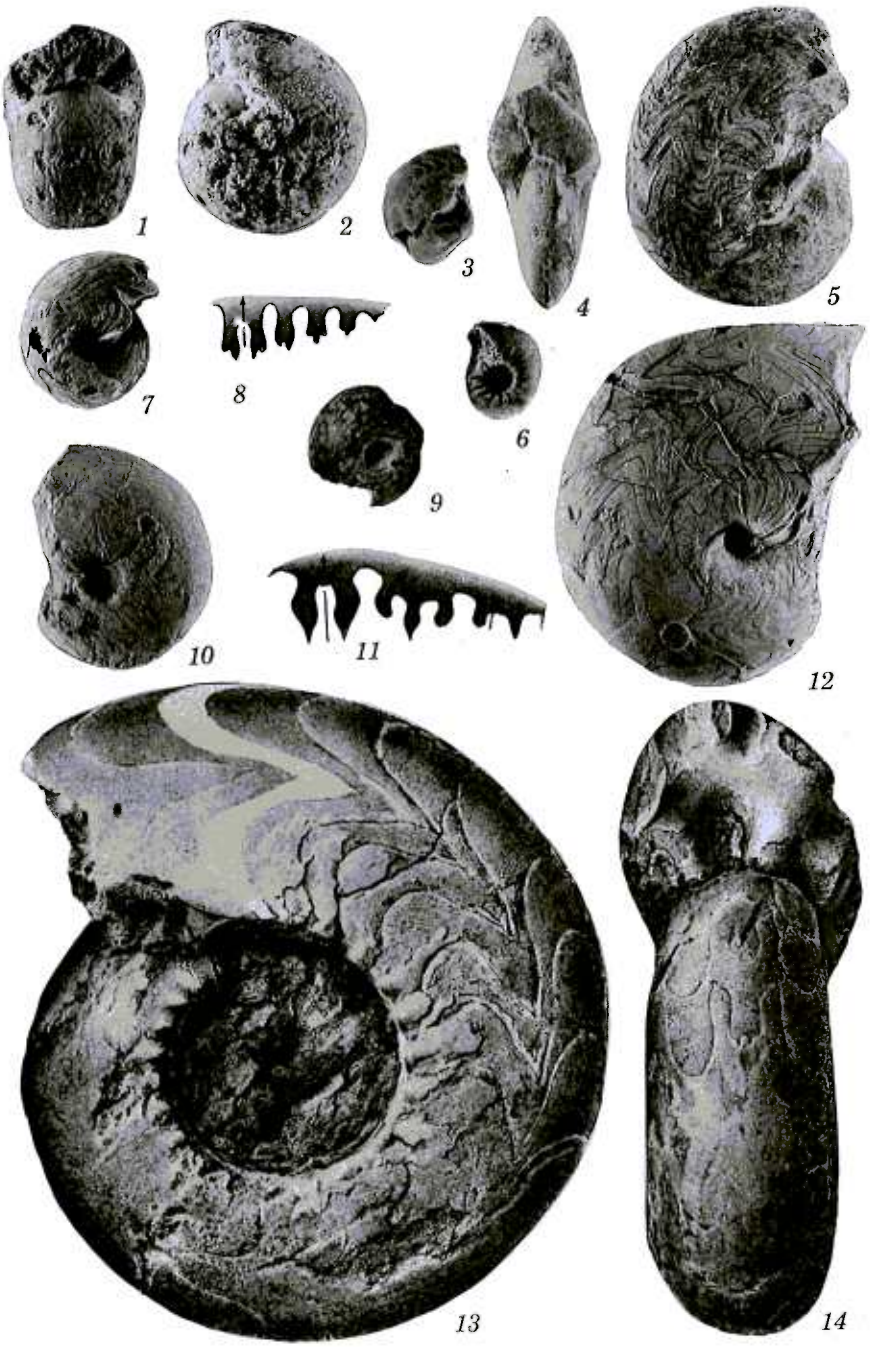
8, 9. *Peritrochia* sp. Suture pattern, x4, and lateral view, x2, of small specimen from the Nellie Bly, 6.5 miles west of Sand Springs, Tulsa County, SUI 640 (from Miller and Cline). 58

10. *Gordonites oklahomensis* (Miller and Owen). Lateral view, x1, of specimen from the Boggy formation in sec. 27, T. 3 N., R. 7 E., Pontotoc County, OU 412. 61

11. *Proshumardites senex* (Miller and Cline). External suture, x2, of small cotype from the Nellie Bly, 6.5 miles west of Sand Springs, Tulsa County, SUI 641 (from Miller and Cline, 1934). 56

12. *Goniloboceras goniolobum* (Meek). Lateral view, x1, of specimen from the Wewoka near Ada, Pontotoc County, OU 3800. 67

13, 14. *Gastrioceras adaense* Miller and Owen. Lateral view of the holotype, and ventral view of a paratype, both x1, and both from the Union Valley, SE¼ NE¼ NE¼ sec. 29, T. 3 N., R. 7 E., Pontotoc County, SUI 13956, 13957 (from Miller and Owen, 1944). 70


1
2
3
4
5
6
7
8
9
10
11
12
13
14

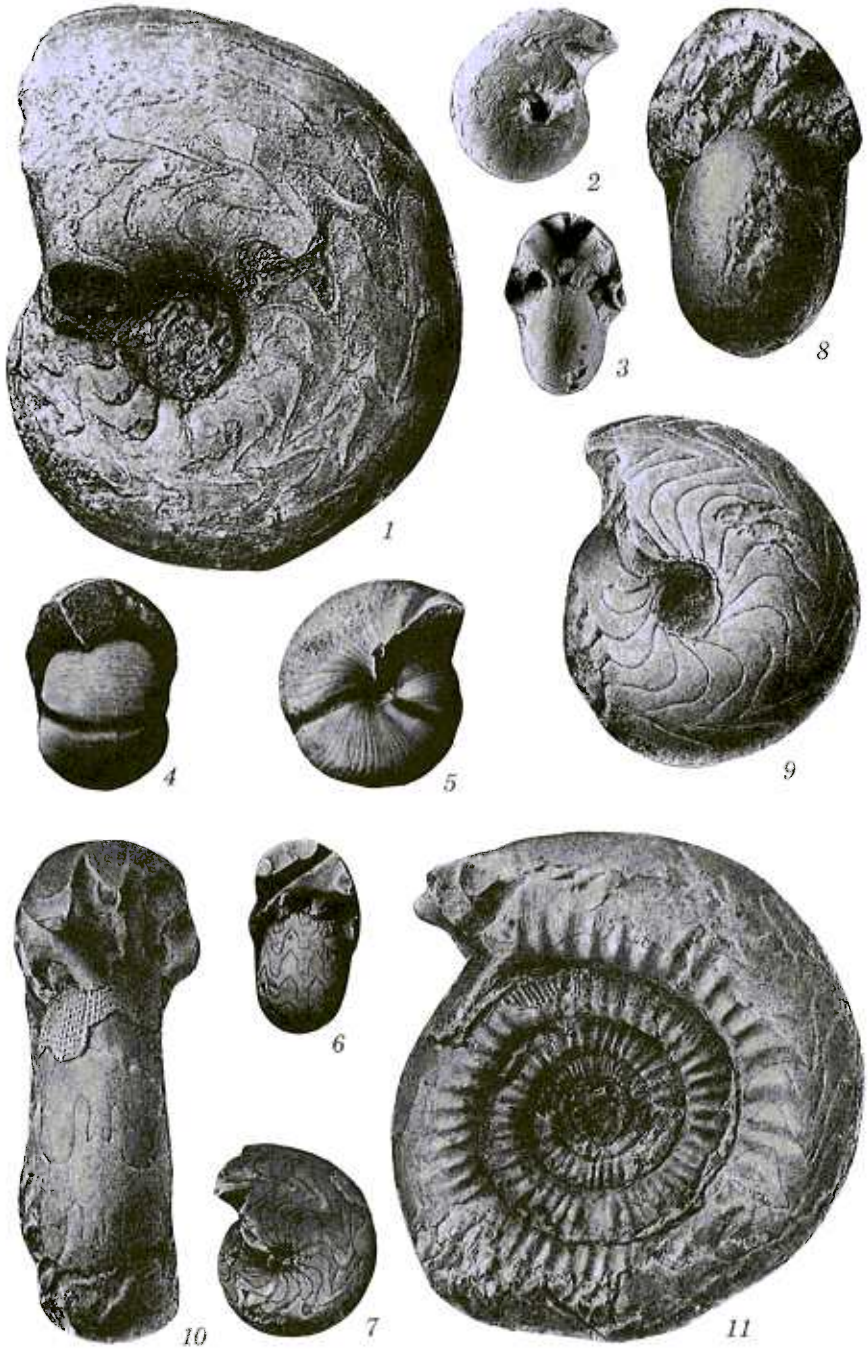

1
2
3
8
4
5
9
10
6
7
11

PLATE 8

Figure *Page*

1. *Pintoceras postvenatum* Plummer and Scott. Large specimen, x1, from the lower Wewoka in sec. 24, T. 5 N., R. 8 E., Hughes County (from Miller and Furnish, 1958), SUI 1962. 100

2-7. *Bisatoceras primum* Miller and Owen.
1, 2. Lateral and ventral views, x2.5, of specimen from the Wewoka, sec. 33, T. 5 N., R. 8 E., Pontotoc County, OU 369.
4, 5. Ventral and lateral views, x4, of an immature syntype.
6. Ventral view of one syntype, x2.
7. Lateral view of another syntype, x2.
Syntypes are from the Seminole formation about 0.75 mile south of Collinsville, Tulsa County, SUI (figs. 4-7 from Miller and Owen, 1939). 61

8, 9. *Cravenoceras? morrowense* Miller and Moore. Ventral and lateral views, x1, of typical specimen from the Union Valley, SE¼ NE¼ NE¼ sec. 29, T. 3 N., R. 7 E., Pontotoc County, SUI 13947 (from Miller and Owen, 1944). 59

10, 11. *Gastrioceras branneri* Smith. Ventral and lateral views, x1, of a specimen from the Union Valley at the same locality as 8, 9, SUI 13953 (after Miller and Owen, 1944) (see also pl. 10, fig. 4). 72

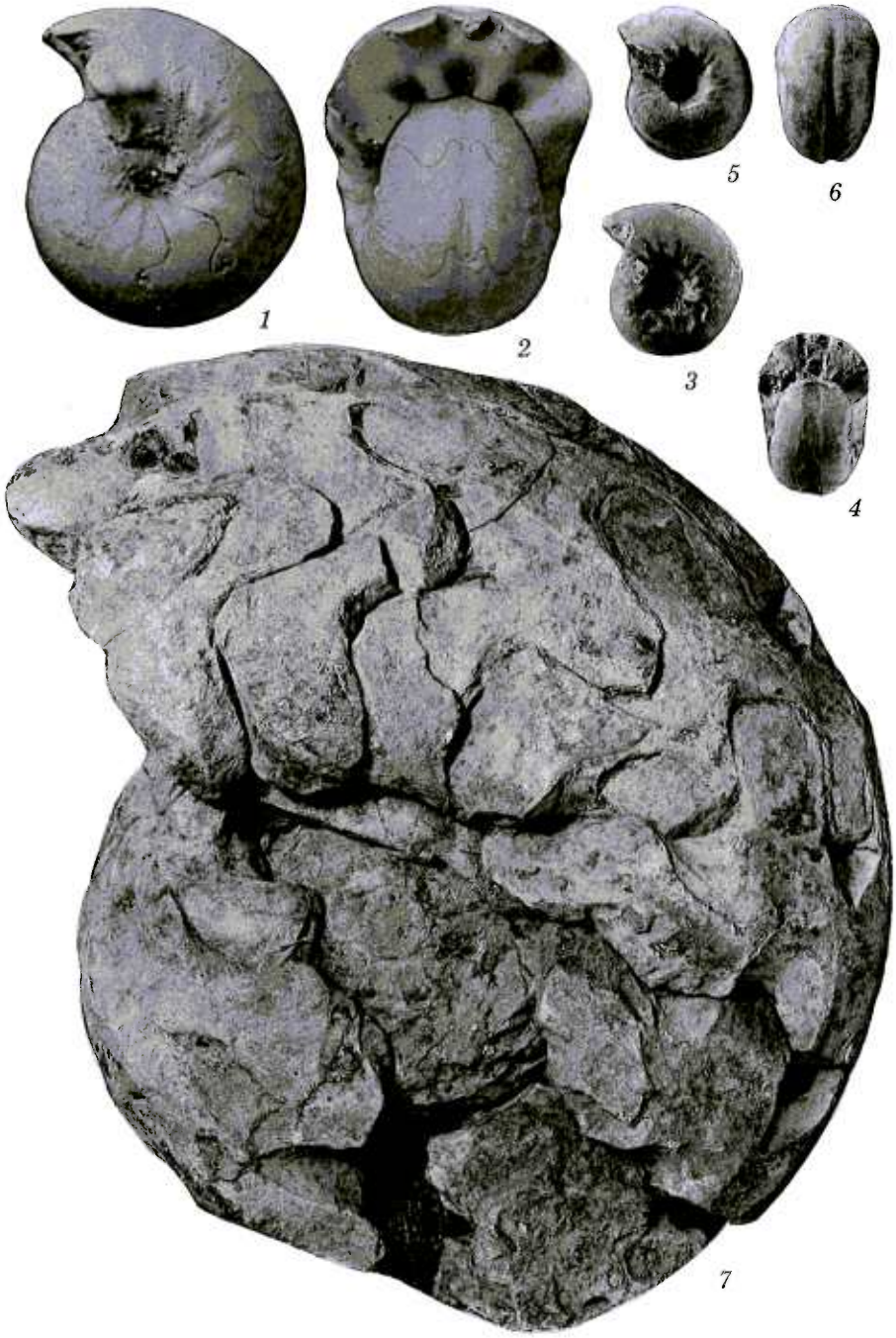
PLATE 9

Figure *Page*

1-4. *Wewokites newelli* Unklesbay, new species
1, 2. Lateral and ventral views, x6, of specimen from the Wewoka 2.4 miles west of Okmulgee on Highway 56, Okmulgee County, OU 4206.
3, 4. Lateral and ventral views of specimen from the Wewoka, NE¼ sec. 26, T. 11 N., R. 10 E., Okfuskee County, OU 3831. 66

5, 6. *Wewokites venatus* (Girty). Lateral and ventral views, x2.5, of specimen from the Wewoka 2.4 miles west of Okmulgee on Highway 56, Okmulgee County, OU 3835. 65

7. *Eoasianites subdiscus,* new species. Lateral view, x0.5, of large specimen from the Buckhorn asphalt pit south of Ada, Oklahoma, OU 3945. 89


1
2
3
4
5
6
7

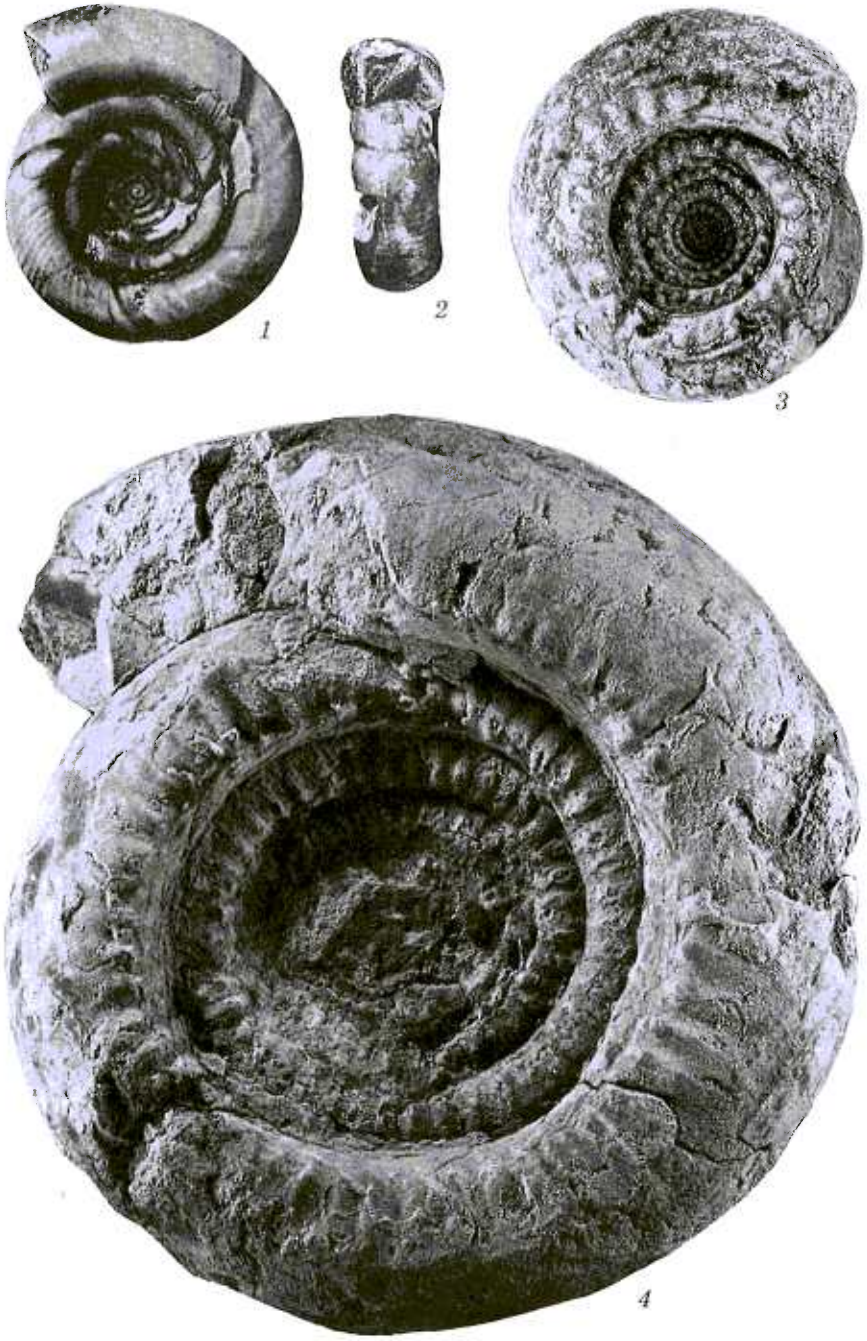

1
2
3
4

PLATE 10

Figure *Page*

1, 2. *Gastrioceras prone* Miller and Owen. Lateral and ventral views of the holotype, x4 and x3 respectively, from the Seminole formation about 0.75 mile south of Collinsville, Tulsa County, SUI (from Miller and Owen, 1937). 75

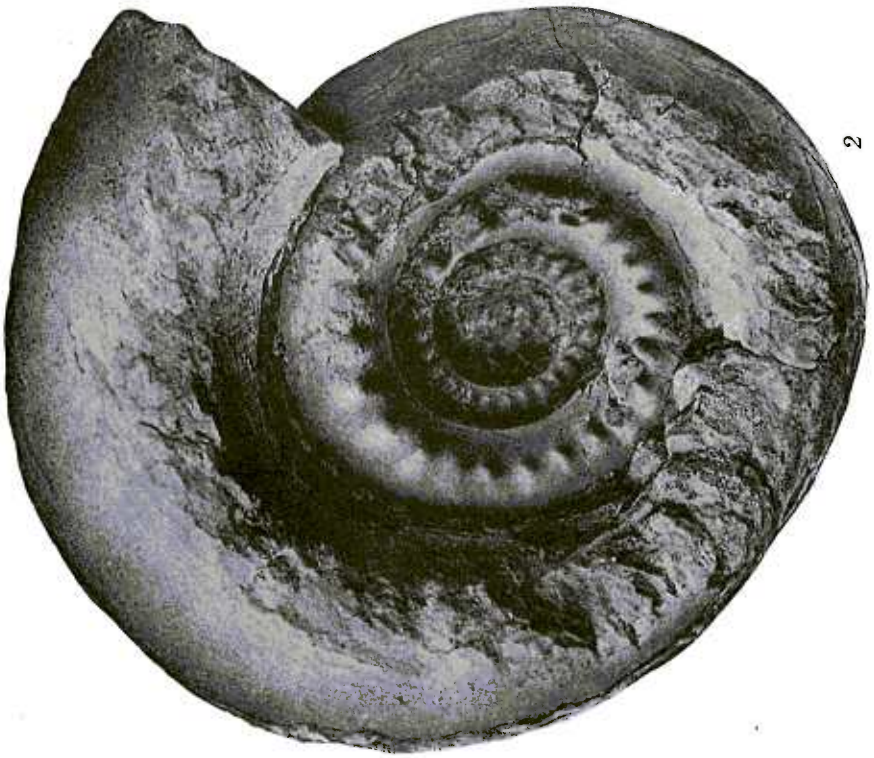
3. *Gastrioceras fittsi* Miller and Owen. Lateral view, x1, of specimen from the Union Valley formation at Lovelady Switch about 2 miles northwest of Stonewall, Pontotoc County, OU 3816 (see also pl. 11, figs. 1, 2). 74

4. *Gastrioceras branneri* Smith. Lateral view, x1, of specimen from the Union Valley formation, sec. 7, T. 3 N., R. 8 E., Pontotoc County, OU 3755 (see also pl. 8, figs. 10, 11). 72

PLATE 11

Figure *Page*

1, 2. *Gastrioceras fittsi* Miller and Owen. Ventral and lateral views of the holotype, x0.6, from the upper part of the Union Valley formation near Lovelady Switch, about 7 miles southeast of Ada, Pontotoc County, SUI 13959 (from Miller and Owen, 1944) (see also pl. 10, fig. 3). 74



2

1

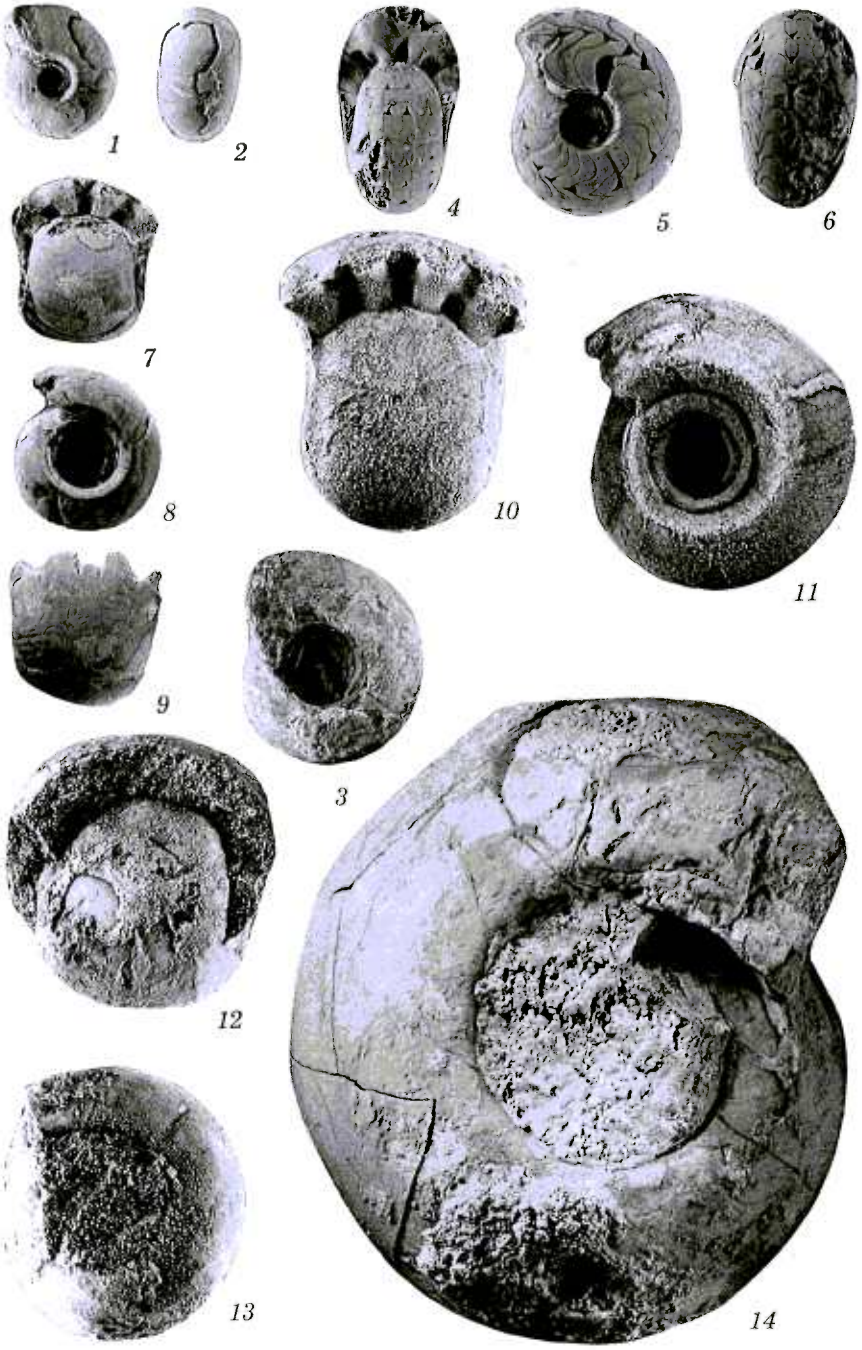

1
2
4
5
6
7
10
11
8
9
3
12
13
14

PLATE 12

Figure *Page*

1-3. *Eoasianites anguloumbilicatus* (Plummer and Scott).
1, 2. Lateral and ventral views, x1, of specimen from the top of the Chanute formation on Highway 20, 4.2 miles west of railroad crossing in Skiatook, Osage County, OU 3878.
3. Lateral view, x1, of specimen from the Coffeyville formation, sec. 36, T. 12 N., R. 9 E., Okfuskee County, OU 3877. 79

4-6. *Eoasianites kansasensis* (Miller and Gurley). Apertural, lateral, and ventral views, x1, of specimen from the upper Wetumka formation, SW¼ sec. 10, T. 15 N., R. 13 E., Okmulgee County, OU 774. 85

7-11. *Eoasianites angulatus* (Girty).
7-9. Apertural, lateral, and ventral views, x1, of specimen from the Wewoka, SE¼ sec. 1, T. 10 N., R. 10 E., Okfuskee County, OU 381.
10, 11. Apertural and lateral views, x1, of specimen from the Vamoosa, 2 miles south-southwest of Wynona, Osage County, OU 3828. 76

12, 13. *Eoasianites globulosus* (Meek and Worthen). Apertural and lateral views, x1, of specimen from the Union Valley, at Lovelady Switch 2 miles northwest of Stonewall, Pontotoc County, OU 3880. 82

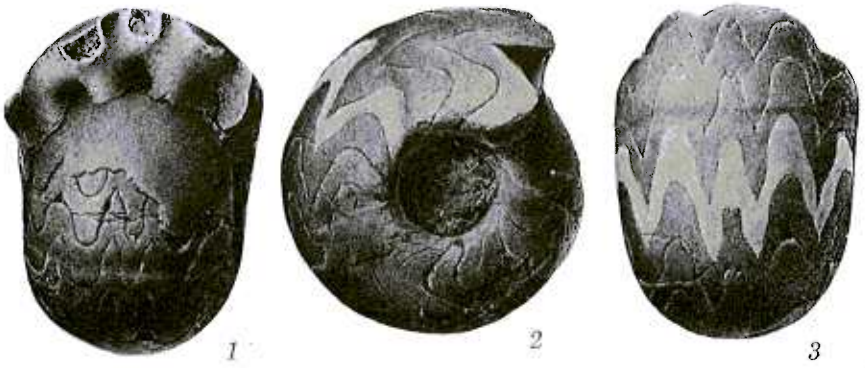
14. *Eoasianites excelsus* (Meek). Lateral view, x1, of specimen from the Wann formation, "NE¼ SW¼ sec. (1?) T. 25 N., R. 12 E.," Washington County, OU 3787 (see also pl. 13, fig. 4). 80

PLATE 13

Figure *Page*

1-3. *Eoasianites oblatus* (Miller and Moore). Three views, x1, of typical specimen from the Union Valley formation, SUI 13951, (from Miller and Owen, 1944). 87

4. *Eoasianites excelsus* (Meek). Ventral view, x1, of specimen from the Wetumka shale, sec. 20, T. 2 N., R. 8 E., Coal County, OU 397 (see also pl. 12, fig. 14). 80



1 2 3

4

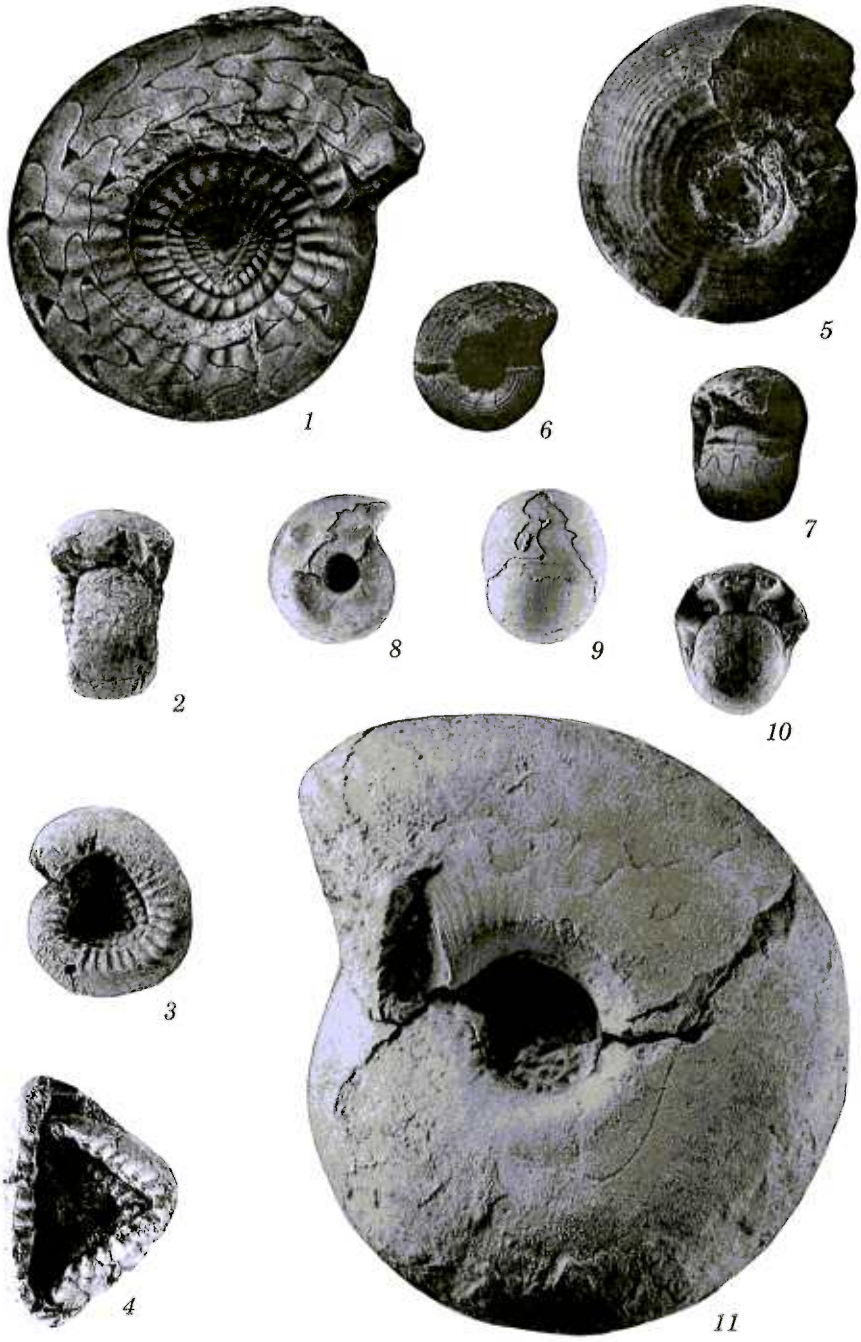

1
5
6
7
2
8
9
10
3
11
4

PLATE 14

Figure *Page*

1-4. *Paralegoceras texanum* (Shumard).
1. Lateral view, x1, of mature specimen from the lower Atoka near Clarita, Coal County, SUI 13998 (from Miller and Furnish, 1940).
2, 3. Ventral and lateral views, x2.5, of small specimen from the Boggy formation in sec. 17, T. 2 N., R. 7 E., Pontotoc County, OU 3759.
4. Lateral view, x2.5, of small specimen from the Atoka at Barnett Hill, near Clarita, Coal County, OU 3790. 104

5-7. *Owenoceras retiferum* (Miller and Owen). The two syntypes, x2, from the Seminole formation 0.75 mile south of Collinsville, Tulsa County; figure 5 is SUI 1997 (from Miller and Owen, 1937). 90

8-11. *Eoasianites hyattianus* (Girty).
8-10. Three views, x1, of specimen from the Wewoka, sec. 10, T. 13 N., R. 12 E., Okmulgee County, OU 3872.
11. Lateral view, x1, of large individual from the Wewoka, sec. 24, T. 5 N., R. 8 E., Pontotoc County, OU 3873. 84

PLATE 15

Figure *Page*

1. *Pseudoparalegoceras kesslerense* (Mather). Lateral view, x1, of a poor specimen from the Union Valley at Lovelady Switch, 2 miles northwest of Stonewall, Pontotoc County, OU 3772. 93

2-4. *Eothalassoceras inexpectans* (Miller and Owen). Lateral view, x1, of specimen from the Seminole formation near Collinsville, Tulsa County, OU 3616; and two views, x2, of a syntype from the same horizon and locality, SUI 1996, (from Miller and Owen, 1937). 116

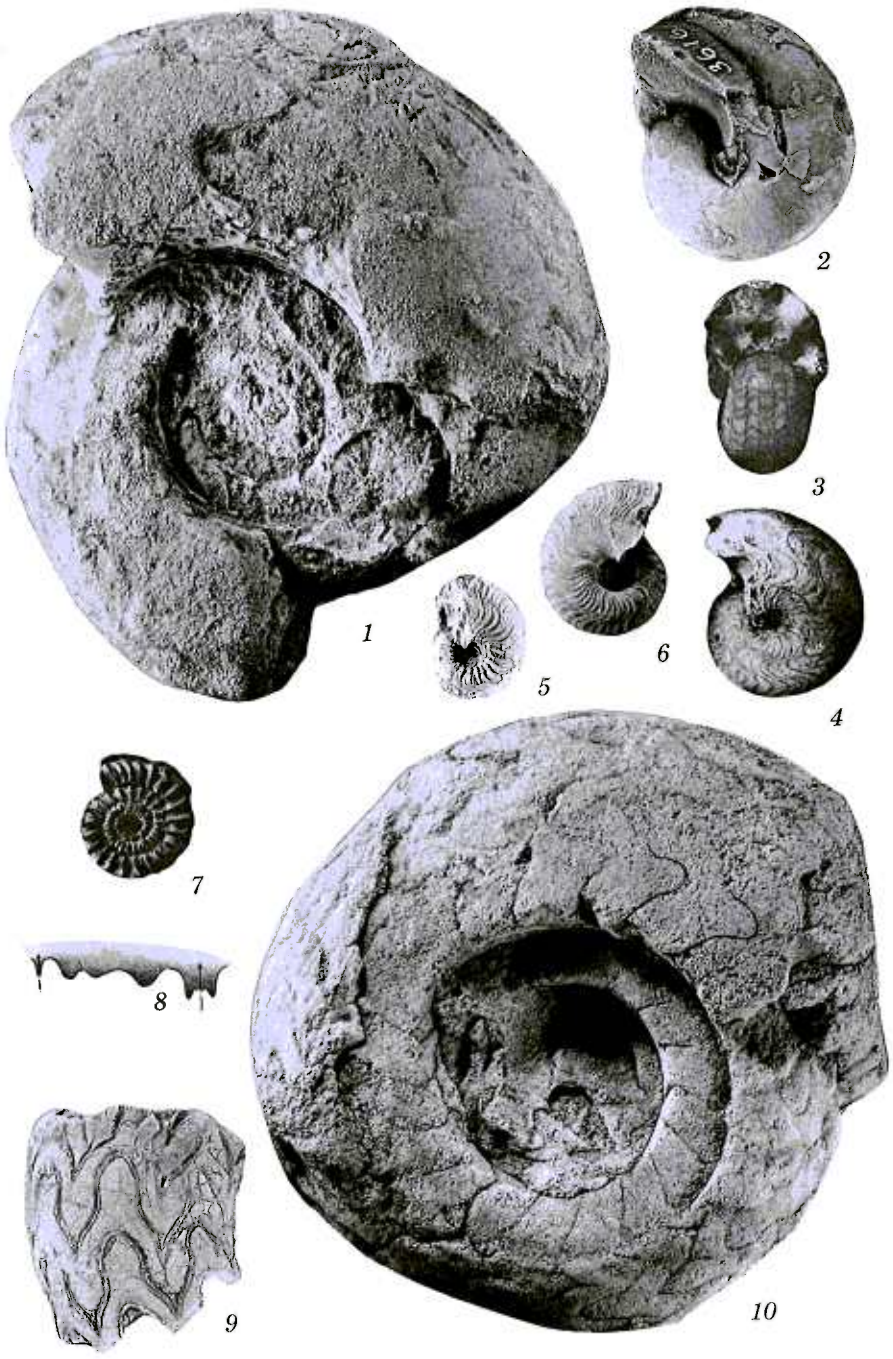
5. *Neodimorphoceras lenticulare* (Girty). Lateral view, x2, of specimen from the Wewoka, 2.4 miles west of Okmulgee on Highway 56, Okmulgee County, OU 3781. 112

6. *Dimorphoceras politum* (Shumard). Lateral view, x2, of specimen from the Wewoka, 0.7 miles north of Preston, Okmulgee County, OU 3763. 110

7, 8. *Eupleuroceras bellulum* Miller and Cline. Lateral view of a cotype, x2, and a suture, x12, from another cotype; both from the Nellie Bly 6.5 miles west of Sand Springs, Tulsa County (from Miller and Cline, 1934). 91

9. *Pseudoparalegoceras brazoense* Plummer and Scott. Lateral view, x1, of fragment from the Boggy formation in sec. 27, T. 3 N., R. 7 E., Pontotoc County, OU 3774. 93

10. *Pseudoparalegoceras compressum* (Hyatt). Lateral view, x1, of specimen from the basal Atoka in Salt Hollow, Sequoyah County, OU 3617. 91


1
2
3
4
5
6
7
8
9
10

1

2

4

3

5

6

PLATE 16

Figure *Page*

1, 2. *Pseudoparalegoceras williamsi* Miller and Downs. Lateral views, x1, of two specimens from the Atoka at Barnett Hill near Clarita, Coal County, OU 3596 and 3777. 94

3. *Prouddenites primus* Miller. Diagrammatic representation of a mature suture, x4, based on a specimen (SUI 634) from the Nellie Bly, 6.5 miles west of Sand Springs, Tulsa County (from Miller and Cline, 1934) (see also pl. 19, figs. 5-10). 121

4. *Schistoceras hildrethi* (Morton). Lateral view, x1, of specimen from the Kanwaka shale, NE¼ sec. 32, T. 24 N., R. 9 E., Osage County, OU 591. 98

5. *Schistoceras missouriense* (Miller and Faber). Lateral view, x1, of specimen from the Vamoosa, about 2 miles south-southwest of Wynona, Osage County, OU 3786. 96

6. *Diaboloceras varicostatum* Miller and Furnish. Lateral view, x1, of a partially restored specimen from the Atokan Coody sandstone, near the top of Braggs Mountain southeast of Muskogee, Muskogee County, SUI 1418 (from Miller and Furnish, 1958) (see also pl. 18, figs. 5, 6). 106

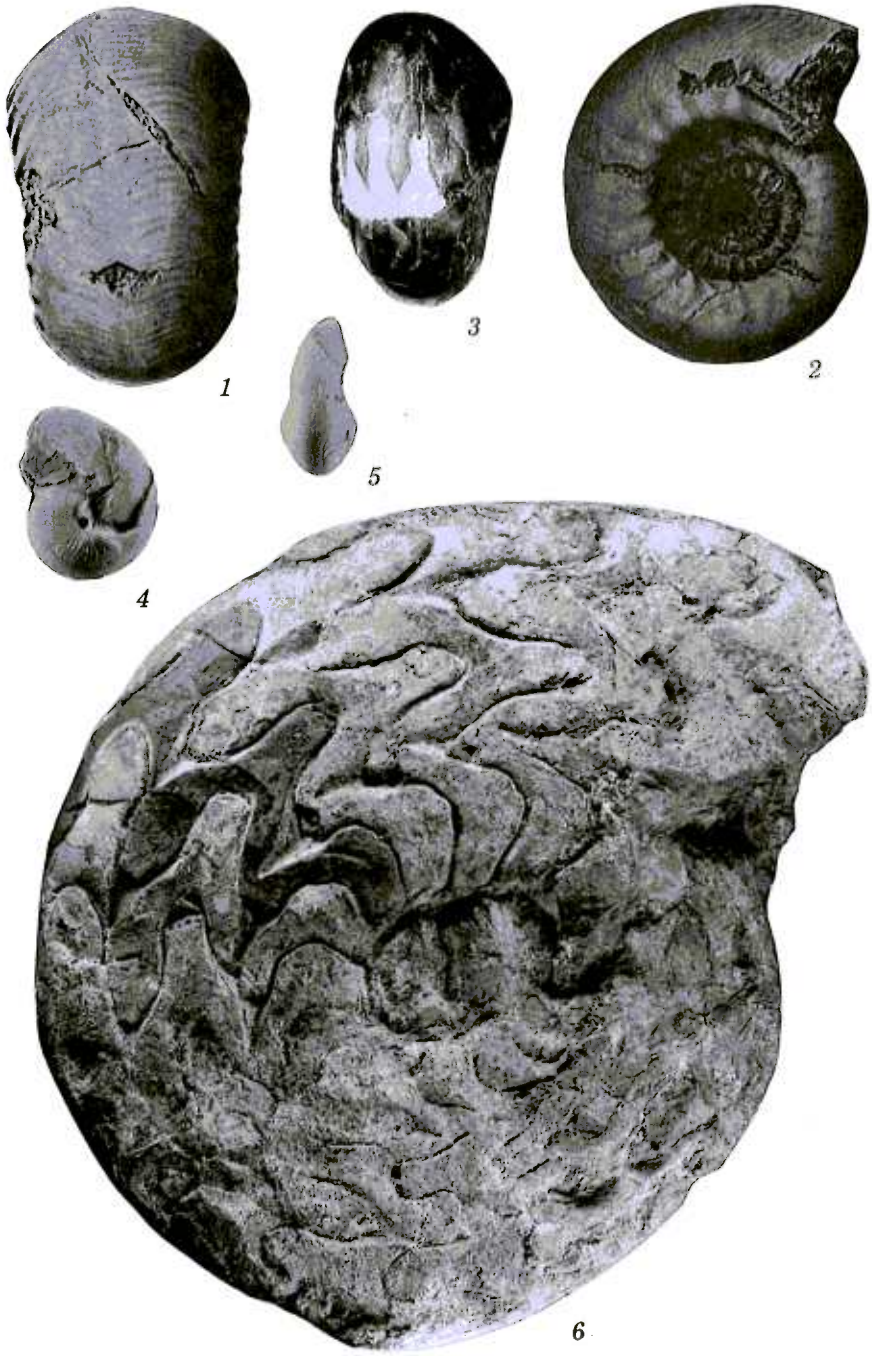
PLATE 17

Figure *Page*

1-3. *Pintoceras unicum* (Miller and Owen).
1, 2. Two views of a topotype, x2.5, SUI 1961.
3. A ventral view of another topotype, OU 3167, both from the Seminole formation about 0.75 mile south of Collinsville, Tulsa County.
(figs. 1, 2, from Miller and Furnish, 1958). 101

4, 5. *Maximites cherokeensis* (Miller and Owen). Lateral and ventral views, x3, of specimen from the Wewoka in the NE¼ NE¼ sec. 2, T. 14 N., R. 12 E., Okmulgee County, OU 3782. 53

6. *Paralegoceras iowense* (Meek and Worthen). Lateral view, x1, of specimen from the Buckhorn asphalt pit in NE¼ sec. 26, T. 1 S., R. 3 E., Murray County, OU 3810. 102


1
2
3
4
5
6

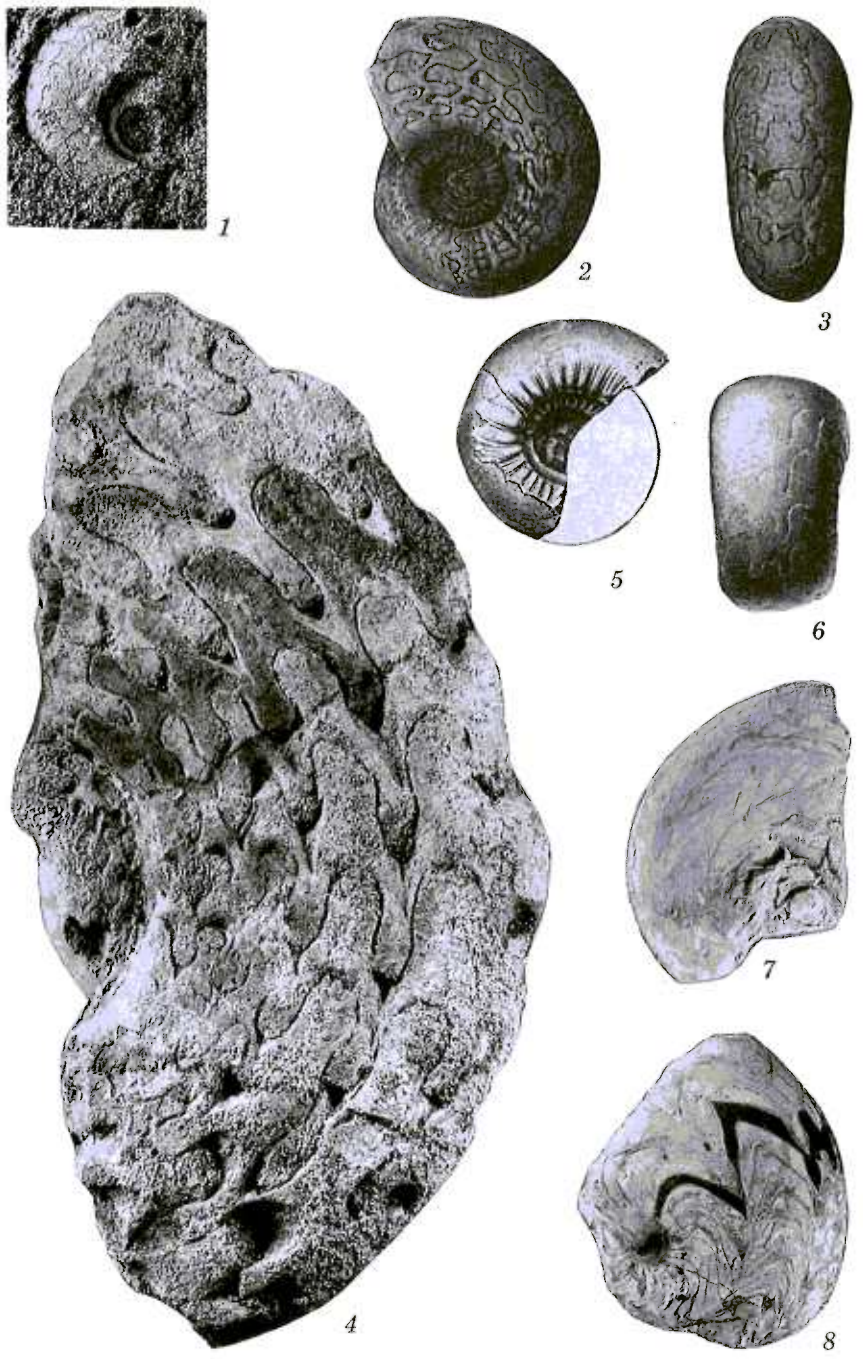

1
2
3
4
5
6
7
8

PLATE 18

Figure *Page*

1. *Boesites girtyi* (Plummer and Scott). Lateral view, x0.5, of small specimen from the Atoka at Barnett Hill near Clarita, Coal County, OU 3764. 118

2-4. *Wellerites mohri* Plummer and Scott. Two views, x5, of small specimen exposing inner volutions, from the Wewoka about 7 miles east of Ada, Pontotoc County, SUI 13845 (from Miller and Furnish, 1958); and lateral view, x1, of large individual from the Buckhorn asphalt pit in NE¼ sec. 26, T. 1 S., R. 3 E., Murray County, OU 3788. 107

5, 6. *Diaboloceras varicostatum* Miller and Furnish. Lateral and ventral views, x2.5, of small syntype showing ornamentation of inner whorls, from a Smithwick horizon near the eastern margin of the Sierra Diablo of West Texas, SUI 1415 (from Miller and Furnish, 1940) (see also pl. 16, fig. 6). 106

7. *Neodimorphoceras oklahomae* (Girty). Lateral view, x1, of specimen from the middle of the Wewoka, S½ SW¼ sec. 28, T. 7 N., R. 9 E., Hughes County, OU 3793. 113

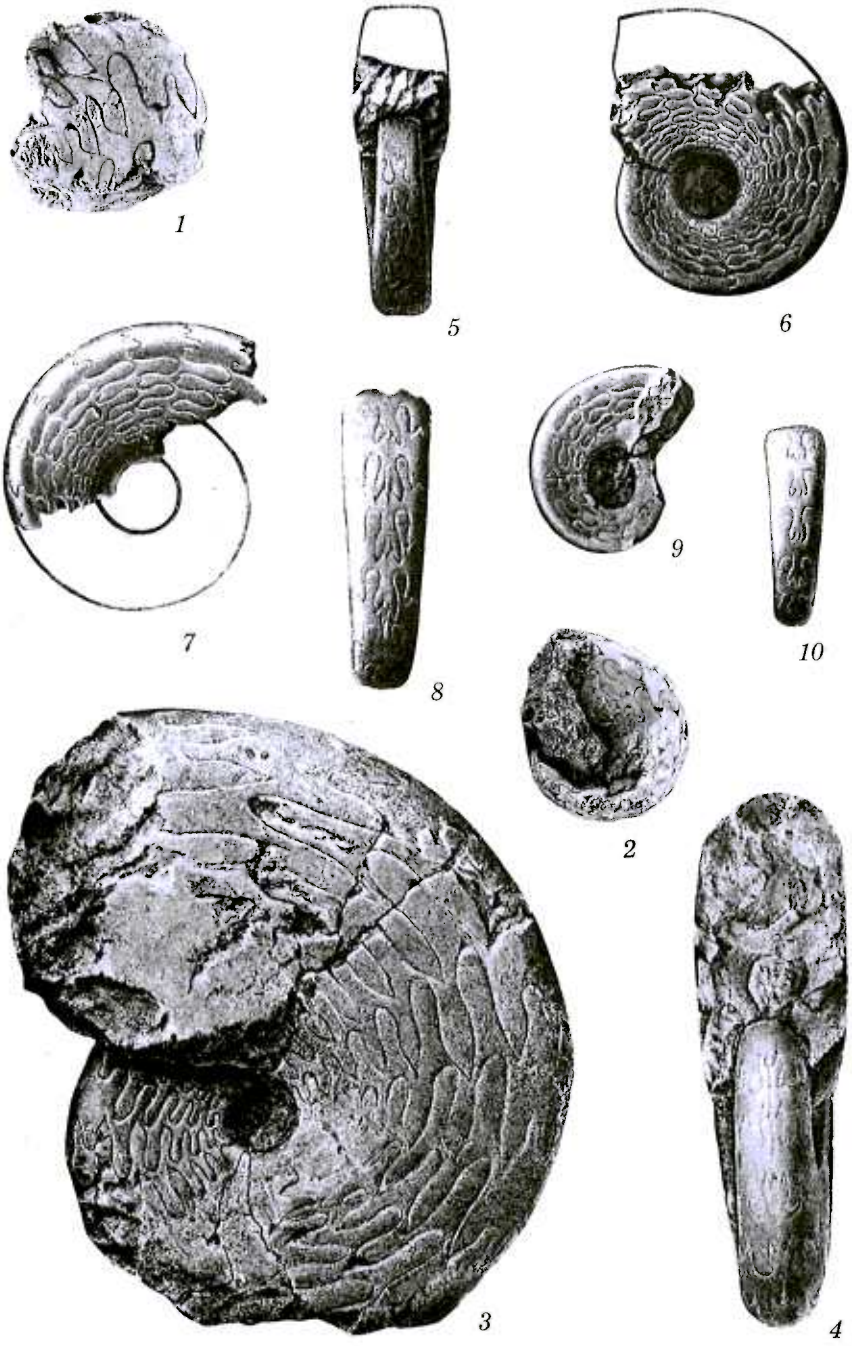
8. *Neodimorphoceras texanum* (Smith). Lateral view, x1, of specimen from the Wewoka, sec. 24, T. 5 N., R. 8 E., Pontotoc County, OU 102. 115

PLATE 19

Figure *Page*

1-4. *Pronorites arkansasensis* Smith.
1. Lateral view, x1, of specimen from the Atoka, near Clarita, Coal County, OU 3819.
2. Lateral view, x1, of another specimen from same locality, OU 3820.
3, 4. Two views, x1, of large specimen from the Union Valley near Lovelady, about 7 miles southeast of Ada, Pontotoc County, SUI 13942 (from Miller and Owen, 1944). 119

5-10. *Prouddenites primus* Miller.
5, 6. Two views, x1.5, of specimen from the Nellie Bly west of Sand Springs, Tulsa County.
7-10. Two specimens, x2, from the Nelagoney formation at Wild Horse, Osage County. 7, 8, SUI 1422. 9, 10, SUI 1423. (all from Miller and Furnish, 1940) (see also pl. 16, fig. 3). 121



1

5

6

7

8

9

10

2

3

4

INDEX

(Main reference pages are in italics)