OKLAHOMA GEOLOGICAL SURVEY

CARL C. BRANSON, DIRECTOR

Circular No. 31

DESMOINESIAN FUSULINIDS OF NORTHEASTERN OKLAHOMA

by

RICHARD D. ALEXANDER

Norman

1954

OKLAHOMA GEOLOGICAL SURVEY

CARL C. BRANSON, DIRECTOR

Circular No. 31

DESMOINESIAN FUSULINIDS OF NORTHEASTERN OKLAHOMA

by

RICHARD D. ALEXANDER

with a section on stratigraphy

by

CARL C. BRANSON

and a

section on stratigraphic significance

by

CARL C. BRANSON AND RICHARD D. ALEXANDER

Norman

1954

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

William Dee Little, Chairman ..... Ada
Guy Harris ..... Ardmore
Wharton Mathies, Secretary ..... Clayton
Frank Buttram ..... Oklahoma City
John Rogers ..... Tulsa
Julius H. Johnston ..... Lawton
Clee O. Doggett ..... Cherokee
Claude Star Chambers, M.D. ..... Seminole
Stephen Augustus Bryant, Assistant Secretary ..... Cushing

Mell A. Nash, Chancellor ..... Oklahoma City
Tom G. Sexton, Administrative Assistant ..... Oklahoma City

REGENTS OF THE UNIVERSITY OF OKLAHOMA

George F. Short, President ..... Oklahoma City
Dave Morgan, Vice President ..... Blackwell
Rayburn L. Foster ..... Bartlesville
Quintin Little ..... Ardmore
Joe W. McBride ..... Anadarko
W. D. Grisso ..... Oklahoma City
Thomas Richard Benedum ..... Norman

George Lynn Cross, President, University of Oklahoma ..... Norman
Emil R. Kraettli, Secretary ..... Norman

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

DESMOINESIAN FUSULINIDS OF NORTHEASTERN OKLAHOMA

by

RICHARD D. ALEXANDER

Abstract

Twenty species of fusulinids are identified and described, and seven of the species are new. The fusulinids were collected from fourteen stratigraphic units of Desmoinesian age, ranging from the base of the Savanna formation to high in the Marmaton group. The faunules are definitely fixed in stratigraphic position and should be useful in establishing correlations with adjacent areas. Some correlations are suggested.

INTRODUCTION

This investigation was undertaken in order to give a description of the fusulinids of the Des Moines series of northeastern Oklahoma. In this region the Des Moines series has many fusulinid zones, some of which have been well known for years, but few of the fusulinid faunules have been described. During the course of this work, fusulinid faunules from fourteen zones were collected. These range from the Spaniard limestone through the Altamont limestone. No fusulinids were found in the Lenapah limestone, but it is reported to have a faunule of dwarfed forms in an outcrop near the type locality in Nowata County, Oklahoma.

The specimens were collected during the fall and winter of 1952-53. A few localities are mentioned in the literature and other localities were suggested by students actively mapping the rocks in northeastern Oklahoma.

ACKNOWLEDGMENTS

The writer is grateful to Dr. Carl C. Branson, Professor of Geology, for his assistance, both in the field and at the University of Oklahoma, and for advice in all phases of this thesis. Also, my gratitude to Dr. Charles Ryniker, geologist with the Gulf Oil Company in Tulsa, Oklahoma, for suggesting collecting localities in the Pawnee, Lower Fort Scott, Tiawah, and Spaniard limestones; to Mr. L. E. Fitts, Jr., geologist with the Union Oil Company of California in Tulsa, Oklahoma, who originally found the fusulinellas in the Sam Creek limestone, and who gave detailed instructions on the required collecting technique; to Mr. Cassius M. Cade, III, then a graduate student at the University of Oklahoma, who guided the writer to localities where fusulinids were found in the Worland, Myrick Station, and Wimer School limestones; to Mr. W. F. Monk, graduate student at the University of Oklahoma, who greatly assisted in the photographic work; to Dr. Kaspar Arbenz, Associate Professor of Geology, who gave many helpful suggestions during the preparation of this thesis; to Mr. R. J. Alexander, geologist with the California Company in Pensacola, Florida, for suggesting this type of thesis and who taught the writer much of the technique of preparation of thin sections; to H. C. Skinner, graduate student at the University of Oklahoma who drafted the descriptive charts used in the thesis and who was helpful in many phases of the work; and finally to Mr. H. L. Strimple of Bartlesville, Oklahoma, who taught the writer how to do detailed paleontological collecting.

PROCEDURE

With a few exceptions, at least five axial sections and three sagittal sections were made of each species. Thin sectioning was done by hand, using silicon carbide powder of number 600 grit as the abrasive. The fusulinids were polished by means of a few strokes on alumina powder in order to orient the section properly and to cut the proloculus at its center. This procedure gives a smoother surface and a better reflection. The polished surface shows details which are important in determining the position of the axial or sagittal plane. After the proper axial plane was found, the fusulinid was turned over and the sectioning finished with silicon carbide number 600 grit. A good discussion of sectioning technique may be consulted in Dunbar and Henbest: Illinois Geological Survey, Bulletin Number 67, 1942.

The last few sections were cemented with Lakeside Brand Thermoplastic Cement Number 70. This thermoplastic is excellent for working with specimens which tend to crumble as the section nears the proper thickness.

After sectioning, the forms were measured for their length, width, form ratio, diameter of proloculus, thickness of wall, and tunnel angle. The septal count was made in sagittal sections. These measurements and septal counts are used for classifying fusulinids specifically.

The prepared sections were photographed at standard magnification of 10 diameters on most forms, but using 50 diameters on the minute forms from the Sam Creek and Inola limestones. A Leitz Aristophot camera was mounted over a Leitz Ortholux microscope for taking the photomicrographs. Kodak Super Ortho-Press film was used in order to get high contrast. The incorporated illuminating system of the Ortholux microscope was operated at five volts, and all diaphragms were wide open throughout the system. All photomicrographs taken at 10 diameters were exposed for 0.1 second, and those taken at 40 diameters were taken at one second. Test prints were made at different exposure times from each negative, and the exposure time giving the best results was used for making the final prints. All photographic work was done in the Department of Geology photography laboratory.

The final step was the permanent preparation of the slides of type specimens. These types were cemented with thermoplastic and cover slips were placed over them. They are deposited in the University of Oklahoma Paleontological Collections.

OUTLINE OF DESMOINESIAN STRATIGRAPHY

BY CARL C. BRANSON

The rocks of the Des Moines series crop out in a northeast striking belt across northeastern Oklahoma. The dip is from 30 to 60 feet a mile to the northwest and cuestas are developed on the more resistant beds. The nearly continuous sequence exposed allows a thorough search for fusulinid zones, and these can be accurately placed in the stratigraphic section. The region has been mapped in detail by graduate students of the University of Oklahoma who worked under the writer's supervision and with assistance from the

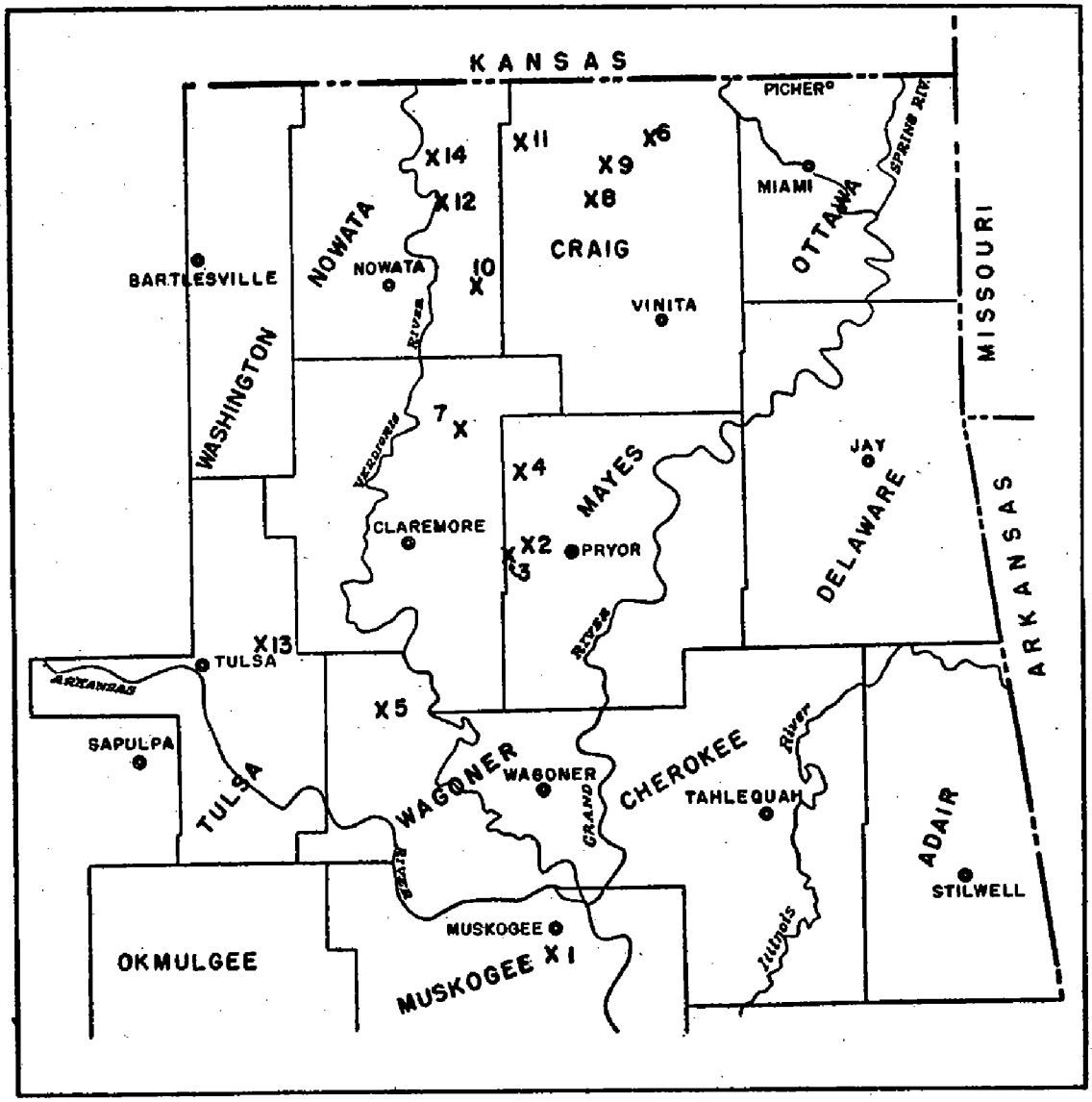


Figure 1—Index map of northeastern Oklahoma showing fusulinid localities.

1. Spaniard limestone member, Savanna formation. SW ¼ sec. 2, T. 14 N., R. 18 E., Muskogee County, Oklahoma.
2. Sam Creek limestone member, Savanna formation. SW ¼ sec. 4, T. 21 N., R. 18 E., Mayes County, Oklahoma.
3. Inola limestone member, Boggy formation. SE ¼ sec. 7, T. 21 N., R. 18 E., Mayes County, Oklahoma.
4. Inola limestone member, Boggy formation. NW ¼ sec. 32, T. 23 N., R. 18 E., Mayes County, Oklahoma.
5. Tiawah limestone member, Senora formation. SE ¼ sec. 26, T. 19 N., R. 15 E., Wagoner County, Oklahoma.
6. Russell Creek limestone member, Senora formation. SW ¼ sec. 11, T. 28 N., R. 20 E., Craig County, Oklahoma.
7. Verdigris limestone member, Senora formation. SE ¼ sec. 3. T. 23 N., R. 17 E., Rogers County, Oklahoma.
8. Breezy Hill limestone member, Senora formation. SW ¼ sec. 24, T. 28 N., R. 19 E., Craig County, Oklahoma.
9. Blackjack Creek limestone member, Fort Scott formation. NW ¼ sec. 13, T. 28 N., R. 19 E., Craig County, Oklahoma.
10. Higginsville limestone member, Fort Scott formation. SE ¼ sec. 28, T. 26 N., R. 17 E., Nowata County, Oklahoma.
11. Wimer School limestone member, Labette formation. NE ¼ sec. 9, T. 28 N., R. 18 E., Craig County, Oklahoma.
12. Myrick Station limestone, Pawnee limestone member, Oologah formation. NE ¼ sec. 12, T. 27 N., R. 16 E., Nowata County, Oklahoma.
13. Pawnee limestone member, Oologah formation. NW ¼ sec. 28, T. 20 N., R. 14 E., Tulsa County, Oklahoma.
14. Worland limestone, Altamont limestone member, Oologah formation. NW ¼ sec. 14, T. 28 N., R. 16 E., Nowata County, Oklahoma.

Oklahoma Geological Survey. The outcrops searched for fusulinids were located on the manuscript maps.

The rocks are those of the shelf facies, deposited upon the platform north of the McAlester Basin. The sediments are characterized by predominance of shale, northward thinning, and by arrangement in coal cycles. The limestones are impure; some are

sandy, many are cap rock limestones which grade into clay ironstones or are carbonaceous. In view of the shallow water origin of most of the limestones, it is astonishing to find that so many bear fusulinid faunas.

The Oklahoma Geological Survey employs a system of nomenclature for the region consistent with that of the McAlester Basin. The formational units are thicker and represent more time than do those discriminated by geologists in states to the north. The names used for stratigraphic units are all those agreed upon by the Nevada Conference[1]. The cyclical units termed "formations" by that conference are here referred to as "coal cycles".

1. Searight, W. V., et al, 1953. Amer. Assoc. Petroleum Geologists, Bull., vol. 37, pp. 2747-2749.

PENNSYLVANIAN SYSTEM

DES MOINES SERIES

Krebs group

The rocks of the Krebs group[2] have a total thickness of about 350 feet in northeastern Oklahoma. They rest with unconformity and overlap upon rocks of the Atoka formation, the Morrow formation, or upon different units of the Mississippian at various localities in the region.

Hartshorne formation—The Hartshorne formation has not been definitely identified in the shelf region.

McAlester formation—The mappable base of the McAlester formation in northeastern Oklahoma is the base of the Warner sandstone member, and the top is at the base of the Spaniard limestone member of the Savanna formation. The McAlester contains no limestones and no fusulinids were found.

Savanna formation—The base of the Savanna formation is at the base of the Spaniard limestone member, and the top is at the base of the Bluejacket sandstone member of the Boggy formation. The Spaniard limestone is, in Mayes and Craig Counties, a thin calcareous clay ironstone without fusulinids. In Wagoner and Muskogee Counties, it is two or more feet thick, contains many fossil corals, is an impure crystalline limestone, and yields a few fusulinids at many localities. These fusulinids are the oldest ones known from the shelf area.

The second limestone in the Savanna formation is the Sam Creek limestone member. Near Pryor, it is a compact clay ironstone overlain by about three feet of nodular, fossiliferous, gray shale. The Sam Creek contains poorly preserved, generalized fusulinellas at at least one locality, where they are rare in the clay ironstone and locally abundant in the shale above.

---

2. Oakes, M. C., 1953. Amer. Assoc. Petroleum Geologists, Bull., vol. 37, p. 1523.

The third and highest, persistent limestone of the Savanna is the Doneley limestone member, a bed of dirty limestone to dark clay ironstone 2 to 4 inches thick. No fusulinids were found in the member. The Savanna limestone members are the "Brown limes" of subsurface terminology.

Boggy formation—The base of the Boggy formation is at the base of the Bluejacket sandstone member and its top is above the Weir-Pittsburg coal and below the Tebo coal. Immediately above the Bluejacket sandstone is a sequence of four cyclical units, each containing a zone of marine fossils. The cap rock limestone of the lowest of these cycles contains abundant fusulinids. The name Inola limestone is here restricted to the lowest limestone, the only one that yields fusulinids. Fusulinids are reported from the Inola limestone at the type locality, Inola Mound.[3]

In the Boggy formation above the Inola is a shale sequence which contains the Weir-Pittsburg coal and the various tongues of the Taft sandstone, but there is no potential fusulinid zone.

Cabaniss group

Senora formation—The top of the Senora formation is at the base of the Blackjack Creek limestone member of the Fort Scott formation. The base has not been definitely determined. It lies above the Weir-Pittsburg coal and above all or most of the sandstone members of the Taft sandstone. The Senora definitely includes the Tiawah limestone and the Tebo coal. The base of the Senora marks an important event in Oklahoma stratigraphic history. The Thurman and Stuart formations of the Cabaniss group are overlapped south of the shelf region, the pre-Cabaniss units were faulted before Cabaniss time,[4] and the fauna of the Krebs is in contrast to that of the Cabaniss. The break may represent the Pottsville-Allegheny break of eastern United States.

The Tiawah limestone member is the lowest persistent limestone of the Senora, and it carries abundant fusulinids in its crops in northern Wagoner County and the adjacent part of Rogers

3. Ryniker, Charles, 1953. Personal communication.

4. Oakes, M. C., 1953. Amer. Assoc. Petroleum Geologists, Bull., vol. 37, p. 1525.

County. It is a whitish to light pink, dense limestone from 2 to 5 feet thick. The limestone is a good subsurface marker, where it is termed the "Pink lime".

The Chelsea sandstone member rests on the eroded surface of older members of the Senora and on members of the Boggy formation as low as the Bluejacket sandstone. It is the "Skinner sand" of the subsurface.

In northern Craig County, the Chelsea pinches out, and above the Tiawah limestone is a shale sequence which contains two persistent limestones. The lower of these is the Russell Creek limestone member[5], light gray, impure, carbonaceous and ferruginous limestone which makes the cap of the Mineral coal. This limestone contains abundant well-preserved fusulinids.

Above the Russell Creek is the clay-ironstone which is the cap rock of the Fleming coal. In southern Kansas, this bed is a dirty limestone and it carries fusulinids.

Throughout the region the Croweburg coal is a persistent bed in the middle of the Senora formation. The coal is generally called the Broken Arrow coal in Oklahoma. From 15 to 35 feet above the Croweburg is a widespread limestone member, the Verdigris limestone. It is a gray, siliceous and ferruginous, crystalline limestone which characteristically is brown on weathered surfaces. It is from 5 to 11 feet thick, and at nearly every crop it contains fusulinids.

Above the Verdigris, the Wheeler and Bevier coals are exposed at few places. The shale sequence above the Bevier horizon is the Lagonda member, which contains the erratic sandstone bodies called the "Prue sand" and "Squirrel sand" in subsurface. At the top of the Lagonda is the Iron Post coal, which is closely overlain by the Breezy Hill limestone member. The Breezy Hill grades from a light brown, dense, silty limestone in Craig County, to a gray crystalline limestone in northern Rogers County, and to a gray crystalline limestone overlain by dark gray argillaceous lime-

---

5. Branson, Carl C., 1954. Okla. Acad. Sci., Proc., vol. 33, p. 191.

stone in southwestern Rogers County. It contains fusulinids at every locality and they are especially abundant in the northern exposures.

Excello shale—The Excello consists of black, fissile shale with abundant subspherical phosphatic concretions.

MARMATON GROUP

The Marmaton group is the third and the highest group of the Des Moines series. It includes the rocks from the base of the Fort Scott limestone formation to the unconformity at the base of the Seminole formation.

Fort Scott limestone formation—The Fort Scott formation consists of two limestone members and intervening shale from the Kansas state line to northwestern Rogers County. The lower limestone is the Blackjack Creek limestone member, and it is traceable to south of the Arkansas River. It is a gray, impure, crystalline limestone which has a maximum thickness of 28 feet. Fusulinids are abundant in several beds at many localities. The upper limestone is the Higginsville limestone member, a gray, compact, crystalline limestone with numerous dark shale partings. It reaches a maximum thickness of 35 feet in Craig County and passes into shale in western Rogers County. Fusulinids are abundant in some of the layers.

The Fort Scott limestone and the Breezy Hill limestone are the "Oswego lime" of subsurface.

Labette shale formation—The Labette shale is a unit about 160 feet thick consisting predominantly of shale. Sandstone tongues within it are common and are the "Peru sand" of subsurface. In the upper half of the formation are two limestones, the upper one named the Wimer School limestone by Cade[6]. The Wimer School carries fusulinids at one locality. At the top of the Labette is a coal identified as the Lexington coal.

Oologah formation—The name Oologah is here used for the sequence of beds between the base of the cap rock of the Lexington coal and the top of the Altamont limestone in Nowata County;

6. Cade, C. M. III, 1953. Tulsa Geol. Soc., Digest, vol. 21, p. 138.

and for the equivalent sequence of limestones not yet subdivided in the vicinity of Tulsa. In Nowata County, the Oologah consists of the Pawnee limestone at the base, the Pawnee consisting in upward sequence of the cap rock of the Lexington coal, the Anna shale, the Myrick Station limestone, and the Coal City limestone. The middle part of the Oologah is the Bandera shale, which thins southward from more than 100 feet at the Kansas line to 2 feet near Tulsa. The upper member of the Oologah is the Altamont limestone member, which in turn has been subdivided into the Amoret limestone below and the Worland limestone above, with a shale interval between.

Fusulinids have been found in several of the units of the Oologah. The Myrick Station limestone bed of the Pawnee yields fusulinids in a zone 6 to 7 feet above the top of the Anna shale at one locality in Nowata County. This limestone is a massive, crystalline limestone. The Coal City limestone consists of compact, irregularly-bedded, light gray crystalline limestone, and it carries fusulinids in its upper part in Tulsa County. The Amoret yielded no fusulinids. The Worland limestone is gray, massive cherty limestone about thirty feet thick. Fusulinids occur in a sandy zone about a foot above the base at one locality in Nowata County. The Oologah is the "Big lime" of Oklahoma subsurface.

Nowata shale formation—The Nowata shale is a sequence of dark shales between the top of the Altamont limestone and the base of the Lenapah limestone.

Lenapah limestone formation—The Lenapah limestone consists of impure, compact, light gray limestone below, separated from dense, gray, algal limestone above by an irregular zone of greenish nodular fossiliferous shale. It is reported to carry a faunule of aberrant fusulinids at a locality near the type section, but these were not collected. The Upper Labette, Oologah, Nowata, and Lenapah are the age equivalent of the Wewoka formation of the McAlester Basin.

Holdenville shale formation—The Holdenville shale is the highest unit of the Des Moines series. It is missing over much of the area investigated by erosion at the beginning of Missourian time. No fusulinids have been found in the Holdenville.

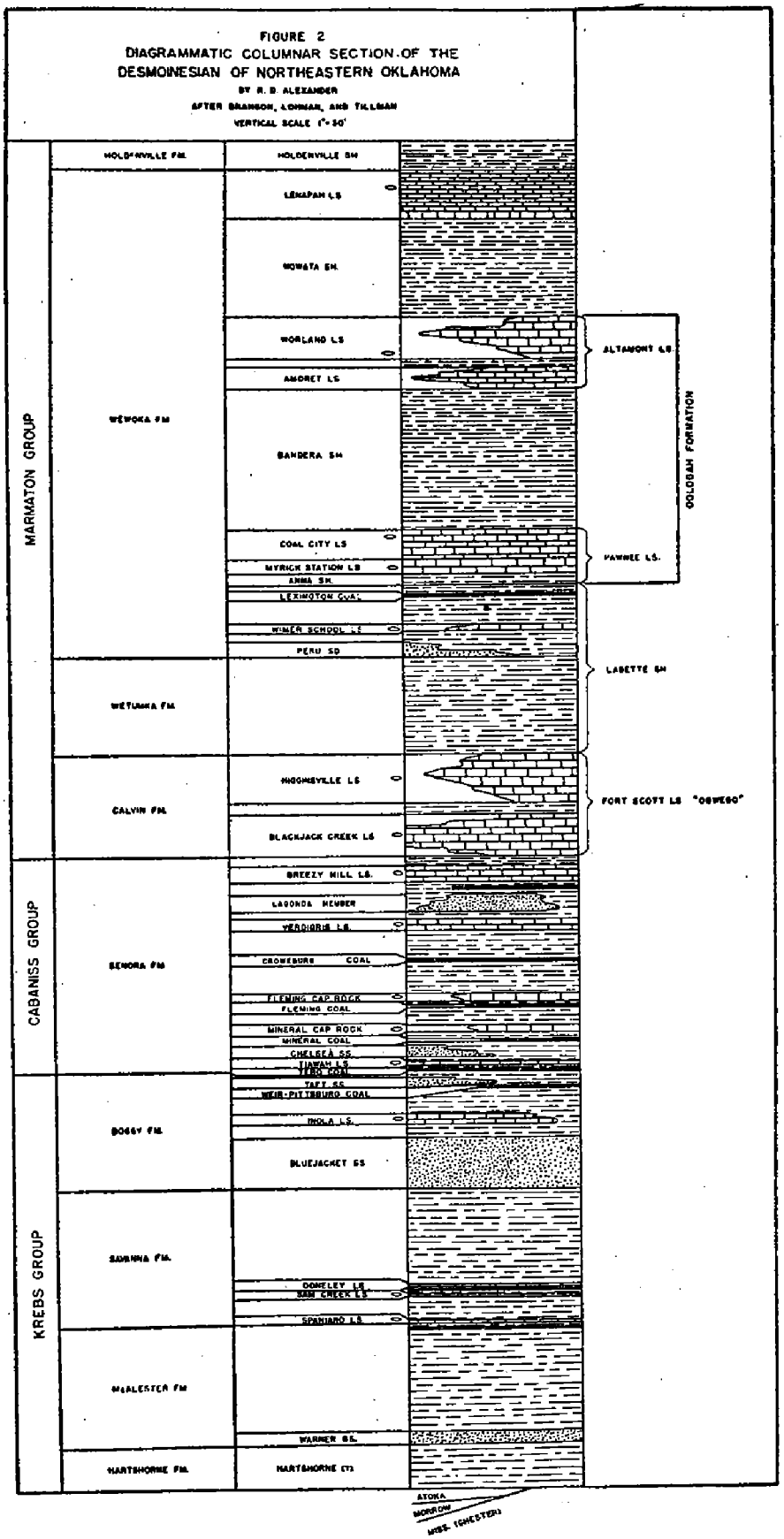


FIGURE 2
DIAGRAMMATIC COLUMNAR SECTION OF THE DESMOINESIAN OF NORTHEASTERN OKLAHOMA
BY R. D. ALEXANDER
AFTER BRANSON, LOWMAN, AND TILLMAN
VERTICAL SCALE 1"=50'

DESCRIPTION OF SPECIES

Genus PSEUDOSTAFFELLA Thompson, 1942

PSEUDOSTAFFELLA HOLLINGSWORTHI (Thompson), 1935

Plate 1, figs. 1, 2.

Staffella hollingsworthi Thompson, 1935. Jour. Paleontology, vol. 9, pp. 119-120, pd. 15, figs. 1-5. Upper Boggy formation, Pontotoc County, Oklahoma.

Pseudostaffella hollingsworthi (Thompson). Thompson, 1942. Amer. Jour. Sci., vol. 240, p. 410.

Discussion: This is a minute form which caught between the 40 and the 60 mesh screens. The specimens agree in all respects with the species described by Thompson. Associated with *P. hollingsworthi* (Thompson) in the "Upper Boggy" formation of Pontotoc County, Oklahoma, are *Wedekindellina euthusepta* (Henbest), *Fusulinella trisulcata* Thompson, *Eoschubertella gallowayi* (Skinner), and *Fusulina leei* Skinner. This zone is the time equivalent of the Lower Inola limestone of Mayes County, Oklahoma, where the only difference in the fusulinid fauna is that *Wedekindellina henbesti* (Skinner) is present instead of *W. euthusepta.*

Occurrence: Lower Inola limestone, SE ¼ of section 7, T. 21 N., R. 18 E., Mayes County, Oklahoma. The locality is on the north side of State Highway 20 at the top of the hill formed by the Bluejacket sandstone approximately five miles west of Pryor.

Genus EOSCHUBERTELLA Thompson, 1937

EOSCHUBERTELLA GALLOWAYI (Skinner), 1931

Plate 1, fig. 3

Schubertella gallowayi Skinner, 1931. Jour. Paleontology, vol. 5, pp. 256-257, pl. 30, figs. 1, 5, and 5a. Marl immediately overlying the Bluejacket sandstone, Mayes County, Okla. (Marl is the Lower Inola limestone in weathered condition.)

Fusulinella gallowayi (Skinner). Thompson, 1935. Jour. Paleontology, vol. 9, pp. 298-299, pl. 26, figs. 7-9. Immediately above the Bluejacket sandstone, Mayes County, Oklahoma.

Schubertella gallowayi (Skinner). Thompson, 1937. Jour. Paleontology, vol. 11, p. 124.

Discussion: The specimens studied came from the approximate type locality of Skinner. They agree in all respects with the types, but are not abundant. For a discussion of the associated fusulinids, see the discussion under *Pseudostaffella hollingsworthi* (Thompson).

Occurrence: Lower Inola limestone, SE ¼ of section 7, T. 21 N., R. 18 E., Mayes County, Oklahoma. The locality is on the north side of State Highway 20 at the top of the hill formed by the Bluejacket sandstone approximately five miles west of Pryor.

Genus FUSULINELLA Möller, 1877

FUSULINELLA, new species

Plate 1, figs. 4-7

?Fusulinella aff. *F. devexa* Thompson, 1948. Thompson, 1953. Jour. Paleontology, vol. 27, p. 322, pl. 41, fig. 21.

Description: Ellipsoidal to fusiform test of 4 volutions with a length up to 0.8 mm. and a width up to 0.36 mm., giving an adult form ratio of near 2.5 for a maximum, but most ratios are nearer to 2.0. Septa are fluted only near the poles, where there is some gentle fluting. Walls are moderately thick for such a small form, ranging up to 0.015 mm. Tunnel angle normally about 20°, with the tunnel appearing as a low hollowed out area in the thick wall. Chomata are normally indistinct as such, but in most specimens appear as small acute points alongside the tunnel. The proloculus is large compared to the size of the test and is irregularly shaped. Range of proloculus size is from 0.055 mm. to 0.070 mm.

Discussion: This species in general resembles *Profusulinella fittsi* (Thompson), 1935, and *Fusulinella oliviformis* Thompson, 1935, which are of Atokan age. *Fusulinella,* new species, more

closely resembles *Profusulinella fittsi* in its general appearance in that the test shape and size of the proloculus is similar. Their differences are distinct, however, in that the wall of our species is thinner, the proloculus is irregularly shaped, and the form ratio is larger. The number of septa was not determinable due to the poor preservation of individuals. Sagittal sections tend to break up before they are thin enough for study, and many attempts to get sagittal sections proved fruitless.

Table 1. *Fusulinella* new species. Sam Creek limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
122	.780	.357	2.08	.065	.095	.140	.245	.375			1.3	1.9	2.0	2.1		
123	.585	.350	1.67	.070	.120	.200	.270				0.8	1.0	1.7			
124	.705	.285	2.47	.055	105	.178	.190				1.1	1.2	2.1			
125	.575	.315	1.83	.065	.120	.210	.285				1.2	1.6	2.0			
126	.520	.290	1.79	.055	.094	.170	.290				1.3	1.2	1.4			
127		.335														

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
122	.006	.010	.012	.012									18	11		
123	.006	.010	.012													
124	.005	.010	.012	.012									20			
125	.007	.012	.012													
126	.006	.012	.015	.012												

The specimen illustrated by Thompson appears to belong to this species and it was collected at the same locality.

Occurrence: Sam Creek limestone, SW ¼ of section 4, T. 21 N., R. 18 E., Mayes County, Oklahoma. This locality is across the road to the east from the Osage Free Will Baptist Church on Seminole Creek. The forms are in the limestone, but are much more abundant in the overlying shale. They occur in small pockets in the shale as far as four feet above the limestone. Collecting must consist of taking several shale samples at various horizons and at different places on the same horizon. As an example, the author took two samples on one horizon within one foot of each other and one had abundant *Fusulinella* new species while the other was barren.

My thanks to Mr. L. E. Fitts, Jr., geologist with the Union Oil Company of California in Tulsa, Oklahoma, who first found this form and who gave the writer detailed instructions on how to collect them.

FUSULINELLA TRISULCATA Thompson, 1935

Plate 1, fig. 8

Fusulinella trisulcata Thompson, 1935. Jour. Paleontology, vol. 9, pp. 303-304, pl. 26, figs. 20-22. Upper Boggy formation, Pontotoc County, Oklahoma.

Discussion: Our Northeast Oklahoma specimens agree with Thompson's types from the "Upper Boggy" formation of Pontotoc County, Oklahoma. They occur abundantly with the fusulinid fauna discussed under *Pseudostaffella hollingsworthi* (Thompson). One should have no trouble distinguishing *Fusulinella trisulcata* Thompson from the juvenarium of *Fusulina leei* Skinner, because of its smaller form ratio and smaller proloculus.

Occurrence: Lower Inola limestone, SE ¼ of section 7, T. 21 N., R. 18 E., Mayes County, Oklahoma. Locality is on the north side of State Highway 20 at the top of the Bluejacket sandstone escarpment approximately five miles west of Pryor.

Genus WEDEKINDELLINA Dunbar and Henbest, 1933

WEDEKINDELLINA EUTHUSEPTA (Henbest), 1928

Plate 1, fig. 9

Fusulinella euthusepta Henbest, 1928. Jour. Paleontology, vol. 2, pp. 80-81, pl. 8, figs. 6-8; pl. 9, figs. 1 and 2. Stonefort limestone, Williamson County, Illinois.

Wedekindella euthysepta (Henbest, 1928). Dunbar and Henbest, 1930. Amer. Jour. Sci., vol. 220, pp. 357-364. (*F. euthysepta* Henbest designated as type species of new genus.)

Wedekindia euthysepta Dunbar and Henbest, 1931. Amer. Jour. Sci., vol. 221, p. 458. (The name *Wedekindella* pre-occupied in obscure footnote by Schindewolf for cephalopod. New name *Wedekindia* proposed.)

Wedekindellina euthysepta Dunbar and Henbest, 1933, in Cushman, Foraminifera, etc., Cushman Lab. Foram. Research, Spec. Pub. 4, p. 134, key plate 10, figs. 13-15. (Second name also preoccupied by generic name proposed in obscure footnote. Third new name proposed.)

Wedekindellina euthysepta (Henbest), 1928. Thompson, 1934. Univ. of Iowa Studies in Natural History, vol. 16, no. 4 (new series, no. 284), pp. 282-285, pl. 20, figs. 1, 2, 7, 9, 12, 13, 17, 22, 24-27. Cherokee shale, 35 feet below Whitebreast coal, Lucas and Monroe Counties, Iowa.

Wedekindellina dunbari Thompson, 1934. Univ. of Iowa Studies in Natural History, vol. 16, no. 4 (new series, no. 284), pp. 285-287, pl. 20, figs. 3, 6, 15, 16, 20, and 21. Cherokee shale, 35 feet below Whitebreast coal, Lucas and Monroe Counties, Iowa.

Wedekindellina euthysepta (Henbest), 1928. Dunbar and Henbest, 1942 Ill. Geol. Surv. Bull. 67, pp. 98-100, pl. 8, figs. 1-23; pl. 9, figs. 1-4.

Wedekindellina euthysepta (Henbest), 1928. Henbest, 1953. U. S. Geol. Survey, Oil and Gas Invest., Chart OC 44, Lower part of Division III, Hartville fm., Hartville uplift, Wyoming.

Discussion: The forms are clearly conspecific with *W. euthusepta* (Henbest). Specimens are abundant and are associated with *Fusulina kayi* Thompson, 1934. These two forms are also associated 35 feet below the Whitebreast coal in Lucas and Monroe Counties, Iowa.

Occurrence: Fleming Cap Rock, coal strip pit, 2½ miles north of Fleming, Kansas.

WEDEKINDELLINA HENBESTI (Skinner), 1931

Plate 1. figs. 10, 11

Wedekindia henbesti Skinner, 1931. Jour. Paleontology, vol. 5, p. 259, pl. 30, figs. 2 and 3. Marl immediately overlying the Bluejacket sandstone, Mayes County, Oklahoma. (Marl is the Lower Inola limestone).

Wedekindellina henbesti (Skinner), 1931. Thompson, 1934. Iowa State Univ., Studies in Natural History, vol. 16, p. 279.

Wedekindellina henbesti (Skinner), 1931. Dunbar and Henbest, 1942. Illinois Geol. Survey, Bull. 67, p. 99. pl. 9, figs. 5-8. Marly zone overlying Bluejacket sandstone, sec. 7, T. 21 N., R. 18 E., near Pryor, Oklahoma.

Wedekindellina henbesti (Skinner), 1931. Thompson, 1945. Kansas Geol. Survey, Bull. 60, pp. 58-59, pl. 4, figs. 13-17. Lower Youghall fm., Sheep Mountain Canyon, northeastern Utah.

Description: Test small, slender, elongate, with acutely pointed poles. Mature forms have 10 to 10½ volutions with length of test up to 5.54 mm. and a width up to 1.33 mm., giving a form ratio of from 3.46 to 4.62. Septa are plane except for some small folding near the poles. Proloculus varies from 0.060 mm. to 0.083 mm. Walls are thin, varying from an initial thickness of 0.007 mm. to 0.030 mm. in mature volutions. The tunnel angle varies from 12° to 30° from the third volution to the sixth volution. Chomata form small but well defined symmetrical ridges.

Table 2. *Wedekindellina henbesti* (Skinner). Lower Inola limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
9	3.46	1.0	3.46	.060	.125	.178	.232	.320	.409	.552	2.1	2.9	3.8	3.6	3.8	3.9
10	5.54	1.2	4.62	.084	.198	.232	.303	.392	.516	.677	1.4	3.1	3.8	4.3	3.9	4.2
11	2.80	0.8	3.50	.071	.107	.178	.232	.303	.392	.535	2.3	3.0	4.0	4.7	4.7	4.2
12	3.86	0.93	4.15	.060	.124	.178	.267	.338	.463	.623	1.7	3.0	2.7	3.5	4.0	4.0
13	3.53	0.98	3.69	.060	.107	.144	.214	.303	.374	.481	1.7	2.5	2.5	2.5	3.5	3.6
14		1.13			.089	.125	.214	.338	.445	.569						
15		1.33			.107	.161	.231	.356	.480	.677						
16		1.07			.124	.178	.249	.338	.445	.569						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
9	.012	.018	.018	.020	.025	.025							12	17	17	17
10	.012	.014	.024	.020	.030	.025							19	21	24	30
11	.012	.014	.020	.022	.022	.022							20	20	24	22
12	.011	.014	.018	.018	.022	.022							12	22	22	25
13	.010	.012	.018	.022	.023	.024							13	15	19	26
14	.009	.012	.018	.022	.018	.025	10	12	14	17	20	21				
15	.005	.009	.014	.024	.020	.025	10	12	14	16	20	20				
16	.007	.012	.018	.020	.025	.025	10	14	15	18	21	23				

Discussion: The specimens studied came approximately from the type locality of *Wedekindellina henbesti* (Skinner). This species occurs abundantly associated with *Fusulina leei* Skinner, *Fusulinella trisulcata* Thompson, *Eoschubertella gallowayi* (Skinner), and *Pseudostaffella hollingsworthi* (Thompson). The latter four species are associated with *Wedekindellina euthusepta* (Henbest) in the "Upper Boggy" in Pontotoc County, Oklahoma, thus giving an excellent time zone from the shelf area to the McAlester Basin.

Occurrence: The material studied came from the Lower Inola limestone in the SE ¼ of section 7, T. 21 N., R. 18 E., Mayes County, Oklahoma. Locality is on the north side of State Highway 20 at the top of the hill formed by the Bluejacket sandstone approximately five miles west of Pryor. *Wedekindellina henbesti* (Skinner) is also present in the Lower Inola limestone in the NW ¼ of section 32, T. 23 N., R. 18 E., Mayes County, Oklahoma.

Genus FUSULINA Fischer de Waldheim, 1829

FUSULINA ATTENUATA, new species

Plate 1, figs. 12-15

Description: Elongate fusiform test having 9 volutions and a curving axis of coiling. Adults have a length of 7 or 8 mm. and a width of up to 2.6 mm., giving an adult form ratio of nearly 3. Lateral slopes of walls straight to gently concave. Septa are highly fluted. giving rise to many chamberlets in the axial region. Septal count ranges from near 12 in the first volution to near 33 in the sixth volution. Proloculus varies from 0.100 mm. to 0.130 mm. Wall is of medium thickness for the genus, ranging from near 0.018 mm. in the first volution to near 0.045 mm. in the sixth volution. Tunnel angle rather wide, from 15° in the third volution, to near 35° in the sixth volution. Chomata are ridge-like in the first few volutions, and slightly irregular but mainly ridge-like in the later volutions.

Discussion: The distinguishing features of this form are the manner of septal fluting, the appearance of the wall, and the nature of the chomata.

The species is named from Latin attenuatus, -a, -um, meaning attenuated, made thin. This refers to the shape of the adult test.

Table 3. *Fusulina attenuata,* new species. Tiawah limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
25	7.26	2.53	2.87	.130	.249	.374	.569	.855	1.25	1.73	1.6	2.3	2.2	2.9	2.9	3.0
26	6.60	2.40	2.75	.115	.249	.374	.534	.802	1.12	1.50	1.5	2.0	2.0	2.1	2.2	2.4
27	3.80	1.73	2.19	.100	.178	.285	.409	.587	.776	1.14	1.2	1.3	2.0	2.0	1.8	1.9
28	4.26	1.47	2.90	.115	.214	.303	.445	.677	.944	1.28	1.5	1.9	2.6	2.7	2.8	3.2
29	5.33	1.80	2.96	.120	.232	.338	.517	.548	.997	1.39	2.0	2.2	2.3	2.4	2.6	2.8
30		2.20			.196	.463	.623	.873	1.21	1.60						
31		2.60			.214	.356	.534	.802	.926	1.48						
32		2.20			.248	.392	.552	.802	.908	1.46						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
25	.020	.036	.036	.045	.045	.045							19	22	21	31
26	.035	.025	.036	.045	.045	.045							20	15	23	25
27	.018	.020	.025	.045	.040	.042							15	11	18	22
28	.025	.030	.036	.036	.040	.054							23	25	35	34
29	.018	.036	.036	.036	.027	.036							19	21	26	28
30	.025	.027	.040	.040	.054	.036	11	24	25	24	28	30				
31	.009	.025	.040	.036	.036	.036	12	20	23	26	28	35				
32	.027	.030	.045	.042	.036	.050	13	17	23	26	31	33				

Occurrence: Tiawah limestone, SE ¼ of section 26, T. 19 N., R. 15 E., Wagoner County, Oklahoma. Outcrop is located in ditches on either side of the road. Forms are abundant and excellent specimens weather out of the limestone.

FUSULINA EQUABILIS, new species

Plate 2, figs. 1-4

Description: Test fusiform with lateral slopes flat, poles subacute. Mature specimens have 9 volutions, a length near 5.2 mm. and a width of up to 2.9 mm., with an average nearer 2.4 mm. Form ratio of adults from 1.67 to 2.12. Shape is uniform throughout growth, giving a form ratio of near 1.4 in the first volution, to near 1.9 in the sixth volution. The septa are strongly folded throughout the length of the test, numbering from 10 in the first volution, to 34 in the sixth volution. Proloculus varies from 0.075

mm. to 0.105., average near 0.095 mm. Wall thickness is moderate, varying from 0.012 mm. in the first volution, to near 0.045 mm. in the sixth volution. The tunnel angle is uniform and rather narrow, varying from 14° in the first volution, to 21° in the sixth volution. Chomata are high symmetrical ridges in the early volutions, and later tend to be deposited upon the septa, giving a rather irregular appearance.

Discussion: This species roughly resembles *Fusulina haworthi* (Beede), 1916, emend. Dunbar and Henbest, 1942, in its general shape. The outstanding differences are the much smaller proloculus of *Fusulina equabilis,* new species, and its smaller tunnel angle.

The species is named from Latin aequabilis, -e, meaning equal. This refers to the regularity of the tunnel angle.

Table 4. *Fusulina equabilis,* new species. Russell Creek limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
33	5.20	2.87	1.82	.075	.160	.249	.374	.569	.818	1.17	1.5	1.4	1.7	1.8	1.8	1.7
34	4.87	2.46	1.98	.095	.160	.285	.427	.658	.908	1.23	1.5	1.1	1.4	1.6	1.5	1.8
35	4.66	2.20	2.12	.095	.178	.286	.427	.623	.873	1.19	1.3	1.4	1.2	1.8	1.9	2.0
36	4.60	2.20	2.09	.100	.160	.267	.392	.588	.854	1.18	1.5	1.8	1.9	1.9	1.9	2.0
37	4.00	2.40	1.67	.105	.214	.320	.392	.748	.944	1.50	1.3	1.4	1.9	1.5	1.8	1.7
38		2.26			.178	.338	.516	.712	.961	1.30						
39		2.33			.196	.338	.559	.854	1.12	1.60						
40		2.26			.232	.356	.570	.802	1.28	1.65						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
33	.012	.027	.025	.025	.027	.040							17	21	15	16
34	.012	.036	.027	.042	.045	.045							16	17	14	16
35	.025	.027	.027	.030	.027	.040							14	15	18	17
36	.025	.027	.027	.045	.036	.036							18	16	18	21
37	.025	.036	.040	.045	.050	.045							14	14	12	15
38	.025	.027	.027	.027	.040	.027	10	18	22	26	31	34				
39	.018	.027	.030	.040	.040	.045	13	17	23	28	32	32				
40	.022	.027	.036	.036	.030	.027	12	22	26	29	31	33				

Occurrence: Russell Creek limestone. SW ¼ of section 11, T. 28 N., R. 20 E., Craig County, Oklahoma. The specimens are found abundantly on blocks of limestone and weathered ferru-

ginous shale which have been thrown out at the side of old coal strip pits. They occur with a molluscan faunule comprised mainly of gastropods.

FUSULINA EQUILAQUEATA, new species

Plate 1, figs. 16-19

Description: Test fusiform to elongate fusiform. Length of mature forms is from 6 mm. to 8 mm. with a width of up to 3 mm., giving a mature form ratio of between 2 and 3. Mature forms have 8 volutions in which the septa are uniformly and highly fluted throughout the length of the test. Septa are uniform in height, all nearly four-fifths the height of the chamber, with few or none in contact with the adjacent wall. The septal count varies from near 12 in the first volution, to near 36 in the sixth volution. The diameter of the proloculus varies from 0.145 mm. to 0.185 mm., with an average of 0.160 mm. The wall is of average thickness for the genus, from 0.018 mm. in the first volution, to about 0.045 mm. in the sixth volution. The tunnel angle is irregular and varies consider-

Table 5. *Fusulina equilaqueata,* new species. Verdigris limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
41	7.54	2.70	2.79	.160	.302	.374	.623	.872	1.16	1.58	2.1	2.3	2.0	2.4	2.5	2.2
42	7.80	2.46	3.17	.160	.285	.445	.658	.912	1.19	1.87	2.0	1.7	1.8	2.2	3.0	2.9
43	6.53	2.13	3.06	.145	.320	.516	.765	1.10	1.48	1.96	1.9	2.1	2.2	2.6	3.6	2.9
44	6.33	2.40	2.64	.160	.320	.516	.765	1.05	1.46	1.96	1.6	1.6	1.8	1.9	2.0	1.9
45	5.73	3.00	1.91	.185	.356	.552	.802	1.14	1.58	2.10	2.4	2.6	2.6	2.3	2.2	2.4
46		2.40			.374	.516	.819	1.10	1.46	1.81						
47		2.80			.285	.463	.659	.890	1.25	1.69						
48		2.80			.356	.498	.747	1.05	1.46	2.01						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
41	.018	.018	.025	.036	.040	.043							22	18	26	23
42	.018	.022	.036	.036	.040	.045							22	17	27	34
43	.018	.020	.036	.036	.045	.030							22	25	38	33
44	.018	.020	.027	.036	.036	.045							19	19	26	25
45	.024	.036	.036	.036	.040	.045							16	24	19	20
46	.018	.036	.036	.040	.047	.047	13	26	26	29	30	30				
47	.018	.022	.045	.050	.045	.032	12	18	21	28	35	38				
48	.027	.027	.030	.030	.045	.045	12	22	27	31	37	38				

ably. Average tunnel angles are from about 20° in the third volution, to about 25° in the sixth volution, with tunnel angles ranging from extremes of 16° to 38°. Chomata show considerable variation in individual specimens, ranging from well defined ridges to irregular deposits upon the septa.

Discussion: The specimens show wide variation in mature form ratio, but other factors indicate that only one species is represented. They are silicified, but details show well when studied under a microscope, and a proper identification is possible.

The species is named from Latin aequus, -a, -um, meaning equal, plus Latin laqueatus, -a, -um, meaning paneled, fretted, looped. The name refers to the equal height of the septal fluting.

Occurrence: Verdigris limestone, SE ¼ of section 3, T. 23 N., R. 17 E., Rogers County, Oklahoma. The Verdigris limestone throughout most of the northeastern part of Oklahoma has abundant to common fusulinids. They are silicified at all localities checked, or are not well preserved and are unfit for study at the few localities where they are not silicified.

FUSULINA EXPEDITA, new species

Plate 2, figs. 5-8

Description: Test elongate fusiform with 8 or 9 volutions in adult specimens. Length up to about 5 mm. and width averaging near 2.5 mm., giving a mature form ratio of between 2 and 2.3. Lateral slope of walls essentially flat. Septa are strongly fluted across the length of the volutions, and number from near 10 in the first volution, to near 35 in the sixth volution. The proloculus is spherical and ranges in diameter from 0.060 mm. to 0.105 mm., with an average near 0.100 mm. The wall is slightly thinner than average for the genus, ranging from near 0.018 mm. in the first volutions, to near 0.038 mm. in the sixth volution. The tunnel angle ranges from 14° in the third volution, to 30° in the sixth volution, with some individuals having a uniform tunnel angle of near 17°. Chomata are deposited as ridges in the first three volutions, and tend to become irregular in the later volutions.

Table 6. *Fusulina expedita,* new species. Breezy Hill limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
49	4.10	1.67	2.46	.060	.125	.214	.338	.516	.747	1.07	1.3	1.5	2.3	2.4	2.7	2.7
50	3.80	1.67	2.28	.095	.196	.267	.410	.605	.819	1.12	1.5	2.2	2.4	2.3	2.5	2.5
51	2.94	1.53	1.92	.105	.214	.321	.481	.677	.908	1.23	1.9	2.1	2.2	2.1	2.0	2.0
52	3.13	1.40	2.24	.093	.160	.232	.409	.588	.855	1.25	1.9	2.1	2.0	2.1	2.6	2.5
53	3.73	1.60	2.33	.105	.178	.302	.409	.605	.802	1.16	1.4	1.8	2.7	2.7	2.7	2.7
54		2.53			.196	.284	.427	623	.873	1.19						
55		2.64			.196	.302	.445	.677	.979	1.17						
56		2.13			.178	.284	.409	.605	.838	1.16						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
49	.012	.015	.036	.036	.036	.036							17	24	24	30
50	.020	.018	.027	.040	.036	.040							15	19	21	19
51	.025	.027	.027	.034	.036	.040							17	21	17	17
52	.022	.032	.036	.040	.040	.030							14	19	16	17
53	.012	.018	.025	.036	.036	.032							16	18	20	27
54	.018	.024	.027	.030	.045	.045	11	18	22	28	33	39				
55	.018	.027	.040	.030	.045	.045	12	17	18	24	29	30				
56	.018	.022	.036	.045	.045	.036	9	15	21	27	28	36				

Discussion: All specimens are weathered and there is some question as to the exact length of adult forms. They are most abundant in the top bed of the Breezy Hill limestone, but good specimens are difficult to find. This species resembles elongate variations of *Fusulina haworthi* (Beede), 1916, emend. Dunbar and Henbest, 1942. The outstanding difference is the fact that the proloculus of *Fusulina expedita* is much smaller. *Fusulina retusa* Thompson and Thomas, 1953, from 340 feet above the base of the Casper formation of Wyoming is similar, but is more inflated and has a larger tunnel angle.

The name of this species comes from Latin expeditus, -a, -um, meaning unimpeded, lightly clad. This refers to the thinness of the wall.

Occurrence: Breezy Hill limestone, SW ¼ of section 24, T. 28 N., R. 19 E., Craig County, Oklahoma. The species occurs throughout the Breezy Hill limestone, but specimens are concentrated near the top. It is associated with *Fusulina plena,* new species.

FUSULINA GIRTYI (Dunbar and Condra), 1927

Plate 2, fig. 9

Fusulina ventricosa Meek and Worthen, 1874 (not *Fusulina cylindrica* var. *ventricosa* Meek and Hayden, 1854), Geol. Surv. of Ill., vol. 5, p. 560, pl. 24, figs. 8a, 8b.—Meek, Amer. Jour. Sci., 3rd ser., vol. 7, p. 484, 1874. Herrin limestone, Fulton and Peoria Counties, Illinois.

Girtyina ventricosa (Meek and Worthen), 1874. Staff, 1912. Palaeontographica, vol. 59, pt. 3, pp. 164-165, pl. 18, figs. 2, 5, and 7.—Cady, Ill. Geol. Surv., Rept. of investigations, no. 2, pp. 8-9, text fig. 2, 1925. Herrin limestone, Saline and Williamson Counties, Ill.

Fusulinella girtyi Dunbar and Condra, 1927. Nebr. Geol. Surv., 2nd ser., Bull. 2, pp. 76-78, pl. 2, figs. 1-4 (not fig. 5), Herrin limestone, Fulton and Peoria Counties, Ill.; Fort Scott limestone, Mystic, Iowa, and Oswego, Kansas.

Fusulinella (*Girtyina*) aff. *ventricosa* (Meek and Worthen), 1873. Henbest, 1928. Jour. Paleontology, vol. 2, p. 83, pl. 9, figs. 3, 4, and 6 (not pl. 10, figs. 1-7). Herrin limestone, Saline County, Illinois.

Beedeina girtyi (Dunbar and Condra), 1927. Galloway, 1933. Manual of Foraminifera, pp. 401-402, pl. 36, figs. 1-7.

Fusulina girtyi (Dunbar and Condra), 1927. Thompson, 1934. Iowa Univ. Studies in Natural History, vol. 16, no. 4 (new series no. 284), pp. 314-316, pl. 22, figs. 1, 5, 7, 20. Limestone 18 feet above the Mystic coal, Appanoose and Monroe Counties, Iowa.

Fusulina girtyi (Dunbar and Condra), 1927. Dunbar and Henbest, 1942. Ill. Geol. Surv., Bull. 67, pp. 115-117, pl. 11, figs. 1-17; pl. 12, figs. 2-8, 10-11. Brereton (Herrin), Bankston Fork, and St. David limestones, Ill.

Fusulina girtyi (Dunbar and Condra), 1927, Henbest, 1953. U. S. Geol. Survey, Oil and Gas Invest., Chart OC 44. Middle part of Division III, Hartville fm., Hartville uplift, eastern Wyoming.

Description: Test is a ventricose form of medium size with a mature form ratio near 1.70. The striking features of the internal structures are the narrow tunnel, the angle of which varies from 12° to 16°, and the uniform height between successive volutions. Measurements agree in all respects with those of the types.

Discussion: *Fusulina girtyi* (Dunbar and Condra) was collected at two horizons in this area, in the Lower, and in the Upper Fort Scott limestones. The specimens in the Upper Fort Scott limestone are weathered, but are certainly conspecific with the ones in the Lower Fort Scott limestone, where they are common but are greatly outnumbered by specimens of *Fusulina haworthi* (Beede) emend. Dunbar and Henbest.

Occurrence: Lower Fort Scott limestone (Blackjack Creek), NW ¼ of section 13, T. 28 N., R. 19 E., Craig County, Oklahoma, and in the Upper Fort Scott limestone (Higginsville), SE ¼ of section 28, T. 26 N., R. 17 E., Nowata County, Oklahoma.

FUSULINA HAWORTHI (Beede), 1916, emend. Dunbar and Henbest, 1942

Plate 2, figs. 11-12

Girtyina haworthi Beede, 1916. Indiana Univ. Studies, vol. 3, no. 29, p. 14. (Not *Fusulinella haworthi* of Dunbar and Condra, Nebr. Geol. Surv., 2nd ser., Bull. 2, p. 62, pl. 2, figs. 6-11.) Lower Fort Scott limestone, Fort Scott, Kansas.

Fusulina haworthi (Beede), 1916. White, 1932. Univ. of Texas, Bull. 3211, pp. 26-27, pl. 1, figs. 4-6. Gordon limestone, Upper Millsap Lake formation, Palo Pinto County, Texas.

Fusulina stookeyi Thompson, 193. Iowa Univ. Studies in Natural History, vol. 16, no. 4 (new series no. 284), pp. 316-318, pl. 22, figs. 3, 15, 16, and 21. Shale 18 feet above the Mystic coal, Appanoose and Monroe Counties, Iowa.

Fusulina haworthi (Beede), 1916. Dunbar and Henbest 1942. Ill. Geol. Surv., Bull. 67, pp. 119-121, pl. 12, fig. 1; pl. 14, figs. 1-18. Brereton and St. David limestones, Ill.

Description: Fusiform test of medium size; about 8 volutions in mature individuals. Length near 5 mm., with a width up to 2.8 mm., mature form ratio of little more than 2.0. Volutions uniformly fusiform and septa are uniformly and strongly fluted throughout the volutions. Septa vary from near 11 in the first volution, to near 42 in the sixth volution. The tunnel angle is irregular, but tends generally to increase from near 17° in the third volution, to near 20° in the sixth volution. Chomata form by thickening of septa, with the result that they are highly irregular and do not form ridges on the wall.

Discussion: This species is the most abundant of the three present in the Lower Fort Scott limestone. These specimens show a little variation from the types in that the average proloculus is a little larger, and the septal count tends to be a little greater. However, these variations fall within the limits of the types.

Occurrence: Lower Fort Scott limestone (Blackjack Creek) NW ¼ of section 13, T. 28 N., R. 19 E., Craig County, Oklahoma.

Table 7. *Fusulina haworthi* (Beede), 1916, emend. Dunbar and Henbest, 1942. Lower Fort Scott limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
65	4.40	2.10	2.10	2.10	.320	.410	.765	1.10	1.60	2.14	1.3	1.7	1.6	1.6	1.7	1.6
66	4.52	2.53	1.79	.170	.356	.605	908	1.37	1.87	2.52	1.5	1.6	1.6	1.5	1.6	1.8
67	4.30	2.26	1.90	.170	.320	.534	.890	1.23	1.66	2.07	1.7	2.2	2.1	1.9	1.8	1.9
70		2.80			.256	.498	.747	1.03	1.41	1.76						
71		2.53			.339	.552	.855	1.23	1.62	2.16						
72		2.80			.320	.498	.730	1.03	1.41	1.78						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
65	.027	.027	.027	.036	.040	.045										
66	.036	.036	.027	.045	.040	.040							17	19	22	20
67	.027	.032	.036	.036	.045	.045							16	18	23	22
70	.025	.036	.045	.045	.045	.036	14	24	29	35	40	42	17	18	16	20
71	.027	.040	.045	.040	.045	.040	11	17	25	32	38	42				
72	.027	.036	.040	.045	.045	.048	14	24	28	33	35	41				

Specimens were collected in shallow ditches along either side of the road. Specimens are extremely abundant and are easily collected. The species occurs with *F. girtyi* (Dunbar and Condra), and *F.*, new species.

FUSULINA KAYI Thompson, 1934

Plate 2, figs. 13-16

Fusulina kayi Thompson, 1934. Iowa Univ. Studies in Natural History, vol. 16, no. 4 (new series no. 284), pp. 303-305, pl. 21, figs. 1, 2, 4, 5, 8, 12-15, 19, and 20.

Description: Test fusiform, with 7 volutions in mature individuals. Length near 3 mm. and a width up to 1.87 mm., with an average width nearer to 1.3 mm. Form ratio of adults varies from near 2.2 to near 2.7. Septa are strongly fluted throughout the length of the test, varying from near 10 in the first volution, to near 30 in the sixth volution. Proloculus essentially spherical, varying from 0.060 mm. to 0.105 mm. Wall thin, diameter from 0.008 mm. in the first volution to 0.022 mm. in the fifth volution. Wall is markedly

Table 8. *Fusulina kayi* Thompson, 1934. Fleming cap rock.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
113	2.33	1.07	2.18	.090	.196	.249	.356	.463	642	.873	1.2	1.9	1.9	2.2	2.4	2.4
114	2.00	.733	2.73	.060	.143	.214	.338	.498	.712		1.5	1.8	2.1	2.6		
115	3.00	1.27	2.36	.060	.143	.231	.356	.516	.780	1.03	1.3	1.6	1.5	2.0	2.4	2.4
116	2.00	.733	2.73	.090	.178	.267	.374	.535	.748		1.1	1.5	1.9	2.3	2.7	
117	2.67	1.07	2.50	.105	.231	.338	.516	.765	1.07		1.5	1.6	2.2	2.4	2.4	
118		1.87			.125	.214	.312	.413	.623	.943						
119		1.40			.178	.214	.481	.713								

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
113	.010	.012	.012	.012	.018	.012							15	19	28	
114	.008	.012	.015	.018	.012								20	22	22	
115	.010	.012	012	.012	.012	.012							16	18	22	
116	.008	.010	.015	.018	.018								23	27		
117	.010	.012	.018	.018	.018	.018							22	21	27	30
118	.008	.012	.012	.018	.022	.018	11	15	18	20	22	29				
119	.008	.012	.020	.018	.022		10	17	19	23	25					

reduced in thickness after the fifth volution; lateral slope of wall essentially flat. Tunnel angle increases from near 19° in the third volution, to near 30° in the sixth volution. Chomata form well developed ridges which are regular except in the last two or three volutions, where they become slightly irregular due to deposition upon septa, as well as upon the wall.

Discussion: This is the smallest species of *Fusulina* collected for this paper. The specimens agree exceptionally well with Thompson's description of the types from Iowa. The species closely resembles *Fusulina lucasensis* Thompson, 1934, in many respects, but *Fusulina kayi* Thompson differs in having a larger proloculus, and in having a thinner wall.

Occurrence: Fleming cap rock. Coal strip pit 2½ miles north of Fleming, Kansas. Collected by Dr. C. C. Branson at locality of Wallace B. Howe.

FUSULINA LEEI Skinner, 1931

Plate 2, figs. 19-20

Fusulina leei Skinner, 1931. Jour. Paleontology, vol. 5, pp. 257-258, pl. 30, figs. 4 and 6. Marl immediately overlying the Bluejacket sandstone, Mayes County, Oklahoma.

Fusulina leei Skinner. Thompson, 1934. Iowa Univ. Studies in Natural History, vol. 16, no. 4 (new series no. 284), pp. 301-303, pl. 21, figs. 3, 7, 10, and 18. Cherokee shale, 35 feet below the Whitebreast coal, Lucas and Monroe Counties, Iowa.

Fusulina leei Skinner. Thompson, 1934. Jour. Paleontology, vol. 9, p. 305, pl. 26, figs. 17-19. Upper Boggy formation, Pontotoc County. Oklahoma.

Fusulina leei Skinner. Dunbar and Henbest, 1942. Ill. State Geol. Surv., Bull. 67, pp. 109-111, pl. 5, figs. 1-8; pl. 6, figs. 1-10. Curlew limestone, Saline and Gallatin Counties, Illinois.

Description: Test small, elongate fusiform, with rather acute poles. Mature specimens have 7½ volutions with a length of around 5 mm., and a width up to 1.88 mm., giving a form ratio of from 2.55 to 5.03, with the greatest frequency near 3.0. Septa are

greatly to moderately folded with many showing irregular spacing. Proloculus varies from 0.80 mm. to 0.106 mm. Walls moderately thin, varying from 0.010 mm. in the first volution to as much as 0.045 mm. in mature volutions. The tunnel angle varies from 13° to 30° from the third to the sixth volution. Chomata are prominent and rather narrow.

Table 9. *Fusulina leei* Skinner, 1931. Lower Inola limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
17	3.93	1.47	2.68	.080	.160	.250	.374	.570	.820	1.28	1.2	1.8	2.2	2.4	2.6	2.4
18	4.86	1.60	3.03	.094	.196	.285	.392	.481	.677	.926	1.3	1.6	1.7	2.0	2.3	2.7
19	4.13	1.67	2.48	.100	.178	.285	.427	.641	.925	1.28	1.7	1.8	2.2	2.6	2.6	2.6
20	3.00	1.13	2.65	.106	.196	.285	.445	.605	.855	1.18	1.8	2.0	2.1	2.2	2.3	2.5
21	3.40	1.33	2.55	.100	.196	.285	.409	.623	1.01	1.56	1.3	1.9	2.2	2.5	2.3	2.8
22		1.67			.222	.250	.392	.579	.837	1.14						
23		1.60			.180	.267	.409	.623	.855	1.19						
24		1.88			.180	.267	.409	.650	.818	1.10						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
17	.024	.025	.025	.030	.043	.036							17	23	23	30
18	.020	.020	.020	.025	.038	.036							19	18	27	25
19	.014	.030	.027	.045	.045	.045							15	20	20	24
20	.023	.020	.030	.025	.030	.045							18	20	25	30
21	.014	.023	.023	.036	.030	.045							13	19	24	29
22	.010	.020	.024	.036	.036	.025	10	13	17	22	23	30				
23	.010	.024	.025	.027	.032	.030	11	17	18	22	27	30				
24	.012	.024	.025	.025	.025	.022	10	14	17	23	29	28				

Discussion: The specimens studied came approximately from the type locality of *Fusulina leei* Skinner. The association of *F. leei* with other fusulinid species is discussed under *Pseudostaffella hollingsworthi* (Thompson). *F. leei* is the longest ranging species of *Fusulina* studied in this paper, and because of this long range is not of use in precise regional correlations.

Occurrence: Lower Inola limestone in the SE ¼ of section 7, T. 21 N., R. 18 E., Mayes County, Oklahoma. Locality is on the north side of State Highway 20 at the top of the hill formed by the Bluejacket sandstone approximately five miles west of Pryor. *F. leei* is also present in the Lower Inola limestone in the NW ¼ of section 32, T. 23 N., R. 18 E., Mayes County. Oklahoma.

FUSULINA MEGISTA Thompson, 1934

Plate 3, figs. 4-11

(?) *Fusulinella meeki robusta* Dunbar and Condra, 1927, Nebraska Geol. Survey, Bull. 2, ser. 2, pp. 80-82, pl. 15 fig., 7, 8. Pawnee ls., Pawnee, Kansas.

Fusulina megista Thompson, 1934. Univ. of Iowa Studies in Nat. Hist., vol. 16, no. 4 (new series no. 284), pp. 32-323, pl. 23, figs. 4-6. 50 feet above the Mystic coal, Appanoose County, Iowa.

Fusulina megista Thompson, 1934. Dunbar and Henbest, 1942. Ill. Geol. Surv., Bull. 67, pp. 126-127, pl. 17, figs. 12-20. Piasa, Cutler, and Lonsdale limestones, Illinois.

Fusulina megista Thompson, 1934. Henbest, 1953. U. S. Geol. Survey, Oil and Gas Invest., Chart OC 44. Upper part of Division III, Hartville fm., Hartville uplift, Wyoming.

Description: Large, fusiform test of 10 volutions having a length of near 9.2 mm. and a width of up to 3.67 mm., giving an adult form ratio of near 2.6, although most specimens show a form ratio of near 2.2. Wall is inflated at the equator, and the poles may be irregularly directed. The proloculus is spherical and varies in diameter from 0.125 mm. to 0.205 mm. The wall is of medium thickness for the genus, but does show a rather wide variation. Septa are highly fluted throughout the length of the test and number from near 11 in the first volution, to near 40 in the sixth volution. The tunnel angle is uniform, averaging near 17° with a variation within the species from 12° in the third volution, to 22° in the sixth volution. The chomata are irregular due to disposition upon and near to the septa.

Discussion: This form was described originally as *Fusulinella meeki* var. *robusta* Dunbar and Condra, 1927. This subspecific name is a stillborn junior homonym of *Fusulinella robusta* (Meek and Hayden), 1858.

Immature specimens of this species closely resemble *Fusulina illinoisensis* Dunbar and Henbest, 1942. The form identified as *Fusulina* cf. *illinoisensis* by Dunbar and Henbest[7] is conspecific

7. Dunbar and Henbest, 1942. Ill., Geol. Survey, Bull. 67, p. 119.

with *Fusulina megista* Thompson, 1934. *Fusulina megista* has a long range for a species of *Fusulina*, ranging in Illinois from the Brereton through the Lonsdale limestones. In Oklahoma this species ranges from the Wimer School limestone member of the Labette shale, through the Pawnee limestone.

Occurrence: Pawnee limestone. NW ¼ of section 28, T. 20 N., R. 14 E., Tulsa County, Oklahoma: Wimer School limestone. NE ¼ of section 9, T. 28 N., R. 18 E., Craig County, Oklahoma.

Table 10. *Fusulina megista* Thompson, 1934. Pawnee limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
89	5.27	2.67	1.97	.205	.302	.498	.703	.961	1.37	1.83	1.3	1.7	2.0	2.1	1.9	1.8
90	4.07	2.26	1.80	.160	.320	.534	.819	1.17	1.57	1.87	1.5	1.6	1.9	1.7	1.6	2.0
91	9.20	3.50	2.66	.160	.280	.450	.645	1.02	1.60	1.88	1.5	1.8	1.3	1.9	1.8	1.9
92	4.47	2.00	2.23	.188	.338	.516	.837	1.30	1.76	2.30	1.5	1.7	1.9	1.7	1.9	2.0
93	6.13	2.73	2.24	.170	.338	.516	.783	1.16	1.58	2.12	1.2	1.5	1.7	1.7	1.7	1.8
135	7.50	3.20	2.34	.125	.220	.320	.505	.740	1.09	1.50	1.4	1.8	1.7	1.5	1.7	1.8
94		2.66			.267	.445	.659	1.01	1.48	2.08						
95		2.53			.320	.535	.837	1.23	1.80	2.31						
96		2.40			.302	.445	.623	.890	1.23	1.64						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
89	.024	.036	.036	.036	.040	.045							15	13	21	21
90	.027	.036	.045	.036	.040	.040							19	16	17	18
91	.027	.030	.030	.045	.045	.055							14	17	19	22
92	.030	.036	.045	.036	.045	.042							15	17	20	20
93	.024	.036	.045	.036	.050	.045							14	15	16	18
135	.027	.030	.040	.040	.055	.045							14	12	18	16
94	.024	.030	.045	.045	.045	.045	11	19	20	24	30					
95	.024	.036	.047	.043	.047	.047	11	18	23	29	34	36				
96	.024	.024	.040	.040	.050	.050	10	22	23	28	30	35				

FUSULINA MYSTICENSIS Thompson, 1934

Plate 2, figs. 20-21

Fusulina mysticensis Thompson, 1934. Iowa Univ. Studies in Natural History, vol. 16, no. 4 (new series no. 284), pp. 319-320, pl. 23, figs. 1-3. Upper Des Moines shale, 30 feet above the Mystic coal, Appanoose County, Iowa.

Fusulina mysticensis Thompson, 1934. Dunbar and Henbest, 1942. Ill. Geol. Surv., Bull. 67, pp. 127-129, pl. 18, figs. 1-3. Lonsdale limestone, Peoria County, and Piasa limestone, Jersey County, Illinois.

Description: Test large, elongate, sub-cylindrical, poles blunted, with a curved axis of coiling. Mature specimens have 8 volutions, a length of near 9 mm., and a width near 3 mm., giving a form ratio of near 3. Internal features comparatively variable. Early poles are acutely pointed while mature poles are blunt. First 3 to 5 volutions have chomata deposited in ridges upon the wall, while later volutions have chomata deposited upon the septa, giving an irregular and indistinct appearance. Septa are highly fluted, forming chamberlets which occupy a large proportion of the test. Septa are irregular in number, varying widely between individuals. Range of septal count is from near 10 in the first volution to near 40 in the sixth volution. The proloculus varies from 0.100 mm. to 0.190 mm. in diameter. The wall is of medium thickness for the genus, and

Table 11. *Fusulina mysticensis* Thompson, 1934. Worland limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
105	8.74	2.93	2.89	.130	.249	.427	.677	.961	1.37	1.82	2.1	2.4	2.6	2.8	2.9	3.1
106	6.26	2.63	2.38	.160	.249	.409	.552	.802	1.10	1.51	1.8	1.7	2.0	2.0	2.2	2.3
107	7.00	2.40	2.92	.190	.267	.392	.570	.819	1.17	1.64	1.3	1.7	2.1	2.4	2.3	2.2
108	6.02	2.53	2.45	.165	.285	.392	.605	.873	1.28	1.76	1.5	2.0	2.2	2.4	2.4	2.5
109	5.26	2.33	2.26	.102	.196	.302	.427	.605	.765	1.30	1.6	1.8	2.2	2.4	2.8	2.4
110		3.06			.356	.552	.747	1.05	1.44	1.96						
111		2.86			.320	.463	.659	.925	1.28	1.71						
112		2.80			.267	.392	.588	.837	1.16	1.57						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
105	.015	.025	.036	.027	.045	.040							21	21	27	31
106	.018	.036	.027	.036	.045	.042							15	20	16	17
107	.027	.018	.036	.036	.036	.036							22	21	22	29
108	.024	.027	.032	.036	.047	.045							17	16	20	22
109	.012	.015	.024	.045	.036	.036							19	20	22	27
110	.022	.025	.036	.027	.042	.036	18	26	27	31	37	38				
111	.020	.024	.024	.024	.036	.024	12	21	27	29	34					
112	.012	.024	.027	.027	.036	.036	11	19	23	27	33	36				

the lateral slope appearance depends upon the direction of section, due to the curved axis. Tunnel angle varies from 15° in the third volution to near 30° in the sixth volution.

Discussion: This form is found abundantly near the base of the Worland limestone at the locality given below. The measurements agree moderately well with those of the types except for the following three factors; the form ratio is rather smaller than the average of the types, the proloculus shows a wider variation range, and the number of volutions in mature forms seems to be one less than in the types. These differences are not of major importance and this form is considered conspecific with the types from Iowa.

Occurrence: One foot above base of the Worland limestone. NW ¼ of section 14, T. 28 N., R. 16 E., Nowata County, Oklahoma.

FUSULINA NOVAMEXICANA Needham, 1937

Plate 3, figs. 1-3

Fusulinella meeki Dunbar and Condra, 1927 (part). Nebr. Geol. Surv., Bull. 2, 2nd ser., pp. 78-80, pl. 2, figs. 12, 13, and 14. Millsap Lake limestone in the Strawn group of Texas. Not pl. 14, figs. 4-6, which are topotype specimens from Rich Hill, Missouri.

Fusulinella (*Girtyina*) aff. *ventricosa* (Meek and Worthen?), 1874. Henbest, 1928. Jour. Paleontology, vol. 2, pp. 76-79, pl. 10, figs. 5 and 7, and probably also figs. 1a and 3. Stonefort limestone, Williamson County, Illinois.

Fusulina novamexicana Needham, 1937. New Mexico School of Mines, Bull. 14, pp. 23-25, pl. 2, figs. 11-15. Magdalena limestone, Socorro County, New Mexico.

Fusulina novamexicana Needham, 1937. Dunbar and Henbest, 1942. Ill. Geol. Surv., Bull. 67, pp. 113-115, pl. 10, figs. 7-17. Stonefort limestone, Illinois, and Spaniard Creek limestone of the Savanna fm., Oklahoma. (Properly called the Spaniard limestone.)

Description: Test medium large, thickly fusiform to ventricose. Mature specimens have 9 volutions; length about 5 mm. and width up to 2.6 mm., giving a form ratio for mature forms of from 1.6 to little greater than 2.0. The septa are strongly folded across the length of the test and vary from about 10 in the first volution to as many as 50 in the sixth volution. Proloculus varies from 0.080 mm. to 0.120 mm. Walls are of medium thickness, varying from an average of 0.018 mm. in early volutions to as much as 0.054 mm. in late volutions. The tunnel angle varies from as little as 12° to as much as 19°, with the tunnel of an individual tending to remain rather constant. Chomata form on septa bordering the tunnel and tend to be asymmetrical and indistinct at places, while prominent at others.

Discussion: *Fusulina novamexicana* Needham is the earliest *Fusulina* found in this area. It is even more widespread than is *F. leei* Skinner, being found in New Mexico, Texas, and north to Illinois. This species resembles *F. girtyi* Dunbar and Condra, 1927,

Table 12. *Fusulina novamexicana* Needham, 1937. Spaniard limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
1	4.20	2.60	1.60	.080	.196	.338	.482	.694	.979	1.28	1.4	1.5	1.5	1.6	1.5	1.4
2	3.67	1.27	2.92	.100	.142	.302	.553	.658	.783	1.05	1.1	1.4	1.1	1.4	1.8	1.8
3	3.00	1.80	1.67	.120	.214	.338	.498	.588	.873	1.99	1.2	1.5	1.7	1.9	1.7	1.5
4	3.36	2.13	1.81	.105	.196	.322	.463	.552	.783	1.12	1.3	1.3	1.2	2.5	2.4	2.4
5	2.66	1.67	1.59	.100	.214	.321	.482	.695	.963	1.89	1.2	1.5	1.4	1.5	1.6	1.5
6		2.00			.198	.267	.427	.588	.713	1.56						
7		2.54			.198	.267	.409	.534	.783	1.07						
8		1.40			.232	.320	.445	.641	.890	1.21						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
1	.036	.012	.025	.036	.036	.036							13	13	14	12
2	.012	.027	.027	.045	.036	.036							15	15	15	17
3	.025	.036	.036	.030	.046	.054							14	14	16	18
4	.018	.018	.024	054	.054	.036							16	16	18	19
5	.018	.018	.036	.036	.036	.036							15	14	15	13
6	.018	.018	.024	.036	.036	.045	10	13		30	36					
7	.018	.018	.027	.036	.036	.036	10	19	27	33	37	50				
8	.018	.027	.036	.040	.040	.047	13	24	26	29	35	41				

rather closely, but they can be distinguished by the following features; the wall of *F. novamexicana* is thinner in the immature volutions; the form ratio of volutions varies in *F. novamexicana* but is nearly constant in *F. girtyi*: and the diameter of the proloculus of *F. novamexicana* is much smaller, averaging 0.100 mm., whereas the diameter of the proloculus of *F. girtyi* is around 0.170 mm.

Occurrence: Spaniard limestone. SW ¼ of section 2, T. 14 N., R. 18 E., Muskogee County, Oklahoma. The outcrop is located in an artificial stream bed approximately one quarter of a mile east of a railroad underpass on State Highway 2 on the south edge of Muskogee.

FUSULINA OCCULTIFONS, new species

Plate 4, figs. 1-4

Description: Test fusiform to ventricose. Length of adults up to 4.50 mm. with a width of up to 2.46 mm., giving a form ratio of between 1.55 and 1.93. Mature specimens have 8 volutions, which have strong septal fluting throughout. Septa number from near 11 in the first volution, to near 27 in the sixth volution. Height of volutions increases markedly during growth. The proloculus is small, varying in diameter from 0.055 mm. to 0.078 mm. The wall is thin, varying from 0.010 mm. in the first two volutions, to an average of near 0.030 mm. in the sixth volution. The tunnel angle is uniform, varying only about 5° as a rule within individuals, but varying from 15° to 32° within the species. Chomata are ridge-like in the first three volutions, but become irregular in later volutions due to deposition upon septa.

Discussion: This species is unlike others in that it has an unusually small proloculus, and the shape and arrangement of wall are distinctive. It resembles *Fusulina girtyi* (Dunbar and Condra), 1927, but the two outstanding differences are that *Fusulina occultifons,* new species, has a much smaller proloculus, and its later deposits of chomata are irregular and indistinct, whereas the chomata in *Fusulina girtyi* form distinct deposits along the entire tunnel.

Table 13. *Fusulina occultifons,* new species. Upper Fort Scott limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
73	4.40	2.33	1.89	.075	.142	.214	.338	.605	.980	1.46	1.4	1.7	2.1	1.9	2.1	1.9
74	3.86	2.00	1.93	.078	.160	.250	.410	.641	1.01	1.44	1.2	1.4	1.3	1.8	1.9	2.0
75	2.73	1.60	1.71	.075	.142	.250	.481	.837	1.37	1.89	1.0	1.4	1.9	2.3	1.8	1.5
76	3.93	2.46	1.59	.075	.160	.267	.445	.694	1.10	1.60	1.2	1.3	1.7	1.9	1.8	1.8
77	3.50	2.26	1.55	.055	.125	.196	.320	.516	.801	1.21	1.0	1.5	1.7	1.8	1.8	1.7
78		2.06			.107	.178	.320	.481	.855	1.35						
79		2.26			.125	.214	.338	.605	1.05	1.58						
80		1.93			.125	.214	.356	.605	.997	1.46						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
73	.010	.012	.025	.027	.027	.030							23	24	20	22
74	.010	.010	.025	.030	.030	.036							26	26	31	32
75	.010	.015	.027	.036	.040	.040							27	17	23	
76	.010	.025	.036	.025	.027	.027							17	19	15	16
77	.010	.010	.025	.022	.022	.026							21	26	21	20
78	.007	.012	.024	.027	.036	.027	9	12	14	16	24	27				
79	.012	.012	.024	.036	.036	.030	7	11	15	18	20	26				
80	.012	.012	.024	.040	.045	.027	9	11	15	18	25	34				

The species is named from Latin occultus, -a, -um, meaning hidden, or concealed, plus Latin fons, meaning a fountain or source, origin. This refers to the minute proloculus, which is difficult to find.

Occurrence: Upper Fort Scott limestone, SE ¼ of section 28, T. 26 N., R. 17 E., Nowata County, Oklahoma. The forms are extremely abundant in the roadcut and in a quarry in the field just to the north. The best collecting is in the roadcut as most of the forms in the quarry are crushed. Associated with *Fusulina occultifons* is *Fusulina girtyi* (Dunbar and Condra), but that species is evidently rare as only a few poorly preserved specimens were observed.

FUSULINA PLENA, new species

Plate 4, figs. 5-8

Description: A moderately large, fat, gibbous species; length in adults of near 6 mm. and width averaging near 2.8 to 3 mm.,

giving a form ratio of near 2 or slightly less. Adults have 11 volutions which have highly fluted septa throughout. The septa vary from near 10 in the first volution, up to near 50 in the sixth volution. There are prominent axial deposits for a species of the genus, the lateral slope of the wall is generally slightly concave, and the poles are subacute to blunt. The proloculus is subspherical and varies in diameter from 0.100 mm. to 0.140 mm., with a diameter of 0.115 mm. normal. The wall is moderately thick, varying from near 0.018 mm. in the first volution, to near 0.045 mm. in the sixth volution. The tunnel angle is uniform, varying only about 4° in individuals, with a variation for the species from 11° in the third volution, up to 22° in the fifth volution. Chomata are deposited upon the septa and give rise to an irregular pattern.

Discussion: This form is distinctive due to the large number of volutions, the prominent axial deposits, and the nature of the tunnel. The species resembles *Fusulina illinoisensis* Dunbar and Henbest, in its general appearance. However, *Fusulina plena* has more volutions than does *Fusulina illinoisensis* and is larger.

Table 14. *Fusulina plena,* new species. Breezy Hill limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
57	5.66	3.20	1.77	.115	.214	.286	.465	.694	.962	1.33	1.8	2.2	2.7	2.4	2.4	2.1
58	4.94	3.00	1.64	.140	.249	.392	.534	.783	1.12	1.50	1.2	1.3	1.5	1.5	1.4	1.4
59	6.13	2.93	2.09	.115	.178	.320	.498	.712	1.01	1.35	1.7	1.7	2.0	2.3	2.2	2.1
60	4.53	2.87	1.58	.100	.160	.249	.392	.588	.820	1.16	1.5	1.4	1.6	1.7	1.7	1.6
61	4.93	2.73	1.80	.115	.196	.301	.463	.694	.908	1.23	1.3	1.5	1.9	1.7	1.7	1.8
62		3.00			.267	.392	.534	.747	1.07	1.50						
63		2.67			.249	.356	.516	.676	.855	1.16						
64		3.26			.214	.427	.587	.837	1.16	1.57						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
57	.022	.027	.030	.040	.040	.036							16	16	22	20
58	.027	.027	.030	.036	.045	.045							17	15	14	17
59	.020	.030	.036	.040	.040	.045							13	16	15	18
60	.012	.020	.040	.040	.045	.045							13	12	17	16
61	.012	.024	.036	.036	.036	.045							12	13	15	11
62	.018	.018	.030	.036	.054	.054	10	17	26	30	34	40				
63	.018	.024	.027	.027	.036	.040	11	18	26	31	32	35				
64	.018	.018	.027	.045	.045	.040	11	20	25	29	35	49				

The species is named from Latin plenus, -a, -um, meaning full, occupied, full of. This refers to the shape of the test and to the axial fillings.

Occurrence: Breezy Hill limestone. SE ¼ of section 3, T. 23 N., R. 17 E., Rogers County, Oklahoma. The limestone is well exposed in some coal strip pits and this species is abundant in a two inch zone near the middle of the limestone. The species is associated with *Fusulina expedita,* new species, but each species is abundant in a separate zone and the two are easily distinguished externally.

FUSULINA TUMIDA, new species

Plate 4, figs. 9-12

Description: A thickly fusiform test having 9 or even 10 volutions in mature forms. Length up to near 5.5 mm. and width up to 3.6 mm., giving a mature form ratio of near 1.5. The shape is uniform throughout growth. Septa are strongly fluted throughout

Table 15. *Fusulina tumida,* new species. Myrick Station limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
97	4.80	3.16	1.52	.190	.303	.481	.694	.997	1.39	1.92	1.2	1.8	1.9	2.0	1.7	1.5
98	4.66	3.20	1.46	.190	.374	.552	.819	1.09	1.66	2.21	1.4	1.5	1.7	1.9	1.6	1.5
99	5.53	3.60	1.54	.210	.437	.659	.962	1.32	1.67	2.24	1.5	1.8	1.6	1.5	1.4	1.4
100	4.13	2.93	1.41	.235	.410	.587	.802	1.12	1.53	2.01	1.7	1.8	2.0	1.8	1.7	1.6
101	3.87	2.46	1.57	.175	.267	.481	.748	1.07	1.42	1.89	1.9	1.9	2.0	1.8	1.7	1.7
102		3.93			.320	.481	.713	1.05	1.44	1.92						
103		2.93			.338	.516	.730	1.03	1.41	1.91						
104		3.00			.338	.552	.855	1.18	1.62	2.08						

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
97	.024	.024	.030	.042	.042	.038							16	16	20	18
98	.027	.027	.027	.036	.040	.040							21	17	21	18
99	.027	.027	.036	.040	.036	.045							14	16	14	17
100	.036	.036	.036	.036	.036	.045							16	21	24	
101	.027	.036	.030	.036	.040	.040							19	18	16	16
102	.024	.030	.036	.036	.050	.045	10	21	27	34	39	48				
103	.024	.027	.036	.045	.045	.036	10	20	27	32	39	47				
104	.022	.027	.030	.050	.036	.042	10	21	28	36	39	46				

the volutions and number from 10 in the first volution to 47 in the sixth volution. The proloculus is large and spherical, varying from 0.175 mm. to 0.235 mm. in diameter. The wall is of medium thickness, varying from near 0.024 mm. in the first volution, to near 0.040 mm. in the sixth volution. The tunnel angle is moderately narrow, averaging near 18° from the third volution to the sixth volution. Chomata are deposited upon the septa, but do not become quite as irregular as in some species.

Discussion: This form resembles *Fusulina girtyi* (Dunbar and Condra) in its general appearance. However, *Fusulina tumida,* new species, can easily be distinguished from *Fusulina girtyi* by its greater length, greater width, larger proloculus, and larger tunnel angle.

The name of the species comes from Latin tumidus, -a, -um, meaning swollen or tumid. This refers to the thickly fusiform test.

Occurrence: Myrick Station limestone. NE ¼ of section 12, T. 27 N., R. 16 E., Nowata County, Oklahoma. Specimens are moderately abundant in a three inch zone 6.7 feet above the base of the limestone at this locality.

FUSULINA, new species

Plate 2, fig. 17

Description: A fusiform specimen with slight inflation of the equatorial region, a length of 4.07 mm. and a width of 2.06 mm., giving a form ratio of 1.97. Test has 7 volutions and the internal features are similar to those of *Fusulina haworthi* (Beede), 1916 emend. Dunbar and Henbest, 1942. The proloculus is rather large, 0.190 mm. in diameter. The wall is extremely thin, with the thickness varying only between 0.025 mm. to 0.027 mm. in the first six volutions. The septa are strongly fluted throughout the length of the test. The tunnel angle is wide and varies between 25° and 27° from the third volution to the sixth volution. Chomata form deposits upon the septa and are irregular in appearance.

Discussion: This is the only specimen of ths description found out of thirty sections cut. It is associated with abundant *Fusulina girtyi* (Dunbar and Condra) and *Fusulina haworthi* (Beede). Its

form ratio and general appearance are similar to those of *Fusulina haworthi,* but the specimen differs distinctly because of its extremely thin wall and its wider tunnel angle.

Occurrence: Lower Fort Scott limestone. NW ¼ of section 13 T. 28 N., R. 19 E., Craig County, Oklahoma.

Table 16. *Fusulina,* new species. Lower Fort Scott limestone.

Specimen	Length	Width	Ratio	Diam. proloc.	HEIGHT OF VOLUTIONS						FORM RATIO OF VOLUTIONS					
					1	2	3	4	5	6	1	2	3	4	5	6
68	4.07	2.06	1.97	.190	.338	.552	.854	1.34	1.81	2.35	1.4	1.4	1.4	1.4	1.6	1.7

Specimen	THICKNESS OF SPIROTHECA						SEPTAL COUNT						TUNNEL ANGLE			
	1	2	3	4	5	6	1	2	3	4	5	6	3	4	5	6
68	.025	.025	.027	.027	.025	.025							26	27	25	25

STRATIGRAPHIC SIGNIFICANCE

by

CARL C. BRANSON AND RICHARD D. ALEXANDER

The range of the genus *Fusulina* is from bottom to top of the Desmoinesian stage, and the genus is unknown in rocks of other stages. Species of the genus *Wedekindellina* occur in abundance in rocks of middle Desmoinesian age and some species are found in upper Desmoinesian rocks. One species is widespread in early Missourian rocks. Specimens of the genus *Fusulinella* are especially characteristic of rocks of Atokan age, but the genus ranges through the Desmoinesian and into younger rocks.

Fusulinid genera are of value in age determination of sedimentary rocks because they have restricted ranges. The ranges of some genera are shown graphically in Figure 3. Species can be used for age discrimination in two ways: first, by observation of the stage of phylogenetic development within the genus; second, by correlation with beds of known stratigraphic position on the basis of occurrence of the same species or association of species. Fusulinids are more useful in stratigraphic work in Pennsylvanian and Permian marine rocks than is any other fossil because they are abundant in many zones, a complete faunule can be collected in a few minutes, they were evolving rapidly during those periods while most other groups were not, and they can be recovered and identified in well cuttings.

In general, age zones are correlated by using widespread species known to have short ranges and by comparison of closely related species. In the rocks of Illinois, Dunbar and Henbest[8] recognized time zones and subzones marked in order from older to younger by the *Fusulinella iowensis* faunule, by the *Wedekindellina euthusepta* faunule, by the *Fusulina leei* faunule (range is in part that of *Wedekindellina euthusepta*), by the *Fusulina girtyi* faunule, and by the *Fusulina eximia* faunule.

---

8. Dunbar and Henbest, 1942. Ill., Geol. Survey, Bull. 67, pp. 28-30.

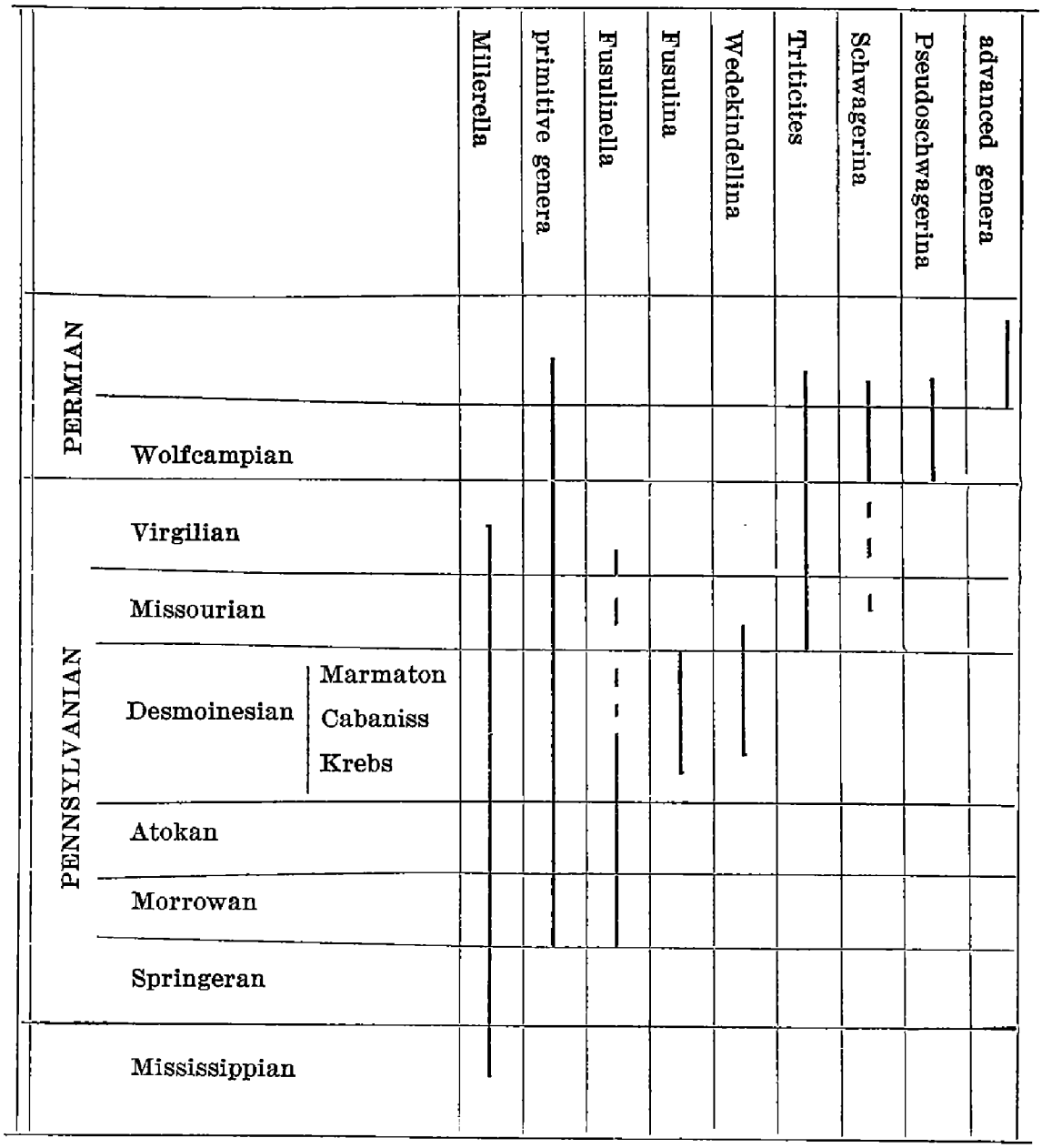


Figure 3

RANGES OF FUSULINID GENERA IN NORTH AMERICA

The Iowa Desmoinesian fusulinids were studied by Thompson[9]. He did not give formal names to the paleontological zones, but his work shows the sequence:

Fusulina eximia faunule	80 feet above the Mystic coal
Fusulina mysticensis, F. megista faunule	50 feet above the Mystic coal
Fusulina girtyi faunule	18 feet above the Mystic coal
Wedekindellina euthusepta late faunule	8 feet above the White Breast coal
Fusulina kayi, F. leei, W. euthusepta faunule	35 feet below the White Breast coal
Fusulinella iowensis faunule	90 feet below the White Breast coal

In the Desmoinesian rocks of the Hartville uplift of eastern Wyoming, Henbest[10] recognized a sequence of faunules:

Fusulina acme, F. piasaensis, F. megista
Fusulina girtyi, F. illinoisensis, F. knighti
Fusulina rockymontana, F. distenta, Wedekindellina euthusepta

Alexander[11] has described a number of occurrences in the Ardmore Basin and Ada area, which can be tabulated in sequence as follows:

Fusulinella sp.	Confederate limestone
Fusulina n. sp.	Homer limestone, Holdenville formation
Fusulina haworthi	Middle Wewoka form.
Fusulina inconspicua	Lower Wewoka form.
Fusulina cf. F. lucasensis	Arnold limestone
Fusulina leei	Upper Boggy formation
Fusulinella sp.	Lower Boggy formation
Fusulina n. sp., Wedekindellina euthusepta	Pumpkin Creek limestone

9. Thompson, M. L., 1934. Univ. of Iowa, Studies in Natural History, vol. 16, no. 4, pp. 277, 278.

10. Henbest, L. G., 1953. U. S. Geol. Survey, Oil and Gas Invest., Chart OC 44.

11. Alexander, R. J., 1952. Unpublished Master of Science thesis, Univ. of Okla., chart.

The present work has established the presence in northeastern Oklahoma of the following distinctive fusulinid faunules:

Fusulina megista faunule	Wimer School, Pawnee, Altamont
Fusulina girtyi faunule	Fort Scott formation
Fusulina plena faunule	highest Senora
Fusulina equilaqueata faunule	Verdigris limestone
Fusulina kayi, Wedekindellina euthusepta faunule	Cap rock of Fleming coal
Fusulina attenuata faunule	Tiawah limestone
Fusulina leei, Wedekindellina henbesti faunule	Inola limestone
Fusulinella sp. faunule	Sam Creek limestone
Fusulina novamexicana faunule	Spaniard limestone

The lowest member of the section in which fusulinids were found is the Spaniard limestone, basal member of the Savanna formation. It is correlated with the Pumpkin Creek limestone of the Ardmore Basin in which there is a closely related species. The Stonefort limestone of Illinois bears *Fusulina novamexicana*, and since that species is in the Spaniard, the two beds are correlated. The species was originally described from a locality near Socorro, New Mexico, where the beds are covered and are intensely faulted.

The Sam Creek limestone member of the Savanna formation contains the next higher fusulinid zone. It yields a possible new species of *Fusulinella,* but specimens are not sufficiently well-preserved to permit use of the form as a means of correlation.

The Inola limestone (name restricted to the first limestone above the Bluejacket sandstone) carries five fusulinid species. Four of these are known from a zone in the "Upper Boggy" of Pontotoc County[12], and the rocks are considered to be of the same age. *Fusulina leei,* which occurs in the Inola in northeastern Oklahoma. appears to have a long range and to occur at age levels as old as lower Krebs and as young as middle Cabaniss.

The earliest Cabaniss fusulinids (*Fusulina attenuata*) occur in the Tiawah limestone, which has been correlated on stratigraphic

12. Alexander, R. J., 1952. Unpublished Master of Science thesis, Univ. of Okla.

grounds with the Seahorne limestone of Illinois. The Russell Creek limestone (cap rock of the Mineral coal) carries *Fusulina equabilis,* a species not yet recognized elsewhere. The fusulinids of the cap rock of the Fleming coal are *Fusulina kayi* and *Wedekindellina euthusepta,* two species which mark a zone 35 feet below the White Breast coal in Iowa.

A new species of *Fusulina, F. equilaqueata,* characterizes the Verdigris limestone. This species should be found in one of the three ledges of the Ardmore limestone at its type locality in Missouri.

The Breezy Hill limestone occurs in Oklahoma, Kansas, and Missouri. Its fusulinid faunule, consisting of *Fusulina expedita* and *F. plena,* is the highest of the "Cherokee" and is quite distinct from that of the early Marmaton rocks only a few feet higher.

The lower member of the Fort Scott limestone formation is the Blackjack Creek limestone. Its characteristic species are *Fusulina girtyi* and *F. haworthi,* and these indicate equivalence with the Hanover limestone of Illinois. *F. haworthi* occurs in fossiliferous limestone nodules in the Wewoka formation in Pontotoc County, Oklahoma. On stratigraphic evidence, the Wewoka zone should be considerably younger than the Blackjack Creek. The Blackjack Creek specimens of *Fusulina haworthi* were compared with specimens collected at the type locality in Oswego, Kansas, and they are clearly conspecific.

Fusulina girtyi was also found in the Higginsville limestone and a related, but more advanced, species occurs in the Myrick Station limestone. The Wimer School limestone and the upper part of the Pawnee limestone contain *Fusulina megista,* a species of the type of *F. illinoisensis* but more advanced. In immature and weathered specimens, the similarity to *F. illinoisensis* is striking. In Illinois, *F. girtyi* and *F. haworthi* characterize the upper part of the Brereton cyclothem. On stratigraphic evidence, the Higginsville is a correlative of the St. David limestone of Illinois and the Pawnee of the Brereton. Wanless has published a cross-section in which he shows the Oklahoma equivalent of the Brereton cyclo-

them to be all of the beds from the base of the Fort Scott to the top of the Pawnee. The apparent anomalies in fusulinid distribution would be expected in such a situation.

The uppermost unit of the Altamont, the Worland limestone, is the Worland limestone of Iowa, and has been correlated with the Piasa limestone of Illinois. *Fusulina mysticensis* occurs in all of these units and appears to be a good index species, although it also occurs in the Lonsdale limestone of Illinois, which is a probable correlative of the Lenapah.

The fourteen fusulinid-bearing zones in the Desmoinesian rocks of northeastern Oklahoma provide a type sequence for use of these fossils in correlation. Several of the faunules correspond to known fusulinid faunules elsewhere, and the others will be sought in rocks of similar stratigraphic position in the Midcontinent. This paper provides a sequence of described fusulinid faunules fixed in stratigraphic position in a new region.

	SPANIARD	SAM CREEK	INOLA	TIAWAH	RUSSELL CK.	FLEMING CAP	VERDIGRIS	BREEZY HILL	BLACKJACK CK.	HIGGINSVILLE	WIMER SCHOOL	MYRICK STATION	U. PAWNEE	WORLAND
Pseudostaffella hollingsworthi			x											
Eoschubertella gallowayi			x											
Fusulinella trisulcata			x											
Fusulinella sp.		x												
Wedekindellina euthusepta						x								
Wedekindellina henbesti			x											
Fusulina attenuata				x										
Fusulina equabilis					x									
Fusulina equilaqueata							x							
Fusulina expedita								x						
Fusulina girtyi									x	x				
Fusulina haworthi									x					
Fusulina kayi						x								
Fusulina leei			x											
Fusulina megista											x		x	
Fusulina mysticensis ,														x
Fusulina novamexicana	x													
Fusulina occultifons										x				
Fusulina plena								x						
Fusulina tumida												x		

Figure 4.

STRATIGRAPHIC OCCURRENCE OF FUSULINID SPECIES IN NORTHEASTERN OKLAHOMA

BIBLIOGRAPHY

Alexander, R. J., 1952. An objective study of Pennsylvanian Fusulinidae from the Ardmore-Ada areas, Oklahoma: Unpublished Master of Science thesis, Univ. of Oklahoma, 74 pages, 6 plates.

Beede, J. W., 1916. New species of fossils from the Pennsylvanian and Permian rocks of Kansas and Oklahoma: *Indiana Univ. Studies,* vol. 11, pp. 118-125, pl. 22.

Branson, Carl C., 1954. Marker beds in the lower Desmoinesian of northeastern Oklahoma. *Okla. Acad. Sci.,* vol. 33, Proc. for 1952, pp. 190-193.

Cade, C. M., III, 1953. The geology of the Maramaton group of northeastern Nowata and northwestern Craig Counties, Oklahoma: *Tulsa Geol. Soc., Digest,* vol. 21, pp. 130-148, pl. 1.

Cheney, M. G., et al, 1945. Classification of Mississippian and Pennsylvanian rocks of North America: *Amer. Assoc. Petroleum Geologists, Bull.,* vol. 29, pp. 125-169, text figs. 1-3.

Chrisman, L. P., 1952. The geology of the Big Cabin Creek area, Craig County, Oklahoma: Unpublished Master of Scienre thesis, Univ. of Okla., 66 pages, map.

Claxton, C. D., 1952. The geology of the Welch area, Craig County, Oklahoma: Unpublished Master of Science thesis, Univ. of Okla., 43 pages, map.

Dunbar, C. O., and Condra, G. E. 1927. The Fusulinidae of the Pennsylvanian system in Nebraska: *Nebraska Geol. Survey,* 2nd ser., Bull. 2, 135 pages, 15 plates.

Dunbar, C. O., and Henbest, L. G., 1930. The fusulinid genera *Fusulina, Fusulinella,* and *Wedekindella*: *Amer. Jour. Sci.,* vol. 220, pp. 357-364.

————————, 1931. *Wedekindia,* a new fusulinid name: *Amer. Jour. Sci.,* vol. 221, p. 458.

Dunbar, C. O., and Henbest, L. G., 1942. Pennsylvanian Fusulinidae of Illinois: *Illinois Geol. Surv., Bull.* 67, pp. 218; pls. 1-23.

Galloway, J. J., and Harlton, B. H., 1928. Some Pennsylvanian Foraminifera of Oklahoma, with special reference to the genus Orobias: *Jour. Paleontology,* vol. 2, pp. 338-357, pls. 45-46,

Galloway, J. J., and Ryniker, C., 1930. Foraminifera from the Atoka formation of Oklahoma: *Okla. Geol. Survey,* Circ. No. 21, pp. 1-36, pls. 1-5.

Henbest, L. G., 1928. Fusulinellas from the Stonefort limestone member of the Tradewater formation: *Jour. Paleontology,* vol. 2, pp. 70-85, pls. 8-10.

Henbest, L. G., 1953. In Love, J. D., Henbest, L. G., and Denson, N. M., Stratigraphy and paleontology of Paleozoic rocks, Hartville area, Eastern Wyoming: *U. S. Geol. Survey, Oil and Gas Invest.,* Chart OC 44.

Lohman, C., Jr., 1952. Geology of the Whiteoak area, Craig and Rogers Counties, Oklahoma: Unpublished Master of Science thesis, Univ. of Okla., 89 pages; map.

Meek, F. B., and Worthen, A. H., 1875. Geology and paleontology of Illinois, *Geol. Surv. of Illinois,* vol. 5, p. 560, pl. 24.

Moore, R. C., 1936. Stratigraphic classification of the Pennsylvanian rocks of Kansas: *Kansas State Geol. Survey.* Bull. 22, pp. 1-256.

Moore, R. C., et al, 1944. Correlation of Pennsylvanian formations of North America. *Geol. Soc. Amer., Bull.,* vol. 55, chart no. 6, facing p. 706.

———————, 1949. Divisions of the Pennsylvanian system in Kansas: *Kansas Geol. Survey, Bull.* 83, pp. 7-63.

Morgan, G. D., 1924. Geology of the Stonewall Quadrangle, Oklahoma: *Okla. Bureau of Geol., Bull.* 2, pp. 1-248.

Needham, C. E., 1937. Some New Mexico Fusulinidae: *New Mexico School of Mines, Bull.* no. 14, 88 pages, 12 plates.

Newell, N. D., and Koroher, R. P., 1937. The fusulinid, *Wedekindellina,* in mid-Pennsylvanian rocks of Kansas and Missouri: *Jour. Paleontology,* vol. 11, pp. 698-705, pl. 93.

Oakes, M. C., 1953. Krebs and Cabaniss groups, of Pennsylvanian age, in Oklahoma. *Amer. Assoc. Petroleum Geologists, Bull.,* vol. 37, pp. 1523-1526.

Roth, R., and Skinner, J. W., 1930. The fauna of the McCoy formation, Pennsylvanian, of Colorado: *Jour. Paleontology,* vol. 4, pp. 333-352, pls. 28-31.

Skinner, J. W., 1931. Primitive fusulinids of the Mid-Continent region: *Jour. Paleontology,* vol. 5, pp. 253-259, pl. 30.

Staff, H. von, 1912. Monographie der Fusulinen, Teil III, Die Fusulinen (Schellwienien) Nordamerikas: *Paleontographica,* vol. 59, pp. 157-192, pls. 15-20, text figs. 1-17.

Thompson, M. L., 1934. The fusulinids of the Des Moines series of Iowa: *Iowa, Univ., Studies in Nat. History,* vol. 16, no. 4 (new series no. 284), pp. 277-332, pls. 20-23.

———————, 1935. The fusulinid genus *Staffella* in America: *Jour. Paleontology,* vol. 9, pp. 11-120, pl. 13.

————————, 1933a. Fusulinids from the Lower Pennsylvanian Atoka and Boggy formations of Oklahoma: *Jour. Paleontology,* vol. 9, pp. 291-306, pl. 26.

————————, 1936. Fusulinids from the Black Hills and adjacent areas in Wyoming: *Jour. Paleontology,* vol. 10, pp. 95-113, pls. 13-16.

————————, 1936a. The genotype of Fusulina s.s.: *Amer. Jour. Sci.,* vol. 232, pp. 287-291.

————————, 1936b. Pennsylvanian fusulinids from Ohio: *Jour. Paleontology,* vol. 10, pp. 673-683, pls. 90-91.

————————, 1937. Fusulinids of the subfamily Schubertellinae: *Jour. Paleontology,* vol. 11, pp. 118-125, pl. 22.

————————, 1942. New genera of Pennsylvanian fusulinids: *Amer. Jour. Sci.,* vol. 240, pp. 403-420, pls. 1-3.

————————, 1945. Pennsylvanian rocks and fusulinids of east Utah and northwest Colorado correlated with Kansas section: *Kansas, State Geol. Survey. Bull.* 60, pp. 17-84, pls. 1-6.

————————, 1945a. Upper Desmoinesian fusulinids. *Amer. Jour. Sci.,* vol. 243, pp. 443-455, pls. 1-2.

————————, 1948. Studies of American fusulinids: *Univ. of Kansas,* Paleontological Contributions, No. 4, Protozoa, Article 1, 184 pages, 38 plates.

————————, 1953. Primitive Fusulinella from southern Missouri. *Jour. Paleontology,* vol. 27, pp. 321-327, pls. 41-42.

Thompson, M. L., and Scott, H. W., 1941. Fusulinids from the type section of the Lower Pennsylvanian Quadrant formation: *Jour. Paleontology,* vol. 15, pp. 349-353, pl. 48.

Thompson, M. L., and Thomas, H. D., 1953. Fusulinids of the Casper formation of Wyoming, *Wyo. Geol. Survey, Bull.* No. 46, pp. 15-56, pls. 1-8.

Tillman, J. L., 1952. Geology of the Tiawah area, Rogers and Mayes Counties, Oklahoma: Unpublished Master of Science thesis, Univ. of Okla., 65 pages, map.

Wanless, H. R., 1950. Late Paleozoic cycles of sedimentation in the United States: *International Geol. Congress,* Rept. of the 18th session, pt. 4, pp. 17-28.

White, M. P., 1932. Some Texas Fusulinidae: *Univ. of Texas, Bull.* 3211, pp. 1-32, pl. 1.

Wilson, C. W., Jr., and Newell, N. D., 1937. Geology of the Muskogee-Porum District, Muskogee and McIntosh Counties, Oklahoma: *Okla. Geol. Survey, Bull.* 57, 43-56, 156-184.

PLATE 1

Figures — Page

1-2. *Pseudostaffella hollingsworthi* (Thompson), 1935 17
Inola limestone, SE ¼ of section 7, T. 21 N., R. 18 E., Mayes County, Oklahoma. 1. Sagittal section, x 40. 2. Axial section, x 40.

3. *Eoschubertella gallowayi* (Skinner), 1931 17
Inola limestone, same locality as figs. 1-2. Axial section, x 40.

4-7. *Fusulinella,* new species 18
Sam Creek limestone, SW ¼ of section 4, T. 21 N., R. 18 E., Mayes County, Oklahoma. 4-6. Axial sections, x 40. S. Sagittal section, x 40.

8. *Fusulinella trisulcata* Thompson, 1935 20
Inola limestone, same locality as figs. 1-2. Axial section, x 40.

9. *Wedekindellina euthusepta* (Henbest), 1928 20
Fleming cap rock, coal strip pit 2½ miles north of Fleming, Kansas. Axial section, x 10.

10-11. *Wedekindellina henbesti* (Skinner), 1931 21
Inola limestone, same locality as figs. 1-2. 10. Axial section, x 10. 11. Sagittal section, x 10.

12-15. *Fusulina attenuata,* new species 23
Tiawah limestone, SE ¼ of section 26, T. N., R. 15 E., Wagoner County, Oklahoma. 12. Sagittal section, x 10. 13-15. Axial sections, x 10.

16-19. *Fusulina equilaqueata,* new species 26
Verdigris limestone. SE ¼ of section 3, T. 23 N., R. 17 E., Rogers County, Oklahoma. 16-18. Axial sections of silicified specimens, x 10. 19. Sagittal section of a silicified specimen, x 10.

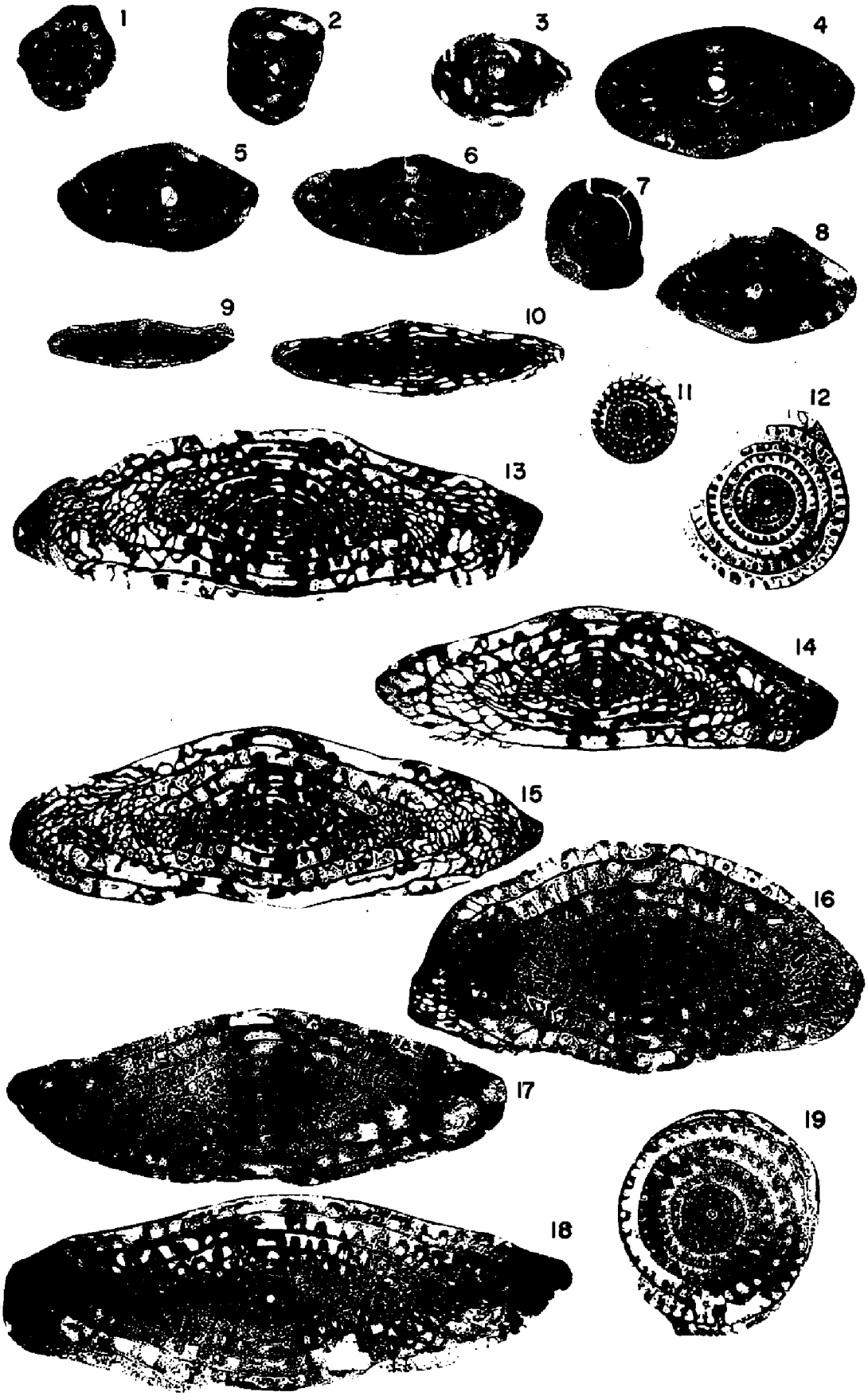

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

PLATE 2

(All views x 10)

Figures — Page

1-4. *Fusulina equabilis,* new species 24
Russell Creek limestone, SW ¼ of section 11, T. 28 N., R. 20 E., Craig County, Oklahoma. 1-3. Axial sections. 4. Sagittal section.

5-8. *Fusulina expedita,* new species 27
Breezy Hill limestone, SW ¼ of section 24, T. 28 N., R. 19 E., Craig County, Oklahoma. 5-7. Axial sections. 8. Sagittal section.

9. *Fusulina girtyi* (Dunbar and Condra), 1927 29
Blackjack Creek limestone, NW ¼ of section 13, T. 28 N., R. 19 E., Craig County, Oklahoma. Axial section.

Henbest, 1942 30

10-12. *Fusulina haworthi* (Beede), 1916, emend. Dunbar and Blackjack Creek limestone, same locality as fig 9. 10-11. Axial sections. 12. Sagittal section.

13-16. *Fusulina kayi Thompson,* 1934 32
Fleming cap rock, coal strip pit 2½ miles north of Fleming, Kansas. 13. Sagittal section. 14-16 Axial sections.

17. *Fusulina,* new species 44
Blackjack Creek limestone, same locality as fig. 9. Axial section. This figure demonstrates the difficulty in showing specific difference by illustration in that figures 10 and 17 appear to be photographs of the same species.

18-19. *Fusulina leei* Skinner, 1931 33
Inola limestone. SE ¼ of section 7, T. 21 N., R. 18 E., Mayes County, Oklahoma. 18. Axial section. 19. Sagittal section.

20-21. *Fusulina mysticensis* Thompson, 1934 36
Worland limestone, NW ¼ of section 14, T. 28 N., R. 16 E., Nowata County, Oklahoma. 20. Axial section. 21. Sagittal section.

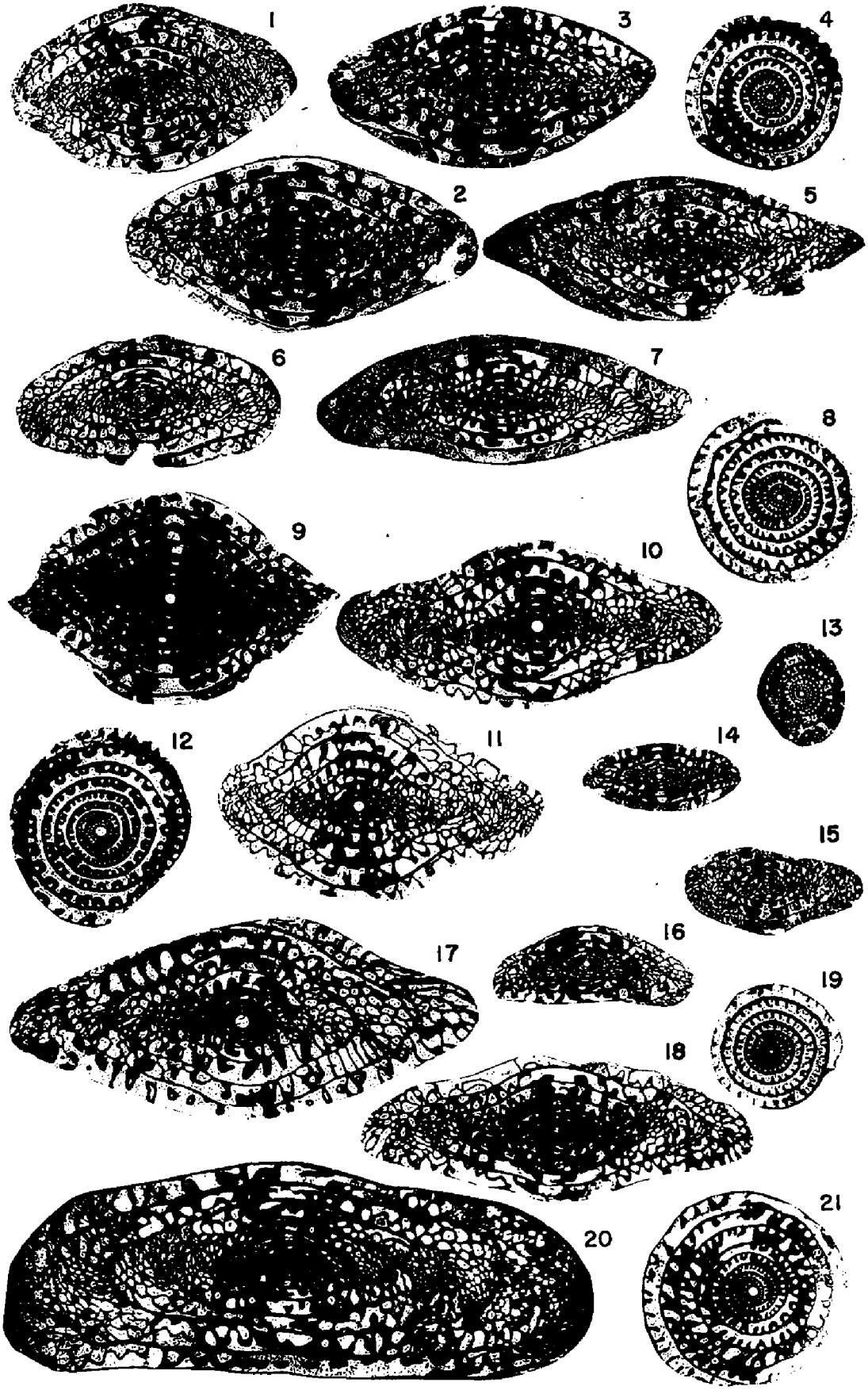

1
3
4
2
5
6
7
8
9
10
13
12
11
14
15
16
17
19
18
20
21

PLATE 3

(All views x 10)

Figures — Page

1-3. *Fusulina novamexicana* Needham, 1937 38
Spaniard limestone, SW ¼ of section 2, T. 14 N., R. 18 E., Muskogee County, Oklahoma. 1-2. Axial sections. 3. Sagittal section.

4-11. *Fusulina megista* Thompson, 1934 35
4-7. Pawnee limestone, NW ¼ of section 28, T. 20 N., R. 15 E., Tulsa County, Oklahoma. 4, 6, 7. Axial sections. 5. Sagittal section. 8-11. Wimer School limestone, NE ¼ of section 9, T. 28 N., R. 18 E., Craig County, Oklahoma. 8-10. Axial sections. 11. Sagittal section.

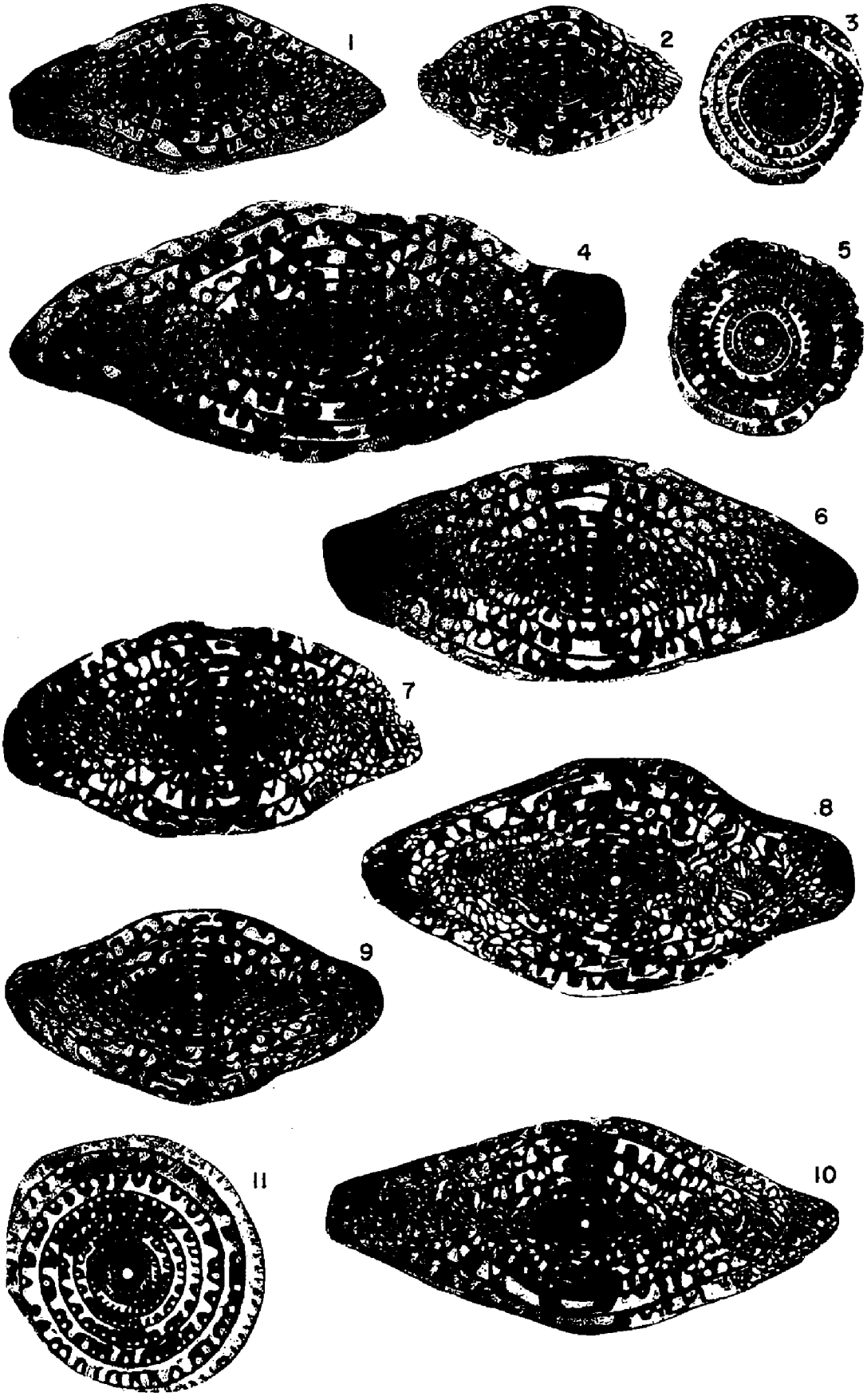

1
2
3
4
5
6
7
8
9
11
10

PLATE 4

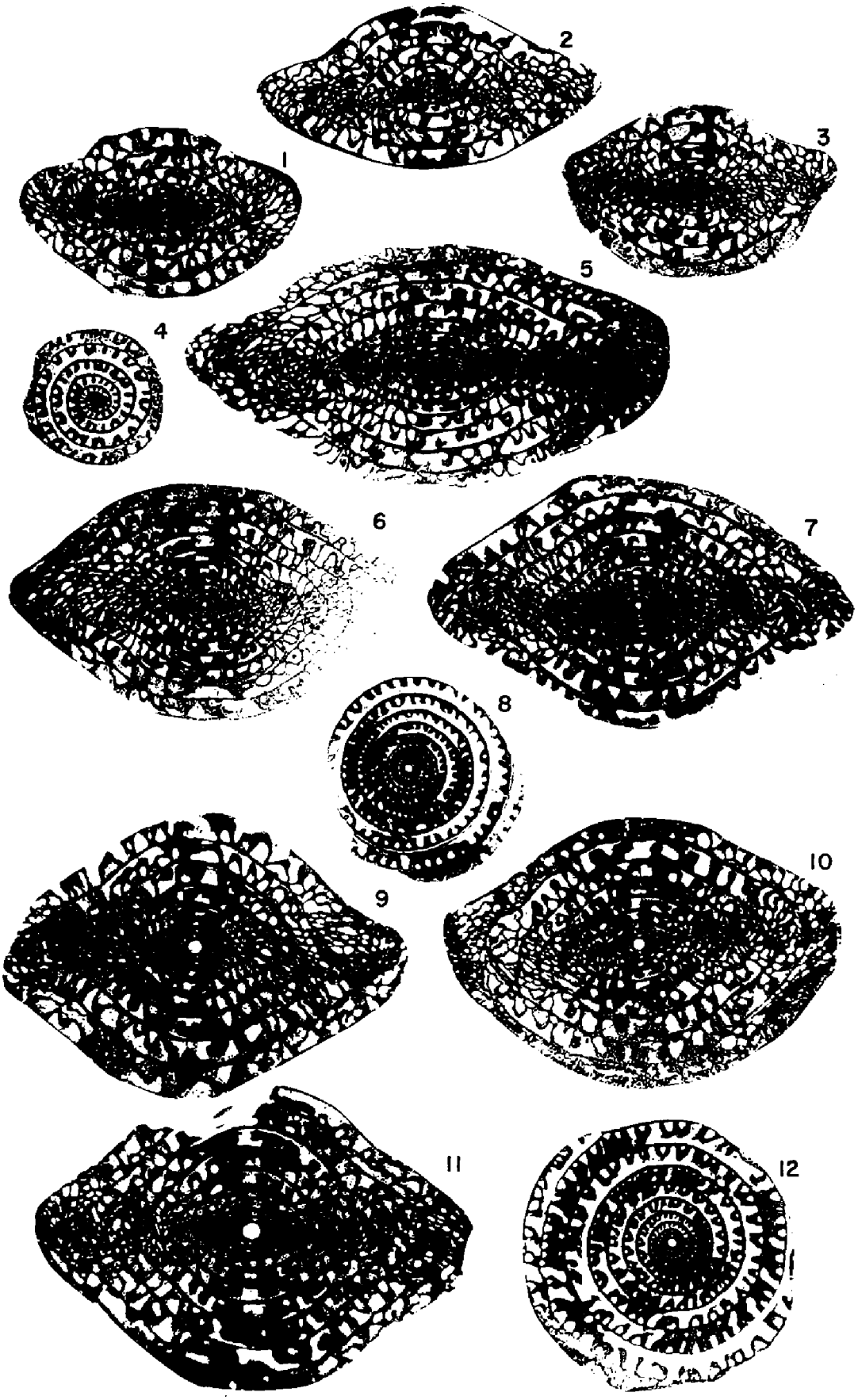
(All views x 10)

Figures Page

1-4. *Fusulina occultifons,* new species 40
Higginsville limestone, SE ¼ of section 28, T. 26 N., R. 17 E., Nowata County, Oklahoma. 1-3. Axial sections. 4. Sagittal section.

5-8. *Fusulina plena,* new species 41
Breezy Hill limestone, SE ¼ of section 3, T. 23 N., R. 17 E., Rogers County, Oklahoma. 6-7. Axial sections. 5. Tangential section. 8. Sagittal section.

9-12. *Fusulina tumida,* new species 43
Myrick Station limestone, NE ¼ of section 12, T. 27 N., R. 16 E., Nowata County, Oklahoma. 9-11. Axial sections. 10. Sagittal section.


1
2
3
4
5
6
7
8
9
10
11
12

INDEX