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**PENNSYLVANIAN FORAMINIFERA (EXCLUSIVE OF THE FUSULINIDAE)  
OF THE MARMATON GROUP IN SOUTHEASTERN KANSAS AND  
NORTHEASTERN OKLAHOMA**

By

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PENNSYLVANIAN FORAMINIFERA (EXCLUSIVE  
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NORTH-CENTRAL OKLAHOMA

by

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## ABSTRACT

The Marmaton (Pennsylvanian) shales and shale partings of limestones have a microfauna consisting of small brachiopods, bryozoans, conodonts, fusulinids and other foraminifers, gastropods, ostracodes, and worm fossils. Fragments of macrofossils, such as brachiopods, crinoid plates and stems, echinoid plates and spines, productid spines, and sponge spicules are also present. This report describes and illustrates 29 forms of Foraminifera (exclusive of Fusulinidae).

The report includes material collected from thirty-four localities in southeastern Kansas and north-central Oklahoma. A few samples were collected from the Cherokee shale, which underlies the Marmaton.

Smaller foraminifers are fairly well represented in the shales and shale partings within the Marmaton group. Only 61 of the 130 samples collected yielded foraminifers. The forms found in the Marmaton sediments include the following genera, named in order of approximate relative abundance; Tetrataxis, Ammodiscus, Climacammina, Deckerella, Polytaxis, Globivalvulina, Endothyra?, and Endothyranella, plus several others of lesser importance.

## INTRODUCTION

Purpose and Scope of the Investigation

Pennsylvanian Foraminifera (exclusive of the Fusulinidae) of the Mid-Continent Region have received very little attention during the last twenty-five years. It seemed important the relative abundance, stratigraphic distribution, and variety of smaller foraminifers in the rocks of the Marmaton group be determined.

This paper includes material collected from thirty-four localities in the Marmaton group of southeastern Kansas and north-central Oklahoma. In two localities, samples were collected from the Cherokee shale which underlies the Marmaton. In these two localities the samples were collected just below the base of the Blackjack Creek limestone member of the Fort Scott limestone formation.

Only the softer shales were sampled, but samples were collected from every suitable outcrop and from each bed from the Blackjack Creek limestone member of the Fort Scott limestone formation to the Holdenville shale formation at the top of the Marmaton. No attempt was made to sample harder material such as limestone because the amount of time required to collect and to process the samples in the laboratory would be excessive.

Occurrences of fusulinids, ostracodes, conodonts, crinoid fragments, and productid spines, plus a few others of lesser importance are noted in the description of the samples.

### Historical Review

Only limited work has been done on the Upper Paleozoic smaller foraminifers of the Mid-Continent Region or of other parts of the United States since 1930.

Erich Spandel (1901) was one of the first to write a larger paper on the Upper Paleozoic Foraminifera of the United States. He described five genera and eight species of smaller foraminifers and one genus of fusulinid from the lower Wabaunsee group near Hooser, Kansas.

Little further work was done until 1927, when Cushman and Waters published several papers on the Pennsylvanian foraminifers from Texas and Michigan. During the two year period 1927-28, Galloway and Harlton together published a few papers on Pennsylvanian Foraminifera of Oklahoma.

Five papers appeared in 1930 on the foraminifers of the Brownwood shale of Texas, Cisco group of Texas, Atoka formation of Oklahoma, Wetumka, Wewoka and Holdenville formations of Oklahoma, and the McCoy formation of Colorado. Harlton (1933) wrote a paper on the Johns Valley shale in Oklahoma which includes several forms of Foraminifera. Plummer (1945) described the smaller foraminifers of the Marble Falls, Smithwick and lower Strawn rocks in Texas. The latest published work was presented by Lehmann in 1953, primarily on foraminifers of the Glen Eyrie shale of Colorado.

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### PROCEDURES

#### Field

The area covered by the investigation includes Linn, Bourbon, Crawford, Neosho, Labette and Montgomery counties in southeastern Kansas and Craig, Nowata and Rogers counties in north-central Oklahoma (Fig. 1).

An attempt was made to collect shales from almost every outcrop listed by Jewett (1945), Moore (1937), and Alexander (1954). Most of the collecting localities were selected from Jewett's paper. Nearly a hundred localities were visited during July, October, and November, 1955, but samples from only thirty-four localities contained foraminifers. The shale samples were collected from road-side cuts, river banks, railroad cuts and steep hills.

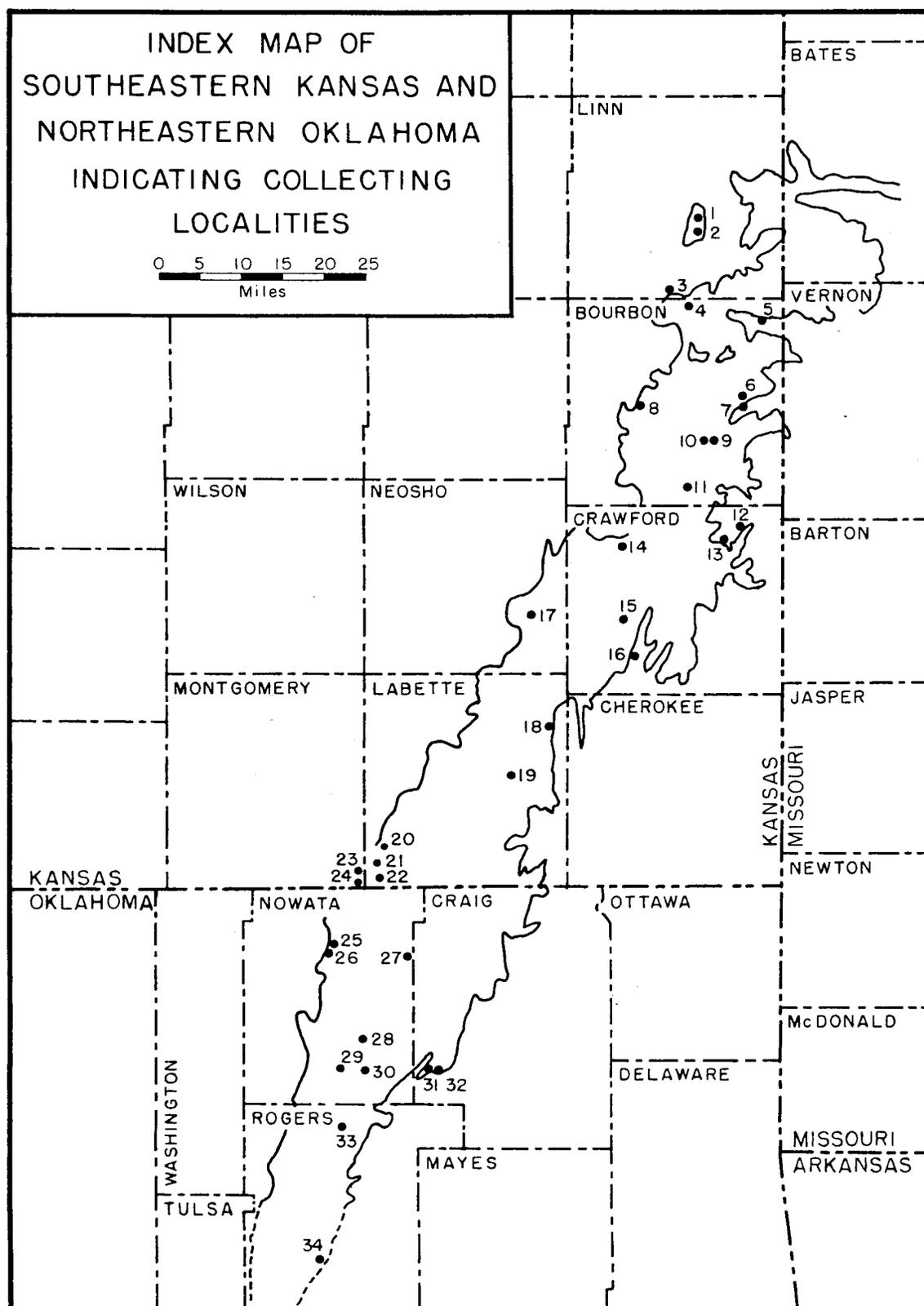


Fig. 1. Outcrop map of Marmaton group showing localities of samples.

Most of the shale samples of the Marmaton group were collected at intervals of three, six, nine, or twelve inches, depending on the thickness of shale members. For example, if the shale bed is twenty-four inches thick, samples would be taken at six inch intervals or if the bed is nine inches thick, it would be taken at three inch intervals. In other words, the thicker the shale bed, the larger the interval. The average weight of the shale sample was  $3\frac{1}{2}$  pounds.

#### Laboratory

The shale samples were completely dried before treatment with kerosene. The shale must be perfectly dry before treating with kerosene because kerosene is incapable of "pushing" the water out of the pores of wet shales. The dried shale samples are treated with kerosene for twenty-four hours. Next, the kerosene is drained off and the treated sample is soaked in water for two or more hours before heat is applied. Then, the shales are boiled with a small amount of sodium carbonate in order to facilitate disintegration. The shale is boiled, washed, treated with sodium carbonate, and decanted several times until most or all of the clay is removed.

#### Photography

The foraminifers were photographed at magnifications of around 25 diameters. A four-by five-inch New-Vue expanding bellows camera was mounted over a Bausch and Lomb biologic microscope for taking the

photomicrographs. Kodak Panatomic-X cut film was used in order to obtain maximum detail and for moderate contrast. The illuminating system consisted of two types of light; a strong yellow monochromatic light (Kodak Wratten Filter No. 15G) which was directed at a low angle over the fossil in order to bring out the details and also a Bausch and Lomb lamp set as a back light in order to balance the shadow. Most of the photomicrographs were exposed between 3.5 and 4.0 minutes at  $f/24$  or slightly less, using a 32 mm. objective.

#### STRATIGRAPHY OF THE MARMATON GROUP

Rocks of the Marmaton group constitute the upper part of the Desmoinesian Series (upper middle Pennsylvanian). The lower part of the Desmoinesian consists of rocks of the Cherokee group which underlies the Marmaton group. The upper boundary of the Desmoinesian Series is marked by a disconformity, which is inconspicuous in most localities. Rocks of the Missourian Series lie disconformably on the Marmaton (Fig. 2).

The Marmaton group contains four prominent limestone formations and four shale formations which are exposed in southeastern Kansas and north-central Oklahoma. The following classification is taken from Moore (1949.):

Pennsylvanian

Missourian Series

Desmoinesian Series

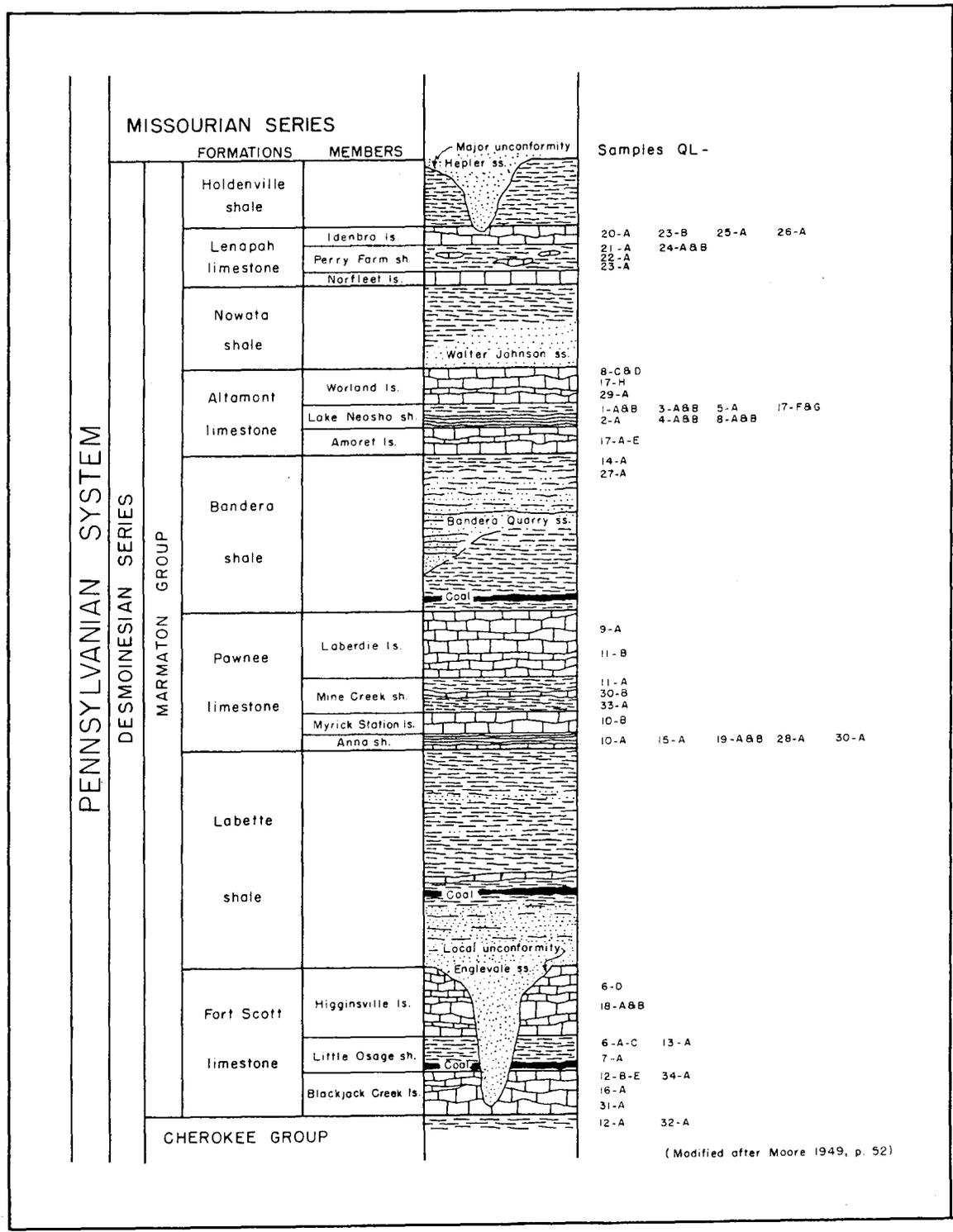


Fig. 2. Stratigraphic section indicating position of samples.

Marmaton group

Holdenville shale formation

Lenapah limestone formation

Idenbro limestone member

Perry Farm shale member

Norfleet limestone member

Nowata shale formation

Walter Johnson sandstone member

Altamont limestone formation

Forland limestone member

Lake Neecho shale member

Amoret limestone member

Bandera shale formation

Bandera Quarry sandstone member

Pawnee limestone formation

Lalerdie limestone member

Mine Creek shale member

Myrick Station limestone member

Anna shale member

Labette shale formation

Englevale sandstone member

Fort Scott limestone formation

Higginsville limestone member

Little Osage shale member

Blackjack Creek member

Cherokee group

Marmaton rocks are exposed in southeastern Kansas and north-central Oklahoma in a northeasterly belt ranging in width from 10 to 25 miles. The outcrop belt extends from Missouri into the northeastern part of Linn County, outcropping in Linn, Bourbon, Crawford, Cherokee, Neosho, Labette, and Montgomery counties, Kansas and into Nowata, Craig, and Roger counties of north-central Oklahoma. The general strike is N. 30° E. and the dip, which is westerly, averages about 20 feet per mile.

#### GENERAL STATEMENTS CONCERNING FORAMINIFERA

Foraminiferal remains were abundant in only five samples from the Blackjack Creek limestone member of the Fort Scott limestone formation and the Amoret limestone member of the Altamont limestone formation. In general, the foraminifers are more abundant from the lower part of the Marmaton group. This may be due partly to the less abundant exposed outcrops of the upper Marmaton. A few samples from the Nowata shale, Lenapah limestone, and Holdenville shale formations were devoid of foraminifers.

Most of the samples were found to have highly weathered calcareous material, and in these the chances of finding foraminifers are reduced. In the field it is almost impossible to determine whether the shales are partly weathered.

Bailey (1935) states that microfossils are about equally abundant in the light and dark colored shales, but a closer analysis of the distribution of forms brings out a few significant facts. In rocks of the Marmaton group, Foraminifera are considerably more abundant in lighter colored shales, particularly those of cream-yellow color. Several samples were collected from the shale partings of the Blackjack Creek limestone member of the Fort Scott limestone formation at Locality QL-12 which are light cream-yellow in color and which contain abundant foraminifers. The same holds true for the light-colored shales of the Amoret limestone at Locality QL-17. Many other light-colored shales from other parts of the Marmaton were almost devoid of foraminifers. This may be the result of weathering. Some hard black shales from the Anna shale of the Pawnee limestone formation were completely devoid of foraminifers. The greenish gray shales of the Lenapah limestone yielded few foraminifers.

Bailey (1935) states that foraminifers flourished in clear water. It seems that some of the shale partings of the Blackjack Creek limestone member of the Fort Scott limestone formation were deposited during a short interval of deep water. No foraminiferal genus was found to be restricted to the black shales. Bailey states that Globivalvulina and Spirilina are found in lighter colored shales. This hypothesis seems to hold well because most of the Globivalvulina came from lighter colored shales of Blackjack Creek limestone, Anna shale, Amoret limestone and Lake Neosho shale.

Bailey found that the foraminifers Tetrataxis and Deckerella are fairly abundant in the black shales of the lower Cherokee of Missouri. Bailey (p. 491) found foraminifers more abundant in the lighter-colored shales. In this study foraminifers were not abundant in the dark shales of the Fort Scott limestone formation.

Twenty-nine species and unnamed forms referable to twenty-one genera are described and discussed in this paper. Several of the forms were not named because the specimens are badly weathered, deformed, or broken.

Tetrataxis is the most common genus of foraminifers in rocks of the Marmaton group. Forty-nine of the 61 samples contain these foraminifers (Table 1). Tetrataxis is common in the lower part of the Marmaton group, particularly in the members of the Fort Scott limestone formation. Large Tetrataxis have been found in some of the shale partings in the formation. In general, Tetrataxis decreases in numbers and in overall size from the Fort Scott limestone formation to the Lenapah limestone formation, but a few large specimens do occur in the Perry Farm shale at Locality QL-24.

Ammodiscus semiconstrictus var. regularis Waters is the second most common foraminifer in the samples. It was found in 29 samples. It is widespread stratigraphically but is less abundant than Tetrataxis. It occurs in almost every kind of rock, including cream-yellow, black, and grayish colored shales. It is common in black shales, such as the Little Osage and Anna, but is less abundant in lighter colored shales. Where Tetrataxis occurs in large numbers,



Ammodiscus semiconstrictus var. regularis is less abundant. In the Blackjack Creek limestone at Locality QL-12, Ammodiscus is rare but Tetrataxis is abundant.

The textularid foraminifers including Climacammina and Deckerella are the third most abundant and widespread. In general, both genera are rare. They occur mainly in shale partings of the limestones, such as the Blackjack Creek, Laberdie, and Worland. These foraminifers occur very rarely in the thicker shale members of the Marmaton. They occur in shale partings with Tetrataxis. It is rare for these textularids not be associated with Tetrataxis. This association, however, does not hold for other areas, such as the Wayland shale member of the Graham formation of Texas and the Holdenville shale of Oklahoma.

Polytaxis laheei is usually associated with textularid foraminifers and occurs in the partings of the limestones. The occurrence of Polytaxis laheei is considerably less than the other three forms mentioned above. The type of sediments in which this foraminifer occurs in other areas has not been recorded.

Globivalvulina biserialis is next in order of abundance. It occurs in lighter-colored shales and in shale partings. It has been found in large numbers in the Amoret limestone (shale portion) at Locality QL-17. None has been found above the Altamont limestone formation.

Endothyra? ameradaensis is scarce, but it is fairly widespread stratigraphically. It occurs in lighter-colored shales. The same also applies to Endothyranella, which is next in order of abundance.

Several other foraminifera genera of still lesser abundance were studied such as Tuberitina, Ammovertella, Tolypamina, and Calciwertella, etc.

THE ROLE OF SMALLER PENNSYLVANIAN FORAMINIFERA IN  
STRATIGRAPHY

Cooper (1947, p. 261) states that the stratigraphic range of smaller Foraminifera is too long for them to be useful as index fossils. The fusulinids have proved to be of great value as zonal markers. The lack of value of the smaller foraminifers may be due in part to the lack of extensive studies. Also, Cooper points out that Helen J. Plummer has found, after extensive work on the Texas Pennsylvanian foraminifers, that most of the species have long vertical ranges that they are of little value in regional stratigraphy. Faunal assemblages apparently follow facies, and the faunas in general are repeated with repetition of facies in the column.

I wish to point out that species of Tetrataxis do not seem to go through any morphological or evolutionary changes from the lower to upper part of Pennsylvanian System. A general reduction of size in Tetrataxis from the lower to the upper part of Desmoinesian indicates little because a few of them are just as large throughout the sections. Tetrataxis conica of Cisco (Virgilian Equivalent) possess average dimensions of 0.65 mm. in diameter and 0.50 mm. in height. Some specimens of the Blackjack Creek limestone are of about the same size.

More work should be done on Pennsylvanian Foraminifers in order to see if there is any possibility of employing them as index or zonal fossils.

## SYSTEMATIC DESCRIPTIONS

## Family SACCAMMINIDAE

## Subfamily SACCAMMININAE

## Genus THURAMMINOIDES Plummer, 1945

## THURAMMINOIDES SP.?

## Plate 1, fig. 1

The test of Thuramminoides sp.? is subhemispherical in shape and is slightly compressed, having a diameter of 0.33 mm. and a height of 0.21 mm. The exterior surface is composed of very fine quartz grains.

Discussion.--Thuramminoides sp.? compares closely with T. sphaeroidalis Plummer, but there are a few differences between these forms. The average diameter of the specimens studied about 0.30 mm., but the specimens of Plummer's forms are 0.70 mm. in diameter. I did not find any entirely compressed specimens showing the internal structure like Plummer illustrated. Also most of my specimens did not exhibit a spongy appearance even in some of the weathered forms.

Occurrence.--Thuramminoides sp.? is rare in the Amoret limestone member of the Altamont limestone formation (QL-17-E) and in the Anna shale member of the Pawnee limestone formation (QL-28-A).

## Family AMMODISCIDAE

## Subfamily AMMODISCINAE

## Genus AMMODISCUS Reuss, 1861

## AMMODISCUS SEMICONSTRICTUS VAR. REGULARIS Waters

## Plate 1, fig. 2

Ammodiscus semiconstrictus var. regularis WATERS, 1927, Jour. Paleontology, vol. 1, p. 132, pl. 22, figs. 2a, 2b; ———, CUSHMAN AND WATERS, 1928, Jour. Paleontology, vol. 2, p. 359, pl. 47, fig. 3-5; ———, CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 40, pl. 2, figs. 13-15.

The test of Ammodiscus semiconstrictus var. regularis Waters is free, involute, biconcave, nearly circular and small, having a diameter up to 0.50 mm. and a thickness of 0.10 mm. The proloculus is very small and ovoid. The diameter of the tube increases gradually from the prolocular region to the aperture. There are four to six coils in an adult test. The sutures are deep and well defined. The wall is finely arenaceous. The circular aperture is at the terminus of the tubular chamber.

Discussion.—Ammodiscus semiconstrictus var. regularis differs from A. semiconstrictus in a few respects, particularly in the lack of the test constrictions, smaller size and fewer coils that are characteristic of the typical variety. There is a possibility that weathering removed the constricted portion of the test and gave it the appearance of A. semiconstrictus var. regularis instead of

A. semiconstrictus semiconstrictus. I found that many of the Marmaton specimens are oval in shape, which makes it easy to confuse them with another species. Actually this distortion is probably caused by such factors as weight of sediments and compression.

There are several species of Ammodiscus which appear to be alike in their general shape, form, size, manner of coiling, etc.;

A. bradynus Spandel, A. cheradospirus Loeblich and Tappan, A. dominicensis Bermudez, A. incertus var. discoideus (D'Orbigny) Loeblich and Tappan, A. nitidus Parr, A. parri Crespin, A. parianus Hedberg, A. planorbis Høglund, A. restinensis Berry, and A. semiconstrictus Cushman plus a few others. Some of these species are too long in range to be used stratigraphically, taking for example the geologic range of A. semiconstrictus which occurs from the Pennsylvanian to the Cretaceous. It must be kept in mind that it is easy to confuse the various species of Ammodiscus.

Occurrence.--Ammodiscus semiconstrictus var. regularis occurs widely throughout the Marmaton group and was found to be common in the Anna shale member of the Pawnee limestone formation (QL-19-A). It is rare in the Cherokee shale group (QL-12-A and 32-A), in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-B, 31-A, and 34-A), in the Little Osage shale member of the Fort Scott limestone formation (QL-6-A-C and 13-A), in the Higginsville limestone member of the Fort Scott limestone formation (QL-18-A), in the Anna shale member of the Pawnee limestone formation (QL-10-A and 15-A), in the Myrick Station limestone member of the Pawnee limestone

formation (QL-10-B), in the Mine Creek limestone member of the Pawnee limestone formation (QL-11-A, 30-B, and 33-A), in the Laberdie limestone member of the Pawnee limestone formation (QL-9-A), in the Bandera shale formation (QL-27-A), in the Lake Neosho shale member of the Altamont limestone formation (QL-1-B, 2-A, 17-F, and 17-G), in the Worland limestone member of the Altamont limestone formation (QL-8-C), in the Perry Farm shale member of the Lenapah limestone formation (QL-21-A, 22-A, and 23-A), and in the Idenbro limestone member of the Lenapah limestone formation (QL-20-A and 26-A). In Texas, this species is widespread in the upper Pennsylvanian and lower Permian rocks in Sutton County and occurs in the Wayland shale member of the Graham formation of the Cisco group, in Young, Jack and Coleman counties and in the Gaptank County, Texas. This species is present in the Dornick Hills formation in Oklahoma.

## Subfamily TOLYPAMMININAE

Genus TOLYPAMMINA Rhumbler, 1895

TOLYPAMMINA CONFUSA (Galloway and Harlton)

Plate 1, figs. 3-6

Ammovertella? confusa GALLOWAY AND HARLTON, 1928, Jour. Paleontology, vol. 2, p. 344, pl. 45, fig. 5.

Tolypammina confusa GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv., Circ. no. 21, p. 11, pl. 1, fig. 14.

The test of Tolypammina confusa (Galloway and Harlton) is attached, and irregularly coiled around an echinoid or productid spine or similar object. The tubular chambers usually adhere to spines which have a length of 0.63 to 1.46 mm., and the greatest diameter of the tube is 0.26 mm. The wall of the test is finely arenaceous. The aperture is nearly circular.

Discussion.--There is uncertainty about the specific identity of the specimens studied because they are not as irregularly coiled as the original types. The specimens studied are more regular in manner of coiling, than indicated by Cushman and Waters and Galloway and Harlton.

Galloway and Harlton (1928, p. 344) stated that Ammovertella? confusa may belong to genus Tolypammina. The differences between the two genera are not very striking. Most species of Tolypammina are not free. They are coiled in the early stages and become uncoiled and nearly straight in the later stages. Usually they are attached to a

plate, but some species of Ammovertella are coiled on foreign objects. More studies are needed to reclassify these foraminifers.

Occurrence.--Tolypammina confusa occurs rarely in the Marmaton rocks, and has been found in the Little Osage shale member of the Fort Scott limestone formation (QL-6-A-C and 7-A), in the Anna shale member of the Pawnee limestone formation (QL-28-A) and in the Worland limestone member of the Altamont limestone formation (QL-8-D). This form occurs at several places in the Middle Pennsylvanian rocks near Ardmore, Love County, Oklahoma.

TOLYPAMMINA INCLUSA (Cushman and Waters)

Plate 1, fig. 7

Psammophis inclusus CUSHMAN AND WATERS, 1927, Contr. Cushman Lab. Foram. Res., vol. 3, pt. 3, no. 46, p. 148-149, pl. 26, fig. 12.

Tolypammina inclusa GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv. Circ. no. 21, p. 11, pl. 1, figs. 12, 13.

Ammovertella inclusa CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 44-45, pl. 7, fig. 13.

The test of Tolypammina inclusa (Cushman and Waters) probably was attached to some calcareous surface or algae almost throughout its length. The length of the mass is 1.05 mm. and the width of the tube is 0.25 mm. The tubular chamber is twisted and coiled throughout its length. One side of the test is flat and the other side is rounded, indicating that it may have been attached. The exterior surface is coarsely textured, containing sand grains which are unevenly distributed throughout the test. The apertural opening probably is circular.

Discussion.--Cushman and Waters (1927a, p. 148-149) originally gave Tolypammina inclusa the generic name Psammophis, but it was later referred to Tolypammina. The original description differs from the one given by Galloway and Ryniker (1930), because the test in its early stages is close-coiled planispirally. In later stages the tube swings back and forth about the early portion. T. inclusa consists of a gradually enlarging tube which is coiled once at the beginning, and later is irregularly folded or meandering. The specimen examined compares with the description given by Galloway and Ryniker (1930) more closely than Cushman and Waters' descriptions having an irregularly meandering, loosely coiled, gradually enlarging tube and being quite closely agglutinated.

Occurrence.--Tolypammina inclusa is extremely rare in the Little Osage member of the Fort Scott limestone formation (QL-6-B). It also has been found in the South Bend shale of the Graham formation in Young County, Texas. It occurs abundantly in the Atoka formation in Oklahoma.

## Genus AMMOVERTELLA Cushman, 1928

## AMMOVERTELLA ELONGATA (Cushman and Waters)

## Plate 1, fig. 3

Calcitornella elongata CUSHMAN AND WATERS, 1928, Contr. Cushman  
Lab. Foram. Res., vol. 4, pt. 2, no. 59, p. 47 pl. 6, fig. 5.

Ammovertella elongata GALLOWAY AND RYNIKER, 1930, Oklahoma Geol.  
Surv. Circ. no. 21, p. 10, pl. 1, figs. 10, 11.

The test of Ammovertella elongata (Cushman and Waters) probably was once attached to a foreign object. A portion of one side of the test is flat and smooth. The length of the test is usually around 3.25 mm., and the largest diameter of the tube is 0.60 mm. In the early stages, the tube is coiled nearly twice planispirally, later becoming uncoiled, evolute, highly elongated and irregularly meandering. The diameter of the test increases in size gradually from the beginning to the end. Growth lines are very prominent on the exterior of the test. The wall is smooth, containing very fine sand grains. The aperture is circular and occurs at the terminal part of the tube.

Discussion.—The original illustration by Cushman and Waters does not compare closely with the illustration published by Galloway and Ryniker or with my specimens. The original description states that the tubular chamber bends back and forth on itself along a nearly straight axis. Neither Galloway and Ryniker specimens or my specimens possess this particular characteristic. The early portion of Ammovertella elongata is closely coiled planispirally, and later a portion is elongate and irregularly meandering.

Boie proposed the name Psammophis (1827) as a genus of snake in the family Colubridae. Schellwien (1898) proposed the name Psammophis for a foraminiferal genus. Cushman (1928) introduced the name Ammovertella for the homonym. Actually, these foraminifers exhibit a snakelike appearance. It is obvious that Schellwien was not aware of this preoccupied name proposed by Boie when he used Psammophis for a foraminiferal genus.

Occurrence.--Ammovertella elongata is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D). It is also found in the upper Pennsylvanian and lower Permian rocks of Sutton County, Texas and is present in the Graham formation of the Cisco group in Archer and Young counties, Texas. This species is abundant in the Atoka formation in Oklahoma.

Genus TREPEILOPSIS Cushman and Waters, 1928

TREPEILOPSIS GRANDIS (Cushman and Waters)?

Plate 1, fig. 9

Turritellella grandis CUSHMAN AND WATERS, 1927, Contr. Cushman Lab.  
Foram. Res., vol. 3, pt. 3, no. 46, p. 149, pl. 26, fig. 9.

Trepeilopsis grandis CUSHMAN AND WATERS, 1928, Contr. Cushman Lab.  
Foram. Res., vol. 4, pt. 2, no. 59, p. 38, pl. 4, figs. 12a, 12b, 13.

The test of Trepeilopsis grandis (Cushman and Waters)? probably was coiled around a productid or echinoid spine or similar object. The tubular chamber is tightly coiled in the early stages. The last

portion of the tube bends back and extends over the earlier coils in nearly a straight line. The length of the test is 0.67 mm. and its diameter is 0.53 mm. The greatest diameter of the tube is 0.21 mm. The exterior surface of the wall is finely arenaceous. The aperture is indistinct, and it probably is at the end of the tubular chamber.

Discussion.--Since my specimen is badly weathered and I am not sure of its material, it has been referred with question to Trepeilopsis grandis? On the whole, it seems to compare closely with the description and illustration given by Cushman and Waters (1928). The central portion of the test is almost completely filled by mineralized material.

Cooper (1947) named another species of Trepeilopsis that as T. mississippiana. The description by Cooper closely compares with the one given by Cushman and Waters (1928a) for T. grandis and with mine. T. mississippiana differs from T. grandis (Cushman and Waters) by the marked curvature of the latter portion of the tube and from T. spirans Cushman and Waters by the flaring aperture. Also, it can be separated from T. mississippiana by the smaller size, tighter coil, and the long taper of the latter.

Occurrence.--Trepeilopsis grandis? occurs rarely in Kansas in the Little Osage shale member of the Fort Scott limestone formation (QL-6-B). It has been described from the upper Strawn in Palo Pinto County, Texas.

## Family LITOLIDAE

## Subfamily BAPLOMERASMIINAE

## Genus AMMOBACULITES Cushman, 1911

## AMMOBACULITES? SP.

## Plate 1, fig. 10

The test of Ammobaculites? sp. is probably free, crozier shaped, and large, having a length of 1.60 mm. The diameter of the coil is 0.73 mm. and the diameter of the tube is 0.63 mm. This form shows two stages of growth which are coiled and then uncoiled. In the early or coiled stage, the test is more or less tightly coiled planispirally, and the chambers gradually increase in size. At the end of the fifth or sixth chamber of the last whorl, the shell becomes rectilinear. In this last stage, the chambers increase more slowly in size, and there are four rectilinear chambers. The sutures are distinct and narrow in the rectilinear stage but in the coiled portion the sutures are less prominent. The exterior finish of the wall is smooth and contains fine sand grains. The aperture is probably at the end of the test.

Discussion.—This form compares closely with the illustration given by Crespin and Parr (1947, p. 25, 27) for Ammobaculites woolnoughi from the Australian Permian. My specimen is nearly flat on one side which may indicate that the test was attached to some foreign object or was subjected to compression. Possibly the shell was subjected to compression because the sutures and chambers in the coiled portion

are not very distinctive. Crespin and Parr's specimens differ from mine in the following respects; the wall is more coarsely arenaceous, chambers seem to be slightly more inflated in general throughout the test and expand more rapidly in the rectilinear stage.

Occurrence.--Ammobaculites? sp. occurs rarely in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D).

Subfamily ENDOTHYRINAE

Genus ENDOTHYRA Phillips, 1846

ENDOETHYRA? AMERADAENSIS Harlton

Plate 1, figs. 11, 12

Endothyra ameradaensis HARTLTON, 1927, Jour. Paleontology, vol. 1, p. 19, pl. 2, figs. 4a-c.

Haplophragmoides ciscoensis HARTLTON, 1928, Jour. Paleontology, vol. 1, p. 307, pl. 52, fig. 5a, 5b.

Endothyra ameradaensis GALLOWAY AND HARTLTON, 1928, Jour. Paleontology, vol. 2, p. 347-348, pl. 45, figs. 9a-c; -----, WARTHIN, 1930, Oklahoma Geol. Survey Bull. no. 53, p. 20, pl. 1, fig. 12.

The test of Endothyra? ameradaensis Harlton is free, almost planispiral, small, and has a diameter up to 0.63 mm. The chambers of the test are slightly globular and the periphery is nearly angular. There are about ten chambers in the last whorl. The chambers seem to undergo a greater increase in size in the last whorl than in the penultimate whorl. The sutures are distinctly depressed, and they radiate from the umbilical regions. The chambers of earlier coils are

visible in some specimens. The exterior surface of the test is smooth and calcareous. The aperture is at the terminal wall of the last chamber, having a high arched opening at the base of the chamber.

Discussion.--Endothyra? ameradaensis has a wide range in size. Harlton (1927, p. 19) reported in his original description that specimens were found to have a maximum diameter of 0.75 mm. Later, he described some *Atoka* specimens which possess a diameter of 0.35 mm.

The chambers of the earlier coils of a few of my specimens are more nearly visible than Harlton's types. In the original illustration, the early chambers are not shown, but the description indicates their presence.

Occurrence.--Endothyra? ameradaensis is common in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E) and in the Amoret limestone member of the Altamont limestone formation (QL-17-B). This species is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D), in the Higginsville limestone member of the Fort Scott limestone formation (QL-18-A), in the Amoret limestone member of the Altamont limestone formation (QL-17-C and E), and in the Perry Farm shale member of the Lenapah limestone formation (QL-24-A). It questionably occurs in the Altamont limestone formation (QL-29-A), and in the Perry Farm shale member of the Lenapah limestone formation (QL-21-A). In Oklahoma, E.? ameradaensis occurs in the Upper Glenn formation in Carter County, and also in the *Atoka* formation in

Latimer County. This species is common in the Newoka formation in central Oklahoma. This form was reported as Haplophragmoides ciscoensis Harlton in the Cisco formation, Eastland County, Texas.

ENDOTHYRA? MEDIA Waters

Plate 1, figs. 13, 14

Endothyra media WATERS, 1927, Jour. Paleontology, vol. 1, p. 273, pl. 42, figs. 11a, b, and 12; ———, CUSHMAN AND WATERS, Texas Univ. Bull. no. 3019, p. 47, pl. 3, figs. 17a, 17b.

The test of Endothyra? media Waters is free, nearly planispirally coiled, convolute, and large, having a diameter of 1.10 mm. and a thickness of 0.55 mm. The chambers of the test are moderately inflated and the periphery is well rounded. There are nine chambers in the last formed whorl of most specimens. The sutures are distinct and depressed. The exterior surface of the test is rough and calcareous. The aperture consists of a wide arched opening, and it is located at the terminal wall of the last chamber.

Discussion.—My specimens of Endothyra? media compare closely with the description and figures given by Cushman and Waters (1930, p. 47) of specimens from the Cisco group of Texas. Both species differ in a few respects from those originally described. The Marmaton specimens have more inflated chambers and the last chamber is slightly more inflated than the preceding ones. Waters states that his specimens compare closely with the Canyon specimens, and he decided to place them under the same name. In general, the chambers of both the Cisco

specimens and the Marmaton specimens are slightly more inflated than the original types. The original description also states that the sutures are slightly depressed and distinct, but the Kansas specimens possess much more distinctive sutures.

It is difficult to observe the differences between Endothyra and Plectogyra (1950) from external examination because the later whorls embrace the earlier ones, thus obscuring the pattern of earlier coils. A sagittal thin section of the test should be made to determine the difference between these genera. Thin sectioning will show that Plectogyra coils in a three dimensional spiral pattern, but Endothyra is almost planispiral. On account of the scarcity of Endothyra? in Marmaton rocks, it was impossible to make thin sections. Most of the specimens seem to be nearly planispiral, and even the last chamber is in line with the preceding chambers.

Occurrence.--Endothyra? media is rare in the Amoret limestone member of the Altamont limestone formation (QL-17-D), and in the Perry Farm shale member of the Lenapah limestone formation (QL-22-A). This form questionably occurs in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E and 16-A), and in the Amoret limestone member of the Altamont limestone formation (QL-17-E). Also, E. media occurs in the Canyon group and in the lower Cisco group of Texas.

Genus GLYPHOSTOMELLA Cushman and Waters, 1928

GLYPHOSTOMELLA TRILOCULINA (Cushman and Waters)

Plate 1, fig. 15

Ammochilostoma (?) triloculina CUSHMAN AND WATERS, 1927, Contr.  
Cushman Lab. Foram. Res., vol. 3, pt. 3, no. 46, p. 152, pl. 27,  
figs. 5a, 5b.

Glyphostomella triloculina CUSHMAN AND WATERS, 1928, Contr. Cushman  
Lab. Foram. Res., vol. 4, pt. 2, no. 59, p. 54, pl. 6, figs.  
11-13; pl. 7, fig. 1; -----, CUSHMAN AND WATERS, 1930, Texas  
Univ. Bull. no. 3019, p. 78, pl. 9, figs. 1-9.

The test of Glyphostomella triloculina (Cushman and Waters) is free, nearly planispiral, and globular, having a diameter of 0.60 mm. and a thickness of 0.47 mm. The test consists of three globular chambers. Two of the chambers are smaller and the other is relatively large. The sutures are deep and distinct. The exterior surface of the wall is smoothly finished and also finely arenaceous. The aperture is slit-like and it occurs at the base of the chamber in the median line.

Discussion.--Cushman and Waters (1927) originally proposed the generic name Ammochilostoma for Glyphostomella triloculina. In some respects G. triloculina resembles Ammochilostoma galeata. Also G. triloculina compares with Bradyina both having two slit-like apertural openings at the base of the last chamber, a character particularly diagnostic of most species of Bradyina. In most cases the slit-like openings are larger and more numerous in species of Bradyina than in G. triloculina.

It should be pointed out that Bradyina holdenvillensis Harlton does not compare closely with type species of the genus, Bradyina nautiliformis Moeller for the following reasons. The test of B. holdenvillensis is not truly trochoid, has no distinctive umbilical area, and is not symmetrically coiled. It is suggested that B. holdenvillensis should be referred to the genus Glyphostomella.

Occurrence.--Glyphostomella triloculina occurs rarely in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E) and in the Worland limestone member of the Altamont limestone formation (QL-8-D). It is also found below the Gunsight limestone of the Graham formation in Young County, Texas and in the Cisco group of Texas.

Genus ENDOTHYRANELLA Calloway and Harlton, 1930

ENDOTHYRANELLA ARMSTRONGI Plummer

Plate 1, fig. 16

Endothyranella armstrongi PLUMMER, 1930, Texas Univ. Bull. no. 3019, p. 18, pl. 1, figs. 9a-c, 10, 11, 12a, 12b, 13a, 13b, 14a, 14b, 15; -----, LEHMANN, 1953, Contr. Cushman Found., vol. 4, pt. 2, no. 82, p. 70, pl. 11, figs. 4-6.

The test of Endothyranella armstrongi Plummer is free, crozier shaped, bilaterally symmetrical to slightly asymmetrical, and small; having a diameter of 0.52 mm. and a length of 0.62 mm. This form shows two stages of growth, coiled and then uncoiled. In the coiled stage, the chambers increase in size slowly, are inflated, numerous

and slightly embracing. There are seven to nine chambers in the final whorl of the coiled portion, and one or two chambers arranged in the uniserial portion. They increase in size only slightly in the rectilinear portion. The sutures are distinct and depressed throughout the test. The exterior surface is smooth and calcareous. The aperture is endothyrine in the coiled portion, and in the rectilinear portion consists of a small circular opening at the end of the last chamber.

Discussion.--I found that my specimens are larger than the specimens described by Plummer (1930, p. 18). The diameter given for Plummer specimens are 0.40 mm. for a fully developed coil and the length of three straight chambers is about 0.35 mm. My description for this foraminifer compares closely with the original description.

Occurrence.--Endothyranella armstrongi occurs rarely in the Altamont limestone formation (QL-29-A) and questionably in the Amoret limestone member of the Altamont limestone formation (QL-17-E). Also, E. armstrongi has been found in the Mineral Wells formation in the Strawn group, Texas. E. armstrongi occurs commonly in the Glen Eyrie shale of Colorado.

## ENDOTHYRANELLA MINUTA (Waters)

Plate 1, fig. 17

Ammobaculites minuta WATERS, 1927, Jour. Paleontology, vol. 1, p. 133, pl. 22, figs. 3a, 3b.

Endothyranella minuta GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv. Circ. no. 21, p. 14, pl. 2, figs. 5a-c, 6a-c.

The test of Endothyranella minuta (Waters) is free, crozier shaped, bilaterally symmetrical to slightly asymmetrical, and small, having a maximum diameter of 0.45 mm. The entire length of the test is 0.69 mm., and the length of the rectilinear portion is 0.25 mm. This form exhibits two stages of growth, coiled and then uncoiled. In the coiled portion, the chambers increase slowly in size, and they are slightly inflated, numerous, and slightly embracing. There are seven to nine chambers in the final whorl. In the rectilinear portion, there are three or four chambers arranged in a uniserial manner, and they increase in size slowly. The external furrows are distinct and deep throughout the test. The exterior surface of the test is smooth and calcareous. The aperture is at the end of the last chamber of the rectilinear portion and is circular.

Discussion.--Endothyranella minuta is closely similar to E. powersi (Harlton), but the former differs in being smaller and having fewer chambers to a whorl. E. powersi has eight to ten chambers to a whorl, and the chambers are more closely appressed. E. stormi (Cushman and Waters) from the middle Pennsylvanian of Texas, may be conspecific with E. minuta. E. armstrongi Plummer and E. minuta are similar except that the former is larger.

Originally, Waters (1927, p. 133) referred Endothyranella minuta to the genus Ammobaculites, but Galloway and Ryniker later referred it to Endothyranella because it has a calcareous wall. The exterior surface of most species of Ammobaculites are finely arenaceous and are composed of agglutinated sand grains.

Occurrence.--Endothyranella minuta is common in the Amoret limestone member of the Altamont limestone formation (QL-17-B and C) and in the Altamont limestone formation (QL-29-A). This species is rare in the Little Osage shale member of the Fort Scott limestone formation (QL-6-C), in the Anna shale member of the Pawnee limestone formation (QL-28-A), in the Amoret limestone member of the Altamont limestone formation (QL-17-A and E) and in the Lake Neosho shale member of the Altamont limestone formation (QL-5-A), and questionably occurs in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D), in the Amoret limestone member of the Altamont limestone formation (QL-17-D) and in the Worland limestone member of the Altamont limestone formation (QL-8-D). It has been found in the Dornick Hills formation in Carter County, Oklahoma. This species is very scarce in the Atoka formation in Oklahoma.

## Family TEXTULARIIDAE

## Subfamily TEXTULARIINAE

## Genus TEXTULARIA DeFrance, 1824

## TEXTULARIA EXIMINA (Eichwald)?

## Plate 2, fig. 1

Textularia eximina EICHWALD, 1860, *Lethaea Rossica*, vol. 1, p. 355, pl. 22, figs. 19a-d.

Textularia eximina H. B. BRADY, 1876, *Pal. Soc. Mon.* 30, p. 132-133, pl. 10, figs. 27-29; -----, CUSHMAN AND WATERS, 1930, *Texas Univ. Bull.* no. 3019, p. 53-54, pl. 4, figs. 9-11.

The test of Textularia eximina (Eichwald)? is free, slender, elongate, and sharply tapering, having a length of 1.18 mm., a breadth of 0.51 mm. and a thickness of 0.45 mm. The test is biserial. The test has six or seven pairs of chambers which gradually increase in size in a uniform manner. The sutures are less compressed and distinct in the early stages, but are more pronounced in the later portion. The exterior finish of the wall is rough and coarse, containing cemented quartz grains. The aperture probably is simple and of textularian type.

Discussion.--In some respects the general shape, arrangement of chambers, and appearance of my specimen compares closely with Cushman and Waters (1930) description of Textularia eximina except for its size and aperture. The aperture described by Cushman and Waters (1930) and the original description by Eichwald has an arched opening at the

inner margin of the final chamber, but my specimen does not have this type of opening. My specimen possesses "pore-like" openings, but they may not be true "pore-like" openings because these openings may have been occupied by sand grains which have broken away. The sizes and the number of chambers of Cushman and Waters' specimens do not compare with my specimen. I found that my specimen has a length of 1.15 mm. and possess about seven pairs of chambers, but the specimens described by Cushman and Waters measures about 0.75 mm. and having up to ten pairs of chambers. My specimen is broader than Cushman and Waters' specimens.

Brady (1876) identified Textularia eximina from the Carboniferous of England and the Carboniferous of Russia. Cushman and Waters claim that the specimens in the Cisco group of Texas agree closely with the excellent figures by Brady, which are much more satisfactory than Eichwald's figures.

Occurrence.--Textularia eximina? is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-31-A). This species also occurs in the Harpersville formation in a coal mine in the vicinity of New Castle, Texas and also in the South Bend shale member of the Graham formation in Young County, Texas.

## Genus PALAEOTEXTULARIA Schubert, 1920

## PALAEOTEXTULARIA? SP.

## Plate 2, fig. 2

The test of Palaeotextularia? sp. is free, very broad and bluntly tapering, having a length of 1.65 mm., a breadth of 0.91 mm. and a thickness of 0.67 mm. It is biserial throughout. The test has six or seven pairs of chambers which increase in size in a uniform manner. The sutures are compressed, distinct, and nearly parallel throughout. The wall is rough and coarse, containing quartz grains. The aperture probably consists of a low central slit at the base of the apertural face.

Discussion.--My specimen seems to compare closely with Palaeotextularia asper Cooper from the Kinkaid formation (Mississippian) from Johnson County, Illinois, in a few respects, but my specimen differs in size, shape, and arrangement of chambers. P. asper is small, having a length of almost 0.91 mm. and a breadth of 0.50 mm. and its sutures are more distinctly parallel and deeper. Also, the chambers of P. asper are slightly smaller in proportion to the size of the test than my specimen.

Palaeotextularia grahamensis Cushman and Waters does not compare closely with my specimen because P. grahamensis has a more narrowly tapering, elongated, and slightly smaller test.

Harlton (1933, p. 11) described textularian type of tests from the Johns Valley shale of Oklahoma as Paleotextularia sp. The specimens

described by Harlton differ from mine in some respects. Harlton's specimens are more robust, increases in size more abruptly, are more narrow, more widely tapering, and have chambers which increase more gradually. Harlton's specimens have a length of 1.44 mm. and a thickness of 0.58 mm. The dimensions of both forms are very similar. In general, the arrangement of chambers, deepness of sutures and general appearance of the Oklahoma and Kansas specimens compare closely.

Occurrence.--Palaeotextularia? sp. is scarce in the Little Osage shale member of the Fort Scott limestone formation (QL-6-C).

Genus CLIMACAMMINA H. B. Brady, 1873

CLIMACAMMINA CUSHMANI (Harlton)

Plate 2, figs. 3-5

Cribrostomum cushmani HARLTON, 1928, Jour. Paleontology, vol. 1, p. 308, pl. 53, figs. 1a-c.

Climacammina cushmani CUSHMAN AND WATERS, 1928, Jour. Paleontology, vol. 2, p. 124-126, pl. 17, figs. 1-3, 5-8.

The test of Climacammina cushmani (Harlton) is free, slightly elongated, and large. The largest specimen was found in the Marmaton rocks has a length of 2.00 mm, a breadth of 1.04 mm. and a thickness of 1.00 mm. This foraminifer shows two stages of growth, which are biserial and uniserial. In the early or biserial stage, the test shows a typical textularian development of chambers which gradually increase in size from the earliest portion to the end of the biserial stage. This

foraminifer usually has six pairs of chambers in the biserial portion. In the uniserial stage, the test has two to four chambers which are subcylindrical in shape. The periphery in the biserial stages are less rounded. The sutures are distinct and moderately depressed in both stages. The exterior walls of the test are coarsely textured and contain numerous sand grains scattered at random. In the biserial portion, the aperture is simple and textularian, but in the uniserial portion, the terminal wall has a central rounded aperture surrounded by a series of triangular openings with apices toward the central aperture. In the final stages the apertures become irregular, lobed and elongated and are scattered over the whole outer terminal wall.

Discussion.--Climacammina cushmani is easily distinguished from C. cylindrica Cushman and Waters. During the juvenile stage, both species undergo nearly the same apertural development, possessing a textularian type. A later stage with a single aperture in the middle of the face is followed by a three-apertural stage, which has a small central circular aperture surrounded by a series of six or seven triangular apertures with their apices toward the central aperture. At this point, the apertural development is complete for C. cylindrica, but not for C. cushmani. In the final stages of C. cushmani the openings of the aperture become irregular, lobed, elongated, and scattered over the whole outer terminal wall. In general, the apertural development, such as the apices of the triangular openings of C. cylindrica, is more regular than in C. cushmani. According to Cushman and Waters (1928) C. cylindrica is also distinguished from C. cushmani by its elongated

and subcylindrical test. For example, in the adult stage of C. cylindrica, the breadth and thickness of both are 0.60 mm. and have a length of 2.00 mm., but C. cushmani has a length of 2.25 mm., a breadth of 1.10 mm., and a thickness of 0.90 mm.

A number of Marmaton specimens of C. cushmani are slightly smaller than the ones found in Texas.

Occurrence.--Specimens of Climacammina cushmani are mostly from shale partings which are common in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D, 12-E, 16-A, and 31-A) and in the Worland limestone member of the Altamont limestone formation (QL-8-D). This species is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-34-A), in the Myrick Station limestone member of the Pawnee limestone formation (QL-10-B), in the Laberdie limestone member of the Pawnee limestone formation (QL-9-A) and in the Worland limestone member of the Altamont limestone formation (QL-17-E). C. cushmani has been found to occur in the Millsap Lake formation of the Strawn, found in the middle Kickapoo Falls limestone in Parker County, Texas.

## Genus DECKERELLA Cushman and Waters, 1928

## DECKERELLA CLAVATA Cushman and Waters

## Plate 2, figs. 6, 7

Deckerella clavata CUSHMAN AND WATERS, 1928, Jour. Paleontology, vol. 2, p. 130, pl. 19, figs. 1, 2, 5; -----, GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv. Circ. no. 21, p. 22, pl. 4, figs. 15a, 15b.

The test of Deckerella clavata Cushman and Waters is free, large and elongated. The length of the specimens range up to a maximum of 1.68 mm., having a breadth of 0.63 mm. and a thickness around 0.58 mm. This foraminifer consists of two stages of growth, biserial and uniserial. In the early or biserial stage, the test is highly tapered, slightly compressed, and the chambers show a distinct textularian development. The chambers gradually increase in size from the earliest portion to the end of the biserial stage. Usually this foraminifer has around six pairs of chambers in the biserial portion. In the uniserial stage, the test has two or three chambers which are almost cylindrical in shape. The periphery in the biserial stage are rounded. The sutures are distinct and slightly depressed in the biserial stage but are more depressed in the uniserial stage. The exterior finish of the wall is coarse and rough, containing grains of sand. In the terminal wall of the uniserial portion, the aperture consists of two elongated elliptical openings with a narrow partition in between.

Discussion.--Deckerella clavata differs from D. laheei Cushman and Waters in a few respects. In the biserial portion, D. clavata is

broader, more widely tapering. In general, D. laheei is longer than D. clavata and consists of four or five uniserial chambers, while the latter has about two or three.

In general, my specimens of Deckerella clavata are slightly smaller than the ones described by Cushman and Waters from the Millsap Lake formation of the Strawn of Texas. The specimens described by Galloway and Ryniker from the Atoka formation were found to have a length of 2.00 mm.

Occurrence.--Deckerella clavata has been found to be rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D), in the Higginsville limestone member of the Fort Scott limestone formation (QL-6-D), in the Mine Creek shale member of the Pawnee limestone formation (QL-30-B), in the Laberdie limestone member of the Pawnee limestone formation (QL-9-A), in the Lake Neosho shale member of the Altamont limestone formation (QL-4-B), and in the Idenbro limestone member of the Lenapah limestone formation (QL-20-A). In other localities this species has been found from the Millsap Lake formation of the Strawn, in Parker County, Texas. It is also common in the Atoka formation of Oklahoma.

## DECKERELLA LAHEEI Cushman and Waters

Plate 2, figs. 8-10

Deckerella laheei CUSHMAN AND WATERS, 1928, Jour. Paleontology, vol. 2, p. 130, pl. 18, figs. 1-14; pl. 19, figs. 3, 4, 6; -----, CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 57, pl. 11, figs. 1-14; -----, WARTHIN, 1930, Oklahoma Geol. Surv. Bull. no. 53, p. 31, pl. 2, figs. 3a-b.

The test of Deckerella laheei Cushman and Waters is free, large, and elongated. The length of the specimens ranges up to a maximum of 1.77 mm., with a breadth of 0.64 mm. and a thickness of 0.64 mm. This foraminifer consists of two prominent stages of growth from biserial to uniserial. In the early or biserial stage, the test is slightly tapered, slightly compressed and the chambers show a textularian development. The size of the chambers increases greatly from the earliest portion to the end of the biserial stage. This foraminifer possesses about seven or eight pairs of chambers in the biserial portion. The uniserial stage consists of four to six chambers which are subcylindrical in shape. The peripheral edge in the biserial stage are slightly angular. The sutures are not distinct and are only slightly depressed in the earlier part of the biserial portion, but are more compressed and distinct in the later part of the biserial and in the uniserial stages. The exterior finish of the wall is coarse and rough. In the terminal wall of the uniserial portion the aperture consists of two elongated elliptical openings with a narrow partition in between.

Discussion.--Deckerella laheei differs from D. clavata Cushman and Waters in a few respects. D. laheei is slightly more slender and more

nearly cylindrical in form. In the uniserial stage, it possesses up to five chambers while D. clavata has only two or three. D. clavata has greater breadth, particularly in the last portion of the biserial stage. Also, the biserial chambers of D. clavata are slightly larger in size. The biserial portion of D. clavata is more widely tapering than is D. lahsei. The apertural area of both species are similar, but they differ in size. The aperture of D. clavata is smaller.

Occurrence.--Deckerella lahsei is common in the Worland limestone member of the Altamont limestone formation (QL-8-D). This form is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D and 31-A), and in the Idenbro limestone member of the Lenapah limestone formation (QL-20-A). In Texas, this form is found in the Graham formation of the Cisco group in Stephens County, and in the Wayland shale member of the Graham formation in Young County. In Oklahoma, it is scarce in the Wewoka formation but is common in the Holdenville formation.

## Family OPTHALMIDIIDAE

## Subfamily CORNUSPIRINAE

## Genus CORNUSPIRA Schultze, 1854

## CORNUSPIRA? SP.

## Plate 2, fig. 11

The test of Cornuspira? sp. is planispirally coiled, compressed, involute, and somewhat large, having a diameter of 1.28 mm. This foraminifer was probably attached to some surface because one side of the test is flattened and the other side is slightly convex. The sutures are distinct and deep. The wall has a gritty appearance, containing fine sand grains.

Discussion.--Because Cornuspira? sp. is rare, full diagnosis was not possible. My specimen compares closely with the genotype species, C. thompsoni Cushman and Waters. My specimen resembles C. thompsoni in general shape, form of test, coil and composition. However, C. thompsoni differs from my specimen in having a smaller diameter and a smoother wall. C.? sp. does not show the proloculus, the early chambers, or the aperture. C. thompsoni is one of the very few coiled foraminifers which is convex on one side and round on the other, but most of the other species of Cornuspira are rounded on both sides. Some species of Cornuspira have a diameter of more than 2.00 mm.

Occurrence.--Cornuspira? sp. is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E).

## Genus ORTHOVERTELLA Cushman and Waters, 1928

## ORTHOVERTELLA? SP.

## Plate 2, fig. 12

The test of Orthovertella? sp. is free, irregularly coiled, and twisted, having a diameter of 0.68 mm. and the total length is 0.93 mm. In the juvenile stage, the tubular chamber may be close coiled, later becoming twisted into a confused mass. Finally, the shell becomes uncoiled and linear, piercing through the confused mass. The exterior surface is smooth and contains growth lines almost throughout the test. The aperture is probably circular, and appears at the end of the linear portion.

Discussion.--My specimen of Orthovertella? sp. compares closely with the type species of Orthovertella, O. protea Cushman and Waters. O.? sp. possesses growth lines, but other species of the genus, such as O. protea and O. sellardsi Plummer, lack this characteristic. In another respect O.? sp. is unlike O. protea because it does not seem to coil in many definite planes, but O.? sp. is irregularly twisted into a "Gordian Knot." After the tube gnarled around a few times, it became uncoiled and pierced through the contorted mass of tubes in a linear manner.

Occurrence.--Orthovertella? sp. is rare in the Mine Creek shale member of the Pawnee limestone formation (QL-11-A) and in the Little Osage shale member of the Fort Scott limestone formation (QL-6-B).

## Genus CALCIVERTELLA Cushman, 1928

## CALCIVERTELLA ADHERENS Cushman and Waters?

## Plate 2, fig. 13

Calcivertella adherens CUSHMAN AND WATERS, 1928, Contr. Cushman Lab.  
Foram. Res., vol. 4, pt. 2, no. 59, p. 48-49, pl. 6, fig. 7.

Amnovertella adherens (part) GALLOWAY AND RYNIKER, 1930, Oklahoma  
Geol. Surv. Circ. no. 21, p. 10, pl. 1, fig. 7.

Calcivertella adherens CUSHMAN AND WATERS, 1930, Texas Univ. Bull.  
no. 3019, p. 66, pl. 6, fig. 4.

The test of Calcivertella adherens Cushman and Waters? is meandering, large, and probably attached to some calcareous surface. The estimated total length of the meandering tube is around 3.50 mm. The diameter of the tube near the end is 0.31 mm. In the early stages, the tube probably was coiled nearly planispirally. In the uncoiled portion, the tube zigzags and the diameter of the tube gradually increases in size. The exterior wall of the test is smooth and finely arenaceous. The test possesses a circular type of aperture at the end of the tubular chamber, having a diameter of 0.25 mm.

Discussion.--Galloway and Ryniker (1930) changed the generic reference from Calcivertella to Amnovertella, but Cushman and Waters later (1930) retained the original generic reference in their paper on Texas forms. Galloway and Ryniker (p. 10) stated "whether or not the early undulating portion of the test is also coiled or merely undulating is scarcely of specific, much less of generic importance." The tube of the specimens described by Cushman and Waters more or less zigzags rather

than undulates as indicated by illustration and description by Galloway and Ryniker. Galloway and Ryniker specimens and to those of Cushman and Waters are not entirely similar. It is suggested that Galloway and Ryniker should not have emended the generic name from Calcivertella to Ammovertella, but they should have given their specimens a new species name.

I am not certain that my specimen is referable to Calcivertella adherens? because of several reasons. It compares closely with the description of Texas specimens by Cushman and Waters (1930, p. 66), having a irregularly coiled test in the early portion, and a last formed tube that tends to become straight. My specimen does not sinuate as strongly as the specimen described by Cushman and Waters, it does not seem to be entirely attached because a large portion of the tube is rounded, and it has a peculiar sinuous characteristic. There is a possibility that it may be a fossil worm. Several of the abovementioned specimens do not seem to be foraminifers and may be fossil worms. I did find several specimens of Spirobis sp. along with C. adherens?. More work is needed to reclassify several of these "foraminifers", such as Ammovertella undulata, A. elongata, Tolypamnina inclusa, etc., all of which exhibit sinuous characteristics and have growth lines.

Occurrence.--Calcivertella adherens? is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D and 12-E) and in the Anna shale member of the Pawnee limestone formation (QL-28-A). This species was found rarely in the Graham formation of the Cisco group in Young County, Texas. It also occurs in the Atoka rocks of Oklahoma.

## Family PROCHAMINIDAE

## Subfamily TETRATAXINAE

## Genus GLOBIVALVULINA Schubert, 1920

## GLOBIVALVULINA BISERIALIS Cushman and Waters

## Plate 3, figs. 1, 2

Globivalvulina biserialis CUSHMAN AND WATERS, 1928, Contr. Cushman Lab. Foram. Res., vol. 4, pt. 3, no. 61, p. 64-65, pl. 8, figs. 7a-c; -----, CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 70, pl. 8, figs. 1-5; -----, GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv. Circ. no. 21, p. 16, pl. 2, figs. 10a, 10b, 11; pl. 3, figs. 2a-c; -----, LEHMANN, 1953, Contr. Cushman Found., vol. 4, pt. 2, no. 82, p. 73, pl. 12, figs. 10-12.

The test of Globivalvulina biserialis Cushman and Waters is free, more or less hemispherical in shape, and small, having a diameter up to a maximum of 0.73 mm. and a maximum height of 0.48 mm. The chambers of the test are nearly crescentic in appearance and are slightly inflated. The chambers alternate on both sides of the elongate axis producing a biserial arrangement on the dorsum. The final chamber is less inflated, and it extends nearly across the periphery. Each chamber of the test overlaps the preceding ones. The sutures are very distinct and deep. The exterior surface of the test is smoothly finished and calcareous. The aperture is on the ventral side, consisting of a more or less crescentic type of opening.

Discussion.--Globivalvulina biserialis possesses a distinctive "braided" appearance of chambers which is particularly diagnostic

of the species itself. The chambers are arranged in a biserial manner along a nearly straight axis. G. biserialis is unlike other species such as G. bulloides (Brady), G. cora Harlton, G. gaptankensis Harlton, and G. ovata Cushman and Waters, because it has more elongated and slightly inflated chambers. The test of these other species possess more globular and more spherical chambers.

Globivalvulina biserialis and G. ovata are distinctly different because the chambers of G. ovata seem to be normal to each other.

Occurrence.--Globivalvulina biserialis is common in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E), in the Amoret limestone member of the Altamont limestone formation (QL-17-D and E), and in the Altamont limestone formation (QL-29-A). This species is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D and 16-A), in the Anna shale member of the Pawnee limestone formation (QL-28-A), and in the Lake Neosho shale member of the Altamont limestone formation (QL-3-A and B). G. biserialis occurs in the Bunger limestone of the Graham formation and other Cisco group rocks of Texas and is common in the Atoka formation of Oklahoma. This species is rare in the Glen Eyrie shale of Colorado.

## GLOBIVALVULINA OVATA Cushman and Waters

Plate 3, figs. 3, 4

Globivalvulina ovata CUSHMAN AND WATERS, 1928, Contr. Cushman Lab. Foram. Res., vol. 4, pt. 3, no. 61, p. 65, pl. 8, figs. 8a-c; -----, CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 71, pl. 8, figs. 6-11; -----, LEHMANN, 1953, Contr. Cushman Found., vol. 4, pt. 2, no. 82, p. 73-74, pl. 12, figs. 7-9.

The test of Globivalvulina ovata Cushman and Waters is free, more or less ovate, and small, having a diameter of 0.50 mm. and a height of 0.30 mm. The chambers of the test are inflated and nearly globular except for the final chamber. The final chamber is more elongated and larger than any preceding chambers and extends nearly across the periphery. Chambers of the test are arranged in a nearly biserial manner, and they overlap. The sutures are deep distinct. The exterior surface of the test is smoothly finished and calcareous. The aperture is on the ventral side, consisting of a more or less crescentic opening.

Discussion.--Globivalvulina ovata differs from G. biserialis Cushman and Waters in a few respects. It has broader exposures of chambers on the surface and the biserial arrangement of chambers is less pronounced. The test of G. bulloides (Brady) is more oblong in shape and the chambers are more spherical and inflated than in G. ovata. The chambers of G. gaptankensis Harlton is much more nearly spherical than either G. ovata or G. bulloides. Most species of Globivalvulina are in the same general size range from 0.30 to 0.50 mm.

Occurrence.--Globivalvulina ovata is common in the Amoret limestone member of the Altamont limestone formation (QL-17-E), and is rare in the Amoret limestone member of the Altamont limestone formation (QL-17-D) and in the Lake Neosho member of the Altamont limestone formation (QL-3-B). G. ovata has been found in the Graham formation of the Cisco group in Young County, Texas. This species is rare in the Glen Eyrie shale in Colorado.

Genus TETRATAXIS Ehrenberg, 1854

TETRATAXIS CONICA Ehrenberg

Plate 3, figs. 5-8

Tetrataxis conica EHRENEBERG, 1854, Mikrogeologie Leipzig, Deutschland, p. 24, pl. 37 (group 11), fig. 12; -----, HARLTON, 1927, Jour. Paleontology, vol. 1, p. 22-23, pl. 4, figs. 5a-d; -----, CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 75, pl. 7, figs. 2a, 2b, 4, 5a, 5b; -----, LEHMANN, 1953, Contr. Cushman Found., vol. 4, pt. 2, no. 82, p. 72, pl. 12, figs. 1-3.

The test of Tetrataxis conica Ehrenberg is free, conical in shape, with the central portion highly spired and forming an equilateral triangle in lateral view. Forty-four specimens were found to have an average diameter of 0.68 mm. and a maximum diameter of 1.03 mm. These specimens also have an average height of 0.57 mm. and a maximum height of 0.75 mm. The form ratios of these forty-four specimens range from 1.10:1 to 1.44:1, and the average is 1.24:1. The chambers are numerous and poorly defined in the earlier whorls, but become more distinct and are elongated in shape in the last few whorls. The sutures are barely

distinct in earlier stages but become more distinct and depressed in the outer region. The exterior surface of the wall is smoothly finished and finely arenaceous. The aperture is on the ventral side and has a simple and nearly trilobate type of opening. The ventral area is slightly concave in the central portion.

Discussion.--Tetrataxis millsapensis Cushman and Waters differs from T. conica in a few respects. Its sutures are more distinct, the general size is slightly larger, and it has a sharper spire.

The form ratios of both Tetrataxis conica and T. millsapensis are similar. Also, Cushman and Waters (1928a, p. 51) stated that T. millsapensis is a distinctively larger species and seems to be characteristic of zones in the lower Pennsylvanian. A large number of my specimens seem to compare closely with the specimens described by Ehrenberg, but they do not seem to compare with Cushman and Waters specimens from the Ciace group of Texas, for their specimens have coarsely arenaceous exterior walls.

Some specimens of T. conica have been found to have ratios greater than 1.40:1. These high ratios are caused by weathering and by compression of sediments. The spire of most of my specimens lack the original sharpness.

Occurrence.--Tetrataxis conica is common in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D and E, 31-A and 34-A), in the Higginsville limestone member of the Fort Scott limestone formation (QL-6-D) and in the Laberdie limestone member of the Pawnee limestone formation (QL-9-A). This species is rare in the

Cherokee shale group (QL-12-A), in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-C and 16-A), in the Higginsville limestone member of the Fort Scott limestone formation (QL-13-B), in the Anna shale member of the Pawnee limestone formation (QL-15-A), in the Myrick Station limestone member of the Pawnee limestone formation (QL-10-B), in the Lake Neosho member of the Altamont limestone formation (QL-17-G), in the Worland limestone member of the Altamont limestone formation (QL-8-C and D) and in the Idenbro limestone member of the Lenapah limestone formation (QL-25-A and 26-A). It also occurs in the Anardarche limestone of the Upper Glenn formation in Carter County, Oklahoma near Ardmore. This species is well developed in some parts of the Graham formation of the Cisco group in Young County, Texas. T. conica is scarce in the Glen Eyrie shale of Colorado.

TETRATAXIS CORONA Cushman and Waters

Plate 3, fig. 11

Tetrataxis corona CUSHMAN AND WATERS, 1928, Contr. Cushman Lab. Foram. Res., vol. 4, pt. 3, no. 61, p. 65, 67, pl. 8, figs. 10a, 10b; -----, CUSHMAN AND WATERS, 1928, Jour. Paleontology, vol. 2, p. 371, pl. 49, fig. 12; -----, CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 75-76, pl. 7, figs. 3, 8; -----, GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv. Circ. no. 21, p. 17-18, pl. 3, figs. 5a-c; -----, LEHMANN, 1953, Contr. Cushman Found. vol. 4, pt. 2, no. 82, p. 72-73, pl. 12, figs. 4-6.

The test of Tetrataxis corona Cushman and Waters is free, nearly conical in shape, with the central portion moderately spired, and the outer region is spreading and flared. The diameter of a typical test

is 0.65 mm. and the height is 0.20 mm. In the early stages, the chambers are indistinct, but they become more distinct in the last few whorls. The exterior surface of the wall is smoothly finished and finely arenaceous. The aperture is on the ventral side, having a trilobate type of opening. The apertural area is slightly convex in the central portion but more flat in the outer portion.

Discussion.--My specimens compare closely with the description given by Cushman and Waters (1928b, p. 65, 67) but have a small central prominent spire and later spreading chambers. My specimens are badly weathered and slightly compressed.

Textrataxis scutella Cushman and Waters differs from T. corona in having a larger diameter and a much smaller spire and its form ratio is nearly twice as large as T. corona. T. scutella appears to be nearly flattened.

Galloway and Ryniker (1930, p. 17) seem to have a different species of Tetrataxis rather than T. corona because it does not seem to compare closely with the original description and illustration of that form. Its lateral slope are not as concave. Their species lacks a distinctive central spire, and the sutures are very distinct throughout the entire test even in the earlier whorls and its chambers are larger in breadth and less elongated.

Occurrence.--Tetrataxis corona is rare in the Idenbro limestone member of the Lenapah limestone formation (QL-25-A). This species questionably occurs in the Cherokee group shale (QL-32-A) and in the Lake Neosho shale member of the Altamont limestone formation (QL-3-A).

This form also has been found in the upper Pennsylvanian and lower Permian rocks in a well in Sutton County, Texas, Wayland shale member of the Graham formation in Young County, Texas and it has been found to occur as high in the Cisco group as the Camp Colorado limestone of the Pueblo formation in Coleman County, Texas. Galloway and Ryniker revealed the presence of this foraminifer in the Atoka formation of Oklahoma. T. corona has been found to occur rarely in the Glen Eyrie shale of Colorado.

TETRATAXIS MAXIMA Schellwien

Plate 4, figs. 1, 2

Tetrataxis maxima SCHELLWIEN, 1898, Paleontogr. Bd. 44, Lief. 5-6, p. 274, pl. 24, figs. 5-10; -----, GALLOWAY AND HARTLON, 1928, Jour. Paleontology, vol. 2, p. 355, pl. 46, figs. 7a-d.

The test of Tetrataxis maxima Schellwien is free, its sides slope slightly inward, it is conical in shape with the central portion moderately spired, and it forms an isosceles triangle in lateral view. The diameter of two typical specimens were found to have an average of 1.32 mm. and a maximum of 1.60 mm. They also have an average height of 0.75 mm. and a maximum of 1.00 mm. In the early stages the chambers are very narrow and elongated, but in later stages they become slightly wider and more elongated. The sutures are in general quite distinct. The exterior surface of the wall is smoothly finished and finely arenaceous. The complex aperture is located on the ventral side.

Discussion.--Tetrataxis maxima can be distinguished easily from T. maxima var. depressa Schellwien. It is only slightly depressed. In lateral view T. maxima is nearly straight from the spire to the periphery.

Occurrence.--Tetrataxis maxima is common in the Worland limestone member of the Altamont limestone formation (QL-8-D). This species is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-34-A), in the Mine Creek shale member of the Pawnee limestone formation (QL-30-B), in the Lake Neosho shale member of the Altamont limestone formation (QL-5-A), and in the Perry Farm shale member of the Lenapah limestone formation (QL-24-A). It questionably occurs in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D), in the Lake Neosho shale member of the Altamont limestone formation (QL-3-B), and in the Laberdie limestone member of the Pawnee limestone formation (QL-9-A). T. maxima occurs in the Wapanucka limestone (shale portion), Pittsburg County, Oklahoma.

TETRATAXIS MAXIMA VAR. DEPRESSA Schellwien

Plate 3, figs. 9, 10

Tetrataxis maxima var. depressa SCHELLWIEN, 1898, Palaeontogr. Bd. 44, Lief. 5-6, p. 275, pl. 24, figs. 11, 11a; -----, GALLOWAY AND HARTON, 1928, Jour. Paleontology, vol. 2, p. 356, pl. 46, figs. 8a-c.

The test of Tetrataxis maxima var. depressa Schellwien is free and more or less conical in shape, with the central portion distinctly

spired. In the early stages the test is cone shaped, but it becomes more spreading and flaring in the latter portion. The diameter of thirty-nine specimens were found to have an average of 0.86 mm. and a maximum of 1.15 mm. These specimens also have an average height of 0.48 mm. and a maximum of 0.70 mm. The form ratios of these thirty-nine specimens range from 1.60:1 to 2.00:1, and the average is 1.85:1. The chambers are indistinct in the earlier portion but are slightly more distinct in the later stages. The sutures are indistinct and slightly depressed. In some specimens the sutures are more distinct in the later portion of the test. The exterior surface of the wall is smoothly finished and finely arenaceous. The aperture is on the ventral side, having a simple and trilobate type of opening. The ventral area is slightly concave in the central portion.

Discussion.--Galloway and Harlton (1928, p. 356) gave the dimensions of their Oklahoma specimens of Tetrataxis maxima var. depressa as follows; 0.78 mm. in diameter and 0.34 mm. in height. The ratio of the Oklahoma forms average 2.3:1, but my specimens average 1.85:1.

Tetrataxis corona Cushman and Waters and T. concava Galloway and Ryniker differ from T. maxima var. depressa in a few respects. They have more depressed and more distinctive sutures, larger chambers in proportion to size, and slightly smaller spire. Some specimens of T. maxima var. depressa appear to be more depressed near their periphery than others.

Occurrence.--Tetrataxis maxima var. depressa is common in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-34-A), in the Higginsville limestone member of the Fort Scott limestone formation (QL-6-D), in the Anna shale member of the Pawnee limestone formation (QL-19-B and 28-A), in the Amoret limestone member of the Altamont limestone formation (QL-17-A), in the Lake Neosho shale member of the Altamont limestone formation (QL-1-B and 3-A), in the Worland limestone member of the Altamont limestone formation (QL-17-H), in the Altamont limestone formation (QL-29-A) and in the Perry Farm shale member of the Lenapah limestone formation (QL-23-A and 24-A). This species is rare in the Cherokee shale group (QL-12-A), in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-C, 12-D, and 31-A), in the Anna shale member of the Pawnee limestone formation (QL-15-A, 19-A, and 30-A), in the Mine Creek shale member of the Pawnee limestone formation (QL-11-A and 30-B), in the Laberdie limestone member of the Pawnee limestone formation (QL-9-A), in the Amoret limestone member of the Altamont limestone formation (QL-17-C-E), in the Lake Neosho shale member of the Altamont limestone formation (QL-3-B, 5-A, 8-A, 8-B, and 17-G), in the Worland limestone member of the Altamont limestone formation (QL-8-D), in the Perry Farm shale member of the Lenapah limestone formation (QL-22-A and 24-B) and in the Idenbro limestone member of the Lenapah limestone formation (QL-20-A, 23-B, and 26-A). It questionably occurs in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E), in the Laberdie limestone member of the Pawnee limestone formation

(QL-11-B), in the Bandera shale formation (QL-14-A), in the Anoret limestone member of the Altamont limestone formation (QL-17-B), in the Lake Neosho shale member of the Altamont limestone formation (QL-1-A, 2-A, and 4-A) and in the Perry Farm shale member of the Lenapah limestone formation (QL-21-A). T. maxima var. depressa has been found to occur in the Wapanucka limestone (shale portion), Pittsburg County, Oklahoma.

Genus POLYTAXIS Cushman and Waters, 1928

POLYTAXIS LAHEEI Cushman and Waters

Plate 4, figs. 3-6

Polytaxis laheei CUSHMAN AND WATERS, 1928, Contr. Cushman Lab. Foram. Res., vol. 4, pt. 2, no. 59, p. 51, pl. 7, fig. 7; -----, WARTHIN, 1930, Oklahoma Geol. Surv. Bull. no. 53, p. 26, pl. 1, figs. 21a, 21b.

The test of Polytaxis laheei Cushman and Waters is free, sub-circular, and plano-convex, with the central portion narrowly and low spired. The diameter of four specimens average 1.40 mm. and the maximum diameter is 1.77 mm. In the early stages of the test, there are two or three elongated polygonal chambers in a whorl, but the number of chambers per whorl increases gradually from the central portion to the outer portion. In the last formed whorl, there are six or seven elongated polygonal chambers. In general, the length and width of the chambers increases nearly proportionally from the spire. The periphery is rounded. The sutures are very distinct and depressed throughout the test, except the

low spired region. In some specimens these sutures do not show well because of weathering. The exterior surface of the wall is smoothly finished and finely arenaceous. The aperture is on the ventral side, having a very complex structure. The ventral side is slightly depressed.

Discussion.--Cushman and Waters (1926, p. 51) gave no reasons for erecting the genus Polytaxis. They stated that species such as Tetrataxis multiloculata Cushman and Waters (1927a, p. 153) should be known as P. multiloculata and Schellwien's Tetrataxis maxima var. depressa belongs to Polytaxis. This change has been based on the fact that the later chambers are spreading and many chambers make a series about the peripheral edge.

Tetrataxis multiloculata differs from Polytaxis laheei in a few respects. The later chambers of P. laheei are much more elongated and the ventral side of P. laheei has triangular or polygonal projections of the chambers overlapping toward the center. Cushman and Waters also stated that the genus has developed from Tetrataxis and represented a specialized structure. P. laheei has six chambers in the last whorl while T. multiloculata has twelve. In general both have the same size range, and the same characteristics, structures and form.

Warthin (1930) states that Polytaxis laheei is distinguished from P. multiloculata, which occurs in slightly higher beds in Texas, by its thin edged and depressed unthickened sutures.

Occurrence.--Polytaxis laheei is common in the Higginsville limestone member of the Fort Scott limestone formation (QL-6-D), in the Anna shale member of the Pawnee limestone formation (QL-19-B), in

the Myrick Station limestone member of the Pawnee limestone formation (QL-10-B), in the Laberdie limestone member of the Pawnee limestone formation (QL-9-A), and in the Worland limestone member of the Altamont limestone formation (QL-8-D). This species is rare in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D and 12-E) and in the Worland limestone member of the Altamont limestone formation (QL-8-C), and questionably occurs in the Mine Creek shale member of the Pawnee limestone formation (QL-11-A) and in the Lake Neosho shale member of the Altamont limestone formation (QL-8-A). P. laheeii also occurs in the Millsap Lake formation of the Strawn group in Parker County, Texas. It is common in the Holdenville formation in Oklahoma.

Family PLACOPSILINIDAE

Subfamily PLACOPSILININAE

Genus PLACOPSILINA d'Orbigny, 1850(1849 MS.)

PLACOPSILINA CISCOENSIS Cushman and Waters?

Plate 4, fig. 7

Placopsilina ciscoensis Cushman and Waters, 1930, Texas Univ. Bull. no. 3019, p. 74, pl. 12, figs. 7, 9.

The test of Placopsilina ciscoensis Cushman and Waters? is attached to a calcareous surface. The chambers are hemispherical in shape having a diameter around 0.40 mm. The length of the specimen is 0.55 mm.,

and the chambers are arranged in a nearly uniserial manner. The sutures are not well defined because the chambers are not in contact with one another. The wall is rough and coarse, and it contains very fine arenaceous material with calcareous cement. The aperture is unknown.

Discussion.--It is interesting to note that there are more than fifty species of Placopsilina compiled by Elias and Messina (1940). Several of the species do not seem to belong in this genus because of the arrangement and shape of their chambers and type of sutures. For example, the type species P. cenomana d'Orbigny does not even resemble my specimen because the first few chambers of the test are slightly coiled and the sutures are less distinct. Also the chambers are not hemispherical or globular. Also P. cornuta Terquem does not resemble either the type specimen or my specimen. The test of P. cornuta is elongated. Since there are many dissimilar forms, this genus requires further study.

Occurrence.--Placopsilina ciscoensis? is scarce in the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D). It has been found in the Graham formation of the Cisco group in Young County, Texas.

## Family (UNCERTAIN)

## Subfamily ?

Genus TUBERITINA Galloway and Harlton, 1928

TUBERITINA BULBACEA Galloway and Harlton

Plate 4, figs. 8, 9

Tuberitina bulbacea GALLOWAY AND HARLTON, 1928, Jour. Paleontology, vol. 2, p. 346-347, pl. 45, figs. 8a-d; -----, CUSHMAN AND WATERS, 1930, Texas Univ. Bull. no. 3019, p. 78-79, pl. 9, figs. 10-14; -----, GALLOWAY AND RYNIKER, 1930, Oklahoma Geol. Surv. Circ. no. 21, 1930, Oklahoma Geol. Surv. Bull. no. 53, p. 29, pl. 1, fig. 22.

The test of Tuberitina bulbacea Galloway and Harlton is free, more or less flask-shaped, having a thick neck. The chamber has a thickness of 0.40 mm. and a length of 0.48 mm. The total length of the test including the "neck region" range up to 1.13 mm. The exterior surface of the test is slightly punctate.

Discussion.--According to Galloway and Harlton (1928, p. 346) the bulbous chambers of Tuberitina bulbacea probably were attached to plants by a basal disc.

It is possible that the apertures or foramen were filled by mineralization. Galloway and Harlton state that it is unusual for a foraminifer to lack foramina or an aperture. They also pointed out that very small mural pores were found and these are obscure and scarcely visible in thin sections. Tuberitina bulbacea resemble in shape the sporangia of mildews and other Fungi, but the calcareous perforate walls resemble Foraminifera.

Colonial forms of Tuberitina bulbacea have not been found in the Marmaton rocks in which two or more chambers are separated by thick necks in an irregular uniserial arrangement as revealed by Galloway and Harlton (1928, p. 346).

Harlton originally included species of this genus under the genus Archaelagena (1927, p. 24). It seems that A. parkeriana is synonymous with the three species A. kansasensis, A. adaensis, and A. plummerae.

Occurrence.--Tuberitina bulbacea is common in the Amoret limestone member of the Altamont limestone formation (QL-17-A) and rare in the Amoret limestone member of the Altamont limestone formation (QL-17-C). In Oklahoma, this species occurs in the Anadarche limestone of the Upper Glenn formation in Carter County, in the Atoka formation in Latimer County and also abundant in the Holdenville formation. It also occurs in the Cisco group rocks of Texas. According to Galloway and Harlton (1928, p. 347) this species is very widespread in both Oklahoma and Texas, where it is found in the lower and middle Pennsylvanian rocks.

## REGISTER OF COLLECTING LOCALITIES

## Kansas

Linn County

Locality QL-1: NW corner of Section 33, T. 21 S., R. 24 E. A small ditch outcrop on the east side of a north-south section gravel road which is situated on a low south-slope. This exposure is located about  $5\frac{1}{2}$  miles west of Pleasanton. The Altamont limestone and Bandera shale formations are fairly well exposed. The composite samples were taken from the Lake Neosho shale member. The total thickness of the exposed outcrop is about 12 feet.

Sample QL-1-A: Lake Neosho shale is light olive-yellow to dark gray in color, clayey, hard when dry and gummy when wet. This six inch composite sample was taken at a point four inches above the base of the Lake Neosho shale. The washed sample is composed of common conodonts, brachiopods, and productid spines, and rare crinoid stems. Foraminifera include questionably Tetrataxis maxima var. depressa.

Sample QL-1-B: Lake Neosho shale has the same type of shale as above, except that this sample contains phosphatic nodules. This a composite shale sample of the upper six inches of the Lake Neosho shale member. The washed sample is composed of common small brachiopods, brachiopod fragments, bryozoans, conodonts, and crinoid stems. Foraminifera include common

Tetrataxis maxima var. depressa, and rare Ammodiscus semiconstrictus var. regularis, and fusulinids.

Locality QL-2: Near the center of south line of NE $\frac{1}{4}$  of Section 8, T. 22. S., R. 24 E. A roadside outcrop on the crest of a small hill on a north-south section road. This outcrop is about 1 $\frac{1}{2}$  miles northeast of Mound City. A old Missouri Pacific Railroad bed cuts through the outcrop in an east-north-east--west-south-west direction. There is a small farmhouse on the east side of the road about 75 feet south of the old railroad bed. In general the Altamont limestone and Nowata shale formations are not well exposed here and only 10 feet are visible.

Sample QL-2-A: Lake Neosho shale is light olive-gray in color, crumbly, clayey, and soft. This is a composite shale sample of the upper seven inches of the Lake Neosho shale. The washed sample is composed of common conodonts, rare ostracodes, small brachiopods, and crinoid stems. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, and questionably Tetrataxis maxima var. depressa.

Locality QL-3: SW $\frac{1}{4}$  of Section 12, T. 23 S., R. 23 E. The natural exposure occurs in loose, small, thin brecciated-like masses in a pasture along a small intermittent stream bank on a low south slope between 50 and 150 feet north of a east-west section road. The Altamont limestone and Bandera shale formation are exposed. The upper part of the Altamont limestone are very well exposed in a nearby quarry just about 100 feet east of the abovementioned

exposure. Two composite samples were obtained from the Lake Neosho shale member. The total thickness of the exposed outcrop is about 20 feet.

Sample QL-3-A: Lake Neosho shale is light greenish in color, crumbly, and clayey, containing phosphatic nodules. This composite shale sample was taken from the lower three inches of the Lake Neosho shale. The washed residue is composed of common brachiopods, brachiopod fragments, and productid spines, and rare bryozoans, and crinoid stems. Foraminifera include common fusulinids, and Tetrataxis maxima var. depressa, and rare Globivalvulina biserialis, and questionably Tetrataxis corona.

Sample QL-3-B: Lake Neosho shale is light-gray in color, crumbly clayey, soft, containing phosphatic nodules and masses of Chaetetes sp. This composite shale sample was taken from the upper three inches of the Lake Neosho shale. The washed residue contains common bryozoans, small brachiopods, and crinoid stems, and rare echinoid spines. Foraminifera include rare fusulinids, Globivalvulina biserialis, G. ovata, and Tetrataxis maxima var. depressa, and questionably T. maxima.

#### Bourbon County

Locality QL-4: Near the center of west-line of Section 30, T. 23 S., R. 24 E. A small outcrop occurring alongside the east side of

north-south gravel section road on a steep south slope. The exposure is located about one-half mile north of the highway junction of K-7 and 31 and is also  $1\frac{1}{2}$  miles north of Harding. Power lines overhang the outcrop and it is diagonally across from a farmhouse which is on the west side of the road. Altamont limestone and Bandera shale formations outcrop at this locality. Samples were collected from the Lake Neosho shale which overlies the Bandera shale. Amoret limestone member is missing here. This is a twenty foot exposure.

Sample QL-4-A: Lake Neosho shale is olive to gray in color, clayey, flaky, hard when dry, gummy and sticky when wet. The composite shale sample was taken from the second six inches from the base of the Lake Neosho shale. The washed sample is composed of common conodonts and productid spines, and rare small brachiopods. Foraminifera include questionably Tetrataxis maxima var. depressa.

Sample QL-4-B: Lake Neosho shale has the same type of shale as mentioned above. This composite shale sample was taken from the fourth six inches which is below the Worland limestone. The washed residue is composed of common ostracodes, conodonts, and holothurian elements, and rare bryozoans, brachiopods, and echinoid spines. Foraminifera include rare Deckerella clavata.

Locality QL-5: Slightly north of SE corner of Section 33, T. 24 S., R. 23 E. A roadside exposure on the west side of a north-south section road on low north slope. It is about 50 feet south of the Little Osage River culvert. The outcrop is about  $3\frac{1}{2}$  miles east of Fulton. About 15 feet of Altamont limestone and Bandera shale formations are exposed here. Two composite samples were obtained from the Lake Neosho shale. The Bandera shale is extremely blocky which is a diagnostic feature of the lower part of the outcrop in this locality.

Sample QL-5-A: Lake Neosho shale is yellowish-gray in color, thick plate-like, and gummy when wet. This is a composite sample of the upper one foot of the Lake Neosho shale. The washed sample is composed of common crinoid stems, and small brachiopods, and rare holothurian elements and conodonts. Foraminifera include rare Endothyranella minuta, Tetrataxis maxima, and T. maxima var. depressa.

Locality QL-6:  $E\frac{1}{2}NW\frac{1}{4}$  of Section 19, T. 25 S., R. 25 E. This is a recently quarried outcrop which is 50 feet east of a north-south road and it is approximately one mile north of the center of Fort Scott and is about one-half mile south-east of highways U. S. 54 and 69 junction. The members of the Fort Scott limestone formation range from Little Osage shale to Higginsville limestone. The Higginsville limestone is very massive in the upper part and bedding planes are indistinct. Several composite samples were obtained from the Little Osage shale and Higginsville limestone. The total thickness of the exposure is about 10 feet.

Sample QL-6-A: Little Osage shale is black in color, plate-like, hard, and containing a few small phosphating concretions. This seven-inch composite shale sample was obtained from a position ten inches below the Houx limestone. The washed residue is composed of common brachiopod fragments, and pyritized productid spines, and rare bryozoans. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, and Tolypammina confusa.

Sample QL-6-B: Little Osage shale has the same type of shale as mentioned above. This is a two inch composite shale sample which was taken just below the base of the Houx limestone. The washed residue is composed of common conodonts, bryozoans, crinoid stems, small brachiopods, ostracodes, and productid spines. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Orthovertella? sp., Trepelopsis grandis?, Tolypammina confusa, and Tolypammina inclusa.

Sample QL-6-C: Little Osage shale is orange-yellow in color, shaly, crumbly and soft. This is a composite shale sample of the upper three inches of the Little Osage shale just below the base of the Higginsville limestone. The washed residue is composed of common ostracodes, productid spines, and small brachiopods, and rare bryozoans, and conodonts. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Endothyranella minuta, Palaeotextularia? sp., and Tolypammina confusa.

Sample QL-6-D: Higginsville limestone contains a yellow, clayey to limy, soft to hard shale. The shale sample was collected from various bedding planes of the limestone up to about three feet above the base. The washed residue is composed of abundant bryozoans, common crinoid stems, productid spines, small brachiopods, echinoid plates, and rare echinoid spines, and ostracodes. Foraminifera include common Polytaxis laheeii, Tetrataxis conica, T. maxima var. depressa, and rare Deckerella clavata.

Locality QL-7: SE of SW of Section 19, T. 25 S., R. 25 E. An excellent exposure of the Cherokee shale group and Fort Scott limestone formation in the Missouri Pacific Railroad cut in the city of Fort Scott about 500 feet east of the Missouri Pacific Railroad depot which is just east of highway U. S. 54 and 69. The railroad classifying yard is just west of the 75 foot cut. This is the type locality of the Fort Scott limestone formation.

Sample QL-7-A: Little Osage shale is black in color, slightly fissile, and hard containing small phosphatic concretions. This is a six inch composite shale sample which was taken just above the Summit coal. The washed residue is composed of common small gastropods, productid spines, and ostracodes. Foraminifera include rare Tolypammina confusa.

Locality QL-8: SW $\frac{1}{4}$ SE $\frac{1}{4}$  of Section 24 and NE $\frac{1}{4}$ NE $\frac{1}{4}$  of Section 25,

T. 25 S., R. 22 E.; NW $\frac{1}{4}$ NW $\frac{1}{4}$  of Section 30, T. 25 S., R. 23 E.

Outcrops of Altamont limestone formation in an area about two miles east of Uniontown exposed on north and south sides of old highway U. S. 54. Locality for sample QL-8-A (NW $\frac{1}{4}$ NW $\frac{1}{4}$  of Section 30, T. 25 S., R. 23 E.) is on the south side of the highway on a west slope. A sample was taken from the Lake Neosho shale.

Locality for samples QL-8-C and 8-C (SW $\frac{1}{4}$ SE $\frac{1}{4}$  of Section 24, T. 25 S., R. 22 E.) is on the north side of the highway in a barnyard particularly in the west part of it. The barn is situated about 50 to 75 feet east of the outcrop. Sample QL-8-D was obtained 75 feet east of the barn in a pig's sty on a low west slope just east of a small intermittent stream valley.

Locality for sample QL-8-B (NE $\frac{1}{4}$ NE $\frac{1}{4}$  of Section 25, T. 25 S., R. 22 E.) is along a St. Louis and San Francisco Railroad cut which is south of the highway. The railroad bed is about ten feet below the road and it is not readily visible from the road because of dense vegetation.

Sample QL-8-A: Lake Neosho shale is light olive-yellow in color, crumbly, hard, and containing a few phosphatic nodules.

This is a composite sample of the entire thickness of the Lake Neosho shale. The washed residue is composed of common crinoid stems, echinoid spines, ostracodes, and productid spines. Foraminifera include common fusulinids, rare Tetrataxis maxima var. depressa, and questionably Polytaxis lahsei.

Sample QL-8-B: Lake Neosho shale has the same type of shale as mentioned above. This is a composite sample of the entire thickness of the Lake Neosho shale. The washed residue is composed of common echinoid spines, ostracodes, and productid spines. Foraminifera include common fusulinids, and rare Tetrataxis maxima var. depressa.

Sample QL-8-C: Worland limestone contains a dark gray, slightly plate-like, and hard shale. This sample was taken from a 0.3 foot parting which is nine feet above the base of the limestone. The washed residue is composed of rare conodonts. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Polytaxis laheeii, and Tetrataxis conica.

Sample QL-8-D: Worland limestone contains a slightly yellowish-gray, limy and hard shale. This sample was taken from a two inch parting from the upper portion of the Worland limestone. The washed sample is composed of common brachiopods, crinoid stems, and echinoid spines, and rare bryozoans. Foraminifera include common Climacammina cushmani, Deckerella laheeii, Polytaxis laheeii, and Tetrataxis maxima, rare Glyphostomella triloculina, Tetrataxis conica, Tetrataxis maxima var. depressa and Tolypammina confusa, and questionably Endothyranella minuta.

Locality QL-9: Near the center of south line of SE $\frac{1}{4}$  of Section 10, T. 26 S., R. 24 E. An excellent exposure of the Laberdie limestone member of the Pawnee limestone formation on the north side of

highway K-39 about two miles east of Ronald. The lower members of the Pawnee limestone formation are not well exposed, but outcrops are seen on a low east slope. Two samples were obtained from the shale-parting of the Laberdie limestone.

Sample QL-9-A: Laberdie limestone contains a light yellow-gray, mottled yellow, slightly limy, plate-like, and soft shale. Samples were obtained from a two inch parting in the Laberdie limestone which is 84 inches above the base. The washed residue is composed of common bryozoans, crinoid stems, and conodonts, and rare brachiopod fragments, and crinoid plates. Foraminifera include common Polytaxis lahesi, and Tetrataxis conica, rare Ammodiscus semiconstrictus var. regularis, Glimacamina cushmani, Deckerella olavata, fusulinids, and T. maxima var. depressa, and questionably T. maxima.

Locality QL-10: Near the center of the south line of Section 8, T. 26 S., R. 24 E. A roadside exposure of the Pawnee limestone and Labette shale formations on the north side of a east-west blacktop highway K-39. The outcrop is situated on a east slope and it is about one mile east of Ronald. About 20 feet of the formations are exposed. Samples were secured from the Anna shale and from the shale parting of the Myrick Station limestone.

Sample QL-10-A: Anna shale is buff to dark gray in color, plate-like, and slightly carbonaceous. This is a composite sample from the upper one inch of the Anna shale just below the Myrick Station limestone. The washed residue is composed of

common conodonts, and productid spines, and rare bryozoans, and echinoid spines. Foraminifera include rare Ammodiscus semiconstrictus var. regularis.

Sample QL-10-B: Myrick Station limestone contains a yellow, limonitized, and slightly granular shale. This sample is from a one to three inch discontinuous shale parting about 24 inches from the base of the limestone. The washed residue is composed of common bryozoans, brachiopods, and crinoid stems, and rare conodonts, productid spines, and echinoid plates. Foraminifera include common fusulinids, and Polytaxis laheeii, rare Ammodiscus semiconstrictus var. regularis, Climacamina cushmani, and Tetrataxis conica.

Locality QL-11: Near the center of Section 7, T. 27 S., R. 24 E. A 20 foot exposure of the Pawnee limestone formation is present on the west side of the highway K-7 in a deep roadside gully, and it is 50 feet south of a culvert. Samples were obtained from the Mine Creek shale and Laberdie limestone members. This outcrop is about two miles west of Pawnee.

Sample QL-11-A: Mine Creek shale is a yellowish-tan in color, slightly carbonaceous, clayey and soft shale. This composite sample was taken from the full two inch thickness of the Mine Creek shale. The washed residue is composed of common small brachiopods, and conodonts, and rare echinoid spines, and productid spines. Foraminifera include rare

Ammodiscus semiconstrictus var. regularis, Orthovertella  
sp., and Tetrataxis maxima var. depressa, and questionably  
Polytaxis laheeii.

Sample QL-11-B: Laberdie limestone contains a yellow, and soft shale. This sample consists of material from a number of discontinuous lens like partings in the limestone. The washed residue is composed of common echinoid spines, and crinoid stems. Foraminifera include questionably Tetrataxis maxima var. depressa.

Crawford County

Locality QL-12: Near the center of west line of Section 5, T. 28 S., R. 25 E. An excellent roadside exposure of the lower part of the Fort Scott limestone formation on both sides of highway U. S. 69. This is one of the few localities where Blackjack Creek limestone member contains several shale partings. A sample was taken from the Cherokee group shale and from each of the four partings of the Blackjack Creek limestone. The exposed thickness of the Blackjack Creek limestone is about 10 feet.

Sample QL-12-A: Cherokee shale is brown gray in color, shaly, and hard. This is a composite sample of the upper two inches of the Cherokee shale just below the base of the Blackjack Creek limestone. The washed residue is composed

of common productid spines, and rare, bryozoans, conodonts, and crinoid stems. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Tetrataxis conica, and T. maxima var. depressa.

Sample QL-12-B: Blackjack Creek limestone contains a orange-yellow, clayey, and soft shale. This sample is from a one or two inch parting in the Blackjack Creek limestone which is about twelve inches above the base. The washed residue is composed of common brachiopods, bryozoans, conodonts and productid spines. Foraminifera include rare Ammodiscus semiconstrictus var. regularis.

Sample QL-12-C: Blackjack Creek limestone contains a light brownish-gray, chunky, clayey, and hard shale. This sample is from a one to two inch parting which is about 36 inches from the base of the limestone. The washed residue is composed of common productid spines, and echinoid spines, and rare echinoid plates. Foraminifera include rare Tetrataxis maxima var. depressa and T. conica.

Sample QL-12-D: Blackjack Creek limestone contains a light gray (mottled yellow), limy, hard, and chunky shale. This is a one to two inch parting in the limestone which was obtained about 75 inches above the base of the limestone. The washed residue is composed of common brachiopod fragments, echinoid plates, bryozoans, and ostracodes. Foraminifera include common Climacammina cushmani, and Tetrataxis conica, rare

Ammobaculites? sp., Amnovertella elongata, Calciwertella adherens?, Deckerella clavata, D. laheeii, Endothyra? ameradaensis, Globivalvulina biserialis, Placopsilina ciscoensis?, Polytaxis laheeii, Pseudostaffella sp., Staffella sp., and Tetrataxis maxima var. depressa, and questionably Tetrataxis maxima, and Endothyranella minuta.

Sample QL-12-E: Blackjack Creek limestone contains a light-yellow, clayey, and soft shale. This is from a two or three inch parting in the limestone which was obtained about 84 inches above the base of the Blackjack Creek limestone. The washed residue is composed of brachiopod fragments, crinoid plates stems, Spirobis sp., and ostracodes. Foraminifera include common Climacamina cushmani, Endothyra? ameradaensis, Globivalvulina biserialis, and Tetrataxis conica, rare Calciwertella adherens?, fusulinids, Glyphostomella triloculina, Millerella sp., Polytaxis laheeii, Cornuspira? sp., and questionably Endothyra? media, and Tetrataxis maxima var. depressa.

Locality QL-13: Near the SW corner of Section 11, T. 28 S., R. 24 E.

About 20 feet of the lower part of the Fort Scott limestone formation is exposed in a field about 50 feet south of a east-west gravel section road. This outcrop is about four miles east of Farlington. Shale sample was secured from the upper part of the Little Osage shale.

Sample QL-13-A: Little Osage shale is dark orange to light gray in color, shaly, crumbly, and soft. This composite sample was obtained from the upper six inches of the Little Osage shale just below the Higginsville limestone. The washed residue is composed of common bryozoans, brachiopod spines, and ostracodes, and rare conodonts, and small brachiopods. Foraminifera include rare Ammodiscus semiconstrictus var. regularis.

Locality QL-14: Near the center of  $S\frac{1}{2}SE\frac{1}{4}$  of Section 23, T. 28 S., R. 22 E. A small exposure of Amoret limestone and Bandera shale present on the east side of highway K-3. The outcrop is in a small roadside ditch, and it is just south of a bridge. The locality is about four miles south of Hepler. A sample was obtained from the Bandera shale.

Sample QL-14-A: Bandera shale is dark tan to chocolate brown in color, clayey, and soft. This is a composite sample of the upper three inches of the Bandera shale. The washed residue is composed of common crinoid stems, and rare brachiopod shell fragments. Foraminifera include questionably Tetrataxis maxima var. depressa.

Locality QL-15: Near the south-west corner of  $SE\frac{1}{4}$  of Section 35, T. 29 S., R. 22 E. A six foot exposure of the Pawnee limestone formation situated in a field about 50 feet north of a east-west section road. A small southwardly intermittent stream cuts through the outcrop. This locality is about three miles south and 0.4

mile east of highway junction K-3 and 57. A sample was obtained from the Anna shale just below the Myrick Station limestone.

Sample QL-15-A: Anna shale is brownish-black in color, plate-like, and hard. The composite sample was obtained from the upper one inch of the Anna shale. The washed residue is composed of common conodonts. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Tetrataxis conica, and T. maxima var. depressa.

Locality QL-16: SW $\frac{1}{4}$  of Section 24, T. 30 S., R. 22 E. A 25 foot road-side exposure present on both sides of highway U. S. 160. The rocks are present on a steep east slope particularly near the crest of the hill. The exposures are about 500 feet west of Lightning Creek bridge and about 6 $\frac{1}{2}$  miles from the junction of highways U. S. 160 and K-7. The top of the Blackjack Creek limestone is now being used for road grading purposes. The outcrop is much more prominent on the north side of the road than on the south side. A sample was obtained from the shale-parting of the Blackjack Creek limestone.

Sample QL-16-A: Blackjack Creek limestone contains a mottled yellow and gray, and limy shale. This sample contains a mixture of shales from various local, and small partings throughout the limestone particularly in the upper portion of the member. The washed residue is composed of common bryozoans, and crinoid stems. Foraminifera include common

Climacammina cushmani, and fusulinids, rare Globivalvulina biserialis, and Tetrataxis conica, and questionably Endothyra? media.

Neosho County

Locality QL-17: Near the center of the west line of Section 30, T. 29 S., R. 21 E. This exposure is about 1.8 miles south of St. Paul and along a north-south section road on a north slope curving slightly to the northeast. Most of the shales in this locality are soft. Several composite samples were taken from the members of the Altamont limestone formation such as Amoret limestone, Lake Neosho shale, and the Worland limestone. The total thickness of the outcrop is about 19 feet.

Sample QL-17-A: Amoret limestone contains a buff, crumbly, and slightly limy shale. This composite shale sample was taken from the first six inches from the top of the lower limestone bed which is 18 inches in thickness. The washed residue is composed of common bryozoans, crinoid stems, echinoid plates and spines. Foraminifera include common Tetrataxis maxima var. depressa, and Tuberitina bulbacea, and rare Endothyranella minuta, and fusulinids.

Sample QL-17-B: Amoret limestone has the same type of shale as mentioned above. This composite shale sample was taken from the second six inches from the top of the lower limestone bed. The washed residue is composed of abundant

crinoid stems, and common bryozoans, echinoid spines, ostracodes, and productid spines. Foraminifera include common Endothyra? ameradaensis, and Endothyranella minuta, and questionably Tetrataxis maxima var. depressa.

Sample QL-17-C: Amoret limestone contains a light gray with mottled yellow, slightly limy, clayey, and hard shale. This composite shale sample was taken from the third six inches from the top of lower limestone bed. The washed residue is composed of common ostracodes and brachiopod fragments. Foraminifera include common Endothyranella minuta, and rare Endothyra? ameradaensis, Tetrataxis maxima var. depressa, and Tuberitina bulbacea.

Sample QL-17-D: Amoret limestone contains a light yellowish-gray, limy, clayey, chunky, and soft shale, containing a few phosphatic nodules. This is a two inch composite shale taken just above the middle massive limestone bed which is about two feet in thickness. The washed residue is composed of common brachiopod fragments, crinoid stems, ostracodes, and productid spines, and rare echinoid spines. Foraminifera include common Globivalvulina biserialis, rare Endothyra? media, Globivalvulina ovata, Milleiella sp., and Tetrataxis maxima var. depressa, and questionably Endothyranella minuta.

Sample QL-17-E: Amoret limestone contains a light yellowish-gray to brownish-gray, slightly plate-like, slightly limy, and hard shale. This is a six inch composite sample which was

taken above sample QL-17-D just below the upper limestone bed of the Amoret limestone. The washed residue is composed of abundant gastropods, brachiopods, echinoid spines, productid spines and ostracodes. Foraminifera include common Globivalvulina biserialis, G. ovata, and Pseudostaffella sp., and rare Endothyra? ameradaensis, Endothyranella minuta, Tetrataxis maxima var. depressa, and Thuraminoides sp., and questionably Endothyra? media, and Endothyranella armstrongi.

Sample QL-17-F: Lake Neosho shale is light olive-gray in color, clayey, chunky and hard. This is a composite shale sample of the lower foot of the Lake Neosho shale. The washed residue is composed of common brachiopods, ostracodes, and productid spines. Foraminifera include rare Ammodiscus semiconstrictus var. regularis.

Sample QL-17-G: Lake Neosho shale is light olive gray in color, slightly laminated, chunky and hard. This is a composite shale sample of the upper foot of the Lake Neosho shale. The washed residue is composed of common brachiopod shell fragments, conodonts, and productid spines, and rare bryozoans, crinoid stems, and ostracodes. Foraminifera include common fusulinids, and rare Ammodiscus semiconstrictus var. regularis, Tetrataxis conica, and T. maxima var. depressa.

Sample QL-17-H: Worland limestone contains a light tan, clayey, crumbly, hard, and slightly limy shale. This shale is from a local parting in the upper part of the Worland limestone.

The washed residue is composed of common crinoid stems, and rare bryozoans, brachiopod shell fragments, echinoid plates and spines. Foraminifera include common Tetrataxis maxima var. depressa, and rare Climacamina cushmani, and fusulinids.

#### Labette County

Locality QL-18: Near the NE corner of Section 8, T. 32 S., R. 21 E.

A 17½ feet exposure of the Fort Scott limestone formation which is about 0.6 mile northeast of Montana and four miles south of highway U. S. 160. The outcrop is on the west side of a north-south section road on a steep north slope. Samples were taken from the partings of the Higginsville limestone.

Sample QL-18-A: Higginsville limestone contains a orange-yellow, crumbly, and soft shale. This sample is from a two inch shale parting in the Higginsville limestone which is about twelve inches above the base. The washed residue is composed of abundant brachiopod shell fragments, common ostracodes, productid spines and echinoid spines, and rare conodonts. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, and Endothyra? ameradaensis.

Sample QL-18-B: Higginsville limestone contains a orange-yellow, crumbly, and soft shale. This sample is from a two inch shale parting in the Higginsville limestone which is about 30 inches above the base. The washed residue is composed

of bryozoans, crinoid stems, echinoid spines and productid spines. Foraminifera include rare Tetrataxis conica.

Locality QL-19: Near the SW corner of the Section 3, T. 33 S.,

R. 20 E. This ten foot exposure of the Pawnee limestone formation is about four miles east of Altamont on highway U. S. 59. The outcrop is exposed near the top of the east slope on both sides of the highway. There is a farmhouse on each side of the highway. The outcrop is 100 feet east of a north-south section road. Two composite shale samples were obtained from the Anna shale just below the Myrick Station limestone.

Sample QL-19-A: Anna shale is light buff in color, crumbly, shaly, and soft. This is a composite shale taken from the lower seven inches of the soft part which is just above the hard, black shale portion of the Anna shale. The washed residue is composed of common bryozoans, conodonts, and productid spines, and rare crinoid stems, and ostracodes. Foraminifera include common Ammodiscus semiconstrictus var. regularis, and rare Tetrataxis maxima var. depressa.

Sample QL-19-B: Anna shale is light yellow-gray in color, shaly, and soft. This composite sample was taken from the upper seven inches of the soft shale portion which underlies the Myrick Station limestone. The washed residue is composed of abundant bryozoans, and common small brachiopods, ostracodes, and productid spines. Foraminifera include common Polytaxis laheei and Tetrataxis maxima var. depressa.

Locality QL-20: Near the NE corner of Section 24, T. 34 S., R. 17 E.

A ten foot exposure of the Lenapah limestone at the corner of section roads. This outcrop is located in the extreme southwestern corner of Labette County which is two miles east of Labette-Montgomery county line, and three north of highway U. S. 166. A sample was taken from the shale parting of the Idenbro limestone.

Sample QL-20-A: Idenbro limestone contains a light gray (mottled white), crumbly, and soft shale. This sample is from the four inch parting of the Idenbro limestone. The washed residue is composed of rare crinoid stems, and plates. Foraminifera include rare Deckerella clavata, D. laheeii, Ammodiscus semiconstrictus var. regularis, and Tetrataxis maxima var. depressa.

Locality QL-21: Near the center of south line of Section 23, T. 34 S., R. 17 E. A fifteen foot exposure of the Lenapah limestone formation is present along both sides of a narrow east-west section road on the crest of the hill. The Perry Farm shale is well exposed here, but the upper member of the Lenapah limestone formation are partially covered. A composite shale sample was secured from the softer portions of the Perry Farm shale.

Sample QL-21-A: Perry Farm shale is light buff in color, crumbly, and soft. This is a composite sample from various soft shale portions of the member. The washed residue is composed

of rare productid spines, crinoid stems, and ostracodes. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, and questionably Endothyra? ameradaensis, and Tetrataxis maxima var. depressa.

Locality QL-22: Near the SW corner of Section 1, T. 35 S., R. 17 E.

This is a six foot outcrop of the Lenapah limestone and Nowata shale formations which are 50 feet west of a north-south section road. A farmhouse is about 200 feet southeast of the exposure. A sample was taken from the Perry Farm shale just below the Idenbro limestone. In general, this exposure contains several feet of shale, but a large percentage of the shale are very hard and no collections were made from them.

Sample QL-22-A: Perry Farm shale is light yellowish-gray in color, slightly slabby, and very hard containing a few limestone nodules. This is a composite sample of the Perry Farm shale particularly the upper softer portion. The washed residue is composed of rare bryozoans, conodonts, and crinoid stems. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Endothyra? media, and Tetrataxis maxima var. depressa.

#### Montgomery County

Locality QL-23: Near the center of Section 33, T. 24 S., R. 17 E.

A three or four foot exposure of the Lenapah limestone formation in a road-cut on highway U. S. 166 about two miles west of the

of the Montgomery-Labette county line. The road-out is  $\frac{1}{2}$  mile west of the Pumpkin Creek bridge. Samples were collected from the Perry Farm shale and Idenbro limestone members of the Lenapah limestone formation.

Sample QL-23-A: Perry Farm shale is light tan in color, slightly limy, shaly, and soft. This is a composite sample from the upper six inches of the ten inch shale member. The washed residue is composed of abundant productid spines, and common Ambocoelia sp., brachiopods, brachiopod shell fragments, bryozoans, crinoid stems, Marginifera sp., and sponge spicules. Foraminifera include common fusulinids, Pseudostaffella sp., and Tetrataxis maxima var. depressa, and rare Ammodiscus semiconstrictus var. regularis.

Sample QL-23-B: Idenbro limestone contains a yellow-gray, crumbly, and soft shale. This shale sample is from a one inch parting in the Idenbro limestone which is about 30 inches above the base. The washed residue is composed of common crinoid stems. Foraminifera include common Tetrataxis maxima var. depressa.

Locality QL-24: Near the center of the east line of Section 6, T. 35 S., R. 17 E. A five or six feet exposure of the Lenapah limestone formation encircling a water hole in a pasture about 25 feet west of a north-south section road. The water hole is about 30 feet in length and 10 feet in width. Two composite samples of the Perry Farm shale were obtained.

Sample QL-24-A: Ferry Farm shale is light gray in color, slightly crumbly, shaly, and soft. This is a composite sample of the lower six inches of the shale member. The washed residue is composed of abundant Marginifera sp., and productid spines, common brachiopod shell fragments, and bryozoans, and rare crinoid stems. Foraminifera include common Tetrataxis maxima var. depressa, and rare Endothyra? ameradaensis, and Tetrataxis maxima.

Sample QL-24-B: Ferry Farm shale is light gray in color, slightly limy, slightly crumbly, shaly, and soft. This is a composite sample of the upper six inches of the shale member just below the Idenbro limestone. The washed residue is composed of common brachiopod shell fragments, bryozoans, and productid spines. Foraminifera include rare Millerella sp., and Tetrataxis maxima var. depressa.

Oklahoma

Nowata County

Locality QL-25: South of the center of Section 19, T. 28 N., R. 16 E.

This locality is about 0.6 mile north of Bells Spur and 2.7 miles north of Lenapah. The Lenapah limestone formation is exposed on the east side of highway U. S. 169 on the bank of Hickory Creek a small intermittent stream. The outcrop is about 20 feet below the highway. A composite sample was obtained from the shale portion of the Idenbro limestone member.

Sample QL-25-A: Idenbro limestone contains a blue-gray, shaly, slightly limy, platy, and soft shale. This is a composite shale sample from the upper six inches of the one foot shale portion of the lower part of the Idenbro limestone. The washed residue is composed of abundant productid spines, and common bryozoans, crinoid plates and stems. Foraminifera include common fusulinids, and Pseudostaffella sp., and rare Tetrataxis conica, and T. corona.

Locality QL-26: Near center of Section 30, T. 28 N., R. 16 E. An excellent exposure of Lenapah limestone in a quarry at Bells Spur just west of highway U. S. 169 and about 2 miles north of Lenapah. This has been designated by Chern as the type locality for the Lenapah limestone formation. A composite sample was obtained from the shale portion of the Idenbro limestone member.

Sample QL-26-A: Idenbro limestone contains a blue-gray, slightly limy, and soft shale. This is a composite shale sample from the upper six inches of the one foot shale portion of the lower part of the Idenbro limestone. The washed residue is composed of abundant productid spines, brachiopod shell fragments, bryozoans, and crinoid stems, and common Hustedia sp., and Marginifera sp. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Tetrataxis conica, and T. maxima var. depressa.

Locality QL-27: SW $\frac{1}{4}$  of Section 24, T. 27 N., R. 17 E. The Amoret limestone member of the Altamont limestone formation and the

Bandera shale formation are exposed on the north and south sides of highway O-10. The highway cuts through the exposure in a steep south slope. This outcrop is one-half west of the Nowata-Craig county line. A sample was collected from the Bandera shale.

Sample QL-27-A: Bandera shale is buff in color, thick, and plate-like. This is a composite shale sample from the uppermost one inch of the Bandera shale which is just below the Amoret limestone member. The washed residue is composed of common brachiopods, bryozoans, conodonts, ostracodes, and productid spines, and rare crinoid stems. Foraminifera include rare Ammodiscus semiconstrictus var. regularis.

Locality QL-28: SW $\frac{1}{4}$  of Section 6, T. 26 N., R. 17 E. In this locality the Anna shale member of the Pawnee limestone and Labette shale formations are in general not well exposed. The road-cut is on the east of highway O-28 at a low westerly bend and on low south slope. This locality is about one mile south of Childers. Most of the shales of the Anna shale are very hard and a collection was taken from the softer portions of the shale member.

Sample QL-28-A: Anna shale is buff in color, soft, granular, and slightly limy. This is a composite sample from a number of softer shale portions of the Anna shale particularly around two feet from the base of the member. The washed material is composed of common brachiopod fragments, crinoid stems, ostracodes, and productid spines. Foraminifera

include common fusulinids, and Tetrataxis maxima var. depressa, and rare Calcivertella adherens?, Endothyranella minuta, Thuramminoides sp.?, Tolypamina confusa, and Globivalvulina biserialis.

Locality QL-29: Near the SE $\frac{1}{4}$  corner of Section 28, T. 26 N., R. 16 E.

A seven foot exposure of the Altamont limestone formation in a road cut on highway U. S. 60 about 1.8 miles east of the junction of highways of U. S. 60 and 169 in the eastern part of the city of Nowata. It was discovered by digging that the Bandera shale formation is present underneath the Altamont limestone formation. A sample was obtained from one of the partings in the limestone.

QL-29-A: Altamont limestone contains a shaly, buff, crumbly, and soft shale. This sample was obtained from a two inch discontinuous parting in the Altamont limestone which is about seven feet above the base. The washed material is composed of abundant productid spines, and common bryozoans, crinoid plates and stems, and ostracodes. Foraminifera include common Endothyranella minuta, Globivalvulina biserialis, and Tetrataxis maxima var. depressa, rare Endothyranella armstrongi, and questionably Endothyra? ameradaensis.

Locality QL-30: Near the center of south line of Section 26, T. 26 N.,

R. 16 E. A 75 foot exposure of the Pawnee limestone and Labette shale formations which are on highway U. S. 60 about 3 $\frac{1}{2}$  miles east of the junction of highways U. S. 60 and 169. The highway cuts deeply through Labette shale formation and the members of

of the Pawnee formation which cap the hill. The exposure is about 0.2 mile west of the Verdigris River bridge. This locality is popularly known as Coody's Bluff. Collections were made from the Anna and Mine Creek shales.

Sample QL-30-A: Anna shale is light orange in color, shaly, crumbly, and soft. This is a composite shale from the upper two inches of the Anna shale just below the Myrick Station limestone. The washed residue is composed of abundant crinoid stems, common bryozoans, and conodonts, and rare ostracodes. Foraminifera include rare Tetrataxis maxima var. depressa.

Sample QL-30-B: Mine Creek shale is greenish-yellow in color, shaly, crumbly, and soft. This is a composite shale sample from the one foot Mine Creek shale. The washed material is composed of common brachiopod shell fragments, bryozoans, and crinoid stems. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, Deckerella clavata, Tetrataxis maxima, and T. maxima var. depressa.

#### Craig County

Locality QL-31: Near the center of Section 34, T. 26 N., R. 18 E. A three or four feet exposure of the Blackjack Creek limestone on the north side of highway U. S. 60 about 3.3 miles east of the Nowata-Craig county line. A sample was taken from the Blackjack Creek limestone shale parting.

Sample QL-31-A: Blackjack Creek limestone contains a buff, slightly limy, shaly, and soft to hard shale. This sample was secured from a discontinuous parting in the Blackjack Creek limestone which is about  $2\frac{1}{2}$  feet above the base. The washed residue is composed of common bryozoan, crinoid stems, and echinoid spines. Foraminifera include common Climacammina cushmani, fusulinids, and Tetrataxis conica, and rare Ammodiscus semiconstrictus var. regularis, Deckerella laheei, Tetrataxis maxima var. depressa, and Textularia eximina?

Locality QL-32: SW corner of Section 35, T. 26 N., R. 18 E. A 10 foot exposure of Blackjack Creek limestone member of the Fort Scott limestone formation and Cherokee shale group in an old coal mining excavation on the north side of highway U. S. 60. This locality is about 4.2 miles east of Nowata-Craig county line. A collection was made from the Cherokee shale.

Sample QL-32-A: Cherokee shale is light yellowish-gray to gray in color, slightly limy, crumbly, and soft. This is a composite sample from the upper two inches of the Cherokee shale just below the Blackjack Creek limestone. The washed residue is composed of common brachiopods, brachiopod shell fragments, bryozoans, crinoid stems, and productid spines, and rare crinoid plates. Foraminifera include rare Ammodiscus semiconstrictus var. regularis, and questionably Tetrataxis corona.

Rogers County

Locality QL-33: SW corner of Section 30, T. 24 N., R. 16 E. All members of the Pawnee limestone formation and the Labette formation are exposed in this locality. The outcrop is on the south side of a east-west section road just east of a crossroad. It is about 50 feet east of a small intermittent stream culvert. The locality is about eight miles east of Tolala. A collection was taken from the Mine Creek shale.

Sample QL-33-A: Mine Creek shale is gray in color, slightly limy, soft, and plate-like. This is a composite sample of the Mine Creek shale which is one foot in thickness. The washed residue is composed of abundant brachiopod shell fragments and productid spines, and common conodonts. Foraminifera include rare Ammodiscus semiconstrictus var. regularis.

Locality QL-34: Near the center of south line of Section 11, T. 21 N., R. 15 E. All members of the Fort Scott limestone formation and a portion of the upper Cherokee shale group are exposed. The outcrop is on both sides of highway O-20 on a west slope. There is a house on the south side of the road and a tavern on the north side of the road. This locality is about three miles west of Claremore. A sample was taken from the Blackjack Creek limestone member of the Fort Scott limestone formation.

Sample QL-34-A: Blackjack Creek limestone contains a light buff, shaly, granular when dry, soft and crumbly shale.

The shale sample is from a one to two inch parting in the Blackjack Creek limestone which is about 30 inches above the base of the member. The washed residue is composed of common brachiopods, bryozoans, and productid spines, and rare echinoid spines, and ostracodes. Foraminifera include common Tetrataxis conica and T. maxima var. depressa, and rare Ammodiscus semiconstrictus var. regularis, Climacammina cushmani, and Tetrataxis maxima.

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## EXPLANATION OF PLATE I

- FIGS. 1--Thuramminoides sp.?, Dorsal view, X44.3. Specimen from the Anna shale member of the Pawnee limestone formation (QL-28-A). (p. 17)
- 2--Ammodiscus semiconstrictus var. regularis Waters, Side view, X46. Specimen from the Perry Farm shale member of the Lenapah limestone formation (QL-21-A). (p. 18)
- 3-6--Tolypammina confusa (Galloway and Harlton), 3, Side view, X35.7; 4, side view, X23.3; 5, side view, X45; 6, side view, X34. Specimens 3, 4, 6 from the Little Osage shale member of the Fort Scott limestone formation (QL-6-B) and specimen 5 from the Little Osage shale member of the Fort Scott limestone formation (QL-7-A). (p. 21)
- 7--Tolypammina inclusa (Cushman and Waters), Top view, X23. Specimen from the Little Osage shale member of the Fort Scott limestone formation (QL-6-B). (p. 22)
- 8--Amnovertella elongata (Cushman and Waters), Top X21.1 Specimen from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D). (p. 24)
- 9--Trepeilopsis grandis (Cushman and Waters)? Lateral view, X46. Specimen from the Little Osage shale member of the Fort Scott limestone formation (QL-6-B). (p. 25)
- 10--Ammobaculites? sp., Side view, X22.3. Specimen from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D). (p. 27)
- 11, 12--Endothyra? ameradaensis Harlton, 11, Side view, X33.2; 12, peripheral view, X31.9. Both specimens from the Amoret limestone member of the Altamont limestone formation (QL-17-C). (p. 28)
- 13, 14--Endothyra? media Waters, 13, Side view, X25; 14, peripheral view, X23.8. Both specimens from the Amoret limestone member of the Altamont limestone formation (QL-17-D). (p. 30)

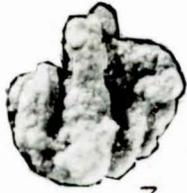
- 15--Glyphostomella triloculina (Cushman and Waters),  
Side view, X35. Specimen from the Blackjack  
Creek limestone member of the Fort Scott  
limestone formation (QL-12-E). (p. 32)
- 16--Endothyranella armstrongi Plummer, Side view,  
X45. Specimen from the Altamont limestone  
formation (QL-29-A). (p. 33)
- 17--Endothyranella minuta (Waters), Side view,  
X47.5. Specimen from the Amoret limestone  
member of the Altamont limestone formation  
(QL-17-B). (p. 35)

LAUKEL-THESIS

PLATE I



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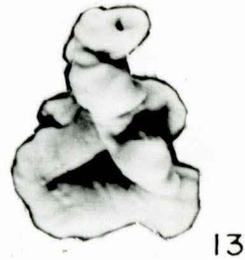
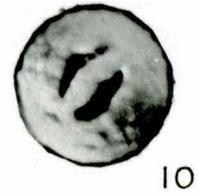
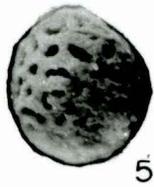
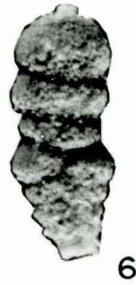
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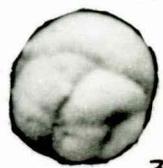
## EXPLANATION OF PLATE II

- FIGS. 1--Textularia eximina (Eichwald)?, Lateral view, X34.5. Specimen from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-31-A). (p. 37)
- 2--Palaeotextularia? sp., Lateral view, X23.4. Specimen from the Little Osage shale member of the Fort Scott limestone formation (QL-6-C). (p. 39)
- 3-5--Climacamina cushmani (Harlton), 3, Lateral view, X25; 4, lateral view, X23.5; 5, apertural view, X21. Specimens 3, 5 from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E) and specimen 4 from the Worland limestone member of the Altamont limestone formation (QL-17-H). (p. 40)
- 6, 7--Deckerella clavata Cushman and Waters, 6, Lateral view, X27; 7, lateral view, X22.2. Specimen 6 from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D) and specimen 7 from the Idenbro limestone member of the Lenapah limestone formation (QL-20-A). (p. 43)
- 8-10--Deckerella laheei Cushman and Waters, 8, Lateral view, X23.6; 9, lateral view, X22.5; 10, apertural view, X38.5. All specimens from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D). (p. 45)
- 11--Cornuspira? sp., Side view, X26.2. Specimen from the Blackjack Creek limestone of the Fort Scott limestone formation (QL-12-E). (p. 47)
- 12--Orthovertella? sp., Lateral view, X34.2. Specimen from the Mine Creek shale member of the Pawnee limestone formation (QL-11-A). (p. 48)
- 13--Caloivertella adherens Cushman and Waters?, Side view, X22. Specimen from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D). (p. 49)

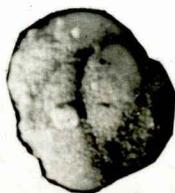


## EXPLANATION OF PLATE III

- FIGS. 1, 2--Globivalvulina biserialis Cushman and Waters, 1, Dorsal view, X47; 2, dorsal view, X49. Both specimens from the Ameret limestone member of the Altamont limestone formation (QL-17-E). (p. 51)
- 3, 4--Globivalvulina ovata Cushman and Waters, 3, Dorsal view, X48; 4, dorsal view, X47. Both specimens from the Ameret limestone member of the Altamont limestone formation (QL-17-E). (p. 53)
- 5-8--Tetrataxis conica Ehrenberg, 5, Lateral view, X34.8; 6, lateral view, X34.6; 7, apertural view, X23.6; 8, dorsal view, X37.4. Specimens 5, 7 from the Higginsville limestone member of the Fort Scott limestone formation (QL-6-D), specimen 6 from the Cherokee shale group (QL-12-A) and specimen 8 from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E). (p. 54)
- 9, 10--Tetrataxis maxima var. depressa Schellwien, 9, Lateral view, X20; 10, dorsal view, X23.2. Specimen 9 from the Higginsville limestone member of the Fort Scott limestone formation (QL-6-D) and specimen 10 from the Perry Farm shale member of the Lenapah limestone formation (QL-23-A). (p. 59)
- 11--Tetrataxis corona Cushman and Waters, Dorsal view X47.3. Specimen from the Idenbro limestone member of the Lenapah limestone formation (QL-25-A). (p. 56)



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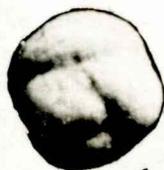
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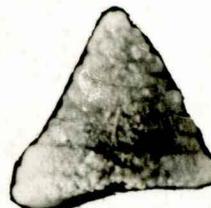
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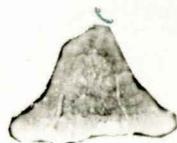
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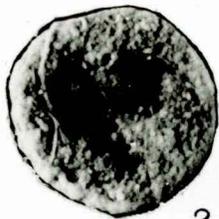
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## EXPLANATION OF PLATE IV

- FIGS. 1, 2--Tetrataxis maxima Schellwien, 1, Lateral view, X27.2; 2, apertural view, X22.2. Both specimens from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-34-A). (p. 58)
- 3-6--Polytaxis laheeii Cushman and Waters, 3, Dorsal view, X23.3; 4, dorsal view, X23.6; 5, dorsal view, X21; 6, apertural view X22. Specimen 3 from the Laberdie limestone member of the Pawnee limestone formation (QL-9-A), specimen 4 from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D) and specimens 5, 6 from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-E). (p. 62)
- 7--Placopsallina discensis Cushman and Waters?, Dorsal view, X46. Specimen from the Blackjack Creek limestone member of the Fort Scott limestone formation (QL-12-D). (p. 64)
- 8, 9--Tuberitina bulbacea Galloway and Harlton, 8, Lateral view, X35; 9, lateral view, X34.4. Both specimens from the Amoret limestone member of the Altamont limestone formation (QL-17-C). (p. 66)



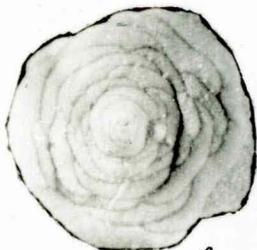
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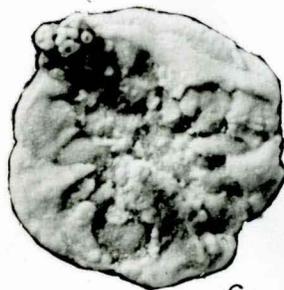
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