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Chas. N. Gould, Director.

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GEOLOGY OF LOVE COUNTY OKLAHOMA

BY
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NORMAN
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The manuscript for this report was prepared by Mr. Bullard in 1922, and early in 1923, and was practically ready for printing at the time when the entire Survey appropriations were vetoed by Ex-Governor Walton.

The present director fell heir to this and other manuscripts on assuming charge of the Survey July 1, 1924. The scientific staff printed on this page is that of the Survey in 1923, at the time when the Survey was temporarily discontinued.

CHAS. N. GOULD, DIRECTOR.

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GEOLOGY OF LOVE COUNTY, OKLAHOMA

INTRODUCTION

LOCATION

Love County is located in the extreme south central part of Oklahoma and comprises T. 6 to 9 S. and Rs. 3 E. to 3 W. It contains nine whole townships and parts of ten others, giving a total area of approximately 523 square miles. Red River forms the southern boundary, Marshall County the eastern, Carter County the northern, and Jefferson County the western. Love County was formerly part of the Chickasha Nation and was named for Robert Love, a governor of that tribe, who made his home in the southern part of the area. The Gulf, Colorado and Santa Fe Railroad, running north and south, passes approximately through the center of the county. Marietta is the principal town and county seat.

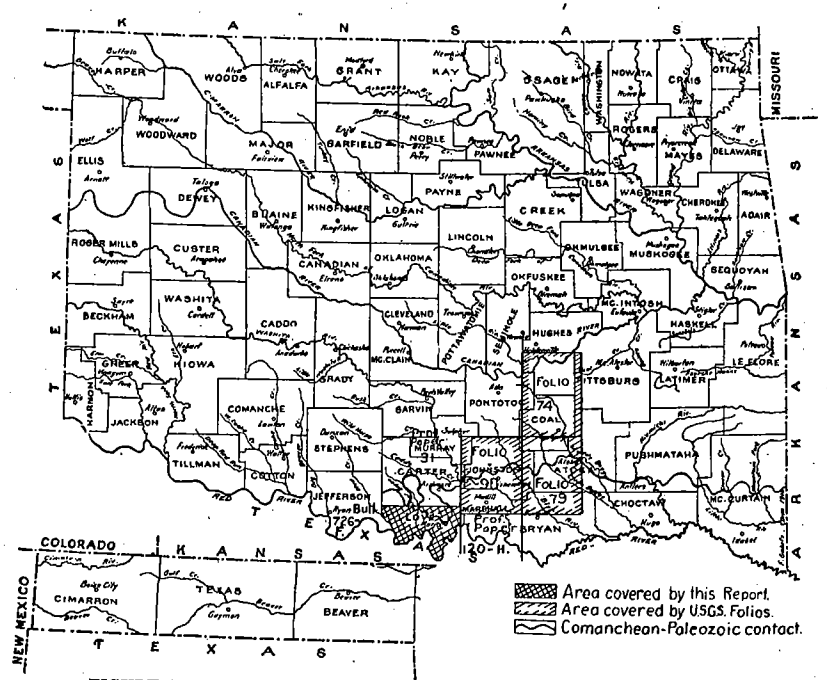


FIGURE 1. INDEX MAP SHOWING AREA INCLUDED IN THIS REPORT

FIELD WORK

The field work upon which this report is based, was done during the summers of 1919, 1920, 1921, and 1922. Approximately five months was spent in the field, divided as follows: Areal mapping, three and one-half months; detail work with plane table and alidade on the structures of the area, two weeks; measuring sections, two weeks, and two weeks was spent in collecting fossils. Practically all the section corners can be found and in a great many cases the section lines are open or fenced so that the horizontal control for mapping was easily within the limits of land surveys. The areal geology was checked with an instrument when the area was detailed in mapping the structure.

The Comanchean formations exposed in the area, from oldest to youngest, are as follows: Trinity sand, Goodland limestone, Kiamichi formation, Caddo formation, Bokchito formation, and the Bennington limestone. There is a small area of Paleozoic rocks exposed in the Criner Hills uplift, located in the north-central portion of the county. These were not studied except in so far as it was necessary in checking the Paleozoic-Comanchean contact.

The Criner Hills uplift is located principally in Carter County, only the southern end extending into Love County. The Criner Hills uplift was studied by Taff[1] and more recently by Goldston[2]. A review of these studies will be given in so far as they have a bearing on the Geology of Love County.

ACKNOWLEDGEMENTS

The writer wishes to make grateful acknowledgment for direction and help to Mr. C. W. Shannon, Director of the Oklahoma Geological Survey, under whose supervision the work was done and the report prepared. The writer was assisted in the field by Mr. Charles R. Rider in 1919, by Mr. A. C. Wright in 1920, and by Mr. R. J. Cullen in 1922. Chemical samples of the Goodland limestone were collected by Mr. M. C. Oakes, who also assisted the writer in measuring sections and collecting fossils. Chemical analyses of the Goodland limestone included in this report were made by Mr. A. C. Shead, Chemist for the Oklahoma Geological Survey. Miss Bess U. Mills, Assistant Draftsman of the Oklahoma Geological Survey did the drafting on all maps, charts, etc. included in this report. Dr. H. P. Bybee of the University of Texas, who was working on an area adjoining to the northwest, visited the field party several times and offered valuable suggestions in regard to the methods best suited to carrying on the field work. Dr. C. E. Decker spent three days in the area collecting fossils and the writer wishes particularly to acknowledge his suggestions regarding the paleontology and structure. The Comanchean-Paleozoic contact was mapped by Clyde Mallot in 1916. This work was checked by the writer and with few exceptions found to be correct. The writer is deeply indebted to Dr. C. W. Honess of the Oklahoma Geological Survey for critically reading the manuscript and offering helpful suggestions regarding it.

1. Taff, J. A., Preliminary Report on the Geology of the Arbuckle and Wichita Mountains, in Indian Territory and Oklahoma: U. S. Geol. Survey Prof. Paper 31, 1904.

2. Goldston, W. L. Jr., Differentiation and Structure of the Glenn formation: Am. Assoc. Pet. Geol., Vol. 6, No. 1, pp. 5-24, 1922.

PHYSIOGRAPHY

PHYSIOGRAPHIC DIVISIONS

The greater part of Love County lies in the general physiographic division of North America, known as the Gulf Coastal Plains. The Gulf Coastal Plains consist of those sediments that were deposited in a nearly horizontal position with only a slight dip toward the gulf, and include all the rocks from the Comanchean up to the present, surrounding the Gulf of Mexico.

Love County is included in the Red River Valley region of Oklahoma. The Red River region is the northern limit of the Gulf Coastal plains. It is that area extending along southern Oklahoma from Love County eastward, that lies in the northern drainage basin of Red River.

DRAINAGE

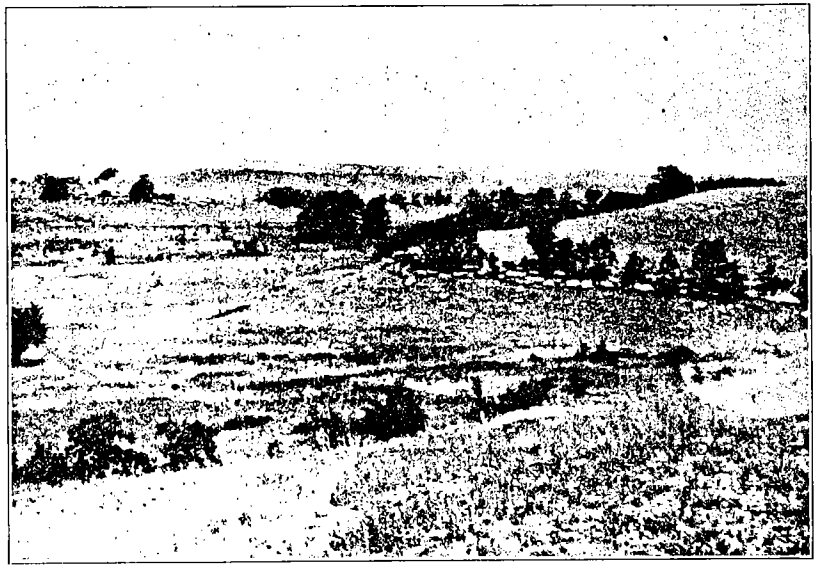
Red River and its tributaries drain the entire area of Love County. The principal tributaries are Hickory Creek, which drains the north eastern part of the county, and Walnut Bayou and Mud Creek, which drain the central and western parts of the county respectively. The drainage, which is to the south and east, conforms in general to the normal dip of the surface (Comanchean) rocks. As a rule the streams have narrow channels with broad flood plains. In the early spring and fall, during the rainy periods, these streams spread out over their flood plains covering the surrounding country. In general, excellent soil is found along the streams. The Red River valley may be characterized as a broad, flat area with rounded sand dunes in some parts and excellent alluvial soil in others.

TOPOGRAPHY

The topography of Love County may be characterized as rolling to hilly. The range in elevation is from 1,000 feet above sea level southeast of Marsden to 593 feet on Red River at the Marshall-Love County line. In the Criner Hills elevations of 150 to 300 feet

PLATE I.

A. VIEW OF THE GOODLAND ESCARPMENT 7 MILES WEST OF MARIETTA



B. ANOTHER VIEW OF THE GOODLAND ESCARPMENT AT THE ABOVE LOCATION.

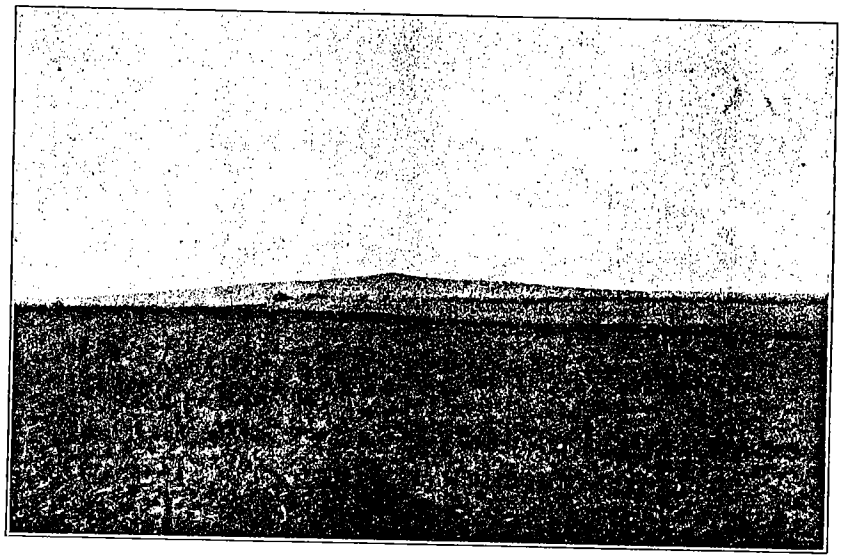
above the surrounding country are not uncommon. In the Comanchean area the maximum relief is probably less than 150 feet except along Red River where bluffs 200 feet above the water level are found.

GOODLAND ESCARPMENT

The main topographic feature, other than the Criner Hills, is the Goodland escarpment which is found in the eastern part of the County. The Goodland limestone, which is a massive, hard, semi-crystalline limestone averaging about 25 feet in thickness, outcrops in a broad U-shaped area in the eastern half of the county outlining in general the Marietta syncline. Underlying the Goodland limestone is the Trinity sand which is a loose, unconsolidated pack sand. The difference in hardness of these two formations gives rise to a very pronounced escarpment where the Goodland limestone outcrops in contact with the Trinity sand. This escarpment is continuous and regular, usually from 75 to 100 feet high, being one of the most prominent topographic features in Love County.

Another very noticeable feature of the surface of Love County is the line of symmetrical hills southeast of Marietta. These hills rise 150 to 200 feet above the valleys at their base. They are all in line trending in a southeast direction. The rocks on top of these

PLATE II.



VIEW OF THE SYNCLINAL HILL THREE MILES SOUTHEAST OF MARIETTA, COMMONLY KNOWN AS THE "PEAK". THIS PICTURE WAS TAKEN FROM A POSITION ABOUT TWO MILES NORTH OF THE HILL

hills represent the youngest Comanchean sediments in the county. After mapping the structure of the region it was found that the hills occupied approximately the trough of a syncline. In other words the **structural low is the topographic high.**

THACKERVILLE BEND

Another very marked physiographic feature of this area is the large and abrupt meander, known as Thackerville bend, that Red River makes on the southern boundary of Love County. This meander forms a peninsula shaped area about 14 miles long and from 5 to 7 miles in width. It will be noted from the accompanying map that the river follows the Goodland limestone, which outcrops along the west side of the bend for about 14 miles before it cuts across the outcrop.

This deflection in the course of the river may be due to some structural feature although it seems simpler to account for the course of the river at this point by the difference in hardness of the Goodland limestone and the underlying Trinity sand. The river coming in contact with the Goodland limestone would be deflected in an effort to find a course that offered less resistance than cutting across the outcrop of the Goodland limestone. Such a course would be along the Trinity-Goodland contact. The river then was pushed along this contact, which was also down the dip, until it was easier to cut across the outcrop than continue southward.

HORSESHOE BEND

In connection with the very peculiar meander of Red River at Horseshoe bend in T. 8 S., R. 2 E., an anticline was noted at that place with an axis running approximately North 30 degrees west. It will be noted from the accompanying geologic map (Plate XIX) that an anticline is suggested from the arrangement of the outcrops. No detailed work was done in this particular area but it is evident that a structure, or a fold is present in this bend. It is the writer's opinion that the "high" of the structure is located in the bend across the river on the Texas side. This is impossible to prove as river sediment has covered all this area and no outcrops are available. If the high point of the structure is in the bend on the Texas side it would suggest that the river has flowed around the end of this fold rather than cut across it.

It is an interesting fact that a great many bends in various streams have been accounted for by some structural feature existing at that point. With this in mind a very logical place to investigate for structures would be where abnormal bends occur in streams.

CRINER HILLS

The Criner Hills have been described by Taff[3] as the Arbuckle Mountains in miniature. They are located in Carter County, only

3. Idem., P 8.

the southern extremity extending into Love County. The Criner Hills are made up essentially of the same formations as are exposed in the Arbuckle Mountains up to and including the Glenn formation. The limestones as a rule form the hills and the shales the valleys. Some of the hills in this area rise 300 feet above the valleys at their base.

The Criner Hills were covered by Comanchean sediments and in comparatively recent geologic time have been exposed by erosion. The Paleozoic rocks which make up the Criner Hills are much harder and more resistant to the processes of erosion than the Trinity sand which covered them. During the process of weathering, the Trinity sand was eroded much more rapidly than the Paleozoic rocks so that the harder rocks soon developed into hills.

The structure and relationship of the Comanchean and Paleozoic rocks will be discussed under the heading, "Structure."

STRATIGRAPHY

GENERAL STATEMENT

The surface rocks in Love County are mainly Comanchean in age. However in the Criner Hills there is a considerable area of Pennsylvanian rocks and near Overbrook a small V-shaped area of Paleozoic rocks older than Pennsylvanian. Those rocks, which are the Viola limestone and the Woodford chert, have been exposed by faulting, and at the same time the remainder of the Paleozoic section was faulted out. In the western part of the county the Permian underlies the Comanchean but does not extend very far to the east. Well records in the eastern part of the county show that the Comanchean lies directly upon the Pennsylvanian. Whether the Permian ever covered the eastern part of the county cannot be definitely determined but it is thought that it probably did and was removed by pre-Comanchean erosion.

PRE-PENNSYLVANIAN ROCKS

The Paleozoic rocks older than the Pennsylvanian in Love County are restricted to a narrow V-shaped area in Secs. 1 and 2, T. 6 S., R. 1 E. Only two of the formations, the Viola limestone and the Woodford chert of the pre-Pennsylvanian Paleozoic section are exposed. These exposures are the result of faulting which at the same time probably faulted out the remainder of the section. The Viola limestone outcrops in the northeast corner of sec. 2, T. 6 S., R. 1 E. The Woodford chert outcrops in a narrow strip in about the center of the north half of sec. 1, T. 6 S., R. 1 E. These formations have the same lithological characteristics as the corresponding formations in the Arbuckle Mountains and the reader is referred

to United States Geological Survey, Prof. Paper No. 31, or Geologic Atlas, Tishomingo Folio (No. 98) for a description of these formations.

PENNSYLVANIAN ROCKS

The Pennsylvanian rocks in this area completely surround the older Paleozoics, outcropping in the north-east corner of T. 6 S., R. 1 E., and in the north half of T. 6 S., R. 2 E. The Pennsylvanian in this area is represented by the Glenn formation. This formation has recently been studied and subdivided by Goldston[4] and a brief summary of his work in so far as it has a bearing on this area is as follows:

"The Glenn formation lies directly above the Caney shale. The strata of the Glenn have been strongly folded. They consist of 15,000 to 19,000 feet of shales, sandstones, limestones and conglomerates which stand practically on edge. On the east, south, and southwest these rocks disappear beneath the Cretaceous sands of the Trinity formation. On the northwest the overlapping redbeds rest unconformable upon the upturned edges of the Pennsylvanian strata. The Glenn formation apparently lies unconformably upon the Caney shale, the two series being separated largely upon the basis of lithology. A section representing the maximum thickness of the Glenn sediments was measured southeast from the Criner Hills, and had a total thickness of 19,000 feet. Other sections gave 13,000 to 15,000 feet. The Glenn has been subdivided into five members. Beginning with the basal member they are: Springer, Otterville, Cup Coral, Deese and Hoxbar members.

Springer Member includes the basal part of the Glenn formation consisting of 4,000 to 6,000 feet of sediments——. It occurs around the Criner Hills covering a zone of about 1½ miles in width. The sediments of the Springer consist largely of black and blue shales. Near the top blue predominates though even here and there are zones of black shales several feet thick. South of Woodford and east of the Criner Hills asphalt deposits occur in the upper beds of this member.

Otterville Limestone. South of Ardmore it runs southward paralleling the Springer member east of the Criner Hills. The Otterville limestone is characterized by its oolitic texture. It consists of about 70 feet of solid brown limestone which grades into several beds of brown limestone separated by blue shales.

Cup Coral Member. This member parallels the Otterville limestone. It is composed of 1,500 to 1,800 feet of sediment which covers a zone ranging from 1-3 to 1-2 mile in width. These sediments consist of blue shale separated by thin sandstone and an occasional limestone. This member is easily distinguished by a white limestone bed near the top which carries a large cup coral, *Campophyllum torquim.*

Deese Member. Its sediments with a total thickness of 6,000 to 8,000 feet are characterized by a large number of massive sandstones, conglomerates, and shales and a few limestones.

Hoxbar Member. It is composed of 4,000 feet of uppermost sediments of the Glenn formation. The basal sediments of this member are characterized by several brown limestones, one of which is a prolific *Fuslina cylindrical* horizon. The upper part of the member is characterized by white sandstones which are separated by light blue to yellow and red shales. Near the top of this member, four miles east of Ardmore, a coal seam, two to four feet thick, occurs in these sediments.

4. Idem., p. 8.

CORRELATION TABLE

North Central Texas	Oklahoma South of Arbuckle Mountains	Oklahoma North of Arbuckle Mountains
Canyon formation	GLENN FORMATION Hoxbar member	Holdenville shale Wewoka formation Wetumka shale Calvin sandstone
Strawn formation	Deese member Cup Coral Member	Sonora formation Stuart shale Thurman sandstone
Millsap formation	Otterville limestone	Boggy shale Savana sandstone McAlester shale
Smithwick shales Marble Falls Limestone	Springer member	Hartshorne sandstone Atoka formation Wapanucka limestone
Lower Bend shale	Caney shale	Caney shale

PERMIAN ROCKS

In the early reports of both the Oklahoma Geological Survey and the United States Geological Survey the western part of Love County was shown to be covered by rocks of Permian age. In 1915 the Permian-Comanchean contact was mapped as extending only a short distance to the west of Walnut Creek Bayou in central Love County, and extending north to the township line running about midway between Ardmore and Marietta. In later reports the contact was shifted farther to the west. When the writer began work in the area (1919) it was the general opinion that the Comanchean-Permian contact was along Mud Creek in the extreme western part of Love County. However, C. W. Shannon[5] of the Oklahoma Geological Survey, who has done considerable work to the north and west of this area is of the opinion that there is no Permian exposed on the surface in Love county, and that the Permian-Comanchean contact is still farther to the west.

The Permian-Comanchean contact is difficult of delineation because the basal member of the Trinity sand contains beds of red

5. Shannon, C. W., Oral communication.

shale and sandstone, very similar to the Permian red beds. The contact has been mapped on a quartz conglomerate, supposedly at the base of the Comanchean, but there are many conglomerates in the lower part of the Trinity formation and it is extremely difficult to determine whether the particular conglomerate in question is a basal conglomerate or an intraformational conglomerate.

It is the writer's opinion, since making a trip over the area with Mr. Shannon, that the Permian-Comanchean contact lies to the west, and that there is no Permian exposed at the surface in Love County.

COMANCHEAN ROCKS

GENERAL STATEMENT

The Comanchean rocks of Love county lie unconformably on the underlying Paleozoic sediments. After the later had been deposited a series of diastrophic movements occurred in which the strata were intensely folded and faulted. After a period of erosion a part of the area, at least, was submerged during Permian time. Following Permian time the area was exposed to erosion until the encroachment of the sea in which the Comanchean sediments were deposited. The Comanchean sediments were deposited in a nearly horizontal position on the eroded and upturned edges of the older rocks. They have remained in their nearly horizontal position with a gentle dip to the southeast interrupted only by a few minor folds.

The Comanchean formations exposed in Love county are as follows:

Washita Group	Bennington limestone
	Bokchito formation
	Caddo formation
	Kiamichi formation
Fredericksburg Group	Goodland limestone
Trinity Group	Trinity sand

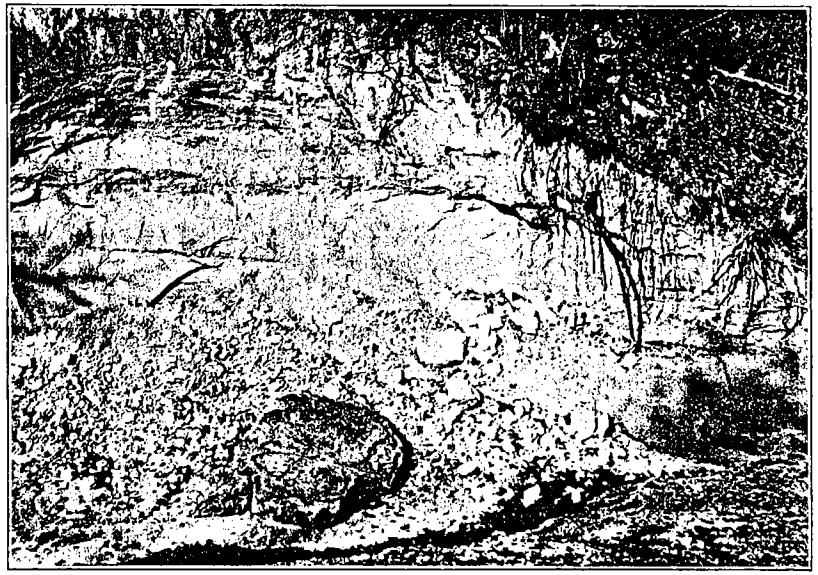
TRINITY GROUP

TRINITY SAND

The Trinity sand is named for the Trinity river of central Texas where the formation is well exposed. The Trinity sand is the beach or near shore deposit of the Comanchean sea which transgressed upon the land from the southeast. Its progress was slow enough so that the Paleozoic rocks which underlie the Comanchean sediments were worn smooth and upon this weathered surface the Trinity sand was deposited in about the same relative position that it is now found.

The Trinity sand is composed of fine incoherent pack sands, local coarse conglomerates, and occasional lentils of clay and shale. However, the Trinity sand is extremely variable and it is not unusual to find beds of red or blue shale, or thin calcareous sandstones. At one horizon a zone approximately 10 feet in thickness was filled with carbonized wood. As a rule there is a basal conglomerate made up of quartz and chert pebbles ranging from a fraction of an inch to three inches in diameter. In some cases the conglomerate is silicified, forming a hard glassy quartzite. These conglomerates are not limited to the base but are quite common throughout the lower part of the formation. The intraformational conglomerates are very easily confused with the basal conglomerate.

PLATE IV.



VIEW OF THE TRINITY SAND OUTCROP ON ROCK CREEK FOUR MILES WEST OF MARIETTA.

The following discussion is quoted from Oklahoma Geological Survey Bulletin No. 19, pt. II[6]. It deals in particular with the lower part of the Trinity sand as exposed in the extreme western part of Love county and the adjoining area in Texas.

"About 4½ miles southwest of the town of Leon, Okla., is a crossing on Red River known as Rock Bluff Ferry. On the Oklahoma side the area in the big bend of the river consists of a sand-covered, flat plain, and terraces sloping gently to the river. On

6. Okla. Geol. Survey, Bull. No. 19, pt. 2, pp. 308-11.

the Texas side the bluff rises abruptly to a height of 100 feet above the low-water level. The section is well exposed and was examined for a distance of about 4 miles. The rocks exposed show from approximately the base of the Trinity sand series up into the formation, a distance of 100 feet at the immediate bluff, and in going back from the river a short distance the Goodland limestone is found overlying the Trinity formation.

"The section at Rock Bluff Ferry is a fair average of the Trinity formation in the area under consideration, yet it cannot be taken as a typical section, since the degree of variation from place to place is great.

"At the crossing the low-water line is about 710 feet above sea level, and the top of the highest part of the bluff from 100 to 110 feet higher. Beginning at the base, the following section is exposed: At the base 16 feet of cross-bedded, fine to coarse sands with interbedded chert and quartz pebbles. The mass of the material varies in color from light yellow to saffron. The pebbles range from a few, irregularly distributed, to a solid mass varying in size from that of a pea to 3 inches in diameter. The mass of sand is loosely cemented and disintegrates readily into loose sand and gravel. The pebbles are chiefly light-colored, but all colors may be found. Locally the sand contains streaks of red, sandy clay, and in places the sand is blackish on the outside, often showing hardened masses with blackened surfaces.

"Above this gravelly conglomerate are about 32 feet of loose pack-sand white to yellow in color, containing many spherical forms of bright yellow, unconsolidated sand. A little farther to the northwest, at about the same horizon, are found numerous marble-like hard sand-balls consisting of white, rounded grains of sand in more or less concretionary form, and yellow or black on the outside. Sometimes several of these are cemented in one mass.

"At this particular location is a lenticular band of red to chocolate-colored sandy shale 3 inches to 12 inches thick. About 5 or 6 feet higher in the pack-sand there is a little clay, in which the color grades from yellow to purple. These 5 or 6 feet of clay, with the sand, make up to a total thickness of about 43 feet. In places the sand becomes gray, green, and brown, while at about 43 feet from the base the sand and clay contain a large amount of limy streaks and irregular concretions. A material of similar nature continues upward for a distance of 25 feet or more to the base of a hard capping conglomerate-pebble bed. Near the top of the sand are some thin layers of gypsum. Hard concretions are also found in the upper part of this series. The bluff is capped with a ledge of conglomerate about 3 feet thick, consisting of fine to coarse, oolitic-like grains and pebbles of varying size. The conglomerate

is hard, massive, in part cross-bedded, and cemented together with a white, chalky-appearing cement. In general, the mass is given a mottled appearance.

"This is due to the presence of pebbles, colored pink, red, yellow, purple, greenish, brown, white, clear, and blue, with all variations in shade. Some of the pebbles are rounded, others subangular and irregular, but always with smooth surfaces.

"Going to the southward a considerable thickness of sand and local conglomerates is found between the main conglomerate bed and the Goodland limestone.

"The following description of a section just west of the Rubottom store, in the W. ½, sec. 13, T. 7 S., R. 3 W., along the east side of the small stream, gives a fair idea of the condition to the north of the above location. In the cut along the stream, sandstone of supposed Cretaceous age rests on a considerable thickness of red shale, which may replace a part of the sand and conglomerate in the section to the south, or it may be the top of the Permian series.

Sections along stream west of Rubottom store.

	Feet
Underlying red shale	30
White to greenish sandstone, with massive, round and kidney-shaped concretions	10-20
Quartzite conglomerate	2
Shaly interval	5
Calcareous quartzite	2
Shaly interval	8
Soft, sandy limestone	2
Sand and gravel	20
Quartzite bed	3

"Beginning a few rods north of the above location with the conglomerate bed in the bottom of stream the following section occurs to the top of the hill:

Section 20 rods north of above section.

	Feet
Sandy gravel conglomerate (1 pebble found 3 inches in diameter)	½
Basal part of sandstone, with fine conglomerate cemented with lime. Sandstone weathers out into rough irregular masses	15
White, greenish, shaly sandstone, with many calcareous, irregular surface concretions	10
Deep red to purple sandy shale	7
Yellow sandstone, with interbedded limestone at top, glassy quartzite associated with oolitic quartz and pebbles	24

"Heavy conglomerate, weathered out and lying about in large fragments.

"Sections similar to the upper members of those given above may be made at many localities over the area north of Red River. The characteristic rocks over the surface of the area are heavy quartzite conglomerates, chief of which is the one represented at the top of the Rock Bluff section. It is a heavy, massive quartz-conglomerate, with pebbles ranging from a fraction of an inch in diameter to 3 inches or more. The pebbles are all chert and quartz. The basal conglomerates exposed in Rock Bluff do not extend far to the northward. The principal sandstones outcropping, come in between the horizon of the heavy conglomerate, and represent various horizons in the pack-sand. The outcropping sandstones are irregular masses weathered into rough, kidney-shaped bodies, having a characteristic blocking. These sandstones are all dark-colored on the outside, and on the inside vary from gray, mottled, soft sandstones to hard, red, irony sandstones, in some cases becoming almost flinty. There are characteristic grains and cleavage planes in the sandstone which group them all in one series. However, there is little reason to believe that the principal sandstone of the area is a distinct sandstone occupying a definite horizon, but locally there may be one or more layers or masses occurring at any horizon within a favorable distance of 100 feet, or at any level throughout the thickness of the pack-sands shown in the above sections. These sandstones are chiefly much hardened or indurated masses. There is, however, one principal level of the sandstone masses which occurs about 35 feet below the heavy conglomerate. In some places the heavy conglomerate rests directly on the masses of sandstone, the intervening pack-sand and associated materials having been removed chiefly by the action of water. In other places the conglomerate and sandstone rest on heavy red shale beds of Permian age. All the intervening materials have disappeared, and the more resistant parts make up a new succession.

"In some instances the heavy conglomerate caps the hills and presents a good section of the series. Half a mile to a mile away the same bed of conglomerate is found apparently in place, but 50 to 100 feet lower, the full section of unconsolidated material having disappeared."

Section[7] *of the Trinity sand on the south bank of Red River, Sec.* 13, *T.* 8 *S., R.* 1 *W.*

This section is found on the bluffs which occur at the point the river makes a sharp bend to the northeast between Warrens Bend and Sivells Bend.

Goodland limestone	Thickness in Feet
Finely stratified laminated brown clay	11' 9"
Indurated oyster shell breccia	1' 5"
Oyster bed (*Exogyra texana*)	0' 3"
Bituminous clay interstratified with yellow sand	1' 5"
Hard bluish sandstone	0' 6"
Calcareous hard sandstone with selenite in joints	1' 4"
Marly clay, locally carbonaceous, containing an abundance of fossils	4' 0"
Oyster shells (*Ostrea crenulimargo*)	0' 2"
Dark brown marly clay	0' 3"
Black carbonaceous clay	3' 6"
Massive white pack sand	21' 6"
Greenish blue shale, appearing to be a lense	1' 6"
White pack sand	23' 0"
Hard pure white sand	2' 0"
Sandy yellowish, white to gray clay	14' 6"
White, pink, red to yellow sand	32' 6"
Hard indurated masses of brown sandstone	1' 0"
Sandy clay, red, purple, yellow and white	48' 0"
White pack sand	12' 0"
Water level—Red River	
Total	181' 7"

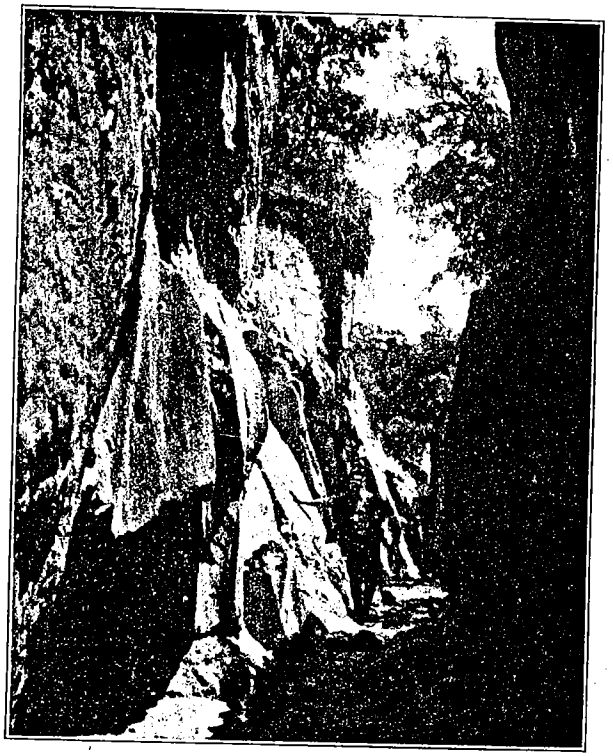
The Trinity sand in this area varies in thickness from 0 to 600 feet according to well records. It is practically impossible to measure a complete stratigraphic section of the Trinity sand as it weathers so easily and loose sand usually covers the surface.

The Trinity weathers, forming a flat to gentle rolling plain. It is usually covered with a thick growth of scrub oak and black jack. Small ravines in the Trinity are characterized by almost perpendicular sides.

The Trinity sand outcrops as will be noted from the accompanying map (Plate No. XIX) in the northeastern part of the county, in a narrow strip through the central part and covers all the western half of the county. The Trinity sand in this area is not very fossiliferous as a whole, although there are a number of calcareous clays in the upper part that contain an abundance of fossils. Fossil wood is abundant in most localities. Drifts of wood have apparently collected near the shore and have been fossilized. A hill was found in Marshall County that was made up principally of fossil wood. The Trinity sand is a heavy water horizon, most of the water wells in the county deriving their supply from this formation.

7. This section was measured by the author with the assistance of the student of the University of Texas Geology Camp, Gainesville, Texas, Summer, 1924.

PLATE V.



VIEW OF A RAVINE IN THE TRINITY SAND.

FREDERICKSBURG GROUP

GOODLAND LIMESTONE

The Trinity sand is overlaid by the Fredericksburg group which is represented in Love County by the Goodland limestone. The Goodland limestone received its name from the town of Goodland, Choctaw County, Oklahoma, where the type section is found. The Goodland limestone is a pure, semicrystalline, massive white limestone approximately 25 feet in thickness. It is composed of four distinct beds ranging in thickness from 3 to 8 feet. The lowest bed is from 2 to 4 feet thick and is a concretionary nodular limestone, containing thin beds of marly shale. This bed according to Stephenson[8] represents the Walnut shaly member of the Fredericksburg Group, which is well developed in central Texas, reaching a

8. Stephenson, L. W., A Contribution to the Geology of Northeastern Texas and Southern Oklahoma: U. S. Geol. Survey Prof. Paper 120, pp. 129-163, 1918.

thickness of over a hundred feet. In the Atoka[9] and Tishomingo[10] Folios, Taff did not recognize the Walnut shaly member but included this lower bed with the Goodland limestone. In Love County the Walnut shaly member is not sufficiently developed to warrant its separation so that it will be included in the Goodland limestone and described as the lower bed or bed No. 1 of that formation.

It is desired to call the readers attention to the various shaly horizons in the upper 25 feet of the Trinity sand, as given in the section of the Trinity exposed on the south bank of Red River between Warrens Bend and Sivells Bend, particularly the marly clay horizon, 4 feet in thickness, which occurs between 16 and 17 feet below the Trinity-Goodland contact. It is probable that these beds are the equivalent of the Walnut Clay of Central Texas, rather than the beds immediately underlying the Goodland, as used by Stephenson and other authors.

The writer[11] had an opportunity to study this section in Cooke County, Texas which lies immediately south of Love County and it was observed that the marly clay bed, above referred to, thickens rapidly to the south and that in the southern part of Cooke County it reaches a thickness of approximately 25 feet, and occupies a position immediately underneath the Goodland limestone.

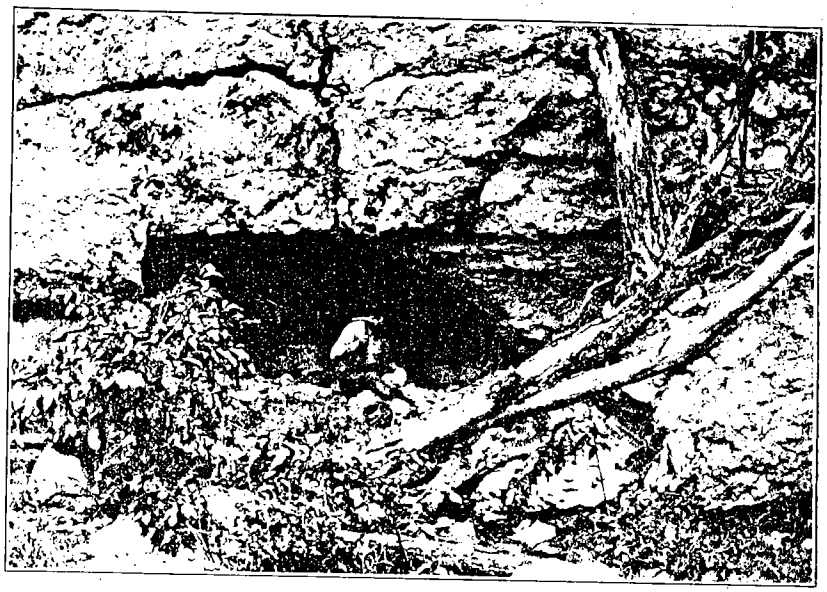
The Goodland limestone usually outcrops in a bluff or escarpment forming a table land with an escarpment overlooking the Trinity sand. The escarpment formed by the Goodland limestone is very prominent in Love County and can be seen for miles. The Goodland limestone weathers by solution into irregular rounded boulders or slabs full of large holes, which lie about the surface giving the appearance of old dry bones. The upper part of the Goodland weathers also by exfoliation at right angles to the bedding planes, giving a shattered appearance to the outcrop.

The Goodland limestone outcrops (Plate No. XIX) in a narrow strip which forms a broad U in the central part of the county. The outcrop of Goodland is usually only a few hundred feet in width. Good contacts of the Trinity-Goodland are not very common due to the slumping of the Goodland over the contact. Where it has been found a yellowish brown pack sand underlies the Goodland limestone. The upper contact is usually well defined. The overlying formation being principally a clay, is usually removed by erosion leaving a bench of Goodland limestone.

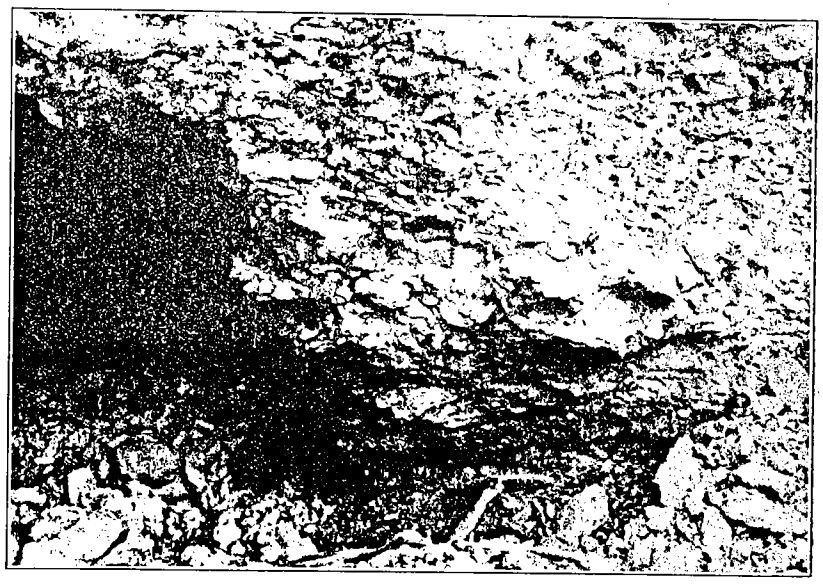
The top of the Goodland limestone is characterized by a peculiar ammonite, *Schloenbachia acutocarinata* (Shumard) which oc-

9. Taff, J. A., U. S. Geol. Survey Geol. Atlas, Atoka Folio (No. 79), 1902.
10. Taff, J. A., U. S. Geol. Survey Geol Atlas, Tishomingo Folio (No. 98), 1903.
11. With the University of Texas Geology Camp, Gainesville, Tex., Summer 1924.

PLATE VI.

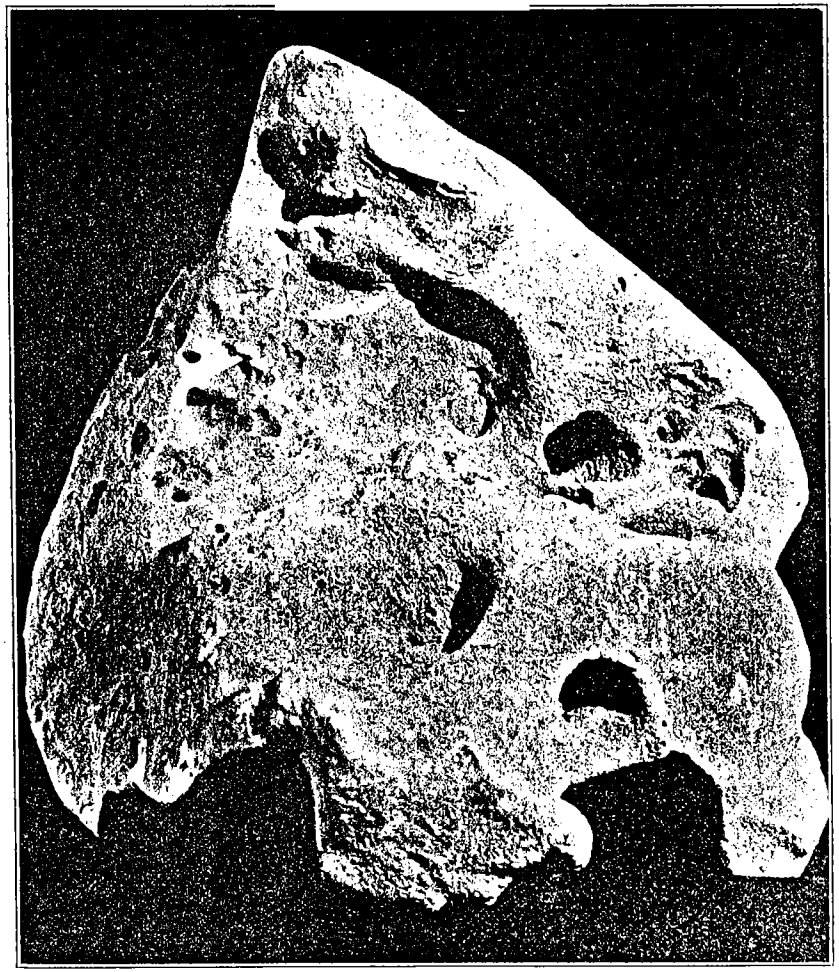


A. LOWER PART OF THE GOODLAND LIMESTONE IN THE SW. ¼ SEC. 5, T. 7 S., R. 2 E., IN THE CREEK JUST WEST OF THE GULF COLORADO AND SANTA FE RAILROAD CUT THROUGH THE GOODLAND LIMESTONE OUTCROP



B. VIEW OF THE LOWER BED OF THE GOODLAND LIMESTONE AT THE ABOVE LOCATION.

PLATE VII



A WEATHERED MASS OF GOODLAND LIMESTONE, SHOWING CHARACTERISTIC WEATHERING

curs in the upper few feet of the formation. It is an excellent index fossil as it is not known to occur at any other horizon in this area.

The top of the Goodland was the horizon used in mapping the structure of this area.

Following are several sections of the Goodland limestone and the formations immediately above and below it. These sections give a detailed description of the individual beds.

Section of Goodland limestone Love County, Oklahoma

This section was measured in the SE¼ sec. 5, T. 7 S., R. 2 E., in the creeks on each side of the Gulf, Colorado and Santa Fe railroad, where it cuts through the Goodland outcrop about 2½ miles north of Marietta.

CHARACTER OF THE BEDS

		Thickness in Feet
Bed No. 4	White massive limestone, harder than the underlying beds and given to breaking off in flat plates at right angles to the bedding planes	7' 8"
Bed No. 3	Massive white limestone, slightly chalky	6' 5"
Bed No. 2	Massive white limestone, chalky and locally has a a well developed parting 18 inches from the base	5'10"
Bed No. 1	Marly limestone rather sandy, very fossiliferous	3' 4"
	Total thickness	23' 3"

All of the above section was measured east of the railroad except the lower bed which was measured on the west side and a level carried to the outcrop on the east side of the track. It was necessary to do this because in the section on the east side of the track the lower bed was covered by stream deposit. The two exposures are less than 100 yards apart.

Section measured along Creek on west side of Gulf Colorado and Santa Fe Railroad, due west of the cut through the Goodland outcrop in the SE¼ sec. 5, T. 7 S., R. 2 E.

		Feet
Caddo formation	White limestone	
Kiamichi formation	Oyster shell conglomerate	1'10"
	Bluish green clay marl	32' 5"
	Brown sandy limestone	0' 6"
Goodland limestone	Massive white limestone	24' 8"
Trinity sand	Soft yellowish brown pack-sand	10' 9"
	Blue and yellow sandy shale	?

Section of Goodland limestone on Rock Creek about 5 miles west of Marietta.

This section was measured on the east bank on the creek about 50 yards north of the main east and west road, in the southwest corner of sec. 16, T. 7 S., R. 1 E.

Bed No. 4	Hard, white to cream colored limestone, massive, very brittle with conchoidal fracture and a shattered surface due to exfoliation	8' 8"
Bed No. 3	Massive white limestone, chalky	7' 2"
Bed No. 2	Massive white limestone, chalky	5' 1"
Bed No. 1	Marly concretionary limestone with sand and shale in lower part	2' 5"
	Total thickness	23' 4"

PLATE VIII.

COMPLETE SECTION OF THE GOODLAND LIMESTONE IN THE CREEK JUST EAST OF THE GULF COLORADO AND SANTA FE RAILROAD CUT THROUGH THE GOODLAND OUTCROP IN THE SW. ¼ SEC. 5, T. 7 S., R. 2. E.

At the above section the Trinity-Goodland contact is about 40 feet above the stream level and a clear cut contact can be obtained by digging away the loose debris which has slumped down.

Section[12] *of the Goodland limestone on the south bank of Red River, Sec. 13, T. 8 S., R. 1 W.*

This section is found on the bluffs which occur where the river makes a sharp bend to the northeast, between Warrens Bend and Sivells Bend. It immediately overlies the section of the Trinity sand, given on page 21.

Kiamichi formation:	Thickness in Feet
Marly white limestone	4' 3"
Marly clay	0' 2"
Massive white limestone	3' 5"
Marly shale	0' 1"
Massive white limestone	1' 0"
Marly clay	0' 1"
Massive white limestone	2' 0"
Marly clay	0' 1"
Massive white limestone	3' 0"
Marly nodular limestone	0' 9"
Massive white limestone	5' 8"
Nodular shaly limestone	4' 0"
Total	32 Feet

It will be noted that the above section is approximately 10 feet thicker than section given for the northern part of Love County. Practically all the formations of the Comanchean thicken to the south.

Chemical samples were collected[13] at two of the sections and analysis[14] was made of each bed separately in order to see if there was any change in the composition of the individual beds, which probably could not be detected in an analysis of the total thickness.

12. Idem., p. 21.
13. Oakes, M. C., Collector, Okla. Geol. Survey.
14. Shead, A. C., Chemist, Okla. Geol. Survey.

Analysis of Goodland limestone from section No. 1, SE¼ sec. 5, T. 7 S., R. 2 E., about 2½ miles north of Marietta.

Bed	Top Bed	No. 4	No. 3	No. 2	No. 1
SiO_2		1.01	3.10	6.42	27.48
Al_2O_3		0.38	0.78	1.03	4.16
Fe_2O_3		0.68	0.68	0.75	2.05
MgO		0.53	0.54	0.55	0.71
CaO		54.57	53.10	50.71	35.11
H_2O		0.08	0.11	0.17	1.31
H_2O Organic matter		Trace	Trace	Trace	0.28
TiO_2		0.00	0.00	0.03	0.13
CO_2		43.54	42.40	40.53	28.42
P_2O_5		0.037	0.041	0.04	0.079
MnO		0.044	0.044	0.057	0.093
Total		100.87%	100.795%	100.387%	99.822%
Insoluble siliceous residue		1.17%	3.45	7.28	29.54
H_2O ($Fe_2O_3Al_2O_3$ etc.)		1.10	1.50	1.82	6.42
Loss on Ignition		43.47	42.43	40.73	30.01

Analysis[15] *of Goodland limestone from (Rock Creek Section) SE¼ of SW¼ sec. 16, T. 7 S., R. 1 E., about five miles west of Marietta, Love County, Oklahoma.*

	Bed No. 1 (Bottom Bed) Sample No. 8	Bed No. 2 Sample No. 9	Bed No. 3 Sample No. 10	Bed No. 4 Sample No. 11
SiO_2	13.32%	8.62%	2.58%	1.31%
Al_2O_3	2.81	1.42	0.56	0.48
Fe_2O_3	0.32	0.27	0.02	0.13
FeO	0.81	0.35	0.52	0.29
MgO	Trace	0.54	0.14	0.40
CaO	45.72	49.60	54.02	54.82
H_2O	0.80	0.31	0.14	0.14
CO_2	36.00	39.68	42.56	43.20
TiO_2	0.13	0.09	0.00	0.00
Total	99.91%	100.88%	100.54%	100.77%
Thickness of beds	2'6"	5'1"	7'2"	8'10"

Sample No. 9 of Bed No. 2 was badly weathered.

A point to be noted in considering these analyses is the large per cent of silica and alumina in Bed No. 1 and the decrease to nearly nothing in the top bed. In working on the Goodland it would

15. Idem., p. 28.

be probably safe to assume that if the lower bed was only slightly developed and the upper bed was well developed that it would run very pure. The reverse would be true should the lower bed be well developed.

WASHITA GROUP

GENERAL STATEMENT

The Washita group lies conformably on the Fredericksburg group. It is made up of four formations as follows:

Washita group..... { Bennington limestone
Bokchito formation
Caddo formation
Kiamichi formation

The Washita group consists chiefly of shaly clay and marl with limestone and sandstone interbedded, having a total thickness of approximately 310 feet in Love County. The limestone beds, although subordinate to the shaly clay, form several definite horizons that are readily traceable throughout the area, and are valuable key beds in determining the structure. The sandstone beds are limited to the top of the group, occuring in the Bokchito formation. They are seldom more than two feet thick.

The Washita group was subdivided by Hill[16] and also by Taff[17] (see Pl. XII). The divisions as recognized by Taff have been followed in this report.

The Washita group is the highest division of the Comanchean or Lower Cretaceous. All of the subdivisions of the Washita group have been recognized and mapped in Love County.

KIAMICHI FORMATION

The Kiamichi formation is named for the Kiamichi river, on which it is typically exposed in Choctaw County, Oklahoma. Upon the Goodland limestone are some platy layers of a slightly siliceous, brown shaly limestone. These layers are but a few inches thick and will not be noticed unless a clear cut contact between the Kiamichi and Goodland is found. These few inches represent the transition beds between the Goodland limestone and the Kiamichi formation. A blue-green clay marl approximately 30 feet in thickness succeeds this basal shaly strata. Overlying this clay marl bed is a hard brown limestone bed about one foot thick.

16. Hill, R. T., Geography and Geology of the Black and Grand prairies, Tex.: U. S. Geol. Survey twenty-first Am. Rept., pt. 7, 1901.

17. Taff, J. A., U. S. Geol. Survey Geol. Atlas, Tishomingo (No. 98) and Atoka (No. 79) folios.

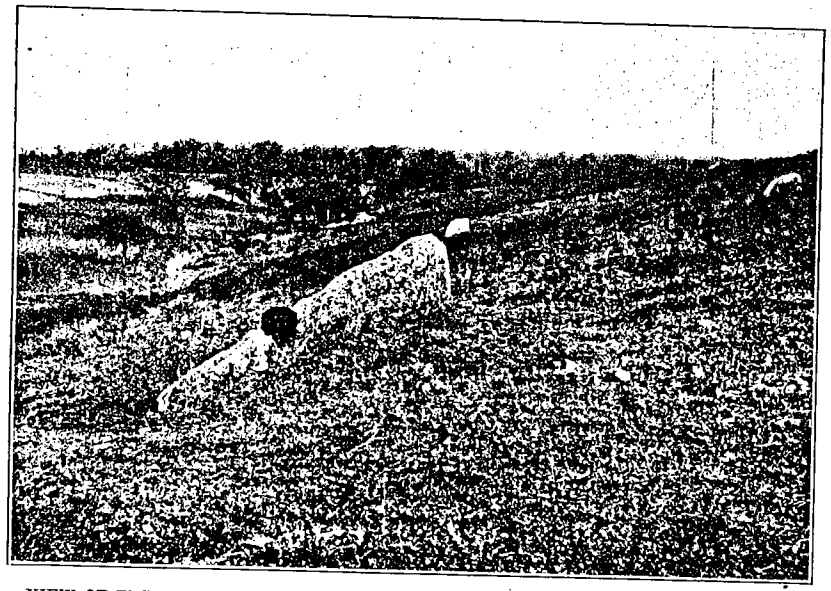
PLATE IX.

VIEW SHOWING THE GOODLAND-KIAMICHI CONTACT IN THE SW. ¼ SEC. 5, T. 7 S., R. 2 E

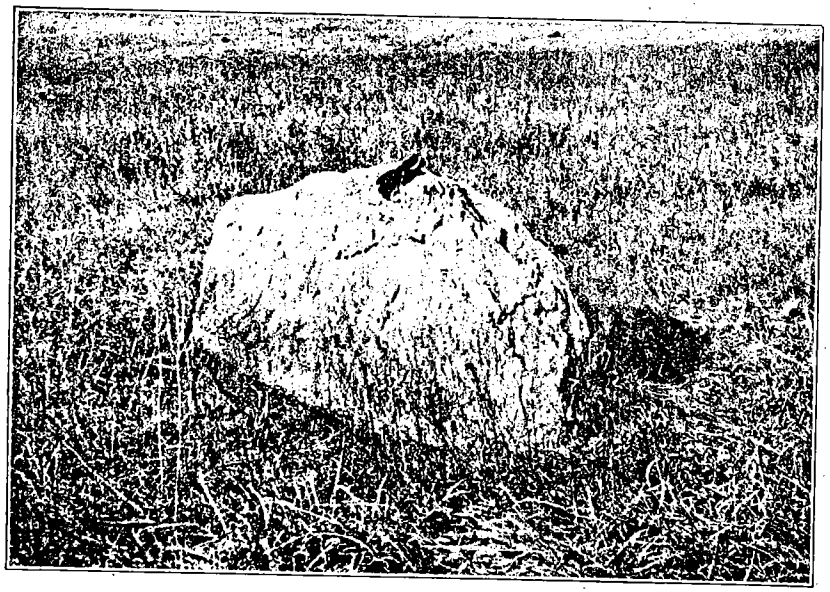
This limestone bed is completely filled with oyster shells *Gryphea navia* Hall so that it is frequently referred to as an oyster shell conglomerate. The top of the Kiamichi formation was mapped on this bed. It makes a small, but recognizable bench at most places below which large slabs of this oyster shell conglomerate stand on edge and are referred to as "edge rocks." The weathering of the soft clay-marl underlying this hard limestone caused it to slump, breaking into large slabs which are found standing at every angle.

The total thickness of the Kiamichi formation in Love County is approximately 35 feet. The Kiamichi formation outcrops in a narrow band lying immediately above the Goodland limestone.

PLATE X.



A. VIEW OF THE KIAMICHI OYSTER BED COMMONLY KNOWN AS "EDGE ROCK" SHOWING MANNER IN WHICH IT SLUMPS. THIS VIEW WAS TAKEN ABOUT 2½ MILES NORTH OF MARIETTA.

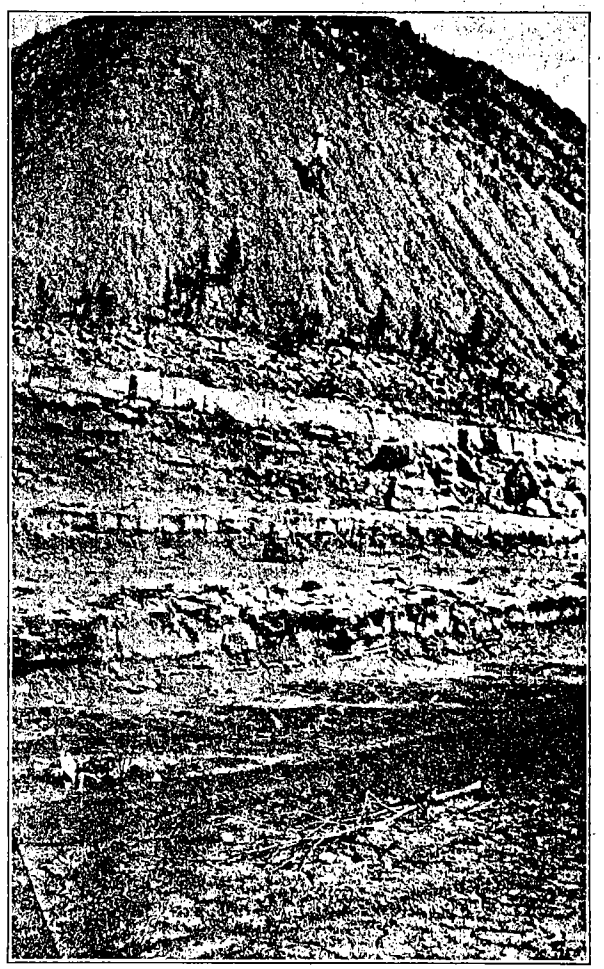


B. ANOTHER VIEW AT THE ABOVE LOCATION

CADDO FORMATION

The Caddo formation was referred to by Taff[18] as the Caddo limestone. In Love County the Caddo is made up principally of shale with numerous beds of limestone interbedded, so that, in this report, it is called the Caddo formation. The name Caddo was

PLATE XI.



LOWER PART OF THE CADDO FORMATION ON THE WEST SIDE OF HORSESHOE BEND, SEC. 22, T. 8 S., R. 2 E.

18. Idem., p. 30.

given by Taff because of the excellent exposures of this formation near the town of Caddo, Bryan County, Oklahoma.

The basal 22 feet of the Caddo formation is composed of alternating beds of limestone and shale in about equal parts. The limestone beds vary in thickness from a few inches to 2 to 3 feet, separated by a like thickness of shale. The limestone is a yellowish marly limestone and a hard white limestone very similar to the Goodland limestone in unweathered appearance. The shales are very calcareous and bluish gray colors predominate. About 16 feet above the top of the Kiamichi formation is a white to cream colored limestone with interbedded shales from 4 to 6 feet thick, which can be easily recognized, because of the abundance of large ammonites, both in the limestone and the shale. The ammonites are very abundant and the majority of them are from 1 to 3 feet in diameter. This is the only horizon in the Comanchean of Love County that ammonites of this size have been found. This horizon is therefore very valuable as a key bed in working on the structure of the region. Another very interesting occurrence in the Caddo formation is the large fossil fucoids (?) which occur on many of the limestone beds of the Caddo formation. They are not limited to any definite horizon, occuring throughout the formation, although so far as known they do not occur in any other formation. Iron stains are abundant on the limestone beds in the lower part of the Caddo formation. The stains are due to the weathering of Pyrite (Iron sulphide) which occurs as thin veins and inclusions in the limestone.

Overlying the basal beds of limestone and shale is a shaly clay member 56 feet thick. It is a bluish gray shaly clay without any well defined stratification or bedding, rather soft and easily weathered. It lies immediately above the "large ammonite" horizon. Succeeding this shaly member is 75 feet of alternating beds of cream colored limestone and bluish gray shale. These beds differ from the basal beds of the formation in that the shale beds are usually much thicker than those in the base. The beds of shale in the upper portion of the Caddo formation range from a few feet to over 30 feet in thickness. The limestone beds rarely exceed 4 or 5 feet in thickness. At the top of the Caddo formation is a limestone member 19 feet thick with numerous shale partings. This bed is equivalent, in part at least, to the Fort Worth limestone of the Texas section. The Caddo formation has a total thickness of approximately 150 feet. Briefly summarized the Caddo formation consist of alternating beds of white limestone and bluish gray shale. It can be divided into three members; namely the lower, middle and upper. The lower member consists of 22 feet of alternating beds of limestone and shale. The middle member is 56 feet thick and is entirely shale. The upper member

consists of about 75 feet of alternating beds of limestone and shale similar to the lower member except as a rule the shale beds are much thicker. Of the total thickness of the Caddo formation about one third consists of limestone and two thirds shale.

The Caddo formation is very fossiliferous containing an abundance of well preserved fossils. The Caddo formation outcrops in an oblong area surrounding the town of Marietta and lying in the basin of the Marietta syncline.

Section of the Caddo formation.
Love County, Oklahoma.

Lower part of the section including the 56 foot shale member was measured on the west bank of Red River in sec. 22, T. 8 S., R. 2 E. The upper part of the section was measured on the east bank of Red River in sec. 13, T. 8 S., R. 2 E.

Top	Thickness in Feet
White limestone with shale partings	19'
Bluish gray shaly clay	14'
Alternating beds of limestone and shale	8'
Bluish gray shale	17' 4"
Alternating beds of limestone and shale	19' 6"
Bluish gray shale	56' 0"
Alternating beds of limestone and shale. Large ammonites abundant	5' 3"
Massive white limestone	2' 0"
Alternating beds of limestone and shale with large ammonites abundant in top	4' 8"
Altternating beds of cream colored limestone and bluish gray shale	9' 0"
Total thickness	154' 2"

BOKCHITO FORMATION

The Bokchito formation is so named because of the excellent exposures on Bokchito Creek in the vicinity of the town of the same name in Bryan County, Oklahoma. It is composed of clay and sandy clay, with beds of friable brown sandstone, siliceous shell limestone and ferruginous concretions of sand and clay totaling approximately 140 feet in thickness.

The Bokchito formation is the equivalent of the Denton, Weno, and Pawpaw formations of North Central Texas, which attain a total thickness of 210 feet. This rapid thinning of the sediments to the north during Bokchito time marks the beginning of the retreat of the Comanchean sea. It is interesting to note that this thinning did not begin until about the middle of Bokchito time, for the lower 70 feet of the Bokchito, which is equivalent to the Denton formation, has the same thickness in Love County as farther south.

The Bokchito outcrops in a roughly circular area, lying in the basin or trough of the Marietta syncline to the southeast of Marietta. Due to the character of the formation it is difficult to obtain a clear cut section of the entire formation.

The following section was the best one obtainable in the area under consideration.

Section of Bokchito formation.
Love County, Oklahoma.

This section was measured on the east bank of Red River in the northwest corner of sec. 13, T. 8 S., R. 2 E., about one-half mile north of Tucks' Ferry.

Top	Thickness in Feet
Blue clay marl	0'11"
Brown, Hard, Calcareous, Indurated, sandstone	1' 6"
Shale with iron concretions and shell beds of iron replacements, *Protocardia* abundant	37' 4"
Brown sandstone	0' 6"
Brown shell beds (*Gryphea washitaensis*) with shale partings	3' 6"
Blue shale	34' 0"
Sandstone, brown, massive containing many ripple marks	2' 6"
Blue shale	36' 8"
Total thickness	120'

In the above section the brown shell horizon containing *Gryphea washitaensis* Hill, which occurs about 70 feet from the base, is probably the Denton-Weno contact. The hard indurated calcareous sandstone which occupies the top of the hill is probably the Quarry limestone. It is then evident that the sediments representing the Pawpaw formation have been removed by erosion.

The Bokchito formation contains at least two horizons in which there is an abundance of highly fossiliferous ferruginous clay sand concretions. The lower of these beds is distinguished by the presence of a great number of *Turritella* sp. while the upper bed contains only an occasional *Turritella* and a great many small pelecypods. The first mentioned horizon is located below the Quarry limestone, and the latter is located above it.

The Bokchito forms a reddish brown soil, which is characterized by a large number of small ironstone fragments and concretions.

In going over the area for the first time it seems as though there is a great deal more sandstone in the section than is really present, which is due to the fact that the sandstone resists weathering to a greater degree than the shale, so the sandstone is left lying about the surface, while the shale is carried away.

BENNINGTON LIMESTONE

The Bennington limestone is the uppermost formation of the Comanchean in this region. The Bennington limestone is brownish white, massive limestone containing an abundance of fossils. It is composed in a large part of countless specimens of a small Pelecypod, *Exogyra arietina* Roemer. It rarely exceeds 10 feet in thickness.

The Bennington limestone is represented in Love County by one small outlier covering only a few hundred feet, capping the highest hill southeast of Marietta in sec. 27, T. 7 S., R. 2 E. It is only a few feet thick, the remainder having been removed by erosion. Remnants of Bennington limestone have been found on other hills but no distinct beds were present. The Bennington limestone is well developed in Bryan County, particularly near the town of Bennington. The Bennington limestone is equivalent to the Mainstreet limestone of North Texas.

CORRELATION OF COMANCHEAN FORMATIONS.
(After Austin Folio No. 76)

Love County, Okla. Okla. Geol. Survey, Bull. No. 33.	Austin Quadrangle, U. S. Geol. Survey, Austin Folio, No. 76.
Bennington limestone.	Buda limestone Del Rio clay
Bokchito formation. Caddo formation. Kiamichi formation.	Georgetown limestone.
Goodland limestone.	Edwards limestone. Comanche Peak limestone. Walnut clay.
Trinity sand.	Glen Rose formation. Travis Peak formation.

TERTIARY DEPOSITS

Covering the tops of many of the hills and resting unconformably on all of the Comanchean sediments alike is a thin mantle of gravel. This gravel consists chiefly of quartz pebbles, well rounded and ranging from gravel up to pebbles several inches in diameter. This material has been questionably referred to as "Tertiary Gravels." It is supposed that these gravels came from the Rocky Mountain region and probably represent remnants of a Tertiary peneplain. Another suggestion that seems very probable is that

they are related to a former course of some stream, in this case most likely Red River. This is a question, however, that cannot be settled in view of the limited amount of work that has been done on it.

A well consolidated conglomerate was found along the bank of the Creek in about the center of sec. 20, T. 7 S., R. 3 W. This conglomerate looks very much like concrete and is made up of limestone pebbles and material derived from the Comanchean formations, cemented with sand. It was observed for a considerable distance along this particular stream and in places was from 8 to 10 feet thick. Remnants of a similar conglomerate were observed along other streams but no distinct beds were found.

RIVER DEPOSITS

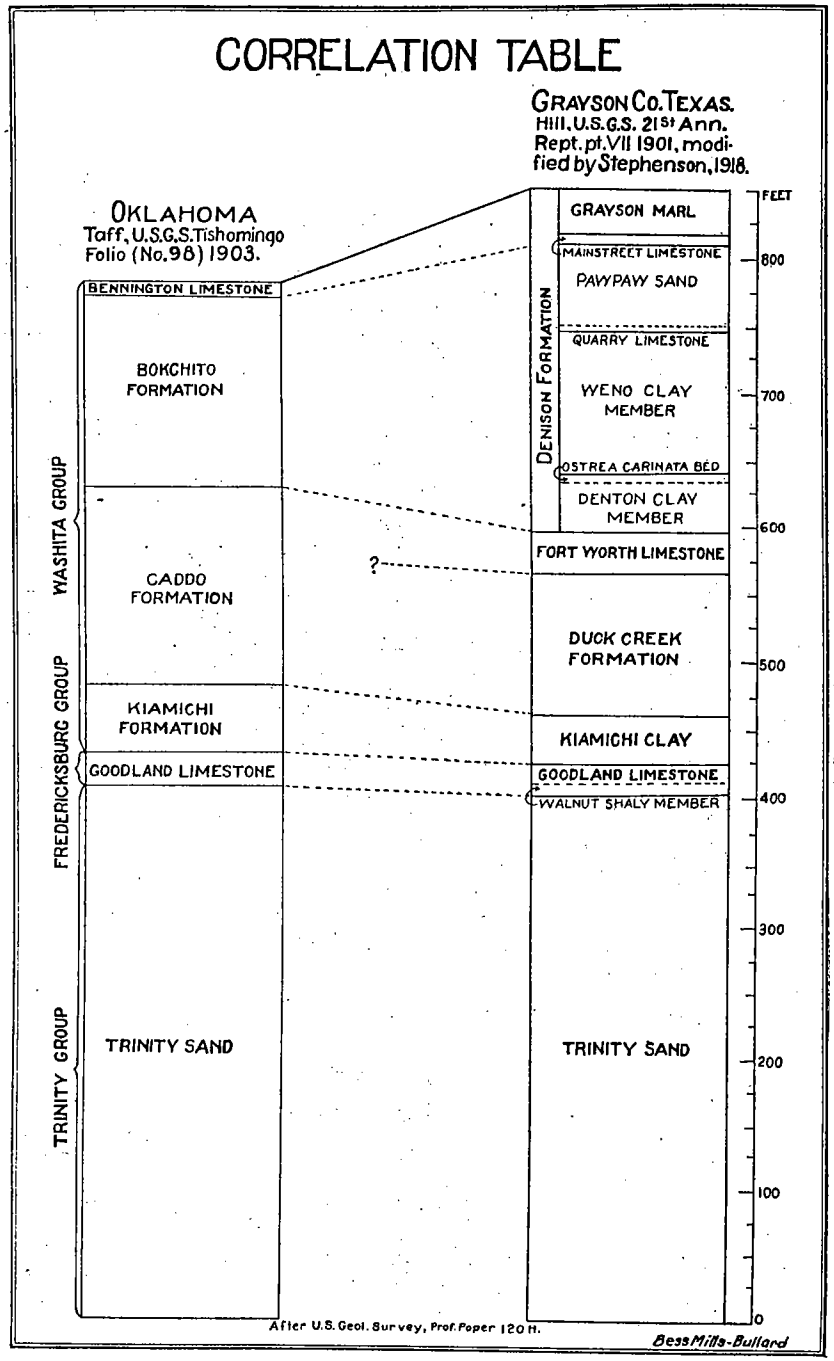
Along Red River a broad flood plain has been developed. In places it extends for three or four miles from the present course of the river. The flood plain is covered with rich alluvial soil in places and in other places with river sand. Some of the best farming land in Oklahoma lies in the Red River flood plain. The famous "Love's Valley," located principally in the northwest part of T. 8 S., R. 3 E., is located on the flood plain of Red River. In the south and southwestern part of the County the flood plain is composed principally of sand and is of little value for farming purposes.

The following logs will give an idea of the formations as reported in logs of wells drilled in this area.

Logs of Manhattan Oil Co.'s well, Hodges farm, NW, NW, SE¼ sec. 18, T. 8 S., R. 2 E., Love County, Oklahoma.

Formation	Thickness Feet	Bottom	Formation	Thickness Feet	Bottom
Yellow clay	20	20	White sand	10	510
Blue gumbo	100	120	Gray shale	15	525
Gray lime	10	130	Shale	15	540
Black shale	5	135	Water sand	110	650
Blue gumbo	15	150	Sand	60	710
Gray shale	30	180	Red rock	6	716
Blue gumbo	25	205	Gray shale sandy	19	735
Brown gumbo	5	210	Red rock	5	740
Blue gumbo	10	215	Water sand	5	745
White sand	60	275	Gray shale	80	825
Gray shale—6 blrs. wtr.	15	290	Sand	60	885
White sand	120	410	Sandy shale mixed	40	925
White lime	20	430	Mixed lime and shale	25	950
Water sand	8	438	White water sand	35	985
Hard lime	10	448	White lime	15	1000
Red rock	7	455	Broken lime	14	1014
Hard lime	10	465	Broken lime and sand	36	1050
Gray shale	35	500	Hard lime and shells	10	1060

PLATE XII.



Hodges No. 1 Sec. 18, T. 8 S., R. 2 E. (Concluded)

Formation	Thickness Feet	Bottom
Lime and broken shell	5	1065
White water sand	45	1110
Broken lime and shells	150	1260
Blue shale	135	1395
Water sand	5	1400
Blue shale	20	1420
Water sand	10	1430
Blue shale	25	1455
Water sand	5	1460
Blue shale	55	1515
Water sand	20	1535
Sandy lime	20	1555
Lime and sand	20	1575
Sandy lime	10	1585
Blue shale	62	1647
Water sand	10	1657
Blue shale	48	1705
Broken lime sandy	15	1720
Blue shale	40	1760
Water sand	29	1789
Blue shale	46	1835
Red rock	10	1845
Brown shale	20	1865
Gray shale	50	1915
Water sand	10	1925
Blue shale	50	1975
Water sand	15	1990
Blue shale	35	2025
Water sand	23	2048
Blue shale	4	2052
Hard shell	3	2055
Blue shale	3	2058
Hard shell	2	2060
Blue shale	62	2122
Water sand	44	2146
Blue shale	11	2157
Water sand	22	2179
Blue shale	46	2225
Water sand	20	2245
Broken sand and shale	8	2253
Blue shale and shell	55	2108
Water sand	18	2426
Blue shale	5	2431
Red rock	5	2436
Blue shale	6	2442
Water sand	10	2452
Blue shale	8	2460
Water sand	10	2470
Blue shale	3	2473
Lime shell	5	2478
Blue shale	10	2488
Blue shale	7	2495
Water sand	10	2505
Blue shale	35	2540
Hard sand, gray	7	2547
Blue shale	178	2725
Shale gray	155	2880
Water sand	13	2893
Lime shale	7	2900
Blue shale	70	2970
Lime shale	2	2972
Blue shale	35	3007

Log of Schaffer Oil and Refining Co.'s well on the J. E. Rose farm, NW. NW. NW. SE. sec. 6, T. 7 S., R. 1 E., Love County.

Formation	Thickness Feet	Bottom
Sand-wtr.	568	568
Lime shell	1	569
Blue clay	10	579
Sand	31	610
Rock sand	35	645
Hard sand	8	653
Sand lime shell	5	658
Red sand clay	6	664
Mixed formation	6	670
Streaks of sand	60	730
Streaks of sand, blue shale	33	763
Shell lime	4	767
Red shale	23	790
Blue clay	65	855
Streaks of blue clay	85	940
Wtr. and-wtr.	4	944
Lime shell	4	948
Blue shale	8	956
Lime	4	960
Lime shell	2	962
Blue shale	38	1000
Blue shale	60	1060
Grey sand	35	1095
Red gumbo	4	1099

Rose NW. NW. NW. SE. sec. 6, T. 7 S., R. 1 E., (concluded)

Formation	Thickness Feet	Bottom
Red mud	4	1103
Blue shale	7	1110
Blue shale	10	1120
Hard white sand	20	1140
Red sand	10	1150
Red lime shell	8	1158
Blue shale	22	1180
Sand red shale	50	1230
Shell lime	3	1233
Grey shale	11	1244
Brown sand	16	1260
Grown sand	20	1280
Blue, red clay	26	1306
Wtr. and-wtr.	4	1310
Blue-red shale	10	1320
Blue clay	10	1330
Red shale	52	1382
Lime shell	3	1385
Red shale	5	1390
Hard packed sand	30	1420
Red shale	18	1438
Rock	7	1445
Sandy lime-blue shale	20	1465
Hard blue lime shell	25	1490
Hard sandy lime	32	1522
Blue mud	13	1535
Blue mud	40	1575
Sandy lime	10	1585
Blue mud	27	1612
Hard shell	3	1615
Hard lime rock	15	1630
Hard lime	5	1635
Blue shale	38	1673
Hard shell	12	1685
Blue mud	4	1689
Hard lime	2	1691
Blue mud	2	1693
Hard lime	7	1700
Hard rock	25	1725
Flint rock	5	1730
Hard rock	5	1735
Blue mud	9	1744
Blue shale	20	1764
Wtr. and	8	1772
Mud	1	1871
Blue clay	10	1891
Wtr. sand	10	1901
Blue clay	4	1905
Blue shale	16	1921
Blue mud	52	1973
Hard lime	5	1978
White lime	6	1984
Hard lime	25	2009
Flint rock	2	2011
Hard lime	4	2015
Hard rock	32	2047
Rock	6	2053
Blue mud	2	2055
Blue clay	3	2058
Wtr. and	7	2065
Blue mud	15	2080
Blue shale	8	2088
Rock	10	2098
Blue shale	11	2109
Lime	24	2133
Hard rock	6	2139
Lime	6	2145
Rock	24	2169
Hard lime	33	2202
Lime	4	2206
Hard blue shale	18	2224
Lime	2	2226
Blue clay	19	2245
Blue mud	9	2254
Mud	24	2278
Blue mud	43	2321
Blue shale	35	2356
Hard blue shale	24	2380
Hard blue shale-shell	10	2390
Mud	12	2402
Lime shell	9	2411
Sandy lime	7	2418
Mud	2	2420
Sandy lime	3	2423
Sand rock	19	2442
Lime rock	4	2446
Blue shale	16	2462
Mud	14	2476
Blue shale	4	2480
Shell	2	2482
Mud	3	2485
Salt wtr. sand	15	2500
Lime shell	7	2507
Blue shale	9	2516
Coarse sand	20	2536
Lime shell	3	2539
Sand rock	31	2570
Wtr. sand	9	2579
Blue shale	2	2581
Sand rock	4	2585
Lime shell	1	2586
Sand rock	16	2602
Lime shell	1	2603
Sand rock	22	2625
Blue shale	25	2650
Mud	6	2675
Sand rock	17	2667
Hard shell	2	2669

Rose NW. NW. NW. SE. sec. 6, T. 7 S., R. 1 E., (concluded)

Formation	Thickness Feet	Bottom	Formation	Thickness Feet	Bottom
Blue shale	20	2695	Hard blue shale	11	2767
Lime shell	5	2700	Soft blue shale	15	2782
Blue shale	5	2705	Blue shale	64	2846
Blue shale-lime shell	2	2707	Brown shale	79	2925
Blue shale	49	2756			

Log of Robinson No. 1, drilled by Crosbie, Lynch and Stahl in Sec. 16, T. 8 S., R. 2 E., Love County, Okla.

Formation	Thickness Feet	Bottom	Formation	Thickness Feet	Bottom
Gumbo and Rock, Hard	25	25	Shale and sand	30	1180
Broken lime	45	70	Clay, blue	40	1220
Clay, Blue hard	42	112	Hard sand and rock	13	1233
Lime and shale	12	124	Hard sand	27	1260
Lime, blue hard	5	129	Sandstone, hard	20	1280
Lime, white hard	6	135	Sandstone	50	1330
Lime and shale	4	139	Sandstone, shale, blue	10	1340
Water sand	43	182	Blue shale, and clay	15	1355
Shale and lime, blue hard	7	189	Blue shale, chestnut	12	1367
Sand, soft	59	248	Blue shale and rock	28	1395
Lime, rock	6	254	Shale and rock, blue	27	1422
Lime, gray, hard	13	267	Shale and rock, blue	12	1434
White sand	11	278	Shale and sand	36	1470
Clay blue	22	300	Shale and clay	26	1496
Sandy clay	28	328	Blue clay	37	1533
Lime and shale	9	337	Blue shale	7	1540
Lime and sand	29	366	Blue shale and clay	54	1594
Lime, blue hard	49	415	Sandy shale	16	1610
Gumbo	61	476	Shale and clay	20	1630
Blue clay	29	505	Sandstone and shale	55	1685
Sand, slight showing	33	538	Brown shale	13	1698
Red Clay	14	550	Sandstone and shale	72	1770
Sand, hard	5	555	Brown shale	30	1800
Shells and rock	12	567	Shale and sandstone	70	1870
Clay	58	625	Sandy shale	18	1888
Sandy gumbo, hard	15	640	Water sand	9	1897
Sandy clay hard	15	655	Gumbo	13	1910
Sandy and rock, hard	3	658	Sand, show of oil	1	1911
Sandstone	7	665	Blue shale	12	1923
Rock and sand	25	690	Blue gumbo	16	1939
Rock, hard	15	705	Sandy shale	26	1965
Rock and sand	7	712	Gumbo	13	1978
Sand, white	13	725	Sandy shale, hard	20	1998
Clay, blue	8	733	Sandy shale, blue	17	2015
Sand and shale, blue	92	825	Water sand	10	2025
Sand and shale, blue	65	890	Sandy shale	13	2038
Hard sand	35	925	Gumbo	12	2050
Sandy shale and rock	45	970	Hard sand and shale	18	2068
Shale and charty rock	25	995	Hard sand and shale	29	2097
Sandy shale and chalk	45	1040	Water sand	18	2115
Sandy	8	1048	Sandy shale, blue	35	2150
Sandy shale and rock	22	1070	Sandy lime	25	2175
Sandy shale	80	1150	Gumbo	20	2195

This well "reported" to have been 2752 feet deep.

STRUCTURE

GENERAL STATEMENT

The general structure of Love County is of two types, (1) pre-Comanchean and, (2) post Comanchean. The pre-Comanchean, or in this case, Paleozoic structures are those structures that were developed prior to the deposition of the Comanchean sediments and are concealed by them, except in a few places where the Comanchean has been removed by erosion. The only place in Love County where the Paleozoic rocks are exposed is in the Criner Hills area, in the north central part of the county.

The post-Comanchean structure is that developed in the Comanchean sediments after their deposition. Minor structures developed during deposition, such as cross bedding, properly belong to the subject of sedimentation and will not be considered in this report. The greater portion of Love County is covered by Comanchean sediments which normally form a gentle monocline dipping from 30 to 80 feet per mile to the south or southeast toward the coast. This gentle monoclinal dip is interrupted in several places in Love County by local folds, which will be discussed in detail.

PRE-COMANCHEAN STRUCTURES

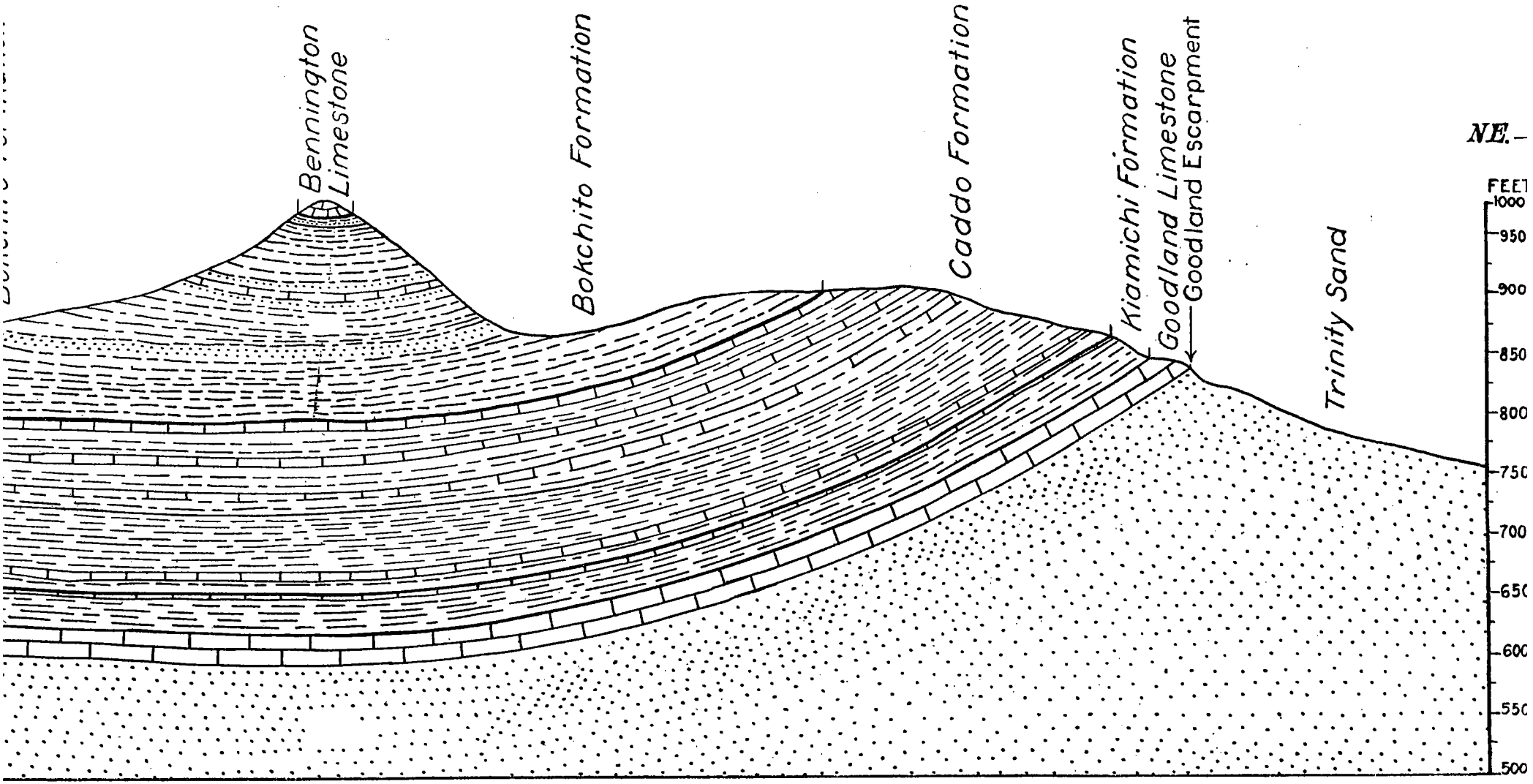
The pre-Comanchean structure is represented at only one place in Love County. It is exposed in the Criner Hills area in the north central part of the county. This area was first studied by Taff[19] and recently Goldston[20] studied the area in detail and subdivided the Glenn formation. The writer has done no detailed work in this region but the results of Goldston's work will be given in so far as it has a bearing on the Geology of Love County.

"The Criner Hills consist of a number of parallel northwest southeast ridges separated by narrow valleys. The Arbuckle limestone, Viola limestone, Hunton limestone and Sycamore limestone form the ridges. The Simpson formation, Sylvan shale and the Woodford chert form the valleys.

Structurally the Criner Hills consist of remnants of three folds. The Arbuckle anticline forms the western portion, the Viola anticline includes the southeastern part and the Sylvan syncline forms the central and southwestern part of the hills. The uplift is bounded on the west by a fault. This fault obliterates the south limb of the Arbuckle anticline, and has a throw of sufficient displacement to bring the basal sediments of the Glenn formation in contact with the Arbuckle limestone. On Hickory Creek this fault is intersected by the Sylvan fault which runs northeast across the

19. Taff, J. A., Preliminary Report on the Geology of the Arbuckle and Wichita Mountains, in Indian Territory and Oklahoma: U. S. Geol. Survey Prof. Paper 31, 1904.

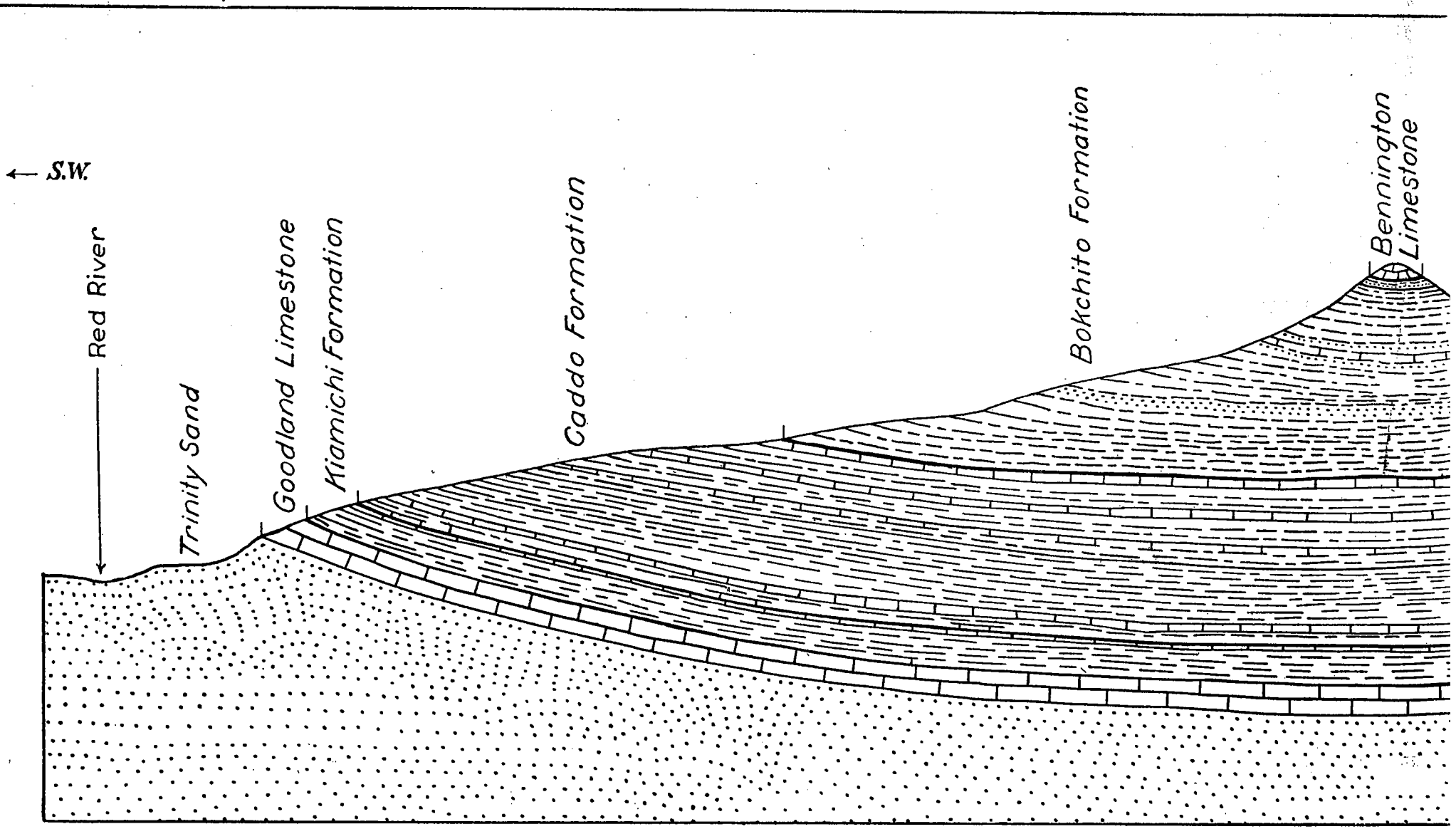
20. Goldston, W. L. Jr., Differentiation and Structure of the Glenn formation: Am. Assoc. Pet. Geol., Vol. 6, No. 1, pp. 5-25, 1922.



ST OF MARIETTA, LOVE COUNTY, OKLA., ACROSS THE MARIETTA SYNCLINE

2 3/4 1 2 3 MILES

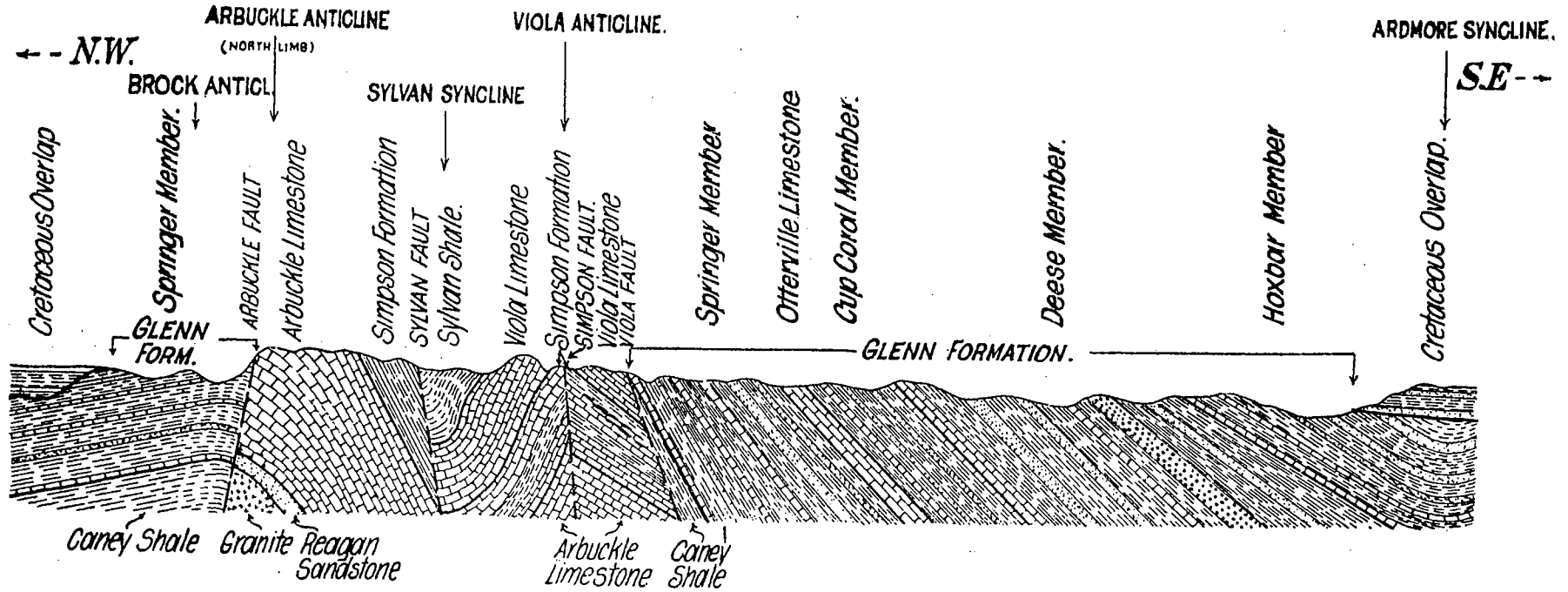
HORIZONTAL SCALE



STRUCTURE SECTION (B-B' Pl. XIX) SOUTHEAST OF MARIETTA, LOVE C(

GEOLOGY OF LOVE COUNTY, OKLAHOMA

PLATE III.



(After Goldston)

PLATE XVI.

VIEW SHOWING THE PENNSYLVANIAN STANDING ON EDGE SURROUNDED BY THE TRINITY SAND, SEC. 30, T. 6 S., R. 2 E.

Sylvan syncline. The Viola anticline is cut by the Simpson fault, which almost parallels the axis of this fold. A fourth fault exists on the east exposure of the Viola limestone. With the exception of two small areas, these faults limit the hills on the east.

The sediments of the Glenn surround this intensely folded and faulted area of pre-Pennsylvanian rocks. On the north and west side the basal part of the Springer is exposed. On the east side the whole section from Springer to Hoxbar is exposed. These sediments assume the shape of an anticlinorium which has been intensely faulted on the west side and overturned in places on the east side. On the east side the dip of the rocks varies from 55° to 70°. On the north side from 25° to 50° and on the west from 10° to 20°."

The Comanchean as will be noted from the cross section (Plate No. XIV) overlaps the edge of the Pennsylvanian, represented by the Glenn formation, unconformably.

POST-COMANCHEAN STRUCTURE

The surface of Love County could, from a structural standpoint, be divided into two parts: (1) areas where the structure can be determined from the surface and (2) areas in which the structure cannot be determined from the surface. The western half of the county, or in fact, all of the Trinity outcrop would fall in this latter class, while the east central part would be included in the first division. All the knowledge regarding the structure

of this region has been gained by studying the limestone beds overlying the Trinity sand. The principal key horizon used in mapping the structure was the Goodland limestone, which immediately overlies the Trinity sand. It is a very prominent bed and to one familiar with the Comanchean section, there is no danger in confusing it with other limestones that occur in the same general area.

The northeastern portion of the county forms a part of the west wing of the Preston anticline,[21] which to the writer seems to be a reflection of the Criner Hills in the Comanchean sediments (See Plate No. XVIII). Paralleling the Criner Hills is a large syncline which the writer has called the Marietta syncline because the town of Marietta lies approximately on its axis.

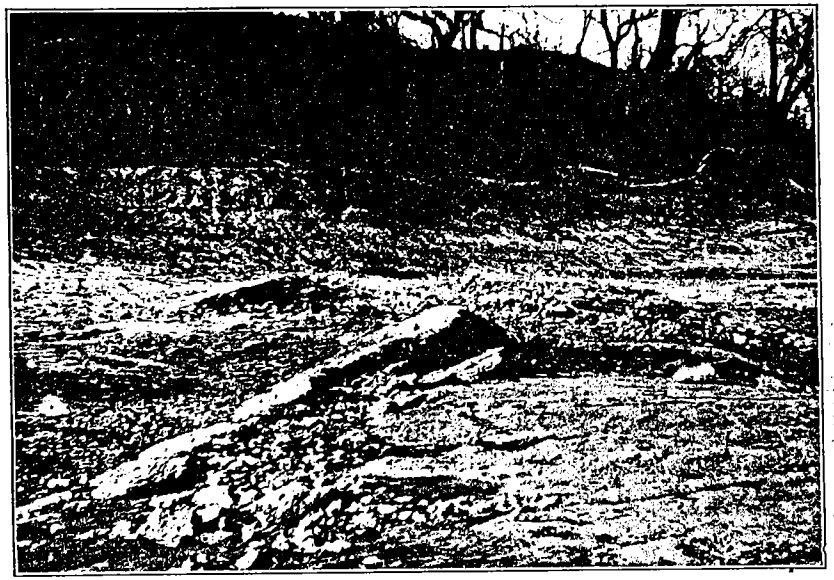
MARIETTA SYNCLINE

The Marietta syncline was mapped on the Goodland limestone which outcrops in a broad U-shaped area in the eastern part of the county. It enters Love County on the east side of the large peninsula-shaped area made by the meander of the Red River, known as Thackerville Bend, extending in a general northwest direction for about 15 miles, then taking a general southeast course it follows the western side of the Thackerville Bend to the most southern point before the river cuts across the outcrop. A line of levels was run on top of the Goodland limestone beginning at the point where the Goodland limestone enters the County on the east and continuing around the outcrop until it was covered by river sediment in the Thackerville Bend. With elevations obtained from this traverse and additional points gained by use of the barometer, enough information was obtained to enable the writer to draw structural contours on the syncline.

The Marietta syncline was found to be a synclinal nose, pitching to the southeast, asymmetrical in shape with the steep side to the northeast. The axis of the syncline trends approximately due northwest. The nose of the syncline is a little south and to the northwest of Marietta. Southeast of Marietta the syncline begins to broaden and flatten. South of the town of Bomar it is thought that the beds are about normal, although the few outcrops available make it impossible to determine their position with any degree of accuracy. On the northeast side of the syncline the dip averages from 75 to 85 feet per mile to the southwest. On the southwest side the dip is about 60 to 65 feet per mile to the northeast, probably more east than north. The structural contours, as will be noted on the Geologic map (Plate No. XIX), are fifty foot contours and are drawn on the top of the Goodland limestone. The

21. Hopkins, O. B., Powers, Sidney, and Robinson, H. M., Structure of the Madill-Denison Area, Oklahoma and Texas: U. S. Geol. Survey Bull. 736-A, 1922.

PLATE XVII.



VIEW OF THE BUCKLING IN THE KIAMICHI OYSTER BED ON THE WEST SIDE OF HORSESHOE BEND, SEC. 22, T. 8 S., R. 2 E.

hills southeast of Marietta, consisting of Bokchito formation, the highest of which is capped by the Bennington limestone, lie approximately in the trough of the syncline.

HORSESHOE BEND

A preliminary survey in the vicinity of Horseshoe Bend, in the southwestern part of T. 8 S., R. 2 E. shows indications of folding at that point. An anticlinal structure seems to be present with its axis running approximately north 30° west. Good southwest and northeast dips can be observed on limestone beds in the lower part of the Caddo formation near the edge of the water level in Red River. A very sharp buckling has occurred at two points in the Gryphea conglomerate which occurs at the top of the Kiamichi formation, exposed in the bed of Red River in the NW. cor. of sec. 22, T. 8 S., R. 2 E. These two buckles are about two hundred yards apart, each making a very sharp crested fold (see Plate No. XVII). These buckles are probably the result of a slumping of the beds on the crest of the structure.

The arrangements of the outcrops on the geologic map also indicate the presence of an anticline at this point. It will be noted that a small area of Kiamichi is shown at the edge of the river, in

the northeast corner of sec. 22, T. 8 S., R. 2 E. Surrounding this outcrop of Kiamichi is the Caddo formation and surrounding the Caddo is the Bokchito formation. Not enough detailed work was done in the area to outline the structure but it is thought that the "high" point is probably across the river in Horseshoe Bend on the Texas side. A well was drilled in sec. 16, T. 8 S., R. 2 E., supposedly on this structure to a depth of 2752 feet without encountering oil or gas. A log of this well will be found under the heading Stratigraphy.

WALNUT BEND

About five miles south of the above described area, and due east of Thackerville is another bend, known as Walnut Bend. From the Geologic map it will be noted that a narrow strip of the Caddo formation outcrops along the west bank of Red River. This outcrop is surrounded by river sand so that the only information obtainable is from the outcrop of the Caddo formation. It is thought that detailed work in this area might disclose the presence of a structure similar to the one in Horseshoe Bend.

WESTERN PART OF COUNTY

In the western part of the county no structures were observed although very little of the territory was gone over in detail. It is thought that folds are probably present in this area but it is questionable whether they could be located from the surface due to the character of the surface rocks. The Trinity sand, which is characteristically loose and unconsolidated covers the surface in this area and as no beds or horizons have been found which could be correlated or traced for any distance it is practically impossible to determine the structure from surface exposures. This portion of Love County is on a line of folding with the Hewitt and Healdton Oil fields to the north and it is altogether likely that there are structures in the Pennsylvanian which do not show on the surface.

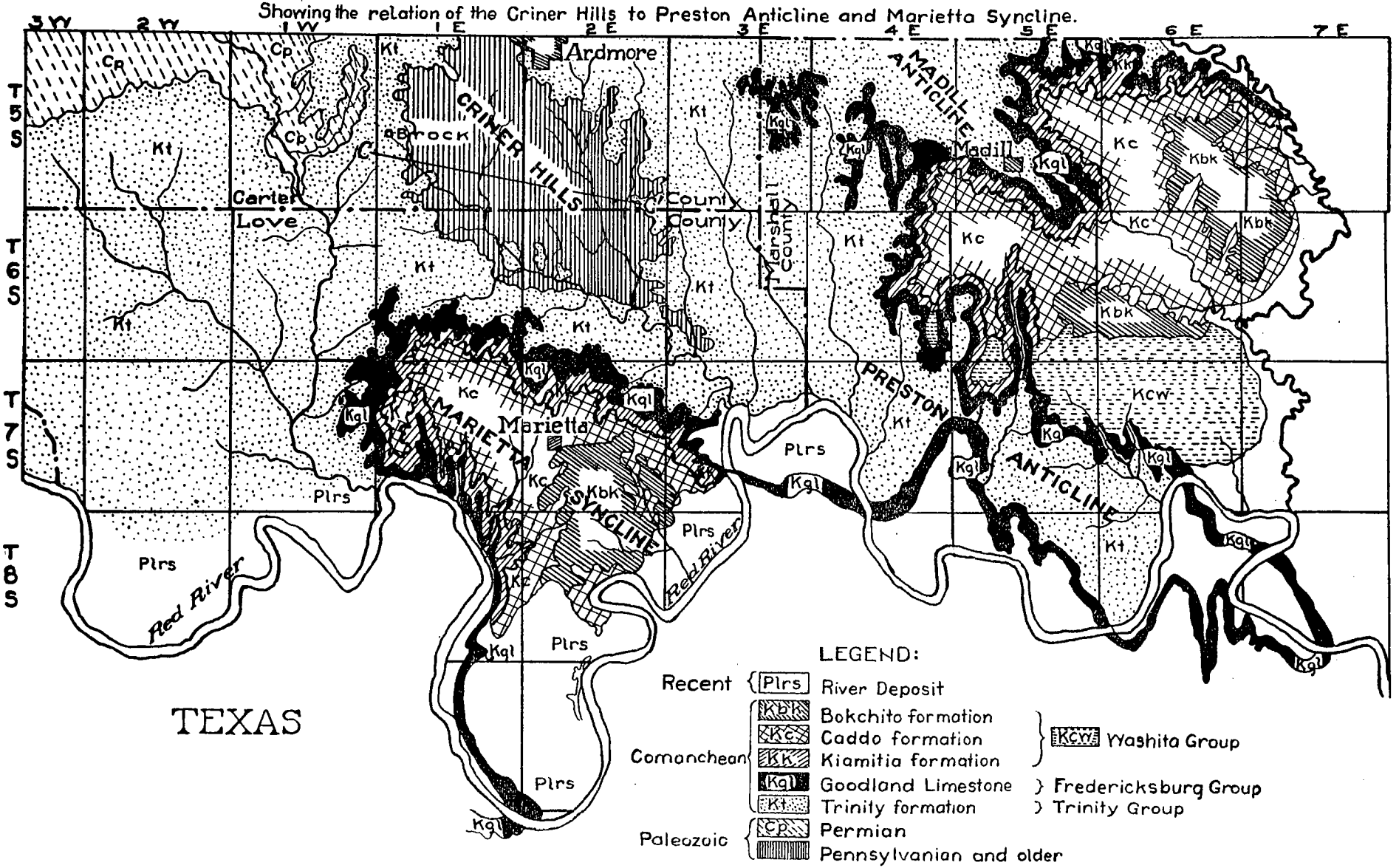
Many times a high degree of dip will be observed in the beds overlying the Trinity sand or in the Trinity itself. These dips however are not constant and they may lead one to believe that a structure is present. This erratic dip is frequently caused by the soft, underlying pack sands becoming saturated and the overlying beds slumping. In working on the Trinity sand or beds overlying the Trinity extreme care must be taken not to confuse dips due to slumping with the true dip.

ORIGIN OF THE FOLDS

In considering the origin of the folds of this area two possible explanations suggest themselves: (1) that the folds are a result of the settling of the Comanchean sediments over topographic highs

GEOLOGIC MAP OF SOUTH CENTRAL OKLAHOMA

Showing the relation of the Criner Hills to Preston Anticline and Marietta Syncline.



Bess Mills-Bullard.

of the pre-Comanchean land surface and (2) that the folding occured along lines of weakness developed before the deposition of the Comanchean sediments.

In support of the first suggestion the relation of the Criner Hills and the Preston anticline is pertinent. As may be seen from Plate No. XVIII the Preston anticline is superimposed on the Criner Hills uplift. The Criner Hills were probably considerably higher at the time of the encroachment of the Comanchean sea and for a time were islands in this sea. However they were finally buried by Comanchean sediments. It seems probable that the Preston anticline may be a result of a settling of the Comanchean sediments around and over these buried hills. The Healdton structure to the northwest of Love County is over a buried limestone hill very similar to the Criner Hills except that the Healdton Hills[22] have not been uncovered by erosion. Whether the structure at Healdton is due to a later growth of an earlier fold has not been proved. It is suggestive to the writer that since many of the structures of the Mid-Continent field are located over former topographic highs it is very likely that a settling of sediments over these hills has been an important factor in the development of these folds.

In support of the second suggestion is the observation that later folding is most likely to follow lines of previous folding; as here the initial dips favor flexures. In the case of the Preston anticline, a line of weakness had been developed by the folding of the Criner Hills at the close of the Paleozoic era. Subsequent movements in this area therefore would be more likely to occur along this axis of established weakness. Hence, if there were movements operating from the same direction after the deposition of the Comanchean sediments, it might well be expected to develop a fold over the Criner Hills rather than at some other place.

Good arguments can be advanced in support of the alternative hypothesis above suggested, but the writer does not think that there is enough evidence at hand at present to prove either of them.

ECONOMIC GEOLOGY

OIL AND GAS

The surface rocks in Love County are chiefly Comanchean in age and the principal oil and gas horizons of this region occur in the Pennsylvanian. There is an angular unconformity between these two systems in this area so that it is extremely difficult, if not impossible, to be sure that structures favorable to the accumulation of oil, which may exist on the surface, extend into the Pennsylvanian and vice-versa, that the structures in the Pennsylvanian may not be reflected on the surface. However, it is thought that any folding which might have occurred after the deposition of the Comanchean would probably occur along lines of previous movement. So that a slight structure in the Comanchean might indicate a very pronounced structure in the Pennsylvanian. This is, however, only theoretical and remains yet to be demonstrated.

22. Powers, Sidney, The Buried Healdton Hills: Trans. A. I. M. E., Vol. 59, 1917.

Some production has been obtained in the basal beds of the Trinity sand in Marshall County[23] but this oil evidently migrated from the underlying Pennsylvanian beds. So far as is known, no oil occurs indigenous to the Comanchean sediments in this general region.

The eastern part of the county near the Criner Hills would not be considered favorable territory for the production of oil or gas due to the intense folding that the rocks have undergone. Oil that was present in the Pennsylvanian of this area would have escaped in the form of gas, except the heavier portions which would remain in the form of asphalt. Field investigations tend to bear out this relation. Large deposits of asphalt occur in the Trinity sand adjacent to the Criner Hills.

In the Brock structure, which borders the Criner Hills to the north of Love County, oil is found in a rather steeply folded and faulted anticline. It is probable, however, that the fault sealed the reservoir rocks below and has been the most important factor in the accumulation of oil. Conditions similar to those found at Brock while very unusual, might be expected along the southwest flank of the Criner Hills.

The presence of the Marietta syncline should not necessarily prevent the production of oil from the underlying Pennsylvanian rocks. The unconformity between these two systems makes it very difficult to tell anything regarding the structure of the Pennsylvanian from the surface, and it is possible that structures favorable for the accumulation of oil are buried by the Comanchean sediments.

In the western part of the county the surface is covered by the Trinity sand, and due to the unconsolidated and extremely variable character of this formation it is nearly impossible to tell anything regarding the subsurface structure from the surface. However, it is thought that there are excellent chances for the discovery of oil and gas in this portion of the county. An extension of the line of folding and of the Hewitt and Healdton fields, parallel to the general trend of folding in this part of the state, extends through the western part of Love County.

23. Taff, J. A. and Reed, W. J., Madill Oil Pool, Oklahoma: U. S. Geol. Survey Bull. 381-D, pp. 504-513, 1910.

While any drilling in this area must be considered strictly "wildcat" drilling, it is the writer's opinion that this portion of the county is favorably located with reference to oil and gas production. It is altogether probable that folds similar to the fields to the northwest are buried by the mantle of Comanchean which covers this portion of the county.

In view of present information the whole of Love County (with the exception of a small area in the Criner Hills) must be considered probably oil and gas territory. It must be kept in mind, however, that it is an area in which the surface rocks are unconformable on the oil and gas horizons and that surface indications may or may not be of any value in locating new fields.

SUMMARY OF OIL AND GAS DEVELOPMENT

PRESENT ACTIVITIES IN LOVE COUNTY

(Reports up to date March 10, 1923.)

J. C. Cooke Oil Co., Leflore No. 1. Center N. E. of the NW of the NE sec. 13, T. 6 S., R. 1 E. 3029 ft. abandoned hole in lime, no good shows found. March 15, 1923.

Strum and Crosbie drilling on the Pittman Ranch in the SE cor. NW SW of sec. 20, T. 6 S., R 1 E. Drilling at 3,040 ft.

Union Petroleum and Supply Co. Draughon No. 1. Center E line S½, SW sec. 27, T. 6 S., R. 1 E. Drilling at 2,550 ft.

Reid-Davenport Oil Co., Gray No. 1, NE cor. sec, 9, T. 7 S., R. 1 W. 1,039, drilling in hard blue shale—March 8, 1923.

Drillers Syndicate on Wilson farm, NW cor. NE¼ sec. 11, T. 7 S., R. 2 E. Drilling at 1,800 ft.—March 10, 1923.

Crosbie et al on Robertson farm, Cen. SW ¼, SE¼ sec. 16, T. 8 S., R. 2 E. Shut down at 2,750 ft.

Sims Oil Co. on the Starritt farm, SE of the NE¼ sec. 29, T. 6 S., R. 3 E., near Enville, formerly operated by the Northwest Oil Co., but closed down due to a legal tangle was purchased by the Sims Oil Co. The hole is 1,100 feet deep and drilling will be continued.

HISTORICAL RECORDS

(Date given with each report.)

G. F. Noble Oil Co. in sec. 31, T. 6 S., R. 1 W., reported a good gas show at 1,450. Well drilling at 1,800 feet. 3-28-20.

Marietta Oil Co., on Cal Stewart Ranch in sec. 36, T. 6 S., R. 3 E., abandoned well at 2,000 feet. 5-2-17.

Live Stake Petroleum Co. drilled a dry hole in sec. 36, T. 6 S., R. 2 E., on the Draughon farm. Several good oil shows were reported. 1-17-17.

Schaffer Oil and Gas Co. drilled a dry hole in the NW cor. of the SE¼ sec. 6, T. 7 S., R. 1 E. Depth 2,865. 7-17-21.

Manhattan Oil Co. in the SE¼ sec. 18, T. 8 S., R. 2 E., drilled a dry hole to a depth of 3,007 feet. Salt water practically all the way down. No good oil shows reported. 1921.

C. E. Zahn and others in sec. 15, T. 8 S., R. 2 E., is drilling at 1,200 feet. 8-5-17.

Pierce Fordyce interests in sec. 24, T. 7 S., R. 3 W., are drilling at 625 in blue mud. 10-21-16.

Marietta Oil Co. on Cal Stewart Ranch in sec. 34, T. 6 S., 3 E., are drilling at 2,187 feet. 4-6-17.

Pierce-Fordyce interests in the SW cor. NE of the SE¼ sec. 13, T. 7 S., 3 W., drilling at 2,170 feet. 6-12-17.

ASPHALT DEPOSITS

The asphalt deposits of Love County have not been studied in detail although extensive deposits are known to occur. The following descriptions are quoted from Bulletin No. 2 of the Oklahoma Geological Survey.[24]

"Location number one:—This occurrence is found on the SW. ¼ sec. 6, T. 6 S., R. 2 E., about three quarters of a mile southeast of Overbrook. The material is a sand asphalt which occurs in a thick, continuous Pennsylvanian sandstone member of irregular sedimentation, and with a dip of 65° S. 37° W. The asphaltic material, which is thought to be the residium of an old petroleum deposit, occurs along the bedding plane of the sandstone. The outcrop as exposed is approximately forty yards wide by fifty yards long.

"A few years ago the rock asphalt was quarried but for some reason operations have been suspended though the deposit does not appear to be exhausted. The quarry was operated in a hill side so that drainage was accomplished by gravity. Steam power was employed for hoisting the product from the pit and loading it on the cars which were brought over a spur from the railroad, a short distance west of the mine.

"Location number two:—Location number two consists of two occurrences in sec. 27, T. 6 S., R. 2 E. One of these is a sand asphalt deposit on the hill north of Hickory Creek in the north half of the section, probably in the northwest corner of the northeast quarter. The other is found south of Hickory Creek and consists of a small amount of petroleum issuing from a spring surrounded by sand asphalt. The latter occurrence was reported by Larkin and no data given other than that it occurred in the Trinity formation, probably near the base. The occurence in the north half of the section is on land owned by H. C. Drawn of Marietta. This has been prospected but never exploited on a commercial scale. There are at present two prospect pits, about 100 feet apart, that are from ten to twenty feet deep. This deposit parallels the outcrop of the members of the Glenn formation which appear at the Cretaceous contact a few miles to the northwest, and are in strike with the sandstone which bears the asphaltic material at Overbrook and in sec. 26, T. 5 S., R. 1 E. This occurrence, however, is found near the base of the Trinity formation. As a rule the Trinity formation

24. Hutchinson, L. L., Rock Asphalt Asphaltite, Petroleum and Natural Gas in Oklahoma, Okla. Geol. Survey Bull. 2, pp. 61-63, 1911.

bears little evidence that asphaltic matter could have originated in it, and it is therefore thought that the asphalt of these occurrences is the result of petroleum seepage from the Pennsylvanian rocks below.

"The rock above the rock asphalt is thin and friable. The outcrop is on an elevation so that mines could be operated by hillside or open cut methods and drained by gravity. The pits would be only about two miles from the G. C. & S. F. R. R. With comparatively little labor a road could be opened to the right-of-way where a commercial siding could doubtless be constructed. If, however, this plan were inadvisable the station of Overbrook is only five miles distant and the roads are tolerable.

"Location number three:—This location consists of three exposures in sec. 35, T. 6 S., R. 2 E. As reported by Larkin they consist of oil springs with deposits of viscous asphaltic material surrounding the seepages. The one which occurs in the northeast corner of the southeast quarter is accompanied by considerable sulphur water. The material is all found in an indurated member of the Trinity formation.

"Location number four:—Location number four, also reported by Larkin, consists of two occurrences in the S. ½ sec. 1, T. 7 S., R. 2 E. Both of these occurrences are oil springs with deposits of asphaltic material surrounding them. The oil collects on the surface in considerable quantities so that the inhabitants of the community skim it off for medicinal purposes. Like the occurrences just described this is also in an indurated member of the Trinity sandstone. The dip is southeastward at low angles.

"Location number five:—These occurrences, reported by Larkin, are found in secs. 4 and 5, T. 7 S., R. 3 E. and consist of one natural and two artificial exposures. The natural exposure is an oil spring on Powder Creek in the NW. ¼ SE. ¼ sec. 4. There is little or no asphalt present and the oil seems to be of paraffin base. The other two occurrences consist of an oil, similar to that found in the spring on Powder Creek, on the water in wells, dug for domestic purposes, in the SW. ¼ NE. ¼ sec. 4, and the SE ¼ SE. ¼ sec. 5. So far as could be told the deposits are both in the lower portion of the Trinity formation. Little or no asphaltic material occurs at any point in that neighborhood.

"Location number six:—This is a reported occurrence of asphaltic material in SE. ¼ sec. 32, T. 6 S., R. 3 E. Nothing definite could be learned concerning the character and amount of the material. It is reported that the exposure occurs about a mile north of the mouth of Pumpkin Creek in upturned rock, therefore it is doubtless in the Glenn formation of Pennsylvanian age.

"Location number seven:—Location number seven consists of a portion of the S. ½ sec. 9 and N. ½ sec. 16, T. 6 S., R. 3 E. At different places over the area described deposits of what seems to be impure paraffin or mineral wax occur. At present the land is leased by the American Paraffin Company. The material is found in the Trinity formation but the exact horizon was not determined."

GLASS SAND

The writer has made no investigations in regard to the glass sand resources of Love County other than to note that in many places the Trinity sand is remarkably pure and probably suitable for use as a glass sand. The following description of a glass sand locality in Love County is taken from Bulletin No. 10 of the Oklahoma Geological Survey.[25]

"Overbrook and Marietta.—The Trinity is exposed on the Gulf, Colorado, and Santa Fe Railroad between Overbrook and Marietta, where some thick beds of sandstone occur. On a small tributary of Little Hickory Creek one-fourth mile west of Greenville a sand bluff 25 feet high is exposed. The base is not shown (fig. 2). The top 15 feet of the bed is represented by sample G1 and the bottom 10 feet by sample G2, analyses of which are given below. The sand is of a brownish gray color and the grains are sub-angular and fairly uniform in size although rather small. The bed is covered with about 3 feet of surface soil which can be removed easily. This is an excellent location as it is only about 500 yards from the railroad and a spur could be run to the bed with very little grading.

"The outcrop of the bed extends for considerable distance up and down the ravine and the beds show little or no cross-bedding. The dip is apparently very gentle to the southeast. The upper 15 feet contains such a large percent of iron that it is unfit for anything but bottle glass. The grains are angular but too small to produce the best results. The 10 feet at the bottom is sufficiently pure for the manufacture of some of the better grades of glass. The quality of this sand may be improved, as a large percent of the impurities can be removed by washing.

"On the south bank of Little Hickory Creek about one-half mile east of the bluff just described and about 50 yards above the railroad crossing 25 feet of sand are exposed in a bluff. In appearance the sand here is the same as that in the bluff farther west, but as the base of this bluff is covered by sand which has fallen from the top, no fresh sample could be obtained. The sand in this bed

25. Buttram, Frank, Glass Sands of Oklahoma, Okla. Geol. Survey, Bull. No. 10, pp. 79-80, 1913.

is easily accessible and only about 3 feet of the loose surface soil need be removed.

"Within the next mile to the south other bluffs of sand having the same appearance as that at Greenville are exposed. Furthermore, to the eastward are still other bluffs but these latter are not near any transportation facilities and were not closely inspected."

Analysis of samples of sand from near Greenville.

No.	Fe_2O_3	Al_2O_3	CaO	MgO	SiO_2	Organic matter
G 1	.42	1.88	.22	.04	96.988	.28
G 2	.21	.73	.105	.032	98.878	.132

Size of grains of samples of sand from near Greenville.

Mesh No.	40	60	80	100	200	Pan	Total
G1	1.01	5.71	9.75	3.56	73.05	6.90	99.98
G2	.5	1.65	18.10	24.5	51.52	2.75	100.02

AGRICULTURE

Love County is chiefly an agricultural area. The Trinity sand which covers the northern and western parts of the County forms a very sandy soil, rather poor and unsuited to farming. However, much cotton is grown in this area, and along the several creeks considerable corn is grown. The Trinity outcrop is usually covered with a growth of scrub oak and black jack.

The soils on the prairie or limestone areas, in the central and southeastern portion of the County, are as a rule very fertile. The limestone and shales weather to a black gumbo like soil which is very productive. The best type of farming land in this area, however, lies on the shaly formations: namely, the Kiamichi, the middle member of the Caddo, and the shales in the Bokchito. The soil on the outcrop of the Goodland limestone and the limestones in the Caddo formation are usually very thin and are used for pasture lands.

Some of the best land in the County is to be found in the valley of Red River on an old flood plain. The famous "Love's Valley," located along Red River southeast of Marietta, is a former flood plain of Red River and contains excellent alluvial soil. In most places, however, the soil along the river consists chiefly of sand and is of little value for farming purposes.

The principal crops raised in Love County are cotton and corn. In the sandy areas, particularly in Thackerville bend, south of Marietta, a great many watermelons and cantaloupes are raised and shipped north for the early markets and later in the season melons are shipped south. Very little small grain is raised in Love County.

At one time the entire area of Love County was included in a few large ranches. However, in recent years, these ranches have been cut up into farms and at present the cattle industry is of secondary importance.

NOTES ON THE PALEONTOLOGY OF THE COMANCHEAN OF LOVE CO., OKLAHOMA.

The importance of paleontology in stratigraphic work needs no emphasis. It was thought advisable therefore to include in this brief report a few of the fossils that mark important horizons in the Comanchean of Love County. Some of the outstanding facts regarding the Paleontology that the writer has found helpful in his field work will be noted with the hope that others working in the area or in similar areas will also find them helpful. A detailed report on the Paleontology of the Comanchean of Oklahoma is being prepared by Dr. C. W. Honess in conjunction with the writer. However, it will be several years before the work is ready for final publication.

The lowest definable fossil horizon in the Comanchean of Love County occurs in the basal bed (Walnut Clay equivalent) of the Goodland limestone. It is marked by an abundance of fossils, particularly a rather small easily recognizable echinoid, *Enallaster texanus* Roemer. This species so far as is known does not occur abundantly elsewhere in the section. Other fossils occuring in abundance at this horizon include *Exogyra texana* Roemer, *Protocardia texana* (Conrad) and *Cyprimeria texana* (Roemer).

The top of the Goodland limestone contains a peculiarly marked ammonite, *Schloenbachia acutocarinata* Shumard. This ammonite is limited in vertical distribution occuring only in the upper few feet of the Goodland limestone, a few scattered individuals ranging into the basal part of the Kiamichi formation.

The top of the Kiamichi formation is marked by a hard lime conglomerate from one to two feet thick composed almost entirely of *Gryphea navia* Hall. This species also occurs rather abundantly in the clay underlying the shell conglomerate. An ammonite, *Schloenbachia belknapi* (Marcou), very similar to *Schloenbachia acutocarinata* occurs in the upper part of the Kiamichi fromation, a few forms ranging into the basal part of the Caddo formation.

The lower part of the Caddo formation, that is the lower 22 feet, which consists of alternating beds of limestone and shale, constitute the next section. Throughout this section there is an abundance of *Inoceramus comancheanus* Cragin. They do not occur abundantly at any other horizon in the region. The extremely large

ammonite, *Desmoceras brazoense* (Shumard) dominates the lower part of the Caddo formation. Although limited to the upper part of this section, they occur in such abundance and are so large that they are by far the most prominent fossil in this section. Other ammonites found in the lower part of the Caddo formation include *Schloenbachia trinodosa* Boese and *Hamites comanchensis* (Winton & Adkins). An abundant horizon of *Hemiaster whitei* Clark occurs immediately above the massive bed or the large ammonite horizon in the lower part of the Caddo formation.

The upper part of the Caddo formation including about 75 feet of alternating beds of limestone and shale immediately overlying the clay shale member constitute the next section. It is characterized by a great number of forms rather than the marked abundance of any single species. Two important echinoids occur in this section, namely *Holaster simplex* Shumard and *Hemiaster elegans* Shumard. The well known ammonite *Schloenbachia leonensis* Conrad also occurs in this section. A rather abundant Pecten horizon is present near the top of the Caddo formation. The top of the Caddo contains an abundance of *Exogyra americana* Marcou. Large fucoids occur abundantly throughout the Caddo formation.

The Bokchito formation which consists principally of clay and sandstone with occasional shell beds is not very fossilliferous except locally. Several of the shell beds have been replaced entirely by iron. The most prominent of these shell beds is found near the top of the formation and consists principally of *Protocardia texana* Conrad with numerous other fossils in lesser abundance.

The Bennington limestone is characterized by an abundance of *Exogyra arietina* Roemer. It also contains a few *Ostrea quadriplicata* Shumard, *Kingena wacoensis* (Roemer), and a few Echinoids.

A general summary of the facts is as follows:

Enallaster texana in abundance denotes lower Goodland limestone.

Schloenbachia acutocarinata indicates upper Goodland limestone.

Gryphea navia is characteristic of the Kiamichi formation.

The following fossils indicate lower Caddo: *Inoceramus comancheanus, Hamites fremonti, Hamites comanchensis, Schloenbachia trinodosa, Desmoceras brazoense, Hemiaster whitei.*

The following fossils indicate upper Caddo: *Hemiaster elegans, Holaster simplex, Schloenbachia leonensis.*

The large fucoids are characteristic of the Caddo formation.

Shell beds replaced by iron are characteristic of the Bokchito formation.

Exogyra arietina is characteristic of the Bennington limestone.

PLATE XX

FIGURES 1-2. DESMOCERAS BRAZOENSE (SHUMARD.)

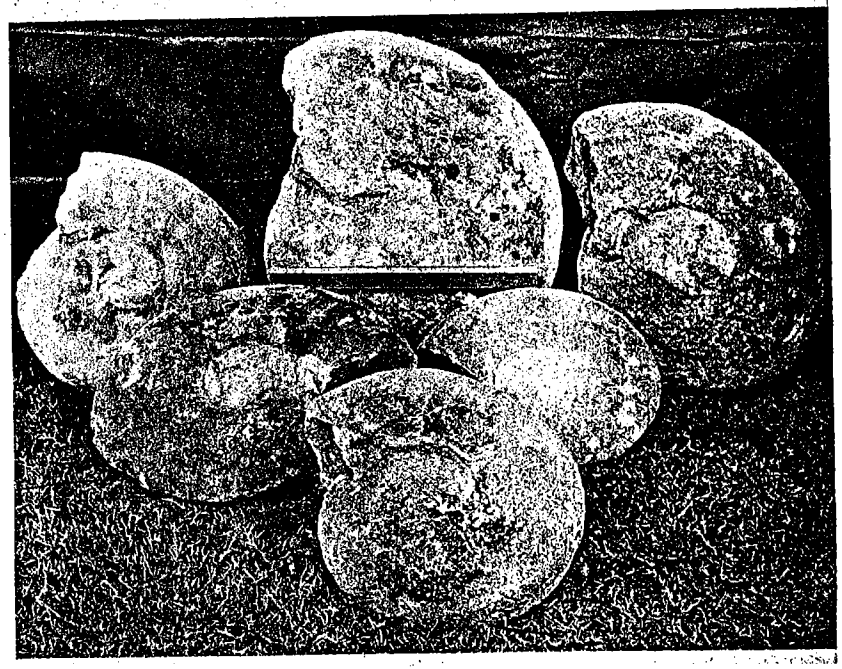
ABUNDANT: Lower Caddo formation 15 to 20 feet above top of the Kiamichi formation.

LOCALITY: West side of Horseshoe Bend, Red River, Love County, Okla.

SIZE: Compare with 15-inch ruler in picture.

PLATE XX.

1



2

PLATE XXI

FIGURE 1. SCHLOENBACHIA ACUTOCARINATA (SHUMARD.)

ABUNDANT: Upper part of the Goodland limestone.

LOCALITY: Love County, Okla.

SIZE: x0.7.

FIGURE 2. SCHLOENBACHIA BELKNAPI (MARCOU.)

OCCASIONAL: Upper Kiamichi formation.

Locality: Love County, Okla.

SIZE: x0.5.

PLATE XXI.

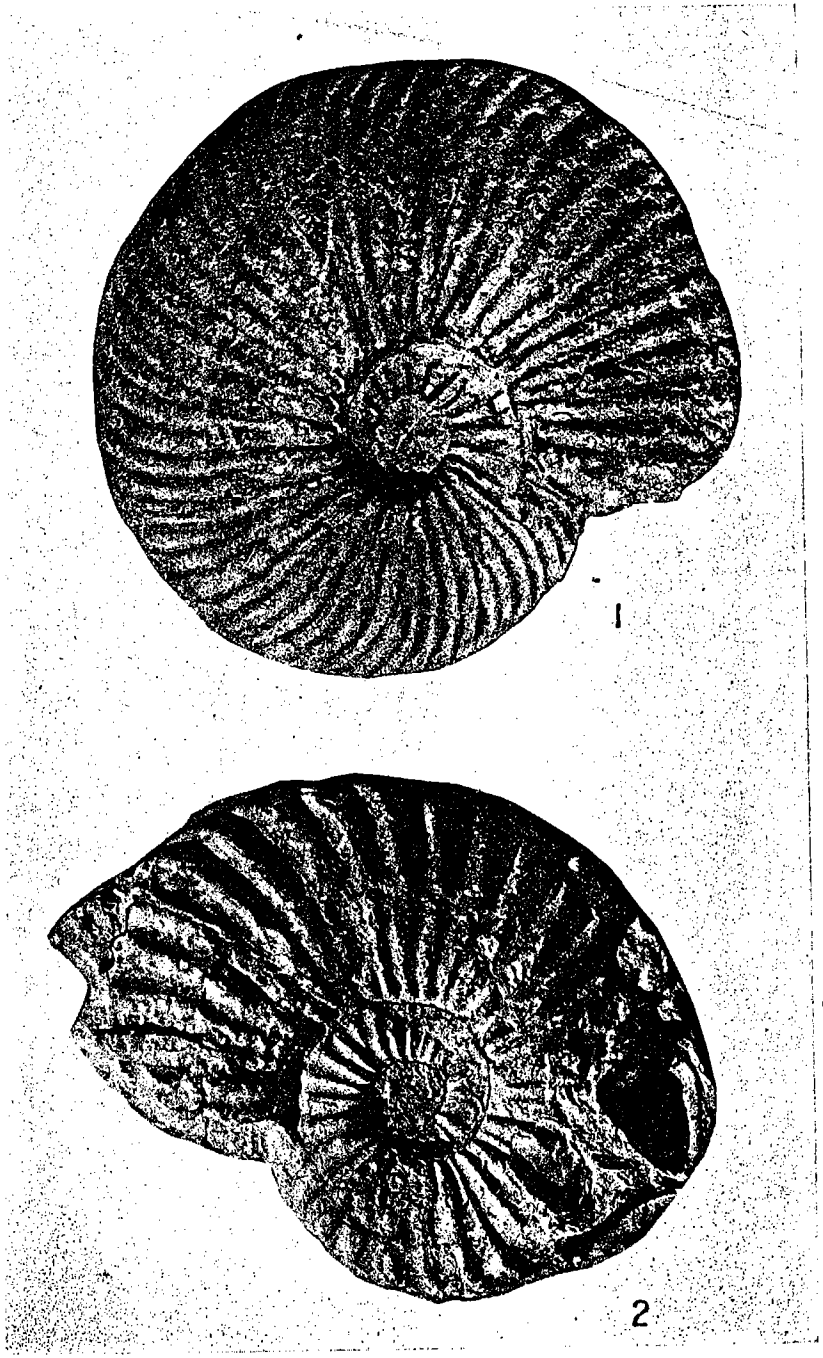


PLATE XXII

FIGURE 1. SCHLOENBACHIA LEONENSIS CONRAD.

OCCASIONAL: Upper Caddo formation.

LOCALITY: Tucks Ferry, Love County, Okla.

SIZE: x0.3.

FIGURE 2. SCHLOENBACHIA TRINODOSA BOESE.

OCCASIONAL: Upper part of the lower Caddo formation above the Desmoceras brazoense horizon.

LOCALITY: West side of Horseshoe Bend, Love County, Okla.

SIZE: x0.6.

PLATE XXII.

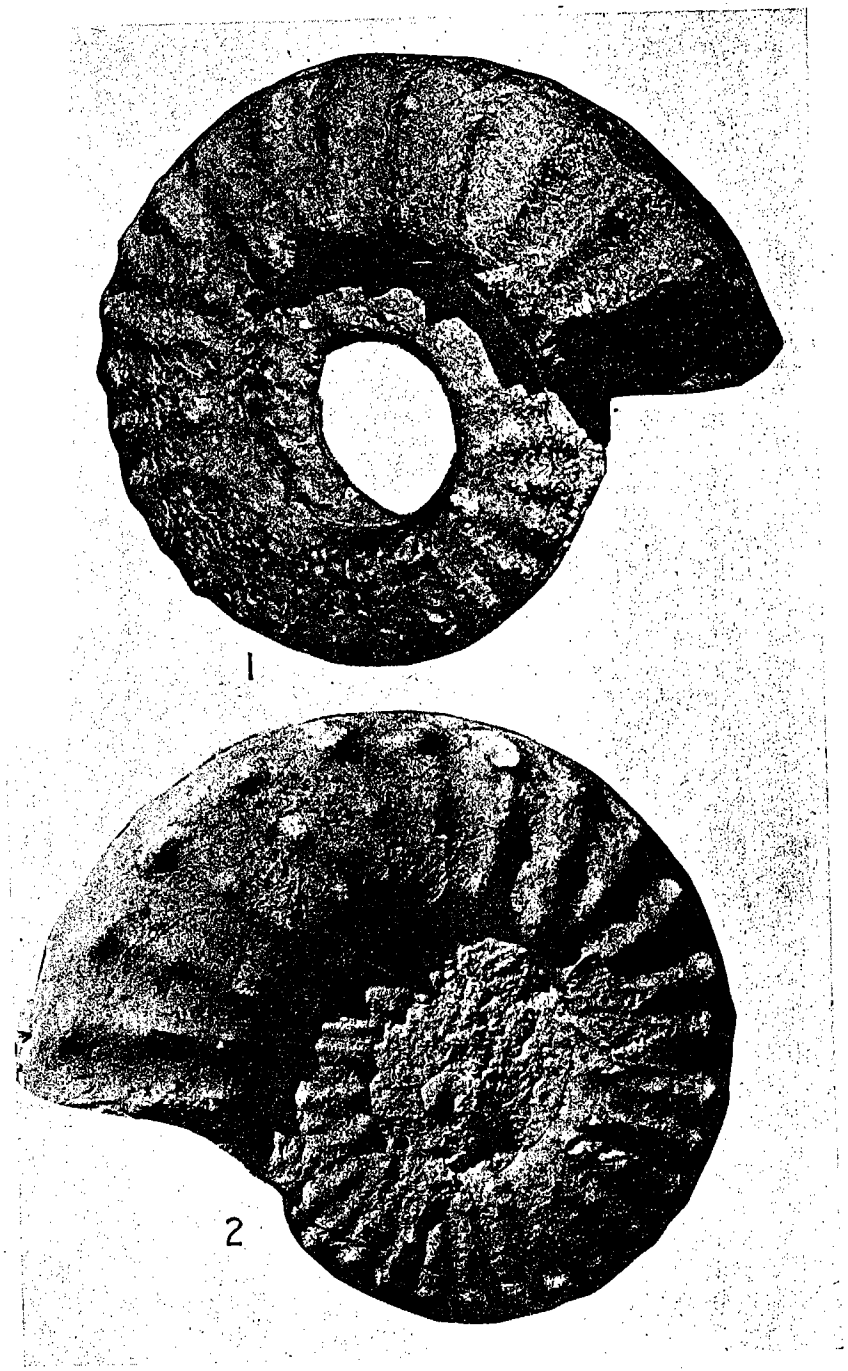


PLATE XXIII

FIGURE 1. SCHLOENBACHIA BELKNAPI (MARCOU.)

OCCASIONAL: Upper Kiamichi formation.

LOCALITY: West side of Horseshoe Bend, Love County, Okla.

SIZE: x0.25.

FIGURE 2-3. HOLASTER SIMPLEX SHUMARD.

RATHER ABUNDANT: Upper Caddo formation.

LOCALITY: Just above Tucks Ferry, Red River, Love County, Okla.

SIZE: x0.8.

PLATE XXIII.

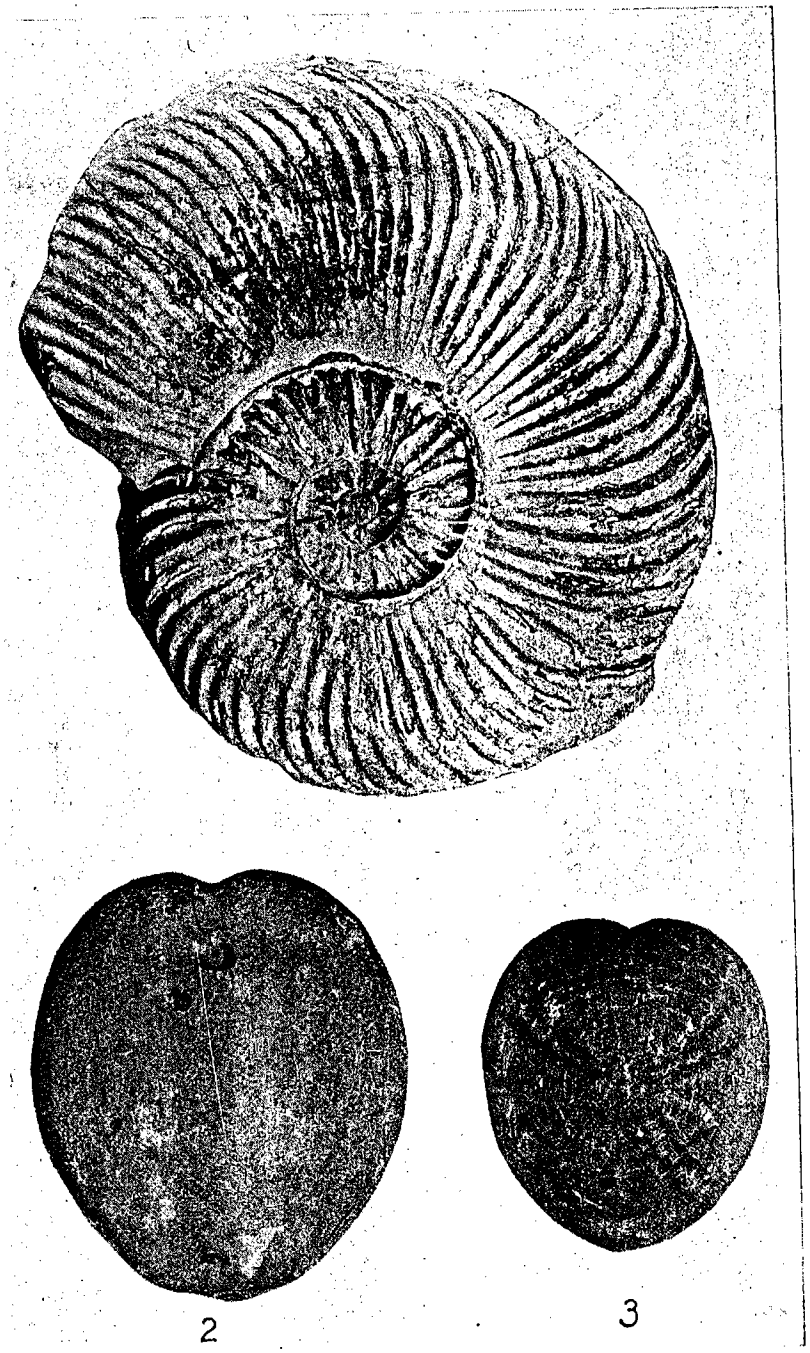


PLATE XXIV

FIGURES 1-2. HEMIASTER ELEGANS SHUMARD.

RATHER ABUNDANT: Upper Caddo formation.

LOCALITY: Above Tucks Ferry, Red River, Love County, Okla.

SIZE: x0.8.

PLATE XXIV.

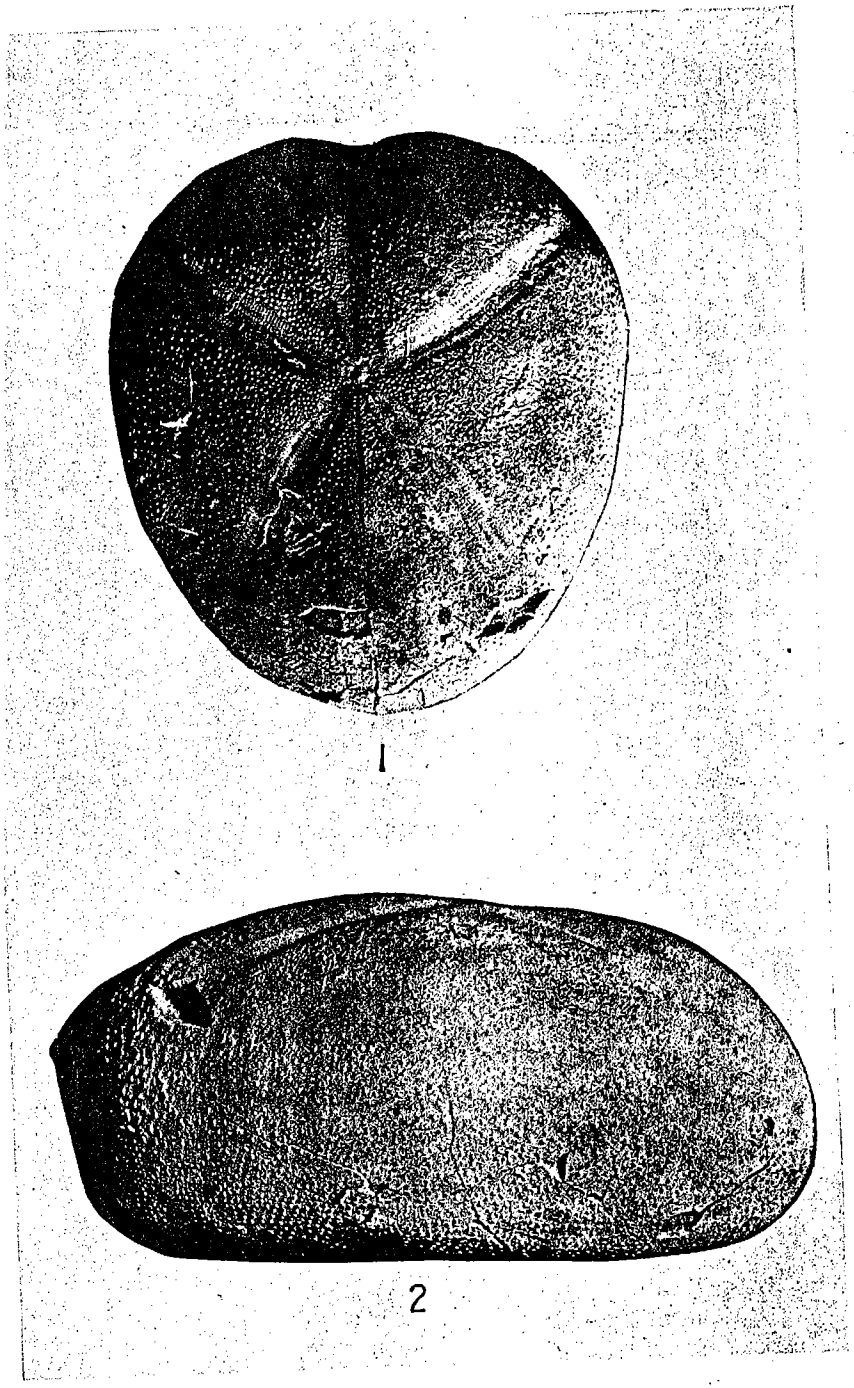


PLATE XXV

FIGURES 1-5. ENALLASTER TEXANUS ROEMER.

ABUNDANT: Lower bed, Goodland limestone.

LOCALITY: On Rock Creek, west of Marietta, Love County, Okla.

SIZE: x0.8.

FIGURE 6. HOLASTER SIMPLEX SHUMARD.

RATHER ABUNDANT: Upper Caddo formation.

LOCALITY: Above Tucks Ferry, Red River, Love County, Okla.

SIZE: x0.8

PLATE XXV.

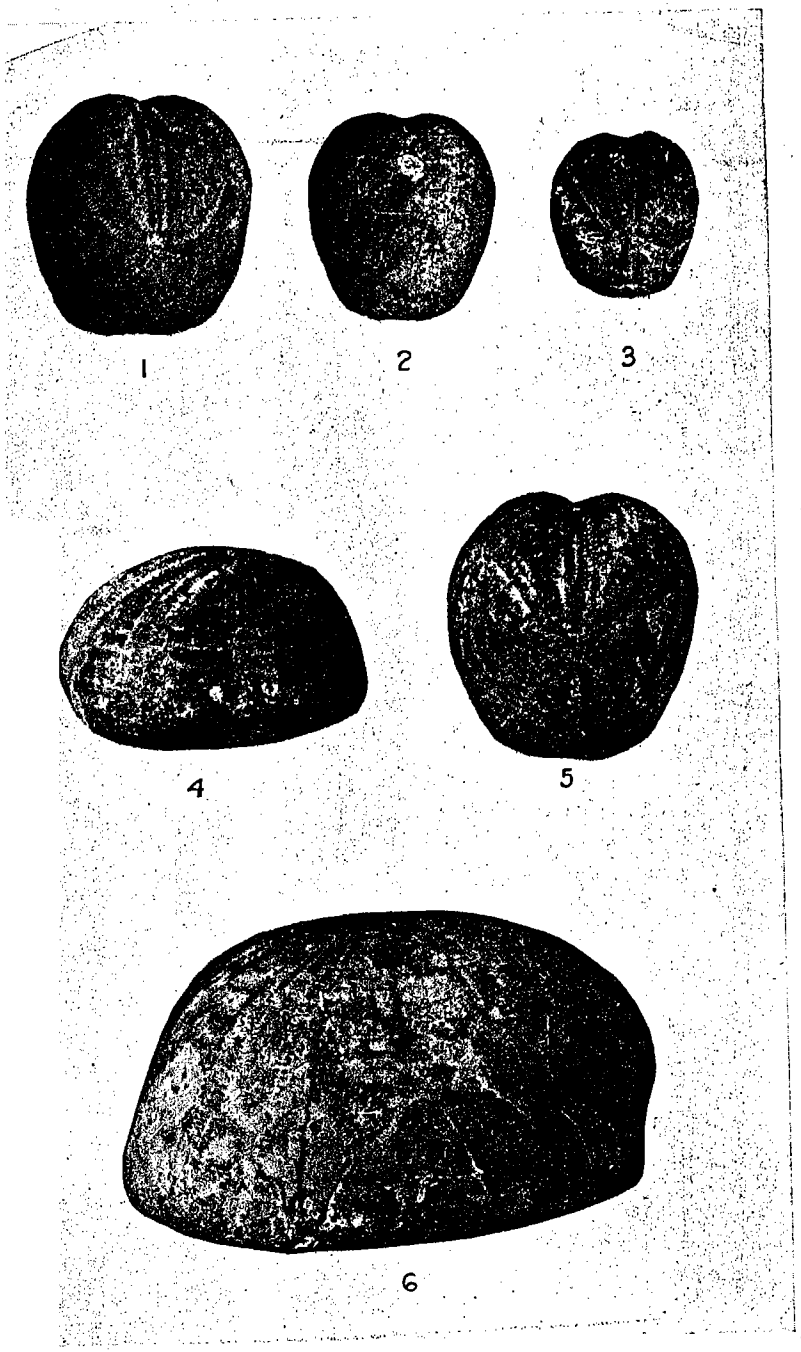


PLATE XXVI

FIGURES 1-4. EXOGYRA ARIETINA ROEMER.

ABUNDANT: Bennington limestone.

LOCALITY: Top of the "Peak" about three miles southeast of Marietta, Love County, Okla.

SIZE: x0.8.

FIGURES 5-6. KINGENA WACOENSIS (ROEMER.)

ABUNDANT: Bennington limestone.

LOCALITY: Love County, Okla.

SIZE: x1.5.

FIGURES 7-8. GRYPHEA NAVIA HALL.

ABUNDANT: Kiamichi formation.

LOCALITY: Love County, Okla.

SIZE: x0.8.

PLATE XXVI.

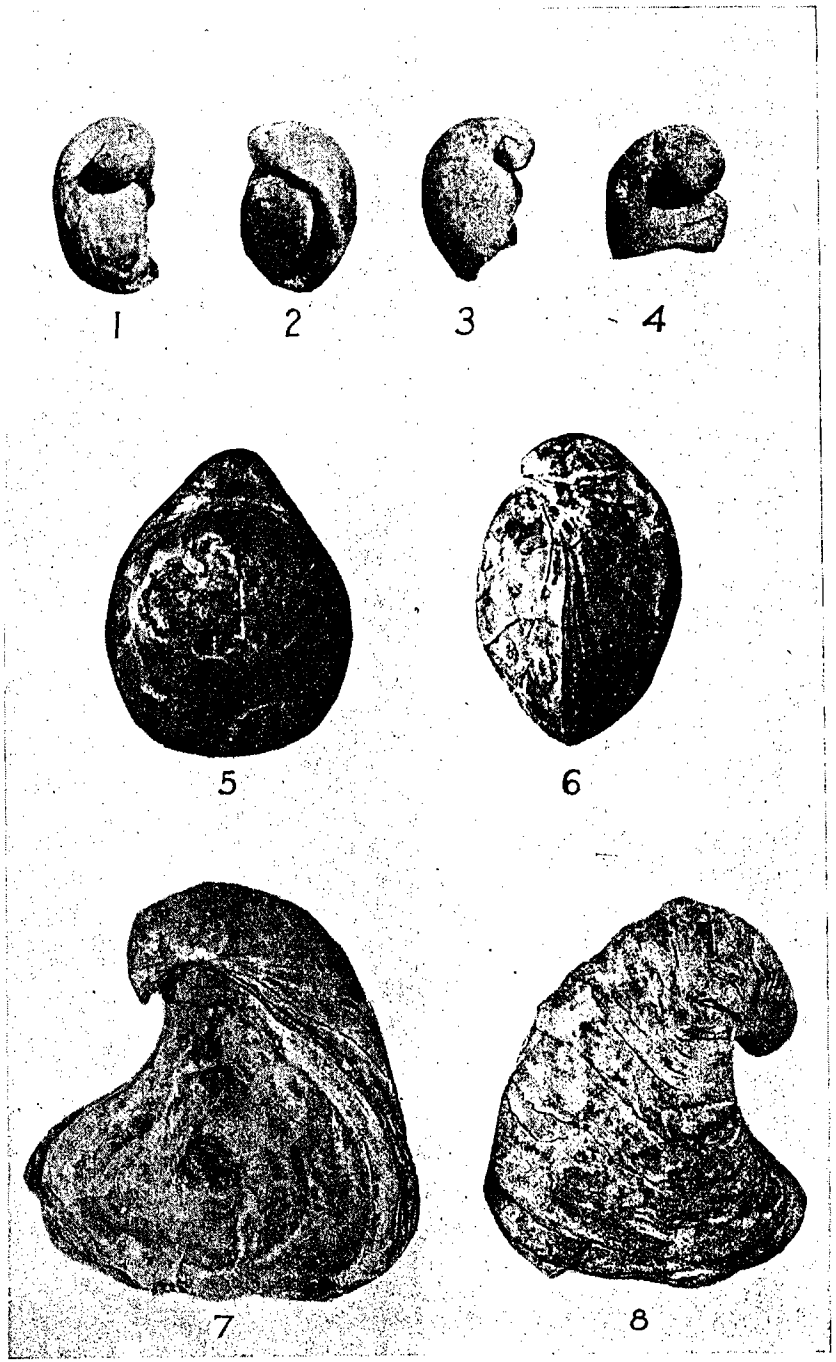


PLATE XXVII

FIGURES 1-2. INOCERAMUS COMANCHEANUS CRAGIN.

ABUNDANT: Lower Caddo formation below "large ammonite" horizon.

LOCALITY: West side of Horseshoe Bend, Red River, Love County, Okla.

SIZE: x0.8.

PLATE XXVII.

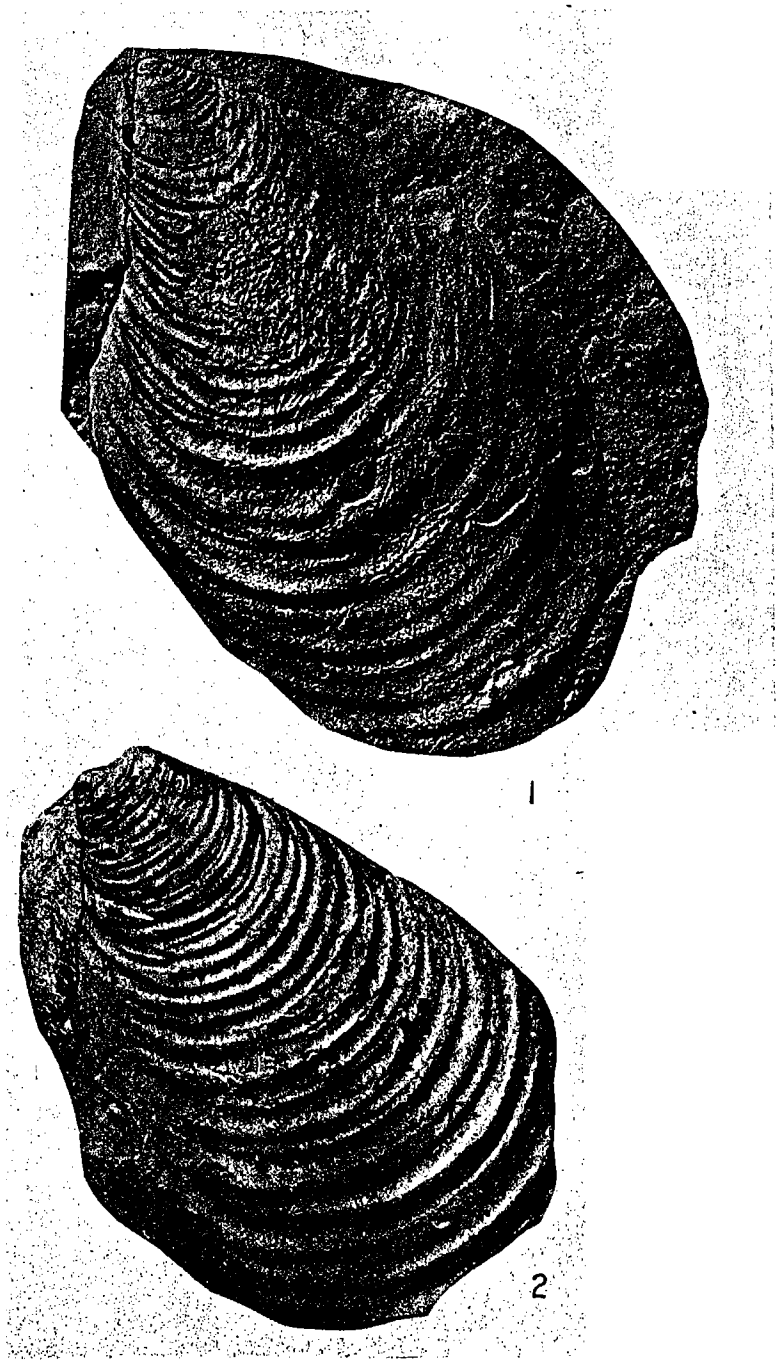


PLATE XXVIII

FIGURE 1. FOSSIL FUCOIDS (?).

ABUNDANT: On limestone beds in the Caddo formation.

LOCALITY: Love County, Okla.

SIZE: x0.4.

PLATE XXVIII.

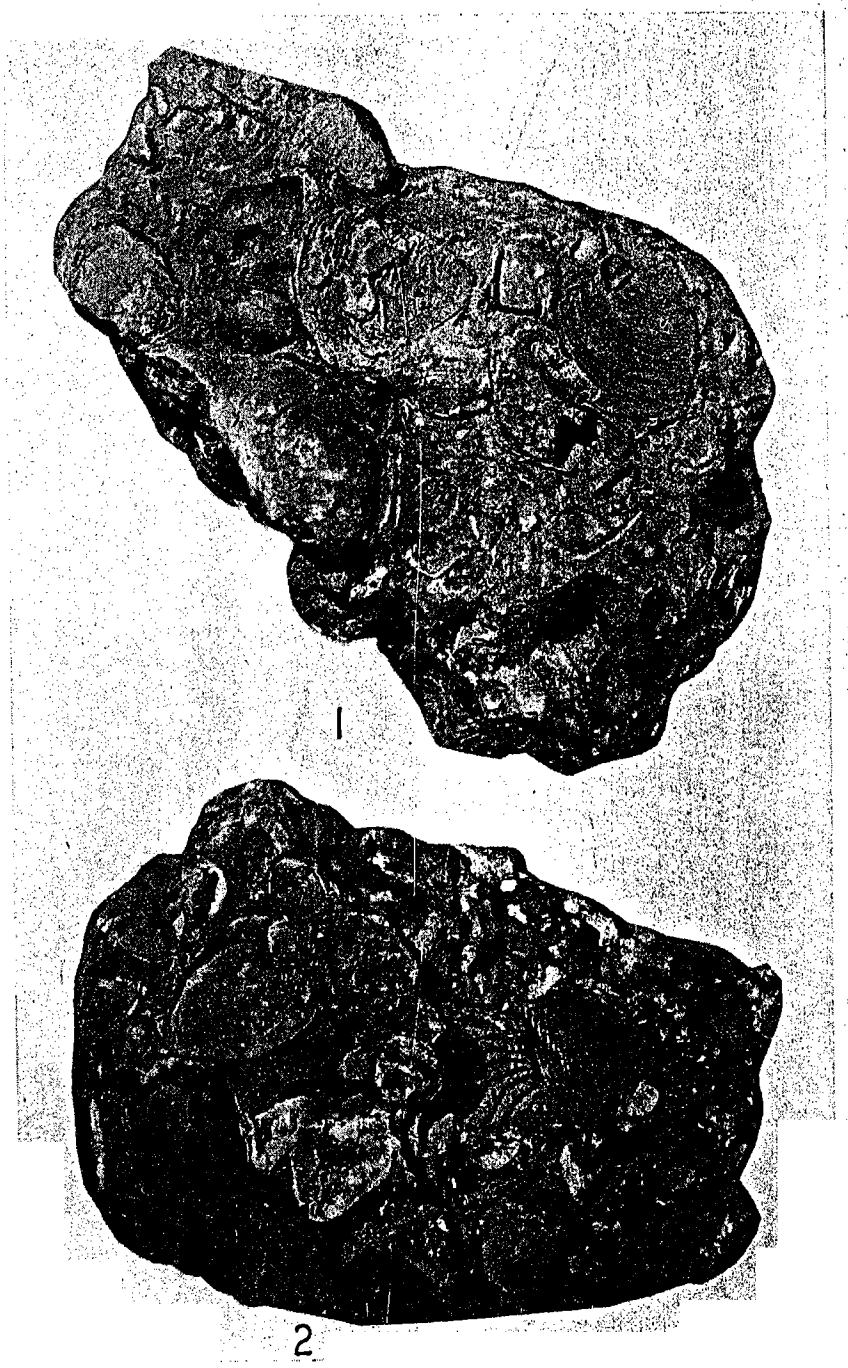
PLATE XXIX

FIGURES 1-2. SHELL BEDS OCCURRING IN THE UPPER PART OF THE BOKCHITO FORMATION, SHOWING A MASS OF SHELLS, PRINCIPALLY PROTOCARDIA TEXANA (CONRAD), REPLACED ENTIRELY BY IRON.

LOCALITY: The hills southeast of Marietta, Love County, Okla.

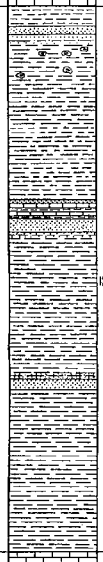
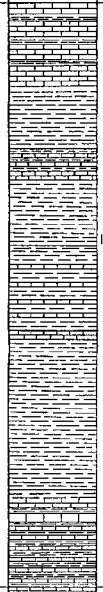
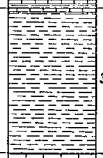
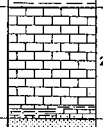
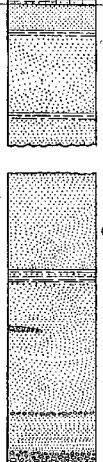
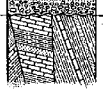
SIZE: x0.8.

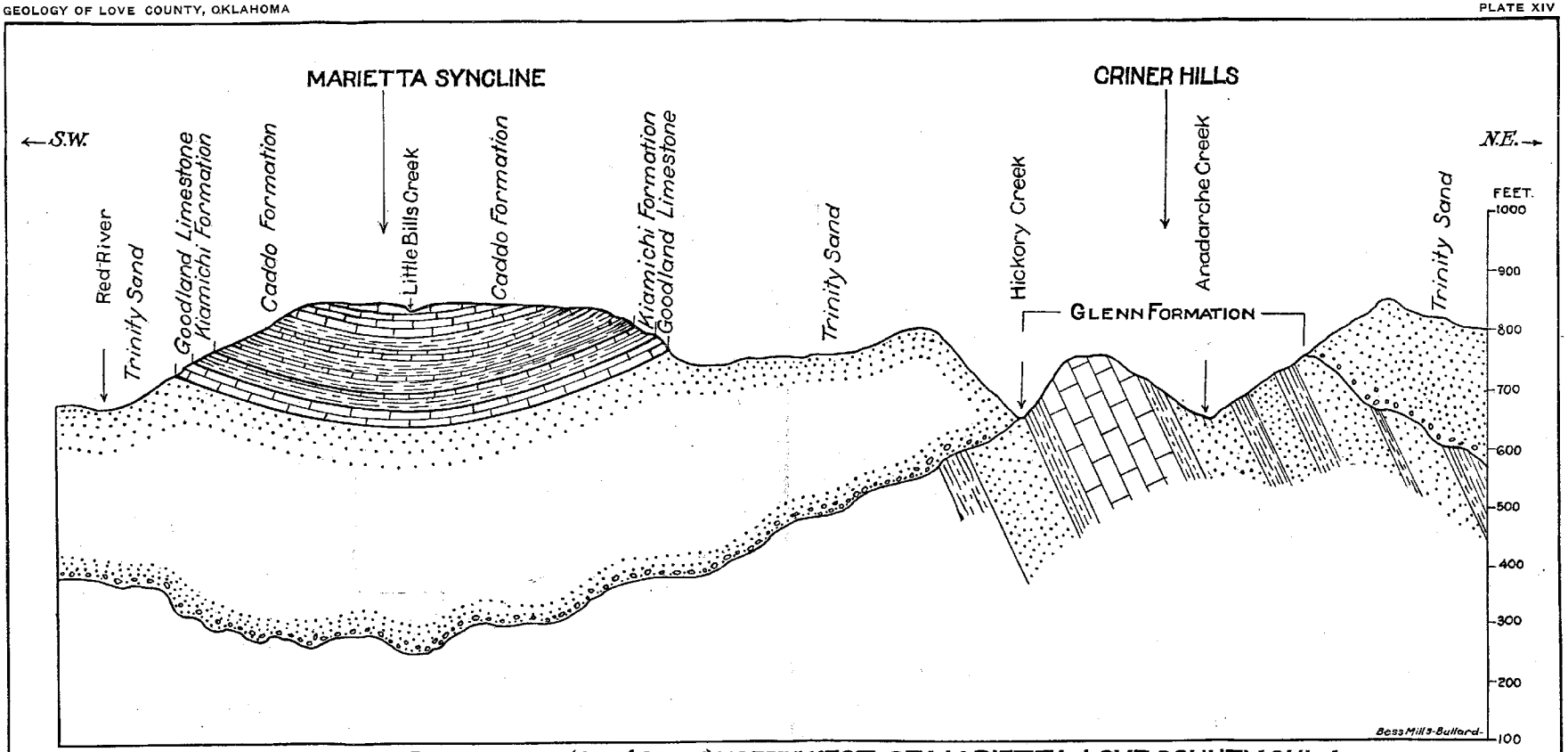
PLATE XXIX.



COLUMNAR SECTION

GENERALIZED SECTION OF THE COMANCHEAN OF LOVE COUNTY, OKLAHOMA

SYSTEM	GROUP	FORMATION	SYMBOL	SECTION	THICKNESS IN FEET	CHARACTER OF ROCKS	CHARACTER OF TOPOGRAPHY
COMANCHEAN	WASHITA	BENNINGTON LIMESTONE	Kb		5-10	Massive, brownish-white, shell limestone.	Caps highest hill in the County
		BOKCHITO FORMATION	Kbk		120-130	Blue shale Brown friable sandstone Bluish-brown shale containing iron concretions and segregations, and shell beds of iron replacement. Brown friable sandstone Yellowish-brown shale beds; shale partings Brown sandstone Blue shale Massive brown sandstone. Ripple marks abundant. Blue to brown shale	Rounded hills, slopes and rolling land
		CADDO FORMATION	Ka		150-160	Alternating beds of white limestone and bluish gray shale. Bluish gray shale Alternating beds of white limestone and bluish gray shale. Blue gray shale Alternating beds of limestone and shale. Blue gray shale Large Ammonite horizon. (Schloenbachia brazoense) Alternating beds of white to yellow limestone and blue-gray shale.	Low escarpments and rolling land.
		KIAMICHI FORMATION	Kk		30-35	Hard limestone composed principally of oyster shells. (Gryphea navia.) Green-yellow marly clay.	Large slabs standing at steep angles; known as "edge rock." Lower slopes of escarpments and rolling prarie land.
	FREDERICKSBURG	GOODLAND LIMESTONE	Kgl		20-30	Massive white limestone Marly nodular limestone.	Benches and bluffs capping steep escarpments.
	TRINITY	TRINITY SAND	Kt		0-600	Fine white to yellow pack sands with occasional lenses of red and blue shale Lenses of quartz conglomerate similar to basal conglomerate. Basal quartz conglomerate pebbles. (from size of a pea to three inches in diameter)	Steep lower slopes of escarpments, rough hilly land, low rounded hills, and wide valleys.
		UNCONFORMITY					
		PALEOZOIC chiefly PENNSYLVANIAN					



STRUCTURE SECTION (A-A' PI.XIX) NORTHWEST OF MARIETTA, LOVE COUNTY, OKLA.
SHOWING RELATION OF COMANCHEAN SEDIMENTS TO THE CRINER HILLS.

0 1/2 1 2 3 4 MILES

HORIZONTAL SCALE