THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

GEOLOGY OF THE HOMINY AREA, OSAGE COUNTY, OKLAHOMA

A THESIS

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

MASTER OF SCIENCE

[redacted]

BY [redacted]

ORVILLE R. RUSSELL [redacted]

Norman, Oklahoma

1955

GEOLOGY OF THE HOMINY AREA,

OSAGE COUNTY, OKLAHOMA

A THESIS

APPROVED FOR THE SCHOOL OF GEOLOGY

BY

[redacted]

ACKNOWLEDGEMENTS

The writer wishes to express his sincere appreciation to Dr. Carl C. Branson who supervised this investigation. Grateful thanks go to Dr. Kaspar Arbenz and Dr. George G. Huffman who read this manuscript and gave constructive criticism. The writer also wishes to thank the Oklahoma Geological Survey for the loan of the aerial photographs and Mr. Malcolm C. Oakes for instruction in their use.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

GEOLOGY OF THE HOMINY AREA, OSAGE COUNTY, OKLAHOMA

CHAPTER I

INTRODUCTION

Location

The area considered in this report will be referred to as the Hominy area. It includes Twps. 23 N., 7 and 8 E., 22 N., R. 8 E.; all that part of Twps. 21 and 22 N., R. 7 E. which lies north of the Arkansas River; and the northern part of T. 21 N., R. 8 E. This area is situated in the south-center of Osage county, Oklahoma, and comprises approximately 150 square miles.

Osage county lies in the north-central portion of Oklahoma, and the Hominy area, which is about 40 miles west of Tulsa, Oklahoma, is easily accessible by three higways. State Highway 99 nearly parallels the eastern boundary of the area. State Highway 20 bisects the area in an east-west direction, and U. S. Higway 64 passes near the southern edge.

The Hominy area is located in the Sandstone Hills of the Osage Section of the Central Lowlands (Fenneman, 1938, p. 617). The topography is marked by eastward facing cuesta escarpments of very low angle dip, and has a maximum relief of about 400 feet.

Due to the abrupt topographic changes in a cuesta influenced region it is impractical to construct roads along section lines, consequently most roads in this area meander and vary greatly in the state of improvement of the roadbed. However, as a whole, the county maintains good dry weather roads in this area.

Purpose of the Investigation

The purposes of this investigation were to make a detailed study of the stratigraphic and lithologic character of the formations, and to prepare a geologic map with the aid of aerial photographs.

This study and report was made in conjunction with the joint project of the School of Geology of the University of Oklahoma and the Oklahoma Geological Survey of making a detailed study of the surface geology of the State of Oklahoma.

Methods of Investigation

The mapping of the area considered in this report was done during the summer months of 1953. Field studies were facilitated by the use of stereoscopic pairs of aerial photographs. Key beds, drainage, structural data, and the land net were mapped on acetate overlay sheets on these photos and later transferred to the base map.

Detailed stratigraphic measurements were made with the hand level and tape. Lithologic descriptions were made during the measurements, and rock samples and fossils were collected.

The color of the rock samples are indicated in two ways. The writer's field description of the color is noted, and the color code of the "Rock-Color Chart" of the National Research Council is placed in parentheses.

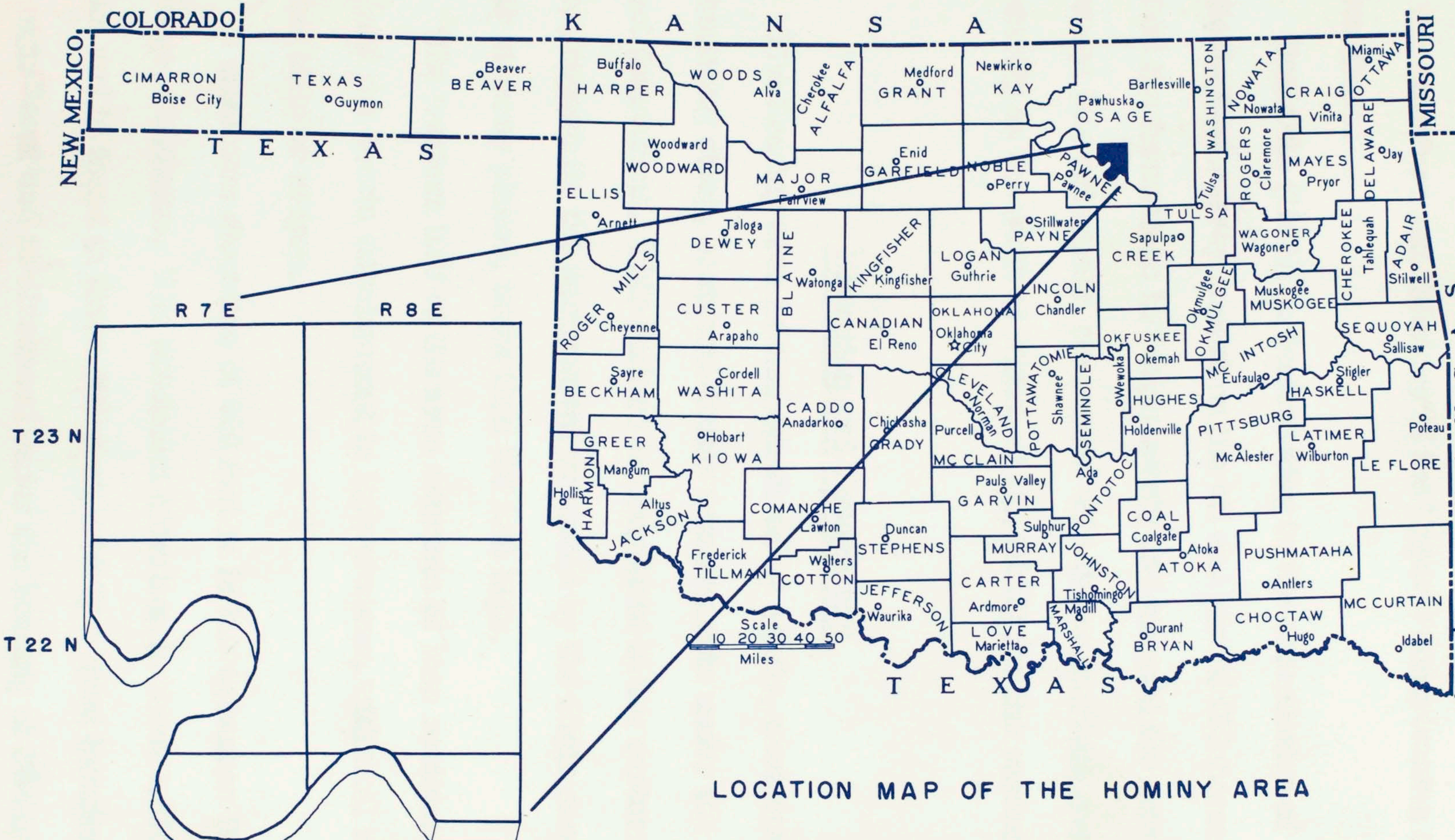
Previous Investigations

One of the first efforts to classify the Pennsylvanian rocks in northeastern Oklahoma was made by Drake (1898). In his map, the line at the base of the Permian was drawn several hundred feet below the presently accepted Pennsylvanian-Permian contact.

Adams, Girty, and White (1903) attempted to show the litholgical phases of the Carboniferous of Kansas and the Indian Territory of Oklahoma. The Pawhuska limestone, now known as the Deer Creek limestone, was mapped across Osage, Pawnee, and part of Payne counties.

In his report on the Ponca City oil and gas field, Ohern (1912) gave a brief description of the Elgin sandstone and the lithology above this formation.

During the years of 1917 and 1918, field investigations in the Osage Indian Reservation were conducted under the direction of K. C. Heald. Several parties participated in this investigation and most of



LOCATION MAP OF THE HOMINY AREA

FIGURE NO. 1

Osage county was mapped. White, et al (1922) gave a detailed description of the structure and lithology of the Upper Pennsylvanian and Permian formations.

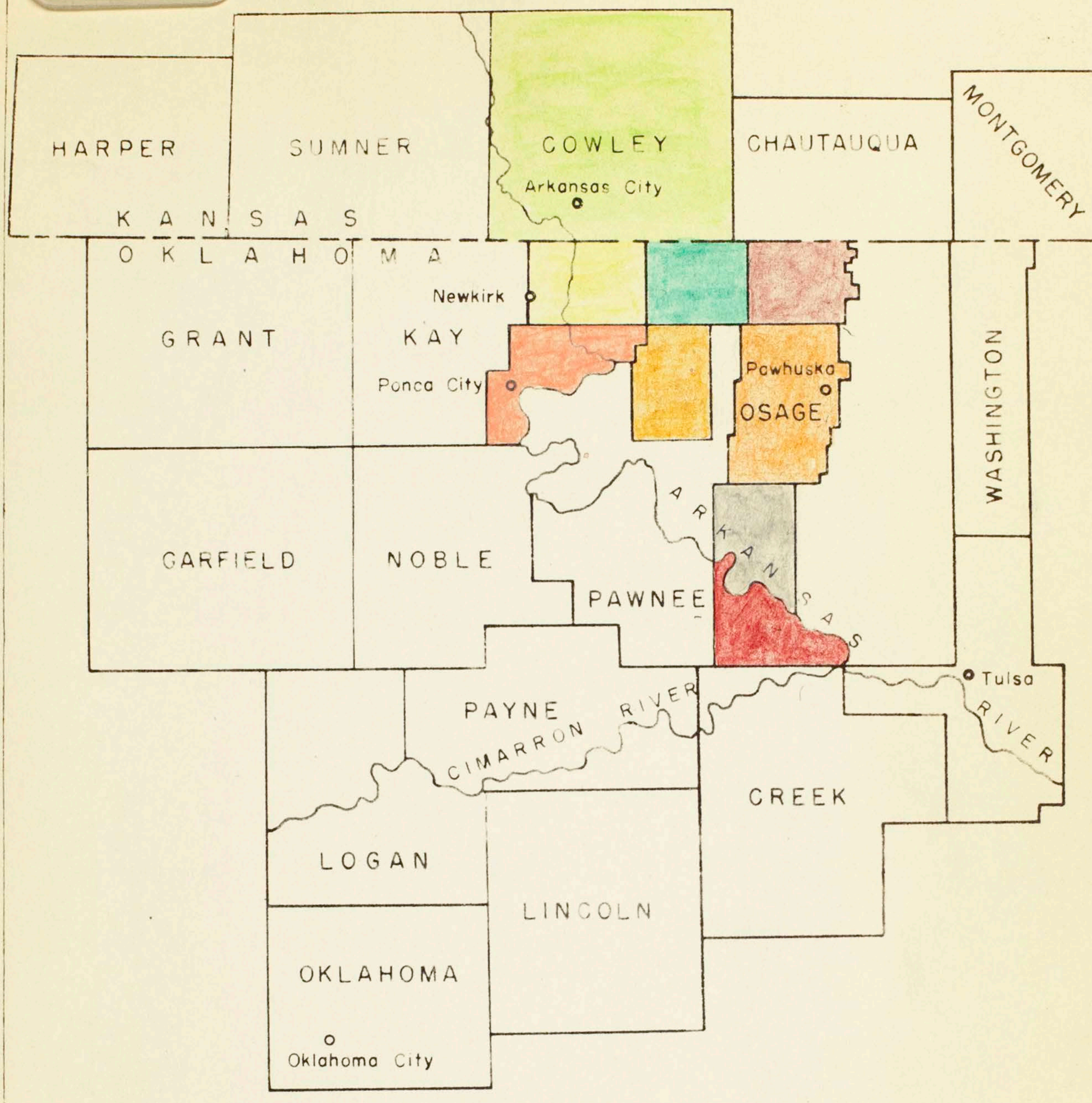
Beckwith (1928), in contributing to the compilation of an Oklahoma Geological Survey report on the oil and gas of Oklahoma in 1928, described the formations in Osage county and mapped the outcrops. This report was primarily concerned with the subsurface geology and drew heavily on the work of White, et al., (1922) for the surface information.

Elevation and Topography

The Hominy area is characterised by gently, westward dipping beds producing steep, eastward-facing escarpments under the more resistant formations. This feature is prominent in the eastern half of the area, especially the escarpment produced by the Elgin sandstone, which is at many places, more than 100 feet high.

The western half of the area consists of less resistant formations, and the cuesta development is less obvious, with well rounded, elongated hills or ridges.

A minimum elevation of 650 feet is in the Arkansas River valley near Osage, Oklahoma. The maximum elevation is about 1,060 feet above sea level and is found in three different, widely spaced locations. This fact is significent and is discussed under the heading of Geological History.



Legend of Adjacent Mapped Areas

- N.E. Kay County, Okla., A. J. Hruby, M. S. Univ. of Okla., 1955
- S.E. Kay County, Okla., C. R. Noll, Jr., M. S. Univ. of Okla., 1955
- Foraker Area, Osage County, Okla., R. C. Taylor, M.S. Univ. of Okla., 1953
- Burbank-Shidler Area, Osage County, Okla., D.L. Vosburg, M.S. Univ. of Okla., 1954
- Pearsonia Area, Osage County, Okla., J. A. Carter, Jr., M.S. Univ. of Okla., 1954
- Pawhuska Area, Osage County, Okla., P. J. Shannon, M. S. Univ. of Okla., 1954
- Hominy Area, Osage County, Okla., O. R. Russell, M.S. Univ. of Okla., 1955
- Cowley County, Kansas, Kansas Geological Survey, Bulletin 12, 1929
- Hallett Area, Pawnee County, Okla., P. B. Greig, M. S. Univ. of Okla., 1954

FIGURE 2

Drainage

There are two main watersheds in the Hominy area. The crest of the divide between them trends approximately from the north central edge to the southeast corner of the area. All run-off on the eastern watershed drains into Hominy Creek and ultimately into the Verdigris River to the east. The run-off on the western side drains southward into the Arkansas River, which bounds the southern edge of the area under study.

The entire area is highly dissected and the subsequent and re-sequent streams are often greatly influenced by the joint pattern prevalent in all the resistant formations.

Although a high percentage of the streams and tributaries in this area are intermittent, the water table is sufficiently high for water to stand in the major streams throughout the year, but there is little if any flow. Springs are uncommon and the only ones observed were flowing from under the massive beds of the Elgin sandstone.

Vegetation

The cuestas of Elgin sandstone are abundantly covered with thick growths of blackjack and other scrub oaks. The Lecompton limestone outcrops are normally grass covered as are the shale slopes immediately above the Lecompton. Higher in the section this shale body permits the growth of oak trees and many of the dip slopes of these are so covered.

The Turkey Run limestone and the overlying shale formation are favorable for the growth of oak trees, but the shales immediately below the limestone will support only grasses. This was a great aid in walking outcrops as well as in mapping on aerial photographs.

The Bird Creek, Wakarusa, and Stonebreaker limestones are covered with luxuriant grasses with an occasional clump of trees.

The terrace deposits in Twps. 21 and 22 N., R. 7 E. are covered with dense growths of oak. The alluvium along many of the streams is covered with a diverse flora of oak, elm, persimmon, hickory, and sycamore.

There is a definite division of vegetation in the area. The heavily wooded area is to the east and south, and the open grassland area is on the west.

Exposures

Good exposures, suitable for measuring, are rare in this area. However, due to the resistant nature and thickness of the Elgin sandstone and the Lecompton limestone, their outcrops are very prominent and easily mapped.

The Turkey Run limestone, although resistant, is at many places overlain by a thick sandstone, and debris and weathered material often obscure the outcrop.

A massive sandstone also overlies the Bird Creek limestone and its position at many places can only be inferred by the presence of float material.

The Wakarusa limestone does not form prominent outcrops, but it is easily traced throughout the area.

The Stonebreaker limestones are poorly resistant and easily eroded. The outcrops are obscure and can only be traced by the variation in color and type of vegetation.

CHAPTER II

STRATIGRAPHY

Virgil Series

The Virgil series, as proposed by Moore (1932), includes all the Upper Pennsylvanian beds between the unconformity at the base of the Tonganoxie sandstone to the unconformity at the base of the Indian Cave sandstone, which marks the Pennsylvanian-Permian boundary.

In Kansas this interval is characterized by alternating limestones and shales, and alternating marine and non-marine deposits. Thin coal beds are common, and are persistent over wide areas. They are normally too thin for commercial importance but are indicative of cyclical sedimentation.

To the south in Oklahoma, the limestone beds become more argillaceous and many units "shale out".

The Virgil series has been divided into, in ascending order: Douglas, Shawnee, and Wabaunsee groups. The Shawnee and the Wabaunsee groups are represented in the Hominy area.

Shawnee Group

The Shawnee group was first described by Haworth (1898, p. 93) as extending from the top of the Oread limestone upward to the base of the Burlingame limestone.

Moore (1936, p. 150) redefined the Shawnee group by including in it all beds from the top of the Topeka limestone to the top of the Lawrence shale. This definition removed several formations from the top and included the Oread limestone at the base. "Thus limited the group is a very well differentiated assemblage of strata, in which thick limestones and a distinctive type of cyclic sedimentation are prominent features." (Moore, 1949, p. 139)

In the Hominy area the Shawnee group is predominantly sandstone and shale with a few limestone beds at the upper part of the section.

The Topeka limestone has been correlated by Moore (1932) with the Turkey Run limestone of Oklahoma. The Oread limestone is absent in the Hominy area so the Shawnee group may be considered to extend from the base of the Kanwaka shale to the top of the Turkey Run limestone.

Vamoosa Formation

The Vamoosa was named by Morgan (1924, p. 125) for exposures about one-half mile east of the townsite of Vamoosa, Seminole county, Oklahoma. He described it as 230 feet of chert conglomerates, massive, coarse, red and brown sandstone, and red shales, underlain by about 30 feet of dark shale.

In Okfuskee county, Rios (1951, p. 150) described an unconformity at the base of the lowermost conglomerate of the Vamoosa, and proposed that the black shale be removed from the Vamoosa formation.

The Vamoosa members change facies and thin to the north with the coarse clastics grading into fine grained sandstones and shales. Rios (1951, p. 154) measured a maximum thickness of 690 feet in Okfuskee county. Greig (1954, p. 21) gave a thickness of approximately 400 feet in Pawnee county. In the Hominy area, with only the Kanwaka and Elgin members of the Vamoosa mapped, it is over 330 feet thick. The formation is predominantly dark gray to buff shale with one or more thick beds of fine grained, light brown to rust colored sandstone.

Kanwaka Shale Member

Definition. The Kanwaka shale was named by Beede (1902, p. 163) from an unpublished manuscript of G. I. Adams. He applied it to beds from the top of the Oread limestone to the base of the Lecompton limestone.

Distribution and Thickness. The Kanwaka shale and its equivalents can be traced from east central Oklahoma across Kansas and into Nebraska. In central Kansas the thickness of the combined members of the Kanwaka is about 100 feet. In the Hominy area their thickness is 250 to 300 feet.

Character. In north and central Kansas the Kanwaka is predominantly shale, but as the outcrop is traced southward, a massive sandstone body, known as the Elgin sandstone, begins to develop. In the area considered in this report this sandstone is a prominent feature measuring from 20 to 100 feet in thickness.

The shale below the Elgin sandstone is dark gray, fissile, and non-calcareous. Many thin sandstone stringers are dispersed throughout the section. These sandstones may be seen in an excellent exposure at the east end of the Cleveland bridge across the Arkansas River. Also at this location a small normal fault may be observed in the shale. (Fig. 3). It apparently does not extend into the Elgin sandstone above. The base of the Kanwaka is not exposed at this location, but the section exposed measures about 90 feet.

The Kanwaka shale above the Elgin sandstone is a yellowish brown to gray, sandy shale with the upper part just below the Lecompton limestone, grading into maroon shale. The section in the roadcut in SE 1/4, sec. 20, T. 23 N., R. 8 E. measures 52 feet, with an upper maroon zone about 15 feet in thickness. Good exposures of the rocks of this interval are uncommon, as it is normally covered with float material from the Lecompton limestone above.

In the S 1/2, sec. 3, T. 22 N., R. 8 E. a section measured in the new roadcut of State Highway 20 shows a greater thickness of shale. A 30 to 40 foot section, entirely covered except for the top 12 feet, apparently consists of gray, blocky shale. Above is about a 20 foot

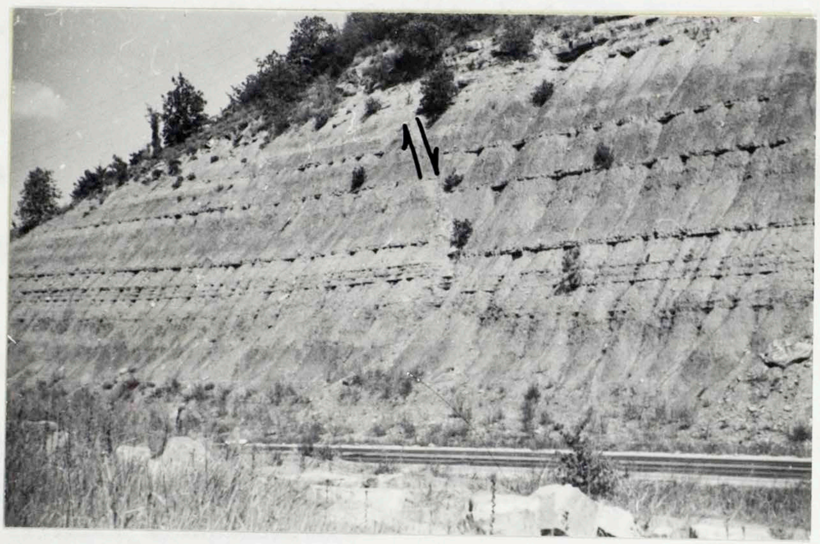


Figure 3. The upper portion of the Kanwaka shale at the east end of the Cleveland Bridge, T. 21 N., R. 8 E. Notice the fault in the center of the picture.

transition zone of mixed gray and maroon shale overlain by about another 20 feet of maroon shale, which is in turn overlain by 10 feet of gray shale. The shale lies immediately below the Lecompton limestone. This is an interval of more than 80 feet, but does not necessarily represent a regional thickening to the south. It is more probable that it represents a shale zone within the underlying Elgin sandstone.

Paleontology. Fossils occur in the Kanwaka shale but are difficult to find. The only collecting locality found in the Hominy area is on the south side of the large sandstone-capped hill in sec. 7, T. 23 N., R. 9 E. The fossils occur in a small depression approximately half way up the hillside. Species found in the Kanwaka are:

Crinoidea
- columnals

Brachiopoda
- Chonetinella flemingi (Norwood and Pratten)
- Crurithyris planoconvexa (Shumard)
- Linoproductus sp.
- Punctospirifer kentuckiensis (Shumard)
- Wellerella osagensis (Swallow)

Pelecypoda
- Astartella vera Hall
- Nuculana bellistriata (Stevens)

Gastropoda
- Glabrocingulum grayvillense (Norwood and Pratten)
- Meekospira peracuta var. choctawensis Girty
- Trepospira discoidalis Newell
- Worthenia tabulata (Conrad)

Elgin Sandstone Member

Definition. Haworth (1898, p. 64) described the Elgin sandstone, and on the recommendation of G. I. Adams named it after the excellent exposures near Elgin, Kansas. Moore (1951, p. 67), in referring to the Kanwaka shale in Kansas, stated:

> In southern Kansas, much of the interval between the Lecompton and Oread formations is occupied by sandstone, sandy shale, and red shale, collectively called the Elgin sandstone. The thickness ranges from about 40 to 145 feet.

In Oklahoma, one or more beds of sandstone occupying this interval are referred to as the Elgin sandstone.

Distribution and Thickness. The Elgin sandstone extends northward from east central Oklahoma into southern Kansas where it grades into shale. As mentioned above it varies from 40 to 145 feet in thickness in southern Kansas. In the Hominy area it varies from 20 to 100 feet in thickness and consists of one to two distinct beds of sandstone. At the dam site of Hominy Lake in sec. 34, T. 23 N., R. 8 E. the Elgin consists of a single bed of sandstone (Fig. 4). The exposed section measures about 90 feet, but there are several feet not exposed at the base. Judging the thickness of the covered section to the exposed sandstone base downstream, the total thickness of the Elgin is estimated as slightly more than 100 feet. The Elgin changes facies within a short distance, and Greig (1954) reported as many as four distinct beds of sandstone separated by shale.

Character. The Elgin sandstone is, essentially, a single massive bed of fine to medium grained sandstone; however, many shale lentil developments occur within the sandstone body. Near Arondale, in T. 23 N., R. 8 E., a shale lentil in the Elgin produces a double ledge. In T. 22 N., R. 7 E. a medium grained, limonitic mottled sandstone lies just below the Lecompton limestone. A few poorly preserved marine fossils were found in the lower part of the bed. It is of limited areal extent and is normally concealed by float material from the limestone formation above.

The color of the Elgin varies from a pure white near the base to a deep rust color higher in the section. It is predominantly light gray on fresh surfaces, but weathers to varying colors. (Two samples from near the base of the formation are 5 YR 5/6 and 10 YR3/4) Where the iron content is high the Elgin weathers to a deep reddish brown.

The Elgin sandstone shows some cross-bedding but is characterized by contortions within the body of sand (Fig. 5). These convolutions vary in diameter from a few inches to several feet and in dip from horizontal to overturned. A unique feature is that the bedding is undisturbed above and below the contortions. Many theories have been advanced to explain this feature, which is not uncommon in the Pennsylvanian sandstones of Oklahoma, but the author favors the explanation of Pettijohn (1949, p. 145). He attributes it to subaqueous slumping or

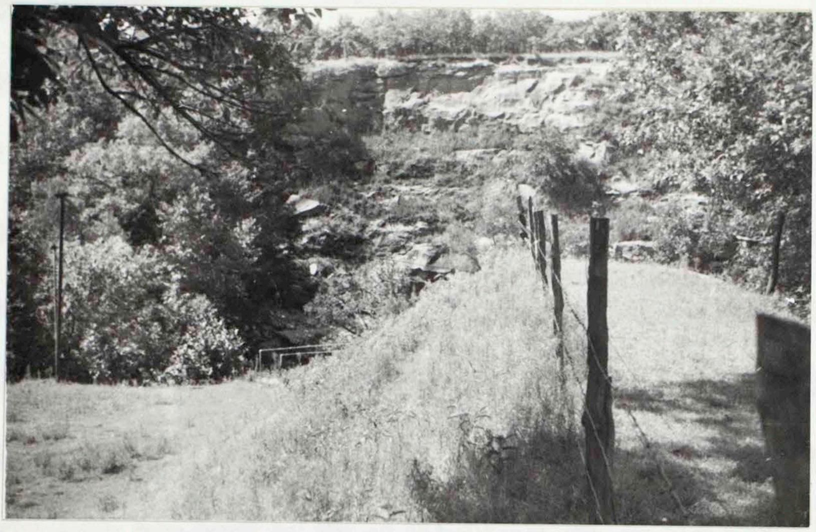


Figure 4. The massive, continuous bed of Elgin sandstone at the dam site of Hominy Lake, sec. 34, T. 23 N., R. 8 E.

Figure 5. Contortions in the Elgin sandstone. Sec. 32, T. 22 N., R. 8 E.

gliding. It has been shown that this movement can occur on slopes of less than one degree.

The Elgin forms prominent, tree covered cuestas throughout the Hominy area, and many steep escarpment faces are present. Small springs can at many places be found near the base of these cliffs.

The lowermost section of the Elgin becomes thin bedded, and there are alternating beds of sandstone and shale. The section becomes more argillaceous downward and grades into the Kanwaka shale below.

In the new roadcut of State Highway 20, in the SW 1/4, sec. 2, T. 22 N., R. 8 E., a channel has cut into the Elgin sandstone. This channel, more than 10 feet deep and 100 feet across, is filled with a non-fossiliferous, dark bluish gray, silty shale interbedded with thin layers of silt. The directional trend of the channel is impossible to determine from the limited exposures, but it is presumed to be in an approximate north-south direction.

The east bank of the channel is abrupt, and the shale-sandstone contact is nearly vertical. The channel bed slopes gently upward to the west side with no sharp abutment against the Elgin. The dip of the bedding within the channel is about 5° E. This is opposite to the regional dip of the formations in the area, which is about 0.5° W. This is interpreted as a local marine current channel rather than a continental stream bed. This interpretation is based on the uniform, fine grained nature of the sediments throughout the channel filling.

Paleontology. Fossils are rare in the Elgin, but a few plant remains were found near the base of the formation in sec. 4, T. 21 N., R. 8 E. on the hill at the east end of the Cleveland bridge. Pelecypod casts and a few other fossils were found at the location on the section line between secs. 19 and 20, T. 22 N., R. 8 E.

Pawhuska Formation

J. P. Smith (1894, p. 199) named the Pawhuski limestone for exposures northwest of the town of Pawhuski, Oklahoma. H. C. Hoover had described this formation and outcrop in an unpublished report of the Arkansas Geological Survey in 1892. He described it as a massive, fossiliferous limestone 100 feet thick, and Smith derived his information from this report.

Adams (1903) and Snider (1911) made references to the Pawhuski limestone in reports, and the spelling was changed to "Pawhuska". Heald (1918, p. 66) described the interval in detail and raised the unit to formation rank.

The Pawhuska formation is now considered to extend from the base of the Lecompton limestone upward to the top of the Turkey Run limestone.

Distribution and Thickness. Moore (1949) gave a thickness of the rocks of the Pawhuska formation in Kansas as 225 to 250 feet.

Shannon (1954, p. 24) measured a section of more than 200 feet in the Pawhuska area. In the Hominy area, in sec. 24, T. 22 N., R. 7 E., the interval is approximately 100 feet. To the south (Greig, 1954, p. 34) the thickness "...ranges from 96 feet in the northern part of the Hallett area to 56 feet in the southern portion."

The thinning to the south can probably be explained by the pinching out of many of the limestone and shale units in that direction.

Character. In Kansas the strata of the Pawhuska formation contain as many as twelve named limestones. These limestones are separated by shale beds of varying thickness, and the area is marked by an absence of sandstones. As the limestone outcrops are traced southward they thin and disappear and sandstones develop.

In the Hominy area only four limestones are present. The Lecompton limestone and the Turkey Run limestone, which mark the lower and upper limits of the formation, are present throughout the area. The Deer Creek limestone extends southward to T. 22 N. where it thins and grades into a sandstone. The Plummer limestone occurs in two localities only in the Hominy area and also disappears in T. 22 N.

Lecompton Limestone Member

Definition. The Lecompton limestone was named by Haworth (1895, p. 276) for exposures near Lecompton, Kansas. He described it as three fossiliferous limestones separated by thin shales with a total thickness of 25 feet.

Moore (1949, p. 152), by the present definition, described it as "... four closely associated limestones, which with the included shales have a total thickness... of 35 to 40 feet..." in central Kansas.

Distribution and Thickness. The Lecompton limestone can be traced from Nebraska, across Kansas, and to east central Oklahoma. Moore (1949, p. 152) stated:

> Persistence of lithologic and paleontologic characteristics of the Lecompton permit definite identification of this formation and of various members at many exposures from Nebraska to Oklahoma. In southernmost Kansas and northern Oklahoma, however, some of the limestones disappear, and going southward, all the limestone members eventually disappear.

In the Hominy area the Lecompton consists of slightly more than 20 feet of thin-bedded limestone.

Character. In the Pawhuska area, Shannon (1954, p. 20) described the Lecompton as a series of shale and sandstone beds with numerous thin limestone lentils of limited lateral extent. These characteristics extend into the Hominy area, but the Lecompton rapidly changes in lithology and thickness. In sec. 20, T. 23 N., R. 8 E. it consists of a series of alternating, thin-bedded limestones and shales, with shale predominating. Three miles south, in sec. 8, T. 22 N., R. 8 E., at the site of the Hominy Limestone Quarry, the Lecompton is a wavy-bedded limestone more than 22 feet thick (Figs. 6 and 7).

A detailed description of the Lecompton was made from expos-

Figure 6. The Lecompton limestone at the Hominy Quarry, in sec. 3, T. 22 N., R. 8 E., two miles west of Hominy, Oklahoma.

Figure 7. This picture of the Lecompton limestone in the Hominy Quarry shows the thin, wavy-bedding so characteristic of this formation.

ures in the SE 1/4, sec. 10, T. 22 N., R. 8 E. Approximately 3 feet from the base of the formation an 18 inch layer of massive, dark limonitic colored limestone occurs (5 YR 3/4). It weathers to a lighter orange rust color (5 YR 5/5). A light gray limestone layer (5 Y 7/1) at the top of the Lecompton also weathers to a bright orange rust color (10 YR 5/4). These two beds are similar on a weathered surface but are easily distinguished when broken. They are persistant throughout most of the area except in the north half of T. 23 N., R. 8 E., where the Lecompton "shales up" and the top limestone disappears.

The Lecompton limestone, due to its greater thickness, forms prominent cuestas immediately behind those of the tree covered Elgin sandstone. Most of the Lecompton outcrops are restricted to the ridge behind the Elgin cuestas; however, due to the deep erosion of Bug Creek, in T. 22 N., R. 7 E., the Lecompton is exposed at the bridge across Bug Creek in sec. 10, T. 22 N., R. 7 E. (Fig. 8). About a mile upstream in sec. 35, T. 23 N., R. 7 E. the upper portions of the Lecompton are again exposed. These two outcrops are probably due to being on the upthrown side of the fault shown on Plate I in secs. 34 and 35.

Paleontology. At several localities, colonies of the coral *Caninia torquia* were found near the base of the Lecompton. Fossils found in the Lecompton limestone are:

Plantae

Cryptozoon sp.

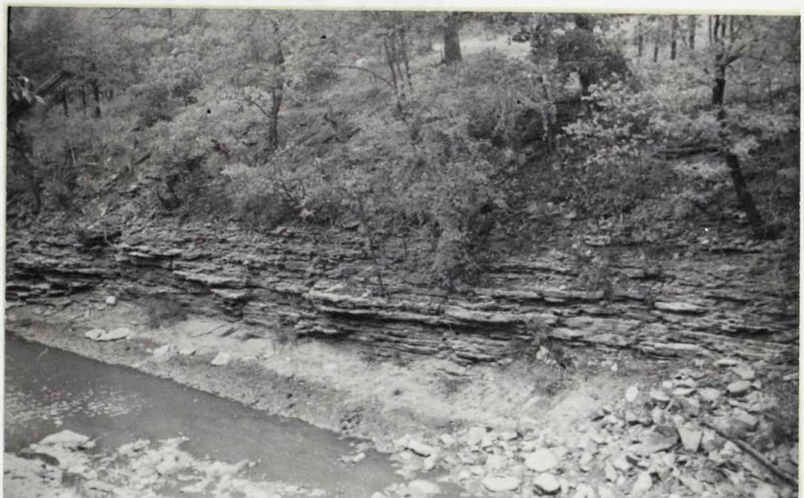


Figure 8. The Lecompton limestone at the bridge near the mouth of Bug Creek in sec. 10, T. 22 N., R. 7 E. It is about 25 feet thick in this locality.

Protozoa

Triticites sp.

Anthozoa

Caninia torquia (Owen)
Syringopora sp.

Crinoidea

columnals

Brachiopoda

Composita subtilita (Hall)
Crurithyris planoconvexa (Shumard)
Enteletes hemiplicatus (Hall)
Hustedia mormoni (Marcou)
Marginifera sp.
Neospirifer dunbari King

Two thin limestones, considered part of the Lecompton limestone crop out beside the road in SE 1/4, sec. 20, T. 23 N., R. 8 E. (See measured section XIV) They consist almost entirely of colonies of *Cryptozoon* similar to those found in the Wakarusa limestone. This is the only location where this fossil was observed in the Lecompton.

At many places the Lecompton is overlain by about a foot of limy shale which contains an abundance of *Triticites*.

Interval above the Lecompton Limestone

In the southern half of the Hominy area a bed of dull gray to buff, blocky shale, 12 to 15 feet thick, lies above the Lecompton limestone. This is in turn overlain by a fine grained, dirty white, massive sandstone which has fine limonitic specks disseminated throughout. This sandstone is persistent over most of the area and in sec. 19, T. 22

N., R. 8 E. where it is over 30 feet thick it forms prominent falls in stream channels.

Above this sandstone the gray shale is more arenaceous and a few feet below the Turkey Run limestone the shale is maroon and indicates possible non-marine deposition.

In the northern half of the area the rocks of the interval between the Lecompton and the Plummer limestones are predominantly shale as the sandstone bed is only a few feet thick.

Plummer Limestone Member

Definition. The Plummer limestone was named for exposures on the Plummer Ranch in T. 26 N., R. 9 E. by Winchester (1918, p. 12). He described it as a "black, flinty, angular limestone" separated into two benches by 6 to 8 feet of shale.

Distribution and Thickness. The Plummer is of limited extent. Winchester (1918, p. 12) noted exposures on the Myers gas dome in the southwest of T. 27 N. Shannon (1954, p. 26) correlated the Plummer with the top ledge of the Lecompton limestone in the Pawhuska area. The author is inclined to doubt this correlation because of two outcrops, found in the Hominy area, which lie approximately 25 feet above the Lecompton and fit the description of Winchester's Plummer limestone.

Character. The Plummer is not a continuous unit and is found only in two localities within the Hominy area. An outcrop in sec. 26,

Figure 9. Large, angular blocks of the Plummer limestone in sec. 26, T. 23 N., R. 7 E.

T. 23 N., R. 7 E., near the ford of an east branch of Bug Creek, (Fig. 10) consists of a single ledge of a 20 to 24 inch thick limestone. It is a dark gray to black (N 4), flinty limestone which weathers in sharp angular blocks. The weathered surface is, in many places, highly stained with iron oxide (10 YR 5/4) to a depth of more than one inch. A 4 to 5 inch zone of fusulinid coquina occurs at the top of the Plummer at this exposure. At this outcrop the interval below the Plummer consists of about 20 feet of gray fissile shale. This interval was measured from the lowest exposure in the creek bed and does not give the entire section from the underlying Lecompton limestone.

The other outcrop of the Plummer is near the center of sec. 35, T. 23 N., R. 7 E. Here the Plummer is about 15 feet above the Lecompton.

Paleontology.

Plantae

Cryptozoon sp.

Protozoa

Triticites sp.

The Cryptozoon was an isolated colony that may either have been from the Plummer limestone or the shale immediately below.

Interval above the Plummer Limestone

In sec. 26, T. 23 N., R 7 E. the 27 foot interval between the Plummer and Deer Creek limestones is mostly gray shale, but a sandstone occurs in the upper half of this shale body. This sandstone weathers in a peculiar manner and apparently resembles the sandstone which Winchester (1918, p. 12) described about 20 feet below the Plummer at the type area. He described it as "... a very persistant sandstone bed about 2 feet thick, which, because of its peculiar ragged manner of weathering, was called the 'ragged sandstone'..."

The sandstone above the Plummer was seen only at the location in sec. 26 and is not persistant. It probably is incorporated in the much thicker sandstone body in the southern part of the Hominy area.

Gray, silty shale overlies this sandstone bed and extends upward to the Deer Creek limestone.

Deer Creek Limestone Member

Definition. The Deer Creek limestone, as described by Bennett (1896, p. 152) at the type section near Topeka, Kansas, consists of three limestones separated by shales, with a total thickness of 205 feet. It is separated from the overlying Topeka limestone by 60 feet of shale, and occurs about 100 feet above the Lecompton limestone.

Distribution and Thickness. Outcrops of the Deer Creek limestone extend completely across Kansas and into Nebraska, where the individual beds were named by Condra.

In the Pawhuska area it was described by Shannon as varying in thickness from 15 feet near the airport at Pawhuska to as much as 34 feet in sec. 21, T. 25 N., R. 8 E. It thins rapidly near the Hominy area and in sec. 30, T. 24 N., R. 8 E. it is only 5 feet thick.

Exposures of the Deer Creek are poor in the Hominy area but appear to be less than 2 feet thick in sec. 6, T. 23 N., R. 8 E. Exposures are intermittent to the south, and outcrops shown on the map are identified as Deer Creek by stratigraphic position and lithology.

Character. Carter (1954, p. 31) described the Deer Creek in northern Osage county as having ". . . a soft, sandy, fossiliferous limestone at the top, underlain by either a wavy bedded, light gray, dense limestone or a thick, platy, lithographic to finely crystalline, buff limestone. . .".

In the Hominy area the Deer Creek is a light gray (N 7), dense, arenaceous limestone mottled with fine specks of rust (10 YR 6/6) on fresh surfaces. It weathers to a light gray to nearly white, rotten, crumbly mass which may be found only within a short distance of the outcrop. This description resembles that of the top section of the Deer Creek as described by Carter (1954, p. 31) in the Pearsonia area north of Pawhuska, Oklahoma.

In secs. 23 and 26, T. 23 N., R. 7 E., blocks of the Deer Creek limestone have been removed from the road bed. These blocks measure about 18 inches in thickness and show mottled, limonitic iron stains (5 YR 2/4) through much of the limestone.

At the south line of sec. 36, T. 23 N., R. 7 E., the Deer Creek is light gray (N 7), massive, dense, arenaceous limestone about 6 inches

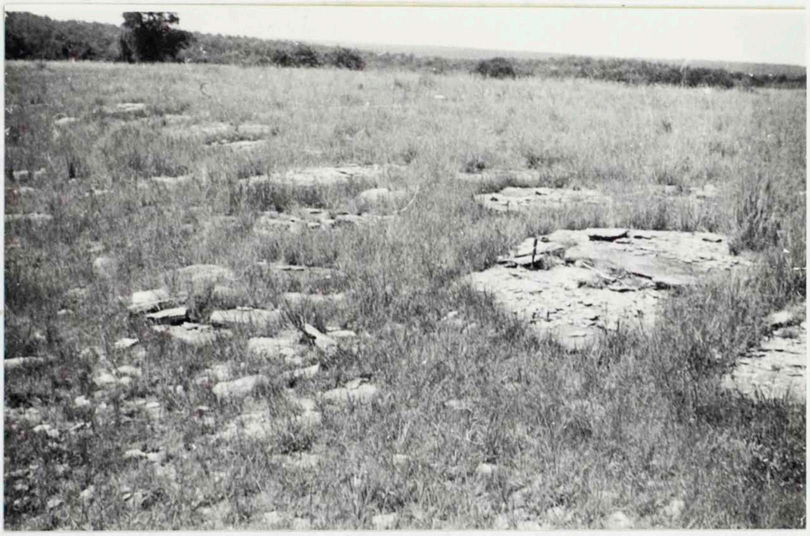


Figure 10. Thin, weathered blocks of the Deer Creek limestone in sec. 26, T. 23 N., R. 7 E.

thick. It is overlain by 6 inches of fine grained, tan sandstone with limonitic specks evenly distributed throughout.

In the NE 1/4, SE 1/4, NW 1/4, sec. 30, T. 22 N., R. 8 E., a 4 feet thick, light gray, wavy-bedded limestone occurs which is questionably identified as Deer Creek. The bed thins rapidly away from this point, and no other exposures south or west of this locality were found. This leads the writer to the conclusion that this is the southward extent of the Deer Creek limestone. Also, Greig (1954, personal communication) reported the Deer Creek missing in the Mallott area immediately south of the Arkansas River.

In sec. 14, T. 23 N., R. 7 E., the Deer Creek is nearly 2 feet thick and has passed into an algal phase. It consists entirely of small algal pellets ranging up to 10 mm. in diameter.

An algal limestone similar to the above limestone occurs only a few feet below the Turkey Run limestone about a mile to the west in the SW 1/4, sec. 16, T. 23 N., R. 7 E. This limestone is quite prominent in the stream bed of Bug Creek, but cannot be traced away from this locality due to a covering of alluvium.

If this is a continuation of the algal zone of the Deer Creek it indicates a local convergence towards the Turkey Run. This could be explained by the formation of the algal limestone on a topographic high on the ocean floor. This would require a change of dip on the floor of only 0.8°, and this is not unreasonable to expect.

Another, and more reasonable explanation considering the limited information available, is that it is an isolated algal limestone lense with no relationship to the underlying Deer Creek limestone.

Paleontology. The Deer Creek in the Hominy area is sparingly fossiliferous, and those fossils found were so poorly preserved that identification could not be made.

Interval above the Deer Creek Limestone

The interval between the Deer Creek and Turkey Run limestones, in sec. 26, T. 23 N., R. 7 E., contains 32 feet of shale and thin interbedded sandstones. The shale immediately above the Deer Creek is gray and maroon interbedded, and is arenaceous. Higher in the section the shale is gray with a few thin sandstones.

Turkey Run Limestone Member

Definition. The Turkey Run limestone was first described and named by Heald and Mather (1919, p. 158) for exposures near the head of Turkey Run Creek in secs. 9, 16, and 17, T. 24 N., R. 8 E. They described it as a fine grained, thin bedded, hard, and brittle limestone from 1 to 3 feet thick, which weathers into smoothly rounded slabs a few inches thick.

Distribution and Thickness. Moore (1949, p. 120) correlated the

Turkey Run with the Coal Creek limestone member of the Topeka formation in Kansas.

Shannon (1954, p. 48) traced the outcrop of the Turkey Run across the Pawhuska area to within one-half mile of the northern boundary of that area, where the lithology changes.

Carter (1954, p. 42) had difficulty in following the outcrop northward in the Pearsonia area, and he described the unit as a thin algal limestone.

Character. In the Hominy area the Turkey Run varies from 18 to 24 inches thick. The lower 4 inches is dark gray and platy with an abundance of small *Triticites* and brachiopod and crinoidal fragments. The upper portion is dense, brittle, dark bluish gray (N 4), massive limestone. It contains many *Triticites* in the lower 4 to 6 inches and broken fossil remains are profuse throughout the remainder of the bed. A thin layer of platy, shaly limestone about one inch thick occurs at the top of the Turkey Run.

Locally the Turkey Run contains many iron stained, calcium carbonate nodules disseminated through the body of limestone. The Turkey Run is dense and brittle, and the broken surfaces exhibit a subconchoidal fracture. Pieces struck together, or with a hammer, give a distinctive metallic ring.

The Turkey Run weathers medium gray to dull tan (5 Y 6/2). It exhibits the joint pattern characteristic in this area and this jointing

Figure 11. The Turkey Run limestone in the road-cut at the west side of sec. 32, T. 23 N., R. 8 E. Notice the difference in the rate of weathering of the top and bottom of this limestone.

produces large angular blocks on the weathered slopes.

The upper and lower portions of the bed are more resistant to weathering than the center portions. This produces an anvil appearance of many of the exposed blocks.

Indications of the cyclic sedimentation so characteristic in Pennsylvanian sediments in Kansas and elsewhere are found below the Turkey Run limestone in the NW 1/4, NE 1/4, SW 1/4, sec. 19, T. 22 N., R. 8 E. At this location, in the ditch beside the road, a one-half inch band of coal smut occurs 10 inches below the Turkey Run limestone. This is underlain by 2 feet of blue gray clay. In sec. 33, T. 22 N., R. 7 E., this band of smut has increased to one inch in thickness, and in the Hallett area Greig (1954, p. 41) reported a 6 inch layer of lignite below the Turkey Run.

The coal smut does not occur in the Hominy area north of the locality in sec. 19.

Paleontology. Many fossil fragments occur in the Turkey Run limestone, but identifiable fossils are uncommon.

Protozoa
Triticites sp.

Crinoidea
columnals

Brachiopoda
Dictyoclostus portlockianus (Norwood and Pratten)
Neospirifer dunbari King

Wabaunsee Group

The Wabaunsee formation, later raised to group rank, was described by Prosser (1895). The base of the formation was defined as the top of the Osage Coal horizon and the top defined by the base of the Cottonwood limestone. The group was later restricted by Condra (1935) to exclude beds now classified as Permian, and include beds from the top of the Topeka limestone to the top of the Brownville limestone.

Moore (1949, p. 167) stated that in Kansas shale is more prominent in the Wabaunsee than in the adjoining parts of the geologic section, and that there are extensive sandstones. These features are similar in the Hominy area, but some of the sandstones are quite thick.

Moore (1949, p. 167) gave a thickness of the Wabaunsee as about 500 feet. A complete section is not present in the area of this report, but it is about 350 feet thick in southern Osage county.

In the Hominy area the Wabaunsee group includes all formations under consideration from the top of the Turkey Run limestone through the Stonebreaker limestones.

Interval above the Turkey Run Limestone

Moore (1949, p. 166) correlated the interval between the Turkey Run and Bird Creek limestones with the Severy-Aarde shale interval in Kansas.

The Severy shale was described and named by Haworth (1898, p. 66) from field notes of G. I. Adams. It was named for exposures near Eureka, Kansas, and has a thickness (Moore, 1949, p. 171) of about 70 to 80 feet.

The Aarde shale was named by Moore (1932, p. 94) and was described as consisting of 3 feet of yellowish gray clayey shale.

The Bachelor Creek limestone,which separates these shales, is absent to the south in Kansas and Oklahoma so the combination of the names was proposed.

In the Hominy area the Severy-Aarde interval is about 40 to 70 feet thick. The lithology of the interval is predominantly shale, but in a few localities, such as in sec. 8, T. 22 N., R. 8 E., a sandstone unit attains a thickness of more than 35 feet. This sandstone is a fine to medium grained, dirty white bed with considerable cross-bedding near the top.

In sec. 27, T. 23 N., R. 7 E., this sandstone unit is only about 3 feet thick. The change in thickness of the sandstone is accompanied by a corresponding change in the thickness of the interval between the two limestones.

About 8 feet below the Bird Creek limestone the normal gray shale section becomes interbedded and mottled with maroon shale; however, immediately below the Bird Creek there is about 3 feet of olive drab to gray shale.

A zone of gray platy shale just overlying the Turkey Run limestone contains a rather rich faunal suite. Fossils found are:

Anthozoa
- _Lophophyllidium_ sp.

Crinoidea
- columnals and radials

Echinoidea
- echinoid plates

Brachiopoda
- _Chonetes granulifer_ Owen
- _Crurithyris planoconvexa_ (Shumard)
- _Hustedia mormoni_ (Marcou)
- _Juresania nebrascensis_ (Owen)
- _Lissochonetes geinitzianus_ (Waagen)
- _Neospirifer dunbari_ King
- _Punctospirifer kentuckiensis_ (Shumard)

Bryozoa
- _Rhombopora lepidodendroides_ Meek
- _Fenestella_ sp.

Pelecypoda
- _Myalina_ sp.

Bird Creek Limestone Member

Definition. Heald named the Bird Creek limestone for exposures along Bird Creek and its tributaries in Osage county, Oklahoma. Although named by Heald, Bowen (1918, p. 137) was the first to have the name published. He described it as:

> . . . a dense, fine grained non-crystalline rock about 4 feet thick. On the fresh surface it is commonly lead-gray to black and weathers to a dirty buff or yellow. When struck with the hammer it breaks along bedding planes. . . . It

contains fossils of a few species but they are not abundant.

Distribution and Thickness. Moore (1949, p. 166) correlated the Bird Creek limestone with the Church limestone member of the Howard formation. In discussing the Church limestone Moore (1949, p. 173) stated "the lithologic and faunal characters of the Church limestone are remarkably constant throughout its outcrop from Nebraska and Iowa to north-central Oklahoma." In the Pawhuska area Shannon (1954, p. 54) reported a thickness varying from 20 to 30 inches thick with some thinning to the south. In the Hominy area it is 18 to 20 inches thick.

Character. The Bird Creek varies lithologically from a dense, dark gray to black (N 4), massive limestone similar to the Turkey Run, to a light gray (5 YR 5/1), thin wavy-bedded limestone (Fig. 12). It weathers to small, irregular flags which are a dirty, gray buff (5 YR 6/1). They weather rapidly and only locally does the Bird Creek form a prominent outcrop.

The variation in thickness in the Hominy area from that at the type section to the north indicates a southward thinning. This is also borne out by Greig (1954, p. 46) with a measurement of the Bird Creek of less than one foot in the southeastern part of the Hallett area.

Paleontology. The Bird Creek limestone is sparingly fossiliferous and the fossils are poorly preserved. A thin layer of platy fusulinid coquinoid limestone, containing an abundance of Triticites, occurs

Figure 12. The Bird Creek limestone showing the thin, wavy-bedding exhibited by this limestone at most exposures. This outcrop is in the road cut of the old State Highway 20, just west of Dug Creek in sec. 27, T. 28 N. R. 7 E.

at the top of the bed.

Protozoa

Triticites sp.

Brachiopoda

Composita subtilita (Hall)
Chonetes granulifer Owen
Dictyoclostus americanus Dunbar and Condra
Marginifera sp.
Punctospirifer kentuckiensis (Shumard)

Bryozoa

Rhombopora lepidodendroides Meek

Interval above the Bird Creek Limestone

In sec. 27, T. 23 N., R. 7 E., the interval between the Bird Creek and the Wakarusa limestones measures 88 feet. Most of this interval is covered, but float material indicates several beds of sandstone. In this locality the Bird Creek is overlain by 17 feet of dirty tan shales, which are in turn overlain by a 10 inch bed of light gray (5 Y 6/2), crystalline limestone containing many *Chonetes*. This limestone bed thickens southward and is composed chiefly of algal pellets. In sec. 26, T. 22 N., R. 7 E., this algal limestone is more than 6 feet thick and forms a definite ledge where the road crosses it, and for some distance in each direction. It thins rapidly to the south and was not detected in T. 21 N.

In sec. 35, T. 22 N., R. 7 E. the interval between the Bird Creek and Wakarusa limestones measures 103 feet, with a 25 feet maroon shale section a short distance below the Wakarusa.

Sections measured in secs. 10 and 11, T. 23 N., R. 7 E. indicate a decrease of sandstones as compared to sections in the southern half of the area. Also in this locality several thin maroon and algal limestones are present. The section is approximately 100 feet thick.

This interval in Kansas contains numerous thin limestones and named shales. Most of these limestones drop out as the outcrops are traced southward and no definite correlation can be made in the Hominy area. Shannon (1954, personal communication) reported the Rulo limestone to extend within two miles of the Hominy area, so one of the algal limestones near the top of this shale interval may be its equivalent.

Wakarusa Limestone Member

Definition. Beede (1898, p. 30) applied the name "Wakarusa" to a limestone exposed on Wakarusa Creek south of Auburn, Kansas. Moore (1936, p. 219) later identified this limestone as the Reading. The Wakarusa is now considered the first resistant unit above the Burlingame limestone.

The Wakarusa limestone was correlated by Moore (1949, p. 183) with the "Cryptozoon limestone" of Oklahoma, which was described by Heald (1918, p. 64).

Distribution and Thickness. The Wakarusa extends from Nebraska to Oklahoma, and ranges from about 2 feet to about 18 feet in thickness, with the thicker sections containing considerable shale(Moore, 1949, p. 183). In northern Osage county, Oklahoma, Carter (1954, p. 49) measured a section more than 20 feet thick; however, most of the rock of the interval was shale. To the south it thins and thickens within a short distance.

Character. In the Hominy area the Wakarusa is a dense, brittle, fossiliferous, dark gray (N 5) limestone. It weathers to small irregular slabs which are medium gray to dull tan (5 Y 7/1). These pieces are normally within a short distance of the outcrop, and the outcrop is seldom prominent, indicating a limestone which weathers rapidly.

In sec. 2, T. 23 N., R. 7 E., algal organisms occur in colonies within the Wakarusa. These Cryptozoon colonies vary from 2 to 6 inches across and are numerous in this locality. Southward they are less abundant and none was found in the exposures in R. 22 N. This southward gradation in concentration of Cryptozoon was noted in the Wakarusa by Shannon (1954, p. 62) in the Pawhuska area, and Greig (1954, p. 49) found none in the Hallett area. This indicates a difference of environmental conditions within the Wakarusa seas from north to south. This change is also indicated by the change in thickness of the limestone. Shannon (1954, p. 62) found an average thickness of about one foot in the Pawhuska area. In the road cut at the north section line of sec. 2, T. 23 N., R. 7 E. an exposure of the Wakarusa is about 10 inches thick. In sec. 30, T. 23 N., R. 7 E. the Wakarusa (Fig . 14) measures about 5 feet and is shale and limestone. In the Hallett area, Greig (1954, p. 50) gave a thickness

Figure 13. The Wakarusa limestone. Weathered blocks on the outlier in sec. 2, T. 23 N., R. 7 E.

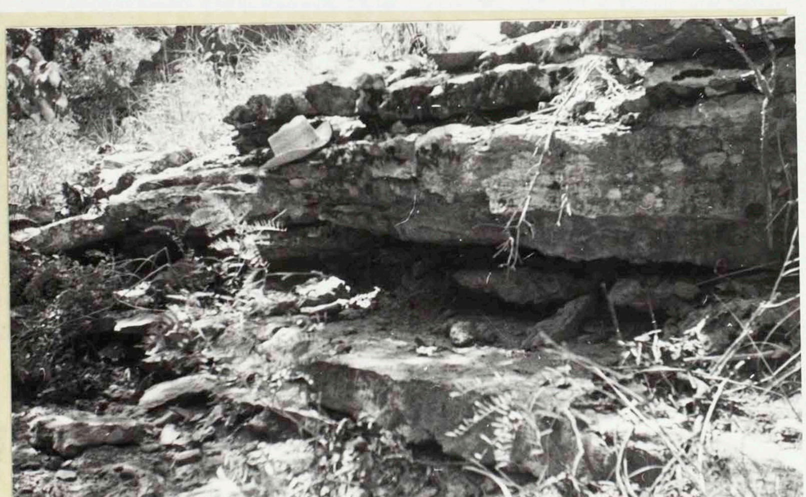


Figure 14. The Wakarusa limestone interbedded with shale in sec. 30, T. 23 N., R. 7 E.

of 7.5 feet of limestone and shale.

Exposures of the Wakarusa, in the Hominy area, are almost entirely limited to the west slope of the Sycamore Creek stream channel; however, an outlier of Wakarusa capping a high hill in the NW 1/4, sec. 35, T. 22 N., R. 7 E. should be noted as it is 5 miles from the nearest exposure.

Paleontology. Fossils are not common in the Wakarusa limestone but are well preserved. The species found are:

Plantae
- Cryptozoon sp.

Protozoa
- Triticites sp.

Brachiopoda
- Chonetes granulifer Owen
- Composita subtilita (Hall)
- Crurithyris planoconvexa (Shumard)
- Enteletes cf. hemiplicatus (Hall)
- Linoproductus sp.
- Marginifera muricatina Dunbar and Condra
- Neospirifer dunbari King
- Wellerella osagensis (Hall)

Bryozoa
- Rhombopora lepidodendroides Meek

Auburn Shale Member

The Auburn shale, named by Beede (1898, p. 30) for exposures in southern Kansas, extends from the Wakarusa to the Reading limestone. Moore (1949, p. 183) described it as containing both marine and non-marine sandstones and shales. It extends from Nebraska to Oklahoma and varies in thickness from 20 to 70 feet.

Exposures of this interval are almost lacking in the Hominy area. In the northern portion of the area it seems to consist predominantly of gray shale with a few thin sandstones. Southward, in secs. 30 and 31, T. 23 N., R. 7 E. the sandstone thickens and exposures in a tributary of Sycamore Creek measure more than 25 feet of fine grained sandstone.

The Auburn is relatively non-fossiliferous except for a thin limestone in the upper part of the section. It contains:

Brachiopoda
- Chonetes granulifer Owen
- Crurithyris planoconvexa (Shumard)
- Hustedia mormoni (Marcou)
- Linoproductus prattenianus (Norwood and Pratten)

Bryozoa
- Rhombopora lepidodendroides Meek
- Fenestella sp.

Pelecypoda
- Myalina (Orthomyalina) subquadrata Shumard

Stonebreaker Limestone

Definition. The Stonebreaker limestone was named by Heald (1918a, p. 131) for outcrops on the Stonebreaker Ranch near Pawhuska, Oklahoma. He described it as a dark blue to light gray limestone, with ocher-yellow limonite stains, measuring from 2 to 16 feet in thickness.

Carter (1954, p. 56) believed that Heald intended the name to apply only to the limestone which correlated with the Reading limestone, but geologists later extended it to include the equivalent of the Elmont limestone of Kansas.

Distribution and Thickness. Beckwith (1928, p. 17) stated that the Stonebreaker varies in thickness from 4 to 16 feet in the northern part of Osage county to more than 50 feet in the southern part. Near the Oklahoma-Kansas boundary, Carter (1954, p. 50) measured a total thickness of 35 feet.

In sec. 4, T. 23 N., R. 7 E. the Stonebreaker members measure more than 60 feet, with most of the strata consisting of shale.

Character. All the units of the Stonebreaker weather rapidly, making lithologic study and mapping difficult.

Greig (1954, p. 52) mapped two members of the Stonebreaker limestone and tentatively correlated them with the Reading and Elmont limestones of Kansas. However, in the Hominy area three units are present throughout most of the area and in sec. 31, T. 23 N., R. 7 E. the middle unit apparently is divided into two separate and distinct beds. With this complication it does not seem feasible to attempt a correlation in this area with Kansas units.

In sec. 4, T. 23 N., R. 7 E. three limestone units are present, but only the upper and lower units are mapped.

The lower Stonebreaker consists of about one foot of blocky,

Figure 15. Lower Stonebreaker limestone in sec. 18, T. 23 N., R. 7 E. At this locality it is a maroon and gray mottled unit.

Figure 16. The middle Stonebreaker limestone. This outcrop shows the thin-bedded, shaly nature of this unit.

maroon mottled (5 YR 8/1) limestone with a thin layer of dense, arenaceous, light gray (5 Y 8/1) limestone at the top (Fig. 15). The maroon (5 R 4/2) portion contains an abundance of large, fat Triticites. This lower unit is separated from the second, or middle limestone unit, by about 15 feet of light gray, sandy shale.

The middle Stonebreaker limestone has a basal, massive layer 1.5 feet thick which contains many Triticites and Myalina. Above this is a 2 feet maroon limestone section. It, and the remaining 5 or 6 feet of light gray limestone are less resistant and weather back more rapidly (Fig. 16). As a result the true thickness of this unit is difficult to determine at most places without extensive removal of soil and weathered material.

A shale and sandstone bed separates the middle limestone from the upper limestone unit. The upper Stonebreaker is a massive, light gray (5 Y 7/1), non-fossiliferous, finely crystalline limestone about 3 feet thick. It weathers to irregular blocks (Fig. 17) which are slightly darker (5 Y 6/1) than the fresh surface.

In sec. 31, T. 23 N., R. 7 E. the lower Stonebreaker unit is similar to exposures to the north. The middle Stonebreaker has thickened southward and appears to have divided into two distinct beds. The lower bed is thin, with platy layers interbedded with gray shale. It contains many gastropod casts which are unidentifiable. It is approximately 5 feet thick. The upper bed, about 10 feet above the lower, consists of one foot of gray limestone composed almost entirely of small algal pellets ranging from microscopic to 15 mm. in diameter.

The upper Stonebreaker limestone is separated from the middle Stonebreaker by a 25 to 30 feet covered zone. This interval is largely shale but about 5 feet, in the upper portion, consists of a massive, medium grained, light gray sandstone. The upper Stonebreaker in this locality is also similar to exposures to the north, and is a light gray, finely crystalline limestone (Fig. 17).

Paleontology.

Lower Stonebreaker limestone.

Protozoa

Triticites sp.

Middle Stonebreaker limestone.

Protozoa

Triticites sp.

Brachiopoda

Chonetes granulifer Owen
Echinoconchus semipunctatus (Shepard)
Dictyoclostus americanus Dunbar and Condra
Linoproductus sp.

Pelecypoda

Myalina sp.

Gastropoda

Bellerophon sp.
Euphemites sp.
Glabrocingulum grayvillense (Norwood and Pratten)
Meekospira sp.
Worthenia tabulata (Conrad)

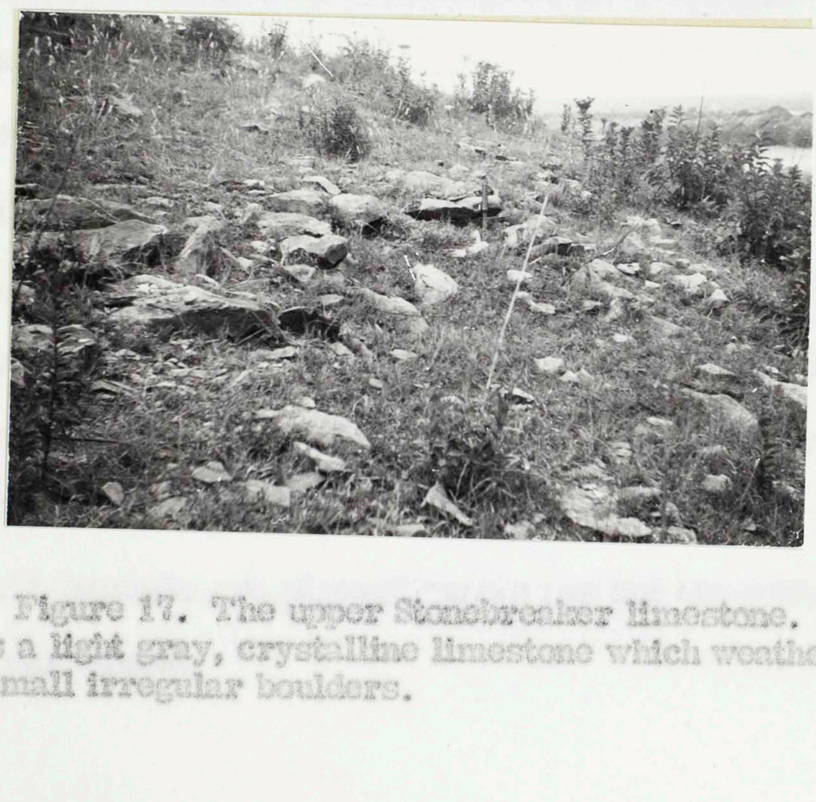


Figure 17. The upper Stonebreaker limestone. It is a light gray, crystalline limestone which weathers to small irregular boulders.

Upper Stonebreaker limestone.

Protozoa

Triticites sp.

Terrace and Alluvium Deposits

Terrace deposits of fine grained sand occur in the southwest corner of the Hominy area. These sands cover several square miles and are found as high as 200 feet above the present river bed. The sand is unconsolidated and shows little stratification; however, few exposures are good enough to determine if bedding is present.

Flood plain deposits are common in the lower extentions of the major streams. The alluvium is composed of fine grained sand, silt, and clay. A sieve analysis was run on this material and 44% is smaller than 0.062 mm. The fine material supports vertical banks along the stream channels. Some banks along Hominy Creek are over 30 feet high (Fig. 18).

These deposits are of questionable age but are probably both Pleistocene and Recent.

Figure 18. The vertical wall characteristic of the eroded aluvial flood plain of Hominy Creek. Sec. 2, T. 23 N., R. 8 E.

CHAPTER III

STRUCTURE

Regional

Physiographically, the Hominy area is situated in the central portion of the Osage section of the Central Lowlands (Fenneman, 1938, p. 665). Structurally, it is located at the eastern edge of the Prairie Plains homocline. Regionally prominent structures around this area are the Ozark Dome to the east, the Arbuckle Mountains and the Mc-Alester Basin to the south, the Anadarko Basin to the southwest, and the buried Nemaha Ridge to the west and north.

The Prairie Plains homocline in northeastern Oklahoma is locally deformed by small, slightly elongated domes and basins. Also, several zones of en echelon faults trend north-south across east central Oklahoma and into southern Kansas.

With the discovery of oil and gas in northeastern Oklahoma, these structures came to the attention of petroleum geologists and numerous papers and several theories have been presented which attempt to explain the origin and inter-relationship of these features.

The suggestion that the folding in the Mid-Continent oil fields was caused by vertical pressures from laccolithic action was made by Gardner (1917).

In discussing the oil domes of central Kansas, Blackwelder (1920) stated that differential compaction over buried hills would account for those structures.

Millikan (1920) presented considerable data about the folds and faults in Osage county but made no attempt to interpret the information.

A year later, Fath (1921) attempted an explanation of the faults by horizontal movements along lines of weakness in strong, deep-lying rocks. The drag from this movement on the overlying weak sediments would tear the lower parts of these sediments and short fractures would open at about 45° to the direction of movement.

Sidney Powers (1925) illustrated the thinning of sediments over the anticlines and suggested that this was produced by continued development throughout Paleozoic time. This development, according to Powers, was produced by deposition over hills on the sedimentary floor. Uniform lateral compression of a large segment of the basement rocks, taking place at a considerable depth below the Paleozoic crust, would increase the vertical expression of these hills in relation to the floor upon which they rest and thus produce the doming of the sediments. He also stated that faults occurring in Pennsylvanian rocks are restricted to formations of that age.

Foley (1926) proposed a rotational stress produced by the Ozark Uplift on the southeast and the buried Nemaha Ridge on the northwest. According to this theory, the forces were in a direction normal to the strike of the faults. In a discussion of this theory, Lahee (1926) doubted the ability of the basement rocks to transmit forces the required distances. Thom (1926) doubted the active influence of the Ozark region. In its stead, he suggested that the major force was transmitted from the Ouachita overthrust being crowded into the gap between the Ozarks and the Arbuckles.

Brown (1928) concluded that folds produced by rotational stresses would be much elongated, and that the types found in Osage county could only be produced by compressional forces from all directions, or at least two independent sets of forces at right angles to each other.

Later, in the same year, Brown (1928a) published the results of experiments made to test Fath's theory and concluded that both folding and faulting could be produced by shifting along buried faults, but that the folds were much elongated.

McCoy (1921) explained the folding and faulting by the presence of two sedimentary basins. One in southeastern Kansas and one north of the Arbuckle Mountains. During Pennsylvanian times the areas of Osage, Pawnee, and Creek counties acted as a fulcrum between the two basins. Tension produced in the formation of these basins would produce faults of a northwest-southeast trend. The several zones of faulting was produced by the shifting of the fulcrum point.

Sherrill (1929) introduced the idea of the possibility of a torsional force having produced the faulting. If stresses are applied in a direction tending to move the northeast and southwest areas down in relation to the opposite corners, the twisting could produce breaks with a trend in a northwesterly direction. Introducing another factor he stated:

> . . . suppose that the twist itself is not carried to such an extent that the northwest breaks are not developed, but that while the beds are in this state of torsion an uplift along a general north and south axis increase the stress. Only a component of this increase might appear slight in itself, yet be sufficient to cause breaks in the general area where it is effective. These breaks should trend northeast due to the dominant guidance of the twist; and, as they would occur in the north and south steepened area, they should as north and south trends of en echelon breaks... .

Nevin and Sherrill (1929) emphasized Gardner's viewpoint of twelve years earlier which stated that the folding was produced by vertical forces produced by zones of weakness and flowage in the crystalline basement rock.

Their two theories, published simultaneously, propose entirely different types of forces for the development of the folds and the faults in central Oklahoma.

Kramer (1934) believed that the couple producing the rotational stress in Foley's theory was developed by westward elongation of the

Ouachita overthrust. Also, with this force being more active, it would produce southward movement on the east side of the buried fault.

Link (1929), in an expansion of the Nevin and Sherrill theory stated:

> . . . if the existance of a pre-Paleozoic or pre-Pennsylvanian topography, consisting of a series of hogbacks, or cuestas, striking approximately N 25° E, as well as irregularly spaced knobs or hill tops, can be established, the differential settling of later sediments over and around these buried features could give rise to feeble tensile stresses, causing the development of incipient en echelon fissures along which would occur adjustment by normal faulting. Furthermore, later, but very feeble, local compressive forces may also have been operative and accentuated the lines of weakness already developed.

The foregoing is a generalized summary of most of the theories which have been proposed to explain the faults and folds of the Mid-Continent area.

The parallel lineation of the fault zones and the Nemaha Ridge suggests an inter-relationship. Rubey (1926) pointed out many deformation features in the United States trend slightly east of north. This seems to indicate a definite grain in the crystalline basement rock.

This writer believes his opinions can best be expressed by paraphrasing the conclusions of Merritt and McDonald (1926) in their excellent discussion of the theories which had been presented at the time of their writing in 1926.

No single theory will suffice to explain the whole structural problem. The theories of differential settling or compaction, folding by vertical thrust, warping of sediments accompanied by faulting during deposition, torsional stresses, and direct tangential compression all fall short of solving the complete problem. Rotational stresses transmitted by slipping of the underlying crystalline rocks will more nearly explain the origin of all the forms of deformation in the area under consideration. Other forces may have been present to the extent of modifying the structural features in the area, but they aren't necessary to explain the deformation found here.

Local Structure

The structure of the Hominy area proper consists of westward dipping beds of about one-half degree. This homocline is interrupted by small flexures spaced intermittently throughout the area. These flexures consist of slightly elongated domes and basins and usually have less than 30 feet of closure, with an occasional closure of over 50 feet. The placement of the domes is irregular, but the orientation is predominantly northeast.

One of the zones of en echelon faults crosses the area near the western edge of R. 8 E. These are normal faults, trending from N. 20° to 35° W. (Millikan, 1920, p. 150), showing small displacement, and in many instances it is difficult or impossible to determine the relative movement.

One of the more prominent faults in the area, located in sec. 9,

T. 23 N., R. 7 E. has shifted the Deer Creek limestone slightly above the Turkey Run limestone with a displacement of more than 30 feet. Another in sec. 8, T. 22 N., R. 8 E. has a displacement of 25 feet. These faults are relatively short, with a lateral extent usually less than one mile.

A fault was observed in the NE 1/4, sec. 36, T. 23 N., R. 6 E. Its strike is just south of west. This is unusual in that it is almost 90° to the strike of the other faults in this area. It has a displacement of approximately 15 feet. The north side has moved downward and placed the overlying sandstone even with the upper Stonebreaker limestone. Due to the lush growth of grass it was impossible to determine the lateral extent of the fault into the area considered in this thesis.

There is no horizontal displacement discernable in any of the faults. The apparent movement of the fault in secs. 9 and 16, T. 23 N., R. 7 E. is due to erosion rather than to movement.

In the Hominy area the faults, which are determinable, show a predominance of upthrow sides on the northeast, but this is of no significance regionally as there seems to be an equal number both ways.

Jointing is prominent in the area and is displayed by most of the limestones and massive sandstones. It is easily detected on aerial photographs by the influence it exerts on the drainage pattern. The direction of the jointing varies somewhat but N. 40° W. and N. 110° W. are common.

CHAPTER IV

GEOLOGIC HISTORY

Regional

A northward transgressing sea across Oklahoma and Kansas deposited the Cambro-Ordovician Arbuckle limestone on an irregular Pre-Cambrian surface. Granite hills standing above this surface formed small islands. This is indicated by those "hills" extending through the Arbuckle limestone and into the overlying formations.

Sediments were deposited in this sea with several interruptions and disconformities until the close of Hunton time. Neither Hunton nor Sylvan sediments are found in north-central Oklahoma today.

A post-Hunton, pre-Woodford uplift tilted the strata in a south-southeast direction. All the formations from Arbuckle to Hunton were truncated and the area eroded to a peneplain.

The Woodford shale, referred to in much literature as the Chattanooga shale, and the Mississippian limestone formations were evenly deposited over most of north-central Oklahoma. However, the Woodford shale is absent over much of Osage county. Buchanan (1927, p. 1311) said this was "due to a lack of deposition on a probable lowland mass which the writer has named 'Osage Island'." Leatherock and Bass (1936) believed data insufficient to determine if the Woodford was deposited and eroded or not deposited.

The Mississippian limestone was deposited disconformably on the Woodford black shale. After deposition of this limestone, emergence occurred accompanied by folding and faulting, and followed by erosion. Complete peneplanation did not occur as many "highs" exceeding 500 feet are found at the basal unconformity of the Pennsylvanian system.

Pennsylvanian and Permian sediments were laid down with minor interruptions. Pennsylvanian times were characterized by a series of transgressions and regressions of shallow seas on a stable platform producing cyclical deposition of marine and non-marine sediments.

A late or post-Permian uplift gently tilted the entire region to the west, giving the formations dips now ranging from 0.5 to 1 degree in Osage county.

The history of the area is uncertain through Mesozoic and most of Cenozoic times, but northeast Oklahoma apparently was not greatly effected by the orogenic movements during those eras.

Remnants of an old peneplain are indicated by hills of equal elevation found over a wide area in northern Oklahoma. Ham (1939) has placed the age of this peneplain as probably Upper Pliocene or

Lower Pleistocene. Rejuvenation of an epeirogenic nature then produced erosion in the Hominy area with down-cutting of more than 400 feet.

Many streams show evidence of having become aggraded in Quaternary times. This is indicated by deep alluvial fills in the major streams, some being more than 30 feet thick. Again minor rejuvenation occurred in Late Pleistocene or Early Recent times causing the streams to cut through this alluvial fill to bedrock leaving steep banks or escarpments along the channels.

Local

The Upper Pennsylvanian formations which crop out in the Hominy area are Virgilian in age. The escarpments trend in a general north-south direction and the beds, or their correlatives, can be traced from southern Oklahoma northward across Kansas and into Nebraska and Iowa.

The beds are composed of sediments which indicate shallow water deposition on a relatively stable platform or shelf. The predominance of limestones in Kansas, the increase of clastic sediments to the south, and the increase of formation thickness southward indicate the source of the sediments was in that direction.

The repeated alternation of sand, shale, and limestone suggests cyclical sedimentation which is so characteristic of Pennsylvanian deposits. This is supported by a coal smut found below the Turkey Run limestone and the numerous maroon shales which are terrestrial or near shore facies. The fossils found in many of the formations suggest a shallow water environment.

CHAPTER V

ECONOMIC GEOLOGY

There are two chief sources of income in the Hominy area. Oil, by far the most outstanding, is produced from nearly a dozen structures and 18 horizons in this area, and has been an important economic product since shortly after the turn of the century. Although not so important as it once was, it still accounts for much of the prosperity of the region.

Much of the area, particularly the western half, is covered with bluestem grasses, and cattle grazing is the other chief source of income. Much of the grass is sold each year as baled hay, but is of secondary importance.

Agriculture is minor, as the only suitable land for cultivation is on the wider alluvial flood plains and terrace deposits. Sorghum crops and watermelons are about the only crops produced.

Limestone beds in the Hominy area are too thin to be commercially quarried with the exception of the Lecompton limestone. A quarry in sec. 8, T. 23 N., R. 9 E., was operated by a local concern, but at the [illegible] went out of business. A cheap source of stone is

CHAPTER V

ECONOMIC GEOLOGY

There are two chief sources of income in the Hominy area. Oil, by far the most outstanding, is produced from nearly a dozen structures and 15 horizons in this area, and has been an important economic product since shortly after the turn of the century. Although not as important as it once was, it still accounts for much of the prosperity of the region.

Much of the area, particularly the western half, is covered with luxuriant grasses, and cattle raising is the other chief source of income. Much of the grass is sold each year as baled hay, but is of secondary importance.

Agriculture is minor, as the only suitable land for cultivation is on the wider alluvial flood plains and terrace deposits. Sorghum crops and watermelons are about the only crops produced.

Limestone beds in the Hominy area are too thin to be commercially quarried with the exception of the Lecompton limestone. A quarry in sec. 3, T. 22 N., R. 8 E. was operated by a local concern, but in the summer of 1953 it went out of business. A cheap source of water is not available, and the limestone is too dirty to be utilized in concrete work without washing, consequently the market for the product was limited.

This quarry is now (Dec. 1954) being reopened by the Park Ward Company of Oklahoma City, and extensive removal of overburden is being conducted.

The Kanwaka shale has been tested and found suitable as a brick clay. If a market becomes available this could prove a potential industry in this area.

BIBLIOGRAPHY

Adams, G. I., Girty, G. H., and White, David, 1903. "Stratigraphy and Paleontology of the Upper Carboniferous Rocks of the Kansas Section," U. S. Geol. Survey, Bull. 211, 123 pp.

Beckwith, H. T., 1928. "Geology of Osage County," Okla. Geol. Survey, Bull. 40 (T), 56 pp.

Beede, J. W., 1898. "The Stratigraphy of Shawnee County," Kan. Acad. Sci., Trans., vol. 15, pp. 27-34.

_____, 1902. "Coal Measures Faunal Studies, II," Kan. Univ. Sci. Bull. vol. 7, no. 7, pp. 163-181.

Bennett, John, 1896. "A Geologic Section along the Kansas River from Kansas City to McFarland," Kan. Univ. Geol. Survey, vol. 1, pp. 107-128.

Blackwelder, E., 1920. "The Origin of the Central Kansas Oil Domes," Amer. Assoc. Petroleum Geologists, Bull., vol. 4, pt. 1, pp.89-94.

Bowen, C. F., 1918. "Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma," U. S. Geol. Survey, Bull. 686 (L), pp. 137-148.

Brown, R. W., 1928. "Origin of the Folds of Osage County, Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 12, pt. 1, pp. 501-513.

_____, 1928a. "Experiments Relating to the Results of Horizontal Faulting," Amer. Assoc. Petroleum Geologists, Bull., vol. 12, pt. 1, pp. 715-720.

Buchanan, G. S., 1927. "Distribution and Correlation of the Mississippian of Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 11, no. 12, pp. 1307-1320.

Condra, G. E., 1935. "Geologic Cross Section, Forest City, Missouri to Du Bois, Nebraska," Nebr. Geol. Survey, Paper 8, 23 pp.

Drake, N. F., "A Geological Reconnaissance of the Coal Fields of the Indian Territory," Amer. Philos. Soc. Proc., vol. 36, pp. 326-419.

Fath, A. E., 1921. "The Origin of the Faults, Anticlines, and Buried 'Granite Ridge' of the Northern Part of the Mid-Continent Oil and Gas Field," U. S. Geol. Survey, Prof. Paper 128 C, pp. 75-84.

Foley, L. L., 1926. "The Origin of the Faults in Creek and Osage Counties, Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 10, pt. 1, pp. 293-303.

Fenneman, N. M., Physiography of Eastern United States. New York and London: McGraw-Hill Book Company, Inc., 1938. 691 pp.

Greig, P. B., 1954. "Geology of the Hallett Area, Pawnee County, Oklahoma," M. S. thesis, Univ. of Okla., 91 pp.

Gardner, J. H., 1917. "The Vertical Component in Local Folding," Southwestern Assoc. Petroleum Geologists, Bull., vol. 1, pp. 107-110.

Ham, W. E., 1939. "Origin and Age of the Pawhuska Rock Plain of Oklahoma and Kansas," M. S. thesis, Univ. of Okla., 50 pp.

Haworth, Erasmus, 1895. "The Stratigraphy of Kansas Coal Measures," Kan. Univ. Quart., vol. 3, pp. 271-290.

_______, 1898. "Special Report on Coal," Kan. Univ. Geol. Survey, vol. 3, 347 pp.

Heald, K. C., 1918. "Geological Structure of the Northwestern Part of the Pawhuska Quadrangle, Oklahoma," U. S. Geol. Survey, Bull., 691 (C), pp. 57-100.

_______, 1918a. "Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma," U. S. Geol. Survey, Bull. 686 (K), pp. 129-135.

_______, and Mather, K. F., 1919. "Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma, Tps. 24 and 25 N., R. 8 E.," U. S. Geol. Survey, Bull. 686 (M), pp. 149-170.

Kramer, Wm., 1934. "En Echelon Faults in Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 18, pt. 1, pp. 243-250.

Lahee, F. H., 1926. "Discussion of the Origin of the Faults in Creek and Osage Counties, Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 10, pt. 1, pp. 300-301.

Leatherock, Constance and Bass, N. W., 1936. "Chattanooga Shale in Osage County, Oklahoma and Adjacent Areas," Amer. Assoc. Petroleum Geologists, Bull., vol. 20, pt. 1, pp. 91-101.

Link, T. A., 1929. "En Echelon Tension Fissures and Faults," Amer. Assoc. Petroleum Geologists, Bull., vol. 13, pt. 1, pp. 627-643.

McCoy, A. W., 1921. "A Short Sketch of the Paleogeography and Historical Geology of the Mid-Continent Oil District and its Importance to Petroleum Geology," Amer. Assoc. Petroleum Geologists, Bull., vol. 5, pp. 541-584.

Merritt, J. W. and McDonald, O. G., 1926. "Oil and Gas in Creek, County, Oklahoma," Okla. Geol. Survey, Bull. 40 (C), pp. 11-35.

Milliman, C. V., 1920. "Inter-Relations of the Folds of Osage County, Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 4, pp. 151-158.

Moore, R. C., 1932. "A Reclassification of the Pennsylvanian System in the Northern Mid-Continent Region," Kan. Geol. Soc., Guidebook, Sixth Ann. Field Conference, pp. 79-98.

_____, 1936. "Stratigraphic Classification of the Pennsylvanian Rocks of Kansas," Kan. Geol. Survey, Bull. 22, 256 pp.

_____, 1949. "Divisions of the Pennsylvanian Systems in Kansas," Kan. Geol. Survey, Bull. 83, 203 pp.

_____, et al., 1951. "The Kansas Rock Column," Kan. Geol. Survey, Bull. 89, pp. 52-94.

Morgan, G. D., 1924. "Geology of the Stonewall Quadrangle, Oklahoma," (Okla.) Bureau of Geology, Bull. no. 2, 248 pp.

Nevin, C. M. and Sherrill, R. E., 1929. "The Nature of Uplifts in North-Central Oklahoma and their Local Expression," Amer. Assoc. Petroleum Geologists, Bull., vol. 13, pt. 1, pp. 23-30.

Ohern, D. W. and Garrett, R. E., 1912. "The Ponca City Oil and Gas Field," Okla. Geol. Survey, Bull. no. 16, pp. 12-13.

Pettijohn, F. J., Sedimentary Rocks. New York: Harper & Brothers Publishers. 1949. 526 pp.

Powers, Sidney, 1925. "Structural Geology of the Mid-Continent Region: A Field for Research," Geol. Soc. Amer., Bull., vol. 36, pp. 379-392.

Prosser, C. S., 1895. "The Classification of the Upper Paleozoic Rocks of Central Kansas," Jour. of Geology, vol. 3, pp. 682-705; 764-800.

Ries, E. R., 1951. "The Geology of Okfuskee County, Oklahoma," Ph. D. thesis, Univ. of Okla., 213 pp.

Rubey, W. W., 1926. "Discussion of the Origin of the Faults in Creek and Osage Counties, Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 10, pt. 1, pp. 302-303.

Shannon, P. J., 1954. "The Geology of the Pawhuska Area, Osage County, Oklahoma," M. S. thesis, Univ. of Okla., 98 pp.

Sherril, R. E., 1929. "Origin of the En Echelon Faults in North-Central Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 13, pt. 1, pp. 31-37.

Smith, J. P., 1894. "The Arkansas Coal Measures in their Relation to the Pacific Carboniferous Province," Jour. of Geology, vol. 2, pp. 187-203.

Snider, L. C., 1911. "Preliminary Report on the Clays and Clay Industries of Oklahoma," Okla. Geol. Survey, Bull. 7, 70 pp.

Thom, W. T., Jr., 1926. "Discussion of the Origin of the Faults in Creek and Osage Counties, Oklahoma," Amer. Assoc. Petroleum Geologists, Bull., vol. 10, pt. 1, pp. 300-301.

White, David, et al., 1922. "Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma," U. S. Geol. Survey, Bull. 686, 427 pp.

Winchester, D. E., 1918. "Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma, T. 27 N., R. 9 E.," U. S. Geol. Survey, Bull. 686 (C), pp. 11-16.

MEASURED STRATIGRAPHIC SECTIONS

Bed		Feet
	1. Sec. 7, T. 23 N., R. 7 E., Measured in the ditch beside highway 20 on the west side of Bug Creek.	
17	WAKARUSA limestone, medium to light gray, massive, weathers to light gray nodular pieces. Upper zone is locally ferruginous and contains many crystals..........	2.0
16	Covered..	66.0
15	Sandstone, medium grained, buff. Lower 4 feet thin bedded. Upper 6 feet massive..................................	10.0
14	Limestone, medium gray, fossiliferous, varies from thinly bedded to massive in short distances....................	0.5
13	Shale, light buff to dirty tan. Lower 4 feet contains small, irregular, pale brown nodules..........................	17.0
12	CEDAR CREEK limestone, dense, dark gray, bedded, sparingly fossiliferous, ½ inch layer of Syringopora at the top..	2.5
11	Shale, maroon and light yellowish gray variegated..........	7.0
10	Covered..	2.0
9	Limestone, dark grayish black, dense, brittle..................	0.5
8	Sandstone, fine grained, micaceous..................................	2.5
7	Limestone, light gray, fine grained, arenaceous..............	0.5

APPENDIX

MEASURED STRATIGRAPHIC SECTIONS

Bed		Feet
	I. Sec. 7, T. 23 N., R. 7 E., Measured in the ditch beside Highway 20 on the west side of Bug Creek.	
17	WAKARUSA limestone, medium to light gray, massive, weathers to light gray nodular pieces. Upper zone is locally ferruginous and contains many cryptozoons..........	3.0
16	Covered..........	60.0
15	Sandstone, medium grained, buff. Lower 4 feet thin bedded. Upper 6 feet massive..........	10.0
14	Limestone, medium gray, fossiliferous, varies from thinly bedded to massive in short distances..........	0.8
13	Shale, light buff to dirty tan. Lower 4 feet contains small, irregular, calcareous nodules..........	17.0
12	BIRD CREEK limestone, dense, dark gray, bedded, sparingly fossiliferous. 2 inch layer of _Triticites_ at the top..........	2.2
11	Shale, maroon and light yellowish gray variegated..........	7.0
10	Covered..........	2.0
9	Limestone, dark grayish black, dense, brittle..........	0.5
8	Sandstone, fine grained, pinkish..........	2.5
7	Limestone, light gray, fine grained, arenaceous..........	0.8

6	Sandstone, massive, fine grained with small dots of iron oxide presenting a finely mottled rust appearance......	2.0
5	Clay, red and yellow variegated..	1.0
4	Shale, dark gray, weathers to light buff. Lower 6 feet very calcareous but grades to a more arenaceous shale and calcareous indications disappear..............................	18.0
3	Shale, buff, calcareous, with an abundance of Chonetes. Top 1 inch colored with ferruginous material..................	3.0
2	Shale, black, organic, fossiliferous, platy..........................	0.1
1	TURKEY RUN limestone, dark gray black, dense, brittle. Bottom 4 inches contains an abundance of Triticites. Bottom surface very irregular....................................	1.6

H. Sec. 36, T. 22 N., R. 7 E., southwest side of a Wakarusa limestone outlier.

8	WAKARUSA limestone	
7	Covered, probably gray shale..	21.0
6	Shale, maroon..	24.0
5	Limestone, partially covered. Lower 6 inches maroon, conglomeritic. A piece of green, argillaceous limestone, containing Chonetes was found here. Upper 2 feet dull gray, with local ferruginous stains................................	2.5
4	Covered, partially. Probably maroon and gray shale.......	26.0
3	Limestone, argillaceous, dirty in the lower part. Weathers to brown. Upper 2 inches is light gray, dense, arenaceous, with a few maroon nodules imbedded. Weathers to a medium gray..	1.0
2	Covered, probably shale and sandstone..........................	28.5
1	BIRD CREEK limestone..	2.2

III. Section 30, T. 23 N., R. 7 E., in the south tributary to the main stream at the extreme west side of the section.

3	Sandstone, light gray, massive, medium grained	24.0
2	Covered	17.0
1	WAKARUSA limestone, bedded, medium gray, crystalline	5+

IV. Sec. 24, T. 22 N., R. 7 E., measured on the hillside west of the road.

5	TURKEY RUN limestone, dense, massive, dark gray to black. Many *Triticites* in the lower 4 to 6 inches	1.5
4	Covered, probably shale	40.0
3	Covered, probably sandstone	16.0
2	Covered, probably shale	22.5
1	LECOMPTON limestone.	

V. Sec. 19, T. 22 N., R. 7 E. Section measured in the ditch on the east and south side of the road.

11	TURKEY RUN limestone	1.5
10	Shale, gray	0.8
9	Coal, smut	0.05
8	Clay, blue gray underclay	2.0
7	Shale, lower 4 feet maroon with calcareous nodules. Upper 8 feet gray	12.0
6	Limestone, argillaceous. Lower 8 inches massive and light gray. Upper 10 inches very thin bedded and shaly	1.5
5	Shale, maroon	5.0

4	Limestone, arenaceous, yellowish brown. Weathers a slightly lighter color	0.8
3	Shale, maroon	14.0
2	Limestone, yellowish brown, arenaceous. Weathers to a light yellowish brown, limonitic color	0.3
1	Shale, maroon and gray	1.0

VI. Sec. 19, T. 22 N., R. 8 E. Measured on the west side of the road on a Lecompton limestone capped escarpment.

17	Sandstone, fine grained, dirty white, massive with fine limonitic specks. Shows jointing N. 40° W. and N. 110° W.	5.0
16	Shale, gray to buff, blocky	13.0
15	LECOMPTON limestone, top. Thin bedded, shaly. Interbedded with fossiliferous shale. Has an abundance of <u>Triticites</u>	1.5
14	Limestone, dense, fossiliferous, dark brown limonitic stained	0.5
13	Limestone, massive, dense, non-fossiliferous, dark gray	1.0
12	Limestone, dense, wavy-bedded, light gray, fossiliferous	3.0
11	Limestone, dense, dark brown limonitic stained, fossiliferous	1.5
10	LECOMPTON limestone, base. Dense, light gray, wavy-bedded, fossiliferous	3.0
9	Shale, gray	10.0
8	Limestone, dense, brown. Weathers to a light yellowish brown	0.8
7	Shale, gray	1.0

6 Shale, maroon.. 5.0

5 ELGIN sandstone, upper unit. Light gray, massive, fine grained, with some bedding near top. Weathers light brown. Contains many small rust spots and a few poorly preserved marine fossils.................................. 22.0

4 Shale, greenish gray, with about 2 feet of maroon shale at the top.. 28.5

3 Shale, olive gray, contains many small, light gray to white, calcareous nodules.. 11.0

2 Covered, probably shale.. 51.0

1 ELGIN sandstone, top of lower unit.................................. 10+

VII. Sec. 10, T. 23 N., R. 7 E. Measured in a small tributary at the northern outcrop of the Bird Creek limestone.

7 Limestone, arenaceous, reddish brown. Contains many Myalina.. 0.8

6 Sandstone, light gray, thin bedded with many maroon spots.. 1.7

5 Shale, maroon, containing many small maroon, calcareous nodules. Disappears under covered section..... 0.8

4 Covered, probably shale.. 12.0

3 Sandstone, medium grained, ferruginous stained............... 0.8

2 Covered, probably shale.. 28.5

1 BIRD CREEK limestone, dark gray, brittle, massive......... 1.8

VIII. Sec. 16, T. 22 N., R. 7 E. Measured in a stream bed about 50 yards west of the road and about 1/4 miles north of the Blackburn bridge.

13	Sandstone, light gray, medium grained. Thin bedded in the lower 4 feet	8.0
12	Shale, maroon and gray. Grades into sandstone	3.0
11	Limestone, thin bedded in the lower 6 inches. Contains a profusion of small, slender Triticites	1.0
10	Shale, maroon. Upper 3 inches contains maroon calcareous nodules	1.3
9	Shale, gray	5.0
8	Sandstone, light gray, massive	10.0
7	Shale, gray	15.0
6	Sandstone, medium grained, massive	3.0
5	Shale, gray	2.0
4	BIRD CREEK limestone, dark gray, brittle, bedded	2.0
3	Shale, fissile, gray	5.5
2	Sandstone, light gray, massive, medium grained	0.8
1	Shale, red and green	10+

IX. NE 1/4 NW 1/4 SW 1/4, sec. 35, T. 22 N., R. 7 E.

9	BIRD CREEK limestone.	
8	Shale, gray	4.5
7	Shale, maroon and gray	4.5
6	Sandstone, thin bedded, light buff, fine grained	1.0
5	Shale, maroon, with two argillaceous sandstone stringers, each 1 inch thick	0.8
4	Sandstone, fine grained, light buff, bedded	0.6

3 Shale, brown.. 0.3

2 Sandstone, fine grained, light buff.. 1.0

1 Shale, gray... 2+

X. Sec. 4, T. 28 N., R. 7 E. Section taken about 50 yards west of the survey pin marking the center of sec. 4.

9 Limestone, massive, light gray, finely crystalline.......... 3.0

8 Covered, probably shale.. 18.0

7 Sandstone, light tan, medium grained, massive............... 3.0

6 Covered, probably shale.. 12.0

5 Limestone, light gray, poorly resistant, weathers back... 7.0

4 Limestone, light gray, crystalline. Contains many _Myalina_ and _Triticites_. Upper 6 inches maroon, fossiliferous.. 2.0

3 Shale, light gray, arenaceous... 5.0

2 Covered, probably shale.. 10.0

1 MIDDLE STONEBREAKER limestone. Chiefly a thin maroon limestone with many large, fat _Triticites_. Has a thin layer of dense, arenaceous, limonitic limestone.. 1.0

XI. Sec. 7, T. 28 N., R. 7 E. Measured in a road ditch about 1/4 mile from Highway 20.

10 Sandstone, fine grained, buff... 1.0

9 Shale, gray... 1.0

8 Sandstone, fine grained, shaly, buff gray......................... 1.5

7 Shale, predominantly maroon with gray........................ 1.5

6 MIDDLE STONEBREAKER limestone. Maroon, weathers unevenly and to a light brown. Has an abundance of small *Triticites*.. 0.5

5 Shale, light gray, arenaceous, calcareous........................ 1.5

4 Shale, maroon and gray... 5.0

3 Limestone, limonitic, arenaceous, thin maroon veins throughout. Thin shale break between this bed and the above limestone. Green limestone float found here........ 0.5

2 LOWER STONEBREAKER limestone. Nodular, maroon, arenaceous. Sparingly fossiliferous, poorly preserved specimens. Thin fossiliferous layer at the bottom......... 1.5

1 Shale, predominantly maroon. Contains calcareous nodules.. 3+

XII. Sec. 26, T. 23 N., R. 7 E. Measured about 1/4 mile down the stream from the ford.

4 DEER CREEK (?) limestone. Light gray, arenaceous, locally considerable iron stain. Few fossils poorly preserved.

3 Covered. Much of this interval is sandstone................. 27.0

2 PLUMMER limestone. Fresh surface dark black, brittle. Weathered surface light rust brown. Small *Triticites* distributed throughout. Weathered surface 1 to 3 inches deep. Top 1 inch layer brownish buff and contains an abundance of *Triticites*........................ 1.5

1 Shale, gray, calcareous.. 6+

XIII. Sec. 23, T. 23 N., R. 7 E. Measured on the west side of the road at the southern edge of the section.

3 TURKEY RUN limestone.

7	Covored, probably shale	17.0
6	Sandstone, light gray, fine grained, bedded, ferruginous specks	4.0
5	Shale, maroon and tan, arenaceous	4.0
4	Sandstone, medium grained, light brown	0.2
3	Shale, maroon and tan banded. Very arenaceous	4.0
2	Covered, probably shale	4.0
1	DEER CREEK limestone	0.9

XIV. SE 1/4, sec. 20, T. 28 N., R. 8 E. Measured in the road cut on the south side of Nicicoh Creek.

20	Sandstone, shaly, limonitic stained, fine grained massive	0.7
19	Shale, dark gray, platy	32.5
18	Limestone, dense, brittle, limonitic. Weathers in blocks due to jointing	4.5
17	Shale, gray, platy	2.0
16	Limestone, dark grayish brown, dense, brittle, fossiliferous	0.3
15	Shale, gray, platy	1.0
14	Limestone, dark grayish brown, dense, brittle, fossiliferous	0.5
13	Shale, tan to gray, blocky	1.5
12	Limestone, nodular, brown, algal. Contains an abundance of Cryptozoon	0.9
11	Shale, tan, blocky, rotten	0.5

10	Limestone, shaly, fossiliferous, brown. Weathers to thin flags. Differential limonitic staining with circular gray zones within the brown	0.7
9	Shale, gray, platy	0.9
8	Limestone, limonitic colored, fossiliferous	0.7
7	Shale, gray, platy	3.0
6	Shale, maroon and gray, platy	1.0
5	LECOMPTON limestone, basal unit. Highly limonitic, arenaceous. Thin bedded near the base	4.0
4	Shale, maroon and gray, platy	15.0
3	Shale, gray, platy	10.0
2	Covered, probably shale	28.0
1	ELGIN sandstone, top of the formation	

XV. Measured in the stream bed west of the road in sec. 18, T. 22 N., R. 7 E.

13	Sandstone, light gray, medium grained, thin bedded in the lower half	8.0
12	Shale, maroon and gray, grades into sandstone	3.0
11	WAKARUSA limestone, thin bedded. Profusion of small *Triticites* in the lower 6 inches. Upper 6 inches light gray and fossiliferous	1.0
10	Shale, maroon, platy	1.0
9	Shale, gray, platy	5.0
8	Sandstone, fine grained, light gray, massive	10.0
7	Shale, gray	15.0

6	Sandstone, massive, fine grained	3.0
5	Shale, gray, platy	2.0
4	BIRD CREEK limestone, dark gray, bedded	2.0
3	Shale, gray, platy	5.5
2	Sandstone, massive, light gray	0.9
1	Shale, maroon and gray	10+