OKLAHOMA GEOLOGICAL SURVEY
Chas. N. Gould, Director

Bulletin No. 40-XX

OIL AND GAS IN OKLAHOMA

HUGHES COUNTY

By
J. Phillip Boyle

NORMAN
MAY, 1930

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FOREWORD

In 1917 the Oklahoma Geological Survey issued Bulletin 19, Part II, entitled "Petroleum and Natural Gas in Oklahoma." This volume was so popular that the supply was soon exhausted and for several years copies have not been obtainable.

The present Director has seen the need of a revision of this bulletin. On account of the lack of appropriations he has not been able to employ sufficient help to compile the data, and has called on some twenty representative geologists throughout the State to aid in the preparation of reports on separate counties. These gentlemen, all busy men, have contributed freely of their time and information in the preparation of these reports.

It will be understood that the facts as set forth in the various reports represent the observation and opinion of the different men. The Oklahoma Geological Survey has every confidence in the judgment of the various authors, but at the same time the Survey does not stand sponsor for all statements made or for all conclusions drawn. Reports of this kind, are at best, progress reports, representing the best information obtainable as of the date issued, and doubtless new data will cause many changes in our present ideas.

The chapter on Hughes County has been prepared by Mr. J. Phillip Boyle, a consulting geologist of Oklahoma City, who also wrote the chapter on Wagoner and Okfuskee counties. Mr. Boyle's experience in these counties has stood him in good stead in the preparation of the manuscript.

Norman, Oklahoma — CHAS. N. GOULD,

May, 1930. — Director.

HUGHES COUNTY

By

J. Phillip Boyle

This report is written for the purpose of giving in a general way the geology, both surface and subsurface, and its relation to the past and future production of oil and gas in Hughes County, Oklahoma.

Acknowledgments

In compiling this report some of the data used has been obtained from the following individuals and bureaus to whom the writer wishes to express his thanks for their assistance:

Charles N. Gould, Oklahoma Geological Survey; Luther H. White, J. A. Hull Company; Roy D. Jones, Oklahoma City; J. D. Watson, Tulsa; Arthur Burress and Louis Roark, Okmulgee; Fred Capshaw and William J. Armstrong, Oklahoma City; the United States Geological Survey, and the Oklahoma Geological Survey.

Location

Hughes County is located a little south of the east-central part of the State. It extends from Tps. 4 to 9 N., inclusive, and from Rs. 8 to 12 E., inclusive, or 19 whole townships and parts of 7 others. The entire area is approximately 790 square miles.

Figure 1. Index map of Oklahoma showing location of Hughes County.

Topography

Hughes County is located in a region of sandstone hills and broad gentle valleys. The topographic features are an expression of the outcropping sandstone formations which make up the hills. The broad valleys are due to the outcropping of the shale formations. Although the topography in parts of the country appears quite rugged, a maximum difference of only 400 feet occurs between the tops of hills and the bottoms of the valleys.

The county is drained by two rivers, two creeks, and their tributaries. The northern divide parallels the course of the South Canadian River, paralleling the river through the county about six miles to the north. North of this divide the water flows into the North Canadian River. The southernmost divide crosses the county through the southern half of T. 5 N. The area between the northern and the southern divides is drained by the South Canadian River. The area lying south of the south divide is drained by Caney and Muddy Boggy creeks.

The lowest point above sea level is in the bed of South Canadian River where it crosses the east line of the county. The maximum elevation in the county is approximately 1,150 feet, located in sec. 3, T. 7 N., R. 11 E.

GEOLOGY

The formations exposed in Hughes County, with the exception of Recent deposits occurring in river bottoms, and a few Pleistocene deposits, belong to the Pennsylvanian system. These layers of sediments consist of sandstones, shales, conglomerates, and limestones. The shales, which are usually found in the valleys, are in predominance, while the sandstones, usually expressed topographically by the hills, are second in abundance.

The regional dip of the formations exposed at the surface in Hughes County is to the northwest at the rate of 50 to 80 feet per mile. This normal dip of the formations has been disturbed in almost every township by local folding and faulting.

Surface Formations

GUERTIE SAND

This formation occurs in a narrow irregular strip through the south part of T. 5 N., R. 9 E., along the north line of T. 4 N., R. 9 E.; thence runs diagonally across T. 4 N., R. 10 E., and extends into the southwest corner of T. 4 N., R. 11 E. It lies unconformably upon all the Carboniferous beds exposed, and its original source was probably that of an old course of South Canadian River. It is apparently of the same age as like formations found in Wagoner County along the Arkansas River. It is composed of loose sand, quartz, and quartzite pebbles. Farther south this formation is found overlying the Cretaceous.

The material in this formation has been derived from all formations crossed and eroded by the river during the time when the Canadian followed a different course from the present one, and at a higher level. It was probably laid down just prior to the time the Canadian River started cutting its way through the first layers of the Calvin sandstone in the vicinity of Calvin. This formation varies in thickness from 0 to 50 feet. The dip, which is the gradient of the old river, is at the rate of about four feet per mile; thus, the old stream had about the same gradient as the present Canadian River.

FRANCIS FORMATION

This formation is the highest Pennsylvanian formation exposed in Hughes County. Only the lower one-third of this formation occurs within the boundaries of the county. It outcrops in the east one-third of T. 9 N., R. 8 E., and in sec. 2, T. 8 N., R. 8 E. The total thickness is approximately 100 feet.

SEMINOLE CONGLOMERATE

The Seminole conglomerate is exposed in a strip approximately two miles wide, from sec. 6, T. 9 N., R. 9 E.; thence south and west to sec. 11, T. 8 N., R. 8 E. It again enters the county with a wider exposure of 2½ to 3 miles wide, through the center of the north line T. 7 N., R. 8 E., and bears southward until it crosses the county line in sec. 17, T. 6 N., R. 8 E. Its exposure is marked by more or less rugged hills, with sharp escarpments usually covered by black jack vegetation, or by long rounded hills covered with gravel.

This formation is composed of shales and sandstones, with many conglomerate beds in the sandstones. The top, middle, and base of this formation are marked by heavy sandstone layers, and in these members occur the conglomerate horizons. The conglomerate is composed of chert and quartz pebbles, which are usually well rounded, and white to yellow and dark red in color. The cementing material contains a high percentage of iron. The clays and shales occurring in this formation are rather well stratified where exposed, and are blue, red, and yellow in color, and very sandy in character.

The dip of this formation is approximately 4° northwest. The entire formation has an approximate thickness of 170 feet.

HOLDENVILLE SHALE

The Holdenville shale, directly underlying the Seminole, is exposed in a narrow strip, from one to three miles wide, across the county from the center of the north line of T. 8 N., R. 9 E.; thence south and westward to the center of the west line of T. 6 N., R. 8 E. It varies in thickness from 200 feet in the northern part of the county to 260 feet in the south.

In the north this formation is composed chiefly of shales interstratified with a few sandstone members. It contains some thin-bedded limestone members in the south, but is made up principally of shales. Its outcrop is not noticeable except where the sandstones come to the surface, and where the thin-bedded limestone members are exposed. The outcrop of the top of this formation is made much more noticeable by the abrupt change in topography caused by the lowest member of the Seminole formation.

WEWOKA FORMATION

This formation is one of the thickest in the county, and is exposed over an area six to eight miles wide, running in a southwesterly direction and covering all or parts of Tps. 5 to 9 N., Rs. 8 to 10 E. The Wewoka is composed of soft brown sandstone interstratified with soft blue clays and occasional limestone lenses. The formation thickens to the northeast and in the northern part of the county, has an approximate thickness of 600 to 650 feet. The thickness is approximately 700 feet in the south end of the county. Most of the beds of the Wewoka are soft and are therefore unmappable because of covering, but some of the harder sandstone ledges resist erosion sufficiently to make high escarpments.

WETUMKA SHALE

The Wetumka shale occurs directly under the Wewoka formation and above the Calvin sandstone. It is composed almost wholly of friable, laminated clay shales, interstratified with a few thin-bedded sandstone lenses. The top of the formation is well defined by the prominence of the lowest member of the Wewoka. The bottom of the formation is hard to distinguish from the underlying Calvin and can only be determined by the change in color in the shales.

The Wetumka is exposed in a narrow strip across the entire county from north to south. It is found over an area approximately one to three miles wide, from sec. 5, T. 9 N., R. 11 E., to sec. 33, T. 5 N., R. 9 E. The thickness increases from north to south, having a variable thickness of 100 to 200 feet.

CALVIN SANDSTONE

This formation, lying directly under and grading into the Wetumka shale, is most noticeable of all formations outcropping in this county. This is because it forms a long line of east-facing escarpments running in a northeast-southwest direction, overlooking the valley floor of the Senora formation. The formation is composed chiefly of massive sandstone. At the top occurs some 50 to 60 feet of thin-bedded sands and clays which are easily weathered, and do not show prominently in the topography. The formation thickens from the south toward the north from 140 to 260 feet. It is particularly noticeable by the growth of oak forests.

SENORA FORMATION

The Senora is exposed in all or a part of Tps. 4 to 9 N., Rs. 9 to 12 E. This formation is composed principally of interstratified sandstones and shale beds, having a thickness of 400 to 600 feet in the north end of the county. It thins to the south by the lensing of the sandstone beds. In some areas these thin-bedded sandstones are sufficiently hard that the exposure can be easily mapped, but as a whole the formation is not well exposed.

STUART SHALE

The Stuart shale, directly underlying the Senora formation, is exposed in Tps. 4 and 5 N., Rs. 10 and 11 E., except where covered by the Guertie sand, and along the southeast side of T. 4 N., R. 9 E. Its exposure varies from two to four miles in width. This formation varies in thickness from 100 feet to approximately 200 feet and thickens toward the northeast.

The formation is composed of three members; an upper and lower shale member, separated by a variable sandstone, 10 to 50 feet thick. The lower member of this formation, which carries a sandstone-chert conglomerate, has an approximate thickness of 100 feet. This member is covered by timberland. The upper member is exposed principally in the escarpments below the lower sandstone member of the Senora. The strike of this formation as it enters Hughes County is almost due northeast-southwest, but changes to an almost east-west direction because of the anticlinal folds and faults found some 12 miles to the south.

THURMAN SANDSTONE

The Thurman sandstone is exposed in a small part of sec. 13, T. 5 N., R. 11 E.; has a wide exposure over the east two-thirds of T. 4 N., R. 11 E.; and is not found again exposed in the county with the exception of a very small area in sec. 31, T. 4 N., R. 10 E., and secs. 34, 35, and 36, T. 4 N., R. 9 E.

This formation is composed of one principal conglomerate bed consisting of chert pebbles mixed with coarse quartz sand, which, together with some sandy shale members, make up the formation. After the deposition of this prominent member of the Thurman, the sediments became finer, resulting in fine-grained sandstones. The formation reaches a thickness of about 200 feet in this area, but decreases toward the west. The upper sand members of the Thurman contain beds of shale, and in the extreme western exposure there are some small lenses of limestone.

The normal dip of the Thurman is north and west 60 to 100 feet per mile. The sandstone forms rugged hills covered with oak vegetation.

BOGGY SHALE

The Boggy shale is the oldest formation exposed in Hughes County and covers a small area of approximately 2½ square miles in the southeast corner of T. 4 N., R. 11 E. It directly underlies the Thurman sandstone and overlies the Savanna sandstone where the latter is present. It consists of a great thickness of shale and irregularly distributed thin-bedded sandstones.

The formation thickens from the southwest toward the northeast, being approximately 500 feet thick in the southwest part of the county and 1,000 feet thick in the northeast part. The heaviest sandstone member occurs near the base of the formation, and is known to oil producers as the Salt sand.

Stratigraphic Section, Hughes County

AGE	FORMATION	THICKNESS Feet
RECENT	Sands, clays, gravels, silts	0-100
PLEISTOCENE	Guertie sand	0-50
PENNSYLVANIAN	Francis formation	0-100
	Seminole conglomerate	100-170
	Holdenville shale	200-260
	Wewoka formation	600-700
	Wetumka share	100-150
	Calvin sandstone	200-240
	Senora formation	
	Stuart shale	600-750
	Thurman sandstone	
	Boggy shale	

Subsurface Formations

SAVANNA FORMATION

This formation is approximately 1,000 feet thick in the south end of the county, and thins rapidly toward the northeast to approximately 100 feet. It is composed of alternate layers of shales and sandstones.

The Savanna produces both oil and gas in its sandstone members. It directly underlies the Boggy formation, but is not found present in some areas.

McALESTER FORMATION

This formation is principally shale with some sandstone members. Most of these sandstones are found at the base of the formation, and are known as the Booch and Gilcrease sands in the various pools of the county.

The normal dip of the formation is northwest. The McAlester formation is thinnest in the northwest part of the county where it is approximately 300 feet thick, but increases to approximately 650 feet in the southeast.

HARTSHORNE SANDSTONE

This formation is principally important on account of its association with the lowest and most valuable coal bed in the Choctaw coal field. It lies just below the McAlester formation and is present in the southern part of the county, but probably is not present to the northwest.

ATOKA FORMATION

The Atoka formation is made up of a great thickness of shales with some sandstone and limestone members. The sandstone members occur near the middle of the formation and are known as the Dutcher sand series. The formation varies in thickness from 350 to 1,000 feet, thickening from the northwest toward the southeast.

WAPANUCKA (MORROW) LIMESTONE

This formation occurs throughout Hughes County. Its normal dip is to the northwest. It consists of shales, sands, and limestones; and varies in thickness from 100 to 350 feet. The Wapanucka limestone comes to the surface approximately 12 miles south of the county.

PAPOOSE-CROMWELL HORIZON

Lying unconformably upon the Caney shale (and the Pitkin limestone farther north) occurs a horizon of variable thickness of 200 to 400 feet, carrying sand members known over the county in various oil pools as the Lyons-Quinn, Papoose, and Cromwell sands. This horizon, consisting predominantly of sandstones, is interstratified with shale layers. To date, in Hughes County, it is the principal producing hori-

zon. This horizon is usually distinguished by the lowest lime member of the Morrow formation directly overlying it.

CANEY SHALE AND BOONE FORMATION

The Boone formation, directly underlying the Caney shale, is of Osage and Meramec age. It consists of one limestone member overlain by a shale member. This limestone member is variable in thickness. It is found to thicken from the southwest toward the northeast in well logs.

The Caney shale, directly overlying the Boone, has a variable thickness and an unconformable contact with the Cherokee shales above.

A few miles north of the north line of Hughes County, the upper member of the Mississippian (the Pitkin limestone) occurs as a massive limestone member, but as this formation is traced south into Hughes County it is found to grade into shale and thin limestone lenses.

CHATTANOOGA SHALE

This formation, the lowest member of the Mississippian, consists of a hard, well-laminated shale, dark brown to black in color. It directly underlies the lower member of the Mississippi lime, and is one of the best datum horizons in eastern Oklahoma. It has a variable thickness and overlaps all older formations down to and including the Arbuckle limestone.

MISENER SAND

This formation, composed of wind-blown sand, occurs in scattered areas in the northern part of the county. It is usually white in color and very clean. Where present it lies upon the Hunton, Sylvan, or Viola limestone and directly underlies the Chattanooga shale. It is unconformable at the top and bottom.

HUNTON FORMATION

This formation, Siluro-Devonian in age, directly underlies the Chattanooga shale., where the Misener sand is absent. It converges toward the northeast. Where present, this formation directly overlies the Sylvan shale, Misener sand, and the Viola limestone.

SYLVAN SHALE

This formation, Richmond in age, directly underlies the Hunton formation where present, and where the Hunton is absent, it directly underlies the Chattanooga shale. It is a calcareous shale, white and blue to green in color, and varies in thickness, thickening toward the southwest.

VIOLA LIMESTONE

This formation, Ordovician in age, is found throughout the county, and is one of the principal datums used by geologists for correlating

the formations lying below the Mississippian. It is white to gray in color, usually hard, and has an approximate thickness of 60 to 80 feet in the northeastern part of the county, thickening toward the southwest. Its normal dip is to the southwest.

This formation directly underlies the following formations; the Misener sand, Sylvan shale, Hunton formation, and Chattanooga shale. It is an important casing point in the drilling of wells to the Simpson formation.

SIMPSON FORMATION

WILCOX SAND

This formation represents the upper sand member of the Simpson formation in this area. It has been found present everywhere in Hughes County where drilling has gone deep enough to penetrate it. It directly underlies the Viola limestone and directly overlies the Tyner horizon. It has a variable thickness, thickening from the northeast toward the southwest.

This formation is most productive of oil and gas, and at the present time wells producing from this horizon are limited to the north and extreme western parts of the county.

TYNER FORMATION

This formation consists of a series of alternating white to green sands and green, white, and red shales. It is the lowest producing member of the Simpson formation in this county and is easily distinguished from the upper Simpson members by its color and the character of the sand grains. The formation dips normally to the southwest at the rate of 20 to 30 feet per mile. The top of this formation is usually marked by a white sand or a fine-textured green shale.

The Tyner series has been found present everywhere in Hughes County where wells have been drilled to a sufficient depth to penetrate the horizon. It is found to be much thicker in the southeastern part of the county than in the northeastern part.

BURGEN LIMESTONE

This limestone, consisting of a single member, is found in the northeast part of the county and has a thickness of from 30 to 70 feet. It represents the lowest limestone member of the Simpson formation and directly overlies the Burgen sand. The writer does not have any well records which have penetrated the Burgen horizon in the south and east parts of the county.

BURGEN SANDSTONE

The Burgen sand directly underlies the Burgen limestone and lies unconformably upon the Siliceous lime, with the exception that in some instances a shaly member occurs below the sand.

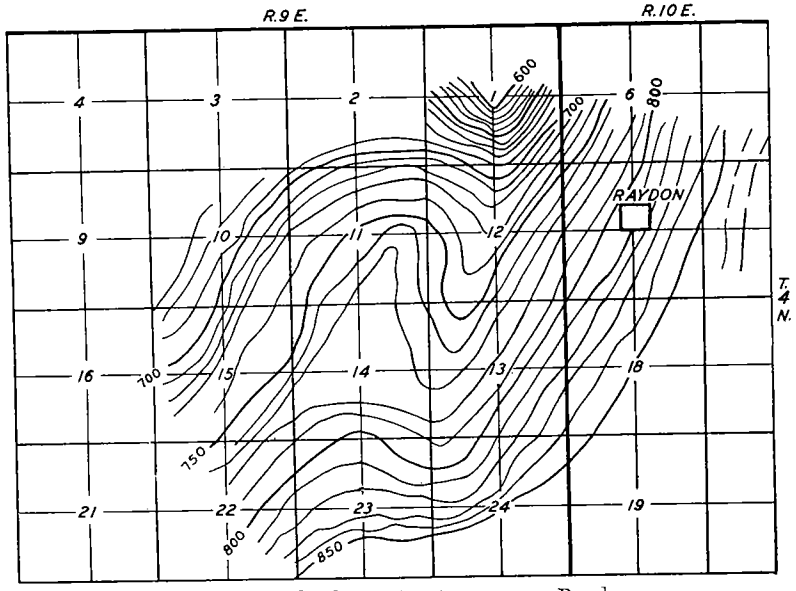

Figure 2. Surface structure near Raydon.

ARBUCKLE (SILICEOUS) LIMESTONE

This limestone, found over wide areas throughout the State, has a variable thickness in eastern Oklahoma. It lies unconformably upon the granite and the Reagan sandstone where the Reagan is present. There is a wide unconformity at the top. The thickness of the Arbuckle limestone in Hughes County has not been ascertained by drilling.

This limestone is Cambro-Ordovician in age. It is likely to produce some gas at the top of the formation under favorable conditions, but the writer does not know of any production coming from this limestone in Hughes County.

Surface Structure

The nose is the predominant type of surface structure producing oil or gas in Hughes County. Very often, beginning with the top contour of the nose, and extending eastward, a terraced condition exists, with the production lying just west and north of the terrace. Sometimes these terraced structures end with a fault on the east side which become closed structures with depth.

In addition to the terraced nose, almost every other type of surface structural condition is found in the county, from the long anticlinal type to the small dome. Surface geology in Hughes County is very important as it usually reflects a more disturbed condition in the lower formations. Anticlinal types of structures are more likely to be found east of the outcrop of the Calvin sandstone.

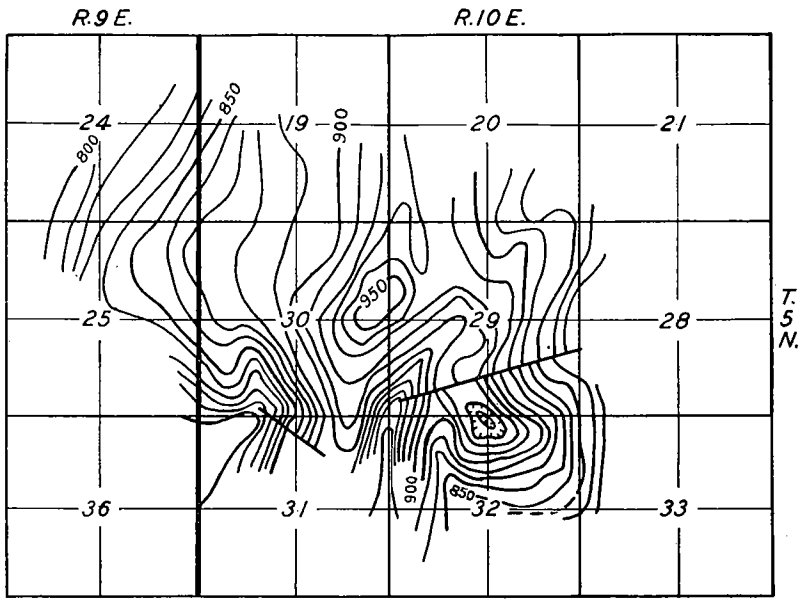

Figure 3. Surface structure in T. 5 N., Rs. 9 and 10 E.

The two most recent changes in the surface conditions of Hughes County occurred during a wide-spread period of peneplanation, probably in Jurassic times. The second important change occurred when the South Canadian River started cutting through the old surface level, on which the Guertie sand was laid down.

Subsurface Structure

The major structural conditions existing in Hughes County consist of one major synclinal basin which almost covers the southeast part of the county east of the outcrop of the Wetumka formation. This basin plunges rapidly east from the outcrop of the Wetumka.

West of this outcrop the Arbuckle floor rises rapidly to the Seminole County area on the west and to Okfuskee County on the north. These lower formations are also affected by the proximity of some large faulted anticlines on the south, and the Ada arch to the west. The movements causing this synclinal basin on the east were gradual and were more or less continuous almost up to the present time. This

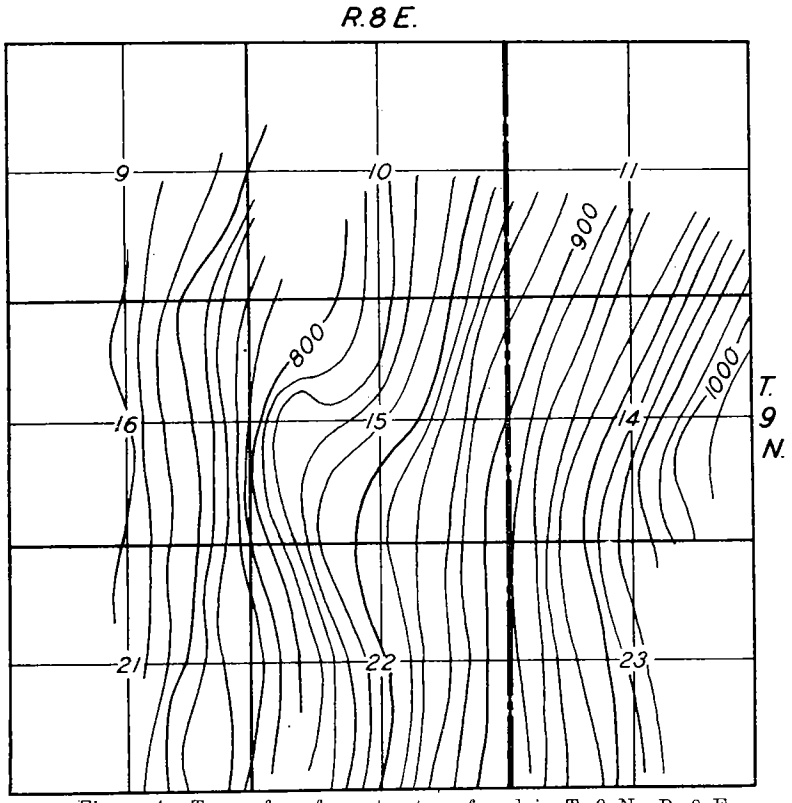

Figure 4. Type of surface structure found in T. 9 N., R. 8 E.

Arbuckle high in the west part of the county was present during the deposition of all the Pennsylvanian rocks. This condition resulted in a wedge-like cross-section of each formation, with the sharp end of the wedge toward the west and the blunt end toward the east, the rapidity and amount of thickening dependent upon the rapidity of the sea advance and retreat during the time each formation was laid down. The greatest wedging seems to have taken place prior to the deposition of the Hartshorne sandstone, but the thickening in the formations above the Hartshorne continues to the surface beds.

OIL AND GAS DEVELOPMENT

Hughes County has been proved oil and gas territory for many years. One of its outstanding fields is the Papoose field located in the northern part of the county and extending into southern Okfuskee County. This field, discovered in 1923, reached a peak of 39,814 barrels of oil per day early in 1925. Production is mainly from the Gilcrease and Papoose sands, with initial outputs ranging from 30 to 3,600 barrels per day. Gas in this field is important also and the amount per well varies from 10 to 100 million cubic feet. These sand horizons occur at depths of 3,070 and 3,350 feet respectively. Tests to the Wilcox sand, found at a depth of 4,130 feet, have proved unproductive of oil or gas. Plate I shows the various producing horizons of Hughes County.

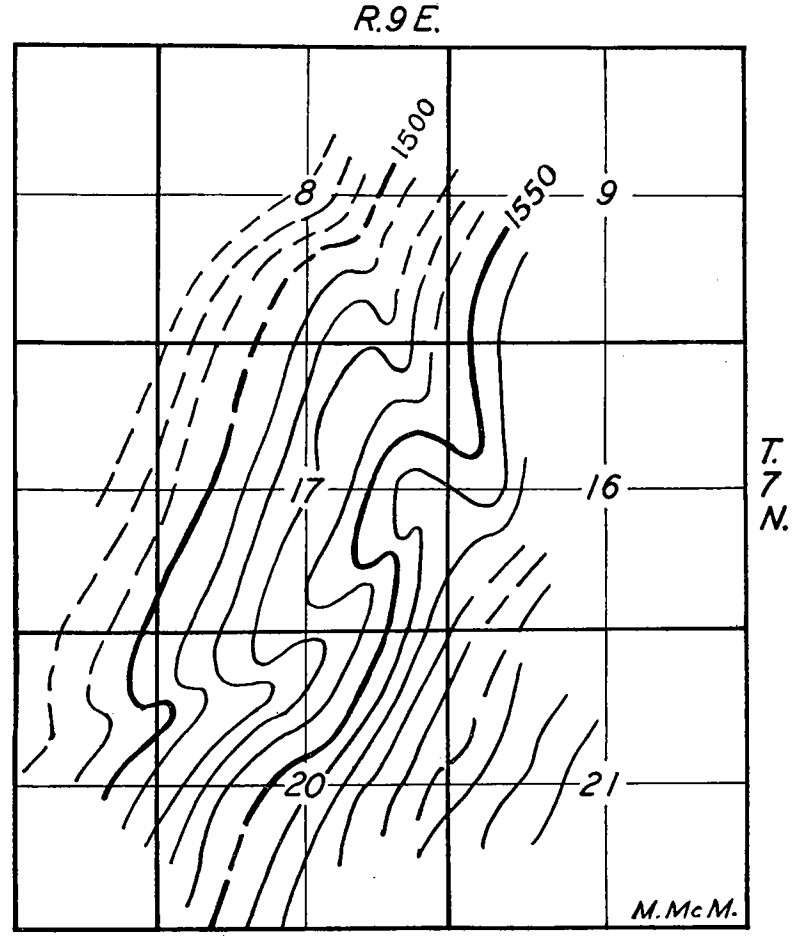

Figure 5. Surface structure in T. 7 N., R. 9 E.

ALABAMA

The Alabama oil and gas field, located in the northern part of T. 9 N., R. 11 E., was opened in 1917 with a gas well by Gillispie and others. Deeper drilling in the area started in 1925 and oil production ranging from 20 to 200 barrels was obtained in the Deaner and Lyons-Quinn sands at depths of 2,910 and 3,130 feet.

ALLEN

The Allen dome, originally developed in Pontotoc County, has proved productive northward both in southeastern Seminole and southwestern Hughes counties. The Wilcox sand discovery well in the Allen field was drilled by the Sinclair Oil & Gas Co., No. 2 Amos-B, SE. cor., NE.¼, SW.¼ sec. 7, T. 5 N., R. 8 E., Seminole County. This well found the Wilcox at 4,158 feet on Sept. 16, 1928 for a production of 40 barrels per hour. Shallower horizons which produce in the Allen field are Boggy, Savanna, Wapanucka, Cromwell, and Gilcrease. This structure is located on a nosing which plunges northeast from the Arbuckle uplift.

This field, opened in 1918, had shallow gas production and later oil from the Lyons-Quinn horizon found at a depth of 2,900 feet. The wells ranged from 10 to 50 barrels in daily output, though the main importance of this field is for gas.

FUHRMAN-TRANSCONTINENTAL

This pool was one of the major spots of interest in the latter part of 1925 as a result of the discovery well drilled by the Fuhrman Petroleum Company and the Transcontinental Oil Company in sec. 26, T. 9 N., R. 9 E., for 1,200 barrels of oil per day at a depth of 3,360 feet from the Lyons-Quinn sand.

HOLDENVILLE

One of the first wells in the Holdenville pool was drilled by the Penn-West Oil Company in sec. 4, T. 7 N., R. 8 E., with a production of 16 million cubic feet of gas per day and 5 barrels of oil. The producing horizons are the Booch, Gilcrease, Smith, Hunton, and Wilcox. The Wilcox is found at a depth of 4,180 feet with oil production as high as 4,000 barrels per day, having a gravity of 39°B.

NEWMAN

This field, discovered by W. C. Newman and associates in 1923, was famous because of the "Vaseline" well, located in sec. 31, T 8 N., R. 12 E. This well produced from the Lyons-Quinn horizon encountered at a depth of 3,710 feet at a rate of fifty barrels per day, and the oil was of 38°B. gravity and a paraffin base.

WETUMKA

The Wetumka field is located in the northern part of T. 9 N., R. 10 E. It was opened in 1919. Wells in the Deaner and Hunton horizons produced initially at a rate of fifty to eight hundred barrels of 39°B. oil per day. The Deaner is encountered at 2,900 and the Hunton at 3,755 feet. The Wilcox has been found barren at 4,000 feet.

WEWOKA

The Wewoka field, located principally in Seminole County, covers a part of western Hughes County. The important producing horizons of this field are: Smith sand, (the upper part of the Cromwell horizon); the Sykes sand, (also of the Cromwell); the Hunton limestone; and the Seminole sand, (of the Simpson formation). The important production from the Seminole sand in Hughes County centered in sec. 5, T. 7 N., R. 8 E.

YEAGER

The Yeager oil and gas field, opened in 1917, is located in T. 8 N., R. 10 E. The surface formations are the Wewoka and Wetumka of Pennsylvanian age. The wells produce from the Booch, Gilcrease, Lyons-Quinn, and Wilcox horizons, encountered at depths of 2,790, 3,040, 3,520, and 3,920 feet respectively, at the rate of 25 to 500 barrels per day initially and 1 to 30 million cubic feet.

Future Production of Oil and Gas

From the oil producers' standpoint, Hughes County may be divided into two areas: one which lies west of the exposure of the Wetumka formation, where subsurface conditions controlling the production of oil and gas will be found approximately equivalent to the horizons in eastern Seminole and southern Okfuskee counties; and the other area which is defined by the producing fields in the western part of the county.

The eastern area will probably not be as prolific in oil and gas production as the western. All sands will be found at greater depths, increasing in depth from west to east, and from north to south. Plate I shows type well logs in the various parts of the county.