OKLAHOMA GEOLOGICAL SURVEY
Chas. N. Gould, Director

Bulletin No. 40-Y

OIL AND GAS IN OKLAHOMA

GEOLOGY OF HARMON, GREER, JACKSON, AND TILLMAN COUNTIES

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NORMAN
JANUARY, 1928

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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.

Mr. R. L. Clifton, the author of this report, is also the author of Bulletin 40-A., the first report of the Oil and Gas series. This report is a continuation of Clifton's studies on the stratigraphy of the Permian of western Oklahoma, and the map accompanying this report showing the geology of Harmon, Greer, Jackson, and Tillman counties is the first detailed map to be published on this area.

CHAS. N. GOULD,
Director

January, 1928

Harmon, Greer, Jackson, and Tillman Counties.

By

R. L. Clifton

INTRODUCTION

The four counties of Harmon, Greer, Jackson, and Tillman, occupy the southwestern portion of Oklahoma. Lying as these counties do, on the southwestern flank of the Wichita Mountain uplift, and bordering the north bank of the Red River, they may be said to belong to the Red River district of Oklahoma.

It shall be the purpose of this report to discuss the oil and gas possibilities of the four counties, and at the same time to delineate some of the geologic and other factors found to exist within the limits of the counties. A geologic map is included as a part of this report. (Plate I).

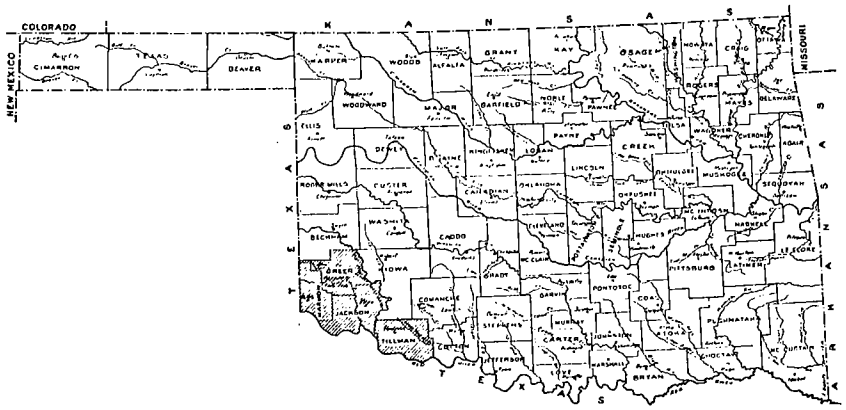

Fig. 1.—Map of Oklahoma showing location of Harmon, Greer, Jackson, and Tillman counties.

Acknowledgments

The writer wishes to thank C. N. Gould, Director of the Oklahoma Geological Survey, for the helpful suggestions he has given in the preparation of this report. And without specific reference to others, the writer wishes to acknowledge a debt of service to those geologists who have worked in the area of these four counties. This report then, may be considered a composite work, representing the opinions and conclusions of the writer, influenced to a large extent by the writings and the personal communications of other geologists familiar with this area.

General and Historical Geology of the Four Counties

The surface exposures within the limits of the counties of Harmon, Greer, Jackson and Tillman belong, for the most part, to the Permian system. There is a considerable area of Recent sands and alluvium deposits within the counties. Along the northeastern limits of this area there is a more or less attenuated line of pre-Cambrian exposures, consisting of low-lying granite peaks and knobs that rise but a few hundred feet at the most, above the level plain of this area. A correlation table for the oldest to the youngest formations appearing as surface exposures within the four counties, is given below:

Correlation of formations in Harmon, Greer, Jackson and Tillman Counties.

GROUP		Oklahoma	Texas
Cimmaron Series	Woodward Group	Whitehorse sandstone	Double Mountain
		Dog Creek shale	
	Blaine	Blaine gypsums	
	Enid	Chickasha	
		Duncan	
		Hennessey	Clear Fork
		Garber	Wichita

The historical geology of the four counties is intimately related to the cycle of events included in the history of the Wichita Mountains. The oldest Paleozoic beds were evidently deposited in an area relatively free from orogenic movements. It is probable that the horizontal attitude of the older beds was but little disturbed until about the close of Ordovician or later deposition. It is believed by Taff and others that crustal deformation became pronounced during early Pennsylvanian times, resulting in the elevation of the Wichita Mountains. These mountains then,—as well as the present Wichita Mountains—are but the uplifted peaks of the ancient sea floor, upon which Cambrian and younger sediments were deposited.

Subsequent to the early Pennsylvanian uplift, the upturned beds were subjected to erosion and finally peneplanation to a marked degree and by the close of Pennsylvanian times, this area again became submerged. Detrital material forming the clastic and indirectly the non-clastic beds of the Permian, was deposited on the eroded Pennsylvanian surfaces. An area of deltaic Permian deposits was laid down on the truncated and tilted older beds, as a more or less narrow border or periphery around the Wichita uplift. To the south, away from the Wichita uplift, deposition was continuous from early Pennsylvanian to the close of Permian times, since the evidence of a marked unconformity between the late Pennsylvanian and the early Permian beds disappears rapidly to the south. Later, and after the close of Permian times, the Wichita Mountain area again was elevated to its present height, thus tilting the beds in the area of the four counties southwestward. Subsequent erosion has removed much of the Permian deposits from the immediate area of the uplift, while streams have channelled fairly deep valleys in the beds away from the uplift. The net result of the two primary crustal uplifts has been to tilt the older,—or Pennsylvanian beds, as a specific instance—at a higher angle than the younger, or Permian beds were tilted.

HARMON COUNTY

Location

Harmon County is located in the extreme southwestern part of the State. It extends from T. 1 N. to T. 6 N., inclusive, and from R. 24 W. to R. 27 W., inclusive. The county embraces 11 entire townships and the parts of 11 others. The total area of Harmon County is approximately 567 square miles.

Geography

DRAINAGE AND TOPOGRAPHY

The county is drained by Red River and its tributaries, the principal ones of which are Lebos Creek, Salt Fork, and Elm Fork of Red River. The drainage plane slopes in a general southeast direction.

The greater portion of the area of the county lies in the region of the Gypsum Hills. The topography is that of a level plain, dissected by stream and erosion channels. Much of the central portion of the county is covered by an area of sand and alluvium deposits. The northern part of the county presents a typical red beds hills topography that is the area of the highest relief in the county.

Geology

STRATIGRAPHY

The rocks exposed at the surface belong to the Permian and to the Quaternary systems. The area of the Permian beds greatly exceeds that for the younger sands and alluvium.

The Permian exposures belong to the following horizons; the Blaine, Dog Creek, and Whitehorse formations. Miser has shown on the recently published state map an area of Cloud Chief exposures appearing at the surface in northern Harmon County, but recent field work does not convince the writer that any Permian beds as young as the Cloud Chief appear as surface outcrops in the county. Accordingly, the map accompanying this report does not include an area of Cloud Chief exposures.

The Blaine Gypsum beds appear as a sort of concentric band of outcrops extending from the southwestern part of the county, thence eastward, along the eastern portion of the county, to the limits of T. 5 N., where, in the north part of the township, the Blaine outcrops extend westward to the Texas line. The Blaine formation presents four or more series of discontinuous beds of gypsum and magnesium-calcium carbonate beds, with interbedded red clays and shales throughout the area of its outcrops. Occasionally the gypsum beds have a tendency to erode locally in a series of low escarpments.

The Dog Creek formation appears as a surface outcrop in T. 5 N., and extends as far east as R. 24 W. In small areas overlying the Dog Creek shale there occurs an area of Whitehorse sandstone beds. Approximately the lower half of the Whitehorse section is represented in the county. To the northeast, this formation has an average thickness of about 425 feet.

In the central portion of the county there is an area of sand and alluvium beds, within whose limits there occur isolated exposures of Permian beds belonging, for the most part, to the Blaine formation.

There is a narrow band of Recent sands along the larger streams of the county. The principal area of such beds is along the Red River.

As formal evidence affording a direct bearing upon the age and correlation of the Permian exposures in the county, it may be stated that the writer has collected fossils of a few specimens from certain dolomitic beds appearing near the top of the Blaine formation. The fossiliferous beds occur in the western part of the county, along the Texas line, in Tps. 3, 5, and 6 N., where a few specimens of *Schizodus* and *Pleurophorus* were collected. The same fossils were also collected to the west, in Texas, from the same series of beds.

REGIONAL AND STRUCTURAL GEOLOGY

The strata in Harmon County dip at a low angle to the southwest, and at right angles to the axis of the Wichita uplift. It has been stated by Taff and others that the Wichita uplift occurred during early Pennsylvanian times, although it is believed that the area of Harmon County was subjected to crustal deformations of perhaps lesser intensity from about the close of Ordovician times until the beginning of Pennsylvanian times,—all of which have influenced the subsurface beds in this area. Following the first appearance of the Wichita Mountains as such, the area was greatly eroded, and by the close of Pennsylvanian times, the

area of the Wichita uplift again became a depositional zone. The Permian deposits, largely derived from the eroded old land mass of the Wichita uplift, were laid down on the tilted and truncated Pennsylvanian and older beds. At the close of Permian times or later, this area was again subjected to uplift, elevating the Wichita Mountains to their present position.

The various crustal deformations have left their influence upon the beds in the area of Harmon County. The older Paleozoic beds are perhaps more tilted and folded than are the younger Permian beds. Folds and structural reversals most likely occur in the subsurface beds. Gould and Lewis[1] have recently shown that the eastern limits of the Palo Duro Basin may extend as far eastward as the limits of T. 4 N., R. 25 W. The occurrence of this structural feature only stresses the fact that folds and synclines in the subsurface beds are to be expected in the area in which Harmon County lies.

ECONOMIC GEOLOGY

At present there is no production of oil and gas in commercial quantity within the limits of the county. Six or more wells have been drilled, some of which have reported showings of oil and gas, yet the net result of the wells drilled up to the present has been very disappointing. However, none of the deeper tests, as for example the three deeper tests drilled in R. 26 W., have penetrated even the full Pennsylvanian section, so while these three wells may have tested much of the Paleozoic section, the fact remains that the older, or Ordovician beds at least remain untested in these wells. It is evident from subsurface studies that these three tests show a well defined monoclinal dip to the southwest away from the axis of the Wichita uplift and it is possible that no one of the wells was located on a well defined structure. At any rate the deduction based on the results obtained in those wells drilled in the county, that oil and gas will not be found ultimately, is open to question.

Summary

Harmon County must be regarded as lying within possible oil and gas territory. To the south in Texas, the lower Permian horizons, and the greater part of the entire Pennsylvanian section are known to be productive of oil and gas. These same beds, or their stratigraphic equivalents underlie the greater part of Harmon County. It is of course granted that there is some thinning of the Pennsylvanian section, in comparison to the same section to the south in Texas.

Underlying the Pennsylvanian beds, considerable thickness of Ordovician beds most likely occurs. The Arbuckle limestone is possibly extensive over the entire county. It is possible that thin sections of the Simpson formation may be represented as subsurface beds, in much of

1. Gould, C. N., and Lewis, Frank E., The Permian of western Oklahoma and the Panhandle of Texas: Oklahoma Geol. Survey, Circular 13, 1926.

the county, since the presence of beds referable to this formation have been reported from Stephens County,[2] Oklahoma, and in other areas[3] adjacent to the Wichita uplift. Again thin sections, or erosional remnants of the Viola lime might occur within the county. The presence of these older Paleozoic beds, if no more than erosional remnants, may be regarded as additions to possible petroliferous beds, or, again these erosional remnants, if present, might serve as buried hills or elevations over which younger beds might be folded or over which compactional forces on younger beds could possibly create slight reversals in the regional dip, which would form the proper structural condition for the accumulation of oil and gas. While the writer believes that the theory of compaction and differential settling in younger sediments over hills or elevation in older rocks to account for major structural uplifts or folds has been much over-estimated by some geologists, yet the fact remains that compaction and differential settling do furnish the possible physical conditions necessary to form the smaller terrace-like types of structures, such as are found to exist in many other areas and which are believed to be present in this county.

Below is given the log of the well drilled by the Auto Oil and Gas Syndicate. This log is fairly representative of subsurface conditions for the south part of the county.

Auto Oil & Gas Syndicate's Gillentine No. 1, sec. 21, T. 3 N., R. 26 W.

Drilling Commenced, 1-15-20; drilling completed, 5-12-21

Formation	Top	Bottom
red-blue clay mixed	00	59
gyp rock	59	69
red clay	69	89
blue clay	89	91
gyp rock	91	96
blue gumbo	96	102
gyp rock	102	108
blue gyp	108	112
red clay	112	122
white hard gyp	122	127
hard sand	127	129
blue gumbo	129	132
gyp rock	132	134
red clay tough	134	144
hard gyp rock	144	155
blue gumbo	155	162
red shale	162	172
white rock	172	192
blue gumbo	192	198
gyp rock	198	205
blue shale	205	209
red shale	209	219
blue gumbo	219	226
gyp rock	226	256
blue gumbo	256	264
red shale	264	279
gyp rock	279	318
blue shale—wtr. sand	318	325
gyp rock	325	329
wtr. sand	329	335
gyp rock	335	337
blue gumbo	337	341
red rock	341	351
blue gumbo	351	359
red shale	359	366
blue rock	366	368
blue rock	368	371
red bed	371	386
blue gumbo	386	391

(Continued on page 11)

2. Gouin, Frank, Oil and gas geology in Stephens County: Oklahoma Geol. Survey, Bull. 40-E, 1926.
Gouin, Frank, Oil and gas geology of Beckham County: Oklahoma Geol. Survey, Bull. 40-M, 1927.
3. Becker, Clyde M., Oil and gas geology of Caddo and Grady counties: Oklahoma Geol. Survey, Bull. 40-I, 1927.

Formation	Top	Bottom
red bed with light stream of H_2O	391	402
blue bed	402	423
red bed	423	453
blue gumbo	453	468
red shale	468	473
salt	473	480
red bed	480	500
chocolate shale	500	520
blue gumbo	520	525
chocolate shale	525	550
gumbo	550	564
chocolate	564	580
red bed	580	601
salt	601	606
red bed	606	616
lime shell	616	620
red shale	620	666
lime rock	666	675
brown shale	675	681
red bed	681	690
lime	690	701
red bed	701	730
red shale	730	750
red rock	750	760
red shale	760	810
salt	810	815
red shale	815	855
salt	855	862
red hard shale	862	930
salt—with oil show	930	935
sand shale	935	1010
red hard shale	1010	1060
red sandy shale	1060	1100
salt rock	1100	1108
salty red shale	1108	1150
red sandy shale	1150	1200
hard red shale	1200	1230
blue hard shale	1230	1235
red shale	1235	1280
blue shale	1280	1287
cavey red shale	1287	1310
blue shale	1310	1380
red shale	1380	1395
blue shale	1395	1410
salt rock	1410	1417
red shale	1417	1425
blue shale	1425	1445
lime shell	1445	1462
salty red shale	1462	1470
blue lime shell	1470	1480
blue shale	1480	1510
blue lime shell	1510	1535
soft blue shale	1535	1590
hard blue shale	1590	1610
hard red rock	1610	1612
blue shale	1612	1635
red rock	1635	1640
blue streak	1640	1645
red cavey shale	1645	1670
blue lime shale	1670	1675
red shale	1675	1715
gyp rock	1715	1720
red shale	1720	1735
white rock	1735	1740
red shale	1740	1760
sand red shale	1760	1800
hard red rock	1800	1825
white rock	1825	1830
show oil red shale	1830	1855
red shale —broken	1855	1910
A mucky red shale (with lime shells)		
soft shale	1910	1935
white rock	1935	1945
red shale	1945	1960
lime shell	1960	1965
red shale	1965	1980
lime shell	1980	1990
red shale	1990	2010
blue shale mixed with lime shells	2010	2205
white lime rock	2205	2225
blue shale hard in some places mixed with lime shells	2225	2300
lime shells	2300	2306
blue shale	2306	2324
lime rock	2324	2331
blue shale with broken lime shells between them	2331	2365
hard lime rock	2365	2368
lime shells	2368	2384
lime rock very soft	2384	2389
hard shale	2389	2403
hard white lime rock	2403	2414
blue shale—hard and soft in some places	2414	2437
lime rock	2437	2442
hard lime rock—soft in places	2442	2455
hard white lime	2455	2470

(Continued on page 12)

Formation	Top	Bottom
white sandy lime	2470	2480
white lime	2480	2510
blue shale	2510	2520
white lime	2520	2530
white sandy lime	2530	2545
white lime	2545	2565
blue shale	2565	2570
white lime	2570	2600
sandy lime	2600	2650
white lime	2650	2670
blue shale	2670	2685
white lime	2685	2705
gray lime	2705	2710
white lime	2710	2730
sandy lime	2730	2760
gray lime	2760	2775
black slate	2775	2780
gray lime	2780	2790
sand white with gassy odor	2790	2805
white lime	2805	2810
black slate	2810	2815
sandy steaks with gas	2815	2840
wtr sand —salty	2840	2865
blue lime	2865	2880
gray sandy lime	2880	2900
black slate	2900	2930
gray lime	2930	2940
blue shale	2940	2950
sandy gray lime	2950	2960
flinty gray lime	2960	2965
gray sandy lime	2965	2985
gray lime	2985	2990
white sand no show of oil or wtr.	2990	3000
white sandy lime	3000	3015
gray lime	3015	3025
black slate	3025	3030
white lime	3030	3050
blue shale	3050	3053
black slate	3053	3058
sandy lime, wtr.	3058	3073
black slate mixed with with sandy white lime	3073	3093
gray lime	3093	3103
black slate with shells of gray lime and sandy streaks	3103	3180
blue shale	3180	3185
black slate with sand	3185	3190
brown shale with lime	3190	3195
black slate	3195	3200
brown shale	3200	3205
white slate— sand	3205	3215
hard white slate	3215	3240
hard gray lime	3240	3244
slate with sand, some wtr.	3244	3250
hard gray lime	3250	3253
slate white, some sand, more wtr..	3253	3260
slate—lime shells	3260	3270
white sandy lime	3270	3275
slate—lime shells	3275	3290
hard gray lime	3290	3295
slate—with lime	3295	3305
gray lime	3305	3310
slate—lime shells	3310	3325
gray lime	3325	3335
slate T. D.	3335	3350

Future tests drilled in Harmon County should be started with the plan in view of testing the top of the Ordovician limestone, which should lie at an approximate depth of 3,000 to 5,000 feet, or even at a greater depth. The deeper depths are to be expected in the southwestern part of the county. The older Paleozoic rocks no doubt dip sharply to the southwest. At any rate no test should be regarded as conclusive for any location, unless the top of the older Paleozoic rocks has been tested.

If possible, geological evidences of structural conditions or reversals in dip in the surface and even the subsurface beds should be given serious consideration in the location of any test. While this is no assurance of ultimate success, it nevertheless eliminates some of the elements of chance against the drilling of dry holes.

GREER COUNTY

Location

Greer County is located in the southwestern part of the State. It extends from T. 3 N. to T. 7 N., inclusive, and from R. 20 W. to R. 25 W., inclusive. The county embraces 12 entire townships and parts of 12 others, whose total area is approximately 624 square miles.

Geography

DRAINAGE AND TOPOGRAPHY

The county is drained by Elm Fork, Salt Fork, and North Fork of Red River. The drainage slopes more or less rapidly to the southeast.

The county lies wholly in the area of the Gypsum Hills and the Red Beds Plains, except for small outcrops of more or less local and attenuated pre-Cambrian exposures, that form the northwestward extension of the Wichita Mountains. There is also a small area of sand and alluvium deposits along the courses of the larger streams. In places the topography is deeply dissected by stream erosion, the Gypsum Hills forming a dominant feature of the relief.

Geology

STRATIGRAPHY

The surface rocks belong to the pre-Cambrian and the Permian, while along the streams there are to be found areas of Recent deposits of sand and alluvium.

The pre-Cambrian rocks at the surface in Greer County consist of granite for the most part. These exposures are isolated granite knobs or peaks and ridges, of the Wichita Mountains, which rise abruptly a few hundred feet above the red beds plains. The largest of these granite ridges is known as Headquarters Mountain, near the city of Granite. The approximate area of this mountain is three square miles and which has an elevation of about 500 feet above the surrounding plain.

The Permian beds exposed in Greer County belong to the following formations, from the oldest to the youngest: the Hennessey, Duncan, and Chickasha, of the Enid group; and the Blaine formation. These Permian formations consist of red clays, shales, sandstones, some calcareous sandstones and shales, gypsum, and dolomite.

The Hennessey formation,[4] or the Clear Fork beds as its Texas equivalent is called, appears at the surface in the eastern part of the county, just west of North Fork of Red River. The Duncan sandstone

4. Gould, C. N., Officer, H. G., and Aurin, Fritz., The subdivision of the Enid formation: Bull. Am. Assn. Pet. Geol., vol. 10, no. 8, 1926.

and Chickasha formation appear as surface beds in the northern part of the county. The Duncan sandstone, which is correlative with the San Angelo formation as described by Beede, can be traced by more or less attenuated exposures through the county southward to the Red River. Excellent exposures of the Chickasha are observed in the county. The purplish-red color of the Chickasha affords a means by which this formation may traced through the county.

The Blaine formation overlying the Chickasha, consists of five or more beds of gypsum and dolomite, interbedded with red clays and shales. The Blaine exposures cover the greater and the western portion of the county.

REGIONAL AND STRUCTURAL GEOLOGY

Greer County lies chiefly on the southwest slope of the Wichita Mountain uplift. The beds here dip at fairly steep angles, away from the axis of the uplift. In the eastern portion of the county the Paleozoic section—chiefly Permian beds—is very thin over the area of this uplift. Southwestward away from the uplift, older Paleozoic beds begin to come in as subsurface formations, and in this area the Ordovician and the Pennsylvanian beds underly the Permian unconformably. The strata dip to the northeast in the northeastern part of the county. It is certain that the Permian beds overlap the eroded and tilted ends of Pennsylvanian beds in the area of the Wichita uplift.

The older Paleozoic beds are much folded and tilted due to the crustal deformations which have taken place in this area since middle Pennsylvanian times. Structural conditions should not be lacking unless subsequent erosion has modified the older beds too greatly by planation.

ECONOMIC GEOLOGY

Greer County lies in probable oil and gas territory. Due to the thinness of the Paleozoic section in the immediate area of the Wichita uplift, it is not likely that oil in commercial quantity will be found. True, oil has been found in small quantities in several wells and at shallow depths in this area. The oil has come from, or else near, the unconformity where Permian beds most likely overlie pre-Cambrian rocks. Away from the uplift a greater Paleozoic section occurs. Given the proper structural conditions, then oil in commercial quantities may be expected.

Development in Greer County began as early as 1901, since that time ten or more wells have been drilled in the county. At the present date it cannot be said that oil and gas in commercial quantities have been found, although several small oil wells have been completed for a production of one to four barrels daily. Gas to the amount of better than 2,000,000 cubic feet was found in one well.

Commerce Trust No. 1, *Cen. SW.¼ SW.¼ Sec.* 4, *T.* 3 *N., R.* 22 *W.*

Drilling Commenced, 7-1-24; Drilling Completed, 3-1-25.

Formation	Top	Bottom
red bed	00	105
red sand	105	115
red rock	115	140
sand (water)	140	160
red bed	160	1325
lime	1325	1330
blue shale	1330	1370
lime	1370	1375
blue shale	1375	1400
red bed	1400	1420
blue shale	1420	1500
lime	1500	1505
blue shale	1505	1525
white shale	1525	1545
red bed	1545	1555
blue shale	1555	1570
pink slate (cave)	1570	1600
lime white	1600	1605
white shale	1605	1625
slate & shells	1625	1885
lime	1885	1935
shells	1935	1950
red rock	1950	1997
sand & shells	1997	2007
red rock	2007	2030
red rock	2030	2045
red rock & shells	2045	2080
sand (water)	2080	2095
red rock & shells	2095	2346
red bed	2346	2387
red sandy shale	2387	2485
red mud	2485	2490
sand	2490	2515
red mud	2515	2525
red shale	2525	2565
red mud	2565	2575
white sand	2575	2585
red mud	2585	2590
lime white	2590	2620
red mud	2620	2650
sand	2650	2760
black shale	2760	2763
sand (water)	2763	2815
blue shale	2815	2820
sand	2820	2835
slate & shells	2835	2850
red rock	2850	2855
sand	2855	2880
blue shale	2880	2890
sand	2890	2898
red mud	2898	2905
sand	2905	2934
black shale	2934	2944
red mud	2944	2980
sand	2980	3005
sand	3005	3020
blue shale	3020	3050
sand	3050	3055
red mud	3055	3060
sand white	3060	3085
blue shale	3085	3100
sand (hole full water)	3100	3108
lime	3108	3110
black shale	3110	3116
sand	3116	3120
black shale	3120	3125
lime black	3125	3135
blue shale	3135	3146
lime black	3146	3155
shale	3155	3158
lime	3158	3160
shale	3160	3165
lime	3165	3168
shale	3168	3171
lime	3171	3172
red mud	3172	3175
sand white	3175	3192
lime	3192	3195
sand (water)	3195	3222
Total Depth		3222

Summary

Too much of the area of Greer County is included in the immediate area of the Wichita uplift to be regarded as favorable oil and gas territory. However, the western portion of the county should be regarded as very probable oil and gas territory. A considerable section of Permian beds is known to exist in the western portion of the county. Likewise, underlying the Permian beds in this area, there should be a considerable section of Pennsylvanian and older beds, where possibilities for oil and gas under favorable structural conditions, should be re-

garded as good. Until more tests have been drilled in the western and southwestern parts of the county, deep enough to test the Pennsylvanian and the Ordovician beds, which are believed to be present in this area, Greer County cannot be regarded as an impossible oil and gas area. (See remarks on Harmon County, page 9).

JACKSON COUNTY

Location

Jackson County lies in the Red River area of southwestern Oklahoma. The county extends from T. 2 S. to T. 4 N., inclusive, and from R. 18 W. to R. 23 W., inclusive. It comprises 12 entire townships and the parts of 21 others, the total area of which is approximately 811 square miles.

Geography

DRAINAGE AND TOPOGRAPHY

The county is drained by Red River and its tributaries, chief among which are North Fork, Salt Fork, and Gypsum Creek. The drainage in general flows to the southeast.

Jackson County exhibits four types of topography, namely, Wichita Mountain, Sand Hills and Alluvium, Red Beds Plains, and Gypsum Hills areas.

The northeastern portion of the county is in the area of the Wichita Mountains whose isolated peaks and ridges of granite rise a few hundred feet above the surrounding plain.

The sand and alluvium area lies principally in the southern and central parts of the county, along Red River and Salt Fork. The Red Beds Plains area includes the greater portion of the county and lies west of the Wichita Mountain area.

To the west of the Red Beds Plains there is a considerable area having a relief dominated by low gypsum hills and escarpments, which gives this portion of the county a typical Gypsum Hills topography.

Geology

STRATIGRAPHY

The surface rocks in Jackson County belong to the pre-Cambrian, Permian, and Quaternary or Recent.

The pre-Cambrian exposures lie in the northeastern part of the county. These consist for the most part of granite peaks and intruded dikes. The granite knobs and peaks appear as low-lying elevations, protruding above the level plain.

The Permian beds appearing as surface exposures, from the oldest to the youngest are the Hennessey, Duncan, Chickasha and Blaine formations.

The Hennessey formation outcrops in the eastern and the extreme

southeastern parts of the county. The writer correlates the Hennessey beds as a part of the Clear Fork division of the Texas section.

There occurs, extending through the central part of the county, an area of exposures belonging to the Duncan and the Chickasha formations. Beginning at Red River, near the town of Elmer, the Duncan beds can be traced in a nearly continuous line across the county. The Duncan, or the San Angelo as the Texas equivalent has been called by Dr. Beede, can be seen in the bluffs on the south bank of Red River.

Excellent exposures of the Chickasha appear above the Duncan, in its outcrops across the county. Southwest of Olustee and along Red River prominent exposures of the Chickasha occur.

The western one-third of the county is included in the area of the Blaine gypsums. Due to erosion and possibly solution and slumping, no one of the three or more beds of the Blaine can be traced across the county without difficulty. The Blaine formation in Jackson County presents a series of three or more discontinuous gypsum beds, with interbedded horizons of dolomite, red clay and shale.

In the northern part of the county, the chief streams are bordered by beds of Recent deposits, consisting of sands, gravels and alluvium.

STRUCTURAL GEOLOGY

The county, lying as it does in the area of the Wichita uplift, has a southwest regional dip. In general the beds dip at a low angle to the southwest. In many parts of the county there may be local variations in dip. However, in much of the area of the county, the nature of the surface beds is such that variations from the regional dip are not easy to detect. Structures or folds, or terraces have been reported by geologists who have worked in the county. It is certain that the different orogenic movements related to the history of the Wichita uplift have tilted the older rocks, and perhaps in some instances to have folded them to a marked degree. A study of the logs of those wells that have been drilled in the county shows a marked thickening of subsurface beds away from the Wichita uplift. The degree of tilting for the older beds is much greater than it is for the younger or Permian beds. It may be assumed with some reason that the Pennsylvanian, and older Paleozoic beds may be more greatly folded than the younger beds, and that subsurface structures, in these older rocks—granting that they are present —might have no reflection whatever in the upper or surface beds.

DEVELOPMENT

Six or more wells have been drilled in the county. Apparently, with but one possible exception, those few wells which have been drilled in the southern portion of the county where the thickest Permian and Pennsylvanian beds occur, have not been drilled deep enough to test even the full Pennsylvanian section.

It is quite possible that the Douglas Oil Company well, drilled in sec. 20, T. 3 N., R. 20 W., encountered Ordovician beds at an approxi-

mate depth of 3,300 feet. A study of the log of this well indicates that the base of the Pennsylvanian beds occurs at about 3,150 to 3,300 feet. The writer is inclined to refer the beds encountered below 3,345 feet to the Arbuckle formation, on no stronger evidence than that of drillers' logs. There is, however, the alternate possibility that the beds, or at least the lower part from 3,345 to 3,755 feet, are older than the Arbuckle limestone.

Douglas Oil Company's Baker No. 1, NW.¼ SW.¼ SE.¼, Sec. 20, T. 3 N., R. 20 W.

Drilling Commenced, 6-14-23; Drilling Completed, 4-25-24.

Formation	Top	Bottom
cellar	00	12
red rock, soft	12	1125
shale, brown, soft	1125	1155
shale, blue, soft	1155	1170
shale, brown, soft	1170	1178
lime, shell, hard	1178	1180
shale, brown, soft	1180	1225
shale, blue soft, caving at 1250	1225	1300
shale, red, soft caving bad	1300	1440
sand, red & gray, hard	1440	1450
shale, red, soft, cleavage bad	1450	1600
sandy shale, brown, soft	1600	2480
sand, gray, soft	2480	2485
shale, black, soft	2485	2505
shale, brown, soft	2505	2515
shale, sandy, red, soft	2515	2540
shale, blue, soft	2540	2560
sandy shale, red, soft,	2560	2685
sandy shale, blue soft	2685	2694
sandy shale, red soft	2694	2725
lime, gray, hard	2725	2750
sandy shale, brown, soft	2750	2815
lime, gray, hard	2815	2825
sandy shale, brown, soft	2825	2850
sand, green, hard	2850	2860
shale, black, soft	2860	2875
lime, light, hard	2875	2885
sandy, shale, blue	2885	2915
stray sand, soft, water	2915	2940
water, sand, white, medium	2940	2950
sand, white, soft	2950	2975
shale, blue, soft	2975	2985
lime, gray, hard	2985	3000
shale, red, soft	3000	3005
shale, blue, soft, cleavage some	3005	3015
sandy lime, gray, hard	3015	3025
shale, blue, soft	3025	3055
sand, gray, hard	3055	3060
shale, blue soft	3060	3075
lime, light, hard	3075	3080
shale, black, soft	3080	3105
sand, gray, hard	3105	3108
shale, blue, soft	3108	3115
shale, black, soft	3115	3125
water, sand, gray, medium	3125	3133
shale, black, soft	3133	3140
granite, gray, hard	3140	3148
shale, blue, soft	3148	3180
sand, gray, soft	3180	3345
3200-3250 enough water to drill with, 3349 hole caving some		
lime, white, hard	3345	3430
lime, white, soft	3430	3505
lime, green, soft	3505	3515
lime, white, soft	3515	3535
sandy lime, white. soft	3535	3550
sand, white, soft,	3550	3555
lime, blue, soft	3555	3560
water sand	3560	3570
sand, white, soft	3570	3580
sandy lime, white, soft	3580	3630
sand, white, soft, water, sand	3630	3650
sandy lime, white, soft	3650	3660
lime, white, soft,	3660	3670
sandy lime, white, soft	3670	3680
sand, white, soft	3680	3700
lime, gray, soft	3700	3710
lime, white, soft	3710	3715
sand, white, soft	3715	3720
sandy lime, white, soft,	3720	3735
lime, white, hard T. D.	3735	3755

Of the six or more wells that have been drilled in the county, at least three of them have reported showings of oil and gas. Development so far has been discouraging and no production of commercial importance has been found in the county.

Summary

Jackson County is within possible oil and gas territory. The scarcity of surface structural conditions cannot be taken as a criterion for subsurface conditions. The Pennsylvanian and older Paleozoic rocks may be very much folded, yet the sequences of the Wichita Mountain uplift, its erosion, submergence, deposition and subsequent uplift might not reflect the folds that may occur in the older rocks in the younger Permian beds. Permian folding should extend downward into the oldest rocks, but it is quite possible that folds in the older rocks do not extend into the youngest Permian beds in the county.

Future drilling ventures should be undertaken in those areas where some evidence of folding is known to exist. The tests located on such geological evidences should be carried deep enough to reach the older, or Ordovician beds, which are certain to underlie the greater part of the county. So far as the writer is aware, but one test has been drilled deep enough to test even the full Pennsylvanian section in the southern portion of the county. No test in the county should be regarded as conclusive, regarding the oil and gas possibilities of any area, until that well has been drilled to at least the top of the Ordovician beds, if pres-

ent in that area. The Arbuckle limestone, or the Ordovician siliceous limestone—as its equivalent to the northeast is called—undoubtedly underlies the greater part of the county in the area away from the Wichita uplift. Above this limestone it is quite probable that a thin section of the Simpson formation might occur. The Ordovician beds should be regarded as possessing some possibilities for oil and gas, then any well drilled in the southern portion of the county should expect to encounter Ordovician beds at a depth varying from 3,300 to 4,500 feet, depending of course, upon the proximity of the test to the Wichita Mountains and the intensity of the fold or structure upon which the particular well is to be drilled.

It may be stated with certainty that with two or perhaps three exceptions, none of the six or more wells that have been drilled within the limits of the county, have completely tested the possibilities of these locations, for the reason that drilling was stopped too soon. In other words, the possibilities of any location has not been tested until the Ordovician or older rocks have been reached by the drill.

TILLMAN COUNTY

Location

Tillman County is located in the southwestern part of the State, in the tier of counties north of Red River and bordering on Texas. It extends from T. 6 S. to T. 1 N., inclusive, and from R. 14 W. to R. 19 W., inclusive. The county includes 18 entire townships and the parts of 12 others, whose total area is approximately 862 square miles.

Geography

DRAINAGE AND TOPOGRAPHY

The county is drained by Red River, the principal tributary of which is Deep Red Run and its branches.

The topography of the county represents generally broad smooth surfaces, over which occur a few isolated hills and divides of low relief, that have been preserved by ledges of more resistant rock. Occasionally, the smooth surfaces of the county are very much dissected by streams, thus affording locally a sculptured "badlands" or Red Beds topography.

Geology

STRATIGRAPHY

The beds exposed at the surface in Tillman County belong to the Permian and the Quaternary or Recent.

The Permian formations appearing at the surface in the county, from the oldest to the youngest are the Hennessey, Garber and Wellington formations, or their Texas equivalents, the Wichita-Clear Fork beds.

The Wichita beds outcrop in the extreme eastern and southeastern parts of the county and represent but a small portion of the area of the

county. West of the Wichita beds there is a considerable area of Clear Fork exposures which makes up more than half of the total area of Tillman County. The Wichita-Clear Fork beds in many local places are covered by alluvial deposits so that even in the area of these exposures, the true character of these beds is not readily discernible.

In general the Permian beds consist of red clays, shales, sandstones, and conglomerates, especially mudstone conglomerates. The red clays and shales occur in the north and northeastern portion of the county. The sandstones in this area are limited and appear as small discontinuous beds. In the southern and central portions of the county, the red clays and shales contain interbedded sandstones, which are usually crossbedded and are often lenticular along the line of outcrops.

The western portion of the county embraces an area of Quaternary or Recent exposures, consisting of sands and alluvium. Occasionally there appear outcrops of Permian beds as isolated exposures within this area.

Along Red River and along the lower courses of Deep Red Run, there are narrow or border-like exposures of Recent sands and alluvium.

STRUCTURAL GEOLOGY

Tillman County lies well within the influence of the Wichita Mountain uplift. The normal dip of the beds is in general to the southwest, with local variations in the regional dip. An example of this variation is to be noted along the axis of the Devol anticline, described by Munn.[5]

Apparently there is a synclinal structure, or probably a series of smaller synclines and anticlines, extending in an east-west direction through the central part of the county. Howell[6] has referred to this structural condition as the red River syncline.

Structural conditions in the Grandfield district have been discussed at some length by M. J. Munn.[7] Other geologists have called attention to the presence of folds and terraces in Permian areas outside of the Grandfield district. It is reasonable to assume that reversal in the regional or normal dip exists in the Permian and older beds within the limits of Tillman County. The Wichita uplift, as well as the Red River uplift in Texas, has no doubt modified the attitude of the beds with respect to their normal position, so that structural folds or reversals occur in the subsurface beds, even though the nature of the surface exposures increases the difficulty to detect folds.

DEVELOPMENT

Much development has been done in Tillman County and some production has been found, but at the present time there is no producing well of commercial importance. The development has been confined to

5. Munn, M. J., The Grandfield District, Oklahoma: U. S. Geol. Survey, Bull. 547, 1914.
6. Howell, J. V., Some structural factors in the accumulation of oil in southwestern Oklahoma: Econ. Geol. vol. 17, no. 1, 1922.
7. Munn, M. J., op. cit.

the southeastern portion of the county, where in 1920, a shallow field having three producing horizons of small daily output was discovered. This field, known as the Grandfield district, is but an extension of the Burkburnett Texas field. The few wells in the extension had an initial production of about 100 barrels for a maximum. The main production came from what the writer correlates as the Cisco formation.

Several wells, drilled outside the Grandfield district, have reported showings of oil and gas.

A report of the Armstrong Oil Company's test in sec. 6, T. 4 S., R. 18 W., is included as a part of this report. Though the Armstrong well was drilled with standard tools, most of the drilling in Tillman County has been done with rotary tools.

Armstrong Oil Company's test in SE.¼ NE.¼ Sec. 6, T. 4 S., R. 18 W.

Drilling Commenced, Aug. 1919; Drilling Completed, May, 1921

Formation	Top	Bottom
quick-wtr., sand	00	84
red shale	84	540
salt water	540	550
red shale	550	640
blue shale	640	651
lime rock	651	652
oil sand	652	657
gumbo	657	660
red gumbo	660	816
sandy lime	816	830
red gumbo	830	860
hard sand	860	873
lime	873	875
sand rock	875	885
lime rock	885	890
red gumbo	890	900
gumbo	900	920
gyp	920	930
gumbo	930	935
gumbo	935	945
lime rock	945	953
gumbo	953	958
shale	958	968
shale	968	970
gumbo	970	978
gumbo	978	984
lime rock	984	986
lime rock	986	990
gumbo	990	993
gumbo	993	1000
sandy shale	1000	1003
lime rock	1003	1005
gumbo	1005	1010
shale	1010	1013
blue shale	1013	1018
blue gumbo	1018	1030
sandy lime	1030	1035
sand	1035	1040
sandy lime	1040	1042
shale	1042	1047
gumbo	1047	1055
shale	1055	1060
water sand	1060	1065
sandy lime	1065	1070
sand rock	1070	1080
blue gumbo	1080	1085
gumbo	1085	1100
shale	1100	1120
sand rock	1120	1130
lime rock	1130	1133
sand rock	1133	1138
sandy lime	1138	1140
shale	1140	1150
gumbo	1150	1158
gumbo	1158	1175
sand rock	1175	1178
gumbo	1178	1187
lime	1187	1192
lime rock	1192	1197
pack sand	1197	1203
lime rock	1203	1205
gumbo	1205	1220
pack sand	1220	1225
gyp	1225	1230
gyp	1230	1238
gumbo	1238	1242
pack sand	1242	1253
sand rock	1253	1275
blue gumbo	1275	1279
sand rock	1279	1285
gumbo	1285	1290
pack sand	1290	1310
sand rock	1310	1312
sandy shale	1312	1318
sand rock	1318	1320

(Continued on page 23)

Formation	Top	Bottom
shale	1320	1328
gumbo	1328	1345
sandy shale	1345	1353
gumbo	1353	1388
shale	1388	1396
lime rock	1396	1398
sand rock	1398	1404
gumbo	1404	1418
hard sand	1418	1420
gumbo	1420	1430
shale	1430	1440
gumbo	1440	1447
blue shale	1447	1452
gumbo	1452	1460
shale	1460	1466
gumbo	1466	1474
sandy lime	1474	1478
blue gumbo	1478	1483
sand rock	1483	1488
gumbo	1488	1490
sand rock	1490	1497
sand rock	1497	1508
sandy shale	1508	1520
shale	1520	1523
sand rock	1523	1525
lime rock	1525	1530
gumbo	1530	1535
sand rock	1535	1540
hard sandy shale	1540	1548
sand rock	1548	1552
hard sand	1552	1553
sand rock	1553	1560
gumbo	1560	1565
sand rock	1565	1570
gumbo	1570	1575
blue gumbo	1575	1582
rock	1582	1590
gumbo	1590	1592
sand rock	1592	1595
hard sand	1595	1600
sand rock	1600	1635
shale-gumbo	1635	1649
sand rock	1649	1655
sandy lime	1655	1658
sand rock	1658	1661
sandy lime	1661	1666
gumbo-sandy shale	1666	1686
gumbo-shale	1686	1713
sandy lime	1713	1717
sand rock	1717	1726
gumbo	1726	1732
sand rock	1732	1734
lime rock	1734	1738
hard sand-lime rock	1738	1764
lime rock	1764	1774
lime rock	1774	1777
lime rock	1777	1780
hard lime	1780	1785
pack sand	1785	1790
red shale	1790	1830
red shale	1830	2004
white gumbo	2004	2010
blue shale	2010	2037
lime rock	2037	2042
blue shale	2042	2060
sand rock—little show gas	2060	2065
blue shale	2065	2093
red shale	2093	2150
blue gumbo	2150	2190
pack sand	2190	2205
gumbo	2205	2215
sandy lime	2215	2225
blue shale	2225	2290
water sand	2290	2300
red shale	2300	2380
red sand rock	2380	2400
gumbo	2400	2410
sand	2410	2430
gumbo	2430	2435
lime	2435	2460
blue shale	2460	2471
lime	2471	2472
blue shale	2472	2478
lime	2478	2480
sandy lime	2480	2485
blue shale	2485	2490
shale-gumbo	2490	2500
gumbo-red sand	2500	2507
water sand	2507	2520
gumbo	2520	2530
sand lime	2530	2545
gumbo	2545	2555
blue shale	2555	2560
crystalized sand	2560	2583
gumbo	2583	2590
sand	2590	2597
gumbo	2597	2608
gumbo-blue	2608	2670
sand	2670	2678
lime	2678	2685
lime	2685	2800
sandy lime	2800	2815
? ? ?	2815	2840
? ? ?	2840	3020
slate T. D.	3020	3037

Summary

Tillman County lies in probable oil and gas territory, and the development up to the present time has not disproved this statement. Within the knowledge of the writer, but one well has been drilled deeper than 3,600 feet. This test did not penetrate the full Pennsylvanian section.

Underlying the greater part of the county, beds of Ordovician age are certain to be found. There is every reason to believe that the older Paleozoic beds, which as yet have never been tested in Tillman County, so far as the writer has been able to learn, may be petroliferous.

Structural conditions favorable for the accumulation of oil and gas are known to occur in the general area in which Tillman County lies. A study of subsurface conditions prompts the statement that the older beds thicken away from the axis of the Wichita uplift. Likewise, the older beds are inclined at higher angles than are the younger Permian or Paleozoic beds. It is quite possible that the older Paleozoic beds are also much more folded and tilted than are the Permian beds. Structures in the general area of the county are certain to increase with depth. In the drilling of any well in the county, it should be planned to carry the development deep enough to test the Ordovician beds, which are certain to underlie the greater portion of the county. No test may be regarded as sufficient until the Ordovician, or older beds are encountered by the drill.

To the north and northeast of the Wichita uplift, the Arbuckle or Ordovician siliceous limestone and the Simpson sand are known to occur. The Arbuckle limestone should be found in the general area of Tillman County, or at the least, in the southern part of the county. It is not improbable that at least thin beds of the Simpson sand may also be found locally in the county. Hence no test may be regarded as conclusive unless the older rocks are tested.

It is presumed that the Arbuckle limestones will be encountered in the southern part of the county at a depth varying from 3,600 to 5,000 feet, depending, of course, upon the proximity of the test to the Wichita uplift and the intensity of the fold or structure upon which the test may be located.