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SUBSURFACE GEOLOGY  
AND OIL AND GAS RESOURCES OF  
OSAGE COUNTY, OKLAHOMA

PART 6. Township 28 North, Ranges 10 and 11 East  
and Township 29 North, Ranges 9 to 11 East

BY

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## FOREWORD

This report on the subsurface geology of Osage County, Okla., describes the structural features, the character of the oil- and gas-producing beds, and the localities where additional oil and gas may be found. It embodies a part of the results of a subsurface geologic investigation of the Osage Indian Reservation, which coincides in area with Osage County. The investigation was conducted by a field party of the Geological Survey of the United States Department of the Interior in 1934 to 1937 and involved the study of the records of about 17,000 wells that have been drilled in Osage County. Funds for the investigation were allotted to the Geological Survey by the Public Works Administration. The primary purpose of the examination was to obtain geologic data for use in the administration of the Indian lands. The results of the inquiry have shown that many localities in Osage County outside the present producing oil fields are worthy of prospecting for oil and gas and that additional oil and gas can be found also by exploring deeply buried beds in old producing fields.

All townships in Osage County that contain many wells are described; the information furnished by such townships is ample for drawing detailed subsurface structure-contour maps. The descriptions of several contiguous townships are combined in separate reports, which are issued as parts of a single bulletin. No edition of the consolidated volume will be published, but the several parts can be bound together if desired.

The subsurface investigation of Osage County was carried on mainly by L. E. Kennedy, W. R. Dillard, H. B. Goodrich, Charles T. Kirk, J. D. McClure, Otto Leatherock, Constance Leatherock, W. E. Shamblyn, J. N. Conley, H. D. Jenkins, J. H. Hengst, G. D. Gibson, and N. W. Bass, geologists. The work of each geologist contributed more or less to the results of the investigation in each township. However, the investigations of the individual townships in Osage County were made mainly by various individuals of the group, and their names appear in the township descriptions. In addition to those whose names appear above, valuable assistance in the compilation of information was given by Lucile Linton, S. B. Thomas, R. C. Beckstrom, B. A. Lilienborg, J. G. Dwen, K. H. Johnson, J. G. Beaulieu, C. R. Viers, E. L. Hitt, Grace Clark, R. A. Payne, and J. C. Rollins.

Oil companies and individuals who contributed information are too numerous to acknowledge all by name. Special mention is made, however, of Laughlin-Simmons & Co. and the Indian Territory Illuminating Oil Co. for supplying most of the well elevations used in Osage County; of the Continental Oil Co., Tidal Oil Co., Sinclair Prairie Oil Co., Indian Territory Illuminating Oil Co., Phillips Petroleum Co., W. C. McBride, Inc., The Carter Oil Co., and others for supplying well logs, maps, cuttings, and cores of the producing sands in Osage County.

H. D. Miser, geologist in charge of the section of geology of fuels, supervised the work upon which this report is based. Appreciative acknowledgment is here made of many suggestions made by him during the progress of the investigation and during the preparation of the manuscript. Grateful acknowledgment is due the officers of the Osage Indian Agency at Pawhuska and the late John M. Alden and others in the Tulsa office of the Geological Survey for cooperation and assistance; also Hale B. Soyster and H. I. Smith, of the Geological Survey, for sponsorship and interest in the investigation.

N. W. BASS.

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PLATE 6. Map of T. 28 N., Rs. 10 and 11 E., and T. 29 N., Rs. 9 to 11 E.,  
Osage County, Okla..... In pocket



# **SUBSURFACE GEOLOGY AND OIL AND GAS RESOURCES OF OSAGE COUNTY, OKLA.**

## **Part 6. Township 28 North, Ranges 10 and 11 East, and Township 29 North, Ranges 9 to 11 East**

By H. B. GOODRICH, L. E. KENNEDY, AND OTTO LEATHEROCK

### **ABSTRACT**

The five townships—T. 28 N., Rs. 10 and 11 E., and T. 29 N., Rs. 9 to 11 E.—whose subsurface geology and oil and gas resources are described in this report lie in northeastern Osage County, Okla. The north boundary of the area coincides with the Oklahoma-Kansas State boundary, its southeast corner is about 8 miles northwest of Bartlesville, and its southwest corner is about 13 miles northeast of Pawhuska.

The oil and gas development of Osage County began in the area embraced in these five townships. The first well in the county, which was then known as the Osage Nation, was drilled in August 1896, in sec. 13, T. 29 N., R. 10 E., as a dry hole. The production of oil and gas in these five townships began in 1903 in the northern part of T. 29 N., R. 11 E., by extending fields producing from the Wayside sand in Kansas across the State boundary into Oklahoma. A few more than 1,000 wells, including oil wells, gas wells and dry holes, have been drilled to date.

Oil or gas has been obtained from eight zones, which lie at depths ranging from 475 to about 2,000 feet. The well that has reached the greatest depth—2,527 feet—is in the NE $\frac{1}{4}$  sec. 3, T. 28 N., R. 10 E. This well (No. 322) penetrated 700 feet into the Siliceous lime. Of the eight producing zones, six are in the Pennsylvanian series. The Wayside sand is the producing zone in most wells, the Weiser sand in many, and the Peru sand in many others. The Burgess sand-Mississippi lime zone produces gas or oil in many wells, most of which are in the central and south-central parts of the area included in the five townships. The Siliceous lime and the Layton, Musselle, and Torpedo sands have produced oil or gas in a few wells.

The regional dip of the rocks in the area is westward at the rate of 25 feet to the mile as measured on the top of the Oswego lime. Uniformity of the monoclinical dip, however, is interrupted by many folds, the most pronounced of which are in the east half of Range 10 E. The subsurface folds are in general similar to the folds in the exposed rocks, but the structural relief in the buried rocks is greater than that in the exposed rocks and the crests of the anticlines and domes in the buried rocks are offset a short distance from the crests in the exposed rocks. The data on subsurface conditions are not adequate to determine whether the few small faults that have been observed in the exposed rocks continue to any considerable depth.

The investigation has shown that very few localities outside the known producing fields merit testing for oil and gas; that a few of the fields might be extended somewhat by drilling additional wells and others enlarged by deepening old wells

into older rocks; and that the amount of oil produced in some fields would be increased by repressuring the reservoir sand with gas or water. Repressuring operations are being carried on already in a few places.

### INTRODUCTION

This report describes the subsurface geologic features, the oil- and gas-producing rocks, and the areas favorable for additional oil- and gas-prospecting, in T. 28 N., Rs. 10 and 11 E., and T. 29 N., Rs. 9 to 11 E. It is the sixth of a series of reports covering parts of Osage County. The structure of the buried rocks, the location of producing or abandoned oil and gas wells and dry holes, and the ownership of leases on Dec. 31, 1938, are shown on the accompanying map (pl. 6). The structure contour lines shown in black, in Tps. 28 and 29 N., R. 10 E., and T. 28 N., R. 11 E., are drawn on the top of the Oswego lime. The structure contour lines shown in blue, in T. 29 N., R. 9 E., and T. 29 N., R. 11 E., are drawn on the top of the Lenapah limestone, because in these two townships many wells penetrated this limestone but very few wells penetrated the deeper Oswego lime. The oil- or gas-bearing beds in producing wells and abandoned producers and the deepest beds penetrated in dry holds are shown on the map by colors on the black well symbols. Special symbols indicate wells that produced oil or gas from shallow depths but were drilled deeper to test older rocks.

All the oil- or gas-producing beds in the five townships are described briefly; these beds and all other rocks that have been penetrated by the drill are shown graphically in a generalized columnar section on plate 6. The thickness of a formation as shown on the columnar section is not necessarily its thickness in all parts of the area, but is representative of the central part of the area. The beds that produce oil or gas are indicated on the columnar section by colors that correspond to the colors on the well symbols on the structure contour map. Oil- and gas-producing beds in each of the five townships are listed also in the following table:

*Oil- or gas-producing beds in T. 28 N., Rs. 10 and 11 E., and T. 29 N., Rs. 9, 10, and 11 E., Osage County, Okla.*

T. 28 N., R. 10 E.	T. 28 N., R. 11 E.	T. 29 N., R. 9 E.	T. 29 N., R. 10 E.	T. 29 N., R. 11 E.
Mussellem sand. Layton sand. Wayside sand. Welser sand. Peru sand. Burgess sand-Mississippi lime zone. Siliceous lime.	Mussellem sand. Layton sand. Wayside sand. Peru sand. Burgess sand-Mississippi lime zone.	Torpedo sand.  Wayside sand. Peru sand. Burgess sand-Mississippi lime zone.	Mussellem sand. Layton sand. Wayside sand. Welser sand. Peru sand. Burgess sand-Mississippi lime zone. Siliceous lime.	Layton sand. Wayside sand. Welser sand. Burgess sand-Mississippi lime zone.

The rocks exposed in T. 28 N., Rs. 10 and 11 E., and T. 29 N., Rs. 9 to 11 E., belong mainly to the Nelagoney formation, the Elgin

sandstone, and the Pawhuska formation, all of the Pennsylvanian series. With the exception of the Pawhuska formation, which consists largely of limestone, the exposed rocks are composed principally of sandstone and shale, although there are a few thin beds of limestone. The geographic distribution of the exposed rocks is shown on the geologic map of Oklahoma.<sup>1</sup> The character and structure of the rocks have been described by Heald, Bowen, Goldman, Robinson, and Beckwith.<sup>2</sup> The structure, contour maps of the exposed rocks prepared by Heald, Goldman, and Robinson were followed in drawing the subsurface structure contours on plate 6, particularly in areas for which little information on the attitude of the buried rocks was available.

### OIL- AND GAS-PRODUCING BEDS

Oil or gas has been produced in T. 28 N., Rs. 10 and 11 E., and T. 29 N., Rs. 9 to 11 E., from eight zones, ranging from the uppermost part of the Siliceous lime, of Ordovician age, to the Torpedo sand, of Pennsylvanian age. The area is part of a broad northeastward-trending belt in which the Burgess sand-Mississippi lime zone is the most prolific producer, but in these townships the Wayside sand is the main producer. The other producing zones yield oil or gas in only a few places. The larger pools in the Wayside sand lie in T. 29 N., Rs. 9 to 11 E. Secondary recovery operations are being applied to this sand in a few places. The oil- and gas-producing beds are described briefly, from the oldest to the youngest, on the following pages.

#### SILICEOUS LIME

No samples of the Siliceous lime from wells in these five townships were studied, but samples from wells in other parts of Osage County were examined with the microscope. The examination showed that the upper part of the Siliceous lime consists mainly of finely crystalline brown to white dolomite that commonly contains chert. The thickness of the Siliceous lime in these townships is unknown, because no well has passed through it. One well, however, reached a point 700 feet below the top. Deep wells elsewhere in Osage County show that the lime is commonly thin and that in a few places on the crests of steeply folded domes it is absent but in areas remote from the domes it may reach a thickness of 1,000 feet or more. In southern Osage County the Siliceous lime yields oil in many fields. In the entire

<sup>1</sup> Miser, H. D., Geologic map of Oklahoma, U. S. Geol. Survey, 1926.

<sup>2</sup> Heald, K. C. (T. 29 N., R. 9 E.), Geologic structure of the northwestern part of the Pawhuska quadrangle, Okla.: U. S. Geol. Survey Bull. 691, pp. 57-100, pl. 13, 1918; Bowen, C. F. (Tps. 28 and 29 N., Rs. 9 and 10 E.), Goldman, M. I., and Robinson, H. M. (T. 28 N., Rs. 11 and 12 E.), Goldman, M. I. (T. 29 N., Rs. 11 and 12 E.), in White, David, and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pp. 43-58, 329-352, 359-384, pls. 8, 49, and 54, 1922; Beckwith, H. T., Oil and gas in Oklahoma, Geology of Osage County: Oklahoma Geol. Survey Bull. 40, vol. 3, pp. 211-267, pl. 1, 1928.

northeastern part of the county, although it commonly yields gas on domes, it yields oil only in one locality—the Pond Creek dome in sec. 3, T. 28 N., R. 10 E., and sec. 34, T. 29 N., R. 10 E.

#### **BURGESS SAND-MISSISSIPPI LIME ZONE**

Oil and gas are produced from beds that lie at or near the contact of the Cherokee shale and the Mississippi lime in several small tracts in the area that are widely separated. The well logs indicate that in most places the oil and gas occur in the uppermost 75 feet of the Mississippi lime but that in some places they occur in the Burgess sand that overlies the lime. The rocks at or nearly adjacent to the contact of the Cherokee shale and the Mississippi lime are referred to herein as the Burgess sand-Mississippi lime zone because it is impossible to differentiate them in the drillers' logs. No samples of these rocks from wells in the five townships were examined with the microscope, but examination of samples from other parts of Osage County show that the Burgess sand consists of fine to coarse quartz sand and that the uppermost part of the Mississippi lime consists mainly of weathered chert.

#### **PERU SAND**

The Peru sand occurs in the Labette shale between the Big lime and the Oswego lime. It produces oil or gas in a few wells on the Pond Creek dome in Tps. 28 and 29 N., R. 10 E., in a few wells on the West Mission Creek anticline in T. 28 N., R. 10 E., and in a few wells on the Crane dome in T. 28 N., R. 11 E. Elsewhere the sand is recorded in some logs but not in others which indicates that it occurs as lenses. Microscopic examination of samples of the Peru sand from two wells shows it to be fine-grained and to contain alternating laminae of shale and sand. Although daily yields of oil and gas from the Peru sand are generally small, the wells producing from it are long-lived.

#### **WEISER SAND**

The Weiser sand occurs in a shale between the upper and lower limestone members of the Big lime. It is present only in parts of the area. This sand produces oil and some gas on the Pond Creek dome, in Tps. 28 and 29 N., R. 10 E., and in the NE¼ sec. 36, T. 29 N., R. 11 E.

#### **WAYSIDE SAND**

The Wayside sand occurs in the upper part of the Nowata shale beneath a persistent limestone that is believed to be the Lonapah. The sand was named from the oil field near Wayside Kans., and is known also in parts of northeastern Oklahoma, as the Whiting sand and the Ramsey sand.



The Wayside sand is the main producing zone in these five townships. It occurs as elongated lenses, and the oil pools in it appear to be controlled by the distribution of the sand rather than by the attitude of the rocks. The logs of many wells near the main oil pools show that the sand pinches out on the margins of the pools. Most wells producing from this sand have small daily yields, but they produce for a long time. The total production to the acre, however, has been small. Secondary recovery operations have been applied in a few places in pools that produce from the Wayside sand.

#### LAYTON SAND

The Layton sand occurs in the upper part of the Coffeyville formation, below the Hogshooter limestone. The sand appears to persist as a single bed from 10 to 60 feet thick in T. 28 N., R. 11 E., and T. 29 N., R. 9 E. In parts of T. 29 N., Rs. 10 and 11 E., however, this sand zone is about 100 feet thick and contains a bed of limestone and some sandy shale near the middle of the zone. The occurrence of this limestone bed casts some doubt upon the identification of the Hogshooter limestone as shown in the columnar section on plate 6.

#### MUSSELLEM SAND

The Mussellem sand lies in the lowermost 50 feet of the Ochelata formation. The sand appears to be persistent but is recorded in most logs as two beds separated by shale. The Dewey limestone underlies this sand in most places, but in a few places the Dewey appears to be absent and the Mussellem sand merges below with the Peoples sand. The Mussellem sand yields water in most wells but has yielded gas or oil in a few wells, notably in the NE $\frac{1}{4}$  sec. 34, T. 29 N., R. 10 E., in the SE $\frac{1}{4}$  sec. 27, T. 28 N., R. 10 E., and in the SE $\frac{1}{4}$  sec. 28, T. 28 N., R. 11 E.

#### TORPEDO SAND

The logs of nearly all wells in the five townships record sand in the middle of the Ochelata formation. The sand is recorded in many logs as a single bed 200 feet thick and in many others as several beds separated by shale. A thin bed of limestone that is tentatively correlated with the Panther Creek limestone member occurs intermittently near the top of the sand zone. The sand zone is locally called the Big sand. It is probably equivalent to the Clem Creek and Torpedo sandstones and the beds that lie between them. For convenience, the upper part of this zone is designated herein the Torpedo sand. The sand zone yields water in most places, but the upper part produced gas for a time in five wells in secs. 16 and 21, T. 29 N., R. 9 E.

## T. 28 N., R. 10 E.

T. 28 N., R. 10 E., is in northeastern Osage County. Its north boundary is 4 miles south of the Oklahoma-Kansas State line, and its southeast corner is 12 miles northwest of Bartlesville. Oil or gas has been produced from six pools in the township. Seven zones have yielded oil or gas. Of these zones, the Burgess sand-Mississippi lime zone, which lies at a depth of about 1,600 feet, has yielded oil or gas in more wells than any of the others. Twelve wells have reached the Siliceous lime at depths ranging from 1,800 to 2,100 feet and two of these have produced oil. Eleven wells have produced oil and one well has produced gas from the Peru sand, at depths of about 1,150 to 1,450 feet. The Weiser sand has yielded oil in two wells in the northern part of the township and gas in one well in the southern part. The Wayside sand has yielded oil in a few wells at depths of about 1,250 feet. The Layton sand has yielded a small amount of oil in one well. The Musselmem sand has yielded gas in one well.

About 188 wells have been drilled in T. 28 N., R. 10 E., of which 85 produced oil, 61 produced gas, and 42 were dry. Of these, 45 of the oil wells and 21 of the gas wells have been abandoned. The dates of drilling of the first wells in the township were not learned, but it is known that some wells on the Pond Creek dome were drilled in 1911. In 1914 a dry hole that tested the Siliceous lime was drilled between the Pond Creek and Birch Creek domes. During the same year the first oil well producing from the Mississippi lime was drilled in sec. 16 on the Spring Creek dome. In 1915 a dry hole was drilled in sec. 20 on the Rattlesnake anticline. Development on the West Mission Creek anticline began in 1916. Most of the gas wells on the East Mission Creek anticline were drilled in 1924 and 1925. Four or five wells were drilled in the township in 1937.

The subsurface investigation of T. 28 N., R. 10 E., was conducted mainly in 1935 by L. E. Kennedy and Otto Leatherrock. The data on production were compiled in 1938 by Miss Anna L. Weinrich, of the Osage Indian Agency from records on file at the agency.

## STRUCTURE AND DEVELOPMENT

The regional dip of the rocks in this township is westward at the rate of 35 feet to the mile, as measured on the top of the Oswego lime. This regional dip is interrupted, however, by many domes, anticlines, synclines, and structural basins. The most prominent folds are the Pond Creek and Birch Creek domes, the West Mission Creek and East Mission Creek anticlines, and the western part of a large structural basin that lies mainly in T. 28 N., R. 11 E. The subsurface structural features in general conform with those in the exposed rocks,<sup>3</sup> except that they are more pronounced.

<sup>3</sup> Bowen, O. F., in White, David, and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pp. 49-55, pl. 8, 1922.

## POND CREEK DOME

The Pond Creek dome which covers a larger area than most domes in Osage County, is a large complex fold whose south half is in the northern part of T. 28 N., R. 10 E., and whose north half is in the southern part of T. 29 N., R. 10 E. The crest of the dome is in the NW¼ sec. 2 and the NE¼ sec. 3, T. 28 N., R. 10 E. The structural closure of the dome, as mapped on the top of the Oswego lime (pl. 6) is about 60 feet, which is somewhat greater than the closure in the exposed rocks.

Oil or gas has been produced on the Pond Creek dome from the Musselmem, Layton, Weiser, and Peru sands, the Burgess sand-Mississippi lime zone, and the Siliceous lime. Of these, the Burgess sand-Mississippi lime zone yields oil or gas in more wells than all the other zones combined. The Musselmem sand yielded gas at an initial daily rate of 950,000 cubic feet at a depth of 460 feet in well 411 in the NW¼ sec. 1, and yielded shows of gas in many wells on the Pond Creek dome. Well 3, in the NE¼SW¼ sec. 2, produced nine barrels of oil a day from the Layton sand at a depth of 740 feet, and a few wells on the dome yielded small shows of oil from this sand. Two wells, Nos. 9 and 12, in the NW¼ sec. 2, produce oil from the Weiser sand, which is about 40 feet thick and lies at a depth of 990 feet. A few other wells on the dome produced shows of oil or gas from this sand. Six wells in secs. 1 and 2 produced oil from the Peru sand at depths of about 1,150 feet. The initial daily yields of the wells producing from the Peru sand ranged from 4 to 20 barrels. Possibly additional wells that would produce could be drilled to the Peru sand in the NW¼ sec. 1 and in sec. 2, near the wells that are already producing.

About half of the 78 wells that reached the Mississippi lime yielded oil or gas from the Burgess sand-Mississippi lime zone, which lies at a depth of about 1,700 feet. Development of the oil and gas in this zone on the Pond Creek dome began in 1911, and by 1925 most of the wells had been drilled. The producing wells are in several groups that are widely distributed on the dome and separated by large tracts that contain no wells. Most of the gas wells are on the higher part of the dome and are within the area enclosed by the —500-foot contour line, drawn on the top of the Oswego lime (pl. 6). Thus the gas-bearing area extends from the crest of the dome down the flanks to points where the rocks are as much as 100 feet lower than on the crest. A large area surrounding the central gas-bearing area produces mainly oil. The altitude of the top of the Oswego lime in the oil-bearing area has a vertical range of 170 feet.

The initial daily yields of the gas wells producing from the Burgess sand-Mississippi lime zone ranged from 1½ to 10 million cubic feet, and the initial daily yields of the oil wells ranged from 2 to 100 barrels. Only 10 oil wells and 12 gas wells are still producing; all the others have been abandoned.

The oil and gas in most wells occur in porous chert and cherty limestone in the uppermost 100 feet of the Mississippi lime. In three wells a thin bed of sand that may represent the Burgess sand lies on the Mississippi lime.

It is likely that additional wells that would produce oil and gas from the Burgess sand-Mississippi lime zone could be drilled on the Pond Creek dome in the untested areas around the group of wells near the corner common to secs. 9, 10, 15, and 16. The initial daily yields of the old wells, however, were only 8 to 10 barrels, which indicates that the daily yields of new wells also would be small.

The Siliceous lime has been tested by four wells—two near the crest of the dome and two low on the southeast flank. The two wells near the crest produced some oil, and the two on the flank yielded water. Well 322 in the NE $\frac{1}{4}$  sec. 3, which is the deepest well in the township, reached a total depth of 2,527 feet. This well penetrated 700 feet into the Siliceous lime; it was then plugged back to the uppermost beds of the Siliceous lime, from which it produced a total of 4,415 barrels of oil in 9 months. The well was abandoned in 1922. Another well (No. 1) was drilled in 1928 about 250 feet south of well 322 and produced oil from the same zone. Well 1 is still producing, and up to August 31, 1938, it had produced a total of 19,351 barrels. The occurrence of commercially valuable oil in the Siliceous lime here is noteworthy, because this is the only place in northeastern Osage County where oil has been produced from this zone, except half a mile to the north, in the SW $\frac{1}{4}$  sec. 34, T. 29 N., R. 10 E., where a total of only 452 barrels was produced in another well.

The total amount of oil produced from the part of the Pond Creek dome that lies in T. 28 N., R. 10 E., is shown in the following table:

*Oil produced from the Pond Creek dome in T. 28 N., R. 10 E.*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
NE $\frac{1}{4}$ sec. 1.....	Prior to July 1916.....	50,357	
NW $\frac{1}{4}$ sec. 1.....	March 1921.....	18,238	
SE $\frac{1}{4}$ sec. 1.....	April 1921.....	15,146	
NE $\frac{1}{4}$ sec. 2.....	March 1921.....	564	Abandoned Sept. 1, 1929.
SE $\frac{1}{4}$ sec. 2.....	Prior to July 1916.....	6,912	Do.
NW $\frac{1}{4}$ sec. 2.....	do.....	20,580	
SW $\frac{1}{4}$ sec. 2.....	do.....	13,298	
NE $\frac{1}{4}$ sec. 3.....	February 1917.....	23,766	
NW $\frac{1}{4}$ sec. 3.....	Prior to July 1916.....	39,956	Abandoned in May 1935.
NE $\frac{1}{4}$ sec. 4.....	September 1919.....	20,254	Abandoned in April 1936.
NW $\frac{1}{4}$ sec. 4.....	June 1935.....	1,633	Do.
SE $\frac{1}{4}$ sec. 4.....	August 1922.....	748	Abandoned in June 1924.
NE $\frac{1}{4}$ sec. 10.....	June 1933.....	563	Abandoned in January 1935.
NW $\frac{1}{4}$ sec. 10.....	July 1920.....	8,812	Abandoned in May 1935.
SW $\frac{1}{4}$ sec. 10.....	January 1918.....	58,750	
NE $\frac{1}{4}$ sec. 11.....	March 1918.....	8,952	Abandoned in January 1935.
NW $\frac{1}{4}$ sec. 11.....	do.....	11,860	Abandoned in 1935.
SW $\frac{1}{4}$ sec. 11.....	do.....	3,216	Abandoned in August 1924.
NW $\frac{1}{4}$ sec. 15.....	June 1921.....	27,600	
NE $\frac{1}{4}$ sec. 16.....	May 1917.....	14,554	
		345,759	

**BIRCH CREEK DOME**

The Birch Creek dome, whose crest is in the NW¼ sec. 14, covers only a small area. The dome's structural closure is about 70 feet on the Oswego lime and about 40 feet on the exposed rocks. Oil is produced from the Burgess sand-Mississippi lime zone in several wells, most of which are on the east flank of the dome. The well logs indicate that the Burgess sand is absent and that the oil occurs in the upper 60 feet of the Mississippi lime, which lies at a depth of about 1,720 feet. The average initial daily yield of the wells was 22 barrels. If the productive area is estimated at 80 acres, the total amount of oil produced to the acre up to August 31, 1938, was 1,575 barrels. It appears probable that other wells that would produce could be drilled in the W½ sec. 14 and the NE¼ sec. 15. Wells of only small capacity would be expected. A dry hole in the southeast corner of sec. 10 reached the Siliceous lime but did not constitute an adequate test of this lime because the hole is low on the flank of the dome. The center of the NW¼ sec. 14 is recommended as a suitable site to test the Siliceous lime, which would be encountered at a depth of about 2,000 feet.

The total amount of oil produced from the Birch Creek dome, as compiled from records of the Osage Indian Agency, is shown in the following table:

*Oil produced from the Birch Creek dome in sec. 14, T. 28 N., R. 10 E.*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)
NE¼ sec. 14.....	July 1920.....	24, 282
NW¼ sec. 14.....	July 1919.....	74, 118
SW¼ sec. 14.....	February 1925.....	24, 766
		123, 166

**SPRING CREEK DOMES**

Two domes, called herein the Spring Creek domes, lie near the center of the township. The structural closure on each dome is small, and the positions of the structure contour lines as drawn on the east dome are speculative. Oil has been produced from the Burgess sand-Mississippi lime zone in one well on the northeast dome and in several wells on the southwest dome, and gas has been produced from this zone in one well on the southwest dome. The well logs indicate that the oil and gas occur in the uppermost 40 feet of the Mississippi lime, which lies at a depth of about 1,850 feet. The initial daily yields of the oil wells ranged from 5 to 28 barrels. Most of the wells were drilled from 1920 to 1927 and are still producing.

The total amount of oil produced from the Spring Creek domes, as compiled from records at the Osage Indian Agency, is shown in the following table:

*Oil produced from the Spring Creek domes*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)
SW $\frac{1}{4}$ sec. 15.....	June 1927.....	4, 548
NW $\frac{1}{4}$ sec. 16.....	July 1920.....	16, 597
SE $\frac{1}{4}$ sec. 16.....	September 1920.....	30, 711
SW $\frac{1}{4}$ sec. 16.....	October 1917.....	16, 232
NW $\frac{1}{4}$ sec. 21.....	October 1922.....	1, 374
		69, 462

<sup>1</sup> Abandoned in November 1925.

**RATTLESNAKE ANTICLINE**

The subsurface structure contours on plate 6 showing the Rattlesnake anticline, in secs. 30, 29, 20, and 21, are projected mainly from Bowen's structure contour map of the exposed rocks.<sup>4</sup> The altitude of the top of the Oswego lime, is known positively in only two places on the anticline. As shown on plate 6, two subsidiary domes appear on the anticline—one in secs. 20 and 21 and the other in sec. 30. Two wells reached the upper part of the Mississippi lime. The well near the crest of the southwest dome in sec. 30 produces gas from the uppermost part of the Mississippi lime. The dry hole in the southwest corner of sec. 20, which was drilled in 1915, prior to Bowen's examination of the exposed rocks, also tested the Mississippi lime. Additional gas wells probably could be obtained in this lime on the higher parts of the dome in sec. 30, and oil might be found on the flanks. The Siliceous lime also might yield gas or oil on the crest of the dome. Additional gas and oil wells might be obtained in the Mississippi lime on the dome in the SE $\frac{1}{4}$  sec. 20. Drilling depth to the Mississippi lime in secs. 20 and 30 is a little less than 2,000 feet and to the Siliceous lime a little more than 2,200 feet. Inasmuch as most wells in this region have had small daily yields, new wells also would be expected to have relatively small yields.

**WEST MISSION CREEK ANTICLINE**

The West Mission Creek anticline trends northeastward through secs. 33, 34, and the W $\frac{1}{2}$  sec. 27, thence eastward through the E $\frac{1}{2}$  sec. 27 into sec. 26. The anticline contains three subsidiary domes that are separated by shallow saddles.

Oil or gas has been produced on the anticline from five zones. Sixteen wells produced gas and four produced oil from the Burgess sand-Mississippi lime zone, which lies at a depth of about 1,850 feet. The gas or oil in most wells occurs in the uppermost 30 feet of the Mississippi lime, but the Burgess sand, which lies on the lime,

<sup>4</sup> Bowen, C. F., in White, David, and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pl. 8, 1922.

is present and, according to the well logs, yielded gas in two wells. The gas-bearing part of the zone extends from the crest of the anticline 80 feet down the flanks. The few wells that produced oil from the Burgess sand-Mississippi lime zone are low on the north flank of the anticline.

The Peru sand yielded oil for a time in the S½ sec. 27, from five wells that were drilled from 1917 to 1920. It now yields gas in one well. The oil wells were abandoned after recovering slightly less than 500 barrels to the acre. On the middle one of the three domes on the anticline, the Weiser sand yielded gas in two wells in the SW¼ sec. 27 and the NW¼ sec. 34. The initial daily yields of the wells were 1 million and 2 million cubic feet, respectively. The Wayside sand has produced oil in a few wells on the north flank of the anticline. This sand lies at a depth of about 1,260 feet. It is very fine grained and contains thin lenses of shale in well 4 in the NE¼ sec. 27, whose well cuttings were examined with the aid of a microscope. The Musselmem sand yields gas in well 4 in the northeast corner of the SE¼ sec. 27, from a depth of 820 to 830 feet. Well 4 produced initially 3 million cubic feet of gas a day. Several other wells on the anticline also reported shows of gas or oil from the Musselmem sand.

The Siliceous lime has been tested by 5 wells that are low on the flanks of the anticline. This lime might yield gas or oil on the crests of the domes, where it would be reached at a depth of about 2,150 feet. A few additional wells in the N½ sec. 33 and E½ sec. 28 might yield gas from the Burgess sand-Mississippi lime zone. All three of the other zones that yield oil or gas are potential producers in all new wells that may be drilled here, but only small daily yields should be expected.

The total amount of oil produced from the West Mission Creek anticline, as compiled from records at the Osage Indian Agency, is shown in the following table:

*Oil produced from the West Mission Creek anticline*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
NW¼ sec. 22.....	February 1920.....	572	Abandoned in December 1920.
SE¼ sec. 22.....	{ February 1920..... March 1935..... }	5, 104	{ Abandoned in December 1920; redrilled in 1935.
SW¼ sec. 22.....	January 1920.....	729	Abandoned in May 1921.
NE¼ sec. 27.....	May 1934.....	7, 191	
SW¼ sec. 27.....	August 1920.....	201	Abandoned in September 1920.
SE¼ sec. 27.....	December 1919.....	2, 746	Abandoned in July 1921.
		16, 543	

## EAST MISSION CREEK ANTICLINE

The East Mission Creek anticline extends northeastward across sec. 36 and part of sec. 25, T. 28 N., R. 10 E., and parts of secs. 30 and 31, T. 28 N., R. 11 E. The anticline contains two domes whose crests are in the E½ sec. 36. The structural closure on the Oswego lime (pl. 6) is considerably greater than that in the exposed rocks,<sup>5</sup> and the highest point on the crest of the anticline on the Oswego lime lies a little more than a quarter of a mile northeast of its crest in the exposed rocks.

Nine wells on the anticline in secs. 25 and 36 yield gas from the Burgess sand-Mississippi lime zone, which lies at a depth of about 1,880 feet. The gas occurs in the uppermost 50 feet of the Mississippi lime, according to the well logs, although the Burgess sand is reported to be present in about half the wells. The initial daily yields of the wells ranged from 1½ to 2½ million cubic feet. The gas-producing area has been defined by dry holes.

The Siliceous lime might yield gas and possibly oil on the anticline. The center of the west line of the NE¼NE¼ sec. 36 is a favorable site for a well to test the Siliceous lime. It would be reached at a depth of about 2,100 feet.

## SECS. 7, 18, AND 19

A dome of considerable structural closure in secs. 7 and 18 is shown on plate 6, and a dome of low structural relief in sec. 19. The positions of the subsurface structure contours in secs. 7, 18, and 19 are based almost entirely on Bowen's structure contour map of the exposed rocks,<sup>6</sup> because only one well in the area establishes the altitude of the top of the Oswego lime. Any prospecting in these sections, therefore, should be guided by detailed mapping of the exposed rocks.

## T. 28 N., R. 11 E.

T. 28 N., R. 11 E., is in northeastern Osage County. Its north boundary is 4 miles south of the Oklahoma-Kansas State line, and its southeast corner is 8 miles northwest of Bartlesville.

Oil and gas operations in the township began in 1914, when a dry hole was drilled to the Mississippi lime in the NW¼ sec. 20. The well is low on the flank of a structural basin that occupies a large area in the west-central part of the township. The first well to produce gas from the Mississippi lime was drilled in 1921 in the SW¼NW¼ sec. 31, on the East Mission Creek anticline. In the same year a show of gas from the Wayside sand led to development of the gas field on the Woodring anticline. Most of the wells in this field,

<sup>5</sup> Bowen, C. F., in White, David, and others, *Structure and oil and gas resources of the Osage Reservation, Okla.*: U. S. Geol. Survey Bull. 686, p. 53, pl. 8, 1922; Goldman, M. I., and Robinson, H. M., *idem.*, p. 382, pl. 54.

<sup>6</sup> Bowen, C. F., *idem.*, pl. 8.



however, were drilled in 1925, although about 1922 an oil well was completed in the Musselmem sand in the SE $\frac{1}{4}$  sec. 28. In 1934 several wells were drilled to the Peru sand on the Crane dome in secs. 29 and 30, and in 1936 two wells were drilled to the Layton sand in the SW $\frac{1}{4}$  sec. 29.

The subsurface investigation of T. 28 N., R. 11 E. was conducted in 1935, mainly by Otto Leatherrock. Miss Anna L. Weinrich, of the Osage Indian Agency, compiled the data on production in 1938, from records on file at the agency.

### STRUCTURE AND DEVELOPMENT

The buried rocks dip westward across T. 28 N., R. 11 E., at an average rate of about 25 feet to the mile, as measured on the top of the Oswego lime. Several folds interrupt the regional westward dip. The most pronounced of these are the Whaleback, Woodring, and Tongue anticlines, the Crane dome, the large structural basin in the west-central part of the township, and the smaller basin in secs. 24, 25, and 36. The structural basin in the west-central part of the township is noteworthy because it appears to be the largest of such basins in Osage County.<sup>7</sup>

The main structural features in the buried rocks (see pl. 6) are reflected in the attitude of the exposed rocks, as shown by Goldman and Robinson,<sup>8</sup> but they differ considerably in local details. The buried rocks are more steeply folded than the exposed rocks, and the crests of folds in the buried rocks are not directly beneath the crests in the exposed rocks. The exposed rocks in a few localities are cut by faults, but the data on subsurface conditions are too meager to determine the depth to which the rocks are displaced.

The positions of the structure contours as shown on plate 6 are necessarily speculative in much of this township, because there are very few wells from which altitudes of the datum bed could be determined.

Only small amounts of oil and gas have been produced in three small fields in the southwestern part of the township. The oil and gas occur in five zones, which are, in ascending order, the Burgess sand-Mississippi lime zone and the Peru, Wayside, Layton, and Musselmem sands. Only gas is produced from the Burgess sand-Mississippi lime zone, and all the gas wells except two produce from this zone. All the oil wells except one produce from the Peru sand or the Wayside sand. Two wells produce a small amount of gas from the Layton sand and one produces oil from the Musselmem sand. The total amount of gas produced was not learned, but the total amount of

<sup>7</sup> Bass, N. W., Kennedy, L. E., Dillard, W. R., and Leatherrock, Constance, *Subsurface geology of Osage County, Okla.*: U. S. Dept. Interior Press Mem. 105368, pl. 1, 1936.

<sup>8</sup> Goldman, M. I., and Robinson, H. M., in White, David, and others, *Structure and oil and gas resources of the Osage Reservation, Okla.*: U. S. Geol. Survey Bull. 686, pl. 54, 1922.

oil produced to August 31, 1938, was 58,951 barrels. This small yield of oil, which came from 13 wells, offers little encouragement for additional exploration in the township. Furthermore, the geologic facts available do not indicate that large undiscovered pools of oil and gas are present here.

#### WOODRING ANTICLINE

The Woodring anticline is an elongated upfold that trends north-westward through secs. 33 and 28. The crest of the anticline as mapped on the Oswego lime (pl. 6) lies a little more than a quarter of a mile west of its crest in the exposed rocks, as mapped by Goldman and Robinson.<sup>9</sup> A structural terrace in the exposed rocks in the S½ sec. 28 appears as a dome on the top of the Oswego lime.

Gas has been produced on the anticline from the Burgess sand-Mississippi lime zone in seven wells, oil has been produced in nine wells and gas in one well from the Wayside sand, and oil has been produced from the Musselmem sand in one well. The average initial daily yield of the gas wells producing from the Burgess sand-Mississippi lime zone was about 1¼ million cubic feet. According to the drillers, logs, the gas occurs in the uppermost 35 feet of the Mississippi lime, which lies at a depth of about 1,800 feet. The Wayside sand lies at a depth of about 965 feet. The initial daily yields of the oil wells producing from this sand ranged from 10 to 75 barrels. The total amount of oil to the acre recovered from the Wayside sand on the Woodring anticline from 1926 to the end of 1938 is estimated at 350 barrels. The Musselmem sand yielded water in most wells in the field but produced oil in one well at a reported rate of 2 barrels a day. The Musselmem sand lies at a depth of about 475 feet.

It appears likely that a few additional wells in the SW¼ sec. 28 might produce gas from the Mississippi lime and that a few wells in the SW¼ sec. 27, NW¼ sec. 34, and NE¼ sec. 33 might produce oil from the Wayside sand. The yields of the wells would likely be small. The Siliceous lime might yield gas on the crest of the dome. A test well near the center of the SE¼SW¼ sec. 28 would reach the Siliceous lime at a depth of about 2,075 feet.

The total amount of gas produced on the Woodring anticline was not learned. The total amount of oil produced to August 31, 1938, as compiled from the records of the Osage Indian Agency, is shown in the following table:

<sup>9</sup> Goldman, M. I., and Robinson, H. M., op. cit., pl. 54.

*Oil produced from the Woodring anticline*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
SE¼ sec. 28.....	March 1925.....	26,377	Includes 631 barrels produced from 3 wells in April and May 1920.
SW¼ sec. 28.....	January 1926.....	6,005	
NE¼ sec. 33.....	June 1926.....	824	Abandoned in September 1928.
NW¼ sec. 34.....	April 1926.....	3,383	
		36,589	

**CRANE DOME**

The Crane dome, whose crest is in the SW¼ sec. 29, has a structural closure of about 50 feet on the top of the Oswego lime and about 20 feet on the exposed rocks.<sup>10</sup> The crest of the dome on the Oswego lime lies about 1,000 feet southwest of its crest on the exposed rocks.

Oil or gas has been produced on the dome from the Burgess sand-Mississippi lime zone and the Peru and Layton sands. Four gas wells, whose initial daily yields ranged from 1 to 1½ million cubic feet, produce from the Burgess sand-Mississippi lime zone. According to the drillers' logs, however, no Burgess sand is present here and the gas occurs in the uppermost 40 feet of the Mississippi lime. The depth to the top of the Mississippi lime is about 1,920 feet.

Four wells in the SW¼ sec. 29 and the SE¼ sec. 30 on the west flank of the dome produce oil from the Peru sand. This sand is about 40 feet thick and lies at a depth of about 1,275 feet. Microscopic examination of drill samples showed that the reservoir bed is composed of fine-grained, angular sand that contains thin lenses of shale. The initial daily yields of the wells ranged from 10 to 65 barrels. The wells produced a total of 22,362 barrels of oil from January 1934, when production began, to August 31, 1938.

Two wells in the SW¼ sec. 29 produce gas from the Layton sand. The total yield from the wells was not learned, but the initial daily yields were only about 500,000 cubic feet from each well. The Layton sand is about 30 feet thick and lies at a depth of about 800 feet.

Dry hole No. 1 in the SW¼SW¼ sec. 29 on the west flank of the dome reached the Siliceous lime at a depth of 2,183 feet, where it obtained gas in an estimated daily volume of 500,000 cubic feet. Gas in an estimated daily volume of 1½ million cubic feet was encountered at a shallower depth in the uppermost beds of the Mississippi lime.

The gas-producing area in the Mississippi lime and the oil-producing area in the Peru sand probably could be extended somewhat by drilling more wells, but wells with small daily yields would be expected

<sup>10</sup> Goldman, M. I., and Robinson, H. M., op. cit., pl. 54.

## EAST MISSION CREEK ANTICLINE

The northeastern part of the East Mission Creek anticline, which lies mainly in T. 28 N., R. 10 E., extends into secs. 30 and 31, T. 28 N., R. 11 E. Three wells in the NW $\frac{1}{4}$  sec. 31, on the east flank of the anticline, have produced gas from the Burgess sand-Mississippi lime zone, which lies at a depth of about 1,840 feet. The drillers' logs indicate that no Burgess sand is present here and that the gas-bearing zone lies in the uppermost 60 feet of the Mississippi lime. The gas-producing area appears to be defined by dry holes in the NW $\frac{1}{4}$  sec. 31 and the SW $\frac{1}{4}$  sec. 30. The dry hole in the southwest corner of the NW $\frac{1}{4}$  sec. 31 had a show of oil in the Peru sand but failed to become a producing well.

## T. 29 N., R. 9 E.

T. 29 N., R. 9 E., is a fractional township consisting of about 24 square miles in northeastern Osage County. Its north boundary coincides with the Oklahoma-Kansas State boundary, and its south boundary is 18 miles north of Pawhuska.

Oil is produced from two relatively large fields in the township. The Wayside sand is the reservoir bed in most wells. The depth to this producing sand is about 1,450 feet. The Torpedo sand has yielded gas in five wells; the Peru sand has yielded a small amount of oil in one well; and the Burgess sand-Mississippi lime zone has yielded oil or gas in four wells. Two test wells reached the Siliceous lime, but this lime does not yield oil or gas in this fractional township.

A total of 246 wells have been drilled in T. 29 N., R. 9 E., of which 199 produced oil, 8 produced gas, and 39 were dry holes. Up to December 31, 1938, 73 oil wells and 7 gas wells had been abandoned. Drilling in the township began in August 1896, in the NE $\frac{1}{4}$  sec. 13. The well drilled here was the second in Osage County, which at that time was known as Osage Nation. The well was completed in September 1896 as a dry hole, after reaching a total depth of 1,515 feet. In October 1904, well 1 in the NW $\frac{1}{4}$  sec. 17 discovered oil in the Wayside sand at a depth of 1,488 feet. In 1904 and 1905 four shallow gas wells were drilled in sec. 16. By the end of 1905, ten wells had been drilled, the deepest of which in the NE $\frac{1}{4}$  sec. 29, reached the Mississippi lime. Although a few wells in the South Elgin field were drilled as early as 1904 to 1907, most of them were drilled from 1917 to 1920. In the Buck Creek field a few wells were drilled in 1904, others in 1913, and others from 1918 to 1930.

The subsurface investigation of T. 29 N., R. 9 E., was made in 1935, mainly by Otto Leatherock. The data on production were compiled in 1938 by Miss Anna L. Weinrich of the Osage Indian Agency, from records on file at the agency.

**STRUCTURE AND DEVELOPMENT**

The regional dip of the rocks in T. 29 N., R. 9 E., is westward at the rate of 35 feet to the mile, as measured on the top of the Oswego lime. This regional dip is interrupted by a few small folds of low structural relief. There are fewer folds in this township than in most of the townships in eastern Osage County. The individual structural features of the buried rocks correspond broadly to those of the exposed rocks. The two main oil pools appear to be controlled by factors other than the local structure of the rocks. The attitude of the buried rocks is shown on plate 6 by structure contour lines in blue drawn on the top of the Lenapah limestone. It was impractical to use the top of the Oswego lime as the datum for drawing the structure contours for this township, as has been done for most townships in Osage County, because so few wells reached the Oswego lime.

**SOUTH ELGIN FIELD**

The South Elgin field occupies a triangular area that lies in the north-central part of the township. The field was developed as a southward extension of the Elgin field of Kansas. A few wells were drilled here from 1904 to 1907, but most of the wells were drilled from 1917 to 1920. Many wells, most of them on the east margin of the field, have been abandoned. The initial daily yields of the wells ranged from 5 to 800 barrels, but for most wells were about 100 barrels. The oil occurs in the Wayside sand at a depth of about 1,400 feet. The lensing out of the oil-bearing sand appears to control the occurrence of oil in this field, rather than the attitude of the rocks. The oil pool extends eastward from a position low on the northeast flank of the Benchmark anticline across the syncline in secs. 15 and 22 and for a considerable distance up the flank of the monocline that occupies the eastern third of the township. The logs of several dry holes in secs. 14, 23, and 26 show definitely that the reservoir sand pinches out on the east margin of the field, and the logs of dry holes in secs. 16, 21, 22, and 27 indicate that the sand probably becomes shaly on the southwestern margin of the pool also.

One well in the northeast corner of sec. 21 produces oil from the uppermost beds of the Mississippian lime; no Burgess sand is present here. The initial daily yield of this well was 7 barrels at a depth of 2, 170 feet.

The total amount of oil produced from the South Elgin field, except that produced prior to July 1916, is shown in the following table:

*Oil produced from the South Elgin field*

Tract	Date of first production	Production July 1916 to Aug. 31, 1938 (barrels)	Remarks
NW¼ sec. 14.....	March 1919.....	196, 998	Abandoned in December 1935.
SW¼ sec. 14.....	January 1919.....	137, 210	Abandoned in June 1935.
NE¼ sec. 15.....	July 1919.....	88, 889	
NW¼ sec. 15.....	Prior to July 1916.....	108, 894	
SW¼ sec. 15.....	January 1918.....	96, 390	
SE¼ sec. 15.....	December 1917.....	233, 883	
NE¼ sec. 16.....	Prior to July 1916.....	99, 417	Abandoned in November 1932.
NW¼ sec. 16.....	February 1920.....	15, 438	Do.
SE¼ sec. 16.....	September 1921.....	2, 681	
NE¼ sec. 17.....	March 1921.....	17, 624	
NW¼ sec. 17.....	Prior to July 1916.....	41, 353	
NE¼ sec. 18.....	do.....	11, 144	
NE¼ sec. 21.....	August 1927.....	2, 142	
NE¼ sec. 22.....	July 1917.....	294, 589	
NW¼ sec. 22.....	March 1918.....	63, 135	
SE¼ sec. 22.....	January 1920.....	129, 055	
NW¼ sec. 23.....	May 1919.....	12, 715	Abandoned in December 1930.
SW¼ sec. 23.....	June 1920.....	3, 124	Abandoned in January 1928.
NE¼ sec. 27.....	August 1920.....	34, 456	Abandoned in June 1933.
		1, 589, 137	

**BUCK CREEK FIELD**

The Buck Creek oil field lies low on the southwest flank of the Benchmark anticline and occupies parts of secs. 17 to 21. A few dry holes were drilled in this area as early as 1904 to 1906, but the systematic development of the oil field began in 1912. The initial daily yield of the wells ranged from a few barrels to 500 barrels, but for most wells was about 25 barrels. The initial daily yields in the Buck Creek field were less than in the South Elgin field. The total yield to the acre has been about 1,000 barrels. The oil is produced from the Wayside sand at a depth of about 1,500 feet. The Wayside sand pinches out on the southwest and south margins of the field, as shown by the logs of dry holes in secs. 19, 20, and 29. A few dry holes east of the field define the eastern limit of the oil-bearing area. The data available suggest that the producing area might be extended northward in sec. 17.

Well 12 in the SE¼ sec. 18 produces oil from the Peru sand at a depth of about 1,775 feet. This well was drilled in 1921 and yielded initially 7 barrels a day. It was temporarily abandoned in 1933 but was again placed in production in 1937. On August 31, 1938, the well had produced a total of 14,481 barrels. The Peru sand was reported in the logs of a few other wells in the field but did not yield oil or gas.

The amount of oil produced from the Buck Creek field is shown in the following table:

*Oil produced from the Buck Creek field*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
SE¼ sec. 17.....	September 1921.....	19, 381	Amount produced in 1933 not included.
SW¼ sec. 17.....	September 1917.....	124, 243	
SE¼ sec. 18.....	1921.....	14, 481	
			Produced 13,862 barrels from 1921 to November 1933, and 619 barrels from April 1937 to August 31, 1938.
SE¼ sec. 20.....	June 1921.....	37, 968	Abandoned in November 1936.
SW¼ sec. 20.....	1918.....	46, 816	
NE¼ sec. 20.....	1918.....	169, 708	Amount produced prior to July 1916 not included.
NW¼ sec. 20.....	Prior to July 1916.....	135, 111	
SW¼ sec. 21.....	April 1922.....	42, 088	Abandoned in August 1936.
NW¼ sec. 21.....	April 1923.....	10, 411	
		600, 297	

**BENCHMARK ANTICLINE AND DOMES IN SECS. 28, 29, 32, AND 33**

The Benchmark anticline is a broad fold whose crest trends south-eastward through secs. 17, 16, and 21. A low structural saddle crosses the anticline in the SW¼ sec. 16 and divides the anticline into two domes. The crest of the southeast dome is in the NE¼ sec. 21, but the data are too few to define the northwest dome closely.

Gas was produced for a time from the Torpedo sand in five wells in the SW¼ sec. 16 and the NW¼ sec. 21, and it is now produced from the Mississippi lime in one well and in the NE¼SW¼ sec. 16, in the saddle between the domes. At least one of the gas wells was drilled as early as 1904. Oil is produced from the Wayside sand in a few wells in the N½ sec. 17 and the northeast corner of sec. 18. The total amount produced however, is small. Oil is produced from the Mississippi lime in one well in the northeast corner of sec. 21, but that well is described in connection with the South Elgin field. A well in the NE¼ sec. 28, low on the south-plunging nose of the anticline, produced initially 10 barrels of oil and 1½ million cubic feet of gas a day from the Mississippi lime. It was completed as a gas well.

More wells with small daily yields might be obtained by drilling to the Wayside sand in the W½ sec. 17, and gas might be found in the Siliceous lime on the crest of the dome in the NW¼NE¼ sec. 21.

A well on a small dome in the NE¼ sec. 32 produced a small amount of oil and gas from the uppermost beds of the Mississippi lime. The initial daily yield of this well was reported to be 6 barrels of oil and 1½ million cubic feet of gas.

**T. 29 N., R. 10 E.**

T. 29 N., R. 10 E., is a fractional township that embraces about 24 square miles in northeastern Osage County. Its north boundary

coincides with the Oklahoma-Kansas State boundary, and its southeast corner is about 16 miles northwest of Bartlesville.

About 170 wells have been drilled in the township, of which 92 produced oil, 47 produced gas, and 31 were dry. Of these, 23 oil wells and 29 gas wells have been abandoned. Seven zones have yielded oil or gas. Only 1 well produced oil from the upper beds of the Siliceous lime. This well, which is in the SW $\frac{1}{4}$  sec. 34 produced a total of only 452 barrels. The upper beds of the Mississippi line have produced oil and gas in many wells in several places in the township. The Peru sand yields oil in 1 well in the SW $\frac{1}{4}$  sec. 35. The Weiser sand produces oil or gas in many wells in secs. 34 and 35, and the Wayside sand is the main producing zone in secs. 14, 15, 23 and 24. The Layton sand produces oil in 2 wells in secs. 14 and 15, and the Musselshell sand has yielded a small amount of gas in the NE $\frac{1}{4}$  sec. 34.

Well 1, in the NE $\frac{1}{4}$  sec. 13, drilled in 1896 by the Phoenix Oil Co., was the first well drilled in Osage County. It was drilled to a total depth of 1,100 feet and penetrated the Wayside sand. It is reported to have had only a small show of oil. Most of the wells on the Pond Creek dome were drilled from 1912 to 1917. Most of those on the North Caney River anticline were drilled in 1925 and 1926, although a few were drilled as early as 1917. Most of the wells on the West Turkey Creek anticline were drilled in 1917 and 1918.

The subsurface investigation of T. 29 N., R. 10 E., was conducted in 1935, mainly by Otto Leatherrock. The production statistics were compiled in 1938 by Miss Anna L. Weinrich, of the Osage Indian Agency, from records on file at the agency.

### STRUCTURE AND DEVELOPMENT

The regional dip of the rocks in T. 29 N., R. 10 E., is westward at the rate of 38 feet to the mile, as measured on the top of the Oswego lime. This regional dip is interrupted by several folds, of which the West Turkey Creek and North Caney River anticlines and the north half of the Pond Creek dome are the most pronounced.

The structural features of the buried rocks conform in general with those in the exposed rocks,<sup>11</sup> except that these features are more pronounced in the buried rocks and that the crests of the folds are not directly beneath the crests in the exposed rocks.

#### WEST TURKEY CREEK ANTICLINE

The West Turkey Creek anticline is a narrow fold that extends northwestward through sec. 25 and the NE $\frac{1}{4}$  sec. 26, thence northward through the E $\frac{1}{2}$  sec. 23, W $\frac{1}{2}$  sec. 24, W $\frac{1}{2}$  sec. 13, and E $\frac{1}{2}$  sec. 14. (See pl. 6.) The crest of the anticline on the top of the Oswego lime

<sup>11</sup> Bowen, C. F., in White, David, and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pp. 43-58, pl. 8, 1922.



through most of its length lies more than half a mile west of its crest in the exposed rocks.

Although no oil or gas is now being produced on the West Turkey Creek anticline, both were produced there for many years. Several wells produced oil from the Wayside sand at a depth of about 1,100 feet. The initial daily yields of these wells ranged from 25 to 60 barrels. The thickness of the Wayside sand as recorded in the well logs ranged from 5 to 23 feet, and the areas of thicker sand supplied the wells with the large daily yields. Six wells on the West Turkey Creek anticline produced oil and one well produced gas from the Burgess sand-Mississippi lime zone. According to the well logs, the Burgess sand is absent and the oil and gas occur in the uppermost 60 feet of the Mississippi lime. The initial daily yields of the oil wells ranged from 15 to 60 barrels.

The total amount of oil recovered from the West Turkey Creek anticline from 1917 to August 1938 was about 700 barrels to the acre. The small total yields of the wells offer little encouragement for additional exploration in the field. Gas might be found in the Siliceous lime, however, on the crests of the small domes on the anticline, where the lime would be encountered at a depth of about 1,950 feet.

The total amount of oil produced from the West Turkey Creek anticline, as compiled from records of the Osage Indian Agency, is shown in the following table:

*Oil produced from the West Turkey Creek anticline*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
NW¼ sec. 24.....	June 1917.....	59,933	Abandoned in November 1938.
SW¼ sec. 24.....	July 1917.....	4,631	Do.
SE¼ sec. 23.....	March 1917.....	20,808	Abandoned in April 1930.
NE¼ sec. 23.....	September 1917.....	15,378	Do.
		100,750	

#### NORTH CANEY RIVER ANTICLINE

The North Caney River anticline occupies about 2 square miles in the northern part of this fractional township. The structural closure of the anticline is about 50 feet on the top of the Oswego lime. Oil has been produced from the Wayside sand in many wells on the northeast flank of the anticline; gas and oil have been produced from the Burgess sand-Mississippi lime zone in several wells that are widely separated on the anticline; and a small amount of oil has been produced from the Layton sand in two wells on the northeast flank.

The oil pool in the Wayside sand extends from a point in the NE¼SE¼ sec. 15, where the rocks are about 20 feet lower structurally than on the crest of the dome, to the NW¼NW¼ sec. 14, where the

rocks are about 70 feet lower than on the crest. The depth to the oil-bearing sand is a little less than 1,100 feet in most wells. During a life of 13 years, the total amount of oil produced from the Wayside sand has been about 1,000 barrels to the acre. The initial daily yields of the wells ranged from 2 to 75 barrels. Wells with the larger daily yields are in parts of the field in which the sand is thicker. Most of the wells with very small daily yields are in parts of the field in which the sand is only a few feet thick. The sand pinches out in the SE $\frac{1}{4}$  and the W $\frac{1}{2}$  sec. 15, a short distance southwest of the oil pool.

Two wells in the NE $\frac{1}{4}$  sec. 15 and the NW $\frac{1}{4}$  sec. 14 produce from the Layton sand at depths of 833 and 920 feet, respectively. These wells were drilled in 1926 and are still producing. Their initial daily yields were small, and the probability of further commercial development is doubtful.

Twelve wells have produced gas and three have produced oil from the Burgess sand-Mississippi lime zone, at depths that ranged from 1,630 to 1,760 feet. All oil wells and all except 3 of the gas wells have been abandoned. The initial daily yields of the oil wells ranged from 8 to 50 barrels, and their total yield through a life of 8 years was only 3,454 barrels. The initial daily yields of the gas wells ranged from 1 million to 6 million cubic feet, but the total yield of gas was not learned. Gas has been produced not only on the crest of the anticline but also on its flank at a point as far as 75 feet below the crest. The gas and oil occur in the uppermost porous beds of the Mississippi lime; the Burgess sand, according to the well logs, appears to be absent. It might be advisable to deepen into the Mississippi lime a few wells in secs. 15 and 14 that now produce oil from the Wayside sand. The Siliceous lime might yield oil or gas—more likely gas—on the crest of the anticline. This lime was tested by well 13, in the northwest corner of the SE $\frac{1}{4}$  sec. 15, on the northeast flank of the anticline.

The total amount of oil produced from the North Caney River anticline, as compiled from records of the Osage Indian Agency, is shown in the following table:

*Oil produced from the North Caney River anticline*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
NW $\frac{1}{4}$ sec. 14.....	August 1925.....	45,588	Amount produced in August 1938 not included.
SW $\frac{1}{4}$ sec. 14.....	January 1926.....	5,593	
SE $\frac{1}{4}$ sec. 15.....	November 1925.....	51,500	Do.
NE $\frac{1}{4}$ sec. 15.....	December 1925.....	106,009	
NW $\frac{1}{4}$ sec. 16.....	May 1918.....	3,454	Abandoned in February 1926.
NW $\frac{1}{4}$ sec. 23.....	July 1917.....	2,254	
		217,557	Abandoned in April 1930.

## POND CREEK DOME

The northern part of the Pond Creek dome occupies an area of a little more than 3 square miles in the southern part of the township. This part of the dome includes a small subsidiary dome in the S½ sec. 27, an anticlinal nose that trends southwestward through the W½ sec. 34 and the S½ sec. 33, and a small structural basin in sec. 35.

Oil or gas has been produced on the Pond Creek dome from five zones; these are, in ascending order, the top beds of the Siliceous lime, the Burgess sand-Mississippi lime zone, the Peru sand, the Weiser sand, and the Musselmem sand. Only the Burgess sand-Mississippi lime zone and the Weiser sand produce in more than a very few wells. The Siliceous lime yielded a total of 452 barrels of oil in well 3,440, in the SE¼SW¼ sec. 34, during its life of three years. Well 154, in the W½SE¼ sec. 34, tested the Siliceous lime but obtained only a show of oil from it at a depth of 1,810 feet.

The uppermost beds in the Mississippi lime, which are herein included in the Burgess sand-Mississippi lime zone, have yielded oil and gas in an extensive area on the Pond Creek dome at a depth of about 1,650 feet. The initial daily yields of the oil wells ranged from 5 to 20 barrels, and the yields of the gas wells ranged from 1 to 7½ million cubic feet. All but 6 of the 13 oil wells and all but 10 of the 28 gas wells have been abandoned.

The Peru sand, which lies at a depth of about 1,200 feet, yields oil in well 7, in the SW¼ sec. 35, and it yielded gas for a time in well 3439, in the NE¼ sec. 34. The initial daily yield of the oil well was 2 barrels, and that of the gas well was 2½ million cubic feet.

The Weiser sand has yielded oil in 19 wells, 5 of which have been abandoned, and gas, at a depth of about 1,100 feet, in two wells. The initial daily yields of the oil wells ranged from 10 to 260 barrels, but the yields of most wells were less than 50 barrels. Most of the wells were drilled in 1913 and 1914. The logs of wells in the oil pool and the area surrounding it indicate that the oil-bearing sand is lenticular and that the limits of the pool in this sand are probably determined by the lensing out of the permeable part of the sand rather than by the attitude of the rocks. The oil and gas pool in the Weiser sand lies on the northeast flank of the Pond Creek dome. The sand is structurally 50 feet lower at the southeast margin of the pool than at the southwest margin. The total amount of oil produced from the Weiser sand was not learned, because the records of the amount produced prior to July 1916 were not available. This sand, however, yielded about 850 barrels to the acre from July 1916 to August 1938.

The Musselmem sand supplied shows of gas in many wells on the Pond Creek dome and yielded gas for a time in well 420 in the southwest corner of the NE¼ sec. 34. The sand lies at a depth of 490 feet

in this well. The initial daily yield of the well was 800,000 cubic feet.

The total amount of oil produced from the northern part of the Pond Creek dome, as compiled from records of the Osage Indian Agency, is shown in the following table:

*Oil produced from the Pond Creek dome*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
NE¼ sec. 34.....	Prior to July 1916.....	59,967	Amount produced in August 1938 not included.
SE¼ sec. 34.....	.....do.....	22,317	Amount produced from May to August 1938 not included.
SW¼ sec. 35.....	.....do.....	48,053	Abandoned in July 1927.
SE¼ sec. 33.....	September 1921.....	2,649	Amount produced from well 3434 to 1920.
NW¼ sec. 34.....	April 1918.....	431	Abandoned in July 1920.
SW¼ sec. 34.....	May 1919.....	452	
NW¼ sec. 35.....	Prior to July 1916.....	40,288	
		174,157	

#### SEC. 29

Three wells were drilled, one in 1920 and two in 1925, in the SE¼ sec. 29 on a broad, gently dipping anticlinal nose. These wells produced gas at initial daily rates of 1,000,000 to 2,400,000 cubic feet from the uppermost beds of the Mississippi lime at a depth of about 1,750 feet. Other producing wells might be obtained to the southeast along the crest of the anticlinal nose.

#### T. 29 N., R. 11 E.

T. 29 N., R. 11 E., is a fractional township that comprises about 24 square miles in northeastern Osage County. Its north boundary coincides with the Oklahoma-Kansas State line, and its southeast corner is 13 miles northwest of Bartlesville.

About 330 wells have been drilled in this township, of which 252 have produced oil, 12 have produced gas, and 66 were dry holes. Oil or gas has been produced from four zones, of which the Wayside sand is the main producing zone. The Burgess sand-Mississippi lime zone and the Weiser and Layton sands have yielded small amounts of oil or gas in a few wells.

In 1903 and 1904 gas wells producing from the Wayside sand were completed in the N½ sec. 15, and most of the wells producing from this sand in secs. 17 and 18 were also drilled in those years. These producing areas represent southward extensions of producing fields in Kansas. In 1907 the oil field in secs. 15 and 16 was extended southward into sec. 21, and from 1917 to 1927 it was further extended southward into sec. 27. A well that produced initially 500 barrels a

day was drilled in the NE $\frac{1}{4}$  sec. 35 in 1920. This was followed rapidly by the drilling of most of the wells in the pool that lies mainly in sec. 35. Three wells in the NE $\frac{1}{4}$  sec. 36 were drilled from 1920 to 1926. The wells in the SW $\frac{1}{4}$  sec. 31 were drilled in 1914. One well in the NW $\frac{1}{4}$  sec. 29 was drilled in 1915, but most of those in secs. 29 and 30 and the SW $\frac{1}{4}$  sec. 20 were drilled from 1919 to 1921.

The subsurface investigation of T. 29 N., R. 11 E., was conducted in 1935, mainly by L. E. Kennedy and Otto Leatherrock. The data on production were compiled in 1938 by Miss Anna L. Weinrich of the Osage Indian Agency, from records on file at the agency.

### STRUCTURE AND DEVELOPMENT

The regional dip of the rocks in T. 29 N., R. 11 E., is westward at the rate of about 27 feet to the mile as measured on the top of the Oswego lime. The subsurface structure contour lines shown in blue on plate 6 were drawn on the top of the Lenapah limestone because most wells penetrated this limestone but did not reach the deeper lying Oswego lime, which is the datum used for drawing the subsurface contours for most of Osage County. The regional dip is not uniform, however, but is modified by several anticlines, domes, synclines, and structural basins.

The main folds are the North Skull Creek and South Skull Creek anticlines in the central part of the township and the North Gobbler and South Gobbler anticlines in the western part of the township. The folds in the buried rocks (see pl. 6) are similar in general to the folds in the exposed rocks;<sup>12</sup> but the buried rocks are more steeply folded than the exposed rocks, and the crests of the folds in the buried rocks do not lie directly beneath the crests in the exposed rocks.

### HICKORY CREEK FIELD

The Hickory Creek field extends in a long narrow belt from sec. 16 southeastward to sec. 36, nearly across the township. A narrow prong of the field extends northeastward through the S $\frac{1}{2}$  sec. 15 and the W $\frac{1}{2}$  sec. 14. The oil and gas occur mainly in the Wayside sand at depths ranging from about 900 to 1,000 feet. Most wells in the field produce oil; a very few produce gas. Two wells produce oil from the Layton sand, one well produces oil from the Weiser sand, and a few others produce oil or gas from the Burgess sand-Mississippi lime zone.

The field is in an area in which the rocks are folded into several low domes, anticlines, synclines, and structural basins. (See pl. 6.) The oil-producing area extends across tracts whose rocks are structurally high and other tracts whose rocks are structurally low. In the

<sup>12</sup> Goldman, M. I., in White, David, and others. Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pp. 335-346, pl. 49, 1922.

most productive part of the field, which is in the NE $\frac{1}{4}$  sec. 35, the rocks are structurally low. The maximum difference in altitude of the Wayside sand in the oil-producing part of the field is 110 feet. Although the attitude of the beds does not appear to control the occurrence of the oil in the Wayside sand, it appears to have influenced to some extent the segregation of the oil and gas, as the Wayside sand yields gas on the dome in sec. 34 and has yielded gas in one well on the dome in sec. 16, but elsewhere it yields oil. The logs of many dry holes a short distance to the southwest of the field and of others a short distance to the northeast show that the Wayside sand pinches out on the margins of the field. Therefore, it appears reasonable to conclude that the occurrence of the oil is controlled mainly by the distribution of the Wayside sand.

The few wells that produce from the Burgess sand-Mississippi lime zone appear to obtain their oil and gas from the uppermost 40 feet of the lime. The data available indicate that the yields of the wells have been small. A few wells in the field have tested the Siliceous lime, but none appear to be favorably situated structurally.

The initial daily yields of the oil wells producing from the Wayside sand ranged from less than 10 barrels to 500 barrels, but the yields of most wells were less than 50 barrels. The initial daily yields of many wells in the NE $\frac{1}{4}$  sec. 35 ranged from 80 to 200 barrels. The average yield to the acre in the Hickory Creek field to August 31, 1938, was about 1,000 barrels. The total yield to the acre in the NE $\frac{1}{4}$  sec. 35 alone, however, was about 3,000 barrels. Although the average daily yield of the wells in the field is small, the wells are long-lived. Many of them have been producing for more than 20 years.

The initial daily yields of the gas wells producing from the Wayside sand in sec. 34 ranged from 1,000,000 to 2,300,000 cubic feet. Gas was produced for a time in one well on the dome in sec. 26, but the yield was not learned.

A few additional oil wells producing from the Wayside sand might be obtained in the NE $\frac{1}{4}$  sec. 34 and the NW $\frac{1}{4}$  sec. 35, in the gap between the producing areas in these sections. Gas might be produced from the uppermost beds of the Mississippi lime and from the uppermost beds of the Siliceous lime on the crest of the South Skull Creek anticline in the NE $\frac{1}{4}$  sec. 34. The possible gas-bearing zone in the Mississippi lime would be encountered at a depth of about 1,700 feet, and the gas-bearing part of the Siliceous lime would be reached at a depth of about 2,050 feet.

The total amount of oil produced from the Hickory Creek field, as compiled from records of the Osage Indian Agency, is shown in the following table:

*Oil produced from the Hickory Creek field*

Tract	Date of first production	Production to Aug. 31, 1938 (barrels)	Remarks
NW $\frac{1}{4}$ sec. 14.....	March 1921.....	35, 843	
SW $\frac{1}{4}$ sec. 14.....	March 1920.....	126, 341	
SW $\frac{1}{4}$ sec. 15.....	Prior to July, 1916.....	17, 413	Abandoned in October 1932.
SE $\frac{1}{4}$ sec. 15.....	December 1919.....	70, 749	
NE $\frac{1}{4}$ sec. 16.....	September 1917.....	2, 683	Abandoned in March 1923.
NW $\frac{1}{4}$ sec. 16.....	.....do.....	4, 597	Abandoned in July 1925.
SE $\frac{1}{4}$ sec. 16.....	Prior to July 1916.....	52, 009	
NE $\frac{1}{4}$ sec. 21.....	.....do.....	65, 921	
SE $\frac{1}{4}$ sec. 21.....	March 1919.....	21, 626	
NW $\frac{1}{4}$ sec. 22.....	July 1918.....	30, 308	
SW $\frac{1}{4}$ sec. 22.....	June 1920.....	103, 294	
SW $\frac{1}{4}$ sec. 25.....	October 1920.....	12, 298	
SW $\frac{1}{4}$ sec. 26.....	March 1921.....	7, 450	Abandoned in January 1928.
SE $\frac{1}{4}$ sec. 26.....	September 1920.....	86, 145	
NE $\frac{1}{4}$ sec. 27.....	June 1924.....	3, 303	Abandoned in September 1933.
NW $\frac{1}{4}$ sec. 27.....	November 1923.....	203, 172	
SW $\frac{1}{4}$ sec. 27.....	May 1923.....	93, 768	
SE $\frac{1}{4}$ sec. 27.....	August 1924.....	113, 885	
NE $\frac{1}{4}$ sec. 34.....	February 1925.....	39, 239	
NW $\frac{1}{4}$ sec. 34.....	May 1925.....	788	Abandoned in August 1927.
NE $\frac{1}{4}$ sec. 35.....	April 1920.....	480, 173	
NW $\frac{1}{4}$ sec. 35.....	.....do.....	121, 098	
SW $\frac{1}{4}$ sec. 35.....	June 1921.....	14, 184	Abandoned in December 1927.
SE $\frac{1}{4}$ sec. 35.....	May 1921.....	1, 268	Abandoned in February 1923.
NW $\frac{1}{4}$ sec. 36.....	August 1920.....	141, 869	
SW $\frac{1}{4}$ sec. 36.....	May 1921.....	3, 846	Abandoned in October 1927.
		1, 853, 270	

**NE $\frac{1}{4}$  SEC. 36**

Several wells, a few of which have produced oil, have been drilled in the NE $\frac{1}{4}$  sec. 36 and the SE $\frac{1}{4}$  sec. 25. Two wells produced initially 5 barrels of oil a day from the Wayside sand, and three wells produced initially from 2 to 8 barrels a day from the Weiser sand. The Wayside sand lies at a depth of about 900 feet, and the Weiser sand at a depth of about 1,000 feet. Oil was first produced here in 1925, and the total yield to August 31, 1938, was 18,830 barrels.

**NORTH GOBBLER AND SOUTH GOBBLER ANTICLINES**

Two broad anticlines that are arranged en échelon extend north-eastward through the west half of the township. Sixteen wells have been drilled on the anticlines, but only a few in the SW  $\frac{1}{4}$  sec. 20, NW $\frac{1}{4}$  sec. 29, and the NE $\frac{1}{4}$  sec. 30 have produced oil. Most of the wells reached the Mississippi lime, and two wells reached the Siliceous lime. The well in the NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$  sec. 20 was drilled in 1921, and after producing a total of only 316 barrels from the Mississippi lime it was abandoned. The wells in the NW $\frac{1}{4}$  sec. 29 and the NE $\frac{1}{4}$  sec. 30 produced for about 4 years from the Burgess sand-Mississippi lime zone, which was encountered at a depth of about 1,700 feet. The well logs indicate that the Burgess sand is absent here and that the oil occurs in the uppermost beds of the Mississippi lime. These wells were

drilled in 1918 and 1919 and were abandoned in 1923; their initial daily yields ranged from 5 to 20 barrels. A total of 3,471 barrels of oil was produced from the wells in the NW¼ sec. 29, and a total of 10,752 barrels from the wells in the NE¼ sec. 30.

Well 162 in the SE¼ sec. 31, near the crest of the South Gobbler anticline, is reported to have produced a show of oil in the Mississippi lime, but it yielded water from the Siliceous lime, which was encountered at a depth of 1,748 feet.

#### SW¼ SEC. 31

Some oil and gas have been produced from the uppermost beds of the Mississippi lime in the SW¼ sec. 31. The initial daily yield of the one gas well was reported as 1½ million cubic feet, and the initial daily yields of the two oil wells were reported as 8 and 225 barrels respectively. Some of these wells were drilled in 1914. The total yield of oil and gas was not learned.

#### SECS. 17 AND 18

About 20 wells were drilled in 1903 and 1904 in the northern parts of secs. 17 and 18. Most of these wells produced oil for several years from the Wayside sand at depths ranging from about 1,000 to 1,100 feet. The producing area represents a southward extension of an oil pool that lies mainly north of the State boundary, in Kansas. These early wells were abandoned after producing for about 5 years, and the amount of oil produced from them was not learned. A few dry holes were drilled from 1919 to 1925 in secs. 17 and 18 outside the oil pool, and four wells that produced were drilled in the old, abandoned field in 1927. These four wells are still producing. The total yield from them to August 31, 1938, was 12,952 barrels.

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