UNITED STATES DEPARTMENT OF THE INTERIOR

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

PART 4. TOWNSHIPS 24 AND 25 NORTH
RANGES 10 AND 11 EAST

GEOLOGICAL SURVEY BULLETIN 900–D

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary
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W. C. Mendenhall, Director

Bulletin 900–D

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

PART 4. Townships 24 and 25 North Ranges 10 and 11 East

BY

L. E. KENNEDY, J. D. McCLURE
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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. Shamblin, 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 acknowledgement is here made of many suggestions made by him during the progress of the investigation and during the preparation of the manuscript. Grateful acknowledgement 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.

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By L. E. KENNEDY, J. D. MCCLURE, H. D. JENKINS, and N. W. BASS

ABSTRACT

The four townships—Tps. 24 and 25 N., Rs. 10 and 11 E.—whose subsurface geology and oil and gas resources are described in this report, lie in east-central Osage County, Okla., a few miles southwest of Bartlesville. They contain many oil and gas fields, including, in whole or in part, the Pershing, Avant, Barnsdall, Woolaroc and Quapaw fields. About 2,350 wells have been drilled. Of these, several that are still producing oil were drilled as early as 1905 and 1906. Most of the other wells were drilled prior to 1923, although some drilling is still in progress. Oil or gas is produced from 10 zones, but the Bartlesville sand is the producing bed in most wells. Depths to the Bartlesville range from about 1,600 to 2,100 feet. It is noteworthy that the Siliceous lime, which is a prolific producer of oil in southern Osage County, yields only gas in these four townships.

Tps. 24 and 25 N., Rs. 10 and 11 E., are part of a broad region that includes most of northeastern Oklahoma in which the rocks dip westward at an average rate of about 40 feet to the mile. This regional dip is not uniform, however, but is interrupted by domes, anticlines, synclines, and basins, most of which have structural closures of less than 100 feet on the Oswego lime. The top of the Oswego lime (Fort Scott limestone) is the subsurface datum bed used in drawing the structure contour lines shown on plate 4.

Gas in the Ordovician beds, and to a less extent in other beds, appears to be concentrated in the structurally higher parts of the domes and anticlines. The occurrence of oil in the Bartlesville sand and in the Jones and Cleveland sand zone and probably in some of the other sands appears to be controlled by the distribution of the reservoir rocks rather than by their structural attitude.

The investigation has shown that in Tps. 24 and 25 N., Rs. 10 and 11 E., there are several localities where prospecting may reveal accumulations of oil and gas as yet unknown. Much oil will eventually be produced by repressuring the Bartlesville sand or the Jones and Cleveland sand zone with gas or water in fields that derive their oil from these zones. The Avant field in T. 24 N., R. 11 E., is being repressured with gas and is giving a satisfactory yield.

INTRODUCTION

The subsurface geologic features, the oil- and gas-producing beds, and the areas that are favorable for the discovery of additional oil and gas in Tps. 24 and 25 N., Rs. 10 and 11 E., Osage County, Okla., are described in this report, which is the fourth of a series of reports

covering 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 are shown on the accompanying map (pl. 4). The oil- or gas-bearing beds in producing and abandoned wells and the deepest beds penetrated in dry holes are shown on the map by colors printed over the black well symbols. Wells that produced oil or gas from beds of shallow depth and were drilled deeper to test older rocks are indicated by special symbols.

All the oil- and gas-producing beds in Tps. 24 and 25 N., Rs. 10 and 11 E., are described briefly, but the other rocks that have been penetrated are not described. All rocks penetrated by the drill are shown graphically, however, in a generalized columnar section on plate 4. In this columnar section each bed that produces oil or gas is indicated by a colored circle. Circles in correspondent colors are used as overprints on the well symbols on the structure-coutour map. The oil- and gas-producing beds in each of the four townships are shown also in the following table:

Oil- or gas-producing beds in Tps. 24 and 25 N., Rs. 10 and 11 E., Osage County, Okla.

T. 24 N., R. 10 E.	T. 25 N., R. 10 E.	T. 24 N., R. 11 E.	T. 25 N., R. 11 E.
Mussellem and Peoples sand zone.			
Layton sand.			
Jones and Cleveland sand zone.			
Big lime.			Big lime.
Peru sand.		Peru sand.	
	Oswego lime.	Oswego lime.	Oswego lime.
	Squirrel sand.		
Bartlesville sand.	Bartlesville sand.	Bartlesville sand.	Bartlesville sand.
Burgess sand-Mississippi lime zone.	Burgess sand-Mississippi lime zone.	Burgess sand-Mississippi lime zone.	Burgess sand-Mississippi lime zone.
Simpson formation or Siliceous lime.	Siliceous lime.	Simpson formation or Siliceous lime.	Simpson formation or Siliceous lime.

All rocks exposed in Tps. 24 and 25 N., Rs. 10 and 11 E., belong to the Nelagoney and Ochelata formations of the Pennsylvanian series. Their distribution is shown on the geologic map of Oklahoma by Miser.[1] The distribution and description of many key beds and the structural attitude of the exposed rocks were set forth many years ago by Hopkins, Powers, Bowen, Winchester, and Heald,[2] who also prepared structure contour maps of the area. These maps were used extensively in drawing the structure contour lines on plate 4, particularly in areas for which few or no specific data on the attitude of the buried rocks are available.

[1] Miser, H. D., Geologic map of Oklahoma, U. S. Geol. Survey, 1926.

[2] Hopkins, O. B., and Powers, Sidney (T. 24 N., R. 11 E.), Hopkins, O. B. (T. 25 N., R. 11 E.), Bowen, C. F. (T. 24 N., R. 10 E.), Winchester, D. E., Heald, K. C., and others (T. 25 N., R. 10 E.), in White, David and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pp. 17–26, 59–90, 237–253, 1922.

OIL- AND GAS-PRODUCING BEDS

Oil or gas has been produced in Tps. 24 and 25 N., Rs. 10 and 11 E., from 10 zones, ranging from the upper part of the Siliceous lime of Ordovician age to the Mussellem and Peoples sand zone of Pennsylvanian age. The Siliceous lime in these four townships has yielded only gas, although this lime is a prolific oil producer in many places in southern Osage County. The main part of the area in Osage County in which the Burgess sand-Mississippi lime zone is the producing zone forms a broad northeastward-trending belt that extends a short distance northwest of these four townships. Drilling to this zone, however, in Tps. 24 and 25 N., Rs. 10 and 11 E., has so far found gas in only a few wells and small amounts of oil in a very few. The Bartlesville sand in these four townships has yielded many times as much oil as all the other producing zones combined. It has yielded oil or gas in every section in T. 24 N., R. 11 E., in several large fields in T. 24 N., R. 10 E., and in T. 25 N., R. 11 E. Wells producing from the Bartlesville sand are long-lived and this sand appears to respond particularly well to secondary recovery operations, such as repressuring by gas or water. The oil- and gas-producing beds are described briefly, from the oldest to the youngest, on the following pages.

SILICEOUS LIME AND SIMPSON FORMATION

Gas has been found in Ordovician rocks in a few localities on relatively steeply folded domes in Tps. 24 and 25 N., Rs. 10 and 11 E. It is noteworthy, however, that no oil is produced from these rocks either in this area or elsewhere in northeastern Osage County except at one locality, in sec. 3, T. 28 N., R. 10 E. But Ordovician rocks are prolific oil producers in many fields in the southeastern quarter of Osage County, some of which are only a few miles southwest of the four townships here described. The Ordovician rocks in Tps. 24 and 25 N., Rs. 10 and 11 E., consist of the upper part of the Siliceous lime and, in part of the area, the lower part of the overlying Simpson formation as defined by Luther White.[3] The lower part of the Siliceous lime is of Cambrian age.

No samples of the Siliceous lime or of the Simpson formation from wells in these four townships were studied, but samples of these rocks from other parts of Osage County were examined under the microscope. This examination showed that the uppermost part of the Siliceous lime consists mainly of finely crystalline brown to white dolomite that commonly contains chert. It is in these beds

[3] White, L. H., Subsurface distribution and correlation of the pre-Chattanooga ("Wilcox" sand) series of northeastern Oklahoma: Oklahoma Geol. Survey, Bull. 40, vol. 1, pp. 23–24, and 30–32, 1928.

that gas is found on steeply folded domes and anticlines. The gas-bearing zones in different areas are not necessarily equivalent, because the erosion that took place prior to the deposition of the beds that overlie the Siliceous lime doubtless removed a much thicker column of the Siliceous lime on some domes than on others.

The Siliceous lime varies greatly in thickness in these four townships. Well 8 on the Birch Creek dome, in the SE¼ sec. 30, T. 24 N., R. 11 E., recorded sedimentary rocks, almost all limestone, with a total thickness of only 218 feet between the Pennsylvanian series and the pre-Cambrian rocks. It is impossible to determine from the log what part of this limestone sequence represents the Siliceous lime and what part, if any, represents the Mississippi lime. The data show, however, that at most, only a small remnant of the Siliceous lime is present above the peak of pre-Cambrian rocks under the crest of the dome. The Siliceous lime was penetrated in well 17 of the Barnsdall Oil Co., in the NW¼ sec. 12, T. 24 N., R. 10 E., where it is 796 feet thick and is underlain by granite. This well is on an anticline, and the lime is probably thinner here than in the near-by synclines. Abundant evidence obtained from deep wells shows that the Siliceous lime is commonly thin over sharply folded domes and anticlines in this part of Oklahoma. Therefore, this lime is probably much thicker in other parts of these four townships than it is in this well, and it may reach a thickness of 1,000 feet or more in some places.

In this part of Osage County the Simpson formation is a thin northward-tapering wedge whose irregular margin passes northwestward through the southwestern fifth of T. 24 N., R. 11 E., and along the southwestern edge of the northeastern third of T. 24 N., R. 10 E.[4] It is entirely absent from T. 25 N., Rs. 10 and 11 E., and from the northeastern third of T. 24 N., R. 10 E., and the northeastern four-fifths of T. 24 N., R. 11 E. The Simpson formation consists mainly of medium to coarse, rounded to angular quartz sand, which in this area has been designated the Burgess sand by Luther White.

BURGESS SAND-MISSISSIPPI LIME ZONE

A few wells in these four townships have produced small amounts of oil and others have produced gas from rocks that lie at or near the contact of the Mississippi lime and the Cherokee shale. In southeastern Osage County fine to coarse sand, known as the Burgess sand, occurs in the basal part of the Cherokee shale and yields both oil and gas. In some places the sand lies on weathered chert of the

[4] White, L. H., Subsurface distribution and correlation of the pre-Chattanooga ("Wilcox" sand) series of northeastern Oklahoma: Oklahoma Geol. Survey, Bull. 40, vol. 1, pl. 2, 1928.

underlying Mississippi lime, and in other places it is separated from the chert by a thin bed of shale. Rocks recorded as sand in many drillers' logs are really chert that in drilling has been ground to fine particles by the bit. Because it is impossible to differentiate them in the drillers' logs, these rocks at or nearly adjacent to the contact of the Cherokee shale and Mississippi lime are referred to, in this report, as the Burgess sand-Mississippi lime zone. Examination with the microscope of a few sets of samples from wells in these four townships and in adjacent townships suggest that little or no true Burgess sand occurs in Tps. 24 and 25 N., Rs. 10 and 11 E., and that the oil and gas are found in weathered chert in the uppermost part of the Mississippi lime. Much of the uppermost few feet of the chert is deeply weathered to a white porous rock and is mingled with fine to coarse, angular to rounded quartz sand. Samples taken below this weathered material consist mainly of unweathered light- and dark-gray chert that is broken by the drill into sharply angular fragments. Limestone commonly occurs with the chert and is interbedded with it through much of the interval of about 275 feet that is occupied by the Mississippi lime.

Most of the oil fields in the Burgess sand-Mississippi lime zone in Osage County lie in a broad belt that trends northeastward through the central part of the county. This belt lies immediataely northwest of another broad belt that contains many oil and gas pools in the Bartlesville sand. The belt in which the Burgess sand-Mississippi lime is the oil-producing zone includes only the northwesternmost part of the area described in this report. The Burgess sand-Mississippi lime zone lies at a depth of about 1,750 to 1,850 feet in the easternmost part of these townships, but its depth increases westward to about 2,100 to 2,200 feet on the western boundary.

BARTLESVILLE SAND

Tps. 24 and 25 N., Rs. 10 and 11 E. lie in a broad northwestward-trending belt in northeastern Oklahoma that is characterized by many oil and gas pools in the Bartlesville sand. The well-known Pershing, Wynona, Barnsdall, West Barnsdall, Avant, Woolaroc, and Quapaw fields, all of which derive their oil and gas from the Bartlesville sand, lie wholly or partly in these four townships. The sand occurs as thick lenses in the lower part of the Cherokee shale. In the eastern part of the area the sand lenses are separated from the underlying Mississippi lime by 75 to 90 feet of shale. In the western part they are separated from the Mississippi lime in most places by only a few feet of shale, and in a few places the sand lies in contact with the lime. Depths to the Bartlesville sand in the eastern part of the area range from about 1,500 to 1,700 feet, and in the western part from about 1,975 to 2,075 feet.

Microscopic examination made by Constance Leatherock of samples of the Bartlesville sand from many wells in these four townships shows it to be composed mainly of fine to medium subangular quartz grains and small amounts of other minerals, including mica and feldspar. Mica makes up less than 1 percent of the sand; it is most abundant in the shaly parts. Some of the sand is very fine grained and some is coarse. Much of the medium grained sand and all of the coarse sand is subrounded; the very fine sand is angular. Small concretions of siderite occur commonly in the very fine and silty parts of the sand. The Bartlesville sand is similar in composition and physical character to the Burbank (Red Fork) sand, which occurs somewhat higher in the Cherokee shale and is important as an oil producer in western and southern Osage County, Okla., and in Cowley, Butler, and Greenwood Counties, Kans. The Bartlesville sand is also similar to the Bluejacket sandstone member of the Cherokee, which crops out in northeastern Oklahoma [5] and is equivalent to a part of the Bartlesville.

The subsurface geologic investigation of Osage County has shown that the Bartlesville sand was laid down as a series of beach deposits on the western shore of the Cherokee sea; [6] that the oil-bearing sand occurs as lens-shaped bodies that are longer than wide; and that the lenses are distributed for the most part independently of the structural attitude of the rocks. Several of these conclusions are particularly well illustrated in Tps. 24 and 25 N., Rs. 10 and 11 E. The long, narrow oil- and gas-producing sand body in the Woolaroc field trends northward in a nearly straight course across local domes, anticlinal noses, and synclines. The accumulation of oil here apparently is not controlled primarily by the structural attitude of the rocks. For example, in the SW¼ sec. 13, T. 25 N., R. 11 E., which has had the largest total yield of all the leases in the field, the producing sand is structurally low, but in the lease that adjoins it on the west, which has had the next largest yield, the sand is structurally high. Locally in this field, as in the SW¼ sec. 12 and NW¼ sec. 13, gas is segregated into the crest of a small dome. Wells near the east and west margins of the field have had relatively small yields and several dry holes a short distance outside the field found the sand absent. Cross-sections of the sand body, prepared from drillers' logs, show that it is lens-shaped, with an arched top and a nearly plane-like base.

Another example of the occurrence of sand bodies of this age independently of structure is provided by the oil-producing sand

[5] Miser, H. D., Geologic map of Oklahoma, U. S. Geological Survey, 1926.

[6] Bass, N. W., Leatherock, Constance, Dillard, W. R., and Kennedy, L. E., Origin and distribution of Bartlesville and Burbank shoestring oil sands in parts of Oklahoma and Kansas: Am. Assoc. Petroleum Geologists Bull., vol. 21, no. 1, pp. 55–56, 1937.

body of the Quapaw field, which is 4½ miles long. It extends across local high and low structural features, and its southwestern part lies mainly in the saddle between the Javine anticline and the West Javine dome. A narrow belt that trends northeastward along the middle of the field contains the wells that have had large initial yields and the leases that have had the largest total yields. Individual wells and leases on the margins of the field have had small yields.

The Bartlesville sand gives up its oil at a relatively slow rate but yields oil through a long period of time. Several wells in these four townships that were drilled in 1905 or 1906 and many that were drilled from 1911 to 1915 are still producing. The fact that wells in the S½ sec. 23, T. 24 N., R. 10 E., drilled in 1938 had initial daily yields ranging from 5 to 177 barrels indicates that the older wells in the Bartlesville sand have not drained oil from a very large area; these new wells are less than 1,500 feet from wells that have been producing oil for 32 or 33 years.

Old oil fields in the Bartlesville sand are receiving much attention from operators because of the successful operation of gas-repressuring and water-flooding projects in a few fields in northeastern Oklahoma and southeastern Kansas. A part of the Avant field in T. 24 N., R. 11 E., is being repressured with gas, and the wells are responding with greatly increased yields.

SQUIRREL SAND

Lenses of sand occur between the Verdigris lime and the Oswego lime in parts of the area embraced in the four townships. This sand has yielded shows of oil or gas in many wells but has produced commercial amounts in very few.

OSWEGO LIME (FORT SCOTT LIMESTONE)

The Oswego lime has produced oil and gas in a few localities in Tps. 24 and 25 N., Rs. 10 and 11 E. This limestone is one of the most persistent rock units in northeastern Oklahoma and because of its persistence has long served as one of the most useful key beds in subsurface geologic mapping. In Tps. 24 and 25 N., Rs. 10 and 11 E., the Oswego lime is recorded in the logs as limestone about 75 feet thick. Some logs record one or two beds of shale 10 to 15 feet thick. In many localities in Osage County the oil- and gas-bearing beds of the Oswego lime have responded with increased yields when treated with acid.

PERU SAND

The Peru sand occurs locally in the upper part of the Labette shale and only a few feet below the Big lime. It is less than 30 feet thick in most places. This sand is unimportant as a producer of oil or

gas in these four townships, although it has yielded small amounts in two wells in secs. 15 and 21, T. 24 N., R. 11 E., and in one well in sec. 4, T. 24 N., R. 10 E.

BIG LIME (OOLOGAH LIMESTONE)

The Big lime is a persistent limestone unit that ranges from 75 to 100 feet in thickness in Tps. 24 and 25 N., Rs. 10 and 11 E. A bed of shale about 10 feet thick is recorded about two-thirds the way above the base of the lime in many logs. The Big lime yields oil in a few wells in the Pershing field in T. 24 N., R. 10 E., and in one well in the NE¼ sec. 27, T. 25 N., R. 11 E. Recently, a few of these wells were treated with acid and they responded with increased yields.

JONES AND CLEVELAND SAND ZONE

An oil-bearing sand that ranges from a few feet to 30 feet in thickness and lies about 50 feet below the Checkerboard limestone occurs in the south-central part of T. 24 N., R. 10 E. Precise correlation of individual beds in this zone through a large area cannot be made from the well logs, but this sand appears to lie in about the stratigraphic position of the upper part of the Jones and Cleveland sand zone of southern Osage County. It is the main oil-bearing zone in the Birch Creek field. Shale is recorded in the logs at the horizon of the sand in most other parts of Tps. 24 and 25 N., Rs. 10 and 11 E.

LAYTON SAND

The uppermost part of the Coffeyville formation is composed of interbedded sandstone and shale. This sandy zone is known as the Layton sand. It can be identified in most logs by the Hogshooter limestone, which overlies it. Gas was produced for a time from the Layton sand in one well in sec. 4, T. 24 N., R. 10 E., in the Pershing field.

MUSSELLEM AND PEOPLES SAND ZONE

A sequence of shale, sandstone, and limestone about 200 feet thick overlies the Hogshooter limestone. This sequence occupies the position of the Nellie Bly formation, the Dewey limestone, and the lowest part of the Ochelata formation of northeastern Oklahoma. In northeastern Osage County, including much of T. 25 N., R. 11 E., the Dewey limestone is recorded in the logs of most wells and can be traced readily from well to well. In the southern and western parts of Tps. 24 and 25 N., Rs. 10 and 11 E., however, the horizon of the Dewey limestone and the horizons of beds immediately above and below the Dewey are occupied by a sequence of sandstone, sandy

shale, and thin beds of limestone. The upper part of this sequence is believed to represent the Mussellem sand, and the lower part the Peoples sand. This sand zone is of little importance as a producer of oil and gas in these four townships, although it yielded gas for a time in one well in the NE¼NW¼ sec. 6, T. 24 N., R. 10 E., in the Pershing oil field.

T. 24 N., R. 10 E.

T. 24 N., R. 10 E. is in east-central Osage County, 5 miles southeast of Pawhuska. Pershing is in its northwest corner. Several oil fields lie wholly or partly in the township. A few areas yield gas. The main oil fields are the southeastern half of the Pershing field, the easternmost part of the Wynona, and the Birch Creek and West Barnsdall fields.

The Bartlesville sand is the principal oil- and gas-producing zone in most of the fields. In the Birch Creek field the Jones and Cleveland sand zone is the main producing zone. Six other zones also yield oil or gas in a very few wells. Wells producing from the Bartlesville sand in the eastern part of the township are about 1,850 to 1,900 feet deep, and those in the western part are about 2,100 feet deep. Wells producing from the Jones and Cleveland sand zone in the Birch Creek field are about 1,350 feet deep.

More than 8 million barrels of oil has been produced from T. 24 N., R. 10 E. The yield to the acre is not large, but a few leases (each lease includes about 160 acres) have yielded more than 400,000 barrels each. For example, more than 500,000 barrels has been produced from each of two leases in the Pershing field, and more than 400,000 barrels from each of three other leases in the Pershing field, from one lease in the Wynona field, and from one lease in the West Barnsdall field. All these leases have been producing oil since 1918 or 1919, and the lease in the West Barnsdall field has been producing since 1906. The total yield from other leases in the township ranges from less than 1,000 barrels to more than 300,000 barrels each. All the leases with large yields produce oil from the Bartlesville sand. The largest yield from the Jones and Cleveland sand zone, a little more than 170,000 barrels, came from the SE¼ sec. 28; of the 23 wells on this lease, however, 2 produced from the Bartlesville sand.

Several of the 650 wells in T. 24 N., R. 10 E., were drilled more than 30 years ago. Two oil wells in sec. 30, one in sec. 26, three in sec. 23, and three in sec. 14 were drilled in 1905, and of these nine wells six are still producing. By the end of 1906 about 25 wells had been drilled in the West Barnsdall field. A few were drilled in 1907 and 1908, several were added in 1911, several others from 1913 to 1915, and a few from 1923 to 1925. A few wells whose initial yields

have ranged from 5 to 175 barrels were drilled in sec. 23 in 1938. Most of the wells in sec. 22 were drilled from 1913 to 1916. Most of the wells in the Birch Creek field were drilled from 1920 to 1926. Two wells in sec. 30 were drilled in 1905, but most of the others were drilled between 1917 and 1920. The wells in secs. 18 and 19 were drilled from 1919 to 1921. Most of the wells in the Pershing field were drilled in 1919 and 1920, although a few were drilled in 1918 and a few in 1922 and 1923.

The subsurface investigation of T. 24 N., R. 10 E., was made in 1935, mainly by L. E. Kennedy. 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. 24 N., R. 10 E., is slightly south of west at a rate of about 37 feet to the mile, as measured on the top of the Oswego lime. In much of eastern Osage County the regional westward dip is interrupted by many local folds. There are fewer folds in T. 24 N., R. 10 E., however, than in the townships adjoining it on the east and west. Much of T. 24 N., R. 10 E., lies in a narrow northeastward-trending belt in eastern Osage County that is essentially devoid of prominent structural features.[7]

Flanking this belt on the northwest and on the southeast are two other belts that are characterized by many folds of considerable structural relief. The edges of each of these two folded belts cross T. 24 N., R. 10 E. The Red Eagle and Pencresdall anticlines and the Birch Creek dome (the latter mainly in T. 24 N., R. 11 E.) lie on the northwestern margin of the southeastern folded belt; and the North and South Cochahee domes, East Birdseye anticline, and the Four Mile dome lie on the margin of the northwestern belt. These anticlines and domes are the main structural features in T. 24 N., R. 10 E. They are prominent in the exposed rocks and even more pronounced in the buried rocks (pl. 4). No faults are known to cut the rocks in T. 24 N., R. 10 E.[8]

RED EAGLE ANTICLINE

A large fold in the northeastern part of the township, called by Bowen[9] the Red Eagle anticline, occupies a part of the West Barnsdall field. Twelve wells on the anticline were producing oil as early as

[7] Bass, N. W., Kennedy, L. E., Dillard, W. R., and Leatherock, Constance, Subsurface geology of Osage County, Okla., United States Department of the Interior Press Memorandum 105368, p. 11, pls. 1 and 2, 1936.

[8] 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. 5, 1922.

[9] Bowen, C. F., idem, pp. 22–23 and pl. 5.

1906, and half of them are still producing. All the wells produce from the Bartlesville sand except one, which produces from the Big lime. The Bartlesville sand lies at depths of 1,800 to 1,900 feet in much of the area. The sand is recorded in many wells as from 75 to 100 feet in thickness. During the early life of the field the upper part of this sand yielded gas, and the lower part yielded oil in most wells. The logs of a few wells record a bed of shale near the middle of the sand body, but logs of most wells record a solid body of sand. The initial daily yields of the wells ranged from 10 to 1,600 barrels and averaged about 200 barrels.

Dry holes and abandoned wells appear to have defined the producing area of the Bartlesville sand in much of the Red Eagle part of the West Barnsdall field, but the western boundary has not been defined in the E½ sec. 11. The producing area might be extended westward by drilling additional wells there. At least one well, probably well 9 or 6 in the S½S½NE¼ sec. 11, near the crest of the dome, should be deepened into the Siliceous lime. This recommendation is made notwithstanding the fact that one well in the NW¼ sec. 12 tested these deeply buried rocks and failed to find oil or gas. The Burgess sand-Mississippi lime zone is barren of oil and gas in most places in this part of Osage County; nevertheless, it cannot be entirely eliminated as a producer without a test.

PENCRESDALL ANTICLINE

The rocks in the east-central part of the township are folded into a pronounced anticline, which Bowen [10] referred to as the Pencresdall anticline. The Oswego lime has a structural closure of about 60 feet (pl. 4), which is more than twice the amount of its closure in the exposed rocks.[11] The crest of the anticline in the Oswego lime is a short distance west of its crest in the exposed rocks.

Oil has been produced from the Bartlesville sand since 1905 in secs. 13, 14, 23, and 26, on the Pencresdall anticline. Several wells were drilled there in 1905 and 1906, others from 1913 to 1915, others in 1919 and 1920, one in 1924, and several in 1938.

The Bartlesville sand lies at a depth of about 1,900 feet. The wells yielded initially from 5 to 1,500 barrels a day, and those in the north-central part of the SE¼ sec. 14 had the largest initial yields. It is noteworthy that wells drilled in 1938 in the S½ sec. 23 have yielded initially as much as 175 barrels a day from the Bartlesville sand, notwithstanding that most of the wells one-fourth to three-fourths of a mile south of them have been producing from the Bartlesville sand for more than 30 years. These facts suggest that

[10] Bowen, C. F., op. cit., p. 23 and pl. 5.
[11] Bowen, C. F., op. cit., pl. 5.

the sand is not highly permeable over a very large area and that oil produced from an individual well is drained from only a small area surrounding that well.

Other wells should be drilled to the Bartlesville sand in the SW¼ sec. 14, the NE¼ and S½ sec. 23, and the NW¼ sec. 26 to define the boundaries of the oil pool. The Burgess sand-Mississippi lime zone holds little promise as a producer of oil or gas in this area, but the Siliceous lime should yield gas near the crest of the anticline. Well 2 in the NE¼NW¼NE¼ sec. 23 appears to be favorably located for testing the Siliceous lime.

BIRCH CREEK DOME

A part of the west flank of the large Birch Creek dome, whose crest is in the southwestern part of T. 24 N., R. 11 E., lies in secs. 25 and 36, T. 24 N., R. 10 E. Several wells in secs. 25 and 36, all of which are abandoned, produced oil for a time from the Bartlesville sand. The wells in the SE¼ sec. 25 had a total yield of about 18,000 barrels, and the wells in the SE¼ sec. 36 a total yield of about 16,000 barrels.

BIRCH CREEK FIELD

An area of irregular shape in the south-central part of the township, known as the Birch Creek field, yields oil from a few less than 100 wells. The field lies mainly in secs. 33, 34, 27, and 28, but includes also wells in sec. 22, the SE¼ sec. 21, and the SW¼SE¼ sec. 15. The rocks in this field are flexed into gently folded anticlinal and synclinal noses (pl. 4), which appear to exert little or no control on the occurrence of the oil. Sand that is from 10 to 25 feet thick and lies at a depth of about 1,350 feet yields the oil in most of the wells. This sand occurs about 40 feet below the Checkerboard limestone and thus lies at the stratigraphic horizon of the upper part of the Jones and Cleveland sand zone of southern Osage County, just as it does in a few wells in secs. 25 and 36, T. 24 N., R. 9 E., described in Bulletin 900–C. Five wells in secs. 27 and 28, in the Birch Creek field, yield oil from the Bartlesville sand. The initial yields of the producers from this sand ranged from 8 to 120 barrels a day. The total yield from the Birch Creek field to the end of 1937 was relatively small. The maximum yield of any individual lease, about 170,000 barrels, has been obtained from the SE¼ sec. 28. The NE¼ sec. 33 has yielded about 102,000 barrels from less than half the number of wells that are in the SE¼ sec. 28.

The distribution of the wells in the Birch Creek field indicates that the producing area could be extended by additional drilling in the W½ sec. 22, SE¼ sec. 21, W½ sec. 27, NE¼ sec. 28, E½

sec. 33, and W½ sec. 34, although only wells with small yields should be expected. Several existing wells should be deepened to test the Bartlesville sand.

PERSHING FIELD

The southeastern part of the Pershing oil and gas field [12] extends from the northwest corner of the township southeastward to the center of sec. 15. The field lies on a broad anticline that trends northwest through the northwestern part of the township and contains several prominent domes, including the North Cochahee dome, whose crest is in the SW¼ sec. 31, T. 25 N., R. 10 E., the South Cochahee dome, whose crest is in the S½ sec. 5, and the small unnamed dome whose crest is in the SW¼ sec. 10. These three domes are separated by shallow structural saddles. Relatively deep synclines bound the major anticline on the northeast and on the southwest. That the producing area in the Bartlesville sand coincides closely with the structurally high area is noteworthy, because in many places in Osage County oil pools in the Bartlesville sand extend across some areas that are structurally low and others that the structurally high.

Of about 270 wells that have produced oil or gas in the part of the Pershing field that lies in T. 24 N., R. 10 E., all but 10 produced from the Bartlesville sand. The sand lies at depths ranging from 1,920 to 2,080 feet and is recorded in the logs of most wells as being from 80 to 100 feet thick. The lower third or half of the sand yields oil, and the upper part yields gas. Only gas was produced on the crest of the North Cochahee dome. The initial yields of the oil wells ranged from 5 to 5,500 barrels a day, and the yields of the gas wells ranged from 5 to 7 million cubic feet a day. The average initial daily yields of the oil wells were as follows: In sec. 6, 325 barrels; in sec. 4, 245 barrels; in secs. 9, 10, and 16, 150 barrels; in sec. 5, 115 barrels; and in sec. 7, 55 barrels. In a small part of the field the Bartlesville sand is being repressured with gas.

Two wells in the SE¼ sec. 5 and two in the NW¼ sec. 8 produced oil from the Big lime at initial daily rates of from 40 to 150 barrels. Other wells had shows of oil or gas in the Big lime, and still others had shows in the Oswego lime. It is possible that profitable production of oil and gas might be developed from these limes by acid treatment. The Peru sand yielded oil for a time in two wells in the SW¼ sec. 4, but the logs of most wells in the field record shale at the horizon of the Peru sand. One well in the NW¼ sec. 6 had an initial yield of 5½ million cubic feet of gas a day from the Mussellem and Peoples sand zone, and the logs of other wells record shows of

[12] Rubey, W. W., Progress report on a subsurface study of the Pershing oil and gas field, Osage County, Okla.: U. S. Geol. Survey Bull. 751, pp. 23–70, 1925.

gas from this zone and from the younger Okesa, Torpedo, and Clem Creek sand zone. It is possible that additional gas could be produced from these two sand zones, both of which lie at shallow depths. Several wells had shows of oil from the Layton sand, and one well in the SW¼ sec. 4 produced gas from this sand. One well in the NW¼ sec. 6 on the North Cochahee dome produced gas from the Siliceous lime, which was encountered at a depth of 2,250 feet.

Most of the producing areas in the main producing sand—the Bartlesville—appear to have been drilled thoroughly, except in the southeastern part of the field, where the distribution of the wells suggests that the producing area in sec. 9, SW¼ sec. 10, and sec. 15 might be extended by additional drilling. There is also a possibility that the field could be extended northeastward and southwestward. Throughout eastern Osage County most of the areas of oil-bearing Bartlesville sand are elongated northeastward, and if several producing fields are combined they form a northeastward-trending belt. This characteristic directional trend is clearly illustrated by the alinement of the producing areas of Bartlesville sand shown on plate 4. A striking exception is the northwestward elongation of the Pershing field, but this may possibly be due to the fact that several of the northeastward-trending belts are closely spaced. Possibly one of these latter belts extends northeastward from the Wynona field, in secs. 18 and 19, into the Pershing field, where it may include sec. 8, the northwestern part of sec. 9, the southeastern half of sec. 5, and all of sec 4. Another belt may extend northeastward from the southeastern part of the Wynona field through the part of the Pershing field that includes the southeastern half of sec. 9, all of secs. 10 and 16, and the northwestern part of sec. 15, to undiscovered oil-bearing areas in the N½ sec. 10 and parts of secs. 3 and 2. The small oil-producing areas in the Bartlesville sand in the east-central part of T. 25 N., R. 10 E. (see pl. 4), may lie in one or more of these hypothetical belts.

EAST BIRDSEYE ANTICLINE

The East Birdseye anticline, in secs. 18 and 19, lies in the easternmost part of the Wynona field, which is described in Bulletin 900–C. The Oswego lime is much more steeply folded (see pl. 4) than the exposed rocks[18] and the crest of the anticline in the Oswego lime lies a short distance north of its crest in the exposed rocks.

Of 47 wells drilled on this anticline 40 produced oil from the Bartlesville sand and 3 produced from the Burgess sand-Mississippi lime zone. The depth to the Bartlesville sand ranges from 2,000 to

[18] 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. 5, 1922.

2,150 feet, and the depth to the Burgess sand-Mississippi lime zone ranges from 2,070 to 2,175 feet. The initial daily yields of the wells in the Bartlesville sand ranged from 5 to 400 barrels and the initial yields of the wells in the Burgess sand-Mississippi lime ranged from 90 to 250 barrels. Many wells had shows of gas in the Okesa, Torpedo, and Clem Creek sand zone. The Siliceous lime has been tested by well 2 in the SW¼SE¼SW¼ sec. 18, a short distance south of the crest of the anticline (see pl. 4). By the end of 1937 a little more than a million barrels of oil had been produced from the part of the Wynona field that lies in T. 24 N., R. 10 E. The wells in this field were drilled between 1919 and 1921.

Although it appears that the producing area on the East Birdseye anticline is fairly well defined, additional wells drilled in the SE¼ sec. 18 might produce oil, and the Okesa, Torpedo, and Clem Creek sand zone might yield some gas.

FOURMILE DOME

The east flank of the Fourmile dome, whose crest is in sec. 25, T. 24 N., R. 9 E., occupies parts of secs. 30 and 31, T. 24 N., R. 10 E. Eight wells on the dome in secs. 30 and 31 produced oil from the Bartlesville sand, and three produced oil from the Jones and Cleveland sand zone. The distribution of the wells suggests that the producing area of the Bartlesville sand might be extended in the NW¼ sec. 30 and possibly in the SW¼ sec. 30, but the initial yields of the wells in sec. 30, which ranged from 10 to 75 barrels a day, indicate that wells with small yields should be expected. The fact that well 1, in the southwest corner of the NW¼ sec. 30, has been producing since 1903 suggests that it is a considerable distance from the edge of the oil field.

YIELDS

The total amount of oil produced in T. 24 N., R. 10 E., from July 1916 to the end of 1937, as compiled from records of the Osage Indian Agency, is shown in the table following. Earlier data for a few tracts were procured from other sources.

Oil produced in T. 24 N., R. 10 E.

Tract	Date of first production	Production to end of 1937 (barrels)	Remarks
SW¼ sec. 1	1906	28, 217	Data prior to 1917 from Barnsdall Oil Co.
NW¼ sec. 4	December 1919	12, 706	Production only to end of 1935.
SW¼ sec. 4	November 1918	253, 421	
NE¼ sec. 5	January 1920	67, 737	
NW¼ sec. 5	1919	592, 067	
SW¼ sec 5	November 1918	42, 301	Abandoned in 1930.
SE¼ sec. 5	March 1919	454, 976	
NE¼ sec. 6	July 1918	287, 273	

Oil produced in T. 24 N., R. 10 E.—Continued

Tract	Date of first production	Production to end of 1937 (barrels)	Remarks
NW¼ sec. 6	June 1918	430,999	
SW¼ sec. 6	August 1918	89,233	
SE¼ sec. 6	do	601,463	Abandoned in 1931.
NE¼ sec. 7	January 1919	233,817	
NW¼ sec. 7	May 1919	49,625	
SE¼ sec. 7	August 1919	34,129	
NE¼ sec. 8	May 1919	454,819	
NW¼ sec. 8	June 1919	262,535	
SW¼ sec. 8	March 1921	57,854	
SE¼ sec. 8	do	10,096	Abandoned in 1933.
NE¼ sec. 9	January 1920	37,639	
NW¼ sec. 9	May 1919	190,584	
SW¼ sec. 9	May 1920	547	Abandoned in October 1920.
SE¼ sec. 9	December 1919	321,677	
SW¼ sec. 10	May 1919	93,181	
NE¼ sec. 11	1906	488,772	Data prior to 1917 from Barnsdall Oil Co.
N½SE¼ sec. 11	1906	188,465	Do.
S½SE¼ sec. 11	Prior to July 1916	180,381	
NE¼ sec. 12	do	14,705	Abandoned in March 1925.
NW¼ sec. 12	do	181,621	
SW¼ sec. 12	do	156,898	
SE¼ sec. 12	do	9,150	Abandoned in 1922.
SW¼ sec. 13	do	56,282	
NE¼ sec. 14	do	16,946	
SW¼ sec. 14	November 1920	18,094	
SE¼ sec. 14	Prior to July 1916	128,782	
NE¼ sec. 15	do	25,492	
NW¼ sec. 15	Prior to July 1920	30,390	
SW¼ sec. 15	April 1920	9,889	
SE¼ sec. 15	August 1917	14,154	
NE¼ sec. 16	April 1919	137,748	
NE¼ sec. 18	1921	58,209	Abandoned in 1937.
NW¼ sec. 18	May 1920	83,713	Abandoned in 1933.
SW¼ sec. 18	May 1919	433,687	
SE¼ sec. 18	March 1919	99,988	
NE¼ sec. 19	February 1919	27,438	Abandoned in 1931.
SE¼ sec. 21	July 1925	9,628	
NE¼ sec. 22	Prior to July 1916	20,573	Abandoned in 1928.
NW¼ sec. 22	do	14,146	Do.
NE¼ sec. 23	1906	194,690	Data prior to 1917 from Barnsdall Oil Co.
NW¼ sec. 23	1906	26,736	Do.
SW¼ sec. 23	1906	118,538	Do.
SE¼ sec. 23	March 1920	9,951	
NW¼ sec. 24	Prior to July 1916	38,365	
SW¼ sec. 25	May 1921	27	Abandoned in July 1925.
SE¼ sec. 25	May 1920	18,308	Abandoned in 1928.
NE¼ sec. 26	Prior to July 1916	66,920	
NW¼ sec. 26	January 1917	89,039	
SW¼ sec. 27	June 1923	51,931	
NE¼ sec. 28	May 1921	82,332	
NW¼ sec. 28	April 1923	13,435	
SW¼ sec. 28	July 1920	53,127	
SE¼ sec. 28	April 1922	170,034	
NW¼ sec. 30	July 1921	14,094	
SW¼ sec. 30	Prior to July 1916	155,153	
NE¼ sec. 33	May 1923	101,836	
NW¼ sec. 33	February 1925	1,319	Abandoned 1928.
SE¼ sec. 33	December 1922	12,431	
NW¼ sec. 34	July 1922	108,212	
SW¼ sec. 34	1920	106,312	
NW¼ sec. 36	January 1920	2,819	Abandoned in 1923.
SW¼ sec. 36	January 1919	16,265	Do.
		8,463,921	

T. 25 N., R. 10 E.

T. 25 N., R. 10 E., is in east-central Osage County. Its west boundary is 3 miles east of Pawhuska, the county seat. Nelagoney is near the center of the township, Tallant is in its southeastern part, and Pershing is near its southwest corner.

This township has produced relatively small amounts of oil and gas. A part of the northeastern margin of the rich Pershing field occupies less than a square mile in the southwest corner of the township, and the southwestern part of the Quapaw field extends a short distance into sec. 25. A few wells elsewhere in the township have also produced small amounts of oil or gas. Although the main producing zone is the Bartlesville sand, four other zones have yielded oil or gas or both. These zones, named in ascending order, are the Siliceous lime, the Burgess sand-Mississippi lime zone, the Squirrel sand, and the Oswego lime. The Burgess sand-Mississippi lime zone and the Siliceous lime have yielded only gas.

Of about 150 wells that have been drilled in the township a few were drilled a short distance south of Nelagoney in 1906. Most of the other wells south of Nelagoney were drilled in 1918 and 1919. Many of the wells on the southwestern part of the Cedar Creek anticline were drilled in 1910 and 1911, and those on its northeastern part were drilled from 1920 to 1922. The wells in secs. 25 and 36, on the West Javine dome, were drilled from 1914 to 1919, and those in secs. 19, 30, 31, and 32, in the Pershing field, from 1917 to 1923. Little or no prospecting has been done in the township for many years, but in sec. 31 on the North Cochahee dome, an old gas well was recently deepened from the Oswego lime into the Siliceous lime and found gas that flowed at the rate of 7½ million cubic feet a day.

The subsurface investigation of T. 25 N., R. 10 E., was made in 1935 by H. D. Jenkins. 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 rocks in T. 25 N., R. 10 E. have a regional westerly dip across the township of about 35 feet to the mile, as measured on the top of the Oswego lime. The regional dip is interrupted locally by anticlines, domes, synclines, and basins, each of which occupies only a few square miles. This township contains fewer local folds than the townships adjacent to it on the east and west. Much of it lies in a northeastward-trending belt in eastern Osage County that contains very few folds.[14] The main upfolds (see pl. 4) are the North Cochahee, West Javine, and Kiheki domes and the Cedar Creek anticline. A deep structural basin occupies parts of secs. 3 and 4, and another occupies parts of secs. 5, 6, 7, and 8. These folds are

[14] Bass, N. W., Kennedy, L. E., Dillard, W. R., and Leatherock, Constance, Subsurface geology of Osage County, Okla.: United States Department of Interior Press Memorandum 105368, pls. 1 and 2, 1936.

present also in the exposed rocks,[15] but the degree of folding in the exposed rocks is less than in the deeply buried rocks. A few short faults with a vertical displacement of only a few feet cut the exposed rocks in secs. 2, 5, 6, and 12,[16] but no faults were detected in the deeply buried rocks.

NORTH COCHAHEE DOME

Much of the North Cochahee dome lies in sec. 31. The crest of the dome on the Oswego lime lies a few hundred feet southwest of its crest in the exposed rocks, and the inclination of the Oswego lime on the flanks of the dome is about twice as great as that of the exposed rocks. Oil and gas have been produced from the Bartlesville sand in many wells; oil is produced from the Squirrel sand in one well and gas is produced from the Siliceous lime in one well. The well producing from the Squirrel sand produced for a time from the Bartlesville sand, but it was later plugged back to the Squirrel sand. Very few wells have been drilled on the higher parts of the dome, because there the Bartlesville sand yields gas instead of oil. The logs of many wells record shows of oil and gas in the Oswego lime. Many logs record shows of oil in the Squirrel sand. A few logs record shows of gas in the Mussellem and Peoples sand zone and in the Okesa, Torpedo, and Clem Creek sand zone. Gas was produced for several years from the Oswego lime from well 187 near the crest of the dome. The well yielded initially 20 million cubic feet a day; later it was deepened to the Siliceous lime and again yielded gas at the rate of 7½ million cubic feet a day.

Most of the oil wells in sec. 31 have been producing for nearly 20 years, and the total yield to the acre of the oil-bearing area is larger than is common for the Bartlesville sand. The single well in the southwest corner of the NE¼ sec. 31 had produced a total of 34,295 barrels by the end of 1937. These two facts suggest that the producing area might be extended northeastward in the NE¼ sec. 31.

It appears probable that gas could be obtained from the Oswego lime and the Siliceous lime in several wells near the crest of the dome and that acid treatment of these gas-bearing zones would result in increased yields.

NELAGONEY ANTICLINE AND CENTRAL PART OF THE TOWNSHIP

On the anticlinal nose south of Nelagoney 17 wells have been drilled, 11 of which have produced some oil. The oil was found in

[15] Winchester, D. E., Heald, K. C., and others, in White, David, and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pl. 10, 1922. Rubey, W. W., Progress report on a subsurface study of the Pershing oil and gas field, Osage County, Okla.: U. S. Geol. Survey Bull. 751, pl. 8, 1925.

[16] Winchester, D. E., and Heald, K. C., and others, op. cit.

the Bartlesville sand, which lies at a depth of about 2,000 feet. The well logs indicate that this sand occurs in two or more beds that are separated by thin beds of shale. Additional producing wells could probably be obtained by drilling in the E½ sec. 29 and the NW¼ sec. 28. The initial yields of the present producers, which ranged from 5 to 100 barrels a day, indicate that only small yields should be expected in new wells.

Inasmuch as many oil-bearing lenses of Bartlesville sand in Osage County trend northeastward, a large area extending northeastward from the producing area in secs. 28 and 29 should be considered as prospectively valuable for oil in this sand. The fact that some of this area is structurally low should not be considered particularly unfavorable, because many tracts in Osage County with large yields from the Bartlesville sand are in areas that are structurally low. The amount of oil found in the Bartlesville appears to depend upon the permeability, thickness, homogeneity, and other characters of the sand, including its degree of saturation and porosity, rather than upon the attitude of the rocks. On the other hand, this area lies near the irregular northwestern margin of the region that contains Bartlesville sand, and it is, therefore, not improbable that much of the central part of T. 25 N., R. 10 E., may contain no Bartlesville sand. Nevertheless, the records of several wells in widely separated localities do not indicate that the sand is absent. In the dry hole in the northeast corner of sec. 21 the upper part of the Bartlesville yielded some gas, and the lower part yielded water. In the dry hole in the SW¼ sec. 15 this sand, which is recorded as being 90 feet thick, produced water. Sandy shale was recorded at the Bartlesville horizon in the dry hole in the northwest corner of sec. 16, but sand was recorded at this horizon in the southeast corner of the NE¼ sec. 17 and in the northeast corner of sec. 19. In the dry holes in the southwest corner of the NW¼ sec. 17 and the southeast corner of the NE¼ sec. 18, some oil was found in the upper part of the sand and water in the lower part. Most of the wells in secs. 9 and 10 and all those in secs. 2 and 3 record either no Bartlesville sand or only a single bed 10 to 15 feet thick.

CEDAR CREEK ANTICLINE

The Cedar Creek anticline is a relatively large fold in the east-central part of the township. The crest of the anticline in the Oswego lime lies about 2,000 feet southwest of its crest in the exposed rocks. Although 43 wells have been drilled on the anticline in T. 25 N., R. 10 E., the yields were small. About half of them produced oil and a few produced gas. The initial daily yields of the wells ranged from 5 to 200 barrels. The total yield of all tracts in secs.

13, 14, 23, and 24 between 1916 and 1937 was 190,785 barrels. Most of the wells were completed between 1919 and 1922, but some were completed as early as 1911. In each of the years 1923, 1924, 1926, 1932, 1933, 1936, and 1937 one lease was abandoned, and all the wells in the field had been abandoned before the end of 1937. Most of the wells obtained their oil from the Bartlesville sand, which lies at a depth of about 2,000 feet. The logs record the Bartlesville sand as being in several beds, separated by shale. The Oswego lime yielded oil and gas in a few wells and shows of oil and gas in many wells. The Squirrel sand yielded a small amount of oil in one well in the SW¼ sec. 13.

Although the small total yields of the wells in this field indicate that large yields should not be expected from new wells, yet it is possible that some additional oil and gas could be produced without great expense. A test well should be drilled in the center of the west line of the NW¼SW¼ sec. 13, and if large shows of oil or gas are found in the Oswego lime, it should be treated with acid. The Bartlesville sand may yield oil here. It is predicted that the Siliceous lime, which would be encountered at a depth of a little more than 2,200 feet, will yield gas instead of oil, because gas is commonly present in the Siliceous lime in this part of Osage County, but no oil has been produced from it.

WEST JAVINE DOME AND SEC. 36

The dome whose crest is in sec. 25 appears to be a subsidiary structural feature developed on a northwest-trending prong of the Javine anticline. Hence it is designated on plate 4 as the West Javine dome. It is separated from the main part of the Javine anticline by a low saddle in the W½ sec. 30, T. 25 N., R. 11 E. The amount of closure in the Oswego lime is about twice that in the exposed rocks. The crest of the dome in the Oswego lime lies a little more than a quarter of a mile north-northwest of its crest in the exposed rocks.[17] Oil is produced from the Bartlesville sand in several wells in the SE¼ sec. 25 on the south flank of the dome. Gas has been produced from the Oswego lime in one well on the crest and from the Burgess sand-Mississippi lime zone in two wells near the crest of the dome. The initial daily yield of the gas well producing from Oswego lime was 4½ million cubic feet, and the initial daily yields of the other two gas wells were 5 million and 8 million cubic feet, respectively. The initial daily yields of the oil wells ranged from 5 to 70 barrels. The oil wells were drilled in 1916 and 1917, and by the end of 1937 they had produced a total of 107,786 barrels.

[17] Winchester, D. E., and Heald, K. C., and others, in White, David and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pl. 10, 1922.

The crest of the dome is a prospectively valuable site for a well to test the Siliceous lime, in which gas rather than oil may be found. The lime lies at a depth of about 2,100 feet at the location of well 2 in the SW¼SE¼NE¼ sec. 25. It is possible, also, that additional wells in the SE¼ sec. 25 would find oil in the Bartlesville sand and thus extend the producing area some distance southwestward. That a part of sec. 36, T. 25 N., R. 10 E., may contain oil-bearing Bartlesville sand is suggested by the trend of the Quapaw oil field across a part of T. 25 N., R. 11 E., into sec. 25, T. 25 N., R. 10 E., and by the apparent alinement of the main producing area of the West Barnsdall field in T. 24 N., R. 10 E., with the trend of the Quapaw field. The fact that the rocks throughout much of sec. 36 are structurally low does not lessen materially the prospect that the section may be valuable for oil in the Bartlesville sand. In this connection, it is noteworthy that the most productive part of the Quapaw field lies on the northwest flank of the Javine anticline, more than 100 feet structurally lower than the crest of that anticline.

KIHEKI DOME

The small Kiheki dome, whose crest is in secs. 10 and 3, has been tested by a few wells. Two wells produced gas from the Siliceous lime, and a third well, whose initial daily yield of gas was 2,225,000 cubic feet, produced from the Burgess sand-Mississippi lime zone. Well 375, whose initial daily yield of gas in 1927 was 10 million cubic feet, is still producing. The logs of the two wells producing from the Siliceous lime indicate that the Oswego lime had showings of gas amounting to 1 to 2 million cubic feet a day in each well. Smaller showings were found in the Mussellem and Peoples sand zone. Additional gas wells could probably be obtained on the crest of the dome, a short distance east of the old wells. The Oswego lime also, might yield profitable amounts of gas if treated with acid. The logs of the old wells indicate that the Bartlesville sand is thin or locally absent in this part of the township.

SOUTH-CENTRAL PART OF THE TOWNSHIP

An area of several square miles in the south-central part of the township offers somewhat remote possibilities of yielding oil from the Bartlesville sand. As pointed out in the description of T. 24 N., R. 10 E., bodies of oil-bearing Bartlesville sand in eastern Osage County commonly lie in northeastward-trending belts. It is possible that such a belt trends northeastward through the south-central part of this township and lies about parallel with the belt formed by the Quapaw and West Barnsdall fields in T. 25 N., Rs. 10 and 11 E., and T. 24 N., R. 10 E. Accordingly, parts or all of secs. 22, 23, 26,

27, 28, 33, 34, and 35 have some prospective value as areas that may produce oil from the Bartlesville sand.

YIELDS

The total amount of oil produced in T. 25 N., R. 10 E., from July 1916 to the end of 1937, as compiled from records of the Osage Indian Agency is shown in the table following. Earlier data were not available.

Oil produced in T. 25 N., R. 10 E.

Tract	Date of first production	Production to end of 1937 (barrels)	Remarks
NE¼ sec. 13	September 1919	36,896	Abandoned in 1932.
NW¼ sec. 13	do	6,473	Abandoned in 1924.
SE¼ sec. 13	do	70,089	Abandoned in 1933.
NE¼ sec. 14	April 1920	5,431	Abandoned in 1926.
SE¼ sec. 14	January 1920	22,180	Abandoned in 1937.
SW¼ sec. 19	1920	6,944	Abandoned in 1923.
NE¼ sec. 23	February 1920	41,542	Abandoned in 1936.
NW¼ sec. 24	April 1921	8,174	Abandoned in 1923.
SE¼ sec. 25	Prior to July 1916	107,786	
NE¼ sec. 29	do	29,102	
NW¼ sec. 29	do	14,119	
SE¼ sec. 29	May 1919	40,173	
NW¼ sec. 30	1920	32,630	Abandoned in 1928.
SW¼ sec. 30	1919	39,924	
NE¼ sec. 31	1918	34,295	
NW¼ sec. 31	1919	339,487	
SW¼ sec. 31	1921	2,908	
SE¼ sec. 31	1919	147,673	
SW¼ sec. 32	1919	10,918	Abandoned in 1928.
		996,744	

T. 24 N., R. 11 E.

T. 24 N., R. 11 E., is in east-central Osage County, 11 miles southwest of Bartlesville. Barnsdall is in the western part of the township.

This township lies in a region containing many oil and gas fields that produce from the Bartlesville sand. This sand has yielded either oil or gas or both oil and gas in every section in the township. The township lies in the heart of the stripper-well region, so-called because the daily yield of the wells is small, ranging from less than a barrel to a few barrels. It is generally thought that the oil- and gas-producing areas in T. 24 N., R. 11 E., are fully drilled. It is noteworthy, therefore, that this investigation has revealed several localities in the township that will in all probability afford additional paying oil wells and a few localities that will afford additional paying gas wells. Investigations made by operating oil companies in northeastern Oklahoma have shown that the Bartlesville sand is well suited to repressuring with gas or water. Many areas in this township producing from the Bartlesville sand where the sand lies at depths of 1,600 to 1,900 feet will eventually be repressured by one

of these methods. A part of the Avant field in the southeastern part of this township, where the Bartlesville sand lies at a depth of about 1,600 feet, is being repressured with gas.

Oil has been produced in T. 24 N., R. 11 E., for more than 30 years. Many oil wells were drilled in 1905 in secs. 24, 25, 36, 16, 21, and 28. Most of these early wells are still producing, and repressuring operations in the reservoir sand in many areas will extend the life of the wells many more years. Most of the wells in the Avant field, in the eastern part of the township were drilled from 1905 to 1913, others from 1918 to 1920. Recently many wells in this field have been deepened through the lower part of the Bartlesville sand, new wells have been drilled, and most of the old wells have been reconditioned as a part of the gas-repressuring operations there.

Most of the wells in the S½ sec. 1 and the N½ sec. 12 were drilled in 1925, and those in secs. 3, 4, and 5 from 1918 to 1920. Most of those in sec. 11, the NW¼ sec. 14, and the E½ sec. 15, were drilled in 1919 and 1920. Most of the wells in sec. 10, the W½ sec. 15, secs. 16, 21, and 28, were drilled from 1905 to 1914. Several of the wells in the area west of Barnsdall were drilled in 1913 and 1914; many of those north, east, and south of Barnsdall were drilled in 1919 and 1920. A few wells on the Birch Creek dome were drilled in 1908, others in 1911 and 1912, 1914 to 1916, 1919 and 1920. Most of the wells in the SW¼ sec. 31 were drilled in 1918 and 1919.

The subsurface investigation of T. 24 N., R. 11 E., was made in 1935, mainly by L. E. Kennedy. 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. 24 N., R. 11 E., is westward about 35 feet to the mile, as measured on the top of the Oswego lime. This regional dip is interrupted by many domes, anticlines, synclines, and structural basins, whose structural closure is commonly less than 100 feet. The total area covered by each of these local folds is from 1 to 6 square miles. The township lies in a northeastward-trending belt in eastern Osage County that contains many folds of relatively large structural relief. The Birch Creek dome, whose crest is in secs. 29 and 30, is the most sharply folded dome in the township. The pre-Cambrian rocks, which include granite, lie at shallow depth (1,761 feet) on the crest of this dome, as on many other sharply folded domes in southeastern Osage County. Other prominent folds in the township are the South Bigheart, Minnehoma, and Manhattan domes, the dome in sec. 5, and the Dogthrasher and Eleven-Twelve anticlines.

All the main structural features on the Oswego lime (see pl. 4) and other deeply buried rocks are found also in the exposed rocks,[18] but the folds in the subsurface rocks are much steeper than the folds in the exposed rocks. Short normal faults with displacements of as much as 30 feet cut the exposed rocks in several places in the west half of the township.[19] The available data do not reveal whether the Oswego lime and other deeply buried rocks are also cut by the faults.

It is noteworthy that the occurrences of oil in the main producing zone (the Bartlesville sand) are independent of the attitude of the rocks. The producing rocks on many of the tracts that have had large total yields are structurally low, and on several of the tracts that have had small total yields they are on or near the crests of domes or anticlines. Therefore, the upfolds here have much less value than in many oil-bearing districts. The upfolds, however, have potential value as sites for gas wells. All the gas wells that produce from the Burgess sand-Mississippi lime zone or the Siliceous lime and many of those that produce from the Bartlesville sand are on the higher parts of the domes and anticlines.

The crests of most domes in Osage County lie a short distance west, northwest, or southwest of the crests in the exposed rocks, but the Minnehoma dome in T. 24 N., R. 11 E., fails to conform to this general rule, as its crest on the Oswego lime lies 1,800 feet east-northeast of its crest in the exposed rocks.

AVANT FIELD AND ELEVEN-TWELVE ANTICLINE

The northwestern part of the Avant field lies in the eastern part of T. 24 N., R. 11 E., and includes all of sec. 13, the SE¼ sec. 14, all of secs. 23 to 26, the E½ sec. 35, and all of sec. 36. In this area 278 oil wells, 6 gas wells, and 11 dry holes have been drilled. With the description of the Eleven-Twelve anticline is included the description of the S½ sec. 1 and all of sec. 12, in which 22 oil wells (several now abandoned), 2 gas wells (now abandoned), and 2 dry holes were completed. All the oil and gas so far discovered occurs in the Bartlesville sand, except in well 53, in the SE¼NW¼ sec. 23, which yielded initially 10 barrels a day from the Burgess sand-Mississippi lime zone.

The main folds in this part of the township are the northwestern part of the Eleven-Twelve anticline in secs. 12 and 13, a dome in the NE¼ sec. 23, the Manhattan dome in the SE¼ sec. 23 and SW¼ sec. 24, a syncline in sec. 36, and several anticlinal and synclinal noses.

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[18] Hopkins, O. B., and Powers, Sidney, in White, David and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pl. 37, 1922.

[19] Hopkins, O. B., and Powers, Sidney, idem., pl. 37.

The common conception that large initial yields of oil from individual wells and large total yields from tracts are found in areas whose rocks are structurally high does not appear to apply to the Avant field and the Eleven-Twelve anticline. Many of the wells in this district with large initial yields and several of the tracts with large total yields, such as those in the SE¼ sec. 13 and the N½ sec. 25, are in synclinal areas; and wells with small yields, such as those in the SE¼ sec. 23, are on domes. Wells on the higher parts of the Eleven-Twelve anticline yielded only gas. These facts indicate that although within the reservoir sand the gas is segregated in the structurally high areas, the distribution of the oil is controlled in the main by factors other than the structural attitude of the rocks.

Inasmuch as many of the wells were drilled 25 to 33 years ago the data concerning initial yields, total yields, and logs are incomplete. The information available indicates that the initial daily yields of the oil wells ranged from 5 to 850 barrels. The initial daily yields of the gas wells in secs. 12 and 13 on the Eleven-Twelve anticline ranged from 5 to 12½ million cubic feet. Many of the leases in the field have not been completely drilled; but as the work of repressuring the oil-bearing beds proceeds it is likely that wells will be drilled in the comparatively large untested tracts within the field. Many wells in the field are bottomed above the base of the sand, but recently several old wells have been deepened and some oil has been found in the lower untested part of the sand.

The prospects for obtaining oil in the Burgess sand-Mississippi lime zone are not attractive. Several wells in the field, including one on the Eleven-Twelve anticline, and one on the dome in the NE¼ sec. 23, have been drilled into the Mississippi lime, but all except one failed to find oil or gas in a paying amount. The Siliceous lime, also, has been tested by a few wells, but these were not located on structural highs. It is possible that the Siliceous lime might yield gas on the crest of the Eleven-Twelve anticline and on the crest of the Manhattan dome, although the rocks on the Manhattan dome are not so sharply folded as on most domes that yield gas from the Siliceous lime.

The distribution of the producing wells in secs. 1 and 2 and the S½ sec. 13 suggests that additional wells should be drilled in the SW¼, NW¼, and NE¼ sec. 12, the SW¼ sec. 1, and the SW¼ sec. 13. All wells in the field that have not already penetrated the full thickness of the Bartlesville sand should be deepened to the base of the sand, unless they are yielding excessive amounts of water.

SECS. 2 AND 11, E½SE¼ SEC. 3, E½E½ SEC. 10, E½ SEC. 15, AND N½ AND SW¼ SEC. 14

The rocks in secs. 2 and 11, and the E½SE¼ sec. 3, E½E½ sec. 10, E½ sec. 15, and N½ and SW¼ sec. 14 dip westward at a relatively

uniform rate of about 100 feet to the mile. Their structural attitude in itself does not suggest the probability that they contain oil or gas. Nevertheless more than 575,000 barrels of oil and an unknown amount of gas have been produced from the Bartlesville sand in these tracts since 1919, the year production began. The producing wells are confined to several small areas that are separated by undrilled tracts, and this odd distribution indicates that additional drilling might provide many more producing wells. For example, the row of five wells along the west side of the NW¼ sec. 11 produced 85,032 barrels of oil from 1920 to the end of 1937, an average of 17,000 barrels per well. Yet no offset wells have been drilled on the west or east of these producers. The lease adjacent on the south has produced 10,516 barrels per well, and the NW¼ sec. 14 has produced 11,573 barrels per well. The oil-bearing Bartlesville sand is probably present in the entire tract that lies between the producing area in the SW¼ sec. 11 and the producing area in the NW¼ sec. 11; and it probably extends northwestward through much of the E½E½ sec. 10 and the E½SE¼ sec. 3. Likewise, the producing area in the NW¼ sec. 14 may extend southward into the SW¼ sec. 14. Additional wells should be drilled on all these tracts to explore the Bartlesville sand. Wells about 1,650 to 1,750 feet deep would penetrate the entire sand body.

SEC. 3

The southern part of a relatively narrow oil field that trends southward across sec. 34, T. 25 N., R. 11 E., occupies the north-central part of sec. 3, and six wells, five of which have been abandoned, are in the south-central part of sec. 3. All the wells derived their oil from the Bartlesville sand at depths of about 1,750 to 1,800 feet. This oil field lies on the west and southwest flanks of a narrow anticline whose crest trends southwest and south from the SW¼ sec. 23, through the E½ sec. 27 and sec. 34, T. 25 N., R. 11 E., into the NW¼ sec. 2, T. 24 N., R. 11 E., a total distance of 3 miles. Gas was found in the Bartlesville sand in many wells on the higher parts of the anticline in T. 25 N., R. 11 E. A total of 270,146 barrels of oil had been produced in the N½ sec. 3 from 1920, when production began, to the end of 1937, and a total of 57,507 barrels was produced from the few wells in the S½ sec. 3. The distribution of the wells and the general habit of the oil-bearing Bartlesville sand to occur in elongated lenses indicate that oil-bearing sand probably is continuous between the wells in the N½ and those in the S½ sec. 3. Accordingly, additional wells should be drilled in the W½SE¼ sec. 3, and probably also in the E½SW¼ of that section.

DOGTHRASHER ANTICLINE

The crest of the Dogthrasher anticline extends northeastward from the NW¼SE¼ sec. 21 through the NE¼ sec. 21, SE¼ sec. 16, W½ sec. 15, S½ sec 10 into the NE¼ sec. 10. (See pl. 4.) The structure of the buried rocks is dissimilar to that indicated by the attitude of the exposed rocks, and the crest of the fold in the exposed rocks is about 1,800 feet northwest of its crest in the buried rocks, which is an uncommon relationship in Osage County. About 125 wells have been drilled on the anticline, and oil is produced throughout its length.

In all except a very few wells the oil is derived from the Bartlesville sand, whose base lies at depths of about 1,650 to 1,750 feet. One well in the NW¼ sec. 15 yielded oil from the Peru sand. The initial daily yields of all wells in the field ranged from 5 to 600 barrels. The amount of the initial yields and of the total yields of the wells appears to bear no relation to the position of the wells on the anticline. The SE¼ sec. 16 has yielded much more oil than any other lease in the field, yet it lies mostly in the structural saddle between two subsidiary domes on the anticline, and much of it is fairly low on the west flank of the anticline. Several of the wells have been producing since 1905 or 1906, and many have been producing since 1911 or 1912.

The margins of the producing area on the Dogthrasher anticline appear to have been defined by abandoned wells and dry holes, except in the northeastern part. It is likely that additional producing wells could be drilled in sec. 10, north and northwest and possibly southeast of the producers now there. Oil-bearing sand may occupy all of the area between the producing wells near the center of sec. 10 and the abandoned wells in the southern part of sec. 3. The Siliceous lime might yield gas on the crest of the anticline in the S½NW¼ sec. 15, where it would be encountered at a depth of about 2,150 feet.

MINNEHOMA DOME

The Minnehoma dome, whose crest is in the SW¼ sec. 27, occupies an area of about 2 square miles. It has a structural closure on the Oswego lime of nearly 100 feet, which is several times the amount of its closure in the exposed rocks. The crest of the dome on the Oswego lime (pl. 4) is 1,800 feet east of the crest in the exposed rocks.[20] The exposed rocks near the crest of the dome are cut by a northwestward-trending fault, along which the rocks have a maximum vertical displacement of about 50 feet. It could not be deter-

[20] Hopkins, O. B., and Powers, Sidney, in White, David and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pl. 37, 1922.

mined from the well logs whether the fault cuts the Oswego lime and other deeply buried rocks. Oil has been produced from the Bartlesville sand for many years on the north and southwest flanks and the crest of the dome. About 40 wells have been drilled, most of which are about 1,700 feet deep and produce oil from the Bartlesville sand. The initial daily yields ranged from 5 to 300 barrels. A total of 371,648 barrels of oil was produced from the dome between July 1916 and the end of 1937. The figures of production for the period prior to July 1916 are not available. It appears probable that additional producing wells could be obtained throughout much of the SW¼ sec. 27, and probably a part of the NW¼ sec. 34 and the NE¼ sec. 33. Well 6 in the SW¼ sec. 27, was drilled only recently and yielded 15 barrels of oil a day. Well 457, in the SW¼ sec. 27, which had produced oil from the Bartlesville sand, was deepened in 1938 to the Siliceous lime, which yielded 4,750,000 cubic feet of gas a day.

BIRCH CREEK DOME

One of the most prominent domes in eastern Osage County is the Birch Creek dome, in the southwestern part of T. 24 N., R. 11 E. Its structural relief is nearly 200 feet on the Oswego lime (pl. 4) and a little more than half that amount in the exposed rocks.[21] The dips of the rocks on the flanks of the dome are steeper than on most domes in this part of Osage County; they reach an angle of about 4° on the north flank and slightly less on the northwest flank. The crest of the dome in the Oswego lime lies about 1,000 feet northwest of its position in the exposed rocks.

A crystalline rock reported to be granite was encountered at a depth of 1,761 feet in well 8 in the center of the west line of the E½E½SE¼ sec. 30, near the crest of the dome. The so-called granite was encountered below a sequence of limestone beds 218 feet thick that contains a shale bed 7 feet thick lying 26 feet above the base. Possibly this entire sequence belongs in the Mississippi lime, although positive identification of the limestone cannot be made from the drillers' logs. If this entire sequence represents the Mississippi lime, the Siliceous lime, which is about 1,000 feet thick in much of the region, is absent over the "granite" peak.

The Birch Creek dome has been disappointing as the site for a large oil field. The dome lies adjacent to a southwestward-trending belt of oil-saturated Bartlesville sand that extends nearly across the township. The Bartlesville sand has yielded oil in many wells on the northeast, north, and southwest flanks of the dome, and it has yielded gas in several wells that are higher on the flanks of the dome than the oil wells. The initial daily yields of the oil wells ranged

[21] Hopkins, O. B., and Powers, Sidney, op. cit., pl. 37.

from 5 to 500 barrels, and the initial yields of the gas wells from 6 to 28 million cubic feet. The average total yields of the oil wells were not large. Moreover, wells drilled throughout a large tract on and near the crest of the dome failed to produce either oil or gas. The amount of the initial daily yield and apparently the total yield of wells appears to be controlled by factors other than the position of the wells on the fold. The trend of the producing area through the central part of the township and the alinement of the tracts on the northeast flank of the Birch Creek dome that have relatively large total yields, suggest that the presence of the thick portion of an elongated sand body may be the main factor that determines the large total yields. Three of the wells that are high on the dome yielded gas from the Burgess sand-Mississippi lime zone.

The logs of the wells near the crest of the dome indicate that the Bartlesville sand is separated by shale partings into several beds. Well 316–6 on the crest of the dome produced gas from the Oswego lime at an estimated rate of 8 million cubic feet a day, but was carried on down into the Burgess sand-Mississippi lime zone, from which it produced gas at a rate of 10½ million cubic feet a day. Well 7 was then drilled nearby to the Oswego lime but failed to yield gas. Although the log of well 8, near the crest of the dome, indicates that the Siliceous lime there is either very thin or absent, wells located on the flanks of the dome, 40 to 60 feet structurally below the crest, probably would encounter the Siliceous lime and might find it to be gas-bearing. A fair location for a test well would be the northeast corner of the SE¼SW¼ sec. 29, where gas shows in the Oswego lime, Bartlesville sand, Burgess sand-Mississippi lime zone, and Siliceous lime should be tested. If one or more of these zones yields gas in valuable quantities, other wells should be drilled in the S½ sec. 29. Most of the area included in the Birch Creek dome has already been thoroughly tested for oil, but probably a few wells with small daily yields could be added in the N½ sec. 29, the NE¼ sec. 30, and possibly the E½NW¼ sec. 30.

SOUTH BIGHEART DOME

A broad-topped dome is shown on plate 4, south of Barnsdall. It is called herein the South Bigheart dome, after the old town of Bigheart, now renamed Barnsdall. The dome has a structural closure of about 50 feet on the Oswego lime and is represented in the exposed rocks by an anticlinal nose that trends southward through sec. 18 into the NE¼ sec. 19. Eleven wells have been drilled on the dome. Of these, three in the SE¼ sec. 18 had an initial daily yield of 5 to 20 barrels of oil from the Bartlesville sand, two in the NE¼ sec. 19 had an initial daily yield of 1½ to 2 million cubic feet

of gas from the Bartlesville sand, and two had an initial daily yield of 10 to 12 million cubic feet of gas from the uppermost part of the Ordovician rocks. The logs of two of the wells record shows of gas in the Oswego lime, but the amounts of the gas shows are not given.

The drillers' logs of the wells that produced gas from Ordovician rocks show the gas-producing beds as sand. Samples of the rock were not available for examination with the microscope, and it could not be determined from the logs whether the gas-bearing zone represents a thin remnant of the Simpson formation, which is known to be present a short distance to the southwest,[22] or whether it lies in the upper part of the Siliceous lime. The Bartlesville sand in the SE¼ sec. 18 and in sec. 19 is thin and occurs somewhat higher stratigraphically than the oil-bearing part of the Bartlesville sand in the eastern and central parts of the township.

It appears that the South Bigheart dome has been adequately tested, but it is possible that some additional gas could be obtained from the Ordovician rocks.

NORTH BIGHEART ANTICLINE

A poorly defined anticline trends westward through the southern part of secs. 8 and 7 and thence southwestward through the NW¼ sec. 18 into the N½ sec. 13 of T. 24 N., R. 10 E., adjacent on the west. Three low domes lie along the crest of the anticline. (See pl. 4.) The anticline coincides only in a general way with the structural features in the exposed rocks,[23] which are cut by a short fault that trends northwest through the NW¼ sec. 18 and the SW¼ sec. 7 and has a throw of about 60 feet,[24] but it is impossible to determine from the well logs whether the deeply buried rocks are displaced.

Only 3 of 48 wells drilled on the anticline in T. 24 N., R. 11 E., proved to be dry holes. One well in the SW¼ sec. 9 yielded gas from the Siliceous lime; all other wells yielded oil from the Bartlesville sand. Several of the wells in the NW¼ sec. 18 and the SW¼ sec. 7 and the two wells in the NW¼NE¼ sec. 17 were drilled in 1913 or 1914 and are still producing. Most of the other wells were drilled in 1920. Well 20 in the NW¼ sec. 18, which was drilled in 1914, is widely known, because its pump jack stands in the middle of the main street of Barnsdall. This well has been seen and commented on by thousands of motorists, and a sketch and description

[22] White, L. H., Subsurface distribution and correlation of the pre-Chattanooga ("Wilcox" sand) series of northeastern Oklahoma: Oklahoma Geol. Survey Bull. 40, vol. 1, pl. 2, 1928.

[23] Hopkins, O. B., and Powers, Sidney, in White, David, and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pl. 37, 1922.

[24] Hopkins, O. B., and Powers, Sidney, idem., p. 246.

of it appeared a few years ago in Robert Ripley's well-known newspaper feature, "Believe it or not."

The irregular distribution of the producing wells on the North Bigheart anticline and the absence of bordering dry holes indicates that several undrilled areas of considerable extent are underlain by oil-bearing Bartlesville sand. It is not unlikely that much of the undrilled parts of sec. 17, the S½ and NW¼ sec. 8, the E½ and SW¼ sec. 7, and the N½ sec. 18 is oil-bearing. The last-named tract includes the NE¼ sec. 18, now the town site of Barnsdall, in which the mineral rights, including oil and gas, have passed from the Osage Indian tribe. Only wells with small initial daily yields should be expected, but the wells would probably be long-lived. Drilling depths should be from about 1,700 to 1,800 feet.

DOME IN SE¼ SEC. 17

The dome whose crest is in the SE¼ sec. 17 appears to be a relatively unimportant structural feature. Its southeast flank and the saddle between it and the dome in the NE¼ sec. 21 are speculative as shown on plate 4, because no datum points were available in the southwestern part of sec. 16. Only a low anticlinal nose is present in the exposed rocks in the SE¼ sec. 17. In all, 21 wells were drilled on the dome from 1918 to 1922. Of these, 19 produced oil from the Bartlesville sand, and 15 are still producing. The initial yields of the wells ranged from 10 to 90 barrels a day. The dry hole and two abandoned producers in the N½N½ sec. 20 discourage further drilling to the south, but it appears reasonable to conclude that the producing area could be extended in other directions, particularly to the north. The structural attitude of the rocks need not be considered in prospecting this area for oil in the Bartlesville sand, because the occurrence of oil in this sand does not appear to be controlled by the attitude of the beds. Drilling depths to the base of the Bartlesville sand would be about 1,800 feet.

DOME IN SEC. 5

The broad-topped dome that appears on plate 4 in sec. 5 extends into secs. 4, 6, 7, 8, and 9. This dome appears to be the subsurface expression of a dome in the exposed rocks in the SW¼ sec. 4.[25] Some doubt exists as to the relationship of the two domes, because the crest of the subsurface dome lies half a mile west of the crest of the dome in the exposed rocks. Oil has been found in the Bartlesville sand in 15 wells on the dome and gas in one well. The initial yields of the oil wells are recorded on the logs as ranging from 5 to 1,000 barrels a day. Additional wells should be drilled on all

[25] Hopkins, O. B., and Powers, Sidney, op. cit., pl. 37.

sides of the producing area to determine the limits of the field. Drilling depth to the base of the Bartlesville sand is about 1,800 feet. Gas might be obtained from the Siliceous lime on the crest of the dome.

YIELDS

The total amount of oil produced in T. 24 N., R. 11 E., from July 1916 to the end of 1937, as compiled from records of the Osage Indian Agency, is shown in the table following. Earlier data were not available.

Oil produced in T. 24 N., R. 11 E.

Tract	Date of first production	Production to end of 1937 (barrels)	Remarks
NW¼ sec. 1	November 1921	15,076	
SW¼ sec. 1	November 1924	25,794	
SE¼ sec. 1	December 1925	19,970	
NE¼ sec. 2	July 1920	525	Abandoned in 1925.
NW¼ sec. 2	January 1921	4,526	Abandoned in 1928.
SW¼ sec. 2	July 1920	52,308	
NE¼ sec 3	do	202,788	
NW¼ sec. 3	do	67,358	
SW¼ sec. 3	do	20,660	Abandoned in 1935.
SE¼ sec. 3	do	36,847	
NW¼ sec. 4	do	39,656	
SW¼ sec. 4	August 1920	3,768	
NE¼ sec. 5	July 1920	48,234	
SW¼ sec. 5	March 1922	6,698	
SE¼ sec. 5	October 1920	13,363	
SE¼ sec. 6	March 1921	9,339	
NE¼ sec. 7	November 1920	14,984	
SW¼ sec. 7	July 1920	115,430	
SE¼ sec. 7	do	210,132	
NW¼ sec. 8	August 1920	59,510	
SW¼ sec. 8	do	181,728	
SE¼ sec. 8	January 1920	23,098	
SE¼ sec. 9	July 1920	47,862	
NE¼ sec. 10	do	10,585	
NW¼ sec. 10	do	29,696	
SW¼ sec. 10	do	140,130	
SE¼ sec. 10	May 1919	27,516	
NE¼ sec. 11	April 1921	7,118	Abandoned in 1934.
NW¼ sec. 11	February 1921	85,032	
SW¼ sec. 11	March 1920	52,579	
SE¼ sec. 11	March 1922	6,474	
NE¼ sec. 12	May 1922	101,905	
NW¼ sec. 12	March 1924	9,016	
SW¼ sec. 12	March 1922	10,051	
SE¼ sec. 12	April 1922	7,120	Abandoned in 1932.
NE¼ sec. 13	Prior to July 1916	80,689	
NW¼ sec. 13	do	23,237	
SW¼ sec. 13	do	57,203	
SE¼ sec. 13	do	287,166	
NE¼ sec. 14	December 1920	1,128	Abandoned in 1922.
NW¼ sec. 14	August 1919	243,031	
SW¼ sec. 14	January 1923	19,652	
SE¼ sec. 14	December 1918	209,272	
NE¼ sec. 15	July 1919	23,884	
NW¼ sec. 15	Prior to July 1916	59,876	Abandoned in 1935.
SW¼ sec. 15	do	14,703	Abandoned in 1924.
SE¼ sec. 15	September 1919	99,330	
NE¼ sec. 16	Prior to July 1916	283,561	
NW¼ sec. 16	May 1918	11,166	
SW¼ sec. 16	Prior to July 1916	59,166	Abandoned in 1935.
SE¼ sec. 16	do	546,263	
NE¼ sec. 17	do	60,511	
NW¼ sec. 17	April 1919	76,293	
SW¼ sec. 17	February 1919	39,407	
SE¼ sec. 17	December 1918	107,754	
NW¼ sec. 18	Prior to July 1916	106,792	
SE¼ sec. 18	August 1920	10,111	Abandoned in 1932.
SE¼ sec. 20	Prior to July 1916	18,857	Abandoned in 1930.
NE¼ sec. 21	do	170,196	

Oil produced in T. 24 N., R. 11 E.—Continued

Tract	Date of first production	Production to end of 1937 (barrels)	Remarks
NW¼ sec. 21	Prior to July 1916	58,343	
SW¼ sec. 21	do	40,084	Abandoned in 1931.
SE¼ sec. 21	do	22,476	Abandoned in 1929.
NW¼ sec. 22	do	1,606	Abandoned in 1922.
SW¼ sec. 22	do	11,936	Do.
NE¼ sec. 23	do	188,346	
NW¼ sec. 23	February 1919	17,480	Record to end of 1934.
SW¼ sec. 23	December 1918	121,137	
SE¼ sec. 23	Prior to July 1916	71,198	
NE¼ sec. 24	do	254,119	
NW¼ sec. 24	do	226,286	
SW¼ sec. 24	do	116,334	
SE¼ sec. 24	do	182,685	
NE¼ sec. 25	do	208,560	
NW¼ sec. 25	do	197,737	
SW¼ sec. 25	do	200,682	Record through Sept. 1936.
SE¼ sec. 25	do	222,701	Do.
NE¼ sec. 26	do	292,199	
SE¼ sec. 26	do	66,283	Do.
NE¼ sec. 27	April 1917	32,677	
NW¼ sec. 27	Prior to July 1916	247,625	
SW¼ sec. 27	do	97,093	
NE¼ sec. 28	do	37,562	Abandoned in 1925.
NW¼ sec. 28	do	224,960	
SW¼ sec. 28	do	79,315	Abandoned in 1932.
SE¼ sec. 28	December 1919	16,343	
NE¼ sec. 29	Prior to July 1916	70,825	
NW¼ sec. 29	do	165,167	
SW¼ sec. 29	do	72,285	Last oil in 1934.
SE¼ sec. 29	do	226,355	
NE¼ sec. 30	July 1919	128,020	
NW¼ sec. 31	1920	20,043	Abandoned in 1931.
SW¼ sec. 31	November 1918	128,216	Do.
NE¼ sec. 33	May 1919	63,436	
NW¼ sec. 34	May 1921	11,567	
NE¼ sec. 35	Prior to July 1916	92,629	Record through Sept. 1936.
SE¼ sec. 35	do	105,406	Do.
NE¼ sec. 36	do	30,386	Do.
NW¼ sec. 36	do	103,599	Do.
SW¼ sec. 36	do	157,010	Do.
SE¼ sec. 36	do	65,636	Do.
		8,992,651	

T. 25 N., R. 11 E.

T. 25 N., R. 11 E., is in east-central Osage County, and its northeast corner is 6 miles southwest of Bartlesville. It lies in a region that has produced oil and gas, mainly from the Bartlesville sand, for 30 years or more, but production in this township did not begin until 1915. A total of more than 10 million barrels of oil and an unknown quantity of gas had been produced from T. 25 N., R. 11 E., by the end of 1937. Essentially all of the oil has come from the Bartlesville sand. The large Woolaroc and Quapaw fields are the two main oil-producing areas, and a third is the narrow area in secs. 34 and 27 that extends southward into sec. 3, T. 24 N., R. 11 E. The daily yields of wells in T. 25 N., R. 11 E., are relatively small, but the wells are long-lived.

Most of the wells in the Quapaw field were drilled from 1915 to 1919. Most of those in the Woolaroc field were drilled from 1917 to 1920, but many wells near the south end of this field were not drilled

until 1936. The gas wells in the E½ sec. 22 were drilled from 1914 to 1917; the wells in the western part of sec. 27 and the E½ sec. 28 were drilled in 1918 and 1919; and most of those in secs. 33 and 34 and the S½ sec. 27 were drilled from 1922 to 1925. Most of the wells are 1,650 to 1,800 feet deep.

The logs indicate that most of the producing wells do not penetrate the lower part of the Bartlesville sand. It is probable, however, that when old wells are deepened and new wells are drilled in old producing areas in connection with secondary recovery operations, additional oil will be found in the lowest part of the Bartlesville sand, as in the Avant oil field, which lies a few miles south and southeast of this township.

The subsurface investigation of T. 25 N., R. 11 E., was made in 1935, mainly by G. D. McClure. The statistics of the oil production of many leases were compiled in part in 1938 by Miss Anna L. Weinrich of the Osage Indian Agency.

STRUCTURE AND DEVELOPMENT

Regionally, the rocks dip westward across T. 25 N., R. 11 E., at the rate of about 35 feet to the mile, as measured on the top of the Oswego lime. This regional dip is interrupted by many small domes, anticlines, and synclines. The Javine anticline in the southwestern part of the township is the most prominent fold. It has a structural closure of about 70 feet in the Oswego lime (pl. 4) and covers a total area of only a few square miles.

It is noteworthy that most of the domes and anticlines in T. 25 N., R. 11 E., are essentially barren of oil, but that prolific oil pools occur in the synclines that are between the main domes and anticlines. This distribution of the oil pools is such as to lead to the conclusion that the occurrence of the oil is independent of the structural attitude of the rocks. On the other hand, the domes and anticlines in this township appear to have controlled the occurrence of gas.

The elongated Woolaroc field in the eastern part of the township is a striking example of an oil pool that appears to occur independently of the local structure of the rocks. The reservoir sand in this field passes indiscriminately over local highs and lows and the flanks of folds, and the amount of oil supplied by the sand to individual wells and tracts bears no relation to the structural attitude of the rocks. Likewise, much of the prolific Quapaw oil field, which extends diagonally northeastward through the southwestern part of the township, lies low on the flank of the most prominent anticline in the township and extends across local anticlinal noses and synclines. It is apparent, therefore, that a knowledge of the structure of the rocks is not so necessary to the oil operator here as in many other oil-bearing regions.

WOOLAROC FIELD

The Woolaroc field extends from secs. 1 and 2, T. 25 N., R. 11 E., southward across the township and part way into sec. 1, T. 24 N., R. 11 E. The field is less than a mile wide throughout most of its length. Oil and gas occur in the Bartlesville sand at depths of 1,700 to 1,800 feet. In sec. 1, T. 25 N., R. 11 E., gas occurs also in the Oswego lime, Burgess sand-Mississippi lime zone, and the Siliceous lime.

The reservoir sand body of the Woolaroc field is more easily studied than most Bartlesville sand bodies of eastern Oklahoma, because the logs of many of the wells on the margins of the field appear to have been recorded in more detail than those of wells in other parts of the region. Nevertheless many cross sections extending westward across the field show somewhat conflicting features. On the whole, however, they indicate that the sand body has a relatively flat base and an arched top and that it pinches out both to the east and to the west. Microscopic examination of samples of the sand from a few wells shows it to be composed mainly of fine to very fine quartz grains that are fairly well to well sorted.

The oil-bearing Bartlesville sand thus exhibits many of the characteristics of the so-called shoestring sands of southeastern Kansas and northeastern Oklahoma,[26] which probably were formed as offshore bars along the shore of the Cherokee sea. The Woolaroc sand body is believed to have had a similar origin.

In most wells in the field the upper part of the Bartlesville sand is gas-bearing and the lower part is oil-bearing. Only gas is produced from the sand on the crest of the dome that occupies the area surrounding the common corner of secs. 11 to 14 and from the sand on the Phillips anticline in the E½ sec. 1 and the SE¼ sec. 12. The initial daily yields of most of the oil wells ranged from 5 to 250 barrels, but well 8, in the SW¼ sec. 12, is reported to have an initial yield of 3,000 barrels a day. It is not uncommon in the Woolaroc field for wells with small daily yield to be offset by wells with large yield; also, the initial yield of the wells and the total yield of the tracts appear to bear no relation to their structural position. The SW¼ sec. 13, which had produced the largest amount of oil by the end of 1937, lies in a local structural basin on the east flank of a small dome whose crest is in the SE¼ sec. 14. The second largest total yield was obtained from the SE¼ sec. 14, which includes the dome just mentioned. The average yield to the acre for the Woolaroc field to the end of 1937 was about 2,000 barrels.

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[26] Bass, N. W., Origin of the shoestring sands of Greenwood and Butler counties, Kans.: Kansas Geol. Survey Bull. 23, pp. 9, 63–66, 69–78, pls. 1, 10–14, 1936.

Wells in the field should be deepened to the base of the Bartlesville sand before abandonment, and the entire area should be investigated for its adaptability to repressuring with gas, air, or water. The investigation would require laboratory study of cores of the sand collected at localities spaced systematically through the field. A final decision as to the advisability of drilling additional wells should depend largely upon the performance of the present producing wells, but the distribution of the wells in a few leases suggests that additional wells should be drilled with the usual regular spacing until the margins of the field are defined. These leases include the E½ sec. 35, W½ sec. 36, SE¼ sec. 26, E½ NW¼ sec. 25, SE¼ sec. 23, W½ sec. 24, NW¼ sec. 13, NE¼ sec 14, and possibly the NW¼ sec. 12.

QUAPAW FIELD

The Quapaw oil and gas field, as the name is used herein, includes the producing area that extends from secs. 15 and 16 southwestward to secs. 30 and 31. A part of the field lies on the flanks of the Javine anticline, whose crest is near the northeast corner of sec. 31. The Bartlesville sand contains oil and gas at depths of about 1,600 to 1,800 feet. According to the logs the sand is 50 to 100 feet thick in much of the area. Many wells did not pass through the sand, however; these wells should be deepened through the sand before they are abandoned, provided they are not now producing large amounts of water.

The initial daily yields of the wells in the Quapaw field ranged from a few barrels to 1,000 barrels. Wells throughout most of the field have been long-lived. Most of the wells were drilled between 1915 and 1920 and are still producing. Much more oil has been produced to the acre in the Quapaw field than in the Woolarac field. The most productive part of the Quapaw field lies in a narrow belt about midway of the field, extending from the southwest corner of sec. 30 diagonally northeastward to the center of sec. 16. In this belt the wells had large initial daily yields, and the tracts have had large total yields. This most productive part of the reservoir sand has a definite, almost straight-line trend through the field, and the amount of oil it produces appears not to be influenced by the local structural features. This relationship is typical of shoestring oil-bearing sands elsewhere in Oklahoma and in Kansas. It is believed that the sand body in the Quapaw field belongs to the shoestring type. The narrow belt that trends lengthwise near the median line of the field and has furnished the large yields probably consists of the thickest and most homogeneous and permeable part of an elongated bar-shaped sand body.

The Bartlesville sand in the Quapaw field appears to be thoroughly drilled, but the relatively large yields from this sand indicate that the field should be further investigated with a view to possible secondary recovery operations, such as repressuring with gas or water. Some repressuring is already being carried on in this field.

JAVINE ANTICLINE

The Javine anticline is the most pronounced fold in the township. It lies in a belt of steeply folded rocks that trends southwestward for many miles beyond the township. This anticline has a structural closure of 70 feet on the Oswego lime (see pl. 4) and about 30 feet in the exposed rocks.[27] It is separated from the Boston-Osage anticline, which lies to the northeast, by a relatively deep saddle in sec. 29. The crest of the Javine anticline has proved disappointing as a site for a large oil and gas field. The large Bartlesville sand body that lies in part on the northwest flank of the anticline thins toward the crest and there yields only small amounts of oil and relatively large amounts of gas with the oil. One well drilled in 1918 on the crest found gas in the Burgess sand-Mississippi lime zone and a show of gas in the Bartlesville sand. The anticline appears to have been adequately tested except for the Siliceous lime, which probably lies at a depth of about 2,100 feet on the crest. The Siliceous lime is important here as a prospective gas producer, because it yields gas on most of the prominent domes and anticlines in this part of Osage County. A future supply of gas on the Javine anticline will be particularly valuable here if gas should be used to repressure the Bartlesville sand of the oil fields in the region.

BOSTON-OSAGE ANTICLINE

The Boston-Osage anticline, as the name is used in this report, is restricted to the fold whose crest is in the NE¼ sec. 28. The crest of the anticline on the Oswego lime lies a few hundred feet northwest of its position in the exposed rocks. Small amounts of oil and gas have been produced from the Bartlesville sand in several wells at widely spaced localities on the flanks of the anticline. Gas has been produced from the Burgess sand-Mississippi lime zone in several wells, but all have been abandoned. The producing area low on the northwest flank of the fold is a part of the Quapaw oil field, already described. The group of wells in the central and west-central parts of the E½ sec. 29 has produced about 75,000 barrels of oil in 20 years. This producing area possibly could be extended

[27] Hopkins, O. B., in White, David, and others, Structure and oil and gas resources of the Osage Reservation, Okla.: U. S. Geol. Survey Bull. 686, pl. 11, 1922.

northward and southward by additional drilling, but only wells with small daily yields should be expected. The small group of wells surrounding the quarter corner common to secs. 27 and 28, all but one of which have been abandoned, had produced about 75,000 barrels to the end of 1937. Other small producers possibly could be found northeast and south of this group, but it is doubtful that the daily yields to be expected would justify the expense of drilling. A well should be drilled on the crest of the anticline for gas in the Siliceous lime, which should be encountered at a depth of a little less than 2,100 feet. This well may also find paying quantities of gas in rocks younger than the Siliceous lime, particularly the Burgess sand-Mississippi lime zone and the Bartlesville sand.

EAST BOSTON-OSAGE ANTICLINE

A relatively broad anticlinal fold, designated on plate 4 as the East Boston-Osage anticline, extends northward from sec. 2, T. 24 N., R. 11 E., to the NE¼ sec. 27, T. 25 N., R. 11. E., and thence northeastward into sec. 23. It includes two low domes in secs. 27 and 23. In the E½ sec. 34, near the south end of the anticline, the exposed rocks are cut by a fault that has a throw of about 60 feet.[28] The meager data furnished by the logs of wells in secs. 34, 35, and 27 indicate that the fault does not displace the deeply buried rocks. Gas is produced on the higher part of the anticline from the Bartlesville sand and from the Burgess sand-Mississippi lime zone. Oil is produced from the Bartlesville sand on the west flank of the fold in secs. 34 and 27 and from the Big lime in one well on the crest of the dome in the NE¼ sec. 27. The initial daily yields of the gas wells ranged from 1 to 6 million cubic feet, and the initial daily yields of the oil wells ranged from 10 to 225 barrels. Most of the oil wells, however, had initial yields of less than 100 barrels a day. The average yield to the acre for the oil-producing area in the W½ sec. 34 was a little less than 3,000 barrels to the end of 1937, but this is a larger yield to the acre than has been obtained from many areas in Osage County producing from the Bartlesville sand.

The distribution of the oil wells suggests that additional wells should be drilled near the present producers in the central part of the NW¼ sec. 34 and in the N½ sec. 27. The Siliceous lime should be tested on the crest of the dome in the NE¼ sec. 27 and on the dome in the SW¼ sec. 23, where it will be encountered at a depth of about 2,150 feet and probably will yield gas. Gas might be found also in the Oswego lime, Bartlesville sand, and Burgess sand-Mississippi lime zone.

[28] Hopkins, O. B., op. cit., pl. 11 and p. 87.

DOME IN SEC. 33

A small dome is shown on plate 4 in the E½ sec. 33 on the crest of an anticlinal nose that projects southwestward from the East Boston-Osage anticline. Several wells on the dome, all of which have been abandoned, have produced oil from the Bartlesville sand. Their initial daily yields ranged from 5 to 75 barrels, and their total yield was 59,141 barrels, of which 50,715 barrels came from five wells in the E½ sec. 33. The yields of these wells and of the wells in the NE¼ SE¼ sec. 28, on the Boston-Osage anticline (61,277 barrels), suggests that other wells with small yields could be found in the Bartlesville sand in the NE¼ sec. 33 and the SE¼ sec. 28 in the area that lies between the two groups of productive wells in secs. 28 and 33. Other wells might be drilled in the SE¼ sec. 33. The fact that in much of the area between the wells in the NE¼SE¼ sec. 28 and the wells in the E½ sec. 33 the rocks are structurally low does not detract from the value of the area as a prospective producer of oil from the Bartlesville sand. The prospect for finding gas in the Siliceous lime and in the Burgess sand-Mississippi lime zone on this dome is not so good as on some other domes in this region, because this dome has only a small structural closure and its crest is much lower than the crests of nearby domes and anticlines.

DUNN AND LOST CREEK ANTICLINES

The Dunn and Lost Creek anticlines lie in the northwestern part of the township. The Dunn anticline trends westward through secs. 9, 8, and 7; the Lost Creek anticline trends southeastward from the northwest corner of sec. 5 and joins the Dunn anticline in the W½ sec. 8. The positions of the structure contours that show these anticlines on plate 4 are based on only a few datum points; therefore the mapping here is somewhat speculative. Gas has been produced from the Burgess sand-Mississippi lime zone and from the Siliceous lime in wells that are widely distributed along the crests of these anticlines. The initial yields of the wells ranged from 1 to 4 million cubic feet a day, but most of them yielded from 2 to 3 million cubic feet a day. It appears probable that other gas wells could be completed in the Burgess sand-Mississippi lime zone and the Siliceous lime in the W½ sec. 8 and the S½ sec. 9. A very small amount of oil was produced from the Bartlesville sand in three wells, now abandoned, a short distance west of the center of sec. 9. Possibly paying wells could be drilled in the area just northeast of these abandoned producers.

NORTH-CENTRAL PART OF TOWNSHIP

A characteristic of shoestring oil fields in northeastern Oklahoma and southeastern Kansas is their end-to-end arrangement in north-

eastward-trending belts. Within each belt, however, the individual fields are offset from the neighboring fields. The Quapaw field may lie in a hypothetical belt of this type that includes the fields in the eastern part of T. 24 N., R. 10 E., and possibly other fields, yet undiscovered, northeast of sec. 16, T. 25 N., R. 11 E. If there is an undiscovered field just northeast of the Quapaw field, likely it lies not directly in the projection of the median line of the Quapaw field, which would pass diagonally northeast through the center of sec. 10 and the center of sec. 2, but northwest or southeast of such a median line. If such a field exists, it probably lies northwest of the northeastward projection of the Quapaw field, because the logs of the dry holes in the SE¼ sec. 9 and the S½ sec. 10 show shale and limestone occupying the main part of the zone that is occupied elsewhere by the Bartlesville sand. Also, the three wells a short distance west of the center of sec. 9 found the Bartlesville sand to be from 25 to 32 feet thick and produced oil from it for a time. It is suggested that the area surrounding the corner common to secs. 3, 4, 9, and 10 would be a favorable site for a test. A prospect hole here would be a wildcat in the true sense of the term, but the objective sand lies at shallow depth and only a moderate expenditure would be required to test it. Furthermore, the venture would not wholly lack a chance for success. The fact that the rocks here lie in a syncline (see pl. 4) need not be considered unfavorable for oil in the Bartlesville sand.

YIELDS

The total amount of oil produced in T. 25 N., R. 11 E., from July 1916 to the end of 1937, as compiled from records of the Osage Indian Agency, is shown in the table following. Earlier data were not available.

Oil produced in T. 25 N., R. 11 E.

Tract	Date of first production	Production to end of 1937 (barrels)	Remarks
SW¼ sec. 1	June 1917	17,896	
NE¼ sec. 2	July 1920	12,567	Abandoned in 1929.
SW¼ sec. 2	April 1920	24,116	Abandoned in 1930.
SE¼ sec. 2	June 1917	215,000	
SW¼ sec. 7	July 1921	161	Abandoned in 1921.
NW¼ sec. 9	March 1919	14,131	Abandoned in 1923.
NE¼ sec. 11	November 1917	124,909	
SE¼ sec. 11	August 1917	177,641	
NW¼ sec. 12	May 1920	5,282	Abandoned in 1935.
SW¼ sec. 12	March 1917	185,905	
NE¼ sec. 13	November 1919	1,871	Abandoned in 1928.
NW¼ sec. 13	July 1919	59,554	
SW¼ sec. 13	May 1920	431,021	
SE¼ sec. 13	March 1922	7,143	Abandoned in May 1928.
NE¼ sec. 14	December 1917	222,064	
SE¼ sec. 14	October 1918	367,761	
NW¼ sec. 15	November 1919	892	Abandoned in 1921.
SW¼ sec. 15	October 1918	69,527	Abandoned in 1929.
NW¼ sec. 16	October 1917	47,755	Do.
SW¼ sec. 16	Prior to July 1916	631,931	
SE¼ sec. 16	November 1918	95,760	

Oil produced in T. 25 N., R. 11 E.—Continued

Tract	Date of first production	Production to end of 1937 (barrels)	Remarks
NE¼ sec. 17	October 1921	1,159	Do.
NW¼ sec. 17	March 1920	1,788	Abandoned in 1928.
SW¼ sec. 17	April 1918	2,866	Abandoned in 1924.
SE¼ sec. 17	Prior to July 1916	39,773	Do.
NW¼ sec. 18	January 1920	28,239	Abandoned in 1931.
SW¼ sec. 18	1920	1,374	Abandoned in 1924.
NE¼ sec. 19	Prior to July 1916	43,503	
SW¼ sec. 19	do	53,020	
SE¼ sec. 19	do	557,195	
NE¼ sec. 20	do	292,174	
NW¼ sec. 20	do	95,708	
SW¼ sec. 20	do	587,376	
SE¼ sec. 20	do	343,840	
NE¼ sec. 21	do	29,541	
NW¼ sec. 21	do	77,600	
SW¼ sec. 21	February 1918	224,439	
SE¼ sec. 21	March 1921	4,227	
NW¼ sec. 22	October 1919	14,903	Abandoned in 1929.
NE¼ sec. 23	July 1920	143,429	
SE¼ sec. 23	November 1920	111,909	
NW¼ sec. 24	October 1920	118,569	
SW¼ sec. 24	August 1920	198,911	
NE¼ sec. 25	April 1920	3,788	Abandoned in 1933.
NW¼ sec. 25	July 1920	175,244	
SW¼ sec. 25	August 1919	110,042	
SE¼ sec. 25	do	55,492	
NE¼ sec. 26	June 1920	282,409	
SE¼ sec. 26	July 1920	142,832	
NE¼ sec. 27	Prior to July 1916	32,568	
NW¼ sec. 27	August 1919	5,600	
SW¼ sec. 27	October 1920	7,595	Abandoned in 1931.
SE¼ sec. 27	July 1923	4,971	Do.
NE¼ sec. 28	July 1918	8,878	
SE¼ sec. 28	December 1918	61,277	Abandoned in 1930.
NE¼ sec. 29	May 1917	67,288	
NW¼ sec. 29	Prior to July 1916	168,019	
SW¼ sec. 29	October 1917	49,470	
SE¼ sec. 29	October 1919	54,192	
NE¼ sec. 30	Prior to July 1916	889,774	
NW¼ sec. 30	do	320,250	
SW¼ sec. 30	do	764,661	
SE¼ sec. 30	do	338,612	
NE¼ sec. 31	do	136,341	
NW¼ sec. 31	do	185,374	
SW¼ sec. 31	August 1918	30,257	
NE¼ sec. 33	March 1922	30,902	Abandoned in 1934.
NW¼ sec. 33	May 1925	2,720	Abandoned in 1932.
SW¼ sec. 33	April 1925	5,706	Abandoned in 1926.
SE¼ sec. 33	June 1922	19,813	Abandoned in 1924.
NW¼ sec. 34	March 1921	298,887	
SW¼ sec. 34	June 1921	272,955	
SE¼ sec. 34	April 1925	946	Abandoned in 1931.
NE¼ sec. 35	August 1920	48,212	
SE¼ sec. 35	November 1933	48,259	
NE¼ sec. 36	January 1920	7,143	
NW¼ sec. 36	July 1919	227,408	
SW¼ sec. 36	June 1930	17,007	
SE¼ sec. 36	January 1921	87,995	
		10,647,317	

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Symbol on Map	Lessee
A	Bonnell, R. A.
B	Barnsdall Oil Co.
C	Barnsdall Oil Co. and Indian Territory Illuminating Oil Co.
D	Central Supply Co.
E	Cities Service Oil Co.
F	Cities Service Oil Co. et al
G	Coldren, H. R.
H	Connelly, E. L., et al
I	Continental Oil Co.
J	Darby Petroleum Corporation
L	Devonian Oil Co.
M	Elm Oil Co.
N	Foster & Davis and Indian Territory Illuminating Oil Co.
P	Harland Oil Co.
Q	Haskell, Frank, et al
R	Indian Territory Illuminating Oil Co.
S	Indian Territory Illuminating Oil Co. and Pittsburg Oil & Gas Co.
T	Knupp Oil Co.
U	Magnolia Petroleum Co.
V	Mid-Continent Petroleum Corporation
W	Midco Oil Corporation
X	Midstates Oil Corporation
Y	Midstates Operating Corporation et al
Z	Morrison, J. E.
BB	Morrison, James E., et al
BC	McDonnell, John V., et al
BD	McMahon & Price
BE	Nicaragua Oil Co.
BF	Pepis, A.
BG	Peters Petroleum Corporation
BH	Peters Petroleum Corporation et al
BJ	Phillips Petroleum Co.
BK	Phillips Petroleum Co. et al
BL	Plymouth Petroleum Co.
BM	Plymouth Petroleum Co. et al
BN	Royal Oil & Gas Corporation
BP	Sidwell Drilling Co.
BQ	Sinclair Prairie Oil Co.
BR	Skelly Oil Co.
BS	Sterling Oil & Gas Co. and Superior Oil Corporation
BT	The Texas Co.
BU	Western American Oil Co.
BV	Winona Oil Co.
BW	Wolverine Petroleum Corporation
BX	Sun Oil Co.

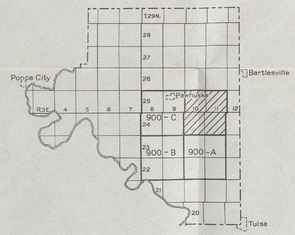
EXPLANATION FOR MAP

Colors on symbols for oil and gas wells indicate producing beds and on symbols for dry holes indicate deepest beds penetrated. Colors correspond to colors shown on columnar section. Color omitted from wells whose producing bed was not determined.

- Oil well
- Abandoned oil well
- Gas well
- Abandoned gas well
- Dry hole
- Oil well that tested the Mississippi lime but produces oil from younger beds
- Gas well that tested the Mississippi lime but produces gas from younger beds
- Abandoned oil well that tested the Mississippi lime but produced oil from younger beds
- Abandoned gas well that tested the Mississippi lime but produced gas from younger beds
- Oil well that tested Ordovician beds but produces oil from younger beds
- Gas well that tested Ordovician beds but produces gas from younger beds
- Abandoned oil well that tested Ordovician beds but produced oil from younger beds
- Abandoned gas well that tested Ordovician beds but produced gas from younger beds
- Oil well changed to water-flood intake well
- Oil well changed to air or gas repressure well
- Oil well changed to salt water disposal well
- Gas well changed to salt water disposal well

Wells in which altitudes of datum bed (Oswego lime) are unknown, owing either to lack of well log or to lack of altitude of well mouth, are indicated by a dashed line beneath the well numbers.

Structure contours. Contour interval, 20 feet. Altitudes in feet below sea level. Contours broken in areas lacking control; depression contours indicated by hachured lines



KEY MAP

Key Map of Osage County, Okla., showing location of areas described in this report and in Geological Survey Bulletin 900-A, B, and C

R. 10 E. R. 11 E.

T. 25 N. T. 24 N.

NELAGONEY
NELAGONEY ANTICLINE
MIHEKI DOME
DUNN ANTICLINE
LOST CREEK ANTICLINE
CLEAR CREEK ANTICLINE
QUAPAW FIELD
WEST JAVINE DOME
TALLANT
NORTH COCHANCE DOME
PERSHING
PERSHING FIELD
SOUTH COCHANCE DOME
WEST BARNSDALL FIELD
BARNSDALL
BARNSDALL FIELD
WYNONA FIELD
EAST BIRDSEYE ANTICLINE
SOUTH BIGHEART DOME
BIGHEART NORTH ANTICLINE
BIGHEART ANTICLINE
BIRCH CREEK FIELD
FOURMILE DOME
BOSTON ANTICLINE
BOSTON EAST ANTICLINE
AVANT FIELD
MANHATTAN DOME
WOLCO
MINNEHOMA DOME
ELEVEN-TWELVE ANTICLINE

Base map compiled from General Land Office plats
Oil and gas wells compiled from maps of Osage Indian Agency

MAP OF TOWNSHIPS 24 AND 25 NORTH, RANGES 10 AND 11 EAST, OSAGE COUNTY, OKLAHOMA

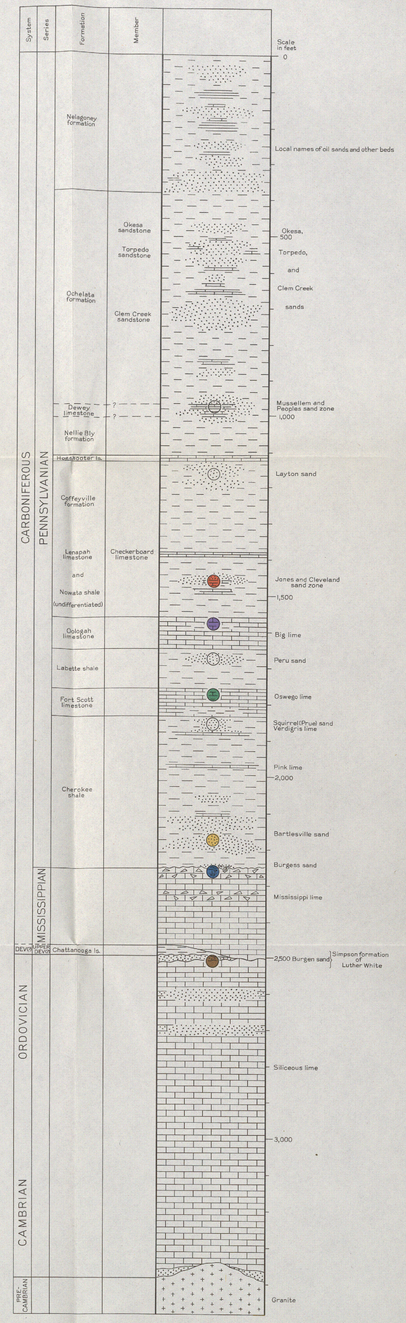
Shows the subsurface geologic structure of the top of the Oswego lime (Fort Scott limestone), the producing beds in oil and gas wells, the deepest rocks penetrated in dry holes, and the lease ownership as of October 1, 1938

1 ½ 0 1 2 Miles

1940

Prepared by L. E. Kennedy, J. D. McClure, H. D. Jenkins, and N. W. Bass

COLUMNAR SECTION OF THE ROCKS ENCOUNTERED IN DRILLING



EXPLANATION FOR COLUMNAR SECTION

- Limestone
- Cherty limestone
- Shale
- Sandstone
- Red rock
- Crystalline rocks
- Unconformity

Colors in circles in columnar section correspond to colors used on map to indicate producing beds in oil and gas wells and deepest beds penetrated in dry holes