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OIL AND GAS IN OKLAHOMA

OIL AND GAS GEOLOGY OF CARTER COUNTY

By
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FOREWORD

In 1917 the Oklahoma Geological Survey issued Bulletin 19 part 2 entitled, "Petroleum and Natural Gas in Oklahoma." This volume was so popular that the supply was soon exhausted, and for several years copies have not been obtainable.

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

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

Dr. C. W. Tomlinson, geologist of the Schermerhorn-Ardmore Company has had wide experience in the oil fields of southern Oklahoma. He has, in connection with his work in petroleum geology, spent considerable time on the complex geology of the Ardmore Basin, making him especially well qualified to write on the oil and gas geology of Carter County. Dr. Tomlinson has obtained the services of several of his colleagues in Ardmore to write the detailed geology of several of the fields of this county. This report, then, represents the best information available as of this date on the oil and gas geology of this county.

September, 1928.

Chas. N. Gould,
Director.

OIL AND GAS IN OKLAHOMA

CARTER COUNTY

ACKNOWLEDGMENTS

Mr. C. L. Cooper and Dr. Charles N. Gould of the Oklahoma Geological Survey have furnished valuable assistance and advice in the preparation of this paper. The geologists of the county, and the producers and purchasers of oil and gas have collaborated willingly in completing the maps and production records. The production statistics compiled by the Krohn Oil Review of Ardmore have been very useful. Free use has been made of all previous publications relative to the geology of this part of Oklahoma. Particular thanks are due the following men for reports on the major fields of the county: Mr. A. M. Meyer, Sholom Alechem; Mr. Geo. E. Burton, Hewitt; Mr. John R. Bunn, Fox; and Messrs. Sam H. Woods and J. P. McKee, Graham.

PHYSIOGRAPHY

The highest point in Carter County lies in sec. 36, T. 1 S., R. 2 W., in the western end of the Arbuckle Mountains, and has an elevation of about 1,330 feet. The elevation of the lowest point, on the Washita River at the east line of the county, is approximately 630 feet above sea level, giving the county a total relief of 700 feet. The topography varies from rugged hill country to rolling uplands, with small stretches of flat bottom lands along the major streams. The northern part of the county drains into Washita River, mostly through Caddo Creek. The southern portion drains into Red River, principally through Walnut Bayou and Big Hickory Creek.

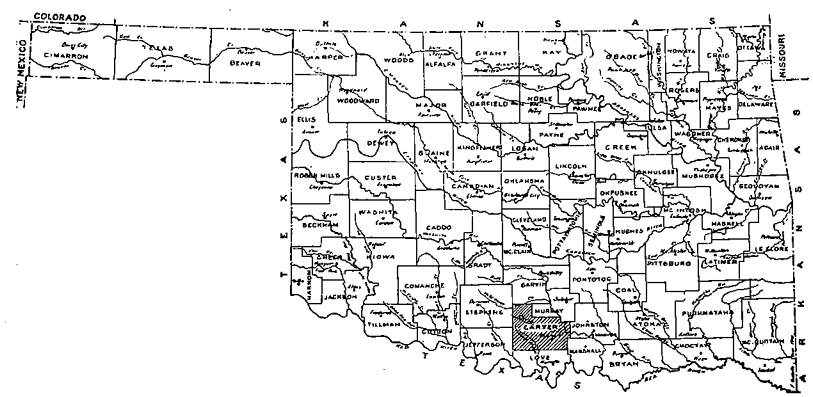


Figure 1. Index map of Oklahoma showing area covered by this report.

The sandier portions of the county were originally, and still are for the most part, covered with low oak forest. These include the greater part of the areas occupied by the Trinity sand, the red beds above the Pontotoc series, the Deese formation, and the sandy members of the other Pennsylvanian formations. Clayey and limy soils provide smaller areas of open grassland, particularly on the lower red beds (Pontotoc series), the Caney shale, the Sycamore, Viola, and Arbuckle limestones, and the shale and limestone members of the Pennsylvanian formations above the Caney. In the area of Pennsylvanian rocks, ridges covered with blackjack timber commonly alternate with strips of prairie in the narrow intervening valleys, creating stripes of vegetation running parallel to the strike of the underlying rocks and therefore stretching as a rule from northwest to southeast across country.

Relatively simple dendritic drainage forms occupy the areas of gently-dipping rocks, including the Cretaceous system and the late Pennsylvanian red beds. The older rocks have been so steeply folded that minor drainage lines have adjusted themselves to structure in many places in the eastern part of the county, creating typical trellised drainage. However, the major streams in the areas of marine Pennsylvanian and older rocks appear to have been superimposed upon the Pennsylvanian mountain structures, and have been strong enough to maintain their former courses across the resistant ridges which now occur in this area. Examples are the course of Washita River through its gorge at the south edge of the Arbuckle Mountains on the north line of the county, and the course of Hickory Creek through the Criner Hills in secs. 26 and 35, T. 5 S., R. 1 E., near the south line of the county. The Washita River above the gorge in Murray County, however, is mainly in a synclinal position, and follows the course of least resistance through the Arbuckle Mountains.

It is probable that the courses of these major streams were acquired when this county was entirely covered by a mantle of Cretaceous or possibly Tertiary sediments lying unconformably above the folded Paleozoic rocks. The surface of the county in late Tertiary or Quaternary time was probably a plain sloping gently southeastward, part of the Great Plains which then stretched more smoothly and more nearly continuously than now from the Rocky Mountains to the Gulf of Mexico. It is not likely that within the limits of Carter County there were any monadnocks rising above the general level of this gently-sloping surface.

The present erosion surface on the Hoxbar and older formations in Carter County probably differs only slightly from the erosion surface which was created here immediately following the later Pennsylvanian mountain building in this region. That surface was buried beneath the red beds, and in part at least has only been re-exposed in relatively recent times. A part of it was probably exposed to erosion just prior to Trinity time, but this Jurassic erosion cannot have cut very deeply below the old late-Pennsylvanian peneplain.

STRATIGRAPHY

PRE-CAMBRIAN ROCKS

No pre-Cambrian rocks outcrop or have been reached by the drill in Carter County. Two miles north of the County line in Murray County, however, is a mass of the pre-Cambrian Colbert porphyry, rising in the East Timbered Hills to the highest point in the Arbuckle Mountains, above 1,400 feet in altitude. This "consists largely of pink feldspar phenocrysts in a reddish to gray groundmass, cut by numerous diabase dikes."[1]

Five and one-half miles east of the northeast corner of Carter County is the western edge of a much larger area of pre-Cambrian rock, the Tishomingo granite. This is uniformly coarse-grained, more typically plutonic than the Colbert porphyry with its dense groundmass, and probably formed at greater depth than the latter. It is described by Gould as "largely a coarse-grained, pinkish granite associated with quartz-monzonite, aplite, and granite porphyry, cut with dikes of various basic materials."[2]

The exposed area of the Tishomingo granite is some 30 miles long by 10 miles wide, and its extent beneath the Cretaceous sediments of the Gulf Coastal Plain may be much greater. These dimensions suggest that it is of batholithic origin. No remnant is now exposed of the original overlying rocks into which this igneous mass was intruded, as the roof was wholly eroded away in this area prior to the deposition of the Reagan sandstone in upper Cambrian time.

The lack of metamorphism in the Tishomingo granite and the Colbert porphyry suggests that they are not older than Algonkian. They may be as recent as Keweenawan or even Cambrian.

Ten to 15 miles southwest of the southwest corner of Carter County, certain wells[3] in the vicinity of the Oscar and Nocona oil pools have penetrated granite at depths less than 2,000 feet.

This appears to form part of a group of buried mountain ranges extending southeastward from the Wichita Mountains as far as Denton and Grayson counties, Texas. They probably form part of the same mountain system with the Criner Hills and the buried hills beneath the Healdton, Hewitt, and Brock (Crinerville) oil pools in Carter County. This system was formed early in the Pennsylvanian period.

In spite of these occurrences of granitic rocks at or near the surface both north and south of Carter County, it is believed that the surface of the granite is at least 5 miles deep in the Ardmore syncline

1. Gould, Charles N., Index to the Stratigraphy of Oklahoma. Oklahoma Geol. Survey, Bull. 35, p. 11, 1925.
2. Loc. cit.
3. E. g., Humble Oil & Ref. Co.'s well No. 1 Alexander, NW.¼ NE.¼ NE.¼ sec. 19, T. 7 S., R. 5 W., which logged pink granite from 1,924 feet to total depth of 1,980 feet.

and three miles deep even beneath the anticlinal oil fields in northern Carter County—the Graham, Fox, and Sholom Alechem pools. No production of oil or gas is to be expected from these granitic rocks.

REAGAN SANDSTONE

This formation, of upper Cambrian age, does not outcrop in Carter County, and has not been reached in any well; but the Reagan overlies the Colbert porphyry two miles north of the north line of the county, and forms the base of the sedimentary sequence overlying the Tishomingo granite east of Carter County, so that it probably underlies the entire county. It averages about 300 feet thick in the Tishomingo district, and grades from very coarse arkosic sandstone at the base to relatively fine-grained shaly calcareous sandstone near the top.[4] The Reagan sandstone would make an excellent reservoir rock for the accumulation of petroleum, but no bituminous shale or other promising source rocks from which oil might be derived occur in normal contact with it, and it is older than any sand at present yielding commercial petroleum anywhere in the world. No production is therefore to be expected from this sandstone.

ARBUCKLE LIMESTONE

This great Cambro-Ordovician mass of limestone and dolomite has a measured thickness exceeding 7,800 feet[5] along U. S. Highway No. 77 near the north line of the county, although only the upper part of it is exposed south of the line. It occupies most of the upland area in each of the major anticlines of the Arbuckle Mountains. The upper part appears also in the Criner Hills.

The Arbuckle limestone has been identified tentatively in logs of wells in the Healdton oil field, and may occur beneath the Brock field also. A sandy phase near the top of the formation is tentatively correlated with the Turkey Mountain oil sand of northern Oklahoma, but no production of oil or gas has been obtained from the Arbuckle limestone in southern Oklahoma.

SIMPSON FORMATION

The Ordovician is made up of "sandstones and thin limestones with interbedded greenish clay shales and marls", which average about 1,500 feet in total thickness.[6] This formation occupies a valley belt encircling the main plateau formed by the Arbuckle limestone in the Arbuckle Mountains. It occurs also in the Criner Hills, and has been found in wells in the Brock and Healdton fields, and possibly at Hewitt also.

A little high grade oil has been produced in the Healdton field from sandy limestones assigned to this formation. The Simpson contains

4. Cf. J. A. Taff, Tishomingo Folio. U. S. Geological Survey, Geol. Atlas of the U. S., Folio No. 98, 1903.
5. Decker, Charles E., and Merritt, Clifford A., Physical Characteristics of the Arbuckle Limestone: Oklahoma Geol. Survey, Circular No. 15, pp. 15 and 37, 1928.
6. Gould, Chas. N., op. cit., p. 14.

thick porous sandstones, tentatively correlated with the Wilcox and Burgen sands, and these sands probably underlie most of the county: but they have not yet been found in any well. It is reasonable to expect that valuable production will be obtained in Carter County from these sands. They probably occur at least two miles deep, however, in the oil fields of the northern part of the county.

VIOLA LIMESTONE

This Ordovician limestone has a thickness of 500 to 750 or more feet[7] in the Arbuckle Mountains and the Criner Hills. Gould describes it as "thin to heavy-bedded massive, homogeneous limestone," which "is typically exposed as a series of bare, rounded limestone knobs, lying outside of the eroded Simpson Valley."' It has been reported in wells in the Brock (?), Hewitt, and Healdton oil fields, but has yielded no oil in this county. A few wells in the Hewitt and Brock fields have yielded large but short-lived production from what appears to be the surface of unconformity between Ordovician and Pennsylvanian rocks —possibly from a basal conglomerate of the soil and subsoil material formed on the Ordovician rocks in Pennsylvanian time.

SYLVAN SHALE

"A greenish shale, weathering typically into long, narrow valleys, usually wooded; thickness averaging 150 feet."[8] This shale occurs in the Arbuckle Mountains and Criner Hills, but is rarely exposed. It has been tentatively identified in one well in the Hewitt field, but yields no oil or gas.

HUNTON FORMATION

The Hunton formation is sub-divided paleontologically into four thin formations, to-wit: (in order from the lowest upward): Chimneyhill limestone and Henryhouse shale (Silurian), Haragan shale and Bois d'Arc limestone (Devonian); with a total thickness of 150 to 300 feet.[9] The limestones outcrop usually in low, bare stony ridges, and the shales in grassy valleys. Both shales include very limy members, and a dense limestone or marl in the Haragan contains some of the most generously fossiliferous strata in the county. At least the lower three of these "Hunton" formations outcrop in the southern edge of the Arbuckle Mountains and at Rock Crossing in the Criner Hills, and the uppermost Hunton limestone at these localities is commonly identified with the Bois d'Arc.

This formation yields oil in important quantities in Seminole and adjoining counties of Oklahoma, but not, as yet, in Carter County. It has not been positively identified in any wells in the county.

7. Op. cit., p. 15.
8. Op. cit., p. 16.
9. Op. cit., p. 17.

WOODFORD CHERT

Thin-bedded black or banded chert and siliceous black shale, with a considerable thickness of highly bituminous black shale, of a type elsewhere regarded as a possible future direct source of oil obtainable from it by distillation. The maximum thickness is about 425 feet.[10] It is probably an important original source of oil now found in sandstone or limestone members of other formations. The age is Mississippian or upper Devonian and it outcrops in the south edge of the Arbuckle Mountains, and at the southeast and northeast edges of the Criner Hills. It has been found in one well in the Hewitt field.

SYCAMORE LIMESTONE

"Rather hard blue limestone, weathering yellow."[11] It forms the southernmost ridge of the Arbuckle Mountains where its thickness ranges up to 400 feet or more,[10] and outcrops also in the Criner Hills. It is the "Mississippi Lime" of southern Oklahoma, and is not certainly identified in any wells in Carter County.

CANEY SHALE

As the term is here employed, the Caney shale includes approximately 2,000 feet of black bituminous shales immediately overlying the Sycamore limestone. The top of the formation is drawn at the base of the Rod Club sandstone member of the Springer formation. This usage corresponds as nearly as can be determined to that of Taff, who first employed the name Caney in this district,[12] although Miser's recent geologic map of Oklahoma[13] included the entire Springer formation as part of the Caney.[14]

As above restricted, the Caney consists exclusively of black bituminous fissile shales, varied only by ferruginous, calcareous, and phosphatic concretions. Fossils have never been found in it except in the basal 200 to 500 feet of the formation, where they are fairly numerous and are generally regarded as indicating late Mississippian age. The Caney occupies a fertile lowland belt of cultivated fields and grassy pastures at the south foot of the Arbuckle Mountains, and a similar strip 8 miles long by ½ mile wide in the axis of the Caddo anticline in Tps. 3 and 4 S., R. 1 E. It is believed to have been found in one or two wells in the Hewitt field, and in wells on the Preston and Mannsville-Madill anticlines in Marshall County. A well[15] drilled on the Caddo anticline in 1927,

10. Cooper C. L., personal communication.
11. Gould, op. cit., pp. 22-23.
12. Taff, J. A., Tishomingo Folio. U. S. Geological Survey, Geol. Atlas of the U. S., Folio 98, 1903.
13. Miser, H. D., Geologic map of Oklahoma: U. S. Geol. Survey and Oklahoma Geol. Survey, 1927.
14. For further discussion of the Caney correlation as affecting Carter County see: C. W. Tomlinson. The Pennsylvanian System in the Ardmore Basin. Oklahoma Geol. Survey, Bull. 46, 1928.
15. L. E. Trout's well No. 1 Noble, center SE.¼ NW.¼ sec. 22, T. 3 S., R. 1 E.

starting several hundred feet below the top of the Caney shale, penetrated 3,500 feet into that formation without reaching even the distinctive basal portion of it. Due to the very steep dips on this anticline, which is practically a hairpin fold, it is probable that this well actually cut less than 1,000 feet of beds in drilling 3,500 feet.

Like the Woodford, the Caney shale is probably an important original source for oil, though wholly lacking in reservoir rocks.

SPRINGER FORMATION[16]

This formation, 3,000 feet or more in thickness, consists in the main of barren black shales like the restricted Caney shale below it, with hard ferruginous and calcareous concretions. However, the Springer contains several persistent sandstone members which afford important prospects for future oil production in Carter County.

At the base of the Springer formation is the Rod Club member, a sandy zone 250-400 feet thick containing several sandstones ranging up to 25 feet in maximum individual thickness. About 1,000 feet above the Rod Club is the white, massive Overbrook sandstone, ranging from 45 to 100 feet thick which is thoroughly saturated with asphalt along several miles of its outcrop in T. 3 S., R. 1 W., where it possesses its maximum thickness and was formerly quarried for asphalt. Three hundred to 500 feet higher in the section is the Lake Ardmore member, a persistent sandstone 15 to 20 feet thick and very similar to the Overbrook. From 100 to 300 feet above the Lake Ardmore sandstone is the Primrose member, a zone of shaly to thin-bedded semi-crystalline calcareous sandstone 150 to 250 feet thick, locally carrying one to two feet of impure unfossiliferous limestone.

Except for the shales above the Primrose member and a single locality in the Overbrook (?) sandstone, the Springer formation has so far proved almost wholly barren of fossils. Its age is probably earliest Pennsylvanian.

The Caney shale and the Springer formation together contain over 4,000 feet of bituminous shales. These formations may have been the chief source for the oil which has accumulated in younger Pennsylvanian beds in this region. Unlike the Caney and Woodford formations, the Springer contains excellent reservoir rocks. Although its sandstone members probably are not now yielding oil in Carter County they are believed to underlie the Graham, Fox, and Sholom Alechem fields at depths of a mile or more, and may be expected to yield oil at lesser depths in the Overbrook anticline. The Springer formation is not present in the Brock, Hewitt, or Healdton fields, where it is cut out by unconformity.

16. For more detailed description of this and other Pennsylvanian formations see: Tomlinson, op. cit. (cf. footnote 14).

DORNICK HILLS FORMATION[16]

Immediately above the Springer occurs the Dornick Hills formation, consisting of bluish and tan shales interrupted by limestones and sandstones, with conspicuous limestone conglomerates south of Ardmore. The pebbles of the conglomerates consist chiefly of pre-Pennsylvanian limestones and chert such as now outcrop in the Criner Hills. At the base of the formation is the Jolliff member, a tan fossiliferous limestone from 4 to 15 feet thick, locally associated with a little conglomerate. The next resistant member, the Otterville limestone, is a ledge of ferruginous, oolitic, and locally conglomeratic limestone about 25 feet thick.

The most resistant part of this formation is a massive limestone conglomerate with associated limestones and sandstones, known as the Bostwick member. It disappears northward from Ardmore. Above the Bostwick member occur three or more very fossiliferous limestones including the coarsely crystalline and oolitic Lester limestone. At the top of the formation is the Pumpkin Creek limestone, which has a maximum exposed thickness of 70 feet, including 20 feet of shaly beds.

The Dornick Hills formation shows a greater change of thickness than any of the other Pennsylvanian formations in this area. It is about 4,000 feet thick near the north edge of Love County, thinning to 2,500 feet near Ardmore and to less than 1,500 feet near the village of Glenn, where the conglomerates are absent. The Dornick Hills formation is believed to be at least partially equivalent to the Bend group of Texas.

The productive oil sands in the Graham, Fox, and Sholom Alechem fields belong, in part at least, to the Dornick Hills formation, and this may possibly be true of Hewitt also. The formation does not occur, however, in the Healdton or Brock fields, where it is cut out by unconformity.

DEESE FORMATION[16]

The Deese formation is about 7,000 feet thick in Love County, diminishing to about 5,000 feet northwest of Ardmore. It is characterized by a succession of sandstone beds and chert conglomerates, separated by blue and tan shales with a few limestone members which diminish or disappear to the southeast. The Deese is believed to be at least partially equivalent to the Strawn group of Texas, and to the Wewoka and subjacent formations of northeastern Oklahoma, down at least to the Boggy and possibly to the Atoka.

About 800 feet above the Pumpkin Creek limestone occurs the Devil's Kitchen member, some 500 feet thick, comprising two massive buff sandstones each from 60 to 200 feet thick, separated by a shale interval with 10 feet or more of fossiliferous impure limestone and cal-

careous shale. The upper sandstone contains chert grains, and develops southeast from Ardmore into a coarse conglomerate of angular to subangular chert pebbles.

Above the Devil's Kitchen member is a series of blue and tan shales with numerous sandstone ledges, two or three of which carry abundant chert pebbles in some localities. The Arnold member north of Ardmore, near the middle of the formation, includes also a fossiliferous limestone up to 50 feet thick. Much thinner limestone beds occur at several other horizons in the Deese formation north of Ardmore, but have not been noted to the south.

Sandstone members of the Deese are extensively saturated with asphalt, and have been quarried for their asphalt content, on both flanks of the Overbrook anticline and on the southwest flank of the Caddo anticline. The Deese formation occurs at least on the flanks of all the major oil fields in Carter County, and may be producing in the southern group. The producing section in the Sholom Alechem field may include the base of the Deese. (See following descriptions of separate fields.)

HOXBAR FORMATION

The Hoxbar formation in the type area southeast of Ardmore includes about 4,000 feet of strata. It disappears unconformably beneath the red beds near Ardmore, and beneath the Trinity in Love County. It is believed to be at least partially equivalent to the Canyon group of north-central Texas.

As with the rest of the Pennsylvanian section, the Hoxbar consists dominantly of shale, with interbedded resistant members of limestone and sandstone. The base of the formation has been drawn at the base of the Confederate limestone member, the lowest persistent limestone of this upper Pennsylvanian sequence. This member reaches a maximum thickness of about 60 feet at its westernmost outcrop, northwest of Ardmore. Elsewhere it contains conglomerate streaks, with chert and limestone pebbles which are found also in a ledge some 200 feet higher in the section.

Some 400 feet above the Confederate member is the Union Dairy limestone member, locally carrying abundant *Fusulinae* and other fossils. Eight hundred feet above the base of the Hoxbar occurs the Westheimer member, including a 10 foot pinto limestone conglomerate of variegated pebbles of chert, shale, and limestone in a limestone matrix, together with a calcareous sandstone or sandy limestone.

About 600 feet above the Westeimer member occurs the Crinerville limestone member, 10 feet or more in thickness. The lower layers locally are crammed full of *Fusulinae*. The Anadarche conglomerate lies about 1,800 feet above the base of the formation. It carries pebbles of chert and of early Pennsylvanian as well as pre-Pennsylvanian limestones. Some 200 feet higher is the Anadarche limestone, a very dense, hard, bluish-gray limestone up to 20 feet thick.

Some 600 feet above the Anadarche member is the Daube member, including a limestone similar to the Anadarche limestone, associated in one locality with a limestone conglomerate.

Just below the Daube limestone occurs the only bed of coal known in the Ardmore basin. This coal reaches a maximum reported thickness of four feet, and is known for at least 4 miles along the strike in T. 5 S., R. 2 E.

Above the Daube limestone the upper 1,200 feet of the Hoxbar formation consist of tan to brown shales with several sandy limestones or calcareous sandstones, including the Zuckerman sandy limestone member.

The Hoxbar formation is not certainly known to be producing oil in Carter County, but it is probable that at least the higher oil sands in the Brock field belong to this formation, and the position of the pay sands at Healdton and Hewitt within the Pennsylvanian system is in doubt. Thick sections of brown shale reported beneath typical red beds in certain synclinal areas, especially in Tps. 3 and 4 S., R. 1 W., may be upper Hoxbar.

PONTOTOC SERIES

The Hoxbar and all older formations throughout Carter County, after the close of Hoxbar sedimentation, were folded into a series of mountain ranges, which were eroded to a peneplain during the ensuing portion of the Pennsylvanian period. Over this peneplain and across the truncated edges of the now steeply-dipping older formations, there spread in late Pennsylvanian or earliest Permian time a new series of sediments radically unconformable with the older beds. The first of these, as shown by Birk,[18] belongs to the Pontotoc series, which lies in different parts of the county upon each of the older formations from the Hoxbar to the Arbuckle limestone.

The maximum known thickness of the Pontotoc at its outcrops in Carter County is about 400 feet. A greater thickness, probably due to the addition of lower arkosic beds is suspected in some of the synclinal troughs a short distance west or southwest of the outcrop.

The most easily traceable member of this series is the Hart limestone, an unfossiliferous gray limestone "formed with reworked material from the Ordovician limestones in the Arbuckle Mountains,"[19]

18. Birk, Ralph A., The extension of a portion of the Pontotoc Series around the western end of the Arbuckle Mountains: Bull. Amer. Ass'n. Pet. Geol. vol. 9, pp. 983-989, 1925.

19. Birk, Ralph A., op. cit., p. 986.

which has a maximum thickness of 200 feet in T. 1 S., R. 2 W. Locally, farther south, it plays out entirely or is represented only by associated red shales containing small, roughly spherical limestone concretions. These occur also as constituents of beds of arkosic limestone conglomerate which underlie the more typical Hart limestone in places, but are much more widespread than the limestone itself south of the Arbuckle Mountains.

The Hart limestone member locally constitutes nearly all that is recognizable of the Pontotoc series. In most places, however, it is underlain by from 50 to 200 feet of deep red shales and coarse arkose with beds of sandstone. Asphalt occurs in these beds in secs. 10 and 11, T. 2 S., R. 2 W. Birk[20] also maps a little Stratford shale (part of the Pontotoc) overlying the Hart limestone in T. 1 S., R. 2 W.

"The oil in the Homer shallow field is found in sand breaks in the Hart limestone member at an average depth of 200 feet."[21] The oil and part of the gas of the Wheeler pool, the oil at Blue Ribbon, the shallowest oil in the Wildcat Jim field, and the gas (and oil shows) found in the Graham field at about 900-1,000 feet, also come from the basal part of the red beds, probably from the Pontotoc series. The unconformable overlap of the Pontotoc on older Pennsylvanian rocks also sufficed to trap the asphalt of the little Sopasco pool, and may similarly be responsible to a large extent for the Roundup, Cox, and Wildcat Jim pools, where anticlinal closure in the productive strata has not been proved. The oil produced in all these pools is of heavier gravity than the average in any of the major pools of the county.

CISCO (?) RED BEDS

Above the Pontotoc series there outcrop in Carter County at least 1,000 feet of typical "red beds", so-called from the dark red shales and reddish-buff cross-bedded sandstones which make up much of the sequence. Much of the sandstone is buff, brown, gray, or white rather than red, however; and there are bluish, tan, green, and white shales as well as red. Perhaps the most common type of sandstone is semi-crystalline and almost white when fresh, but mottled with dark-brown specks and blotches (probably of ferruginous stain) in the weathered portions.

Sands in this sequence yielded the shallower gas in the Wheeler pool, and the first oil produced in the Graham field, from depths less than 300 feet. They yield showings in most of the other fields of Carter County. Asphalt saturations and seepages at outcrops of these sands in the Wheeler and Graham fields were directly responsible for the discovery of those pools, although such seeps and saturations occur also in adjoining areas where prospects of commercial oil production are very poor.

20. Op. cit., Fig. 1, p. 985.

21. Birk, R. A., op. cit., p. 989.

One of the highest members of the red beds of Carter County is a white, massive cross-bedded sandstone which forms a scarp fronting northeast along the southwest side of the Healdton field, and underlies gentle dip slopes extending from the scarp to the southwest corner of the county, interrupted by valleys and ravines which have cut to lower strata. This Cornish sandstone member immediately underlies the city of Ringling and the village of Cornish, just over the line in Jefferson County.

Outcrops of this and closely associated sandstone beds are traceable through ten or twelve townships in the eastern part of Jefferson County, where in general they underlie a much-dissected plateau surface, finally disappearing westward and northwestward beneath higher strata. The same beds appear to underlie the dissected plateau between Nocona and Belcherville, Texas, just across Red River, and to be equivalent to beds in the middle or upper portions of the Cisco group farther southwest. However, this correlation is not in accord with paleontologic determinations of the Permian-Pennsylvanian contact, which has commonly been placed at the top of the Cisco in Texas, but at the top of the Pontotoc or even lower in Oklahoma.

The Cisco red beds below the Cornish sandstone member generally possess ruggedly dissected topography, clad with oak woods. The higher beds include more shales, giving rise to broad upland prairies.

TRINITY SAND

The Trinity sand, of early Comanchean age, spreads across most of the southern edge of Carter County, unconformably overlapping all older formations. It is about 400 feet thick and consists chiefly of poorly consolidated soft massive buff to pale reddish sandstone, with buff to greenish sandy clays and an occasional thin streak of maroon clay shale. Through most of its area the basal 10 feet or more of the formation consists of a hard coarse sandstone or conglomerate, varying from white to dark brown and commonly so well cemented as to be truly quartzitic. Grains and pebbles of clear quartz are most abundant, set in a chalk-white matrix. Chert pebbles and grains are present in variable proportions, and there are pebbles of older quartzites. Feldspar and limestone are rare or absent.

Near Washita River at the east side of the county, where the present Trinity outcrops closest to the limestone plateau of the Arbuckle Mountains, an entirely different facies appears at the base of the formation. It is a massive chalky limestone 40 feet or more in maximum thickness, with streaks and vugs of calcite spar, and locally containing abundant pebbles of the subjacent formations.

Petrified wood is fairly common in the Trinity. Fragments of this, with boulders of the basal Trinity quartzite or conglomerate and pebbles derived from the latter, are scattered over the uplands for several miles north of the present limits of the formation. There are also isolated patches of residual sand which probably represent former Trinity outliers. A remarkable bit of additional evidence of greater extent of the Trinity in former times was found in a well in the Cox pool[22], where Comanchean fossil shells were obtained at a depth of 90 feet. The surface formation at this point is recent alluvium, surrounded by post-Pontotoc red beds. The Comanchean sediments here must occupy a valley in the pre-Trinity erosion surface.

No conglomerate has been noted in the Trinity of Carter County except at or very near the base of the formation. Where well exposed, most of the Trinity sediments are readily distinguishable from the Carboniferous red beds. To the latter are unhestitatingly assigned the typical red beds near Orr in the northwest corner of Love County, underlying the unique basal Trinity quartzitic conglomerate.[23]

Parts of the Trinity formation are well saturated with asphalt over considerable areas in T. 6 S., Rs. 2 and 3 E., in Love County. It has yielded small production of oil in the Madill pool and gas in the Enos pool, both in Marshall County. However, no indications of asphalt or of oil or gas have been noted in this formation in Carter County.

GOODLAND LIMESTONE

"A pure, semicrystalline, massive white limestone approximately 25 feet in thickness".[24] It occurs in Carter County only as the caprock of the Provence Buttes, occupying a total area of 100 acres or so in secs. 3, 4, and 10, T. 5 S., R. 3 E.

HIGH-LEVEL GRAVELS

Unconsolidated gravels cap several upland areas in the north half of T. 3 S., Rs. 1 E. and 1 W., with smaller patches on hilltops elsewhere in the county. They consist chiefly of limestone and chert pebbles apparently derived from the Arbuckle Mountains, although quartzite pebbles of unknown origin dominate in similarly situated gravels in Jefferson County. These gravels are probably fluviatile, and constitute remnants of a sheet of gravel which appears to have spread over much or all of the county in late Pliocene or Pleistocene time, prior to the excavation of modern stream valleys below that level.

Bench gravels, also consisting largely of pebbles derived from the Arbuckle Mountains, occur in the same townships at one or more terrace levels lower than the gravels just discussed, but higher than the

22. Humble Oil & Refg. Co.'s No. 1 Hefner, Center SW.¼ NE.¼ NE.¼ of sec. 16, T. 2 S., R. 2 W. Verbal communication from Geo. E. Burton.
23. But cf. C. W. Shannon as quoted by Fred M. Bullard, in his Geology of Love County, Oklahoma: Oklahoma Geol. Survey, Bull. 33, pp. 15-16, 1925.
24. Bullard Fred M., Geology of Love County, Oklahoma: Oklahoma Geol. Survey, Bull. 33, p. 22, 1925.

modern flood-plains of adjacent streams. Red alluvium, derived from the red beds north and northwest of the Arbuckle Mountains and transported through the mountains by the Washita River, occurs on similar but larger terraces along that stream.

RECENT ALLUVIUM

All the streams in the county engage in alternate cutting and filling as rainfall varies. In the main, erosion has the upper hand. Recent alluvial deposits vary from coarse, poorly-rounded, ill-assorted gravels, to fine loess-like silt. The most remarkable Recent deposits in the county, from an economic standpoint, are the small accumulations of tarry asphalt. The largest of these, in the Wheeler field near the SE. corner of sec. 21, T. 3 S., R. 2 W., covers an acre or more and is several feet thick.

The only fossils so far reported from the Quaternary deposits of Carter County is a mastodon tooth found in sec. 4, T. 4 S., R. 1 E. It was exposed in a cut bank of alluvium by the under-cutting of a small stream.

THE PENNSYLVANIAN-PERMIAN CONTACT

The contact between the Pennsylvanian and Permian systems in northern Oklahoma is drawn on the geologic map of Oklahoma at the base of the Cottonwood limestone. Beede[25] preferred to draw it from 40 to 150 feet lower, somewhere between the Neva limestone and the base of the Elmdale shale. Farther south, in the Stonewall quadrangle, Morgan[26] placed the Permian-Pennsylvanian contact at the base of his Hart limestone, the lowest member of his Stratford formation of the Pontotoc series. Miser's map shows clearly that this horizon is lower than either the Cottonwood or the Neva and lower than the Cushing limestone. It probably corresponds roughly to the top of the Buck Creek formation of northern Oklahoma, some 350 feet below the Cottonwood. The Hart limestone, as shown by Birk[27], is the lowest member of the Pontotoc series which now extends continuously around the west end of the Arbuckle Mountains, overlapping all older formations to the Cambrian. The base of the Permian, as chosen by Morgan in central Oklahoma, therefore coincides with the horizon of tremendous angular unconformity produced by late Pennsylvanian mountain building and erosion in southern Oklahoma. For the western Arbuckle region and the Ardmore district this is a very satisfactory division between stratigraphic units which are structurally and historically distinct. Unfortunately it is lower than the horizon paleontologically

25. Beede, J. W., The Neva limestone in northern Oklahoma: Oklahoma Geol. Survey, Bull. 21, pp. 21-23, 1914.
26. Morgan, Geo. D., Geology of the Stonewall quadrangle: Bureau of Geology, Bull. 2, 1925.
27. Birk, R. A., The extension of a portion of the Pontotoc series around the western end of the Arbuckle Mountains: Bull. Am. Assoc. Pet. Geol., Vol. 9, No. 6, pp. 983-989, 1925.

selected for the Permian-Pennsylvanian contact in the marine sections farther north and farther south.

Part or all of the Cisco group of Texas, there regarded as Pennsylvanian in age, is represented in southern Oklahoma in the lower 1,500 feet of the red beds overlying the great post-Hoxbar angular unconformity.[28] The Wichita-Clearfork of Miser's map also includes an equivalent of at least the upper half of the Cisco group.

DEVELOPMENT

Importance of age of folding

The date of folding of a given mountainous anticline in this region is of vital importance to the oil producer who is testing its commercial possibilities. In the folds formed in early Pennsylvanian time, the drill passes through a relatively thin section of upper Pennsylvanian beds into exceedingly steeply folded pre-Pennsylvanian strata lying unconformably beneath them. In these older rocks no commercial production of importance has yet been obtained in Oklahoma south of the Arbuckle and Wichita Mountains, although the possibilities have by no means been exhaused. In the late Pennsylvanian folds of northern Carter County, on the other hand, there is every reason to expect a complete section of the Pennsylvanian system lying conformably above the older rocks. In none of these fields has the drill yet penetrated entirely through the Pennsylvanian, although a depth of 5,120 feet has been reached, stopping in the uppermost part of the Springer formation.

FOX FIELD

By

John R. Bunn

EARLY DRILLING IN THE FOX FIELD

The Fox field embodies the producing oil and gas wells in the S.½ secs. 19, 20, 21, and 22, in the W.½ sec. 26, and in secs. 27, 28, 29, 32, 33, 34, and 35, T. 2 S., R. 3 W., Carter County, Oklahoma.

In 1912 the Gypsy Oil Company, finding indications of a favorable oil and gas structure in the red beds at Fox, secured leases in sections 16, 21, 22, 27, 28, and 34. This company drilled a test well to 1,585 feet near the SW. cor, sec. 22, but it proved to be a dry hole.

In 1915, however, the Gypsy brought in a gas well in the west half of the Fox field. This well, Gypsy No. 1 Johnson in the SW.¼ sec. 28, T. 2 S., R. 3 W., was completed at 2,018 feet on December 25,

28. Tomlinson, C. W., Op. cit.

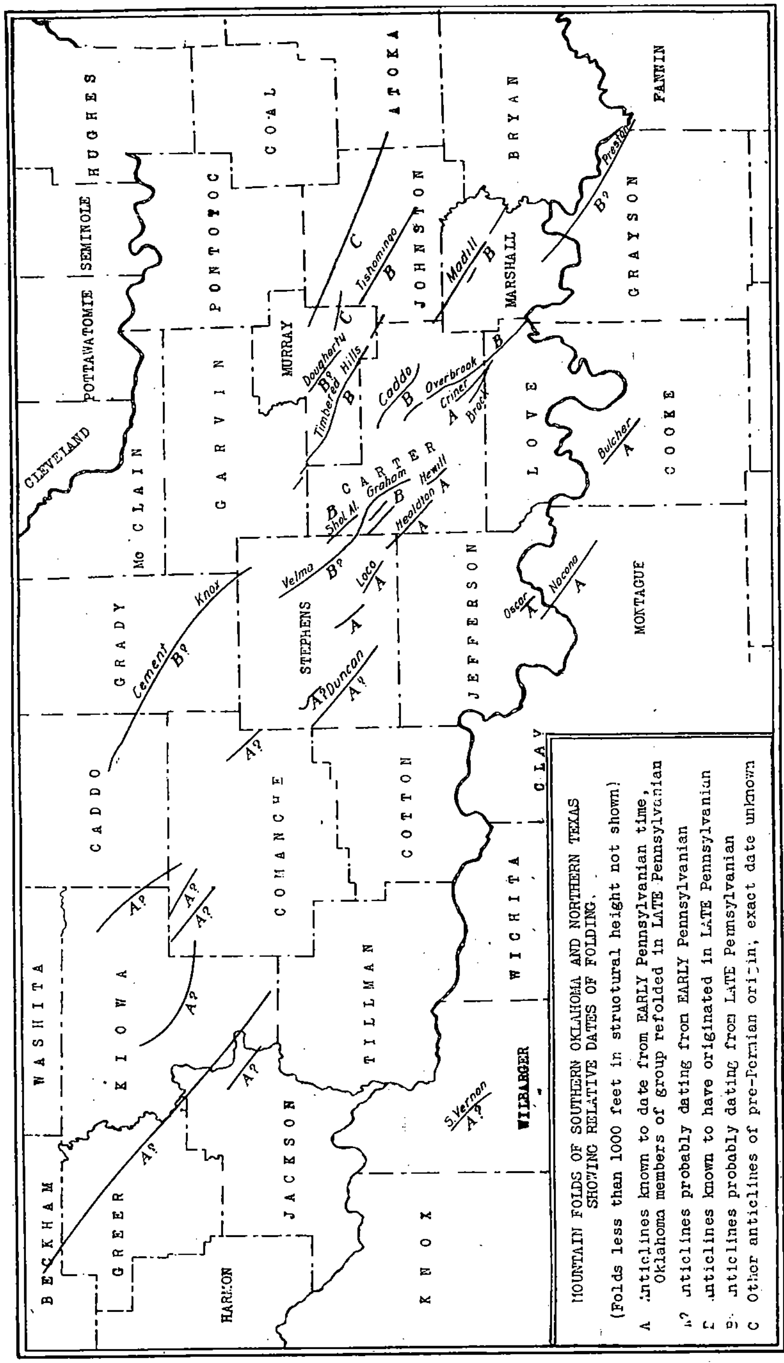


Figure 2.

1915, with initial open flow of 22 million feet per day. The rock pressure was not determined.

The first oil well in the Fox field was in the west half of the field and was known as Gypsy No. 1 Mattie Morris in the NW. cor NE.¼ SE.¼ NE.¼ sec. 29, T. 2 S., R. 3 W., completed at 2,033 feet on April 2, 1917, with an initial production of 604 barrels during the first 24 hours.

The first oil well drilled in the east part of the field was the Empire No. 1 Ella Williams, on restricted Indian land, on a working agreement with S. M. Davis and C. R. Smith, who held the lease. This well was completed in February, 1919.

The Humble Oil and Refining Company, Wirt Franklin, Fox Petroleum Company, and the Magnolia Petroleum Company soon after completed producing wells on leases held by them to the north and east of the Empire well.

In 1918, prior to the completion of the Empire No. 1 Ella Williams, the Humble had completed a shallow gas well in the NW.¼ section 35.

STRATIGRAPHY

Red beds to a depth of 1,050 to 1,200 feet form the uppermost series of rocks penetrated in the Fox field. These beds consist of red, brown, and gray shales and sandstones with an occasional thin nodular limestone stringer.

Unconformably underlying the red beds is a series of steeply dipping Pennsylvanian rocks consisting of blue shales, sandstones, and thin limestones, thought to belong to the Deese and Cup Coral members of the Glenn formation. No strata older than Pennsylvanian have as yet been penetrated in the Fox field.

STRUCTURE

The structure of this field may be described as consisting of two major anticlinal folds, roughly parallel and connected by a dome-like saddle, all having a definite northwest-southeast trend.

Production in the northwest area of the Fox oil and gas field is on a narrow, elongated, and steep anticline. The dip and shape of this anticline is quite comparable to the Graham anticline.

Production in sections 22, 26, 27, 34 and 35 is found on a fold that is lower structurally, much flatter, and of larger extent. On this fold are several minor domes and terrace structures.

The productive area of the larger and flatter fold is limited to the northwest by two dry holes; the Magnolia Petroleum Company, No. 1

Morris, sec. 21, T. 2 S., R. 3 W., with a total depth of 3,320; and Wirt Franklin, No. 1 Bently, sec. 28, T. 2 S., R. 3 W., with a total depth of 2,702 feet. These wells appear to be low structurally.

The adjustment of oil and gas to structure is very exact. In all instances gas is found in the higher structural points with the oil farther down the flanks and in the low areas between the minor folds.

PRODUCING HORIZONS IN THE FOX FIELD

Shallow Gas Sand. At the intersection of secs. 26, 27, 34, and 35 T. 2 S., R. 3 W., a shallow gas sand, found at a depth of 900-950 feet, yielded considerable gas and was used in early development of this part of the field. The C. R. Smith No. 1-A Fee, in section 26, had initial gas volume of 18 million cubic feet at 270 pounds rock pressure. This well was completed September 10, 1918. The most recent completion in this sand, the Rockland No. 8 Brooks, completed March 19, 1923, had initial gas volume of 2 million cubic feet at 80 pounds rock pressure, showing the depleted condition of the gas sand at that time. There has been a total of six wells drilled for gas production from this sand, of which five obtained production, while a sixth, at a depth of 1,000 feet, found nothing but a trace of gas and oil, with some water.

Stray Upper Gas Sand. Magnolia No. 1 Heffner-Mills, sec. 27, T. 2 S., R. 3 W., found a productive upper gas sand from 1,615 to 1,665 feet. The production from this sand was five million cubic feet at 500 pounds rock pressure. This sand is stratigraphically 420 feet higher than the productive zone termed the first sand horizon. Wells drilled with rotary tools have not tested this sand, so that its productive extent is unknown. Wells drilled with cable tools at other parts of the field found a prolific water sand at this horizon.

The existence of several distinct folds and the variation in depth and nature of producing sands, caused considerable confusion in the early correlation of sands in this field. The producing horizons at Fox have never been named, but for the sake of clarity and convenience, they will be termed the first and second producing horizons, and the third, fourth, fifth, and sixth sands.

First Sand Horizon. Gas wells of large initial volume have been obtained in this sand horizon, Gyp y No. 2, Mattie Morris, sec. 28, T. 2 S., R. 3 W., had an initial gas volume of 60 million cubic feet per day from this sand. So far this has been the largest gas well ever completed in the Fox-Graham area. A number of other gas wells have been completed in this sand with initial volumes ranging from 40 to 50 million cubic feet per day.

Many oil wells have also been completed in this sand. The largest of these wells was Gypsy No. 1 Mattie Morris, sec. 29, T. 2 S. R. 3 W., which flowed 604 barrels during the first 24 hours.

Many wells which originally produced dry gas from this sand are now producing oil with very little gas.

This sand horizon in most instances consists of a zone from 80 to 120 feet thick. In some wells it is logged as a solid oil or gas sand, but in most instances it is logged as two or more sands, with intervening beds of lime, sandy lime, and sandy shale. From 100 to 150 feet above the top of the upper member of this horizon is the base of the last water sand of the field. No intermediate water sands have been encountered.

Production from this sand horizon has been more extensively developed in secs. 28, 29, 33, 34, and 35, T. 2 S., R. 3 W. In sections 26 and 27 this sand horizon has generally been cased off and production obtained from lower sands, but when production has been secured from it, the wells have been small.

Second Sand Horizon. The second sand horizon is quite similar to the first, but in most instances thicker bodies of unbroken sand are present. This horizon generally ranges from 60 to 130 feet in thickness. In some wells as much as 100 feet of solid oil sand is present. In general there are several productive sands in this horizon, separated by thin shale and lime beds. An interval of shale and sandy shale from 70 to 150 feet thick separates the first and second sand horizons.

This productive zone is the most extensively developed oil producing horizon in the Fox field. In the S.½ sec. 27, T. 2 S., R. 3 W., the thickest bodies of unbroken sand have been found. Wells when first completed have initial production ranging from 250 to 350 barrels for the first 24 hours.

The second sand horizon is a gas producer of great importance. In section 27, C. R. Smith No. 1 Fee with an initial production of 44 million cubic feet at 813 pounds rock pressure, and C. R. Smith No. 2 Fee, with initial production of 60 million cubic feet at 750 pounds rock pressure, show the importance of this horizon. Other wells, having initial production ranging from 25 to 50 million cubic feet per day, have been completed in this sand in section 27.

In secs. 32 and 33, T. 2 S., R. 3 W., some big gas wells were found in this same horizon. The Gypsy No. 2 Moncrief in section 32, blew in for 45 million cubic feet for the first 24 hours, at 608 pounds rock pressure, and the Gypsy No. 2 Lindersmith in section 33, had an initial yield of 50 million cubic feet for the first twenty-four hours.

Edge wells producing from the first sand horizons have found water in the second sand horizon in some instances. Love and Thurmond No. 1 Fee, sec. 27, T. 2 S., R. 3 W., a well located structurally low, was originally drilled into the second sand, but finding water was plugged back and is now producing from the first sand. Since most of the adjoining wells produce from the second sand horizon and only a few from the first, it is possible that edge water encroachment has been more rapid in the second sand horizon than in the first.

The Third Sand. A sand of irregular extent and thickness has been found by certain wells in different parts of the Fox field. This sand is found at depths of 400 to 500 feet below the first sand horizon, and is not present in several wells drilled stratigraphically lower than this horizon. It is possible that this sand is a lower member of the second sand horizon and not a distinct and different sand. There have been six gas wells with initial volumes ranging from 5 million to 25 million cubic feet per day completed in this sand. Gypsy No. 2 Pruitt, section 29, with an initial volume of 25 million cubic feet at 540 pounds rock pressure, has been the gas well of maximum initial production.

The Gypsy No. 1 Fitzgerald, is the only well to this sand that produced oil when first completed. It flowed 175 barrels during the first 24 hours. Several of the wells originally producing gas now produce oil.

The Fourth Sand. Magnolia No. 9 Heffner-Mills, section 27, and Gypsy No. 5 W. B. Johnson, section 28, penetrated a gas sand occurring from 550 to 590 feet below the top of the first sand horizon. These wells had an initial volume of 10 and 25 million cubic feet per 24 hours, with rock pressure of 1,100 and 900 pounds respectively. It is thought that Carter No. 2 Tucker, with a total depth of 2,725 feet is producing from this sand. A poor and indefinite log makes correlations uncertain.

Humble No. 3 Lester, section 35, reached the fourth sand at 2,695 feet, this sand occurring 400 feet lower structurally than the same sand in Gypsy No. 5 W. B. Johnson, section 28, two miles distant. The interval between the top of the first sand horizon and this sand was approximately the same in both wells. The fourth sand in the Humble No. 3 Lester, was penetrated but a few feet, and according to the log carried water. The fact that the upper sands in this well produced gas in commercial quantities makes the presence of water in the fourth sand hard to explain.

The Fifth Sand. A few wells i. the Fox field have penetrated a deep sand lying approximately 970 feet below the top of the first producing sand horizon. Gas production was obtained in this sand by the Gypsy No. 2 Fitzgerald in section 28 at a depth of 3,012 to 3,053 feet. The initial gas flow of this well was 15,493,000 cubic feet with rock pressure of 910 pounds.

The Humble No. 2 Ruth Williams in the SW.¼ NE.¼ SW.¼ section 27 found the fifth sand at a depth of 2,970 feet, but was drilled to a deeper sand.

Franklin No. 5 Williams, in the NE.¼ NE.¼ SW.¼ sec. 27 penetrated the top of the fifth sand at a depth of 2,950 feet. This well was likewise carried to a deeper sand. Both the Franklin No. 5 Williams and the Humble deep well, however, set pipe above the fifth sand and obtained production from this and lower sands.

C. R. Smith in his No. 5 Fee, section 26, penetrated the fifth sand at a depth of 3,245 feet. This well was located low on structure and is apparently an edge well. It was completed as a small well producing a low gravity oil. The low gravity of the oil is due to the low structural position of this well.

The fifth sand correlates with the Johnson sand of the Graham field which is the chief producing sand of that area.

The Sixth Sand. A sand encountered approximately 365 feet below the top of the fifth sand in Franklin No. 5 Williams at a depth of 3,315 feet, and likewise penetrated by the Humble No. 2 Ruth Williams in section 27 at a depth of 3,320 feet, has been termed the sixth producing sand horizon of the Fox field. This sand probably correlates with the Graham sand of the Graham field. The lower sand and lime bodies recorded in the Franklin No. 5 Williams belong to the lower Graham sand series.

Log of Wirt Franklin, No. 3, Love & Thurmond.

NE.¼ SW.¼ SE.¼ sec. 27, T. 2 S., R. 3 W. Completed February 19, 1921.

Formation	Top	Bottom	Formation	Top	Bottom
red bed	0	25	hard sand	500	502
hard sand	25	50	sandy shale	502	519
gas sand	50	56	sand-bldrs.	519	522
hard sand rock	56	60	shale-bldrs.	522	550
hard sand	60	66	sandy shale	550	580
shale	66	106	hard sand	580	590
sand rock	106	125	gumbo	590	614
sand	125	140	hard rock	614	623
red bed	140	170	gumbo	623	631
sand rock	170	174	hard sand	631	634
red bed	174	194	gumbo	634	655
hard rock	194	204	blue shale	655	667
oil sand	204	212	sand rock	667	673
gumbo	212	222	oil sand	673	675
sand rock	222	232	sand rock	675	700
gumbo	232	252	sandy shale	700	720
sand rock	252	312	oil sand	720	722
sand rock-pyrites	312	322	sand rock	722	735
sand rock	322	331	red bed	735	758
sandy shale	331	341	gumbo	758	763
gumbo	341	351	sand	763	772
hard sand	351	365	lime rock	772	779
sandy shale	365	400	sand rock	779	789
sand-bldrs.	400	465	shale	789	799
sandy shale	465	500	gyp	799	807
			lime shell	807	819

(Continued on page 28)

Formation	Top	Bottom
hard sand rock	819	837
sandy shale	837	915
hard sand	915	947
gumbo	947	954
shale	954	974
gumbo	974	984
blue shale	984	1076
shell	1076	1081
hard sand	1081	1093
sand rock	1093	1102
sandy shale	1102	1138
sand	1138	1142
shale	1142	1167
sand	1167	1177
sandy shell	1177	1197
shale	1197	1207
shell	1207	1217
shale	1217	1225
sand	1225	1231
sandy shale	1231	1298
hard sand	1298	1304
sandy shale	1304	1312
sand rock	1312	1315
gumbo	1315	1323
sandy shale	1323	1361
hard sand	1361	1417
lime rock	1417	1419
oil sand	1419	1421
sand rock	1421	1437
sandy shale	1437	1467
sand rock	1467	1526
gumbo	1526	1530
sand rock	1530	1559
gyp	1559	1569
sand rock	1569	1584
lime shell	1584	1589
sand rock	1589	1627
sandy lime	1627	1629
sand	1629	1639
lime	1639	1645
sand rock	1645	1647
sandy lime	1647	1663
shell	1663	1675
sand rock	1675	1685
asphalt	1685	1689
sand rock	1689	1705
sandy shale	1705	1720
gyp	1720	1723
sand rock	1723	1752
sandy shale	1752	1767
sand rock	1767	1769
gyp	1769	1771
sandy shale	1771	1788
lime	1788	1798
rock	1798	1803
sandy lime	1803	1817
sand rock	1817	1835
sandy shale	1835	1845
gumbo	1845	1851
sandy shale	1851	1867
oil sand	1867	1869
sandy shale	1869	1918
hard sand	1918	1936
sand rock	1936	1943
lime rock	1943	1945
sandy lime	1945	1961
sand	1961	1975
sandy lime	1975	1989
sandy lime rock	1989	2015
sand-shale	2015	2055
hard sand	2055	2105
hard sand rock	2105	2120
hard sand show oil	2120	2140
shale	2140	2218
sand	2218	2229
oil sand	2229	2269
broken sand	2269	2273
blue shale	2273	2275
gyp rock	2275	2277
oil-gas sand	2277	2296
hard gas sand	2296	2303
oil-gas sand	2303	2351

SUMMARY AND CONCLUSIONS

1. Red beds to a depth of 1,050 to 1,200 feet overlie the Fox field.

2. Steeply dipping Pennsylvanian rocks of middle Glenn age lie unconformably below the red beds.

3. The Fox field consists of several pronounced anticlinal folds with definite structural trends.

4. Oil and gas are bing produced from six distinct horizons, of which the first and second sand horizons are the most extensively developed. The third, fourth, fifth, and sixth sands have been penetrated by comparatively few wells. These sands have furnished commercial production when penetrated on favorable locations and are a potential reserve of great importance to producers in this field.

THE GRAHAM FIELD

By

Sam H. Woods and J. P. McKee

LOCATION

The Graham field is located in secs. 5, 6, and 8, T. 3 S., R. 2 W., and secs. 30, 31, and 32, T. 2 S., R. 2 W., and secs. 15, 22, 23, 24, 25, 26, and 36, T. 2 S., R. 3 W.

HISTORY OF DEVELOPMENT

The first well drilled by the Kirk Oil Company in April, 1917, is located in the NW.¼ NE.¼ sec. 31, T. 2 S., R. 2 W. It had three to four barrels of heavy black oil at 270 feet. Four more similar shallow wells were drilled in the vicinity. The original well was then deepened to 1,490 feet, making an estimated production of 14 million cubic feet of gas per day with 650 pounds rock pressure.

The discovery oil well, located in the SW.¼ SW.¼ NE.¼ sec. 31, T. 2 S., R. 2 W., was drilled jointly by Roy M. Johnson, the Healdton Petroleum Company, and C. R. Smith. This well had 15 million cubic feet of gas at 1,478 feet. It was later deepened to 2,539 feet, producing 90 barrels of oil per day from sand at 2,466 to 2,539 feet. From June, 1922, development was rather active until the pool had been defined in all directions.

STRATIGRAPHY

Permian. The surface rocks over the Graham field are of Permain or late Pennsylvanian age. The section is approximately 1,000 feet thick, and consists of red shales and sandstones with some gray shales.

The base of the series is exposed about eight miles northeast of Graham at the western edge of the Arbuckle Mountains, where it overlaps successively the Pennsylvanian, Mississippian, Devonian, Silurian, and Ordovician. These beds repose at an angle of about 45 degrees, dipping southwest from the axis of the Arbuckle uplift.

The Permian beds rest unconformably upon the Pennsylvanian rocks in the Graham field, where the dips in the Pennsylvanian rocks range from 10 to 40 degrees.

In the Graham pool a limestone member has been found in many wells near the base of the red beds that has been regarded as basal Permian and the equivalent of Morgan's Hart[29] limestone member of the Stratford formation.

29. Morgan, Geo. D., Geology of the Stonewall Quadrangle: Bureau of Geology, Bull. 2, Norman, Oklahoma, pp. 137-140, 1924.
Birk, R. A., Tracing a part of the Pontotoc series around the western end of the Arbuckle Mountains: Bull. Am. Assoc. Pet. Geol., Vol. 9, No. 6, pp. 983-984, 1925.

Pennsylvanian. The following is a portion of Tomlinson's[30] description of the Pennsylvanian rocks associated with oil and gas production in the Graham field.

> The sequence of strata in the Pennsylvanian producing zones in the Graham field resembles quite closely a sequence to be found in the outcrops of the "Cup Coral member" of the Glenn formation between Graham and Ardmore. No limestone member more than two or three feet in thickness is exposed in the outcrops of Carboniferous strata between Ardmore and Graham, between the Otterville limestone, immediately underlying the "Cup Coral member," and the Sycamore limestone (Mississippian) below * * *.
>
> A 30 foot bed of true limestone has been found in two Graham wells below all present producing horizons. This may be regarded as sufficient proof that the producing zones are not older than the "Cup Coral member." It is suggested the deep limestones in these two wells may be Otterville * * *.
>
> A number of cores taken from the Johnson sand in the Graham field contain fossils. From these more than a dozen species have been identified * * * . A comparison of a list of these species with the faunal list published by Girty and Roundy[31] shows that nearly all the species obtained from the Johnson sand are found in the outcrops of the "Cup Coral member" of the Glenn formation.

STRUCTURE

The subsurface structure of the Graham field can be readily worked, as the top of the Johnson sand serves as an excellent datum horizon. The structure on this horizon shows a pronounced elongated anticlinal fold, the major axis extending northwest-southeast, to the east line of sec. 22, T. 2 S., R. 3 W., where the direction of the axis swings almost due west to the end of the field in that direction. Dips to the east, northeast, and north are much steeper than elsewhere around the field, standing as much as 40 degrees in places.

PRODUCING SANDS

Following is a description of the producing horizons of the Graham field taken largely from the report by George and Bunn.[32]

SHALLOW OIL SANDS

Showings of heavy oil or gas have been found in many of the shallow Permian sands penetrated in the Graham field. These sands range in depth from 150 to 1,100 feet. They are of an irregular and lenticular nature, medium fine-grained and loosely cemented. In the N.½ sec. 31, T. 2 S., R. 2 W., several shallow wells produced from four to six barrels of 19 gravity oil. In the E.½ sec. 6, T. 3 S., R. 2 W., several wells produced small amounts of gas at depths varying from 435 to 650 feet. In the early development of the field fuel oil and gas from these wells were used in drilling.

30. Tomlinson, C. W., Contribution to the petroleum engineering in the Fox and Graham oil and gas fields: Bull. U. S. Bureau of Mines, pp. 4-5, 1924.
31. Girty, Geo. H. and Roundy, P. V., Notes on the Glenn formation of Oklahoma: Bull. Am. Assoc. Pet. Geol., vol. VII, pp. 332-388, 1923.
32. George, H. C., and Bunn, John R., Petroleum engineering in the Fox and Graham oil and gas fields: Bull. U. S. Bureau of Mines, pp. 12-16, 1924.

Producing Horizons, Graham Field

AGE	HORIZON	RELATION OF PRODUCTION TO STRUCTURE	LITHOLOGIC CHARACTER	THICKNESS OF SAND & ZONE (Feet)	DEPTH (Feet)	AV. INIT. PROD. OIL (Bbls.)	AV. INIT. PROD. GAS (M.cu.ft.)	GRAVITY
PERMIAN	SHALLOW OIL AND GAS SANDS	Southeast edge of Graham anticline	Medium fine-grained, loosely cemented sands	Av. 20 sand Av. 25 sand Av. 15 sand	250 435 650	3	Gas Gas	19.0
	PATSY GAS SAND	SW. flank of southern producing zone		Av. 10 sand	900-985		8 Dry	
PENNSYLVANIAN	KIRK GAS HORIZON	Highest structural points	Sandy limes and limes	Zone 30-50	1,450-1,800		15 Wet	
	JOHNSON SAND HORIZON	Oil on flanks Gas on higher structual points	Fine-grained soft, porous sands	Zone 150-300 Sands av. 55	1,830-2,180	200	24 Wet	31
	GRAHAM SAND HORIZON	Best prod. on top of structure and SW. flank		Zone 200 Sands av. 35	2,050-2,630	350	15 Wet	33.0
	UN-NAMED	Southeast of top of structure	Hard, close fine-grained sands	Sands av. 19	3,220	15		38.8
	SMITH SAND	Southeast of top of structure		Av. 15 sand	3,375	60		39.9

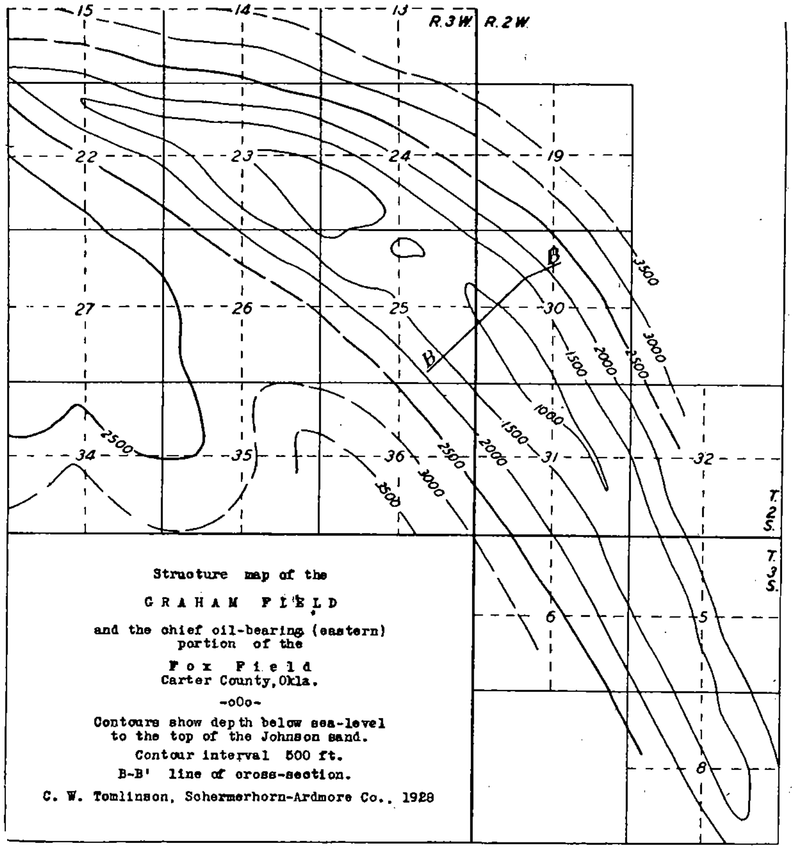


Figure 3.

Log of Schermerhorn-Ardmore Co., No. 1, G. E. Holman.

SW.¼ NW.¼ SE.¼ sec. 25, T. 2 S., R. 3 W. Completed November 30, 1923

Formation	Top	Bottom
sand & rock	0	31
hard sandy lime-shells	31	47
hard lime	47	51
blue shale	51	75
red bed	75	112
OIL sand	112	122
sand & shale	122	185
OIL sand	185	213
lime rock	213	216
hard sand & shale	216	246
water sand	246	263
pack sand	263	335
sand & clay	335	346
sand & boulders	346	405
lime rock	405	408
sharp sand	408	523
shale	523	644
hard sand	644	756
sticky shale	756	778
hard sand	778	815
hard rock	815	817
hard sand	817	866
lime rock	866	894

(Continued on page 33)

Formation	Top	Bottom
hard shale & sand	894	923
lime rock	923	936
gumbo	936	946
hard sand-sand rock	946	995
sand rock & lime	995	1017
shale	1017	1029
broken lime	1029	1041
hard sand	1041	1063
rock	1063	1065
hard rock	1065	1073
hard lime rock	1073	1078
hard lime pts of iron	1078	1085
lime rock	1085	1089
broken lime	1089	1094
lime rock	1094	1102
hard sand	1102	1104
sandy lime	1104	1129
sandy lime & lime	1129	1155
broken lime	1155	1185
hard broken lime	1185	1197
hard shale	1197	1200
GAS sand	1200	1203
broken lime	1203	1222
gumbo	1222	1246
GAS sand	1246	1257
hard lime	1257	1264
hard sand	1264	1285
broken lime	1285	1297
gumbo-hard sand	1297	1328
GAS sand	1328	1337
shale	1337	1359
hard sand	1359	1390
shale	1390	1392
sticky shale	1392	1426
tough gumbo	1426	1456
boulders	1456	1458
sandy shale	1458	1491
shell & GAS sand	1491	1495
shale	1495	1553
GAS sand	1553	1554
shale	1554	1581
KIRK SAND ZONE:		
GAS sand	1581	1582
lime rock	1582	1585
hard lime	1585	1592
GAS sand core 1598′	1592	1602
shell	1602	1605
GAS sand, salt wtr. S. L. M.	1605	1616
hard sand	1616	1618
Broken lime	1618	1620
hard lime rock	1620	1621
lime	1621	1621½
sandy shale	1621½	1660
sticky shale	1660	1716
sand, show GAS	1716	1717
blue shale	1717	1745
blue shale	1745	1755
gumbo	1755	1765
shale carrying Gas	1765	1795
sandy shale	1795	1817
hard shale	1817	1832
gumbo	1832	1874
sticky shale	1874	1900
sand rock	1900	1902
shale	1902	1914
JOHNSON SAND ZONE:		
lime	1914	1919
OIL sand	1919	1923
gumbo	1923	1926
brown shale	1926	1933
GAS sand	1933	1948
sand, solid	1948	1953
GAS & OIL sand	1953	1965
broken mixed shale & gas sand. S. L. M.	1965	1969
mixed shale	1969	2000
shell	2000	2001
sand-core at 2011′	2001	2011
clay & brown shale	2011	2016
hard sand, show GAS	2016	2022
GAS sand-lime	2022	2027
shell	2027	2028
hard shale & shells	2028	2035
GAS sand, showing some oil	2035	2039
mixed shale	2039	2054
hard shell	2054	2055
sticky shale	2055	2059
sand, showing good	2059	2074
mixed shale, showing some OIL sand	2074	2087
blue shale	2087	2095
mixed shale	2095	2125
DEEPENING RECORD		
shale	2125	2132
shell	2132	2133
gumbo	2133	2143
shale	2143	2173
black shale	2173	2187
broken sand	2187	2192
sandy shale	2192	2198
shale	2198	2213

(Continued on page 34)

	Formation	Top	Bottom
ATLANTIC SAND ZONE	broken sand	2213	2215
ATLANTIC SAND ZONE	sandy shale	2215	2216
ATLANTIC SAND ZONE	hard sandy lime	2216	2220
ATLANTIC SAND ZONE	lime shell	2220	2222
ATLANTIC SAND ZONE	sandy shale	2222	2235
ATLANTIC SAND ZONE	sand, showing OIL & GAS	2235	2241
ATLANTIC SAND ZONE	sand, OIL	2241	2253
ATLANTIC SAND ZONE	lime shell	2253	2256
	shale	2256	2262
	lime shell	2262	2264
	shale	2264	2280
	gumbo	2280	2284
	sticky shale	2284	2300
	brown shale	2300	2315
	sandy shale	2315	2319
	brown shale	2319	2327
	hard sandy lime	2327	2331
	lime shell	2331	2334
Rickets Sand Zone	brown sand	2334	2337
Rickets Sand Zone	sand	2337	2339
Rickets Sand Zone	sandy shale	2339	2345
Rickets Sand Zone	sandy shale-br. sand	2345	2353
Rickets Sand Zone	sand—OIL showings	2353	2360
	sandy shale	2360	2368
	sticky shale	2368	2378
	sand	2378	2381
	sticky brown shale	2381	2386
	sticky shale	2386	2395
	brown shale	2395	2405
	gumbo	2405	2414
	shale	2414	2436
	OIL sand (Graham Sand)	2436	2447
	sticky shale	2447	2452
	shell	2452	2453
	sticky shale	2453	2460
	gumbo	2460	2463
	shell	2463	2465
	gumbo	2465	2475
	shale	2475	2490

TOTAL DEPTH—S. L. M.

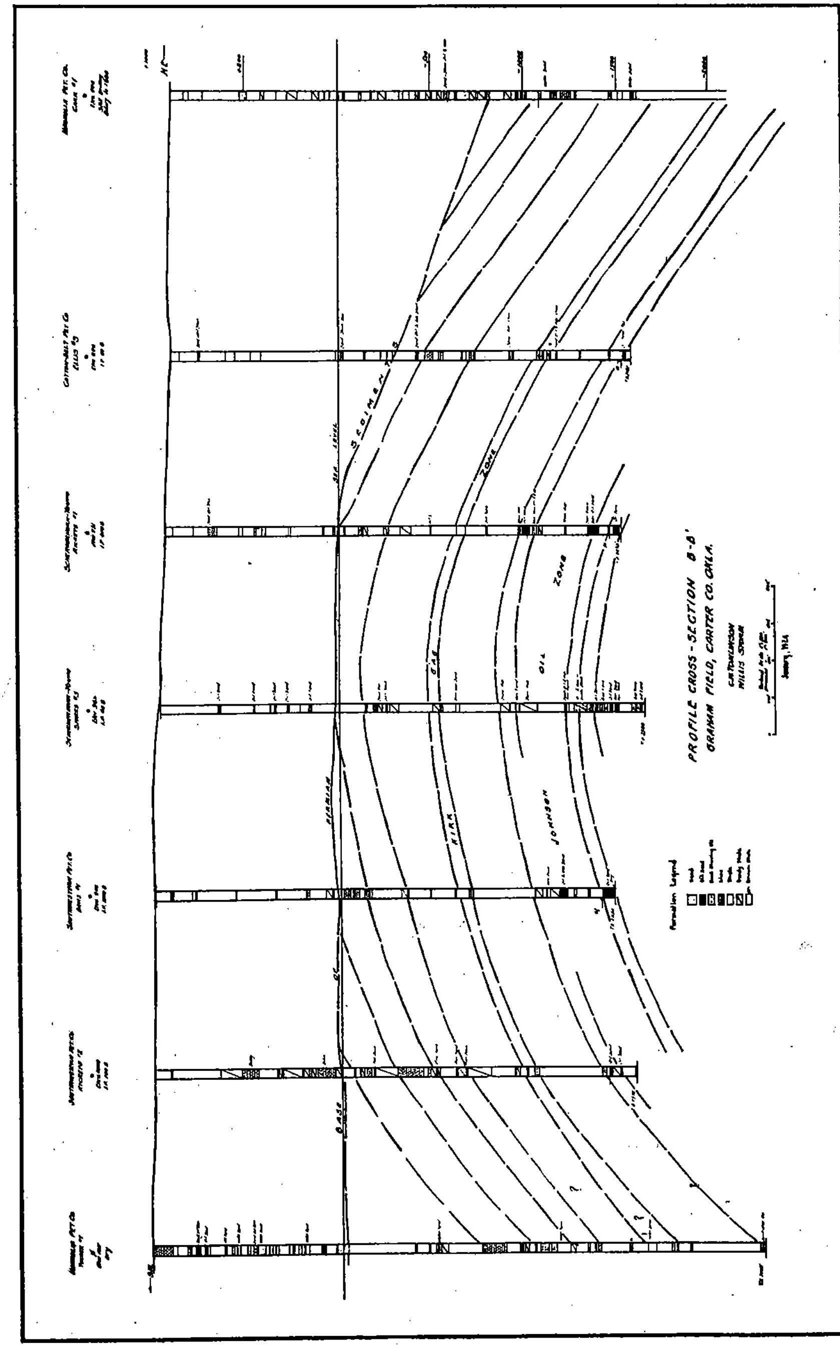
PATSY GAS SANDS

A sand found by the Patsy Oil and Gas Company and the Kirk Oil Company at a depth of 985 feet near the cen. sec. 6, T. 3 S., R. 2 W., produced 17 million cubic feet of gas in the initial well. This sand was productive in several other wells in the E.½ sec. 6, T. 3 S., R. 2 W. The initial production of wells from this sand was 8 million cubic feet of dry gas. This sand is medium fine-grained and loosely cemented.

THE KIRK GAS HORIZON

A gas and water horizon from 30 to 150 feet in thickness and occurring along the axis of the structure, produced gas in a few wells. This horizon was found at depths ranging from 1,450 to 1,800 feet. Rotary cores have shown this horizon to be very calcareous in nature and associated with sandy limes and limes. Production of gas from this horizon is limited to the highest structural points. This zone was found to carry water on the flanks and was usually cased off. George and Bunn found that no wells produced oil from this horizon although rotary cores had shown the presence of saturated oil sands. Later H. E. Ley[33] contended that some wells had been plugged back to this horizon and were producing oil.

33. Ley, H. E., Note on Kirk gas and water horizon: Bull. Am. Assoc. Pet. Geol. vol. 9, no. 6, p. 1024, 1925.



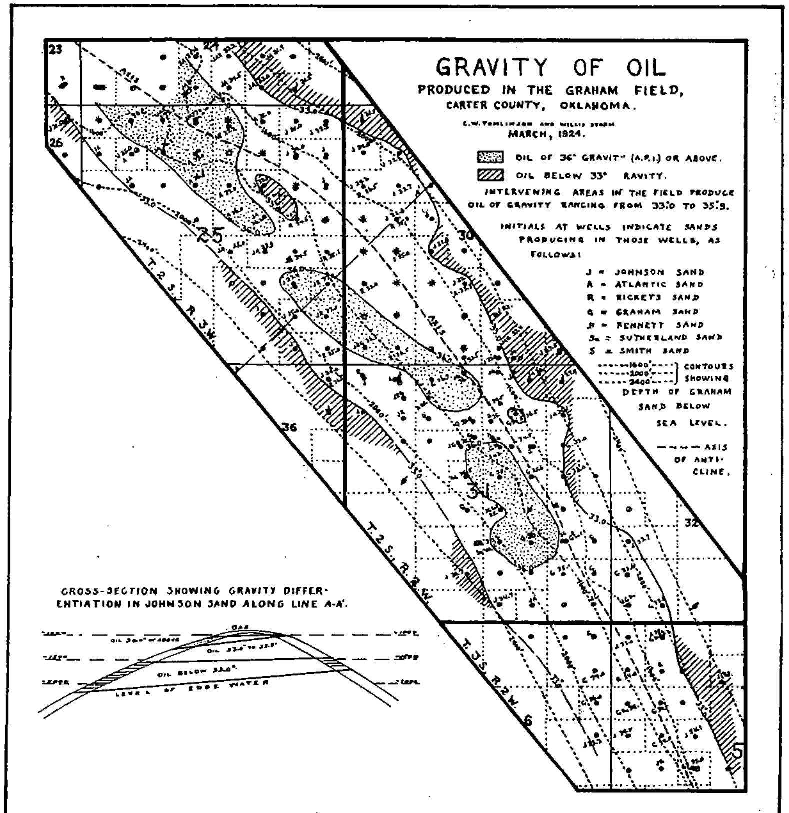
(Illustration through courtesy of American Association of Petroleum Geologists)
Figure 4.

JOHNSON SAND HORIZON

The top of this horizon is found at depths ranging from 1,830 to 2,180 feet along the axis of the Graham anticline. This zone lies from 250 to 475 feet below the base of the Kirk gas sands and is separated from it by a shale interval. This interval is easily recognized in well logs and has been used in subsurface correlations.

This zone ranges in thickness from 150 to 300 feet. The upper Johnson sands are usually thinner than the lower Johnson sands, and are fine-grained, soft, and porous. The interval between these two sands is greatest in the southeast end of the field, decreasing to the northwest. The edge water level in this horizon is higher on the northeast flank than on the southwest flank of the fold.

The initial production of wells from this horizon averaged 200 barrels of oil and 24 million cubic feet of gas per well. The gravity of the oil averages about 31 degrees.



(Illustration through courtesy American Association of Petroleum Geologists)

Figure 5.

GRAHAM SAND HORIZON

In the southeast part of the field the Graham sand horizon lies about 450 feet below the base of the lower Johnson sand horizon. The interval thins to the northwest until in sec. 24, T. 2 S., R. 3 W., it is less than 200 feet. The interval is largely shale with a few thin beds of limes, sands, and sandy shales.

The Graham horizon averages about 200 feet in thickness, and the Graham sands average from 30 to 40 feet in thickness and are less lenticular than those of the Johnson horizon. These sands are fine-grained, soft, and porous.

Initial production of wells in the Graham horizon averages 350 barrels, 15 million cubic feet of wet gas. The gravity of the oil averages 32 degrees.

DEEPER SANDS

Production of 15 barrels of 38.8 gravity oil from an unnamed and relatively unimportant sand has been obtained in one well in sec. 31, T. 2 S., R. 2 W. This sand was topped at 3,217 feet. This sand was found in other nearby deep wells but failed to produce.

A lower sand, topped at about 3,375 feet, produced small amounts of oil in a few wells in sec. 31, T. 2 S., R. 2 W. The initial production of these wells averaged about 60 barrels of 39 gravity oil.

Deeper drilling in the Graham field has not met with any success. In the northwest portion of the field these deeper sands failed to produce.

The Graham field has produced at this writing (July, 1928) nearly 16 million barrels of oil from 320 wells.

THE HEALDTON POOL

EARLY HISTORY

About the year 1888 a visiting prospector drilled a well some 400 feet deep on a sloping prairie in what later turned out to be the S.½ sec. 5, T. 4 S., R. 3 W. He struck a sand which filled the hole with tarry fluid and slopped over, letting heavy black asphaltic oil creep down the slope, where it lay for years afterward. It was not a commercial venture at that early date, and the discoverer moved on to other fields.

In 1912 two young business men of Ardmore, Roy M. Johnson and Edward Galt, interested Wirt Franklin and others in the possibilities of this area, and got together a block of leases. The following year they succeeded in persuading J. M. Critchlow of Titusville, Pa., to drill a test well on land belonging to Mr. Franklin in sec. 8, T. 4 S., R. 3 W. In August, 1913, it was completed as a 25 barrel well at a depth of 920 feet. A second well was then drilled one-half mile farther northwest, and this one yielded 300 barrels per day. This well started the earnest development of the field.

By November, 1914, there were some 275 producing wells in the field. Low prices of crude oil slowed up development during 1915, but in 1916 the main part of the field was fully developed, and in 1917 the southeast extension was defined.

PRODUCTION

The Healdton oil pool is by far the largest in Carter County, both in area and in yield. Between two and three times as extensive as any other pool (see statistical table), and covering nearly 40 per cent of the total productive area of the county, it has produced to date 50 per cent more oil than all the other pools in the county. Hewitt alone has exceeded Healdton in per acre yield.

No other pool in Oklahoma south of Cushing and Glenn pool approaches Healdton in continuous productive area, or has equaled its total production to date. None of the pools in the Seminole group has yet passed Healdton in total production, in spite of their much larger flush yield. Healdton is phenomenal among Oklahoma pools in its exceedingly slow rate of decline. Although it reached its peak 12 years ago, its present daily production is one-fourth as great as in the peak month. Certain leases in the field which reached peak production in 1916 have not yet (1928) fallen to one-half of their 1916 average yield.

Although Healdton production has been aided to some extent in the past two or three years by drilling additional wells inside the proven area, these wells have tapped no new sands. Vacuum has not been used to any considerable extent as an aid to production, nor has flooding or repressuring been tried. It seems safe to predict that ten years from now Healdton will be producing more oil than any pool in the present Seminole group, and that its productive life will continue through additional decades.

Although Healdton's average yield per acre to date is only a little over 20,000 barrels, certain tracts (parts of leases) in the northwestern part of the pool have yielded over 100,000 barrels per acre, and are still adding 5,000 barrels per acre to those figures each year. Several different companies and landowners own rich spots of this kind. Obviously, the greater part of the field has averaged considerably less than 20,000 barrels per acre to date. One or two edge properties in the southeastern part of the field have been abandoned, and scattered wells throughout the field have met the same fate; but the total number of producing wells has been kept nearly constant by new drilling in the richer areas.

PRODUCING SANDS

The great bulk of Healdton's production comes from a group of Pennsylvanian sands known as the Healdton sand zone, from 800 to

1,200 feet deep. The gravity of this oil ranges from 25° to 37° A. P. I., with most of it between 31° and 35°. Gas and a little oil have been obtained from shallower Pennsylvanian sands scattered through a belt of blue shale between 400 and 800 feet deep. The only persistent member of this series, which is of little commercial consequence, occurs 150 to 200 feet above the top of the main Healdton zone. In the southeastern part of the field little production is obtained above 1,200 feet, but moderately prolific Pennsylvanian sands, carrying oil of similar gravity, are found at various depths down to 2,050 feet. Half a dozen deep wells in the south-central portion of sec. 4, T. 4 S., R. 3 W., have obtained small production of very light (40° to 45°) oil from Ordovician sandy limestones at depths ranging from 2,100 to 4,200 feet. Only three of these are now producing and their total yield is only about 50 barrels per day. One of these wells, now abandoned (Bullhead Oil Co.'s No. 1 Daney), was the first Ordovician producer in Oklahoma,[34] antedating the first Wilcox sand development. It was drilled in 1917.

The extraordinary although variable thickness of oil sands in the main Healdton sand zone in the northwest one-half or two-thirds of the Healdton field is largely responsible for the remarkably long life and slow decline of oil production there. Solid sands from 40 to 150 feet thick are the rule rather than the exception if the well records are trustworthy; some wells have logged between 200 and 300 feet of sand in this zone. Such thicknesses of solid or nearly solid sand of good porosity are known only in the outcrops of the Deese formation in the Pennsylvanian sediments of Carter County. The outcropping Deese sandstones, as a rule, vary much less rapidly along the strike than do the Healdton oil sands; but the variability of the latter may be due to their proximity to the rugged buried hills of Ordovician rocks which rise in places above the level of the pay sands.

The suggestion that these sands may belong in the Deese formation is admittedly based on very inconclusive evidence. Available paleontologic evidence marks them as Pennsylvanian, but is not adequate to determine their exact position in that system.[35]

The surface rocks in the Healdton field are late Pennsylvanian (Cisco ?) or early Permian red beds, 200 to 500 feet thick over most of the field but increasing to 800 feet at some places along its borders. The highest member exposed in the field is the Cornish sandstone, which caps a butte in sec. 6, T. 4 S., R. 3 W., and a scarp at the northwest corner of that section.

34. Powers, Sidney, The Healdton oil field, Oklahoma: Econ. Geol., vol. 12, p. 600, 1917.

35. Powers, Sidney, loc. cit.
Gardner, James H., The oil pools of southern Oklahoma and northern Texas: Econ. Geol., vol. 10, pp. 425-426, 1915.
Powers, Sidney, Age of the oil in southern Oklahoma fields: Trans. Amer. Inst. Min. Met. Eng., vol. 59, pp. 571-577, 1918.
Bartram, John G., and Roark, Louis, The Healdton field, Oklahoma Bull. Am. Assoc. Pet. Geol., vol. 5, pp. 470-471, 1921.

Log of J. B. Schermerhorn, Inc., No. 29 Schermehorn.
SE.¼ SW.¼ NW.¼ sec. 5, T. 4 S., R. 3 W. Completed April 27, 1927.

Formation	Top	Bottom		Formation	Top	Bottom
yellow clay	0	15		blue shale	442	459
blue clay	15	27		lime	459	465
red bed	27	48		blue shale	465	615
pin shale	48	58		Oil sand, show		
red bed	58	120		of oil	615	628
lime shell	120	122		blue shale	628	948
blue shale	122	140	HEALDTON SAND ZONE	soft Oil sand	948	1012
water sand	140	168		blue shale	1012	1031
blue shale	168	195		lime shell	1031	1037
red bed	195	232		Oil sand		
lime	232	236		(Pay sd.)	1037	1046
sand	236	257		lime	1046	1053
red bed	257	313		Oil sand		
lime	313	315		(Pay sd.)	1053	1064
sand	315	321		lime	1064	1066
lime shells	321	341		Oil sand		
red bed	341	386		(Pay sd)	1066	1072
Oil sand				lime	1072	1074
show of oil	386	392		Oil sand		
blue shale	392	417		(Pay sd.)	1074	1077
lime	417	428		hard lime		
pink shale	428	442		(SLM)	1077	1088

(Shot formation 1031-1080 with 50 qts. 4-27-27.)

STRUCTURE

The Healdton field is strictly anticlinal. According to the structural map by Bartram and Roark, reproduced herewith (see Fig. 6), the top of the Healdton sand zone is about 275 feet above sea level at the highest point on the fold. Production extends down the flank until that horizon reaches sea level, and in places about 300 feet below. The broader parts of the arch are fairly flat, with dips of one degree or less, but a maximum dip (for the producing Pennsylvanian sands) of about 15 degrees is attained on the flanks of the anticline.

Over the flat part of the arch the surface red beds parallel the underlying productive Pennsylvanian section fairly closely, so that the unconformity between the two is inconspicuous. To the west and south, and in part to the east, the flanks of the fold are also well shown in the red beds, but with dips averaging only about one degree, as against 5 to 15 degrees in the Healdton sand zone. The surface of unconformity at the base of the red beds appears to slope away from the field at an intermediate rate, so that the red beds thicken by the addition of lower members which failed to cover the Healdton anticline.

The unconformity between the marine Pennsylvanian section, including the productive sand series, and the underlying Ordovician is much more pronounced within the area of the field than is the upper unconformity just described. The surface of the Ordovician appears to be hilly, with a local relief of several hundred feet. At one point in the SE.¼ sec. 5, T. 4 S., R. 3 W., it projects up through the Healdton sand zone into the base of the overlying blue shales, within 800 feet of the surface of the ground, causing a dry hole (Sinclair Oil & Gas Co.'s No. 7 Million & Thomas) to appear in the midst of the field. Nearby wells drilled to 1,100 or 1,200 feet do not reach the Ordovician. In secs. 15 and 16, T. 4 S., R. 3 W., its depth ranges from 1,200 to 1,500 feet or more, and it is below 2,000 feet in the southeastern part of the field, where a much thicker Pennsylvanian section appears. Powers[36] recognizes three moderately productive Pennsylvanian oil sands (the Jackson, Simpson, and Pugh sands) below the Healdton sand zone in the southeastern half of the field, which apparently terminate against the Ordovician buried limestone hills after the manner of the lower oil sands in the Brock field.

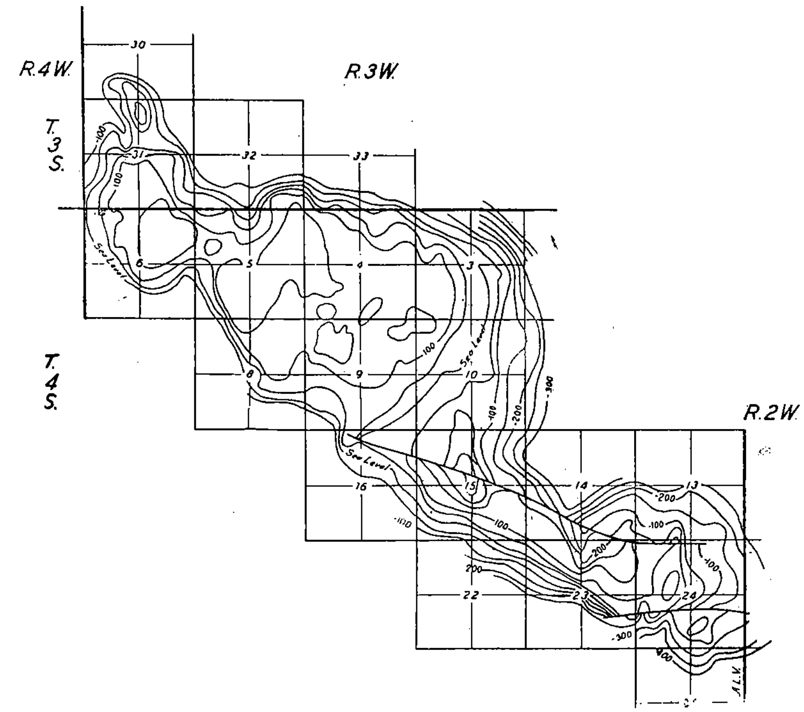


Figure 6. Structure map of Healdton field. Contours on Healdton sand zone. (After Bartram and Roark).

36. Op. cit.

Bartram and Roark[37] say that the Ordovician formations penetrated in the Healdton field are believed to include the Viola limestone, Simpson formation, and Arbuckle limestone. They state that the first two have been identified by fossils, and that the Simpson formation includes the Orodvician productive horizon in two wells (in sec. 4, T. 4 S., R. 3 W.). Complete information from the Ordovician wells is not available, but it is supposed that the Simpson formation underlies the Pennsylvanian rocks across the central and southeastern parts of sec. 4, T. 4 S., R. 3 W., with the Arbuckle appearing to the south and southwest and the Viola to the north.

The straightness of the southwest edge of the Healdton field, and the steep Pennsylvanian dips along that edge, suggest the possibility of a fault bordering the buried Ordovician hills on that side, comparable to the Criner fault along the corresponding side of the Criner Hills, but this is wholly conjectural. The situation in the Brock field and the Criner Hills, folds of similar age and orogenic history to those at Hewitt and Healdton, suggests that dips in the Ordovician rocks at Healdton are probably much steeper than in the overlying Pennsylvanian. This makes it rather difficult to locate a particular horizon in the Ordovician except by accident. If the Wilcox and other sand members of the Simpson formation are present beneath the Healdton field, and with any such thickness as they possess in their nearest outcrops in the Arbuckle Mountains, they may yet yield splendid production in this pool. Their presence is open to question, but the prospect warrants further exploration.

HEWITT[38]

By

Geo. E. Burton

LOCATION

The Hewitt oil field is located in secs. 9, 10, 15, 16, 21, 22, 23, 27, and 28, T. 4 S., R. 2 W., Carter County, Oklahoma, fifteen miles west and two miles north of Ardmore. It is only four miles east of the east end of the great Healdton oil pool. There is a small pool lying to the southeast of the Hewitt field which is sometimes regarded as an extension. In this paper. however, only the Hewitt field proper will be discussed.

HISTORY

The Hewitt field was discovered June 5, 1919, when the Texas Company No. 1, A. E. Denny, NE.¼ NW.¼ NW.¼ NW.¼ sec. 27, T. 4 S., R. 2 W., found big pay sand at a depth of 2,100-3,134 feet which

37. Op. cit.
38. Geo. E. Burton, Humble Oil and Refining Company, Box 58, Ardmore, Okla.

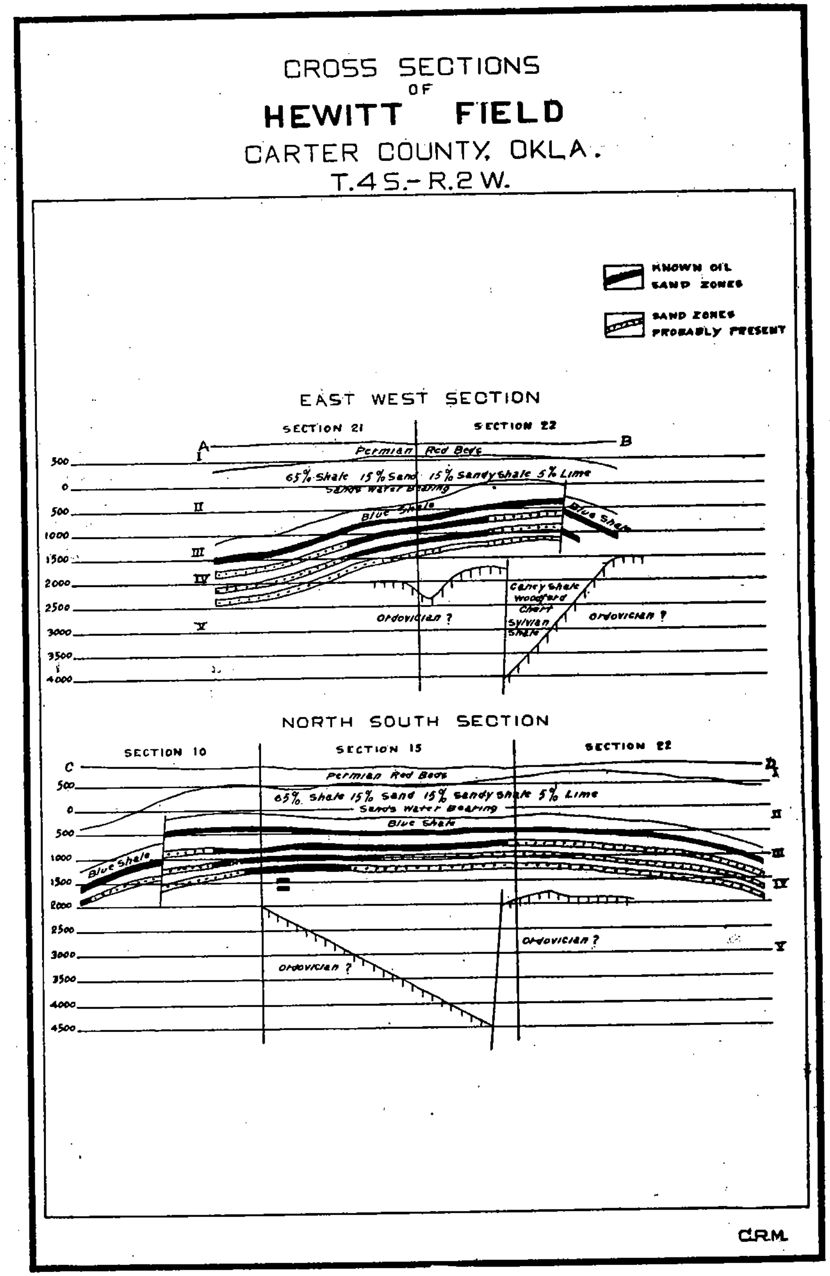


Figure 7.

flowed an initial production of 410 barrels of oil. This location was made on a surface anticline, but after the field was developed, it was found that the discovery well was very near the south edge of the field. The production from the Hewitt field reached its maximum during the month of September, 1921, when the average daily production over the entire month was 43,902 barrels of oil.

In June, 1922, Baker and Strawn in their Dillard No. 8-B, 1,610 feet east and 290 feet south of NW. cor. sec. 22, T. 4 S., R. 2 W., discovered deep production in lime from 2,863-2,878 which made 450 barrels initial production. This production was reported as coming from the Viola lime at the time of completion. About 24 wells were drilled in the vicinity of the Baker Strawn discovery in search of the deep production. The Carter Oil Company No. 33 Noble, SW.¼ NE.¼ NE.¼ sec. 21, T. 4 S., R. 2 W., was the most sensational find, making 14,000 barrels initial production at 2,941-2,942 feet. On account of the quick decline of this lime production and the intensely folded and faulted condition of the pre-Pennsylvanian rocks the search for this production was soon abandoned. It has been only a small factor in the production of the field.

GEOLOGY

The rocks at the surface in the Hewitt field are Permian red beds. Drilling in the field has revealed five zones (Figure 7) as follows:

Zone 1, Permian red beds, 1,300 feet thick around the edge of the field, thinning to 200 feet over the center of the field;

Zone 2, made up of about 65 per cent shale, 15 per cent sand, 15 per cent sandy shale, and 5 per cent lime, most of the sands water bearing;

Zone 3, a rather regular blue shale zone maintaining a thickness of about 300 feet over the entire field;

Zone 4, 1,400 feet of sand and shale, the main oil bearing zone in the field, with six more or less well developed, fairly continuous, sands and numerous sand lenses; and

Zone 5, an irregular zone made up of limestones, shales, and some sandstones, with as much as 1,400 feet of limestone in some of the wells.

Zone 1 is Permian red beds. Zones 2, 3, and 4 are Pennsylvanian. Zone 5 is pre-Pennsylvanian and in this zone investigators have reported Caney shale, Woodford chert, Viola lime, and probably Simpson formation. There is an unconformity between the Permian red beds and

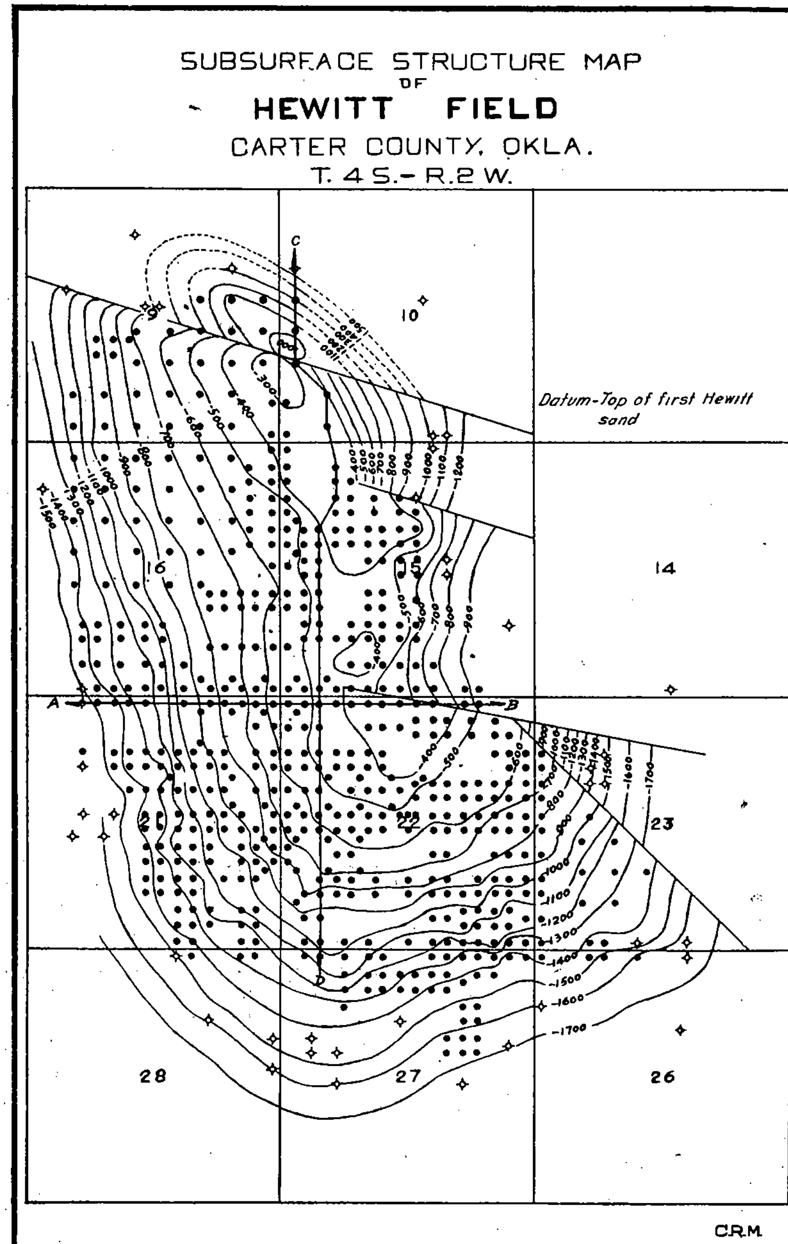


Figure 8.

Pennsylvanian (between zones 1 and 2) and another unconformity between Pennsylvanian and pre-Pennsylvanian (between zones 4 and 5).

STRUCTURE

There seems to be surface structure at Hewitt, although the high point on the surface high is somewhat south of the subsurface high. At the time the discovery of oil was made there was considerable open acreage in this area and this surface structure was, of course, the only geological aid to buying. The result was that what afterwards proved to be a great deal of the best acreage commanded small prices or was unsold while some of the acreage that brought high prices was later proved barren of oil. The subsurface fold[39] mapped (Fig. 8) on the top of the first Hewitt sand is a north-south trending, somewhat faulted, anticlinal fold, the highest point on which is just north of the SE. cor. sec. 9, T. 4 S., R. 2 W.

Structural conditions in the rocks below the Pennsylvanian are quite complex. Fig. 9 shows a possible interpretation of these conditions. North of the fault cutting the north part of section 22 and the SW. cor. section 16, it is probable that the contours represent the dip and strike of what is usually regarded as Viola lime. The contours south of this fault probably represent the topography of the buried Viola ridge.

Two sections are shown (Fig. 7) one north-south and the other east-west across the field. These sections show the unconformity between the red beds and the Pennsylvanian and also the unconformity between Pennsylvanian and pre-Pennsylvanian.

ECONOMIC IMPORTANCE

At the end of 1927 Hewitt had 806 producing wells, giving a total production of 60,349,876 barrels. There are 3,050 producing acres in the Hewitt field, the per acre yield to the end of 1927 would then be 19,786 barrels. The decline curve for Hewitt shows that at the end of 1941 the average production per well per day will be 2.8 barrels. Up to the end of 1941 it is figured that with present methods of production, an additional 22,920,000 barrels will be produced. This will be an additional per acre yield of 7,515, making a total ultimate per acre yield of of 27,301 barrels per acre. It is possible that by 1941 oil may be priced so that the wells will continue to be produced even when the average per well per day becomes much less than 2.8 barrels. The Hewitt field has made good money for its producers because its flush production came when the general production of oil was low, with consequent handsome prices.

39. Map made by W. E. Hubbard, Humble Oil & Refining Company.

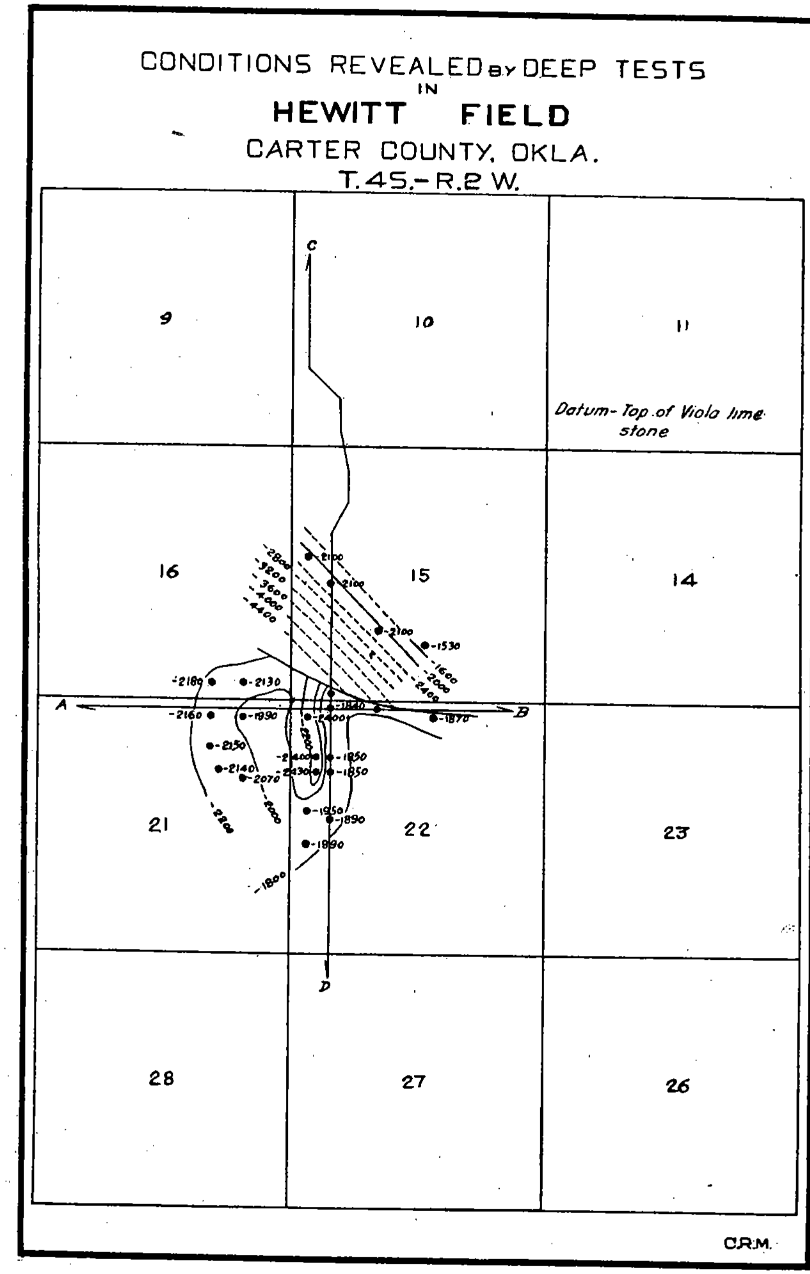


Figure 9.

Log of the Texas Co., No. 7, V. E. Dillard.

SE.¼ NE.¼ NW.¼ NE.¼ sec. 27, T. 4 S., R. 2 W. Completed October 6, 1920.

Formation	Top	Bottom
surface soil	0	8
mud	8	45
sand	45	70
red bed	70	80
sand	80	130
red bed	130	160
shale	160	170
red bed	170	190
sand	190	205
red bed	205	230
shale	230	240
sand	240	265
red bed	265	275
shale	275	300
sand	300	380
shale	380	405
sand	405	415
shale	415	465
sand	465	550
shale	550	555
lime	555	560
blue shale	560	600
sand	600	615
shale	615	640
sand	640	670
lime	670	675
shale	675	825
lime	825	840
shale	840	1000
sand	1000	1010
shale	1010	1150
sand	1150	1160
shale	1160	1250
lime	1250	1260
shale	1260	1360
lime	1360	1370
shale	1370	1475
sand	1475	1500
shale	1500	1645
sand	1645	1700
shale	1700	1820
sand	1820	1845
shale	1845	1923
lime	1923	1930
shale	1930	2000
sand	2000	2020
shale	2020	2266
lime	2266	2271
sandy shale	2271	2298
oil sand (Hewitt sand)	2298	2351

SHOLOM ALECHEM[40]

By

A. M. Meyer

ACKNOWLEDGMENTS

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LOCATION

The Sholom Alechem field at this time extends northwest from the cen. sec. 11, T. 2 S., R. 3 W., to the cen. sec. 12, T. 1 S., R. 4 W. It is one and one-fourth miles across at its widest part but averages about three-fourths mile.

HISTORY

The discovery well of the Sholom Alechem field was the Humble Oil and Refining Company No. 1 Jennings in the SW.¼ SW.¼ SE.¼ sec. 28, T. 1 S., R. 3 W., completed in December, 1923. It was drilled to a total depth of 4,065 feet and had an initial production of 90 barrels on the pump after plugging back to 3,382 feet. It was one of the few standard tool wells drilled in the field.

40. A. M. Meyer, Atlantic Oil Producing Co., Ardmore, Okla.

The second well to be completed was the Magnolia Petroleum Company No. 1 Hardin in the SE. ¼ SE.¼ NE.¼ sec. 19, T. 1 S., R. 3 W., which was completed in April, 1924 with an initial production of about 100 barrels. From these two wells the field has spread to its present state of development.

STRATIGRAPHY

Lenticular is the one term descriptive of all the sediments penetrated by the drill. Red beds and sandstones, with some conglomerates which outcrop over the field, extend to a depth of 1,400 to 2,000 feet below the surface.

Beds probably belonging to the Pontotoc of upper Pennsylvanian age are found below the red beds. They consist of blue, brown, and gray shales with some red shale interbedded with coarse and fine sandstones, conglomerate, and some limestones. As a rule the clastic sediments become coarser toward the unconformable contact of the Pontotoc with the Glenn of middle Pennsylvanian age. The thickness of this coarse material at the base of the Pontotoc varies from 150 to 800 feet and seems to be thicker along the structure than it is in wells drilled low or off the structure. Beds belonging to Glenn of middle Pennsylvanian age are in contact with the Pontotoc.

In the northwest part of the field along the highest parts of the structure a dense to crystalline white limestone of Glenn age is found in contact with the Pontotoc. It is from 200 to 400 feet thick with a few of the logs showing an even greater thickness. Locally it carries shows of oil and gas. This lime is best developed in sec. 19, T. 1 S., R. 3 W., and northwestward. Southeast of sec. 19, T. 1 S., R. 3 W., it breaks up into a number of thinner limestones and in a number of logs of wells drilled in the southern part of T. 1 S., R. 3 W., it cannot be recognized with any degree of satisfaction. This lime horizon forms the best general marker in the field.

A cross-section (Plate II) from the northwest part of the field to the southeast part which illustrates the change in this lime, was made using the logs of wells characteristic of the part of the field in which they were drilled. One well, Wirt Franklin and Atlantic No. 1 Brittain, is producing from the Pontotoc. With but few other exceptions the production is coming from below the lime horizon.

The producing sands can in general be divided into three sand zones. The individual sandstone beds in all the horizons are very lenticular.

The first sand zone is from 20 to 150 feet below the base of the big lime section, which is from 0 to 150 feet thick. The best production from this zone is found in that part of the field north and west of sec. 19, T. 1 S., R. 3 W. It also produced in some of the wells in secs. 32 and 33, T. 1 S., R. 3 W., and in T. 2 S., R. 3 W. It is not represented in a number of the wells drilled in the field.

The second sand zone is about 300 feet below the top of the first. It is from a few feet to 200 feet thick and is missing in some of the wells.

The third sand zone which is the most persistent is from 250 to 350 feet below the top of the second.

Some of the wells in the field have found production from sands that do not fit into any of the above zones. The wells that have been drilled below the third sand zone in the northwest part of the field found a thin series of limes at approximately 600 feet below the top of the third sand horizon and then went into black shale. In the southeast part of the field, at the horizon of this black shale, a series of thin sands and sandy shales are found from which some production has been obtained. (See log of Schermerhorn-Ardmore Co. No. 2 Lyles in the cross-section). Robert Roth[41] of the Atlantic Oil Producing Co. who has examined cuttings from a number of wells drilled in the field has contributed the following on the stratigraphy:

> Starting from the surface down we have various thicknesses of the so-called Permian red beds, usually about 1,500 feet. Below this we find the first zone which can in any way be called a true zone. It is about 400 feet thick and consists of very arkosic sand, separated by thin beds of various colored red and gray shales and dolomites. At the base of this zone there is a gradational but rather sharp demarcation from the next zone. This zone is usually very conglomeratic and chert pebbles predominate, though arkose is still present to a considerable extent. This second zone is also about 400 feet thick, and lies above a point where fossils are first found which lived in the depositing sea. These two zones are very clastic; they were deposited with great rapidity; some of the arkoses may almost be called a granite wash; they show practically no weathering; their deposition appears to be purely mechanical; and probably were derived from the Arbuckle and Wichita Mountains. In this interesting zone of coarse sedimentation one may read the rapid erosion of nearby land masses as the cherty limestones were removed and the pre-Cambrian granites were brought to the surface and their erosion contributed the final arkoses. The advancing sea (?) which deposited these zones seems to have covered an erosional peneplain as far as the upper Pennsylvanian is concerned. The Pennsylvanian rocks composing the sediments involved in this peneplanation were highly folded and probably faulted to considerable extent. To prove this the first fossiliferous formations penetrated by the drill differ widely in different sections. The wells drilling in on the sides of the peneplaned folds encounter younger beds and a much increased thickening of the shales, sands, and chert beds above the thick limestone horizon found in the field. No attempt has definitely been made to tie this limestone with any outcrop in the Glenn formation as exposed, principally because a good faunal section of the Glenn has not yet been obtained. Some light on the age of this massive limestone may be given by comparison of the fauna contained in it and the shales above and below with the Pennsylvanian found north of the Arbuckle Mountains. The wells which are off the Sholom Alechem structure show considerable shales above the limestone. The fauna found in the upper part of these shales suggests a fairly close correlation with the Belle City and Francis. The shales immediately above the limestone and the limestone itself have many forms which are also contained in the Holdenville. The shales below this limestone are in many cases non-fossiliferous and in many cases those fossils which are found in the cuttings probably came from above. However, it seems that these lower shales which contain the main producing horizon are probably of Wetumka and Wewoka age, though in some cases it seems that part of these lower shales contain a fauna which is very similar to some that I have found in the Stuart and Sonora groups. In all events they certainly are not any older if as old.

41. Roth, Robert, Personal communication. (As the systematic microscopic study of well cuttings is in its infancy in southern Oklahoma, the contributions by Roth and Harlton should be considered as progress reports and subject to change as more information becomes available on this and adjoining areas.)

There is some controversy over the part of the Glenn in which the Pennsylvanian section in the Sholom Alechem field should be placed. At this time the writer tentatively correlates the section from the top of the lime to approximately 600 feet below the third sand zone, with the Deese. The top of the black shale horizon in the northwest part of the field and the top of the sand and sandy shale series in the southeast part of the field would then be the contact of the Deese and Dornick Hills.

Bruce Harlton of the Amerada Petroleum Corporation has kindly contributed the following on the paleontology of the Sholom Alechem field:

> The surface formation of the Sholem Alechem field is in the Wichita series of Permian age and varies in thickness from 1,580-1,650 feet. Near the top of this formation there occurs a fossiliferous limestone zone which carries abundant fossils:
>
> Bairdia sp. — Rhombopora lepidodendroidae
> Jonesina arcuata (Bean) — Meek and other bryozoas
>
> Underlying the Wichita formation there occurs the Pontotoc series of upper Pennsylvanian age, which is composed of conglomeratic material containing mainly quartzite, feldspar, and chert. Its thickness varies from 100-300 feet. The beginning of the Pontotoc is marked by a great hiatus as the Hoxbar formation is entirely missing on top of the structure. The Pontotoc series is underlain by the upper Glenn or Deese formation of middle Pennsylvanian age. The top of this formation may be encountered anywhere from 1,700-1,900 feet.
>
> The Deese formation consists in its upper portion mainly of limestone. The first 100 feet is a rapidly changing unit, sometimes it consists of sandy limestone and again it may be sandstones, shales, and thin limestones.

Below this 100-foot unit there occurs a solid limestone body anywhere from 200-400 feet in thickness. The lower portion sometimes is interbedded with thin shale layers. This entire body is very fossiliferous and contains very diagnostic fossils:

Bradyina holdenvillensis Harlton
Tolypammina grahamensis Harlton
Orobias texana (Harlton)
Crisrostomun jeffersonensis Harlton
Globivalvulina gaptankensis Harlton
Cornuspira harltoni (Cushman and Waters)
Textularia grahamensis Cushman and Waters
Stachia pupoides (Brady)
Climacammina antiqua Brady
Textularia maxima var. depressa Schwellwien, etc., etc.
Endothyra bowmani Phillips
E. involuta Galloway and Harlton
Ammobaculites rectum (Brady)
Tetrataxis decurrens (Brady)
Ammphissites dattoensis Harlton
A. centrinota Ulrich
Hollina granifera Ulrich
Kirkbya permiana n. var.
Bairdia subelongata Jones and Kirkby

The upper Deese limestone is underlain by shales, sandstones, and thin limestones.

In the lower formations of the Sholom Alechem field there occur three zones in which oil is found. The upper two zones are determined, based upon paleontological evidence, as belonging to the Deese formation. The third zone suggests lower Glenn in age.

Log of Amerada Pet. Corp., Hanson No. 2.
Sec. 12, T. 1 S., R. 4 W.

	Depth	Formation
WICHITA	998	Buff fine text. ss.
	1121-40	Buff fine text. ss.
	1140-90	Do. with ls. and shale partings
	1190-1439	Buff fine text. ss. with occasional bed of shale
	1439-47	Buff sandy limestone
	1447-54	Buff fine text. ss.
	1522-74	Buff fine text. ss
PONTOTOC	1595-1658	Cgl. ss. with coarse quartzite and feldspar
	1658-63	Cgl. made up of coarse quartzite and chert
	1663-1888	Cgl. made up of chert, feldspar and coarse quartzite, etc.
UPPER GLENN	1888-1917	Buff sandy ls.
		Fusulina secalica Say
		Rhombopora lepidodendroidae Meek
		Orobias bassleri Galloway and Harlton
		Amphissites dattonensis Harlton
	1917-47	Buff calc. ss. with chert partings
		Fusulina secalica Say
		Rhombopora lepidodendroidae Meek
	1947-60	Buff sandy ls.
		Fusulina secalica Say
		Rhombopora lepidodendroidae Meek
		Abundant Crinoids
		Tolypammina grahamensis Harlton
		Fusulina bocki Moller
		Orobias texana Harlton

(Continued on page 53)

	Depth	Formation
UPPER GLENN	1960-2256	Buff fine grained ls.
		Fusulina secalica Say
		Rhombopora lepidoednroidae
		Tolypammina grahamensis Harlton
		Bradyina holdenvillensis Harlton
		Amphissites dattonensis Harlton
		Bairdia subelongata Kirby
		Ammobaculites rectum (Brady)
		Climacammina antiqua Brady
		Cornuspira harltoni Cushman and Waters
		Cornuspira involuta Galloway and Harlton
		Textularia grahamensis Cushman and Waters
	2256-2306	Buff sandy ls.
		Rhombopora lepidoednroidae Meek
		Tolypammina grahamensis Harlton
	2306-35	Buff ls. with shale
		Rhombopora lepidodendroidae Meek
		Fusulina secalica Say
		Tolypammina grahamensis Harlton
	2350-52	Greenish fine grained shale
	2352-62	Buff sandy ls.
	2362-2414	Buff fine grained ls.
		Rhombopora lepideodrnoidae Meek
		Fusulina secalica Say
	2414-49	Buff fine grained sandy ls.
	2449-69	Buff calc. ss.
	2469-2525	Green shale with ls. and ss. Partings
		Rhombopora lepidodendroidae Meek
	2525-29	Buff ls. with shale
	2529-49	Green shale with cgl. partings
		Fusulina cylindrica Fischer
		Crinoids
	2549-76	Green shale with ls. and ss. partings
		Fusulina secalica Say
		Tolypammina grahemensis Harlton
	2576-2609	Green shale with ls.
		Calcitornella tuberculata Galloway and Harlton
	2642	Buff ss. (saturated with oil)
	2649-94	Grey green shale with ss. partings
		Rhombopora lepidodendroidae Meek
	2700-40	Buff ls. with ss.
		Tolypammina grahamensis Harlton
		Crinoids
		Fusulina secalica Say
		Rhombopora lepidodendroidae Meek
		Shell fragments
	2760-2850	Green fine grained shale
		Crinoids, shell fragments
		Tolypammina grahamensis Harlton
		Ammodiscus incertus d'Orbigny
		Bairdia subelongata Jones and Kirkby
	2875-80	Buff fine text. ss.
	2880-2910	Buff cherty ls. with ss.
		Rhombopora lepidodendroidae Meek
		Fusulina cylindrica Fischer
		Crinoids
	2910-20	Buff. ss. with ls. and shale partings
		Rhombopora lepidodendroidae Meek
		Healdia boggyensis Harlton
	2920-36	Buff ls. with ss. and shale
		Tolypammina grahamensis Harlton
		Crinoids
	2936-39	Buff ss. with shale and ls.
	2939-41	Green and red shale with ls. and ss. partings.
		Crinoids
		Tolypammina grahemsis Harlton

(Continued on page 54)

	Depth	Formation
UPPER GLENN	2941-43	Buff fine text. ss. (saturated with oil)
	2943-64	Buff cherty ls. with shale and ss.
	2964-73	Buff ss. with shale
		Cribrostomum jeffersonensis Harlton
		Tuberitine bulbacea Galloway and Harlton
		Healdia sp. (broken)
	3000-05	Buff very fine text. ss.
	3029-3072	Buff ss. with ls. and shale
		Rhombopora lepidodendroidae Meek
		Crinoids
		Tolypammina grahamensis Harlton
		Climacammina gracilis Moller
		Ammodiscus sp.

[Still drilling in upper Glenn (Deese) near base.]

Log of Amerada Pet. Corp., Hanson No. 1.

Sec. 12, T. 1 S., R. 4 W.

	Depth	Formation
WICHITA	20-69	Grey impure limestone
		Bairdia n. sp.
		Jonesina arcuata (Bean)
		Rhombopora lepidodendroidae Meek
		Fenestella sp.
	1314½-15½	Buff fine grained pyrit. shale
	1329-63	Buff fine text. ss.
	1363-68	Buff argill. ss.
	1368-76½	Buff ss. with shale
	1376½-84	Buff pure ang. ss.
	1384-1401	Buff pyrit. shaly ss.
	1401-08	Red shale with ls. and ss.
	1408-10	Green glauconitic shale
	1410-12	Green shale with ss.
	1412-21	Grey argill. ss.
	1421-23	Buff pure ang. ss.
	1423-23.9	Do. with gray shale
	1425-65	Buff fine text. ss.
	1465-85	Buff ss. with shale
	1485-92	Do. with shale and ls.
	1500-1624½	Buff pyrit. ss. (This sandstone gradually grades into the Pontotoc series).
PONTOTOC	1624½-27	Do. with coarse quartz pebbles
	1627-34	Buff fine text. ss.
	1634-50	Do. with quartz pebbles, chert, and shale
	1650-1709	Conglomerate
UPPER GLENN	1709-21	Green argill. ss.
		Amphissites centromata U. & B.
		A. dattonensis Harlton
		Rhombopora lepidodendroidae Meek
		Orobias texana Harlton
		O. bassleri Galloway and Harlton
	1721-47	Grey argill. ss. with chert
		Staffella texana Harlton
		Tolypammina grahamensis Harlton
		Crinoids

(Continued on page 55)

	Depth	Formation
UPPER GLENN	1747½-52	Grey fine grained shale with ls. and chert
	1752-58	Buff fine grained ls.
		Fusulina secalica Say
		F. bocki Moller
	1748-93	Buff. ss. with shale and ls. and chert, some green shale partings
	1793-2010	Buff to grey fine grained ls.
		Bradyina holdenvillensis Harlton
		Globivalvulina gaptankensis Harlton
		Cornuspira harltoni Cushman and Waters
		Climacammina antiqua Brady
		Endothyra involuta Galloway and Harlton
		Fusulina cylindrica Fischer
		Tuberitina bulbacea Galloway and Harlton
		Hollina granifera Ulrich
		Amphissites dattonensis Harlton
		Bairdia subelongata Jones and Kirkby
		Fusulina secalica Say
	2010-41	Do. with interbedded shale
		Fusulina secalica Say
		Rhombopora lepidodendroidae Meek
	2041-47	Buff crinoidal ls.
		Fusulina secalica Say
		Fusulina cylindrica Fischer
	2047-69	Buff crinoidal ls. with few shale cavings
		Fenestella sp.
		Fusulina bocki Moller
		Bradyina holdenvillensis Harlton
		Rhombopora lepidodendroidae Meek
	2069-87	Buff crinoidal ls. with abundant concretions
	2087-90	Buff fine text. ss.
	2090-93	Buff siliceous crinoidal ls.
	2097-98	Buff fine text. ss.
	2098-2560	Missing
	2560	Buff ss. with few shale partings
		Very abundant Ammodiscus and Crinoids
		Calcitornella tuberculata Galloway and Harlton
	2677-85	Buff fine text. ss.
	2853-59	Do. with shale partings
		Healdia boggyensis ? Harlton
	2931	Brown ss. (saturated with oil)
	2941	Grey argillaceous ls.

STRUCTURE

The structure contoured on the Glenn is an anticlinal fold with a maximum closure of more than 1,200 feet, with a northwest-southeast trend typical of the southern Oklahoma fields. The anticline is modified by nosings on the flanks and by rapid changes in the amount of dip.

In the northwest part of the field there is a dip along the southwest flank which amounts to as much as 520 feet between locations. At the base of this steep dip some of the best wells in the field have been brought in. The contours of the structure map (Plate III) are drawn on a datum approximately 535 feet below the top of the first sand zone.

PRODUCTION

The highest single initial production in the field was 2,973 barrels. The average initial production has been about 280 barrels. Decline curves on a number of the wells in the field show an expected ultimate yield of 6,000 barrels per acre for some of the smaller wells to 18,000 barrels for some of its better wells. The average decline is very slow.

Log of Schermerhorn-Ardmore Co. No. 1 Lyles.

NW.¼ SE.¼ NW.¼ sec. 11, T. 2 S., R. W. Completed June 26, 1926.

		Formation	Top	Bottom
		hard sand	0	27
		red bed	27	90
		bro. sand & lime rock	90	185
		strks of sand & red bed	185	245
		red bed	245	375
		strks. of sand red bed	375	470
		hard sand, sand rock, streak red bed	470	530
		red bed	530	720
		red bed & sand rock	720	780
		hard sand	780	800
		red bed	800	890
		sand hard	890	910
		red bed	910	960
		hard sand	960	970
		sticky red bed	970	1070
		red bed	1070	1120
		hard sand	1120	1135
		red bed	1135	1202
		lime shell	1202	1205
		broken lime	1205	1209
		stky. shale & lime shs.	1209	1298
		red bed strks. of shale	1298	1350
		hard sand	1350	1375
		blue shale	1375	1428
		sticky shale	1428	1470
		hard sand	1470	1490
		lime	1490	1495
		lime	1495	1497
		sticky shale	1497	1530
		lime shells	1530	1532
		stick shale	1532	1570
		shale & shells	1570	1590
		lime	1590	1615
		sticky shale lime shells	1615	1652
		broken lime	1652	1672
		shale & hard sand	1672	1703
		hard lime & sand	1703	1705
		lime & strks. of sand	1705	1730
		sticky shale & lime	1730	1752
		broken lime	1752	1800
		stky. shale & lime shs.	1800	1830
		broken lime	1830	1868
		broken lime & shale	1868	1900
		sticky shale & shells	1900	1913
		broken lime	1913	1962
		blue shale	1962	2000
		sticky shale	2000	2117
		grey sand	2117	2121
		sticky shale	2121	2170
		hard sand	2170	2173
		hard shale	2173	2187
		hard shale	2187	2190
		broken lime	2190	2200
		sticky shale	2200	2240
		hard shale	2240	2244
		shale & shells	2244	2253
FIRST SAND ZONE	Sand 1 (No Pay)	sand lime oil sand	2253	2258
FIRST SAND ZONE	Sand 1 (No Pay)	broken lime hard	2258	2270
FIRST SAND ZONE	Sand 1 (No Pay)	hard shale	2270	2281
FIRST SAND ZONE	Sand 1 (No Pay)	sandy lime	2281	2289
FIRST SAND ZONE	Sand 1 (No Pay)	sticky shale	2289	2293
FIRST SAND ZONE	Sand 1 (No Pay)	hard sand	2293	2305
		lime	2305	2311
		hard shale	2311	2320
		sticky shale	2320	2347
		broken lime	2347	2350

(Continued on page 57)

		Formation	Top	Bottom
		hard sandy shale	2350	2364
		hard shale	2364	2370
		sticky shale	2370	2400
		sandy shale	2400	2415
		sticky shale	2415	2439
		tuff gumbo	2439	2445
		gumbo	2445	2450
		sticky shale	2450	2480
		sandy shale	2480	2500
		hard shale	2500	2508
		blue shale	2508	2570
		sticky shale	2570	2606
SECOND SAND ZONE	Sand 3 (No. Pay)	lime sandy	2606	2609
SECOND SAND ZONE	Sand 3 (No. Pay)	hard sandy lime	2609	2615
SECOND SAND ZONE	Sand 3 (No. Pay)	light brown sand	2615	2619
SECOND SAND ZONE	Sand 3 (No. Pay)	sandy shale	2619	2625
SECOND SAND ZONE	Sand 3 (No. Pay)	sandy lime	2625	2630
SECOND SAND ZONE	Sand 3 (No. Pay)	hard sand	2630	2635
SECOND SAND ZONE		sand & shale	2635	2640
SECOND SAND ZONE		blue shale	2640	2657
SECOND SAND ZONE		sandy shale	2657	2663
SECOND SAND ZONE		gumbo	2663	2670
SECOND SAND ZONE		brown & blue shale	2670	2690
SECOND SAND ZONE		sticky shale	2690	2700
SECOND SAND ZONE		sandy shale	2700	2710
SECOND SAND ZONE		hard sandy lime	2710	2712
SECOND SAND ZONE		sandy lime	2712	2714
SECOND SAND ZONE		brown sand	2714	2717
SECOND SAND ZONE		gray sand	2717	2726
SECOND SAND ZONE		sticky shale	2726	2731
SECOND SAND ZONE		sandy lime	2731	2746
SECOND SAND ZONE		sticky shale	2746	2765
SECOND SAND ZONE	Sand 6 (No Pay)	sandy lime	2765	2770
SECOND SAND ZONE	Sand 6 (No Pay)	pink shale	2270	2773
SECOND SAND ZONE	Sand 6 (No Pay)	broken oil sand	2773	2777
SECOND SAND ZONE	Sand 6 (No Pay)	hard sandy lime	2777	2779
SECOND SAND ZONE	Sand 6 (No Pay)	sandy lime show gas	2779	2781
SECOND SAND ZONE		sandy shale	2781	2788
		blue shale	2788	2795
		sandy shale	2795	2810
		sticky shale sdy shale	2810	2822
		lime shells	2822	2833
		sandy shale	2833	2838
		blue shale	2838	2906
		sandy shale	2906	2914
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	sandy shale oil sand	2914	2916
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	broken oil sand	2916	2926
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	hard sh. & shells	2926	2932
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	broken oil sand	2932	2937
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	brown shale	2937	2945
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	lime shells	2945	2946
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	brn. and blue shale	2946	2951
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	bkn. oil sand	2951	2960
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	soft oil sand	2960	2965
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	hard lime	2965	2966
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	lime	2966	2969
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	hard shale	2969	2974
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	lime	2974	2976
THIRD SAND ZONE	Sand 8 (Main Pay, SE.½)	oil sand	2976	2997
THIRD SAND ZONE		blue shale	2997	3005
THIRD SAND ZONE		gumbo & gravel	3005	3014
THIRD SAND ZONE		gumbo & gravel	3014	3019
THIRD SAND ZONE		blue shale	3019	3030
THIRD SAND ZONE		hard shale	3030	3032
THIRD SAND ZONE		sticky shale	3032	3062
THIRD SAND ZONE	Sand 9	broken oil sand	3062	3066
THIRD SAND ZONE	Sand 9	blue shale	3066	3070
THIRD SAND ZONE	Sand 9	broken lime	3070	3075
THIRD SAND ZONE	Sand 9	lime	3075	3077
THIRD SAND ZONE	Sand 9	broken oil sand	3077	3079
THIRD SAND ZONE	Sand 9	broken oil sand	3079	3081
THIRD SAND ZONE	Sand 9	sticky shale	3081	3101
THIRD SAND ZONE	Sand 9	sandy shale	3101	3111
THIRD SAND ZONE	Sand 9	broken sand	3111	3117
THIRD SAND ZONE		blue shale	3117	3124
THIRD SAND ZONE		sandy shale	3124	3132
THIRD SAND ZONE		hard shale	3132	3165
THIRD SAND ZONE	Sand 10	broken oil oil sand	3165	3168
THIRD SAND ZONE	Sand 10	blue shale	3168	3175
THIRD SAND ZONE	Sand 10	sticky shale	3175	3183
THIRD SAND ZONE	Sand 10	oil sand	3183	3185
THIRD SAND ZONE	Sand 10	broken oil sand	3185	3189
		blue shale	3189	3215
		hard shale	3215	3225
		blue brown shale	3225	3245

(Continued on page 58)

	Formation	Top	Bottom
	blue & brown shale	3245	3260
	sandy shale	3260	3275
	hard shale	3275	3292
	sticky shale	3292	3300
	hard shale	3300	3311
	sticky shale	3311	3319
	hard shale	3319	3345
	blue shale	3345	3358
	broken lime	3358	3360
	hard shale	3360	3374
	blue shale	3374	3393
	hard shale	3393	3400
	blue brown shale	3400	3405
	hard shale	3405	3413
	blue shale	3413	3427
	sticky shale bldrs.	3427	3445
	blue shale & shells	3445	3466
	blue & sticky shale	3466	3491
	sticky shale	3491	3493
	broken lime	3493	3496
	blue shale	3496	3505
FOURTH SAND ZONE; Sand 14	broken oil sand	3505	3512
	oil sand	3512	3514
	shell, lime	3514	3515
	lime	3515	3517
	hard shale	3517	3529
	hard lime	3529	3530
	lime	3530	3533
	broken oil sand	3533	3538
	lime shells	3538	3539
	hard shale & lime	3539	3548
	blue shale	3548	3562
	lime	3562	3563
	strks. bro. oil sand	3563	3564
	blue shale & shells	3564	3574
	blue shale streaks of oil sand	3574	3582
	lime	3582	3584
	sticky shale	3584	3588
	blue shale	3588	3592
	hard shale	3592	3618
	lime	3618	3620
	blue shale	3620	3620
	broken oil sand	3626	3628
	blue shale streaks of oil and gas sand	3628	3632
FOURTH SAND ZONE	blue shale	3632	3648
Sand 16	Oil sand & str. bl. sh.	3648	3656
	broken oil sand	3666	3672
	sticky shale	3672	3677
	blue shale	3677	3683
	sandy shale & bro. oil s.	3683	3692
	sandy shale & broken oil sand	3692	3699
	blue & brown shale	3699	3711
	hard shale	3711	3714
	blue shale	3714	3720
	hard shale	3720	3724
	blue shale with streaks of oil sand	3724	3739
	sandy shale streaks of oil sand	3739	3748
	sticky shale oil sand	3748	3752
	blue shale & broken oil sand	3752	3765
	hard shale	3765	3770
	TOTAL DEPTH		3770

Minor Pools

BAYOU

The Bayou pool is often called the Hewitt southeast extension, although a gap of condemned territory over half a mile in width intervenes between the two. Its production is usually included with that of Hewitt in news reports. The Bayou area produces from part of the same series of Pennsylvanian sands as the Hewitt pool, but finds them at greater depth and much less prolific in yield. Its per acre yield (nearly 11,000 bbls.) is somewhat greater than that of the other fields

of the county excepting Healdton and Hewitt, but this may be credited to the fact of closer drilling in the Bayou than at Graham or Sholom Alechem, for example.

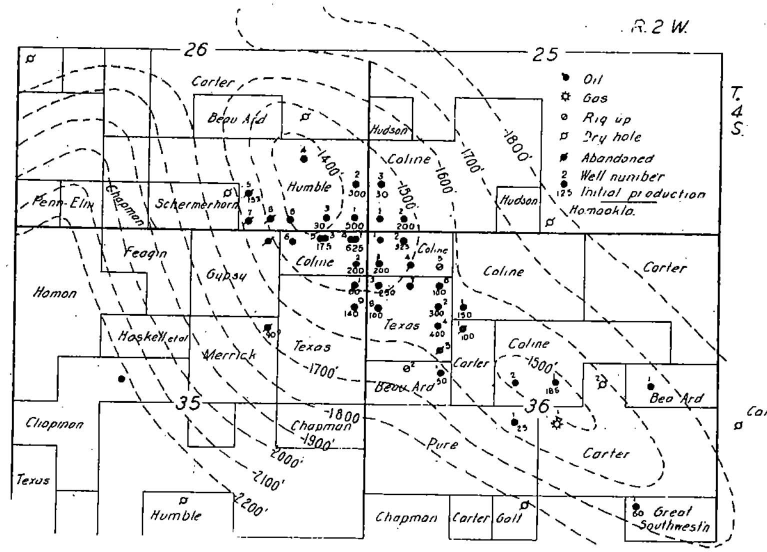


Figure 10. Structure map of Bayou pool.

This little pool owes its existence to a minor closure along the Hewitt anticlinal axis southeast of the main pool and at a lower structural level. From 200 to 700 feet of red beds cover the surface. The anticlinal crest indicated in the surface beds is one-fourth mile or more to the southwest of that in the Pennsylvanian producing section. There are two chief sands, at average depths of 2,300 and 2,850 feet, respectively. The upper one carries gas on the crest of the fold. One isolated well one-half mile southwest of this pool produces from sands found at 3,600 to 3,900 feet. No rocks older than Pennsylvanian have been reached. Dips in the producing sands average 8 or 10 degrees, but attain a maximum of 23 degrees.

The discovery well, No. 1 Harts, was drilled by the Coline Oil Co., in 1921, in the SW. cor. sec. 25, T. 4 S., R. 2 W. Practically no drilling has been done in this pool since 1923.

Log of Humble Oil & Refg. Co., No. 1, Gill.

SE.¼ SE.¼ SE.¼ SE.¼ sec. 26, T. 4 S., R. 2 W. Completed May 12, 1921.

Formation	Top	Bottom
Sand	0	210
hard sandy shale	210	576
hard sand rock	576	629
sandy shale	629	679
lime	679	680
sand	680	721
blue shale	721	813
gumbo	813	829
lime rock	829	831
gumbo	831	894
shale & gumbo	894	945
rock	945	964
gumbo & shale	964	1070
rock	1070	1077
gumbo	1077	1098
blue shale	1098	1173
lime	1173	1202
sand	1202	1206
gumbo	1206	1217
hard sandy shale	1217	1335
gumbo	1335	1466
sand	1466	1470
gumbo	1470	1497
hard shale	1497	1521
sand rock	1521	1529
rock	1529	1530
lime	1530	1548
blue shale	1548	1590
gumbo	1590	1610
blue shale	1610	1650
gumbo	1650	1703
rock	1703	1705
hard sand	1705	1775
gumbo	1775	1794
rock	1794	1814
blue shale	1814	1916
gumbo	1916	1926
blue sandy shale	1926	1998
gumbo	1998	2012
blue sandy shale	2012	2086
gumbo bldrs. & shale	2086	2173
hard sand	2173	2213
hard shale	2213	2216
blue shale	2216	2264
trace oil sand	2264	2267
blue shale	2267	2278
oil sand T. D.	2278	2811

WILDCAT JIM

This pool takes its name from the efforts at discovery made by the Wildcat Jim Oil Co., in 1915-17 in the SW.¼ sec. 18, T. 2 S., R. 2 W., where two small wells (later abandoned) of heavy black oil were completed in a sand near the base of the red beds, about 1,660 feet deep. The Coline Oil Co., in 1916 obtained a 70 barrel well (No. 1 Pierce) of 22 gravity oil in a Pennsylvanian sand at 2,600 feet one-half mile farther north, in section 7. These early wells offered so little promise that only about one additional well a year was drilled until 1925, when some better results and good market prospects caused a pipeline outlet to be provided, and a spurt of drilling followed. In 1926 several excellent wells were completed in the SE.¼ sec. 7, T. 2 S., R. 2 W., but only three or four wells have been drilled since that year.

The field is not yet sufficiently well defined to make possible an adequate description of its structure. Anticlinal closure is doubtful. Its present limits are determined in part by the fact that the edge wells are too small to encourage further drilling, although dry holes limit the pool in some directions. Dips in the chief producing sands average 10 degrees or less. Production comes from much the same section of the Pennsylvanian system as in the Sholom Alechem field, plus the

sand at the base of the red beds, which is probably in the Pontotoc series and yields heavier oil than the deeper sands. The field does not promise to average more than 3,000 barrels of oil per acre, though some tracts will do considerably better than that.

Log of Roxana Petro. Corp., No. 3, E. Kauffman.

NE.¼ SE.¼ SE.¼ sec. 7, T. 2 S., R. 2 W. Completed April 8, 1926.

Formation	Top	Bottom
surface	0	5
red bed	5	45
sand	45	255
red bed, grav & sand	255	265
hard sand	265	270
sandy lime	270	273
broken sandy lime	273	279
sand	279	346
lime shells	346	349
sand	349	396
red bed & sand	396	445
sandy lime	445	450
red bed & sand	450	510
lime shells	510	511
sandy shale	511	558
sand	558	583
sandy lime	583	589
sand	589	594
sandy lime	594	595
sandy shale	595	605
sand	605	628
sand & hard shells	628	650
broken sandy lime	650	690
blue shale	690	720
sandy shale	720	745
hard sand	745	758
shale & gyp.	758	770
red bed & sand	770	887
lime	887	893
shale	893	930
hard sand	930	947
shale	947	992
red bed, bldrs & s.	992	1013
shale	1013	1043
broken lime	1043	1050
shale	1050	1075
broken lime	1075	1083
gumbo	1083	1100
red bed	1100	1175
broken lime	1175	1181
shale	1181	1243
hard sand	1243	1248
shale	1248	1260
red b. boulders & s.	1260	1270
broken lime & sand	1270	1290
broken lime	1290	1296
red bed	1296	1322
lime	1322	1334
r. b. grav. & ls. shells	1334	1356
broken lime	1356	1368
lime	1368	1380
red bed	1380	1384
shale & brkn oil s.	1747	1759
shale	1759	1880
lime shells	1880	1881
shale	1881	1883
gumbo & boulders	1883	1898
sticky shale	1898	1965
lime shells	1965	1966
shale	1966	2008
gas sand	2008	2010
broken sand & shale	2010	2020
lime shells	2020	2025
shale	2025	2030
sandy shale	2030	2065
shale	2065	2100
red mud	2100	2120
shale	2120	2165
sandy shale	2165	2170
shale	2170	2315
lime	2315	2320
broken sand	2320	2335
sandy shale & ls. sh.	2335	2345
hard sand	2345	2355
shale	2355	2460
oil sand	2460	2495
total depth	2495	
broken lime	1384	1399
shale	1399	1443
sandy shale	1443	1453
broken lime	1453	1464
shale	1464	1476
broken lime	1476	1482

(Continued on page 62)

Formation	Top	Bottom	Formation	Top	Bottom
sticky shale	1482	1496	lime	1625	1626
shale & lime shells	1496	1525	shale	1626	1642
broken lime	1525	1541	lime	1642	1653
shale	1541	1586	shale	1653	1655
gumbo	1586	1594	lime	1655	1669
lime	1594	1600	shale & brkn oil s.	1669	1672
shale	1600	1621	shale	1672	1746
broken lime	1621	1625	lime shells	1746	1747

WHEELER

H. B. Goodrich, a pioneer among petroleum geologists in Oklahoma, is credited with the discovery of this first oil pool to be opened south of the Arbuckle Mountains in the State. His attention was attracted to the area by an accumulation of asphalt which had seeped from an

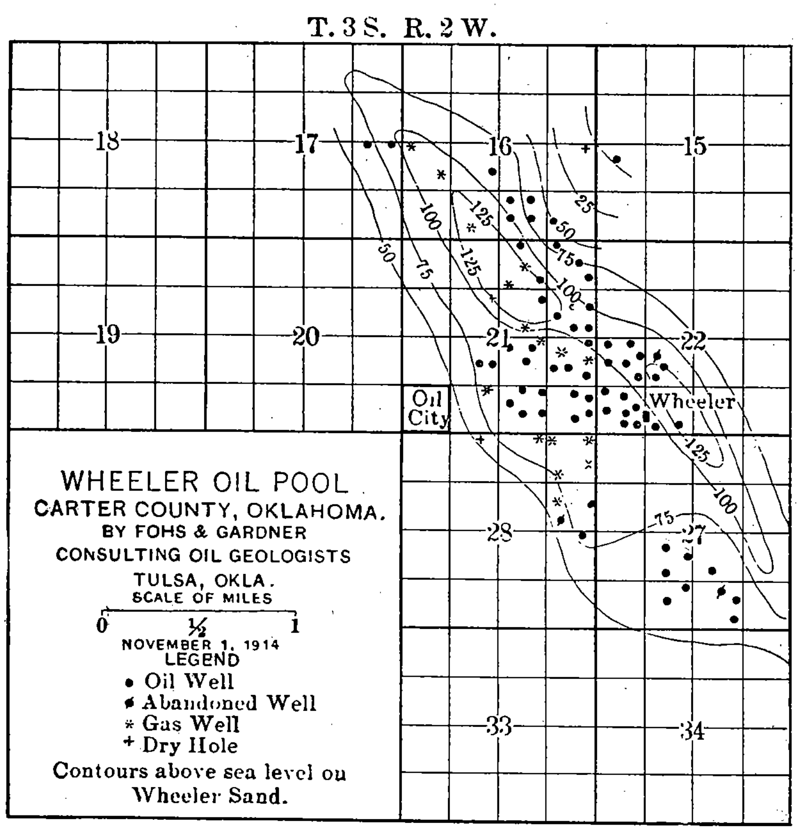


Figure 11. Reproduced from Economic Geology, vol. 10, fig. 5, 1915

outcropping sand in the post-Pontotoc (Cisco ?) red beds near the SE. cor. sec. 21, T. 3 S., R. 2 W. This evidence was reinforced by the presence of an anticline in the surface rocks (see map, Fig 11, reproduced from Fohs and Gardner.[42])

All of southern Indian Territory, and the red beds region in particular, had been regarded with so much disfavor by the oil industry up to that time that extra courage was demanded for this venture. The discovery well was drilled by the Coline Oil Co. in 1904. According to Gardner[43] and Fohs[44], the surface rocks show about 125 feet of reverse dip toward the Arbuckle Mountains. Two gas sands were found, at about 230 and about 600 feet, respectively, and an oil sand in the base of the red beds at about 1,000 feet. The latter is described as varying from fine sand to coarse gravel. The oil is heavy (17 to 23 degrees) and black. Two or three deep wells in section 21 penetrated the marine Pennsylvanian (one of them to 3,900 feet) without success.

A pipeline was built to provide Ardmore with its first supply of gas, but there has never been a regular pipeline outlet for the oil. Most of the field is operated by the Coline Oil Co. Two or three minor operators sell their production for fuel oil, delivering it by tank-wagon to various parts of the county. The area of the field probably could be extended somewhat if production of this type should become profitable.

TATUMS

In January, 1927, the Magnolia Petroleum Company surprised the oil fraternity of southern Oklahoma by completing as producing oil wells, within a week of each other, two rank wildcat tests only six miles apart. One was No. 1 Burr, in sec. 31, T. 1 N., R. 3 W., in the southwest corner of Garvin County near the village of Tussy, and the other was No. 1 Pollock in sec. 14, T. 1 S., R. 3 W., discovery well of the Tatums pool. Neither well was large enough to insure profitable returns on additional drilling, which has therefore proceeded no faster than offset requirements compelled. However, the Tatums pool soon yielded some better producers, and has now (June, 1928) built up a production exceeding 1,500 barrels per day. Enough drilling has been done to prove the presence of an anticline. The productive sands apparently correlate satisfactorily with a portion of the oil-bearing sequence in the neighboring Sholom Alechem field, and are probably in the Dornick Hills formation. Red beds are 1,000 to 1,500 feet deep. Drilling is relatively easy, and rotary tools land casing on the 2,200 foot sand in 20 days or less, and complete 2,600 foot wells in less than 30 days.

42. Gardner, James H.. The oil pools of southern Oklahoma and northern Texas: Econ. Geol., vol. 10, Fig. 59, 1915.
43. Gardner, James H., Op. cit., pp. 429-430.
44. Fohs, F. Julius, quoted by Gardner, loc. cit.

COX

Discovery of this pool must be credited to the sales ability of Edwin B. Cox of Ardmore, chief landowner in the pool, and to the persistent wildcatting policy of the Magnolia Petroleum Company in southern Oklahoma. Oil is found in Pennsylvanian sands from 1,000 to 1,400 feet deep, just under the red beds. The field is not defined at either end by dry holes, but by wells too small to be profitable on the present market. Definite anticlinal closure cannot yet be proved to exist here, and the pool may owe its accumulation to a small terrace or nose, aided by the unconformity at the base of the red beds, truncating the productive sands below.

Log of Magnolia Petro. Co., No. 2, May Cox.
NE.¼ NE ¼ SE.¼ sec. 16, T. 2 S., R. 2 W. Completed June 19, 1926.

Formation	Top	Bottom	Formation	Top	Bottom
sand lime	0	6	shale	570	600
sand rock	6	15	red mud	600	610
red rock	15	98	sandy shale	610	635
water sand	98	103	blue mud	635	652
red rock	103	108	lime	652	672
blue mud	108	120	sand	672	680
red rock	120	145	blue mud	680	700
water sand	145	160	sand	700	710
red rock	160	170	blue mud	710	745
red gumbo	170	180	sandy shale	745	760
red mud	180	195	red gumbo	760	770
red rock	195	223	blue mud	770	820
red mud	223	284	red mud	820	835
sand	284	292	blue shale	835	892
blue mud	292	300	red mud	892	960
red gumbo	300	305	hard lime shell	960	967
blue mud	305	350	red mud	967	1012
water sand	350	392	broken sand	1012	1038
blue mud	392	415	show of oil		
sand	415	440	blue slate	1038	1060
blue mud	440	460	sandy shale	1060	1070
red mud	460	465	blue slate	1070	1192
blue mud	465	490	lime shell	1192	1195
sandy shale	490	508	blue slate	1195	1208
sand	508	518	broken sand	1208	1211
lime shell	518	523	broken oil sand	1211	1268
red mud	523	550	shale	1268	1270
water sand	550	563	pay sand		
lime	563	570	Total depth	1270	

ROUNDUP

This little pool was opened in 1926 by F. W. Merrick of Ardmore. Except for very steep dips in the Pennsylvanian pay sands it is very similar in character to the Cox pool a mile farther northwest, and the two areas may really be parts of the same pool. The Roundup pool is partially defined to the southeast and west. Extension in any direction must await better market conditions, although there is a pipeline outlet.

BLUE RIBBON

Shortly after the opening of the Wheeler pool (in 1904), a well drilled by the American Industrial Development Co., in sec. 19, T. 4 S., R. 1 W., near Blue Ribbon School, some 7 miles southeast of Wheeler, encountered favorable showings at shallow depth. In 1925 McCrory Brothers of Ardmore completed two wells near this old test, obtaining initial production of 10 to 15 barrels per day from a sand in the red beds at a depth of 700 feet. The Oklahoma Pipe Line Co. gave them a connection. One or more adjacent failures have since been drilled, but the two producers are still making oil—somewhat less than 10 barrels a day.

SOPASCO

This little enterprise, abandoned for the present at least, comprised three small asphalt wells which were drilled through the gently-dipping Pontotoc series and obtained their production from nearly vertical older Pennsylvanian sands below, at depths from 165 to 480 feet. The output was used for a short time in the manufacture of paint by the Southwestern Paint and Asphalt Co., of Ardmore, which drilled the wells.

HOMER

Some 70 shallow wells have been drilled in the Homer area, of which all but 15 have had showings or small production of oil or gas, at depths ranging from 40 to 350 feet. There are said to be about 15 wells now in shape to produce, with a combined capacity of 30 or 40 barrels per day. The property of J. P. Hivick is being produced, although there is no regular market for the oil. It is a heavy green crude, reported to be unusually high in lubricants. No pipeline outlet has ever been provided for this pool, but at times in the 12 years since its discovery some of the oil has been hauled to Davis by tank trucks and shipped thence by rail.

The oil is found in the Pontotoc series, in and just below the Hart limestone member, which outcrops close to the field and has its maximum thickness in this vicinity. There is no anticlinal closure, but the pool occurs on the flank of a broad nose plunging gently away from the west end of the Arbuckle Mountains.

BROCK (CRINERVILLE)

By

Sidney Powers[45]

LOCATION

Crinerville oil field, named from a school house is 2 miles southeast of Brock and 7 miles southwest of Ardmore. The field extends southeast from the C. S. L. SW.¼ sec. 17, through the E.½ sec. 20 and the E.½ sec. 28, the cen. sec. 32, T. 5 S., R. 1 E. By July, 1927, 5½ years after the discovery, 139 oil wells (7 now abandoned), 3 gas wells (2 now abandoned), and 46 dry holes had been drilled. The depth of production ranged from 845 to 2,200 feet. The initial production averaged about 50 barrels, and the settled production, 15 barrels.

This field is located 15 miles southeast of the southeastern end of Healdton and 10 miles southeast of the southeastern extension of Hewitt. It lies in a belt parallel to the Criner Hills and at a distance ranging from one-quarter to three-quarters of a mile from their southwestern flank. It is 15 miles south of the Arbuckle Mountains.

GEOLOGY

Geologic History. Within the Arbuckle Mountains there are exposed pre-Cambrian granites and the well-known section of Paleozoic sedimentary rocks extending upward through the Caney shales of Mississippian age and through part of the Glenn and other formations of Pennsylvanian age. The most important group of rocks is that of the Ordovician limestones. Structural conformity marks the entire pre-Pennsylvanian section when considered as a whole, but there is an unconformity above the Hunton group (Devonian at the top) which marks undulating folding of the entire region. This folding is known best on the north flank of the Arbuckle Mountains, at Seminole and other oil fields.

Fragments of the formations in the Arbuckle Mountains, from the Arbuckle at the base through to the Sycamore limestone at the top, are exposed in the Criner Hills, the older rocks generally speaking, being on the southwest side. Faulting has masked the relationship of different formations, but structural conformity is supposed to exist to the top of the Woodford.

On the west side of the Criner Hills, the wells at Crinerville start in the Hoxbar formation and find Ordovician limestones below, with an intervening wedge of the Deese formation which thickens southwestward from the axis of the anticline. Cuttings from wells show

45. Consulting geologist, Amerada Petroleum Corporation, Box 2022, Tulsa, Oklahoma. Original article revised and condensed by C. W. Tomlinson from the Bull. Am. Assoc. Pet. Geol. vol. II, pp. 1067-1085, 1927. Illustrations used through courtesy of the Am. Assoc. Pet. Geol.

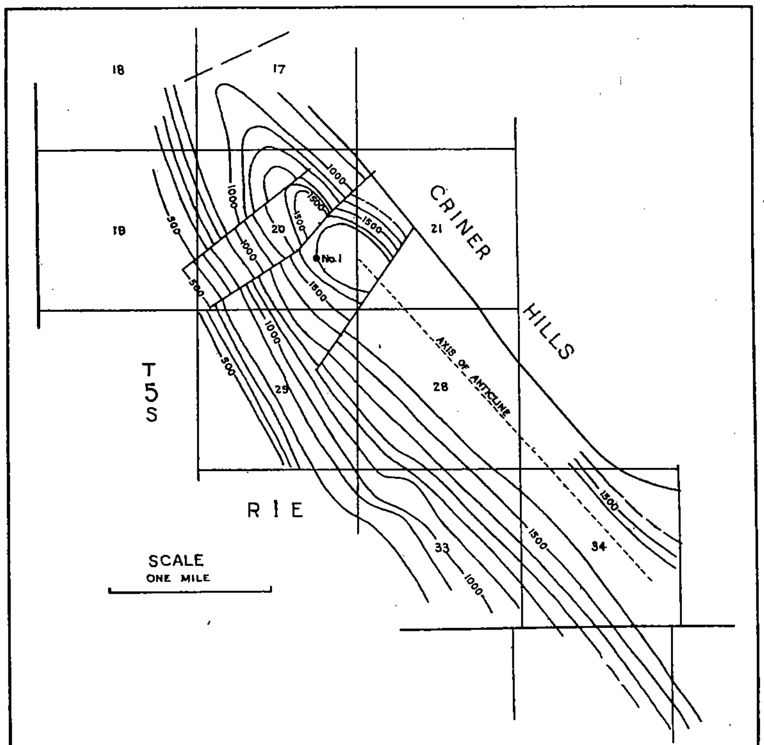
that the buried Ordovician rocks are Arbuckle on the east, but both the Simpson formation and Viola limestone may occur under the field. This unconformity proves that the folding and faulting of the ancestral Criner Hills took place after the deposition of the Springer formation and before the deposition of the Deese formation. The writer believes that the uplift is a part of the ancestral Wichita Mountains, and that these mountains were once continuous as far southeast as Gainesville, Texas, but that granite was exposed in a few places in the portion now concealed by Permian and late Pennsylvanian rocks.

Coarse conglomerates in and directly beneath the Otterville limestone and in higher members of the Dornick Hills formation on the east side of the Criner Hills, fix the time of the uplift of the ancestral Criner Hills and Wichita Mountains. The pebbles are largely of Ordovician limestone; there are none of granite because whatever granites were exposed in the Wichitas were too far distant. It is evident that these conglomerates came from the nearby ancestral Criner Hills and the area to the west—the Wichita Mountains. Finally this region was leveled and submerged by the upper Deese. Conglomerates have not been found at the unconformity under Crinerville on the west side of the Hills.

Both the northern Arbuckles and the Wichitas were folded early in the Pennsylvanian. Refolding and faulting occurred several times during the Pennsylvanian and at the close of this period. The ancestral Criner Hills were faulted again late in the Pennsylvanian. These faults on the west and north sides of the present hills were normal with a downthrow of at least 1,000 feet on the west and north. After this faulting, compression, which squeezed the plastic Pennsylvanian shales against the resistant block of limestone and made the anticlinal fold seen at the surface at Crinerville. This folding probably occurred at the time the Ardmore basin was compressed into long anticlines and synclines.

Sedimentation recommenced before the Permian. The Pontotoc arkoses and conglomerates were deposited late in the Pennsylvanian on the flanks of the Arbuckles and on the northeastern flank of the Wichitas, the ancestral Healdton, Hewitt, and Criner Hills. Still later Pennsylvanian or early Permian red beds overlie the Pontotoc. Another uplift folded the red beds into gentle flexures, and some of the anticlines of this generation overlie the older ones. The folds in the red beds cannot be mapped with satisfaction because of cross-bedding and scarcity of exposures. These sandstones and shales covered an area of considerable relief in which the hills were anticlines. It seems remarkable that these hills are not reflected more distinctly because there are only about 300 feet of red beds under Healdton, and 2,400 feet under an area 3 miles north of this field.

Trinity sand, of Lower Cretaceous age, was deposited throughout most of southern Oklahoma, and probably on the Criner Hills. The character of folding of the Cretaceous is indicated in the Preston anticline of Marshall County, yet the Cretaceous beds do not reflect folding in the older rocks in Cooke County, Texas.



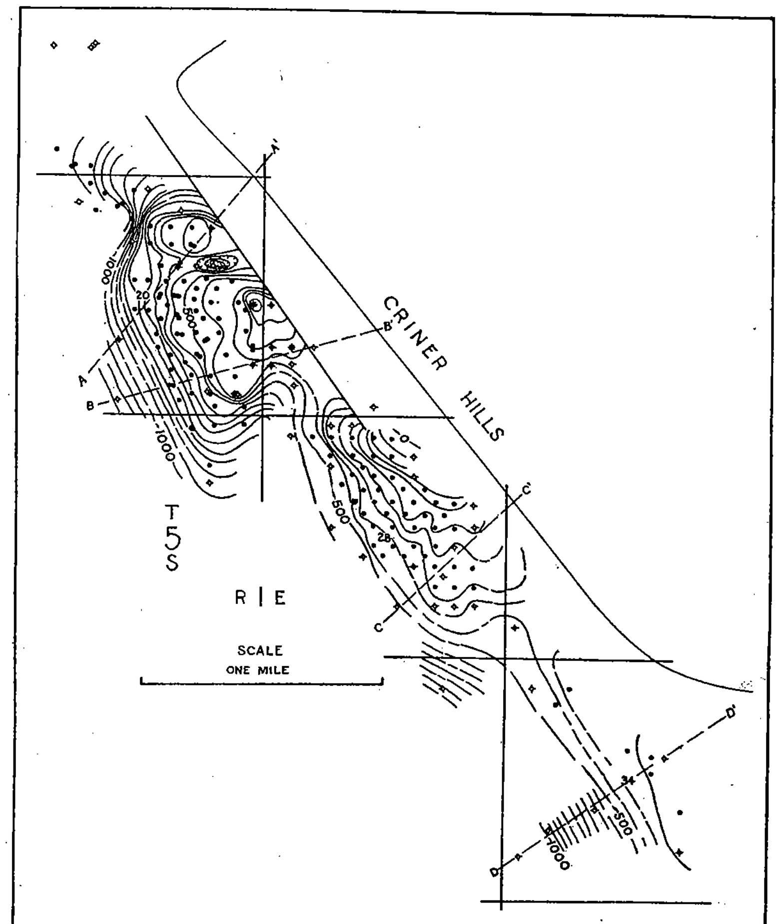
(Illustration through courtesy of American Association of Petroleum Geologists)

Figure 12. Structure contours, above sea level, of the surface geology, Brock (Crinerville) anticline. Contour interval, 100 feet. Datum, sea level. Location of the discovery well is shown.

Later uplift has elevated the peneplain of the Arbuckles and the antecedent Washita River. Still later uplift has elevated the lower peneplain of the softer rocks. It is difficult to connect the anticlinal hills of Healdton, Hewitt, Velma, and other fields with differential uplift in post-Cretaceous time because most of the anticlines in the Mid-Continent region have been hills at several times since the Ordovician.

STRUCTURE

Surface Structure. The axis of the Crinerville fold extends northwest and southeast, but it might be termed a "geological accident" because of its superposition on truncated Ordovician limestones and its faulted relationship to the present Criner Hills with downthrown beds dipping steeply toward a normal fault, and also because the fold dies out at a shallow depth.



(Illustration through courtesy of American Association of Petroleum Geologists)

Figure 13. Structure contours of the Brock (Crinerville) oil field, below sea level, on the "second" oil sand. Contour interval, 50 feet. Location shown of sections D-D of Figure 15. The anticline at the surface cannot be recognized at this horizon, depth 900-1,800 feet.

The surface structure contour map of the anticline (Fig. 12) is based on planetable mapping of limestone outcrops. In order to confirm the presence of a northeast dip where there are no exposures, several excavations were made in the Pennsylvanian shales at the faulted contact with the Criner Hills, and two lines of shallow holes were drilled across the axis of the anticline. Instead of drag dips, steep northeast dips were found in the shales at the fault plane.

The anticline is a symmetrical fold which starts in sec. 2, T. 6 S., R. 1 E., as a nose cut off on the south by a fault against the Criner Hills. The axis runs parallel to the fault at the west side of the Criner Hills as far as the center of the west line of sec. 17, T. 5 S., R. 1 E., where it is cut off by a fault. North of this point the limestones bend broadly around the Criner Hills and do not seem to be affected by the Crinerville fold. The length of the fold is 4 miles.

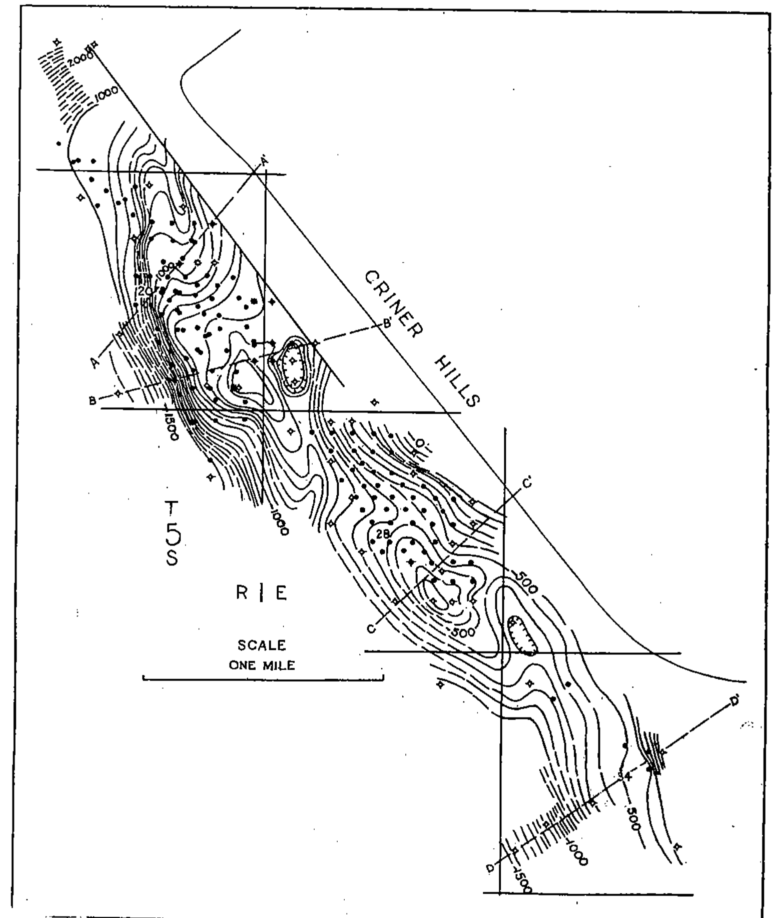
Closure was not found along the anticlinal axis, though there is almost a closure in the southeast corner of section 20. In section 34 the axis plunges more steeply northwest and older beds occur at the surface.

Faulting is very common at the surface, but minor faults die out at a shallow depth.

Subsurface Structure. The structure on the second oil sand is shown in Figure 13. There is a general southwesterly dip, with high areas in sections 20, 28, 34, and separated by synclines. The cross-faults at the surface (Fig. 12) are not clearly shown at this horizon, but those with the largest throw may extend to this depth. Another fault is shown in sections 21 and 17 parallel to the Criner Hills because the Ordovician was found in the easternmost well 400 feet higher than in the offset on the west in section 21. The correlations are too unsatisfactory to prove that this fault cuts the Pennsylvanian.

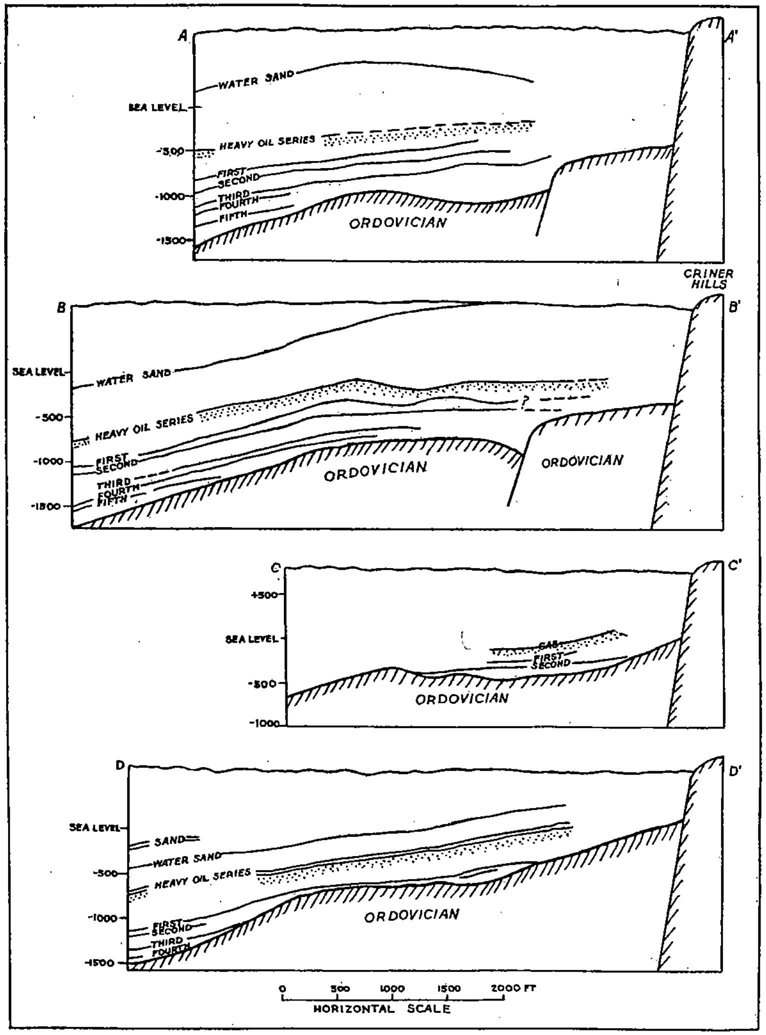
The eroded and folded surface of the Ordovician (Fig. 14) resembles the structure of the second sand, but the west slope is much steeper and there is a more pronounced flattening in the E.½ of section 20. The Pennsylvanian sands overlap this surface, and each has a separate short line against it. The highest, or first, sand has its shore line on the eastern edge of the field in sections 28 and 34. Low hills and valleys, with a local relief of 50 feet or less, have been found on the surface of the limestone, and some of the hills project above the pay sand in the SE. cor. section 20, the SE.¼ section 28, and cen. section 34 (Fig 13). The larger valleys underlie those shown on the second sand map. This relief is in places so local that both in section 28 and in section 20 a five-spot well in the center of a rectangle of producers 400 feet and 460 feet apart was a dry hole because the lime projected above the level of the sand.

The distribution and structure of the oil sands which rest against and on the Ordovician unconformity are determined by the configuration of this surface in upper Deese time. Explanation of the irregularities in the surface of the Ordovician is found in the lithology of the older rocks. The folding which made the anticline in the upper beds tilted all the rocks toward the southwest at an angle of about 10°.



(Illustration through courtesy of American Association of Petroleum Geologists)

Figure 14. Structure contours of the Brock (Crinerville) oil field on the eroded surface of the Ordovician, below sea-level, at a depth underground of 1,200-2,500 feet in the producing area. There is no hill on this eroded surface underlying the anticline at the surface. Oil was produced from the Ordovician in four wells surrounding the NE. cor SE.¼ SE.¼ section 20. Contour interval 50 feet.



(Illustration through courtesy of American Association of Petroleum Geologists)

Figure 15. Cross-sections of the Brock (Crinerville) oil field showing that the anticline disappears in the Pennsylvanian strata and that the eroded surface of the Ordovician is irregular. The subsidiary fault block west of the main Criner Hills fault was a topographic ridge during the deposition of the Pennsylvanian. Location of the sections shown on Figures 12 and 13. Length of section A-A', one mile, and depth, 2,500 feet. Vertical scale in feet.

FAULTING

The gently curved fault line which separates the Pennsylvanian and Ordovician at the surface slopes away from the Hills at an angle of about 70°. The sinuous plane in many places follows the strike of the steeply tilted limestones, and this fact makes the contact appear as though the Pennsylvanian shales had slid away from steep-sided limestone hills. Drilling has, however, proved a major fault with a drop of about 1,000 feet. The fault seems to turn at right angles in sec. 17 and to continue northeast; farther east it makes two more similar turns to encompass the north end of the hills, or else there are two sets of faults.[46] It is possible that at these corners short faults extend between the Pennsylvanian outcrops, and therefore cannot be found.

South of the oil field the major fault turns and extends north and south and cuts off the anticline in secs. 1 and 2, T. 6 S., R. 1 E. Still farther south the Pennsylvanian beds dip away from the fault at an angle of 15° and there is no anticline.

On the map of surface structure contours (Fig. 12) several cross-faults may be seen, each with a downthrow on the northwest. The maximum vertical displacement along the major faults is 250 feet. Innumerable small faults occur which cannot be shown except on a large-scale map, and many other faults probably exist in the area of no exposures. The major faults have their greatest displacement at the crest of the anticline, and most of the faults practically die out at a depth of about 900 feet. In these particulars they resemble the faults at Salt Creek, Wyoming.

Both the anticlinal and the minor faults disappear within 900 to 1,000 feet of the surface by flowage of the shale. It is clear that the anticline is not due to settling or compacting of the shales—one of the theories advanced to account for the anticlinal folds in northern Oklahoma. It was made by the same tangential compression which squeezed the Pennsylvanian sediments of the Ardmore basin into tightly folded long anticlines and synclines. Intensity of folding seems to increase upward, but this appearance may be due to buckling against the major fault plane. There are no drag dips in the Pennsylvanian at this fault, but instead there are steep dips toward the plane. The minor cross-faults may have been caused by this buckling.

RESERVOIR ROCKS

The reservoir rocks, with the exception of the Ordovician limestone in four wells which produced from this horizon, are thin fine-grained sands which feather out or merge into brown shale where they intersect the unconformable surface of the older limestone. The

46. C. W. Tomlinson believes that these contacts on the northern edge of the Criner Hills are unconformities instead of faults; (Letter of October 19, 1926).

productivity of wells has not been as great as in similar fields of southern Oklahoma, comparing sands of equal thickness. This may be due to shale content. There are no "shells" or cap rocks over the sands, and the change from shale to sand in cable-tool wells is frequently noticed only from cuttings. During Pennsylvanian sedimentation no sandstone was exposed in the Criner Hills, and the nearest source for quartz grains must have been miles away; hence the oil sands probably represent material derived from the washing of sandy muds at or near sea-level in a shallow sea free from well-defined beaches and bars and entirely free from pebbles derived from the underlying limestone.

Volume of gas and water pressure are both low. The gas wells have yielded less than 5,000,000 cubic feet a day. Water has not been troublesome except in one well drilled into the Ordovician, from which a pocket of sulphur gas caused an artesian flow of sulphur water for several days.

Pennsylvanian shales are evidently the source rocks, and in this field, where the sands are more or less lenticular, it seems logical to assume the generation of oil locally.

Development of the field has brought many surprises. It was first thought that the oil sands were anticlinal, and that production would be both east and west of the axis of the surface anticline; but the structure proved to be three terraces on a monocline, and the wells on the reverse dips in sections 20 and 21 found brown shale instead of sand. It was also thought that accumulation would be on the more gentle dips, but the reverse is true. Wells making 200 barrels offset small wells making 25 barrels, and the explanation appears to be sand condition rather than structure. Salt-water wells and some which missed the oil sands have been drilled along the supposed trace of subsurface cross-faults which are beneath the major surface faults. The small wells in section 34, where the structure resembles that in section 28, are explained by a thin and shaly sand. In brief, accumulation depends on the lensing-out of the sands and on the lithology of the sand bodies. Accumulation under similar structural conditions may be expected beneath *any* homocline where sands in a thick shale section are cut off by progressive overlap on an older eroded surface; especially with the aid of anticlinal nosing to localize the accumulation.

DEVELOPMENT

The Crinerville anticline seems to have been known since about 1916, but neglected as a possible oil prospect. It was discovered by Amerada Petroleum Corporation about June 1, 1920, and the leasehold was secured in 1920 and 1921, giving a solid block except for fee lands of Westheimer & Daube and F. E. Watkins.

The discovery well, Sammy Baptiste No. 1, was located by E. L. DeGolyer near the center of the SE.¼ sec. 20, on the west side of the

small closure in contours of the surface geology shown in Figure 1. It was commenced in December, 1921, and the first sand was struck at 1,321 feet, January 15, 1922. The first sand was only 4 feet thick and good for about 50 barrels. A second sand at 1,371 feet was good for 20 barrels; and a third, from 1,564 to 1,629 feet, made 90 barrels. This well flowed from the third sand for 3 years before it was put on the pump. These three are the principal sands in section 20, the wells being completed so that they produce either from the first two together by setting a perforated liner through the first sand, or else from the third sand. Two deeper oil sands, called the fourth and fifth, occur locally on the northern and western flanks of the anticline.

Soon after the discovery of the field, Westheimer & Daube completed a well in section 21 in the top of the Ordovician, with "sand" at depths ranging from 1,585 to 1,682 feet, flowing 250 barrels. The Pennsylvanian sands were not productive. Two offsets to this well made 600 to 1,100 barrels, respectively; but the well highest in the producing horizon drained the oil, and all three wells declined rapidly and were abandoned within a year. As the oil was exhausted the sulphur water increased. With the exception of one gas well, other nearby wells drilled into the Ordovician found only sulphur water with more or less sulphur gas.

The field was a disappointment until large wells were found in the north half of section 20 in 1923. By 1924, production seemed to be defined by dry holes. A hand drill was used to locate the axis of the anticline at the surface in sections 28 and 27, and a well was drilled on the Clay farm, in the center of the west line of the NE.¼ sec. 28 on this axis.

Oil was found in a sand from 1,074 to 1,083 feet in Clay No. 1 on October 27, 1924. The well flowed 230 barrels steadily and opened the extension in section 28. The main producing horizon is the second sand. A few wells yield oil from a sand intermediate between the first and second of the original field, but not present there.

A second extension of production, in section 34, near the center of the section, was made in May, 1925, but the wells are very small.

OIL AND GAS

The oil is green by reflected light and amber by transmitted light, and is similar to other Mid-Continent oil of the same grade. The average gravity in section 20 is 34°; in section 28, 39°; and in section 34, 27.8°. The oil in the last two pools is darker than that of the same gravity in section 20. The gravity of the oil in the fourth and fifth sands is 36°, and the color is lighter. The gravity of the oil in the Ordovician limestone was the same as in the Pennsylvanian sands. Differences in gravity of the oil in the three pools indicate no connection between the sands.

The casinghead gas carries 1½-2½ gallons of gasoline per thousand cubic feet of gas, and the volume of casinghead gas in section 20 is approximately 1,000 cubic feet per barrel of oil, and only half this amount in section 28. It is notable that the oil from the Ordovician was low in sulphur, although the accompanying gas was full of sulphur.

Gas has been found in three wells in Pennsylvanian sands and in one well in the Ordovician limestone. The maximum volume of the first wells did not exceed 3,000,000 cubic feet, but on Ordovician well (Marris No. 2) had a volume of 30,000,000 cubic feet of sulphur gas and caused an artesian flow of salt water of 15,000 barrels a day with about 200 barrels of oil. The rock pressure at Farve No. 9, in section 20 was only 335 pounds at 1,486 feet, instead of a normal pressure of about 500 pounds.

WATER

Water pressure is very low throughout the field, and this is one of the reasons for the small production. There is bottom water in section 28, and several wells have been plugged back. Edge water has not encroached on the field. Water invariably produces 2-8 per cent of bottom sediment which is treated chemically and settled out.

Water pressure was high in the Ordovician limestone and flowed all the oil out of this limited reservoir. Two of the wells flowed 600 barrels of oil a day, but the producing horizon was so closely conne underground that each well affected the others and all went to water eventually, the highest well structurally being the last flooded. After water appeared in a well it increased very rapidly in quantity. Water and gas from the Ordovician have a strong sulphur odor.

OIL AND GAS PRODUCTION

All of the wells are drilled with standard tools, and the average time of drilling 1,000 feet is 3 weeks. The spacing is 4 acres to the well.

The productive life of the field will probably be at least 20 years. The maximum production per acre will be 10,000 barrels for the 100 acres of the Farve lease, and 7,000 barrels for the Sammy Baptiste lease south of it. Owing to the fact that there is only one good oil sand in section 28, the production there will be only 5,000 barrels per acre.

The total ultimate yield of the field will be about 3,300,000 barrels from 560 acres, or 5,900 barrels per acre.

Log of Amerada Petroleum Corp., No. 5, J. Gardner.

SW.¼ NW.¼ NE.¼ sec. 20, T. 5 S., R. 1 E. Completed June 24, 1924.

Formation	Top	Bottom
soil	0	7
gravel	7	9
lime	9	14
clay yellow	14	20
mud blue	20	60
sand, hard, dry	60	70
water sand	70	80
blue shale	80	124
lime	124	134
sand	134	147
blue shale	147	160
water sand	160	169
7 bailers water per hour		
lime	169	172
blue shale	172	181
lime	181	217
blue shale	217	410
water sand	410	420
3 bailers water per hour		
blue shale	420	425
sand	425	438
blue shale	438	470
mud blue	470	510
lime	510	530
sand dry	530	552
shale	552	572
water sand	572	590
blue shale	590	596
water sand	596	604
blue shale	604	769
lime blue	769	777
blue shale	777	960
lime	960	1003
sand	1003	1010
shale	1010	1016
lime	1016	1018
dry sand	1018	1020
shale blue	1020	1140
sand	1140	1150
shale blue	1150	1170
sand-show oil	1170	1182
blue shale	1182	1325
sandy shale	1325	1330
sand	1330	1340
sandy shale	1340	1368
sand	1368	1371
sandy shale	1371	1386
sand	1386	1389
sandy shale	1389	1403
sand	1403	1406
show of oil		
sandy lime	1406	1411
sandy shale	1411	1445
gravel	1445	1455
red rock	1455	1469
blue shale	1469	1477
sandy lime	1477	1484
shale	1484	1488
broken sand	1488	1494
show of oil		
shale & sand blue	1494	1506
sand	1506	1520
showing of oil black		
mud blue	1520	1543
shale blue	1543	1610
red bed	1610	1615
lime	1615	1625
oil sand	1625	1660
blue shale	1660	1667
Total Depth		1667

Statistical Data on Carter County Oil and Gas Fields.

FIELD	DATE OF DISCOVERY	DATE OF PEAK PRODUCTION	PEAK DAILY PRODUCTION (Highest Mo. bbls.)	AVERAGE DAILY PRODUCTION Dec., 1927 (Bbls.)	INITIAL DAILY PRODUCTION (Bbls. per well)			TOTAL PRODUCTION TO DEC. 31, 1927 (Oil in Barrels; gas in million cu. ft.)		PRODUCTIVE AREA (Dec. 31, 1927 Acres)	NUMBER OF PRODUCING WELLS Dec. 31, 1927	AV. NO. OF AC. PER WELL (Incl. aban. prod.)	TOTAL OIL PRODUCTION PER ACRE (To Dec. 31, 1927)		GRAVITY OF OIL (A. P. I. Scale)	Av. Price Rec'd. For Flush Prod. (Approx.)	DEPTH OF PAY SAND (Feet)
					Gas	Max.	Av.	Oil	Gas				Gas	Oil			
HEALDTON[1]	Aug. 1913	Mar. 1917	56,000	14,403	......	6,000	180	148,211,277	(a)	7,250	1,950	3.7	......	20,443	26-42	0.60	450-2,700
HEWITT	June 1919	Sept. 1921	43,900	8,397	......	14,000	300	59,474,947	(a)	2,780	784	3.4	......	21,393	33-38	3.00	1,100-3,530
GRAHAM	Mch. 1922	Apr. 1924	16,800	4,706	43	1,200	260	15,516,277	11,000*	2,740*e*	322	8.0	69	6,014	27-38	1.50	1,400-3,400
FOX	Oct. 1918	Apr. 1922	4,400	1,828	60	600	125	8,522,934	37,000*	1,530*d*	105	9.8	83	7,678	27-35	1.00	1,800-3,600
BAYOU	Feb. 1921	1922	2,000*	250*	......	500	175	1,867,750*	(a)	175	29*	6.0	......	10,673	32-36	1.80	2,200-3,900
BROCK	Jan. 1921	Aug. 1925	2,200	919	......	1,100	50	2,580,249	(a)	480*e*	130	3.8	......	5,375	27-37	2.00	800-2,100
SHOLOM ALECHEM[1]	Oct. 1923	June 1927	18,628	11,560	73	2,980	280	8,014,670	(b)	2,210*e*	238*k*	9.7	......	4,072	27-36	1.50	1,900-4,000
WHEELER	Oct. 1905	1920?	300	100*	13½	68	15*	250,000*	500*	640	50*f*	6.0	......	391*	17-23	0.50	860-1,000
WILDCAT JIM	1917	Nov. 1926	1,590	1,017	......	1,100	100	770,807*j*	......	410	41*g*	10.0	......	2,083	19-30	1.00	1,500-2,700
HOMER	1916	1925	75*	40*i*	......	10*	3*	5,000*	......	30	15*fm*	1.5	......	167*	20*	0.50	40-250
COX	Jan. 1926	Nov. 1926	400	244	......	220	52	193,602	......	250	25	10.0	......	774	20-27	1.30	1,000-1,400
ROUNDUP	Ma. 1926	Jan. 1927	30	20	......	24	25	12,071	......	30	3	10.0	......	402	26	1.50	1,025-1,280
SOPASCO	Feb. 1926	1926	5	0	......	3	2	500*	......	20	2	10.0	......	25*	11-18	0.75	165-480
BLUE RIBBON[2]	May 1926	1926?	35	2	......	30	25	2,300*	......	10	2	5.0	......	230*	27	1.55	685-700
TATUMS	Jan. 1927	Future	Future	500*	......	425	212	90,000*	(a)	70	7	10.0	......	1,300*	20-28	0.85	2,200-2,750
TOTALS	......	......	74,000	43,997	......	14,000	103	245,513,384	48,500	18,555*l*	3,381	6.2	52	13,853	11-42	1.32*h*	40-4,000

EXPLANATION:

1. Includes small area in Stephens County.
2. Blue Ribbon School House, sec. 19, T. 4 S., R. 1 W.

* Approximate value.

a. Casinghead gas only.
b. Used in field only.
e. Includes 220 acres yielding only gas.
f. Does not include abandoned wells.
g. Includes 4 gas wells.
h. Average of all fields.
i. Reported capacity; not producing steadily at this
k. Includes 24 gas wells.
l. Less than 3½% of total area of Carter County (532,480 acres).
m. Not on steady production.