T. 27 N., R. 7 E.

By K. C. Heald.

INTRODUCTION.

T. 27 N., R. 7 E., is in the southeast corner of the Foraker quadrangle, Osage County. (See fig. 1.) This area was mapped by the writer in 1915, and the geologic structure was described in a paper published by the U. S. Geological Survey in 1916.[1] Subsequent work near the margin of this area revealed the necessity of some revision, and during June, 1918, a few days were spent in procuring data to make the necessary changes. The revision was confined to territory near the south boundary of the township.

It may be noted that the structure contours along the south edge of this area as shown on Plate XX do not exactly join with those in the northeast corner of T. 26 N., R. 7 E., as shown on the map in Bulletin 686–L. This discrepancy is not due to either observational error or difference of opinion concerning the contouring, but rather to the fact that the elevations on which the contouring for Plate XX is based were referred to the Foraker limestone as a datum, and those which control the contouring in Bulletin 686–L were referred to a much lower horizon. Because of convergence the two datum planes are not exactly parallel, and hence the contours show the slight discrepancy mentioned above.

STRATIGRAPHY.

EXPOSED STRATA.

The exposed rocks in T. 27 N., R. 7 E., include shales, limestones, and sandstones of upper Pennsylvanian age. Shales predominate, but the prominent outcrops of the limestones make them by far the most noticeable. The sandstones are very inconspicuous except in the southeast corner of the township. The general character and relation of the beds are shown graphically in the stratigraphic section

[1] Heald, K. C., The oil and gas geology of the Foraker quadrangle, Osage County, Okla.: U. S. Geol. Survey Bull. 641, pp. 17–47, 1916.

(fig. 24). The characteristics of a few of the beds that were particularly helpful in determining the structure are given in detail below.

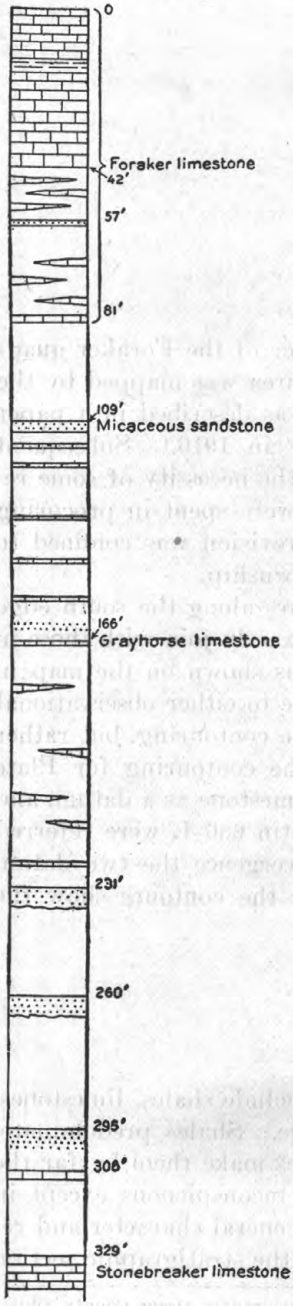

FIGURE 24.—Stratigraphic section showing rocks exposed in T. 27 N., R. 7 E.

Foraker limestone.—The Foraker limestone is made up of a series of limestone beds with thin intervening beds of shales and a few local lentils of sandstone. The total thickness of the formation in this township is about 80 feet. The limestones are massive, dense, hard, fossiliferous, and cherty and show a weathered surface of light gray to seal-brown. Most of the chert is reddish on the weathered surface and pigeon-blue on the fresh surface and carries an abundance of fossil *Fusulina*, which are dull white to yellowish white. In one bed about 26 feet below the top of the formation most of the chert is decomposed and presents a peculiar porous appearance. This characteristic made the bed which carries this decomposed chert of particular assistance in determining the geologic structure. The Foraker limestone covers a large part of T. 27 N., R. 7 E., and much of the structure has been determined from elevations taken on one or another of its constituent beds.

Micaceous sandstone.—A micaceous sandstone about 28 feet below the base of the Foraker limestone was used in determining the structure over a part of this township. It is a particularly good horizon marker, as there is no other sandstone with which it might possibly be confused for a considerable distance either above or below it. In the southern part of the township there are lentils of sandstone not far from the outcrop of the micaceous sandstone, but the lithologic character of the micaceous sandstone is so distinctive that there is small chance of miscorrelation. It has a reddish-gray weathered surface and a fresh surface of slightly lighter color thickly dotted with brown spots. Its most distinctive feature is the presence of muscovite, which in many localities is very prominent and which can always be detected if the rock is carefully examined.

The sandstone is well exposed on the hill near the center of sec. 14, T. 27 N., R. 7 E.,

where it crops out some distance below the top of the hill. The sandstone that caps the hill is a lentil in the Foraker limestone above the micaceous sandstone.

Stonebreaker limestone.—The Stonebreaker limestone was used as the key bed in determining the shape and size of the anticline in the extreme southeast corner of T. 27 N., R. 7 E. In that locality it is about 250 feet below the base of the Foraker limestone. It is 16 feet thick and consists of a series of thin limestone beds with intervening shales. The limestone is hard, tough, and sparingly fossiliferous. The most abundant fossils are small *Fusulina*, but one bed also carries many Cryptozoa, most of which have a fragment of a bryozoan as a nucleus. The weathered surface is light gray with many blotches of limonite-yellow. This limestone has been described more fully by the writer in another paper.[1]

PENNSYLVANIAN ROCKS NOT EXPOSED.

Below the surface there is a series of about 2,500 feet of Pennsylvanian rocks resting upon the Mississippian limestones. The exact horizon where the Pennsylvanian rocks stop and the Mississippian rocks begin has not been determined, although it is known that the limestone called the "Mississippi lime" by drillers is very near the top of the Mississippian series. The general sequence of the beds is shown graphically in Plate XX.

SANDS CARRYING OIL OR GAS.

No drilling has been done in T. 27 N., R. 7 E., but some idea of the approximate position of the gas or oil bearing beds underlying this township may be gained by a study of the records of the wells in the Pearsons Switch gas and oil field, which lies less than a mile east of the eastern boundary of the township. The assumption that the oil and gas bearing sands of the Pearsons Switch field underlie the township to the west is justified by the facts that the higher beds have been recognized in the Mayers gas field, 5 miles to the southeast, which shows that they have a considerable extent, and that the bed which carries the oil at Pearsons Switch is believed to be the "Mississippi lime" which is recognized in wells in many parts of the Osage Reservation and which is probably the most widespread oil and gas bearing bed in this general region.

Most of the gas in the Pearsons Switch field comes from a series of six sands, the highest of which is about 630 feet below the Stonebreaker limestone and the lowest about 420 feet lower. Below these sands there is a series about 600 feet thick of barren shales and sandstones, and next a sand about 30 feet thick which is reported to carry

[1] Heald, K. C., Geologic structure of the northwestern part of the Pawhuska quadrangle, Okla.: U. S. Geol. Survey Bull. 691, pp. 63–64, 1918 (Bull. 691–C).

gas but from which no gas has ever been utilized. Below this bed no oil or gas bearing sands have been reported, but a bed of limestone, which is probably the Fort Scott ("Oswego") limestone, about 2,100 feet below the Stonebreaker limestone carries gas and has given a showing of oil. About 400 feet deeper the top beds of the "Mississippi lime" carry both oil and gas. Although only a single well has been drilled to the "Mississippi lime" in the Pearsons Switch field, its initial flow of 400 barrels a day amply justifies a recommendation that wells be bored to this horizon on all the pronounced anticlinal folds in this general region.

The beds below the top of the "Mississippi lime" have not been reached by any of the wells that have been drilled within a few miles of T. 27 N., R. 7 E., so it is impossible to state whether or not these beds contain oil or gas. However, it is known that elsewhere in the Osage Reservation beds from 100 to 300 feet below the top of the "Mississippi lime" carry oil and gas, and tests in T. 27 N., R. 7 E., must reach these horizons to be adequate.

STRUCTURE.

GENERAL FEATURES.

The rocks in T. 27 N., R. 7 E., have an average westerly dip of about 33 feet to the mile. The beds do not slope uniformly but form series of alternating "steeps" in which the westerly dip may be as great as 120 feet to the mile and "flats" in which the rocks may even slope to the east for a short distance.

The axes of the anticlines and domes which modify the general structure are shown in figure 25.

ANTICLINES, DOMES, AND TERRACES.

DUGOUT CREEK ANTICLINE.

The axis of the Dugout Creek anticline trends southwestward from the northwest corner of sec. 9 to the southwest corner of sec. 18. (See fig. 25.) It is a gentle fold that plunges to the west with no reversal of the westerly dip except for a very small domelike bulge in the east-central part of sec. 18, which is probably too insignificant to have any effect on the tendency of the structure to bring about an accumulation of oil or gas. Folds of this general type have not been found very productive elsewhere in the Osage Reservation, although small oil and gas wells have been developed on some of them. It is recommended that no test holes be drilled on this anticline unless some of the structurally more favorable areas near by yield either oil or gas in quantity. If a well is sunk on this anticline a good location should be near the SE. ¼ SE. ¼ sec. 7.

NORTH BIRD CREEK ANTICLINE.

The axis of the North Bird Creek anticline extends from the NE. ¼ sec. 11 to a point near the center of the NW. ¼ sec. 20. (See fig. 25.) The fold is long and relatively narrow, and the rocks along the axis plunge westward with no hint of a reversal of dip. On the flanks of the fold the beds dip rather steeply to the northwest and southeast; and on the tip in sec. 20 there is a very pronounced westerly dip.

Although this is a prominent fold the absence of any closure or dip to the east makes it seem rather improbable that it has been effective in producing the formation of a large pool of either oil or gas. However, it is certainly better suited to have brought about such an accumulation than the territory immediately to the north or south of it; accordingly, if any area near by whose structure appears more favorable yields gas or petroleum, it will be perfectly justifiable to make careful tests of this fold. Good locations for such tests are the SW. ¼ SW. ¼ sec. 11 and extreme southwest corner of sec. 15. A test might also be made in the E. ½ sec. 20. If oil or gas is not found in the shallow sands which are productive at Pearsons Switch and should here lie between 950 and 1,450 feet below the surface, the wells should be deepened to the "Mississippi lime" and should not be abandoned until a depth of at least 3,000 feet is attained, unless oil or gas is encountered at shallower depth.

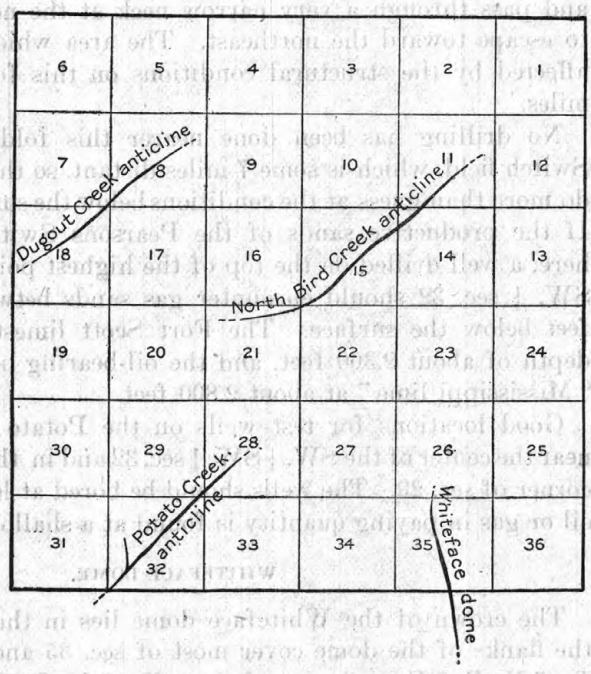

FIGURE 25.—Sketch showing approximate positions of axes of anticlinal folds in T. 27 N., R. 7 E.

POTATO CREEK ANTICLINE.

The axis of the Potato Creek anticline extends from a point near the southwest corner of sec. 32 to the middle of sec. 28, T. 27 N., R. 7 E. (See fig. 25.) On this axis there are two minor domelike

bulges—one in the SW. ¼ sec. 32, the other in the SW. ¼ sec. 28—so that the top of the anticline has a sway-backed profile, being highest near the ends. The dome in the SW. ¼ sec. 32 is more pronounced and has a closure of about 15 feet. The closure on the dome in sec. 28 is probably a little less than 10 feet.

In spite of its small closure this anticline should be effective in stopping the migration of oil or gas, and if these substances are present at all in this region they should be found below this fold. Dips on all sides of the fold are pronounced, and any oil or gas moving up the dip would have to traverse the length of the anticline and pass through a very narrow neck at the north end of the fold to escape toward the northeast. The area which may be favorably affected by the structural conditions on this fold exceeds 2 square miles.

No drilling has been done nearer this fold than the Pearsons Switch field, which is some 7 miles distant, so that it is impossible to do more than guess at the conditions below the surface at this locality. If the productive sands of the Pearsons Switch field are present here, a well drilled on the top of the highest point of the fold in the SW. ¼ sec. 32 should encounter gas sands between 1,000 and 1,400 feet below the surface. The Fort Scott limestone should lie at a depth of about 2,360 feet, and the oil-bearing bed on the top of the "Mississippi lime" at about 2,800 feet.

Good locations for test wells on the Potato Creek anticline are near the center of the SW. ¼ SW. ¼ sec. 32 and in the extreme southeast corner of sec. 29. The wells should be bored at least 3,000 feet unless oil or gas in paying quantity is found at a shallower depth.

WHITEFACE DOME.

The crown of the Whiteface dome lies in the SE. ¼ sec. 35, and the flanks of the dome cover most of sec. 35 and the SW. ¼ sec. 36, T. 27 N., R. 7 E., and most of sec. 2, T. 26 N., R. 7 E. (See fig. 25 and Pl. XX.) This is a pronounced fold with a closure of about 25 feet and it may influence the accumulation of oil or gas over 2 square miles or more.

The Whiteface dome is but 3 miles from the Pearsons Switch anticline, which is known to contain large volumes of gas and oil. The closure of the Whiteface dome is almost as great as that of the Pearsons Switch anticline, and the areas covered by the two folds are about the same. Accordingly it seems reasonable to believe that this dome will yield both gas and oil. There is ample gathering ground to the northwest, west, and south of the dome, and from this gathering ground the oil and gas may be expected to travel up the steep westerly dip and collect under the crown of the dome and on its flanks. The shallow sands that yield gas in the Pearsons Switch

field should underlie the crown of the Whiteface dome at a depth of 680 to 1,200 feet. The Fort Scott limestone should be encountered at a little more than 2,100 feet, and the top of the "Mississippi lime" at about 2,500 feet. Besides the sands mentioned there may also be productive sands at greater depth, and the possibilities of the Whiteface dome should not be considered exhausted until deep drilling has established the presence or absence of these lower beds.

Good locations for testing this dome are the southwest corner of the SE. ¼ and the center of the SW. ¼ sec. 35, T. 27 N., R. 7 E., and the southeast corner of the NW. ¼ sec. 2, T. 26 N., R. 7 E. A well drilled at any of these locations should not be abandoned until a depth of at least 2,700 feet is attained, unless oil or gas is encountered at less depth.