T. 25 N., R. 9 E.

By K. C. Heald.

INTRODUCTION.

The field work in T. 25 N., R. 9 E. (see fig. 1), on which the accompanying report is based, was done by K. C. Heald, K. F. Mather, D. E. Winchester, D. D. Condit, F. R. Clark, and W. B. Emery, geologists, assisted by J. Lee Bossemeyer, W. G. Gulley, Willard Miller, J. M. Vetter, H. J. Weeth, Lewis Mosburg, and Richard L. Triplett, instrument men. The areas mapped by the different men interfinger so intricately that it is not practicable to outline the portion worked by each man. The names of the geologists are given in the order of their responsibility for the completed map.

KEY BEDS.

The exposed rocks in this township are all of upper Pennsylvanian age and include sandstone, limestone, and shale. Sandstones predominate, forming more than half of the total thickness of the exposed rocks, but there are some thick beds of shale, and in the western part of the township limestones are very conspicuous. (See Pl. VII and fig. 6.)

The geologic structure was determined from elevations taken on a great number of beds. Some of these beds occur only in very small areas, but others are traceable for long distances. The more persistent and helpful of these key beds are described briefly below.

Oread limestone.—The middle bed of the Oread limestone of Kansas is unquestionably one of the most important key beds in the Pawhuska quadrangle. It immediately underlies the Elgin sandstone and is particularly helpful in deciphering the structure because there are no other persistent limestones, either above or below it within 100 feet.

The character of this bed is not constant. In the NE. ¼ sec. 15, where it is well exposed in a gully on a steep hillside, it is about 3 feet thick; creamy brown on the weathered surface and a little darker on the fresh surface, with many dark-brown blotches; hard

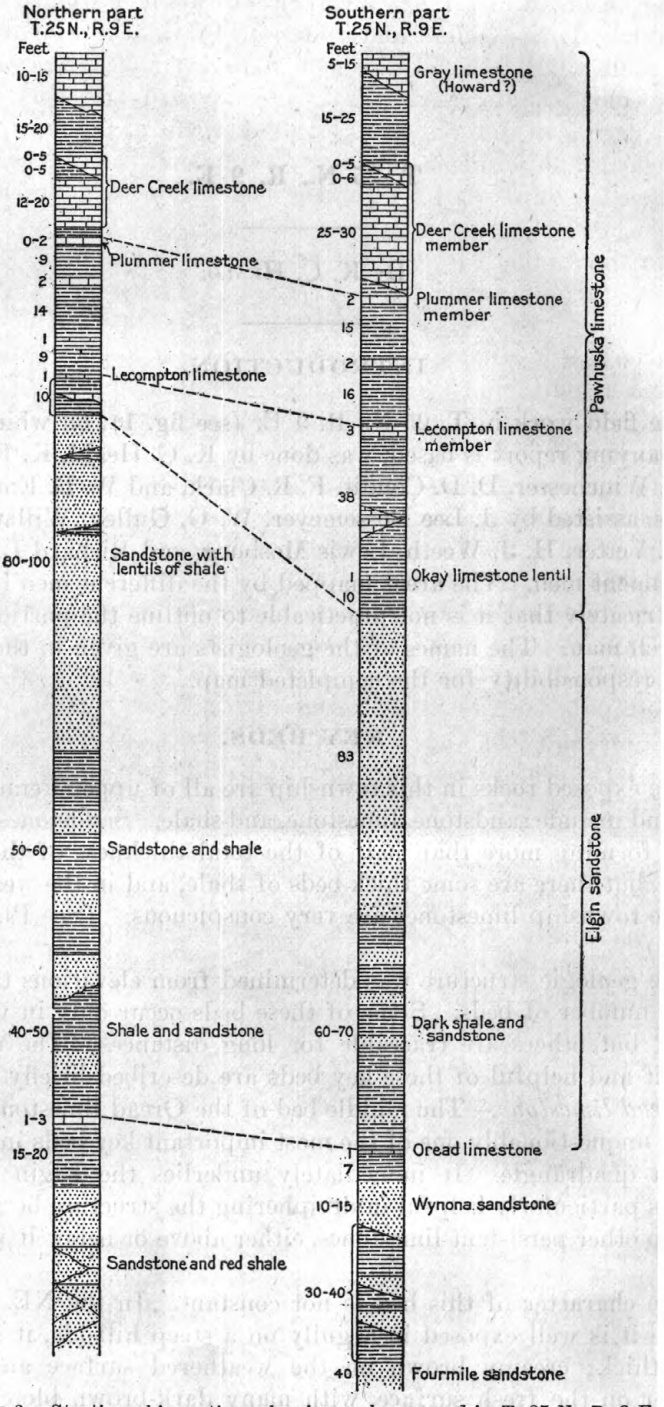

FIGURE 6.—Stratigraphic sections showing rocks exposed in T. 25 N., R. 9 E.

but not massive, breaking down into little slabby chips; and fossiliferous. It is overlain and underlain by thin beds of dark olive-drab shale which is almost as good a marker as the limestone itself, as the color is quite characteristic and it is in places very fossiliferous, differing in this respect from most of the shales in this part of the stratigraphic section. The olive-drab shale above the limestone is succeeded by fissile gray shale. That below is underlain by red shale.

Near the southern edge of the township this limestone, where well exposed, forms a single massive ledge of very hard rock, orange-red on the weathered surface and lighter on the fresh surface which is characterized by much milky calcite. Though this ledge is well exposed at only one or two localities the horizon may be traced by a string of limestone nubbins, ranging in size from that of a pinhead to 3 inches in diameter, which mark the location of the bed. There are other horizons where these limy concretions occur, but this particular formation can be identified by the fossils that weather out of the limestone or the associated shales. *Ambocoelia planiconvexa* and *Worthenia tabulata* are among the most common forms.

Okay limestone.—The Okay is a thin limestone, named from its good exposures on and in the neighborhood of the O. K. ranch in sec. 31. It is the lowest limestone in the Pawhuska formation, its stratigraphic position being about 10 feet above the highest bed of the Elgin sandstone and 50 to 100 feet below the Deer Creek member of the Pawhuska limestone. The color ranges from gray to buff, but the buff predominates. In most places the rock is of flinty hardness and contains an abundance of small *Fusulina*, but either or both of these features may be locally absent.

This limestone appears to be a rather small lentil. It does not crop out north of Clear Creek in this township, and although it extends to the southern line of T. 24 N., it has not been noted by the geologists working the territory to the south.

The outcrop of the bed is inconspicuous, and in places it is traced with extreme difficulty, but such good outcrops as occur are easily found because of their stratigraphic position with respect to the underlying massive Elgin sandstone.

Lecompton limestone.—The Lecompton limestone is a member of the Pawhuska formation, lying 10 to 40 feet above the Elgin sandstone and 30 to 60 feet below the Deer Creek limestone, which is the Pawhuska limestone of the commercial geologists. It is one of the most persistent of the members of the Pawhuska formation and has been traced from the Kansas line through the Pawhuska quadrangle, through the Hominy quadrangle, where it is known to some as the "Hominy lime," and south to the Cushing field, where it is known as the "Pawhuska lime."

It is a hard bed, is not more than 3 feet thick in this township, although much thicker in the region to the south, and forms a conspicuous outcrop in many places, large slabs of it breaking off and littering the hill slopes. Its resistance to disintegration may lead to mistakes in mapping, as large slabs of it that show little or no effect of weathering occur on slopes or in stream beds far below the actual outcrop. The weathered color is commonly orange, though locally it is gray. The fresh surface is lighter in color. The limestone is not markedly fossiliferous except in small areas, but almost anywhere a search will reveal small cup corals (*Lophophyllum profundum*). It is well exposed in sec. 31 near the O. K. barn.

Deer Creek limestone.—The Deer Creek limestone is the most conspicuous member of the Pawhuska formation and is the bed to which the name Pawhuska was originally applied. It ranges in thickness from 12 to 41 feet in this township. The general color of the weathered surface is gray, but there are bands which are cinnamon-brown and blackish blue. These bands are so persistent that they can be traced for considerable distances and used in mapping to determine the structure. In this township a brown band near the top of the limestone and the very top part of the bed, which is of a very dark blackish-blue color with a peculiar velvety-smooth appearance, were especially helpful in mapping.

The Deer Creek limestone is present along the western margin of the township as far south as the south line of sec. 30. Care should be exercised in using it for mapping structure, as there is a pronounced divergence southward between it and the Lecompton limestone, and a still more marked one between it and the top of the Elgin sandstone. (See stratigraphic section, fig. 6.)

PENNSYLVANIAN ROCKS BELOW THE SURFACE.

The unexposed rocks above the Mississippian limestone are of the same general type as those which appear on the surface. (See fig. 7.) Sandstone and shale make about 90 per cent of the total above what is known to the drillers as the Big lime (probably the Pawnee limestone of the Kansas section). Below that horizon there is comparatively little sandstone, but there are massive beds of limestone and much shale. Many of the sandstones in the upper part of the section are water bearing, even on pronounced anticlines, and in some of the synclines they yield great quantities of either salt or fresh water. Most of these water-bearing sands are apparently lenticular, so that wells some miles apart will not always get the water at the same horizons. Two of the sands, however, appear to be present wherever wells have been drilled in the township. The top of one of these sands is commonly found from 160 to 230 feet below the middle bed

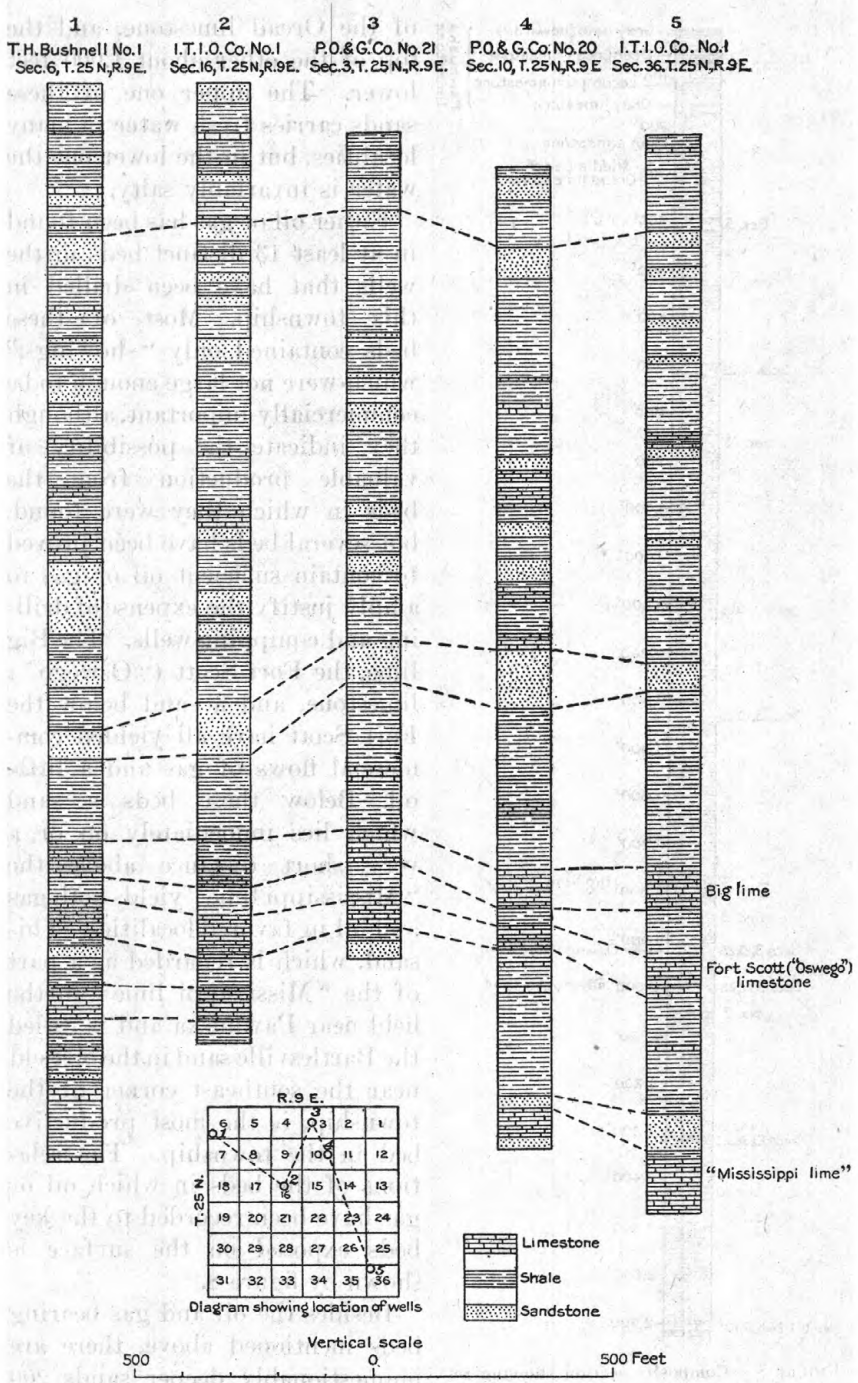

FIGURE 7.—Sections of rocks underlying T. 25 N., R. 9 E., as shown by well records.

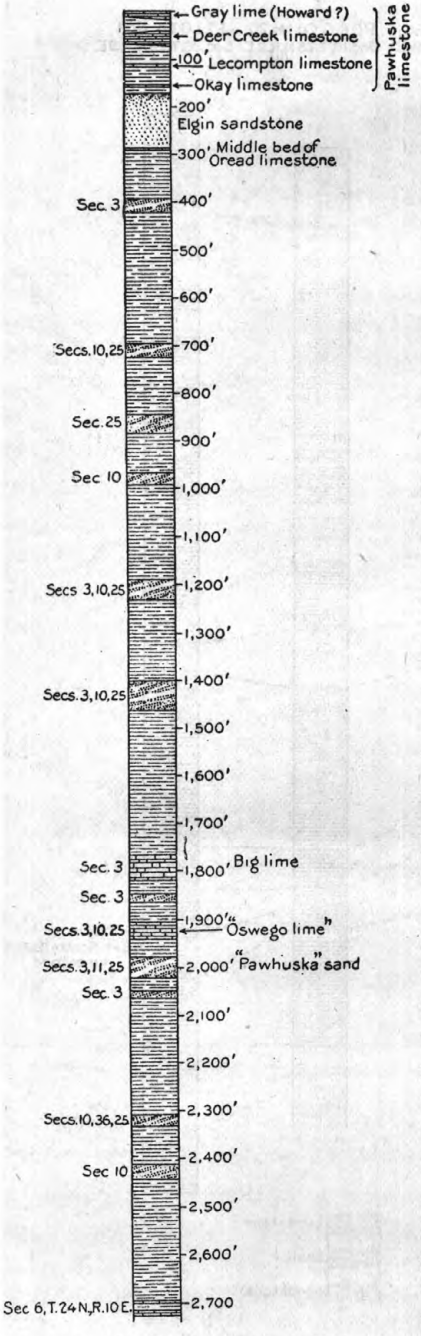

FIGURE 8.—Composite section showing relation of exposed rocks to beds carrying either oil or gas in T. 25 N., R. 9 E.

of the Oread limestone, and the top of the other about 1,000 feet lower. The upper one of these sands carries fresh water in many localities, but in the lower one the water is invariably salty.

Either oil or gas has been found in at least 13 distinct beds in the wells that have been drilled in this township. Most of these beds contained only "showings," which were not large enough to be commercially important, although they indicate the possibility of valuable production from the beds in which they were found, but several beds have been proved to contain sufficient oil or gas to amply justify the expense of drilling and equipping wells. The Big lime, the Fort Scott ("Oswego") limestone, and a sand below the Fort Scott have all yielded commercial flows of gas and a little oil. Below these beds a sand which lies immediately on or a very short distance above the "Mississippi lime" yields both gas and oil in favored localities. This sand, which is regarded as a part of the "Mississippi lime" in the field near Pawhuska and is called the Bartlesville sand in the oil field near the southeast corner of the township, is the most productive bed in the township. The relations of the beds in which oil or gas have been recorded to the key beds exposed on the surface is shown by figure 8.

Besides the oil and gas bearing beds mentioned above, there are unquestionably deeper sands 200 feet or more below any which have

been reached by drilling operations in T. 25 N., R. 9 E. The higher of these deep-lying sands have been proved to contain both oil and gas in other parts of the Osage Reservation, and it seems practically certain that future deep drilling in this township will result in the development of good yields from one or more of these lower beds.

STRUCTURE.

GENERAL FEATURES.

The structure in T. 25 N., R. 9 E., is complicated. Viewed broadly the beds dip a little north of west, but this regional tendency is so

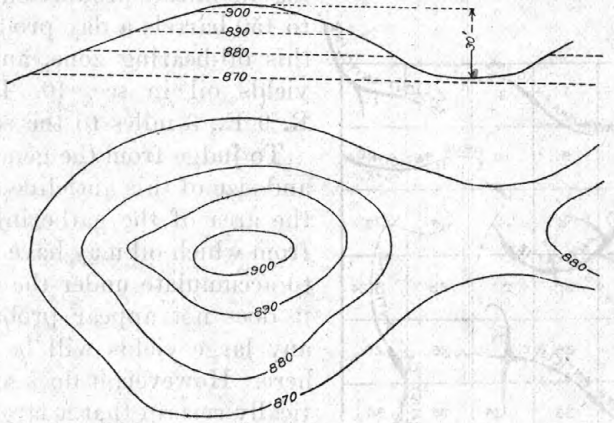

FIGURE 9.—Sketch illustrating an anticline with a closure of about 30 feet.

obscured by the manner in which the beds are folded and faulted that it is not in the least prominent.

The term "closure," which is used in the following descriptions of the individual anticlines, may for all practical purposes be taken to mean the vertical distance between the highest and lowest closed contours on the anticline plus the contour interval. For example, if the highest closed contour represents an elevation of 900 feet, the lowest an elevation of 880 feet, and the contour interval is 10 feet, the closure is approximately 30 feet. (See fig. 9.)

LOOKOUT ANTICLINE.

The highest point of the Lookout anticline lies near the northeast corner of T. 25 N., R. 9 E., and the fold outlined by the closed contours covers territory in all four of the townships that corner here. (See fig. 10.) The dips on all sides are sufficiently pronounced to be detected without difficulty, and the closure is about 40 feet. The area in which the structure seems favorable for the accumulation of oil is about 2 square miles. This includes a projection or anticlinal

nose which extends through the center of sec. 1 and covers much of the S. ½ of sec. 2.

Two wells have been drilled on this anticline since the completion of the field work on which this report is based. One, in sec. 36, T. 26 N., R. 9 E., obtained a large volume of gas in several of the shallower gas-bearing zones and a very strong flow from the Fort Scott ("Oswego") limestone. A second well, in the SW. ¼ sec. 31, T. 26 N., R. 10 E., was drilled through the horizons of the gas-bearing beds of the well in sec. 36 and obtained oil in commercial quantity from the "Mississippi lime." This was to be expected, as on another anticline in sec. 35, T. 26 N., R. 9 E., less than 2 miles distant, wells ranging in initial production from 25 to 150 barrels a day produce from this oil-bearing zone, and it also yields oil in sec. 10, T. 25 N., R. 9 E., 3 miles to the southwest.

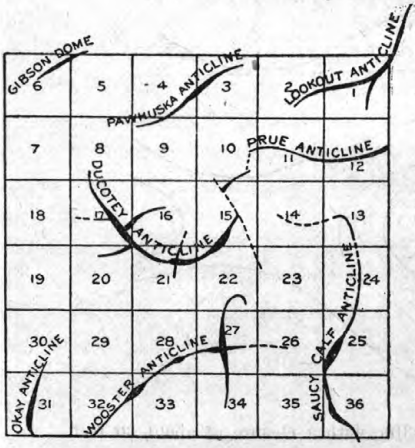

FIGURE 10.—Sketch showing approximate positions of the axes of anticlinal folds in T. 25 N., R. 9 E.

To judge from the general shape and size of this anticline and from the area of the gathering ground from which oil may have migrated to accumulate under the anticline, it does not appear probable that any large yields will be obtained here. However, it does seem practically certain that a large part of the acreage covered by the anticline will yield gas from the shallower sands and oil and gas from the deeper ones. There is also a possibility of oil from the Big lime, the "Oswego lime," or some other of the beds that have yielded showings of oil near by, as well as from beds 100 feet or more below the top of the "Mississippi lime."

PAWHUSKA ANTICLINE.

The Pawhuska anticline, which is crowned by a domelike bulge, covers the W. ½ sec. 3 and the E. ½ sec. 4. The total area covered by beds that are distinctly arched is a little less than a square mile, but the tendency of the structure to influence the accumulation of oil and gas may extend over a considerably larger area. The highest part of the fold is in the SE. ¼ NW. ¼ sec. 3, around which there is a closure of 30 feet.

This anticline has already been extensively drilled. There are several gas wells on its crest and east flank, and the gas field extends across the synclines to the south and east and yields gas from beds low on the flanks of the Prue anticline and the Lookout anticline.

According to the records now available the wells have come in with initial yields as high as 22,000,000 cubic feet a day, but estimates on the flows of some of the first wells brought in place the initial production as high as 40,000,000 cubic feet. Gas was encountered in a number of sands above the Fort Scott ("Oswego") limestone, but the principal producing bed is a sand a little below the Fort Scott. This sand gave good showings of oil in several of the wells, but never enough to make oil production practicable. Two of the wells, in the southeast corner of sec. 3, were drilled to the "Mississippi lime" without encountering additional oil-bearing zones. However, neither of these wells is very favorably located with respect to the structure. One of them is reported to have penetrated the lime to a depth of almost 100 feet, which would insure its passing through the oil-bearing beds of the wells to the northeast and the south, but it can not be said that an adequate test of the oil-bearing possibilities of the "Mississippi lime" under this fold has been made.

The west flanks of most anticlines in the Osage country are far more likely to be productive than are the east flanks. If this holds true for the Pawhuska anticline the most favorable territory on that fold is still undrilled. The only well sunk on the west flank is in the northeast corner of sec. 8 and is so far down the dip that it lies in the trough of a syncline and hence is most unfavorably located. No oil or gas was found in it. It seems quite probable that when the portion of the anticline lying in the E. ½ and NW. ¼ sec. 4 is drilled not only will productive gas wells be obtained, but commercial quantities of oil may also be encountered in the sand which lies close beneath the Fort Scott ("Oswego") limestone, in the upper part of the "Mississippi lime," or in some bed which lies more than 100 feet below the top of the lime and has not yet been reached by the drilling in this general region. A good location for a test is in the town site of Pawhuska near the center of the SE. ¼ sec. 4. This locality may have been drained of a part of its content of gas by the old wells to the northeast, but the deeper sands that were not touched by those wells should be productive. If the well is located on top of the hill the Big lime should be struck at a depth of about 1,500 feet, the "Oswego" at about 1,650 feet, and the "Mississippi" at about 2,050 feet. The drilling should be carried to a depth of 2,400 feet unless oil is encountered at shallower depth. A second location for a test is about 2,600 feet east of the west line and 1,300 feet south of the north line of sec. 4. A third good location is a little east of the center of the SE. ¼ SW. ¼ sec. 4.

GIBSON DOME.

The Gibson dome is a small anticlinal bulge that lies mainly in the northwest corner of sec. 5 and the northeast corner of sec. 6, T. 25 N., R. 9 E., and extends into the southeast corner of sec. 31, T. 26 N.,

R. 9 E. The crown of the dome lies across the line between secs. 5 and 6. The closure is about 20 feet. The area included within the lowest closed contour is little more than a quarter of a mile, and it appears doubtful if the fold is pronounced enough to influence the accumulation of oil or gas over an area of more than half a section.

The eastern flank of this dome is cut by small faults that have a maximum throw of about 25 feet. This displacement is so small and the lateral extent of the breaks is so slight that it does not appear probable that they will affect in any way the oil-retaining possibilities of the fold, but if they do the modification is of such a nature as to make the oil or gas reservoir more effective than it would be if the faults were absent.

This dome has never been drilled. A test which was made in the extreme southwest corner of sec. 6, a mile from the crown of the fold, was carried to the "Mississippi lime" without obtaining either oil or gas in commercial quantity. In fact, the record of this test does not mention even showings of oil or gas.

Conditions are favorable, so that drilling is amply justified. A good location is near the center of the NE. ¼ sec. 6. An alternative location is the extreme northeast corner of sec. 6. If the well is located on the limestone capping the hill, the "Oswego lime" should be struck at a depth between 1,850 and 1,900 feet and the "Mississippi lime" between 2,300 and 2,400 feet.

DUCOTEY ANTICLINE.

The Ducotey anticline is a large fold of irregular shape, whose axis trends in a curved line from the SW. ¼ sec. 17 to a point a little north of the quarter corner between secs. 10 and 15, where it is lost in a long, flat saddle. The general outline of the axis is that of a crescent with the tips pointing northwest and northeast. (See fig. 10.)

There are four distinct domelike humps separated by short saddles on the axis of this anticline, and its flanks are indented by many minor marginal synclines of irregular size and outline. It is, however, definitely bounded on the north by the axis of a major syncline that follows very closely the bed of Bird Creek, on the west and northwest by a monocline that dips west across Clear Creek from a line about a mile east of the creek bed, on the south by a synclinal depression that crosses the southern parts of secs. 20, 21, and 22, and on the east by flat-lying beds that limit it near the east line of sec. 15. The four highest points on this anticline are in the SE. ¼ sec. 17, the NW. ¼ NE. ¼ sec. 21, the SE. ¼ SW. ¼ sec. 15, and the NE. ¼ NW. ¼ sec. 15.

Several faults break the surface beds on this anticline, and three of them are so large that probably they also affect the rocks at the

depth of the oil and gas-bearing beds. One of these faults trends northwestward across the extreme northeast corner of sec. 20 and the SE. ¼ sec. 17 and has a downthrow to the southwest of 25 feet in maximum amount. A second trends north-northwestward across the west side of sec. 16. The downthrow on this fault is to the northeast and is a little more than 20 feet at the point of maximum displacement. The third large fault crosses sec. 15 near the middle of the section. The maximum displacement along this fault is in the southeast corner of the section, where the beds are dropped about 45 feet to the northeast.

Several wells have been drilled on the flanks of this anticline, but with a single exception they are so far down toward the bordering synclines that their failure to obtain either gas or oil in paying quantity is fully explained. The single exception is a test which was drilled in the NE. ¼ NW. ¼ sec. 15, squarely on the crown of the easternmost of the humps which cap the axis of the anticline. It is reported that this well was carried deep enough to penetrate the "Mississippi lime" for at least 50 feet without encountering commercial amounts of either oil or gas, although there were showings of both. A fault passes immediately west of the well and may reach the oil-bearing sand with a displacement sufficient to seal it effectually so that little or no oil or gas could get to the vicinity of the well. However, it is much more likely that the failure of this well is due to local sand conditions, or to the fact that the structure in depth does not parallel that on the surface.

The Ducotey anticline is worthy of very complete testing. Good locations are the NE. ¼ SW. ¼ sec. 15, about the center of sec. 17, the center of the NE. ¼ NE. ¼ sec. 20, and the NW. ¼ NE. ¼ sec. 21.

PRUE ANTICLINE.

The Prue anticline is a long, relatively narrow fold whose axis trends approximately east near the middle of secs. 11 and 12. The area encircled by the lowest closed contour on this fold is only about a square mile, in spite of its length of more than 2 miles, and the closure of 10 feet is insignificant. On the west a saddle separates this anticline from the Ducotey anticline. On the east the outline of the fold is lost under the alluvium of the Bird Creek valley. On the north the rocks dip steeply toward the axis of the syncline that separates this fold from the Pawhuska anticline.

Three faults cut the Prue anticline, but none of them is large enough to have any appreciable effect on the accumulation of oil or gas unless it is a good deal more pronounced in depth than it is on the surface.

Some successful drilling has been done on this anticline. Two wells located very close to the axis in sec. 10 had initial yields of

20 and 25 barrels from the "Mississippi lime." An offset to one of these wells did not make enough oil to be put on the pump but was shut in as a gasser. Two other wells drilled near by had showings of both oil and gas but not enough to make them of value. Besides these wells five others have been bored on the southern flank of the fold. One of them, in the south-central part of sec. 11, was favorably located with respect to the structure, but although it showed some gas there was not enough to justify maintaining it, and it was abandoned.

Though this anticline does not appear to promise large wells, a considerable number of wells of moderate productivity will probably be drilled on it ultimately. Gas may be hoped for at any one of five horizons, ranging from 900 feet above the "Oswego lime" to about 100 feet below the top of the "Mississippi lime," and oil may be looked for either in the bed immediately overlying the "Mississippi lime" or in a bed at greater depth.

Good locations for testing are 500 feet south of the center of the NW. ¼ sec. 11 and about 1,300 feet west of the east quarter corner of sec. 12. These tests should be carried to a depth of at least 2,300 feet if they are to be adequate.

OKAY ANTICLINE.

The axis of the Okay upfold trends from north to south near the center of sec. 31. (See fig. 10.) The anticline is not particularly prominent, for though the dips to the north and west are pronounced, those to the east and south are both gentle and small in vertical extent. The slightest dip is to the south, where the highest point of the saddle that limits the fold on the south is only about 20 feet below the highest point on the anticline.

The possibilities of this anticline are hard to forecast. No drilling has been done within several miles, so the position and character of the possible oil sands here can only be guessed. To judge from the conditions found in the nearest wells there will probably be little or no sand at the horizon generally ascribed to the Bartlesville sand, a short distance above the "Mississippi lime." Accordingly oil must be looked for either in higher beds, particularly in the Fort Scott ("Oswego") limestone and the sand a little below the Fort Scott, from which the heaviest flow of gas in the Pawhuska field is obtained, or in beds associated with the "Mississippi lime," particularly one just capping the lime and a second 90 to 120 feet lower. Drilling 6 miles to the east has indicated that a third possibly productive bed may be expected still deeper in the lime.

A good location for a test appears to be the center of sec. 31. A well located here should strike the Fort Scott limestone between 1,750 and 1,800 feet below the surface, and the "Mississippi lime" between

2,100 and 2,200 feet. A second location is the northeast corner of the NW. ¼ sec. 31. The beds mentioned above will be found to lie a little farther below the surface here than in the center of the section.

WOOSTER ANTICLINE.

The Wooster anticline is a pronounced fold of very irregular outline. The main axis runs in a curving line from the center of the south line of sec. 32 to the center of the east line of sec. 27. Near the middle of sec. 27 this main axis is cut by that of a minor transverse fold which extends north into sec. 22 and south into sec. 34. The branch that runs into sec. 34 is further modified by a small domelike fold to the west of the axis of the larger anticline. The uplift as a whole might be described as an anticline capped by four domes, as there are four domelike dwellings strung along the axis of the major fold and definitely separated by structural saddles.

The territory covered by the distinctly anticlinal structure—that is, by beds which are unquestionably arched—is about 3 square miles in secs. 27, 28, 32, 33, and 34. Not all this area will necessarily yield oil or gas, nor will the production of oil or gas necessarily stop within the limits of the sections mentioned. However, the structure in the territory mentioned is unquestionably of a nature to induce the accumulation of oil or gas, and it is to be hoped that at least a large part of this territory will ultimately prove productive. If this hope is realized it also seems fair to expect that the producing sands will be found to extend westward beyond the limits given above, as the general experience in the Osage country is that oil is found much farther down on the west flanks of anticlines than it is on the north, east, or south flanks.

The proximity of this anticline to the producing wells in secs. 25, 26, 35, and 36 leads to the hope that conditions similar to those in the producing wells will be found under the Wooster anticline. If so, the oil will probably come from the sand known locally as the Bartlesville, which lies just above the "Mississippi lime," although there are also chances of production from shallower sands, notably one 300 feet and another 900 feet above the Bartlesville (?) sand. The depth at which the sands will be encountered will depend on the topography, but in no well drilled on this fold should the Bartlesville (?) lie more than 2,200 feet below the surface.

There appears to be a strong possibility that oil sands lying from 100 to 300 feet below the Bartlesville (?) may be present, and at least one well-located test should be carried to a depth sufficient to prove the character of these lower beds.

Good locations for testing are indicated by the structure to be the southeast corner of the NE. ¼ NE. ¼ sec. 32, the southwest corner of the NW. ¼ SE. ¼ sec. 28, the center of sec. 27, and the center of the SW. ¼ sec. 34.

SAUCY CALF ANTICLINE.

The curving axis of the Saucy Calf anticline trends northward through the western part of secs. 36 and 25 and terminates a little north of the center of sec. 24. (See fig. 10.) The structure is marked by pronounced dips on the north, west, and south, but the dip on the east is much more gentle. The closure is about 25 feet. The anticline is a moderately large one, as the lowest closed contour encircles an area of about 1½ square miles, and the area in which the rocks are flexed into an anticlinal arch is considerably greater.

A group of wells on the crest and east flank of this anticline obtain oil from the "Oswego lime" and Bartlesville (?) sand. Showings of oil and gas have been found in other sands, but not in sufficient quantity to justify their exploitation. The initial production from the Bartlesville sand ranged from 20 to 1,000 barrels a day; the "Oswego lime" yielded from 6 to 20 barrels a day. The condition of the sands beneath this anticline appears to be peculiar, for some of the biggest wells are far down the east flank, where structural conditions as shown by the surface rocks are not particularly favorable for oil accumulation, whereas the only two dry holes that have been drilled are excellently located with respect to the surface structure. For this reason it appears probable that the dry holes do not in any sense mark the borders of the field, but that drilling beyond them may result in further production.

The chances are excellent that a large area on this anticline will yield oil. The present field will probably be extended in every direction. The oil sand may even continue to yield under the shallow syncline that bounds this anticline on the east, although the percentage of oil to gas will grow less and less as the drilling is carried eastward until nothing but gas is obtained, this field being thus joined with the small gas field that has been opened in the extreme southeast corner of sec. 36 and in the sections lying immediately east and southeast of sec. 36.

A deep well that was drilled about a mile southeast of the oil field in sec. 36 proved the presence of a gas-bearing layer more than 200 feet below the lowest producing bed in this field, and it is highly important that wells be drilled deep enough on the Saucy Calf anticline to test this layer and the beds for some distance below it. This will involve drilling to a depth of 2,400 feet or more.

UNFAVORABLE AREAS.

When the structure of T. 25 N., R. 9 E., is considered in a general way it appears that a very large part of the township lies in a zone of marked deformation. This indicates weakness in the rocks or unusual deformational stresses in this restricted zone, or both. In any

event it seems probable that the crumpling of the beds has been going on for a long period—probably since pre-Pennsylvanian time—and that the deep-lying beds accordingly have many wrinkles which do not appear on the surface. The general experience in the Osage region is that these zones of deformation are very likely to contain many pools of oil and gas which are to a certain extent independent of the minor structural features developed at the surface, and accordingly there are few localities in such a zone which are not worthy of a test by drilling. However, one or two districts in the township appear so distinctly unfavorable that it seems best to point them out. Among them is that part of the Bird Creek syncline which follows the course of Bird Creek from the east-central portion of sec. 5 to the center of the NE. ¼ sec. 9. No part of sec. 7 appears promising, and the W. ½ sec. 18, the N. ½ sec. 19, and the W. ½ sec. 20 fall in the same category. The broad, flat area which includes the S. ½ sec. 12, N. ½ sec. 13, and the N. ½ sec. 14 seems to be decidedly unfavorable. The syncline which covers the SE. ¼ sec. 34, and the W. ½ sec. 35 should be avoided, as should also the SE. ¼ sec. 33. Although it is not impossible that oil will be found in any of these unfavorable districts, it seems most likely that no commercial quantities will be obtained. At best they should be left undrilled until the remainder of the township has been explored, and even then they should not be drilled unless the conditions in some adjoining areas are so favorable as to indicate that they contain the extensions of some previously discovered pools.