T. 25 N., R. 10 E.

By Dean E. Winchester, K. C. Heald, and others.

INTRODUCTION.

The field work on T. 25 N., R. 10 E. (see fig. 1), was done by Dean E. Winchester, K. C. Heald, E. Russell Lloyd, and J. P. Buwalda. The areas covered by the different geologists are shown on Plate X. The elevations on the key beds and the exact locations of their outcrops were determined by plane-table surveying, except those on a small area in the southeastern part of the township, where barometers were used to determine elevations, pacing to determine horizontal distances, and compasses to determine directions. In this barometric work all the results were checked by two observers, and any results that appeared to be the least bit doubtful were discarded.

KEY ROCKS.

General features.—The exposed rocks in this township (see fig. 12) are of upper Pennsylvanian age and include sandstones, limestones, and shales. Sandstones form more than half the total thickness of the exposed rocks, but there are also thick beds of shale, particularly in the extreme southeast corner of the township. Limestones are very inconspicuous.

A comparison of the contouring of the structure in T. 25 N., R. 10 E., and that in T. 26 N., R. 10 E., reveals a failure of the contours in the two townships to join exactly. This is not due to faulty observation but rather to the fact that the geologists working in these townships based their work on different assumptions. In T. 26 N., R. 10 E., it was assumed that the key beds are approximately parallel to the middle bed of the Oread limestone, which is well exposed along the west line of the township and is the only part of the Oread represented here, and for most of the township there can be no doubt that this assumption is essentially correct. In T. 25 N., R. 10 E., it was assumed that most of the beds are parallel to the Labadie limestone, and here also the work shows that the assumption is correct. However, there is a convergence between the middle bed of the Oread limestone and the Labadie limestone, and because of this convergence the contouring in the two townships does not exactly connect.

Cochahee sandstone.—The Cochahee sandstone, named from its good exposures on the headwaters of Cochahee Creek, in the southwestern part of T. 25 N., R. 10 E., is a thin, flaggy bed about 45 feet above the Labadie limestone and 125 feet below the Oread limestone. It is very well exposed near Nelagoney, where it forms a rim capping the hill on whose flanks the town is built and shows as a well-defined ledge on the hill slopes overlooking Saucy Calf Creek just northwest of Nelagoney. It is here less than 3 feet thick, although in other places thicknesses of 10 to 25 feet have been noted. The sandstone is massive, hard, and fossiliferous and has a peculiar weathered surface suggesting turkey tracks. This peculiar surface and the fossil *Fusulina*, which in places are extremely abundant in this bed, are its most characteristic features.

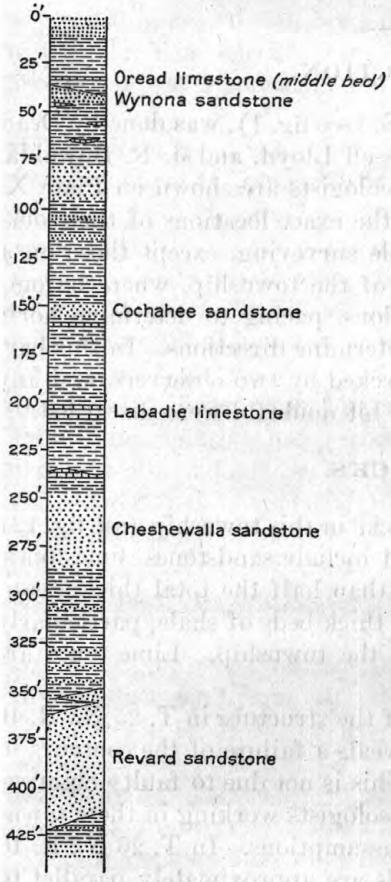

FIGURE 12.—Section of rocks exposed in T. 25 N., R. 10 E.

The Cochahee sandstone was particularly useful in determining the structure in the southwestern portion of the township. (See Pl. X.)

Labadie limestone.—The Labadie is the first limestone of any prominence below the Oread limestone, which is about 180 feet stratigraphically above it. In the northern part of T. 25 N., R. 10 E., it consists of two benches of limestone, each about 2 feet thick, separated by about 10 feet of gray shale. It is not conspicuous in this township and must be traced more by the vegetation, which is of a different character on the lime-impregnated soil from that on sandy soil above and below, than by actual outcrops of the limestone itself.

The outcrop of this bed could not be recognized west of Bird Creek. Lentils of limestone occur at about the horizon which it should occupy, but they show no characteristics which would make an accurate correlation possible. East of Bird Creek there are several good exposures, and it may be traced northwestward to the north line of the township. (See Pl. X.)

The Labadie limestone is both overlain and underlain by gray shale in which are thin beds of sandstone. Some of these thin sandstones are persistent and may be followed with much greater ease than the limestone. One which is about 11 feet below the limestone was particularly helpful in determining the structure in the northeastern part of the township.

Cheshewalla sandstone.—The first heavy bed of massive sandstone below the Labadie limestone is the Cheshewalla. Between it and the limestone are about 60 feet of shale and thin, hard sandstones, and in a few localities there is also a very thin limestone a few feet above the top of the Cheshewalla.

The lithology of the Cheshewalla sandstone is not distinctive enough to permit its identification by this means. It is fine grained, moderately well cemented, rather soft, and cross-bedded. Only a few fossils were noted in it, although there are fossiliferous sandstones both above and below it, and the base of the Cheshewalla itself carries a pelecypod fauna in some localities. Plant fragments are fairly common in it, but they are so thoroughly macerated that they can not be identified.

This sandstone is 20 to 50 feet thick and along most of its outcrop in this township appears as a single heavy bed without interbedded shale. However, it contains local lentils of red shale a mile or less in length, which cause the formation of benches. Such benches are traceable for short distances but are not reliable as horizon markers, as they pinch out most unexpectedly. Moreover, there is a constant temptation to pass over an area where a bench is obscured by talus and to pick up another bench on the other side of the obscure area, correlating the two and continuing the mapping on this basis. Actually there is little need to do this, for the top of the Cheshewalla may be followed very easily. In many localities there is a thin fossiliferous sandstone a short distance above it which makes the identification of the horizon certain. The base of the Cheshewalla may also be followed in parts of the township, but better results may be obtained by tracing one of the thin sandstones that underlie it.

This sandstone is very well developed near the point where Cheshewalla Creek empties into Nelagoney Creek, in the SE. ¼ sec. 9. It also shows up well below the bridge of the Missouri, Kansas & Texas Railway over Bird Creek, northeast of Nelagoney.

Revard sandstone.—The Revard sandstone, which lies about 145 feet below the Labadie limestone, is particularly prominent in the southeastern part of this township. It is 30 to 80 feet thick and consists of massive sandstone very similar to the Cheshewalla sandstone, with lentils of red shale. The shale lentils range in length from a few feet to a mile or more and in thickness from a few inches to 6 feet.

The Revard sandstone is one of the most persistent sandstones in the Pawhuska quadrangle, but in this township it is not a particularly good bed upon which to base structure contouring. The top of the sandstone is not clearly defined, nor is it confined to a single definite horizon. Locally the red shale which directly overlies the Revard sandstone is replaced by lentils of heavy sandstone (see fig. 13), and this introduces the possibility of error in mapping, for there

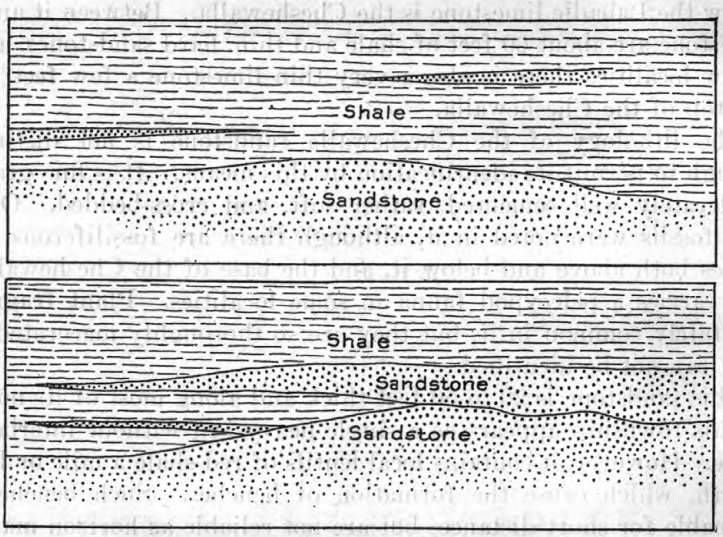

FIGURE 13.—Sketches illustrating observed instances of irregularity in the upper surface of the Revard sandstone in the southeastern part of T. 25 N., R. 10 E.

may be a difference of 30 feet in the total thickness of massive sandstone at points a quarter of a mile apart. Fair results may be obtained by following some of the shale lentils, but they are so short and so likely to be concealed by débris from the overlying beds that they are not very satisfactory as horizon markers. Wherever possible the thin sandstone beds a little below the base of the sandstone series should be utilized. Some of these beds are very persistent and have characteristics that render even isolated outcrops identifiable; for example, some beds carry quantities of small *Fusulina*, and other beds form benches that are definite enough to be traced for considerable distances. In places the base of the massive sandstone may be easily traced, for it is distinctive, being coarser and darker than the upper parts of the Revard sandstone and containing shale inclusions and numerous hollows and pits which presumably were originally occupied by such inclusions.

The type locality for this sandstone is at Revard Point, in sec. 13, T. 26 N., R. 10 E. A good reference locality is on the bluff facing Bird Creek due east of the town of Quapaw, in the NE. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec.

36, T. 25 N., R. 10 E. Here the top of the Revard sandstone is about 45 feet below the top of the hill.

PENNSYLVANIAN ROCKS BELOW THE SURFACE.

The unexposed rocks above the "Mississippi lime" are of the same general type as those which appear on the surface. Sandstone

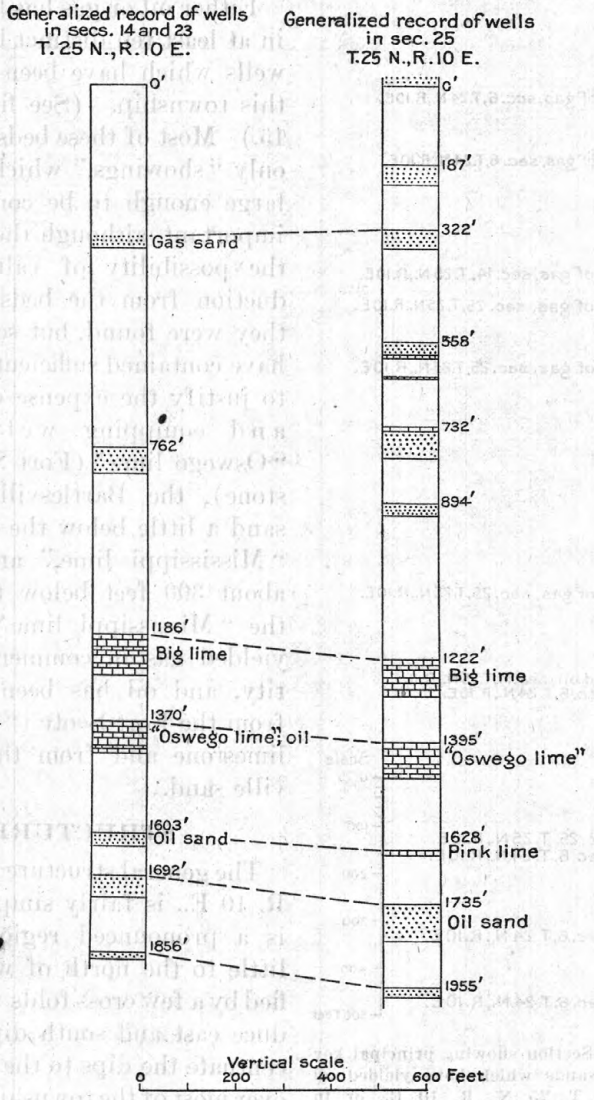

FIGURE 14.—Generalized records from wells in secs. 14, 23, and 25, T. 25 N., R. 10 E.

and shale make up about 90 per cent of the total above what is known to the driller 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 quantities of either fresh or salt water.

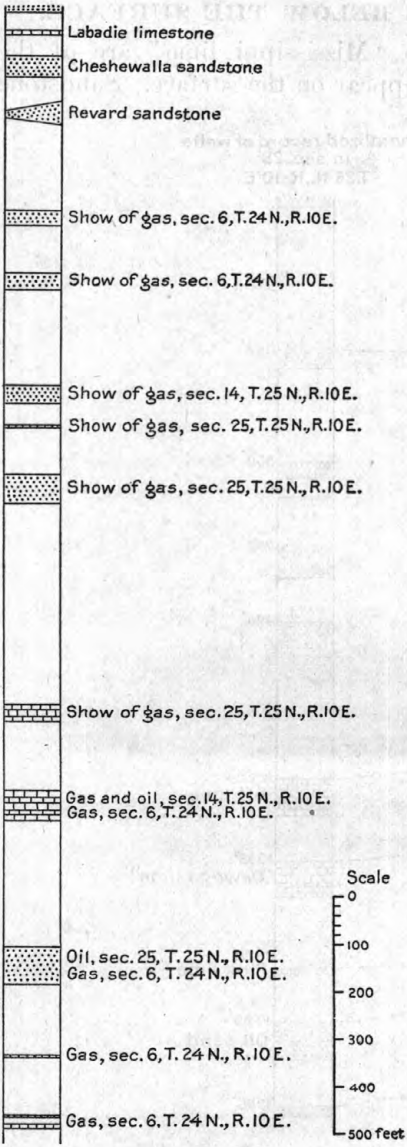

FIGURE 15.—Section showing principal key beds and sands which have yielded oil or gas in T. 25 N., R. 10 E., or in immediately adjacent territory.

Either oil or gas has been found in at least ten distinct beds in the wells which have been drilled in this township. (See figs. 14 and 15.) 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 contained sufficient oil or gas to justify the expense of drilling and equipping wells. The "Oswego lime" (Fort Scott limestone), the Bartlesville sand, a sand a little below the top of the "Mississippi lime," and a sand about 300 feet below the top of the "Mississippi lime" have all yielded gas in commercial quantity, and oil has been produced from the Fort Scott ("Oswego") limestone and from the Bartlesville sand.

STRUCTURE.

The general structure in T. 25 N., R. 10 E., is fairly simple. There is a pronounced regional dip a little to the north of west, modified by a few cross folds that introduce east and south dips and accentuate the dips to the north, but over most of the township the westerly dip dominates the structure.

The term "closure" as used in this report 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—that is, if the highest closed contour represents an elevation of 900 feet, the lowest closed contour an elevation of 880 feet, and the contour interval (vertical distance between successive contours) is 10 feet, the closure is approximately 30 feet.

ANTICLINES, DOMES, AND TERRACES.

KIHEKI DOME.

The highest point on the Kiheki dome is in the NW. ¼ sec. 10. The major axis extends northeastward into sec. 3 and southwestward

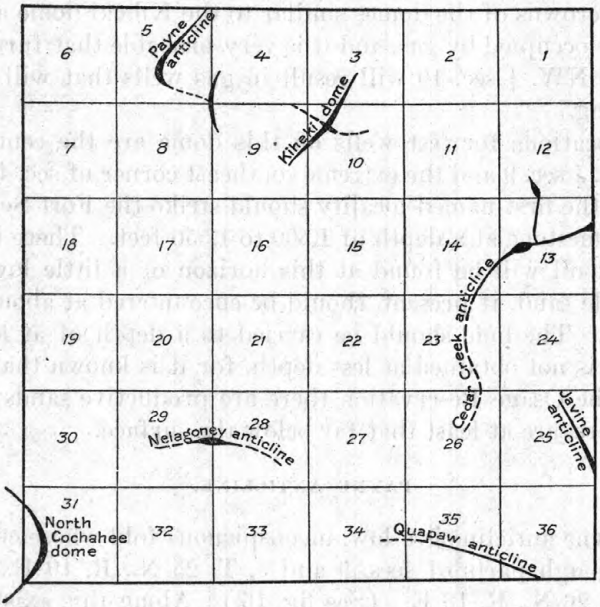

FIGURE 16.—Diagram showing approximate position of anticlinal axes in T. 25 N., R. 10 E.

into sec. 9. (See fig. 16.) The closure is 20 feet. The lowest and gentlest dips are on the southeast flank of the fold; on the other flanks the dips are much steeper. The area covered by this dome is small compared to that of many of the Osage County anticlines, for the lowest closed contour encircles a little less than half a square mile, and the territory over which the structure might be expected to exert an influence on the accumulation of oil or gas is probably a square mile or less.

A single well has been drilled on the Kiheki dome. It was drilled to the "Mississippi lime" and passed through all the beds which are

productive of oil in other parts of this township. Near the bottom of the hole it pierced a gas-bearing stratum which it was estimated would yield between 1,500,000 and 2,000,000 cubic feet a day. This yield was not considered sufficient to justify laying pipe to utilize it, and accordingly the hole was plugged.

The general experience in the Osage country has been that terraces and broad, low anticlines are more likely to be productive on the steeply dipping parts of the flanks than on the flat step of the terrace or the crown of the anticline. It therefore seems that there is much more likelihood that oil will be found in the SW. ¼ sec. 3, the SE. ¼ sec. 4, and the NE. ¼ sec. 9 than in the NW. ¼ sec. 10, where the test well mentioned above is located. (See Pl. X.) On the other hand, the crowns of the domes similar to the Kiheki dome are almost invariably occupied by gas, and it is very probable that further drilling in the NW. ¼ sec. 10 will result in gas wells that will be worth maintaining.

Good locations for test wells on this dome are the center of the NE. ¼ NE. ¼ sec. 9 and the extreme southeast corner of sec. 4. A well drilled at the first-named locality should strike the Fort Scott ("Oswego") limestone at a depth of 1,500 to 1,550 feet. There is a possibility that oil will be found at this horizon or a little lower. The Bartlesville sand, if present, should be encountered at about 1,850 to 1,900 feet. The hole should be carried to a depth of at least 2,300 feet if oil is not obtained at less depth, for it is known that in other parts of the Osage Reservation there are productive sands which, if present here, are at least that far below the surface.

PAYNE ANTICLINE.

The Payne anticline is a low, inconspicuous fold whose curved axis passes through parts of secs. 9 and 5, T. 25 N., R. 10 E., and into sec. 32, T. 26 N., R. 10 E. (See fig. 16.) Along this axis there are two distinct domelike humps where the rocks are arched slightly higher than elsewhere along the axis. The center of the southern of these humps is very near the southeast corner of sec. 5; the other is in the NW. ¼ SE. ¼ sec. 5.

The arch of this anticline is extremely flat. The closure is only 10 feet, and the rocks do not pitch steeply on the flanks of the fold. It would be classed as a terrace except for the presence of the two small humps mentioned above. Nevertheless the area over which it is believed this anticline may influence the accumulation of oil or gas is considerable, including part of the SE. ¼ sec. 4, most of sec. 5, the NE. ¼ sec. 8, and a small part of the NW. ¼ sec. 9.

Two wells that have been drilled near this anticline do not make it appear particularly favorable as a possible reservoir of oil and gas. The well on the Kiheki dome has been discussed above. A

well was drilled to the north, in sec. 32, T. 26 N., R. 10 E., by the Texas Co. in 1918. This test was not well located with respect to the structure, as it was far down on the south flank of a small anticlinal fold and was much closer to the axis of one of the marginal synclines than it was to the crest of the anticline. It was drilled to the "Mississippi lime" without obtaining a commercial flow of gas, although at least three sands yielded small amounts.

A well was drilled in the extreme northeast corner of sec. 7 some years ago. No facts concerning this test beyond its failure to encounter either oil or gas are now available, so it is not known whether or not it was drilled deep enough to pierce the sands which it is believed may carry oil or gas. However, the location of the well is extremely unfavorable, as it lies very close to the axis of a pronounced syncline, and its failure is not surprising.

In wells drilled on the Lookout anticline, less than 2 miles west of the Payne anticline, the Fort Scott ("Oswego") limestone or a sand associated with it has yielded large volumes of gas and a well drilled to the "Mississippi lime" had an initial daily production of about 25 barrels of oil.

From the size and shape of the Payne anticline and the gathering ground from which oil and gas may have migrated to accumulate under the anticline, it appears probable that gas will be found in paying quantity, and at least it is possible that the anticline will yield oil, although probably no large wells will ever be brought in here. Good locations for tests are near the center of the NE. ¼ SW. ¼ sec. 5 and in the center of the NE. ¼ NE. ¼ sec. 8. At these locations the Fort Scott ("Oswego") limestone should be between 1,500 and 1,700 feet below the surface, and the Bartlesville sand, if it is present, about 300 feet deeper.

LOOKOUT ANTICLINE.

The highest point on the Lookout anticline lies near the northwest corner of T. 25 N., R. 10 E., and the structure outlined by the closed contours covers territory in all four of the townships cornering here. The dips on all sides are pronounced. The closure is about 40 feet, and the territory which appears favorable for oil accumulation is about 2 square miles. Only a small part of this fold lies in T. 25 N., R. 10 E., and that part is not pronouncedly favorable for oil or gas, as it is on the southeast flank of the anticline, and the general experience in Osage County is that the west and northwest flanks of the anticlines are the portions most likely to contain oil.

Two wells have been drilled on the Lookout anticline. Both are near the top of the fold and constitute good tests, although neither was carried deep enough to test all the possibly productive sands. One of these tests, in the southeast corner of sec. 36, T. 26 N., R.

9 E., obtained a large volume of gas from shallow sands and a particularly heavy flow from the Fort Scott ("Oswego") limestone. The other, in sec. 31, T. 26 N., R. 10 E., was drilled through the horizons of the gas-bearing sands of the first-mentioned well and obtained oil from the "Mississippi lime." The initial production of this well was reported to be 25 barrels.

The size, shape, and location with respect to regional structure of this anticline lead to the conclusion that probably no very large wells will be developed on it. However, wells of moderate size may be expected. The best location on that part of the anticline which lies in T. 25 N., R. 10 E., appears to be the extreme northwest corner of sec. 6.

CEDAR CREEK ANTICLINE.

Only a portion of the Ceder Creek anticline lies in T. 25 N., R. 10 E. Its axis runs from the central part of sec. 26 northward and eastward and crosses the line into T. 25 N., R. 11 E., a little north of the middle of the east line of sec. 13. There are several gentle cross folds on it, the most pronounced of which joins the axis of the main anticline a little west of the center of sec. 13. (See fig. 16.) Only a single contour closes on that part of the anticline which is in T. 25 N., R. 10 E., and this one is of little significance, as it surrounds a very small upward bulge with a total area of less than 40 acres. However, the top of the anticline is very flat, and this fact makes it appear improbable that oil or gas in any quantity may have migrated along the axis and escaped to the east.

The productivity of this fold has already been demonstrated. Several oil wells and one gas well were drilled on or near its axis in the southern part of sec. 14 and the northern part of sec. 23 in 1910 and 1911 and were productive until 1915, when they were abandoned. These wells had initial yields of 10 to 50 barrels from the Fort Scott ("Oswego") limestone. Only a single dry hole was drilled in this little field, and the reasons why no effort was made to extend the producing area and why the lease was surrendered are not evident. It appears fairly certain that "offsets" to the old wells will encounter either oil or gas in paying quantity, and the fact that the Fort Scott limestone is the productive bed makes the expense of drilling much less than that of the wells which must be bored to the Bartlesville sand or the "Mississippi lime." Furthermore, it has not been established that the deeper beds will not be productive. One well was drilled through a sand corresponding to the Bartlesville sand of the field in sec. 25, without finding either oil or gas in it, but a single well does not prove that the sands are barren at this place. At least one, and preferably two more, should be drilled before such a statement can possibly be justifiable. The very fact that the deeper

sands yield abundantly less than 2 miles away makes it seem doubtful that they will be barren here.

There is strong evidence that a large field will be developed on this anticline. This conclusion is supported by the yield that has already been obtained, by the record of the one deep test which has been drilled on it and which shows abundant sands to act as oil reservoirs at the horizons where productive sands are found in near-by areas, by the productivity of similar folds in the township to the east, and by the presence of a great gathering ground to the west from which the oil may migrate for miles up a steep and uniform slope. Further support is found in a test well which was drilled near the axis of the anticline in the extreme northeast corner of sec 13. This well, which is shown as a dry hole on most of the oil maps of this region, is at present making some gas, and the ground around it shows that it also gave a very strong showing of oil. In fact, the indications are so favorable that an "offset" well would be justified.

This anticline should be very thoroughly tested. The failure of one or more tests will in no wise condemn it, for to judge from the township to the east it is to be expected that the sand conditions here are important and may in places neutralize the effect of the structure. Good locations for testing are listed below:

Center of SE. ¼ NE. ¼ sec. 13.
Center of NW. ¼ NW. ¼ sec. 13.
Center of NW. ¼ SE. ¼ sec. 14.
Center of SW. ¼ SE. ¼ sec. 14.
Center of SE. ¼ NW. ¼ sec. 23.
Center of SE. ¼ SW. ¼ sec. 23.

These tests to be adequate should be drilled at least 300 feet below the top of the "Mississippi lime"—that is, to a depth of at least 2,000 feet, and in some of the locations 2,200 feet. In this distance there are at least seven sands which have a chance to be productive and two beds—the Fort Scott limestone and the Bartlesville sand—which have yielded large quantities of oil and gas in this immediate region.

NELAGONEY ANTICLINE.

The Nelagoney anticline is a small pitching fold whose axis runs almost due west from the middle of sec. 28 to the middle of sec. 29. (See fig. 16 and Pl. X.) Structurally it is really more of a terrace than an anticline or dome, as there is but a single closed contour on it, and this one encircles so small an area that it is not significant. The fold shows moderate dips to the west, gentle dips to the north, very gentle dips to the south, and almost no dip to the east. (See contour map, Pl. X.) In fact, it would not be considered a particularly favorable place for oil and gas accumulation were it not

the only anticline in a wide area, a fact which gives it an excellent chance to entrap a part of the petroleum that has migrated up the dip from broad gathering grounds to the north, west, and south. That it has succeeded in arresting a part of this oil has been demonstrated by several oil wells which were drilled many years ago near the center of sec. 29. The field formed by these wells lies squarely on the axis of the anticline. The oil comes from the Bartlesville sand. The initial production ranged from 10 to 40 barrels, and the wells were long lived.

The size and shape of this anticline do not encourage the belief that any very large wells will be brought in on it. The present producing field occupies a portion of the fold which is structurally as favorable as any other that might have been chosen for testing. It seems probable that this field may be extended to the north and east, although there is a strong possibility that wells drilled more than 600 feet east of the easternmost of the present producing wells will encounter gas rather than oil. To the south the extension of the pool appears to be limited by a dry hole which was recently drilled, but in spite of this there is a very good chance for small production on a plunging anticlinal nose that occupies the SW. ¼ sec. 29 and may be considered a part of the Nelagoney anticline. A good location for a test in this area would be near the center of the west half of the quarter section.

JAVINE ANTICLINE.

Most of the Javine anticline lies in T. 25 N., R. 11 E., but one lobe of it extends into T. 25 N., R. 10 E. The axis of this lobe enters sec. 25 near the southeast corner and extends northward almost to the north line of the section. (See Pl. X.) This fold may be expected to influence oil and gas accumulation throughout the E. ½ and on a part of the NW. ¼ sec. 25.

The productivity of this fold has been established by nine oil wells and three gas wells in T. 25 N., R. 10 E., and by many wells in T. 25 N., R. 11 E. These wells obtain oil from the Bartlesville sand and had initial yields of 10 to 70 barrels a day. The gas wells came in at 4,000,000 to 9,000,000 cubic feet a day and obtain gas from the same sand as that yielding the oil in the oil wells. None of the wells have been bored deep enough to ascertain whether or not oil and gas bearing sands in the "Mississippi lime" underlie this field. However, they are known to be present at other localities in the Osage Reservation, and it should be assumed that they are present here until deep drilling has justified or disproved the assumption.

This anticline should be developed by extending the oil field which already exists. It can probably be extended both to the north and

to the west, although it is probable that the average initial production of the wells drilled west of the present field will be considerably smaller than the average of those which have been drilled to date. The shape of the anticline suggests that in the NE. ¼ NW. ¼ sec. 25 oil may be obtained from some of the sands above the Bartlesville sand, as there is here a structural terrace much like that on which the small field in secs. 14 and 23 is developed. This part of the anticline should be drilled even though attempted extension of the field in the SE. ¼ sec. 25 should result in dry holes.

At least one well should be bored on the Javine anticline to a horizon 300 feet or more below the bottom of any of the existing wells in sec. 25. A good location for this deep well is in the NE. ¼ SE. ¼ sec. 25. A fair location would be about 300 feet north and 900 feet west from the southeast corner of the section. The well should not be drilled farther west than this. Deep drilling far down on the flanks of anticlines is rarely justifiable unless other wells better located have already demonstrated the possible presence of deep-lying oil sands.

QUAPAW ANTICLINE.

The Quapaw anticline is an inconspicuous fold whose axis trends northwestward through the SW. ¼ sec. 36 and across the southern part of sec. 35. There is no closure, and the dips in all directions are gentle. The structure is not well adapted to effect an accumulation of oil or gas, and it is not in the least surprising that wells drilled near the axis of the fold in the SE. ¼ sec. 35 and in the SW. ¼ sec. 36 should have failed to find commercial amounts of oil or gas.

NORTH COCHAHEE DOME.

The North Cochahee dome is a small but well-defined uplift whose crown lies in the SW. ¼ sec. 31. The closure is about 20 feet. The rocks on the flanks of the dome dip fairly steeply in all directions from the crown. The dips to the north are particularly well defined, but the dips to the south are small both in degree and in vertical extent. The territory which seems to be distinctly a part of this dome as distinguished from the general regional structure includes the W. ½ sec. 31, T. 25 N., R. 10 E., and parts of sec. 36, T. 25 N., R. 9 E., sec. 1, T. 24 N., R. 9 E., and sec. 6, T. 24 N., R. 10 E.

Five wells, all excellently located with respect to the structure, have been drilled on this dome, and all have found large volumes of gas with showings of oil. Farther south, in sec. 6, T. 24 N., R. 10 E., wells on a similar dome, which is separated from the North Cochahee dome by a shallow saddle, have had initial yields of 25 to 350 barrels a day. The wells on the North Cochahee dome in sec. 31 are located

a little east of the center of the crown of the dome, but a gas well on this dome in the SE. ¼ sec. 36, T. 25 N., R. 9 E., is considerably west of the axis.

It appears probable that a large part of this dome is occupied by gas and will not yield oil, but oil will probably be found well down on the west, northwest, southwest, and southeast flanks. It seems likely that the oil field which has been developed in the western portions of secs. 25 and 36, T. 25 N., R. 9 E., may be extended to the east and join with the gas field in sec. 31, T. 25 N., R. 10 E., and in the SE. ¼ sec. 36, T. 25 N., R. 9 E.

Gas was found on this dome in many sands, but the strongest flows came from sands which were believed by the drillers to be the Bartlesville and beds in the "Mississippi lime." The deepest pro-

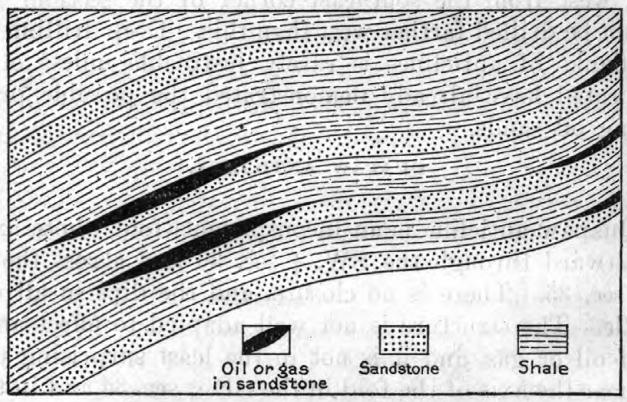

FIGURE 17.—Cross section illustrating flexing of beds in terrace structure and theoretical position of oil pool on terrace.

ducing gas sand is about 300 feet below the top of the "Mississippi lime." The oil wells in sec. 6, T. 24 N., R. 10 E., and secs. 25 and 36, T. 25 N., R. 9 E., obtain their oil from the Bartlesville (?) sand. In secs. 25 and 36 some oil and gas are also obtained from the Fort Scott ("Oswego") limestone.

A good location for a test well on that part of the dome which is in T. 25 N., R. 10 E., is near the southwest corner of the NW. ¼ sec. 31. An alternative location is the southwest corner of the NW. ¼ NW. ¼ sec. 31.

SWAIN TERRACE.

In the SW. ¼ sec. 15 and the NW. ¼ sec. 22 there is an area of terrace-like structure where the rocks dip very gently westward for some distance and then plunge sharply in the same direction, giving a cross section like that shown in figure 17. This terrace may have caused oil or gas to accumulate. Similar terraces elsewhere in Osage County have yielded oil, particularly from the sands above the

Bartlesville. Accordingly it seems that this flexure is worthy of a test. A good location for the test is about 300 feet north and 600 feet west of the southeast corner of sec. 16. In this area drilling below the Bartlesville sand, which should be found at about 1,850 feet, is not recommended.

UNFAVORABLE AREAS.

The structure over much of T. 25 N., R. 10 E., seems to be unsuited to bring about appreciable accumulations of oil or gas. This does not necessarily mean that pools of oil or gas do not exist under the unpromising areas, as favorable conditions in the oil sands may entirely counterbalance the unfavorable effects of the attitude of the beds; but unless these areas are invaded by the extension of pools opened on territory which is structurally more favorable it should not be prospected without due recognition of the risks. The probabilities are very great that such prospecting will result either in total failures or in wells of such small productivity that the cost of drilling will never be repaid. This is shown by the wildcat drilling which has already been done in this township. Of the nine holes known to have been bored outside of any area of anticlinal structure, not a single one showed sufficient oil or gas to justify an attempt at production.

Areas where the structure is unfavorable include the S. ½ sec. 1, all of sec. 2, the N. ½ sec. 3, the N. ½ sec. 4, the E. ½ sec. 6, the SW. ¼ sec. 7, all but the SE. ¼ sec. 11, the N. ½ sec. 12, the W. ½ sec. 16, secs. 17, 18, and 19, the W. ½ sec. 21, the W. ½ sec. 27, the E. ½ sec. 28, all but the SE. ¼ sec. 30, sec. 32, and the W. ½ sec. 33.

The fact that these lands are listed as structurally unfavorable must not be taken to indicate that the rest of the township is structurally favorable. Much of the area not listed above certainly can not be regarded as structurally favorable, but at the same time its structure is not of such a type as to preclude absolutely the possibility of success.