THE LOCO GAS FIELD, STEPHENS AND JEFFERSON COUNTIES, OKLAHOMA.

By CARROLL H. WEGEMANN.

INTRODUCTION.

The Loco gas field is on the line between Stephens and Jefferson counties, Okla., about 3 miles southwest of the village of Loco and 10 miles northwest of the Healdton oil field. (See Pl. VI and fig. 3.) It is 18 miles east of the line of the Chicago, Rock Island & Pacific Railway. For many years asphalt deposits have been known to exist in this vicinity, but deep drilling for oil and gas was not begun until 1912. The first gas well was struck in the spring of 1913, about six months before the Healdton pool was discovered. Six other gas wells of capacities ranging from 6,000,000 to 20,000,000 cubic feet a day have been drilled, but no pipe line has yet been laid to the field and the wells are capped.

The field work on which the following report is based was done in November, 1913, the writer being assisted by Mr. R. W. Howell, of whose aid, both in the field and in the office, he desires to express his appreciation. The report has been prepared under a cooperative agreement between the United States Geological Survey and the Oklahoma Geological Survey, according to which each organization furnished a part of the funds necessary for the work.

Thanks are due to the Oklahoma Diamond Oil & Gas Co., the Washita Gas & Fuel Co., and Messrs. McQueen Bros. for logs of their respective wells; also to Mr. M. M. Hightower, Mr. W. J. Collier, and other residents of the district, who supplied valuable information and extended courtesies during the prosecution of the field work.

HISTORY OF DEVELOPMENT.

For many years asphalt seeps have been known to exist along a belt of territory lying southwest of the town of Loco, in Stephens County, Okla., and extending in a general northwesterly direction. In 1903 an unsuccessful attempt at development of the asphalt deposits was made by the Tar Springs Refining Co., whose works were built just south of the center of sec. 25, T. 3 S., R. 5 W. The refinery burned down soon after operations were begun, and current report states that owing to the lack of transportation facilities the venture would not in any event have been profitable. The same company drilled a well 1,000 feet northeast of the pit from which the asphalt-bearing sandstone was obtained, but apparently met with no success. It is reported that the well is not more than 600 or 700 feet deep.

R. V. LeGrande, of the Tar Springs Refining Co., after the burning of the asphalt plant, opened mines on grahamite deposits in sec. 6, T. 2 S., R. 4 W., 6 miles north of Loco, which for a time were worked with profit. He was also instrumental in putting down a dug well in search of oil near the south quarter corner of sec. 10, T. 3 S., R. 5 W., about a quarter of a mile north of a water well in which asphalt was encountered. The well was 142 feet in depth and by bailing twice daily would produce about 3 barrels of dark, heavy oil every 24 hours. The product was used in the vicinity as lubricating oil.

Deep drilling in the Loco field was begun by the Oklahoma Diamond Oil & Gas Co. in October, 1912. The first well was drilled in sec. 6, T. 3 S., R. 5 W., and encountered traces of oil and gas, but not in quantities sufficient to warrant development. Four other wells were drilled by the same company in the spring of 1913 in secs. 10 and 15, T. 3 S., R. 5 W. All obtained gas under heavy pressure, the estimated capacity of the wells ranging from 6,000,000 to 20,000,000 cubic feet a day. About the same time the Washita Oil & Gas Co. drilled a well in sec. 15 which had a daily capacity of 15,000,000 cubic feet. McQueen Bros. drilled in the SW. ¼ sec. 3 of the same township but obtained only a showing of oil. The Oklahoma Diamond Oil & Gas Co. drilled during the winter of 1913–14 a well in the NW. ¼ SW. ¼ sec. 14, T. 3 S., R. 5 W., which obtained a little heavy oil, but no gas in commercial quantity. During 1914 the same company drilled a dry hole in the NE. ¼ NE. ¼ sec. 10, T. 3 S., R. 5 W., a gas well in the NW. ¼ NW. ¼ sec. 15, T. 3 S., R. 5 W., and an oil well near the middle of sec. 9, T. 3 S., R. 5 W. This last-named well is reported to yield about 25 barrels of heavy petroleum daily, as well as gas in considerable quantity.

The Nippon Oil Co. is at the time of writing (April, 1915) drilling a well in the NE. ¼ SE. ¼ sec. 26, T. 3 S., R. 5 W.

LOCATION OF THE LOCO GAS FIELD WITH REFERENCE TO THE HEALDTON OIL FIELD.[1]

As stated above, the wells in the Loco field are in secs. 9, 10, and 15, T. 3 S., R. 5 W., but outcrops of asphalt-bearing sandstone occupy a belt of territory having a maximum width of 3½ miles and extending from sec. 32, T. 3 S., R. 4 W., northwestward as far as the SE. ¼ sec. 31, T. 2 S., R. 5 W., a distance of about 9 miles.

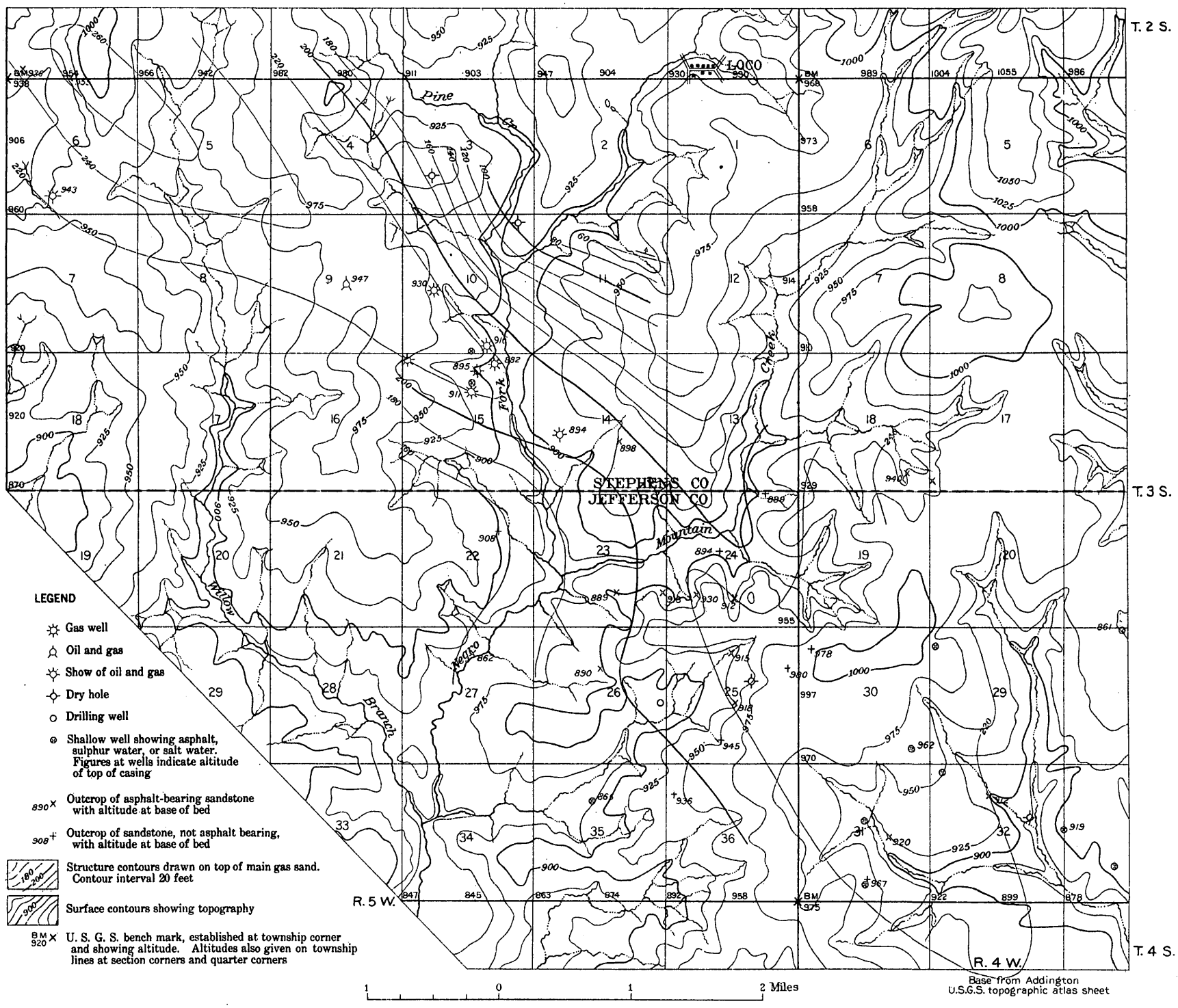
The northwest end of the Healdton pool lies in sec. 36, T. 3 S., R. 4 W., 9 miles southeast of the gas wells at Loco and 4 miles east of the nearest asphalt deposits in the Loco dome. (See fig. 3.)

Between the two fields is an area extending from the NE. ¼ SE. ¼ sec. 36, T. 3 S., R. 4 W., to the SE. ¼ NE. ¼ sec. 32, of the same township, a distance of 4 miles, in which there are no surface indications of petroleum and in which the wells already drilled have failed to encounter oil or gas.

[1] See pp. 13–30 of this bulletin.

U. S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

BULLETIN 621 PLATE VI



MAP OF THE LOCO GAS FIELD, STEPHENS AND JEFFERSON COUNTIES, OKLAHOMA.

By Carroll H. Wegemann.

TOPOGRAPHY.

Loco is on the southwest edge of a belt of sandy wooded country which borders the Arbuckle Mountains. The territory is rather more rolling than that of the treeless plains farther west, but the relief does not exceed 150 feet. The drainage of the Loco field is effected by branches of Mud Creek, a tributary of Red River.

STRATIGRAPHY.

The rocks exposed in the Loco field are of Permian age and consist of sandstone, shale, and fine conglomerate. The rocks lie stratigraphically lower than the beds that are exposed on the surface of the plains region a few miles farther west and are considerably more sandy. The following section of the lowest rocks exposed in the Loco field, which was measured near the crest of the anticline in the SW. ¼ sec. 24, T. 3 S., R. 5 W., will give a general idea of the nature of the rocks exposed, particularly the asphalt-bearing beds.

Section of rocks exposed in the SW. ¼ sec. 24, T. 3 S., R. 5 W.

Top.	Feet.
Sandstone, coarse, buff, or brown, composed of quartz, feldspar, zircon, and a highly altered manganese (?) mineral. Cement brown to opaque; some grains well rounded, others angular. Average diameter of grains, 0.303 millimeter	18
Shale, blue	3
Shale, red (poorly exposed); about 3 feet above the base fragments of very dark ferruginous sandstone lying on surface of outcrop	35
Shale (?); near the top are great numbers of round and irregular-shaped pebbles resembling concretions apparently derived from a bed of shale conglomerate similar to those described by various authors as occurring in the Wichita formation[1]	5
Sandstone, impregnated with asphalt; weathers white	3
Sandstone, calcareous, mottled gray and brown; weathers into large rounded forms, black on surface. Consists of quartz with apatite and rutile inclusions, zircon, and plagioclase; quartz grains somewhat separated from one another, subangular. Cement calcite, parts of which are very impure, giving rise to the mottled appearance	5
Sandstone, greenish white, thin bedded, fine grained. Cement calcite. Some of the layers carry a little asphalt	5
Shale, red and gray	3
Sandstone, cross-bedded, greenish white to black, according to the nature of the cement, which in some layers is calcite and in others entirely asphalt. Consists of quartz, with apatite and rutile inclusions, zircon in comparatively large amount, muscovite, and hornblende (?). The quartz grains are in some specimens separated from one another as if forced apart by the crystallization of the calcite forming the cement between them	5
Shale conglomerate containing pebbles which resemble concretions, bluish gray	⅛
Shale, red.	

[1] Udden, J. A., and Phillips, D. McN., A reconnaissance report on the geology of the oil and gas fields of Wichita and Clay counties, Tex.: Texas Univ. Bull. 246, Austin, 1912.

Overlying the rocks described in the above section are those which form the surface in the timbered belt northeast of the Loco anticline. These consist of alternating beds of shale and sandstone in about equal amount. The sandstone beds are for the most part white, bluish white, or gray, but are in some places red. The rock is comparatively coarse grained, some thin beds being conglomeratic and the individual grains being well rounded. The cement is calcareous. The character of the beds is shown by the following stratigraphic section, which was measured in a deep valley between the old grahamite mines in sec. 6, T. 2 S., R. 4 W., 6 miles north of Loco.

Section of rocks exposed near grahamite mines in sec. 6, T. 2 S., R. 4 W.

Top.	Feet.
Sandstone, white, with brown ferruginous layers	15
Sandstone, white, flecked with brown. Under the microscope shows quartz with rutile and apatite inclusions, altered feldspar, zircon, and tourmaline	15
Cement calcite. Brown specks, probably manganese. Average size of grain 0.126 millimeter	10
Covered; near top 2 to 4 feet of brown ferruginous sandstone, forming ledge	22
Sandstone, buff	2
Covered	20
Sandstone, white; upper part calcareous	6
Sandstone, bluish black, coarse. Contains small round concretions the size of buckshot, which weather out on surface, apparently of same material as mass of the rock. On extraction with chloroform, yields asphaltic oil in considerable amount	12
Sandstone, dark brown, coarse. Color probably due in part to content of manganese oxide. Upper part of bed cream-color streaked with dark brown	9
Conglomerate, pebbles of blue shale, cemented by calcite, hard, dolomitic	½
Sandstone, brown and black	3
Shale, blue	18
Sandstone, white, buff, and brown, hard; calcite cement; contains round pyrite concretions as much as 2 inches in diameter. The basal layers are irregularly impregnated in streaks and patches with petroleum, of which the rock smells strongly. The upper layers of the ledge are shaly and cross-bedded. The bed resembles in many respects the lower asphalt-bearing sandstone exposed in sec. 24, T. 3 S., R. 5 W.	10
Conglomerate, pebbles of blue shale cemented by calcite; a shade of red in some layers	2
Shale, blue, sandy, blotched with red. Base not exposed.	

The sandy series is about 300 feet thick and forms a marked feature of the Permian over a considerable area. It constitutes the surface rocks in the wooded country northeast of the Healdton field as well as the high divide in the vicinity of the grahamite mines. This divide may be traced northwestward to the "base line road" 5 miles

southeast of the Duncan gas field,[1] and it is probable that the low hills that partly encircle the Lawton oil and gas field,[2] 50 miles farther west, are formed by this same sandy series.

Fossil plants have been collected in the vicinity of Dixie, 6 miles east of Loco, from the red shale and fine-grained sandstone within or below the sandy series just described and have been determined by David White as probably of Permian age.

Knowledge of the strata underlying the surface in the Loco field is furnished by the logs of the deep wells. The beds consist of alternating shale and sandstone to a depth of about 800 feet. The red shale extends to depths ranging from 500 to 700 feet, the shale below being prevailingly blue or gray. The sandstone beds in the series just described appear to be fairly continuous over the area and by means of them the logs of the various wells may be correlated. Below this series, which is believed to be of Permian age, lie thick beds of blue or black shale alternating with beds of limestone. The rocks include also beds of sandstone, but the section as recorded in the logs of three of the deeper wells varies greatly, as if different parts of a rock series were penetrated in different wells. This series is believed to be of Pennsylvanian age, which is indicated by certain fossils obtained in the drill cuttings in some of the deeper wells, and is supposed to lie unconformably below the Permian strata. If the Pennsylvanian beds here dip at a considerable angle it is evident that wells put down at different localities will not encounter equivalent beds, and that the variations noted in the well logs are thus easily accounted for. The precise line of demarcation between the Pennsylvanian and the overlying Permian can not be determined, but it probably lies within 200 feet of the sand that in the productive wells is the principal gas horizon. In well No. 6 of the Oklahoma Diamond Oil & Gas Co. (No. 8 on Pl. VII), for example, it would appear to lie somewhere between 650 and 850 feet below the surface, possibly just above the 25 feet of limestone recorded at 860 feet. In well No. 7 of the same company (No. 5 on Pl. VII), which is about a mile northwest of well No. 6, this limestone is not recorded, and in well No. 1 of the Oklahoma Diamond Oil & Gas Co. (No. 1 on Pl. VII), which is 3 miles northwest of No. 7, the beds between 1,086 and 1,461 feet are for the most part limestone.

The unconformity noted in the wells of the Loco field may be well observed along the west end of the Arbuckle Mountains, about 15 miles northeast of the field. Here the horizontal Permian beds lie unconformably on steeply dipping strata ranging in age from Ordovician to Carboniferous, and the same general condition may be seen along the Wichita Mountains, which lie 50 miles northwest of the

[1] See pp. 43–50 of this bulletin.

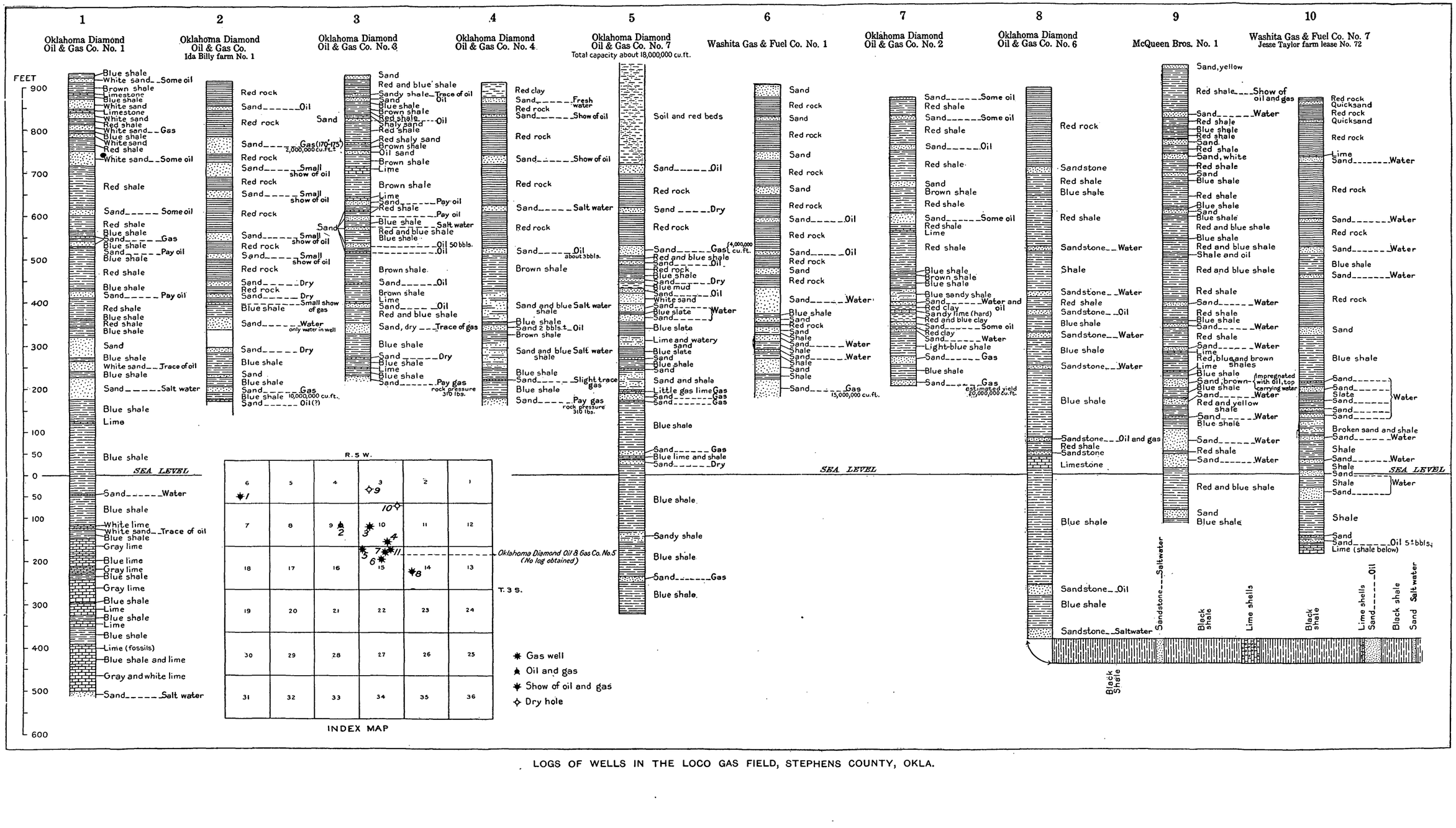
[2] See pp. 71–85 of this bulletin.

Arbuckle Mountains. This unconformity between the Pennsylvanian and the Permian appears to have been only local in extent, for in north-central Texas, where the same rocks are exposed at the surface, the Cisco formation, the highest division of the Pennsylvanian, appears to be perfectly conformable with the overlying Permian beds. Somewhere between the Arbuckle-Wichita uplift and the Texas area the unconformity which exists along the mountains must disappear, but the Loco field is evidently well within the area affected by it. A tentative correlation between certain well logs of the Loco and Healdton fields seems to show that the gas-bearing sands at Loco lie within 200 feet of the surface on the crest of the Healdton dome. As most of the oil at Healdton is found in Permian strata at a depth of 800 or more feet below the surface, it is evident that the Permian beds at Healdton are lower than any represented at Loco and that the Permian in the Healdton field as originally deposited was somewhat thicker than in the Loco area. The surface on which the Permian beds were deposited appears to have been one of considerable relief, and variations in the thickness of the Permian are probably due to the irregularities of the old land surface.

INTERPRETATION OF STRUCTURE CONTOURS.

The structure contours given on Plate VI are drawn upon the surface of the main gas sand (see Pl. VII) and represent the slope of the folded surface of that bed. Every point along any given contour is at the same elevation above or below sea level, the lines being drawn at intervals of 20 feet. To one unfamiliar with the interpretation of contours the following somewhat fanciful conception may be of assistance.

Were it possible to remove all of the overlying strata and to walk about on the surface of the oil sand, the course followed by one who endeavored to walk always at an elevation of 200 feet above the level of the sea, never stepping up or down, but walking always at the one level, would be that indicated by the 200-foot contour on the map. When the pedestrian came to a knoll or jutting point, he would be compelled, in order to keep at the same level, to walk around its side. When he reached the valley which lay between this knoll and the next he would be obliged to walk up the valley to a point where its floor was level with that of the hillside which he had just left. In other words, his course, were it represented by a line, would outline the form of the hills and valleys or their contour. A series of lines ("contours") drawn at given intervals above sea level will indicate very clearly, to one accustomed to the reading of contours, the form of the surface represented by them.



LOGS OF WELLS IN THE LOCO GAS FIELD, STEPHENS COUNTY, OKLA.

STRUCTURE.

Rock structure, as shown on the accompanying map (Pl. VI), has been worked out from a comparison of the logs of the several wells and from observations on an asphalt-bearing sandstone which outcrops at many places in the Loco field and which lies about 600 feet stratigraphically above the principal gas-bearing horizon. This asphaltic sandstone, or rather series of sandstones, for the different beds are separated by thin beds of shale, is about 20 feet thick, as is shown in the stratigraphic section given on page 34. At some places in the exposures it is possible to distinguish the relation of the particular bed on which observations are taken to the other beds in the series. The asphalt-bearing beds are thus a great aid in an accurate determination of the structure, for by calculating the altitude of the base of the series throughout the field, the nature of the rock folds becomes apparent. The asphalt-bearing sandstones in this area are so uniformly impregnated with asphalt as to make it seem probable that they represent former oil sands which have been brought to the surface by erosion, the petroleum in them being oxidized to asphalt.

The largest exposures of the bed of asphaltic sandstone lie in secs. 23, 24, 25, and 26, T. 3 S., R. 5 W., and outline in cross section an anticline the axis of which trends in a northwesterly direction. (See Pl. VI.) The crest of the dome in this vicinity lies in the middle of the SW. ¼ sec. 24, the base of the asphaltic sandstone layer here being at an altitude of 930 feet. From the crest the bed dips to the northeast and to the southwest. To the northeast it may be traced for a quarter of a mile, being well exposed in the SE. ¼ NW. ¼ sec. 24, where, however, the rock is entirely free from asphalt and consists of a hard, compact, dirty-white calcareous sandstone. This rock appears to be identical with certain thin beds that alternate with the asphaltic sandstone beds farther southwest. The base is at an altitude of 894 feet, showing a dip of 36 feet to the northeast between this exposure and the one above described. The bed northeast of this point appears to be practically horizontal for at least half a mile, as the base of what is believed to be the same bed exposed 1,300 feet west of the northeast corner of sec. 24 is at an altitude of 899 feet.

In the SE. ¼ sec. 18, T. 3 S., R. 4 W., are exposed two beds of asphalt-bearing sandstone, the stratigraphic distance between the bases of which is 40 feet. These two sandstone beds are believed to represent the asphalt-bearing sandstone together with the highest bed in the exposure on the wooded knoll at the crest of the dome in the SW. ¼ sec. 24, T. 3 S., R. 5 W. (See p. 33.) If this correlation is correct the lower bed in the SE. ¼ sec. 18, T. 3 S., R. 4 W., lies 41 feet higher than the same stratum a mile to the west, and in the NE. ¼ sec. 24 there is a shallow syncline, on each side of which are showings

of asphalt. The axis of this syncline, as may be seen on Plate VI, plunges to the north.

Southwest of the crest of the anticline, in the SW. ¼ sec. 24, T. 3 S., R. 5 W., the asphalt-bearing stratum dips to the southwest. Its base is at an altitude of 913 feet in the NE. ¼ SE. ¼ sec. 23 and at 889 feet one-third of a mile farther west. In the SE. ¼ NW. ¼ sec. 26 the same stratum is at an altitude of 890 feet, or 40 feet lower than it is on the crest of the dome a mile to the northeast. The same bed is exposed in the NE. ¼ NW. ¼ sec. 25, T. 3 S., R. 5 W., at an altitude of 915 feet, and at the old asphalt works just south of the center of the section it lies at an altitude of 918 feet. It is reported that asphalt was struck in a well 48 feet in depth in the NE. ¼ NW. ¼ sec. 35, T. 3 S., R. 5 W. The altitude of the surface at this well is 865 feet. The shape of the crest of the fold is indicated in sec. 25, T. 3 S., R. 5 W., and sec. 30, T. 3 S., R. 4 W., by altitudes on the bed of sandstone already mentioned as lying about 40 feet above the asphalt-bearing bed. The base of a sandstone believed to represent this higher bed lies at an altitude of 978 feet in the NW. ¼ NW. ¼ sec. 30, T. 3 S., R. 4 W. In the SE. ¼ NE. ¼ sec. 25, T. 3 S., R. 5 W., it is at an altitude of 980 feet, the bed being therefore practically flat between the two places. From the latter point, however, the dip is to the southwest, the base of the bed lying at an altitude of 945 feet in the SE. ¼ SW. ¼ sec. 25, T. 3 S., R. 5 W. What is believed to be the same bed is exposed in the NW. ¼ NW. ¼ sec. 36, where its base is at an altitude of 936 feet.

The extension of the Loco anticline to the southeast is indicated at several places in the southwestern part of T. 3 S., R. 4 W., by the presence of the lower asphalt-bearing sandstone. In the NW. ¼ SE. ¼ sec. 31 the bed is exposed at an elevation of 920 feet above sea level. A few hundred feet northwest of this locality sulphur water was encountered in a dug well. In the SE. ¼ SW. ¼ of the same section water carrying the taste of petroleum was found in a well at a depth of 43 feet, or about 930 feet above sea level. The upper sandstone is here exposed at the surface, its base being at an altitude of 967 feet, and it is probable that the water in the well comes from the top of the lower or asphalt-bearing bed, which is about 21 feet thick. The base of this bed is therefore at an altitude of 909 feet at this locality. The water in the well belonging to E. A. Burton, in the SE. ¼ SE. ¼ sec. 30, T. 3 S., R. 4 W., is highly impregnated with asphalt, which coats the bucket in which the water is drawn. The altitude of the mouth of the well is 962 feet, and the well is reported to be 54 feet in depth, so that the asphalt-bearing sandstone probably lies at an altitude of about 908 feet. In the NW. ¼ NW. ¼ sec. 32, T. 3 S., R. 4 W., salt water was encountered in a well, and in the NE. ¼ NW. ¼ of the same section the asphalt-bearing sandstone outcrops at an altitude of 912

feet. Asphalt is reported in a well in the SE. ¼ NE. ¼ sec. 32, T. 3 S., R. 4 W., which is said to be 40 feet in depth. The altitude of the mouth of the well is 919 feet. A test well 2,100 feet in depth has been drilled in the SW. ¼ NE. ¼ sec. 32, on the Boles farm, which did not encounter oil or gas in paying quantity. Sulphur water is found in a well in the SE. ¼ SW. ¼ sec. 33, in the same township, and salt water is found in a well belonging to Julia Long in the NW. ¼ NE. ¼ sec. 3, T. 4 S., R. 4 W. There are no surface indications of asphalt or petroleum in this vicinity nor to the east as far as the wells in the SE. ¼ sec. 36, T. 3 S., R. 4 W., at the northwest end of the Healdton field. In the NW. ¼ NW. ¼ sec. 29, T. 3 S., R. 4 W., asphalt is reported in an old well, and in the SE. ¼ SW. ¼ sec. 21 of the same township the water in a well on the Sessum farm tastes slightly of petroleum. The well is reported to be 119 feet in depth, and the altitude of its mouth is 861 feet.

Northwest of the outcrops in secs. 23 and 24, T. 3 S., R. 5 W., above described, the lower or asphalt-bearing sandstone is exposed in the NW. ¼ SE. ¼ sec. 14 at an altitude of 898 feet. A mile southwest of this locality a sandstone which is believed to represent the highest bed exposed in the SW. ¼ sec. 24, T. 3 S., R. 5 W. (see section on p. 33), is exposed, its base being at an altitude of 908 feet. In the NE. ¼ NW. ¼ sec. 27 an asphalt seep known as the Tar Spring occurs in what is believed to be the lower or asphalt bed, the base of the asphalt stratum being at an altitude of 862 feet.

Along the stream valley in the NE. ¼ sec. 11 a bed of sandstone is exposed continuously for about half a mile. Altitudes taken at several places along the bed indicate a rather pronounced dip north-northeastward. In the N. ½ sec. 4, T. 3 S., R. 5 W., three different beds of sandstone are exposed, which have a pronounced dip to the northeast. Their relation to the beds thus far described could not be determined. Just north of the township line road, in the SE. ¼ SW. ¼ sec. 31, T. 2 S., R. 5 W., the lower or asphalt-bearing sandstone is exposed, the asphalt stratum being at an altitude of 955 feet. About 600 feet farther east the hill is capped by the upper sandstone, the base of which is at an altitude of 997 feet. The asphalt-bearing bed is exposed in the SW. ¼ SW. ¼ sec. 31, where it lies at an altitude of 936 feet. There is therefore in this locality a dip to the west of 19 feet in about one-third of a mile, and the anticlinal axis lies farther east, its crest being perhaps coincident with that of the wooded hill, part of which lies in the NE. ¼ sec. 6, T. 3 S., R. 5 W.

The structure in the vicinity of the gas wells has been worked out principally by means of the information afforded by the well logs, but as it is often difficult to make exact correlations between the logs of different wells conclusions based upon them must be taken as more or less conjectural. The gas wells in the NE. ¼ sec. 15, T. 3 S., R. 5 W., appear to be on the point of an anticline which extends in a northwest

direction. North of the wells in the east part of section 10 there is a rather steep dip to the northeast (see Pl. VI), which is present also in the NE. ¼ sec. 11, T. 3 S., R. 5 W., as is shown by the exposures of a bed of sandstone at this locality. South of the wells in the south half of sec. 15 there is a dip to the southwest. Under these conditions the end of the anticline in the NE. ¼ sec. 15 constitutes a most favorable location for the accumulation of gas.

In the SW. ¼ sec. 24, T. 3 S., R. 5 W., there is a second end or "nose" of an anticline which might be tested by a well located at the south end of the small wooded knoll at this locality. The dips on the flanks of this fold are not, however, as steep as are those on the flank of the similar structure noted in sec. 15. If the well in the SE. ¼ SW. ¼ sec. 24 were successful the area to the south should be tested, particularly the NE. ¼ sec. 25, T. 3 S., R. 5 W., the southwestern part of sec. 30, T. 3 S., R. 4 W., and the northeastern part of sec. 31, T. 3 S., R. 4 W. The well of the Nippon Oil Co., in the NE. ¼ SE. ¼ sec. 26, T. 3 S., R. 5 W., is on the flank rather than on the crest of the anticline.

If the lower of the two asphaltic sandstone beds exposed in the SE. ¼ sec. 18, T. 3 S., R. 4 W., is the same as the bed exposed in secs. 24 and 25, T. 3 S., R. 5 W., it is evident that the strata are higher in this locality than they are farther to the west, and a test well might be drilled near the southeast corner of sec. 18, T. 3 S., R. 4 W.

The well drilled by the Oklahoma Diamond Oil & Gas Co. near the center of sec. 9, T. 3 S., R. 5 W., on the Ida Billy farm, obtained dark and rather heavy oil with a production as reported of 25 barrels. This well appears to be located on a broad structural terrace, and as far as our present knowledge goes most of the N. ½ sec. 9, with the exception of a small area near the northeast corner, should be territory as good as that on which the well is situated. Well No.1 of the Oklahoma Oil & Gas Co., in the SE. ¼ SW. ¼ sec. 6, T. 3 S., R. 5 W., obtained only showings of oil and gas. The location of the anticlinal axis in this locality is somewhat uncertain; it appears to lie about three-quarters of a mile northeast of well No. 1. A well drilled in the NE. ¼ NE. ¼ sec. 6, T. 3 S., R. 5 W., should prove a fair test of the locality.

The above suggestions in regard to prospecting the field are made after a careful consideration of all the data available. The reader should bear in mind, however, that rock outcrops in parts of this area are very few and that a slight error in correlation between beds in surface exposures or in well logs might change materially the apparent shape of the structure. If the information concerning the area is meager, the predictions in regard to the location of oil and gas pools in it must be either meager or more or less conjectural. The writer in his work has endeavored to go as far as possible in his predictions, trusting to his reader to interpret his remarks in the spirit in which they are written.

ORIGIN OF THE OIL AND GAS.

Oil and gas in the Loco field occur in small quantities in many of the Permian sandstone beds, but the principal gas-bearing zone consists of one or more beds of sandstone occurring within 250 feet of the base of the Permian at depths ranging in the various wells from 650 to 750 feet below the surface. In certain of the deeper wells showings of oil and gas have been obtained in the strata which underlie the Permian and which are probably Pennsylvanian in age. From the fact that in the great oil fields of northern Oklahoma the oil is obtained from beds of Pennsylvanian age, as well as from the nature of the sedimentary rocks themselves (the rocks of the Pennsylvanian containing more organic matter than do those of the Permian) it seems probable that the oil which is found in Permian beds is derived from the underlying older rocks. In the Loco field these rocks are shown to be of Carboniferous age by the crinoid stems and small pelecypods which have been obtained from the cuttings of wells Nos. 1 and 5 of the Oklahoma Diamond Oil & Gas Co. As the oil and gas appear to have accumulated in the Permian strata near the crests of folds, it is evident that the oil must have accumulated since the folding occurred. That the folding occurred in comparatively recent geologic time is indicated by the fact that along Red River southwest of the Loco field the smaller drainage shows a minute adjustment to the structure, which would not be the case had the folding taken place at a very remote period.[1]

Many theories have been advanced to account for the origin and accumulation of oil, but none have met with universal acceptance. To the writer it seems most probable that oil and gas have been derived from organic matter contained in shale or limestone which has been distilled under conditions of heat and pressure produced by earth movement. The oil may have been impelled through the rock pores to its place of accumulation by water under the forces of capillarity and gravity, or it may have migrated through the rocks in the form of gas which afterward condensed into oil.[2]

ANALYSES OF GAS FROM THE LOCO FIELD.

Samples of gas collected by the writer in the Loco field were sent for analysis to the Pittsburgh laboratory of the Bureau of Mines, from which the following results are reported:

[1] Wegemann, C. H., Anticlinal structure in parts of Cotton and Jefferson counties, Okla.: U. S. Geol. Survey Bull. 602, p. 34 1915.

[2] For a fuller discussion of this subject see Wegemann, C. H., and Heald, K. C., The Healdton oil field, Carter County, Okla., pp. 13-30 of this bulletin.

Analysis of gas from well No. 7, of the Oklahoma Diamond Oil & Gas Co., northwest corner of sec. 15, T. 3 S., R. 5 W.

[Analysis by G. A. Burrell; laboratory No. 5864.]

CO_2	0.2
CH_4	75.1
C_2H_6	8.5
N_2	16.2
	100.0

Specific gravity (air=1), 0.67.
Heating value at 0° C. and 760 millimeters pressure, 958 British thermal units.

Analysis of gas from well No. 5 of the Oklahoma Diamond Oil & Gas Co., NE. ¼ sec. 15, T. 3 S., R. 5 W.

[Analysis by G. A. Burrell; laboratory No. 5865.]

CO_2	0.0
CH_4	80.2
C_2H_6	11.1
N_2	8.7
	100.0

Specific gravity (air=1), 0.65.
Heating value at 0° C. and 760 millimeters pressure, 1,061 British thermal units.