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BULLETIN
OF
THE UNIVERSITY OF TEXAS

NUMBER 246.

FOUR TIMES A MONTH

SCIENTIFIC SERIES NO. 23 SEPTEMBER 8, 1912

BUREAU OF ECONOMIC GEOLOGY AND TECHNOLOGY

WM. B. PHILLIPS, Director

A Reconnaissance Report on the Geology of the Oil and Gas Fields of Wichita and Clay Counties, Texas

BY

J. A. UDDEN, Geologist of the Bureau,

ASSISTED BY

DRURY McN. PHILLIPS.

PUBLISHED BY THE UNIVERSITY OF TEXAS

AUSTIN, TEXAS

1912

ORGANIZATION OF THE BUREAU.

The Bureau of Economic Geology and Technology was established by the Board of Regents of The University of Texas, September, 1909. In so far as is possible with the means at hand this Bureau was designed to take the place of the University Mineral Survey, which was established by the Legislature in 1901 and discontinued in 1905. That survey was supported by direct appropriation, the fund being administered by the Board of Regents of the University. The present Bureau is maintained by the University, through a special item carried in the budget.

The laboratory of the Bureau was opened in September, 1910. with Mr. S. H. Worrell as chemist. In September, 1911, Dr. J. A. Udden became geologist for the Bureau and his first work was the preparation of this report on the oil and gas fields of Wichita and Clay Counties.

Exclusive of this Bulletin the following publications have been made by this Bureau:

"The Mineral Resources of Texas," Wm. B. Phillips, issued by the State Department of Agriculture as its Bulletin No. 14, July-August, 1910.

"The Composition of Texas Coals and Lignites and the Use of Producer Gas in Texas," by Wm. B. Phillips, S. H. Worrell and Drury McN. Phillips, University of Texas Bulletin No. 189, July, 1911.

"A map showing the location of iron ore deposits in east Texas, blast furnaces, lignite mines in operation, lignite outcrops, producing oil fields," etc., September, 1912, by Wm. B. Phillips.

In addition the following Press Letters have been issued and widely distributed:

Production and Value of Mineral Waters in Texas.

Clays and Clay Products.

The Fuel Situation in Texas.

Precious Stones in Texas.

Some Ornamental Stones from Texas.

The Iron Ore Situation in East Texas.

High Grade Kaolin in Texas.

Natural Gas in Texas.

The Testing Laboratory of the Bureau.

Phosphate Rock and Nitrate of Soda in Texas.

Production of Coal and Lignite in Texas in 1910.

A New Course in the Technology of Fuels.

Examination of the Oil and Gas Regions in Clay and Wichita Counties.

The Electra Oil Field, Wichita County.

Fuller's Earth in Texas.

Production of Petroleum in Texas.

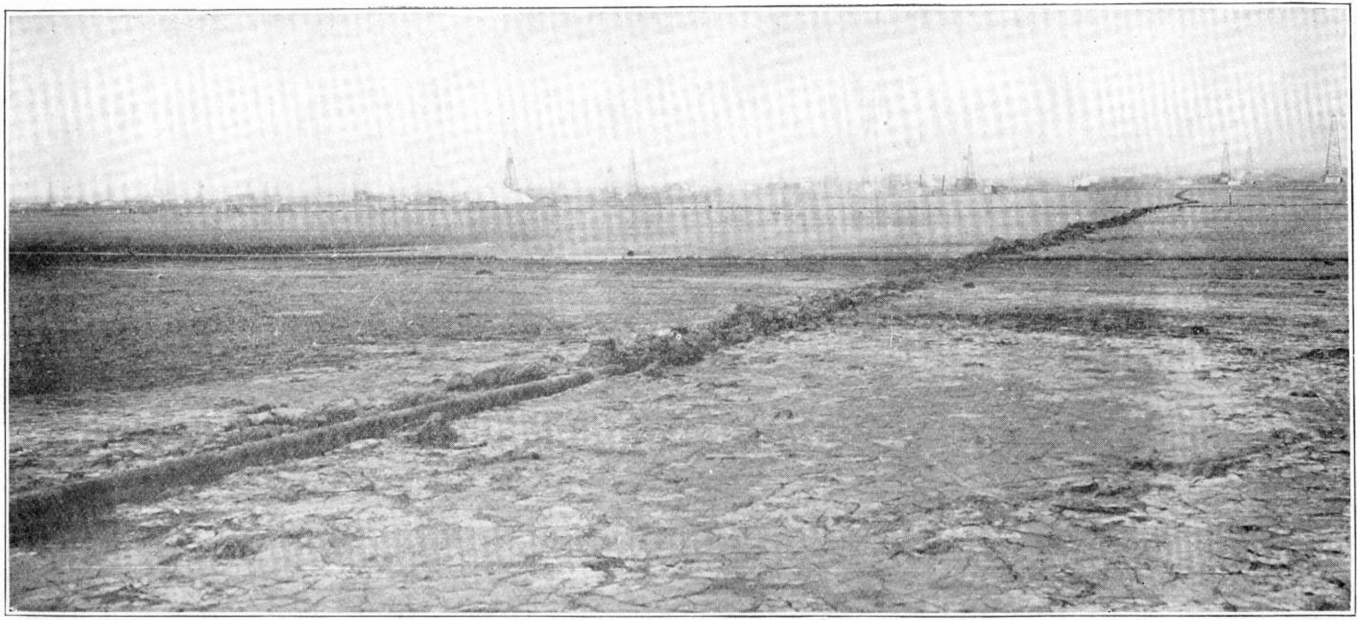
The Mineral Production of Texas in 1910.

Some Conclusions as to the Oil and Gas Fields of Wichita and Clay Counties.

The several editions of these Press Letters are now exhausted.

In the laboratory the study of coals and lignites with reference to their gas producing properties is being continued and the question of briquetting lignites has been taken up.

Address all communications to Wm. B. Phillips, Director Bureau of Economic Geology and Technology, University, Austin, Texas.



The Electra Oil Field, March, 1912. Looking northwest.

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LIST OF ILLUSTRATIONS.

The authors are particularly indebted to Prof. F. L. Whitney of the Department of Geology, University of Texas, for the care and skill with which he has made the photographs mentioned above.

A Reconnaissance Report on the Geology of the Oil and Gas Fields of Wichita and Clay Counties, Texas

By J. A. Udden and Drury McN. Phillips.

GENERAL STATEMENT.

The present study of the Electra oil field and the Petrolia gas field was undertaken with the purpose of learning the physical conditions which have brought about the accumulation of oil and gas in the Pennsylvanian sediments in Wichita and Clay Counties in the north part of the State. With this main object in view and with the limited time at our disposal our observations were mainly directed to features recognized as directly bearing on the immediate subject of the inquiry. Some observation bearing on the Tertiary and on the Quaternary geology of the region and on matters pertaining to geology in general were made only incidentally. The object of this report is similarly limited. This must account for the somewhat unusual form of the paper. It is not a succinct account of the entire geology of the region studied, nor is it entirely limited to the main subject of inquiry, since it appears desirable to place on record also some data incidentally secured. This report, therefore, partakes to some extent of the nature of an account of a special inquiry. To a lesser extent it is an account of a geological reconnaisance. The subjects of special inquiry, it will be perceived, were the stratigraphy and structure of the series of sediments in which the oil and gas occur. These sediments constitute several divisions of the Pennsylvanian series, together with what has come to be known as the Wichita formation.

THE EXPOSED ROCKS.

The Wichita formation is the main part of the bedrock which comes to the surface in the area studied. This rests on the Cisco formation. The surficial boundary between these two for mations in this region has been roughly outlined by earlier students of this region essentially as represented on the accompanying map.* See Plate I. No time was taken for adding any new local details to the course of this boundary, nor to study the criteria for its location.

The Wichita Formation.

On traversing the east half of Wichita County it appears that there were no beds which might be used for correlating all the different exposures. Few sandstones can be traced farther than a mile or two with any degree of certainty. It is only in the southwest part of the county that the stratigraphy and the structure may be worked out in the usual way, by correlation of parts of different sections.

FIELD EXPOSURES.

Opportunities to examine the bedrock in surface exposures in this region are not as many as in some other parts of the State. The best sections appear in the bluffs of the Wichita River. The entire region is one of old mature topography, where slopes are low and where the land is covered with a thin soil, through which the bed rock frequently protrudes, but mostly indistinctly. The streams have broad alluvial valleys, bordered by low bluffs, which are approached by the channels at long intervals. The alluvial plain of the Wichita averages more than three miles in width in Wichita County and the stream is sapping its bluffs in only some few places. The conditions are the same on the Red River, except that the alluvial valley is more irregular in width and that the points of attack by the stream on the bluffs are farther apart. Nevertheless a score and a half of places were selected where the terrances appeared in sufficient distinctness to warrant special descriptions. These follow below in order from east to west.

*W. F. Cummins, Geological Survey of Texas, Second Annual Report, pp. 357-552, Map. 1890. C. H. Gordon, George H. Girty and David White, The Wichita Formation of Northern Texas, Journal of Geology, Vol. XIX, pp. 110-134.

CLAY COUNTY.

Section 1. Section in the east bluff of Wichita River three-fourths of a mile northwest of Byers.

	Thickness in feet.
4. Gray sandstone, with a six inch layer of concretionary conglomerate, greenish gray in color	15
3. Red Clay	8
2. Bluish green shale	6
1. Talus	15
	44

Section 2. In a low bluff facing east, at a point about three miles west of Henrietta and one-half mile south of the Fort Worth and Denver Railroad there are some beds that have been explored for copper, which occurs in the forms of malachite, azurite and gray copper sulphide. The copper has accumulated mostly on the under surface of some carbonaceous clay bands, in cavities once filled with plant remains, and also in some joints in sandstone. The section exposed, partly in an old excavation, is as follows:

	Thickness in Feet.	Inches.
9. Sandstone	8	
8. Black shale		4
7. Sandstone containing carbonaceous shreds of leaves and other vegetation		6
6. Black shale, with a more or less continuous infiltration of copper ore against its lower surface		4
5. Sandstone containing shreds of vegetation		6
4. Black shale, with frequent incrustations of copper ore on the lower surface		2
3. Shale and sandstone	2	
2. Sandstone, impregnated with copper along some joints and containing some impressions of tree stems and other remains of vegetation, which are partly filled with copper ore	2	
1. Shale	1+	
	14+	8

Section 3. About three miles northeast of Wichita Falls a low bluff, facing westward, runs for almost a mile in a general north and south direction. At the north end the strata exposed in this escarpment form an isolated butte. The section in this butte is as follows:

	Thickness in feet.
5. Gray sandstone, soft and homogeneous in some places. In other places concretionary, cross-bedded, or cemented by interstitial lime to a hard rock. This sandstone forms the cap of the escarpment. Maximum thickness.....	8
4. Gray and blotched brown shale, sandy in places and containing calcareous concretions........	8
3. Red shale, with here and there gray blotches and streaks.............................	11
2. Gray sandstone, much cross-bedded, partly straightly and thinly laminated............	3
1. Shale, gray and brownish, with many dark calcareous concretions........................	15
	45

WICHITA COUNTY.

Section 4. At the southeast corner of the Walker-Harvey survey, two and one-half miles northeast of the Union Station at Wichita Falls, a sandstone twelve feet thick, is seen in the low bluff. This sandstone rests on some twenty feet of red and gray shale.

Section 5. In the cut of the Missouri, Kansas and Texas Railroad, on a hill about one mile east of Wichita Falls, a sandstone is exposed which is composed of alternations of flat laminated layers and cross-bedded layers from two inches to a foot thick. Some of the uppermost layers are black from impregnations of iron and manganese oxide.

Section 6. One and one-half miles southeast of Wichita Falls, a low bluff facing west and south follows the east side of an irrigation canal. This bluff consists of five feet of red and blue shale. There is also some conglomerate. The sandstone is typical of this region. It consists of mostly white and subangular quartz, but with some red and pink grains. It is frequently cross-bedded, and the cross-bedded layers alternate with thin, straight layers, lying horizontally. Some of these show extended surfaces, almost perfectly plain and smooth. Small spherical concretions were noted in which the grains of sand were cemented together with calcite or with oxides of iron and manganese. The thickest homogeneous or unstratified layer noted was two feet. Under the sand in some places and interbedded with the lower part of the sand in another place were layers of conglomerate mostly less than a foot thick. This consists of lumps of limey and marly materials and lumps of clay, mostly from one-half to one-third inch in diameter.

The shale is red with bluish-white streaks and blotches. In one place it was cut by a vertical vein of hard red calcareous material, one and one-half inches thick.

Section 7. In the south bank of the Wichita River, about three-fourths of a mile southwest from the Fort Worth and Denver Railroad bridge, the bed rock is exposed for a considerable distance and extends up into the bluff. The exposed section is as follows:

	Thickness in feet.
7. Thin-bedded red sandstone of fine texture, consisting of straight, smooth, and persistent layers from one-eighth to one-half inch thick..	4
6. Red shale with thin blue layers containing streaks of conglomerate consisting of calcareous concretions mixed with lumps of clay, both kinds averaging one-fourth inch in diameter	2
5. Red shale, containing scattered concretions of from one-third of an inch to three inches in diameter. Many of the largest concretions have an irregularly mammilated surface......	25
4. Sandy brown shale........................	1
3. Sandstone, laminated and wavy-bedded......	6
2. Shale, brown and blue, in places consisting of lumps, as if brecciated, or as if it were a conglomerate of mud lumps...................	1½
1. Brown and blue shale with lentils of sand, one foot thick, extending down below water level in the stream............................	3
	42½

Section 8. Near the pavilion at the north end of Wichita Lake, the strata seen consist of:

	Thickness in feet.
4. Gray sandstone	2
3. Red Clay	8
2. Soft white sandstone	3
1. Red clay	2+
	15+

Section 9. About three-fourths of a mile southwest of the E. F. Austin survey, and some two and one-half miles southwest from the railroad station in Wichita Falls are some gullies in the upland. The beds exposed are as below:

	Thickness in feet.
2. Gray sandstone	2
1. Shale, mostly red, with sandy layers with concretions, and thin seams of satin spar gypsum, of a bright orange color	20
	22

Section 10. About four miles south of Burkburnett the Wichita Falls and Northwestern Railroad bed is cut into a low hill a mile south of the main creek running east into Red River. The west bank of this cut shows some cross-bedded sandstone which lies in an old channel evidently cut into the red clay by the currents which deposited the sand. It appears that the current was shifted northward as there was a greater filling-in of sand on the north side. The current must have been thrown back and forth, for along one plane in the main sand deposit on the north side it is clear that the sand below this plane was eroded before the overlying sand was deposited. Later the entire channel was filled with red clay. See fig. 1.

FIG. 1. Section in a cut along the Wichita Falls & Northwestern Railway, three and a half miles south of Burkburnett, Wichita County: a, red shale; b, cross-bedded sand; c, erosional unconformity; d, alternating layers of silt and sand.

Section 11. In the northwest quarter of the W. W. Carroll survey, about six miles north and four miles east of Iowa Park, an exposure shows some slanting sandstone overlain by a few feet of red shale in which there is a thin shell of limestone which lies horizontal.

Section 12. On a hillside near the west side on survey 2, Tarrant County School Land, about three miles north and one mile east of Iowa Park, is a thin dark, sandy limestone, resembling the limestone seen near Burk Station and on Beaver Creek. It is only a few inches thick.

Section 13. In the Red River bluffs on the A. A. Durfee survey, almost due north from Iowa Park, outcrops of the Wichita beds are seen for a distance of some two miles. A section was taken where the bedrock is highest, and this is as below:

	Thickness in feet.
10. Dark red, sandy shale with seams of dark red sandstone from one to two inches thick.......	8
9. Laminated dark red sandstone.............	1½
8. Conglomerate of concretions and lumps of mud, dark red, with thin intercalated layers of sandstone	3
7. Laminated and cross-bedded rusty red and gray sandstone...........................	2
6. Red clay with a six-inch stratum of calcareous light blue shale ten feet above its base. The red clay contains blotched gray concretions a half foot in diameter......................	15
5. Gray, calcareous and sandy rock...........	1½
4. Red shale, in part sandy....................	15
3. Calcareous sandstone with fragments of fossils, in places with many sizes and kinds of concretions. The lower side of this stratum has combs or narrow projecting ridges which fit in the underlying clay..................	1
2. Variegated shale, with calcareous concretions	6
1. Red shale...............................	12
	65

The calcareous seam in number 6 of the above section was noted a half mile farther west in the bluff.

Section 14. One of the deepest sections in the east part of Wichita County is seen on the side of an elongated hill about four miles south of Wichita River, and a short distance north of School Number 18. The following is a description of the section seen on the north side of this hill:

	Thickness in feet.
3. Sandstone, gray, cross-bedded. The thickest single layer of sandstone noted was three feet	15
2. Brown and red shale	65
1. A layer of many large and small calcareous knotty concretions, weathering black, evidently from manganese	1
	81

Section 15. Near the boundary between blocks 6 and 7 of the Palo Pinto County School Land, and about a mile and three-fourths southwest from School Number 18, a long ridge runs east and west, on the side of which the following section was noted:

	Thickness in feet.
4. Gray sand	5
3. Red clay	20
2. Ashen white sand, soft and of rather fine grain. About the middle of this stratum is a black conglomerate consisting of calcareous clay lump pebbles about one-fourth of an inch in diameter and quite uniform in size	7
1. Red clay	7
	39

Section 16. In the west side of the road running north and south along the east side of B. S. and F. survey, one mile west of School Number 9, and about nine miles north and two miles west of Iowa Park, there is a thin shell of light gray limestone overlying some gray shale. This limestone contains unrecognizable organic fragments throughout, and a small coral and a fish scale were noted. It changes into a sandy calcareous rock in a short distance to the northeast. A thousand feet to the northeast from this place there is an exposure in the east bank of the creek, which

probably lies twenty or thirty feet below the above limestone In this exposure is seen a typical instance of contemporaneous erosion in the Wichita formation. A thin gravel of washed concretions lies on a contemporaneously eroded bed of red shale, and over this, a half foot of shale and then three feet of sand, with another streak of soft conglomerate. See fig. 2.

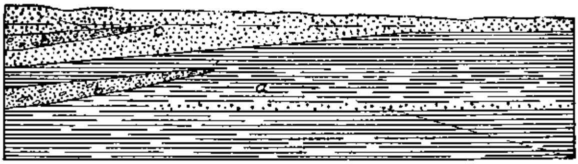


FIG. 2. Wichita beds exposed in the bank of a creek in T. T. Railway Company survey, 9 miles north and 2 miles west of Iowa Park, Wichita County: a, shale; b, conglomerate; c, sandstone.

Section 17. In the south end of the T. E. and L. Co. survey abutting on Red River, about two and one-half miles west of School Number 9, and nine miles west of Burkburnett, a section appearing in the right bank of Cavalry Creek is as follows:

	Thickness in feet.
6. Sandstone and concretion conglomerate......	1
5. Ashen gray and red shale.................	5
4. Streaks of sand and concretionary conglomerate	2
3. Ashen gray and red shale.................	10
2. Streaks of shale, with indistinct remains of vegetation	1
1. Gray shale with streaks of sand and concretionary conglomerate.........................	2
	21

Section 18. The section seen in Finder's Butte, which is located north of the south boundary of Wichita County, due south from School Number 6, is as below:

	Thickness in feet.
2. Gray structureless soft sandstone............	5
1. Red clay with thin streaks of sand in the lower part	20
	25

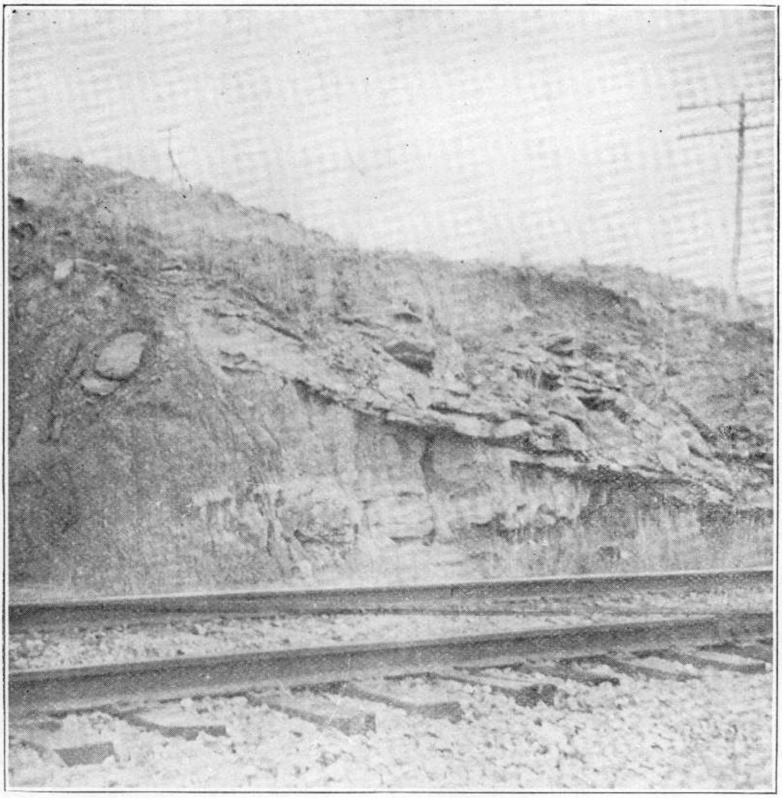
Section 19. In the southeast quarter of the W. C. Eustis survey, about two miles north of Burk Station, two sandstones appear, one in the bottom of the main creek, and one caps the low bluff west of the creek. They are separated by twenty-five feet of red shale, containing many concretions in its upper part. The upper sandstone capping the upland on the west side of the creek is quite regularly cross-bedded, and where it has been eroded below its upper surface the slanting cross-beds show a deceptive resemblance to an outcrop of highly tilted strata of considerable thickness. This is seen in several places just back of the west bluff of the creek.

Section 20. Near the north boundary of the C. T. R. R. Co. survey abutting on Wichita River, about six miles west and one and one-fourth miles south of the railroad station at Iowa Park, there is an eroded bluff showing the following section:

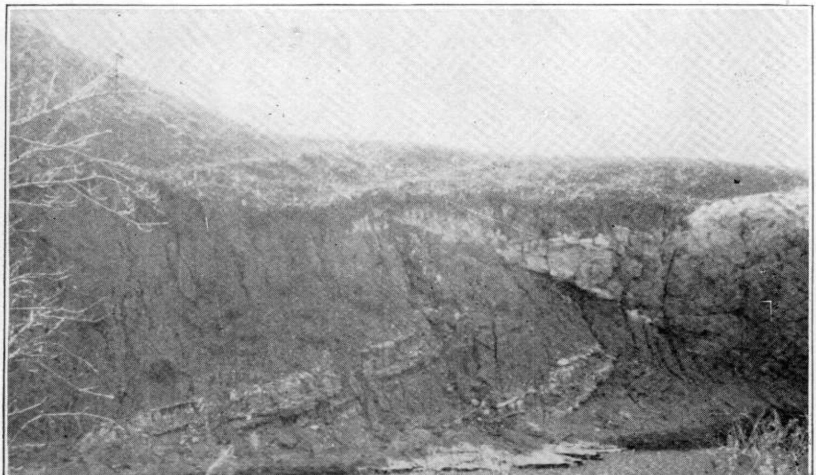
	Thickness in feet.
4. White sandstone, in part cross-bedded.......	4
3. Red clay with many concretions and here and there some sandy streaks..................	15
2. Red sandstone, with cross-bedded structure. This member terminates somewhat abruptly when followed westward..................	10
1. Red shale with white streaks, and with some thin layers of a conglomerate consisting of worn concretions, evidently assorted........	15
	44

The lower sandstone, or a sandstone having the same level in the red shale, runs south in a low escarpment for almost a mile and is again well exposed in some bluffs just south of the main wagon road. At this point it was seen to contain an impression of a fern leaf, like *Pecopteris tenuinervis* F. and W.

Section 21. Near the southeast corner of the B. S. and F. survey, about five miles southwest of Burk Station, the following section appears in a gully:



A. Contemporaneous unconformity seen in a railroad cut 2 miles west of Petrolia, Clay County. Looking east.



B. Exposure in the right bank of China Creek in Block 314, Waggoner Colony Survey, 7½ miles north and 4 miles east of Electra, Wichita County. Looking south. Photograph by I. J. Broman.

	Thickness in feet.
4. Dark limestone	½
3. Red and blue shale	15
2. Sandstone, about	4
1. Red and blue shale	20+
	39½+

About a mile northeast from this place the limestone in the above section is overlain by some six feet of sandstone, and some dichotomously fluted vertebrate teeth were noted in the limestone.

Section 22. In block 314 of the Waggoner Colony survey, about seven and one-half miles north and four miles east of Electra, in the right bank of China Creek, is an exposure of red clay and sandstone, which shows unconformities in bedding. Farthest east is a bank of red clay, some thirty feet high, and this is capped for most of its length by several feet of sandstone. At its eastern edge this sandstone terminates against a rising slope of the clay, like the bank of an old channel. At the west end of the exposure two rising sandy layers have been cut off in the excavation of a contemporaneous channel, or hollow, which later has been filled with sand. See fig. 3 and Plate XV, B.

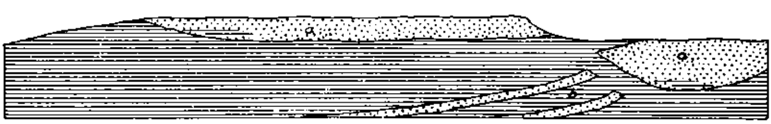


FIG. 3. Exposure in the right bank of China Creek in Block 314, Waggoner Colony survey, 7½ miles north and 4 miles east of Electra, Wichita County. Two sandstone beds, rising from left to right, have been bevelled off. Some clay was later deposited on the eroded slope. The depression was later filled with sand, which overlaps at the right. See also Plate XV, B.

Section 23. On the south side of a projecting upland, about six miles west and two miles south of Burk Station, the following section was noted:

	Thickness in feet.
5. Shale	8
4. Dark gray limestone	½
3. Red shale	20
2. Sandstone, cross-bedded	4
1. Blue shale	8
	40½

Section 24. In the bluffs on the north side of Beaver Creek, on the H. & T. C. R. R. Co. survey number 35, about seven and one-half miles south and two and one-half miles east of Electra, the following section was noted:

	Thickness in feet.
8. Conglomerate of late Tertiary (?) age	3
7. White sandstone, top of Wichita beds in this section	7
6. Sandy gray shale	4
5. Red shale	10
4. Gray shale, with shells of lime and sand	6
3. Dark gray limestone	1½
2. Gray and bluish-gray shale	7
1. Red shale, containing at 18 feet from top a nine-foot white sandstone, which runs out in the section in a short distance to the east	33
	71½

Section 25. In the north bluff of the Wichita River near the west line of the L. T. Miller survey, about eleven miles south and one mile east of Electra, is the highest single exposure of the Wichita beds in Wichita County. It measures 130 feet, and is as below:

	Thickness in feet.
17. Gray shale with thin shells of lime	3
16. Gray limestone of fine texture	2½
15. Bluish gray shale, weathering yellow	16
14. Sand and shale, purplish in color	3
13. Blotched gray and red shale	2
12. Gray sand, cross-bedded	5
11. Yellow and red clay, mostly red in the upper part	23

10. Dull red, silty, soft sandstone, mingled with gray layers	5
9. Gray muddy shale, cross-bedded sandstone and conglomerate consisting of concretions	4
8. Red clay with some gray blotches	10
7. Red clay	16
6. Sand and mottled clay	2
5. Red clayey shale	17
4. Gray sandstone, soft	1
3. Red soft sandstone, cross-bedded	8
2. Blotched, gray and red shale, with layers of gray sand, from one-eighth to one-half inch thick	2
1. Mottled brown and gray shale, mostly brown	11
	130½

Sections 26 and 27. In the west part of the J. A. Roesh survey, about one and one-half miles south of Electra the section seen in the hillsides near an earth tank is as below:

	Thickness in feet.
5. Surface material and some shale	5
4. A slightly sandy layer in shale, containing calcareous concretions. These are mostly from one-half to two-thirds of an inch in diameter, sub-spherical and smooth. Some are compound, consisting of several concretions coalesced into one	1
3. Red clay, or shale	6
2. Blue clay	9
1. White sandstone	4
	25

Half a mile from this point and a little to the west, on the west side of the Electra road, the same section recurs, but here number 4 is capped by a three to four inch sandy limestone, which contains *Estheria minuta* Jones (determined by Dr. J. W. Beede) in considerable numbers. It also contains pieces of imbedded bones and occasional teeth of vertebrates. This bed was again seen a half mile farther west, where a worn fragment of *Myalina Swallovi* McChesney (?) was noted. The sandstone is here marked by vertical straight perforations. The section seen in a bluff facing south near this place is as follows:

	Thickness in feet.
3. Red clay, containing some blue and gray streaks	30
2. Sandstone, with vertical narrow perforations.	½
1. Red Shale	1
	31½

Section 28. In the east bluffs of a north tributary to Beaver Creek near the west line of H. & T. C. R. R. Co. survey 25, about six and a half miles south and one mile west of Electra, the section is as below:

	Thickness in feet.
5. Gray sandstone	2
4. Red shale, with concretions	30
3. Streaks of sandstone, with calcareous layers and frequent fragments of vertebrate bones	2
2. Blue shale	6
1. Red shale	2
	42

Section 29. A section near the south end of the water reservoir one mile west of Electra is as below:

	Thickness in feet.
3. Red and some blue shale, about	20
2. Gray sandstone	2
1. Blue shale	3
	25

WILBARGER COUNTY.

Section 30. A section near the northwest corner of the H. & T. C. R. R. Co. survey 27, about four miles south and two miles west of Electra:

	Thickness in feet.
3. In a well bored for water near this place a dark gray thin limestone was penetrated at the depth of about 45 feet. Fragments of this limestone were seen on the old dump and it was clearly	..

identical with the Beaver Creek limestone. The curb of the well is about twenty feet under a calcareous stratum containing fragments of vertebrate bones, capping a low bluff near this place. The beds between this layer and the limestone in the well consist of red and blue shales, with some sandy layers and streaks of black shale. This shale contains some black impressions of plant leaves. Calcareous sandstone or a concretionary layer caps the adjacent low bluffs..........................	1
2. Red and blue shale, the latter with plant remains, partly exposed, and also partly explored in the well..............................	65
1. Dark gray limestone containing *Syringopora* and *Estheria minuta* Jones*.......................	1
	67

Section 31. About three-fourths of a mile northwest of the Webb Well, on the H. & T. C. R. R. Co. survey 21, about four miles south and two miles west of Electra, a disintegrated gray limestone outcrops on the edge of a low rise in the upland, at an elevation of about 60 feet above Bluff Creek. It is underlain by some gray and red shale, and contains many invertebrate fossils which have suffered weathering and lie scattered on the slope. The forms identified with some doubt are as follows:

	Number noted of each.
Syringopora, sp..............................	12
Cythere, sp..................................	Many
Allorisma terminale Hall.....................	15
Myalina aviculoides M. and W.................	8
Temnocheilus winslovi M and W................	11
Nautilus excentricus M. and H................	3
Bellerophon crassus M. and W.................	30
Pleurotomaria, sp............................	6
Murchisonia, sp..............................	6

GENERAL DESCRIPTION OF THE WICHITA ROCKS.

It is believed that these sections represent different parts of a general section some three hundred feet thick. They are known to include successive strata measuring about two hundred and twenty-five feet, and constituting the uppermost beds exposed in the field examined.

We will regard these sections first as a group representative of a single formation. They all occur within the areal limits of what has come to be known as the Wichita formation.* The thickest section measures only 130 feet in all, and most of them fall short of fifty feet. The total number of feet of rock described is only a few feet more than 1000. Some items are known to be repeated descriptions of the same strata, in places where the sections are not very far apart, and many more of them must include beds that are synchronous and were made at the same time.

From these sections we may obtain a fairly close estimate of the gross nature of the formation. As seen in the exposures, it consists of shales, sandstones, conglomerates and limestones, named in order of their rank as to bulk. Seventy-nine per cent of the total thickness described in the section consists of shale, twenty per cent of sandstone, and less than one per cent each of conglomerate and limestone. There are also gradations between all of these groups. It is believed that the percentage of sandstones determined in this manner is higher than the actual percentage of sandstone in the formation, as this rock stands weathering better than the shales and is hence more frequently preserved in the outcrops. But the difference between the actual and apparent ratios of sandstone and shale can not be very great. In section 25 above, where there is a total of 124 feet of shale and sand the percentage of shale is 83 and that of sandstone 17. The relative quantities of different rocks are shown in the following table, in which the several rocks described and measured in the sections are classified, summed up, and reduced to percentages.

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*W. F. Cummins, First Annual Report of the Geological Survey of Texas, 1889, p. 186. C. H. Gordón, George H. Girty and David White, Journal of Geology, Vol. 19, 1911, pp. 110-134, and others.

TABLE SHOWING TOTAL THICKNESSES IN FEET AND PERCENTAGES OF DIFFERENT KINDS OF ROCKS DESCRIBED IN SECTIONS SEEN IN WICHITA AND CLAY COUNTIES.

	Total feet.	Percent. of total feet.
Shale	789	79
Red shale	(580)	(58)
Red and blue shale	(113)	(11)
Blue shale	(96)	(10)
Sandstone	201	20
Conglomerate	8	.5
Limestone	6	.5
Total	1004	100

AVERAGE THICKNESS OF DIFFERENT BEDS.

The beds described vary in thickness from less than one foot to sixty feet. Not one of the conglomerates or limestones is more than three feet thick and only eleven instances were noted of sandstones exceeding five feet. Of these only three were more than ten feet, while none exceeded fifteen feet. The shales are more heavily bedded. In forty-three instances these measure more than five feet thick, while there were only twenty-three beds of shale measuring less than five feet. These relations are more fully presented in the following table.

TABLE SHOWING FREQUENCY OF DIFFERENT THICKNESSES OF STRATA AS DESCRIBED IN THE SECTIONS NOTED IN CLAY AND WICHITA COUNTIES.

Measured thickness in feet.	1-5	6-10	11-15	16-20	21-25	26-30	41-45	61-65
Number of shale beds	23	17	11	9	3	3	1	1
Number of sandstones	32	8	3					
Number of conglomerates	10							
Number of limestones	8							
Number of all kinds of rocks	73	25	14	9	3	3	1	1

THE WICHITA SHALES.

From the observations made in the field it appears that about seventy-three per cent of the bulk of the shales of the exposed Wichita formation consists of greenish, bluish or light gray shale, and about thirteen per cent consists of alternating layers of red and gray shale or blotched red and gray shale. The greater part of this shale is fine in texture, containing very few quartz grains which measure more than one-sixteenth of a millimeter in diameter.

The Gray and Blue Shale.

The bluish gray or greenish gray shales are usually found under the sandstones and limestones. We also find, in similar situations, streaky or blotched mixtures of gray and red shale.

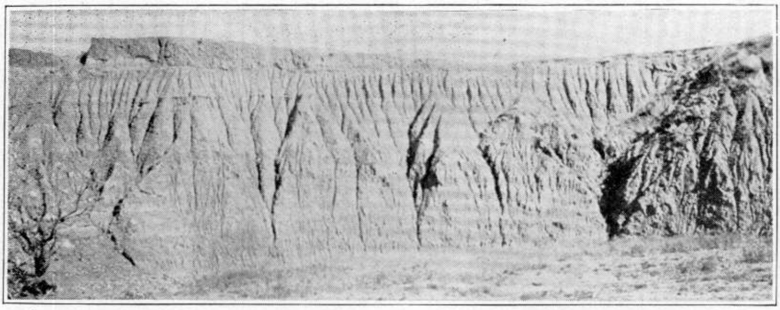
The gray or bluish gray shale frequently contains minute fragments of chitinous, brown translucent fragments of scales of fishes, which sometimes also are found entire. In some of the blue shales these fragments are found in large numbers. Examining some entire scales we find most of them rhombic in outline, or quadrangular-oblong, sometimes with dim concentric contours. See fig. 4, 1-4. In one specimen there were two parallel vessels or grooves, from which smaller short vertical vessels extended. Fig. 4, 7. Some of the chitinous framgents have a system of lacunar cavities, from which radiate small tubules closely imitating in form branching processes of nerve cells. Fig. 4, 5. These scales are evidently from ganoid fishes, possibly such as *Platysomus* or *Paleoniscus.*

Where the gray shales are dark they frequently contain minute imbedded shreds of vegetation and even entire leaves. Bituminous matter is also occasionally present in quantity sufficient to produce a bituminous odor when a fragment of the shale is heated in a closed tube. When large concretions occur in this shale they are usually flat and consist of lime or of carbonate of iron. Small crystals of marcasite also occur. These, as well as the concretions, have often been oxidized, the concretions being more or less completely changed to limonite and the marcasite appearing as rusty specks in the shale.

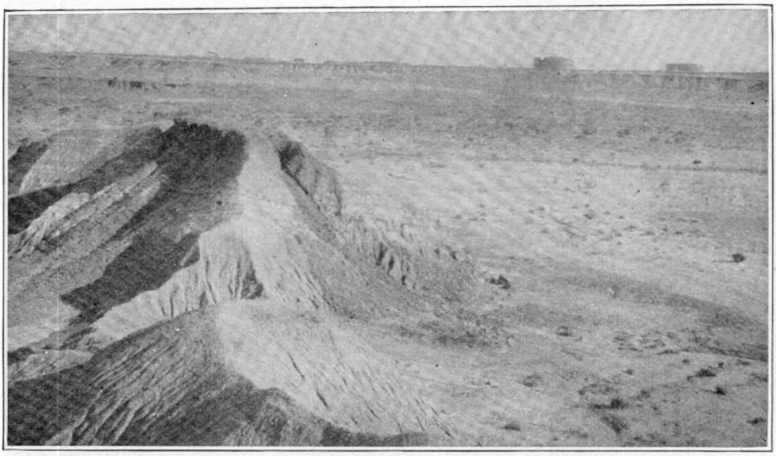
The Red Shale.

The red shale constitutes the greater part of the exposed Wichita formation. The red color is due to the presence of hematitic material. The red tints vary from yellow to light red, dark red, purple, brown and dark brown. Some of the red shales are highly ferruginous, containing no less than ten per cent of oxide of iron. These are generally very fine in texture. The usual percentage of ferruginous material is very much less, probably less than five per cent.

In its texture the red shale is very much like the blue shale, and varies from very fine material to sandy shale. A small part



A. Typical erosion forms of the Wichita red clays, south bank of China Creek, 7½ miles north and 4 miles east of Electra, Wichita County. Looking east.



B. Bad lands topography in the red Wichita shales, 1 mile west of Electra, Wichita County. Looking north.

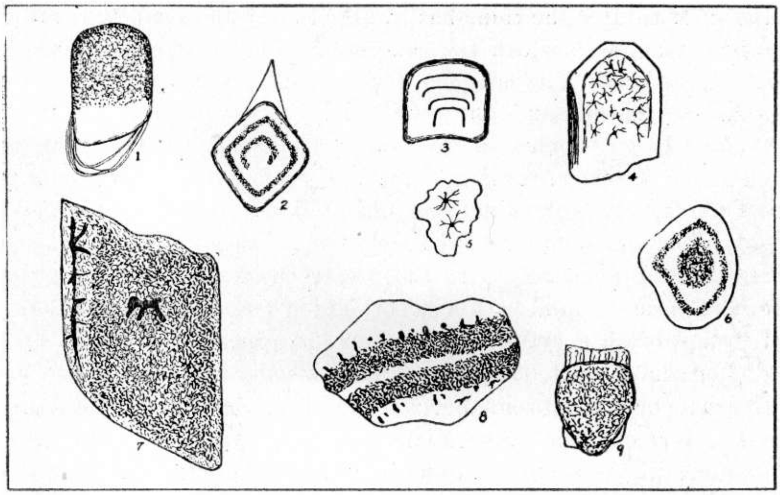


FIG. 4. Fish scales from blue clay in the south part of H. & T. C. Ry. Co. Survey 1, five miles west and one-half mile south of Burk, Wichita County. Numbers 1, 2, 3, 6, 7, 8, and 9 are magnified about 30 diameters, and numbers 4, 5, about 100 diameters. The latter show cavities from which some minute canals radiate. Large canals, like Haversian vessels, are seen in 7. Numbers 1, 2, 3, 4, 6, 7, and 9 are entire scales. Numbers 5 and 6 are fragments.

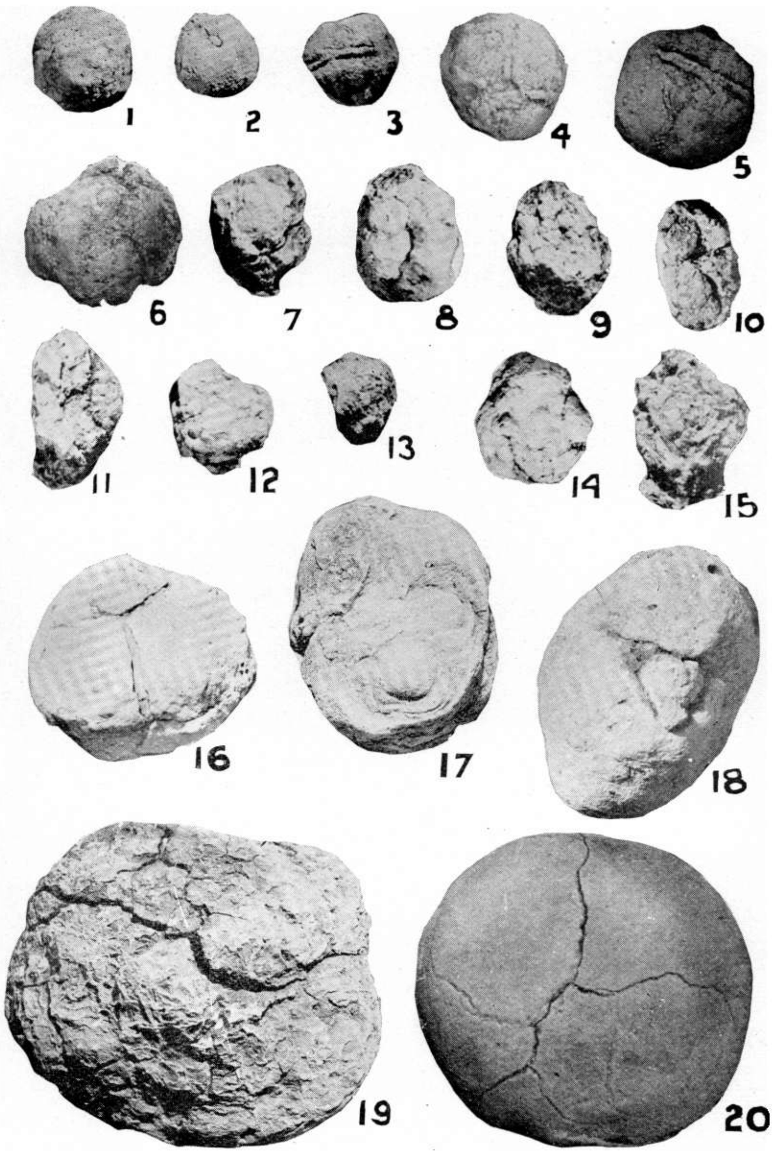
of the shale consists of quartz grains measuring more than one-sixteenth of a millimeter in diameter. With this ingredient there are usually some scales of mica. The hematitic material is present in a state of extremely fine subdivision.

The red shale is in many cases somewhat obscurely stratified, showing hardly any lamination or other perceptible structure in beds several feet thick. In places where it is mingled with gray or white layers, the stratification is very trenchantly shown. See Plate XVI, B. In some such exposures contemporaneous unconformities are to be seen, where a series of overlying laminated shales bend in conformity to the surface of a local excavation in an underlying horizontally stratified clay or shale. See fig. 2.

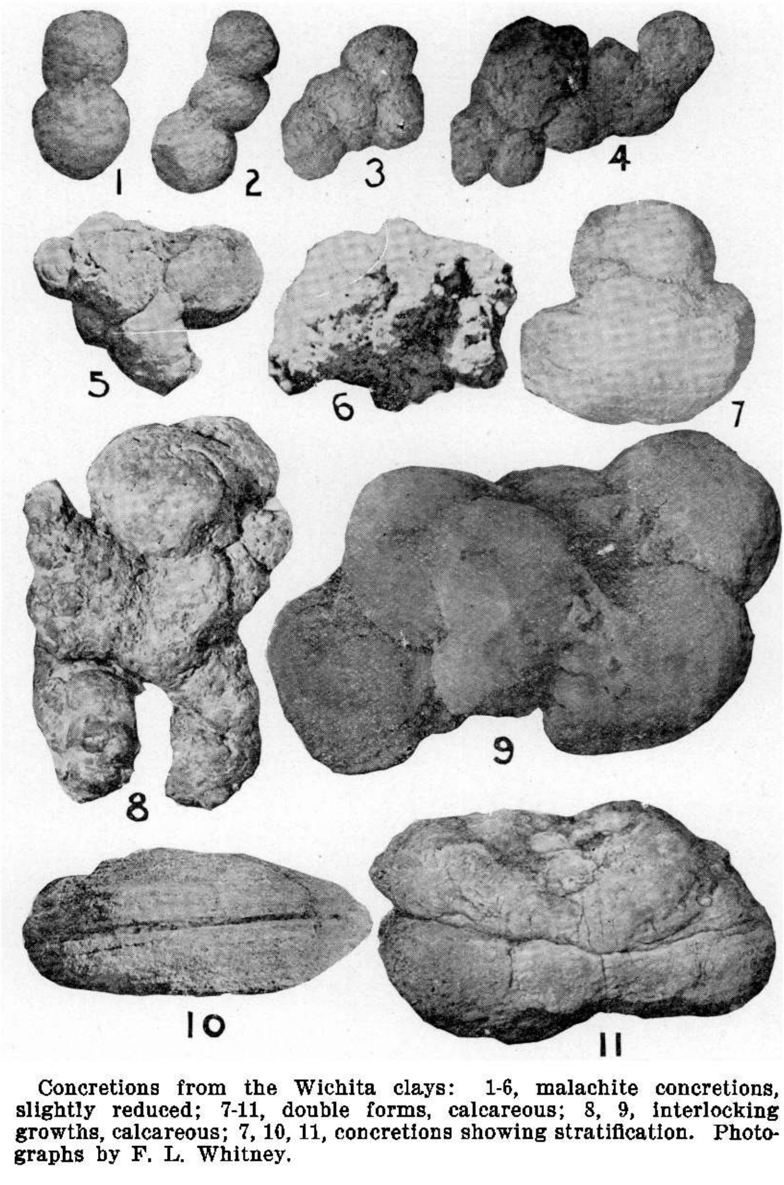
Concretions in the Shale.

The red shale usually contains numerous concretions of material which once no doubt was disseminated generally through the body of the shale. Eroded slopes of this shale are frequently closely strewn with these concretions, which remain intact on the surface after the rains have washed away the readily disintegrated matrix in which the concretions were originally formed and imbedded. The common form of the concretions is an irregular spheroid and the usual sizes are from half an inch to four or five inches in diameter. They usually have a very irregular exterior surface, which in some may be described as irregularly botryoidal, as mammillated, pitted, furrowed, ridged, or which may be so entirely irregular as to defy any general description. Such are the greater number. Only in rare cases are some found with a smooth outer surface. In some cases they approach a cylindric form, and it appears that such concretions have started to form either in some tubular cavities in the shale or around some narrow cylindrical bodies buried in the shale, for some such concretions still show traces of a centrally located tubular cavity. Some concretions of this form were noted at a horizon in a red shale, which in another place, a mile distant, contains sandy layers with fossil leaves, and the suggestion prompts itself that these concretions have grown around roots or small branches of plants originally imbedded in the shale. Some of these concretions were seen to have had an inclined position in the strata. Another instance of cylindric forms was noted in some sandy shales. In this case concretionary lime had cemented the fine sand along a line vertical or slightly inclined to the stratification planes, causing a cylindric or rather double cone-shaped form to weather out from the shale.

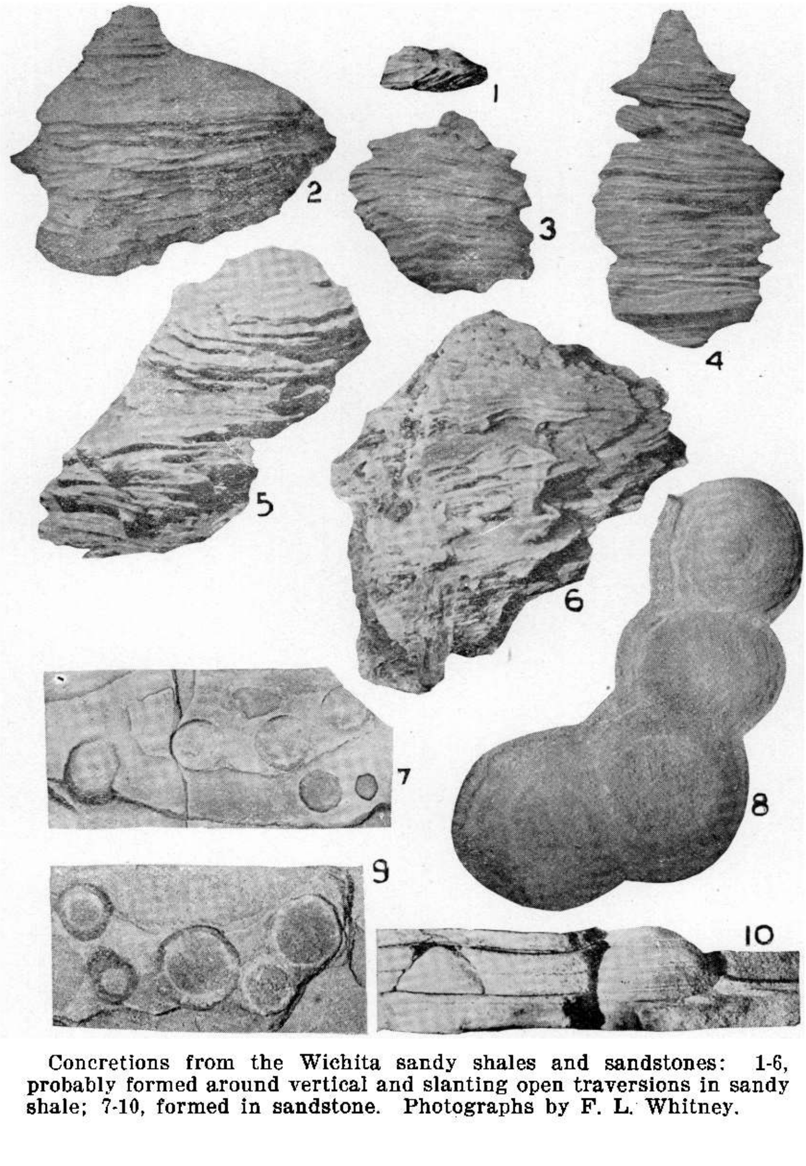
In some places the concretionary material has been deposited along certain structures in the shale, as along sandy layers, or in joints which have developed in the clay. When these joints have opened up in the process the concretionary material takes the form of irregular fissure veins. Some calcareous veins of this kind were noted in a shale bank a short distance northeast from Electra. A system of intersecting joints, closely set, seem to have been developed in the clayey matrix next to some of the large concretions with the result that the calcareous filling in these fissures extends out and away from the concretions and forms an irregular network of ridges on their surfaces. The mammillated and irregularly botryoidal surface on some concretions is clearly the result of an interruption of the concre-



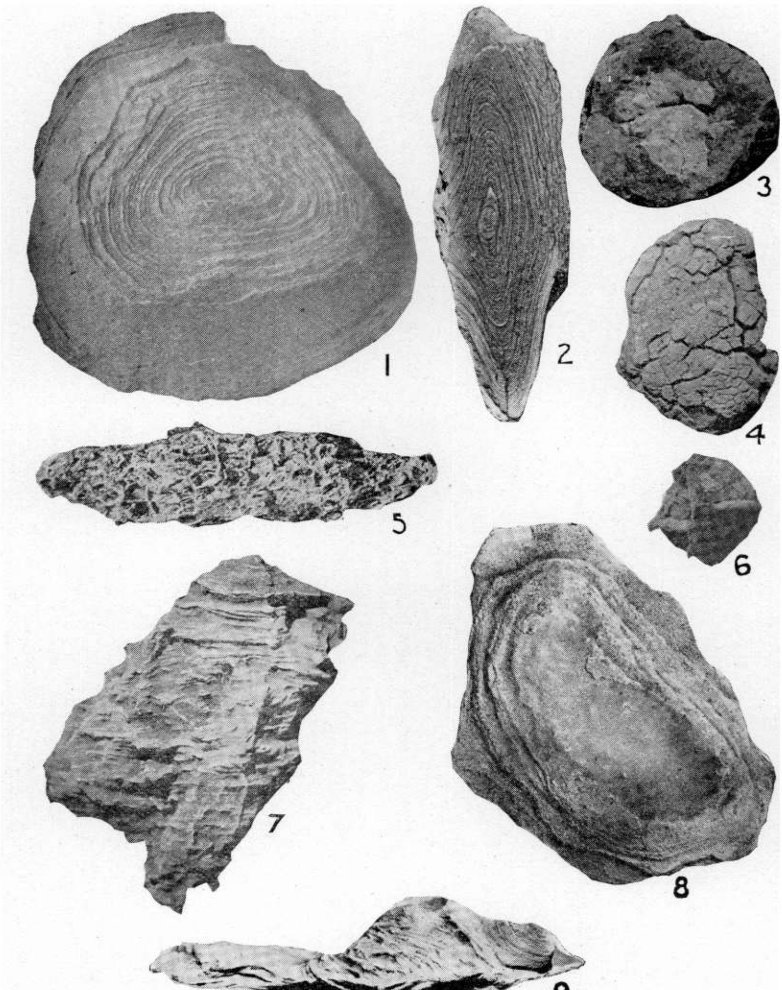
Concretions from the Wichita clays: 1-5, spherical forms; 6-15, irregular spheroids; 16, 19, 20, concretions showing shrinkage cracks; 17, a fractured specimen showing concentric structure; 18, a smaller concretion included in a larger. Photographs by F. L. Whitney.



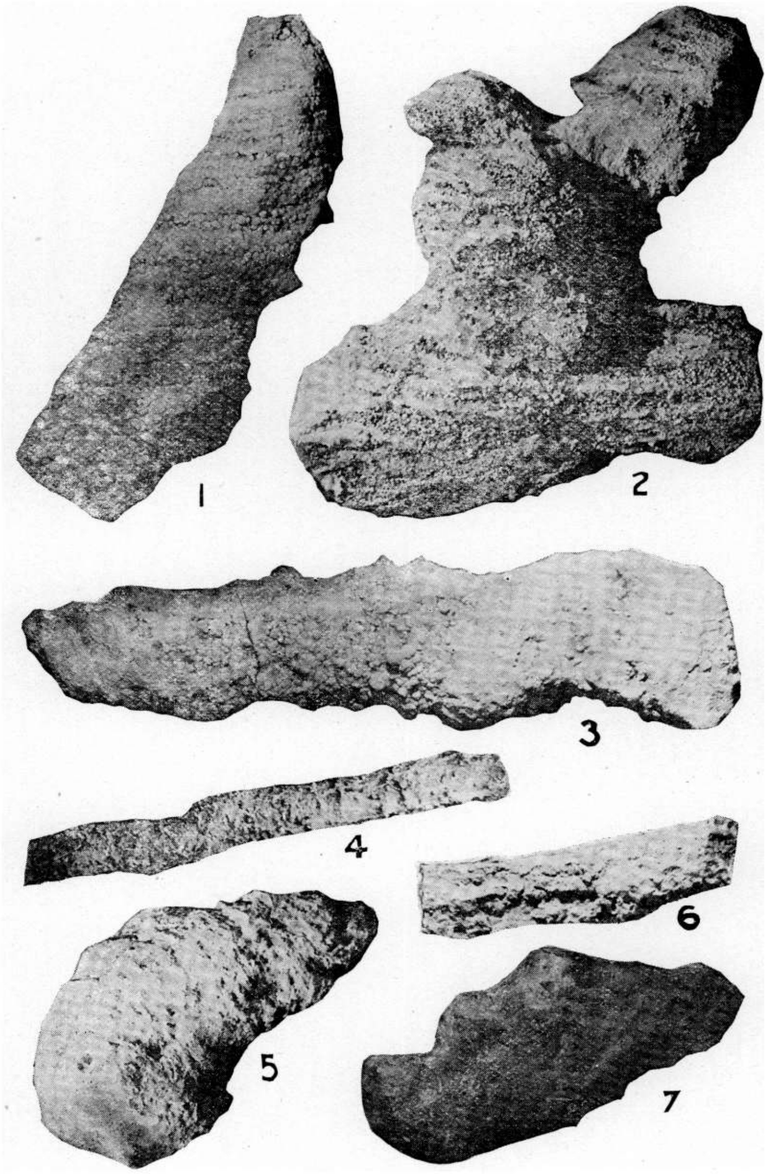
Concretions from the Wichita clays: 1-6, malachite concretions, slightly reduced; 7-11, double forms, calcareous; 8, 9, interlocking growths, calcareous; 7, 10, 11, concretions showing stratification. Photographs by F. L. Whitney.



Concretions from the Wichita sandy shales and sandstones: 1-6, probably formed around vertical and slanting open traversions in sandy shale; 7-10, formed in sandstone. Photographs by F. L. Whitney.



Concretions from the Wichita clays and sandstones: 1, flat form with concentric structure; 2, transverse section of the same; 3, calcareous concretion with nucleus of gypsum; 4, showing shrinkage cracks; 5-7, showing cracks filled with ferruginous (5), gypseous (6), and calcareous (7) material; 7, 8, 9, showing original stratification. Photographs by F. L. Whitney.



Concretions from the Wichita clays: 1-6 have been formed around porous traversions, probably caused by the presence of remains of plants in the original sediments; 7, flat siderite concretion containing delicately preserved imprints of leaves. Reduced to one-fourth natural size. Photographs by F. L. Whitney.

tionary growth, and of a later resumption of the same, which has been more localized.

Internally the concretions in some cases show an irregular concentric structure, and in one locality this was seen to consist of numerous smooth and even concentric layers. More frequently they have radiating internal fissures which are filled by somewhat pure carbonate of lime, either in the form of crystalline calcite, of amorphous calcite or of a white powder of the same mineral. In other instances the internal structure shows that some concretions are aggregations of many concretions of smaller and greatly variable sizes. Photographs of many concretions from the clay are shown and described on Plates XVII, XVIII, XX, and XXI.

SANDSTONES.

The sandstones of the Wichita formation constitute something less than twenty per cent of the whole in the exposures. They are mostly light gray in color, though some are red, dark gray, or mottled.

The development of the sandstones is irregular. They frequently change in thickness and may run out in a few hundred feet. They can seldom be traced in continuous outcrop for more than a mile or two.

Texture.

The sandstones are fine in texture, about eighty-five per cent of the weight of the sand consisting of grains measuring from one-fourth to one-sixteenth of a millimeter in diameter. Grains measuring more than one-fourth of a millimeter are scarce, constituting only a small fraction of a per cent, in case any such grains are present at all. Compared with other sands the Wichita sands are well sorted. They contain very little material in which the grains measure less than one-sixteenth millimeter in diameter. In this respect the Wichita sand is a true beach sand. To plainly present these characteristics a few mechanical analyses have been made as shown on following page. Analyses of the three Cisco sands are also introduced for comparison.

TABLE SHOWING THE MECHANICAL COMPOSITION OF SANDSTONES IN THE WICHITA AND THE CISCO FORMATIONS, IN PERCENTAGES OF WEIGHTS OF DIFFERENT GRADES OF COARSENESS.

Diameter of sand-grains in mm.	Cisco sands.				Wichita sands.						
	South of Bellevue, Clay Co.	Five miles east of Henrietta, Clay Co.	Near Bellevue, Clay Co.	Averages for Clay Co.	Finder's Butte, 3 miles W. N. W. of Holliday, Wichita Co.	Three miles west of Burkburnett, Wichita Co.	Wichita Falls, Wichita Co.	Butte on Palo Pinto School Lands, Wichita Co.	Tenth Cavalry Creek, Wichita Co.	Electra red sand, Wichita Co.	Average for Wichita County.
1—½	1	tr.	tr.	tr.	------	------	------	------	------	------	------
½—¼	20	8	tr.	9	------	------	------	tr.	------	------	tr.
¼—⅛	43	69	84	67	81	79	62	57	43	28	57
⅛—1/16	26	9	10	15	11	13	27	29	38	48	28
1/16—1/32	10	4	6	7	8	8	11	14	19	24	14
1/32—1/64	------	------	------	------	------	------	------	------	tr.	tr.	tr.

The Wichita sands do not appear to be greatly worn, for even the coarser grains are not well rounded. The surface of the sand grains very generally shows the effects of etching, being roughened, or very irregularly pitted. This etching has no doubt been effected by the solvent action of percolating ground water, which at times probably has contained a comparatively large amount of alkalies in solution.

Mineral Character.

The original mineral composition of the sand is more or less clear quartz, some chert, and some orthoclase, and mica. Mica scales are present, but usually very scarce. They are most frequently to be seen in thin-bedded, silty strata of the rock, where they appear most copiously in some seams of the foliated rock. The orthoclase is of a pink color and constitutes probably no more than one per cent of the rock. The relative quantity of chert is difficult to estimate. This constituent consists of grains which are opaque, and either white, yellow, dark gray, or even red, but there is also yellow and red material which is not chert. Some thin sandstones, that merge into limestones, horizontally, contain organic and calcareous fragments which, in rare cases, constitute a large part of the rock material.

Large concretions impregnated with manganese and iron. In a sandstone escarpment in the southeast bank of the West Fork of Trinity River, Archer County.

Secondary Minerals.

Much of the Wichita formation sandstone contains minerals which have been introduced secondarily. The most conspicuous of these are calcite, hematite, limonite, wad, malachite and azurite.

The copper minerals are almost always found impregnating sandstones only in association with plant remains, lodged in beds of shale contiguous to the sandstones. They also appear very sparingly, but persistently, in the thin calcareous and organic sandstones which were seen replacing the limestones horizontally.

The wad is known by its characteristic black color, and is more or less local and concretionary. It has evidently been introduced in the sandstones interstitially by the ground water and was probably derived from the clays of the formation. In some finely stratified sand it impregnates only some of the thin layers and not the others, giving a trenchant expression to the lamination of the rock. In some sandstone strata that occur in outcrops at Petrolia and in the uplands between Wichita Falls and Jolly, the wad has gathered in large flat and round concretion-like parts of the rock which measure up to several feet in diameter, and in some places it has impregnated strata of the sandstone a foot thick for several yards length in the exposures. See Plate XXII for similar concretions as found in Archer County. In the roads east of Petrolia some mill-stone-size concretionary impregnations of wad in the sandstones are disintegrating more rapidly than the mass of the rock, and this causes some peculiar round and shallow hollows in the road bed. In two instances some radiating impregnations of wad were noted. which illustrated the dendritic habit of this mineral.

The ferruginous minerals give the red color noted in some sandstone. It is significant that the red color is most common in the sandstones which have the smallest development. It is specially persistent in a sandstone which is interbedded with red shale in the upper part of the section at Electra. The heavier sandstones of most constant development are more generally gray or white. This suggests that where the ground water has circulated most freely these minerals have not been as frequently deposited as in the strata where the solutions have been more effectively confined.

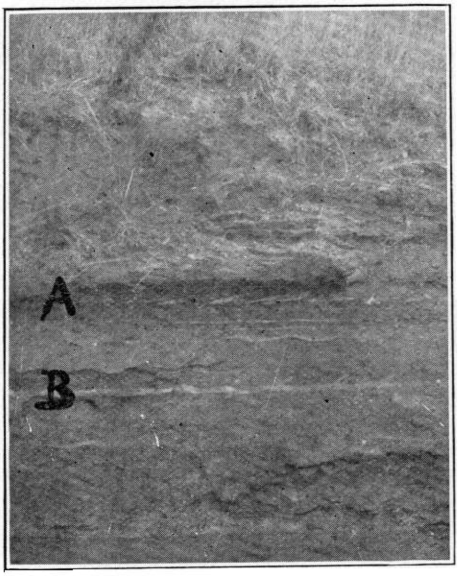
Calcite is present as an introduced material in much of the sandstone. At least a trace of it is present in nearly all sandstones as a more or less effective cementing matrix. Like the wad, it is in some places present in certain layers and seams in greater quantity than in others, and like the wad it has in some places collected into large concretionary forms. These have weathered out and rise as mildly grotesque protuberances from the ground in places where the softer and less effectively cemented main body of such sandstones has been removed by erosion. See Plate XXIII, A and B. In a few instances smaller symmetrical calcareous concretions were noted in the sandstones. These are more frequent in the lower sandstones exposed in Clay County than in the higher sandstones exposed in Wichita County. Plates XIX and XX show various forms of concretions in sandstones.

Characteristic Bedding in Sandstones.

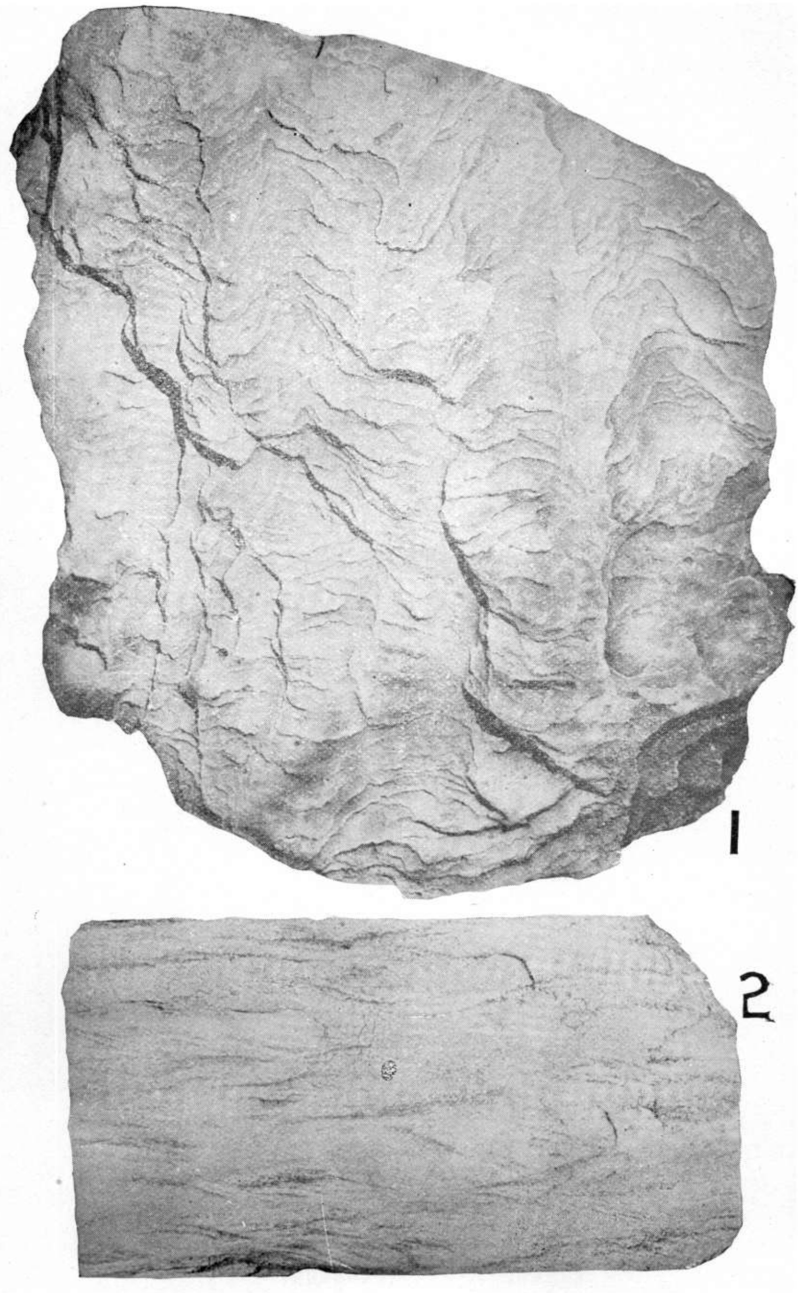
We have already noted that in their mechanical composition the Wichita sandstones resemble beach sands, or near-shore sands, being well sorted. Physical conditions of this kind are also indicated by other features of sedimentation. In a few places the sandstone is a freestone, showing no preferential planes of cleavage in any direction, and no bedding planes of any kind. But no strata of this kind were noted exceeding four or five feet, nor did these appear to run far horizontally. It suggests itself that such beds may once have been small wind drifts on the sandy beaches, which happened to remain undestroyed and to be buried under other sands later brought by the coastal currents of the sea. Usually these sandstones are distinctly stratified and are built in layers from a few inches to a foot or two thick. Sometimes these layers show a fine horizontal lamination. There extend smooth and straight division planes horizontally in the stone for many yards in both dimensions of a horizontal plane. These divide the layers into thin laminae from a sixteenth to a fourth of an inch thick. Even the thinnest of these laminae seem to be traceable for many feet, and with favorable weathering slabs of

A. Concretionary Wichita sandstone near the nortnwest corner of Survey 16, W. W. Carroll, about four miles southeast of Electra, Wichita County. Looking northeast.

B. Concretionary Wichita sandstone near the south bank of China Creek about 2 miles above its mouth. Looking east. I. J. Broman.



C. Red shales (Triassic?) in the bank of Duck Creek on the Spur Ranch in Dickens County. A. and B. are two wavy layers of clay. These are at regular intervals alternately light gray and red in color. The texture is apparently identical throughout these layers. The white color is developed mostly in the wavy slants to the right in the plate. Another layer, resting on B, shows inclined streaks of white on the right side of each wave. This layer is not cross-bedded. W .E. Wrather.



Characteristic bedding of Wichita sandstone. 1. View parallel with bedding plane. 2. View of vertical section. Photographs by F. L. Whitney.

such rock may be split into plates not much thicker than a card-board and as large as a man's hand. In places these thin layers are marked by parallel varicose lines, which seem to be wave marks. In other places the division planes are themselves thrown into very shallow, hardly perceptible folds a few inches wide. These are evidently incipient ripple marks, for in some places they are found in association with well developed ripples. Ripple marks are not very common features in the bedding of these sands, and were noted at only a few places in this field. See Plate XXIV, 1.

Cross-Bedding.

The most frequent and conspicuous bedding characteristic of the Wichita sand-stones is cross-bedding or so-called false bedding. There are few outcrops of sandstone where this form of stratification may not be found. The thinness of the beds in this field prevents it from being developed on a grand scale. The thickest single cross-bedded strata noted here are not more than three feet in thickness, and the common thickness of single layers of this kind is less than one foot. On the other hand, the development of small, fine work in cross-bedding seems to have reached a culmination in these sands. Layers no more than a half inch thick are often seen to be quite regularly cross-bedded. See Plate XXIV, 2. It is evident that this cross-bedding is the result of currents in the direction of the slant of the false bedding. These slants are, in each case, the indices of local currents which produce them. In each outcrop there may often be found several directions of these slants, but usually one or two directions prevail. For the purpose of securing some information on the general direction of the transporting currents which brought this sand, some observations were made on the direction of the slants in the false bedding of the thickest strata. Each slant noted was referred to one of eight directions of the compass, the four cardinal points and the four intermediate points. In all, 125 observations were taken, thirty in Clay County and ninety-five in Wichita County. Tabulating the recorded data we find them as follows:

TABLE SHOWING THE DISTRIBUTION TO EIGHT POINTS OF THE COMPASS OF THE DIRECTIONS OF SLANTS OF FALSE BEDDING IN THE SANDSTONES OF THE WICHITA FORMATION IN CLAY AND WICHITA COUNTIES.

Direction of the slants.	N.	NE.	E.	SE.	S.	SW.	W.	NW.	All.
Number of slants in Clay County	8	1	2	2	1	7	5	4	30
Number of slants in Wichita County	17	2	7	7	10	13	29	10	95
Number of slants in both counties.	25	3	9	9	11	20	34	14	125

Plotting these directions, we find that the resultant for Clay County points about twenty-six degrees north of west, and for Wichita County, about two degrees north of west. All the observations combined make the resultant direction seven degrees north of west. See fig. 5.

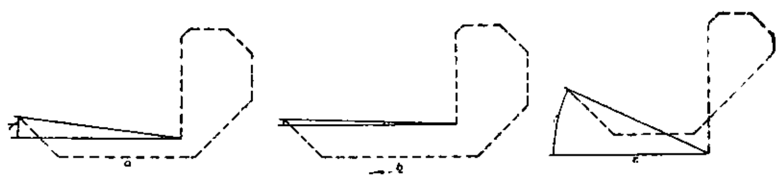
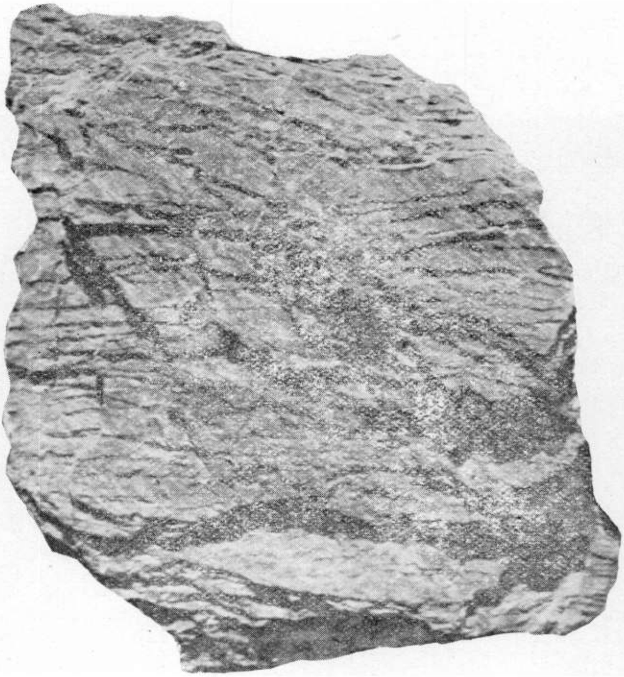
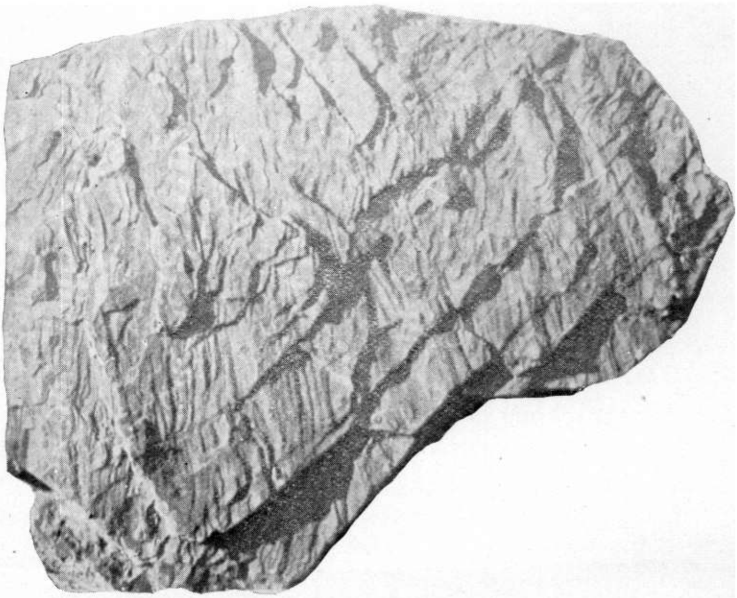


FIG. 5. Resultants of directions of slants in cross-bedding: a, resultant of 125 observations in Clay and Wichita Counties; b, resultant of 95 observations in Wichita County; c, resultant of 30 observations in Clay County.

Significance of Cross-Bedding.

The greater frequency of the westwardly directed depositing currents is clearly shown by these observations. It would nevertheless be hasty to conclude that the resultant direction is a true index of the direction from the land to the sea at the time of the making of these beds. The general direction of transportation in sand bars and sand beaches is not always from the land seaward. It may as well be parallel with the coastline. But it can not be largely from the sea landward. All that we may safely infer from these observations is that the land at that time was not to the west with the sea to the east. If the ancient shoreline extended in a north and south direction, there must have been an open sea to the west. But if the course of the shoreline was from east to west, the land may, so far as these observations are concerned, have been somewhere in a northeast, or an east direction. The northward trend of the resultants renders it unlikely that the shore line extended in an east-west course, as this would require a landward transportation of the sand.





Slabs of sandstone showing faults produced by settling in unindurated sediments. Photographs by F. L. Whitney.

The land hence probably lay to the east, southeast or northeast, all evidence considered, with the open sea to the west, northwest or to the southwest.

Small Contemporaneous Faulting.

Some thin and fine-grained layers of sandstone which are interbedded in the red shales in the brakes of Bluff Creek southwest of Electra, exhibit a peculiar small faulting, which is believed to have taken place almost immediately after the sand was laid down, and before it had become consolidated to any degree. See Plate XXV. Layers of sandstone one to four inches thick are faulted along gently but somewhat irregularly curving lines, which run roughly parallel from a half inch to several inches apart. The displacement at each little fault is from zero to a half inch. We have seen such faulting in rapidly accumulated soft mud settling on sloping banks under its own weight, and we have no doubt but that these structures have a similar origin. Their presence in these beds indicate that sedimentation was rapid. In some sands belonging in about the same horizon and in the same part of the field, were also to be seen some vertical or slightly oblique perforations more or less perfect, seldom more than an eighth of an inch in diameter. These are probably either worm borings of some kind or cavities left by imbedded plant structures.

Some Larger Bedding Structures.

The fact has been mentioned that the sandstone beds can not with certainty be traced for any considerable distance. They disappear, frequently, in less than a mile. Instances of this kind have been referred to in some of the described sections, as in sections 10, 16, 20, 22, and 24. See also Plate XV. Another case of this kind was noted at a point about three miles east of Wichita Falls, where the main wagon road turns up in the low bluff. A silty sand, with a dip that is evidently incidental to the bedding, terminates against a sloping clay surface. The outcrop is somewhat obscure. Other cases of dipping sandstones, where the dip is evidently original in the bedding, were noted in survey 27, H. & T. C. R. R. Co., about six miles south and two miles west of Electra. At this point a sandstone runs some 150 yards with a dip of several degrees to the east, but on all sides of this place the formation lies horizontal. Another dip of this kind was noted in the ravines about two miles south and one mile west of Electra. In a hill facing northeast near the east line of the W. W. Carroll survey, some five and one-half miles north and four miles east of Iowa Park, some layers of sandstone, interbedded with red shale, dip some ten to fifteen degrees to south and disappear from the outcrop. Close to the south the overlying red shale is capped by some thin gnarly black limestone, and this lies horizontal. In all of these cases we believe that the dip is original in the bedding, and in several cases the evidence is clear that an excavation has been made in the accumulating clay and sands, and the dipping beds have been laid down on the sloping sides of the excavation. We believe that these excavations may very well have been made by bottom currents in littoral waters, for there are no evidences of weathering or de ay along the contacts on the bevelled layers. See Plate XV, A. It is well known that sand banks on the gulf coast are continually undergoing changes, and excavations of several feet may be made more or less extensive in the course of a year. Tidal currents are especially effective in such work. The universal occurrence of cross-bedding in these sandstones, and perhaps also the frequent presence of extensive flat and thin lamination which we have described, may perhaps be regarded as additional evidence of tidal action. We believe that these sandstones were originally mostly submerged sandbars and in some cases sandy beaches. Wave marks, marks of rain drops and rill marks are not often to be seen. It appears to us that these should be more frequent, if the greater part of these sands were emerged beach sands.

Fossil Plants.

The only fossils noted in the sandstones were a few impres sions of leaves and some problematic structures which may be impressions of some form of vegetation. The leaves have been examined by David White, who has kindly furnished the following identifications and notes:

1. Pecopteris, a fragment not specifically determinable, on account of obliteration of the nervation.
2. Taeniopteris, several fragments, indistinct as to nervation.

3. Gigantopteris, two or three pieces, one of which is a gigantic overgrown Callipteroid type such as has not been known outside of the Uralian Permian.

Though taken from points several miles apart, it is believed that these leaf impressions come from one and the same horizon, a horizon which seems to be the stratigraphic equivalent of a calcareous bed elsewhere containing vertebrate remains. In the sandstones containing these leaf imprints, the vertical perforations already noted are frequently to be found.

CONGLOMERATES.

In all the sandstones examined in Wichita County and in the northwest quadrant of Clay County no quartz grain or pebble was noted which was more than a millimeter in diameter. Coarse ingredients from the same source as the bulk of the sand have been effectively left behind by the currents transporting the sand. Nevertheless some coarse sediments were found together with the sands and the shale, but these are, as we might say, of indigenous origin, and have not been transported from the same places as the rest of the material in the sands and the shales. These indigenous coarse sediments may be designated as bone breccias and mud-lump conglomerates. We shall describe the bone breccias in connection with the limestones, of which they make a somewhat rare feature. The conglomerate has been noted by all earlier observers in this field. Mr. W. F. Cummins very aptly referred to it as "a peculiar conglomerate." It occurs in most frequent association with sand, quite often appearing as a basal layer under sandstone. Quite frequently it forms separate layers interbedded in sandstone. In the described sections it occurs interbedded in sand in eight cases and underlies sandstone and overlies shale in three instances. In four instances it was found interbedded in shale, which at least in one case was slightly sandy and stratified. The assertion appears to be warranted that the associations of this conglomerate indicate its formation in situations where currents in the depositing waters were active. The conglomerate consists of more or less rounded bodies of indurated and compact calcareous and argillaceous material. Some of these are calcareous, others argillaceous or ochreous. They measure from the size of sand grains to an inch and a half in diameter. Many exhibit an obscure concentric structure, which is most apparent near the periphery. Many have internal fissures such as characterize clay-ironstone concretions and calcareous concretions in clay beds. These balls, as we may call them, are more or less uniform in size for different beds, having evidently been sorted by the transporting currents. In the coarsest conglomerates noted they perhaps average half an inch in diameter, and in the conglomerate of finest texture the individual pebbles averaged less than one-tenth of an inch in diameter. Balls of the size of a pea are common in samples where the sorting has been most perfect. These balls or pebbles are imbedded in a matrix of clay or of sand, or of a mixture of these. The matrix may be only a filling in the interstitial spaces in the conglomerate, but it constitutes more than one-half of the rock. In some localities the conglomerate has evidently suffered alteration from mineralized ground water, in places substituting copper carbonate, ochre or wad for the calcareous ingredients in the rock and in places merely precipitating these minerals in the original matrix.

Conglomerates like this are indeed not unknown in other formations consisting largely of clay and shale. They have been noted by one of the present authors in the late Cretaceous clays in Brewster County in Texas and in the Pennsylvanian in Illinois and in Iowa. In Ohio a somewhat similar rock has been noted and described as a "dessiccation conglomerate."[1] In his paper on "The Physical Origin of Certain Conglomerates,"[2] J. H. Gardner shows how water currents which are overloaded with fine mud will form balls which resemble concretions, and Wm. B. Phillips[3] has described how balls of fine clay are formed in the troughs of the log washers in the treatment of brown ores in Alabama. That most of the balls which make up these conglomerates have been formed by a process of rolling, appears likely from the concentric structure which many of them have. But some of the pebbles have evidently withstood more wear than mere mud

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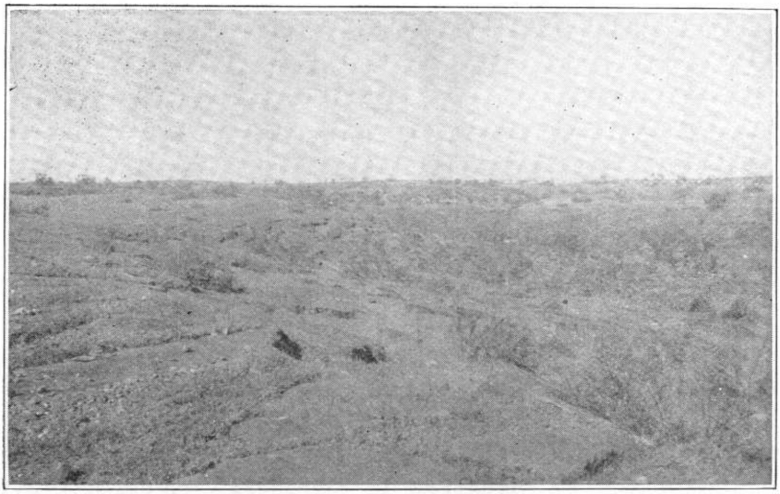
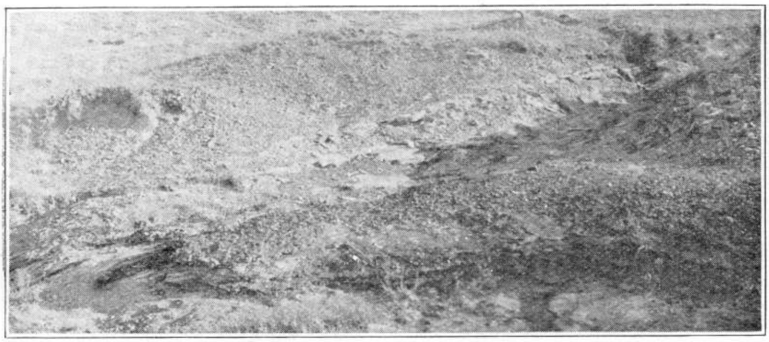
[1]J. E. Hyde, Am. Jour. Sci., Vol. XXV, 1908, p. 400.

[2]Journal of Geology, Vol. XVI, p. 452.

[3]Iron Making in Alabama, Alabama Geological Survey, Second Edition, p. 55.



A. The Beaverburk limestone on the H. & T. C. Ry. Survey 33, 8 miles south and 1 mile east of Electra Wichita County. The limestone blocks are slowly creeping down on the slope from the edge of the hill. This is nearly on a level with the photographic eye. Looking northeast.



B. A sandstone containing small calcareous concretions, originally imbedded in the sand. Erosion has exposed a layer in which the concretions are fairly abundant. These still adhere to the rock, or are only partially laid bare. About 4 miles south of Electra, Wichita County. Looking southeast.

balls can do. These must have been considerably indurated originally, and they have the appearance of being true calcareous concretions. It is believed that such pebbles in the conglomerates may have been washed out from clays in which they first were formed by true concretionary growth. The frequent association of sandstone and of these conglomerates with contemporaneous unconformities or local excavations in the clays, is significant in this connection. It is known that concretionary growths may form quite rapidly, and on the gulf coast places may now be found where the waves are beating down banks of recently formed clay, leaving thin layers of calcareous concretions mingled with sand on the beach at the foot of the clay cliff. A sandy conglomerate of such concretions, that perhaps was laid down on a beach in this manner, was noted in the breaks about four miles south of Electra. The concretions have evidently been imbedded in the upper surface of a stratum of sand to which they adhere in the exposure. See plate XXVI, B. The absence of everything but indigenous material in conglomerates which clearly have been produced by currents of considerable strength, suggests isolation of the coasts from mountain lands, while the Wichita beds of this region were deposited. The underlying beds of the Cisco formation contain pebbles of chert and of granite, which are derived from the Wichita Mountain uplift. Evidently the geographic conditions prevailing during the deposition of the Wichita beds were different from those existing during the making of the Cisco beds.

THE BEAVERBURK LIMESTONE.

While the clays and the sandstones of the Wichita formation are too irregular in their development to be individually correlated, at least one limestone was found which it was possible to follow for a dozen miles or more, even though it may not be quite continuous for this distance. We have called this the Beaverburk limestone, for the reason that it is well developed in the basin of Beaver Creek, and has been traced northeast as far as to Burk Station on the Fort Worth and Denver Railroad.

This limestone caps the upland bluffs on the north side of the Wichita River in the southwest corner of Wichita County, where it has its greatest thickness and measures about three feet. Its outcrops have been traced from this point northeastward across the basin of Beaver Creek, and from there northward and eastward to Burk Station, as indicated on the accompanying map. In the Beaver Creek basin the rock is less than two feet thick, and in some places less than one foot. Northeast from the Beaver Creek basin, and in the vicinity of Burk it is less than six inches thick and is evidently not always present in the section. The horizon where it belongs is, however, marked by a continuation of the dark or greenish-gray shale which underlies. This shale is traceable eastward as far as to the hills two miles northwest of Iowa Park. A thin shell of limestone, which may be a continuation of this limestone, was noted at a point on a hillside three miles north and one and one-half miles east of Iowa Park.

List of Localities of the Beaverburk Limestone.

1. On the north side of the Wichita River in the west part of the L. T. Miller survey 28, five miles above the mouth of Beaver Creek, this limestone caps the river bluff. It is two and one-half feet thick and is overlain by some dark clay, which contains several thin shells of dark limestone like that below.
2. On the H. & T. C. R. R. survey 25, and on the adjoining Childon survey 26, from nine to eleven miles south and a mile east of Electra, are several outcrops in the heads of the ravines, and the rock averages from ten to eighteen inches thick.
3. In the bank of Beaver Creek at the Guthrie Ranch bridge, in the northeast corner of the Bynum survey 22, the limestone outcrops at the north abutment of the bridge. It rests on the usual dark greenish-gray shale.
4. In the breaks of Beaver Creek in the west half of the H. & T. C. R. R. Co. survey 33, about four and a half miles west of the mouth of Beaver Creek, and on its north side, the limestone outcrops extensively. It measures from a foot, or less, to eighteen inches thick. In many places there are a few inches of clay above the main limestone, and then there is a three to four-inch layer of limestone. This contains a Syringopora, in some places in profusion, and some minute gastropod.
5. In the tributary to Beaver Creek running south through the H. & T. C. R. R. Co. survey 35, about seven miles south and

three miles east of Electra, the limestone outcrops on both sides of the creek for a distance of a mile and a half. It is from six to eighteen inches thick, and the upper four inches contain Syringopora in many places.

6. In the north part of the Lamphear survey 2, five and a half miles west and one and one-half miles south of Burk, the limestone rests on dark gray clay and is from four inches to a foot thick.

7. On the slopes of the shallow ravines in the north part of the H. & T. C. R. R. Co. survey 1, about five and one-half miles west of Burk, the limestone is six inches thick and rests on bluish-gray shale.

8. In the south half of the S. B. Burnet survey 12, about four miles west of Burk, the limestone is some four inches thick and crops out in a shallow ravine.

9. On the north side of the main wagon road, about one-fourth of a mile west of Burk, the limestone is a thin shell some three inches thick or less, black and slightly bituminous. It can be traced on the surface a half mile to the east and a short distance to the northwest, and was seen to contain a Syringopora, *Estheria minuta* Jones, and occasional fish scales.

This limestone is mostly a tough dark gray rock, that effectively withstands weathering. It has been used very generally for building stone and in foundations at the neighboring ranches. It breaks along two main systems of joints into rectangular and sometimes diamond shaped blocks, often in sizes small enough to be handled and hauled away. Where the limestone caps a small slope these blocks creep down on its surface, forming a pavement in which the blocks maintain their arrangement in rows for some distance down the slope. This is frequently seen in the breaks on the H. & T. C. R. R. Co. survey 33. See Plate XXVI, A.

Chemical Composition.

Two chemical analyses have been made of this rock by Mr. S. H. Worrell. One of the samples analyzed (1) was collected in the H. & T. C. R. R. Co. survey 33, where the rock has a moderate development for this region, and the other sample (2) is from the vanishing northeast edge of this limestone, where the rock is only three inches thick. It will be noticed that the rock at these two places is very similar in composition, the contents of silica, alumina, oxide of iron, and lime varying but little. The manganese is no doubt a secondary mineral, introduced after the rock was made in the Burk locality. The considerable variation in magnesia may also be the result of secondary local changes. The greater quantity of organic matter in the sample from the north locality is evidently an original difference, as the rocks in this locality show more of organic structure in their texture. These analyses are as below:

Analyses of the Beaverburk Limestone.

1.

	Per cent.
Silica	7.56
Alumina	14.93
Oxide of iron	2.57
Lime	35.74
Magnesia	5.69
Sulphuric acid	0.65
Carbonic acid	33.80
Phosphorus	trace
Water	none
	100.94

2.

	Per cent.
Silica	8.81
Alumina	12.74
Oxide of iron	2.40
Lime	35.14
Magnesia	1.12
Oxide of manganese	3.05
Sulphuric acid	trace
Carbonic acid	34.74
Phosphorus	trace
Alkalies	0.37
Moisture	0.22
Organic matter (by difference)	1.41
	100.00

In its original form the rock is almost compact and structureless, save for the presence of more or less obscure lamination. Under the microscope the sample (1) in the above analyses exhibited an exceedingly fine and homogeneous granular texture, the granules being somewhere near one thousandth of a millimeter in diameter and appearing like the crystals in a fine textured dolomite. In the granular matrix various curving lines were noted, some of which were very thin imbedded small bivalve shells. Several thin sections, cut in three dimensions vertical to each other, of the rock near Burk, consist largely of a tangle of irregularly bending and branching laminate structures, about one twentieth of a millimeter thick. These lie mostly flat with the bedding planes and enmesh a varyingly copious matrix, consisting in part of structureless material and in part of small lump-shaped bodies of lime. There are also various shell fragments, and irregularly shaped impregnations of black bituminous material, scattered through the mass. The structure of the rock suggests that it has been formed, at this point, to some extent from a multitude of thin shells encrusted with lime, which became imbedded in a calcareous precipitate mixed with some fine clay. In the Beaver Creek basin and along Wichita River the rock is in many places somewhat porous, and has a dark brown rusty color. These are evidently secondary characteristics, due to solution and infiltration by the ground water. Irregular pockets filled with crystalline calcite must be ascribed to the same cause.

Fossils of the Beaverburk Limestone.

Aside from the probable fragments of ostracod shells appearing in thin sections of this limestone, only one fossil is fairly abundant. This is a Syringopora consisting of free tubes, circular in cross section, and having external transverse lines of growth. This fossil is fairly abundant in the upper six inches of the limestone in the south part of Wichita County, and no outcrop was noted anywhere in which it was entirely absent. Some places were noted where the coral filled the rock, having grown in colonies a foot wide and from three to four inches high, the tubes frequently being in contact with each other and spreading gently from below upward. A list of all the fossils noted is as below:

	Locality.
Syringopora, sp	In all outcrops.
Myalina, sp	Beaver Creek bluff, four miles above mouth of creek.
A small gastropod	Beaver Creek Bluff, four miles above mouth of creek.
Estheria minuta Jones	Burk.
Fish scales	Burk.

THE BLUFF BONE-BED.

On both sides of Bluff Creek, south of Electra, there is a calcareous bed, or horizon, which in many places caps a bench on either side of the creek. It is most often seen on the west side of the creek, and was traced from a point on the Jno. W. Carter survey 24, half a mile north of the place where Beaver Creek is crossed by the west boundary of Wichita County, to near the center of the H. & T. C. R. R. Co. survey 19, about five miles southwest of Electra, a distance of five miles. Scattered localities of what is either known or believed to be the same horizon were seen in the breaks on the east side of Bluff Creek in a belt about one mile east of the west boundary of Wichita County, and parallel with this, extending from a mile north of Beaver Creek to a point west of Electra. It was also noted in a low bluff or terrace extending from a point a mile south of Electra eastward for three miles on the south side of the headwaters of Buffalo Head Creek, at scattering points in a belt extending three miles east of Electra, and again in the basin of China Creek nearly two miles north of Electra.

List of Localities of the Bluff Bone-Bed.

The details of the observations in these localities may profitably be recorded. They are as follows:

1. A low terrace-like shelf follows the south side of the principal creek draining eastward in the north part of the J. A. Roesh survey, one and one-half miles south of Electra. This is capped by a thin shell of rock consisting of sand, fragments of fish scales and bones, and rolled lumps of marly clay, all imbedded in a matrix of lime and ochreous material. Some eight-inch long spine-like saurian bones were noted and also casts of *Estheria minuta* Jones.

2. On a low hill east of a water tank which is near the west boundary of Wichita County, about two-thirds of a mile north of Beaver Creek, there are remnants of a thin shell of rock, which consists of a compact mixture of rolled calcareous lumps from one-tenth of an inch to half an inch in diameter, fragments of bones and scales of fish, imbedded in a matrix of granular calcareous material, which in some places is crystalline.

3. On a low terrace-like shelf on both sides of Bluff Creek, near the west boundary of Wichita County, and from one-half to one and one-half miles south of Beaver Creek, the capping rock consists of different mixtures of sand, calcareous material, clay and fragments of bones and scales of fishes. There is at this place a stratum of very compact gray limestone, extending for some hundred paces, which contains numerous imbedded shells of an ostracod, probably *Paraparchites humerosus*, and many symetrically grown colonies of a Syringopora, one of which was seen to have begun its growth on a spiral shell (Bellerophon?), an impression of which is left in the base of the polyp colony. Small fragments of bones of vertebrates were also noted.

In a short distance this limestone is not seen any more, but we find at the same horizon a sandstone, which contains much calcareous material, scales of fishes, and many fragments of vertebrate bones.

At another place the horizon is marked by a conglomerate consisting of rolled lumps of calcareous and clayey material imbedded in a sandy matrix in which are also found small fragments of vertebrate bones and scales of fishes.

In all these places the rock containing the vertebrate remains rests on a few feet of blue shale, which again overlies red shale.

4. For some miles to the north of this locality, in the breaks of an irregular belt running parallel with the west boundary of Wichita County, and from one-half to one and a half miles east of this boundary, what is believed to be the horizon of this bone bed is marked by beds of calcareous gray sandstone and irregular beds of red sandstone, frequently showing some vertical perforations and occasionally containing impressions of leaves of ferns, as already described under the heading of sandstones. In most of these localities fragments of bones may be found, and in some, such fragments are fairly abundant. In two

places, a half mile apart and about three and one-half miles south of Electra, the bone fragments were evidently sorted to size and some were slightly worn, as by wave action. On an area of some twenty feet square we collected 42 apparently identical limb-bones of a Clepshydrops, and 17 more limb-bones of nearly the same shape and size, either of the same animal or of Diplocaulus, together with 25 skull bones of *Diplocaulus magnicornis* Cope, 23 pieces from the pectoral girdle and the skull of a Trimerorachis, and various bones of the jaws, the spinal column, and an interclavicle of the same animals. These were all of about the same size, ranging from half an inch to one inch in their largest dimensions. Only a few larger bones were noted of larger size in the same place. The calcareous material of the bone bed seems to be mostly represented by bands of concretions in these localities.

5. At a point near the center of survey 20, about three and one-half miles south and three miles west of Electra, is a limestone which is no doubt the equivalent of the one described on the east side of lower Bluff Creek. This limestone caps an upland bench facing east, having an elevation of some 50 feet above the bed of the creek. It is a dark gray rock, about a foot thick, consisting largely of comminuted shell fragments and imbedded shells of an ostracod like *Paraparchites humerosus* U. & B., and many poorly preserved specimens of other fossils which we have identified as follows:

	Number of specimens noted.
Syringopora, sp.	12
Murchisonia, sp.	6
Pleurotomaria, sp.	6
Allorisma terminale Hall	15
Myalina aviculoides M. & W.	8
Temnocheilus winslovi M. & W.	17
Nautilus, like excentricus M. & H.	3
Bellerophon crassus M. & W.	30

6. In the southeast quarter of the H. & T. C. R. R. Co. survey 19, at a point about three miles south and three and a half miles west of Electra, a hill is covered by a six-inch shell of limestone which is freshly laid bare by erosion over half an acre of surface. This rock is in part a very fine grained light gray lime-

stone and in part an organic calcareous sandstone, consisting of angular grains firmly cemented by a matrix, which is partly crystalline showing continuous reflections along cleavage planes. This contains many small fragments of vertebrate bones and minute specks of malachite. *Paraparchites humerosus* U. & B. was seen to be abundant.

7. About a half mile northwest of the preceding locality (Number 6), a gray sandstone was seen containing several impressions of leaves of ferns. This shell of sandstone was only some three to six inches thick, and was interbedded in gray shale. One of these has been mentioned above and identified as a Gigantopteris by David White, who says it is a gigantic overgrown callipteroid type, such as has not before been known outside of the Uralian Permian.

8. In the breaks about one and one-fourth miles southwest of Electra, the horizcn of the Bluff Bone Bed is apparently represented by a calcareous sandstone a few inches thick, which contains the usual fragments of bones and fish scales.

9. About a mile south of Electra a low flat on the south side of the principal drainage line is capped by a calcareous sandstone from three to six inches thick, no doubt representing the horizon of the Bluff Bone Bed. It becomes a seam of concretions in the exposures farther south and is discontinuous to the westward, where it seems to be represented by some thin sandstone layers. The most calcareous outcrops contain *Estheria minuta* Jones, sometimes in profusion, and in one place a poorly preserved *Myalina* (*swallovi?*) was noted. To the east-southeast this stratum can be traced for a mile and a half and was seen to contain in one place bony spines ten inches in length.

10. In the A. J. Shaw survey 16, about four and one-half miles east of Electra, a calcareous and sandy seam containing vertebrate bones could be traced for a considerable distance on the low slopes of the uplands. It is nowhere more than a few inches thick. In places it contains rolled lumps of calcareous material, concretions, and scales of fishes. A mile further west, and at about the same level, a thin shell rock was found which is a breccia of entire and broken fish scales, mostly from one-eighth of an inch to one-fourth of an inch in diameter. The scales are lodged in a matrix of hematite, calcite and sand. An analysis

made by S. H. Worrell shows that the breccia still contains three and one-half per cent of calcium phosphate.

11. The sandstone seen in some gullies on the north side of the main road about a mile east of Electra is believed to belong to this horizon. It contains impressions of the leaves of a Pecopteris and vertical perforations such as were noted in a sandstone associated with bone-bearing shale in a place four miles south of Electra.

12. At a point about one and one-half miles northeast of the railroad station at Electra, the north bank of a small tributary to China Creek is capped by a sandstone changing into a mud lump conglomerate containing many small fragments of bones. It is less than a foot thick and is part of a sandstone. This sandstone follows the south bank of China Creek for a half mile or more to the southwest and contains occasional scales of fishes and small fragments of bones.

The reason we regard the strata described at these localities as belonging to one horizon is in the first place that no exposures were noted where we found two such horizons overlying each other. There is also one feature which characterizes the rocks in all the localities: one can find in all these places scales of fishes and fragments of vertebrate bones. Furthermore, such observations on the dip of the terranes as it was possible to make show that the outcrops described are in the positions where the general structure of the terranes would place them, if they represent a single horizon.

It seems probable that the horizon represents the coastward featheredge of a limestone which thickens to the southwest and which merges eastward into shore deposits containing in some places wave-washed detritus of the fauna of the time, and at other places containing these and also occasional plant drift lodged in rapidly accumulating sand, while in still other places the calcareous deposition may be represented by merely a layer of concretionary material. This seems the more likely since the calcareous material is most abundant to the west and south and nowhere sufficient to form a true limestone shell in the north and east outcrops. It will be remembered that there was a similar change in the Beaverburk limestone, which has a thickness of three feet in the southwest corner of Wichita County and thins out to a mere shell which merges into a bone and scale bearing sand east of Burk Station, and north of Iowa Park. It is possible that some calcareous, scale and bone bearing layers seen near Wichita Falls and near the Red River bluffs north of Iowa Park are similar littoral equivalents of this limestone.

Fossils of the Bluff Bone-Bed.

Below is a list of the fossils noted in the Bluff bone bed. Localities are indicated by numbers referring to the localities described above. The vertebrates have been determined, some by S. W. Williston and some by R. L. Moodie. The plants have been determined by David White.

	Locality.
Pecopteris, sp. (several specimens)	4
Taeniopteris, sp.	4
Gigantopteris, sp. (two specimens, one of which is said by White to be a gigantic overgrown Callipteroid type, such as has not been before known outside of the Uralian Permian)	11
Walchia, probably W. pinnaformis	11
Syringopora (profuse)	3
Murchisonia (seven specimens noted)	5
Pleurotomaria, sp. (six specimens)	5
Allorisma terminale Hall (many specimens)	5
Myalina aviculoides M. and W?	5
Myalina swallovi McChesney?	9
Temnocheilus winslovi M. & W. (seventeen)	5
Nautilus, like excentricus M. & W. (three)	5
Bellerophon crassus M. & W. (thirty)	5
Bellerophon, sp.	3
Estheria minuta Jones (profuse)	1, 9
Paraparchites humerosus U. & B. (profuse)	3, 6
Scales of fish, and teeth	Everywhere'
Diadectes, sp. (a toe bone and many vertebrae)	4
Naosaurus, sp. (spines)	1
Eryops, sp. (vertebrae, skull bones, interclavicle)	4
Dimetrodon, sp. (parts of a tibia and a mandible)	4
Trimerorachis, sp. (intercentra, pieces of skull, jaw, and bone of the pectoral girdle)	4
Diplocaulus, sp. (skull bones and bones of the pectoral girdle)	4
Clepshydrops, sp. (limb bones, many)	4
Diplocaulus, sp. (limb bones and an interclavicle)	4

GENERAL SECTION OF THE OUTCROPPING ROCKS.

Reviewing all the observations made on the outcropping rocks, it is to be noted that less than one-half of all the localities described can with certainty be referred to their proper position in a general section. The Beaverburk limestone and the Bluff bone bed are the only identifiable units in the field. Of these the Beaverburk limestone does not extend eastward beyond Iowa Park, and the Bluff bone bed is not known to extend farther than four miles east of Electra. Only in one place were the field conditions such that a measurement could be made of the vertical distance between these two key-rocks. This is near the Webb well, just west of the west boundary of Wichita County, four and one-half miles south of Electra. At this place a shallow well has recently been made and a thin limestone, readily identified from fragments as the Beaverburk limestone, has been penetrated at the depth of about forty-five feet. In the low upland near this well the Bluff bone bed lies twenty feet above the curb of the well, so that the distance between these two members in our section is sixty-five feet at this place, as shown in Section 30. above.

The beds above the Bluff bone bed are shown in Sections 27 and 28, above, and consist of thirty feet of red clay overlain by some few feet of sandstone. This clay is also exposed north of the railroad a half mile east of Electra, and in the low bluffs around the artificial lake a mile west of Electra, as well as in the breaks on the east side of Bluff Creek.

About midway between the two key-rocks there is at one place on Bluff Creek a dark bluish-gray or almost black shale, only two feet thick, in which occur some flat clay-iron concretions as large as a hand. See Plate XXI, 7. These, as well as the shale itself, contain fragments of leaves in which the vegetable structure is unusually well preserved.

The sediments below the Beaverburk limestone are seen in several places in a belt about five miles wide, following the north side of the Wichita, from Burk Station southwestward. Such are the strata designated and described as 1, 2, 3 in Section 21; 1, 2, 3, in Section 26: 1 in Section 27: and 1, 2, in Section 28. But in none of these places are there more than 30 feet exposed of the beds below the limestones. Section 25, which is in the north bluff of the Wichita River, shows the thickest single exposure in the region and exhibits 125 feet of the sediments underlying the Beaverburk limestone. In all of these localities there are a few feet of sandstone at from twenty-five to thirty feet below the limestone, and in the deep section on the Wichita River just mentioned, there are four such beds of sandstone, approximately equal distances apart in the lower 125 feet seen. The whole succession of beds which it has so far been possible to construct from exposures is, therefore, as below:

SECTION OF THE WICHITA BEDS KNOWN FROM EXPOSURES.

	Thickness in feet.
Shales above the Bluff bone bed	32
Bluff bone bed	0-5
Shales between the Bluff bone bed and the Beaverburk limestone	65
Beaverburk limestone	0-3
Shales and sands below the Beaverburk limestone	125
	222-230

It is possible that some of the beds described in the east half of Wichita County and in the northwest part of Clay County are to be correlated with some part of the above general section, but it does not seem that such correlation can be made in the usual way. There seem to be no identifiable horizons in this part of the field, so far as yet examined.

STRUCTURE SHOWN IN OUTCROPS.

STRUCTURE AS SEEN IN KEY-ROCKS.

The course of the outcrops of the Beaverburk limestone shows that along this line there is no considerable dip. It maintains an elevation of about 100 to 140 feet above the Wichita River. It has a small dip to the south, north of Beaver Creek. South of Beaver Creek it is essentially horizontal. South-southwest from Electra, as far down as close to Beaver Creek, the Bluff bone bed has a dip of some fifteen to twenty feet to the south. But this dip probably does not reach farther north than to within a mile or two south of Electra. The same bed is seen to lie essentially horizontal along China Creek, which runs from southwest to northeast through the Electra oil field. This horizon is found at about the same level a mile south and again a mile east of Electra. But these are the only structural features that could be satisfactorily made out in the usual way from direct observations on traceable units of the section. The gross attitude of the terranes west of Iowa Park can be said to be horizontal on an east and west line.

STRUCTURE INFERRED FROM DIPS.

As it seemed highly desirable to ascertain the relative position in the general section of the fuel bearing sands at Petrolia and those at Electra, recourse was taken to a rather unusual expedient in the study of dips of flat lying formations . Notes were made on the attitude of the beds wherever opportunity offered itself, for any distance it was found practicable, and by any method available. Use was made of a common hand level for these observations, and in some places use was made of the aneroid. In all 116 observations were made on dips in promiscuous localities over the north half of Clay County, most of Wichita County, and in a few places in the east part of Wilbarger County. These observations were as detailed in the following list, arranged in order from west to east.

LIST OF DIPS.

Wilbarger County.

1. A limestone shell lies fifty feet higher at a point five miles west and one mile south of Electra, than at a point five miles south and two miles west of Electra. This makes a dip to the southeast of fifty feet in about four and one-half miles.

2. In the hills west of Bluff Creek in survey 20, three miles south and two miles west of Electra, a general south dip of about fifteen feet to the mile was noted.

3. Near N. R. Keim's ranch in survey 22, about five miles south and two and a half miles west of Electra, a dip of ten feet in one-half mile to the southwest was noted.

Wichita County.

4. In the H. & T. C. R. R. Co. survey 110, about six miles south and a mile and a half west of Electra, a calcareous seam was seen to dip south about ten feet in a mile.

5. On a creek near the west line of Wichita County and about three and a half miles north of the Fort Worth and Denver Railroad a sandstone dips about fifteen feet to the west in the distance of one-fourth of a mile.

6. In the breaks about the waterworks tank a half mile west of Electra the formations show no appreciable dip in a distance of one-fourth of a mile.

7. A dark limestone which is known to be at a depth of about 105 feet below the level of the railroad station at Electra, was penetrated by a well near the northwest corner of the H. & T. C. R. R. Co. survey 27, four and one-half miles south and two miles west of Electra, at a depth of two hundred and ten feet below the level of the Electra Station. This shows a dip between the two places of 105 feet to the southwest, or about twenty feet to the mile.

8. At a point about one and one-fourth miles southwest of Electra a small dip to the west was noted.

9. A calcareous sandstone overlying a blue shale near the waterworks tank two-thirds of a mile west of Electra is believed to be identical with a similar rock seen in the breaks a half mile southeast of Electra. The elevation is about the same in the two places.

10. About a mile south of Electra the upper one of the two calcareous members in the exposed section was observed at two points half a mile apart, on an east and west line, about on the same level at the two places.

11. Along the east side of the H. T. & B. R. R. Co., about one and one-fourth miles south and one-half mile east of Electra a sandstone lies horizontal.

12. A thin calcareous layer seen on the bank of a creek about a mile and a half north-northeast of Electra railroad station, was identified with a similar stratum seen one-half mile southeast of Electra. In both places this layer lies about thirty-five feet below the elevation of the station, showing that the strata are practically horizontal between these two points on a north and south line.

13. A sandstone appearing in the bed and south slope of a creek one-half mile southeast of Electra dips some eight feet to the northwest in about one-tenth of a mile.

14. At a point about three miles north and one mile east of Electra the formations apparently lie horizontal on an east and west line for a distance of one-fourth of a mile.

15. In the H. & T. C. R. R. Co. survey 25, nine miles south and one and one-half miles east of Electra, a thin dark limestone layer has a dip of about fifteen feet to the north in one mile.

16. Along the creek running through the oil fields north of Electra and northeastward a calcareous stratum which follows the creek on the south side has no appreciable dip in a distance of three-fourths of a mile.

17. In the hills north of Wichita River about five miles west-southwest of the mouth of Beaver Creek, the strata show no dip in a distance of one-half of a mile.

18. In the southeast quarter of the J. A. Roesh survey 8, about two and one-half miles south and one and one-half miles east of Electra, the formation lies horizontal.

19. About four and a half miles north and one mile east of Electra, on the east side of China Creek, the formations lie horizontal.

20. Near the center of the south line of the J. A. Roesh survey 12, about two miles southeast of Electra, is a thin calcareous stratum capping some low banks on the south side of a creek. This stratum dips about ten feet to the east in the distance of a mile.

21. The principal two calcareous members in the exposed part of the general section in Wichita County lie about sixty-five feet apart vertically. Two aneroid measurements were made in an hour's time on the difference of elevation of two outcrops of these members, five miles apart, the upper member outcropping at a point about one mile southeast of Electra and the lower member outcropping north of the old Waggoner ranch, about six miles south and three miles east of Electra. The difference in elevation of these two points measured just sixty-five feet, indicating that the strata lie practically horizontal on a line between these points.

22. On the north side of Beaver Creek about one mile east of School Number 5, and about four miles west of the mouth of this creek, a dark limestone was seen to descend about twenty feet to the west in one mile.

23. Near the southeast corner of H. T. & B. R. R. Co.'s survey 3, six miles south of Electra and two miles east, the sediments seem to lie in a horizontal position.

24. The two highest hills in the W. W. Carroll and the H. & G. N. R. R. Co. surveys, respectively about two and a half and four miles east and each about three and one-half miles south of Electra, are both capped by a sandstone which appears to have once been continuous between the two. The distance between the two hills is about a mile and a half, and the rock capping the east hill lies about fifteen feet lower than the rock on the top of the west hill.

25. Near a tank in the northeast corner of the H. T. & B. R. R. Co. survey 1, four miles south and three and one-fourth miles east of Electra, a thin limestone outcrops which is also seen a mile farther south at about the same level.

26. The two highest points of land seen about three and a half miles east and respectively about two and three miles north of Electra, on the D. L. C. R. R. Co. survey and on the Rich. Mead survey, show a sand which caps the southernmost hill and appears on the upper slope of the northernmost of these two hills. There is a

descent of this rock of about forty feet to the northeast in a distance of about three-fourths of a mile.

27. A thin calcareous seam dips to the northeast some fifteen feet in a mile on surveys S. A. & M. G. R. R. Co. 1, and A. J. Shaw 16, about three and one-half miles east of Electra.

28. Near the northwest corner of the Emma Flemins survey no. 8, about three and one-half miles south and five miles west of Burk, a sandstone which also appears in some hills about three-fourths of a mile to the northeast of this place, is seen to descend about fifteen feet in this distance and direction.

29. In the bluff point between Beaver Creek and Wichita River, on the L. C. Gibbs survey, a mile southwest of School Number 16, the sediments lie horizontal.

30. At a point about four and one-half miles east and one and a half miles north of Electra, on the G. C. & S. F. R. R. Co. survey 9, a thin calcareous stratum runs horizontal on a line extending north and south for a distance of a half mile.

31. On the east end of the G. C. & S. F. R. R. Co. survey, about four miles east and one mile north of Electra, a calcareous stratum shows a dip of about four feet to the northeast in one-tenth of a mile.

32. Near the northeast corner of the B. S. & F. survey, seven and one half miles south and four and one-fourth miles east from Electra, the sediments were apparently horizontal.

33. In the upland bluffs extending from east to west in the A. R. Collins survey 20, four and a half miles west-northwest of Burk, a sandstone was seen to lie horizontal for a distance of half a mile.

34. A thin limestone appearing in the northeast part of the C. C. Lamphear survey 2, about six miles southeast of Electra, and also in a creek about one and two-thirds miles northeast from this survey, in the south part of the S. B. Burnet survey 12, three and one-half miles west of Burk, descends some forty feet in this distance to the northeast.

35. In the southwest quarter of A. R. Collins survey 20, about four and one half miles west-northwest of Burk, a sandstone lies at a slightly lower level than a sandstone, apparently continuous with this, seen a mile further north.

36. A sandstone capping a hill in the northeast part of S. B. Burnet survey 12, about three and one-fourth miles to the west of Burk, shows no dip in a distance of one-twentieth of a mile.

37. A low spur of a bank on the south side of Buffalo Head Creek, about one mile to the west-southwest of Burk Station lies at about the same level as a limestone seen in a creek two miles farther west. The rock in the two places is believed to be the same.

38. In a creek on the S. A. & M. G. R. R. Co. survey, and on the survey north of this, eight miles north and three miles west of

Burk, a sandstone lies horizontal for about a fifth of a mile, running in a northeast and southwest direction.

39. Near the west half of the north line of the W. C. Eustis survey 4, four miles north of Burk, a sandstone dips about ten feet to the east in about one-fourth of a mile.

40. On the highest point of the divide between Buffalo Head Creek and Wichita River, three miles south of Burk, the capping rock dips about eight feet to the northeast in about one-sixth of a mile.

41. In the C. T. R. R. Co. survey, about six miles west and two miles south of Iowa Park, the strata run horizontal for a mile on a north and south line.

42. A dark limestone shell which appears on the low slopes north of the Ft. Worth & Denver Railroad near Burk Station lies horizontal for a distance of one-fourth of a mile on an east and west line.

43. A thin dark calcareous shell caps a low escarpment facing north about three-fourths of a mile south of Burk Station. It has a dip of about fifteen feet to the north in one-half mile.

44. In the H. & G. N. R. R. Co. survey 1, two miles north of Burk, a sandstone lies at the same level at two points three-fourths of a mile apart on a line from northwest to southeast.

45. At Finder's Butte, near the south line of Wichita County, about three miles west and one and one-half miles north of Holliday, the strata lie horizontal for the limited distance they are exposed.

46. A little north of the center of the James A. Bradford survey, about a mile and three-fourths southeast of Burk, the strata lie horizontal.

47. On Tenth Cavalry Creek, from one to two miles south of Red River and from eight to nine miles north of Burk, a sandstone runs horizontal for a distance of a half mile on a north and south line.

48. On Tenth Cavalry Creek, about three miles south of Red River and seven and one-half miles north of Burk, a sandstone lies horizontal in the slopes of the creeks for a distance of three-fourths of a mile, extending in a general direction from northwest to southeast.

49. In the west part of the T. E. Williams survey, about six and one-half miles north and three miles west of Iowa Park, a sandstone lies apparently horizontal for some two hundred feet.

50. Along a ravine running north on or near survey 825 abutting on Red River, some eight miles west of Burkburnett and from one and one-half to two miles south of Red River, a sandstone dips about twenty feet in a half mile to the north.

51. About one mile west of School Number 9, on the west part of the T. T. R. R. Co. survey A 376, some nine and a half miles north and two and a half miles west of Iowa Park, there is a dip to the north of some four feet in one hundred. This dip was observed for

a distance of only about one hundred feet in each of two places, about one-fifth of a mile apart.

52. Near the Archer County line in block 18 on the Denton County School Land, league number 41, due south from Iowa Park, a sandstone capping a low hill dips about fifteen feet in one-fourth of a mile to the northwest.

53. Near the north line of blocks 5 and 6 of the Palo Pinto County School Lands, about six miles south of Iowa Park, a sandstone caps a ridge running about a mile from east to west. There is no discernible dip in this distance.

54. In the B. B. R. R. Co. survey north of School Number 13, about five miles north of Iowa Park, a sandstone was noted which appeared again north of Gilbert Creek. This sandstone had a variable dip to the south, estimated at fifty feet to one mile for a short distance.

55. In the north part of block 12 of the Palo Pinto County School Lands, four and a half miles south of Iowa Park, a sandstone appears on a slope following the east side of a ravine running north. This sandstone dips north about thirty feet in a half mile.

56. A sandstone appearing in the south part of Iowa Park and underlying the north part of the town lies in a horizontal position. Outcrops of a similar sandstone appear on the creeks to the northeast at about the same level. They are believed to be the same sandstone.

57. A half mile north of School Number 18, four miles south of Iowa Park, near the north line of block 19 in the Palo Pinto County School Lands, an outlier of a sandstone caps a hill about eighty feet high. This sandstone dips about fifteen feet to the northeast in one-fifth of a mile.

58. About one-fourth of a mile north of School Number 18 in block number 19 of the Palo Pinto County School Lands, four miles south of Iowa Park, a sandstone dips about fifty feet in one-fifth of a mile to the north.

59. Near the south line of block 12 in the Denton County School Lands, league number 4, a sandstone which caps a low escarpment facing to the south lies fifteen feet lower than a sandstone which caps a low hill a half mile to the southwest. The two sandstones are evidently the same stratum.

60. Near the east line of blocks 20 and 35 of the Palo Pinto County School Lands, three and one-half miles south and one mile east of Iowa Park, an escarpment facing west is capped by a sandstone which dips north thirty feet in a half mile.

61. About three and a half miles west and one-half mile south of Burkburnett, a sandstone following the east bank of a creek running north shows a dip to the north of about four feet in three hundred.

62. Near the north end of W. W. Carroll survey 4, about three and one-half miles south and one-half mile west of Burkburnett, a sandstone dips twenty feet in one-third mile to the north.

63. In the south half of survey 4, four and one-half miles south and one mile west of Burkburnett, a small sandstone dips south about five feet in a fifth of a mile.

64. In the hills and ravines draining north in the W. W. Carroll and J. Johnson surveys, about three and one-half miles south and one-half mile west of Burkburnett, a somewhat discontinuous sandstone, or sandy horizon, shows a dip to the north of about twenty feet in one-half mile.

65. The sandstone capping some hills at a point in the northeast part of the C. T. R. R. Co. survey, three miles south of Burkburnett, is apparently continuous with some sandstone seen on Gilbert Creek two miles to the west. The elevation is about the same in the two places.

66. A sandstone capping some small hills southwest from the railroad bridge across Gilbert Creek, about three miles south and one-half mile east of Burkburnett, has a dip to the east of about eight feet to one-twentieth of a mile. It could be made out for a distance of only three hundred feet, and may represent the original conditions of deposition.

67. A half mile to the southwest of the E. F. Austin survey, about three miles southwest of the Union Station in Wichita Falls, the strata exposed lie in a horizontal position.

68. A sandstone which caps the south bank of Wichita River from the city cemetery to half a mile farther southwest is apparently continuous with the sandstone underlying the south half of the city of Wichita Falls. It shows no determinable constant dip but is practically horizontal for two miles, roughly, east and west.

69. At the east end of Lake Wichita, along the west side of the Wichita Falls and Southern Railroad, a sandstone followed for a distance of a fifth of a mile lay horizontal, on a line from northwest to southeast.

70. A sandstone in the north bluffs of Wichita River north of Wichita Falls lies horizontal in the bluffs for a distance of two miles east and west. The same sandstone appears again at the same level in the south slope to a creek three miles north of the Wichita River bluff.

71. South of the irrigation canal, about one and one-half miles south and a little east of the pumping station of the Wichita Falls Waterworks, a sandstone capping of the edge of the upland lies practically at the same level for the distance of three-fourths of a mile north and south.

72. In the railroad cuts near the pumping station at the tank between the Ft. Worth & Denver and the Missouri, Kansas & Texas

Railroads, about a mile east of Wichita Falls, a sandstone lying horizontal is exposed for about one-tenth of a mile.

73. A low escarpment following the east side of Holliday Creek, about one mile southeast from the Wichita Falls Waterworks pumping station, is capped by a sandstone which dips about fifteen feet in one-half mile to the northwest.

74. Following, roughly, the east line of Wichita County, beginning about a half mile north of the Wichita Valley Railroad and continuing for about a mile to the north, is an escarpment facing to the west capped by a sandstone showing no dip either north or south.

Clay County.

75. On the east bluffs of the Red River, about one and one-half miles down stream from the Clay-Wichita line on the R. E. Sawdon survey, a sandstone lies practically horizontal for a mile in a line northeast-southwest.

76. In the east bluffs of the Red River, about five miles down stream from the Clay-Wichita line, on the F. M. Tucker survey, a well defined sandstone shows a slight dip for half a mile a little south of east.

77. On the M. Bryan survey, about one mile northeast of the preceding observation, a sandstone capping a hill north of a small creek shows a dip to northeast of eight feet in three-fourths of a mile. No corresponding point could be seen south of the creek.

78. In the breaks east of the Wichita River, in the west part of the H. T. & B. R. R. Co. survey 36, about seven and one-half miles west and one and one-half miles south of Petrolia, three ridges extending from west-northwest to east-southeast show sandstones dipping not less than one hundred and twenty feet in one-fourth of a mile to the south-west.

79. About a mile and one-half northeast of observation No. 78, beginning on the H. S. & S. E. Wolf survey and extending into the R. T. Mitchell survey, a sandstone shows horizontal position from all directions. It is continuous for a mile or more.

80. In the hills one mile south of the Wichita River and five and one-half miles west of Petrolia, the strata appear to be horizontal.

81. In the breaks south of the Wichita River, on the E. Story survey 48, about five miles west of Petrolia, a sandstone dips fifteen feet to south, on a north to south line, in one-half mile.

82. Near the southwest corner of the K. McKenzie survey, five miles west and two and one-half miles south of Petrolia, a sandstone in a slope facing north shows a small dip to the south. No sandstone was noted at the corresponding height in the slopes a half mile farther north.

83. In the breaks on the east side of Wichita River on the H. T. & B. R. R. Co. survey, five miles west and one mile north of Petrolia, the rocks lie horizontal.

84. On and north of the W. Richardson survey, four and one-half miles west of Petrolia, there appears to be a slight dip to the southwest.

85. Near the north line of the S. P. R. R. Co. survey 52, four and one-half miles west and one-half mile south of Petrolia, the rocks lie horizontal.

86. In a place about four and one-half miles south and a half mile east of Halsell, in the north half of the H. & T. B. R. R. Co. survey 5, is a dip to the southwest of about eight feet in one-tenth of a mile, showing in the capping sandrock on a hill.

87. In the bluffs on the east side of the Wichita River, west-northwest of Petrolia in the Mrs. E. A. Glasgow survey, the sandstones have apparently no dip.

88. Near the center of the north line of the H. T. & B. R. R. Co. survey 1, about three and one-half miles south and one mile east of Halsell, a sandstone shows a dip to the south of some twenty feet in one mile.

89. In the bluffs east of the Wichita River south of the bridge four miles northwest of Petrolia a sandstone lies horizontal.

90. In the hills about four miles east and four miles south of Halsell the rock lies horizontal.

91. Near the boundary between surveys 12 and 31 of Byers Brothers' subdivision, one mile west of Petrolia, a sandstone has a low dip to north extending one-half mile.

92. In survey 62 of the Byers Brothers' addition, about one and one-half miles northwest of Petrolia, a sandstone which caps an escarpment facing to the west, dips fifteen feet to the northeast in one-fourth mile.

93. About a half mile northwest of Petrolia a sandstone in a creek lies horizontal.

94. Near the center of survey 13, of Parker County School Lands, one and a half miles south-southeast of Petrolia, there is a dip of ten feet in one-half mile to the southwest.

95. Near the south line of survey 13, in the Parker County School Lands, a mile and one-half south and a mile east of Petrolia, a sandstone apparently dips ten feet in one-fifth of a mile, on a north and south line, to the south.

96. In a north slope on the south side of a draw two and one-half miles south-southeast of Petrolia, a sandstone exposure trends east and west and in the distance of one-half mile the rock dips some ten feet to the west.

97. In the southeast part of survey 100 in the Byers Brothers' subdivision, about one and one-fourth miles southwest of Byers, is a dip of some ten feet to the north, on a line running north-northwest, in one-half mile.

98. The lower sandstone appearing in a hill one and one-half miles northeast of Petrolia dips about fifteen feet to the north in one-fourth of a mile.

99. In the bluffs one mile northwest of Byers the rocks lie horizontal for two miles in a northeast-southwest direction.

100. In the north half of survey 3 of the Parker County School Lands, a mile and a half southeast of Petrolia, a sandstone dips some twenty feet to the northeast in one-half mile.

101. Near the center of survey 72 of the Parker County School Lands, three and three-fourths miles south and two and a half miles east of Petrolia, there is a doubtful small dip to the south.

102. A mile and one-fourth east-southeast of Petrolia, near the south line of survey 16 of the Byers Brothers' subdivision, a sandstone dips fifteen feet in one-fourth mile to the east.

103. Three and a half miles south and two and a half miles east of Petrolia, near the center of the south line of survey 61 of the Parker County School Lands, a sandstone lies horizontal on a north and south line a distance of one-half mile.

104. In the west half of block 4 in the Parker County School Lands, not quite two miles southeast of Petrolia, a sandstone cropping out on a slope to the northwest dips some ten feet to the northeast in one-fifth of a mile.

105. One mile south of Byers there appears to be a dip to the north of some ten feet in one-fourth mile.

106. Near the northeast corner of survey 25 in Byers Brothers subdivision, two miles east and one-half mile north of Petrolia, a thin sandstone lies horizontal.

107. At a point about two and one-half miles east and one mile south of Petrolia, near the north line of survey 6 in the Parker County School Lands, the rock lies horizontal, as near as could be made out.

108. In survey 96 of the Parker County School Lands, three and one-half miles east and four and one-half miles south of Petrolia, there is apparently a small dip to the south.

109. In surveys 9 and 20 of the Parker County School Lands, about four miles east and one mile south of Petrolia, a sandstone caps a ridge extending in a north and south direction. This sandstone dips twenty feet to the north in a distance of one-half mile.

110. In the Mrs. Holland survey 21, four and one-half miles east and one mile north of Petrolia, a sandstone capping a low escarpment facing north dips about fifteen feet in a half mile to the east.

111. At a point about seven miles south and five miles east of Petrolia the rock lies horizontal.

112. In the hills one-half mile southeast of the northwest corner of the Montague County School Lands, five and one-fourth miles east and one mile north of Petrolia, a sandstone dips twenty feet in one-third mile to the north.

113. In the hills one-half mile east of the northwest corner of the Montague County School Lands, five and one-half miles east and one and one-half miles north of Petrolia, a sandstone dips twenty-five feet to the north in one-half mile.

114. In the hills about Dickworsham a sandstone lies apparently horizontal for a distance of a half mile from the station.

115. At a point about eight and one-half miles east and six miles south of Petrolia the rocks lie horizontal.

116. In the northwest quarter of section 8 of the Montague County School Lands, nine miles east and one and one-half miles south of Petrolia, the rock lies horizontal for a distance of about one-half mile.

Below is a classified list of the observations given above of places showing dips or horizontal positions of the Wichita formation.

Classified Table of Dips.

NORTH DIPS.

Series number.	Observed distance in miles (horizontal length of dip).	Observed amount of dip in feet.
15	1.00	15
43	.50	15
50	.50	20
51	.04	8
[illegible]	.50	30
58	.20	50
60	.50	30
61	.05	4
62	.33	20
64	.50	20
91	.50	10
97	.50	10
98	.25	15
105	.25	10
109	.50	20
112	.33+	20
113	.50	25

NORTHEAST DIPS.

Series number.	Observed distance in miles.	Observed amount of dip in feet.
26	.75	40
27	1.00	15
28	.75	15
31	.10	4
34	1.66	40
40	.16	8
57	.20	15
59	.50	15
77	.75	8
92	.25	15
100	.50	20
104	.20	10

EAST DIPS.

Series number.	Observed distance in miles.	Observed amount of dip in feet.
20	1.00	10
24	1.50	15
39	.25	10
66	.05	8
76	.50	10
102	.25	15
110	.50	15

SOUTHEAST DIPS.

(None noted.)

SOUTH DIPS.

Series number.	Observed distance in miles.	Observed amount of dip in feet.
35	1.00	10
54	.20	10
63	.20	5
81	.50	15
82	.50	5
88	1.00	20
95	.20	10
1	4.50	50
2	1.00	15
4	1.00	10
101	.50	5
108	.50	5

SOUTHWEST DIPS.

Series number.	Observed distance in miles.	Observed amount of dip in feet.
78	.25	120
84	.50	5
86	.10	8
94	.50	10
3	.50	10
7	5.00	105

WEST DIPS.

Series number.	Observed distance in miles.	Observed amount of dip in feet.
22	1.00	20
96	.50	10
5	.25	15
8	1.00	10

NORTHWEST DIPS.

Series number.	Observed distance in miles.	Observed amount of dip in feet.
13	.10	8
52	.25	15
73	.50	15

Horizontal Positions (No Dip).

NORTH AND SOUTH.

Series number.	Observed distance in miles.
71	.75
74	1.00
103	.50
12	2.00
30	.50
41	1.00
47	.50

EAST AND WEST.

Series number.	Observed distance in miles.
65	2.00
68	2.00
70	2.00
9	1.50
10	.50
14	.25
37	2.00
42	.25
53	1.00

NORTHWEST AND SOUTHEAST.

Series number.	Observed distance in miles.
69	.20
21	7.00
44	.75
48	.75

NORTHEAST AND SOUTHWEST.

Series number.	Observed distance in miles.
75	1.00
90	2.00
16	.75
38	.50
56	.50

ALL DIRECTIONS.

Series number.	Observed distance in miles.
18, 19, 23, 25, 32, 33, 36, 46, 80, 83, 85, 87, 89, 90, 93, 106, 107, 111, 114, 115—each .25 mile	5.25
17, 67, 79, 116—each .5 mile	2.00
45, 72—each .1 mile	.20
36, 49—each .05 mile	.10
11	.20

Absence of Dips.

It will be noted that fifty-six observations show the beds lying horizontal. In twenty-nine of these places the rock appeared to lie horizontal in all directions of the compass for a distance, arbitrarily fixed in the table, at a fourth of a mile from the point of observation. The remaining twenty-five horizontal positions noted were observed for definite directions and measured distances. The alignment of these defined directions to the cardinal points of the compass indicates that the rocks in this area most frequently lie horizontal in the directions which are nearest to a line running from west-northwest to east-southeast. This is even more decidedly indicated by the sums of the combined distances of measured horizontal positions, as will appear from the figures in the following table.

TABLE SHOWING FREQUENCIES AND DISTANCES OF DIFFERENT DIRECTIONS OF OBSERVED HORIZONTAL POSITIONS OF ROCKS IN WICHITA COUNTY, IN THE EAST BORDER OF WILBARGER COUNTY, AND IN THE NORTH HALF OF CLAY COUNTY.

Directions of observed horizontal positions of rock strata.	Total distances measured in miles.	Number of places noted.
North-south	6.25	7
Northeast-southwest	4.75	5

East-west	11.50	9
Northwest-southeast	8.70	4
Arbitrarily, in all directions	7.40	29

General Features of the Dips.

In making observations on dips, the horizontal distances were for the most part estimated, sometimes with the aid of known positions of gates and fences. In a less number of cases, and always in the case of the highest dips, the distances were obtained by pacing, or by a car cyclometer. In every case the distances were expressed in some simple fraction of a mile. The fractions used and the number of times each was used are as below:

	Number of times observed.
One twenty-fifth mile	1
One twentieth mile	2
One tenth mile	3
One sixth mile	1
One fifth mile	6
One fourth mile	8
One third mile	2
One half mile	21
Three fourths mile	3
One mile	9
One and one-half miles	1
One and two-thirds miles	1
Four and one-half miles	1
Five miles	1

Reducing all observations on dips to rates of dip in feet per mile, irrespective of the distance for which they were made, these rates may be conveniently referred to five groups, for a rough presentation of the class of structures they represent, as below:

	Groups of dip.	Number of observations.	Average dip of each group in feet per mile.
1.	Dips of 24 ft. per mile or less	20	15
2.	Dips of 25 to 49 ft. per mile	16	36
3.	Dips of 50 to 74 ft. per mile	15	57
4.	Dips of 75 to 99 ft. per mile	5	79
5.	Dips of 100 ft. per mile, or more	4	272
6.	Maximum rate of dip noted		480

It will be seen that the fifth group differs very considerably from the other groups in its rate of dip. None of these high dips were found to have any great horizontal extent. It is believed that they are limited in extent, and they may be partly due to original tilting in bedding, though this is not believed to be the main cause of the tilts in these particular instances.

Prevailing Directions of the Dips.

If we inquire into the distribution of these dips among the different directions of the compass, we find that they give strong evidence of the existence of a definite trend in some existing gentle deformations. They are, however, almost the only visible superficial evidence which we find of such deformations. It will be remembered that rocks were most frequently found lying horizontal in a west-northwest to east-southeast direction. Correspondingly and inversely, we have found the greatest number of dips to extend in a north-northeast to south-southwest direction, as might have been expected. And in the case of the dips the evidence of such an unequal and significant distribution is quite conclusive. It is evident from the number of observations made on dips in different directions, from the total horizontal distances along which dips have been observed in each direction, and from the amount of descent of strata in each direction. This will be apparent from the following table:

Direction of dip.	Number of dips noted.	Total horizontal distance of dips, in miles.	Total amount of dips (descent of strata), in feet.
East	7	4.05	83
Southeast	0	.00	0
West	4	2.75	55
Northwest	3	.85	38
North	17	6.95	322
Northeast	12	6.82	205
South	12	11.10	160
Southwest	6	6.85	258
The four directions nearest to a W.N.W.-E.S.E. axis	14	7.55	176
The four directions nearest to a vertical to a W.N.W.-E.S.E. axis	**46**	**31.62**	**945**

The difference in the alignments of the distances of observed horizontal and dipping rocks to points of the compass is most clearly apparent, if the proportionate distances of each dip and horizontal attitude noted be laid off on lines extending in the ob-

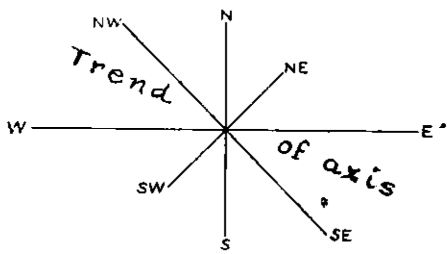


FIG. 6. Lines proportionate in length to the distances for which 54 observations show the rocks to lie horizontal in the directions indicated by the radiating lines. The probable trend of indicated folds is also shown.

served directions. In figure 6, representing the horizontals, the longest lines extend in a west-northwest—east-southeast direction, while in figure 7, representing the dips, the longest lines

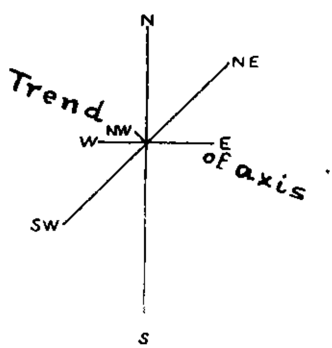


FIG. 7. Lines proportionate in length to total distances for which 60 observations show dips in several directions, as indicated by the radiating lines. The probable trend of indicated folds is also shown.

extend north-northeast—south-southwest. More exact treatment of these data places the trend required by the horizontal observations at about 28 degrees south of east and north of west, and the trend required by the observations on the dips at about 29 degrees north of west and south of east.

Indicated Trend of Existing Folds.

There is good reason to believe that all these data may properly be regarded as chance observations on one or more very shallow and wide folds, anticlines and synclines, trending in an east-southeast to west-northwest direction. In fact, we find that at least one system of dips shows an anticline with such a trend near Petrolia. See Plate I.

East and West Structure.

Our main object in making these observations was to procure some evidence bearing on the gross structure of this region; to learn, if possible, the general attitude of the rocks in the whole area studied, and in particular to obtain data for correlating the general section penetrated by the wells at Petrolia with the general section explored in the wells at Electra.

If we regard all the observations made in the area between Electra and Petrolia as chance observations on the general attitude of the formations, we can estimate from them the probable dip of the terrane on an east and west line. Leaving out all observations west of Electra and all east of the Henrietta (Petrolia) field, thus taking only the numbers from 10 to 100, inclusive, in the list of dips given, and leaving out also dips noted on a north or south line, since these would have no effect on the general east to west attitude of the terranes, we find that a total dip of 30 feet to the west was noted in two places for a combined distance of one and a half miles. Similarly we find a total dip to the east of 53 feet in four places, for a combined distance of 3.33 miles. This represents a dip of 23 feet to the east in a distance of 4.83 miles. The formations were also seen to lie horizontal on an east to west line in 31 places for a combined distance of 17.33 miles. On lines running from east to west the dips noted in 37 localities therefore show on the whole a descent to the east of 23 feet in 22.16 miles. If we similarly figure the dips noted on lines directed northeast, southwest and northwest, and project these distances, and also the slant of the planes in which these dips lie, on an east and west vertical plane, we find the remaining observations show a dip of 5 feet to the east for a combined distance of 23.60 miles.

To sum up: 90 observations, combined, show a general dip to the east of 28 feet between Electra and Petrolia. If these ninety observations between Petrolia and Electra signify anything, they indicate that the formations lie essentially horizontal, on an east and west line in this area. A stratum known to lie at a certain depth under the surface near Petrolia should be found as much deeper under the surface at Electra, as the elevation there is higher. The difference in elevation of the two fields is about 250 feet. Hence a stratum lying 750 feet below the surface at Petrolia should be looked for 1000 feet below the surface at Electra, and a horizon lying 1600 feet below the surface at Petrolia should lie 1850 feet below the surface at Electra, unless there be a change in the thickness of the formations.

THE UNDERGROUND FORMATIONS.

Data secured on the formations penetrated by deep borings remain our chief recourse for information on the deeper stratigraphy of the area. In some respects these data are even more unsatisfactory than the data secured by examination of the surface. The operators have very generously placed a large amount of material at our disposal for study. A number of well records from the two fields explored have been obtained. We have obtained in all some more or less complete records of 226 wells. Many of these records will be found in the Appendix.

A closer inspection of these records shows that some of them are somewhat unreliable. In the Electra field we find two wells, Numbers 65 and 66, only some 250 feet apart. A stratum which in one of these wells is called "sandstone," is in the other called "hard shell rock." In the Henrietta field "gyp rock" is several times reported in some wells from depths where limestone is reported in other wells. Nor are such inaccuracies at all surprising. The development of the Electra field has been rapid, and in the rush and hurry attendant on the opening of a new field there is but little attention given to the making of accurate determinations of the rocks explored. The drillers are usually required to keep a log of the formations penetrated, but their chief concern is to make the hole without accident in as short time as possible, and to detect the presence of oil or gas in the sands. It is only in exceptional cases that the driller is expected to give close attention to the nature of the ground, as in the making of some wildcat wells, where the object is to study the field as much as to bore for oil or gas. In the case of many other wildcat wells hardly any attention is given to keeping a record, the sole purpose being to test some expected fuel bearing stratum.

Many of the drillers in these fields have had their previous training in the oil fields of the coast and at Corsicana, and they have brought with them to this field the descriptive terms in vogue in the fields where they had their training. The formations in this field are quite different from the formations of the coast. They are much older than the formations either of the coast or of the Corsicana field. Most of the clays here are of slightly firmer consistency than in the other fields. The terms "gumbo" and "mud," which have been so freely used here, are less applicable in North Texas than in the coast country. In a number of instances the drillers in this new and unfamiliar field have made use of some noncommittal terms, such as "rock," "hard rock," and "red rock," and "red formation." Such terms require interpretation.

Drillers' Descriptions.

For the purpose of familiarizing ourselves, as it were, with the drillers' nomenclature, we have made a quite extensive study of the names and descriptive terms and phrases used by the drillers. For this purpose we have selected the logs of thirty-seven wells near Petrolia and of ten wells in the Electra field. We have classified the terms used in these records according to our own interpretation of their exact meaning and have noted the number of times each of the terms have been used and the thickness of the several strata they describe in each case. Incidentally this treatment of the data gives us valuable information on the general nature of the terranes explored, and an attempt has been made to use this information also for roughly verifying our correlations of the formations in the two principal fields where these explorations have been made. All the wells studied have a combined depth of 81,153 feet. Below is a table showing the number of times different rocks, expressly named or inferred to be present by interpretation, have been reported, the average thickness and the total thickness of each, as well as the percentage each makes of the total thickness of rocks studied.

Kinds of rock.	Number of times noted.	Average thickness in feet.	Total number of feet reported.	Percentage of all observations.
Gravels	6	7	45	.05
Sandstones	350	42	14,866	18.30
Argillites (shale, clay, mud, etc.)	579	92	53,290	65.60
Limestone	33	27	881	1.10
Gypsum	17	28	478	.50
Surface deposits	11	16	181	.20
Mixtures	94	79	7,445	9.30
Gypsum and other minerals	25	13	335	.40
Unidentified rocks	75	48	3,632	4.50
All rocks	1,196	39.4	81,153	99.95

GRAVELS.

To gravels we have referred four instances of rock reported by drillers as "granite." None of the rock reported as granite was more than a few feet thick and in each case the stratum rested on the usual sediments, clays or sandstones. We found in the belt of country outside of the east boundary of the Wichita formation several thin gravels, which consisted largely of granite pebbles.

In one sense this determination of the drillers is correct, for no doubt the cuttings contained fragments of real granite, when the drill was crushing such gravels. But it is certain that no granite has been encountered *in situ* in any of the wells. Only one sample of gravel from any of the wells was examined. This was from the Bacon well at 1400 feet. It contained some pebbles from 4 mm. to 1 mm. in diameter, most of which were chert, while some were orthoclase, evidently from granite. It does not seem that any of the mud lump conglomerates noted in the outcrops of the Wichita formation have been noticed by the drillers as gravels. This is no doubt due to the softness of the constituent pebbles in those conglomerates. Nothing softer than quartz or feldspar would withstand the impact of the drill sufficiently to have the appearance of gravel in the drillings. Gravel was identified as such in the well records only in two cases, and the combined thickness of these two gravel beds was twenty-seven feet. It will be remembered that the granite gravels were much thinner, averaging less than five feet. One would expect the coarser granite gravels to have a smaller development than finer chert gravels, and such appears to be the case.

SANDSTONES.

We find that undoubted sandstones has been reported under several different designations. The softer beds, which are the more frequent, are generally reported as "sand." When more indurated, they have been called "sand rock," or "rock sand." "Rock and sand" is perhaps to be classified as sandstone, though this seems somewhat uncertain, especially as 230 feet of this was noted as one bed. "Sand shell" is a term used for a thin sandstone, especially if it be somewhat indurated, and perhaps cemented by a calcareous matrix. "Sand boulders" are reported in four instances. Drillers report hard rock as "boulders," when they infer from the behavior of the drill that the hard material on which the bit is working shifts its position under the impact of the tool. It is hardly probable that boulders of sandstone have been penetrated in any of these wells. But we have seen that large concretions occur in some sandstones in Clay County, and it is not impossible that concretions may, sometimes, be so much more indurated than the sandstone in which they are imbedded, that they might be jarred loose by the drill from the rest of the rock, especially if this should be soft and thin. In such case a large sandstone concretion might react on the drill in the same way as a boulder. Possibly, also, thin strata of indurated sandstone when imbedded in soft rock, might appear to behave like a boulder to the drill. The following table shows the frequency of different terms in reporting sandstones.

Driller's names.	Number of times used.	Total thickness reported in feet.
Sand	243	8,842
Sand rock	105	5,706
Rock and sand	1	230
Rock sand	1	60
Sand boulders	4	19
Sand shell	2	9

SHALES AND CLAYS.

Argillaceous beds constitute about seventy per cent of all the material described in the well records examined. Sixty-five per cent have been identified as some kind of argillite, and in the nine per cent of mixtures reported and four per cent of unidentified material there is no doubt enough additional argillites present to make five per cent more of the total. The larger amount of argillites and their many variations in color, texture and contents has caused them to be reported under different descriptive terms and phrases, as shown in the following list:

Driller's names.	Number of times used.	Total thickness reported in feet.
Shale	227	21,141
Mud	164	16,002
Gumbo	41	2,724
Slate	32	1,622
Clay	27	3,115
Qualifying terms alone, as "red," "blue," etc.	20	2,930
Mud and boulders	13	608
Gumbo and boulders	8	640
Mud and rock	7	442
Formation	5	1,944
Cave	5	591
Shale and mud	5	263
Talc	5	44
Shale and gumbo	4	438
Shale and boulders	4	178
Gumbo and rock	3	120
Shale and rock	2	69
Clay and boulders	1	159
Soapstone	1	70
Shale and clay	1	36
Soapstone and rock	1	30
Slate and mud	1	22
Slate rock	1	19
Shale rock	1	3

"Shale" is the name used most frequently and for the greater part of the argillites. "Mud" is evidently a term which has been introduced by drillers from the gulf coast. In the parlance of the driller, "mud" is, in this field, a soft clay or shale, which more readily than other argillites mixes or dissolves in water and thus forms mud. In texture the muds are perhaps slightly coarser than the clay, and they are not as indurated as shale, the constituent particles of the mud being more readily parted by the capillary influx of water than those in shale or in clay of the finest texture. It is quite probable that this difference in behavior may be, to some extent, due to the salinity of the water used in drilling or held in the argillites, and that these terms do not necessarily imply any real difference in the texture of the insoluble constituents of the rock itself. "Gumbo" is another term which seems to have been introduced by the drillers from other fields. It denotes a clay which produces a thick, sticky mud that "gums" on the bit or that adheres to the bit firmly. Some drillers are of the opinion that gumbo is especially abundant in the most productive wells. The gumming of the clay may, no doubt, be caused by the presence of secondarily introduced ingredients, as well as by its original texture. "Slate," which is reported in two cases, is known by its coherence, causing a large part of the rock to appear as thin fragments in the drillings. It has been most frequently noted in the deeper parts of the wells. "Clay" seems to be used for designating the soft argillites of finest texture. The difference between mud, gumbo, and clay is necessarily in many cases slight and there can be no doubt that these terms do not always imply exactly identical distinctions. Sometimes the logs give only the color of the rock penetrated, when it is quite apparent that the full phrase should be "red clay" or "blue shale." In a few cases the word "formation" is used, when from the context it appears that this noncommittal term stands for the name of some argillite. "Cave" is a term used as a name for an argillite which caves into the boring. "Talc" and "soapstone" have been used incorrectly a few times for reporting some clay or shale of fine texture and light color. Neither is to be found in these fields. In twenty-six cases "boulders" are reported as present in gumbo, mud, shale or clay. It is not believed that these are real boulders, for no boulders are known in outcrops of these beds. They are most likely concretionary structures of dark and compact clay-ironstone, also known as septaria and sometimes characterized by fissures filled with calcite spar. Under the drill these might react in the same way as boulders.

LIMESTONES.

Only one per cent of the reported rock consists of limestone. The designations used, and the measurements, are as in the following table:

Driller's names.	Number of times used.	Total thickness reported in feet.
Lime	11	90
Lime shell	7	205
Lime rock	6	80

Limestone is reported in notably unequal amounts in some wells which are not far apart, and it is quite certain that some drillers have failed to report some limestones and that others have reported some rock as limestone which really has been calcareous sandstone. While there can be no doubt that errors have crept in, it is unsafe to guess in what direction there are the most errors. It must be left to later observers to make the correct interpretations. Meanwhile, it appears most useful to give the original records as they were made.

GYPSUM BEDS.

Gypsum has been reported from the deeper part of several wells as "gyp rock" in fifteen cases and twice as "gypsum." While we have found no gypsum in any of the well samples some of these reports may be correct. The fact that gypsum has been reported at several depths in a few wells, while none has been noted in most of the other wells, suggests that the gypsum reported may have been some other rock, such as limestone. The same interpretation is suggested by the fact that fifteen feet of gypsum in one well is said to have been "hard." Another two foot stratum of gypsum is described as "shaly."

OTHER ROCKS AND MINERALS.

Some other rocks and minerals have been reported as follows:

Driller's names.	Number of times used.	Total thickness reported in feet.
Flint rock	18	282
Quartz	3	39
Iron pyrite	2	9
Boulders	2	5
Surface	3	103
Surface clay	3	53
Soil	3	14
Quicksand	1	10
Sod	1	1

With regard to what has been called "flint rock" we believe that some of this must have been hard limestone of fine texture. We know of instances where drillers have reported even compact gypsum as flint, when found in the soft shales. Flint has no doubt been encountered in some of these wells, for we have seen some flint in the cuttings of the deeper wells. But it is not likely that flint beds would average as thick as the beds reported here. One of the flint beds reported measured 30 feet, another 45 feet, and still another 55 feet. Nothing like this has been noted in the Pennsylvanian of the Colorado section, in the north part of Texas, and it is not likely to exist here. The interpretation of the reported "quartz" is quite problematic. It may have been a hard sandstone. Iron pyrite we believe to be correct. The surface deposits are in most cases insignificant in these fields and have naturally not often been noted.

MIXTURES.

No less than nine per cent of the thickness of all reported rock is reported as mixtures, or alternations of two, three, or four different kinds of sediments. The alternations of argillaceous and arenaceous sediments are sometimes so rapid that the correct measuring of the strata of each would entail too much attention by the driller and would be to no purpose. This is quite evident from the following list of items, found in the logs examined. In a few cases, the mixed rocks are more than a hundred feet thick, and could no doubt have been reported separately. It is believed that much the greater part of the material in this list consists of argillites.

Driller's names.	Number of times used.	Total thickness reported in feet.
Sand and shale	17	1,141
Mud and gravel	10	1,107
Sand and slate	7	160
Mixture	6	493
Shale and shells	5	304
Sand rock and shale	4	248
Sand and gumbo	3	65
Gumbo and gravel	3	52
Sand rock and red formation	2	995
Gravel and clay	2	333
Sand, shale	2	201
Mud and gypsum	2	180
Duke's Mixture (facetiously)	2	105
Gypsum and gumbo	2	90
Shale and salt	2	45
Mud, cave and sand	1	390
Clay, sand, rock and gumbo	1	266
Shale and flint shell	1	229
Gyp and lime rock	1	180
Rock, gypsum and lime	1	180
Marl and sand shells	1	90
Blue and shells	1	65
Shell and slate	1	60
Shell and gumbo	1	58
Mud and sand boulders	1	50
Shelly rock and gumbo	1	47
Rock and shells	1	38
Rock and shale	1	35
Shale and gravel	1	35
Gypsum and sand	1	33
Shale and streaks of lime	1	29
Soapstone	1	28
Mud and sand shells	1	22
Rock, flint and gyp	1	18
Sand and gravel	1	18
Sand and clay	1	16
Granite and mud	1	15
Gravel and shells	1	12
Marl and shale	1	10
Mixed	1	2

UNIDENTIFIED ROCKS.

Four and a half per cent of the thickness of all reported rocks have not been definitely identified by the drillers. These have been designated as below:

Driller's names.	Number of times used.	Total thickness reported in feet.
Rock	60	3,556
Shell	11	61
Cap rock	4	15

Some of this rock is no doubt sandstone. It seems that one or two drillers have been in the habit of designating all hard material merely as "rock," while using several more descriptive terms for the different argillites. In most of the records the word rock does not occur. "Red rock," which is reported several times, may be some indurated argillite. "Shell" appears to be used for all thin and hard rock strata. It is believed that most such strata in the terrane explored here are thin limestones. "Cap rock" is a term used for any stratum, more or less indurated, which happens to immediately overlie an oil or gas bearing rock.

Frequencies of Different Thicknesses of Beds Measured.

A table was also prepared to show the frequency of different thicknesses of most kinds of rocks described in the well records. This table is as below:

TABLE SHOWING THE NUMBER OF TIMES DIFFERENT THICKNESSES HAVE BEEN NOTED FOR SEVERAL KINDS OF ROCK.

Limits of thickness of beds in feet.	1—9	10—19	20—29	30—39	40—49	50—59	60—69		80—89		100—199	200—299	300—399	400—790
Sandstones	98	60	44	31	20	20	13	7	5	3	18	6	4	2
Argillites (shale, clay, etc.)	58	76	65	42	31	29	39	22	23	18	95	40	16	10
Limestones	23	9	6	1	1	1	2	1				1		
Mixtures	9	19	14	9	4	5	6	3	3	3	4	6	4	1
Undetermined rock	24	10	11	5	2	3	2	1	2	1	4	1	2	2
All other rocks	21	6	6	3	4	1	1				1			
All kinds of rock	226	180	146	91	62	50	63	34	33	25	110	79	21	14

Most of the sandstones penetrated are less than 30 feet thick, nearly half of those measuring less than 30 feet are less than 10 feet thick, and only about one-sixth of all the sandstones are 60 feet thick or more. Sandstones measuring more than 9 feet become less and less frequent as their thickness increases.

Thin clay beds are less frequent than thin sands. The most common thickness of argillites is from 10 to 19 feet, but from this maximum there is a much more gradual decrease in frequency for increasing thickness than in the case of the sandstone. No less than 161 beds of argillites measured more than 100 feet. The rate of decrease in frequency with increase in thickness is not continuous, but it appears that argillites measuring from 60 to 69 feet were more often found than such as measure from 40 to 49 or from 50 to 59 feet. If this is not due to some method of inaccurate measuring, as by pole lengths, it may indicate some rhythm in sedimentation, or more likely the actual prevalence of one or two beds of this thickness.

More than half of the limestones measure less than ten feet. The frequencies of different thicknesses in the reported mixtures of rocks are distributed very much as they were in the argillites. This circumstance corroborates our conclusion that the greater part of the reported mixed material is shale or clay.

The last line in the table may serve as a general expression of the closeness of differentiation of the terranes practiced in the making of the records, and also as a general expression of the variations in later palaeozoic formations of this region.

Reported Properties of Rocks.

The phrases used by the well men in describing the formations consist for the most part of only two words, the name of the rock and some qualifying word. In a lesser number of cases there are two qualifying words added to the name. A study of the qualifying terms is quite instructive and aids in making correct interpretations of the records. It remains to briefly summarize some notes on this subject.

Of all the rocks named seventy-eight per cent have been also described by a word designating some property. The number of words used for this purpose is quite small, only a little larger than the number of rock names already noted. The simple rock names are about thirty and the simple qualifying words are about forty. If we count the phrases denoting mixtures of rocks, the list of names is considerably longer than the list of words denoting the properties of rocks. We have seen that 1196 rock strata were given a name. Properties were indicated for 926 of these rock units.

We find that these few terms are used to indicate essentially five groups of related properties, viz.: terms implying properties of color, contents, cohesion, stratification, and texture of the rock named. These groups are shown in the following list:

LIST OF TERMS AND PHRASES DENOTING PROPERTIES, SHOWING THE NUMBER OF TIMES EACH HAS BEEN USED.

Color.		Contents.		Cohesion.		Stratification.	
Blue	200	Oil	63	Hard	88	Mixed	35
Red	175	Water	41	Soft	15	Broken	19
White	81	Gas	33	Loose	4	Shelly	2
Red and blue	46	Salt water	17	Shaly	2	Streaks	2
Black	42	Dry	14	Rocky	2	Stratified	1
Brown	24	Oil and gas	6	Tough	2		
Gray	19	Dead	4	Very hard	2		59
Light	9	Oil and water	3	Cavey	1		
Lead colored	8	Salt water and oil	3	Rotten	1	Texture.	
Blue white	4	Fresh water	2				
Dark grey	1	Dead, little water	1		117	Sandy	5
Blue and brown	1	Salt	1			Fine	2
Red and white	1	Oil and salt water	1			"Putty"	1
Blue and black	1					"Porous fossil"	1
			188				
	612						9

It appears that less than one per cent of the rocks are described as to texture, four and a half per cent are described in some loose way as to stratification, ten per cent are described with regard to cohesion, about fifteen per cent are described as to presence or absence of oil, gas, water and salt, and fifty-two per cent are described with regard to color.

Below is a list showing the number of times each term has been used, the class of sediments to which it has been applied and the total and average thickness of each rock unit described.

ROCKS DESCRIBED AS TO COLOR.

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Argillites—			
Blue	170	17,126	101
Red	143	16,846	118
Red and blue	40	4,874	122
White	37	1,444	39

Rocks Described as to Color—continued.

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Black	28	1,494	53
Brown	17	653	38
Dark	9	705	78
Lead colored	8	720	90
Light	7	554	79
Gray	4	72	18
Blue white	2	238	119
Blue and brown	1	201	201
Red and white	1	25	25
Blue and black	1	20	20
Sandstones—			
White	25	959	38
Gray	13	319	25
Black	8	90	11
Brown	5	65	13
Blue	3	79	26
Red	3	76	25
Dark	2	19	9
Red and blue	1	790	790
Light	1	5	5
Dark gray	1	5	5
Limestones—			
Blue	5	33	7
White	2	24	12
White blue	2	24	12
Gray	1	8	8
Gravels—			
Blue	4	18	4
Red and blue	1	22	22
Surface Deposits—			
Red	1	20	20
Mixtures—			
Blue	17	675	40
Red	13	2,062	159
White	5	138	30
Black	4	110	27
Red and blue	4	76	19
Dark	1	181	181
Light	1	20	20
Brown	1	11	11
Unknown Rocks—			
Red	15	1,608	107
White	12	689	57
Black	2	43	21
Gray	1	20	20
Brown	1	10	10
Light colored	1	8	8
Blue	1	3	3

ROCKS DESCRIBED AS TO STRATIFICATION.

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Argillites—			
Mixed	33	3,941	119
Stratified	1	20	20
Sandstones—			
Broken	13	302	23
Mixed	1	35	35

Rocks Described as to Stratification—continued

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Mixtures—			
Broken	5	63	13
Streaks	2	40	20
Mixed	1	21	21
Unknown Rocks—			
Shelly	2	27	14
Broken	1	36	36

ROCKS DESCRIBED AS TO COHESION.

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Argillites—			
Hard	22	1,323	64
Rocky	2	121	60
Tough	2	68	34
Shaly	1	190	190
Rotten	1	20	20
Cavey	1	19	19
Putty	1	10	10
Sandstones—			
Hard	39	1,040	27
Soft	10	206	20
Loose	3	84	28
Gravels—			
Loose	1	5	5
Hard	1	4	4
Limestones—			
Hard	1	1	1
Gypsum—			
Hard	1	18	18
Mixtures—			
Hard	1	32	32
Soft, rotten	3	57	19
Unknown Rocks—			
Hard	23	370	16
Very hard	2	13	6
Soft	2	31	15
Porous fossil	1	6	6

ROCKS DESCRIBED AS TO CONTENTS.

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Sandstones—			
Oil	54	921	17
Water	41	2,250	55
Gas	32	526	16
Salt water	17	1,425	84
Dry	14	252	18
Oil and gas	5	51	10
Dead	4	29	7
Oil and water	3	83	28

Rocks Described as to Contents—continued

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Salt water and oil	2	157	78
Fresh water	2	48	24
Dead, little water	1	15	15
Argillites—			
Oil	3	68	23
Limestones—			
Oil	1	2	2
Mixtures—			
Oil	2	48	24
Oil and salt water	1	24	24
Unknown Rocks—			
Oil	3	10	3
Gas	2	22	11
Oil and gas	1	4	4

ROCKS DESCRIBED AS TO TEXTURE.

	Number of times noted.	Total thickness described, in feet.	Average thickness, in feet.
Argillites—			
Sandy	5	78	15
Fine	1	6	6
Sandstones—			
Fine	1	17	17
Gypsum—			
Shaly	1	2	2

SIGNIFICANCE OF SOME OBSERVATIONS.

Colors are most frequently noted in case of argillites, nearly 80 per cent of all such sediments having been described as to color. The red color is characteristic of the shales in the upper 1000 feet of the deep wells, the blue and light colored shales are most common in the lower 800 feet. Brown color occurs mostly from 500 to 1200 feet below the surface. The black, brown, and dark sandstones average less than half as thick as the white, gray, blue, and red sandstones. This is probably due to the fact that the coloring material, which is mainly some oxide of iron or manganese, has been secondarily introduced by the ground water, which has had comparatively free circulation in the thicker strata. In the thinner sands the ground water may be supposed to have been more stagnant, giving more time for the precipitating agents to act, or for the impregnating minerals to accumulate. The black color in sandstones is mostly due to the presence of iron pyrite. In the shales it is mostly due to the presence of carbonaceous material in the original sediments. From the colors reported for the mixtures and for unknown rocks the inference may be made that the red mixtures and the undetermined red rocks are mostly argillites, as the average thickness reported of these rocks corresponds most closely to the average thickness of red argillites.

The terms denoting contents in rocks have been applied to few other rocks than sandstones and to some undetermined rocks, which probably were sandstones, sandy shale or limestone. Forty-nine per cent of all sandstones have been characterized in this respect. The presence or absence of water has apparently not always been noted. Dry sand was noted in fourteen cases. The sands so characterized averaged only eighteen feet thick. Forty-one water sands have an average thickness of fifty-five feet. Seventeen sands reported as containing salt water averaged eighty-four feet thick. The "dead" sands, being dry sands without gas or oil, average seven feet. All of this suggests that the dry and the "dead" sands are small isolated lentils, out of the way of the main routes of percolation. The gas and the oil sands also average much less in thickness than the water bearing sands, only sixteen and seventeen feet, respectively. To some extent this low average is due to the fact that these rocks have not always been penetrated for their whole thickness.

Only ten per cent of all the rocks have been described as to cohesion or hardness. The less frequent use of descriptive terms of this kind is no doubt due to the fact that such qualities are implied in the rock names themselves, soft sandstone being reported as sand and soft shale as clay. "Hard" is evidently a term of relative significance. In the comparatively soft shales and clays in this region an ordinary limestone may be designated as a hard rock.

Some descriptive words have been used which have no other significance than that the strata penetrated consist of layers of sufficiently marked difference in resistance to the drill to be separately noted, but not thick enough to be separately reported. These beds have been described as mixed, broken or shelly.

"Stratified" and "streaks" are words which seem to have been used in the same way. Descriptive terms of this kind have been used for less than one-twentieth part of all the rocks described.

Words denoting texture have been used very rarely in the description, in less than one per cent of all the rocks, evidently for the reason that this quality is implied in the names.

The Underground Section.

The preceding study of the drillers' records of explored formations convinces us, that while some of the individual records are quite inaccurate, still as a whole, and when properly interpreted, the records constitute a fairly correct and full presentation of the underlying formations extending as far down as to the lowest oil and gas bearing strata in both fields. Fortunately some samples have been secured from some of the deepest wells in both fields. These have been found to contain a few fossils which are believed to furnish evidence proving the identity of the deepest producing sands in the two fields, and showing that these sands are in the Cisco formation, as this formation has been defined by Drake for the section of the Pennsylvanian on Colorado River. We have also obtained from Mr. Frank Culinan, manager of The Producers Oil Company in Wichita Falls, a set of thirty-six samples taken from the Halsell Farm well west of Henrietta. This well is 3985 feet deep, and the samples are mostly from the lower half of the well. The drillers' record of the formations in this well will be found in the appendix, well Number 130. The samples submitted were as below:

Description of Samples From the Halsell Well.

	Depth in feet.
Limestone and sand. The limestone contains much organic material in which were noted Rhombopora, crinoid joints, spines of Productus, a minute apex of a gastropod, an ostracod, and Fusulina cylindrica	1450
Limestone, sand and a little shale, Chaetetes noted	1645
Limestone, shale and sand. The shale is calcareous and emits sulphur in a closed tube before ignition	1822

Gray calcareous shale, containing Fusulina, which is abundant, pieces of crinoid spines, and an apex of a tall spired gastropod 1953

Dark bluish-gray shale, with white porous chert with silicified fragments of fossils. A part is sand with grains from one mm. to one-eighth of a mm. in diameter and showing crystalline facets due to secondary growth. On the label of the sample was the note: "First top shell big salt sand." 2120 to.................................. 2125

Yellowish-gray sand of fine texture. With this was some dark gray shale, some crinoid fragments and some fragments of white chert....................................... 2125

Fine textured yellow sand, with grains from 1-4 to 1-16 mm. in diameter. Some gray shale containing calcareous material 2130

Yellowish sand, gray, of fine texture..................... 2135

Dirty yellowish sand of fine texture..................... 2140

Dull grayish-yellow sand of fine texture................. 2145

Mostly yellow sand. Some dark gray, or almost black shale, and some organic calcareous fragments. Many fragments of white chert and some of coal. The maximum ingredient of the sand is grains from 1-8 to 1-16 mm. in diameter...... 2150

Limestone, yellowish, organic, containing white and yellow chert, having a flat and rectangular cleavage. Rhombopora and crinoid stems were noted. One-fourth of the sample is bluish-gray shale. In this was noted a fragment of pyritized woody tissue.. 2155

Gray shale with some yellowish calcareous organic fragments and some white chert. Fusulina, crinoid stems (one was a half inch in diameter), the apex of a Murchisonia (?) and some thick spines noted.............................. 2160

Yellowish crinoidal limestone, with some chert. There was also some dark gray shale. Fusulina present............ 2165

Gray shale, calcareous, and containing some small flakes of mica 2175

Shale and limestone. The shale is almost black, and breaks into very thin fragments. One fragment was seen to have the impression of a closely ribbed flat shell, some one-half to an inch in diameter, probably an Aviculopecten. One-half of the sample is gray limestone, largely made up of organic fragments. The following fossils were noted: Fusulina (8 fragments), crinoid stems (20), Polypora (?) (2), Rhombopora (1), Retzia (?), very small, (4), Chonetes (1), and a porcellaneous, single apertured foraminifer (?).......... 2180

Most of the sample is fine yellow sand. The rest is gray shale, and organic yellow sand. In this were noted crinoid stems, fragments of shells, and spines of brachiopods............ 2185

Dark gray shale, with some thin layers of fine white sand..... 2185

Gray crinoidal limestone with brachiopod spines, finely tuberculated crinoid fragments, and small pieces of shells....... 2190

Dark gray shale and yellowish limestone. Fossils noted: Fusulina, crinoid stems, spines of Productus, fragments of brachiopod shells, and some minute tests with a porcellaneous lustre, from one-half to one mm. long, oval, either a foramifer or an ostracod, and fragments of some large shell having a transverse columnar structure................ 2195

Dark gray shale, minutely micaceous, containing thin and irregular layers of light gray sand of fine texture. Imbedded fragments of leaves were noted........................ 2200

Gray shale containing calcareous fragments, and some shale containing carbonaceous fragments of vegetable origin. Fossils noted: Ostracod, apex of gastropod, bryozoa, crinoid stems, Chaetetes (?), brachiopod spines, a flat coiled small gastropod, a young Pleurotomaria, base of an echinoid spine 2200

Light gray and soft sandstone with grains mostly from one-fourth to one-sixteenth mm. in diameter, very slightly micaceous. There are also thin laminae of coal showing parallel leaf-veins on the flat side............................ 2215

Greenish-gray, slightly micaceous shale, with abundant fragments of Chaetetes (?), spines of Productus, crinoid stems, and other fossils of unknown kinds..................... 2350

About one-half of this sample is a gray calcareous shale, in which are occasional minute shreds of black fragments of vegetation. Most of the rest of the sample is a mixture of calcareous fragments and gray siliceous sand. Fossils noted: a few crinoids joints, pyritized woody fibre, and a piece of a brachiopod valve. From 2958 to..................... 2974

Dark, almost black shale, calcareous in spots and in part minutely micaceous. Some fine sand. The shale disintegrates when washed. Fossils noted: crinoid stems and spines. On the label was written the word "brake." From 2974 to 2976

Dark, bluish-gray shale of fine texture, slightly calcareous, with occasional black indistinct shreds of vegetation and minute flakes of mica. Fossil fragments exceedingly scarce...... 3015

Black shale showing indistinct impressions of shreds of vegetation on fractured surfaces. There are small imbedded flakes of coaly material. Some shale shows alternate laminae of fine gray sand. All this shale is fissile and sparingly micaceous. One-half, or more, of the sample is yellowish sand, with grains from one-half to one-sixteenth mm. in diameter. There are also some limestone fragments........... 3330

Dove colored slightly micaceous sandy shale and fine-grained sandstone, in about equal quantities. From 3382 to...... 3394

The greater part of the sample is black shale, slightly micaceous, splitting into long and slender shoe-peg-like flakes, calcareous. Heated in a closed tube this shale decrepitates, gives strong sulphurous fumes and becomes magnetic. In the sample is also some sand and some calcareous material. Two fragments of coal were noted. On the label is the note: "no water." From 3418 to.............................. 3440

Yellowish white sand of mechanical composition about as follows:

Diameter of grain in mm.	Per cent.
½-¼	5
¼-⅛	80
⅛-1-16	15

With the sand are some large fragments of dark calcareous shale of fine texture. On the label was the note: "Middle of sand".. 3430

Dark gray shale, with very thin layers of calcareous material. Minute flakes of mica noted, and also some crinoid stems. The shale emits sulphurous odor when heated in a closed tube 3850

Dark gray, almost black shale, of fine texture, very stiff and hard. When rubbed and washed in water, it hardly disintegrates at all, notably less than all the shale above this depth. A part of the sample is calcareous sandstone, light gray, containing a number of green grains (glauconite?). Heated in a closed tube it gives off sulphur fumes and becomes magnetic. Yellow chitinous flakes were noted in the shale. Fossils noted: crinoid stems, cylindric straight spines, fragments showing rectangular cancellations, apparently of organic origin (seen under a 1/6-inch objective), and an undoubted organic structure consisting of fragments of perforate shells of some foramifer like Endothyra. On the label was the word "top." From 3901 to................ 3904

Shale and organic fragmental limestone as in the preceding sample. Also some black shale and coal among all sizes of fragments. Crinoid stems noted. From 3904 to.......... 3906

Black indurated shale as in the preceding two samples. When heated in a closed tube it emits bitumionus fumes and oil. Fossils noted: crinoid joints and fragments of shells. From 3906 to.. 3911

THE BEND?

The last fifteen feet in the well are described by the drillers as "gray lime," and above this is 275 feet of dark shale. Three samples of this shale from 3904, 3906 and 3911 feet below the surface are quite different from the other samples of shale from higher levels in the boring. The latter all contain mica scales and are comparatively little indurated. The three lowest samples of shale, representing a thickness of about ten feet, are stiff and disintegrate comparatively slowly when triturated in water. The samples from 3904 to 3911 feet also contain some glauconitic grains. The organic remains in this rock differ from those in the above, consisting of some cylindric straight spines which may be spicules of sponges, fragments of perforate microscopic shells, like the shells of Endothyra and fragments of some organic structure showing an exceedingly fine cancellated texture. An examination of some shale and limestone of the Bend formation, taken near San Saba, shows that the rocks of this formation contain similar perforate foraminiferal shells locally abundant, also occasional glauconitic or green grains, as well as sponge spicules. We therefore venture the suggestion that the deepest rock noted in this well may belong to the Bend formation. As this formation is separated from the Pennsylvanian by an unconformity, the difference in the hardness of the lower shale may also be accounted for on this hypothesis. The presence of coal in the sample at 3906 feet below the surface makes it certain, at any rate, that this part of the well is not below the Bend formation.

THE STRAWN AND THE CANYON.

To designate the precise limits in this well section which separate the recognized divisions of the Pennsylvanian on the Colorado does not seem to be possible. That the Strawn formation as well as the Canyon formation have their equivalents in the Halsell well section there can hardly be any doubt. The great development of dark shales in the lowest thousand feet suggests the presence of an equivalent of the Strawn formation. The facies and the lithologic characters of the rocks in general would be almost sufficient to demonstrate the presence of the Canyon and the Cisco formations. There are calcareous strata in micaceous shales and sandstones. The shales and sandstones contain shreds of coaly vegetation. Chert is also present in some of the samples. In addition to this the samples contained a few fragmentary fossils, which are characteristic of these two formations on the Colorado river, and these prove the greater part of the well section to be Pennsylvanian beyond question, as may be seen from the following:

	Depths below the surface in feet.
Coal, present as fragments	2150, 2215, 3440, 3906
Woody tissue	2155, 2974
Fragments of plant leaves	2200, 2215
Fusulina	1450, 1953, 2160, 2165, 2195
Endothyra	3904, 3906
Sponge spicules	3904, 3906
Chaetetes, sp	1645, 2200, 2350
Crinoid joints	1450, 2165, 2180, 2185, 2190, 2195, 2200 2350, 2974, 2976, 3850, 3911, 3906
Crinoid fragments (spine-like)	1953, 2125, 2190, 2976
Echinoid spine (basal socket)	2200
Fragments of brachiopod shells	2195, 2974
Productus spines, or spines of other brachiopoda	1450, 2160, 2185 2190, 2200, 2350
Retzia (?)	2180
Chonetes, sp	2180
Bryozoa	2200
Rhombopora lepidodendroides	1450, 2155, 2180
Polypora (?) sp	2180
Aviculopecten, sp	2180
Murchisonia, sp	1953, 2160
Gastropod (apex)	1450, 2200
Pleurotomaria (?), sp	2200
Unidentified organic fragments	3904, 3906, 3911

THE CISCO.

It appears probable that the horizon of the Chaffin coal in the Cisco division corresponds to the dark blue shale reported as underlying the gray lime at from 1644 to 1655 feet below the surface in the Halsell boring, and that the Bull Creek coal is the stratigraphic equivalent of what is reported here as dark blue slate lying from 35 to 70 feet below the "gray lime" at from 1420 to 1436 feet below the surface. It will be recalled that Drake reports having observed Fusulina cylindrica about 150 feet above the Bull Creek coal in considerable abundance* and that this is the uppermost part in the Colorado section from which he reports this fossil. Likewise the limestone at 1445 feet below the surface in the Halsell well is found to contain this fossil, and no rock higher up in this well seems to be of a kind in which this fossil is at all likely to occur, excepting the other thin limestone reported at the depth from 1420 to 1436 feet. This part of the Halsell well section is doubtless also the equivalent of the deeper productive oil and gas sands in the two fields under investigation. These consist of shales, limestones and sandstones, which lie at from 1500 to 1700 feet below the surface in the wells near Petrolia and at from 1800 to 2000 feet below the surface in the Electra field. This general correlation seems to be warranted by palaeontologic evidence as well as by evidence based on the lithologic character of the beds explored by drilling.

We have been fortunate in securing a score of samples of drillings from the deeper parts of several wells in the two principal fuel fields and from a few wells in the surrounding country. These have been carefully examined and some of them have been found to contain sufficient fragments of fossils to demonstrate, with at least a high degree of probability, the Cisco age of these beds, irrespective of any inferences based on the known structure or stratigraphic succession in the series of the rocks of this region. Below is a list of all the organic remains which have been noted.

LIST OF FOSSILS FOUND IN SAMPLES OF DRILLINGS FROM DEEP WELLS IN THE HENRIETTA AND ELECTRA FUEL FIELDS AND SURROUNDING COUNTRY.

Bellevue, Clay County.

		Depth in feet.
Crinoid joint	Bellevue Oil and Gas Co. 1	2030-2038
Productus spine	Bellevue Oil and Gas Co. 1	2030-2038

*Geol. Survey of Texas, Fourth Annual Report, Report on the Colorado Coal Field of Texas, Drake and Thompson, p. 413.

Petrolia, Clay County.

Plant spores	Markowitz 1	1700
Plant spores	Markowitz 1	1750
Ammodiscus (flat coiled)	Morgan Jones 1	1818
Chaetetes (?)	Morgan Jones 1	1818
Crinoid joints	Morgan Jones 1	1818
Crinoid spine	Morgan Jones 1	1818

Halsell Farm, Clay County.

Coal	Halsell Farm 1	2150, 2215
Fragments of woody tissue	Halsell Farm 1	2155
Fragments of plant leaves	Halsell Farm 1	2200, 2215
Fusulina cylindrica	Halsell Farm 1	1450, 1953, 2160, 2165, 2195
Chaetetes (?)	Halsell Farm 1	1645, 2350
Crinoid joints	Halsell Farm 1	1450, 2165, 2180, 2185, 2190, 2195, 2200, 2350
Crinoid spines	Halsell Farm 1	1953, 2125
Archeocidaris spine	Halsell Farm 1	2200
Productus spines	Halsell Farm 1	1450, 2160, 2185, 2190, 2195, 2200, 2350
Retzia, sp	Halsell Farm 1	2180
Bryozoa, undet	Halsell Farm 1	2200
Rhombopora lepidodendroides	Halsell Farm 1	1450, 2155, 2180
Polypora, sp	Halsell Farm 1	2180
Murchisonia, sp	Halsell Farm 1	1953, 2160
Pleurotomaria, sp	Halsell Farm 1	2200

Electra, Wichita and Wilbarger Counties.

Coal	Beat 1	1590, 1595
Coal	Rogers 1	1825, 1840, 2550
Ammodiscus (flat coiled)	Rogers 1	2370, 2500, 2535
Fusulina cylindrica	Rogers 1	1825, 1840, 2380, 2395, 2550
Fusulina cylindrica	Waggoner 16	1840, 1846
Sponge spicules	Tate 1	1630
Cyathophyllid	Rogers 1	2300-2395

Electra, Wichita and Wilbarger Counties—continued.

Cyathophyllid	Waggoner 16	1840, 1846
Chaetetes (?)	Rogers 1	2500, 2535
Productus spine	Rogers 1	2380, 2395
Bryozoa, undet	Beat 1	2110, 2140
Bryozoa, undet	Rogers 1	1825, 1840
Fenestella	Waggoner 16	2500, 2535
Ostracods	Rogers 1	1825, 1840
Fish scales	Tate 1	1630

Seven Miles Southwest of Electra.

Leaf impression in shale	Webb 1	1500
Crinoid joint	Webb 1	1500
Rhombopora lepidodendroides	Webb 1	1500

Oklaunion, Wilbarger County.

Ammodiscus (irregularly curving tubes in limestone)	Guffey 1	1402.

Plant remains occur in dark shales, and where profuse, they sometimes appear in the drillings. Impressions of leaves, showing veining, are sometimes to be found. Carbonaceous shreds of woody fibre occur imbedded in sandstone and sandy shale, especially when these are impregnated with pyrite. Spores, noted in one well, are frequently found in coal and in dark carbonaceous shale in the Pennsylvanian elsewhere. A flat coiled Ammodiscus, which was found in several wells here, can almost always be found in the dark shales of the "upper coal measures" in Illinois and Iowa. An irregularly coiled form of this species, present in the Oklaunion well, is locally profuse in limestone in the Missourian, near the uppermost workable coal beds in Iowa. Chaetetes is also known from the upper coal measures in the Central States, and is reported by Drake from several beds in the Canyon division in this state. Fusulina cylindrica, common in the Canyon and in the lower part of the Cisco, disappears with the limestones and marls as we approach the less calcareous beds of the Wichita formation. In the Pennsylvanian of the great Central coal basin this fossil is almost invariably associated with Rhombopora lepidodendroides, spines of Productus, and some peculiar spine-like parts of a crinoid. These latter have somewhat the outline of a phalangeal bone of the human hand. One side is channelled longitudinally and the reverse side is minutely tubercled after a peculiar pattern. The structures are a millimeter long or less. In a great number of samples of fusulina-bearing shales and limestones examined by the senior author of this report, this fossil has nearly always also been present wherever Fusulina occurs. It is enumerated here as "crinoid spine."

THE UPPER LIMIT OF THE CISCO.

The upper limit of the Cisco division in the sections explored by drilling can only be indicated approximately. This limit has not been as yet clearly shown in the nearest outcrops. Cummins and Gordon have indicated it in a general way as extending from the northeast to the southwest across Clay County. Cummins* locates this boundary a little farther south than Gordon.**

There are along this line some sandstones which locally contain streaks of gravel. But neither these sandstones nor any other beds noted along this boundary, can with certainty be identified with any particular horizon in the well section. Nor have any well drillings with fossils been obtained from any stratum lying less than 1400 feet below the surface. We know that the upper 300 feet or more at Electra belong to the Wichita formation, and that the shales and sands penetrated from 1400 to 2000 feet under the surface belong to the Cisco, but how much of the intervening 1200 feet should be allotted to each, we can only guess from the lithologic appearance of the section as made known by the drillers' records.

The general statement can be made that there is a somewhat gradual change from the sediments in the lower parts of this section to those in the upper part. This we think is shown by a general comparison of the percentages of different rocks in a lower, a middle and an upper division of the section and also by a comparison of the combined thicknesses in each hundred feet of some of the more characteristic or leading sediments. Some tables have been worked out for presenting these comparisons. In

*Second Annual Report of the Geol. Survey of Texas, p. 359 et seq.
**Journal of Geology, XIX, p. 110.

Table I, below, are shown the percentages of each of six kinds of rocks in a lower, a middle, and an upper division in each of thirty-seven wells in the Henrietta field. These three divisions were marked off for each well slightly arbitrarily. The lower division was made to include about 350 feet of strata upward from the lowest productive sand explored. The middle division includes about 500 feet of sediments next above the lower division, and the upper division takes in the remaining 800 to 1000 feet of strata in the upper part of the wells. In Table II the same comparisons are made for twenty-three deep wells in the Electra field. Table III is a combination of Tables I and II.

I.

TABLE SHOWING PERCENTAGES OF DIFFERENT ROCKS IN THREE DIVISIONS OF THE SECTIONS OF THIRTY-SEVEN WELLS IN THE HENRIETTA FIELD.

	Gravel.	Sand.	Shale.	Lime-stone.	Gypsum, etc.	Undetermined.
Upper division	Trace	19	64	Trace	1	16
Middle division	Trace	25	58	Trace	----------	17
Lower division	----------	16	75	.5	2	6

II.

TABLE SHOWING PERCENTAGES OF DIFFERENT ROCKS IN THREE DIVISIONS OF THE SECTIONS OF TWENTY-THREE WELLS IN THE ELECTRA FIELD.

	Gravel.	Sand.	Shale.	Lime-stone.	Gypsum, etc.	Undetermined.
Upper division	1	11	71	3	Trace	14
Middle division	----------	16	70	3	Trace	12
Lower division	----------	11	66	10	1	10

III.

TABLE SHOWING PERCENTAGES OF DIFFERENT ROCKS IN THREE DIVISIONS OF THE SECTIONS OF THE SIXTY WELLS OF BOTH FIELDS.

	Gravel.	Sand.	Shale.	Lime-stone.	Gypsum, etc.	Undetermined.
Upper division	Trace	16	67	1	3	15
Middle division	Trace	21	62	1	1	15
Lower divison	----------	14	71	4	2	8

The general parallelism in the changes shown in the two fields corroborates the conclusion already drawn from other evidence. that the Electra section, excepting its upper part, is the equivalent of the Petrolia section. It has been shown that the uppermost 200 or 300 feet of sediments at Electra are probably absent in the Petrolia section. This is also indicated in the two first tables, the upper division at Electra having a slightly higher per cent of shale and a smaller per cent of sand, owing to the greater prevalence of shale in these upper beds, which are not so largely represented at Petrolia. The greater development of limestone at Electra is the most notable difference in the two sections, but this change is demanded by what is known concerning the geographical conditions attendant on the deposition of these sediments. Electra was farther away from the Cisco-Albany land than Petrolia, the shore being somewhere to the east and the open sea to the west. Hence more limestone is to be expected at Electra.

The change upward in the section is even better shown by the disapparance of black and dark blue shales, and by the interrupted and less and less frequent occurrence of some more than usually white clays reported variously as "white clay" or shale, "chalk," "putty," "talc," or "soapstone." It is also evident from the slightly irregular but progressive increase in the quantity of red clays and shales. For the purpose of seeing these changes clearly, notes were made of the number and thickness of such beds, for each hundred feet below the surface in twenty deep wells in each of the two fuel fields.

TABLE SHOWING THE NUMBER AND COMBINED THICKNESS OF WHITE CLAYS AND DARK CLAYS FOR EACH HUNDRED FEET IN TWENTY WELLS NEAR PETROLIA AND IN TWENTY WELLS IN THE ELECTRA FIELD.

Feet below surface. From—to	Twenty wells near Petrolia.				Twenty wells near Electra.			
	Number of beds of clay.		Combined thickness of beds of clay, in feet.		Number of beds of clay.		Combined thickness of beds of clay, in feet.	
	White.	Dark.	White.	Dark.	White.	Dark.	White.	Dark.
0— 100	0	0	0	0	0	0	0	0
100— 200	0	0	0	0	0	0	0	0
200— 300	0	0	0	0	0	0	0	0
300— 400	0	0	6	0	0	0	0	0
400— 500	0	0	0	0	0	0	0	0
500— 600	1	0	25	0	4	0	97	0
600— 700	2	0	31	0	1	0	25	0
700— 800	6	0	73	0	2	0	14	0
800— 900	5	0	125	0	1	0	59	0
900—1000	1	1	17	59	4	2	29	86
1000—1100	8	2	126	86	4	1	57	5
1100—1200	4	4	200	96	2	2	0	15
1200—1300	3	4	50	184	3	2	14	25
1300—1400	5	7	122	146	4	1	64	40
1400—1500	2	20	39	520	4	1	52	25
1500—1600	12	10	172	134	4	2	18	30
1600—1700	9	9	100	129	2	0	19	0
1700—1800	2	6	93	196	10	6	25	100
1800—1900	1	6	20	58	13	10	12	207
1900—2000	------	------	------	------	4	3	6	44
0—2000	61	69	1093	1608	62	30	491	577

It is seen that the beds of white clay are most numerous at from 1500 to 1600 feet below the surface in Petrolia and that the dark shales are most frequent at the depth of from 1400 to 1500 feet. In the Electra fields these shales are both most numerous at from 1700 to 1900 feet. We may say that the zone of the greatest frequency of dark and white shales and clays is from 1400 to 1600 feet below the surface at Petrolia, and is from 1700 to 1900 feet below the surface at Electra. The dark shales extend up to 900 feet below the surface in both fields and the white clays have been first encountered at from 500 to 600 feet in both fields. These changes are, on the whole, parallel in the two sections and no doubt they can be regarded as marking out, roughly, parts of the sections which are to be correlated in the two fields. As we have already seen from other evidence, the beds lying from 1700 to 1900 feet below the surface at Electra, have their equivalent from 200 to 300 feet nearer the surface at Petrolia. As was found in the case of the exposed limestones, so we find here a horizontal change in the sediments, especially in the development of the dark boggy shales which most notably decrease in the seaward direction. The disappearance of the dark or black and the white clays appears to be the most marked feature of lithologic change in the upper 1400 feet of the two sections. This disappearance takes place in the beds from 500 to 1000 feet below the surface. At the present time it would seem unprofitable to attempt to more closely limit the boundary between the Cisco and the Wichita on the basis of general lithologic characters. The very gradual change from the undoubted Cisco beds to undoubted Wichita beds is even more apparent from a study of the frequency and thickness of red clays. There is a quite uniform increase in the amount of red argillites from the deepest part of the wells up to the surface. This is shown in the following table, which is based on the records of twenty wells in the Electra field and twenty wells near Petrolia.

TABLE SHOWING RELATIVE FREQUENCY AND TOTAL AMOUNTS OF RED AND BROWN CLAY NOTED IN EACH HUNDRED FEET BELOW THE SURFACE IN TWENTY WELLS IN THE ELECTRA FIELD AND IN TWENTY WELLS NEAR PETROLIA.

Feet below surface.	Petrolia.		Electra.	
	Number of beds.	Total thickness.	Number of beds.	Total thickness.
0— 100	42	1304	26	1238
100— 200	29	1084	22	1148
200— 300	25	1026	26	935
300— 400	26	890	29	939
400— 500	24	647	23	830
500— 600	16	581	27	551
600— 700	24	658	24	722
700— 800	21	586	29	658
800— 900	14	446	35	827
900—1000	18	448	21	862
1000—1100	15	454	19	549
1100—1200	13	452	16	526
1200—1300	12	231	13	472
1300—1400	6	261	22	303
1400—1500	10	201	15	415
1500—1600	5	119	16	346
1600—1700	10	71	17	285
0—1700	316	9409	379	11,606

It may be worth the while to note, that if the upper limit of the Cisco be near the lower extreme which we have indicated, the oil sands at about 750 feet below the surface near Petrolia and at about 1000 feet in the Electra field would be at about the same level in the general section as the thin coal seams noted in the Indian Creek bed on the Colorado River.

SUMMARY OF CORRELATIONS.

To sum up the essential correlations for these fuel fields: The Bend formation is perhaps present near 3900 feet below the surface in the southeast part of the area studied. From about 3900 to 1800 feet below the surface the bed rock is an equivalent of the lower half of the Cisco, the Canyon and probably the Strawn divisions on the Colorado River. The Bull Creek coal and its associated dark shales and other beds are probably the stratigraphic equivalents of the dark shales and productive sands lying at from 1500 to 1800 feet below the surface in the wells near Petrolia and at from 1700 to 1900 feet below the surface in the Electra wells. Some thin coal seams noted in the lower part of the Albany sediments in the Colorado River basin may be the stratigraphic equivalents of the zone producing some oil at about 750 feet below the surface in a part of the field at Pe-

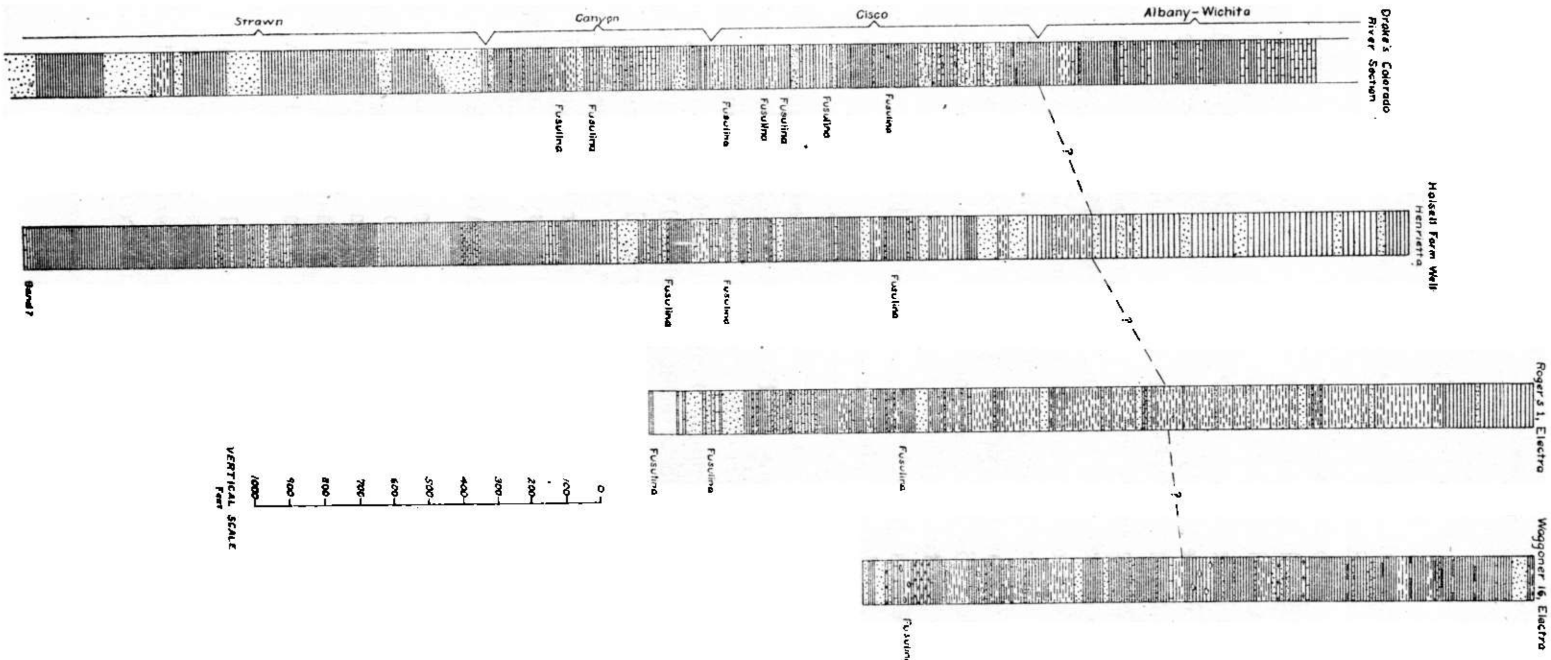


FIG. 8. General correlation of Drake's Colorado River Section with sections of three wells in the Henrietta and Electra Fuel Fields.

trolia and of the productive sands at about 1000 feet below the surface near Electra.

We have shown that it is more than likely that the gas-bearing sands which lie from 550 to 700 feet below sea level in the Henrietta field are at the same horizon in the general section as the oil-bearing beds in the Electra field which lie some 200 or 300 feet deeper, forty miles farther west. We have presented three groups of facts which bear out this conclusion. The Beaverburk limestone shows that the Wichita beds lie practically horizontal on an east and west line for about fifteen miles. Combining ninety observations made on dips in the area between Electra and Petrolia we have found that if these dips be taken to represent the general structure of the terranes between these two points, the beds lie nearly horizontal. Comparing the strata explored in the two fuel fields we have also found that there is in the formations themselves a resemblance which confirms our belief that the deep productive sands in the two fields, as well as the upper sands, are to be correlated with each other.

Fortunately, however, we are not limited to evidence which makes our conclusions on this point almost certain, but still questionable. There is other evidence, which in connection with that already mentioned, must be fairly conclusive, even if the basis of facts involved is somewhat slender. This consists in the presence in the deeper oil bearing deposits in both fields of a few identical fossils. The finding of these fossils also enables us to roughly correlate the underground section in this region with the general section of the Pennsylvanian in Texas.

THE ORIGIN OF THE OIL AND GAS.

It does not seem necessary to here rehearse the various theories advanced to explain the origin of petroleum and natural gas in various parts of the world. The evidence in these fields appears to us decidedly to support the view that the natural hydrocarbons here are derived from organic material, which was an original ingredient in the sediments of the formations where oil and gas are now found, in the shales and clays containing oil sands and gas sands. The present writers are not at all convinced that this statement should be limited so as to apply only to shales which are not of red color. The red shales occasionally show some features which suggest that it may not be safe to conclude that the mud of these deposits was not originally, at least while yet in suspension and immediately upon deposition, very much like the mud in the shales which are now gray, bluish-gray, or quite dark in color. We are not ready to express any opinion on the possibility of much of the red clays having been once gray or blue clays. But it is quite evident from the drillers' records of well sections that red clay frequently runs into gray clay horizontally. Some field appearances in the Wichita formation indicate that the quantity of calcareous or other alkaline material present in the clays, or the proximity of such material, determines to some extent the color of the clays. There is nearly always some blue or gray shale under limestones, or even under bands of calcareous concretions. There are frequently gray clays under sandstones, especially when these have a calcareous matrix. There are occasionally blotched, red and gray shales in which the distribution of these colors clearly shows no relation to the sedimentary structure. Furthermore, instances of change in color have been noted which clearly imply a relation of the present colors to the slow creep of rock moisture and its solvents, as affected by texture of the rock and by the direction of what we might call its capillary grain. See Plate XXIII, C.

Nor are we quite convinced that animal and plant life was always less vigorous during the accumulation of the red shales in the upper part of this section than in the time of the making of the Cisco beds. Animal remains are profuse in the two limestones of the Wichita formations. Fishes must have been abundant in a sea where their scales were washed into sorted sizes, forming layers three to six inches thick. Amphibians must have had a sufficiency of food, at a time when leg bones of dozens of individuals of their tribe were sorted by the waves and washed up on a few square yards of the shore. It does not appear that a theory involving an exotic origin is needed to account for the presence of either oil or gas in the sands of the upper 1000 feet of the section, much less for their presence in the lower part of the section. In fact, organic material is yet present in the thin limestones and blue shales of the Wichita formation in sufficient quantity to give readily noticeable bituminous odors when ignited. The oil and gas are so closely associated with organic remains that an extraneous origin appears quite improbable.

The original presence of organic material in the shales of the Cisco division in sufficient quantities to furnish all the oil and gas in these fields, however rich, is really beyond question. There are several hundred feet of dark and bituminous shales above and below the producing sands, and at least one or two hundred feet of very dark, almost black, shales in close proximity to the oil-bearing sands. On heating these dark shales in a closed tube, they give, almost invariably, not only sulphur fumes, but also fumes of bitumens and of ammonia. The fumes of ammonia are strong enough to give a stinging odor. Ammonia was specially noticeable in dark shale from 2262 feet in the Woodruff No. 2 well and from 2550 feet in Rogers No. 1 well at Electra, and from 1750 feet in the Markowitz No. 1 well, and from 1818 feet in the Morgan Jones No. 1 well, at Petrolia. Some quantitative analyses on these ingredients of the shale have been made by Mr. S. H. Worrell. A sample of shale from 2262 feet below the surface in the Woodruff well No. 2, at Electra, he found to contain 1.05 per cent of nitrogen, equal to 1.19 per cent of ammonia, and another sample of shale from 1818 feet below the surface in the Morgan Jones No. 1 well at Petrolia yielded 1.10 per cent of nitrogen, equal to 1.25 per cent of ammonia. Mr. Worrell has also made an estimate of the quantity of oil in a mixed sample of brown and black shale from the Markowitz No. 1 well. From 200 grains of the material he obtained "5 c. c. of water and about one-half c. c. of oil having an aromatic odor." Red shale constituting about half of the mixture, this would indicate that the black shale contains, at the least, a gallon of oil to the ton at the present time.

It would seem that we have in these analyses a suggestion, if not really a proof, that some of the organic material originally in the shale, has, by a natural distillation, formed the hydrocarbons now held in some of the included sands, leaving a high residue of ammonia in the shale. For the shale which here contains less than a half per cent of oil contains more than one per cent of ammonia. The organic material in these shales resembles that in the oil shales in Scotland, in that it is not present in the shales in the form of bitumen. Mr. Worrell found that it was not soluble in gasoline. Comparing this Cisco material with the Scottish shales as to proportionate contents of oil and ammonia, we find the former has a relatively much higher per cent of ammonia. The average yield of the Scottish shales is about three parts of oil to one part of ammonium sulphate.* In the shale-oil factories in Scotland, a shale like this from the Markowitz well would no doubt be classified as "spent shale," a shale which has by natural distillation lost a part of its oil content.

The high nitrogenous content of these shales, as well as the fact that the oils in these fields have a paraffine base, suggests that the organic material from which the hydrocarbons are derived was of animal rather than of plant origin, as the larger percentage of proteids and albuminoids in animal tissue would account for the large quantity of nitrogenous compounds in the shale. There are, however, also oil-yielding plants, containing much protein substance, as has been shown by Phillips.†

Sedimentary Deposition of Oil.

The subject of the formation of sedimentary deposits containing oil has lately been investigated by Murray Stuart, of the Geological Survey of India. Mr. Stuart has published a paper in the Records of the Geological Survey of India, and this has recently been reviewed by Dr. David White in one of our American journals.‡ The discussion of the subject is timely and Dr. White's review will no doubt interest students of American oil fields. Mr. Stuart has shown that minute droplets of oil can become imbedded in sediments of fine texture by adhering to the particles forming such sediments and sinking with them to the bottom of the basin in which the sediments accumulate. It is an eminently lucid statement of a simple and, as it appears, very general process. Just for this reason his sedimentation theory seems to us an eminently credible one. Organic material is seldom, if ever, wholly absent from fine sediment of any age. A theory accounting for the presence of organic material in sedimentary rocks should explain the quite general presence

*Petroleum Mining. A. Beebe Thompson, pp. 118, 119.

†Bulletin of the University of Texas, No. 5. Texas Petroleum. W. B. Phillips, p. 20.

‡Economic Geology, Jan., 1912, pp. 91-95.

of small quantities of organic material, as well as the exceptional abundance of organic products in some particular strata. Excepting, perhaps, dead seas whose water has been evaporated down to brine, all waters of all ages have contained the more or less disintegrated remains of the life of the day. This life may have been more luxuriant at some times than at others, and more profuse in some localities than in others. A study of the origin of petroleum and natural gas is not merely an inquiry into the exceptional conditions causing abnormally large accumulations of hydrocarbon compounds in small areas of particular strata.

Productive Sands and Coal Horizons.

Returning to the consideration of the Electra and the Henrietta (Petrolia) fuel fields, we find the producing sands lying in the sediments of the Pennsylvanian age, and extending up into the Wichita division, which has been classified as Permian. At no age in the earth's past history is there evidence of a more luxurious vegetation, more widely distributed, than at the time of the forming of the sediments of the Pennsylvanian. Making closer comparisons, we find that the oil-bearing beds correspond to horizons in the Pennsylvanian section which are characterized by beds of coal, proving the contemporaneous existence of profuse vegetation on lands not far distant. This vegetation, so near, indicates contemporaneous favorable conditions for a marine flora and fauna, the remains of which no doubt would enrich the bituminous contents of the finer sediments of the period. Under such conditions local and exceptionally rich accumulations of bituminous material in these formations would be the almost unavoidable result, dependent upon the later slow segregation and tardy interstitial translatory movements of the fluids adjusting themselves continuously to the progressive development of retaining structures, in which they are held at the present time.

THE OIL AND GAS SANDS.

The oil and gas in these fields are contained in sandstones. In the Electra field some little oil has been noted in a few wells in a limestone lying about 90 feet below the surface. This is probably the Beaverburk limestone. From one or two other wells oily shale has been reported. Barring these exceptional instances, the oil and gas in both fields have been obtained from strata of sandstones measuring from a few inches to twenty or thirty feet in thickness. In most wells these have been penetrated for their whole thickness, in others they have been merely entered. Some sands are in single strata, others are in several, separated by thin seams or layers of shale. A review of the several oil or gas sands in both fields shows that only in two instances have any such sands exceeded 40 feet in thickness. The remaining 450 sands in which oil or gas have been noted average nearly twelve feet in thickness, and are distributed among different thicknesses in the two fields as follows:

TABLE SHOWING NUMBER OF OIL AND GAS SANDS OF DIFFERENT THICKNESSES IN THE HENRIETTA (PETROLIA) AND ELECTRA FIELDS NOTED IN SIXTY WELLS IN EACH FIELD.

Limits of thickness in feet.	1—5	6—10	11—15	16—20	21—25	26—30	31—35	36—40
Henrietta—								
Middle and upper sands	13	10	6	3	2	2	--------	--------
Deep sands	23	27	9	8	4	3	3	--------
Stray sands	16	13	10	4	6	1	1	1
Electra—								
Middle and upper sands	19	25	19	27	23	13	3	2
Deep sands	12	10	6	3	3	2	1	--------
Stray sands	28	30	21	15	14	6	1	2
All sands in both fields	111	115	71	60	52	27	9	5

It will be seen that the sands are quite variable in thickness and comparatively thin. They also are quite irregular as to the level at which they lie in the general section. Even if we make allowance for considerable latitude in the making of some measurements, it is evident that many of the sands in some wells have no equivalents in other wells. Nevertheless it appears that the oil and gas sands fall into some well defined groups, and some other groups which are not so well defined. We may designate three groups which are fairly well defined, as the Deep Group, the Middle Group, and the Shallow Group. We would include in the Deep Group the sands lying deeper than 1400 feet below the surface in the Henrietta (Petrolia) field and deeper than 1700 feet in the Electra field. In the Middle Group we would include the sands that cluster around 720 feet below the surface in the Henrietta field, and around 1000 feet in the Electra field. In the Shallow Group we would include the sands lying above 400 feet below the surface in parts of the Henrietta field and 700 feet in the Electra field.

The records of some wells show that there are places in both fields where even the best developed sands are absent. The separate members of the groups are not continuous everywhere, even within the limits of the same field. But it clearly appears that each group is present in both fields.

The Deep Group Sands.

In the Henrietta field the Deep Group clearly consists of two levels of sands, about one hundred feet apart vertically. A well defined dome here easily accounts for differences in reported measurements of at least as much as two hundred feet in the same sand, and thus enables us to recognize the two principal members of this group. The lower of these two sands has been the more reliable as a producer, and this we would call the Lockridge sand, as it was first tapped in Well No. 1 on the Lockridge farm.

The Deep Group at Electra is much less clearly defined, and the various sands thus generally designated are spread through a greater vertical distance. No such structure as at Petrolia is sufficiently evident to explain the differences and we are forced to the conclusion that the oil sands here become more numerous or more broken, possibly both. Thus, pay sands are reported at twenty-five depths between 1750 feet and 1960 feet below surface. Certain of these sands, which from a comparison of all the available records we believe are most regularly developed, are reported five times within a few feet on either side of 750 feet below sea level, five times within a few feet on either side of 695 feet below sea level, and seven times within a few feet on either side of 575 feet below sea level, these distances corresponding to depths below surface of about 1945 feet, 1890 feet and 1825 feet respectively. The two lower of these sands seem best developed in the center of the field, where the surface elevation averages about 1195 feet above sea level, while the upper sand shows best in the wells on the Waggoner tract south of the railroad, where the surface elevation averages about 1250 feet above sea level. As yet no definite correlation of these sands is as clear as at Petrolia, but we believe that two levels, similar to those at Petrolia, will be more clearly outlined with progress in the development of the field.

The Middle Group Sands.

In the Petrolia field, there are again two fairly well defined oil sands comprising a group, though there are several stray sands within the limits set. These well defined sands occur only in a limited portion of the field, which may be said to be restricted to the crest of the dome, and lie at depths close to 660 feet and 720 feet below the surface. These also consist of a basal sand, not penetrated in all the wells, a regularly overlying sand about sixty feet above, and one or two stray sands scattered through the range of the group.

In the Electra field the Middle sands are the largest producers. They are in this field more regularly and more largely developed than in Clay County, and occur in all portions of the field. In most wells they appear as two sands, separated by from forty to one hundred feet of shale, and occurring with greatest frequency near 955 feet and 1040 feet below surface. In some wells there is also a sand at about 820 feet. These sands are not everywhere continuous, but frequently split up into two or three thin sands. There are also stray sands that do not seem to be referable to any of those mentioned.

The Shallow Group Sands.

The productive sands of the Shallow Group are much more irregularly scattered than those of either the Deep or Middle Groups. The area of pay wells in these sands in the Henrietta field, while more extensive than in the case of the Middle Sands, is still closely restricted, and has so far been shown to follow the crest of the local uplift. A comparison of the number of sand beds for each successive ten feet upward from the basal sand of the Middle Group in some fifty wells shows marked increases at about 460 feet and 370 feet above this basal sand in the Henrietta field. This would indicate the existence of sandy horizons. These sands correspond to what are known as the 260-foot sand and the 350-foot sand in the center of the Henrietta field. In addition to these, there are numerous stray sands.

In the Electra field, these Shallow sands have only a small development. The one most regularly reported lies about 510 feet above the basal sand of the Middle Group, but this sand is not reported from all wells, nor is it generally oil-bearing when reported. It is generally referred to in the field as the 530-foot sand.

Irregular Development of Sands.

The position of the sands in the entire section suggests that they are ancient sand bars and perhaps beach sands, built up, washed away, rebuilt, and finally buried under accumulating argillaceous sediments, during a long period of more or less gently changing geographic conditions, involving, on the whole, a progressive sinking of the shoreland and the adjacent bottom of the sea. Sands connected in one place may in another place be separated. Closely contiguous sands may be wholly separate. Sands clearly interrupted at some point may be connected by some devious circuit in an unknown direction.

Conditions like these are plainly suggested by many cases of apparently abnormal vertical distribution of water, gas and oil in the same well, and in sands which are not far apart, and even quite contiguous and apparently confluous. This will be evident from the following observed successive vertical occurrences of oil, gas, and water in wells (a, b, c, etc.), in different parts of the two fields.

OBSERVED VERTICAL SUCCESSIONS OF WATER, OIL AND GAS IN CLOSE LYING SANDS.

PETROLIA.

(a)	(b)	(c)	(d)	(e)	(f)
Gas	Gas	Gas	Gas	Gas	Gas
Gas, oil	Gas	Gas	Gas	Gas	Gas
Oil	Oil	Oil	Oil	Oil	Oil
		Oil	Oil	Oil	Oil
			Oil	Oil, water	Oil

(g)	(h)	(i)	(j)	(k)	(l)
Gas	Gas	Gas	Gas	Gas	Gas
Oil	Oil	Oil	Oil	Gas	Oil
Gas	Gas, oil	Gas	Gas	Gas	Gas
Oil			Gas	Oil	Gas

ELECTRA.

(m)	(n)	(o)	(p)	(q)	(r)
Gas	Gas	Oil, gas	Oil	Oil	Water
Gas	Oil	Oil	Gas	Oil, gas	Oil
		Oil	Oil		

Texture of the Productive Sands.

The texture of the oil and gas yielding sands is usually moderately fine, but coarse sands have also been encountered. The following table of the mechanical composition of some productive sands is believed to be representative for these fields:

TABLE SHOWING THE COARSENESS OF GRAIN OF NINE OIL AND GAS SANDS IN THE HENRIETTA (PETROLIA) AND THE ELECTRA FUEL FIELDS. FIGURES GIVE PERCENTAGES OF WEIGHT OF EACH GRADE OF COARSENESS OF SAND TO TOTAL SAMPLE.

Diameter of grains in millimeters.	Stringer 8 960 ft.	Skinner 4 1000 ft.	Stringer 9 970 ft.	Panhandle 3 1120 ft.	Skinner 1 1009 ft.	Lone Star 1 1684 ft.	McBurney 1 814 ft.	Putnam 16 1020 ft.	Waggoner 12 1800 ft.	Panhandle 3 1510 ft.	Bickley 1 860 ft.	Panhandle 3 1610 ft.
2—1	19	1	tr.	tr.		tr.						
1—½	43	7	5	5		tr.						
½—¼	26	52	15	14	28	19	9	tr.	tr.	tr.	3	tr.
¼—⅛	11	33	60	28	52	75	81	73	72	40	40	23
⅛—1/16	1	7	20	40	20	6	5	18	21	50	34	50
1/16—1/32				13			2	9	7	10	23	25
1/32—1/64												2

THE RETAINING STRUCTURES.

We have found that the dark shale, especially in the lower half of the section, contains much bituminous material. On account of the closeness of the texture of the shale, any oil or gas which this may contain can not be recovered by drilling into this. It is clear that the oil or gas which is now found in the sand has been derived from contiguous shales, whether overlying or underlying the sands, by some exceedingly slow secular transfusion. The sands are therefore the first essential structures necessary for the accumulation of oil or gas in available quantities, as sand rock alone is sufficiently porous to contain any considerable quantity of bitumens.

In any system of rocks, ground water is almost universally present, partly perhaps as an original ingredient, but more generally as a result of rainfall, and consequent secular movement through minute porosities in the terranes. As the ground water is heavier than oil, it will tend in the long run to replace this lighter fluid and cause it to move in any direction that is open. The oil is made to float, as it were. on the heavier fluid. It is apparent that a resulting slow movement of the oil or gas will follow, especially in the relatively more open beds. This will proceed in a direction opposite to the dip, obliquely upward. In porous strata of this kind rising to the surface of the earth, this slow migration of the oil may ultimately result in its entire replacement by the ground water, and in the complete outflow of bituminous materials along the line of outcrops of the porous rock, causing what are known as "oil seeps." It is quite possible that extensive oil accumulations in the Pennsylvanian rocks in the north central part of the State have in this way escaped from the sands which once held them.

It is evident that the oil and gas which is now being recovered in the fields at Petrolia and Electra is confined in the ground by structures which have prevented their replacement by the ground water in the manner described. We have shown that in the country lying between Petrolia and Electra the strata lie practically horizontal. We have also shown that the strata are affected by flexures, which cause them to dip in various directions at low angles. The horizontal position of the terranes in this field is the primary structure which has been the cause of preventing the bitumens from escaping under the pressure of the ground water. But it is evident that no great quantity of oil or gas can be held under the perfectly flat surface of a horizontal layer of shale. This flat condition seems to be the general structure for the region as a whole, and we believe it explains the frequent and very general existence of very small quantities of oil, or of "oil shows," in the wildcat wells.

The Petrolia Flexure.

The local accumulation of oil and gas in paying quantities in these rocks seems to have required here, as elsewhere, pronounced flexures, resulting in inverted basin-like, trough-like folds in heavy layers of relatively impervious shales. Such folds are known as domes or anticlines, according as their shape is more or less circular or elongated. The Petrolia field is a clear case of such a fold. This fold may be said to be an irregularly elongated dome, some 200 feet high and having an area of six or seven square miles. Judging by the deep explorations which have been made up to the present time, it is about twice as long as broad, and the longer axis extends in a west-northwest and east-southeast direction. The structure is clearly shown in the dips of the exposed rocks of the surrounding country, as indicated by the arrows on Plate I. The highest point in the fold lies about one and one-half miles southeast of Petrolia, and another smaller accentuation on the fold apparently exists one and one-half miles still farther southeast. See Plates II, IV, V, VI and VII.

Structure of the Electra Field.

At Electra the structure is at first sight quite perplexing. The sands of the Middle Group, which produce most of the oil in this field, lie essentially horizontal within the area of the greatest production in the present field. See Plates III, and VIII-XII. These sands even show a slight curvature downward into one or two very shallow basins. This is an unexpected condition. The horizontal position of the formations is also evident from the surface outcrops. The strata lie nearly flat over an area of several square miles, extending from one-half mile south of the railroad to at least one mile north of the railroad. Nor is any considerable dip known on a line extending three miles east and west through the centre of the field. But an examination of the outcrops south and southwest from Electra show a persistent dip to the southwest for several miles. The strata dip continuously southward along Bluff Creek as far south as to within a mile of Beaver Creek at a rate which we estimate to be near 15 feet to the mile. Whether there is a corresponding dip to the north on the north side of the field we failed to make out. In this direction exposures are indecisive. But it will be seen that most of the dips noted in the country north from Electra and Iowa Park, as far as to Red River, are to the north, northeast, or east. The observations are too few to prove a general dip in that direction. Some other doubtful evidence of such a dip was noted in the occurrence of a concretionary sandstone at a low elevation, a mile and a half from Red River on China Creek. This sandstone resembles another sandstone lying at a considerably higher elevation on a hill about four miles southeast of Electra. Compare A and B, Plate XXIII. But correlations based on resemblances in sandstones are of little value. What can be said without peradventure of doubt about this field is that it is situated either on the crest of a very wide and flat anticline, or else close to the south edge of a structural terrace, where flat-lying beds soon begin to dip to the south. In either case, the smaller basin-like depressions noted in some of the wells for parts of the field are to be regarded as minor details on a larger structure. They may be due to deformation, but it is quite possible that such slight depressions as have been noted in the Electra field are original in the bedding of these sands. They may have been laid down on the bottom of a basin with even greater downward flexure than these sands show at the present time. This oil field, therefore, may very well be on the crest of an incline which, however, is so flat that the upward folding has not sufficed to quite straighten, or reverse, the original downward curvature of the small basin-like depressions in which the sands were deposited.

Structure of the Sands as Related to Oil and Gas Contents.

Some of the operators in the Henrietta (Petrolia) field are of the opinion that the gas is replenished in some of the sands now tapped, by filtering into these through limited passages connecting with other sands. It appear sthat as the gas is tapped, pressure is lowered, but on shutting the wells down the pressure rises again. as if the supply in the tapped sand were again replenished somewhere from the outside of its own body. From conditions already described it seems quite probable that such transfer may take place from one body of sand to another, where the two are imperfectly separated by sediments of closer texture than sand but not close enough to effectually shut off the connection. Phenomena of this kind may very well be due to local thinning on an elongated bar-like body of sand.

Fractionation By Filtration.

In a study of the diffusion of crude petroleum through fuller's earth recently made by Gilpin and Bransky* of the United States Geological Survey, these authors have shown that when crude petroleum diffuses upward through a tube packed with fuller's earth, a fractionation of the oil occurs. The oil that is afterward

*The Diffusion of Crude Petroleum through Fuller's Earth, Bulletin 475, U. S. Geological Survey, Washington, D. C.

recovered (by the method used by these authors) from the earth from the top of the tube possesses a lower specific gravity than the oil obtained from the earth at the bottom of the tube. They also found that when a solution of benzene and of paraffine is allowed to diffuse upward through a tube packed with fuller's earth, the benzene tends to collect in the lower part of the tube, and the paraffine oil in the upper part.

Several circumstances in these fuel fields are strongly suggestive of the effective operation of some such process of fractionation by diffusion on an extensive scale. The irregular development of the sands is the suggestive geological feature. The ammoniacal residue left in the lower dark shales, as noted in several wells, indicates extensive disintegration of organic compounds and no doubt contemporaneous transfusion of the lighter material through the containing sediments. It seems that in their composition the Electra and the Petrolia oils would illustrate the results of this process operating under natural conditions, for these oils have a paraffine base and contain an unusually high per cent of benzene and kerosene. It is also worth noting in this connection that an oil has been found in Panhandle No. 1 at Petrolia at a depth of 1122 feet, which has a gravity of .72 and contains a notably higher per cent of gasoline than any of the other oils of these fields. This oil came from what we would call a stray sand.

PROSPECTIVE DEVELOPMENT.

Our observations on dips show, as we think, that the general trend of the prevailing structures in this region is from west-northwest to east-southeast. This conclusion is strengthened by the fact that the Petrolia uplift has its major axis extending in about the same direction. The fact that the dips we found in different parts of Wichita and Clay Counties are numerically about equally distributed in both directions away from this hypothetical axis, indicates that the structures which are present are folds, anticlines and synclines, or elongated domes, rather than faults. Dips in faulted formations usually all have the same direction.

At Petrolia the surface dips indicate that the anticlinal structure extends some distance beyond the proven productive area.

This limitation of the productive area may be due to either one of two conditions. The sands may lie in belts which cross the trend of the uplift, and hence run out to the northwest and to the southeast. Explorations are too few to permit anything but speculations as to the form of the deep sands. It appears that this field marks an accentuated tract on a much longer structure. It may very well be that gas and oil have accumulated mostly only in this highest part of the anticline, having drained away upward under the pressure of the ground water from the lower parts of the fold, following its axis lengthwise. It may be that other fields can be found on structures having the same general trend as these have, whether on the same or on other lines. The extreme gentleness of the Electra structure and the indicated irregularity of the uplift at Petrolia make it very likely that existing structures will be difficult to follow, but a knowledge of their general trend should be a distinct advantage in tracing their indistinct outlines.

The existence of oil or gas depends in the first place on the nature of the sediments. Earlier studies of the stratigraphy of the oil-bearing formations in North Texas show that the Albany beds undergo considerable changes southward, becoming to a great extent limestones interbedded with shale. With such a change prospects for oil may become more problematic. How far the conditions associated with the occurrence of oil and gas in this field will obtain in the several directions, east, south and west is only partially known. The formations rise to the eastward. They probably gradually go down to the west. To the south the elevation of the strata is about the same as here for two or three hundred miles. But the nature of the beds changes in this direction. Whether there is a similar change westward is not known. It is indicated by the relative increase in reported limestones in the Electra wells as compared with the wells near Petrolia. The general conditions of stratigraphy and structure certainly do not change very materially in fifty miles in any direction in the territory on the south side of Red River, and it is quite natural that this area should be most actively prospected at the present time.

The features characteristic of the Electra field are the general horizontal attitude of the formations, the irregularity of the small dips which exist and of the sandstone bodies themselves. These circumstances all suggest that other places than the two fields immediately under investigation may exist, where oil and gas have accumulated in quantities commensurate with the production in the fields already known.

Upland Gravels.

A conglomerate which has been variously classified as of Pleistocene or of late Tertiary age should perhaps be noted, for the reason that it has been mistaken by some for being a part of the terranes whose structure determines the oil accumulations in these fields.

This conglomerate is of so late an origin that its distribution is clearly to some extent related to the topography developed by the present drainage. It lies high up on the divides and low down in the larger valleys, and can therefore not have the remotest connection with the structures of the Palaeozoic series. It was noted on some of the highest hills on the divide between the Wichita and the Red River east from Electra, and on some of the hills north and west of Iowa Park. It caps the bluffs on the north side of the Wichita at several points southwest of Iowa Park. It was noted on the north shelf of Beaver Creek, at a point nearly due south of Electra, and again it was found capping the highest point of land on the divide between this creek and the Wichita River, in the southwest corner of Wichita County. Everywhere this conglomerate resembles stream gravel except as to its indurated condition. It is cemented with copious calcareous material, often of a cinnamon color. Cross-bedded sand is generally interbedded with the gravel, and occasionally it contains streaks of yellow and calcareous silt. It appears that this conglomerate is one of the remnants of a long series of stream sediments which have been laid down on the Plains during a time dating back from the late Tertiary age to the late Pleistocene.

An examination of the boulders and pebbles in this conglomerate on Beaver Creek shows that different kinds of rocks are represented by percentages about as indicated in the table below, where similar percentages are also given for pebbles from the gravels in Wichita River.

Kinds of rock.	Boulders from upland conglomerate about three inches in diameter.	Pebbles from upland conglomerate about one-third inch in diameter.	Pebbles from Wichita River one-third inch in diameter.
Quartzite, very hard, in part of dark purple color	44	5	3
Quartzite schist, containing minute crystals of magnetite, and having an amethystine lustre, on a fractured surface	36	15	
Structureless quartz	12	2	27
Chert or flint	4	9	13
Vein quartz	2	33	
Silicified wood	2	1	
Limestone, in part calcareous concretions		35	55
Sandstones		1	
Granite			2

PRODUCTION AND COMPOSITION OF OIL.

The Henrietta (Petrolia) field, while of chief importance on account of its supplies of natural gas, also has a monthly production of about 10,000 barrels of a high grade oil. The maximum gas supply has never been even remotely approached by consumption, but conservative estimates place the available amount as at least two hundred million cubic feet a day. Some estimates exceed this by one-half. See Appendix II, page 283, for a brief discussion of this gas by W. B. Phillips.

The Electra field has had no commercial importance in gas production. Enough gas to run pumping engines and to fire boilers has been obtained from some wells. The maximum production of oil was about 13,000 barrels a day, in November, 1911, but this was not maintained for any long time, and the field is not now (May, 1912), producing more than 10,000 barrels a day. The oil is of a very high grade, and has steadily increased in price since the opening of the field.

Deep Sand Oil of the Henrietta Field.

As before stated, the lower of the two Deep Group sands at Henrietta has shown the larger development and the greater capacity in gas production. Single wells of a capacity of 30,000,000 cubic feet of gas a day have been drilled into this sand, and have maintained this output for months. The small amount of deep oil produced in this field has come almost entirely from this sand, and it seems not at all unlikely that more oil wells will be drilled in as the limits of the gas become more distinct. The maximum reported yield of oil from this sand was in Dunn No. 1, of the J. M. Guffey Petroleum Co., which started with 700 barrels from 1750 feet. This well did not long maintain this flow and it is now some two and a half years later, not making more than 50 barrels. Other deep wells have had initial flows of 100 barrels, but the average is probably considerably below this figure. If we were to include in an average all the deep wells in the field, those yielding no oil except in drips from the gas line as well as those now pumping, the daily yield would probably be less than 10 barrels per well.

The oil from this Deep sand is a high grade light oil excellently adapted to refinery use. The high percentage of gasoline might lead one to the belief that the accompanying gas would yield gasoline in commercial quantities on treatment. A sample of oil, taken in person by one of the authors, was analyzed in the laboratory of the Bureau. This analysis is as follows:

Analysis No. 213.—Crude petroleum from Dunn No. 1 of J. M. Guffey Petroleum Co., at Petrolia, Clay County, Texas, from a depth of 1750 feet. Sampled from pump line on March 13, 1912, by Drury Phillips.

Color	Reddish brown.
Specific gravity	0.802=44.9 B.
Viscosity	36 at 72 deg. F.
Flash point	72 deg. F.
Burning point	72 deg. F.
Heating power	19,860 B. T. U. per pound
Sulphur	Trace

Distillation at a room temperature of 72 deg. F. and barometer at 29.5 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.	35.00	colorless
2. 302 deg. to 392 deg. F.	10.00	colorless
3. 392 deg. to 482 deg. F.	9.00	slightly opaque
4. 482 deg. to 572 deg. F.	12.50	yellowish opalescent
5. Above 572 deg. F.	20.50	"orange pale."
6. Residuum, by weight	6.20	

S. H. WORRELL, Analyst.

A sample of a solid black substance, said by the pump-tender to have accumulated on the valves at the bottom of the well to such an extent as to make "steaming" necessary, was also examined. It was a natural paraffin similar to those noted in other fields* and was found to consist of bitumen with some high grade paraffin. It has been used locally to coat pipes and tanks, but is of no commercial importance.

Deep Sand Oil of the Electra Field.

The deep sands at Electra have not been so thoroughly explored as at Petrolia, and such work as has been done has shown them to be more variable. Some deep wells have been large and steady producers, while others not far removed have been dry or small pumpers. The largest well in the field is the Putnam No. 3, of the old Clayco Oil and Pipe Line Co., now Corsicana Petroleum Co. This had an initial production of 1600 barrels from 1890 feet, and nine months later was still flowing 600 barrels. Stringer No. 4, of the Producers Oil Co., one location west of Putnam No. 3, found a sand at 1895, but this was not good enough to stop in, and the well was drilled to a lower sand at 1942 feet. A little farther east of Putnam No. 3, Woodruff No. 2, of the Corsicana Petroleum Co., went several hundred feet lower and was dry, but Dale No. 1, of the 99 Pumping Co., found a small pay sand at a level to correspond to that in Putnam No. 3. Still further east Buerbaum No. 1 was dry in all these sands. North of these wells McBride-Sheldon No. 1 is a good producer at 1950 feet, while Whitehill-Burns No. 1 was dry, when down more than 2000 feet. Just south of Putnam No. 3, a group of Waggoner wells have been steady producers from these deep sands, but south of the railroad the wells have not kept up their initial production and some have never yielded oil at all in paying quantities. These are instances showing the variable nature of the deep sands in this field.

The oil is similar to that found in the deep wells of the Henrietta field, being a high grade light oil, excellently adapted to refinery use. Three samples of this oil were taken, in three different parts of the field, and from two depths. The oil from Bywaters Nos. 1 and 2, on the west of the field at a depth of 1835 feet is the same as that from Putnam No. 3 in the center at a depth of 1890 feet. Dale No. 1 was thought to be an "edge well"

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*Petroleum Mining, A. Beeby Thompson, p. 299.

and the oil at a depth of 1910, corresponding to 1890 feet in Putnam No. 3, shows a heavier gravity and a smaller amount of light fractions. These analyses follow:

Analysis No. 205.—Crude petroleum from Bywaters Nos. 1 and 2, western part of the Electra field, Wichita County, Texas, from a depth of 1835 feet. Wells pumping about 40 barrels each. Sampled from pump line March 13, 1912, by Drury Phillips.

Color..................	Reddish brown
Specific gravity..........	.816=42 deg. B.
Viscosity...............	40 at 70 deg. F.
Flash point............	70 deg. F.
Burning point...........	70 deg. F.
Heating power..........	17,100 B. T. U. per pound
Sulphur................	Trace

Distillation at a room temperature of 70 deg. F and a barometer at 29.2 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.........	28.50	colorless (naphtha)
2. 302 deg. to 392 deg. F....	11.00	colorless (napthha)
3. 392 deg. to 482 deg. F.....	13.00	colorless (naphtha)
4. 482 deg. to 572 deg. F.....	12.00	colorless (naphtha)
5. Above 572 deg. F........	22.00	brown, heavy and turbid
6. Residuum, by weight....	15.00	

Note: No. 5 distillate solidifies at 48 deg. F. with appearance of vaseline.

S. H. WORRELL, Analyst.

Analysis No. 206.—Crude petroleum from Putnam No. 3, center of the Electra field, Wichita County, Texas, from depth of 1890 feet. Flowing 600 barrels. Sampled from flowing line March 13, 1912, by Drury Phillips.

Color..................	Reddish brown
Specific gravity..........	.817=41.7 deg. B.
Viscosity...............	38 at 72 deg. F.
Flash point.............	72 deg. F.
Burning point...........	72 deg. F.
Heating power..........	18,170 B. T. U. per pound
Sulphur................	Trace

Distillation at a room temperature of 72 deg. F. and barometer at 29.17 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.	26.00	colorless
2. 302 deg. to 392 deg. F.	13.50	colorless
3. 392 deg. to 482 deg. F.	12.50	colorless
4. 482 deg. to 572 deg. F.	13.00	yellowish opalescent
5. Above 572 deg. F.		
1st portion	13.00	yellow, "extra pale"
2nd portion	9.00	yellow, "orange pale"
6. Residuum, by weight. . . .	12.00	

S. H. WORRELL, Analyst.

Analysis No. 210.—Crude petroleum from Dale No. 1, of the 99 Pumping Company, in southeastern part of Electra field, Wichita County, Texas, at a depth of 1910 feet. Well pumping about 20 barrels a day. Sampled from tanks on March 13, 1912, by Drury Phillips.

Color.	Reddish brown
Specific gravity.	.844.=36.3 deg. B.
Viscosity.	38 at 70 deg. F.
Flash point.	70 deg. F.
Burning point.	70 deg. F.
Heating power.	18,500 B. T. U. per pound
Sulphur.	Trace

Distillation at a room temperature of 70 deg. F. and barometer at 29.6 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.	20.00	colorless
2. 302 deg. to 392 deg. F. . .	15.00	colorless
3. 392 deg. to 482 deg. F. . . .	12.00	colorless
4. 482 deg. to 572 deg. F.	11.00	yellowish opalescent
5. Above 572 deg. F.	20.00	"orange pale"
6. Residuum, by weight. . . .	14.20	

S. H. WORRELL, Analyst.

Middle Sand Oil of the Henrietta Field.

It is from the sands of this and the Shallow Group that the bulk of production in this field has come. None of these wells have at any time been large producers, few showing a greater yield than 10 barrels a day. Some have averaged 5 barrels a day for three years, though the general yield is less than this. A small amount of salt water nearly always accompanies the oil.

This oil is heavier than that from the deep sands, and contains less of the lighter distillates, as shown in the following analyses:

Analysis No. 212.—Crude petroleum from Hunt-McGregor well in center of Petrolia field, Clay County, Texas, from 720 feet. Well was pumping five barrels a day. Sampled from pump line on March 15, 1912, by Drury Phillips.

Color..................	Reddish brown
Specific gravity..........	.820=40.8 deg. B.
Viscosity...............	40 at 77 deg. F.
Flash point.............	77 deg. F.
Burning point...........	77 deg. F.
Heating power..........	19,850 B. T. U. per pound
Sulphur................	Trace

Distillation conducted at room temperature of 77 deg. F. and barometer at 29.5 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.........	25.00	colorless
2. 302 deg. to 392 deg. F....	13.50	colorless
3. 392 deg. to 482 deg F....	9.50	colorless
4. 482 deg. to 572 deg. F....	13.00	yellowish opalescent
5. Above 572 deg. F.........	23.00	"orange, pale"
6. Residuum, by weight....	16.00	

S. H. WORRELL, Analyst.

Middle Sand Oil of the Electra Field.

By far the greatest production of the entire region has been shown by the sands of this group. None of the wells have been really big producers. In November, 1911, the average yield was 350 barrels a day from about forty wells. As more wells were drilled, however, both the total and the average decreased, till with about one hundred wells, the average was less than one hundred barrels. The lower of the two principal sands of this group is the more productive, as will be seen from the table on page 118. Flowing wells are more frequently found in the lower sand. The extremely irregular production of the sands may be seen in the group of Skinner and Allen wells a little west of the center of the proven field. Here a good sand, yielding from 100 to 300 barrels, was found in the seven wells shown at depths of from 997 to 1010 feet. A well one location north of No. 16 was dry to 1845 feet, and a well one location north of

No. 19 had only 15 barrels at 1027 feet. Such conditions are not rare in this field, where even in the center of the pool a few feet may mark the difference between a paying well and a dry hole.

The oil is of the same nature as that from the deep sand. As in the case of Dale No. 1, of the 99 Pumping Co., thought to be an "edge well" in the deep sands, so Bickley No. 1 of the Producers Oil Co. is thought to be an "edge well" in the middle sands. It shows about the same difference in composition from the other oils of its group that the Dale oil shows from its group.

Analysis No. 208.—Crude petroleum from Hamilton No. 1, of the Corsicana Petroleum Company, Electra field, Wichita County, Texas, at a depth of 974 feet. Well was pumping 100 barrels a day. Sampled from tank on March 13, 1912, by Drury Phillips.

Color	Reddish brown
Specific gravity	.813=42.5 deg. B.
Viscosity	37 at 72 deg. F.
Flash point	72 deg. F.
Burning point	72 deg. F.
Heating power	18,910 B. T. U. per pound
Sulphur	Trace

Distillation at a room temperature of 72 deg. F. and barometer at 29.4 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.	27.00	colorless
2. 302 deg. to 392 deg. F.	12.00	colorless
3. 392 deg. to 482 deg. F.	12.50	colorless
4. 482 deg. to 572 deg. F.	11.00	colorless
5. Above 572 deg. F.	24.00	yellowish opalescent
6. Residuum, by weight	12.30	

S. H. WORRELL, Analyst.

Analysis No. 207.—Crude petroleum from McBurney No. 1, of the Producers Oil Co., Electra field, Wichita County, Texas, at a depth of 812 feet. Well flowing 215 barrels a day. Sampled from line on March 13, 1912, by Drury Phillips. Practically the same as analysis No. 208.

S. H. WORRELL, Analyst.

Analysis No. 209.—Crude petroleum from Bickley No. 1, of the Producers Oil Co., Electra field, Wichita County, Texas, at a depth of 870 feet. Well pumping 8 barrels a day. Sampled from tank on March 13, 1912, by Drury Phillips.

Color	Reddish brown
Specific gravity	.845=36.1 deg. B.
Viscosity	38 at 72 deg. F.
Flash point	74 deg. F.
Burning point	74 deg. F.
Heating power	18,525 B. T. U. per pound.
Sulphur	Trace

Distillation at room temperature of 74 deg. F. and barometer at 29.2 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.	20.00	colorless
2. 302 deg. to 392 deg. F.	15.00	colorless
3. 392 deg. to 482 deg. F.	10.00	colorless
4. 482 deg. to 572 deg. F.	15.00	yellowish opalescent
5. Above 572 deg. F.	18.00	"orange pale"
6. Residuum, by weight	17.70	(pitchy)

S. H. WORRELL, Analyst.

Shallow Sand Oil of the Henrietta Field.

The most reliable strata for the production of oil in this field lie along the crest of the elongated dome, in a strip approximately two miles long and a mile wide. In this area there are probably three hundred wells, most of which have at some time been producers. The two sands locally known as the 260-foot sand and the 350-foot sand, are easily the largest producers, and considerable oil has been found in a sand at about 160 feet in the northern part of this strip. The two principal sands seem of equal reliability, and the lower of greater productivity, the wells in this sand averaging possibly a barrel a day more than those in the shallower stratum. This slight difference, where a yield of five barrels a day is considered above the average, is almost negligible.

The oil from these shallow sands is heavier than that from the 720-foot sand, which in turn is heavier than the deep oil. There is even noticeable a slight difference in specific gravity and the per cent of lighter distillates in two oils, one from the 350-foot sand, and one from the 260-foot sand. The deeper oil is lighter and has larger quantities of gasoline and kerosene in the first two fractions. Complete analyses follow:

Analysis No. 214.—Crude petroleum from the Hunt McGregor wells in center of the Henrietta field, Clay County, Texas, from a depth of 350 feet. Two wells were pumping about four barrels each into same line, from which sample was taken. Sampled March 15, 1912, by Drury Phillips.

Color	Reddish brown
Specific gravity	.845=39.5 deg. B.
Viscosity	55 at 64 deg. F.
Flash point	64 deg. F.
Burning point	64 deg. F.
Heating power	20,140 B. T. U. per pound
Sulphur	Trace

Distillation at room temperature of 64 deg. F. and barometer at 29.5 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.	19.00	colorless
2. 302 deg. to 392 deg F.	11.50	colorless
3. 392 deg. to 482 deg. F.	14.00	colorless
4. 482 deg. to 572 deg. F.	10.50	yellowish opalescent
5. Above 572 deg. F.	33.00	"orange pale"
6. Residuum, by weight	13.00	

S. H. WORRELL, Analyst.

Analysis No. 211.—Crude petroleum from Joyce wells toward southern edge of Henrietta oil field, Clay County, Texas, from a depth of 260 feet. Well was pumping about three barrels a day. Sampled from line on March 15, 1912, by Drury Phillips.

Color	Reddish brown.
Specific gravity	.861=32.8 deg. B.
Viscosity	64 at 66 deg. F.
Flash point	66 deg. F.
Burning point	78 deg. F.
Heating power	18,000 B. T. U. per pound
Sulphur	Trace

Distillation at room temperature of 66 deg. F and barometer at 29.6 inches.

Fractions.	Per cent.	Color.
1. Up to 302 deg. F.	18.00	colorless
2. 302 deg. to 392 deg. F.	10.00	colorless
3. 392 to 482 deg. F.	11.00	colorless
4. 482 deg. to 572 deg. F.	17.00	yellowish opalescent
5. Above 572 deg. F.	30.00	"orange pale"
6. Residuum, by weight	12.70	

S. H. WORRELL, Analyst.

Shallow Sand Oil of the Electra Field.

The single shallow producing sand that has been found with some regularity lies at about 530 feet below the surface. This seems to have a limited extent, and is found best developed west of the center of the pool. In some cases gas was reported from this sand, but not in commercial quantities. The wells are smaller than the average in the field, rarely yielding more than 50 barrels a day. This production they seem to maintain better than is the case with the production in deeper wells.

Discovery of Oil in Electra Field.

The first reported occurrence of oil in this field was in a well dug in 1900 for water. A well north of what was then Beaver Station found oil at 147 feet. South of the station another well found oil at 205 feet, supplies amounting to 20 gallons. Several barrels of oil were obtained from the first well, and a sample was sent away for analysis. This analysis is as below:

Casper, Wyo., June 21, 1900.

REPORT AND ANALYSIS OF BEAVER, TEXAS, CRUDE PETROLEUM.

Specific gravity of crude oil=.896 at 60 deg. F.
Deg. Beaumé =32 at 60 deg. F.

Fractional distillation of 1000 ccm crude. Divided into fractions of 50 ccm. each.

No.	ccm.	Spec. Grav.	Deg. Bé.
1.	50	.7230	65
2.	50	.7557	57.3
3.	50	.7680	54
4.	50	.7808	51
5.	50	.7940	47.6
6.	50	.8070	44.9
7.	50	.8156	43
8.	50	.8295	40
9.	50	.8400	37.5
10.	50	.8488	36
11.	50	.8742	31
12.	50	.8957	27

Practical refining and yields in commercial products.

Naphtha (Benzene) 65 deg. B.	10 per cent
Kerosene 47 deg. B. 150 deg. F.	40 per cent
Light intermediate distillate 36 deg. B.	10 per cent
Heavy distillate 29 deg. B.	15 per cent
Hard elastic asphalt (residue)	25 per cent
	100 per cent

The Kerosene and Benzene are of good quality, containing but small traces of sulphur compound. The distillates have no lubricating properties, but are suitable for gas making.

If the heavy distillates and light distillates are not distilled off and only Naphtha and Kerosene are extracted, the residue forms a liquid asphalt suitable for fluxing Trinidad or other hard rock asphalts used in the paving and roofing line.

Samples 1-2 represent sample of Naptha.

Samples 3-10 represent sample of Kerosene.

Samples 11-12 represent sample of distillates.

Very respectfully,

(Signed) DR. F. SALATHE,

Mgr. and Supt.

Summary of Production of Electra Field.

The importance of the Electra field lead to the preparation of the following table, which is self-explanatory. The yield from the 1040 foot sand proves its right to be considered the most reliable producer of the field.

TABLE SHOWING THE NUMBER OF WELLS PRODUCING FROM EACH OF THE SANDS AT ELECTRA, AND THE INITIAL PRODUCTION OF EACH, IN HUNDREDS OF BARRELS PER DAY, TO APRIL, 1912.*

From	Initial Production in Barrels Per Day.											All wells.
	0 to 100	101 to 200	201 to 300	301 to 400	401 to 500	501 to 600	601 to 700	701 to 800	801 to 900	901 to 1000	Ab've 1000	
530-foot sand	11	1										12
820-foot sand	6	3	3									12
955-foot sand	6	3	3	4			2	1			1	20
1040-foot sand	13	7	6	1	2	3	1			1	1	35
Deep sands, below 1700 feet	8	4	2	1	1						1	17
Stray sands, above 1000 feet	7	5						1				13
Stray sands, below 1000 feet	7	6	4									17
All sands	58	29	18	6	3	3	3	2		1	3	126

*The data are compiled from the Oil and Gas Journal.

APPENDIX I.

Notes and Acknowledgments.

The following well records are given word for word as they were copied by the authors from the various sources available. No effort has been made to edit or interpret them, and the drillers' descriptions are in every case preserved.

A few of the records are "memory logs." furnished by the drillers in some cases months or even years after the drilling of the well. This is more notably the case with one or two of the shallow wells. With the wells indicated as belonging to any of the larger operators, the records have in most cases been taken direct from official copies of drillers' logs, as reported at the time of drilling. These records vary in detail, as is to be expected, but most of them are fairly reliable indices of the formations. Elevations were obtained from level surveys by one of the larger companies operating in these fields; estimated elevations were often obtained with the assistance of aneroid or hand level.

For the bulk of these well records, we are particularly indebted to the following firms and individuals, to whom we wish to express our appreciation of favors shown:

The Lone Star Gas Company, Fort Worth, Texas; The Producers Oil Company, Houston and Wichita Falls, Texas; The Corsicana Petroleum Company, Corsicana and Electra, Texas; The Gulf Refining Company, Wichita Falls, Texas; The Clayco Oil & Pipe Line Company, Petrolia, Texas: The Red River Oil Company, Electra, Texas; The 99 Pumping Company, Beaumont, Texas; Messrs. W. E. Wrather, George Bumbaugh, A. A. Little, Sidney Webb, W. B. Chaffee, Henry Nichols, Harvey Landrum, J. E. Hardenburg, Bert Leonard, W. S. Mowris, Ed. Dismukes, J. F. O'Neal, J. B. Winfrey, J. Y. and J. W. Culbertson, and others.

Baylor County.

No. 1.—Webb No. 1, Devonian Oil Co. This well is located two and one-half mies southeast of Fuda in Baylor County. The following log is incomplete:

	Feet		
	From	To	Thickness
Top, red clay	0	25	25
Clay and gravel	25	35	10
Red clay	35	120	85
Blue clay	120	165	45
Red clay	165	250	85
Blue clay	250	305	55
Fire clay	305	325	20
Red clay	325	375	50
Gray clay	375	430	55
Red clay	430	440	10
Gray clay	440	450	10
Shell	450	457	7
Clay	457	500	43
Water sand	500	510	10
Blue clay	510	545	35
Sand water	545	550	5
Clay	550	555	5
Hard lime shell	555	560	5
Blue clay	560	600	40
Water sand	600	615	15
Blue clay	615	630	15
Red clay	630	670	40
Blue clay	670	700	30
Red clay	700	790	90
Sand, water	790	805	15
Clay	805	845	40
White shale	845	900	55
Blue clay	900	920	20
White sand	920	930	10
Red clay	930	945	15
Hard shell	945	949	4
Red clay	949	960	11
Sand water	960	965	5
Clay	965	970	5
Sand, water	970	975	5
Red clay	975	1025	50
Blue shale	1025	1040	15
Sand, water	1040	1045	5

Soft clay, colored	1045	1132	87
Sand, water	1132	1140	8
Blue clay	1140	1175	35
Sand, water	1175	1190	15
Soft clay	1190	1200	10
Solid blue shale	1200	1205	5
Blue cave	1205	1240	35
Sand, water	1240	1248	8
Gray cave	1248	1258	10
Sandy shells	1258	1262	4
Blue shale	1262	1275	13
Soft blue clay	1275	1300	25
Gray shale	1300	1355	55
Sand, water	1355	1380	25
Slate	1380	1390	10
Red clay	1390	1405	15

Wilbarger County.

No. 2.—Webb No. 1, Guffey Petroleum Co. This well is located five miles south-southwest of Electra in Wilbarger Co. Drilling had progressed to a depth of 1600 feet with no paying oil or gas sands. Examination of a mixed shale from a depth of 1500 feet showed it to consist of dark green, red and black fragments. One fragment of black shale showed a leaf impression, and some imbedded crinoid joints. Pyrite is present and Rhombopora lepidodendroides was noted.

No. 3.—Allingham No. 1. Electra Oil Field Co. The well is about one mile northeast of No. 2, and had reached a depth of 789 feet.

No. 4.—Tate No. 1, Producers Oil Co. Elevation, 1133. The well is about three miles northwest of Electra.

Samples examined: 1420-1422 feet. A greenish-gray sandstone, the grains mostly from ½ to ⅛ mm. in diameter. It contains dull green imbedded particles and a calcareous cementing material.

1555-1561 feet. A gray salt sand, containing fragments of green shale, some organic lime and some red lime. The sand grains are from ½ to ⅛ mm. in diameter.

1630 feet. A fine textured slightly calcareous greenish-gray and red shale. Slickenside joints and pyrites were noticed. Some few fragments of a gray sandy rock showed portions of fish scales and sponge spicules. Sulphur and oil fumes were noted when the sample was heated in a closed tube.

1655-1661 feet. Gray oil sand. It is of fine texture, a greenish-gray quartz sand carrying some green shale, and some fragments of a dirty amber-colored limestone of waxy lustre. Portions of this lime were organic.

1661-1665. Like the preceding, but coarser.

	Feet From	To	Thickness
Red mud	0	50	50
Oil sand	50	55	5
Red mud	55	135	80
Blue mud	135	270	135
Red mud	270	285	15
Blue mud	285	320	35
Red mud	320	370	50
Blue mud	370	385	15
Red mud	385	500	115
Dry sand	500	510	10
Red mud	510	530	20
Blue shale	530	550	20
Red mud	550	575	25
White mud	575	625	50
Blue mud	625	675	50
Red mud	675	700	25
Blue mud	700	725	25
Gray mud	725	858	133
Red rock	858	900	42
Gray shale	900	932	32
Sand, oil	932	936	4
Gray shale	936	990	54
Lime shell	990	996	6
Blue shale	996	1025	29
Gray shale	1025	1050	25
Lime shell	1050	1056	6
Red shale	1056	1080	24
Shell	1080	1085	5
Red mud	1085	1100	15
Brown shale	1100	1140	40
Shell	1140	1144	4
Red shale	1144	1190	46
Blue shale	1190	1250	60
Red mud	1250	1300	50
Light shale	1300	1350	50
Brown shale	1350	1375	25
Blue shale	1375	1390	15
Lime shell	1390	1396	6
Light shale	1396	1435	39
Blue slate	1435	1480	45
Sand, salt water	1480		..

No. 5.—Waggoner No. 7. Producers Oil Co. Elevation, 1245. Drilling commenced May 6, 1911. Drilling finished Sept. 9, 1911. 198 feet of 12½-inch casing; 496 feet of 10-inch casing; 1336 feet 4

inches of 8-inch casing; 1836 feet of 6-inch casing. Pumping 30 barrels. This is the westernmost, and one of the deepest, producing wells in this field.

	Feet		
	From	To	Thickness
Red and blue mud......	0	610	610
Sand, oil..............	610	615	5
Red and blue mud......	615	790	175
Dry sand..............	790	800	10
Red slate.............	800	820	20
Water, sand...........	820	836	16
Red slate.............	836	851	15
Sand	851	881	30
Blue slate.............	881	886	5
Red slate..............	886	915	29
Blue shale............	915	1005	90
Sand, oil show..........	1005	1008	3
Blue slate.............	1008	1048	40
Red slate..............	1048	1083	35
Red and blue with shells..	1083	1145	62
Brown shale...........	1145	1150	5
Red and blue slate......	1150	1200	50
Blue and red slate......	1200	1225	25
Lime shell............	1225	1230	5
Sand	1230	1279	49
Blue slate.............	1279	1315	36
Sand	1315	1330	15
White slate...........	1330	1340	10
Blue slate.............	1340	1355	15
White lime...........	1355	1380	25
Blue shells...........	1380	1395	15
Sand	1395	1413	18
White mud............	1413	1420	7
Blue mud.............	1420	1480	60
Hard red mud..........	1480	1505	25
Blue mud.............	1505	1545	40
Red mud..............	1545	1595	50
Blue mud.............	1595	1610	15
Sand	1610	1627	17
Blue mud.............	1627	1645	18
Sand	1645	1654	9
Blue shells...........	1654	1704	50
Red mud..............	1704	1714	10
Blue shells...........	1714	1735	21
Red shale.............	1735	1740	5
White lime, sand.......	1740	1780	40
Blue shale............	1780	1805	25

Lime shell	1805	1808	3
Dry sand	1808	1813	5
Blue shale	1813	1838	25
Oil, sand	1883	1865	27
Blue shale	1865	1880	15
Lime shell	1880	1883	3
Blue shale and shell	1883	1960	77

No. 6:—Waggoner No. 5. Producers Oil Co. Elevation, 1263. Drilling commenced June 12, 1910. Drilling finished January 5, 1911. 60 feet of 12½-inch casing; 612 feet of 10-inch drive; 830 feet of 8-inch drive; 1233 feet of 6-inch drive; 204 feet of 6-inch line; 1832 feet of 4 1-2-inch drive. Drillers: W. H. Ellinger and Clyde Rogers. Pumping 45 barrels a day. Sand from 1818 to 1838 feet had good show of gas in top, and last 3 feet slight show of oil. Standing over 48 hours showed bailer full of oil. Sand from 1840 to 1852 showed small amount of gas and oil in last 7 feet. Working barrel is 35 feet off bottom with an 8-foot gas anchor. Well was contracted to depth of 1152 feet, drilled to 1832 with rotary by P. O. Co., and finished with cable tools.

	——Feet——		
	From	To	Thickness
Red and blue sand	0	395	395
Sand rock	395	410	15
Red and blue sand	410	805	395
Sand (some water)	805	825	20
Red clay	825	835	10
Sand (salt water)	835	860	25
Red and blue mud	860	905	45
Sand rock (good show of oil)	905	910	5
Red and blue mud	910	925	15
Sand rock	925	927	2
Red and blue shale	927	1152	225
Red shale	1152	1175	23
Blue shale	1175	1180	5
Red shale	1180	1229	49
Lime shell	1229	1233	4
Water, sand	1233	1282	49
Blue shale	1282	1364	82
Broken sand	1364	1389	25
Water, sand	1389	1404	15
Broken sand	1404	1430	24
Red shale	1430	1450	20
Blue shale	1450	1462	12
Red shale	1462	1485	23

Blue shale	1485	1493	8
Red shale	1493	1537	44
Blue shale	1537	1545	8
Salt water, sand	1545	1575	30
Red mud	1575	1600	25
Lime rock	1600	1610	10
Red mud	1610	1660	50
Lime rock	1660	1670	10
Red mud	1670	1700	30
Lime rock	1700	1705	5
Blue mud	1705	1720	15
Lime rock	1720	1725	5
Sand rock	1725	1728	3
Salt water, sand	1728	1760	32
Blue shale	1760	1791	31
Sand rock	1791	1792	1
Blue shale	1792	1796	4
Lime rock	1796	1799	3
Blue shale	1799	1818	19
Sand, brown	1818	1838	20
Blue shale	1838	1840	2
Gray, soft sand	1840	1852	12

No. 7.—Rogers No. 1. Producers Oil Co. Elevation, 1245. Depth, about 2600 feet and drilling. In this well the greatest thickness of lime encountered in the entire district was met at 2450 feet, extending for a distance of about 200 feet with small breaks of shale and little sand. A showing of oil was reported at 1865, at 2146, and at 2370 feet.

Samples examined:

1825-1840. A black shale with fragments of white organic limestone, giving strong sulphur fumes when heated in a closed tube. Coal and pyrite are present. Bryozoa, Cythere (?) (smooth) and Fusulina were noted.

2370. "Skim of greenish oil." A finely comminuted grayish white calcareous limestone, with flat and oval amber-colored discs 1-2 mm. on longer axis. A flat coiled Ammodiscus. Fragments showing microscopic pits in rectangularly arranged rows were found and other organic fragments.

2380-2395. A yellow limestone containing fragments of cup coral, Fusulina and spines of brachiopods. Some fragments of gray shale.

2395-2400. A white limestone containing fragments of unrecognizable fossils and round and oval bodies less than 1-4 mm. in diameter, some of which are olive colored.

2475. A white limestone containing much pure calcite, and fragments of obscure organic remains. Double crystals of calcite were noted in numbers.

2500-2535. Large sample from dump. Dark red, gray and black shale and some limestone. A bituminous odor was distinct on heating in a closed tube. The limestone is white and yellow. Chaetetes (?), several specimens of flat coiled Ammodiscus, some small ostracods and one bryozoan were noted.

2537. A gray limestone with much pyrite, some clear calcite and shell fragments. Some exceedingly fine sandstone or sandy gray shale also present.

About 2550. From under a thick lime. A dark fire clay, containing pyrite and coal fragments showing vegetable tissue, with many particles of a finely granular fire clay in which are many microscopic specks of carbonaceous material. Fusulina is frequent and a small ribbed shell fragment was noted. Ammonia fumes evident on heating.

About 2560. Pure white limestone, structureless under hand glass, but largely crystalline under 50x magnification, with crystals quite uniform in size. It effervesces promptly. A few minute calcareous cylindric spicules were noted.

2575. A pure white fine grained limestone, showing many lignilitic joints, considerable calcite and a few fragments with indistinct organic structure. The sample darkens on heating in a closed tube.

Figure 8.

The partial log follows:

	Feet		
	From	To	Thickness
Red mud	0	100	100
Blue mud	100	125	25
Red mud	125	160	35
Oil and water, sand	160	170	10
Red mud	170	270	100
Blue mud	270	290	20
Red mud	290	425	135
Blue and red mud	425	460	35
Dry sand	460	480	20
Blue and red mud	480	500	20
Blue shale	500	525	25
Red mud	525	535	10
Blue mud	535	600	65
Red mud	600	615	15
Blue mud and shells	615	655	40
Water, sand	655	690	35
Red mud	690	715	25
Blue mud	715	765	50
White mud	765	775	10
Red mud	775	825	50
Water, sand	825	840	15

Blue mud............	840	875	35
Red mud.............	875	920	45
Blue mud............	920	924	4
Oil, sand.............	924	930	6
Red mud.............	930	950	20
Blue mud............	950	960	10
Red mud.............	960	975	15
Blue mud............	975	1015	40
Red mud.............	1015	1090	75
Blue mud............	1090	1105	15
Oil and water, sand....	1105	1120	15
Sand and break.......	1120	1135	15
Water, sand...........	1135	1155	20
Blue and red mud.....	1155	1220	65
Blue mud............	1220	1234	14
Red mud.............	1234	1240	6
Blue mud............	1240	1245	5
Water, sand..........	1245	1255	10
Red and blue mud.....	1255	1305	50
Blue mud shells.......	1305	1390	85
Water, sand..........	1390	1430	40
Red mud.............	1430	1530	100
Hard sand............	1530	1540	10
Red and blue mud.....	1540	1555	15
Dry hard sand........	1555	1565	10
Red and blue mud.....	1565	1575	10
Light blue mud.........	1575	1585	10
Red mud.............	1585	1600	15
Blue mud shells.......	1600	1700	100
Sand shells...........	1700	1705	5
Blue mud............	1705	1720	15
Lime shell............	1720	1725	5
Blue shale............	1725	1740	15
Red mud.............	1740	1752	12
Sand, broken..........	1752	1790	38
Black shale...........	1790	1820	30
Blue shale............	1820	1825	5
Shale and shells.......	1825	1840	15
Red and blue mud.....	1840	1845	5
Dry sand..............	1845	1850	5
Black slate shells......	1850	1865	15
Oil sand.............	1865	1870	5
Black slate shells.....	1870	1885	15
Black shale...........	1885	1900	15
Hard lime............	1900	1908	8
Brown shale..........	1908	1912	4
Blue shale streaks sand	1912	1938	26

Blue slate	1938	1970	32
Lime	1970	1983	13
Red slate	1983	1985	2
Blue slate	1985	2010	25
Red slate	2010	2028	18
Blue slate	2028	2072	44
Blue slate shells	2072	2080	8
Lime shells	2080	2143	63
Blue slate and shells	2143	2146	3
Sand, oil show	2146	2156	10
Blue slate	2156	2166	10
Lime shell	2166	2181	15
Blue slate	2181	2184	3
Sand shells	2184	2202	18
Broken sand	2202	2206	4
Hard lime	2206	2215	9
Blue slate shells	2215	2223	8
Red slate	2223	2228	5
Blue slate shells	2228	2278	50
Water, sand	2278	2350	72
Blue shale shells	2350	2355	5
Lime shell	2355	2370	15
Sand, oil show	2370	2380	10
Water, sand	2380	2395	15
Gray sand	2395	2450	55
Lime	2450	....	..

No. 8.—Waggoner No. 12, Producers Oil Co.

Clay	0	24	24
Sand and gravel	24	54	30
Shale	54	354	300
Rock	354	357	3
Shale and shells	357	522	165
Hard sand rock	522	544	22
Shale	544	559	15
Rock	559	575	16
Hard shale	575	615	40
Rock	615	633	18
Shale	633	653	20
Rock	653	656	3
Hard shale	656	671	15
Rock	671	673	2
Hard shale	673	689	16
Hard sand	689	703	14
Shale and shells	703	766	63
Hard sand, gas	766	782	16
Hard shale	782	802	20

Hard rock............	802	806	4
Hard shale............	806	892	86
Hard sand............	892	907	15
Shale	907	927	20
Hard sand............	927	943	16
Shale	943	960	17
Rock	960	967	7
Hard shale............	967	993	26
Sand rock............	993	1001	8
Hard shale............	1001	1032	31
Hard sand............	1032	1036	4
Shale	1036	1040	4
Rock	1040	1043	3
Shale	1043	1055	12
Red shale	1055	1083	28
Hard sand, oil........	1083	1113	30
Red shale............	1113	1176	63
Lime and sand........	1176	1231	55
Blue shale............	1231	1281	50
Red shale............	1281	1310	29
Red mud and rocks...	1310	1320	10
Gumbo	1320	1330	10
Hard shale............	1330	1373	43
Lime rock............	1373	1377	4
Shale and shells.......	1377	1403	26
Lime rock............	1403	1407	4
Gumbo	1407	1455	48
Blue shale............	1455	1470	15
Gyp	1470	1482	12
Hard shale and gravel.	1482	1500	18
Hard sand............	1500	1510	10
Gyp	1510	1520	10
Sand rock............	1520	1528	8
Blue shale............	1528	1552	24
Hard lime............	1552	1555	3
Red mud.............	1555	1565	10
Hard sand rock.......	1565	1569	4
Blue shale............	1569	1590	21
Gumbo	1590	1600	10
Blue shale and boulders	1600	1661	61
Red mud.............	1661	1671	10
Hard rock............	1671	1679	8
Gumbo	1679	1695	16
Lime rock............	1695	1707	12
Blue shale............	1707	1717	10
Hard sand rock........	1717	1724	7
Gumbo	1724	1738	14

Blue shale	1738	1764	26
Lime rock	1764	1767	3
Blue shale	1767	1782	15
Lime rock	1782	1784	2
White mud	1784	1786	2
Oil sand, gas	1786	1790	4
Blue shale	1790	1806	16
Lime rock	1806	1808	2
Oil, sand	1808	1814	6
Blue shale	1814	1818	4
Oil, sand	1818	1828	10
Blue shale	1828	1841	13
Lime rock	1841	1844	3
Blue shale	1844	1855	11
Hard lime rock	1855	1869	14

Record not complete. The operators were bailing in this well on March 2, 1912. Said to have had good showing.

No. 9.—Waggoner No. 4. Producers Oil Co. Elevation, 1256. Depth, 2178. Drilling commenced April 15, 1910. Drilling finished August 19, 1910. This is a dry hole in what would seem to be producing territory. A little southwest, No. 6 is a producing well, and north and east Nos. 13 and 14 are producers.

	Feet		
	From	To	Thickness
Red shale	0	200	200
Red sand	200	220	20
Blue mud	220	242	22
Blue shale	242	437	195
White and blue limestone	437	452	15
Blue mud	452	460	8
Black shale	460	500	40
Blue limestone	500	502	2
Blue shale	502	524	22
Red mud	524	564	40
White crystallized limestone	564	580	16
Blue mud	580	590	10
Limestone	590	605	15
Red mud	605	613	8
Hard limestone	613	675	62
Salt water, sand	675	679	4
Hard limestone	679	690	11
Blue shale	690	735	45
Red shale	735	767	32

Blue shale	767	812	45
Red shale	812	842	30
Hard limestone	842	902	60
Red shale	902	920	18
Soft black shale	920	935	15
Salt water, sand	935	944	9
Lime shell	944	949	5
Red shale	949	965	16
Blue shell	965	1007	42
Hard limestone	1007	1013	6
Soft blue shale	1013	1088	75
Red mud	1088	1108	20
Hard sand	1108	1112	4
Soft sand, show of oil	1112	1114	2
Soft blue shale	1114	1214	100
Limestone	1214	1220	6
Hard blue shale	1220	1240	20
Red shale	1240	1305	65
Hard lime shell	1305	1310	5
Soft red shale	1310	1364	54
Hard blue shale	1364	1389	25
Hard limestone	1389	1397	8
Blue shale	1397	1407	10
Blue and red shale	1407	1442	35
Lime shell	1442	1450	8
Black shale	1450	1475	25
Blue shale	1475	1481	6
Black shale	1481	1501	20
Black gumbo	1501	1516	15
Blue gumbo	1516	1550	34
Hard blue limestone	1550	1559	9
Hard black shale	1559	1574	15
Blue shale	1574	1600	26
Blue mud	1600	1608	8
Blue and red shale	1608	1630	22
Hard blue limestone	1630	1633	3
Blue shale	1633	1658	25
Blue mud	1658	1670	12
Red and blue shale	1670	1700	30
Red shale	1700	1714	14
White lime shell	1714	1715	1
Black gumbo	1715	1725	10
Blue shale	1725	1743	18
White and blue limestone	1743	1749	6
Black gumbo	1749	1759	10
Blue shale	1759	1814	55

Blue and white lime....	1814	1817	3
Red shale.............	1817	1828	11
Hard black shale......	1828	1848	20
Blue lime shell........	1848	1864	16
Blue shale............	1864	1875	11
Hard blue lime shell...	1875	1891	16
Blue shale............	1891	1901	10
Hard white lime.......	1901	1903	2
Hard blue shale......	1903	1915	12
Brown and white crystallized limestone...	1915	1920	5
Hard blue shale........	1920	1928	8
Black gumbo..........	1928	1940	12
Hard blue lime shell..	1940	1942	2
Black gumbo..........	1942	1964	22
Hard gray limestone...	1964	1973	9
Hard black shale......	1973	1984	11
Blue shale............	1984	2061	77
Hard crystallized limestone	2061	2079	18
Salt water, sand......	2079	2081	2
Blue shale, sticky.....	2081	2097	16
Hard lime rock........	2097	2102	5
Red shale.............	2102	2131	29
Sand and streaks of lime	2131	2133	2
Lime shell and salt water, sand.........	2133	2146	13
Red and blue mud.....	2146	2151	5
Gray lime shell........	2151	2160	9
Limestone and streaks of sand, no water....	2160	2166	6
Blue and red shale and some gravel.........	2166	2173	7
Hard blue slate.......	2173	2176	3
Limestone	2176	2178	2

No. 10.—Waggoner No. 1. Producers Oil Co. Elevation, 1251. 491 feet of 13-inch casing; 761 feet of 10-inch drive pipe; 1116 feet of 8-inch drive pipe; 1823 feet of 6-inch drive pipe. Drilled by cable. Drilling begun August 8, 1909.

	——Feet——		
	From	To	Thickness
Red clay..............	0	8	8
Sand rock............	8	15	7
Red clay..............	15	70	55

Blue clay	70	100	30
Red clay	100	145	45
Blue clay	145	205	60
Red clay	205	260	55
Blue clay	260	300	40
Red clay	300	335	35
Blue clay	335	390	55
Red clay	390	420	30
Blue clay	420	465	45
Red clay	465	485	20
Blue shale	485	495	10
Blue shale	495	555	60
Hard blue shale	555	590	35
Sand, show of oil	590	600	10
Blue shale	600	620	20
Red shale	620	660	40
Blue shale	660	735	75
Sand, rock, salt water	735	755	20
Blue shale	755	826	71
Red clay	826	846	20
Hard sand, show gas	846	866	20
Blue shale	866	880	14
Red shale	880	900	20
Hard rock	900	916	16
Blue shale	916	956	40
Red shale	956	976	20
Hard sand rock	976	981	5
Blue shale	981	1005	24
Blue shale	1005	1030	25
Hard rock	1030	1040	10
Blue shale	1040	1075	35
Red shale	1075	1095	20
Red shale	1095	1101	6
Soft red shale	1101	1115	14
Oil, sand (eight barrels per day)	1115	1123	8
Blue shale	1123	1195	72
Sand	1195	1201	6
Red slate	1201	1221	20
Blue slate	1221	1226	5
Red slate	1226	1241	15
Blue slate	1241	1261	20
Water, sand, salty	1261	1296	35
Blue slate	1296	1311	15
Lime shell	1311	1316	5
Blue slate	1316	1326	10
Red slate	1326	1339	13

Blue slate	1339	1344	5
Hard sand shell	1344	1351	7
Blue shale	1351	1375	24
Broken sand	1375	1395	20
Salt water, sand	1395	1428	33
Red slate	1428	1490	62
Blue slate	1490	1559	69
Sand shell	1559	1565	6
Blue slate	1565	1625	60
Red slate	1625	1640	15
Shells and blue slate	1640	1700	60
Blue slate	1700	1705	5
Red slate	1705	1715	10
Lime shell	1715	1720	5
Red slate	1720	1735	15
Blue slate	1735	1775	40
Red slate	1775	1795	20
Blue slate	1795	1812	17
Lime shell	1812	1816	4
Blue slate	1816	1823	7
Sand	1823	1828	5
Broken sand	1828	1848	20
Blue shale	1848	1863	15
Blue shale and lime shells	1863	1950	87
Red shale	1950	1965	15
Abandoned.			

No. 11.—Waggoner No. 2. Producers Oil Co. Elevation, 1258. Depth, 1853 feet. 661 feet of 10-inch pipe; 830 feet of 8-inch drive pipe; 1030 feet of 6-inch drive pipe; 1826 feet of 4-inch drive pipe.

	——Feet——		
	From	To	Thickness
Red clay	0	10	10
Sand rock	10	15	5
Red and blue clay	15	165	150
Red rock	165	170	5
Red and blue clay	170	480	310
Sand (show of oil)	480	490	10
Red and blue clay	490	605	115
Sand (salt water and show of oil)	605	630	25
Red and blue clay	630	730	100
Missing	730	790	60
Sand	790	805	15
Red and blue mud	805	825	20

Sand	825	840	15
Red rock	840	950	110
Gray lime	950	958	8
Blue shale, break	958	963	5
Sand, salt water	963	978	15
Red mud	978	980	2
Light blue shale	980	1035	55
Hard lime shell (show of oil)	1035	1037	2
Lime shell break	1037	1040	3
Hard rock	1040	1093	53
Dark blue shale	1093	1107	14
Sand (show of oil)	1107	1111	4
Dark blue shale	1111	1119	8
Gray sand (small show of oil)	1119	1143	24
Sand, occasional break, salt water, little oil	1143	1275	132
Black shale	1275	1340	65
Soft blue and red mud	1340	1380	40
Gumbo	1380	1390	10
Hard blue lime	1390	1392	2
Shale and gumbo	1392	1450	58
Hard salt water, sand	1450	1466	16
Gumbo and shale	1466	1498	32
Hard lime shell	1498	1500	2
Blue and red shale	1500	1540	40
Crystallized lime rock	1540	1544	4
Gumbo	1544	1565	21
Soft blue shale	1565	1575	10
Missing	1575	1590	15
Gumbo	1590	1604	14
Hard blue shale	1604	1616	12
Hard lime shell	1616	1618	2
Blue and red shale	1618	1667	49
Hard gumbo	1667	1685	18
Hard blue shale	1685	1705	20
Red shale	1705	1726	21
Gray lime shell	1726	1738	12
Hard black shale	1738	1786	48
Hard lime shell	1786	1789	3
Blue shale	1789	1800	11
Hard black shale	1800	1823	23
Light blue shale	1823	1826	3
Hard lime shell	1826	1827	1
Blue shale, break	1827	1829	2
Sand	1829	1846	17

Blue shale, break	1846	1847	1
Sand (lower part contained most of oil)	1847	1851	4
Blue shale	1851	1853	2

Wichita County.

No. 12.—Bywaters No. 2. Producers Oil Co. Elevation, 1247. Depth, 1831 feet. Drilling commenced March 22, 1911. Drilling finished May 5, 1911. 22 feet of 10-inch casing; 1792 feet of 6-inch line pipe. Initial production, 50 barrels a day.

	Feet		
	From	To	Thickness
Red clay	0	65	65
Blue shale	65	91	26
White gumbo	91	104	13
Red mud	104	163	59
White shale	163	181	18
Sand rock	181	192	11
Blue shale	192	280	88
Lime rock	280	282	2
Red shale	282	340	58
Lime rock	340	341	1
Blue gumbo	341	362	21
Red mud	363	428	66
Lime rock	428	431	3
Red and blue shale	431	486	55
Sand rock	486	488	2
Red shale	488	509	21
Lime rock	509	514	5
Red shale	514	528	14
Lime rock	528	530	2
White shale	530	556	26
Sand rock	556	562	6
White soapy rock	562	573	11
Red and blue shale	573	582	9
White rock	582	586	4
Red mud	586	604	18
Hard red rock	604	611	7
Lime rock	611	623	12
Blue shale	623	643	20
Red rock	643	661	18
Hard lime rock	661	662	1
Blue shale	662	670	8
Rock	670	672	2
Soft blue shale	672	682	10
Hard shale	682	700	18
Shale and gumbo	700	736	36

Lime rock	736	747	11
Mixed shale	747	803	56
Lime rock	803	804	1
Hard blue shale	804	828	24
Lime rock	828	860	32
Blue shale	860	877	17
Hard lime rock	877	880	3
Lime rock	880	886	6
Blue shale	886	930	44
Sand (show of oil and gas)	930	937	7
Lime rock	937	940	3
Blue shale	940	948	8
Red rock	948	852	4
Gumbo	952	960	8
Blue shale	960	969	9
Hard rock	969	1000	31
Red and blue shale	1000	1022	22
Hard rock	1022	1025	3
Red mud	1025	1042	17
Blue shale	1042	1053	11
Sand rock	1053	1055	2
Blue shale	1055	1075	20
Lime rock	1075	1077	2
Shale and shells	1077	1120	43
Lime rock	1120	1122	2
Sand rock	1122	1139	17
Blue shale	1139	1145	6
Red mud	1145	1176	31
Hard lime and shell	1176	1187	11
Sand, show of oil	1187	1196	9
Hard lime rock	1196	1216	20
White shale	1216	1230	14
Lime rock	1230	1240	10
Red and blue shale	1240	1260	20
Blue shale and shell	1260	1285	25
Lime rock	1285	1294	9
Blue shale	1294	1300	6
Lime rock	1300	1309	9
Hard blue shale	1309	1325	16
Soft rock	1325	1330	5
Blue shale	1330	1337	7
Lime rock	1337	1345	8
Sand	1345	1350	5
Blue shale	1350	1374	24
Sand rock	1374	1390	16
Blue shale	1390	1400	10

Lime rock	1400	1420	20
Blue shale	1420	1428	8
Lime rock	1428	1434	6
Red shale	1434	1449	15
Blue shale and shells	1449	1489	40
Sand rock	1489	1495	6
Blue shale	1495	1512	17
Sand rock	1512	1528	16
Blue shale	1528	1552	24
Sand rock	1552	1558	6
Blue shale and shells	1558	1597	39
Red mud	1597	1607	10
Hard lime	1607	1615	8
Red mud	1615	.1690	75
Rock	1690	1696	6
Gyp rock	1696	1700	4
Blue shale	1700	1756	56
Lime rock	1756	1760	4
Blue shale	1760	1779	19
Lime rock	1779	1783	4
Blue shale	1783	1790	7
Hard lime	1790	1797	7
Oil, sand	1797	1808	11
Blue shale	1808	1814	6
Oil sand	1814	1816	2
Hard dark shale	1816	1830	14
Hard lime	1830	1831	1

No. 13. Bywaters No. 1. Producers Oil Co. Elevation, 1245. Depth, 1842. Drilling commenced April 18, 1910. Drilling finished August 9, 1910. 36 feet of 12 1-2-inch casing; 587 feet of 10-inch drive pipe; 833 feet of 8-inch drive pipe; 1810 feet of 6-inch drive pipe.

	Feet		
	From	To	Thickness
Red mud	0	36	36
Lime shell	36	38	2
Blue mud	38	78	40
Red mud	78	93	15
Blue shale	93	123	30
Lime shell	123	125	2
Sand, little water	125	155	30
Red mud	155	175	20
Blue shale	175	225	50
Red mud	225	265	40
Blue shale	265	355	90
Black mud	355	370	15

Red mud	370	425	55
Blue shale	425	575	150
Red mud	575	610	35
Blue shale	610	620	10
Red mud	620	650	30
Blue shale	650	670	20
Red mud	670	710	40
Blue mud	710	740	30
Lime shell	740	750	10
Blue shale	750	770	20
Salt water, sand	770	778	8
Red mud	778	820	42
Water, sand	820	828	8
Blue shale	828	863	35
Red mud	863	903	40
Blue shale	903	908	5
Red mud	908	930	22
Oil sand (80 ft. fluid after 12 hours)	930	938	8
Black shale	938	993	55
Lime shell	993	997	4
Blue shale	997	1015	18
Lime shell	1015	1018	3
Blue shale	1018	1053	35
Lime shale	1053	1059	6
Red mud	1059	1078	19
Lime shell	1078	1081	3
Red mud	1081	1096	15
Brown shale	1096	1101	5
Dry sand, bottom showed a little water	1101	1141	40
Lime shell	1141	1144	3
Red shale	1144	1184	40
Blue shale	1184	1244	60
Red mud	1244	1294	50
Blue shale	1294	1337	43
Water, sand	1337	1345	8
Red shale	1345	1363	18
Sand, show of oil	1363	1375	12
Brown shale	1375	1400	25
Blue shale	1400	1420	20
Red shale	1420	1450	30
Blue shale	1450	1480	30
Brown shale	1480	1495	15
Red shale	1495	1525	30
Blue shale	1525	1575	50
Red shale	1575	1605	30

Red slate	1605	1653	48
Red shale	1653	1693	40
Lime shell	1693	1702	9
Red shale	1702	1705	3
Crystallized limestone	1705	1710	5
Red shale	1710	1715	5
Blue shale	1715	1752	37
Red shale	1752	1809	57
Black shale	1809	1813	4
Gray sand (small amount of gas)	1813	1815	2
Oil sand (lower 9 ft. contained most oil)	1815	1827	12
Streaks of sand and brown shale	1827	1838	11
Dark slate or hard shale	1838	1842	4

No. 14.—Waggoner No. 6. Producers Oil Co. Elevation, 1246. Depth, 1839. Drilling commenced August 29, 1910. Drilling finished December 13, 1910. 40 feet of 10-inch pipe; 1800 feet of 6-inch pipe; 1821 feet of 4 1-2-inch pipe.

	——Feet——		
	From	To	Thickness
Clay	0	12	12
Water, sand	12	32	20
Yellow clay	32	42	10
Lime shell	42	43	1
Blue shale	43	75	32
Hard limestone	75	77	2
Red and blue shale	77	167	90
Soft, blue shale	167	187	20
Hard limestone	187	191	4
Soft, blue shale	191	234	43
Gray, shelly limestone	234	236	2
Blue shale	236	300	64
Gray lime shell	300	302	2
Red shale	302	384	82
Gray limestone	384	400	16
Red mud	400	403	3
Red shale	403	465	62
Blue lime rock	465	468	3
Hard blue shale	468	486	18
Red shale	486	534	48
Blue shale	534	546	12
Lime shell	546	559	13
Red shale	559	613	54

Hard blue shale	613	627	14
Shelly limestone	627	639	12
Red shale	639	652	13
Blue lime	652	661	9
Blue shale	661	680	19
Red shale	680	747	67
Lime shell	747	753	6
Blue shale	753	808	55
Water, sand	808	826	18
Red and blue shale	826	920	94
Gray water sand	920	942	22
Black gumbo	942	973	31
Limestone	973	975	2
Blue shale	975	995	20
Soft, shelly lime	995	1000	5
Blue shale	1000	1003	3
Lime rock	1003	1005	2
Gumbo	1005	1008	3
Hard lime	1008	1010	2
Gumbo	1010	1090	80
Water, sand	1090	1105	15
Blue shale	1105	1115	10
Lime shell	1115	1117	2
Red and blue shale	1117	1157	40
Water, sand	1157	1161	4
Blue shale	1161	1202	41
Water, sand	1202	1212	10
Gyp rock	1212	1224	12
Hard sand	1224	1250	26
Lime shell	1250	1256	6
Light blue shale	1256	1310	54
Hard blue shale	1310	1318	8
Hard red shale	1318	1338	20
Hard white sand	1338	1359	21
Soft blue shale	1359	1403	44
Hard lime shells	1403	1412	9
Blue shale with streaks of lime	1412	1441	29
Blue shale	1441	1503	62
Blue shale, soft	1503	1528	25
Red and blue shale	1528	1578	50
Hard limestone	1578	1585	7
Hard blue shale	1585	1600	15
Red shale	1600	1605	5
Soft red cave	1605	1612	7
Hard lime	1612	1615	3
Blue shale	1615	1620	5

Red shale	1620	1630	10
Hard blue shale	1630	1634	4
Soft blue shale	1634	1683	49
Hard shale	1683	1704	21
Blue shale	1704	1714	10
Hard lime	1714	1717	3
Blue shale	1717	1763	46
Hard lime	1763	1764	1
Shale and gumbo	1764	1800	36
Hard lime	1800	1810	10
Sand	1810	1814	4
Sand and blue shale	1814	1818	4
Sand and broken shale (show of oil)	1818	1826	8
Sand and blue shale	1826	1837	11
Blue shale	1837	1839	2

No. 15.—Waggoner No. 3. Producers Oil Co. Elevation, 1240. Depth, 1084. Drilling commenced January 24, 1910. Drilling finished March 28, 1910. 66 feet of 12 1-2-inch casing; 632 feet of 10-inch drive pipe; 608 feet of 8-inch drive pipe; 1065 feet of 6-inch drive pipe; 15 feet of 4 1-2-inch perforated.

	Feet		
Red clay	0	10	10
Red mud	10	66	56
Red and blue mixed	66	632	566
Red mud	632	675	43
Blue shale	675	740	65
Lime shell	740	742	2
Missing	742	790	48
Water sand	790	802	12
Blue shale	802	835	33
Hard lime shell	835	837	2
Red rock	837	950	113
Blue shale	950	995	45
Gray sand	995	1003	8
Blue shale	1003	1020	17
Red mud	1020	1050	30
Blue shale, hard	1050	1074	24
Oil sand, soft	1074	1084	10

No. 16.—Allen No. 3. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1204. Depth, 1043. Drilling commenced January 19, 1912. Drilling finished February 6, 1912. Water sand 814 to 844. Oil sand 1027 to 1043.

No. 17.—Allen No. 2. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1199. Depth, 1023. Drilling commenced December 4, 1911. Drilling finished December 23, 1911. Oil sand 1003 to 1013. Drilled to 1023 and plugged back to 1016.

No. 18.—Allen No. 1.—Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1200. Depth, 1057. Drilling commenced October 10, 1911. Drilling finished November 7, 1911. Oil sand 270. Oil sand 996 to 1015. Drilled to 1057 and plugged back to 1015.

No. 19.—Skinner No. 4. Producers Oil Co. Elevation, 1195. Depth, 1017. Drilling commenced February 17, 1912. Drilling finished March 9, 1912. ' 400 feet of 12 1-2-inch casing; 800 feet of 10-inch casing; 907 feet of 8-inch casing; 1004 feet of 6-inch casing. Well came in flowing 250 barrels from 1004 feet, while just across the line, one location west, Allen No. 4 (not on map) went to 1080 with no sand, and when found at that depth it was dry and broken.

	Feet		
	From	To	Thickness
Clay	0	3	3
Red rock	3	43	40
Blue slate	43	73	30
Red rock	73	130	57
Blue slate	130	210	80
Red rock	210	410	200
Blue slate	410	430	20
Red rock	430	460	30
Blue slate	460	480	20
Red rock	480	495	15
Blue slate	495	600	105
Sand, barren	600	615	15
Blue slate	615	665	50
Red rock	665	695	30
Sand	695	710	15
Red rock	710	730	20
Sand	730	750	20
Blue slate	750	780	30
Red rock	780	800	20
Sand, oil show	800	820	20
Red rock	820	907	87
Blue slate	907	950	43
Red rock	950	998	48
White slate	998	1004	6
Oil sand	1004	1016	12
Water, sand	1016	1017	1

No. 20.—Skinner No. 3. Producers Oil Co. Elevation, 1200. Depth, 1036. Drilling commenced January 28, 1912. Drilling fin-

ished February 14, 1912. 405 feet of 12 1-2-inch casing; 900 feet of 10-inch casing; 1015 feet of 8-inch casing. Pumping 135 barrels.

	Feet		
	From	To	Thickness
Red shale	0	22	22
Sand, water	22	26	4
Red and white shale	26	245	219
Sandy lime	245	260	15
White shale	260	348	88
Dark shale	348	405	57
Red and white shale	405	845	440
Shale	845	900	55
White shale	900	940	40
Pink slate	940	1008	68
Sand	1008	1025	17
Red shale	1025	1036	11

No. 21.—Skinner No. 2. Producers Oil Co. Elevation, 1196. Depth, 1047. Drilling commenced January 18, 1912. Drilling finished February 8, 1912. 442 feet of 12 1-2-inch casing; 845 feet of 10-inch casing; 997 feet of 8-inch casing. Pumping 75 barrels.

	Feet		
	From	To	Thickness
Red clay	0	40	40
Lime shell	40	45	5
Red rock	45	120	75
Sand, oil	120	125	5
Red rock	125	235	110
Shale	235	255	20
Red rock	255	345	90
Shell, gas	345	350	5
Red rock	350	390	40
Blue shale	390	410	20
Red rock	410	490	80
Blue shale	490	520	30
Red rock	520	540	20
Light shale	540	560	20
Oil, sand	560	580	20
Red rock	580	630	50
Blue shale	630	640	10
Red rock	640	670	30
Light shale	670	690	20
Oil, sand	690	705	15
Red rock	705	765	60
Light shale	765	775	10

Sand, barren	775	795	20
Red rock	795	825	30
Shale	825	845	20
Red rock	845	855	10
Light shale	855	903	48
Lime shell	903	910	7
Red rock	910	987	77
Sandy shale	987	997	10
Oil, sand	997	1009	12
Red mud	1009	1047	33

Oil sand from 690 to 705 good for 30 barrels.

No. 22.—Skinner No. 1. Producers Oil Co. Elevation, 1204. Depth, 1030. Drilling commenced December 8, 1911. Drilling finished January 17, 1912. 20 feet of 16-inch casing; 405 feet of 12 1-2-inch casing; 741 feet of 10-inch casing; 990 feet of 8-inch casing. Pumping 100 barrels.

	Feet		
	From	To	Thickness
Red and white slate	0	340	340
Sand	340	352	12
Slate	352	400	48
Sand, water	400	406	6
Shale	406	695	289
Sand, show oil, gas, water	695	710	15
Shale	710	990	280
Hard shell	990	995	5
Broken shell, slate	995	1000	5
Sand, oil	1000	1021	21
Shale	1021	1030	9

No. 23.—Stringer No. 15. Producers Oil Co. Elevation, 1193. Depth, 1096. Drilling commenced Jan. 18, 1912. Drilling finished Feb. 10, 1912. Flowing. Plates VIII, A, and X, B.

	Feet		
	From	To	Thickness
Soil	0	2	2
Blue clay	2	60	58
Sand	60	62	2
Red rock	62	205	143
Sand, oil	205	280	75
Red rock	280	290	10
Blue clay	290	318	28
Sand, gas	318	350	32
Lime	350	351	1
Blue clay	351	353	2

Sand	353	361	8
Lime	361	376	15
Sand	376	384	8
Blue clay	384	430	46
Lime	430	435	5
Blue clay	435	450	15
Red rock	450	490	40
Lime	490	520	30
Blue clay	520	525	5
Oil sand	525	545	20
Blue clay	545	620	75
Lime	620	622	2
Blue clay	622	650	28
Red rock	650	682	32
Lime	682	687	5
Red rock	687	720	33
Blue clay	720	765	45
Sand	765	780	15
Blue clay	780	790	10
Red rock	790	805	15
Oil sand	805	815	10
Red rock	815	825	10
Blue clay	825	845	20
Red rock	845	905	60
Blue clay	905	965	60
Oil sand	965	978	13
Blue clay	978	993	15
Lime shell	993	995	2
Red rock	995	1018	23
Lime	1018	1027	9
Sand	1027	1050	23
Red rock	1050	1082	32
Oil sand	1082	1096	14

No. 24.—Stringer No. 13. Producers Oil Co. Elevation, 1195. Depth, 1051. Drilling finished Mar. 1, 1912. Plate VIII, A.

	Feet		
	From	To	Thickness
Soil	0	10	10
Red clay	10	35	25
Hard shale	35	50	15
Red shale	50	75	25
Lime	75	80	5
Red shale	80	102	22
Lime	102	106	4
Red shale	106	200	94
Lime	200	207	7

Blue slate	207	258	51
Hard lime	258	260	2
Oil sand	260	270	10
Lime	270	278	8
Sand, lime shell	278	300	22
Blue slate	300	350	50
Hard lime	350	355	5
Blue shale	355	375	20
Hard lime	375	377	2
Blue shale	377	390	13
Lime	390	395	5
Blue shale	395	400	5
Lime	400	402	2
Shale	402	427	25
Lime	427	433	6
Blue shale	433	439	6
Lime shell	439	441	2
Blue shale	441	453	8
Lime rock	453	456	3
Blue shale	456	495	39
Sand rock	495	497	2
Blue shale	497	505	8
Lime rock	505	507	2
Shale	507	510	3
Lime	510	515	5
Shale, oil	515	548	33
Lime	548	551	3
Blue shale	551	555	4
Lime	555	557	2
Blue shale	557	624	67
Lime	624	632	8
Blue shale	632	712	80
Lime	712	714	2
Red shale	714	725	11
Gumbo	725	755	30
Lime	755	757	2
Blue shale	757	800	43
Shale and shells	800	810	10
Oil sand	810	820	10
Gumbo	820	826	6
Red rock	826	840	14
Blue shale	840	860	20
Gumbo	860	870	10
Blue shale	870	890	20
Red shale	890	934	44
Rock	934	937	3
Red shale	937	950	13

Blue shale and red mud	950	960	10
Oil sand............	960	972	12
Red shale...........	972	1000	28
Dry sand and shale...	1000	1035	35
Oil sand............	1035	1045	10
Sand rock...........	1045	1051	6

No. 25.—Stringer No. 14. Producers Oil Co. Elevation, 1193. Depth, 1081. Drilling commenced Jan. 18, 1912. Drilling finished Feb. 17, 1912. 250 feet of 12 1-2-inch casing; 533 feet of 10-inch casing. A strong gasser at first, but did not last. Plates VIII, A, and XI, A.

	——Feet——		
	From	To	Thickness
Red mud............	0	60	60
Water sand..........	60	68	8
Red and blue shale...	68	140	72
Water sand..........	140	145	5
Red shale and mud...	145	250	105
Sand, oil show.......	250	270	20
Light blue shale......	270	330	60
Sand, gas show.......	330	340	10
Red and blue mud....	340	380	40
Sand, gas show.......	380	390	10
Blue shale...........	390	440	50
Sand, show oil.......	440	450	10
Red and blue shale...	450	505	55
Sand, good oil........	505	530	25
Red mud............	530	545	15
Oil sand, good........	545	550	5
Blue shale...........	550	570	20
Lime, sand gas.......	570	595	25
Blue shale and mud...	595	650	55
Gas sand, good.......	650	675	25
Blue shale and red mud	675	800	125
Light gray shale......	800	815	15
Red mud............	815	825	10
Red mud and blue shale	825	945	120
Lime shell and sand..	945	963	18
Oil sand.............	963	980	17
Red mud............	980	1035	55
Oil sand.............	1035	1060	25
Lime shell...........	1060	1065	5
Red mud............	1065	1081	16

No. 26.—Stringer No. 19. Producers Oil Co. Elevation, 1190. Depth, 1078. Drilling commenced Feb. 19, 1912. Drilling finished

March 7, 1912. 723 feet of 10-inch casing; 965 feet of 8-inch casing; 120 feet of 6-inch casing. Plates VIII, A, XI, B, and XII, B.

	——Feet——		
	From	To	Thickness
Blue clay	0	60	60
Lime	60	66	6
Red rock	66	300	234
Sand, show oil	300	330	30
Red rock	330	340	10
Water sand	340	360	20
Red rock	360	460	100
Lime	460	465	5
Blue clay	465	475	10
Red rock	475	690	215
Water sand	690	725	35
Red rock	725	755	30
Blue clay	755	825	70
Red rock	825	900	75
Lime	900	905	5
Red rock	905	965	60
Oil sand	965	986	21
Red rock	986	1024	38
Oil sand	1024	1051	27
Red rock	1051	1066	15
Oil sand	1066	1078	12

No. 27.—Stringer No. 12. Producers Oil Co. Elevation, 1198. Depth, 958. Drilling commenced Dec. 4, 1911. Drilling finished Jan. 22, 1912. Pumping 150 barrels. Plate VIII, B.

	——Feet——		
	From	To	Thickness
Red and blue mud	0	450	450
Gas shell	450	455	5
Blue and red mud	455	505	50
Oil sand	505	525	20
Blue and red mud	525	575	20
Dry sand	575	580	5
Blue and red mud	580	800	220
Oil and gas sand	800	815	15
Red mud	815	830	15
Blue shale	830	860	30
Red mud	860	920	60
Sandy shale	920	940	20
Oil sand	940	956	16
Shale	956	958	2

No. 28.—Stringer No. 17. Producers Oil Co. Elevation, 1198. Drilling. Plate VIII, B.

	Feet		
	From	To	Thickness
Red rock	0	20	20
Blue slate	20	40	20
Lime	40	55	15
Blue slate	55	95	40
Blue slate	95	185	90
Red rock	185	190	5
Lime	190	200	10
Red rock	200	225	25
Gas sand	225	232	7
Blue slate	232	250	18
Red rock	250	280	30
Sand, oil	280	285	5
Red rock	285	365	80
Blue shale	365	380	15
Red rock	380	435	55
Blue slate	435	455	20
Sand, gas	455	463	8
Red rock	463	480	17
White slate	480	495	15
Lime	495	530	35
Red rock	530	545	15
Lime	545	555	10
Blue slate	555	575	20
Lime	575	582	7
Blue slate	582	610	28
Slate and shells	610	660	50
Sand	660	670	10
Blue slate	670	725	55
Red rock	725	730	5
Sand and slate	730	745	15
White slate	745	755	10
Lime	755	770	15
Blue slate	770	790	20
Red rock	790	795	5
White slate	795	800	5
Red rock	800	820	20
Sand	820	830	10
Red rock	830	850	20
Lime	850	885	35
Blue shale	885	895	10
Red rock	895	905	5
Lime shell	905	910	5
Red rock	910	925	15

Sand	925	952	27
Red rock	952	976	24
Sand	876	992	16
Red rock	992	1030	38
Sand	1030	1048	18
Red rock	1048	1065	17
Lime	1065	1075	10
Red rock	1075	1085	10
Lime	1085	1120	35
Blue slate	1120	1178	58
Lime	1178	1185	7
Slate	1185	1200	15
Sand	1200	1210	10
Lime	1210	1225	15
Sand, water	1225	1240	15
Slate	1240	1260	20
Sand	1260	1270	10
Red rock	1270	1275	5
Sand	1275	1280	5
Red rock	1280	1300	20
Blue shale	1300	1310	10
White shale	1310	1325	15

No. 29.—Stringer No. 10. Producers Oil Co. Elevation, 1195. Depth, 1053. 204 feet of 12 1-2-inch casing; 379 feet of 10-inch casing; 926 feet of 8-inch casing; 1008 feet of 6-inch casing. Flowing 75 barrels. Plates VIII, B, X, A, and XII, A.

	——Feet——		
	From	To	Thickness
Red rock	0	80	80
Blue shale	80	200	120
Red rock	200	225	25
Blue shale	225	315	90
Shale and rock	315	350	35
Lime shell, gas	350	352	2
Brown shale	352	367	15
Lime shell, gas	367	370	3
Blue shale	370	405	35
Red rock	405	430	25
Lime shell	430	434	4
Blue shale	434	444	10
Lime shell	444	449	5
Blue shale	449	510	61
Broken sand and shale	510	518	8
Oil sand	518	542	24
Blue gumbo	542	560	18
Sand shell	560	600	40

Mud and shale rock..	600	870	270
Lime shell...........	870	873	3
Blue shale...........	873	883	10
Shale and rock........	883	930	47
Gas sand............	930	935	5
Oil sand............	935	960	25
Gyp rock............	960	964	4
Blue shale...........	964	969	5
Red rock............	969	994	25
Sand and shale.......	994	1010	16
Lime	1010	1012	2
Blue slate...........	1012	1030	18
Sand shale...........	1030	1037	7
Sand	1037	1043	6
Red cave............	1043	1053	10

No. 30.—Stringer No. 16. Producers Oil Co. Elevation, 1197. Depth, 537. Drilling commenced Jan. 11, 1912. Drilling finished Jan. 31, 1912. 250 feet of 8 1-4-inch casing; 517 feet of 6 5-8-inch casing. Flowing 100 barrels. Plate VIII, B.

	Feet		
	From	To	Thickness
Red mud............	0	55	55
Sand shells..........	55	57	2
White mud..........	57	65	8
Red shale............	65	90	25
White shale..........	90	115	25
Red shale............	115	235	120
White shale..........	235	251	16
Shell	251	252	1
White shale..........	252	272	20
Red shale............	272	322	50
Shell, gas............	322	323	1
Sandy shale..........	323	366	43
Red mud............	363	401	35
White shale..........	401	476	75
Red shale............	476	501	25
White shale..........	501	517	16
Oil sand............	517	537	20

No. 31.—Stringer No. 11. Producers Oil Co. Elevation, 1193. Depth, 540. Drilling commenced Nov. 10, 1911. Drilling finished Dec. 8, 1911. 518 feet of 8-inch casing. 50 barrels. Plate VIII, B.

	Feet		
	From	To	Thickness
Red rock............	0	80	80
Blue shale...........	80	105	25

Red rock	105	225	120
Blue shale	225	245	20
Red rock	245	285	40
Blue shale	285	315	30
Red rock	315	350	35
Lime shell gas	350	352	2
Brown shale	352	367	15
Lime shell gas	367	370	3
Blue shale	370	405	35
Red rock	405	430	25
Lime shell	430	434	4
Blue shale	434	444	10
Lime shell	444	449	5
Blue shale	449	510	51
Broken shale	510	520	10
Oil sand	520	540	20

No. 32.—Stringer No. 9. Producers Oil Co. Elevation, 1193. Depth, 1061. Drilling commenced Sept. 29, 1911. Drilling finished Oct. 25, 1911. 974 feet of 8-inch casing; 1061 feet of 4-inch casing. Flowing 200 barrels. Plates VIII, B, and X, B.

	Feet		
	From	To	Thickness
Clay	0	15	15
Sand, clay, gravel	15	45	30
Shell	45	46	1
Hard red pack sand	46	66	20
Packed gravel	66	91	25
Shell	91	231	140
Hard sand	231	234	3
Shale and rock	234	281	47
Hard sand, oil	281	303	22
Red clay	303	343	40
Shell rock	343	346	3
Hard shale	346	396	50
Shale and rock	396	464	68
Shell	464	466	2
Hard clay	466	482	16
Boulders	482	486	4
Shell	486	498	12
Boulders	498	504	6
Hard clay	504	524	20
Hard sand	524	541	17
Hard lime	541	549	8
Hard shale	549	600	51
Hard shell	600	614	14
Gravel and boulders	614	622	8

Hard shale...........	622	642	20
Rock and boulders....	642	646	4
Sand, shale, shells....	646	786	140
Hard shale..........	786	861	75
Rock, gas, sand.......	861	869	8
Shell	869	911	42
Shale	911	941	30
Rock	941	946	5
Hard shell, sand, rock.	946	958	12
Sand	958	962	4
Shale	962	965	3
Sand	965	975	10
Shale	975	1002	27
Shale and sand.......	1002	1015	13
Hard sand...........	1015	1040	25
Gumbo	1040	1042	2
Hard sand...........	1042	1046	4
Shale	1046	1048	2
Hard sand...........	1048	1061	13

No. 33.—Stringer No. 21. Producers Oil Co. Elevation, 1190. Depth, 1061. Drilling commenced Aug. 24, 1911. Drilling finished Oct. 3, 1911. 960 feet of 8-inch casing; 1061 feet of 6-inch casing. Flowing 60 barrels. Plate VIII, B.

	——Feet——		
	From	To	Thickness
Red clay............	0	26	26
Rock	26	30	4
Rock and gravel......	30	38	8
Rock and shale.......	38	429	391
Sand, oil............	429	434	5
Rock	434	437	3
Hard shale...........	437	445	8
Rock	445	451	6
Shale and gumbo.....	451	470	19
Hard shale...........	470	490	20
Rock	490	513	23
Hard shale...........	513	521	8
Rock	521	523	2
Shale	523	528	5
Rock	528	547	19
Shale	547	553	6
Rock	553	554	1
Hard shale...........	554	598	44
Gumbo	598	646	48
Shale and rock.......	646	652	6
Hard sand...........	652	658	6

Hard shale...........	658	662	4
Sand rock.............	662	672	10
Gumbo	672	707	35
Rock and boulders....	707	710	3
Shale	710	715	5
Gumbo	715	720	5
Shale	720	727	7
Rock and boulders....	727	730	3
Gumbo	730	776	46
Rock and boulders....	776	790	14
Gumbo	790	800	10
Rock and gumbo......	800	819	19
Hard sand, oil........	819	824	5
Hard shale...........	824	834	10
Gumbo	834	870	36
Shale, gumbo, rock....	870	960	90
Hard oil sand........	960	987	27
Shale and boulders....	987	1017	30
Sand rock............	1017	1021	4
Shale	1021	1029	8
Hard oil sand.........	1029	1061	32

No. 34.—Stringer No. 7. Producers Oil Co. Elevation, 1190. Depth, 1061. Drilling commenced Aug. 24, 1911. Drilling finished Oct. 3, 1911. Top of oil sand lies at 1029 feet. Plates VIII, B, and XI, A.

No. 35.—Stringer No. 2. Producers Oil Co. Elevation, 1189. Depth, 987. Drilling commenced July 8, 1911. Drilling finished Aug. 3, 1911. 30 feet of 10-inch casing; 806 feet of 8 1-4-inch casing; 960 feet of 6-inch casing. Flowing. Plate VIII, B.

	——Feet——		
	From	To	Thickness
Clay	0	14	14
Gravel	14	18	4
Blue shale...........	18	160	142
Red gumbo..........	160	270	110
Shale and thin strata oil sand...........	270	330	60
Blue and red shale....	330	400	70
White rock...........	400	406	6
Blue shale...........	406	510	104
White sand and sheets of hard rock.......	510	530	20
Blue shale...........	530	544	14
Oil sand.............	544	558	14
Hard blue lime.......	558	563	5

Shale	563	635	72
Gray crystal rock	635	640	5
Hard shale	640	680	40
Oil sand	680	687	7
Red gumbo	687	722	35
White rock	722	730	8
Gumbo	730	806	76
Oil sand	806	822	16
Shale	822	828	6
Oil sand	828	840	12
Shale	840	850	10
Mixed shale	850	960	110
Oil sand	960	985	25
Mixed shale	985	987	2

No. 36.—Stringer No. 5. Producers Oil Co. Elevation, 1189. Depth, 1074. Flowing 500 barrels. Plate VIII, B.

	Feet		
	From	To	Thickness
Surface clay	0	14	14
Sand and gravel	14	32	18
Clay	32	44	12
Gravel	44	52	8
Hard gravel	52	64	12
Hard red clay and boulders	64	144	80
Shale and boulders	144	284	140
Hard sand	284	300	16
Red clay	300	320	20
Hard sand	320	356	36
Clay and boulders	356	396	40
Rock	396	399	3
Clay	399	419	20
Rock	419	420	1
Hard shale	420	460	40
Rock and boulders	460	464	4
Red clay	464	494	30
Hard shale and boulders	494	514	20
Hard boulders water	514	530	16
Hard gumbo	530	555	25
Hard shale	555	595	40
Rock and boulders	595	611	16
Hard shale	611	641	30
Rock	641	645	4
Hard shale	645	665	20
Hard clay	665	675	10
Hard sand oil	675	688	13

Hard shale and clay...	688	722	34
Rock	722	726	4
Hard shale..........	726	806	80
Hard sand...........	806	821	15
Hard red clay........	821	841	20
Rock	841	845	4
Hard red clay.........	845	865	20
Rock and boulders....	865	873	8
Hard red clay........	873	908	35
Rock	908	912	4
Hard red clay........	912	958	46
Hard sand...........	958	975	17
Hard red clay........	975	990	15
Hard sand and boulders	990	1000	10
Hard shale...........	1000	1035	35
Hard sand...........	1035	1072	37
Shale	1072	1074	2

No. 37.—Stringer No. 3. Producers Oil Co. Elevation, 1189. Depth, 1063. Drilling commenced July 12, 1911. Drilling finished Sept. 13, 1911. 64 feet of 12 1-2-inch casing; 250 feet of 10-inch casing; 523 feet of 8-inch casing; 824 feet of 6 1-2-inch casing; 1045 feet of 5 3-16-inch casing. Flowing 450 barrels. Plate VIII, B.

	Feet		
	From	To	Thickness
Red mud............	0	80	80
Lime shell...........	80	90	10
Red mud............	90	140	50
Blue shale...........	140	150	10
Brown mud..........	150	220	70
Red mud............	220	270	50
Sand oil.............	270	274	4
Blue shale...........	274	290	16
Oil sand.............	290	295	5
Red mud............	295	335	40
Blue shale and sand, gas	335	360	25
Blue shale..........	360	370	10
Lime shell...........	370	380	10
Blue shale and shells..	380	400	20
Red mud............	400	420	20
Salt water...........	420	435	15
Blue shale...........	435	450	15
Red mud............	450	460	10
Blue shale...........	460	515	55
Salt sand............	515	523	8

Blue shale	523	570	47
Red mud	570	580	10
Blue shale	580	660	80
Red mud	660	665	5
Gas	665	670	5
Blue slate	670	700	30
Lime	700	710	10
Blue shale	710	730	20
Red mud	730	824	94
Sand	824	834	10
Red mud	834	870	36
Blue shale	870	950	80
Red mud	950	970	20
Sand	970	980	10
Blue shale	980	1024	44
Sand	1024	1063	39

No. 38.—Stringer No. 6. Producers Oil Co. Elevation, 1189. Depth, 1048. Flowing 60 barrels. Plates VIII, B, and XII, B.

	——Feet——		
	From	To	Thickness
Red clay	0	36	36
Rock	36	40	4
Shale	40	77	37
Hard shale	77	83	6
Rock	83	84	1
Hard shale	84	128	44
Rock	128	131	3
Shale	131	143	12
Rock	143	145	2
Shale	145	269	124
Rock	269	273	4
Shale	273	288	15
Hard sand, oil	288	306	18
Hard shale	306	325	19
Rock	325	329	4
Hard red shale	329	365	36
Rock	365	370	5
Hard shale	370	380	10
Rock	380	383	3
Shale	383	390	7
Rock and boulders	390	410	20
Hard shale	410	433	23
Rock	433	435	2
Hard shale	435	450	15
Rock	450	452	2
Hard shale	452	463	11

Rock	463	464	1
Shale	464	502	38
Rock and boulders....	502	527	25
Shale	527	566	39
Rock and boulders....	566	575	9
Shale	575	595	20
Rock	595	600	5
Shale and shell.......	600	625	25
Gumbo	625	630	5
Shale	630	635	5
Hard rock...........	635	648	13
Shale	648	663	15
Rock	663	669	6
Hard shale and boulders	669	686	17
Hard sand, oil........	686	756	70
Shale and rock.......	756	820	64
Sand rock...........	820	825	5
Gumbo	825	964	139
Shale and rock.......	964	967	3
Sand	967	972	5
Shale	972	1030	58
Sand	1030	1048	18

No. 39.—Stringer No. 1. Producers Oil Co. Elevation, 1187. Depth, 1906. Drilling commenced May 19, 1911. Drilling finished Aug. 19, 1911. 1477 feet of 6-inch liner; 1869 feet of 4-inch liner; 1866 feet of 2 1-2-inch tubing; 40 feet of 4-inch tubing. Plates VIII, B, and XI, B.

	——Feet——		
	From	To	Thickness
Red clay............	0	35	35
Gravel and clay......	35	45	10
Shale	45	270	225
Sand and shale, show oil	270	295	25
Blue shale...........	295	325	30
Sand and shale, show of oil	325	340	15
Blue gumbo..........	340	350	10
Hard shell...........	350	351	1
Shale and flint shell...	351	580	229
Sand, show of oil.....	580	605	25
Blue shale...........	605	645	40
Hard white rock......	645	652	7
Hard shale..........	632	683	31
Broken oil sand......	683	723	40
Gumbo and red shale..	723	1037	314

Hard white sand......	1037	1050	13
Blue gumbo.........	1050	1062	12
Oil sand, some soft...	1062	1070	8
Gumbo	1070	1107	37
White sand..........	1107	1140	33
Gumbo	1140	1157	17
Sand rock...........	1157	1161	4
Shale	1161	1178	17
Hard sand...........	1178	1192	14
Gumbo	1192	1260	68
Gray sand...........	1260	1272	12
Gumbo	1272	1314	42
Sand, show of oil.....	1314	1325	11
Gumbo (thin sand)...	1325	1430	105
Hard sand...........	1430	1440	10
Gumbo	1440	1465	25
Hard sand (set 6 inch at 1467)	1465	1469	4
Hard shale...........	1469	1478	9
Hard lime shell.......	1478	1482	4
Gumbo	1482	1511	29
Oil sand.............	1511	1537	26
Blue shale...........	1537	1547	10
Lime rock...........	1547	1555	8
Blue shale...........	1555	1612	57
Lime rock...........	1612	1615	3
Blue shale...........	1615	1635	20
Hard rock, light......	1635	1640	5
Blue shale...........	1640	1660	20
Lime rock...........	1660	1662	2
Blue shale...........	1662	1667	5
Lime rock...........	1667	1684	17
Blue shale...........	1684	1727	43
Lime rock...........	1727	1736	9
Blue shale...........	1736	1754	18
Oil sand.............	1754	1778	24
Lime shell...........	1778	1783	5
White mud...........	1783	1803	20
Hard lime...........	1803	1823	20
Oil sand.............	1823	1843	20
White sand and mud..	1843	1853	10
White mud..........	1853	1860	7
Lime rock...........	1860	1869	9
Shale	1869	1873	4
Hard red mud........	1873	1882	9
Sand and breaks of shale	1882	1906	24

No. 40.—Stringer No. 4. Producers Oil Co. Elevation, 1198. Depth, 1960. Drilling commenced Aug. 10, 1911. Drilling finished Jan. 5, 1912. 43 feet 6 inches of 10-inch casing; 1673 feet of 6-inch drive; 1855 feet of 4-inch line. Plate VIII, B.

	——Feet——		
	From	To	Thickness
Soil	0	4	4
Sand rock	4	70	66
Blue shale	70	115	45
Lime rock	115	120	5
Blue shale	120	126	6
Red shale	126	307	181
Oil sand	307	312	5
Blue shale	312	353	41
Red shale	353	365	12
Blue gumbo	365	385	20
Shells and gumbo	385	395	10
Hard lime	395	400	5
Blue gumbo	400	415	15
Lime rock	415	417	2
Gumbo	417	430	13
Lime shells	430	436	6
Dry sand	436	440	4
Blue shale	440	459	19
Hard lime	459	462	3
Blue shale	462	478	16
Hard lime	478	482	4
Blue shale	482	540	58
Gumbo and shells	540	550	10
Blue shale and lime shells	550	562	12
Red and blue shale	562	594	32
Sand	594	610	16
Blue shale	610	635	25
Gumbo and shells	635	687	52
Lime rock	687	693	6
Red shale	693	740	47
Sand, oil	740	765	25
Blue gumbo	765	770	5
Sand	770	775	5
Blue slate	775	787	12
Blue shale	787	825	38
Red rock	825	835	10
Blue shale	835	855	20
Red gumbo	855	865	10
Red shale and rock	865	910	45
Blue shale	910	930	20

Red shale	930	960	30
Sand, light	960	965	5
Hard red shale	965	975	10
Blue shale	975	1037	62
Lime rock	1037	1041	4
Red shale	1041	1082	41
Gyp gumbo	1082	1103	21
Blue shale	1103	1124	21
Shale and gumbo	1124	1165	41
Lime and sand	1165	1180	15
Hard blue slate	1180	1230	50
Lime and sand	1230	1250	20
Gumbo and rock	1250	1296	46
Sand rock	1296	1312	16
Hard lime	1312	1320	8
Blue shale and shells	1320	1340	20
Red and blue shale	1340	1420	80
Lime and shells, sand rock	1420	1436	16
White gyp	1436	1444	8
Red and blue shale	1444	1505	61
Lime shell	1505	1507	2
Gumbo	1507	1510	3
Lime shell	1510	1512	2
Blue shale and shells	1512	1545	33
Gyp	1545	1564	19
Blue shale	1564	1580	16
Lime shells	1580	1582	2
Shale and gumbo	1582	1600	18
Hard rock	1600	1610	10
Gumbo and gyp	1610	1630	20
Blue shale	1630	1641	11
Soft lime	1641	1653	12
Gumbo	1653	1657	4
Sand and shale	1657	1662	5
Gumbo	1662	1668	6
Lime rock	1668	1670	2
Blue shale	1670	1695	25
Soft lime	1695	1700	5
Blue shale	1700	1718	18
Hard lime	1718	1720	2
Soft white lime	1720	1730	10
Gumbo	1730	1738	8
Hard lime	1738	1741	3
Gumbo	1741	1753	12
Lime rock	1753	1770	17
White gumbo	1770	1775	5

Lime rock	1775	1812	37
Blue shale	1812	1822	10
Lime rock	1822	1830	8
Red shale	1830	1840	10
Blue shale	1840	1855	15
Oil sand	1855	1869	14
Sand and shale	1869	1872	3
Oil sand	1872	1877	5
Sand and shale	1877	1879	2
Oil sand	1879	1882	3
Shale and sand	1882	1886	4
Dry sand	1886	1895	9
Oil sand	1895	1905	10
Dark blue shale	1905	1925	20
Hard white lime	1925	1942	17
Oil sand	1942	1958	16
Dry sand	1958	1959	1
White mud	1959	1960	1

No. 41.—McBurney No. 1. Producers Oil Co. Elevation, 1196. Depth, 815. Drilling commenced Sept. 24, 1911. Drilling finished Feb. 3, 1912. 161 feet 6 inches of 12 1-2-inch casing; 516 feet 6 inches of 10-inch casing; 717 feet of 8-inch casing; 814 feet of 6-inch casing. Flowing 275 barrels. Plate VIII, B.

	Feet		
	From	To	Thickness
Red mud	0	90	90
Blue shale	90	130	40
Red mud	130	150	20
Oil, sand	150	157	7
Blue shale	157	190	33
Red mud	190	250	60
Blue shale	250	275	25
Red mud	275	350	75
Sand shale	350	360	10
Red mud	360	400	40
Blue shale	400	440	40
Sandy lime (oil)	440	460	20
Blue shale	460	485	25
Red rock	485	500	15
Blue shale	500	650	150
Red mud	650	690	40
Blue shale	690	740	50
Red shale	740	812	72
Oil, sand	812	815	3

No. 42.—Sheldon No. 1. Corsicana Petroleum Co. Elevation, 1201. Depth, 843. Drilling commenced September 23, 1911. Drilling finished October 11, 1911. Producing well. Plate IX, A.

	Feet		
	From	To	Thickness
Soil	0	15	15
Red rock	15	65	50
Showing oil, sand	65	75	10
Blue clay	75	110	35
Red rock	110	331	221
Blue clay	331	375	44
Red rock	375	425	50
Gas and oil, sand	425	450	25
Blue clay	450	550	100
Red rock	550	635	85
Oil, sand	635	655	20
Blue clay	655	670	15
Limestone	670	680	10
Blue clay	680	755	75
Hard lime	755	780	25
Oil and gas, sand	780	805	25
Red rock	805	820	15
Lime rock	820	830	10
Red rock	830	835	5
Oil, sand	835	843	8

No. 43.—Sheldon No. 1. McBride. Elevation, 1189. Depth, 1743. Producing well.

No. 44.—Cross & Brown No. 9. Corsicana Petroleum Co. Depth, 1230. Drilling commenced January 25, 1912. Drilling finished February 28, 1912. 360 feet of 12 1-2-inch casing; 874 feet of 10-inch casing; 1209 feet of 8-inch casing. This well is one of the few dry holes in the proven field, and is surrounded by producing wells. Plate IX, A.

	Feet		
	From	To	Thickness
Red rock	0	130	130
Lime shell	130	132	2
Red rock	132	350	218
Blue shale	350	445	95
Sand, oil	445	451	6
Red and blue shale	451	515	64
Sand, soft white	515	521	6
Blue and white shale	521	632	111
Lime shells	632	642	10

Red rock	642	670	28
Lime shells	670	776	116
Blue shale and red rock	776	945	169
Sand, oil and gas	945	950	5
Blue shale and red rock	950	1190	240
Sand, oil	1190	1195	5
Blue sand, shale	1195	1225	30
Sand, hole full of salt water	1225	1230	5

No. 45.—Cross & Brown No. 6. Corsicana Petroleum Co. Depth, 969. Drilling commenced January 10, 1912. Drilling finished February 10, 1912. 340 feet of 12 1-2-inch casing; 805 feet of 10-inch casing; 951 feet of 8 14-inch casing. This well started with a production of 250 barrels a day. Plate IX, A.

	Feet		
	From	To	Thickness
Soil	0	10	10
White shale	10	20	10
Red shale	20	170	150
Sand	170	180	10
White shale	180	220	40
Red rock	220	310	90
White shale	310	340	30
Red rock	340	430	90
Sand, oil	430	460	30
Red rock	460	515	55
Sand	515	530	15
Red rock	530	640	110
Sand, gas	640	650	10
Brown and red rock	650	790	140
Sand	790	805	15
Brown and red shale	805	905	100
Sand, small gas	905	930	25
Brown shale	930	949	19
Oil sand, good	949	969	20
Oil sand, pay	951	969	18

No. 46.—Cross & Brown No. 7. Corsicana Petroleum Co. Depth, 969. Drilling commenced January 12, 1912. Drilling finished February 6, 1912. 355 feet of 12 1-2-inch casing; 830 feet of 10-inch casing; 937 feet of 8-inch casing; 60 feet of 6 5-8-inch casing.

	Feet		
	From	To	Thickness
Red rock	0	76	76
Blue clay	76	95	19

Red rock	95	105	10
Lime	105	115	10
Red rock	115	180	65
Lime shells	180	190	10
Red rock	190	320	130
Blue clay	320	490	170
Sand, oil	490	500	10
Red rock	500	540	40
Lime	540	545	5
Red rock	545	640	95
Blue clay	640	670	30
Red rock	670	730	60
Blue clay	730	765	35
Red rock	765	790	25
Lime	790	800	10
Red rock	800	850	50
Blue clay	850	875	25
Red rock	875	895	20
Blue clay	895	915	20
Red rock	915	937	22
Oil sand, pay	937	943	6
Slate	943	954	11
Oil, sand	954	976	22

No. 47.—Hamilton No. 9. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1194. Depth, 970. Drilling commenced November 21, 1911. Drilling finished December 26, 1911. Oil sand 522 to 540. Oil sand 946 to 970. Cased in sand. Plates IX, A, X, A, and XII, A.

No. 48.—Hamilton No. 10. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1191. Depth, 1010. Drilling commenced December 4, 1911. Drilling finished December 22, 1911. Oil sand 980 to 996. Drilled to 1010, plugged back to 996 and put on the pump. Plate X, A.

No. 49.—Hamilton No. 11. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1186. Depth, 990. Drilling commenced December 6, 1911. Drilling finished December 30, 1911. Oil sand 830. Oil sand 952 to 980. Drilled to 990, plugged back to 980 and put on the pump. Plate X, A.

No. 50.—Hamilton No. 12. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1183. Depth, 974. Drilling commenced January 5, 1912. Drilling finished January 29, 1912. Gas sand 930 to 935. Oil sand 951 to 974. Plate X, A.

No. 51.—Hamilton No. 7. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1180. Depth, 1024. Drilling commenced

October 12, 1911. Drilling finished November 2, 1911. Oil sand 996 to 1024. Plate X, A.

No. 52.—Hamilton No. 13. Sold by Red River Oil Co. to Corsicana Petroleum Co. Depth 540.

No. 53.—Hamilton No. 6. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1192. Depth, 1050. Drilling commenced October 9, 1911. Drilling finished November 14, 1911. Oil sand 945 to 970. Broken sand 1000 to 1012. Total depth in red rock 1050. Plate IX, A.

No. 54.—Hamilton No. 8. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1179. Depth, 1015. Drilling commenced November 8, 1911. Drilling finished December 3, 1911. Oil sand 988 to 1007. Red rock 1007 to 1015. Plate IX, B.

No. 55.—Hamilton No. 2. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1191. Depth, 1039. Drilling commenced August 23, 1911. Drilling finished September 7, 1911. Oil sand 533 to 553. Oil sand 959 to 978. Drilling was begun again October 10, 1911. Oil sand 1000 to 1020. Big pay sand 1020 to 1039. Plates IX, A, and X, B.

No. 56.—Hamilton No. 1. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1188. Depth, 974½. Drilling commenced July 21, 1911. Drilling finished August 7, 1911. Showing oil 60 feet. Small gas 70 feet. Gas sand 787 to 800 feet. Oil sand 950 to 974 feet 6 inches. Plates X, B, and XII, A.

No. 57.—Hamilton No. 3. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1185. Depth, 990. Drilling commenced August 31, 1911. Drilling finished September 17, 1911. Water sand 20 to 23. Oil sand 957 feet 6 inches to 978 feet 6 inches. Drilling was begun again November 9, 1911. Good sand to 990. Stopped in red rock at 990. Plate X, B, and XII, A.

No. 58.—Hamilton No. 4. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1180. Depth, 1125. Drilling commenced September 20, 1911. Drilling finished October 10, 1911. Oil sand 997 to 1014. Salt water at 1020. Oil sand at 1038 feet 6 inches. Salt water at 1125. Plugged back to 1040 and put on the pump. Plate X, B.

No. 59.—Hamilton No. 5. Sold by Red River Oil Co. to Corsicana Petroleum Co. Elevation, 1180. Depth, 1018. Drilling commenced September 21, 1911. Drilling finished October 5, 1911. Oil sand 1012 to 1018. Stopped in good sand. Plates IX, B, and X, B.

No. 60.—Putnam No. 9. Corsicana Petroleum Co. Elevation, 1189. Depth, 1037. Drilling commenced September 11, 1911. Drilling finished October 27, 1911. 40 feet of 10-inch casing: 547 feet of 8-inch casing; 955 feet of 6-inch casing; 1037 feet of 4-inch casing. This well came in flowing 400 barrels. Plate IX, A.

	Feet		
	From	To	Thickness
Red mud and clay	0	16	16
Gravel and water	16	19	3
Lime shell	19	22	3
Dark sand	22	41	19
Sand rock	41	51	10
Blue gumbo	51	63	12
Hard sand	63	70	7
Broken lime	70	80	10
Red mud	80	87	7
Blue shale	87	204	117
Sand rock	204	215	11
Broken sand	215	274	59
Soft sand	274	294	20
Gypsum	294	311	17
Lime rock	311	315	4
Blue shale	315	325	10
Gypsum rock	325	329	4
Sand oil	329	340	11
Lime rock	340	346	6
Red and blue shale	346	361	15
Soft sand	361	376	15
Red mud and boulders	376	390	14
Black slate	390	402	12
Red mud	402	424	22
Lime rock	424	430	6
Broken slate	430	435	5
Hard lime	435	439	4
Red mud	439	445	6
Sand rock	445	449	4
Blue and red shale	449	468	19
Lime rock	468	472	4
Blue gumbo	472	482	10
Hard blue slate	482	491	9
Sand Rock	491	495	4
Red shale	495	500	5
Hard lime	500	511	11
Red and blue shale	511	521	10
Sand rock	521	528	7
Blue shale	528	536	8

Sand, oil	536	546	10
Hard lime	546	550	4
Red and blue shale	550	590	40
Sand rock	590	600	10
Blue slate	600	621	21
Hard sand	621	625	4
Broken shelly rock	625	641	16
Red gumbo	641	662	21
Hard slate	662	668	6
Sand rock	668	686	18
Blue shale	686	700	14
Red gumbo	700	722	22
Shale and broken rock	722	783	61
Sand rock	783	797	14
Shale and mud	797	816	19
Hard sand	816	821	5
Red and blue mud	821	856	35
Red and blue shale	856	874	18
Hard lime	874	880	6
Blue shale	880	902	22
Red mud	902	910	8
Red and blue shale	910	946	36
Red gumbo	946	955	9
Oil sand	955	968	13
Blue gumbo	968	970	2
Broken rock and shale	970	1011	41
Oil sand	1011	1015	4
Gypsum rock	1015	1018	3
Oil sand	1918	1024	6
Gypsum rock	1024	1030	6
White talc	1030	1033	3
Oil, sand	1033	1037	4

No. 61.—Putnam No. 8. Corsicana Petroleum Co. Elevation, 1187. Depth, 990. Drilling commenced August 26, 1911. Drilling finished September 20, 1911. Plate XI, A.

	Feet		
	From	To	Thickness
Red clay and sand	0	16	16
Red mud and gravel (water)	16	26	10
Red shale and mud	26	76	50
Shelly rock	76	81	5
Red shale	81	270	189
Gravel and hard shale	270	280	10
Flint rock	280	284	4

Red gumbo	284	290	6
Lime shell	290	292	2
Hard shale and boulders	292	300	8
Red gumbo	300	314	14
Lime rock	314	317	3
Shale and boulders	317	327	10
Hard shale	327	350	23
Hard lime shell	350	355	5
Hard shell rock	355	374	19
Hard dark shale	374	380	6
Hard bed boulders	380	383	3
Red shale	383	396	13
Hard boulders	396	399	3
Hard shale and shelly rock	399	415	16
Red gumbo	415	425	10
Lime rock	425	428	3
Red gumbo	428	435	7
Gumbo and shelly rock	435	500	65
Hard shale and shelly rock	500	507	7
Lime rock	507	510	3
Sand rock	510	515	5
Hard shale and lime shells	515	521	6
Gypsum rock	521	525	4
Sand rock	525	529	4
Shale and boulders	529	531	2
Sand rock	531	537	6
Hard shale	537	551	14
Boulders and shale	551	584	33
Sand rock	584	588	4
Red and blue shale	588	636	48
Lime rock	636	639	3
Hard shale	639	690	51
Blue gumbo	690	719	29
Lime shell	719	721	2
Blue shale	721	735	14
Blue gumbo	735	750	15
Red and blue shale	750	800	50
Gas, sand	800	806	6
Red and blue gumbo	806	817	11
Hard shale	817	825	8
Red gumbo, tough	825	845	20
Red and blue shale	845	961	116
Oil, sand	961	990	29

No. 62.—Putnam No. 11. Corsicana Petroleum Co. Elevation, 1185. Depth, 1008. Drilling commenced September 27, 1911. Drilling finished October 28, 1911. 48 feet of 10-inch casing; 978 feet of 8-inch casing; 1008 feet of 4-inch casing. Plate XI, A.

	Feet		
	From	To	Thickness
Red clay	0	16	16
Gravel, water	16	26	10
Red mud and gravel	26	80	54
Sand, oil trace	80	83	3
Red mud and gravel	83	326	243
Hard lime	326	329	3
Red mud and boulders	329	367	38
Hard lime	367	370	3
Red mud	370	390	20
Hard lime	390	393	3
Red mud	393	425	32
Hard lime	425	427	2
Red mud and boulders	427	528	101
Hard lime	528	534	6
Blue gumbo	534	546	12
Red mud and boulders	546	552	6
Sand rock, oil	552	557	5
Water, sand	557	562	5
Hard lime	562	570	8
Red mud boulders	570	620	50
Red and blue shale	620	745	125
Hard lime	745	748	3
Blue and red shale	748	790	42
Lime rock	790	792	2
Blue and red shale	792	798	6
Lime rock	798	799	1
Blue and red shale	799	824	25
Red mud and boulders	824	892	68
Red and blue shale	892	978	86
Broken sand	978	983	5
Oil sand, open	983	1000	17
Red mud	1000	1008	8

No. 63.—Putnam No. 12. Corsicana Petroleum Co. Elevation, 1181. Depth, 1023. Drilling commenced October 10, 1911. Drilling finished November 16, 1911. 84 feet of 10-inch casing; 1006 feet of 8-inch casing; 18 feet of 6-inch perforated. Initial production 125 barrels. Plates XI, A, and XII, A.

	Feet		
	From	To	Thickness
Red mud	0	16	16
Water, sand	16	24	8
Red clay	24	52	28
Mud and shale	52	88	36
Sand, oil	88	95	7
Sand and boulders	95	109	14
Shelly rock and shale	109	153	44
Lime rock	153	160	7
Mud and gravel	160	203	43
Shell, rock and shale	203	267	64
Mud and boulders	267	285	18
Hard shale	285	309	24
Red gumbo	309	340	31
Lime rock	340	342	2
Shale and shelly rock	342	354	12
Blue gumbo	354	358	4
Hard sand, oil	358	383	25
Blue gumbo and boulders	383	394	11
Lime rock	394	398	4
Blue gumbo	398	400	2
Hard lime	400	403	3
Mud and boulders	403	415	12
Lime rock	415	421	6
Blue mud and gravel	421	433	12
Dark hard slate	433	446	13
Hard lime	446	452	6
Blue gumbo	452	464	12
Hard lime	464	467	3
Blue gumbo	467	479	12
Lime rock	479	481	2
Red mud and shale	481	517	36
Dry sand	517	529	12
Blue gumbo	529	537	8
Lime rock	537	544	7
Gumbo and boulders	544	567	23
Hard sand, trace	567	591	24
Blue gumbo and boulders	591	623	32
Sand, oil	623	644	21
Blue gumbo and sand	644	660	16
Lime rock	660	673	13
Blue gumbo	673	747	74
Lime rock	747	750	3
Blue gumbo	750	770	20

Lime rock	770	772	2
Shale and sand	772	780	8
Gumbo and shale	780	820	40
Sand, oil	820	836	16
Blue gumbo	836	850	14
Hard sand	850	854	4
Blue gumbo	854	897	43
Hard slate	897	909	12
Lime rock	909	917	8
Blue gumbo	917	937	8
Blue gumbo	917	937	20
Blue shale	937	955	18
Blue gumbo	955	976	21
Red and blue shale	976	988	12
Shale and dry salt	988	1006	18
Oil sand	1006	1022	16
Red mud	1022	1023	1

No 64.—Putnam No. 10. Corsicana Petroleum Co. Elevation, 1188. Depth, 1065. Drilling commenced Sept. 26, 1911. Drilling finished Oct. 27, 1911. 42 feet of 10-inch casing; 815 feet of 8-inch casing; 1065 feet of 6-inch casing. Plate IX, A.

	——Feet——		
	From	To	Thickness
Red clay	0	16	16
Water gravel	16	28	12
Red clay and gravel	28	45	17
Oil sand	45	63	18
Red and blue shale	63	79	16
Sand, oil	79	85	6
Red and blue shale	85	195	110
Red gumbo	195	210	15
Blue and red shale	210	285	75
Sand and gravel	285	290	5
Red and blue shale	290	315	25
Lime rock	315	317	2
Blue and red shale	317	335	18
Red gumbo	335	355	20
Red and blue shale	355	393	38
Lime rock	393	396	3
Red and blue shale	396	406	10
Red gumbo	406	439	33
Lime rock	439	442	3
Red and blue shale	442	453	11
Lime rock	453	455	2
Red and blue shale	455	465	10

Red gumbo..........	465	495	30
Red and blue shale...	495	505	10
Lime rock...........	505	517	12
Red and blue shale...	517	531	14
Broken sand, oil......	531	555	24
Blue gumbo.	555	557	2
Lime rock...........	557	559	2
Blue gumbo..........	559	565	6
Red and blue shale....	565	600	35
Blue gumbo..........	600	615	15
Red and blue shale....	615	635	20
Hard lime...........	635	638	3
Red and blue shale....	638	680	42
Sand rock...........	680	690	10
Red and blue gumbo..	690	726	36
Lime shell...........	726	730	4
Red and blue shale...	730	740	10
Blue gumbo..........	740	750	10
Red and blue shale...	750	758	8
Tough red gumbo....	758	767	9
Red and blue shale....	767	780	13
Red gumbo..........	780	805	25
Red and blue shale....	805	813	8
Oil sand.............	813	815	2
Red and blue shale...	815	865	50
Lime rock...........	865	867	2
Red and blue shale...	867	877	10
Red gumbo	877	892	15
Red and blue shale....	892	910	18
Red gumbo..........	910	916	6
Red and blue shale...	916	974	58
Oil sand..............	974	993	19
Red and blue shale...	993	1032	39
Sand rock, dry.......	1032	1055	23
Oil sand.............	1055	1065	10

No. 65.—Putnam No. 4. Corsicana Petroleum Co. Elevation, 1187. Depth, 1077. Plates IX, A, and XI, A.

	——Feet——		
	From	To	Thickness
Surface	0	12	12
Gravel	12	18	6
Red mud............	18	45	27
Sand showing oil......	45	71	26
Red mud.............	71	85	14
Oil sand.............	85	90	5
Red mud and boulders.	90	115	25

Oil sand.............	115	121	6
Red mud............	121	129	8
Hard shell...........	129	131	2
Red shale............	131	151	20
Hard shell...........	151	155	4
Red shale...........	155	171	16
Red mud and boulders.	171	192	21
Hard shell...........	192	196	4
Red mud............	196	210	14
Oil sand	210	218	8
Red mud and boulders.	218	236	18
Gravel and mud......	236	244	8
Red mud............	244	261	17
Oil sand.............	261	284	23
Red mud............	284	289	5
Mud and gravel......	289	299	10
Hard rock...........	299	304	5
Red mud............	304	326	22
Hard rock...........	326	328	2
Blue mud............	328	346	18
Blue mud and boulders	346	380	34
Hard rock...........	380	388	8
Red mud............	388	409	21
Oil sand............	409	432	23
Blue mud............	432	448	16
Hard shell...........	448	452	4
Blue mud and boulders	452	472	20
Hard rock...........	472	474	2
Red and blue mud....	474	484	10
Hard shell...........	484	488	4
Blue mud...........	488	509	21
Hard lime rock.......	509	518	9
Blue and red shale...	518	545	27
Sand rock............	545	556	11
Blue gumbo..........	556	576	20
Blue and red shale...	576	584	8
Red gumbo..........	584	597	13
Blue and red shale...	597	622	25
Blue gumbo..........	622	626	4
Hard flint...........	626	635	9
Blue shale...........	635	655	20
Hard shell...........	655	658	3
Blue and red shale...	658	663	5
Hard sand rock......	663	678	15
Red gumbo..........	678	684	6
Blue shale...........	684	716	32
Hard rock...........	716	719	3

Blue and red shale....	719	754	35
Red mud and boulders.	754	810	56
Red and blue shale...	810	817	7
Sand rock...........	817	822	5
Gumbo and boulders..	822	855	33
Blue shale..........	855	872	17
Hard rock...........	872	878	6
Blue and red shale....	878	900	22
Blue gumbo and boulders	900	915	15
Sand rock...........	915	921	6
Blue mud and gravel..	921	945	24
Shale and gravel......	945	972	27
Oil sand.............	972	989	17
Blue slate............	989	996	7
Blue gumbo..........	996	1022	26
Water sand..........	1022	1033	11
Gypsum rock.........	1033	1048	15
Oil sand.............	1048	1076	28
Red and blue gumbo..	1076	1077	1

No. 66.—Putnam No. 2. Corsicana Petroleum Co. Elevation, 1187. Depth, 985. Drilling commenced May 31, 1911. Drilling finished June, 1911. Plate IX, A.

	Feet		
	From	To	Thickness
Soil and clay.........	0	40	40
Red mud............	40	50	10
Sand rock...........	50	80	30
Red mud............	80	183	103
Hard rock...........	183	187	4
Red mud............	187	294	107
Hard rock...........	294	300	6
Blue mud............	300	314	14
Boulders	314	375	61
Sand, show oil.......	375	381	6
Gumbo	381	405	24
Hard rock...........	405	419	14
Gumbo	419	430	11
Hard shell rock......	430	455	25
Gumbo	455	474	19
Mixed mud..........	474	509	35
Hard rock...........	509	522	13
Gumbo	522	553	31
Hard rock...........	553	562	9
Shell rock...........	623	629	6
Gumbo	629	684	55

Hard rock...........	684	694	10
Gumbo	694	724	30
Hard rock...........	724	728	4
Gumbo	728	764	36
Hard rock...........	764	773	9
Shale	773	803	30
Hard rock...........	803	807	4
Gypsum and gumbo...	807	864	57
Shale	864	904	40
Gypsum and gumbo...	904	964	60
Shale	964	974	10
Sand oil.............	974	985	11

No. 67.—Putnam No. 18. Corsicana Petroleum Co. Depth, 992. Drilling commenced Feb. 5, 1912. Drilling finished March 11, 1912. 336 feet 5 inches of 12 1-2-inch casing; 828 feet 10 inches of 10-inch casing; 980 feet of 8-inch casing. Plate IX, A.

	——Feet——		
	From	To	Thickness
Brown soil...........	0	15	15
Red shale...........	15	100	85
Sand	100	105	5
White slate..........	105	150	45
Red shale...........	150	235	85
White slate..........	235	275	40
Sand, oil show.......	275	285	10
White shale..........	285	300	15
Red shale...........	300	340	40
Sand, oil............	340	360	20
White shale..........	360	400	40
Red shale............	400	410	10
Brown shale.........	410	521	111
Sand, salt...........	521	550	29
Brown shale.........	550	600	50
White shale..........	600	674	74
Red shale...........	674	678	4
Sand, oil and gas.....	678	708	30
Sand, oil and water...	708	715	7
Red rock............	715	732	17
White shale..........	732	810	78
Red shale...........	810	828	18
Hard lime...........	828	831	3
White slate..........	831	837	6
Red rock............	837	880	43
Sand, oil	880	883	3
Red rock............	883	980	97
Sand oil.............	980	990	10
Shale	990	992	2

No. 68.—Putnam No. 5. Corsicana Petroleum Co. Elevation, 1187. Depth, 1089. Drilling commenced Aug. 1, 1911. Drilling finished Sept. 23, 1911. Plates IX, A, and XII, B.

	Feet		
	From	To	Thickness
Red sand and clay....	0	8	8
Brown slate..........	8	16	8
Quicksand (water)....	16	23	7
Red mud............	23	63	40
Red mud and boulders.	63	80	17
Sand, trace of oil.....	80	83	3
Red mud............	83	88	5
Hard shelly rock......	88	90	2
Brown slate and mud.	90	130	40
Red mud and gravel..	130	210	80
Red gumbo..........	210	274	64
Hard shelly rock.....	274	278	4
Red mud and gravel...	278	287	9
Sand showing oil.....	287	309	22
Red and blue shale...	309	317	8
Red mud............	317	327	10
Blue mud, thin shells..	327	337	10
Dry sand rock.......	337	361	24
Blue gumbo..........	361	370	9
Hard flint rock.......	370	371	1
Red and blue shale....	371	385	14
Lime rock...........	385	386	1
White talc...........	386	388	2
Lime shelly rock.....	388	396	8
Red and blue shale...	396	408	12
Flint rock...........	408	413	5
Tough red gumbo.....	413	418	5
Red and blue shale...	418	430	12
Blue gumbo..........	430	436	6
Hard flint rock.......	436	437	1
Red mud............	437	443	6
Blue gumbo and boulders	443	456	13
Lime rock	456	458	2
Shelly slate, dark.....	458	476	18
Red mud and shale...	476	515	39
Lime shell...........	515	517	2
Blue gumbo...........	517	526	9
Flint rock, hard......	526	532	6
Red mud and shale...	532	565	33
Hard dark slate......	565	585	20
Blue mud and shale...	585	637	52

Lime rock	637	639	2
Blue gumbo	639	645	6
Lime rock	645	655	10
Hard dark slate	655	679	24
Sand showing oil and gas	679	704	25
Red mud and shale	704	729	25
Hard dark slate	729	734	5
Flint rock	734	772	38
Gypsum rock	772	775	3
Blue gumbo	775	784	9
Red mud and boulders	784	821	37
Hard sand rock, dry	821	824	3
Blue gumbo	824	841	17
Dry sand	841	845	4
Blue mud and gravel	845	887	42
Dark hard slate	887	909	22
Red and blue shale	909	946	37
Red gumbo	946	964	18
Oil sand	964	970	6
White talc	970	972	2
Red mud and boulders	972	979	7
Oil sand	979	988	9
Red gumbo	988	995	7
Red mud and boulders	995	1023	28
Red gumbo	1023	1046	23
Gumbo and gravel	1046	1055	9
Hard sand, dry	1055	1062	7
Oil sand	1062	1088	26
White talc	1088	1089	1

No. 69.—Putnam No. 3. Corsicana Petroleum Co. Elevation, 1200. Depth, 1901. This well was the first well drilled into the deep sand and had an initial production of 1600 barrels. Nine months later it was still flowing about 600 barrels. Plates IX, A, and XI, B.

	——Feet——		
	From	To	Thickness
Red sand and gravel	0	18	18
Hard sand	18	19	1
Red tough mud	19	27	8
Packed sand	27	43	16
Red shale and gravel	43	78	35
Brown slate and mud	78	100	22
Hard gravel and shells	100	112	12
Red mud	112	116	4
Mud and gravel	116	121	5

Flint stone shells.....	121	122	1
Red mud and gravel...	122	181	59
Flint shells..........	181	183	2
Red mud and gravel..	183	282	99
Broken sand rock.....	282	283	1
Red mud and gravel...	283	323	40
Shell rock...........	323	343	20
Red mud and gravel...	343	390	47
Broken sand, show oil.	390	396	6
Red shale...........	396	405	9
Hard rock...........	405	407	2
Broken shells, hard...	407	427	20
Hard flint rock.......	427	429	2
Red and blue shale...	429	444	15
Hard flint shell.......	444	445	1
Mud and gravel......	445	465	20
Hard flint shells......	465	466	1
Red mud and gravel...	466	485	19
Hard flint rock.......	485	486	1
Mud and gravel......	486	495	9
Hardest flint rock.....	495	496	1
Broken rock.........	496	502	6
Blue and red shale....	502	542	40
Broken shell.........	542	544	2
Red and blue shale...	544	560	16
Hard broken rock.....	560	577	17
Red and blue shale...	577	691	114
Hard broken rock....	691	701	10
Red and blue shale...	701	726	25
Oil sand, broken......	726	752	26
White talc...........	752	756	4
Oil sand, salt water and slate	756	780	24
Red and blue shale....	780	784	4
Hard flint shell.......	784	785	1
Red and blue shale...	785	850	65
Red mud and gravel...	850	887	37
Red and blue shale...	887	940	53
Red mud and boulders	940	960	20
Red and blue shale...	960	1049	89
Sand, show oil.......	1049	1057	8
Red and blue gumbo...	1057	1069	8
Red mud and boulders	1069	1108	39
Blue gumbo and fine sand	1108	1112	4
Red mud and gravel...	1112	1180	68
Water sand..........	1180	1195	15

Blue gumbo and boulders	1195	1220	25
Hard broken water sand rock..........	1220	1267	47
Blue gumbo and boulders	1267	1318	51
Water sand..........	1318	1326	8
Blue gumbo and boulders	1326	1340	14
Hard sand rock.......	1340	1348	8
Blue mud and boulders	1348	1369	21
Red joint clay........	1369	1389	20
Red mud and gravel...	1389	1445	56
Red hard boulder.....	1445	1449	4
Red and blue mud and gravel	1449	1469	20
Red and blue shale....	1469	1505	36
Blue gumbo and boulders	1505	1526	21
Hard sand...........	1526	1530	4
Soft blue shale and mud	1530	1549	19
Hard flint rock.......	1549	1551	2
Blue shale...........	1551	1568	17
Hard flint rock.......	1568	1570	2
Soft blue shale.......	1570	1602	32
Oil sand, tested.......	1602	1607	5
White talc...........	1607	1609	2
Red mud............	1609	1617	8
Hard red and blue shale	1617	1620	3
Hard flint...........	1620	1622	2
Blue shale...........	1622	1638	16
Shelly rock..........	1638	1639	1
Hard cavey shale	1639	1655	16
Blue gumbo and sand, possibly water......	1655	1663	8
Brown shale.........	1663	1683	20
Blue gumbo and boulders	1683	1696	13
Blue shale...........	1696	1704	8
Hard flint...........	1704	1707	3
Hard gumbo.........	1707	1715	8
Red shale...........	1715	1729	14
Sand, trace of oil.....	1729	1731	2
Blue gumbo..........	1731	1735	4
Blue and red shale....	1735	1780	45
Hard flint rock.......	1780	1790	10
Soft rock............	1790	1791	1

Hard flint rock.......	1791	1802	11
Blue gumbo..........	1802	1806	4
Hard flint rock.......	1806	1808	2
Soft blue gumbo......	1808	1809	1
Hard flint...........	1809	1811	2
Hard black slate......	1811	1840	29
Dark blue gumbo and boulders	1840	1848	8
Red and blue shale....	1848	1859	11
Hard cap rock........	1859	1861	2
Porous, oil rock and fossil (tested)......	1861	1867	6
Hard rock...........	1867	1869	2
Hard black slate......	1869	1885	16
Red mud and gravel...	1885	1887	2
Blue gumbo and boulders	1887	1890	3
Oil sand, good.......	1890	1901	11

No. 70.—Putnam No. 1. Corsicana Petroleum Co. Elevation, 1186. Depth, 1629. Drilling commenced Oct., 1910. Drilling finished April, 1911. Plates IX, A, and XII, B.

		Feet	
	From	To	Thickness
Soil	0	7	7
Sand rock...........	7	33	26
Red mud............	33	101	68
Sand rock...........	101	107	6
Red mud............	107	171	64
Sand rock...........	171	177	6
Red mud............	177	256	79
Sand rock...........	256	283	27
Red mud............	283	317	34
Sand rock...........	317	334	17
Red mud............	334	365	31
Sand rock...........	365	386	21
Sand, show oil........	386	388	2
Shale	388	392	4
Hard sand rock.......	392	394	2
Shale	394	408	14
Shells	408	412	4
Red mud............	412	428	16
Hard flint rock.......	428	431	3
Mixed mud..........	431	453	22
Hard rock...........	453	455	2
Mixed mud and boulders	455	484	29

Mixed mud	484	504	20
Shale	504	512	8
Mixed mud	512	519	7
Rock and shells	519	532	13
Mixed mud	532	575	43
Hard rock and shells	575	582	7
Blue shale	582	623	41
Red mud	623	633	10
Hard slate	633	646	13
Hard rock and shells	646	659	13
Shale	659	693	34
Sand rock	693	708	15
Shell and rock	708	713	5
Mud and shale	713	899	186
Mixed mud and boulders	899	948	49
Mixed mud	948	969	21
Hard rock	969	973	4
Shale and mud	973	991	18
Shale	991	1004	13
Sand, show oil	1004	1008	4
Mud and boulders	1008	1038	30
Sand, show oil	1038	1060	22
Mud and boulders	1060	1070	10
Gypsum and sand	1070	1103	33
Red mud	1103	1106	3
Mud and boulders	1106	1116	10
Hard slate	1116	1138	22
Sand, show oil	1138	1163	25
Blue mud and shale	1163	1176	13
Hard rock	1176	1178	2
Blue mud and boulders	1178	1192	14
Gypsum	1192	1207	15
Hard rock	1207	1213	6
Gypsum and gumbo	1213	1224	11
Hard rock	1224	1227	3
Shell rock	1227	1243	16
Mixed gumbo and sand	1243	1264	21
Hard sand rock	1264	1286	22
Gypsum and gumbo	1286	1347	61
Hard sand rock	1347	1352	5
Hard rock and shale	1352	1375	23
Gumbo	1375	1383	8
Shale	1383	1395	12
Gumbo	1395	1404	9
Hard rock	1404	1407	3
Shale	1407	1432	25

Hard shell rock.......	1432	1440	8
Gumbo	1440	1465	25
Rock	1465	1469	4
Gumbo	1469	1477	8
Shell rock..........	1477	1485	8
Shale	1485	1494	9
Gumbo	1494	1503	9
Rock and shale......	1503	1515	12
Gumbo	1515	1531	16
Sand, show oil and gas	1531	1543	12
Shale	1543	1547	4
Gumbo	1547	1567	20
Shale	1567	1582	15
Gumbo	1582	1598	16
Hard flint rock.......	1598	1601	3
Gumbo	1601	1616	15
Shale, oil...........	1616	1622	6
Oil	1622	1628	6

No. 71.—Putnam No. 6. Corsicana Petroleum Co. Elevation, 1195. Depth, 1973.

No. 72.—Putnam No. 15. Corsicana Petroleum Co. Elevation, 1198. Depth, 1078. Drilling commenced Nov. 14, 1911. Drilling finished Dec. 25, 1911. 39 feet of 10-inch casing; 1053 feet of 8 1-4-inch casing. Plates XI, A, and XII, A.

	——Feet——		
	From	To	Thickness
Red soil............	0	5	5
Yellow sand.........	5	8	3
Red and blue mud....	8	16	8
Sand rock..........	16	19	3
Red shale...........	19	39	20
Red and blue shale....	39	75	36
Slate and lime shale...	75	83	8
Red and blue shale....	83	110	27
Oil sand............	110	114	4
Red and blue shale...	114	122	8
Sand rock, oil........	122	135	13
Red and blue shale...	135	200	65
Red gumbo..........	200	215	15
Red and blue shale...	215	260	45
Hard shale and slate...	260	264	4
Red gumbo..........	264	289	25
Slate and shale.......	289	294	5
Red gumbo..........	294	310	16
Red and blue shale....	310	360	50

Red gumbo..........	360	375	15
Lime shell...........	375	381	6
Red and blue shale...	381	426	45
Hard blue and red shale and lime shells.....	426	444	18
Red and blue shale....	444	464	20
Lime rock	464	468	4
Red and blue shale...	468	491	23
Lime shell...........	491	494	3
Red and blue shale....	494	515	21
Lime shell...........	515	517	2
Red and blue shale...	517	550	33
Lime shell...........	550	555	5
Red and blue shale...	555	577	22
Hard lime rock.......	577	594	17
Red and blue shale...	594	600	6
Lime rock...........	600	605	5
Red gumbo..........	605	630	25
Oil sand.............	630	636	6
Red gumbo..........	636	654	18
Lime shell...........	654	657	3
Hard red and blue shale	657	686	29
Red gumbo..........	686	700	14
Hard red and blue shale	700	710	10
Lime rock...........	710	721	11
Red and blue shale....	721	756	35
Red gumbo..........	756	771	15
Lime shell...........	771	775	4
Red and blue shale....	775	820	45
Red gumbo..........	820	838	18
Lime shell...........	838	844	6
Red and blue shale....	844	884	40
Red gumbo..........	884	896	12
Oil sand.............	896	900	4
Red gumbo..........	900	906	6
Lime rock...........	906	911	5
Red and blue shale...	911	971	60
Lime rock...........	971	977	6
Red and blue shale...	977	1022	45
Red gumbo..........	1022	1044	22
Blue shale...........	1044	1053	9
Oil sand.............	1053	1070	17
Blue shale...........	1070	1078	8

No. 73.—Waggoner No. 16. Producers Oil Co. Elevation, 1192. Depth, 1950. Initial production flowing 200 barrels. Plate VIII, A. Figure 8.

Samples examined: 1840-1846. A white compact limestone, containing small bivalves and some dark organic fragments often large but indistinct. Some dark grey limestone with many fossil fragments and marcasite. Fusulina, Fenestella and a coral (?) were noted in this dark rock.

	Feet		
	From	To	Thickness
Red clay	0	11	11
Hard lime	11	13	2
Sand rock	13	56	43
Blue shale	56	81	25
Lime rock	81	83	2
Hard blue shale	83	104	21
Lime rock	104	106	2
Blue shale	106	109	3
Lime rock	109	115	6
Blue shale	115	133	18
Rock	133	137	4
Red shale	137	170	33
Lime rock	170	176	6
Blue shale	176	240	64
Lime rock	240	245	5
Blue shale	245	267	22
Lime rock	267	271	4
Blue shale, sand	271	285	14
Lime rock	285	292	7
Shale and gumbo	292	322	30
Red rock	322	326	4
Blue shale	326	362	36
Chalk	362	368	6
Lime rock	368	369	1
Gumbo	369	406	37
Blue shale	406	413	7
Red shale	413	440	27
Lime rock	440	446	6
Shale	446	457	11
Lime rock	457	459	2
Blue shale	459	466	7
Sand and shale	466	471	5
Lime and water sand	471	480	9
Blue shale	480	530	50
Sand rock	530	540	10
Red shale	540	551	11
Hard white lime	551	556	5
Hard blue shale	556	661	105
Lime rock	661	673	12
Gyp and lime	673	682	9

Blue shale...........	682	709	27
Sand rock, oil........	709	723	14
Blue and white shale..	723	729	6
Soft sand, rock, oil....	729	744	15
Hard white gyp.......	744	752	8
Soft sand, oil........	752	769	17
Red gumbo..........	769	803	34
Hard sand, oil.......	803	809	6
Blue and white shale..	809	868	59
Sand rock, oil........	868	876	8
Blue shale...........	876	906	30
Sand rock, oil........	906	913	7
Blue shale...........	913	940	27
Red rock and boulders	940	1009	69
Blue shale...........	1009	1017	8
Gumbo	1017	1050	33
White lime..........	1050	1057	7
White sand..........	1057	1062	5
Blue shale...........	1062	1096	34
Hard white sand......	1096	1103	7
Blue shale...........	1103	1133	30
Slate and shale.......	1133	1156	23
Hard lime...........	1156	1161	5
Soft white sand.......	1161	1174	13
Shale and slate.......	1174	1210	36
Red and white shale...	1210	1240	30
White sand water.....	1240	1261	21
Red shale...........	1261	1311	50
Sand water..........	1311	1342	31
Shale and gumbo.....	1342	1375	33
Red gumbo..........	1375	1404	29
Hard lime...........	1404	1408	4
Red gumbo..........	1408	1421	13
Blue shale and boulders	1421	1450	29
Red gumbo boulders..	1450	1469	19
Sand rock	1469	1476	7
Blue shale...........	1476	1480	4
Hard white sand......	1480	1485	5
Soft brown sand......	1485	1490	5
Shale and boulders....	1490	1510	20
Lime rock...........	1510	1513	3
Gumbo	1513	1540	27
Lime rock...........	1540	1543	3
Blue shale...........	1543	1565	22
Blue and white gumbo	1565	1582	17
Sand rock...........	1582	1586	4

Gumbo and shale.....	1586	1593	7
Sand rock...........	1593	1598	5
Shale and boulders....	1598	1621	23
Blue and red shale....	1621	1634	13
Lime rock...........	1634	1641	7
Blue gumbo..........	1641	1692	51
Shale and boulders....	1692	1709	17
Lime rock...........	1709	1715	6
Red shale...........	1715	1745	30
White rock..........	1745	1751	6
Lime and gyp........	1751	1801	50
Blue lime............	1801	1803	2
Shale and boulders....	1803	1840	37
White lime..........	1840	1851	11
Red and blue shale...	1851	1857	6
Brown sand rock.....	1857	1859	2
Blue shale...........	1859	1864	5
Sand rock oil........	1864	1879	15
White lime and gyp...	1879	1886	7
Oil sand.............	1886	1917	31
Blue shale...........	1917	1931	14
Oil sand.............	1931	1950	19

No. 74.—Waggoner No. 8. Producers Oil Co. Elevation, 1202. Depth, 1949. Drilling commenced September 14, 1911. Drilling finished November 30, 1911. Flowing 200 barrels. Plate VIII, B.

	Feet		
	From	To	Thickness
Red clay.............	0	30	30
Sand rock............	30	61	31
Blue shale...........	61	68	7
White lime...........	68	76	8
Slate and shale.......	76	121	45
Sand rock.............	121	137	16
Hard white lime......	137	140	3
Red and blue shale....	140	205	65
Red mud and clay.....	205	280	75
Sand and shale........	280	307	27
Blue and white shale...	307	350	43
Soft red clay..........	350	405	55
Hard red rock.......	405	407	2
Blue shale...........	407	460	53
Hard white lime......	460	490	30
Hard blue shale.......	490	507	17
Hard rock, slate.......	507	535	28
Hard blue shale......	535	552	17

Gumbo and boulders..	552	580	28
Hard lime rock......	580	587	7
Blue gumbo..........	587	616	29
White lime...........	616	620	4
Red rock..............	620	654	34
Blue shale............	654	668	14
Hard red rock........	668	684	16
Hard boulders.........	684	698	14
Blue white lime........	698	703	5
Hard white rock......	703	710	7
Soft sand rock........	710	733	23
Red and blue shale....	733	755	22
Blue shale............	755	764	9
Sand rock............	764	784	20
Sand rock............	784	788	4
Sand rock............	788	801	13
Red and blue shale....	801	870	69
Blue shale............	870	895	25
Red and blue shale....	895	934	39
White rock...........	934	938	4
Gumbo and boulders...	938	978	40
Red and blue shale....	978	1021	43
Hard white rock.......	1021	1023	2
Gumbo and boulders...	1023	1053	30
Sand rock............	1053	1069	16
Hard blue gumbo......	1069	1093	24
Blue slate............	1093	1113	20
Sand rock............	1113	1117	4
Soft sand rock........	1117	1133	16
Shaly gumbo...........	1133	1155	22
Hard red rock.........	1155	1171	16
Red and blue shale....	1171	1191	20
Hard blue gumbo......	1191	1231	40
Red and blue shale....	1231	1253	22
White sand rock......	1253	1268	15
Shale and boulders....	1268	1303	35
Hard blue shale.......	1303	1324	21
Soft white rock........	1324	1329	5
White sand rock.......	1329	1364	35
Blue and red gumbo...	1364	1382	18
Hard lime rock.......	1382	1387	5
Hard blue shale.......	1387	1407	20
White lime rock.......	1407	1409	2
Hard blue gumbo	1409	1421	12
Shale boulders........	1421	1446	25
Hard red rock.........	1446	1451	5
Shale boulders........	1451	1468	17

Red and blue gumbo...	1468	1490	22
Blue and white shale..	1490	1508	18
Sand rock............	1508	1515	7
Red and blue shale....	1515	1539	24
White and red rock....	1539	1548	9
Blue shale	1548	1573	25
Red and white rock...	1573	1578	5
Blue shale............	1578	1597	19
Brown and white rock	1597	1603	6
Blue and white shale..	1603	1629	26
Sand rock............	1629	1643	14
Red rock.............	1643	1647	4
Blue gumbo...........	1647	1656	9
Blue shale............	1656	1660	4
Hard red rock.........	1660	1671	11
Blue shale............	1671	1690	19
White rock...........	1690	1693	3
Blue and red shale....	1693	1723	30
Hard white and red rock	1723	1727	4
Red and blue shale....	1727	1730	3
White lime rock......	1730	1737	7
Gumbo and boulders...	1737	1749	12
Red and blue shale....	1749	1756	7
Blue and red gumbo...	1756	1767	11
Lime shale...........	1767	1785	18
Hard blue shale.......	1785	1793	8
Hard blue shale.......	1793	1812	19
Hard blue lime.......	1812	1844	32
Black shale...........	1844	1848	4
Lime and gyp.........	1848	1855	7
Hard black shale......	1855	1890	35
White shale...........	1890	1892	2
Lime and sand streaks	1892	1904	12
Blue shale............	1904	1920	16
Soft lime shale........	1920	1923	3
Sand rock............	1923	1949	26

No. 75.—Waggoner No. 9. Producers Oil Co. Elevation, 1196. Depth, 1968. Drilling commenced September 5, 1911. Drilling finished November 24, 1911. Flowing 300 barrels. Plates IX, A, and XI, B.

	Feet		
	From	To	Thickness
Red and blue shale......	0	135	135
Hard rock..	135	137	2
Shale	137	270	133
Shale (oil)...........	270	290	20

Red and blue shale....	290	590	300
Hard lime rock........	590	600	10
Gumbo and shale......	600	960	360
Broken oil, sand......	960	1000	40
Shale and gumbo......	1000	1150	150
Rock	1150	1160	10
Shale	1160	1250	90
Water, sand...........	1250	1280	30
Shale	1280	1425	145
Hard sand rock.......	1425	1431	6
Blue gumbo..........	1431	1660	229
Mixed shale...........	1660	1840	180
Rock and gumbo......	1840	1861	21
Lime rock.............	1861	1868	7
Blue slate	1868	1882	14
Soft shale.............	1882	1887	5
Sand	1887	1888	1
Blue shale.............	1888	1917	29
Hard rock.............	1917	1919	2
Gyp and lime..........	1919	1929	10
Blue shale............	1929	1934	5
Red shale.............	1934	1939	5
White mud............	1939	1946	7
Oil, sand.............	1946	1952	6
Limestone	1952	1960	8
Oil, sand.............	1960	1968	8

No. 76.—Waggoner No. 10. Producers Oil Co. Elevation, 1200. Drilling. Plates IX, B, and XI, B.

	Feet		
	From	To	Thickness
Red rock.............	0	90	90
Blue shale............	90	140	50
Shell	140	143	3
Blue shale............	143	175	32
Red shale............	175	185	10
Blue shale............	185	200	15
Red and blue shale.....	200	400	200
Lime shell............	400	406	6
Red shale.............	406	475	69
Blue shale............	475	500	25
White shale..........	500	535	35
Red shale............	535	600	65
Gray shale............	600	650	50
Red and blue shale....	650	1025	375
Gray shale...........	1025	1050	25
Sand, oil at top.......	1050	1075	25

Brown shale..........	1075	1095	20
Soft gumbo...........	1095	1155	60
Water, sand.	1155	1180	25
Gumbo	1180	1220	40
Sand	1220	1225	5
Hard gumbo..........	1225	1360	135
Hard sand............	1360	1378	18
Gumbo	1378	1435	57
Hard sand............	1435	1445	10
Gumbo	1445	1555	110
Hard sand............	1555	1575	20
Gumbo	1575	1585	10
Lime rock............	1585	1596	11
Gumbo	1596	1620	24
Shale lime and shells..	1620	1640	20
Gumbo	1640	1660	20
Sand rock............	1660	1665	5

No. 77.—Waggoner No. 11. Producers Oil Co. Elevation, 1208. Depth, 1089. Drilling commenced October 10, 1911. Drilling finished November 20, 1911. 1048 feet 8 inches of 8-inch line pipe. Plates IX, B, and XI, B.

	Feet		
	From	To	Thickness
Red clay..............	0	12	12
Water, sand...........	12	20	8
Red clay..............	20	26	6
Sand rock............	26	36	10
Red shale............	36	46	10
Sand rock............	46	66	20
Blue shale............	66	84	18
Lime rock............	84	87	3
Blue shale and shells..	87	130	43
Lime rock............	130	132	2
Shale and shells.......	132	172	40
Lime rock............	172	175	3
Blue shale............	175	180	5
Lime rock............	180	182	2
Shale and rock.......	182	260	78
Rock lime............	260	265	5
Blue shale............	265	285	20
Gumbo	285	300	15
Red shale.............	300	344	44
Rock lime............	344	350	6
Blue shale............	350	400	50
Red shale.............	400	436	36
Sand rock............	436	441	5

Red shale	441	463	22
Gumbo	463	470	7
Rock lime	470	475	5
Gumbo	475	485	10
Rock lime	485	490	5
Blue shale	490	521	31
Sand	521	531	10
Red mud	531	545	14
Rock	545	546	1
Shale	546	553	7
Rock	553	554	1
Shale	554	563	9
Rock	563	564	1
Gumbo	564	578	14
Rock	578	579	1
Shale	579	617	38
Rock	617	619	2
Shale	619	636	17
Rock	636	640	4
Gumbo	640	643	3
Rock	643	644	1
Red mud	644	649	5
Gumbo	649	670	21
Sand rock	670	698	28
Gumbo	698	710	12
Shale	710	724	14
Sand rock	724	727	3
Shale	727	730	3
Rock	730	733	3
Shale	733	751	18
Rock	751	753	2
Gumbo	753	772	19
Sand rock	772	776	4
Gumbo	776	835	59
Shale	835	854	19
Rock	854	857	3
Shale	857	869	12
Rock	869	872	3
Shale	872	892	20
Sand rock	892	895	3
Shale	895	899	4
Sand rock	899	902	3
Shale	902	908	6
Gumbo	908	929	21
Hard red rock	929	1030	101
Red mud	1030	1034	4
Gumbo	1034	1038	4

Shale	1038	1045	7
Lime rock	1045	1050	5
Oil sand	1050	1088	38
Red mud	1088	1089	1

No. 78.—Waggoner No. 14. Producers Oil Co. Elevation, 1219. Drilling. Plate IX, B.

	Feet		
	From	To	Thickness
Red clay	0	20	20
Sand	20	40	20
Blue shale	40	75	35
Red shale	75	110	35
Shale and shells	110	210	100
Sand, oil	210	220	10
Shale and shells	220	480	260
Hard rock	480	485	5
Blue shale	485	500	15
Hard rock	500	505	5
Shale, shells and rock	505	615	110
Hard rock	615	623	8
Gumbo	623	670	47
Hard flint	670	674	4
Blue shale	674	750	76
Soft rock	750	763	13
Gumbo	763	830	67
Rock, sand, gas, oil	830	843	13
Gumbo	843	850	7
Hard lime rock	850	858	8
Red shale	858	873	15
Soft rock	873	903	30
Sand rock	903	914	11
Shale	914	922	8
Rock	922	926	4
Shale	926	947	21
Rock	947	957	10
Shale	957	994	37
Rock and boulders	994	1007	13
Shale	1007	1013	6
Rock	1013	1017	4
Shale	1017	1025	8
Rock	1025	1027	2
Shale	1027	1039	12
Hard lime	1039	1048	9

No. 79.—Waggoner No. 13. Producers Oil Co. Elevation, 1203. Drilling. Plate IX, B.

	Feet		
	From	To	Thickness
Red clay	0	87	87
Sand rock	87	125	38
Red rock	125	137	12
Sand rock	137	169	32
Red shale	169	173	4
Lime rock	173	197	24
Shale	197	211	14
Rock	211	229	18
Red shale	229	234	5
Lime rock	234	244	10
Hard shale	244	290	46
Shale and boulders	290	300	10
Shale	300	360	60
Hard rock	360	367	7
Shale	367	390	23
Rock	390	394	4
Shale	394	420	26
Rock	420	439	19
Shale and red rock	439	487	48
Hard lime	487	497	10
Shale and boulders	497	513	16
Lime rock	513	519	6
Shale	519	551	32
Lime rock	551	553	2
Shale and gumbo	553	624	71
Lime rock	624	625	1
Shale	625	629	4
Lime rock	629	631	2
Shale and boulders	631	639	8
Lime rock	639	642	3
Gumbo	642	647	5
Shale and gravel	647	668	21
Gumbo	668	690	22
Sand rock	690	700	10
Gumbo and gravel	700	731	31
Lime rock	731	732	1
Gumbo	732	752	20
Rock	752	772	20
Shale and red rock	772	830	58
Rock	830	839	9
Shale	839	985	146
Soft rock, sand streaks	985	1020	35
Shale	1020	1048	28
Rock	1048	1054	6
Hard sand, oil	1054	1066	12

Shale	1066	1090	24
Rock	1090	1095	5
Hard sand, oil	1095	1100	5
Hard sand and boulders	1100	1122	22
Sand, oil	1122	1135	13
Hard sand rock	1135	1137	2
Hard sand, oil	1137	1142	5
Hard sand rock	1142	1148	6
Gumbo	1148	1168	20
Hard salt sand	1168	1179	11
Hard slate	1179	1190	11
Hard sand and boulders	1190	1228	38
Rock	1228	1238	10
Gumbo	1238	1250	12
Rock	1250	1256	6
Shale	1256	1270	14
Rock	1270	1280	10
Hard shale	1280	1350	70
Hard sand, salt	1350	1356	6
Rock and boulders	1356	1364	8
Hard shale and rock	1364	1390	26
Hard sand, salt	1390	1396	6
Rock	1396	1402	6
Hard shale	1402	1430	28
Rock	1430	1436	6
Shale	1436	1450	14
Rock and boulders	1450	1458	8
Red gumbo	1458	1470	12
Soft shale	1470	1480	10
Gumbo	1480	1521	41
Sand rock	1521	1522	1
Gumbo and shale	1522	1552	30
Rock	1552	1557	5
Hard shale	1557	1570	13
Soft shale	1570	1591	21
Hard sand rock	1591	1596	5
Shale	1596	1613	17
Rock and boulders	1613	1627	14
Gumbo	1627	1634	7
Hard lime rock	1634	1639	5
Gyp and boulders	1639	1670	31
Gumbo	1670	1685	15
Hard gyp	1685	1697	12
Gumbo and boulders	1697	1715	18
Sand rock	1715	1725	10
Gumbo	1725	1740	15

Lime rock	1740	1754	14
Sand rock	1754	1768	14
Shale	1768	....	..

No. 80.—Allen No. 5. Corsicana Petroleum Co. Elevation, 1178. Depth, 1011. Drilling commenced December 8, 1911. Drilling finished January 26, 1912. 350 feet of 12 1-2-inch casing; 795 feet of 10-inch casing; 990 feet of 9-inch casing. Plate XI, B.

	Feet		
	From	To	Thickness
Red rock	0	150	150
Blue clay	150	300	150
Sand, oil	300	320	20
Red rock	320	350	30
Blue clay	350	500	150
Lime shells	500	505	5
Blue clay	505	705	200
Red rock	705	790	85
Lime	790	795	5
Red rock	795	835	40
Sand, oil	835	855	20
Red rock	855	905	50
Blue clay	905	945	40
Lime	945	950	5
Red rock	950	975	25
Lime	975	980	5
Red rock	980	990	10
Oil, sand	990	1011	21

No. 81.—Allen No. 4. Corsicana Petroleum Co. Elevation, 1179. Depth, 1000. Drilling commenced November 14, 1911. Drilling finished December 7, 1911. 350 feet of 12 1-2-inch casing; 977 feet of 10-inch casing. Plates IX, A, and X, A.

	Feet		
	From	To	Thickness
Red rock	0	75	75
Blue clay	75	125	50
Red rock	125	180	55
Blue clay	180	225	45
Sand, oil	225	245	20
Blue clay	245	260	15
Red rock	260	325	65
Sand	325	340	15
Blue clay	340	345	5
Red rock	345	360	15
Sand	360	370	10

Blue clay	370	505	135
Sand	505	530	25
Red rock	530	575	35
Shells	575	580	5
Sand, oil	580	640	60
Blue clay	640	660	20
Red rock	660	680	20
Lime	680	704	24
Blue clay	704	720	16
Red rock	720	750	30
Lime	750	790	40
Blue clay	790	800	10
Lime	800	815	15
Blue clay	815	855	40
Sand, oil	855	880	25
Red rock	880	890	10
Shells	890	900	10
Blue clay	900	930	30
Red rock	930	945	15
Sand	945	955	10
Red rock	955	977	22
Sand	977	1000	23

No. 82.—Allen No. 3. Corsicana Petroleum Co. Elevation, 1178. Depth, 1043. Drilling commenced December 4, 1911. Drilling finished January 4, 1912. Plates IX, B, and X, B.

	Feet		
	From	To	Thickness
Red rock	0	80	80
Blue clay	80	130	50
Red rock	130	180	50
Sand, gas	180	190	10
Blue clay	190	240	50
Red rock	240	270	30
Lime	270	280	10
Red rock	280	335	55
Blue clay	335	365	30
Sand, oil	365	375	10
Blue clay	375	500	125
Sand	500	525	25
Blue clay	525	560	35
Shell and lime	560	575	15
Blue clay	575	600	25
Red rock	600	640	40
Lime and shells	640	655	15
Red rock	655	720	65
Sand	720	740	20

Blue clay.............	740	780	40
Red rock.............	780	805	25
Lime	805	820	15
Blue clay............	820	880	60
Lime	880	890	10
Blue clay...........	890	925	35
Red rock............	925	955	30
Lime	955	960	5
Sand	960	970	10
Blue clay...........	970	984	14
Sand, oil.............	984	986	2
Blue clay.............	986	999	13
Red rock.............	999	1020	21
Slate	1020	1023	2
Oil, sand.............	1023	1043	20

No. 83.—Allen No. 6. Corsicana Petroleum Co. Elevation, 1197. Depth, 1054. Drilling commenced January 10, 1912. Drilling finished March 2, 1912. 370 feet of 12 1-2-inch casing; 895 feet of 10-inch casing; 975 feet of 8-inch casing. Plates IX, B, and XI, A.

	Feet		
	From	To	Thickness
Red rock............	0	61	61
Blue clay............	61	90	29
Red rock.............	90	130	40
Blue clay............	130	150	20
Red rock............	150	210	60
Blue clay.............	210	290	80
Red rock............	290	370	80
Blue clay.............	370	395	25
Sand, oil.............	395	400	5
Red rock.............	400	460	60
Lime	460	470	10
Blue clay............	470	555	85
Lime	555	564	9
Blue clay............	564	590	26
Red rock............	590	640	50
Blue clay............	640	658	18
Lime	658	670	12
Red rock............	670	685	15
Lime	685	695	10
Blue clay...........	695	728	33
Lime	728	734	6
Red rock............	734	746	12
Lime	746	753	7
Red rock............	753	776	23

Blue clay	776	808	32
Lime	808	811	3
Blue clay	811	870	59
Red rock	870	900	30
Gas, sand	900	912	12
Blue clay	912	940	28
Red rock	940	975	35
Oil, sand	975	985	10
Blue clay	985	1020	35
Red rock	1020	1040	20
Oil, sand	1040	1054	14

No. 84.—Allen No. 1. Producers Oil Co. Elevation, 1202. Depth, 1088. Plates IX, B, XI, A, XII, A, and XII, B.

No. 85.—Allen No. 4. Producers Oil Co. Elevation, 1199. Depth, 1080. Plates XI, A, and XII, B.

No. 86.—Allen No. 7. Producers Oil Co. Elevation, 1190. Depth, 1090. Completed February 24, 1912. 106 feet of 12 1-2-inch casing; 675 feet of 10-inch casing; 875 feet of 8-inch casing; 942 feet of 6 5-8 inch casing. Pumping. Plates XI, A, and XII, B.

	Feet		
	From	To	Thickness
Red mud	0	100	100
Lime rock	100	103	3
Blue shale	103	108	5
Lime rock	108	111	3
Blue shale	111	210	99
Blue slate and sand	210	220	10
Gray shale	220	270	50
Lime rock	270	272	2
Red mud	272	340	68
Blue shale and sand	340	410	70
Lime rock	410	413	3
Red mud	413	460	47
Lime rock	460	461	1
Blue mud	461	520	59
Lime rock	520	524	4
Broken shale	524	620	96
Water, sand	620	628	8
Shale and lime shells	628	670	42
Lime rock	670	675	5
Shale and lime shells	675	740	65
Blue mud	740	790	50
Lime rock	790	793	3

Red mud	793	820	27
Lime rock	820	822	2
Red mud	822	856	34
Gray shale	856	876	20
Oil, sand	876	897	21
Red mud	897	910	13
Lime rock	910	912	2
Gray shale	912	942	30
Oil, sand	942	952	10
Blue and red shale	952	1053	101
Slate and sand, oil	1053	1070	17
Red mud	1070	1088	18
Water, sand	1088	1090	2

No. 87.—Allen No. 2. Producers Oil Co. Elevation, 1202. Depth, 1090. Plates IX, B, and XII, A.

No. 88.—Allen No. 6. Producers Oil Co. Elevation, 1196. Depth, 1071. Drilling completed February 18, 1912. 56 feet of 12 1-2-inch casing; 645 feet of 10-inch casing; 890 feet of 8-inch casing; 1052 feet of 6-inch casing. Pumping. Plates IX, B, and XII, A.

	Feet		
	From	To	Thickness
Red mud	0	10	10
Soft sand	10	24	14
Red mud	24	40	16
Sand rock	40	45	5
Red mud	45	100	55
Hard lime	100	105	5
Red mud	105	175	70
Blue shale	175	200	25
Red mud	200	375	175
Blue shale	375	405	30
Shale and sand	405	420	15
Red mud	420	500	80
Red and blue mud	500	580	80
Blue shale	580	620	40
Salt, sand	620	640	20
Gray shale	640	700	60
Blue and white mud	700	870	170
Blue shale	870	890	20
Oil, sand	890	900	10
Blue shale	900	910	10
Red mud	910	942	32
Oil, sand, poor	942	954	12
Blue shale	954	1015	61

Blue mud............	1015	1055	40
Red and white mud...	1055	1065	10
Red mud.............	1065	1071	6

No. 89.—Wilson and O'Byrne No. 1. Depth, 1650. Oil.

No. 90.—Home Oil Co. No. 1. Depth, 1140. Dry.

No. 91.—Woodruff No. 2. Corsicana Petroleum Co. Elevation, 1204. This well was drilling at a depth in excess of 2300 feet in March, 1912. The log to 2202 feet follows. Plate IX, B, and XI, B.

Samples examined: 2262. Dark greenish-gray shale, giving off sulphurous and bituminous fumes in a closed tube, slightly calcareous and fine in texture. With this were some fragments of gray and yellow limestone.

	Feet		
	From	To	Thickness
Sand, gravel and clay..	0	20	20
Sand	20	45	25
Rock	45	50	5
Sand and gravel.......	50	90	40
Rock	90	100	10
Sand rock...........	100	110	10
Sand rock...........	110	125	15
Sand and gravel.......	125	165	40
Gumbo	165	170	5
Blue sand............	170	183	13
Rock	183	187	4
Gumbo	187	190	3
Rock	190	193	3
Sand and gravel.......	193	240	47
Gumbo	240	250	10
Sand and gravel.......	250	300	50
Rock	300	308	8
Shale	308	325	17
Gumbo	325	340	15
Rock	340	345	5
Gumbo	345	350	5
Red shale............	350	387	37
Sand rock............	387	430	43
Gumbo	430	435	5
Rock	435	448	13
Red shale............	448	460	12
Gumbo	460	465	5
Soapstone	465	475	10
Hard rock............	475	477	2
Sand rock............	477	490	13

Shell rock............	490	492	2
Sand and shale........	492	500	8
Hard rock............	500	502	2
Gumbo	502	512	10
Hard rock............	512	514	2
Gumbo	514	523	9
Shell rock............	523	526	3
Hard gumbo..........	526	540	14
Rock	540	542	2
Gumbo	542	552	10
Rock	552	553	1
Shale and boulders....	553	579	26
Rock	579	580	1
Gumbo and boulders...	580	620	40
Sand shale, oil........	620	625	5
Gumbo	625	635	10
Rock	635	643	8
Shale and boulders.....	643	653	10
Gumbo	653	660	7
Rock	660	665	5
Rock sand, oil.........	665	669	4
Soft shale............	669	685	16
Sand rock............	685	693	8
Shale and boulders....	693	698	5
Shale	698	705	7
Gumbo	705	712	7
Sand rock...........	712	716	4
Shale	716	725	9
Rock	725	730	5
Gumbo and boulders...	730	735	5
Shale	735	760	25
Rock	760	762	2
Gumbo	762	768	6
Rock	768	772	4
Rock	772	783	11
Gumbo	783	790	7
Shale	790	805	15
Gumbo	805	815	10
Hard shale..........	815	824	9
Rock	824	831	7
Sand shale...........	831	857	26
Gumbo	857	865	8
Rock	865	867	2
Shale	867	880	13
Gumbo	880	890	10
Rock	890	895	5
Hard sandy shale.......	895	910	15

Gumbo	910	917	7
Sand rock	917	940	23
Shale	940	952	12
Hard gumbo	952	980	28
Rock	980	981	1
Shale and boulders	981	1000	19
Gumbo	1000	1012	12
Shale	1012	1029	17
Shell rock	1029	1032	3
Gas, sand	1032	1033	1
Rock	1033	1034	1
Soft shale	1034	1040	6
Rock	1040	1042	2
Sand shale	1042	1052	10
Rock	1052	1054	2
Shale and boulders	1054	1064	10
Sand rock	1064	1080	16
Gumbo and boulders	1080	1088	8
Shale	1088	1125	37
Gumbo	1125	1133	8
Sand rock	1133	1153	20
Gypsum and gumbo	1153	1160	7
Hard rock	1160	1168	8
Shale and rock	1168	1175	7
Gumbo and boulders	1175	1185	10
Shale and boulders	1185	1190	5
Shale	1190	1200	10
Gumbo	1200	1218	18
Rock	1218	1220	2
Hard gumbo	1220	1230	10
Shale and gumbo	1230	1250	20
Shale and boulders	1250	1260	10
Shale	1260	1288	28
Rock	1288	1290	2
Gumbo	1290	1308	18
Rock	1308	1310	2
Sand rock	1310	1320	10
Shale and gumbo	1320	1340	20
Shale and boulders	1340	1350	10
Shale	1350	1370	20
Gumbo	1370	1380	10
Gumbo and boulders	1380	1390	10
Very hard rock	1390	1414	24
Soft sand rock	1414	1420	6
Gumbo	1420	1433	13
Rock	1433	1435	2
Sand rock	1435	1442	7

Shale	1442	1450	8
Hard gumbo..........	1450	1454	4
Shale	1454	1460	6
Gumbo	1460	1472	12
Rock	1472	1475	3
Shale	1475	1481	6
Sand rock...........	1481	1495	14
Shale	1495	1509	14
Rock	1509	1510	1
Blue shale...........	1510	1522	12
Sand rock...........	1522	1527	5
Shale	1527	1532	5
Rock	1532	1537	5
Shale and boulders....	1537	1560	23
Gumbo	1560	1570	10
Sand rock...........	1570	1580	10
Hard shale..........	1580	1586	6
Chalk rock..........	1586	1591	5
Gumbo	1591	1600	9
Chalk rock..........	1600	1608	8
Shale	1608	1618	10
Rock	1618	1620	2
Gumbo	1620	1626	6
Rock	1626	1630	4
Shale	1630	1640	10
Rock	1640	1646	6
Shale	1646	1655	9
Gumbo	1655	1661	6
Rock	1661	1666	5
Shale	1666	1680	14
Rock	1680	1685	5
Gumbo	1685	1691	6
Rock	1691	1696	5
Shale	1696	1704	8
Gumbo	1704	1710	6
Rock	1710	1712	2
Gumbo	1712	1718	6
Shale	1718	1734	16
Gumbo	1734	1745	9
Rock	1745	1750	5
Shale	1750	1761	11
Gumbo	1761	1766	5
Shale	1766	1775	9
Rock	1775	1780	5
Shale	1780	1810	30
Gumbo	1810	1815	5
Hard shale..........	1815	1828	13

Rock	1828	1834	6
Shale	1834	1844	10
Hard sand rock, pyrites iron	1844	1855	11
White sand	1855	1862	7
Shale	1862	1868	6
Tough gumbo	1868	1876	8
Boulders	1876	1882	6
Gumbo	1882	1890	8
Gumbo and boulders	1890	1896	6
Rock	1896	1898	2
Red gumbo	1898	1906	8
Rock	1906	1908	2
Gumbo and boulders	1908	1920	12
Chalk rock	1920	1936	16
Gumbo	1936	1947	11
Hard rock	1947	1950	3
Tough red gumbo	1950	1962	12
Rock	1962	1964	2
Gumbo and boulders	1964	1990	26
Shale	1990	2000	10
Rock	2000	2010	10
Gumbo and boulders	2010	2017	7
Hard lime rock	2017	2023	6
Red gumbo	2023	2027	4
Hard rock	2027	2029	2
Sand rock, oil	2029	2031	2
Rock	2031	2032	1
Hard oil sand	2032	2035	3
Hard rock	2035	2036	1
Oil sand	2036	2038	2
Rock	2038	2039	1
Salt water sand	2039	2048	9
Rock	2048	2049	1
Slate and shale	2049	2052	3
Gumbo and boulders	2052	2054	2
Shale and boulders	2054	2062	8
Sand rock	2062	2066	4
Packed sand	2066	2070	4
Gumbo	2070	2073	3
Blue sand rock	2073	2086	13
Hard shale	2086	2096	10
Sand rock	2096	2100	4
Shale	2100	2110	10
Hard lime	2110	2137	27
Shale and boulders	2137	2151	14
Rock	2151	2153	2

Shale	2153	2170	17
Sand rock............	2170	2186	16
Sandy shale, oil......	2186	2196	10
Oil sand.............	2196	2201	5
Salt sand............	2201	2202	1

No. 92.—Culberson No. 1. Elevation, 1213. Depth, 1950. A dry hole in what was considered proven territory. Plate IX, B, and XI, B.

	Feet		
	From	To	Thickness
Red	0	270	270
Oil sand.............	270	278	8
Shale	278	430	152
Little gas............	430	445	15
Red	445	645	200
Hard lime rock........	645	646-6	1′6″
Shale and broken sand..	646-6	690	43′6″
Sand, show oil.........	690	715	25
Shale	715	730	15
Sand, good show oil....	730	737	7
Red	737	770	33
Very hard rock........	770	772	2
Sand	772	781	9
Red	781	840	59
Red	840	850	10
Salt water, sand........	850	870	20
Red	870	977	107
Sand, gas............	977	981	4
Red shale............	981	992	11
Light shale...........	992	1001	9
Hard sand............	1001	1006	5
Light shale...........	1006	1011	5
Very light shale........	1011	1038	27
Very hard and shelly rock	1038	1043	5
Sand rock............	1043	1048	5
Hard lime rock........	1048	1058	10
Oil, sand.............	1058	1068-6	10′6″
Shale	1068-6	1080	11′6″
Salt water, sand........	1080	1098	18
Shale and broken formation	1098	1352	254
Oil, sand, good show...	1352	1354-6	2′6″
Shale, some broken, sand	1354-6	1405	50′6″
Shale	1405	1630	225

Sand	1630	1635	5
Shale	1635	1840	205
Shelly, little gas	1840	1848	8
Shale	1848	1870	22
Sand	1870	1871-6	1′6″
Shale, soft	1871-6	1900	28′6″
Lime rock	1900	1910	10
Black shale	1910	1920	10
White lime rock	1920	1925	5
Hard shale, broken	1925	1950	25

No. 93.—Woodruff No. 1. Whitehill and Burns. Elevation, 1173. Depth, 2035. Dry.

No. 94.—Brewer No. 2. Corsicana Petroleum Co. Elevation, 1224. Depth, 1095. Drilling commenced November 20, 1911. Drilling finished February 6, 1912. 370 feet of 12 1-2-inch casing; 775 feet of 10-inch casing; 1075 feet of 8-inch casing.

	Feet		
	From	To	Thickness
Red rock	0	100	100
Blue clay	100	140	40
Lime	140	145	5
Blue clay	145	225	80
Red rock	225	300	75
Sand	300	330	30
Blue clay	330	370	40
Lime	370	375	5
Blue clay	375	465	90
Red rock	465	525	60
Sand, gas	525	540	15
Blue clay	540	610	70
Red rock	610	650	40
Lime	650	660	10
Blue clay	660	700	40
Red rock	700	775	75
Lime	775	790	15
Blue clay	790	810	20
Red rock	810	830	20
Water, sand	830	860	30
Blue clay	860	900	40
Red rock	900	925	25
Lime	925	935	10
Blue clay	935	945	10
Red rock	945	950	5
Oil, water sand	950	977	27

Lime	977	982	5
Blue clay	982	1010	28
Red rock	1010	1050	40
Lime	1050	1060	10
Red rock	1060	1075	15
Oil, sand	1075	1095	20

No. 95.—Dale No. 1. 99 Pumping Co. Elevation, 1228. Depth, 1920.

No. 96.—Flueshe No. 1. Elevation, 1141. Depth, 2180. This well had numerous sands at approximately regular intervals, but none yielded pay.

No. 97.—Douglas No. 1. Bell and Benson. Elevation, 1234. Depth, 974.

No. 98.—Jennings No. 1. Reed & Co. This well had a good showing in the shallow sands, but drilled on in hopes of a big well deeper.

	Feet		
	From	To	Thickness
Red mud	0	10	10
Sand	10	12	2
Red clay	12	25	13
Mud	25	475	450
Shell	475	478	3
Light shale	478	528	50
Blue shale	528	628	100
Gray shale	628	633	5
Shell	633	635	2
Gray shale	635	640	5
Shell	640	644	4
Gray shale	644	674	30
Red mud	674	689	15
Gray shale	689	750	61
Lime	750	760	10
Shale, gray	760	780	20
Red mud	780	800	20
Blue slate	800	826	26
Water, sand	826	840	14
Red mud	840	875	35
Blue shale and slate	875	911	36
Oil, sand (good)	911	927	16
Red rock	927	1000	73
Blue shale and slate	1000	1035	35
Red rock	1035	1116	81

No. 99.—Honaker No. 1. Corsicana Petroleum Co. Elevation, 1196. Depth, 1673.

No. 100.—Buerbaum and Culberson No. 1. Elevation, 1203. Depth, 2200. Showings were obtained in the shallow sands, but the well is not a producer.

No. 101.—Bickley No. 1. Producers Oil Co. Elevation, 1179. Depth, 870. Drilling commenced January 22, 1912. Drilling finished February 6, 1912. 34 feet of 10-inch casing; 856 feet 6 inches of 6-inch casing. Pumping 25 barrels.

	Feet		
	From	To	Thickness
Clay	0	9	9
Sand	9	16	7
Shale	16	58	42
Sand	58	64	8
Shale	64	104	40
Rock	104	105	1
Shale	105	150	45
Rock	150	154	4
Shale	154	254	100
Boulders	254	257	3
Hard shale	257	287	30
Boulders	287	293	6
Shale	293	385	92
Hard rock, oil at top	385	389	4
Shale	389	459	70
Rock	459	461	2
Hard shale	461	477	16
Rock	477	479	2
Hard shale	479	500	21
Rock	500	502	2
Hard shale	502	580	78
Hard white sand	580	585	5
Hard shale	585	600	15
Rock	600	603	3
Hard shale	603	640	37
Hard sand and oil shale	640	690	50
Rock	690	693	3
Hard shale	693	729	36
Rock	729	733	4
Hard shale	733	784	51
Rock	784	786	2
Hard shale	786	796	10
Gumbo	796	804	8

Hard shale	804	816	12
Shale	816	856	40
Oil, sand	856	870	14

No. 102.—Beat No. 1. Producers Oil Co. Elevation, 1136. This was a dry hole to a depth of 2185 feet, but is being drilled deeper.

Samples examined: 2110-2140. A white granular pure limestone, containing clear calcite in small grains, which appears porous in thin section. Part of the sample consists of structurless limestone. Some organic fragments, imperfectly shaped spines, minute bryozoa (?) or pieces of shells of foraminifera were noted.

	Feet		
	From	To	Thickness
Clay	0	50	50
Red mud	50	250	200
Sand rock	250	260	10
Red mud	260	295	35
Mixed shale	295	387	92
Blue shale	387	415	28
Red mud	415	487	72
Mixed shale	487	580	93
Sand, oil at top	580	670	90
Shale	670	700	30
Red mud	700	705	5
Red rock	705	720	15
Red mud	720	755	35
Lime shell	755	780	25
Shale	780	810	30
Red mud	810	860	50
Sand	860	870	10
Red mud	870	949	79
Lime shell	949	952	3
Red mud	952	965	13
Blue shale	965	1040	75
Red rock	1040	1070	30
Water sand	1070	1075	5
Red mud	1075	1093	18
Water sand	1093	1113	20
Red mud	1113	1164	61
Lime shell	1164	1171	7
Red mud	1171	1182	11
Sand	1182	1186	4
Blue shale	1186	1210	24
Black slate	1210	1215	5
Blue shale	1215	1245	30

Red rock..............	1245	1295	50
Lime shell............	1295	1300	5
Red mud..............	1300	1303	3
Blue shale.............	1303	1325	22
Red mud..............	1325	1416	91
Water sand...........	1416	1436	20
Red mud..............	1436	1440	4
Blue shale.............	1440	1450	10
Water sand...........	1450	1460	10
Blue shale.............	1460	1475	15
Water sand...........	1475	1500	25
Blue shale.............	1500	1550	50
Sand	1550	1590	40
Coal formation (?)....	1590	1595	5
Blue shale.............	1595	1617	22
Water sand...........	1617	1637	20
Blue shale.............	1637	1690	53
Lime shell............	1690	1695	5
Blue shale.............	1695	1705	10
Lime shell............	1705	1710	5
Red mud..............	1710	1715	5
Lime shell............	1715	1720	5
Blue shale.............	1720	1745	25
Red mud..............	1745	1750	5
Blue shale.............	1750	1760	10
Sand	1760	1795	35
Blue shale.............	1795	1820	25
Sand	1820	1840	20
Blue shale.............	1840	1895	55
Red mud..............	1895	1905	10
Blue shale.............	1905	1950	45
Water sand...........	1950	1980	30
Blue shale.............	1980	2000	20
Lime shell............	2000	2005	5
Red mud..............	2005	2060	55
Blue shale.............	2060	2115	55
Lime shell............	2115	2125	10
Blue shale.............	2125	2130	5
Water sand...........	2130	2155	25
Blue shale.............	2155	2185	30
Lime shell............	2185	....	..

No. 103.—Fisher No. 1. Flanagan & Co. This well had been drilled to a depth of 1375 feet with only a few sands and poor showings, but is being drilled deeper in hopes of a deep sand.

No. 104.—Mariott No. 1. Producers Oil Co. Elevation, 1177.

No. 105.—Honaker No. 1. Honaker Oil Co. This well had been drilled to a depth of more than 1800 feet with no pay sands, but is going deeper.

No. 106.—Hines No. 1. Fowlkes Townsite Co. No other data.

No. 107.—A well was drilled 300 feet deep about one-half mile north of Burk Station. The formations were mostly clay and shale, neither water nor oil being obtained.

No. 108.—Fort Worth & Denver Railroad well at Burk Station. In 1900 the Fort Worth & Denver Railroad bored for water near Burk Station. This boring was 280 feet deep and some oil was reported. A memory record furnished by Dr. J. M. Bell of Wichita Falls says the first 167 feet consisted of clay and red shale, under which there was 37 feet of fine hard sand, in which a trace of oil was noted. Under this was blue and red shale to 267 feet, and a coarse sand to the bottom. From this sand, several barrels of a black, heavy lubricating oil were bailed.

No. 109.—On the D. W. Ogden farm, about three miles north of Burk Station, a well some sixty feet deep yas dug over twenty years ago, securing a good supply of water. The elevation of the well is about 1065 feet above sea level. Twenty-seven feet down in this well a thin seam of coal was found, underlying sand. The bottom of the well was in blue clay.

No. 110.—Fassett No. 2. McAllister & Co. Some gas was reported from about 500 feet in this well, with showings of oil. Drilling.

No. 111.—Fassett No. 1. McAllister & Co. This well was lost before any showings had been reached. The tools were moved to No. 110.

No. 112.—Williams No. 1. Buerbaum & Co. Showings had been reported from this well, but no figures were available.

No. 113.—Roberts No. 1. Dismukes & O'Neall. This well was started with a portable machine but changed to a standard derrick and was drilling.

No. 114.—Winfrey No. 1. A good show of oil was found at 144 feet.

No. 115.—Overby No. 2. Dismukes & O'Neall. Drilling.

No. 116.—Overby No. 1. Dismukes & O'Neall. This well was lost at 570 feet and the tools moved to No. 115.

No. 117.—Iowa Park Oil & Gas Co. No. 1. This well is located in the northeast quarter of Survey 12, Tarrant County School Land, about one and three-quarters mile north-northeast from railroad station at Iowa Park, not far from east bank of the principal creek in that survey. The elevation of its curb is 1030 feet above sea level (aneroid checked to Iowa Park depot). It was completed in March, 1911. Water found at 1600 feet below the surface was briny and overflowed for a time. A sample of the last cuttings on the dump of this well consisted of blue and red shale, and fragments of white, pink, brown, and black limestone and of pyrite. A record of the strata penetrated was obtained from the secretary of the company and is as below:

	Feet		
	From	To	Thickness
Red clay	0	665	665
Sand, dry	665	680	15
Red clay	680	725	45
Dry sand, with odor of oil	725	726	1
Red clay, dry	726	975	249
Sand, salt water	975	990	15
"Red and clay"	990	1090	100
Sand, trace of oil	1090	1091	1
Red and blue clay	1091	1120	29
Sand water	1120	1130	10
Red and blue clay	1130	1210	80
Sand water	1210	1240	30
Red and blue clay	1240	1250	10
Sand, water	1250	1280	30
Red and blue clay	1280	1315	35
Sand, very hard, some gas	1315	1350	35
Blue shale	1350	1365	15
Sand, hard	1365	1380	15
Blue shale	1380	1415	35
Sand, hard	1415	1430	15
Blue shale	1430	1475	45
Sand, dry	1475	1485	10
Blue shale	1485	1500	15
Blue shale	1500	1570	70
Sand, water	1570	1605	35
Red clay	1605	1620	15
Sand water (oil show)	1620	1635	15
Blue shale	1635	1650	15

Sand, dry	1650	1665	15
Blue shale	1665	1680	15
Sand, salt water	1680	1760	80
Blue shale	1760	1770	10
Red clay	1770	1795	25
Blue shale	1795	1805	10
Red clay	1805	1820	15
Blue shale	1820	1830	10
Red clay	1830	1840	10
Blue shale	1840	1855	15
Red clay	1855	1860	5
Blue clay	1860	1865	5
Red clay	1865	1876	11

No. 118.—Atkins No. 1. Corsicana Petroleum Co. Drilling.

No. 119.—The Allendale well. This well is located on block 14 of the Denton County School Lands about six miles southwest of Wichita Falls and has an elevation of about 1000 feet above sea level. It is on the south side of the Wichita Valley Railroad. It was drilled 200 feet deep by a private company exploring for oil or gas. It yielded some gas.

The Duckett Brothers made another well, near to this well, 40 feet deep and obtained gas, which issued in quantity sufficient to be ignited a year after the well was completed.

No. 120.—Woodall No. 1. Mowris & Co. Showings were reported from about 900 feet. Drilling.

No. 121.—Marlow and Stone well at Wichita Falls. Near the center of the E. F. Austin survey about two miles west-southwest of the railroad station in Wichita Falls, Marlow and Stone completed an oil test hole in March, 1911. Most of the material penetrated was red and blue clay. There was forty feet of sand somewhere between 500 and 600 feet below the surface. This sand contained salt water near its bottom, which rose only twenty feet in the well. Some slight evidence of gas was also reported. Estimated elevation, 975 feet above sea level.

No. 122.—Bacon Siding No. 1. Thatcher & Culberson. Numerous showings of oil and gas were reported at depths less than 1400 feet, but no authoritative information could be obtained.

No. 123.—Musgrove Farm well. About in the year 1900 a well was made 280 feet deep on the Henry Musgrove farm, on the W. R. Brinley survey, about five miles north of Wichita Falls. Most of the material penetrated was red and blue shale. Salt water was obtained. Oil accumulated on the surface of the water and samples of oil were obtained occasionally for several years after the well was made. Estimated elevation, 970 feet above sea level.

No. 124.—Ice Factory Well, Wichita Falls. This well was made by a local company as a prospect, in 1892. Its depth is reported having been 840 feet. Most of the material below 25 feet was red clay. There was plenty of good water above this red clay, and "indications" of oil were reported in association with salt water from some greater depth. Elevation, 946 feet above sea level. It is located close to the union depot.

Clay County.

No. 125.—Avis No. 1. Avis Oil Co. The well is located about twelve miles west of Henrietta. Three sands showing oil were said to have been found in the first 300 feet, but no authoritative information could be secured.

No. 126.—Thornberry No. 1. Benson and Little. The well is located about eleven miles north-northeast of Wichita Falls, near Old Thornberry. Reports from the first 700 feet mention several good showings at depths approximately equal to those at Petrolia, due allowance being made for difference of elevation. It is estimated that the elevation of the Thornberry well is 930, or about fifty feet below Petrolia.

No. 127.—McGregor No. 1. Jack Kelly. This well is located about half a mile northwest of Mabledean. Several sands, none carrying oil or gas in appreciable quantities, had been reported in the first 1000 feet.

No. 128.—Holt water well. This is a shallow well, bored for water, about four miles south of Halsell in the southern part of Clay County. Sufficient oil to gum on top of the water is said to have come from 120 feet.

No. 129.—Kempner No. 1. Producers Oil Co. Elevation, 954. Depth, 2110. This well was dry, about six miles southwest of the Petrolia Gas Field.

No. 130.—Halsell Farm No. 1. Producers Oil Co. This well is located about six and one-half miles west and one hile south of Henrietta in Clay County, near the northwest corner of survey 6 of the M. Scurlock subdivision. The total depth of this well is 3985 feet, it being the deepest well yet made in this region. Drilling commenced on the first day of April, 1909. The curb of the well has an elevation of 871 feet above sea level, according to a survey made by one of the oil companies now operating in this part of the state. See page 77 and following for descriptions of samples and Fig. 8 for section. The drillers' log is as follows:

	Depth in Feet		
	From	To	Thickness
Red Clay	0	65	65
Salt water, sand	65	90	25
Red rock	90	190	100
Sat water, sand	190	220	30
Red Rock	220	465	245
Salt water, sand	465	505	40
Red rock	505	630	125
Salt water, sand	630	660	30
Red rock	660	772	112
Water, sand	772	797	25
Slate and red rock	797	817	20
Sand, no water	817	841	24
Red rock	842	891	99
Sand	891	911	20
Slate and red rock	911	1010	99
Dry sand	1010	1016	6
Sand	1016	1022	6
Putty	1022	1042	20
Red rock	1042	1092	50
Red mud	1092	1100	8
Water, sand	1100	1150	50
Blue mud	1150	1175	25
Red and white sand	1175	1240	65
Light blue shale	1240	1255	15
Black shale	1255	1275	20
Red shale	1275	1305	30
Brown shale	1305	1313	8
Red rock	1313	1323	10
Gray hard sand	1323	1325	2
Red and blue mud	1325	1355	30
Joint clay	1355	1365	10
Light blue shale	1365	1375	10
White sand	1375	1410	35
White slate	1410	1420	10
Gray lime	1420	1436	16
White sand	1436	1445	9
Gray lime	1445	1455	10
Dark blue slate	1455	1500	45
Red and blue mud	1500	1503	3
Rotten sand	1503	1508	5
Sky blue shale	1508	1513	5

Red cave	1513	1535	22
Dark blue shale	1535	1550	15
White sand	1550	1580	30
Dark blue shale	1580	1644	64
Gray limė, hard	1644	1655	11
Blue shale	1655	1800	44
White sand	1800	1820	20
Shale, breaks, caves	1820	1822	2
Lime shells	1822	1832	10
Gray sand, dry	1832	1837	5
Blue shale	1837	1847	10
Blue mud, caves	1847	1857	10
Light blue shale	1857	1895	38
Dry sand	1895	1905	10
Black slate	1905	1933	28
Sand, salt water	1933	1953	20
Blue marl	1953	1983	30
Gray lime	1983	2008	25
Blue marl	2008	2058	50
Black slate, gritty	2058	2125	67
Sand, artesian flow of salt water	2125	2170	45
Break	2170	2175	5
Sand	2175	2180	5
Sand	2180	2185	5
Sand	2185	2190	5
Sand	2190	2200	10
Hard brown shells	2200	2215	15
Blue shale	2215	2225	10
Sand, dark clay	2225	2280	55
Sand, dark gray, broken	2280	2300	20
Sand, light gray	2320	2335	15
Brown shale	2320	2335	15
Hard shells	2335	2350	15
Light blue slate	2350	2355	5
Brown shale	2355	2425	70
Blue slate	2425	2450	25
Brown limestone	2450	2500	50
Blue shale	2500	2600	100
Blue shale	2600	2675	75
Shells of hard sand with streaks of gray limestone	2675	2700	25
Blue shale	2700	2705	5
Lime shells and streaks of blue shale	2705	2710	5

Lime and streaks of hard sand	2710	2740	30
Light blue shale	2740	2968	228
Six feet sand, a break of 3 and3 feet, solid sand	2968	2980	12
Very black shale	2980	3220	240
Limestone shells	3220	3350	130
Dark shale	3350	3382	32
Light gray sand (shows little water)	3382	3394	12
Dark slate	3394	3415	21
Sand	3415	3440	25
Dark blue shale	3440	3695	255
Dark shale	3695	3970	285
Dark gray lime	3970	3985	15
Lost tool in lime at	3985	....	...

No. 131.—Edrington No. 1. Corsicana Petroleum Co. Elevation, 1000 (estimated). Depth, 1944. This well is located about six miles southwest of the Petrolia Gas Field, and about two miles southeast of No. 129. It is reported a dry hole. Plate V.

	Feet		
	From	To	Thickness
Red mud	0	10	10
Sand rock	10	15	5
Red mud	15	65	50
Sand rock	65	75	10
Blue mud	75	125	50
Sand rock	125	145	20
Red mud	145	150	5
Sand rock	150	165	15
Red mud	165	175	10
Sand rock	175	195	20
Red mud, mixed	195	365	170
Sand rock	365	400	35
Red mud, mixed	400	420	20
Sand rock	420	430	10
Red mud, mixed	430	445	15
Sand rock	445	450	5
Red mud, mixed	450	460	10
Sand rock	460	465	5
Red mud, mixed	465	470	5
Sand rock	470	475	5
Red mud	475	485	10
Sand rock	485	490	5

Red mud, mixed.......	490	525	35
White rock............	525	550	25
Red mud, mixed.......	550	635	85
Sand rock............	635	645	10
Red mud, mixed.......	645	675	30
Sand rock............	675	680	5
Red mud..............	680	690	10
Sand rock............	690	735	45
Blue mud............	735	740	5
Sand rock............	740	760	20
Red mud.............	760	780	20
Flint rock.............	780	785	5
White mud...........	785	795	10
Sand rock............	795	840	45
Red mud, mixed.......	840	860	20
Flint rock............	860	865	5
Gypsum rock...........	865	880	15
Red mud, mixed.......	880	890	10
Sand rock............	890	902	12
Gypsum rock..........	902	912	10
Sand rock............	912	970	58
Red mud..............	970	995	25
Sand rock............	995	1000	5
Red mud, mixed.......	1000	1010	10
Gypsum rock.........	1010	1015	5
Red mud.............	1015	1040	25
Sand rock.............	1040	1078	38
Red mud.............	1078	1110	32
Sand rock............	1110	1175	65
Red mud.............	1175	1215	40
White rock...........	1215	1220	5
Red mud.............	1220	1233	13
Sand rock............	1233	1241	8
Red mud, mixed.......	1241	1262	21
Sand rock..............	1262	1265	3
White mud, mixed......	1265	1282	17
Sand rock............	1282	1291	9
Slate rock.............	1291	1310	19
Blue shale...........	1310	1325	15
Sand rock............	1325	1330	5
Blue shale............	1330	1360	30
Red mud, mixed.......	1360	1395	35
White mud...........	1395	1415	20
Sand rock.............	1415	1420	5
Red mud, mixed.......	1420	1430	10
Sand rock............	1430	1445	15
Red mud............	1445	1465	20

White rock	1465	1480	15
Blue shale	1480	1510	30
Sand rock	1510	1520	10
Blue shale	1520	1602	82
Sand rock	1602	1610	8
Gypsum rock	1610	1614	4
Red mud, mixed	1614	1621	7
Blue shale	1621	1634	13
Sand rock	1634	1645	11
Blue shale	1645	1680	35
Sand rock	1680	1692	12
Red mud, mixed	1692	1705	13
Blue shale	1705	1720	15
Blue lime	1720	1726	6
Sand rock	1726	1739	13
Blue shale	1739	1750	11
Blue lime	1750	1752	2
Blue shale	1752	1756	4
White lime	1756	1761	5
Sand rock	1761	1778	17
Red mud	1778	1802	24
Sand rock	1802	1812	10
Blue shale	1812	1828	16
Sand rock	1828	1839	11
Blue shale	1839	1885	46
Flint rock	1885	1892	7
Red mud, mixed	1892	1908	16
Flint rock	1908	1912	4
Sand rock	1912	1944	32

No. 132.—Morgan Jones No. 1. 99 Pumping Co. This well is on the western edge of the proven gas field at Petrolia. A big gas sand was met at 1685 feet, but was cased off, and the well drilled on to a depth of 1835 feet without finding a paying oil sand. Plate VII.

	Feet		
	From	To	Thickness
Clay	0	10	10
Sand	10	14	4
Yellow clay	14	42	28
Sand	42	44	2
Shale, blue	44	80	36
Sand, show oil	80	87	7
Red mud, mixed	87	140	53
Sand	140	152	12
Hard shale	152	194	42
Red mud, mixed	194	241	47

Sand rock	241	253	12
Hard shale	253	310	57
Gumbo	310	345	35
Shale	345	370	25
Sand rock	370	381	11
Red mud, mixed	381	408	27
Hard shale, dark	408	436	28
Sand rock	436	450	14
Red gumbo	450	490	40
Hard shale, light	490	520	30
Red mud, mixed	520	540	20
Blue shale	540	550	10
Sand, show oil	550	559	9
Gumbo	559	572	13
Sand, rock, water	572	630	58
Shale, blue	630	655	25
Gumbo	655	680	25
Sand rock	680	710	30
Hard light shale	710	750	40
Red mud, mixed	750	795	45
Hard shale	795	820	25
Sand rock	820	855	35
Red mud, mixed	855	895	40
Sand rock	895	930	35
Blue shale	930	956	26
Gumbo	956	960	4
Oil sand, water	960	997	37
Blue shale	997	1005	8
Slate	1005	1050	45
Sand rock	1050	1110	60
Shale, dark	1110	1143	33
Lime and gypsum	1143	1194	51
Shale, black	1194	1223	29
Lime and gypsum	1223	1340	171
Shale, hard	1340	1372	32
Sand, rock	1372	1467	95
Hard shale	1467	1480	13
Blue shale	1480	1495	15
Sand rock	1495	1536	41
Blue shale	1536	1585	49
Hard slatey shale	1585	1602	17
Dead sand	1602	1606	4
Gumbo, blue	1606	1618	12
Sand rock	1618	1631	13
Salty shale, dark	1631	1685	54
Gas, sand	1685	1686′ 6″	1′ 6″
Red shale	1686′ 6″	1690	3′ 6″

Oil sand	1690	1691	1
Hard black shale	1691	1695	4
Hard sand dead	1695	1696	1
Red black shale	1696	1727	31
Sand rock (water)	1727	1732	5
Shale, red, blue	1732	1734	2
Dead Sand	1734	1736′ 6″	2′ 6″
Oil and gas, sand	1736′ 6″	1742	5′ 6″
Slatey shale, black	1742	1753	11
Boulders	1753	1756	3
Flint rock	1756	1759	3
Gumbo	1759	1762	3
Oil and gas	1762	1768	6
Gumbo	1768	1769	1
Slatey shale, dark	1769	1775	6
Black sand	1775	1782	7
Hard shale	1782	1793	11
Dark sand	1793	1802	9
Hard dark lime	1802	1835	33

No. 133.—Byers No. 8. Producers Oil Co. Elevation, 978. Depth, incomplete, 1823. This is a gas well, also producing a small amount of oil. Plate IV.

No. 134.—Byers No. 7. Lone Star Gas Co. Elevation, 970. Depth, 1781. Building commenced Nov. 26, 1910. Drilling finished March 25, 1911. 45 feet of 10-inch casing; 1652 feet of 6-inch casing; 1768 feet of 4-inch casing. This was an edge well which produced about 25 barrels of oil and a small amount of gas when drilled in. Plate IV.

	Feet		
	From	To	Thickness
Red mud	0	50	50
Mixed mud	50	100	50
Rock sand	100	105	5
Red mud	105	175	70
Sand rock	175	185	10
Red mud	185	385	200
Sand rock	385	400	15
Mixed mud	400	500	100
Sand rock	500	525	25
Mixed mud	525	600	75
Sand rock	600	625	25
Red mud	625	700	75
Rock and mud	700	750	50
Mixed mud	750	800	50
Sand rock	800	825	25

Lead colored mud.....	825	900	75
Sand rock...........	900	905	5
Lead colored mud.....	905	1000	95
Sand rock...........	1000	1010	10
Lead colored mud.....	1010	1050	40
Sand rock...........	1050	1055	5
Mud and gypsum.....	1055	1100	45
Lead colored mud.....	1100	1125	25
Sand rock...........	1125	1135	10
Mud and gypsum.....	1135	1155	20
Mud and gypsum.....	1155	1190	35
Sand rock...........	1190	1220	30
Gypsum and lime rock.	1220	1400	180
Dark shale...........	1400	1425	25
Rock sand, salt water..	1425	1485	60
Gypsum rock.........	1485	1528	43
Lime rock...........	1528	1530	2
Dark shale...........	1530	1570	40
White mud...........	1570	1575	5
Dark shale..........	1575	1610	35
White mud..........	1610	1615	5
Dark shale..........	1615	1630	15
Sand rock...........	1630	1635	5
Dark shale...........	1635	1651	16
Sand rock (set 6 inch).	1651	1653	2
Dark shale...........	1653	1654	1
Hard sand rock......	1654	1657	3
Dark shale..........	1657	1660	3
Sand rock...........	1660	1661	1
Dark shale...........	1661	1667	6
Lime rock...........	1667	1668	1
Dark shale...........	1668	1680	12
White mud..........	1680	1690	10
Flint rock...........	1690	1691	1
Dark shale...........	1691	1735	44
White mud..........	1735	1750	15
Red mud............	1750	1755	5
Flint rock...........	1755	1757	2
White mud..........	1757	1765	8
Flint rock...........	1765	1766	1
Dark shale...........	1766	1767	1
Gas sand (set 4 inch).	1767	1776	9
White mud and hard sand	1776	1781	5

No. 135.—Byers No. 9. Producers Oil Co. This well yielded about 50 barrels of oil.

No. 136.—Byers No. 6. Lone Star Gas Co. Elevation, 970 (estimated). Depth, 1769. Drilling commenced May 26, 1910. Drilling finished Sept. 26, 1910. 1558 feet of 6-inch pipe; 1729 feet of 4-inch line pipe; 40 feet of 4-inch perforated pipe. This is a gas well. Plate IV.

	Feet		
	From	To	Thickness
Sand and clay........	0	16	16
Sand rock...........	16	23	7
Blue shale...........	23	340	317
Sand rock...........	340	346	6
Blue shale...........	346	470	124
Sand rock...........	470	474	4
Hard shale..........	474	563	89
Sand rock...........	563	565	2
Mixed shale.........	565	614	49
Flint rock...........	614	634	20
Mixed shale.........	634	852	218
Sand rock...........	852	866	14
Hard sand...........	866	894	28
Sand rock...........	894	945	51
Hard mixed shale.....	945	1019	74
Sand rock...........	1019	1035	16
Mixed shale..........	1035	1261	226
Blue lime rock.......	1261	1271	10
Hard blue shale......	1271	1326	55
Sand rock...........	1326	1366	40
Hard sand rock.......	1366	1382	16
Mixed shale..........	1382	1413	31
Hard shale, mixed....	1413	1484	71
Soft blue shale.......	1484	1521	37
Mixed shale..........	1521	1536	15
Sand rock...........	1536	1537	1
Brown mud..........	1537	1548	11
Blue slate...........	1548	1553	5
Lime rock...........	1553	1554	1
White mud..........	1554	1559	5
Hard gray sand......	1559	1563	4
White mud..........	1563	1581	18
Blue shale...........	1581	1596	15
White mud..........	1596	1607	11
Blue shale...........	1607	1619	12
White mud..........	1619	1631	12
Brown shale.........	1631	1636	5
White mud..........	1636	1671	35
Red and blue shale....	1671	1676	5
Gas sand............	1676	1690	14

White mud..........	1690	1702	12
Gas sand............	1702	1719	17
Gypsum rock.........	1719	1739	20
Dark shale...........	1739	1753	14
White mud..........	1753	1758	5
Dark shale...........	1758	1766	8
White mud..........	1766	1768	2
Sand rock..........	1768	1769	1

No. 137.—Byers No. 4. Lone Star Gas Co. Elevation, 946. Depth, 1721. Drilling commenced June 23, 1909. Drilling finished Sept. 13, 1909. 32 feet 8 inches of 10-inch casing; 1001 feet of 6-inch casing; 1531 feet of 4-inch casing; 1721 feet of 2 1-2-inch casing; 70 feet of perforated pipe in bottom of hole. A producing gas well. Plate V.

	Feet		
	From	To	Thickness
Surface clay.........	0	10	10
Sand rock...........	10	15	5
Red mud............	15	35	20
Sand rock...........	35	55	20
Red mud............	55	70	15
Sand rock...........	70	80	10
Red mud............	80	100	20
Sand rock...........	100	120	20
Red mud............	120	160	40
Sand rock............	160	180	20
Red mud............	180	240	60
Sand rock............	240	300	60
Red mud............	300	350	50
Sand rock............	350	375	25
Red mud............	375	425	50
Sand rock............	425	600	175
Red mud............	600	620	20
Sand rock............	620	700	80
Red mud............	700	740	40
Sand rock............	740	780	40
Red mud............	780	790	10
Sand rock............	790	800	10
Red mud............	800	810	10
Blue mud............	810	815	5
Red mud............	815	840	25
Gypsum rock.........	840	880	40
Sand rock............	880	900	20
Mixed mud..........	900	960	60
Red mud............	960	980	20
Mixed mud..........	980	1000	20

White mud..........	1000	1020	20
Dark mud............	1020	1120	100
Sand rock............	1120	1140	20
Red mud............	1140	1250	110
Water sand, last water.	1250	1510	160
Dark mud...........	1410	1460	50
Sand rock............	1460	1462	2
Red mud............	1462	1495	33
Sand rock............	1495	1500	5
Mud	1500	1505	5
Sand rock............	1505	1507	2
Mud	1507	1520	13
Sand rock............	1520	1530	10
Gray sand...........	1530	1531	1
Blue shale...........	1531	1535	4
Sand	1535	1537	2
Dark shale...........	1537	1584	47
Sand rock............	1584	1585	1
White mud...........	1585	1588	3
Gray flint rock.......	1588	1595	7
Mixed shale..........	1595	1599	4
White mud..........	1599	1601	2
Gas sand............	1601	1604	3
White mud..........	1604	1606	2
White sand rock, no water	1606	1615	9
White mud..........	1615	1617	2
Gas sand............	1617	1619	2
Mixed mud..........	1619	1632	13
Gray sand...........	1632	1636	4
White mud..........	1636	1638	2
Gas sand............	1638	1640	2
Mixed mud...........	1640	1642	2
White mud..........	1642	1648	6
Gas sand............	1648	1650	2
Mixed mud..........	1650	1652	2
White mud..........	1652	1653	1
Gas sand............	1653	1660	7
White mud..........	1660	1662	2
Mixed mud..........	1662	1670	8
White mud..........	1670	1675	5
Mixed mud..........	1675	1685	10
White mud..........	1685	1686	1
Gas sand............	1686	1721	35

No. 138.—Boddy & Wantland No. 1. Lone Star Gas Co. Elevation, 958. Depth, 1902. Drilling completed Aug. 13, 1910. This

is a dry hole on the northern edge of the producing gas field at Petrolia. Plate IV.

	Feet		
	From	To	Thickness
Sod	0	1	1
Red clay	1	15	14
Water sand	15	25	10
Red clay and gravel	25	85	60
Sand	85	88	3
Red clay and gravel	88	133	45
Broken sand	135	163	30
Red clay and gravel	163	213	50
Hard sand rock	213	219	6
Red mud and gravel	219	249	30
Brown clay	249	257	8
Red tough mud	257	287	30
Mud and gravel	287	349	62
Red shale	349	399	50
Broken sand	399	414	15
Red mud	414	519	105
Water sand	519	529	10
Red mud	529	569	40
Red shale	569	694	125
Red mud and gravel	694	714	20
Broken sand	714	724	10
Brown clay	724	754	30
Iron pyrite	754	762	8
Loose gravel	762	767	5
Red mud and gravel	767	842	75
Red tough mud	842	872	30
Mud and gravel	872	927	55
Blue and red mud	927	939	12
Red mud and gravel	939	1002	63
Blue mud and boulders	1002	1007	5
Water sand	1007	1013	6
Red mud and gravel	1013	1040	27
Blue gumbo	1040	1050	10
Red mud and gravel	1050	1092	42
Blue gumbo	1092	1112	20
Hard sand rock	1112	1120	8
Blue gumbo and boulders	1120	1140	20
Black slate and sand	1140	1180	40
Red mud and gravel	1180	1208	28
Blue and red gravel	1208	1230	22
Blue gumbo	1230	1235	5

Sand boulders	1235	1239	4
Hard sand rock	1239	1245	6
Broken sand	1245	1252	7
Blue gumbo and boulders	1252	1275	23
Blue sand and slate	1275	1295	20
Blue gumbo and boulders	1295	1310	15
Water sand	1310	1328	18
Hard sand	1328	1330	2
Blue gumbo and boulders	1330	1335	5
Hard sand rock	1335	1339	4
Blue gumbo and boulders	1339	1345	6
Quartz	1345	1348	3
Blue gumbo and boulders	1348	1358	10
Hard black sand rock	1358	1364	6
Water sand	1364	1375	11
Blue gumbo and boulders	1375	1395	20
Quartz	1395	1399	4
Blüe gumbo	1399	1411	12
Blue and red shale	1411	1471	60
Hard sand rock	1471	1473	2
Soft sand rock	1473	1477	4
Blue gumbo	1477	1479	2
Hard sand	1479	1487	8
Water sand	1487	1492	5
Blue gumbo	1492	1500	8
Blue gumbo and boulders	1500	1506	6
Sand rock	1506	1511	5
White talc (?)	1511	1514	3
Broken sand	1514	1521	7
Water sand	1521	1527	6
Blue hard slate	1527	1543	16
White talc (?)	1543	1547	4
Blue hard slate	1547	1559	12
White talc (?)	1559	1565	6
Broken sand and slate	1565	1577	12
Blue shale	1577	1595	18
Hard shell	1595	1596	1
White talc	1596	1600	4
Blue gumbo	1600	1657	57
Blue shale	1657	1665	8

Blue gumbo..........	1665	1686	21
Blue gumbo and boulders	1686	1713	26
Black shale and sand.	1713	1721	8
Blue shale...........	1721	1751	30
Blue gumbo..........	1751	1768	17
Black slate..........	1768	1786	18
Blue gumbo..........	1786	1817	31
Blue sand rock.......	1817	1818	1
Blue gumbo..........	1818	1881	63
Black slate...........	1881	1891	10
Blue gumbo..........	1891	1902	11

No. 139.—Byers No. 5. Lone Star Gas Co. Elevation, 981. Depth, 1643. Drilling commenced Dec. 4, 1909. Drilling finished Feb. 25, 1910. 96 feet 5 inches of 10-inch casing; 1468 feet of 6-inch casing; 1567 feet of 4-inch casing. Plate IV.

	Feet		
	From	To	Thickness
Red mud............	0	20	20
White rock...........	20	21	1
Red mud	21	81	60
Mixed mud..........	81	200	119
White rock..........	200	205	5
Mixed mud..........	205	400	195
White rock..........	400	420	20
Mixed mud...........	420	600	180
White rock...........	600	630	30
Mixed mud...........	630	800	170
White rock...........	800	810	10
Mud, lead color.......	810	850	40
Gypsum rock.........	850	900	50
Mud, lead color.......	900	970	70
White sand rock......	970	1000	30
Mud, lead color.......	1000	1020	20
Gypsum rock.........	1020	1070	50
White sand rock......	1070	1100	30
Gypsum rock.........	1100	1130	30
Sand rock...........	1130	1150	20
Mud, lead color.......	1150	1160	10
Gypsum rock.........	1160	1175	15
Sand rock...........	1175	1210	35
Brown shale.........	1210	1260	50
Sand rock...........	1260	1300	40
Brown shale.........	1300	1397	97
Sand rock...........	1397	1399	2

Brown shale.........	1399	1431	32
Sand rock...........	1431	1432	1
Brown shale.........	1432	1466	34
Sand rock...........	1466	1470	4
Brown shale.........	1470	1563	93
Flint rock...........	1563	1565	2
White mud..........	1565	1566	1
Sand rock, gas sand..	1566	1568	2
White mud..........	1568	1572	4
Gas sand............	1572	1595	23
Sand rock, hard......	1595	1598	3
Brown shale.........	1598	1600	2
Sand rock...........	1600	1601	1
White mud..........	1601	1605	4
Sand rock, hard......	1605	1607	2
Brown shale.........	1607	1612	5
Gas sand............	1612	1621	9
White mud..........	1621	1624	3
Brown shale.........	1624	1643	19

No. 140.—Blattner No. 1. No data obtained.

No. 141.—Byers No. 2. Producers Oil Co. Elevation, 1010 (estimated). Depth, 2135. This is a dry hole, located about four miles north of the Petrolia gas field.

No. 142.—Byers Block 67. Depth, 1300. This well is about two miles northeast of Petrolia. Little information could be obtained, other than that it produced gas.

No. 143.—Byers No. 1. Lone Star Gas Co. Elevation, 960 (estimated). Depth, 1736. Drilling commenced May 7, 1907. Drilling finished April, 1909. 567 feet of 10-inch line pipe; 1278 feet of 8-inch line pipe; 1598 feet of 6-inch drive pipe; 1683 feet of 4 1-2-inch drive pipe; packer set at 1736 feet; 6-in casing followed through upper gas sand to 1602 feet; 4 1-2-inch casing followed through second gas sand to 1683 feet. Plate VII.

	Feet		
	From	To	Thickness
Red surface clay.....	0	20	20
Water sand..........	20	40	20
Red rock............	40	230	190
Water sand..........	230	245	15
Blue shale...........	245	270	25
Water sand..........	270	285	15
Red rock............	285	350	65

Water sand..........	350	359	9
Red and blue mud....	359	392	33
Water sand..........	392	402	10
Red rock............	402	412	10
Dry sand............	412	417	5
Blue and red mud....	417	500	83
Soapstone and red rock	500	530	30
Red rock............	530	580	50
Sand rock, dry.......	580	583	3
Red rock............	583	660	77
Light shale..........	660	715	55
Gray sand...........	715	730	15
Blue shale...........	730	750	20
Red rock and gravel...	750	785	35
Blue shale...........	785	820	35
White lime..........	820	825	5
Blue shale...........	825	853	28
Gray sand...........	853	870	17
Blue shale...........	870	885	15
Red mud............	885	895	10
White lime	910	913	3
Missing	895	910	13
White sand..........	913	931	18
Blue shale...........	931	936	5
White sand..........	936	975	39
Stratified red and blue.	975	995	20
Blue shale...........	995	1000	5
Blue shale...........	1000	1005	5
White shale.........	1005	1015	10
Red mud............	1015	1020	5
White sand..........	1020	1040	20
Blue shale...........	1040	1045	5
Dark gray sand.......	1045	1050	5
Brown shale.........	1050	1070	20
Blue shale...........	1070	1110	40
Red mud............	1110	1130	20
Blue shale...........	1130	1206	76
Blue and gray shale...	1206	1235	29
Blue sand...........	1235	1240	5
Blue shale...........	1240	1260.	20
Black sand..........	1260	1266	6
Black shale..........	1266	1300	34
Sand	1300	1305	5
Black shale..........	1305	1320	15
Sand	1320	1328	8
Black shale..........	1328	1333	5
Sand	1333	1338	5

Black shale..........	1338	1413	75
Blue sand...........	1413	1428	15
Black shale..........	1428	1433	5
Sand	1433	1438	5
Shale	1438	1443	5
Sand	1443	1448	5
Black sand..........	1448	1453	5
Shale	1453	1461	8
Black sand..........	1461	1464	3
White sand..........	1464	1490	26
Black shale..........	1490	1495	5
Black sand...........	1495	1515	20
Blue mud or shale....	1515	1518	3
Sand and shale.......	1518	1519	1
Blue shale...........	1519	1598	79
Gas sand............	1598	1600	2
Brown shale.........	1600	1608	8
Oil sand (slight showing)	1608	1610	2
Blue shale...........	1610	1670	60
Dry sand (top containing 2nd gas strata).	1670	1686	16
Blue shale...........	1686	1723	37
Dry gray sand........	1723	1727	4
Blue shale...........	1727	1731	4
Gas sand (top very hard)	1731	1736	5

No. 144.—Stine No. 1, Block 13. Lone Star Gas Co. Elevation, 931. Depth, 1726. Drilling completed Sept. 21, 1909. 21 feet 6 inches of 10-inch casing; 930 feet of 6-inch casing; 1426 feet of 4-inch casing; 1726 feet of 2-inch casing. Plate V.

	Feet		
	From	To	Thickness
Surface	0	21	21
Sand rock...........	21	23	2
Red formation.......	23	65	42
Sand rock...........	65	68	3
Red formation........	68	130	62
Sand, "showing of oil".	130	134	4
Red formation........	134	260	126
Sand, "good show of oil"	260	275	15
Red formation........	275	490	215
Hard sand rock......	490	501	11
Red formation........	501	930	429

Red formation........	930	1185	255
Sand	1185	1214	29
Shale	1214	1280	66
Sand, "good show of oil"	1280	1295	15
Red formation........	1295	1376	81
Sand rock...........	1376	1380	4
Black shale..........	1380	1426	46
Sand rock...........	1426	1431	5
Black shale..........	1431	1498	67
Sand rock...........	1498	1500	2
Light shale..........	1500	1517	17
Black shale..........	1517	1576	59
Sand and shale, mixed	1576	1596	20
Shale	1596	1617	21
Sand rock...........	1617	1622	5
Light shale..........	1622	1646	24
Sand, gas and oil.....	1646	1656	10
Sand and shale.......	1656	1675	19
Shale	1675	1726	51

No. 145.—Stine No. 1, Block 24. Lone Star Gas Co. Elevation, 919. Depth, 1576. Drilling commenced Feb. 22, 1909. Drilling completed April 14, 1909. 37 feet 7 inches of 10-inch casing; 999 feet 9 inches of 6-inch casing; 1414 feet of 4-inch casing. Plate V.

	Feet		
	From	To	Thickness
Red mud............	0	40	40
Rock, white sand.....	40	42	2
Red mud............	42	70	28
Rock, white sand.....	70	78	8
Red mud............	78	130	52
Rock, white sand.....	130	132	2
Mud mixed..........	132	230	98
Rock, white sand.....	230	232	2
Mud mixed..........	232	376	144
Rock, white sand.....	376	381	5
Red mud............	381	420	39
Lead color mud.......	420	445	25
Rock, pyrites of iron..	445	446	1
Rock, sand..........	446	450	4
Mixed lead (color?)...	450	460	10
Rock, white, sand.....	550	570	10
Rock, white gypsum...	570	630	60
Oil sand.............	630	634	4
Rock, white sand.....	634	640	6

Mud, blue...........	640	649	9
Rock, white, sand....	649	651	2
Mud, white..........	651	670	19
Rock, white, sand.....	670	710	40
Rock, white, sand, hard	710	715	5
Rock, white sand, salt.	715	720	5
Mud, white..........	720	740	20
Rock, white sand....	740	750	10
Mud, blue	750	770	20
Rock white sand......	770	850	80
Mud, blue..........	850	895	45
Rock, white, sand.....	895	930	35
Mud, blue..........	930	940	10
Rock, flint..........	940	995	55
Mud, dark, nearly black	995	1005	10
Rock, white sand.....	1005	1010	5
Mud, dark..........	1010	1020	10
Rock, white sand.....	1020	1025	5
Mud, dark..........	1025	1030	5
Rock, white sand.....	1030	1035	5
Rock, white sand, hard	1035	1040	5
Mud, dark..........	1040	1085	45
Rock, white sand.....	1085	1090	5
Mud, white..........	1090	1110	20
Rock, white sand.....	1110	1115	5
Mud, white..........	1115	1120	5
Rock, white sand.....	1120	1130	10
Mud, white..........	1130	1200	70
Rock, white sand.....	1200	1235	35
Shale, black.........	1235	1255	20
Mud, lead color......	1255	1300	45
Mud, white..........	1300	1360	60
Rock, white sand.....	1360	1365	5
Mud, lead color......	1365	1370	5
Rock, white sand.....	1370	1372	2
Mud, lead color......	1372	1377	5
Rock, white sand.....	1377	1380	3
Shale, black.........	1380	1416	36
Rock, white sand.....	1416	1419	3
Mud, mixed..........	1419	1423	4
Rock, white sand.....	1423	1424	1
Shale, black.........	1424	1440	16
Rock, white sand.....	1440	1442	2
Shale, black..........	1442	1445	3
Rock, white sand.....	1445	1447	2
Shale, black..........	1447	1499	52

Rock, black and yellow, flint	1499	1500	1
Shale, black	1500	1507	7
Rock, flint, white	1507	1508	1
Shale, black	1508	1515	7
Rock, white sand	1515	1517	2
Shale, black	1517	1523	6
Rock, white flint	1523	1524	1
Shale, black	1524	1530	6
Mud, white	1530	1534	4
Rock, white sand	1534	1535	1
Shale, black	1535	1550	15
Rock, white sand	1550	1551	1
Mud, white	1551	1552	1
Rock, white sand	1552	1554	2
Mixed, red	1554	1570	16
Mixed	1570	1572	2
Gas sand	1572	1576	4

No. 146.—Morgan No. 1. Elevation, 960 (estimated). Depth, 388. This is one of the several hundred shallow wells in the Petrolia field, each pumping from two to five barrels a day.

	Feet		
	From	To	Thickness
Red clay	0	25	25
Fresh water sand	25	58	33
Red	58	218	160
Dry sand	218	219	1
Red	219	255	36
Sand, oil and salt water	255	269	14
Light blue and red	269	334	65
Sand, salt water	334	344	10
Blue shale	344	366	22
Red and blue shale	366	388	22

No. 147.—Morgan No. 2. Elevation as in preceding well. Depth, 266. See note on No. 146.

	Feet		
	From	To	Thickness
Red clay	0	4	4
Hard sand rock	4	9	5
Red and boulders	9	26	17
Sand dry	26	28	2
Red	28	35	7
Sand, dry	35	37	2

Red and light........	37	75	38
Sand, fresh water.....	75	89	14
Red and light........	89	248	159
Blue	248	259	11
Sand, oil and water....	259	266	7

No. 148.—Lochridge No. 1. This was the first gas well drilled in this field and is still a producer. No detailed information could be secured.

No. 149.—Lochridge Farm No. 2. Lone Star Gas Co. Elevation, 940 (estimated). Depth, 1485. Drilling finished 1909. 415 feet of 10-inch casing; 995 feet of 8-inch casing; 1463 feet of 6-inch casing. Plates IV and V.

	Feet		
	From	To	Thickness
Red rock............	0	195	195
Sand	195	207	12
Red rock............	207	222	15
Sand	222	247	25
Blue shale...........	247	252	5
Oil sand.............	252	287	35
Red rock............	287	400	113
Water sand..........	400	420	20
Blue shale...........	420	425	5
Sand	425	495	70
Blue shale...........	495	505	10
Water sand..........	505	525	20
Red rock............	525	595	70
Sand	595	610	15
Red rock............	610	640	30
Blue shale...........	640	645	5
Sand (oil and water)..	645	675	30
Blue shale...........	675	690	15
Sand	690	700	10
Blue shale...........	700	720	20
Sand (oil and water)..	720	735	15
Blue shale...........	735	740	5
Sand (oil and water)..	740	760	20
Blue shale...........	760	780	20
Water sand..........	780	800	20
Brown shale.........	800	900	100
Red rock............	900	965	65
Blue shale...........	965	975	10
Water sand..........	975	995	20
Brown shale.........	995	1090	95

Blue shale	1090	1100	10
Sand	1100	1155	55
Blue shale	1155	1165	10
Sand	1165	1200	35
Black shale	1200	1280	80
Blue shale	1280	1285	5
Sand	1285	1300	15
Blue shale	1300	1305	5
Sand	1305	1315	10
Blue shale	1315	1463	148
Gas sand	1463	1473	10
Red rock	1473	1485	12
Gas sand	1485	....	..

No. 150.—Avis & Smith No. 1. Corsicana Petroleum Co. Depth, 783. This was a dry hole practically in the middle of the proven field.

	Feet		
	From	To	Thickness
Red mud	0	18	18
Sand, white	18	20	2
Rock	20	25	5
Red rock	25	50	25
Rock, white	50	65	15
Mud, mixed (red, white and blue)	65	120	55
Rock	120	121	1
Red rock	121	190	69
Rock grey	190	240	50
Oil sand	240	245	5
Rock, gray	245	280	35
Mud, red and blue	280	360	80
Rock, gray	360	400	40
Mud, blue	400	420	20
Rock, gray	420	435	15
Sand, white	435	440	5
Rock, gray	440	535	95
Mud, blue and red	535	575	40
Rock, gray	575	585	10
Oil sand	585	588	3
Mud, blue	588	620	32
Oil sand	620	624	4
Rock, gray	624	626	2
Mud, blue and red	626	675	49
Rock, gray	675	678	3
Rock, gray (soft, salt water)	678	683	5

Rock, gray (hard)....	683	685	2
Mud, white..........	685	689	13
Rock, blue...........	698	706	8
Mud, white..........	706	711	5
Rock, white..........	711	712	1
Mud, all kinds........	712	726	14
Rock, blue...........	726	727	1
Mud, white..........	727	729	2
Oil sand (tested, no good)	729	734	5
Mud, blue...........	734	740	6
Sand, white..........	740	741	1
Mud, blue...........	741	770	29
Rock, white..........	770	772	2
Sand, white (salt water)	772	783	11

No. 151.—Avis & Smith No. 2. Corsicana Petroleum Co. Elevation, 929. Depth, 1523. Drilling commenced Oct. 12, 1908. Drilling finished Feb. 9, 1909. 47 feet 8 inches of 10-inch casing; 896 feet 9 inches of 8-inch casing; 1246 feet 7 inches of 6-inch casing; 1459 feet 11 inches of 4-inch casing; 1522 feet 11 inches of 2 1-2-inch casing.

	Feet		
	From	To	Thickness
Red mud............	0	7	7
Rock, white..........	7	27	20
Red mud............	27	45	18
Rock, white..........	45	50	5
Red mud............	50	100	50
Oil sand.............	100	105	5
Rock, white..........	105	125	20
Red mud............	125	150	25
Rock, white..........	150	160	10
Oil sand.............	160	165	5
Rock, white..........	165	169	4
Mud, blue...........	169	189	20
Oil sand.............	189	196	7
Rock, white..........	196	200	4
Mud, blue............	200	220	20
Rock, white..........	220	230	10
Mud, blue...........	230	260	30
Oil sand.............	260	265	5
Rock, white..........	265	270	5
Mud, blue	270	285	15
Rock, white..........	285	350	65
Oil sand.............	350	355	5

Rock, white..........	355	385	30
Mud, blue...........	385	395	10
Rock, white..........	395	495	100
Oil sand.............	495	500	5
Rock, white..........	500	520	20
Mud, blue...........	520	550	30
Rock, white..........	550	555	5
Mud, blue...........	555	580	25
Rock, white..........	580	605	25
Oil sand.............	605	610	5
Rock, white (hard)....	610	612	2
Rock white (soft)....	612	615	3
Mud, blue...........	615	620	5
Rock, white..........	620	640	20
Mud, blue...........	640	655	15
Oil sand.............	655	660	5
Mud, blue...........	660	664	4
Rock, white..........	664	674	10
Oil sand.............	674	677	3
Mud, blue...........	677	687	10
Shale, blue..........	687	720	33
Oil sand.............	720	724	4
Rock, white..........	724	770	46
Shale, red............	770	772	2
Rock, white..........	772	784	12
Mud, blue...........	784	850	66
Rock, white..........	850	875	25
Mud, blue...........	875	900	25
Rock, white..........	900	910	10
Mud, blue............	910	925	15
Rock, white..........	925	940	15
Mud, blue............	940	950	10
Rock, white..........	950	998	48
Rock, white..........	998	1000	2
Rock flint...........	1000	1025	25
Shale, blue..........	1025	1035	10
Rock, white..........	1035	1040	5
Shale, blue..........	1040	1060	20
Rock flint...........	1060	1075	15
Rock, sand...........	1075	1080	5
Rock sand (hard)....	1080	1082	2
Rock flint and shell..	1082	1105	23
Shale, blue..........	1105	1120	15
Rock flint...........	1120	1125	5
Rock sand...........	1125	1127	2
Rock, white, flint.....	1127	1145	18
Rock sand...........	1145	1147	2

Oil sand	1147	1150	3
Rock sand	1150	1175	25
Rock sand	1175	1210	35
Rock sand	1210	1212	2
Rock sand	1212	1260	48
Mud, light	1260	1285	25
Rock sand	1285	1300	15
Mud, light	1300	1315	15
Rock sand	1315	1330	15
Mud, light blue	1330	1359	29
Rock sand	1359	1360	1
Mud, blue	1360	1366	6
Rock sand	1366	1380	14
Shale, black	1380	1438	58
Rock, white	1438	1439	1
Shale, black	1439	1459	20
Rock sand, white	1459	1460	1
Shale, black	1460	1463	3
Rock sand	1463	1465	2
Shale, black	1465	1477	12
Rock sand (soft)	1477	1487	10
Shale, blue	1487	1495	8
Shale, red	1495	1500	5
Rock sand	1500	1502	2
Rock, white (gypsum)	1502	1510	8
Shale, blue	1510	1521	11
Gas, sand, white	1521	1523	2

No. 152.—Panhandle No. 1. Lone Star Gas Co. Elevation, 924. Depth, 1592. Sand and rock, 1 to 1506. Gas sand, 1506 to 1511. Shale, 1511 to 1580. Gas sand, 1580 to 1592.

No. 153.—Panhandle Oil Co. No data other than the location was obtained regarding this well.

No. 154.—Wichita Falls Oil and Gas Co. No. 2. This is a gas well, regarding which no information was obtained.

No. 155.—Reed Winfrey No. 7. Elevation, 940 (estimated). Depth, 425. This is a shallow well similar to No. 146.

	Feet		
	From	To	Thickness
Surface	0	100	100
Red mud	100	200	100
Rock	200	250	50
Blue shale	250	266	16

Oil sand.............	266	288	22
Rock and clay........	288	300	12
Slate	300	320	20
Blue shale...........	320	341	21
Oil sand.............	341	354	13
Rock and shale.......	354	400	46
Blue shale...........	400	416	16
Oil sand.............	416	425	9

No. 156.—Reed Winfrey No. 9. Elevation as in No. 155. Depth, 422. See No. 155.

	Feet		
	From	To	Thickness
Surface	0	100	100
Red mud.............	100	150	50
Red mud and sand....	150	200	50
Stone, slate..........	200	250	50
Shale and slate.......	250	266	16
Oil sand.............	266	288	22
Rock and shale.......	288	342	54
Oil sand.............	342	352	10
Red shale and rock....	352	385	33
Rock and shale.......	385	416	31
Broken oil sand......	416	422	6

No. 157.—Lochridge No. 4. Clayco Oil & Pipe Line Co. Elevation, 940 (estimated). Depth, 654. This is producing from a deeper sand than Nos. 155 and 156, but is spoken of as a shallow well.

	Feet		
	From	To	Thickness
Turf	0	10	10
Red mud............	10	199	189
Oil sand, gray........	199	204	5
Red mud............	204	231	27
Blue mud............	231	241	10
Oil sand.............	241	261	20
Blue mud............	261	265	4
Oil sand.............	265	275	10
Red mud............	275	390	115
Blue mud	390	400	10
Sand, water..........	400	425	25
Blue shale...........	425	465	40
Sand, water..........	465	485	20
Blue shale...........	485	498	13
Sand, water..........	498	518	20
Blue slate...........	518	528	10

Red mud	528	645	117
Gray sand	645	647	2
Blue shale	647	651	4
Oil sand	651	654	3

No. 158.—Lochridge No. 2, Lease No. 2. Clayco Oil & Pipe Line Co. Elevation, 940. Depth, 750. This is producing from a still deeper sand than Nos. 155 or 157.

	Feet		
	From	To	Thickness
Red rock	0	240	240
Oil sand	240	260	20
Blue shale	260	270	10
Sand	270	290	20
Red rock	290	360	70
Black shale	360	370	10
Sand	370	400	30
Red rock	400	430	30
Sand	430	460	30
Blue shale	460	475	15
Sand	475	505	30
Red rock	505	635	130
Blue shale	635	640	5
Oil sand	640	650	10
Water sand	650	670	20
Red rock	670	700	30
Blue shale	700	710	10
White shale	710	720	10
Oil sand	720	750	30

No. 159.—Lochridge No. 3, Lease No. 2. Clayco Oil & Pipe Line Co. Elevation, 940. Depth, 744. See No. 158.

	Feet		
	From	To	Thickness
Red rock	0	250	250
Blue shale	250	260	10
Gray sand	260	272	12
Red rock	272	350	78
Blue shale	350	360	10
Gray sand	360	380	20
Red rock	380	400	20
Blue shale	400	412	12
White sand	412	432	20
Red rock	432	510	78
Blue shale	510	530	20

White sand..........	530	542	12
Red rock............	542	610	68
Blue shale..........	610	690	80
White sand..........	690	700	10
Red rock............	700	710	10
Blue shale..........	710	722	12
Oil sand............	722	733	11

No. 160.—Perkins No. 2. Clayco Oil & Pipe Line Co. Elevation, 940. Depth, 649.

	Feet		
	From	To	Thickness
Red rock............	0	190	190
Blue clay............	190	195	5
Sand	195	205	10
Red rock............	205	250	45
Blue clay............	250	255	5
Sand	255	270	15
Red rock............	270	340	70
Blue clay............	340	350	10
Sand	350	370	20
Red rock............	370	385	15
Blue clay............	385	390	5
Sand	390	425	35
Blue shale..........	425	465	40
Blue clay............	465	480	15
Sand	480	515	35
Red rock............	515	565	50
Blue clay............	565	575	10
Sand	575	585	10
Red rock............	585	595	10
Shell	595	600	5
Red rock............	600	610	10
Shale	610	615	5
Blue shale..........	615	620	5
Shell	620	625	5
Red rock............	625	635	10
Blue shale..........	635	644	9
Sand, oil............	644	649	5

No. 161.—Perkins No. 1. Clayco Oil & Pipe Line Co. Elevation, 940 (estimated). Depth, 724.

	Feet		
	From	To	Thickness
Red rock............	0	190	190
Blue clay............	190	195	5
Sand	195	205	10

Red rock............	205	250	45
Blue clay............	250	255	5
Sand	255	270	15
Red rock............	270	340	70
Blue clay............	340	350	10
Sand	350	370	20
Red rock............	370	385	15
Blue clay............	385	390	5
Sand	390	425	35
Blue shale...........	425	465	40
Blue clay............	465	480	15
Sand	480	515	35
Red rock............	515	565	50
Blue clay............	565	575	10
Sand	575	585	10
Red rock............	585	595	10
Shell	595	600	5
Red rock............	600	610	10
Shell	610	615	5
Blue shale...........	615	620	5
Shell	620	625	5
Red rock............	625	635	10
Blue shale...........	635	644	9
Sand	644	654	10
Red rock............	654	656	2
Sand	656	681	25
Blue shale...........	681	691	10
Sand	691	700	9
Blue shale...........	700	720	20
Sand	720	724	4

No. 162.—Perkins No. 3. Clayco Oil and Pipe Line Co. Elevation, 940 (estimated). Depth, 725.

	Feet		
	From	To	Thickness
Red mud............	0	190	190
Gray sand...........	190	195	5
Red shale...........	195	215	20
Gray sand............	215	225	10
Red shale............	225	255	30
Blue shale...........	255	265	10
Gray sand...........	265	280	15
Red shale............	280	345	65
Blue shale...........	345	350	5
Gray sand...........	350	365	15
Red shale...........	365	380	15

Blue shale	380	385	5
Gray sand	385	400	15
Blue shale	400	415	15
White sand	415	440	25
Blue shale	440	450	10
White sand	450	470	20
Blue shale	470	500	30
White sand	500	510	10
Blue shale	510	520	10
Red shale	520	557	37
Blue shale	557	567	10
White sand	567	580	13
Blue shale	580	658	78
White sand	658	675	17
Blue shale	675	685	10
Sand	685	695	10
Blue shale	695	715	20
Sand	715	725-6	10-6

No. 163.—Perkins No. 4. Clayco Oil & Pipe Line Co. Elevation, 940 (estimated). Depth, 730.

	Feet		
	From	To	Thickness
Red rock	0	190	190
Gray sand	190	195	5
Red rock	195	215	20
Gray sand	215	225	10
Red rock	225	255	30
Blue shale	255	265	10
Gray sand	265	280	15
Red rock	280	345	65
Blue shale	345	350	5
Gray sand	350	365	15
Red rock	365	380	15
Blue shale	380	385	5
Gray sand	385	400	15
Blue shale	400	415	15
White sand	415	440	25
Blue shale	440	450	10
White sand	450	470	20
Blue shale	470	500	30
White sand	500	515	15
Blue shale	515	520	5
Red rock	520	560	40
Blue shale	560	570	10
Gray sand	570	575	5
Red rock	575	635	60

Blue shale...........	635	645	10
Gray sand oil........	645	655	10
Gray sand water......	655	675	20
Blue shale...........	675	685	10
Shelly sand..........	685	695	10
Blue shale...........	695	715	20
Sand oil.............	715	730	15

No. 164.—Carrow No. 1. Clayco Oil & Pipe Line Co. Elevation, 935 (estimated). Depth, 653.

	Feet		
	From	To	Thickness
Red and gray clay....	0	190	190
Oil sand.............	190	195	5
Red clay.............	195	217	22
Oil sand.............	217	224	7
Red clay.............	224	236	12
Oil sand.............	236	247	11
Blue shale...........	247	260	13
Red clay.............	260	295	35
Gray shale...........	295	343	48
Oil sand.............	343	365	22
Gray shale...........	365	392	27
Oil sand.............	392	398	6
Blue shale...........	398	405	7
Water sand..........	405	430	25
Gray clay............	430	465	35
Blue clay............	465	504	39
Water sand..........	504	512	8
Red clay.............	512	551	39
Oil sand.............	551	560	9
Blue clay............	560	571	11
Oil sand.............	571	578	7
Red clay.............	578	609	31
Blue clay............	609	649	40
Water sand..........	649	653	4

No. 165.—Holt Farm No. 1. Lone Star Gas Co. Elevation, 939. Depth, 1571. Drilling commenced Oct. 14, 1909. Drilling finished Dec. 13, 1909. Plate V.

	Feet		
	From	To	Thickness
Surface	0	70-6	70-6
Sandy rock and red formation	70-6	746	675-6
Sandy, light show of oil	746	752	6
Sand, salt water......	752	765	13

Red formation	765	917	152
Very hard rock	917	922	5
Soft rock	922	933	11
Sand rock and red formation	933	1252	319
Hard sand, salt water	1252	1417	165
Shale	1417	1554	137
Hard cap rock	1554	1556-3	2′3″
Shale, some shells	1556-3	1564	7′9″
Gas sand	1564	1571-6	7′6″

No. 166.—Beatty. Sun Co. No information other than the location of this dry hole could be obtained.

No. 167.—Wichita Falls Oil & Gas Co. No. 2. This is a producing gas well. No other information could be procured.

No. 168.—Buckley, Brock & Lunday No. 8. Elevation, 910 (estimated). Depth, 332.

	Feet		
	From	To	Thickness
Soil and sand	0	17	17
Sand and gravel	17	20	3
Red clay	20	60	40
Light gray	60	71	11
Red clay	71	80	9
Light	80	90	10
Red	90	130	40
Light	130	141	11
Red	141	171	30
Sand	171	179	8
Red	179	204	25
Light	204	222	18
Sand, oil	222	243	21
Red	243	270	27
Light	270	290	20
Sand, water	290	298	8
Red	298	315	17
Blue	315	324	9
Sand, oil	324	332	8
Red	332		

No. 169.—Buckley, Brock and Lunday No. 9. Elevation, 910 (estimated). Depth, 332.

	Feet		
	From	To	Thickness
Soil and sand	0	20	20
Sand, water	20	26	6

Light, some blue......	26	78	52
Red clay..............	78	85	7
Light	85	92	7
Red	92	138	46
Sand	138	140	2
Red	.140	160	20
Light	160	175	15
Red	175	221	46
Sand	221	246	25
Light	246	275	29
Red	275	291	16
Sand	291	304	13
Red	304	309	5
Shale	309	319	10
Sand	319	332	13
Red	332	...	..

No. 170.—Smith & Webber No. 1. Lone Star Gas Co. Elevation, 928. Depth, 1583. Drilling commenced July 14, 1909. Drilling finished November 10, 1909. 10 feet of 10-inch casing; 1430 feet of 6-inch casing; 1470 feet of 4-inch casing. Plate IV.

	Feet		
	From	To	Thickness
Red clay..............	0	4	4
Sand rock............	4	20	16
Red mud.............	20	40	20
Dark red rock........	40	360	320
Sand (slight show of oil)	360	365	5
Red rock.............	365	390	25
Sand rock............	390	678	288
Red mud and sand shells	678	700	22
Hard blue shale.......	700	765	65
Sand rock............	765	800	35
Blue shale, dark......	800	815	15
Hard sand rock........	815	840	25
Red rock.............	840	900	60
Sand rock............	900	1050	150
Red and blue clay.....	1050	1145	95
Hard gray sand (show of oil and gas)......	1145	1170	25
Hard blue shale.......	1170	1200	30
Hard rock............	1200	1235	35
Blue shale...........	1235	1245	10
Sand rock............	1245	1308	63
Red rock.............	1308	1347	39

Water, sand, rock.....	1347	1365	18
Blue shale............	1365	1370	5
Sand, rock............	1370	1400	30
Hard blue shale........	1400	1415	15
Black shale..........	1415	1440	25
Hard dry sand, rock....	1440	1444	4
Dark blue shale.......	1444	1575	131
Rock	1575	1576	1
Gas, sand............	1576	1583	7

No. 171.—Wichita Oil Co. No. 1. This is a gas well, regarding which no information was secured.

No. 172.—Joyce No. 6. Clayco Oil & Pipe Line Co. Elevation, 930 (estimated). Depth, 386.

	Feet		
	From	To	Thickness
Clay	0	15	15
Water, sand...........	15	41	26
Clay	41	98	57
Oil, sand.............	98	110	12
Clay	110	247	137
Shale and sand........	247	255	8
Clay	255	343	88
Sand	343	350	7
Clay	350	375	25
Shale	375	384	9
Salt water............	384	386	2

No. 173.—Joyce No. 7. Clayco Oil & Pipe Line Co. Elevation, 930 (estimated). Depth, 386.

	Feet		
	From	To	Thickness
Joint clay............	0	35	35
Dry sand.............	35	50	15
Joint clay............	50	90	40
Blue gumbo...........	90	120	30
Joint clay............	120	195	75
Gray sand.............	195	220	25
Red clay.............	220	245	25
Blue shale............	245	250	5
Oil, sand.............	250	270	20
Blue shale...........	270	315	45
Sand	315	335	20
Blue shale............	335	350	15
Oil, sand.............	350	360	10
Red mud.............	360	375	15

Blue shale............	375	383	8
Oil, sand.............	383	386	3

No. 174.—Joyce No. 8. Clayco Oil & Pipe Line Co. Elevation, 930 (estimated). Depth, 386.

	Feet		
	From	To	Thickness
Clay	0	38	38
Sand rock............	38	56	18
Clay	56	116	60
Oil and water, sand....	116	134	18
Clay	134	253	119
Shale	253	260	7
Oil, sand..............	260	274	14
Clay	274	330	56
Oil, sand..............	330	337	7
Clay	337	375	38
Shale and sand.......	375	383	8
Oil, sand.............	383	386	3

No. 175.—Joyce No. 9. Clayco Oil & Pipe Line Co. Elevation, 930 (estimated). Depth, 266.

	Feet		
	From	To	Thickness
Joint clay............	0	35	35
Dry sand.............	35	50	15
Joint clay............	50	100	50
Blue shale............	100	120	20
Sand, oil..............	120	130	10
Joint clay............	130	170	40
Blue gumbo...........	170	200	30
Joint clay.............	200	240	40
Blue shale............	240	251	11
Oil, sand.............	251	266	15

No. 176.—Joyce No. 10. Clayco Oil & Pipe Line Co. Elevation, 930 (estimated). Depth, 386.

	Feet		
	From	To	Thickness
Clay	0	46	46
Sand, rock............	46	62	16
Clay	62	258	196
Oil, sand.............	258	266	8
Clay	266	310	44
Water, sand...........	310	322	12
Clay	322	378	56
Shale	378	383	5
Oil, sand.............	383	386	3

No. 177.—Joyce No. 11. Clayco Oil & Pipe Line Co. Elevation, 930 (estimated). Depth, 387.

	Feet		
	From	To	Thickness
Joint clay............	0	35	35
Sand	35	50	15
Red mud.............	50	90	40
Blue shale............	90	110	20
Sand	110	130	20
Blue gumbo..........	130	200	70
Red mud.............	200	245	45
Blue shale............	245	250	5
Oil, sand..............	250	270	20
Blue shale............	270	315	45
Water, sand..........	315	335	20
Blue shale...........	335	350	15
Red mud.............	350	375	25
Blue shale............	375	384	9
Sand	384	387	3

No. 178.—Lone Star Gas No. 1. Lone Star Gas Co. Elevation, 929. Depth, 1684. Drilling commenced July 14, 1911. Drilling finished November 8, 1911. 287 feet of 12 1-2-inch casing; 1113 feet of 10-inch casing, 1661 feet of 8-inch casing. This was the largest gas well in the field, having a reported production of 30,000,000 cubic feet a day at a pressure of about 700 pounds per square inch, when drilled in. Plate IV.

	Feet		
	From	To	Thickness
Red mud.............	0	15	15
Hard rock............	15	20	5
Mud cave and sand....	20	410	390
Sand	410	435	25
Broken sand..........	435	570	135
Red mud.............	570	600	30
Red and blue cave.....	600	640	40
Sand	640	670	30
Blue mud............	670	695	25
Red mud............	695	700	5
Blue mud............	700	705	5
Sand	705	740	35
Red cave.............	740	755	15
Blue cave.............	755	760	5
Sand	760	775	15
Mixture cave..........	775	925	150
Sand	925	935	10

Blue	935	958	23
Sand	958	968	10
Red and blue mixed....	968	1120	152
Sand	1120	1135	15
Blue	1135	1195	60
Sand	1195	1200	5
Blue	1200	1215	15
Sand	1215	1275	60
Sand	1275	1285	10
Sand	1285	1295	10
Water, sand...........	1295	1430	135
Blue	1430	1470	40
Sand	1470	1480	10
Blue	1480	1490	10
Sand	1490	1510	20
Blue	1510	1580	70
Red	1580	1590	10
Blue, black...........	1590	1610	20
Sand	1610	1684	74

No. 179.—Miller Farm No. 1. Lone Star Gas Co. Elevation, 893. Depth, 1544. Drilling commenced August 27, 1909. Drilling finished November 14, 1909. 26 feet of 10-inch casing; 1502 feet of 6-inch casing; 17 feet of pipe below packer. Plate VI.

	Feet		
	From	To	Thickness
Red mud.............	0	10	10
Soft sand rock.........	10	12	2
Red sand.............	12	75	63
Soft sand rock.........	75	90	15
Red and blue shale; mixed	90	181	91
Missing	181	189	8
Blue shale...........	189	226	37
Hard sand rock.......	226	244	18
Red mud and gravel, mixed	244	384	140
Red mud and sand boulders	384	419	35
Red and blue shale.....	419	429	10
Red mud and gravel, mixed	429	509	80
Missing	509	617	108
Red mud and gravel...	817	647	30
Red and blue shale....	647	670	23
Red mud and gravel...	670	698	28

Red and blue shale mixed	698	715	17
Red mud and gravel	715	744	29
Red and blue gumbo	744	760	16
Hard gravel and red mud, mixed	760	840	80
Red and sand boulders	840	855	15
Missing	853	915	60
Red mud and boulders	915	920	5
Red and blue mud and gravel, mixed	920	950	30
Blue rock and blue gumbo, mixed	950	1025	75
Blue gumbo	1025	1035	10
Blue shelly rock and gumbo	1035	1082	47
Blue gumbo and boulders	1082	1124	42
Hard blue granite	1124	1128	4
Blue gumbo	1128	1160	32
Water, sand	1160	1163	3
Blue granite	1163	1165	2
Missing	1165	1168	3
Hard black rock (broken)	1168	1204	36
Blue gumbo	1204	1215	11
Black sand rock	1215	1219	4
Blue gumbo and bouldere s, mixed	1219	1260	41
Black slate	1260	1270	10
Oil sand (showing smell)	1270	1272	2
Hard black slate	1272	1302	30
Blue gumbo and boulders, mixed	1302	1362	60
White quartz	1362	1383	21
Blue mud and rock, mixed	1383	1408	25
Hard sand	1408	1412	4
Water, sand	1412	1422	10
Blue rock and mud, mixed	1422	1433	11
Black shelly rock	1433	1440	7
Hard sand rock	1440	1448	8
Blue boulders and mud, mixed	1448	1454	6
Hard black slate	1454	1488	34

Sand rock............	1488	1492	4
Blue mud and boulders, mixed	1492	1500	8
Sand rock.............	1500	1503-6	3′6″
Blue shale............	1503-6	1526	22′6″
Hard black slate and sand, mixed........	1526	1543	17
Gas, sand.............	1543	1544	1

No. 180.—Landrum No. 1. Sun Co. No data regarding this well could be obtained.

No. 181.—Landrum No. 2. Sun Co. Elevation, 955. Depth, 1549. This is a dry hole in what is considered proven territory. Plate VII.

	Feet		
	From	To	Thickness
Red clay.............	0	12	12
Hard rock............	12	18	6
Red clay.............	18	50	32
Hard rock............	50	62	12
Red clay, hard boulders	62	110	48
Hard rock, sand, salt water	110	115	5
Red clay, hard boulders	115	144	29
Hard rock, showing oil	144	149	5
Red clay..............	149	157	8
Salt, sand............	157	199	42
Red clay boulders.....	199	242	43
Sand rock, dry........	242	247	5
Red clay boulders....	247	286	39
Sand, rock............	286	288	2
Red and blue shale....	288	331	43
Salt water, sand.......	331	349	18
Red and blue shale.....	349	377	28
Sand, no water.......	377	385	8
Red shale.............	385	392	7
Sand, no water.......	392	398	6
Red shale.............	398	416	18
Boulders	416	417	1
Blue shale............	417	441	24
Salt water, sand.......	441	450	9
Blue shale............	450	480	30
Sand, no water........	480	485	5
Blue shale............	485	532	47
Salt water, sand......	532	550	18
Blue shale............	550	552	2

Salt water, sand........	552	573	21
Blue shale............	573	579	6
Red and blue shale....	579	618	39
Salt water, sand.......	618	627	9
Red, blue and light shale	627	640	13
Oil, sand..............	640	654	14
Black sand...........	654	660	6
Red and blue shale....	660	700	40
Light shale...........	700	730	30
Red and blue shale....	730	780	50
Light shale...........	780	785	5
Oil, sand..............	785	795	10
Blue shale............	795	800	5
Light shale...........	800	840	40
Blue shale.............	840	859	19
Red and blue shale....	859	870	11
Salt water, sand.......	870	882	12
Dead sand............	882	890	8
Talc	890	899	9
Blue shale.............	899	920	21
Talc, resembles coffee grounds, very dark..	920	927	7
Blue shale............	927	930	3
Salt water, sand......	930	960	30
Blue shale............	960	982	22
Very hard black sand..	982	985	3
Blue shale.............	985	989	4
Red and blue shale...	989	1007	18
Blue shale............	1007	1024	17
Salt water, sand.......	1024	1036	12
Dead black sand......	1036	1045	9
Blue shale.............	1045	1048	3
Dead black sand......	1048	1052	4
Red and blue shale....	1052	1073	21
Salt water, sand........	1073	1082	9
Blue shale............	1082	1098	16
Dead black sand.......	1098	1101	3
Very dark blue shale..	1101	1112	11
Red shale............	1112	1124	12
Light shale............	1124	1174	50
Red shale............	1174	1175	1
Dark blue shale.......	1175	1260	85
Light sand............	1260	1265	5
Salt water, sand.......	1265	1275	10
Blue shale.............	1275	1277	2
Salt water, sand......	1277	1456	179
Shale	1456	1549	93

No. 182.—Landrum No. 3. Sealy Oil Co. Elevation, 960 (estimated). Depth, 201.

	Feet		
	From	To	Thickness
Red clay	0	15	15
Dry sand	15	21	6
Light	21	34	13
Red clay	34	60	26
Water, sand	60	69	9
Red clay	69	71	2
Oil, sand	71	97	26
Red clay	97	111	14
Dry sand	111	118	7
Red clay	118	128	10
Dry sand	128	146	18
Red clay	146	150	4
Blue	150	154	4
Red clay	154	183	29
Water, sand	183	201	18
Red clay	201	...	..

No. 183.—Landrum Farm No. 3. Lone Star Gas Co. Elevation, 956. Depth, 1647. This is a producing gas well, seemingly shut off from the proven field by Well number 181. It seems probable that had No. 181 been drilled deeper, it would have struck the gas sand. Plate V.

	Feet		
	From	To	Thickness
Surface and red mud	1	12	12
Light colored rock	12	14	2
Red mud	14	40	26
Light colored rock	40	44	4
Red mud	44	78	34
Sand rock	78	81	3
Red mud	81	135	54
Light colored shale	135	160	25
Light colored rock	160	162	2
Oil, sand	162	167	5
Dead sand and showing little water	167	188	21
Blue shale	188	189	1
Salt water, sand	189	210	21
Red mud	210	260	50
Light colored shale	260	262	2
Oil, sand, very small	262	265	3
Red mud	265	330	65
Light colored shale	330	335	5

Red mud	335	340	5
Sand (some water and oil)	340	358	18
Light colored shale	358	366	8
Red mud	366	377	11
Light colored shale	377	395	18
Blue shale	395	400	5
Salt water, sand	400	415	15
Red and blue mud	415	465	50
Red mud	465	515	50
Light colored shale	515	550	35
Salt water, sand	550	565	15
Very hard sand	565	595	30
Red shale	595	610	15
Light colored shale	610	622	12
Red mud	622	630	8
Light colored shale	630	635	5
Red mud	635	740	105
Light colored shale	740	770	30
Blue shale	770	810	40
Light colored shale	810	849	39
Salt water, sand	849	868	19
Blue shale	868	870	2
Salt water, sand	870	912	42
Blue shale	912	960	48
Salt water, sand	960	983	23
Blue shale	983	993	10
Blue and red shale	993	1028	35
Salt water, sand	1028	1051	23
Blue shale	1051	1063	12
Blue and red shale	1063	1087	24
Black dead sand	1087	1092	5
Salt water, sand	1092	1098	6
Red and blue shale	1098	1208	110
Dead sand	1208	1213	5
Blue shale	1213	1265	52
Salt water, sand	1265	1276	11
Blue shale	1276	1278	2
Salt water, sand	1278	1283	5
Red and blue shale	1283	1385	102
Salt water, sand	1385	1422	37
Blue shale	1422	1427	5
Water, sand	1427	1433	6
Dark blue shale	1433	1613	80
Gas, sand	1613	1618	5
Broken sand and shale	1618	1630	12
Blue shale	1630	1633	3

Broken shale..........	1633	1640	7
Gas, sand............	1640	1647	7

No. 184.—Byers No. 3. Producers Oil Co. Elevation, 975 (estimated). Depth to big salt sand, 1974 feet; reported thickness of sand below this, 536 feet; total depth, 2510 feet. This is a dry well, about two miles northeast of the proven field. The tools were still in salt sand when drilling was discontinued. Plate V.

No. 185.—Landrum No. 1, Lease No. 2. Clayo Oil & Pipe Line Co. Depth, 165. This was a dry hole.

	Feet		
	From	To	Thickness
Clay	0	12	12
Rock	12	20	8
Clay	20	154	134
Oil, sand............	154	165	11

No. 186.—Landrum No. 2, Lease No. 2. Clayo Oil & Pipe Line Co. Depth, 184. See No. 185.

	Feet		
	From	To	Thickness
Clay	0	10	10
Rock	10	20	10
Clay	20	173	153
Oil and water, sand....	173	184	11

No. 187.—Stine No. 1, Block 113. Depth, 878. This was a dry hole.

	Feet		
	From	To	Thickness
White sand...........	735	748	13
Salt, sand	748	756	8
Hard white sand......	756	799	43
Hard rock............	799	800	1
Salt, sand............	800	814	14
Hard rock............	814	818	4
White sand...........	818	827	9
Blue shale............	827	858	31
Hard gray sand........	858	861	3
Shale	861	862	1
Soft shale............	862	874	12
White sand...........	874	878	4

No. 188.—Stine No. 2, Block 113. Depth, 945. See No. 187.

	Feet From	To	Thickness
Clay, sand, rock.......	0	100	100
Gray sand.............	100	112	12
Mixed red clay and sand	112	200	88
Gray sand............	200	209	9
Red rock and clay.....	209	249	40
Gray sand............	249	256	7
Red rock and clay......	256	535	279
White sand............	535	545	10
Shale	545	742	197
White sand...........	742	748	6
Sand	748	870	122
Sand	870	875	5
Light sand...........	875	878	3
White sand............	878	945	67

No. 189.—Matlock Farm No. 1. Lone Star Gas Co. Elevation, 943. Depth, 1644. Drilling commenced August 23, 1909. Drilling finished November 15, 1909. 11 feet of 10-inch casing; 1598 feet of 6-inch casing. Plate IV.

	—Feet— From	To	Thickness
Red mud.............	0	14	14
Sand rock............	14	18	4
Red mud, mixed......	18	190	172
Sand rock............	190	196	6
Red mud mixed........	196	404	208
Flint rock............	404	418	14
Red shale.............	418	470	52
Blue mud, mixed......	470	482	12
Red mud.............	482	500	18
White rock...........	500	518	18
Red mud.............	518	550	32
Sand rock............	550	572	22
Blue mud............	572	595	23
Sand rock............	595	612	17
Red mud.............	612	635	23
Flint rock............	635	641	6
Blue shale...........	641	657	16
Sand rock............	657	685	18
Red mud, mixed........	685	705	20
Flint rock............	705	715	10
Blue mud.............	715	740	25
Red mud..............	740	755	15
Blue shale............	755	773	18
Oil, sand.............	773	776	3

Red mud	776	800	24
Sand rock	800	822	22
Blue mud	822	845	23
White rock	845	860	15
Blue shale	860	890	30
Red mud, mixed	890	915	25
Sand rock	915	940	25
Red mud	940	965	25
Blue shale	965	1000	35
Red mud	1000	1025	25
Sand rock	1025	1045	20
Red mud, mixed	1045	1073	28
Blue shale	1073	1105	32
Sand rock	1105	1130	25
Red mud, mixed	1130	1145	15
Sand rock	1145	1170	25
Blue shale	1170	1185	15
Sand rock	1185	1192	7
Blue shale	1192	1200	8
Oil and gas rock	1200	1204	4
Red mud, mixed	1204	1234	30
Blue shale	1234	1245	11
Oil, rock	1245	1248	4
Red mud	1248	1255	7
Sand rock	1255	1404	149
Red mud, mixed	1404	1440	36
Sand rock	1440	1465	25
Blue shale	1465	1530	65
Blue mud	1530	1550	20
Sand rock	1550	1565	15
Red mud	1565	1598	33
Flint rock	1598	1601	3
Blue shale	1601	1633	32
Oil and gas, sand	1633	1644	11

No. 190.—Wichita Oil & Gas Co. This is a gas well only about twenty feet shallower than Lone Star Gas Well No. 1, with a production of 16,000,000 cubic feet a day at a pressure of 450 pounds per square inch.

No. 191.—Schnell Farm No. 1. Lone Star Gas Co. Elevation, 910 (estimated). Depth, 1696. 420 feet of 10-inch casing; 1039 feet of 6-inch casing; 1433 feet 10 inches of 4-inch casing; 1696 feet of 2 1-2-inch pipe. Plate VII.

	Feet		
	From	To	Thickness
Red formation (set 10-inch casing at 420 on rock)	420	480	60

Hard sand rock......	480	495	15
Red formation........	495	540	45
Sand rock and clay...	540	770	230
Sand (some oil)......	770	790	20
Hard shale...........	790	805	15
Sand rock............	805	810	5
Red shale............	810	848	38
Sand rock...........	848	855	7
Red shale............	855	869	14
Sand rock............	869	885	16
Red shale and clay....	885	921	36
Sand rock...........	921	930	9
Red formation........	930	949	19
Sand rock............	949	957	8
Shale	957	972	15
Hard sand rock.......	972	978	6
Red formation........	978	1039	61
Hard sand rock.......	1039	1051	12
Red formation and rock	1051	1433	382
Sand rock............	1433	1435	2
Shale	1435	1445	10
Sand	1445	1457	12
Shale, light..........	1457	1481	24
Hard sand rock.......	1481	1484	3
Shale	1484	1488	4
Soft sand rock........	1488	1492	4
Shale, fine...........	1492	1498	6
Hard sand...........	1498	1501	3
Blue shale...........	1501	1532	31
Soft sand (some oil)...	1532	1538	6
Shale	1538	1567	29
Sand rock............	1567	1570	3
Red shale............	1570	1578	8
Sand (oil)...........	1578	1581	3
Shale	1581	1583	2
Hard sand rock.......	1583	1585	2
Shale, light..........	1585	1608	23
Oil sand (good)......	1608	1611	3
Shale, dark..........	1611	1634	23
Sand rock (little oil)..	1634	1642	8
Shale	1642	1675	33
Sand rock (some gas).	1675	1683	8
Broken sand, rock and shale	1683	1688	5
Very hard cap rock (lots of gas).......	1688	1696	8

No. 192.—Schnell Farm No. 2. Producers Oil Co. Elevation, 920 (estimated). Depth, 1832. This is a dry hole surrounded by producing wells. Plate VI.

No. 193.—Smith & Webber. Regarding this well, the only information obtainable was that it is a dry hole.

No. 194.—Matlock Lease No. 1. Producers Oil Co. Elevation, 943. Depth, 1920. This is a dry well in apparently proven territory. Plate VII.

No. 195.—Holloway No. 1. Producers Oil Co. Elevation, 942. Depth, 1828. See No. 194. Plate VII.

No. 196.—Home Oil Co. This is a dry well regarding which no further information could be secured.

No. 197.—Producers Oil Co. No information was available regarding this well except that it was a producing oil well.

No. 198.—Higgins Oil Co. This is a dry hole in apparently proven territory.

No. 199.—Schnell Farm No. 4. Lone Star Gas Co. Elevation, 900 (estimated). Depth, 1566. Drilling commenced Feb. 4, 1910. Drilling finished April 27, 1910. 1461 feet of 6-inch casing. 1540 feet of 4-inch casing. Plates IV and VI.

	Feet		
	From	To	Thickness
Water sand..........	420	430	10
Soft gray sand........	430	470	40
Blue shale...........	470	580	110
Red mud and rock....	580	585	5
Bed of sand boulders..	585	588	3
Red mud and rock....	588	670	82
Blue shale...........	670	690	20
Red mud and rock....	690	750	60
Hard sand rock......	750	830	80
Black slate...........	830	870	40
Bed of sand boulders..	870	876	6
Sand rock...........	876	901	25
Soapstone	901	929	28
Red gravel and mud...	929	944	15
Blue mud and boulders	944	974	30
Hard rock and red mud	974	1000	26
Blue granite..........	1000	1003	3

Blue mud and rock....	1003	1048	45
Blue granite.........	1048	1050	2
Hard sand rock.......	1050	1055	5
Blue mud and boulders	1055	1070	15
Blue shale...........	1070	1110	40
Bed of hard sand boulders	1110	1113	3
Hard sand rock.......	1113	1118	5
Blue mud and boulders	1118	1140	22
Gas sand............	1140	1142	2
Gumbo and rock.....	1142	1170	28
Blue shale...........	1170	1197	27
Hard sand rock.......	1197	1205	8
White mud and boulders	1205	1220	15
Black slate and sand...	1220	1232	12
Water sand..........	1232	1236	4
Blue mud and boulders	1236	1248	12
Blue gumbo..........	1248	1260	12
Hard sand rock......	1260	1262	2
Blue gumbo and rock.	1262	1279	17
Water sand..........	1279	1285	6
White mud and gravel.	1285	1300	15
Blue mud and rock...	1300	1310	10
Water sand..........	1310	1315	5
Blue mud and rock...	1315	1339	24
Water sand (show of oil)	1339	1354	15
Blue mud and rock....	1354	1362	8
Blue shale...........	1362	1377	15
Blue mud and rock....	1377	1423	46
Black sand boulders...	1423	1426	3
Hard sand rock.......	1426	1430	4
Blue mud and boulders	1430	1445	15
Broken slate and sand.	1445	1450	5
Blue tough mud......	1450	1458	8
Black soft sand.......	1458	1459	1
Hard sand...........	1459	1461	2
Broken sand and slate.	1461	1483	22
Blue shale...........	1483	1493	10
Black slate..........	1493	1501	8
Blue mud............	1501	1518	17
Black slate..........	1518	1524	6
Blue gumbo..........	1524	1537	13
Hard cap rock........	1537	1540	3
Gas sand............	1540	1566	26

No. 200.—Holloway Farm No. 2. Lone Star Gas Co. Elevation, 920 (estimated). Depth, 1744. Drilling commenced July 7, 1910. Drilling finished Nov. 19, 1910. 212 feet of 12 1-2-inch casing; 764 feet of 10-inch casing; 1350 feet of 8-inch casing; 1742 feet of 6-inch casing. Plates IV and VI.

	Feet		
	From	To	Thickness
Soil	0	2	2
Red clay	2	70	68
Sand, water	70	75	5
Red clay	75	185	110
Sand, water	185	210	25
Red clay	210	375	165
Sand, water	375	385	10
Red clay	385	425	40
Blue mud	425	440	15
Red clay	440	475	35
Sand, water	475	495	20
Blue mud	495	560	65
Sand, water	560	575	15
Blue mud	575	580	5
Sand, water	580	625	45
Mixture	625	710	85
Gray	710	740	30
Red, cave	740	765	25
Sand, dry	765	775	10
Red	775	805	30
Sand, dry	805	815	10
Mixture	815	895	80
Blue	895	905	10
Sand, dry	905	915	10
Mixture	915	975	60
Blue	975	1020	45
Sand, water	1020	1050	30
Blue	1050	1095	45
Mixture	1095	1200	105
Red	1200	1210	10
Blue	1210	1270	60
Sand, water	1270	1320	50
Blue	1320	1350	30
Blue	1350	1505	155
Sand, gas	1505	1520	15
Blue shale	1520	1600	80
Sand, gas	1600	1630	30
Blue	1630	1640	10
Sand, oil	1640	1664	24
Sand, gas	1664	1674	10

Shale	1674	1680	6
Blue shale	1680	1690	10
Red rock	1690	1710	20
Sand, oil	1710	1742	32
Slate	1742	1744	2

No. 201.—Van Winkle No. 1. Lone Star Gas Co. Elevation, 882. Depth, 1725. Drilling commenced Feb. 9, 1910. Drilling finished June 2, 1910. 67 feet of 10-inch casing; 1308 feet of 6-inch pipe; 1431 feet of 4-inch pipe; pulled most of this. This well is south of the producing field and was a dry hole. Plate VII.

	Feet		
	From	To	Thickness
Red mud	0	59	59
Sand rock	59	63	4
Red mud	63	70	7
Sand rock	70	142	72
Red mud	142	172	30
Sand rock	172	180	8
Oil sand	180	185	5
Red mud	185	226	41
Sand rock	226	238	12
Blue shale	238	336	98
Sand rock	336	376	40
Gypsum	376	381	5
Red mud mixed	381	436	55
Sand rock	436	473	37
Blue shale	473	501	28
Sand rock	501	507	6
Blue shale	507	554	47
Sand rock	554	580	26
Red mixed mud	580	604	24
Sand rock	604	609	5
Blue mud mixed	609	723	114
Sand rock	723	729	6
Red mud mixed	729	768	39
Sand rock	768	858	90
White mud	858	864	6
Red mud, mixed	864	925	61
Sand rock	925	941	16
Missing	941	951	10
Sand rock	951	979	28
Blue mud	979	989	10
Sand rock	989	991	2
Blue mud, mixed	991	1005	14
Sand rock	1005	1010	5

Blue mud, mixed.....	1010	1017	7
Sand rock...........	1017	1023	6
Red sand, mixed......	1023	1058	35
Sand rock...........	1058	1084	26
Blue mud............	1084	1092	8
Sand rock...........	1092	1102	10
Flint rock...........	1102	1106	4
Red mud, mixed......	1106	1148	42
Blue shale............	1148	1160	12
Dead sand...........	1160	1162	2
Blue shale...........	1162	1203	41
White mud, mixed....	1203	1225	22
Sand rock...........	1225	1236	11
Red mud, mixed......	1236	1263	27
Blue shale............	1263	1306	43
Hard sand rock......	1306	1311	5
Blue shale............	1311	1373	62
Sand rock...........	1373	1377	4
Blue shale............	1377	1405	28
Red mud, mixed......	1405	1415	10
Blue shale............	1415	1430	15
Hard sand rock.......	1430	1437	7
Dark blue shale......	1437	1457	20
Dark shale and sand, mixed	1457	1476	19
Sand rock...........	1476	1478	2
Dark shale and sand, mixed	1478	1576	98
Dead sand...........	1576	1579	3
Dark shale and sand, mixed	1579	1583	4
Dark sand...........	1583	1585	2
Dark shale and sand, mixed	1585	1605	20
Dead sand...........	1605	1611	6
Dark shale and sand, mixed	1611	1651	40
Hard sand rock......	1651	1653	2
Dark shale...........	1653	1663	10
Gas sand............	1663	1670	7
Black shale..........	1670	1682	12
Gas sand............	1682	1686	4
Dark shale...........	1686	1693	7
Oil sand.............	1693	1695	2
Hard sand rock.......	1695	1697	2
Dark shale...........	1697	1705	8
Water sand..........	1705	1725	20

No. 202.—Taylor No. 2. Lone Star Gas Co. Elevation, 941. Depth, 1815. Drilling commenced July 19, 1910. Drilling finished Oct. 10, 1910. 42 feet of 10-inch casing; 1721 feet of 6-inch line pipe; 80 feet of 4 1-2-inch drive pipe. Plate VI.

	Feet		
	From	To	Thickness
Surface clay	0	23	23
Sand rock	23	190	167
Soft white rock	190	210	20
Sand rock and blue shale	210	230	20
Soft white sand rock	230	252	22
Sand rock	252	292	40
Red and blue mud	292	335	43
White sand, rock and shale	335	355	20
Hard sand rock and shale, mixed	355	382	27
Soft sand rock	382	416	34
Hard sand rock	416	437	21
Blue mud	437	476	39
Red shale	476	514	38
Hard sand rock	514	533	19
Hard blue mud	533	554	21
Red clay	554	597	43
Blue shale	597	655	58
Hard sand rock	655	676	21
Soft sand rock	676	695	19
Red mud	695	736	41
Brown shale	736	757	21
Soft white sand rock	757	782	15
Brown shale	782	825	43
Hard red mud	825	906	81
Sand rock and blue shale	906	944	38
Red mud	944	965	21
Sand rock and blue shale	965	987	22
Hard sand rock	987	1029	42
Hard blue shale	1029	1090	61
Hard red mud	1090	1132	42
Hard red sand rock	1132	1153	21
Hard sand rock and shale	1153	1171	18
Hard blue mud	1171	1195	24
Sand rock	1195	1219	24

Sand rock and shale...	1219	1322	103
Sand rock............	1322	1385	63
Red mud.............	1385	1406	21
Blue shale............	1406	1468	62
Soft blue shale.......	1468	1489	21
Red gumbo (mud)....	1489	1511	22
Hard sand rock.......	1511	1547	36
Hard blue mud.......	1547	1588	41
Blue shale and boulders	1588	1609	21
Sand rock............	1609	1627	18
Hard blue mud.......	1627	1643	16
Hard rock...........	1643	1658	15
Hard gypsum rock....	1658	1676	18
Hard red mud........	1676	1693	17
Hard sand rock and shale	1693	1711	18
Hard sand rock......	1711	1725	14
Blue shale...........	1725	1752	27
Gas sand (oil in last 8 feet)	1752	1764	12
Hard blue shale......	1764	1770	6
Blue shale...........	1770	1815	45
Sand rock (stopped drilling)	1815		

No. 203.—Taylor No. 4. Producers Oil Co. Elevation, 941. Depth, 1766. This was a combination gas and oil well, yielding 12 barrels of oil the first 24 hours. Plate VI.

No. 204.—Taylor No. 3. Producers Oil Co. Elevation, 937. Depth, 1761. This was a small gas well. Plate VI.

No. 205.—Taylor No. 1. Producers Oil Co. Beyond the fact that this was a dry well, no information could be secured.

No. 206.—Holloway, drilling.

No. 207.—Dunn No. 1. Guffey Petroleum Co. Elevation, 934. Depth, 1754. Drilling commenced Aug. 1, 1910. Drilling finished Dec. 17, 1910. 240 feet of 10-inch casing; 1058 feet of 8-inch casing; 1722 feet of 6-inch casing. This well and Dunn No. 2 are the largest producers of oil in the Petrolia field and yield from a greater depth than any other wells. Plate VII.

	Feet		
	From	To	Thickness
Clay	0	16	16
Rock	16	23	7
Red clay.............	23	44	21

Rock	44	75	31
Clay	75	81	6
Rock	81	95	14
Clay	95	112	17
Rock	112	115	3
Clay	115	155	40
Rock	155	181	26
Clay	181	215	34
Rock	215	232	17
Clay	232	276	44
Rock	276	280	4
Clay	280	312	32
Rock	312	320	8
Clay	320	398	78
Rock	398	417	19
Clay	417	481	64
Sand rock	481	485	4
Hard blue shale	485	512	27
Sand rock	512	534	22
Hard blue shale	534	556	22
Rock	556	582	26
Hard blue shale	582	608	26
Rock	608	618	10
Blue shale	618	647	29
Rock	647	658	11
Hard shale	658	694	36
Rock	694	699	5
Red clay	699	720	21
Rock	720	724	4
Hard blue shale	724	768	44
Rock	768	772	4
Blue shale	772	790	18
Rock	790	843	53
Shale and clay	843	882	39
Rock	882	888	6
Hard blue shale	888	905	17
Rock	905	921	16
Hard blue shale	921	933	12
Rock	933	957	24
Hard blue shale	957	962	5
Rock	962	964	2
Hard blue shale	964	1020	56
Rock	1020	1025	5
Hard blue shale	1025	1058	33
Rock	1058	1060	2
Hard blue shale	1060	1108	48
Rock	1108	1110	2

Hard blue shale......	1110	1137	27
Rock	1137	1141	4
Hard shale..........	1141	1184	43
Rock	1184	1196	12
Hard shale..........	1196	1204	8
Rock	1204	1208	4
Shale	1208	1232	24
Hard shale..........	1232	1243	11
Rock	1243	1264	21
Hard blue shale......	1264	1276	12
Rock	1276	1277	1
Shale	1277	1281	4
Rock	1281	1308	27
Shale and boulders....	1308	1330	22
Rock	1330	1334	4
Gumbo	1334	1356	22
Hard shale...........	1356	1396	40
Rock	1396	1402	6
Gumbo	1402	1504	102
Shale and boulders....	1504	1520	16
Shale and boulders....	1520	1600	80
Rock, showing gas....	1600	1618	18
Gumbo, shale and loose boulders	1618	1679	61
Rock, or loose bed of boulders	1679	1686	7
Soft rotten shale (steel line measurement) with salt streaks....	1686	1718	32
Shell rock...........	1718	1722	4
Hard shale..........	1728	1741	19
Hard sand rock, showing gas............	1741	1744	3
Oil sand.............	1744	1754	10

No. 208.—Dunn No. 2. Guffey Petroleum Co. Elevation, 936. Depth, 1760. Drilling commenced Jan. 29, 1911. Drilling finished April 13, 1911. 221 feet of 10-inch casing; 1705 feet of 6-inch casing. See note on No. 207. Plate VI.

	Feet		
	From	To	Thickness
Clay, sand, rock and gumbo	0	266	266
Shale	266	271	5
Rock	271	275	4
Hard shale...........	275	480	205
Rock	480	484	4

Hard shale...........	484	510	26
Rock	510	515	5
Hard shale...........	515	562	47
Rock	562	585	23
Hard shale...........	585	602	17
Rock	602	612	10
Gumbo	612	632	20
Rock	632	647	15
Hard shale...........	647	652	5
Sand rock............	652	672	20
Gumbo	672	710	38
Sand rock...........	710	725	15
Shale	725	755	30
Gumbo	755	828	73
Rock	828	866	38
Gumbo	866	925	59
Rock	925	937	12
Hard sand...........	937	958	21
Gumbo	958	1048	90
Rock	1048	1055	7
Gumbo	1055	1120	65
Sand rock...........	1120	1140	20
Rock	1140	1148	8
Gumbo	1148	1185	37
Rock	1185	1192	7
Gumbo and boulders...	1192	1198	6
Sandy shale, showing some oil...........	1198	1240	42
Gumbo and boulders...	1240	1248	8
Rock	1248	1270	22
Gumbo and boulders...	1270	1295	25
Rock	1295	1310	15
Gumbo and boulders...	1310	1355	45
Sand and shale.......	1355	1388	33
Gumbo	1388	1575	187
Shale	1575	1620	45
Hard sand rock, showing gas............	1620	1630	10
Gumbo and boulders...	1630	1643	13
Rock	1643	1648	5
Second gas sand rock..	1648	1656	8
Gumbo and boulders...	1656	1675	19
Salt and shale........	1675	1688	13
Hard rock...........	1688	1691	3
Soft shale............	1691	1705	14
Gumbo	1705	1718	13

Soft rotten shale, showing some oil........	1718	1738	20
Gumbo	1738	1745	7
Hard oil sand........	1745	1754	9
Gumbo	1754	1755	1
Sand rock............	1755	1756	1
Hard oil sand........	1756	1759	3
Gumbo	1759	1760	1

No. 209.—Fultz No. 1. This is a shallow dry hole.

No. 210.—McAllister No. 1. This is a dry hole.

No. 211.—Fultz No. 2. Sealey Oil Co. Elevation, 910 (estimated). Depth, 250.

	Feet		
	From	To	Thickness
Red clay............	0	10	10
Water sand..........	10	17	7
Red clay.............	17	21	4
Water sand..........	21	49	28
Red clay.............	49	86	37
Dry sand............	86	91	5
Extra red clay........	91	107	16
Light blue...........	107	131	24
Red clay.............	131	139	8
Blue	139	148	9
Red clay.............	148	174	26
Light	174	195	21
Red clay.............	195	226	31
Water sand..........	226	239	13
Yellow	239	250	11

No. 212.—Holloway No. 3. Producers Oil Co. Elevation, 908. Depth, 1900. This is a dry well, somewhat southeast of the proven field. Plate IV.

No. 213.—Stine No. 1, Block 19. Producers Oil Co. Elevation, 940. Depth, 1928. A big salt sand was struck here. It is said this well is to be drilled deeper. Plate VI.

No. 214.—Sealey Co. No information could be secured regarding this well.

No. 215.—Brummett Ellis and Co. No. 1. Elevation, 880 (estimated). Depth, 342.

	Feet		
	From	To	Thickness
Clay	0	20	20
Water sand	20	28	8
Clay	28	35	7
Sand rock	35	100	65
Clay	100	120	20
Oil sand	120	125	5
Clay	125	318	193
Salt water sand	318	342	14

No. 216.—Parker No. 1. Fort Worth Oil Co. No data could be obtained regarding this well.

No. 217.—Smyers No. 1. Depth, 1586. This well is about three miles east a little south of Byers Station and is a dry hole.

	Feet		
	From	To	Thickness
Red mud	0	25	25
Hard sand rock	25	50	25
Red mud	50	60	10
Sand rock	60	100	40
Blue mud	100	125	25
Hard sand rock	125	200	75
Rock	200	350	150
Shale	350	400	50
Soft blue mud	400	500	100
Hard sand rock	500	540	40
Hard rock	540	700	160
Soft shale	700	750	50
Hard sand rock	750	1000	250
Soft red shale	1000	1090	90
Red mud	1090	1100	10
Soft shale	1100	1180	80
Sand rock	1180	1190	10
Hard sand rock	1190	1200	10
Soft sandstone	1200	1300	100
Hard rock	1300	1355	55
Hard sand rock	1355	1375	20
Clay, light blue	1375	1385	10
Soft sand rock	1385	1401	16
Red mud	1401	1418	17
Clay, light blue	1418	1424	6
Soft rock	1424	1433	9
Rock	1433	1443	10
Clay	1443	1452	9

Soft rock............	1452	1458	6
Clay	1458	1472	14
White rock...........	1472	1480	8
White rock...........	1480	1485	5
Clay	1485	1500	15
Gritty mud..........	1500	1504	4
Hard sand rock.......	1504	1506	2
Clay	1506	1512	6
Gritty mud...........	1512	1516	4
Soft white rock.......	1516	1530	14
Gritty mud...........	1530	1532	2
Soft white rock.......	1532	1550	18
Clay	1550	1558	8
Hard flint rock.......	1558	1562	4
Gritty mud...........	1562	1564	2
Soft rock............	1564	1570	6
Gritty mud...........	1570	1575	5
Soft white rock......	1575	1586	11

No. 218.—Singer No. 1. No information could be obtained relating to this well.

No. 219.—Lankford No. 1. Edmond Oil Co. No information could be obtained relating to this well.

No. 220.—Moser No. 1. Producers Oil Co. No information was obtainable.

No. 221.—Douthitt No. 1. Producers Oil Co. This is a dry hole, regarding which no further information could be secured.

No. 222.—Boddy No. 1. Corsicana Petroleum Co. Elevation, 844. Depth, 1770. This is a dry well, about seven miles northeast of Henrietta. Plate XIII.

	Feet		
	From	To	Thickness
Red clay.............	0	40	40
Quicksand	40	50	10
Red mud............	50	125	75
Gray sand...........	125	145	20
Red mud............	145	170	25
Soapstone	170	200	30
Red mud............	200	230	30
White mud..........	230	250	20
Red mud............	250	290	40
White sand..........	290	305	15
White mud..........	305	320	15

Red mud	320	350	30
White mud	350	400	50
White sand	400	410	10
White mud	410	440	30
Red mud	440	480	40
White mud	480	490	10
White sand	490	520	30
Red mud	520	550	30
White mud	550	590	40
Soapstone	590	630	40
Red mud	630	670	40
White mud	670	729	59
Red mud	729	739	10
White sand	739	740	1
Sand (some gas)	740	765	25
Blue shale	765	876	111
Sand	876	900	24
Red mud	900	930	30
White slate	930	945	15
Red mud	945	1000	55
White mud	1000	1065	65
White sand	1065	1075	10
White sand	1075	1180	105
White sand salt	1180	1228	48
Red mud	1228	1355	127
Sand	1355	1380	25
Gray slate	1380	1410	30
Sand, some oil	1410	1418	8
Red mud	1418	1436	18
Sand	1436	1465	29
Blue shale	1465	1476	11
Shale and rock	1476	1490	14
Flint rock	1490	1502	12
Blue shale	1502	1541	39
Slate and rock	1541	1565	24
Sand, some gas	1565	1579	14
Red mud	1579	1589	10
Sand rock	1589	1601	12
Blue shale	1601	1620	19
Shale and rock	1620	1651	31
Sand	1651	1665	14
Shale	1665	1679	14
Red shale	1679	1703	24
Sand	1703	1712	9
Blue mud	1712	1741	29
Blue shale	1741	1752	11
Sand rock	1752	1770	18

No. 223.—Myers Farm No. 1. Producers Oil Co. Elevation, 926. Depth, 2180. Drilling commenced May 27, 1909. Drilling finished Dec. 31, 1909. 176 feet of 12 1-2-inch casing; 589 feet of 10-inch casing; 1310 feet of 8-inch casing; 1942 feet of 6-inch casing. This is a dry hole about one mile southwest of the station at Henrietta. Plate XIII.

	Feet		
	From	To	Thickness
Red mud	0	280	280
Gray water sand	280	300	20
Red cave	300	415	115
Gray slate	415	425	10
Red cave	425	500	75
White water sand	500	525	25
Red cave	525	535	10
Broken sand	535	550	15
Gray salt sand	550	565	15
Red cave	565	575	10
White slate	575	590	15
Red and white, mixed	590	615	25
Salt water sand	615	636	21
Red cave	636	655	19
White slate	655	675	20
Red and blue mud	675	685	10
White slate	685	700	15
Red cave	700	705	5
White slate	705	710	5
White salt sand	710	735	25
Broken gray sand	735	745	10
Hard brown sand, trace of oil	745	755	10
Loose white sand	755	800	45
Broken gray sand	800	810	10
Red cave	810	820	10
White slate and shell	820	825	5
Red cave	825	845	20
Gray shells	845	855	10
Red cave	855	865	10
White sand	865	875	10
Water sand	875	885	10
Slate	885	890	5
Dark gray shells	890	900	10
Light slate	900	910	10
Red bed	910	925	15
Very white sand	925	940	15
Red rock	940	955	15
Gray water sand	955	975	20

Blue slate............	975	980	5
Red rock............	980	1005	25
Blue slate...........	1005	1010	5
Sand, white..........	1010	1020	10
Red marl, streaks of blue shale.........	1020	1030	10
Sand, light gray......	1030	1040	10
Red marl............	1040	1055	15
Sand, gray, dry......	1055	1060	5
Red marl............	1060	1085	25
Sand, white salt water.	1085	1100	15
Sand, broken.........	1100	1115	15
Sand, soft, white......	1115	1125	10
Broken sand.........	1125	1140	15
Blue slate...........	1140	1150	10
Sand, dry, white......	1150	1155	5
Dark blue slate.......	1155	1180	25
Sand streaks, light slate	1180	1200	20
Red marl............	1200	1225	25
Sand, gray...........	1225	1230	5
Red marl............	1230	1270	40
Brown shells.........	1270	1280	10
Red marl............	1280	1330	50
Sand, brown.........	1330	1350	20
Blue slate...........	1350	1380	30
Red marl with streaks of white sand shells.	1380	1470	90
Brown slate..........	1470	1495	25
White slate..........	1495	1606	111
Sand, white, salt water	1606	1628	22
Blue shale...........	1628	1648	20
Sand, white, salt water	1648	1663	15
Blue shale...........	1663	1700	37
White shale..........	1700	1715	15
Sand, white, salt water	1715	1727	12
Black gumbo.........	1727	1737	10
Gray sand...........	1737	1744	7
Blue shale...........	1744	1790	46
Sand with streaks of blue shale.........	1790	1810	20
Sand, white, with salt water	1810	1820	10
Blue shale...........	1820	1840	20
Sand, gray...........	1840	1850	10
Blue slate, streaks of black slate.........	1850	1930	80

Blue slate	1930	2173	243
Sand, gray, with salt water	2173	2180	7

No. 224.—Huggins Oil Co. No data could be obtained relating to this well.

No. 225.—Huggins No. 1. Producers Oil Co. Elevation, 820 (estimated). Depth, 2149. This is a dry hole near the Red River, about 12 miles southeast of Petrolia. Plate XIII.

	Feet		
	From	To	Thickness
Yellow clay	0	20	20
Sand and red marl with water	20	40	20
Quicksand	40	45	5
Red marl	45	350	305
White sand	350	360	10
Red marl and rock	360	390	30
Salt water, sand	390	410	20
Red marl	410	475	65
White sand	475	490	15
Red marl	490	540	50
White salt water sand	540	555	15
Red marl	555	585	30
White sand with streaks of lime	585	700	115
Blue shale, hard to mix	700	750	50
Lime shells, with streaks of white sand	750	760	10
Red marl	760	810	50
Soft white sand	810	820	10
Red marl	820	960	140
Salt water sand	960	1065	105
Blue shale	1065	1170	105
Salt water sand	1170	1190	20
Red marl	1190	1220	30
Gray sand	1220	1225	5
Blue gumbo	1225	1245	20
Salt sand, white	1245	1275	30
Blue gumbo	1275	1285	10
Blue shale	1285	1295	10
Red shale and rock	1295	1310	15
Blue gumbo	1310	1325	15
White soapstone	1325	1337	12
Sand, white, dry	1337	1342	5

Red marl and rock....	1342	1470	138
Blue shale...........	1470	1504	34
Sand, white..........	1504	1519	15
Blue shale...........	1519	1550	31
Sand, white..........	1550	1560	10
Blue shale...........	1560	1610	50
Water sand..........	1610	1630	20
Blue shale...........	1630	1690	60
Sand, white, salt water	1690	1700	10
Blue shale...........	1700	1790	90
Sand, white..........	1790	1810	20
Slate	1810	1840	30
Sand, dry............	1840	1845	5
Brown shale.........	1845	1892	47
Sand shells..........	1892	1895	3
Light blue shells......	1895	1920	25
Brown sand..........	1920	1925	5
Brown shale..........	1925	2147	122
Sand, white, salt water	2147	2149	2

No. 226.—Bellevue Oil and Gas Co. No. 1. The well is about three miles north of Bellevue and is dry. Plate XIII.

Samples examined:

2030-2038.—Gray, yellow, blue and yellowish sand and some gray limestone. Shell fragments, spines of brachiopods, and one crinoid joint were noted.

	Feet		
	From	To	Thickness
Soft red..............	0	73	73
Gray sand............	73	77	4
Soft red..............	77	105	28
Soft water, sand......	105	135	30
Soft red..............	135	175	40
Soft sandy shale.......	175	218	43
Soft red..............	218	226	8
Soft sand shale........	226	285	59
Soft yellow...........	285	320	35
Soft red..............	320	379	59
Soft gray shale........	379	395	16
Soft red..............	395	423	28
Soft blue shale........	423	451	28
Soft gray shale.......	451	467	16
Soft gray sand........	467	489	22
Soft red..............	489	530	41
Soft gray sand.........	530	551	21
Soft red..............	551	570	19
Soft yellow shale.......	570	593	23

Soft red..............	593	610	17
Soft sand..............	610	640	30
Soft blue shale.........	640	663	23
Soft gray sand........	663	667	4
Soft gray shale sand...	667	688	21
Soft gray sand.........	688	708	20
Blue shale............	708	739	31
Soft gray sand........	739	766	27
Blue shale............	766	825	59
Brown shale..........	825	838	13
Gray sand............	838	853	15
Blue shale............	853	871	18
Gray sand............	871	889	18
Blue shale............	889	915	26
Gray sandy shale......	915	931	16
Brown shale..........	931	947	16
Soft blue shale.........	947	963	16
Gray sand............	963	970	7
Sandy shale..........	970	976	6
Blue shale............	976	1040	64
Brown shale..........	1040	1054	14
Gray shale............	1054	1061	7
Brown shale..........	1061	1072	11
Gray sand.............	1072	1084	12
Brown shale..........	1084	1105	21
Blue slate.............	1105	1127	22
Gray sand............	1127	1143	16
Blue slate............	1143	1202	59
Hard lime shell.........	1202	1206	4
Red shale.............	1206	1220	14
Blue shale............	1220	1298	78
Gray sand.............	1298	1302	4
Blue shale............	1302	1360	58
Gray sand............	1360	1378	18
Blue shale............	1378	1403	25
Hard lime shell.......	1403	1405	2
Blue shale............	1405	1419	14
Black shale...........	1419	1438	19
Blue shale............	1438	1476	38
Black shale...........	1476	1518	42
Blue shale............	1518	1538	20
Hard lime shell........	1538	1540	2
Blue shale............	1540	1710	170
Brown shale..........	1710	1803	93
Blue shale............	1803	1830	27
Brown shale.......	1830	1845	15
Hard gray lime........	1845	1860	15

Soft blue shale........	1860	1878	18
Gray shale............	1878	1893	15
Blue shale............	1893	1924	31
Brown shale..........	1924	1957	33
Blue shale.............	1957	1981	24
Brown shale..........	1981	2005	24
Gray sand............	2005	2013	8
Blue shale............	2013	2015	2
Hard lime..............	2015	2032	17
Blue shale............	2032	2060	28
Brown shale..........	2060	2092	32
Blue shale............	2092	2127	35
Hard gray sand........	2127	2130	3

APPENDIX II.

NATURAL GAS FROM CLAY COUNTY,

HENRIETTA-PETROLIA FIELD.

BY

WM. B. PHILLIPS, Director.

Inasmuch as the Bureau of Economic Geology and Technology expects to issue within the next few months a special Bulletin dealing with gaseous fuels in Texas, both natural and manufactured, it is not necessary to enter, in detail, upon this subject now. But as certain analyses of crude petroleum from Wichita and Clay Counties have been given in this Bulletin and as many references have been made to the gas fields at Petrolia, Clay County, it has been thought best to give a few analyses of the gas from this field, with a brief account of the use of this gas in north Texas.

On the 16th and 23d of January, 1912, two analyses of natural gas from Clay County were received from the Dallas Gas Company. They were made by the United Gas Improvement Company, Philadelphia, and were as follows:

Carbon dioxide	0.20	none
Illuminants	0.30	0.30
Ethane	12.50	5.50
Oxygen	0.40	0.20
Carbon monoxide	....	0.30
Hydrogen	0.80	1.00
Methane	47.20	55.90
Nitrogen (by diff.)	38.60	36.80
	100.00	100.00
Specific gravity	....	0.72

Mr. W. M. Russell, City Gas Inspector, Fort Worth, made an analysis of the Clay County natural gas in 1909 as follows:

Carbon dioxide	none
Illuminants	0.80
Oxygen	0.70
Carbon monoxide	trace
Hydrogen	67.93
Methane	trace
Nitrogen (by diff.)	31.57
	101.00

On June 4th, 1912, an analysis of the natural gas supplied to the City of Dallas, from Clay County, was made by Mr. S. H. Worrell, Chemist to the Bureau. The results were as follows:

Carbon dioxide	none
Illuminants	none
Oxygen	none
Carbon monoxide	none
Hydrogen	none
Methane	56.80
Nitrogen (by diff.)	43.20
	100.00

In the Junkers Continuous Gas Calorimeter this gas gave 649 B. T. U. per cubic foot.

In a communication from Mr. N. C. Hamner, Consulting and Analytical Chemist, Dallas, who is also City Chemist, under date of August 14th, 1912, he says: "I have made a number of determinations of the heat value (*he speaks of the natural gas supplied to Dallas from Clay County, W. B. P.*) by means of the Junkers Calorimeter and find it to run about 740 B. T. U. at 0° C. and 29.8 inches of mercury. We calculate to this on account of the fact that the franchise calls for not less than 633 B. T. U. at 0° C. and 29.8 inches of mercury."

The Lone Star Gas Company, Fort Worth, informs us that the average composition of the natural gas from Clay County is about as follows:

Carbon dioxide	0.20
Illuminants	0.30
Oxygen	0.40
Carbon monoxide	0.00
Hydrogen	0.80
Methane	47.20
Ethane	12.50
Nitrogen (by diff.)	38.60
	100.00

This gas is now supplied to the following cities and towns in north Texas by the Lone Star Gas Company: Arlington, Alvord, Bellevue, Bowie, Bridgeport, Byers, Dallas, Dalworth, Decatur, Fort Worth, Grand Prairie, Henrietta, Irving, Petrolia, Rome, Sunset, Wichita Falls. In addition to this service this company is now extending its lines to other cities and towns.

The Wichita Falls Gas Company, Wichita Falls, supplies that city from its wells in Clay County.

It is likely that during the next few months there will be a marked increase in the number of cities and towns in north Texas to be supplied with natural gas, such as Denison, Sherman, Denton, Gainesville, Cleburne, Vernon, Chillicothe, Quanah, and, perhaps, even as far west as Amarillo.

The present piping distance to Dallas is about 125 miles.

The production of natural gas in Texas, 1911, was about 5½ thousand million cubic feet, valued at a little over $1,000,000, by far the greater part coming from Clay County.

The rates for natural gas in Dallas, effective February 14, 1912, were as follows: net, minimum bill per meter per month:

First 10 M. cu. ft.	45 cents per M.
Next 5 M. cu. ft.	40 cents per M.
Next 15 M. cu. ft.	35 cents per M.
Next 70 M. cu. ft.	30 cents per M.
Next 900 M. cu. ft.	20 cents per M.
All over 1000 M. cu. ft.	14 cents per M.

Schedule (A.) boiler rates on term contract, guaranteed minimum bill $60.00 per month:

First 250 M. cu. ft. net	20 cents per M.
All in excess of 250 M. cu. ft. per meter per month	10 cents per M.

Schedule (B.) boiler rates on yearly contract, guaranteed minimum bill $1,200 per annum: 9 cents, net, per M.

Some contracts at Wichita Falls, about 20 miles from the wells in Clay County, have been placed at rates varying from 5 to 7 cents per M. cu. ft. and it is reported that a lower rate would be offered to industrial establishments consuming large quantities of the gas.

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19	Skinner No. 4, P. O. C.	143	
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21	Skinner No. 2, P. O. C.	144	
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25	Stringer No. 14, P. O. C.	148	VIII, A.; XI, A.
26	Stringer No. 19, P. O. C.	148	VIII, A.; XI, B.; XII, B.
27	Stringer No. 12, P. O. C.	149	VIII, B.
28	Stringer No. 17, P. O. C.	150	VIII, B.
29	Stringer No. 10, P. O. C.	151	VIII, B.; X, A.; XII, A.
30	Stringer No. 16, P. O. C.	152	VIII, B.
31	Stringer No. 11, P. O. C.	152	VIII, B.
32	Stringer No. 9, P. O. C.	153	VIII, B.; X, B.
33	Stringer No. 21, P. O. C.	154	VIII, B.
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Well No.	Name	Page	Plate
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38	Stringer No. 6, P. O. C.	158	VIII, B.; XII, B.
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42	Sheldon No. 1, C. P. C.	164	IX, A.
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49	Hamilton No. 11, C. P. C.	166	X, A.
50	Hamilton No. 12, C. P. C.	166	X, A.
51	Hamilton No. 7, C. P. C.	166	X, A.
52	Hamilton No. 13, C. P. C.	167	
53	Hamilton No. 6, C. P. C.	167	IX, A.
54	Hamilton No. 8, C. P. C.	167	IX, B.
55	Hamilton No. 2, C. P. C.	167	IX, A.; X, B.
56	Hamilton No. 1, C. P. C.	167	X, B.; XII, A.
57	Hamilton No. 3, C. P. C.	167	X, B.; XII, A.
58	Hamilton No. 4, C. P. C.	167	X, B.
59	Hamilton No. 5, C. P. C.	167	IX, B.; X, B.
60	Putnam No. 9, C. P. C.	168	IX, A.
61	Putnam No. 8, C. P. C.	169	XI, A.
62	Putnam No. 11, C. P. C.	171	XI, A.
63	Putnam No. 12, C. P. C.	171	XI, A.; XII, A.
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65	Putnam No. 4, C. P. C.	174	IX, A.; XI, A.
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67	Putnam No. 18, C. P. C.	177	IX, A.
68	Putnam No. 5, C. P. C.	178	IX, A.; XII, A.
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70	Putnam No. 1, C. P. C.	182	IX, A.; XII, B.
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81	Allen No. 4, C. P. C.	197	IX, A.; X, A.
82	Allen No. 3, C. P. C.	198	IX, B.; X, B.
83	Allen No. 6, C. P. C.	199	IX. B.; XI, A.
84	Allen No. 1, P. O. C.	200	IX. B.; XI, A.; XII, A.; XII, B.
85	Allen No. 4, P. O. C.	200	XI, A.; XII, B.
86	Allen No. 7, P. O. C.	200	XI, A.; XII, B.
87	Allen No. 2, P. O. C.	201	IX, B.; XII, A.
88	Allen No. 6, P. O. C.	201	IX, B.; XII, A.
89	Wilson & O'Bryne No. 1.	202	
90	Home Oil Co. No. 1.	202	
91	Woodruff No. 2, C. P. C.	202	IX, B.; XI, B.
92	Culberson No. 1.	207	IX, B.; XI, B.
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