OKLAHOMA GEOLOGICAL SURVEY.

Governor R. L. Williams, State Superintendent R. H. Wilson,
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C. W. Shannon, Director.

CIRCULAR NO. 7.

CORRELATION OF THE OIL SANDS IN OKLAHOMA

BY
FRITZ AURIN

NORMAN.
October, 1917.

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CORRELATION OF THE OIL SANDS IN OKLAHOMA.

INTRODUCTION.

The study of subsurface geology is becoming an important phase of economic and stratigraphic geology. When new fields are opened, considerable prospecting follows in that and other areas, and the geologist undertakes to make reconaissance surveys. Much of the vital information is passed by in sueh hasty examinations. Detailed work is essential for accuracy and the structure must be carefully mapped before the location of any wells can be made with certainty. After a field has been developed, a study of the sands and other features of subsurface geology can be made, and is of much benefit in further development.

There are certain areas where the surface indications are insufficient to determine the structure, hence the well records are of the utmost importance. From the well records, certain horizons can be correlated and knowing the elevation at the top of the well, it is a simple matter to contour the horizon.

Realizing the need of specialization in oil geology, some of the large oil companies are establishing departments of subsurface geology as branches of the geologic divisions.

This discussion on the correlation of oil sands of Oklahoma is preliminary to later work which is now in progress, and will probably be issued at some future date as a bulletin.

METHODS OF CORRELATION.

Correlation of oil sands is a subject which takes into consideration many phases of geology. Formations are correlated on paleontological, paleobotanical, stratigraphical, or lithological data, any one or all of which may be used; or possibly from data other than that mentioned. Oil sands, on the other hand, cannot be correlated by all these methods. In fact, only a few can be employed.

The only way in which paleontology and paleobotany are used is in a correlation of the surface formations. There are exceptions to this. For example, many cases have been reported where fossils have been encountered in drilling wells. Data of this nature are important and conclusive if the fossils are typical and characteristic of a formation already

studied at the surface, or encountered in drilling a well in another locality. It is apparent that this method, if possible to use, would be the best and most nearly correct. However, its use in this respect is very limited as a means of correlation of oil sands.

Some oil sands may be correlated if certain characteristic formations either above, below, or near, as the case may be, the oil sands may be recognized. Correlations by this method would be rather indefinite or open to doubt in many instances. Generally, it is necessary to use this method, on account of insufficient data to correlate by other means.

Oil sands are correlated more on lithological data than on any other. It is the most practical method, yet may lead to a serious error if other things are not considered. As an example, the logs of two wells eight miles apart are being compared. Certain limestones occur in both wells and if they were considered together there is a chance for error by mistaking one limestone for another. In this case other methods ought to be used in addition to that already employed. Then again, a formation may be found to change in character from place to place. A limestone may grade into a shale, then to a sandstone, or the reverse may take place. There is also a chance for it to differ materially in thickness or pinch out and then come in again in the section. There are so many variations that to correlate any horizon on lithological data alone would be questionable.

To correlate oil sands we see that it is necessary to use all available data. One method may be sufficient, but to have a correct correlation the surface geology, general and local, changes in dips, characteristic horizons in the logs, altitudes of the wells, and any other data should be used if possible. All these relations can be best shown by platting in columnar form the available well logs showing the data as mentioned above, then by a direct comparison correlations can be made with some degree of accuracy.

WELL LOGS.

As previously stated, the correlations depend upon well logs, together with the altitudes of the wells and surface geology. The log being the most important factor, should be detailed and accurate. The inaccuracy of logs is one of the problems confronting one in this kind of work. It is a known fact that many drillers do not pay very much attention to the accuracy of the log. For example, in off-set wells drilled by different parties a comparison of the logs will show that the horizons vary in every manner, or may be present in one and missing in another. Many drillers will be confused as to the lithological character of the horizons. For instance, they may call a sandy shale a sand, shale, red rock, or most anything. Perhaps some mistakes can be accounted for, as it is not to be expected that drillers have a scientific knowledge of all rocks and their differentiation. In using a log, all these things must be considered and due allowance given for errors.

OIL SANDS.

An oil sand, as defined by common use, is a porous rock containing oil. This definition would be applicable to a limestone if it contained oil. In many instances drillers have reported great thicknesses of dry oil sands. These are not to be considered oil sands, according to the definition, but may, however, be classified as a sand consisting of the proper-sized grains and of sufficient amount of pore space for the rock to serve the purpose of an oil reservoir if the oil were present.

It often happens that one well will prove a "gusher," while another near by, at the same depth and in the same sand, comes in dry. This may be attributed to several causes, the chief of which is that the drill has pierced a close-grained or non-porous part of the reservoir rock.

GEOLOGICAL FORMATIONS.

The geology which is of particular interest to the practical oil man is the extent of formations which are or may be productive of oil and gas. The one series of rocks in Oklahoma that is of special importance from this standpoint is the Pennsylvanian. Practically all of the productive horizons in the Oklahoma fields are from the Pennsylvanian. There are four general areas of exposed Pennsylvanian; The area north of Arkansas River, the area south of Arkansas River, the area north of the Choctaw fault, and the area south of the Arbuckle Mountains.

GENERAL PROBLEMS IN THE CORRELATION OF SANDS IN THE PENNSYLVANIAN.

Several questions arise as to the extent and interval between succeeding formations, and also as to the constancy and correlation of horizons as the formations are traced westward and southward from the northeastern part of Oklahoma. The Cherokee formation, which is the approximate equivalent of the Vinita formation, has a thickness of 450 feet at the southern Kansas line. Southward from this point they thicken rapidly to at least 1,000 feet at Pryor Creek and continue to thicken southward. In the Muskogee quadrangle the Winslow and Boggy formations, about 1,500 feet in thickness, are correlated by Taff with the Cherokee formation. In the Coalgate quadrangle Taff has correlated the Atoka, Hartshorne, McAlester, Savanna, and Boggy formations with the Cherokee. Thus the Cherokee, which has a thickness of 450 feet at the Kansas line, is equivalent to the 9,000 feet of sediments from the base of the Atoka to and including the Boggy. Siebenthal makes the same correlation. On the other hand, Ohern says: "I cannot agree with Siebenthal in saying that in the Coalgate and Atoka quadrangles these 9,000 feet of Pennsylvanian shales and sandstones are represented at the Kansas line by a thickness of but 500 feet of Cherokee. Assuming the verity of his correlation of the Fort Scott of Kansas with the Calvin sandstone of Coalgate quadrangle, still his statement is probably not correct; for the relation of the Vinita formation to the Missis-

sipian below is for the most part, at least, one of overlap. Thus as one follows the Mississippian-Pennsylvanian contact line southward and eastward from the Kansas line, successively older formations appear from beneath those overlying. At most, then, the Cherokee shales can be the equivalent of only a part of the 9,000 feet of Pennsylvanian sediments near Coalgate."

It would appear, then, that productive horizons near the base of the Pennsylvanian encountered in the territory to the north of Muskogee and Okmulgee counties are not the same as the basal horizons encountered in the above-mentioned counties. The writer takes this view, and the correlations as platted on the chart have been made with that in mind.

DISCUSSION OF THE OIL SANDS AND ASSOCIATED HORIZONS FROM OLDEST TO YOUNGEST.

SIMPSON SANDSTONE.

The Simpson sandstone, in the Arbuckle Mountains, and of Ordovician age, is the oldest oil horizon in Oklahoma. As found in places in the Arbuckle Mountains, certain horizons in the Simpson formation are impregnated with asphalt. In this respect it may be considered as a fossile oil sand, but in the Healdton field there is a possibility, according to some geologists, of the Simpson being a productive horizon.

MISSISSIPPIAN LIME.

The "Mississippi lime" of the drillers may be either the Pitkin limestone, limestone in the Fayetteville shales, the Mayes limestone, or the Boone chert. Drilling is usually discontinued when the driller is satisfied that these horizons have been reached. As before stated, oil and gas are not definitely known to occur in, or below these horizons, and in nearly every case where they have been penetrated strong flows of salt water have been encountered. It is probably true that drilling is often discontinued when some of the limestones in the Lower Pennsylvanian are encountered and mistaken for the "Mississippi lime."

PENNSYLVANIAN SANDS.

The oldest sands in the Pennsylvanian occur in the Morrow formation. In the Beland pool two gas sands have been referred to this horizon. One is encountered at a depth of 1,500 feet, and the other at 1,745 feet.

Only brief reference is given to the succeeding sands with their correlations. Some of the main productive horizons will be discussed.

BARTLESVILLE SAND.

The Bartlesville sand is the most widely known oil sand in the State, and more oil has been produced from this sand than from any other horizon in Oklahoma. This sand occurs near the base of the Cherokee formation. The heavy sandstone outcropping east of Welch, at Bluejacket ,and northwest of Vinita, is probably the Bartlesville. It has been

recognized to the westward through Osage County, as far as the drilled areas in Kay County, and to the southwest in the Cushing field, where it has proven the sand of big production. In the latter field it occurs at depths from 2,400 to 2,800 feet. This formation is not an oil sand in all of its areal extent, although the term is very properly applied to the strata occurring at this horizon.

WHEELER SAND.

The Wheeler "sand" of the Cushing field is a good example of formations other than true sands forming oil reservoirs. This sand, which changes in character from an impure limestone to a sandy lime. is probably the equivalent of the Fort Scott or Oswego lime, which is one of the most constant formations underlying practically the entire oil and gas area of northeastern Oklahoma.

LAYTON SAND.

The Layton sand, which has been extensively developed in the Cushing field, probably occurs in the Curl formation. This sand, or its equivalent, has been recognized in various fields in northeastern Oklahoma. At Wynona a sand encountered at a depth of 1,180 feet is probably the Layton or its equivalent. The same is encountered in the Boston, Cleveland, Cushing, Yale, Ripley, Ponca City, and Blackwell fields at depths of 1,240, 1,300, 1,480; 1,975, 2,072; 2,300 and 2,655 feet; respectively.

PONCA AND NEWKIRK SANDS.

The Ponca sand probably occurs in the Buxton formation. At Ponca City this sand is productive of both oil and gas and is encountered at a depth of about 1,550 feet. In the Blackwell field a sand encountered at a depth of about 1,960 feet is probably the Ponca.

The Newkirk sand, which is the equivalent or a part of the Elgin sandstone, is encountered in the Newkirk field, where it is productive of oil at a depth of 900 feet. In the Ponca City and Blackwell fields it is encountered at depths of 975 and 1,440 feet, respectively.

MISCELLANEOUS SANDS.

In the Healdton field about 7 sands productive of oil and gas have been encountered. The deepest is that of the 2000-foot sand encountered in the Fox district. Other sands are encountered at the following depths: 725, 781, 820, 925, 1,040, 1,070 feet. Several other sands are also encountered. It is thought that all these sands, with possibly the exception of the deepest sands, occur in the Permian Redbeds.

In the Wheeler, Duncan, Gotebo, and Lawton fields various oil sands have been encountered in the Permian Redbeds.

The highest stratigraphic productive sand in Oklahoma is that of the 450-foot sand in the Madill pool. This sand occurs in the Trinity sand of Lower Cretaceous age.

SUMMARY.

Data have been collected from most of the important fields of the State. The interpretation of these data is shown on the correlation table accompanying this publication.

The writer is especially indebted to Messrs. Fohs and Gardner, Tulsa, Okla., for information furnished from their correlations of Oklahoma oil sands.

WELL LOGS.

The following well logs are given to show the general characteristics of the oil and gas fields of Oklahoma.

Tammany, Wm. Lowe, No. 2, in sec. 12, T. 14 N., R. 12 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Soil	5	5	Sand	25	1,055
Lime	40	45	Slate	335	1,390
Slate	25	70	Sand (water)	183	1,573
Lime	15	85	Slate	57	1,630
Shelly	40	125	Lime	5	1,635
Slate	125	250	Slate	305	1,940
Lime	20	270	Lime	10	1,950
Slate	30	300	Slate	68	2,018
Lime	15	315	Lime	20	2,038
Slate	125	440	Slate	12	2,050
Lime	10	450	Lime	20	2,070
Slate	225	675	Slate	15	2,085
Lime	25	700	Top oil sand	4	2,089
Slate	75	775	Broken sand and shells	70	2,159
Sand	130	905			
Slate	125	1,030			

Lucinda Johnson No. 1, in NE. ¼ sec. 30, T. 22 N., R. 15 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Soil	18	18	Broken sand	10	680
Blue shale water	132	150	Shale	175	855
Lime	30	180	Sand	6	861
Black shale	5	185	Broken sand, gas	5	866
Lime	12	197	Broken sand	5	871
Shale	40	237	B. Shale	50	921
Lime	8	245	Lime	10	931
Shale	175	420	Black shale	45	976
Lime	25	445	Lime	45	1,021
White shale	40	485	Shale	10	1,031
Sand, gas	15	500	Lime	40	1,071
Shale	100	600	Shale	9	1,080
Sand, gas	15	615	Sand	10	1,090
Black shale	5	620	Lime	7	1,097
Lime	5	625	Sand	5	1,102
Broken sand	5	630	White sand (water)	30	1,137
Shale	40	670			

Log of Monitor Oil Company Well No. 1, Osage County, sec. 25, T. 22 N., R. 7 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Soil	20	20	Sand	15	895
Lime	5	25	Slate	15	910
Red rock	40	65	Sand	105	1,015
Slate	40	105	Slate and sand	35	1,050
Sand	10	115	White slate	20	1,070
Slate	20	135	Sand and slate	25	1,095
Sand	60	195	Lime	3	1,098
Slate	155	350	Blue slate	69	1,167
Red rock	15	365	Lime	38	1,205
Lime	7	372	Blue slate	50	1,255
Red rock	23	395	Sand	15	1,270
Blue slate	30	425	Slate	25	1,295
Sand	6	431	Sand	22	1,317
Slate	19	450	Slate	183	1,500
Sand	10	460	Layton sand	50	1,550
Slate	27	487	Slate	194	1,744
Sand	9	496	Lime	8	1,752
Slate	74	570	Slate	38	1,790
Sand	15	585	Cleveland sand	35	1,825
Slate	37	622	Slate and sand	75	1,900
Blue slate	18	640	Sand	30	1,930
Sand and slate	47	687	Slate	60	1,990
Lime	23	710	Oswego lime	65	2,055
Blue slate	90	800	Slate	10	2,065
Sand	18	818	Oswego lime	45	2,110
Lime	7	825	Slate	55	2,165
Slate and sand	30	855	Peru sand	13	2,178
Slate	25	880			

Stevens No. 1, in sec. 9, T. 14 N., R. 18 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Unrecorded (water)		160	Slate	10	1,490
Slate		450	Lime	15	1,505
Sand	20	470	Sand (water)	65	1,570
Slate, black	155	625	Slate	20	1,590
Lime	10	635	Lime, white	80	1,670
Slate	265	900	Slate, black	20	1,690
Sand	30	930	Lime shells	125	1,815
Slate	75	1,005	Shale, brown	85	1,900
Lime shells	10	1,015	Sand, black	65	1,965
Lime, hard	20	1,140	Slate, sandy	35	2,000
Slate	70	1,210	Slate, black	36	2,036
Lime	20	1,230	Sand	12	2,048
Sand, black	20	1,250	Slate	42	2,090
Slate	50	1,300	Sand	80	2,170
Sand	15	1,315	Slate	10	2,180
Slate	60	1,375	Sand, green	40	2,220
Lime	15	1,390	Red rock	55	2,275
Sand	30	1,420	Slate	25	2,300
Slate	45	1,465	Lime	40	2,340
Lime	15	1,480	Lime, sandy	45	2,385

McCroskey No. 1, SE. cor. NW. ¼ sec. 7, T. 19 N., R. 6 E., Alice-Kathryn Oil Co.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Surface	20	20	Red rock	14	1,365
Lime shell	3	23	Sand, water	28	1,393
Red rock	17	40	Blue slate	5	1,398
Lime shell	6	46	Lime shell—very hard	7	1,405
Shale	24	70	Blue slate	5	1.410
Sand—some water	15	85	Sand	15	1,425
Red rock	5	90	Lime shell	6	1,431
Sand	10	100	Blue slate	20	1,451
Shale	2	102	Lime shell	4	1,455
Gritty slate	38	140	Blue slate	5	1,460
Slate	5	145	Sand	10	1,470
Shells, water	5	150	Blue slate	3	1,473
Red rock	5	155	Lime shell, very hard	57	1,530
Shale, water	5	160	Blue shale	80	1,610
Slate	20	180	Lime shell	2	1,612
Lime shells	7	187	Sandy slate	22	1,634
Gritty shale	58	245	Lime shell	4	1,638
Lime	5	250	Sand	3	1,641
Red rock	35	285	Underreamed 23 feet	23	1,664
Blue slate	15	300	Black slate	61	1,725
Red rock	20	320	Sand, water	81	1,806
Slate and shells	60	380	Black slate	8	1,814
Sand and shells	55	435	Sand (hole full of		
Blue slate	60	495	water)	9	1,823
Red rock	10	505	Slate	10	1,033
Sand	20	525	Brown shale	27	1,860
Blue slate	110	635	Sand	5	1,865
Red rock	10	645	Brown shale	28	1,893
Sand	35	680	White sand	12	1,905
Blue slate	5	685	Shale	245	2,150
Red rock	15	700	White sand—water	27	2,177
Sand	12	712	Slate	221	2,398
Blue slate	123	835	Sand (some oil)	37	2,435
Sand	30	865	Black slate	130	2,565
Sand shale	25	890	Gritty shale	35	2,600
Red rock	5	895	Black slate	118	2,718
Shale	15	910	Lime	57	2,775
Sand	50	960	Slate	20	2,795
Lime and slate	77	1,037	Lime	40	2,835
Sand broken	9	1,046	Black slate	5	2,840
Blue slate	12	1,058	Lime	14	2,854
Red rock	43	1,101	Sand and water	46	2,900
Lime shell	1	1,102	Slate	127	3,027
Red rock	2	1,104	Sand	15	3,042
Red rock	21	1,125	Sandy shale	18	3,060
Sand, water	26	1,151	Lime	5	3,065
Red rock	37	1,188	Blue slate	20	3,085
Lime shells	10	1,198	Shale	42	3,127
Blue slate	62	1,260	Sand, dry	20	3,147
Sand	48	1,308	Sand, oil	22	3,169
Slate	43	1,351	Black shale	115	3,284

Log of Alberta No. 1, SE. ¼ sec. 32, R. 29 N., R. 1 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Soil	55	55	Shale	45	1,490
Gypsum	15	70	Lime	10	1,500
Blue slate	30	100	Shale	75	1,575
Lime	10	110	Lime	25	1,600
Slate	30	140	Shale	10	1,610
Lime	15	155	Lime	35	1,645
Slate	45	200	Shale	5	1,650
Lime	25	225	Lime	50	1,700
Slate	25	250	Blue shale	35	1,735
Red rock	25	275	Sand (gas)	15	1,750
Slate	15	290	Shale	40	1,790
Lime	10	300	Sand	15	1,805
Slate	25	325	Shale	60	1,865
Lime	8	333	Lime	40	1,905
Slate	7	340	Red rock	30	1,935
Sandy lime (gas and			Sand (some gas)	30	1,965
water)	30	370	Red rock	10	1,975
Red rock	35	405	Slate	25	2,000
Shells and slate	15	420	Lime	5	2,005
Lime	15	435	Slate	30	2,035
Slate	15	450	Lime	10	2,045
Lime sand	35	485	Slate	5	2,050
Red rock	30	515	Lime	30	2,080
White shale	5	520	Slate	30	2,110
Shale	5	525	Sand	15	2,125
Red rock	35	560	Slate	60	2,185
Lime	10	570	Lime	15	2,200
Red rock	20	590	Slate	80	2,280
Lime	30	620	Sand (showing of oil)	10	2,290
Red rock	25	645	Slate	15	2,305
Lime	25	670	Sand (water)	70	2,375
Red rock	20	690	Sand	25	2,400
Lime	65	755	Shale	250	2,650
Blue shale	5	760	Sand (gas 2 million		
Lime (gas at 775)	95	855	feet)	15	2,665
Slate	95	950	Sand, oil	10	2,675
Lime	10	960	Sand (water at 2700	75	2,750
Shale	40	1,000	Lime	15	2,765
Lime	25	1,025	Slate	35	2,800
Blue shale	25	1,050	Lime	70	2,870
Lime	10	1,060	Slate	15	2,885
Blue shale	110	1,170	Slate	45	2,930
Lime	70	1,240	Lime	50	2,980
Shale	20	1,260	Shale	50	3,030
Lime	20	1,280	Sand (oil showing)	30	3,050
Shale	45	1,325	Lime	130	3,180
Lime	10	1,335	Lime, caprock	100	3,280
Slate	40	1,375	Sand, gas	25	3,305
Lime	35	1,410	Sand, oil	15	3,320
Slate	15	1,425	Shale	40	3,360
Sand (gas, 10 mil.			Sand, oil	25	3,385
feet, water)	20	1,445			

W. B. Pine No. 1, one-half mi. S. of Henryetta, in T. 11 N., R. 12 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Soil	10	10	Sand, white, (heavy paraffin, oil and gas	11	1,027
Slate, white	91	101	Slate, white (lime shells)	865	1,892
Limestone, hard, gray	4	105	Sand, white, dry	15	1,907
Slate, soft, white	100	205	Limestone, hard, gray	101	2,008
Slate, soft, grayish blue	197	402	Slate, soft, white	5	2,013
Sand, white, (water)	32	434	Limestone, hard, gray	7	2,020
Shale, white	76	510	Coal, fine quality	4	2,024
Shale, grayish, blue	355	865	Limestone, hard, gray	252	2,276
Sand, white, (water)	45	910	Slate, soft, gray	30	2,306
Slate, soft, white	50	960	Lime shell, hard, sandy	3	2,309
Slate, hard, gray	56	1,016			

Log of Mid-Co. Petroleum Co.'s No. 1 well in the N. ½ SW. ¼ sec. 22, T. 23 N., R. 2 W., near Billings, Okla.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Earth	6	6	Red rock	56	696
Lime	24	30	Hard slate	19	715
Sand	4	34	Red rock	25	740
Slate	16	50	Gas sand	15	755
Red rock	10	60	Slate	10	765
Blue slate	37	97	Soft gray lime	42	807
White shale	13	110	Red rock	23	830
Red rock	5	115	Gas sand	12	842
Slate	20	135	Red rock	18	860
Red rock	105	240	Hard sand and gas	10	870
White slate	10	250	Red rock	14	884
Red rock	15	265	Hard, gritty lime, gas	21	905
Lime	4	269	Hard slate	10	915
Red rock	46	315	Red rock	112	1,027
Slate	10	325	Gas sand	20	1,047
Red rock	5	330	Blue slate	2	1,049
White slate	8	338	Sand and lime	17	1,066
Red rock	17	355	Red rock	64	1,130
Soft slate	10	365	Lime	6	1,136
Soft red rock	15	380	Red rock	14	1,150
Lime	8	388	First water sand; water salty	20	1,170
Sand rock	7	395	Slate	25	1,195
White slate	25	420	Lime	23	1,218
Hard lime	15	435	Red rock	52	1,270
Soft lime	15	450	Lime	30	1,300
White slate	42	492	Brown slate	15	1,315
Red rock	28	520	Lime	75	1,390
Gray lime	15	535	Blue slate	5	1,395
Red rock	25	560	Lime	5	1,400
Hard slate	10	570	Lime and slate	76	1,476
Gas sand	12	582	Gas sand	69	1,545
Red rock	38	620	Slate	25	1,570
Blue lime	5	625			
Hard sand	15	640			

Jemima Richards No. 3, SW. of the N. ½ of sec. 3, T. 17 N., R. 7 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Sand	54	54	Lime	9	729
Slate	46	100	Lime	3	732
Lime	5	105	Sand	17	749
Slate	15	120	Lime	4	753
Red rock	48	168	Sand	7	760
Slate	12	180	Slate	16	776
Sand	25	205	Sand	24	800
Slate	29	234	Slate	3	803
Sand	23	257	Sand	7	810
Lime	5	262	Lime	2	812
Sand	22	284	Sand	6	818
Lime	10	294	Slate	62	880
Sand	6	300	Lime	5	885
Slate	5	305	Sand (water)	13	898
Red rock	9	314	Slate	14	912
Slate	21	335	Sand	41	953
Lime	4	339	Slate	16	969
Slate	29	368	Lime	4	973
Red rock	22	390	Sand	39	1,012
Sand	20	410	Slate	13	1,125
Slate	5	415	Slate	201	1,326
Sand	20	435	Lime	6	1,332
Slate	26	461	Slate	15	1,347
Sand	13	474	Sand (Layton)	40	1,387
Slate	15	489	Shale	5	1,392
Lime	21	510	Slate	169	1,561
Sand	20	530	Lime	4	1,565
Slate	4	534	Sand (Cleveland)	12	1,577
Sand	12	546	Slate	444	2,021
Slate	22	568	Wheeler sand	14	2,035
Lime	8	576	Break	12	2,047
Slate	14	590	Lime (2nd gas)	43	2,090
Lime	30	620	Slate	106	2,196
Sand	7	627	Lime	3	2,199
Slate	8	635	Slate	101	2,300
Lime	12	647	Sand (water)	1	2,301
Slate	10	657	Slate	95	2,396
Sand	33	690	Sand (gas)	15	2,411
Slate	20	710	Slate	20	2,431
Lime	10	720	Bartlesville sand*	54	2,485

*Entire production 110 bbls. per hour.

Jack Summers No. 1, in sec. 17, T. 15 N., R. 14 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Shale	200	200	Sand	186	1,176
Lime	10	210	Slate	224	1,400
Sand	15	225	Sand	175	1,575
Slate	650	875	Slate and lime shells	105	1,680
Sand	30	905	Sand	5	1,685
Slate	85	990	Slate and lime shells	60	1,745

Log of Tulsa County well, 250 feet N. and 200 feet W. of SE. cor. sec. 25, T. 19 N., R. 11 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Surface	20	20	Black shale	3	1,077
Sandstone and yel. soil	20	40	Lime shell	83	1,160
Blue shale	20	60	Brown shale	9	1,169
Gray sandy shale	240	300	Lime shell	181	1,350
Dark shale	24	324	Brown shale	3	1,353
Water sand	36	360	Lime shell	27	1,380
Blue shale	8	368	Black slate	165	1,545
Lime shell	32	400	Brown and white shale	3	1,548
Blue shale	40	440	Lime shell	102	1,650
White sandy shale—show of gas	360	800	Blue shale	3	1,653
Brown shale	30	830	Lime shell	122	1,775
Black slate	50	880	White and blue shale	108	1,883
Big lime	145	1,025	Taneha sand	14	1,897
Sandy shale	33	1,058	Blue and black shale	22	1,919
Oswego lime	16	1,074	Oil sand	4	1,923

Log of well, 101 Ranch, in NE. ¼ sec. 25, T. 25 N., R. 1 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Sandy soil	19	19	Black slate	6	742
Gravel	40	59	Hard lime	38	780
White clay (water)	10	69	White slate	50	830
Red rock	12	81	Grayish lime	24	854
Gritty slate	8	89	Black slate with shells	18	872
Red rock	21	110	Black slate with hard shells	24	896
White shale or clay	42	152	Black slate	6	902
Lime shell	9	161	Slate and shells	21	923
White shale or clay	44	205	Reddish tinted slate	37	960
Red rock	26	231	Gritty shell in black slate	45	1,005
Lime shell	3	234	White and black sand	12	1,017
Red rock	60	294	Black slate	45	1,062
Brownish lime	4	298	Slate and shell	4	1,066
Hard black slate	28	326	Soft slate	85	1,151
Reddish lime	24	350	Lime	4	1,155
Red rock	35	385	Very soft slate	75	1,230
Gritty slate	20	405	Hard white sand	6	1,236
Red rock	22	427	Soft black slate	24	1,260
White shale	8	435	Dark soft shale	12	1,272
Brownish lime	8	443	Lime cavings	43	1,315
Hard grayish lime	22	465	White sand (water)	19	1,334
Red shale	35	500	Slate and shells	33	1,367
Lime shell	12	512	Hard lime	18	1,385
Red rock	58	570	Soft dark lime	10	1,395
Red sand	23	593	Soft black shale	23	1,418
Hard white lime	5	598	Red rock	15	1,433
Red shale	27	625	White sand	17	1,450
White sand	35	660	Black slate	10	1,460
Red shale	42	702			
White sand	34	736			

Log of well, 101 Ranch, in NE. ¼ sec. 25, T. 25 N., R. 1 E.—Continued.

Character of rock.	Thickness.	Depth	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Very hard sand	56	1,516	Lime shell	3	2,018
Black shale	6	1,522	Sandy lime	19	2,037
Fine hard sand	7	1,529	Brown shale	3	2,040
Soft shale	20	1,549	White sand	5	2,045
White sand (water)	28	1,577	White shale	13	2,058
Blue shale	3	1,580	White sand	30	2,088
Gritty lime	5	1,585	Black shale	20	2,108
Black slate	53	1,638	Hard lime	6	2,114
Sandy lime	25	1,663	Black slate	49	2,163
Soft black shale	22	1,685	Hard shell	3	2,166
Red shale	5	1,690	Black slate	14	2,180
White sand	15	1,705	Hard white sand	10	2,190
Black slate	3	1,708	Red brown shale	4	2,194
White sand	28	1,736	White slate	5	2,199
Black shale	20	1,756	Very hard white lime (water)	43	2,242
Lime shell	7	1,763	Black slate	26	2,268
Soft black shale	36	1,799	Dark lime	11	2,279
White sand (water)	39	1,838	Black shale	3	2,282
Soft shale	4	1,842	White sand (salt water)	18	2,300
Gritty gray lime	10	1,852	Dark shale	3	2,303
Black shale	6	1,858	Very white sand	59	2,362
Slate and shell	22	1,880	Dark black shale	43	2,405
Soft black shale	5	1,885	Dark lime	6	2,411
Red shale	7	1,892	Blue shale	54	2,465
White lime	30	1,922	White shale	20	2,485
Soft black shale	13	1,935	Dark blue shale	35	2,520
Soft red shale	15	1,950	White sand	56	2,576
White lime	28	1,978			
Red rock cavings	22	2,000			
Hard gray lime	15	2,015			

Albert Whiteturkey No. 2, in NE. cor. sec. 18, T. 26 N., R. 13 E.

Character of rock.	Thickness.	Depth.	Character of rock.	Thickness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Unrecorded	42	42	Break	12	618
Shale	28	70	Lime (little gas)	34	652
Lime	30	100	Slate, black	2	654
Shale, light	95	195	Lime	5	659
Sand	10	205	Shale	6	665
Shale, light	145	350	Sand	15	680
Lime	4	354	Shale	112	792
Break	5	359	Lime, Big	33	825
Lime	6	365	Slate, black	6	831
Shale	27	392	Lime, Big, (little gas)	23	854
Lime	5	397	Break	6	860
Slate, black	8	405	Lime, hard	9	869
Lime	18	423	Slate, black	20	889
Shale, light	15	438	Oil sand	24	913
Sand	30	468	Slate, black	6	919
Shale, light	114	582	Lime, hard	9	928
Lime	24	606	Slate, black	15	943

Albert Whiteturkey No. 2, in NE. cor. sec. 18, T. 26 N., R. 13 E.—Continued.

Character of rock.	Thick-ness.	Depth.	Character of rock.	Thick-ness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Shale	37	980	Shale, sandy	45	1,145
Shell, hard	5	985	Slate, black	17	1,162
Slate	17	1,002	Sand, gas	7	1,169
Shell, hard	3	1,005	Slate	26	1,195
Shale, light	45	1,050	Sand	89	1,284
Shell	3	1,053	Sand, oil	7	1,291
Shale, light	37	1,090	Slate and shale	83	1,374
Slate, black	10	1,100	Miss. lime, Total depth		1,378

Margaret Primeaux No. 1, in sec. 4, T. 25 N., R. 2 E.

Character of rock.	Thick-ness.	Depth.	Character of rock.	Thick-ness.	Depth.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Soil	4	4	Lime	9	758
Clay	40	44	Slate	2	760
Sand and gravel	6	50	Lime	25	785
Lime	20	70	Slate	74	859
Red rock	45	115	Shell	9	868
Shell	5	120	Slate	35	903
Red rock	40	160	Shell	3	906
Lime	5	165	Slate	26	932
Slate	10	175	Lime	3	935
Red rock	59	234	Sand	15	950
Sand (gas)	20	254	Slate	25	975
Red rock	10	264	Lime	10	985
Slate	5	269	Slate	60	1,045
Lime	5	274	Black shale	15	1,060
Slate	13	287	Lime	10	1,070
Red rock	12	299	Slate	60	1,130
Lime	46	345	Shale	15	1,145
Red rock	20	365	Slate	75	1,220
Gas sand	12	377	Lime	15	1,235
Slate	2	379	Slate	25	1,260
Lime	4	383	Lime	15	1,275
Slate	30	413	Red rock	4	1,279
Red rock	42	455	Lime	2	1,281
Lime	10	465	Slate	10	1,291
Red rock	2	467	Lime	15	1,306
Lime	6	473	Slate	12	1,318
Red rock	69	542	Lime	2	1,320
Gas sand	12	554	Red rock	2	1,322
Red rock	18	572	Sand (gas)	10	1,332
Lime	4	576	Slate	20	1,352
Slate	17	593	Lime	10	1,362
Lime	5	598	Slate	35	1,397
Lime	42	640	Lime	15	1,412
Slate	5	645	Slate	10	1,422
Red rock	6	651	Lime	8	1,430
Slate	8	659	Slate	5	1,435
Lime	10	669	Lime	8	1,443
Red rock	10	679	Lime	17	1,460
Lime	26	705	Lime	27	1,487
Slate	8	713	Slate	6	1,493
Lime	10	723	Lime	3	1,496
Sand	20	743	Slate	10	1,506
Break	2	745	Sand	20	1,526
Sand (little gas)	4	749	Black slate	4	1,530
			Oil Sand	19	1,549

Correlation of Oil Sands in Oklahoma.

by Fritz Aurin.

Name of Formation.		Name of sand or horizon.	Correlation with other named sands.	Madill	Healaton	Wheeler	Loco	Duncan	Lawton	Gotebo	Blackwell-Gas	" " -Oil.	Billings
		RANGE.		5 E.	3 W.	2 W.	5 W.	6 W.	10 & 11 W.	16 W.	1 W.	1 E.	2 W.
		TOWNSHIP.		5 S.	3 & 4 S.	3 S.	3 S.	1 N.	1 & 2 N.	7 N.	27 & 28 N.	29 N.	23 N.
CRETACEOUS	TRINITY.	Sand.		450									
PERMIAN.	REDBEDS.	Sand.	Not correlated		725 *	265 *	137 *	250 *	400 *	350 *			
		Sand.			781 *	670 *	590 *	1835	800 ●				
		Sand.			820 ●	960 ●	760 *						
		Sand.			925 ● 80								
		Sand.			1040 ● 50								
		Sand.			1070 ● 30								
	?	Sand.			2000 *								
	UNDESCRIBED SERIES ABOVE HERINGTON LS.	Sand.										350 * 25	
		Sand.										435 * 10	
	GARRISON FORMATION.	Blackwell.									750 * 10	715 * 25	740 * 15
	ESKRIDGE SHALE.	Sand.									960 *	920 * 20	927 * 20
		Sand.									1060		
PENNSYLVANIAN.	ELGIN SANDSTONE.	Newkirk.	Elgin.								1480 30	1440 35	1476 ♦ 69
	BUXTON FORMATION.	Sand.										1750 * 25	
		Sand.										1800 25	
		Ponca.										1960 ♦ 20	1933 ♦
	RAMONA FORMATION.	Musselman											
		Sand.										2280 ♦ 15	
		Sand.											
	CURL FORMATION.	Layton.										2655 ♦ 95	
	NOWATA SHALE.	Wayside.	Jones, Mc. Ewen.									2765 25	
	OOLOGAH FORMATION.	Big Lime.										2930	
	LABETTE SHALES.	Cleveland.											
		Peru.										3050 ♦ 20	
	FT. SCOTT LS.	Oswego Lime.	Wheeler, Swenson.									3300 30	
	ATOKA, HARTSHORNE, McALESTER, SAVANNA, AND BOGGY FORMATIONS (CHEROKEE ?)	Squirrel.	Bixler, Prue.									3360 *	
		Skinner.											
		Red Fork.											
		Nemire											
		Sand.											
		Bartlesville.	Glenn, Gas of Morris										
		Sand.											
		Tucker.	Meadows, Burgess, Taneha, Booch, Squaw.										
		Sand.	Second Booch.										
		Dutcher.	Colbert.										
		Sand.											
		Mounds.											
		Sapulpa.	Morris.										
		Glenn of Morris.											
		Leidecker											
		Sand											
		Muskogee.	Boynton.										
		Miscellaneous Sands.	Sand not correlated.										
	MORROW FORMATION	Sand.											
		Sand.											
		Sand.											
MISS.	PITKIN LIMESTONE												

LEGEND.

- ● Oil producing.
- * Gas producing.
- * Oil & Gas producing
- ♦ Showing of Oil.

Top figure is depth
bottom figure is thic

LEGEND.

Oil producing.
Gas producing.
Oil & Gas producing
Showing of Oil.

Top figure is depth of sand and bottom figure is thickness of sand in feet.

Healdton	3 & 4 S.	3 W.
Wheeler	3 S.	2 W.
Loco	3 S.	5 W.
Duncan	1 N.	6 W.
Lawton	1 & 2 N.	10 & 11 W.
Gotebo	7 N.	16 W.
Blackwell-Gas	27 & 28 N.	1 W.
" " -Oil.	29 N.	1 E.
Billings	23 N.	2 W.
Ponca City	25 & 26 N.	2 E.
Newkirk	28 N.	3 E.
Otoe	23 N.	3 E.
Avery	16 N.	5 E.
Ingalls	19 N.	4 E.
Ripley	18 N.	4 E.
Yale	19 N.	5 E.
Cushing	17 & 18 N.	7 E.
Ranch Creek	21 N.	7 E.
Lauderdale	20 & 21 N.	7 & 8 E.
Cleveland	21 N.	8 E.
Boston	21 N.	7 & 8 E.
Osage Jct.	21 N.	8 E.
Hominy	23 N.	8 E.
Pawhuska	25 N.	9 E.
Wynona	26 N.	15 E.
Nelagony	25 N.	11 E.
Bigheart	24 N.	10 & 11 E.
Hickory Creek	29 N.	11 E.
Caney	29 N.	12 E.
Canary	29 N.	13 & 14 E.
Copan	28 N.	12 & 13 E.
Wann	28 N.	14 E.

Wynona	26 N.	15 E.
Nelagony	25 N.	11 E.
Bigheart	24 N.	10&11E.
Hickory Creek	29 N.	11E.
Caney	29 N.	12 E.
Canary	29 N.	13&14E.
Copan	28 N.	12&13E.
Wann	28 N.	14 E
Dewey-Bartlesville	26&27N.	12&13E.
Avant-Ochelata	23,24&25N.	12 E.
Ramona	24 N.	12 E.
Hogshooter	24,25&26N.	13 E.
California Creek	27 N.	15 E.
Delaware Ext.	27N.	14&15E.
Delaware-Childers	26&27N	16&17E.
Nowata	26 N.	16 E.
Adair	26N.	15E.
Goody's Bluff	25&26N.	16&17E.
Alluwe-Chelsea	24&25N.	16 17E.
Oologah	23N.	15 E.
Weimer	28 N.	18 E.
Collinsville	21&22N.	14 E.
Bird Creek-Flat Rock	20 N.	12&13E.
Owasso	21 N.	13&14E.
Claremore	21 N.	16E.
Harry	19 N.	10 E.
Kellyville	16 N.	10&11E.
Glenn Pool	17&18N.	12 E.
Red Fork	19 N.	12 E.
Colbert	19 N.	12 E.
Catoosa	20N.	15 E.
Inola	19 N.	16 E.

Claremore	21 N.	16 E.
Harry	19 N.	10 E.
Kellyville	16 N.	10 & 11 E.
Glenn Pool	17 & 18 N.	12 E.
Red Fork	19 N.	12 E.
Colbert	19 N.	12 E.
Catoosa	20 N.	15 E.
Inola	19 N.	16 E.
Broken Arrow	18 N.	14 E.
Bixby	17 N.	13 E.
Wicey	16 N.	13 E.
Coweta	17 N.	15 E.
Wagoner	17 N.	18 E.
Porter	16 N.	17 E.
Stone Bluff	16 N.	15 E.
Beggs	14 & 15 N.	12 E.
Preston	14 N.	12 E.
Okmulgee	13 N.	13 E.
Henryetta-Schulter	12 N.	13 E.
Morris	13 N.	14 E.
Bald Hill	15 N.	14 E.
Booch	14 N.	14 E.
Eram	13 & 14 N.	15 E.
Boynton	14 N.	16 E.
Yahola	15 N.	17 E.
Beland	14 N.	17 E.
Muskogee	14 N.	18 E.
Ada	4 N.	6 E.
Allen	5 N.	8 E.
Poteau	7 N.	26 E.
Wewoka	8 N.	8 E.

F. Gahtz. Drn. 1917