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STATE GEOLOGICAL SURVEY of KANSAS

RAYMOND C. MOORE, State Geologist  
KENNETH K. LANDES, Assistant State Geologist

OIL AND GAS RESOURCES  
OF KANSAS IN 1927



By  
L. W. KESLER

MINERAL RESOURCES CIRCULAR 1

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### STATE GEOLOGICAL SURVEY OF KANSAS

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Assistant State Geologist.

## PREFACE.

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The fact that Kansas is one of the leading mineral-producing states in our country is well known to a few. The majority of Americans, including citizens of our own state, associate Kansas with wheat, corn and the other products of the farm, with little, if any, appreciation of the growingly tremendous contribution to its prosperity of the materials from below the surface of the earth. The total new wealth from the latter source has already passed the sum of two thousand two hundred million dollars—\$2,200,000,000. This revenue to the state is a very significant element in its progress.

Petroleum and natural gas have been the largest contributors to the prosperity that has attended development of Kansas mineral resources, and more people have been affected by their influence than any other of our natural resources. Not only has the development of cities, roads, railroads and other material benefits attended the production of our oil and gas, but innumerable less tangible effects have touched our lives. Aside from the millions of dollars earned from the production and refining and distribution of these fuels, are the millions of dollars of royalties, rentals and bonuses received by land holders, of taxes contributed to city, county and state, and the indirect impulse toward added prosperity on even remote lines.

It is very desirable that knowledge of the mineral wealth of Kansas and its possibilities should be disseminated, with the object not merely of attaining a better understanding and appreciation of the nature and problems affecting its development, but that the growth and prosperity of the state may be augmented, that new wealth and larger incentives to commerce and industry, may continue to aid us, and, from the public viewpoint, additional tax-yielding elements may be brought to Kansas.

This paper on the oil and gas developments of the state in 1927 is contributed by Mr. L. W. Kesler, resident geologist for the Sinclair Oil and Gas Company at Wichita and formerly president of the Kansas Geological Society. It presents a concise summary of a subject which is of very widespread interest and importance to Kansas.

RAYMOND C. MOORE.

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# Oil and Gas Resources of Kansas in 1927.

## INTRODUCTION.

This discussion of Oil and Gas Resources of Kansas in 1927 undertakes to present timely information to those interested in oil and gas development and future possibilities within the state.

The following men contributed valuable information: Anthony Folger, Gypsy Oil Company; Homer H. Charles, Southern Kansas Gas Company; R. B. Rutledge, Barnsdall Oil Company; John R. Reeves, Empire Oil and Refining Company; Thomas H. Allen, Midwest Exploration Company; Marvin Lee and John L. Garlough, F. G. Holl, and Amil Anderson, consulting geologists; and A. M. Bell, Gypsy Oil Company. Special acknowledgment is due Mr. Charles for the information furnished relative to the Shoestring area of eastern Kansas, and to Mr. Rutledge for his complete data on Cowley and eastern Sumner counties.

TABLE 1.—Kansas production and completions, by months, for 1927.

MONTHS.	Total completions.	New production, barrels.	Daily average production, barrels.	Dry holes.	Gas wells.	Oil wells.	Average initial production per well.
January.....	134	10,966	121,609	60	5	69	158.9
February.....	114	8,311	119,717	55	6	53	156.8
March.....	151	11,427	118,553	62	6	83	137.7
April.....	154	13,832	117,231	58	8	88	157.2
May.....	105	11,501	119,494	40	6	59	194.9
June.....	112	5,687	114,586	56	9	47	121.0
July.....	163	3,612	111,422	91	6	66	54.7
August.....	55	3,135	111,040	32	4	19	165.0
September.....	78	5,449	111,158	25	5	48	113.5
October.....	82	4,540	112,889	26	5	51	89.0
November.....	137	12,991	110,155	45	16	76	170.9
December.....	48	5,800	110,244	19	3	26	223.1
Totals.....	1,333	98,253	.....	569	79	685	.....

The consideration of western Kansas is based on voluminous data furnished by Mr. Folger. The greater part of his manuscript is in-

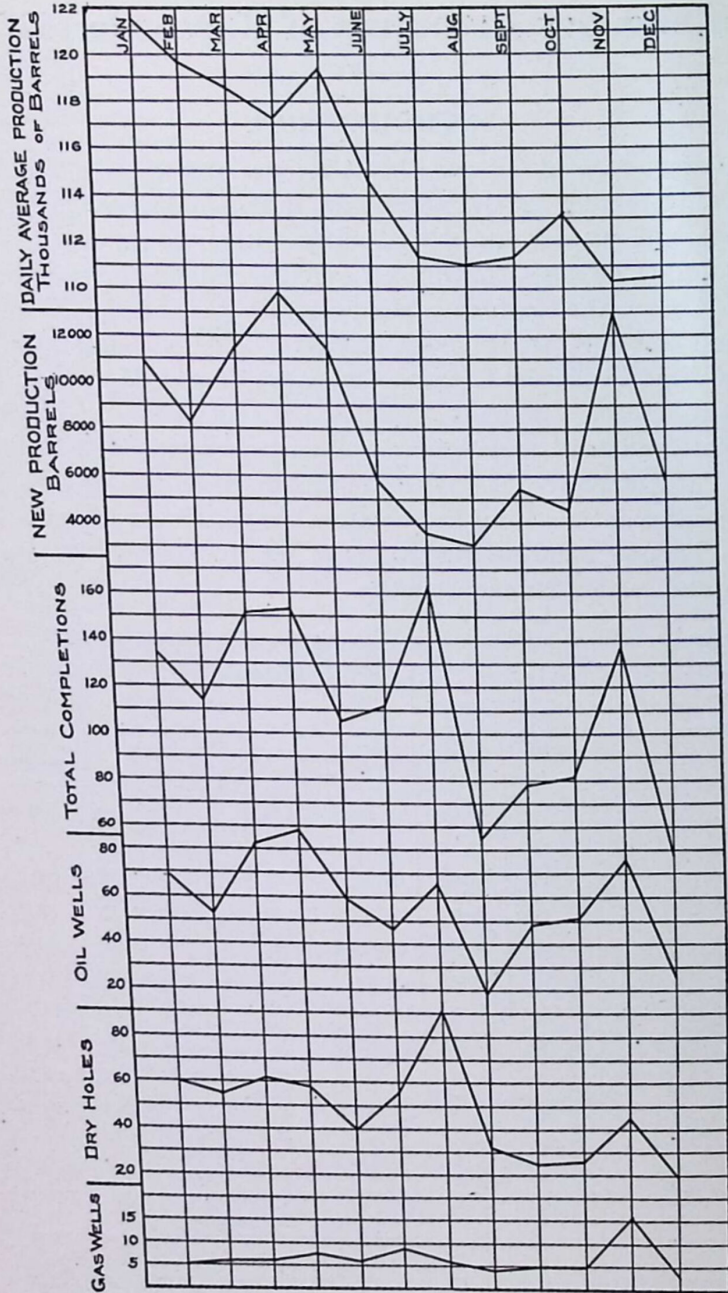


FIG. 1.—Graphic representation of the daily average production, new production, and completions in Kansas, by months, for 1927.

corporated intact within the paper. His great assistance is acknowledged with sincere gratitude.

Production figures have been taken in large part from the *Oil and Gas Journal*.

The state of Kansas produced 41,966,773 barrels of oil in the year 1927, thereby taking fourth place among the oil-producing states of the Union. However, daily average production decreased from 121,609 barrels in January to 110,244 barrels in December. (Table 1.)

Due to excessive flush production and the resulting decline in the price of crude during the year, operations, both in proven and outlying districts, were reduced materially from those of 1926. There were 2,338 completions in 1926, but only a total of 1,333 in 1927. (Table 2 and fig. 2.)

Regardless of this decrease in the total number of completions, Kansas made a slight gain in total production for the year, producing 620,262 barrels more than in 1926. This is accounted for in part by the comparative long life of the settled production from the Bartlesville sand areas to the east of the Nemaha granite ridge, and by prolific production in eastern Sumner county from horizons new in their importance in the state, productive here at two localities along the axis of the granite ridge.

TABLE 2.—Kansas production and completions, 1920 to 1927, inclusive.

YEAR.	Total completions.	Total oil wells.	Total gas wells.	Total dry holes.	Per cent dry holes.	Total new production in barrels.	Average initial production per well in barrels.	Daily average production in barrels.	Total production in barrels.
1920	3,164	2,327	147	690	21.8	181,845	78.1	96,848	35,446,427
1921	1,380	909	118	353	25.6	95,789	105.3	97,943	35,749,268
1922	1,640	1,057	86	497	30.3	74,391	70.4	88,733	32,387,646
1923	1,405	807	63	535	38.1	61,372	76.0	81,677	29,812,123
1924	1,125	650	79	396	35.2	92,668	142.5	81,070	29,671,551
1925	2,003	1,281	86	636	31.7	207,880	162.2	104,525	38,151,622
1926	2,338	1,458	96	784	33.5	173,664	119.1	113,278	41,346,511
1927	1,333	685	79	569	42.8	98,253	142.0	114,977	41,966,773

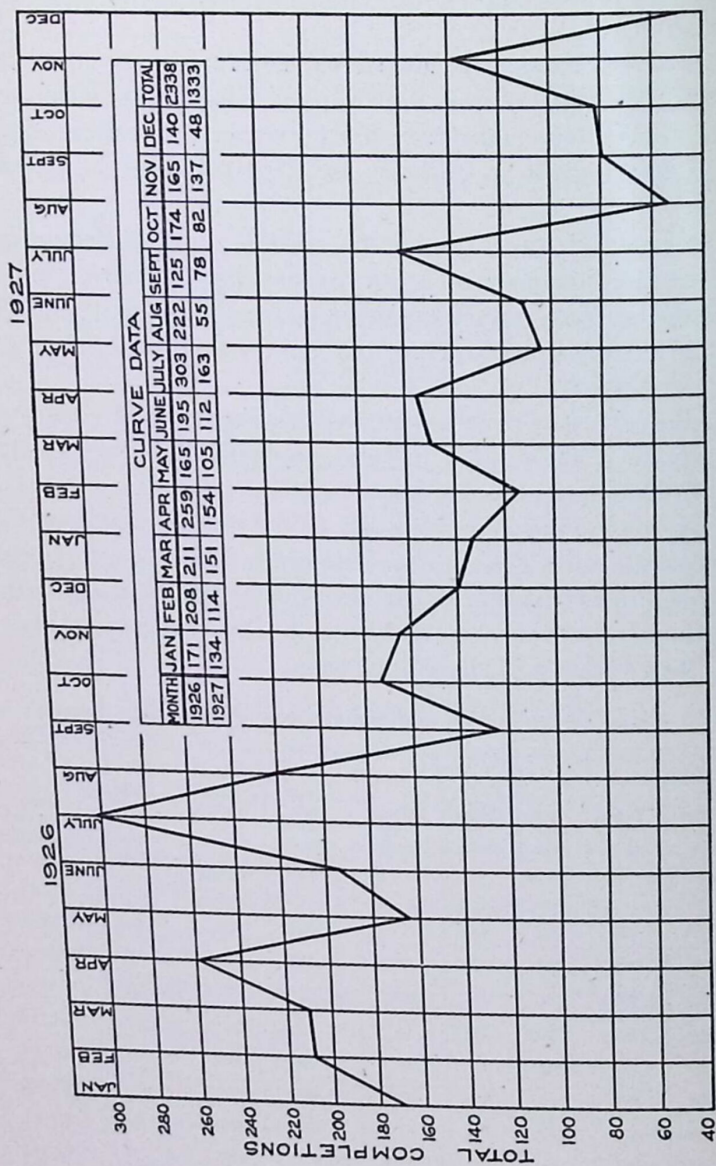


Fig. 2.—Graphic comparison between total completions in Kansas, by months, in 1926 and in 1927.

Figure 3 shows graphically the total production for the state of Kansas from the year 1889 to the year 1927, inclusive. Four stages of development are of particular interest.

1. In 1904 the productive areas of southeast Kansas gave rise to a comparatively great increase in production, the peak of which was not equaled in the succeeding eleven years.

2. In the years 1916 to 1918, inclusive, the El Dorado-Augusta fields built up the gross production for the state to the total of 43,253,470 barrels, the greatest in its history.

3. The Elbing pool, in northwest Butler county, and the Peabody, Covert-Sellers and Florence fields, in southeast Marion county, interrupted the inevitable decline, and in 1920 and 1921 were holding the total at well over 35 million.

4. At the end of 1927, following a healthy increase since 1924, total production for the state was but 1,286,697 barrels below the great El Dorado-Augusta peak.

In 1927 the Sumner county area was most noteworthy. At the end of 1925 this county was at the foot of the list, producing but 3,436 barrels for the year, or 0.01 per cent of the gross production of the state,<sup>1</sup> whereas two years later, at the end of 1927, it completely reversed its position, and headed the list<sup>2</sup> with a yearly production of 6,708,275 barrels, or 16 per cent of the total. (Table 11.)

The Winfield area of Cowley county greatly increased its production over that of 1926. Other areas showing a notable increase are the Shoestring area of Miami county; the Leon-Weaver and Keighley districts of Butler county; Elk county (mainly due to the Webb pool); and Lyon county, due to sand "trend" development in the southwestern part. (Table 11.)

Western Kansas—that is, all of the ranges west of the prime meridian—has made an excellent showing since the discovery of its first commercial oil in December, 1923, by producing a total of 5,442,996 barrels over a period of four years. The Fairport, Russell county, and the Welch, Rice county, pools were the principal contributing factors. The latter, often known as the Hutchinson or Rice county pool, raised its total production for the year from 237,860 barrels in 1926 to 624,264 barrels in 1927, or an increase of 386,404 barrels (table 11 and fig. 6).

1. McWhirt, Burr. Oil Development in Oklahoma and Kansas during 1925: A. I. M. E., *Pet. Dev. and Tech.* in 1925; p. 584.

2. Considered as a production unit, not as a county. In the latter case it ranks third in total production. (Table 10.)

ranging in thickness up to 40 feet, the thickness and porosity changing abruptly. The sand, locally called Big Lake, is at the base of the "big shale," made up of the Dudley and Nowata members of the Marmaton formation,<sup>3</sup> and corresponds in stratigraphic position with the Peru-Wayside sand of Montgomery and Chautauqua counties, Kansas.<sup>4</sup>

As a result of this most profitable production of the Big Lake shoestring, a strong revival in operations took place in 1927, and a number of other oil and gas pools were opened up in the area, most of them in the Big Lake sand. Much promising territory remains untested.

*Franklin County.* No pools were discovered in this county in 1927. In the extreme western part of the county, in sec. 25, T. 16 S., R. 17 E., one 6,000,000-cubic-foot gas well and one having a volume of 15,000,000 cubic feet were completed in the early part of 1924. All other tests in the vicinity and all "wildcats" drilled as a result of these gas wells have been unsuccessful.

*Anderson County.* A most important discovery was made in this county in December, 1927. In sec. 4, T. 21 S., R. 21 E., seven miles east and three miles south of Garnett, the Schermerhorn Oil Company completed a Colony sand (Bartlesville) well at a depth of 710 feet, for an initial production of 50 barrels, having a gravity of 34 degrees Be. This well is significant in that it is the first one producing light oil from the Bartlesville sand in Anderson county, although considerable gas is produced from that horizon. In fact, heretofore there have been no Bartlesville oil pools in the shoestring area north of the south line of T. 25 S. Early in 1928 seven wells were completed and drilling was most active.<sup>5</sup>

A brief review of Anderson county development follows. The most important fields are the Garnett oil shoestring, averaging two locations in width, and extending from sec. 31, T. 20 S., R. 20 E., to sec. 2, T. 21 S., R. 19 E.; the Colony-Welda gas shoestring, about one-half mile wide and thirteen miles long, extending from sec. 20, T. 21 S., R. 19 E., to sec. 12, T. 23 S., R. 18 E.; and the Bush City oil shoestring, averaging one-quarter of a mile wide and developed for thirteen miles in length, from sec. 14, T. 21 S., R. 19 E. to sec. 27, T. 20 S., R. 21 E.

3. Charles, Homer H. Oil and Gas Resources of Kansas, Anderson Co.: State Geol. Sur. of Kan., Bull. 6, pt. 7, 1927; p. 25.

4. Williams, D. W. Correlation of Producing Sands in Southeastern Kansas and Northwestern Oklahoma: Bull. Amer. Assoc. Petrol. Geol., vol. 5, 1921; pp. 293-297.

5. Rich, John L. Personal Communication, Feb. 15, 1928.

The Bush City field is one of the best representatives of the shoestring type of pool in eastern Kansas. From March, 1923, to January, 1926, 775 oil wells, with an initial production each of from 5 to 800 barrels, were completed in this pool. The depth of the wells is from 650 to 850 feet. The gravity of the oil is 36 degrees Be. The average initial production was 60 barrels, declining to 5 barrels at the end of one year, 2 barrels at the end of two years, and 1¼ barrels at the end of a three-year period. The wells located in the synclinal parts of the shoestring made initially 5 to 50 barrels each, while those in the anticlinal areas came in for 50 to 250 barrels. The average recovery per acre by natural methods may be expected to reach a total of approximately 2,500 barrels.<sup>6</sup> A representative decline curve of the Bush City shoestring accompanies this paper. It is typical of the channel deposit fields of that district of eastern Kansas (fig. 4).

*Linn County.* The major development in this county during 1927 took place in the Blue Mound gas field, located in the northeastern part of T. 22 S., R. 22 E., and the western part of T. 22 S., R. 23 E. This old gas pool, which had never been drilled up because of the lack of a market, was extended three miles in a southeast direction by the completion of about 40 wells in a sand below the Bartlesville zone at a depth of 700 feet. These were completed for an initial production of from 1 to 2½ million cubic feet with 210 pounds rock pressure.

*Allen County.* No new pools have been discovered in Allen county for several years. In the southwest corner of the county a few wells have been drilled for "shale gas." This occurs in and immediately below the Fort Scott limestone. The development of "shale gas" wells, with an open flow of only 25,000 to 75,000 cubic feet per day on a commercial basis, demonstrates in a striking manner how near to exhaustion the gas fields in this part of Kansas are at the present time. Fifteen to twenty years ago wells in this district with an initial open flow of 5 to 15 million cubic feet were of common occurrence, and those with only a half million were considered of little consequence and generally not saved.

6. Charles, Homer H. Oil and Gas Resources of Kansas, Anderson County: State Geol. Sur. of Kan., Bull. 6, pt. 7, 1927; p. 72.

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4. Williams, D. W. Correlation of Producing Sands in Southeastern Kansas and Northwestern Oklahoma: Bull. Amer. Assoc. Petrol. Geol., vol. 5, 1921; pp. 293-297.

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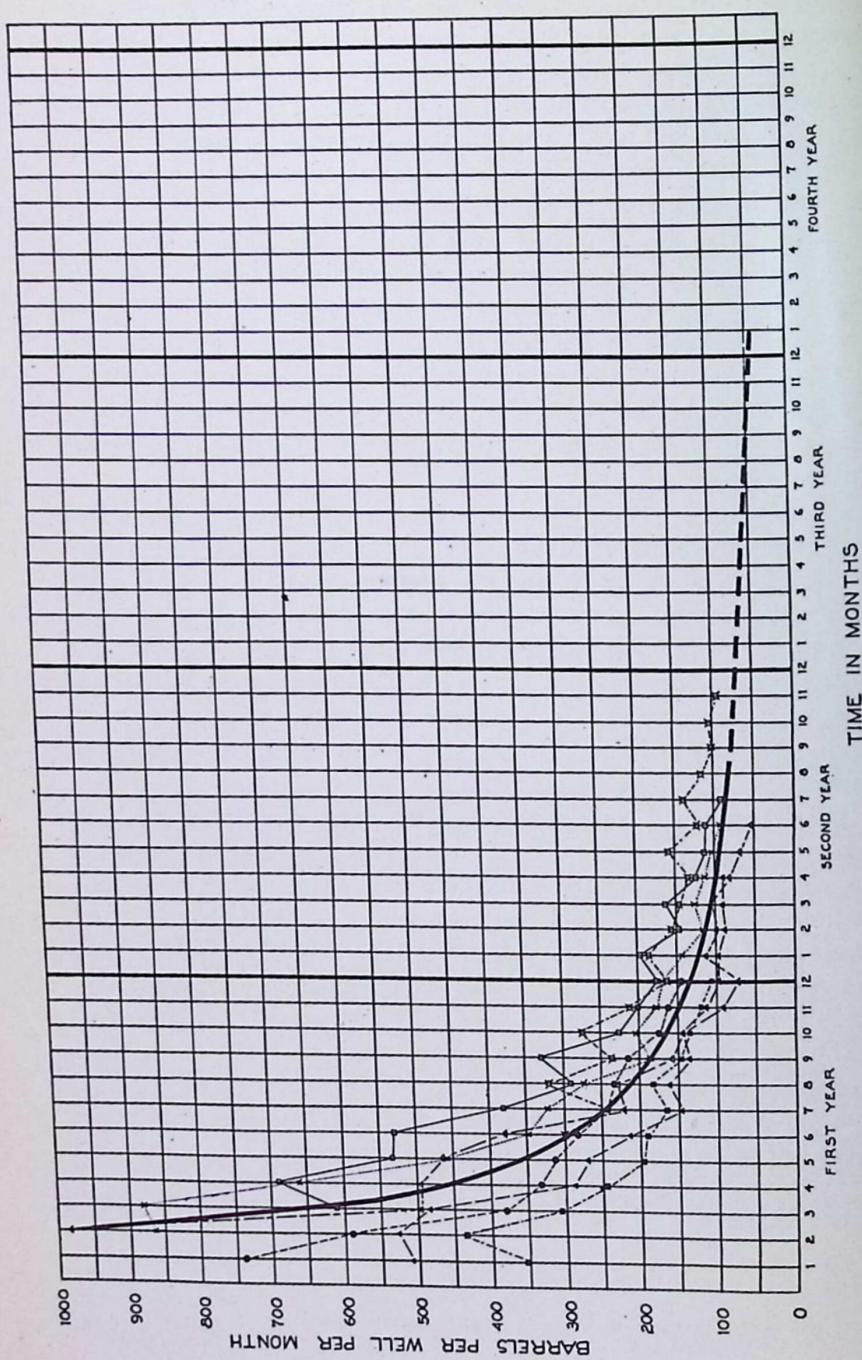


FIG. 4.—Production decline curve of the Bush City shoestring oil field, Anderson county, Kansas. This is a representative decline curve of the channel deposit fields of that district. (Taken from Oil and Gas Resources of Kansas: "Anderson county," by Homer H. Charles; State Geological Survey of Kansas, Bulletin 6, part 7, Lawrence, Kan., 1927.)

### Northeastern Kansas.

*Leavenworth County.* The Linwood gas field, located in sec. 31, T. 11 S., R. 22 E., sec. 6, T. 12 S., R. 22 E., and in secs. 11, 12 and 13, T. 12 S., R. 21 E., has twelve gas wells producing from a sand in the uppermost part of the Cherokee shale, about 50 feet below the Fort Scott limestone. This production is found at an average depth of 600 feet.

The Six Corners gas field, located in secs. 14 and 23, T. 12 S., R. 20 E., with approximately six gas wells, was purchased in 1927 by the Empire Oil and Refining Company for experimental purposes. The research of this company involves a return of gas into the sand, the latter to serve as a reservoir for gas storage.

*Johnson County.* The Craig Station-Monticello gas field located in T. 12 S., R. 23 E., had 30 producing gas wells at the end of 1927 out of an approximate total of 40 wells drilled. Two gas horizons exist here, one in the upper part of the Marmaton formation at 300 feet, the other in the upper Cherokee shale, about 50 feet below the Fort Scott limestone, at a depth of 550 feet.

The Dallas oil and gas field, located in secs. 3, 4, 10, 11, 14 and 15, T. 13 S., R. 25 E., at the close of 1927, had approximately 75 wells, some of them producing oil and some gas. The principal oil production is secured from 60 feet of Bartlesville sand, while the gas comes from a sand in the upper part of the Marmaton formation. The field was abandoned at one time, but operations were renewed about the middle of 1927.

### Southeastern Kansas.

In the productive shallow sand area of southeastern Kansas—Neosho, Labette, Wilson, Montgomery and Chautauqua counties—there have been no discoveries of special interest during the year 1927. Successful operations in this period have been located in areas previously discovered which have been undergoing slow development during the year.

The following table shows the production for 1926 and 1927 for the five counties:

	1926.	1927.
Neosho .....	254,521	222,150
Wilson .....	93,686	83,959
Labette .....	10,371	11,785
Montgomery .....	721,252	578,654
Chautauqua .....	893,685	871,997
Totals .....	1,973,515	1,768,545

production of 500 barrels from the Bartlesville sand. This discovery is further evidence of a north-south sand "trend."

*Leon District.* In township 27 south, range 6 east, and township 28 south, range 6 east, Butler county, a steady development has continued through 1927 as a result of scattered discovery wells, some of which were completed in 1926. This locality has brought forth an important producing horizon, but little discussed and not definitely determined in Kansas until recently, namely, the Viola lime (Urschel lime of Barwick). Being unexpected and located near the town of Leon, it was immediately called the "Leon" lime. With subsequent development and detailed study it has become possible to correlate it definitely with at least part of the Viola limestone of Oklahoma, and accordingly Viola should take precedence over the term "Leon."<sup>8</sup>

In these two townships, at the close of 1927, nine oil wells had been completed in the top of the Mississippi lime at an approximate depth of 2,750 feet, for a total initial production of 1,130 barrels, or an average per well of 125 barrels. The gravity of the oil is 38 degrees Be. Thirty-eight oil wells were completed in the Viola lime at an approximate depth of 3,050 feet, for a total initial production of 5,179 barrels, or an average per well of 136 barrels, also testing 38 degrees Be. Seven tests were dry at this horizon. In the area as a whole 59 wells averaged 2,450 barrels per day in December, 1927, or 41 barrels per well.

The accumulation of oil in the district is due to the presence of anticlinal structure involving much of these two townships. It is indistinct on the top of the Mississippi lime, but rather pronounced on the Viola. The relative size and resulting irregularities of the structure account in part for the scattered development.

*Pierce Well.* In January, 1927, Allison and Fitzwilliams completed a well in sec. 28, T. 25 S., R. 4 E., in the Mississippi lime, for an initial production of 60 barrels, having a gravity of 43 degrees Be. The depth is approximately 2,600 feet. In December the well averaged 25 barrels per day. No further development occurred during the year.

*El Dorado Field.* In the El Dorado pool during 1927 approximately 100 wells were completed in the "650-foot" sand for an average initial production of 5 barrels, having a gravity of 36 degrees Be.

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<sup>8</sup> Reeves, John. Personal communication.  
Barwick, John S. The Salina Basin of North-Central Kansas: Bull. Amer. Assoc. Petrol. Geol., vol. 12, No. 2, 1928; pp. 184, 185.

*Seward-Keighley "Trend."* Considerable attention has been directed during 1927 toward the continuance of the Seward-Keighley "trend" (T. 27 S., R. 7 E.) in a southwesterly direction, but thus far with no success. It is probable, and with good reason, that further attention will be given this area during 1928.

### Greenwood County.

In 1927 Greenwood county produced 27.8 per cent of the gross production of the state (table 10).

The Bartlesville sand is the source of nearly all the production in the county. A comparatively small amount is secured from the Mississippi lime, but other producing horizons are negligible. The average gravity of the oil is 40 degrees Be. Development and new discoveries for 1927 follow:

*Eureka Pool.* The Eureka pool, located in secs. 2 and 3, T. 26 S., R. 10 E., and secs. 33 and 34, T. 25 S., R. 10 E., was discovered some years ago, but in the early part of the summer of 1927 production was extended into the town proper. Town-lot drilling began in June, and at the close of the year 18 oil wells had been completed on the town site for a total initial production of 885 barrels, or an average per well of 49 barrels. Six tests were dry holes. The producing horizon is the top of the Mississippi lime, found at about 1,900 feet. Accumulation here is controlled by structure, a part of the Beaumont anticline.

*Climax Pool.* Production from the top of the Mississippi lime was discovered some time ago at a depth of 1,850 feet, in secs. 4 and 9, T. 27 S., R. 11 E. In 1927 three oil wells with an average initial production of 100 barrels each, and one dry hole, were completed. The gravity of the oil is 32 degrees Be.

*DeMalorie-Souder Extension.* In 1927, one mile west of the DeMalorie-Souder prolific field, an important extension was opened up in the SE corner of sec. 3, T. 22 S., R. 10 E., by Bruce and Bradley and the Skelly Oil Company. Four wells have been completed in the Bartlesville sand, found at a depth of 2,150 feet, for a total initial production of 735 barrels, or an average per well of 184 barrels. The gravity of the oil is 41 degrees Be. This important "trend" extension will be the cause of considerable development during 1928.

*Madison Extension.* In January, 1927, the Roxana Petroleum Corporation, with Schwartz and McDougal, extended production

one mile to the southeast by the completion of a Bartlesville sand well at 1,800 feet, in the NE corner NW $\frac{1}{4}$  NE $\frac{1}{4}$  of sec. 23, T. 22 S., R. 11 E. Ten wells were completed within the year, having a total initial production of 1,570 barrels, or an average per well of 157 barrels. The gravity is 41 degrees Be. This is another extension of Bartlesville sand "trend" production in Greenwood county which offers much possibility and will receive considerable attention in 1928.

*Quincy Pool.* The Quincy Pool, located in secs. 10 and 15, T. 25 S., R. 13 E., was discovered in November, 1927. Four wells in all were completed during the year for a total initial production of 520 barrels, or an average of 130 barrels per well. The oil, testing 39 degrees Be., comes from a Bartlesville sand "trend," found at a depth of 1,450 feet. Gas up to the amount of 750,000 cubic feet is produced with the oil. The discovery is of great importance because of its position as a possible connecting link for other "trends."

*Edwards Pool.* In March, 1927, the Empire Oil and Refining Company opened up an extension to the Seeley pool, one mile southeast of the latter, in secs. 16, 17 and 21, T. 23 S., R. 11 E. Seventeen oil wells were completed in the Bartlesville sand at a depth of 1,900 feet, for a total initial production of 3,038 barrels, or an average of 178 barrels per well. The oil tests 40 degrees Be. This is "trend" production, a part of the "cross-trend" which includes the Seeley and DeMalorie-Souder pools. The extension is still open to the southeast and considerable development may be expected in 1928.

*Lamont Pool.* The most prolific discovery in Greenwood county in 1927 was that of the Lamont pool. The discovery well, Demler No. 1, located in the NW corner NE $\frac{1}{4}$ , sec. 25, T. 22 S., R. 12 E., was completed in June by the Empire Oil and Refining Company at a depth of 1,600 feet, for an initial production of 500 barrels, testing 40 degrees Be. Thirty-one oil wells and seven dry holes had been completed at the close of the year. The total initial production was 9,845 barrels, or an average of 318 barrels per well. The maximum initial production for a single well was 950 barrels. A town-site drilling campaign in Lamont resulted in five of the dry holes and seven of the oil wells on about 40 acres. In December the proven productive area of the pool was over a mile long and a half mile wide, and its daily average production was approximately 3,500 barrels. At the close of the year the two ends of the pool were still open and development was continuing rapidly in both directions.

This "strike" was the most important one in eastern Kansas during 1927, and may develop into one of the best Bartlesville sand "trend" pools in Greenwood county.

### Cowley County.

No new pools were discovered in Cowley county in 1927. In the month of January there were 353 producing oil wells in the county, and in December this number had increased to 402. The total production for the year was 3,097,502 barrels (not including miscellaneous), divided as follows:

Winfield .....	1,206,588
Rainbow Bend .....	802,672
Slick-Carson .....	419,333
Eastman .....	264,252
Graham .....	229,196
Rock .....	96,484
Clark .....	78,977
Miscellaneous (not included).	

The average daily production of the Cowley county fields by months and the number of producing wells is shown in table 3. A brief review of each of the fields to the close of the year 1927, follows:

*Rainbow Bend Pool.* The discovery well of the Rainbow Bend pool was completed December 19, 1923, in the NW corner SE $\frac{1}{4}$  of sec. 20, T. 33 S., R. 3 E., Cowley county, Kansas, by the Waite Phillips Company. At the close of 1927, 125 producing wells had been completed in the field proper and 12 producers in the extension a mile west in sec. 19, T. 33 S., R. 3 E., and sec. 24, T. 33 S., R. 2 E. On March 12, 1927, a producing well was completed by the Barnsdall Oil Company in the NW corner SW $\frac{1}{4}$  of sec. 8, T. 33 S., R. 3 E., a mile and a half north of the field. At the peak of production, reached in June, 1926, the field produced approximately 22,500 barrels daily. At this time 112 million cubic feet of gas was produced with the oil. The gravity is 39 to 41 degrees Be.

In the major part of the field production is secured from a sand in the basal part of the Cherokee shale, resting upon the Mississippi lime and found at a depth of 3,200 to 3,250 feet. In the west extension production is from a similar sand at the same horizon and also from the top of the Ordovician "siliceous lime," found near 3,550 feet. In secs. 7 and 8, T. 33 S., R. 3 E., production is found in the "siliceous lime" at a depth of 3,500 feet.

TABLE 3.—Daily average production, by months, and number of wells, Cowley county, 1927.

Field	Rainbow Bend.		Graham.		Slick-Carson.		Winfield.		Clark & Shafter.		Rock.		Eastman.		Miscellaneous.	
	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.
Month																
January	115	3,084	31	946	26	1,342	87	2,741	11	246	17	298	36	741	30	393
February	115	2,715	31	769	26	1,415	98	2,607	11	216	15	285	37	782	32	345
March	115	2,558	31	688	25	1,287	104	2,768	11	241	15	351	37	856	34	385
April	110	2,363	31	590	25	1,255	108	4,073	11	205	15	261	40	780	36	427
May	110	2,453	31	582	25	1,313	115	3,634	12	226	19	272	40	724	35	439
June	119	2,405	31	562	25	1,220	117	3,363	12	204	19	271	40	728	39	763
July	119	2,318	31	581	25	1,202	117	3,263	12	204	18	254	40	658	41	697
August	119	2,248	31	565	25	1,011	117	3,667	12	219	18	200	40	733	41	696
September	119	2,197	31	553	25	987	121	3,651	12	218	18	239	40	706	42	782
October	119	2,128	31	540	25	931	122	3,437	12	181	18	241	40	701	42	768
November	119	2,092	31	533	25	904	123	3,156	12	200	18	224	40	654	43	709
December	110	1,754	31	567	25	980	123	2,951	12	193	18	216	40	637	43	657

*Graham Pool.* The discovery well in this pool was completed July 1, 1924, in the NE corner of sec. 9, T. 33 S., R. 3 E., Cowley county, by the Marland Refining Company. During the development of this field 35 producing wells were drilled in the east half of sec. 9 and the west half of sec. 10, T. 33 S., R. 3 E. Production is obtained from two horizons, the Layton sand and the "siliceous lime." The former, often termed the "shallow pay," is found at a depth of 2,550 feet, a short distance above the limestone portion of the Kansas City formation. The "siliceous lime" is the more prolific horizon and is encountered at 3,500 feet. The gravity of the oil from the Layton sand is 38.5 degrees Be., and of that produced from the "siliceous lime" 39 to 40 degrees Be. The Ordovician oil has the characteristic hydrogen sulphide odor.

*Slick-Carson Field.* The discovery well of the Slick-Carson field was completed October 29, 1924, in the SW corner NE $\frac{1}{4}$  of sec. 19, T. 32 S., R. 3 E., Cowley county, by T. B. Slick. Twenty-six producing wells have been drilled in this field. Production here is from three horizons. The uppermost is a sand (or sandy phase) in the top of the Kansas City lime, which is probably equivalent to the Layton sand farther south, and found here at an approximate depth of 2,600 feet. There are twelve wells producing from this horizon. The next lower is a sand near the base of the Cherokee shale, from which two wells are productive at a depth of 3,100 feet. The most productive horizon is the "siliceous lime," found at a depth of 3,425 feet and from which 12 wells produced. The oil from this field tests 38 to 40 degrees Be., the gravity rising with the increased depth of the producing horizon.

*Winfield Pool.* In 1927 the Winfield pool produced more than half of the total production of Cowley county. The discovery well, located in the NW corner SE $\frac{1}{4}$  of sec. 36, T. 32 S., R. 4 E., was drilled by the Empire Oil and Refining Company during the latter part of 1914. This production was found in sand at the shallow depth of 1,450 feet in the upper part of the Lawrence shale of the Douglas formation. Soon after the completion of this well A. L. Derby and others secured a producer at this horizon in the north-east quarter of the same section. Following this, 20 additional producing wells were completed. The horizon was productive over a small area only. A short time after these wells were drilled, the Arkansas Fuel Company completed a small producer in the NW $\frac{1}{4}$  of sec. 7, T. 32 S., R. 5 E., in the 2,400-foot sand. On May 11, 1922, the Emerald Oil Company and McKnabb obtained production from the 1,400-foot sand in the NW corner SE $\frac{1}{4}$  of sec. 24, T.

TABLE 3.—Daily average production, by months, and number of wells, Cowley county, 1927.

Field.....	Rainbow Bend.		Graham.		Slick-Carson.]		Winfield.		Clark & Shaffer.		Rock.		Eastman.		Miscellaneous.	
	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.	No. of wells.	Daily average.
MONTH.																
January.....	115	3,084	31	946	26	1,342	87	2,741	11	246	17	298	36	741	30	393
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32 S., R. 4 E., in an area which has been proven by later operations to be the major part of the field.

Further development has extended the production in a discontinuous series of small pools through sec. 13 and the SE $\frac{1}{4}$  of sec. 12, T. 32 S., R. 4 E., and the W $\frac{1}{2}$  of sec. 7 and northward into sec. 6, T. 32 S., R. 5 E. This discontinuous strip of production six miles long follows in a general way the axis of the Winfield closed anticline from which the production is obtained.

On June 29, 1926, the J. A. Hull Company completed an important addition to this area in the NW corner SE $\frac{1}{4}$  of sec. 15, T. 32 S., R. 4 E., by the discovery of oil in the "siliceous lime" at 3,304 feet on the State Home land. This horizon proved to be very prolific here, but only over a small area. Oil is also produced from the Layton sand, and gas from a sand a little above this horizon.

Several shows of oil have been recorded in the lenticular sand in the Weston shale at approximately 1,750 feet. Also numerous shows have been recorded in the sands or sandy limes in the top of the Lansing formation, but no commercial production has been obtained here. This horizon is present at a depth of approximately 1,900 feet.

A few small wells have produced from a sand or sandy limestone occurring in sec. 24, T. 32 S., R. 4 E., at an approximate depth of 2,100 feet, possibly equivalent to the Plattsburg limestone of the Lansing formation.

The most productive shallow horizon is known as the "2,300-foot" sand, which in this locality is a sandy phase of the top of the Kansas City formation, probably equivalent to the Layton farther south.

There are one or two other thin discontinuous sandy phases near the base of the Kansas City formation, and in the Marmaton below, in which frequent shows are recorded and from which a minor amount of production is obtained.

The most productive horizon in the Winfield pool is a sand found at 2,950 to 3,000 feet in the basal Cherokee shale, which in most instances rests unconformably upon the Mississippi lime, but it is separated from the latter in some of the wells by several feet of shale.

The gravity of the oil found in this area ranges from 37.5 to 40.5 degrees Be. Some of the Pennsylvanian producing horizons here are often productive in one or two wells, but dry in the offsets.

*Clark and Shaffer Pools.* The discovery well of the Clark pool was drilled in the NE corner SE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 6, T. 31 S., R. 4 E.,

Cowley county, in 1916, by the Little Pirate Oil Company. Production was limited to four wells, three of which were still producing at the close of 1927. The discovery well of the Shaffer pool was completed in the SE corner NE $\frac{1}{4}$  of sec. 10, T. 31 S., R. 3 E., on November 19, 1924, by the Trees Oil Company. The development here consisted of 10 oil wells. In both pools the producing horizon is a sand in the basal Cherokee shale, 30 to 40 feet above the top of the Mississippi lime and found at 2,850 feet in the Clark pool and at 3,050 feet in the Shaffer. A very small amount of gas is present with the oil. The gravity varies from 37.5 to 38.5 degrees Be.

*Rock Pool.* The discovery well of the Rock pool was completed January 13, 1923, in the NE corner of sec. 15, T. 30 S., R. 4 E., Cowley county, by the Cassoday Oil Company. Since that time 20 producing wells have been completed in the northeast quarter of section 15 and in the near-by parts of adjacent sections. The production comes from a sand in the Cherokee shale approximately 75 feet above the top of the Mississippi lime, and found at an average depth of 2,775 feet. The oil tests 38 degrees Be.

*Eastman Pool.* The discovery well of the Eastman pool was completed in the SW corner of sec. 5, T. 31 S., R. 6 E., Cowley county, February 18, 1924, by the Southwestern Petroleum Company. At the close of 1927, 48 oil wells and 5 or 6 gas wells had been completed in the western half of sec. 5 and the eastern half of sec. 6, T. 31 S., R. 6 E., and in sec. 31, T. 30 S., R. 6 E. The production is obtained from a sand in the basal part of the Cherokee shale, 5 to 50 feet above the Mississippi lime, and found at a depth of 2,800 to 2,850 feet. The oil tests 38 degrees Be. gravity.

*Miscellaneous.* At the close of the year 1927 there were 43 oil wells widely distributed in various parts of Cowley county outside of the above areas, producing a total of 657 barrels daily. A number of them have been producing for several years, but none, including those completed recently, are expected to open up extensive productive areas. Information relative to these miscellaneous areas is presented in table 4.

*Gas in Cowley County.* A considerable amount of gas is produced from a sand or sands in the Admire shale of the Wabaunsee formation. This producing gas area extends in an irregular discontinuous zone from sec. 4, T. 31 S., R. 5 E., southwest to sec. 20, T. 34 S., R. 4 E., an approximate distance of 22 miles. The largest and most

productive parts of it are in the west half of T. 31 S., R. 5 E., the southeastern part of T. 32 S., R. 4 E., the northeastern part of T. 33 S., R. 4 E., the northwestern part of T. 33 S., R. 5 E., and in the NW $\frac{1}{4}$  of T. 34 S., R. 4 E.

In some localities gas in commercial quantity is found at deeper horizons. Of these five are given below. Two wells in sec. 20, T. 31 S., R. 5 E., are producing from a sand in the basal part of the Lawrence shale at a depth of 1,950 to 2,000 feet. In the State Home pool it is produced from the Layton or "2,300-foot" sand. In the NW corner SE $\frac{1}{4}$  of sec. 14, T. 34 S., R. 4 E., a single gas well was completed in a sand at 2,150 feet. In the S $\frac{1}{2}$  of sec. 31, T. 34 S., R. 3 E., two are producing from a sand found at 1,510 feet, and one other test is being drilled here. In the NE corner SW $\frac{1}{4}$  of sec. 18, T. 35 S., R. 3 E., one gas well produces from a sand at 2,015 feet and another in the center of the NE $\frac{1}{4}$  NE $\frac{1}{4}$  of the same section from 2,100 feet.

*Helium.* The existence of noninflammable gas in the area near Dexter in sec. 24, T. 33 S., R. 6 E., at an average depth of 1,000 feet, has been known since the year 1900. The presence of helium in this gas was discovered in 1923. A helium company owned by the Kentucky Oxygen and Hydrogen Company began the construction of a helium extraction plant on May 1, 1927. The plant started operations September 1, 1927, with a capacity of 300,000 cubic feet per day, and handled a total of 36 million cubic feet during the remainder of the year. The average helium content of the gas being used at the close of 1927 was 2 per cent. The residue is 98 per cent nitrogen and the remainder chiefly methane. The entire output is sold to the United States government.

Table 4.—Miscellaneous producing areas in Cowley county.

NAME.	Location.	Date of discovery.	Producing horizon.	Depth.	Number of wells completed as producers.	Number of wells producing at close of 1927.
Fall City Pool, Phillips Petroleum Co.....	E $\frac{1}{2}$ sec. 17, T. 35 S., R. 7 E.....	1918.....	Layton sand.....	2,000	25	14
Olson Pool, T. B. Slick.....	NE $\frac{1}{4}$ sec. 1, T. 35 S., R. 7 E.....	April, 1921.....	Fort Scott.....	2,400	7 or 8	7
S. H. E. Petroleum Co.....	Sec. 24, T. 34 S., R. 6 E.....	May, 1926.....	Layton sand.....	2,150	1	1
Lewis and Hollis Bros.....	SW $\frac{1}{4}$ sec. 25, T. 34 S., R. 6 E.....	September, 1927.....	Top Mississippi lime.....	3,010	1	1
Monitor Oil & Gas Co.....	Sec. 18, T. 33 S., R. 7 E..... Sec. 24, T. 33 S., R. 6 E.....	July 1914.....	Top Mississippi lime.....	2,740	6(?)	(?)
(?).....	Sec. 4, T. 33 S., R. 7 E..... Sec. 33, T. 32 S., R. 7 E.....	(?).....	Kansas City.....	1,900	5	5
Trees Oil Co.....	Secs. 21 and 28, T. 31 S., R. 4 E.....	August, 1925.....	Layton sand.....	2,400	10	10
Shawver and Elwell.....	Sec. 17, T. 34 S., R. 3 E.....	December, 1925.....	Basal Cherokee sand.....	3,360	4	4
Gypsy Oil Co.....	Sec. 5, T. 34 S., R. 3 E.....	June, 1926.....	Top Mississippi lime.....	3,320	1	1

### Sumner County (Ranges East).

This is the banner section for new production in Kansas in 1927. As a unit in the compilation of production figures it heads the list; as a county it ranks third, producing 6,708,275 barrels, 15.98 per cent of the total production of the state. (Tables 11 and 10.) Two prolific pools, the Churchill and Oxford, are responsible for this splendid showing. Both were discovered by means of core-drill exploration and are signal examples of the benefits to be derived from such procedure. The average daily production and number of wells for the year 1927 is shown in table 5. A brief summary of the pools follows:

*Churchill Pool.* This pool was the most important discovery in Kansas during 1926, and was the first production of any consequence on a granite ridge structure south of T. 29 S., R. 4 E., Butler county. The discovery well, located in the NE corner SW $\frac{1}{4}$  of sec. 25, T. 31 S., R. 2 E., was completed July 2, 1926, by the Roxana Petroleum Corporation. During the remaining six months of that year 18 oil wells were completed, and in 1927, 44 additional producers brought the total to 62. The peak of both development and production was reached during the first half of 1927. In December of that year a dozen or more proven locations remained to be drilled. The

TABLE 5.—Daily average production by months and number of wells, eastern Sumner county, 1927.

Field.....	Churchill.		Oxford.		Miscellaneous.	
	Number of wells.	Daily average.	Number of wells.	Daily average.	Number of wells.	Daily average.
January.....	18	15,343	.....	.....	8	539
February.....	19	15,637	.....	.....	9	433
March.....	24	16,115	.....	.....	9	427
April.....	41	16,855	.....	.....	9	411
May.....	49	18,506	1	62	9	365
June.....	50	18,930	1	65	9	371
July.....	50	16,078	1	144	9	302
August.....	50	14,902	7	1,232	9	346
September.....	51	14,195	10	3,370	9	314
October.....	56	14,778	20	6,236	9	290
November.....	59	12,995	21	6,751	9	268
December.....	62	12,451	27	9,162	9	254

actual productive area at the close of the year included approximately 700 acres in secs. 24, 25, 26 and 36, T. 31 S., R. 2 E.

Production is secured from the Stalnaker sand, found at a depth of 1,860 to 1,900 feet, and usually marked by a lime shell at the top. The sand thickness on the structure exceeds 100 feet, and part of it contains numerous shaly phases. The gravity of the oil is 38 degrees Be. Possibilities of deeper producing horizons exist, but no operations, well located on top of the structure, have thus far been drilled to them. Very little gas occurs with the oil, and partly for this reason, air-lifting apparatus has been installed. This is the first field in Kansas to be produced by this method from the time of its discovery. Insufficient data are at hand for the purpose of estimating the ultimate recovery per acre, but it will undoubtedly be highly satisfactory.

*Oxford Pool.* The discovery well of the Oxford pool was completed on the town site of Oxford, 1,000 feet north and 615 feet east of the center of sec. 14, T. 32 S., R. 2 E., Sumner county, early in May, 1927. At the close of the year there were 27 producing wells and a number of others drilling. Production, apparently defined on the north and east, had extended from the SW $\frac{1}{4}$  SW $\frac{1}{4}$  of sec. 12, T. 32 S., R. 2 E., in a southwesterly direction to the NE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 23, T. 32 S., R. 2 E., a distance of a mile and a half. The southern limits of the field are near at hand and the average width will not exceed a half mile.

By far the most important of the producing horizons is the Stalnaker sand, found at a depth of 1,950 to 2,025 feet. This, which is also the productive sand in the Churchill field, four miles to the northeast, is marked at the top by a thin lime or sandy lime shell. It contains a considerable but variable amount of interbedded shale partings or sandy shale. The thickness of the sand on top of the structure is not known, no well having passed through it, but only a short distance down the flank of the structure 150 feet has been found. Two wells in the field have drilled 120 and 130 feet of sand without penetrating its entire thickness.

There are two horizons above the Stalnaker which are commercially productive and several more in which shows of oil have been obtained. Six wells are producing from one of these, a sandy limestone found at an average depth of 1,260 to 1,275 feet. This horizon, apparently by common consent, has been called the top of the Topeka lime, but there is good evidence for the belief that it is

approximately 110 feet higher in the section, but still of Shawnee age. One well, located in block 88, town site, produced considerable oil from a sandy limestone found at a depth of 1,065 feet. This is probably in the lower part of the Wabaunsee formation. A few wells have had commercial shows of oil at 1,600 and 1,775 feet in horizons as yet unidentified. Similar to the Churchill pool, the gravity tests 38 degrees Be., and recovery is assisted by air lift.

*Miscellaneous.* In 1927 nine other oil wells were producing in the eastern part of Sumner county. Five of these, the Miller pool, are located around the center of sec. 17, T. 32 S., R. 2 E., and produce from the Ordovician "siliceous lime" at a depth of 3,650 feet. This oil tests 38 degrees Be. The discovery well was completed by the Roxana Petroleum Corporation June 2, 1926.

#### Marion and Chase Counties.

*Reznicek Pool.* In November, 1926, near the town of Lost Springs, in Marion county, Frank, with Harwood and Winters, completed No. 1 Reznicek, located in the SW $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 22, T. 17 S., R. 4 E., in the "chat" of the Mississippi lime, for an initial production of 75 barrels, testing 37.5 degrees Be. In the spring of 1927 this well was deepened 30 feet, resulting in a new initial production of 275 barrels. By June, 1927, 3 offset wells had been completed for an average initial production of 850 barrels per well. The four were shut in to 50 barrels each per day for the remainder of the year. The total production for 1927, with wells shut in, amounted to 73,947 barrels.

*Lost Springs Town Site Pool.* In the latter part of December, 1927, Loriaux and Robinson completed an oil well on the Lost Springs town site, in sec. 23, T. 17 S., R. 4 E., for an initial production of 200 barrels, also producing from the Mississippi lime "chat" horizon. Early in 1928 many operations are under way, and locations extend all the way from the Reznicek pool to the town site discovery well. The Reznicek pool "shut in" agreement has been lifted.

*Propp Gas Field.* In April, 1926, a gas well was completed in sec. 8, T. 19 S., R. 4 E., Marion county, by Frank and Propp *et al.*, having an open flow of 4,000,000 cubic feet and a rock pressure of 845 pounds. The gas horizon is the Mississippi lime "chat," found at a depth of 2,367 feet. Two additional wells were completed, but for a much less volume and a rock pressure of about 700 pounds. One well was first completed for 15 barrels of oil at a depth of 2,398

feet, 43 feet below the top of the "chat," but this was plugged back later and recompleted as a gas well of 1,250,000 cubic feet capacity.

*Lipps Gas Area.* This area, located in secs. 25 and 36, T. 18 S., R. 6 E., and secs. 29, 30, 31 and 32, T. 18 S., R. 7 E., Chase county, was discovered by Preston and Pasewalk late in 1925, but did not attain its peak until the spring and summer of 1927. At the close of the year 18 gas wells and 9 dry holes had been completed. Four other wells were abandoned because of difficulties. The average initial volume per well was 2,750,000 cubic feet, with a rock pressure of 475 to 480 pounds.

The producing horizon is a true sand with an average thickness of 22 feet in the Lawrence shale, about 120 feet below the top of the Oread lime and 160 feet above the top of the Lansing formation. The field is located on or very close to the principal axis of the Nemaha granite ridge.

## WESTERN KANSAS.

Western Kansas has received but little attention as regards the publication of data on oil and gas production or geologic knowledge gained as a result of the discovery of oil within its limits. Local areas have been treated fully, and a number of "geologic notes" of much value have been set forth.

Information submitted in this paper, however, covers the entire area, townships 1 to 35 south, ranges 1 to 43 west, inclusive, with special reference to the development of oil and gas, and to the important basic principles of geologic interest directly associated with it. Western Kansas, as here treated, comprises the two-thirds of the state, about 54,180 square miles, lying west of the prime meridian. It has produced approximately 5,442,986 barrels of oil, 33 per cent of this during 1927. Therefore, its potentialities should receive much more consideration.

### General Statement.

On the basis of pre-Pennsylvanian stratigraphy, this relatively large area may be divided into three broadly generalized areas: (1) A relatively small area comprising the northeastern and east-central part of western Kansas, wherein a great thickness of Mississippian and Siluro-Devonian sediments separate the Pennsylvanian from the Ordovician. In this area the Ordovician post-"siliceous lime" sediments attain a remarkable thickness which increases progressively northward. (2) An area of considerable extent lying,

in general, south of the Arkansas river from range 1 west to range 43 west, inclusive, but probably extending an undetermined distance north of the river west of Kinsley, wherein both thick and thin Mississippian, but thin or totally absent Siluro-Devonian sediments, separate Pennsylvanian from Ordovician. Here the Ordovician post-"siliceous lime" sediments are relatively thin. (3) A vast area, comprising all of north-central western Kansas, together with an undetermined extent in northwestern western Kansas, wherein Pennsylvanian strata rests directly upon sediments of Ordovician or Pre-Cambrian age.

Further subdivisions and refinements of the above areas can naturally be made, but this in general describes the character and distribution of the sediments which formed the floor over which the Pennsylvanian sea advanced.

The oil fields in western Kansas, with the exception of two, have all been developed within area 3, but this by no means precludes the oil possibilities of the other two areas. Their chief potential producing horizon lies at a considerably greater depth, and therefore exploitation has been slower. In addition, many of the wells which started to this horizon stopped, unfortunately, from 100 to 400 feet short of their objective.

Some years ago the oil horizons under most of western Kansas were thought to be far below reach of the drill. This conclusion was based, in part, upon the opinion that a normal eastern Kansas section existed below the upper Pennsylvanian and Permian. To-day it is known that within area 3 all of the Mississippian and Siluro-Devonian sediments have been removed. Furthermore, due to a regional dip of the Ordovician to the southeast, the latter rises westward nearer and nearer to the surface, and progressively more and more of the lower Pennsylvanian is cut out. Some idea of this convergence between Permian and Ordovician (the maximum convergence is in a northwest-southeast direction) may be gained from the fact that in a distance of 260 miles some 4,420 feet of sediments are cut out between the base of the Cimarron group (Permian), and the Ordovician. This is at the rate of 16 feet per mile.

Within area 3, where Pennsylvanian rests directly upon Ordovician or older sediments, 11 wells have been drilled into the Pennsylvanian basal conglomerate, 65 wells have been drilled into the Ordovician, 12 wells have encountered crystalline rocks after passing through the Ordovician, and 3 wells have passed directly from Pennsylvanian into crystalline rocks.

The extreme western limit in western Kansas, where Ordovician

or older rocks have actually been penetrated, lies in T. 2 S., R. 26 W., Decatur county. A thick Pre-Pennsylvanian section of undetermined age has been drilled in T. 32 S., R. 21 W., Clark county, and in T. 26 S., R. 41 W., Hamilton county, a well has been drilled to a depth of 5,488 feet which possibly encountered rocks of Mississippian age near the bottom of the hole. The greater number of wells which have passed directly from Pennsylvanian into Ordovician lie east of range 25 west.

In 1927 six wells in western Kansas penetrated arkosic, granitic or metamorphic rocks. All of these went directly out of Pennsylvanian into Ordovician. The most interesting of them is that of Hoffine and Crane, No. 1 Bock. Here the top of the Pre-Cambrian metamorphic rocks was encountered at approximately 3,810 feet, and drilling was continued for 1,280 feet in them (probably mostly schist), without, so far as known, reaching granite.

### Development.

A total of 517 wells, drilled for oil and gas, have been completed in western Kansas, ranges 1 to 43 west, to the close of 1927. Of this number, 145 have produced oil and 11 gas, making a total of 156 producing wells, or 30 per cent of the total number drilled. Out of the 62 counties which comprise western Kansas, exploitation for oil and gas has been pursued in 48. About 82 per cent of the wells drilled have been confined to 14 counties, in which the intensity of development ranks as follows:

1. Russell county .....	152	9. Barber county .....	15
2. Sumner county, ranges west...	46	10. Ellsworth county.....	13
3. Rice county .....	45	11. Lincoln county .....	12
4. Kingman county .....	26	12. Harper county .....	12
5. Reno county .....	26	13. Ellis county .....	10
6. McPherson county .....	26	14. Rooks county .....	10
7. Sedgwick county, ranges west..	19		
8. Barton county .....	15	Total completions .....	427

Prior to 1927 the bulk of the prospecting in western Kansas, exclusive of the Fairport field, took place in 1924 and 1926. A renewal of interest and activity during 1927 resulted in the completion of 114 wells, or 22 per cent of the total number which have been drilled. Seventy-five per cent of these were wildcat tests. Thirty were completed as oil wells and six as gas wells.

One of the salient facts from a scientific standpoint about 1927 is that practically all of the wells reached a sufficient depth to increase materially a knowledge of the subsurface stratigraphy of western Kansas. A critical study of the 114 completions shows the depth to which these wells were drilled:

Number of wells.	Depth in feet.
2.....	1,000 to 2,000
6.....	2,000 to 3,000
65.....	3,000 to 4,000
40.....	4,000 to 5,000
1.....	5,000 to 6,000

The following table indicates the stratigraphic horizon to which wells were drilled in this area during 1927:

0 stopped in Cretaceous.	
4 stopped in Permian.....	3 drilled into Cimarron group. 1 drilled into Big Blue group.
25 stopped in Pennsylvanian.....	24 drilled into Missouri group. 1 drilled into Des Moines group.
32 stopped in Mississippian.....	24 drilled into Mississippi lime. 8 drilled into Kinderhook group.
2 stopped in the Siluro-Devonian.	
45 stopped in the Ordovician.....	25 penetrated Ordovician after drilling through a normal section of Mississippian and Siluro-Devonian. 20 passed directly out of Pennsylvanian into Ordovician.
6 stopped in granitic, arkosic or metamorphic rocks.	

### Producing Areas and Producing Horizons.

There are eight actively producing oil areas in western Kansas and two actively producing gas areas. In addition to these there is one abandoned oil-producing area, one potential oil-producing area, and four potential gas-producing areas. The producing areas appear in table 6. The age of the producing horizons, in descending order, and the number of wells producing from each, follows:

Producing horizons.	Producing wells.
1. An unidentified horizon in the lower part of the lower Permian.....	4
2. A gas horizon in the Topeka lime (Shawnee formation): middle Pennsylvanian .....	2
3. "Oswald Series"—9 producing horizons in a 320-foot thickness of strata between the top of the Oswald lime and the base of the Pennsylvanian basal conglomerate: all of middle Pennsylvanian age .....	113
4. Layton sand (Kansas City formation): Pennsylvanian.....	2
5. Basal Kansas City formation: Pennsylvanian.....	1
6. Mississippi lime .....	33
7. Wilcox sand: Ordovician .....	1

Innumerable shows of oil have been encountered in the top of the Lansing formation, in the top of the Mississippi lime, and in the Viola lime. Occasional shows of oil and gas have also been found in the Permian, and in the Wabaunsee and Shawnee formations of the upper Pennsylvanian.

TABLE 6.—Oil and gas development of western Kansas, January, 1924, to December, 1927.

NAME.	Location.	County.	Discovery date.	Number wells producing.	Production, 1927.	Total production.	Gravity.	Producing horizons.
ACTIVE OIL-PRODUCING AREAS.								
Fairport.....	Secs. 29 and 32, T. 11 S. R. 15 W. Secs. 5, 7, 8, 17, 18, T. 12 S., R. 15 W.	Russell.....	1923	102	944,100	4,360,299	40	Middle Pennsylvanian. Nine producing horizons.
Austin.....	Sec. 30, T. 12 S., R. 15 W.	Russell.....	1926	4	24,419	28,729	40	Middle Pennsylvanian. Two producing horizons.
Gorham.....	Secs. 32 and 33, T. 13 S., R. 15 W. Secs. 4 and 5, T. 14 S., R. 15 W.	Russell.....	1926	4	67,719	73,783	37	Middle Pennsylvanian. Two producing horizons.
North Gorham.....	Sec. 7, T. 13 S., R. 15 W.	Russell.....	1927	1	6,811	6,811	39	Middle Pennsylvanian. Five producing horizons.
Rooks county.....	Sec. 11, T. 9 S., R. 16 W. Sec. 3, T. 10 S., R. 16 W.	Rooks.....	1927	2	7,800	7,800	32	Middle Pennsylvanian. Two producing horizons.
Welch.....	Secs. 34 and 35, T. 20 S., R. 6 W. Secs. 2 and 3, T. 21 S., R. 6 W.	Rice.....	1924	27	624,264	923,079	32	Erosional remnants of Mississippi lime.
Abbeyville.....	Sec. 24, T. 24 S., R. 8 W.	Reno.....	1927	1	15,495	15,495	37	Basal Kansas City, Pennsylvanian.
Latta.....	Sec. 9, T. 30 S., R. 2 W.	Sumner.....	1927	2	.....	.....	.....	Layton sand. Pennsylvanian.
ABANDONED OIL-PRODUCING AREA.								
Kingman.....	Sec. 16, T. 27 S., R. 7 W.	Kingman.....	1926	1	4,008	27,000	31	Top Mississippi lime.

TABLE 6—*Concluded.*

NAME.	Location.	County.	Discovery date.	Number wells producing.	Production, 1927.	Total production.	Gravity.	Producing horizons.
ACTIVE GAS-PRODUCING AREAS.								
McPherson.....	Secs. 29 and 32, T. 18 S., R. 2 W.....	McPherson.....	1926	3	.....	748 million	.....	Mississippi lime.
Latta.....	Sec. 9, T. 30 S., R. 2 W.....	Sumner.....	1927	2	.....	.....	.....	Topeka lime, Pennsylvanian.
POTENTIAL GAS-PRODUCING AREAS.								
Liberal.....	Sec. 20, T. 33 S., R. 33 W. Sec. 3, T. 35 S., R. 34 W.....	Seward.....	1924 1927	3	.....	.....	.....	Lower Permian.
Hugoton.....	Sec. 31, T. 33 S., R. 37 W.....	Stevens.....	1927	1	.....	.....	.....	Lower Permian.
Alexander.....	Sec. 13, T. 33 S., R. 13 W.....	Barber.....	1927	1	.....	.....	.....	Top Mississippi lime?
Morrison.....	S. 20, T. 32 S., R. 21 W.....	Clark.....	1926	1	.....	.....	.....	Undetermined.
					Total number of oil wells in western Kansas..... 144			
					Total number of gas wells in western Kansas..... 11			
					Gross production of oil in western Kansas..... 5,422,996			

## Discussion of Areas by Counties.

### RUSSELL COUNTY.

Russell county has produced more oil than any other county in western Kansas, its gross production to the end of 1927 being 4,469,622 barrels, or 81 per cent of the aggregate yield for western Kansas. During 1927 the county produced 1,043,049 barrels.

To the end of 1927 all wells completed in Russell county have come in with a relatively small initial production. Shortly after the close of the year a well was completed having an initial production of 1,000 barrels per day and producing from the Pennsylvanian basal conglomerate. (See Gorham field, below.) Based on past records, this 1,000-barrel well is a decided anomaly, since in Ts. 10 to 16 S., Rs. 10 to 16 W., inclusive, a total of forty wells have been drilled through this Pennsylvanian basal conglomerate into subjacent rocks without discovering oil in commercial quantities. Probably but few of these were located with proper regard for Ordovician structure. In the Fairport field six wells penetrated the basal conglomerate, but only one was well located structurally. Hereafter this conglomerate zone must certainly be considered a potential producing horizon, and the problem of finding commercial production in it resolves itself into finding areas wherein Pre-Pennsylvanian structure is favorable to the accumulation of oil at this horizon.

In the Russell county area ten wells record oil showings in the conglomerate, two wells have passed directly out of the Pennsylvanian into either arkosic or crystalline rocks, and in one well the Pennsylvanian was separated from the arkose by only a few feet of Ordovician. Three wells report oil showings in the arkose itself. It is of importance to note that no production and no oil showings have been reported in this area from rocks of Ordovician age.

In the forty wells in the above area the minimum interval recorded from the top of the Oswald lime to the base of the Pennsylvanian basal conglomerate is 242 feet, and the maximum 720 feet. This interesting variation in interval is shown by wells as follows:

Number of wells.	Interval in feet.
10.....	242 to 300
15.....	300 to 400
12.....	400 to 500
2.....	500 to 600
0.....	600 to 700
1.....	700 to 720

*Fairport Field.* The Fairport field is situated in northwestern Russell county in secs. 29 and 32, T. 11 S., R. 15 W., and secs. 5, 7, 8, 17 and 18, T. 12 S., R. 15 W. This field is known popularly as the Russell field, but locally is termed Fairport. The latter name is now accepted, since additional fields have been found in Russell county. It was discovered on November 24, 1923, by the Valerius Oil and Gas Company at No. 1 Carrie Oswald (actually completed January 11, 1924), located in the SW corner of SE $\frac{1}{4}$  of sec. 8, T. 12 S., R. 15 W., which had an initial production of 250 barrels.

The axis of the field is oriented almost due north and south. It has a maximum length of 3 $\frac{1}{2}$  miles, a maximum width of three-quarters of a mile (six locations) and an average width of one-half mile. The total number of wells drilled at the close of 1927 was 112, of which ten wells, or nine per cent, were dry holes. The field is practically drilled up and another location offsetting any one of the marginal wells will probably result in a dry hole.

The oil zone in the Fairport field ranges from 2,950 to 3,300 feet in depth. Surface and subsurface structure coincide. Production is found in nine horizons, eight below the Oswald and one above, all of which are porous streaks in the lime. These horizons should always be referred to in feet below the top of the Oswald lime, since most wells miss two or more of them. Consequently, the second producing horizon in one well at 45 feet may not correspond to the second producing horizon in its offset well at 85 feet.

The oil horizons in the Fairport field, measured in feet above and below the top of the Oswald lime, with remarks relative to the importance of the production found in each horizon, appear in table 7. Production is not always found at exactly the depths given in this table (table 7), but wherever present it closely corresponds to one of them.

The entire thickness of strata between the top of the Oswald lime and the base of the Pennsylvanian is often popularly referred to as the "Oswald pay." This is an unfortunate circumstance, since the Oswald pay is a definite horizon occurring 0 to 12 feet below the top of the Oswald lime. Furthermore, owing to the fact that the Oswald pay and the 30-foot pay are the most prolific producing horizons, there has arisen an erroneous impression that a well, failing to produce in the top 50 feet below the top of the Oswald lime, automatically becomes a dry hole. Obviously this is not the case, and a well should not be abandoned until it has tested all of the Pennsylvanian below the Oswald lime, including the basal conglomerate, and has penetrated the underlying Ordovician.

TABLE 7.—The producing horizons in the Fairport field, Russell county, Kansas.\*

HORIZON.	Remarks.	Approximate number producing wells.
Dodge pay.....	Occurs 28 feet above the top of the Oswald lime.† Poorest producing horizon.....	3
Oswald pay.....	Occurs 0 to 12 feet below the top of the Oswald lime. Best producing horizon.....	102
30-foot pay.....	Occurs 30 feet below the top of the Oswald lime. Best producing horizon.....	102
45-foot pay.....	Occurs 45 feet below the top of the Oswald lime. Third best producing horizon†.....	?
65-foot pay.....	Occurs 65 feet below the top of the Oswald lime. Fourth best producing horizon†.....	?
75-85-foot pay.....	Occurs 75 to 85 feet below the top of the Oswald lime. Seventh best producing horizon†.....	?
98-foot pay.....	Occurs 98 feet below the top of the Oswald lime. Produces over the smallest area, and therefore defines the first edge water. If oil is not present here, the well is usually abandoned. Some 50 wells have been deepened to this horizon, but only about half have produced oil from it. Second best producing horizon.....	25
160-foot pay.....	Occurs 160 feet below the top of the Oswald lime. Fifth best producing horizon.....	20
220-foot pay.....	Occurs 220 feet below the top of the Oswald lime. This is the lowest producing horizon in the Fairport field. Sixth best producing horizon†.....	?
Basal conglomerate.....	Occurs 280 to 320 feet below the top of the Oswald lime. A total of 6 wells have been drilled into this basal conglomerate zone in the Fairport field, but none have produced commercial quantities of oil.....	0

\* Courtesy Thomas H. Allan, Midwest Exploration Company, Russell, Kan.

† The top of the Oswald lime is the datum plane above and below which all producing horizons are measured.

‡ All wells in the Fairport field are producing from the Oswald and 30-foot pays but may or may not be producing from the lower horizons. It is not feasible to assign any definite number of producing wells where questioned above.

The producing horizons in the Fairport field occur in the basal part of the Pennsylvanian section in the Russell area, but are of middle Pennsylvanian age. The exact age of the top of the Oswald lime is in dispute and is to be correlated with either the Oread lime at the top of the Douglas formation, or with the top of the Lansing formation. The 220-foot pay is probably some part of the Lansing-Kansas City "group," which is usually considered as a unit in this area. The horizon from 280 to 320 feet constitutes an extremely characteristic and widespread conglomerate, made up of an admixture of red, green and yellow chert pebbles, red and green shale, and fragments of limestone. This represents the Pennsylvanian basal conglomerate and marks the zone of a widespread unconformity between Pennsylvanian and Ordovician or crystalline sediments.

The age of the conglomerate in separate localities is seldom the

same because of its progression higher and higher in the section to the west. Below this horizon, in the Fairport field, wells pass immediately into strata of Ordovician age. A number of wells in the field have drilled through the Ordovician into crystalline rocks, but failed to record any oil showings in the former. One well, however, located very near the apex of the field, drilled an extremely thin section of Ordovician and reported an oil showing in the underlying arkose.

The depths from which production is secured in wells outside the Fairport field, in the Russell-Rooks county area, closely follow those listed in the table of producing horizons. (Table 7.) They have, however, a fewer number of "pays" for comparison, and the bulk of the production at the present time is coming from, or close below, the 30-foot pay. This is partially due to the fact that many of the wells have not been drilled very far below the 30-foot horizon. The Fairport field is believed to have more producing horizons, or porous streaks, than the other fields in the area because of its more sharply folded structure in the Pennsylvanian.<sup>9</sup>

All wells in the Fairport field are drilled on the basis of one well to ten acres. The field had practically reached its present limits by the end of 1926. Between January 11, 1924, the date of actual completion of the discovery well and the end of 1924, only 7 producing wells had been completed. Following this, 57 producing wells were added in 1925, 38 wells in 1926, and only 4 wells in 1927, the latter decrease in number due to the fact that the field is about drilled up.

The gravity of the oil ranges from 38 to 42 degrees Be. It requires no treatment prior to its acceptance for pipe-line use.

The gross production to December 31, 1927, was 4,360,299 barrels, or an approximate recovery of 4,075 barrels to the acre. The peak of production was reached in July, 1925, when 182,187 barrels were produced in one month. A production in excess of 150,000 barrels per month was maintained from September, 1925, to July, 1926. During 1927 the field produced 944,100 barrels (table 8), or an average daily production of 2,587 barrels from 102 wells. Of these the maximum initial production per well was 480 barrels, the minimum 20 barrels, and the average 190.

*Austin Field.* The Austin field, sometimes called South Fairport, is located in sec. 30, T. 12 S., R. 15 W. The discovery well, Midwest

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<sup>9</sup>. Thomas H. Allan, Midwest Exploration Co., Russell, Kan. Personal communication to Anthony Folger.

Exploration Company No. 1 Austin, is located in the NE corner of SW $\frac{1}{4}$  of sec. 30, T. 12 S., R. 15 W., and was completed on March 13, 1926, with an initial production of 24 barrels of 38 degrees Be. oil. In this well the top of the Oswald lime was found at 3,031 feet and production comes from the 30-foot pay, at 3,060 feet. Four wells have been completed, two producing from the 30-foot pay at an average depth of 3,050 feet, and two from the 220-foot pay at an average depth of 3,275 feet. The total production from discovery to the close of 1927 from the four wells was 28,729 barrels (table 8). The peak of production has not been reached, and the limits of the field have not been defined.

*Gorham Field.* The Gorham field, in central-western Russell county, is located in secs. 32 and 33, T. 13 S., R. 15 W., and secs. 4 and 5, T. 14 S., R. 15 W. Development has progressed very slowly, only four producing wells being completed by the end of 1927. (See table 8 for production figures.) No dry holes have been drilled.

The discovery well, Midwest Exploration Company No. 36 Dortmund, located in the SE corner NW $\frac{1}{4}$  of sec. 5, T. 14 S., R. 15 W., was completed on October 15, 1926, with an initial production of 120 barrels of 37 degrees Be. gravity oil, coming from the 30-foot pay at a depth of 3,057 feet. Subsequently it was deepened to 3,112 feet, but after encountering water it was plugged back. The top of the Oswald lime occurs at 3,027 feet. The four wells are producing from an average depth of 3,050 feet, from the 30-foot pay.

Early in 1928 Stearns and Streeter Company No. 1 Mermis, located in the SW corner NW $\frac{1}{4}$  SW $\frac{1}{4}$  of sec. 33, T. 13 S., R. 15 W., was completed for an initial production of 1,000 barrels of oil testing 36 degrees Be. This production comes from the top of the Pennsylvanian basal conglomerate, found at a depth of 3,300 feet, 257 feet below the top of the Oswald lime. This further emphasizes that the failure of a well in the Russell area to produce from the top 30 feet of the "Oswald series" is no indication that the well should be abandoned. This is the first time in the history of western Kansas that any production has been encountered in this horizon. Whether or not additional wells in the Russell area will find production of like amount from the basal conglomerate remains unanswered until further exploitation is completed.

The Gorham field has produced 73,783 barrels of oil from its discovery to the end of 1927. During 1927 it produced 67,719 barrels (table 8.)

TABLE 8.—Total production by fields and by months from completion of the first well in January, 1924, to the close of 1927, Russell county.

Fields.....	Fairport.	Austin.	Gorham.	N. Gorham.	Russell Co.
No. of producing wells at close of 1927..	102	4	4	1	111
1924.					
Months.					
January.....	3,565				3,565
February.....	4,930				4,930
March.....	5,983				5,983
April.....	8,940				8,940
May.....	8,587				8,587
June.....	18,630				18,630
July.....	29,047				29,047
August.....	27,280				27,280
September.....	26,700				26,700
October.....	34,658				34,658
November.....	32,760				32,760
December.....	31,186				31,186
Totals.....	232,266				232,266
1925.					
January.....	32,891				32,891
February.....	36,764				36,764
March.....	46,872				46,872
April.....	53,970				53,970
May.....	84,041				84,041
June.....	70,500				70,500
July.....	182,187				182,187
August.....	149,544				149,544
September.....	160,560				160,560
October.....	175,088				175,088
November.....	170,100				170,100
December.....	173,631				173,631
Totals.....	1,336,148				1,336,148
1926.					
January.....	158,255				158,255
February.....	157,836				157,836
March.....	178,949	138			179,087
April.....	166,397	253			166,650
May.....	179,091	244			179,335
June.....	163,725	525			164,250
July.....	158,080	361			158,441
August.....	147,807	559			148,366
September.....	138,522	198			138,720
October.....	140,189	558	1,295		142,042
November.....	132,374		2,386		134,760
December.....	126,560	1,474	2,383		130,417
Totals.....	1,847,785	4,310	6,064		1,858,159

TABLE 8—Concluded.

Fields .....	Fairport.	Austin.	Gorham.	N. Gorham.	Russell Co.
1927.					
January.....	106,545	2,220	1,774	.....	110,539
February.....	85,730	2,076	1,778	.....	89,584
March.....	98,613	1,761	3,872	.....	104,246
April.....	91,896	1,703	6,237	.....	99,836
May.....	86,398	1,786	6,195	.....	94,379
June.....	78,328	1,202	5,339	616	85,485
July.....	77,421	1,824	5,357	1,628	86,230
August.....	73,484	1,758	5,227	1,061	81,530
September.....	67,720	1,653	5,055	970	75,498
October.....	66,262	1,605	9,886	956	78,709
November.....	54,804	3,659	8,469	816	67,748
December.....	56,899	3,172	8,530	764	69,365
Totals.....	944,100	24,419	67,719	6,811	1,043,049
Total for field.....	4,360,299	28,729	73,783	6,811	.....
Grand total production, Russell county to end of 1927.....	.....	.....	.....	.....	4,469,622

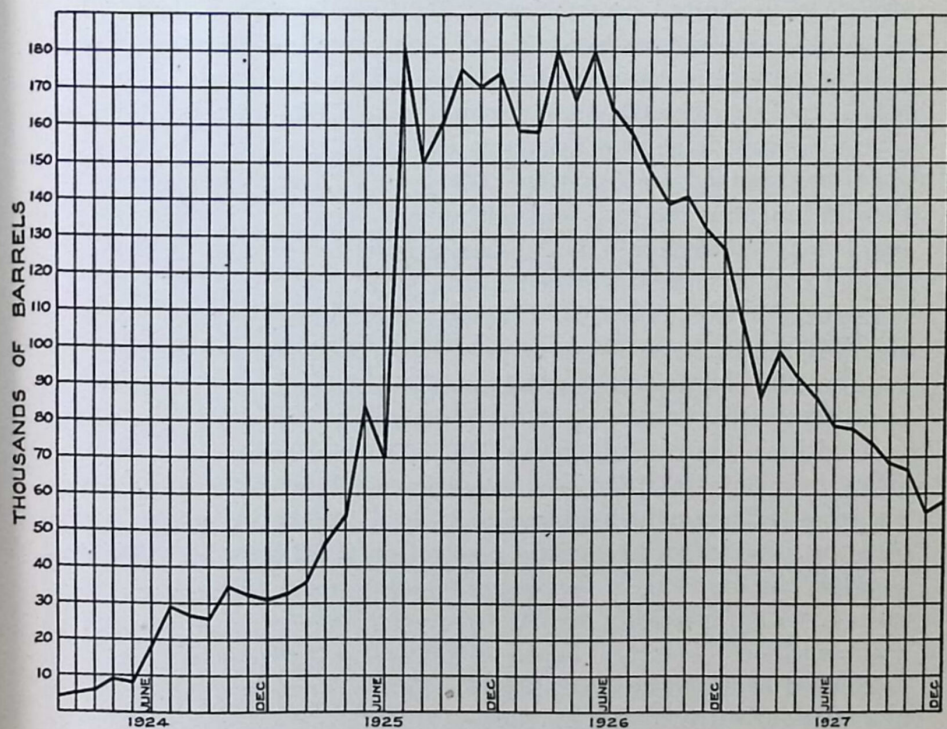


FIG. 5.—Graphic representation showing the total production by months for the Fairport oil field, Russell county, Kansas, from discovery in December, 1923, to the close of 1927. (Not including Austin, Gorham or North Gorham fields.)

*North Gorham Field.* The North Gorham field consists of one well, Stearns and Streeter No. 1 Gorham, located in the SW corner

NE $\frac{1}{4}$  of sec. 7, T. 13 S., R. 15 W., Russell county. It was completed in the latter part of June, 1927, with an initial production of 50 barrels of 39 degrees Be. gravity oil. The top of the Oswald lime was encountered at a depth of 3,088 feet. There are five producing horizons, which, measured below the top of the Oswald lime, occur respectively at 30, 48, 78, 111 and 117 feet. The well has not been deepened to the Pennsylvanian basal conglomerate. To the end of 1927 this well produced 6,811 barrels of oil (table 8).

#### ROOKS COUNTY.

During 1927 production was found for the first time in Rooks county at two separate localities about four miles apart along the same line of folding.

Vickers Petroleum Company No. 1 Luhman, located in the SW corner SE $\frac{1}{4}$  of sec. 11, T. 9 S., R. 16 W., was completed on July 5, 1927, with an initial production of 238 barrels of 41.5 degrees Be. oil. Immediately it settled down to a daily production of 90 barrels, and by the end of the year had fallen off to 50 barrels. Its total output to December 31, 1927, amounted to 7,800 barrels. The top of the Oswald lime was encountered at 3,228 feet. A 50-barrel show was found from 3,254 to 3,258 feet, 26 feet below top of the Oswald lime, but the principal oil horizon occurs at 3,261 $\frac{1}{2}$  feet, 33 feet below. Therefore, the Luhman production is coming from the 30-foot pay. The well was drilled to a total depth of 3,264 feet.

Derby Oil Company No. 1 Kruse, NW corner NE $\frac{1}{4}$  NE $\frac{1}{4}$  of sec. 3, T. 10 S., R. 16 W., was completed in the latter part of December, 1927, for an initial production of 42 barrels of 41 degrees Be. oil. It has since settled down to 30 barrels a day. The top of the Oswald lime was encountered at 3,075 feet. A showing of oil was found from 3,085 to 3,115 feet, which was shot with 60 quarts without result. The producing horizon, 3,126 to 3,134 feet, was shot with 20 quarts and yielded an initial production of 42 barrels. This production, coming from 51 feet below the top of the Oswald lime, corresponds approximately to the 45-foot producing horizon in the Fairport field. The total depth of the well is 3,167 feet.

Neither of the two wells in Rooks county have been deepened to the Pennsylvanian basal conglomerate.

#### RICE COUNTY.

Although third place is accorded Rice county in regard to the total number of tests drilled in the different counties of western Kansas, most of these have been drilled in its one oil field. Only

ten wells have been completed outside of the Welch field. Several of these were started some years before the present subsurface structural conditions were known. Whether or not additional pools will be opened in Rice county and adjacent areas from a similar producing horizon is problematical. Apparently the Welch field is producing under a combination of specialized subsurface conditions. It remains for other tests to be started under a like set of these conditions before much can be said relative to the county's future possibilities.

*Welch Field.* The Welch field, located in secs. 26, 34 and 35, T. 20 S., R. 6 W., and secs. 2, 3 and 11, T. 21 S., R. 6 W., was discovered in April, 1924. This field has been called both the Hutchinson field and the Rice county field, but the term Welch is to be preferred. It is the second field of importance in western Kansas. The original well, Prairie Oil and Gas Company and Meridian Oil and Gas Company No. 1 Welch, located in the SE corner SW $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 34, T. 20 S., R. 6 W., had an initial production of 115 barrels of 33.5 degrees Be. oil from 3,370 to 3,416 feet. By April, 1926, its production had settled to 25 barrels per day, but deepening to 3,490 feet increased this to 230 barrels. A total of 35 wells had been completed at the close of 1927, of which number 8 were dry and abandoned. Three of these were abandoned at shallow depths because of drilling difficulties, without reaching the producing horizons. Therefore, in reality, only five failures have been recorded.

The producing depths range from 3,352 to 3,404 feet. Production is from a chert horizon representing erosional remnants of the Mississippi lime. This chert horizon has been designated as the Welch chert, at first regarded as lower Pennsylvanian in age<sup>1</sup> but indicated by more recent evidence to belong to the Mississippian.<sup>2</sup>

As knowledge of drilling conditions improved it was found that production was aided materially by penetrating completely the total thickness of chert. Out of the 27 producing wells, 16 have been drilled through the chert into the subjacent shale. The minimum thickness of chert is 70 feet, the maximum 120 feet, and the average in excess of 100 feet.

Information relative to the subsurface stratigraphy below the chert is derived from one well only. In 1924 the Prairie Oil and Gas Company No. 1 Wood, located in the SE corner SW $\frac{1}{4}$  NE $\frac{1}{4}$  of sec. 34, T. 20 S., R. 6 W., failed to produce from the chert and was drilled to a total depth of 3,795 feet. The chert was underlain

1. Moore, Raymond C. Early Pennsylvanian Deposits West of the Nemaha Granite Ridge, Kansas: Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 3, 1926; pp. 205-216.

2. Barwick, John S. The Salina Basin of North-Central Kansas: Bull. Amer. Assoc. Petrol. Geol., vol. 12, No. 2, 1928; pp. 177-189.

by 220 feet of shale, and this in turn by 140 feet of limestone. Cuttings, unfortunately, were not saved, but from knowledge of the stratigraphy in closely adjacent areas it appears that the shale is both of Kinderhook (Mississippian) and Ordovician age. Presumably the "Wilcox" sand was not reached.

Production is not so much related to structural conditions as it is to localized porous streaks in the chert, and for this reason it is difficult to determine whether the limits of the field have been defined or not. There appear to be some twenty-five locations remaining to be drilled within the limits of the field as outlined at present. The wells are located on the basis of one to each ten acres. Most of the production is natural. A few of the wells have been shot, but this seems to be detrimental.

During 1927 the Welch field produced 624,264 barrels of oil, or 63 per cent as much oil as produced by the Fairport field in the same period of time. Despite the present approximate equivalence of its production with Fairport, it is generally held that the Welch field does not compare in importance with the Fairport field. This is due to the lower gravity of the oil, its greater depth, a lower recovery per acre (3,420 as against 4,075 barrels), and the difficulty in handling the oil after it is produced. It cuts from 3 to 5 per cent, contains from 5 to 50 per cent B. S. and water, and in some cases must be treated two to three times before it is accepted at the pipe line.

Between its discovery in April, 1924, and June, 1926, the Welch field was relatively of little importance. It had produced but 91,462 barrels, and in the early part of July, 1926, was running only 620 barrels a day (from 8 producing wells). In July, however, the first important well was completed, Youkers-Walsten-Miller Syndicate No. 2 Walsten, located in the SW corner NE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 2, T. 21 S., R. 6 W. It had an initial production of 1,200 barrels of 35.4 degrees Baumé oil from 3,375 to 3,387 feet. Since then two other good producers have been completed and these three constitute the only ones of importance in the field. Data on these three wells are as follows:

Name; date completed; location.	Initial production.	Present daily average.
1. Walsten No. 2, Ind. O. & G. Co. <sup>3</sup> ; July, 1926; SW NE NW, S. 2, T. 20 S., R. 6 W.....	1,200	180
2. Walsten No. 3, Ind. O. & G. Co.; December, 1926; SE NW NW, S. 2, T. 20 S., R. 6 W.....	800	200
3. Miller No. 2, Ind. O. & G. Co.; May, 1927; NW NE NE, S. 3, T. 20 S., R. 6 W.....	1,200	940

3. Completed by Youkers-Walsten-Miller Syndicate. A transfer of interests took place later.

TABLE 9.—Daily average and total production, by months, in the Welch oil field, Rice county, Kansas, from discovery in April, 1924, to end of 1927.

MONTH.	1924.		1925.		1926.		1927.	
	Daily average.	Total production.	Daily average.	Total production.	Daily average.	Total production.	Daily average.	Total production.
January.....			89	2,759	195	6,045	1,075	33,325
February.....			71	1,988	227	6,356	1,055	29,540
March.....			81	2,511	226	7,006	1,304	40,424
April.....	115	3,450	76	2,280	184	5,520	1,012	30,360
May.....	100	3,100	88	2,728	180	5,580	2,098	65,038
June.....	74	2,220	83	2,490	590	17,700	1,844	55,320
July.....	74	2,294	117	3,627	1,279	39,649	2,032	62,092
August.....	69	2,139	115	3,565	1,083	33,573	1,983	61,473
September.....	114	3,420	106	3,180	954	28,620	2,206	66,180
October.....	103	3,193	116	3,596	925	28,675	2,156	66,836
November.....	99	2,970	103	3,090	973	29,190	1,955	58,650
December.....	94	2,914	111	3,441	966	29,946	1,746	54,126
Totals.....		25,700		35,255		237,860		624,264
Total production to date.....								923,079

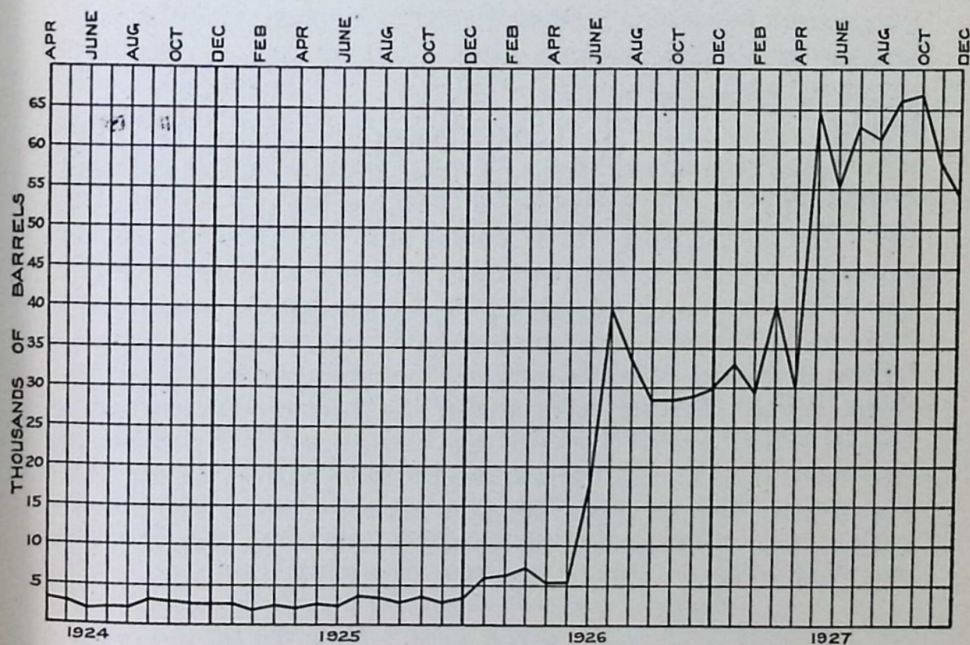


FIG. 6.—Graphic representation showing the total production by months for the Welch oil field, Rice county, Kansas, from discovery in April, 1924, to the close of 1927.

Miller No. 2 has proven to be the best well yet completed in the field. It had a peak production of 1,308 barrels per day, and has produced 159,113 barrels of oil, or 16 per cent of the total production of the field. The monthly production figures for Miller No. 2 from May to December, 1927, are as follows:

May .....	18,168	September .....	18,889
June .....	12,016	October .....	26,791
July .....	12,336	November .....	28,133
August .....	12,140	December .....	30,640

Daily average and total production by months for the Welch field, from discovery to the end of 1927, is shown in table 9. At the close of 1927, 25 oil wells were producing at the rate of 1,746 barrels per day, or an average daily yield of about 70 barrels per well. The average recovery per acre had been about 3,420 barrels. It should be noted that in the Welch field 3 wells have produced the greater part of the total production. Before these three were found a considerable number were drilled which yielded but small quantities of oil. This is characteristic of any "chat" production in Kansas and is one of the reasons why a more concentrated effort is not made to find additional pools of like nature.

#### RENO COUNTY.

Only one producing well has been found in Reno county. It is known as the Abbeyville well.

Hartman and Skaer, No. 1 Smith, center SW $\frac{1}{4}$  of sec. 24, T. 24 S., R. 8 W., was completed January 1, 1927, with an initial production of 325 barrels of 37.1 degrees Be. oil from a depth of 3,540 to 3,544 $\frac{1}{2}$  feet. The oil carried a water content of 3 to 10 per cent and sufficient gas to make it flow frequently. Production slowly fell to 30 barrels per day and in March it was deepened to its total depth of 3,558 feet. This was not of material aid, yielding but 60 barrels of oil and 20 barrels of water, and for that reason was plugged back to the former depth of 3,544 $\frac{1}{2}$  feet. In July production had decreased to 18 barrels. The well was cleaned out in November and came back to 30 barrels. It was producing 35 barrels per day at the end of 1927. The total production at the close of the year was 15,495 barrels. The producing horizon is at or near the base of Kansas City formation.

## KINGMAN COUNTY.

In Kingman County Carter Oil Company and D. P. Fleeger No. 1 Richardson, located in the NE corner SE $\frac{1}{4}$  of sec. 16, T. 27 S., R. 7 W., was completed on January 25, 1926, with an initial production of 120 barrels of 28.5 degrees Be. oil from chert representing the top of the Mississippi lime and found at a depth of 3,853 feet. Gas was present here also. On February 1, 1926, it was deepened to the total depth of 3,894 feet. Oil, found from 3,876 to 3,894 feet flowed over the top of the crown block, and the second initial production was 804 barrels, testing 31.5 degrees Be. and carrying some water. The second day the well produced 546 barrels of oil and a little more water, settling in a short time after to 135 barrels of oil, plus 12 per cent water. In July, 1926, production had fallen off to 60 barrels of oil, plus 17 per cent water, and in September this had decreased to 12 barrels of oil and 100 barrels of water per day. This ratio of production was maintained approximately until it was finally plugged about September, 1927. During its life it produced a total of 27,000 barrels of oil, always flowing. The volume of gas was about two million cubic feet daily and the pressure remained constant from discovery to abandonment.

This discovery resulted in one of the most costly and unsuccessful wildcat plays experienced in western Kansas. As a direct result of it, some 30 wildcat tests were drilled, but none encountered production. Offsets to the producing well were drilled on the east and west, but both were failures. At the close of 1927 Kingman county had no producing wells. Despite the fact that the Mississippi lime has been adequately tested in this county, there are still "Wilcox" sand possibilities.

## SUMNER COUNTY (RANGES WEST).

*Latta Oil and Gas Field.* The Latta Oil and Gas field is located in sec. 9, T. 30 S., R. 2 W. Oil was discovered here in June, 1927, and gas in October, 1927. At the end of the year there were two producing oil wells and two producing gas wells. The oil is derived from the top of the Kansas City formation, found at a depth of 3,030 feet, and the gas is being produced from the Topeka lime (middle Shawnee formation), found at a depth of about 2,000 feet.

The discovery oil well, Champlin Refining Company No. 1 Latta, is located in the SW corner SE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 9, T. 30 S., R. 2 W. Oil was encountered from 3,042 to 3,056 feet, yielding an initial pro-

duction of 100 barrels testing 39 degrees Be. The discovery gas well, Champlin Refining Company No. 2-B Latta, is located in the SW corner SE $\frac{1}{4}$  SW $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 9, T. 30 S., R. 2 W. Six million cubic feet of gas, open flow, was found in sandy limestone from 2,015 to 2,031 feet. The limits of this oil and gas field have not been defined.

#### MCPHERSON COUNTY.

The McPherson Gas field, the most important gas field in western Kansas, is located in secs. 29, 31 and 32, T. 18 S., R. 2 W. Discovered in September, 1926, three gas wells had been completed by the end of 1927, of which number two have yielded a total of 748,810,827 cubic feet of gas. Gas was not actually produced until the latter part of January, 1927. The third well is not yet connected to any pipe line. The wells are located on the apical area of a large dome, with considerable closure developed in the Mississippi lime, along a major subsurface line of folding, a part of the Abilene anticline. The gas is piped to Salina by the United Light and Power Company who are running about 3 $\frac{1}{2}$  million cubic feet per day into the line. A pipe line has just been completed to Hutchinson, and this will materially increase the output of the field. The rock pressure is between 1,050 and 1,100 pounds.

The discovery well in the field, Merriman, Reeves and Shidel, No. 1 Anderson, center SW $\frac{1}{4}$  of sec. 29, T. 18 S., R. 2 W., was completed in September, 1926, for an initial production of 7 $\frac{1}{2}$  million cubic feet of gas from a total depth of 2,943 feet. The top of the Mississippi lime was encountered at 2,905 feet and the first gas at 2,927 feet, increasing as the well was deepened according to the following gauge record:

Volume, cu. ft.	Depth, ft.
1 million .....	2,927
4 million .....	2,935
6 million .....	2,937
6.1 million .....	2,940
7.5 million .....	2,943—Total depth.

The second well, Merriman, Reeves and Shidel No. 2 Anderson, SW corner SE $\frac{1}{4}$  SW $\frac{1}{4}$  of sec. 29, T. 18 S., R. 2 W., was completed in April, 1927, for an initial production gauging 11 $\frac{1}{2}$  million cubic feet. The top of the Mississippi lime was found at 2,929 feet and the well was drilled to a total depth of 2,934 feet.

The third producing well, the Texas Company No. 1 Chindberg, was completed in November, 1927, with an initial production of 8

million cubic feet. This well is located in the NW corner NE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 32, T. 18 S., R. 2 W. The top of the Mississippi lime was encountered at 2,943 feet and the well was drilled to a total depth of 2,968 feet with a progressively increasing amount of gas, as follows:

$\frac{1}{2}$ million cu. ft. at 2,943 ft.
2 $\frac{1}{2}$ million cu. ft. at 2,950 ft.
8 million cu. ft. at 2,968 ft.

At the end of 1927 this well had not been connected to a pipe line. The Texas Company is using the gas to drill a twin test which may be carried to the "Wilcox" sand. In February, 1928, the largest gas well yet completed, McPherson Oil Company No. 1 Anderson, center SE $\frac{1}{4}$  NE $\frac{1}{4}$  of sec. 31, T. 18 S., R. 2 W., was drilled into the top of the Mississippi lime at 2,915 feet, and gauged 18 million cubic feet between 2,947 and 2,953 feet.

The amount of gas produced in the McPherson gas field from the start of production in January to the close of 1927, by months, is as follows:

Month.	Production, cu. ft.	Month.	Production, cu. ft.
January .....	1,459,755	August .....	84,681,751
February .....	34,783,594	September .....	87,591,329
March .....	53,221,272	October .....	84,495,200
April .....	52,584,564	November .....	79,649,460
May .....	71,779,650	December .....	82,401,832
June .....	72,216,457		
July .....	75,250,963	Total for 1927....	748,810,827

### Potential Gas Producing Areas.

*Seward and Stevens Counties.* Three wells in the vicinity of Liberal, Seward county, and a well near Hugoton, Stevens county, are capable of producing considerable quantities of gas. All but one of these are shut in awaiting the construction of pipe lines to Liberal, Hugoton and adjacent towns in extreme southwestern Kansas and the Oklahoma panhandle. A fifth well, northwest of Liberal, had a number of gas showings.

This gas area was discovered in 1922 and 1924, but its possibilities have been enhanced materially by subsequent drilling in 1927. The gas horizons occur in a 200-foot thickness of strata, the top of which ranges from 330 to 420 feet below the base of the Cimarron group. The exact age of the producing horizons has not yet been identified, but they probably occur in the lower part of the Lower Permian somewhere within the Marion, Chase and Council

Grove formations. So far as known, no wells have been drilled to a sufficient depth to reach the oil horizons found in the Amarillo and Oklahoma panhandle areas.

The discovery well in this potential gas area was Defenders and Traders Oil Company No. 1 Boles, located in the NE corner NW $\frac{1}{4}$  of sec. 3, T. 35 S., R. 34 W., Seward county, and completed in December, 1922, at a total depth of 2,918 feet. This test had a small showing of oil and gas at 2,585 feet, 420 feet below the base of the Cimarron group, but encountered its principal gas sand from 2,718 to 2,755 feet, 553 feet below the base of the Cimarron, where it yielded five million cubic feet of gas. The test has been plugged, but gas is still escaping. This was the first producing well completed in western Kansas.

The second well, popularly known as the Liberal gas well, was completed in June, 1924, at a total depth of 2,764 feet. This was Seward Oil and Gas Company No. 1 Seeley, in the NE corner of sec. 20, T. 33 S., R. 33 W., Seward county. Its initial production was one million cubic feet. Four horizons of gas were found, the highest one, 330 feet below the base of the Cimarron group. These gas sands were found at the following depths:

- (1) 2415 to 2427 $\frac{1}{2}$  feet.
- (2) 2645 to 2654 feet.
- (3) 2679 to 2689 feet.
- (4) 2727 to 2749 feet.

Gas from this well is still being produced.

Between 1924 and 1927 no drilling operations were carried on, but in May, 1927, attention was once more directed to this area by the discovery of a seven-million-foot gas well, Independent Oil and Gas Company, No. 1 Crawford, located in the center SW $\frac{1}{4}$  of sec. 31, T. 33 S., R. 37 W., Stevens county. Later this well was deepened to a total depth of 3,502 feet and completed in November of the same year. The top of the gas horizon was encountered at 2,612 feet, 372 feet below the base of the Cimarron group. Four gas horizons are present, having the following capacity:

Volume, cu. ft.	Depth, ft.
1 million.....	2612-2630
7 million.....	2680-2700
5 million.....	2740-2750
2 million.....	2760-2805

This well has been plugged back to 2,700 feet and shut in. On July 9, 1927, the Vickers Petroleum Company completed their

No. 1 Hitch in the center SW $\frac{1}{4}$  of sec. 33, T. 32 S., R. 34 W., Seward county, at a total depth of 4,015 feet. A very small gas showing was found at 2,552 feet, 397 feet below the base of the Cimarron group. In all, three gas showings were encountered, relatively unimportant, but they serve to emphasize the possibilities of this potential gas area.

The most recent completion has been that of Wilson and Moore No. 2 Boles, SE corner NW $\frac{1}{4}$  of sec. 3, T. 35 S., R. 34 W., Seward county, in November, 1927, at a total depth of 2,735 feet. Three million cubic feet of gas was found from 2,702 to 2,735 feet. The well is shut in awaiting the construction of pipe lines.

*Barber County.* At the close of 1927 Barber county was one of the most active counties in western Kansas. Top of the Mississippi lime (?) gas has been found in one well, and an attempt is being made in another operation to test the "Wilcox" sand, if present, for oil possibilities. No oil shows at this horizon have been found so far in Barber county and the play is simply one of anticipation based on theoretical geology. The "Wilcox" sand will not be found in Barber county short of 5,000 feet.

Shaffer Oil and Gas Company No. 1 Alexander, located in the NW corner SE $\frac{1}{4}$  of sec. 13, T. 33 S., R. 13 W., was completed as a gas well in January, 1927. The top of the Mississippi (?) lime was encountered at 4,440 feet, and a volume of gas variously estimated at from 4 to 10 million found from 4,441 to 4,447 feet. It is a wet gas showing a small gasoline content. The well is shut in.

*Clark County.* In the early part of 1926 a gas well was discovered in Clark county; namely, Watchorn Oil and Gas Company No. 1 Morrison, located in the SE corner NE $\frac{1}{4}$  NE $\frac{1}{4}$  of sec. 20, T. 32 S., R. 21 W. The gas came from a sand found at a depth of 5,304 to 5,312 feet, the age of which has not been definitely determined, but is either Mississippian or Ordovician. The well was drilled to a total depth of 5,683 feet, and is the deepest well so far drilled in western Kansas.<sup>4</sup> It is now plugged but enough gas was encountered to render this a potential, but deep, gas-producing area. In 1927 the Watchorn Oil and Gas Company again attempted to reach this gas horizon and drilled two rotary holes in the NW corner NE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 31, T. 32 S., R. 21 W. The first hole was lost at 3,930 feet in March, and the second hole at 4,290 feet in September.

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4. A deeper well has subsequently been drilled in Barber county.

**Interesting and Important Wells Completed During 1927.**

*Sumner County.* Unquestionably the most important well completed during 1927, offering potential production and the possibility of a new field, was that of the Gypsy Oil Company No. 1 Douglas, NE corner SE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 23, T. 34 S., R. 2 W. In July, 1927, this well encountered the top of the "Wilcox" sand at 4,490 feet, and drilled 10 feet into it to the total depth of 4,500 feet, the base not being reached. From 4,492 to 4,500 feet the well made an initial production of 480 barrels, testing 46 degrees Be., accompanied by one million cubic feet of gas. After testing for a few days the well was shut in, and has remained so to the present time. In five days 2,200 barrels of oil were run to storage. The oil flowed by heads at the rate of 250 barrels per day, but the well is capable of making 500 barrels daily on the swab. This is the first and only "Wilcox" sand production in western Kansas. This area may become one of the most important producing areas in western Kansas during 1928 if the well is opened and development follows.

*Reno County.* Important, as well, was the completion of the Marland Oil Company No. 1 Griffin, located in the SE corner NW $\frac{1}{4}$  of sec. 4, T. 26 S., R. 4 W. About the middle of April, 1927, at a depth of 4,121 feet, the top of the Viola (?) lime was encountered, containing a good oil showing through a hole full of water. The water was shut off and on May 5, after deepening two feet, the hole filled with 42 degrees Be. oil and slopped over. At this time no water was present. On May 6, after swabbing at the rate of 35 barrels of oil per hour for four hours, water began to appear again. The production record for the first few days is as follows:

May 6—122 barrels oil and 72 barrels water.

May 7— 84 barrels oil and 49 barrels water.

May 9— 52 barrels oil and 34 barrels water.

Finally it was deepened to a total depth of 4,348 feet in the "siliceous lime" without further benefit, and plugged in October, 1927. In all, it probably produced about 1,500 barrels of oil. It was the best showing during 1927 in a well which was lost, and will undoubtedly cause additional effort to be made to open a productive field at this locality.

*Osborne and Edwards Counties.* Two wells were completed which revealed the presence of unexpectedly deep Pennsylvanian basins. These were Stearns and Streeter Company No. 1 Carlin, SW corner NE $\frac{1}{4}$  of sec. 19, T. 8 S., R. 13 W., Osborne county; and Henry

Rosenthal No. 1 Nebergall, NE corner SE $\frac{1}{4}$  SE $\frac{1}{4}$  of sec. 7, T. 23 S., R. 19 W., Edwards county.

Carlin No. 1 was drilled to 3,990 feet and passed directly from Pennsylvanian into Ordovician. Below the top of the Oswald lime a sequence of 740 feet of Pennsylvanian strata was found. Attention is called to the fact that this is the greatest interval penetrated to date between the top of the Oswald lime and the base of the Pennsylvanian.

Nebergall No. 1 was carried to a total depth of 4,653 feet. The base of the Pennsylvanian was reached at 4,612 feet and was underlain by 41 feet of cherty limestone. The age of this limestone is presumably Mississippian.

*Hodgeman and Logan Counties.* From a scientific standpoint, in supplying interesting information concerning the subsurface stratigraphy at widely separated points in far western Kansas, two wells were of valuable assistance. These are Spencer and Marconnette No. 1 Frizell, SE corner NE $\frac{1}{4}$  of sec. 19, T. 21 S., R. 22 W., Hodgeman county, and Andrews and Lewis No. 1, W. H. Coons, trustee, NW corner NE $\frac{1}{4}$  NW $\frac{1}{4}$  of sec. 14, T. 14 S., R. 33 W., Logan county.

Frizell No. 1 was completed at a total depth of 4,386 feet in strata of Pennsylvanian age, presumably about 225 feet above the base of the Pennsylvanian. It rendered assistance in the interpretation of the log of J. W. Thornburg, No. 1 Whiteside, NW corner SW $\frac{1}{4}$  of sec. 2, T. 24 S., R. 23 W., Hodgeman county, drilled to a total depth of 4,070 feet, which some years ago was thought to have encountered rocks of Mississippian age below 4,034 feet.<sup>5</sup> Based on the examination of cuttings in the Frizell well, Whiteside No. 1 did not reach the base of the Pennsylvanian.

Andrew and Lewis No. 1 was drilled to a depth of 3,855 feet and stopped in strata, the age of which has not been satisfactorily determined. Presumably it penetrated into the upper Pennsylvanian. The chief value derived from this test was that it supplied concrete information on the thickness of the Cimarron group and on the character of the lower Permian strata at this far western locality.

*Barber County.* A deep and interesting well was completed in Barber county in the early part of 1926; namely, the Skelly Oil Company and Merriam No. 1 Hastings, located in the SW corner sec. 30, T. 30 S., R. 14 W., and drilled to a total depth of 4,746 feet. Its chief interest lies in the extremely thin section of Mississippi

5. Roundy, P. V. (U. S. G. S.). Contribution to Stratigraphy of Western Kansas, by K. C. Heald: Bull. Amer. Assoc. Petrol. Geol., vol. 8, No. 2, 1924; p. 242.

lime encountered, and the presence of the Tyner series. A show of oil with a hole full of water was encountered at 4,620 feet in strata of probable Ordovician age.

### **Core Drills and Geophysical Operations.**

Core drills have been operated in Kansas by several of the major oil and gas companies for some period of time. In fact, two prolific fields discovered in the past two years—Churchill and Oxford, both in Sumner county—are the direct result of this positive method of locating structural conditions favorable for the accumulation of oil and gas. During the period of greatest activity in 1927 there were approximately 34 drills operating within the state.

The operation of a number of torsion balances, and, more recently, of magnetometers, has also been decidedly active.

The areas of unreliable surface exposures in eastern and central Kansas (the latter includes the eastern part of western Kansas), where "markers" may be found at reasonably shallow depths, are most suitable for core drill operations. In large areas, irregularly distributed over the far western part of the state, it is questioned whether or not they may be used without unwarranted expense.

The western third of the state, the major part of which is covered by Tertiary deposits, resting upon comparatively thick Cretaceous and Permian sediments, is best adapted to the use of geophysical instruments, because of economical operation in contrast with core drill costs. The geophysical instruments, however, are not limited to any particular area, but may be used in either the east or west divisions of the state.

## **REVIEW AND OUTLOOK.**

### **Eastern Kansas.**

Outstanding developments in eastern Kansas during 1927 were:

- (1) Discovery of the prolific Oxford pool in eastern Sumner county.
- (2) Discovery of the Quincy and Lamont sand "trend" pools in Greenwood county.
- (3) Development of Viola lime production in the Leon area of Butler county.
- (4) Discovery of a 200-barrel oil well on the Lost Springs town site in Marion county.

(5) Discovery of the first oil pool in the Colony (Bartlesville) sand, north of township 26 south, in the shoestring area. Heretofore, has produced gas only.

(6) Development of the Big Lake pool and the resulting increase in production in Miami county.

Many localities exist in eastern Kansas where a search for additional oil and gas reservoirs can well be carried on. Favorable localities, untested, are present in the shoestring area.

The northeastern part of the state has possibilities also. In a part of the area the Cherokee shale is excessively thick and contains sands near its base, occasionally 100 feet or more in thickness, which occupy the same relative position as the Bartlesville sand. Some years will probably pass before this area is sufficiently tested to furnish desirable subsurface information.

Favorable indications are present for extensions of the Greenwood and Butler county sand "trends" and for the discovery and development of additional cross-"trends."

Each year witnesses the discovery of new pools and the development of extensions. Occasionally new producing horizons are found. With the probable improvement of conditions within the industry, and the increasing activity resulting therefrom, there is no reason to believe that the year 1928 will prove to be an exception.

### **Western Kansas.**

Outstanding developments in western Kansas during 1927 were:

- (1) Discovery of oil in the "Wilcox" sand in Sumner county.
- (2) Development proving the presence of an important gas area in McPherson county.
- (3) Discovery of oil at two separate localities in Rooks county.
- (4) Discovery of oil in the basal Kansas City formation in central Reno county.

(5) Great increase in production in the Welch field.

(6) Discovery of additional potential gas areas in Seward and Stevens counties in extreme southwest Kansas.

(7) Discovery (early in 1928) of a 1,000-barrel well, initial production, from a new producing horizon in Russell county.

Many other events have taken place during the year which in themselves may appear inconsequential, but collectively they serve to indicate great potential oil and gas resources in western Kansas.

A sufficient number of wells have now been drilled to locate major

subsurface lines of folding, which will greatly assist in a more intelligent location of future operations. They may be expected to eliminate areas where possibilities for the accumulation of oil and gas are negligible. Future procedure will involve the discovery of local structural conditions, favorable for accumulation, along these major subsurface folds; this by surface mapping, core drilling and geophysical methods. By far the greater number of wells heretofore drilled were located before the present knowledge of subsurface structure was revealed. Many dry holes may be expected, but before abandonment all tests should be carried sufficiently deep to preclude further possibilities of deeper oil horizons. Past records show too many wells which have penetrated almost, but not quite, deeply enough. The importance of locating tests on sound geologic evidence is emphasized, since the subsurface stratigraphy and structure of western Kansas is intricately complex.

No oil has yet been discovered in Barber county, but extensive exploration and an intensive leasing campaign indicate that the county will be somewhat active as soon as conditions within the industry warrant.

In McPherson and Saline counties additional gas areas may be developed. The presence of oil in the Mississippi lime, on the flanks of the McPherson gas dome, or in "Wilcox" sand, if present, under the apical part of the structure, is still problematical, but will receive its due consideration in the near future.

The discovery of new pools in Russell county, which includes a new producing horizon, and of commercial quantities of oil in Rooks county, will add impetus to development and "wildcatting," which will involve Rooks, Ellis, Russell, Rush, Barton and Ellsworth counties.

With the discoveries of 1927 in mind, with due consideration for "near successful" tests—the indicators of a potential oil and gas region—and with improved geologic knowledge, a result of all former operations, much may be expected of western Kansas in coming years.

TABLE 10.—Kansas production by counties, 1927.

<i>County.</i>	<i>Percentage of Kansas production.</i>	<i>Total production for 1927.</i>
Greenwood .....	27.89	11,677,001
Butler .....	25.10	10,517,922
Sumner .....	15.98	6,708,275
Cowley .....	7.38	3,097,502
Marion .....	2.75	1,154,801
Russell .....	2.49	1,043,049
Elk .....	2.13	895,242
Chautauqua .....	2.08	871,997
Anderson .....	1.98	832,411
Miami .....	1.79	753,102
Lyon .....	1.70	715,131
Rice .....	1.49	624,264
Montgomery .....	1.38	578,654
Woodson .....	0.74	312,175
Allen .....	0.57	240,561
Neosho .....	0.53	222,150
Franklin .....	0.39	165,141
Coffey .....	0.24	103,393
Linn .....	0.21	86,855
Wilson .....	0.20	83,959
Douglas .....	0.057	23,901
Harvey .....	0.040	16,868
Reno .....	0.037	15,495
Labette .....	0.028	11,785
Rooks .....	0.019	7,800
Bourbon .....	0.016	6,664
Kingman .....	0.009	4,008
Chase .....	0.008	3,354
Miscellaneous production .....	2.84	1,193,313
		41,966,773

TABLE 11.—Production in Kansas, 1926 and 1927.

<i>Production Unit.</i>	<i>Total production for 1926.</i>	<i>Total production for 1927.</i>	<i>Percentage of total in 1927.</i>
Sumner county (Mainly Churchill and Oxford pools),	1,248,088	6,708,275	15.98
Teeter-Pixlee-Scott (Greenwood county) .....	6,775,808	3,958,357	9.43
Seeley (Greenwood county) .....	4,956,252	3,937,336	9.38
El Dorado (Butler county) .....	2,406,311	2,758,874	6.57
Virgil (Greenwood county) .....	1,672,196	1,820,945	4.34
Winfield (Cowley county) .....	815,197	1,206,588	2.88
Leon-Weaver (Butler county) .....	506,298	1,070,066	2.57
Russell county .....	1,858,159	1,043,049	2.49
Towanda (Butler county) .....	995,137	946,552	2.26
Thrall-Burkett (Greenwood county) .....	1,445,915	938,163	2.24
Keighley (Butler county) .....	509,549	928,548	2.21
Elbing (Butler county) .....	995,851	902,911	2.15
Elk county .....	680,262	895,242	2.14
Chautauqua county .....	893,685	871,997	2.08
Anderson county .....	1,161,282	832,411	1.98
Rainbow Bend (Cowley county) .....	1,405,225	802,672	1.91
Miami county .....	163,523	753,102	1.79
Lyon county .....	625,931	715,131	1.70

<i>Production Unit.</i>	<i>Total production for 1926.</i>	<i>Total production for 1927.</i>	<i>Percentage of total in 1927.</i>
Nuttle-Koogler (Butler county) .....	742,805	713,610	1.699
South Augusta (Butler county) .....	673,594	627,842	1.50
Welch pool (Rice county) .....	237,860	624,264	1.49
Montgomery county .....	721,252	578,654	1.38
Wilson-Dunkle (Butler county) .....	626,032	555,515	1.32
Polhamus (Greenwood county) .....	772,625	519,348	1.24
Peabody (Marion county) .....	660,935	512,098	1.22
Sallyards (Greenwood county) .....	591,123	502,852	1.195
North Augusta (Butler county) .....	521,880	493,702	1.17
Fox-Bush (Butler county) .....	616,660	458,864	1.09
Slick-Carson (Cowley county) .....	545,627	419,333	0.999
Eastern Butler county .....	1,044,959	416,271	0.990
Woodson county .....	(?)	312,175	0.74
Florence (Marion county) .....	411,149	285,905	0.68
Covert-Sellers (Marion county) .....	310,105	282,851	0.67
Eastman (Cowley county) .....	320,269	264,252	0.63
Allen county .....	297,807	240,561	0.57
Graham (Cowley county) .....	454,202	229,196	0.55
Neosho county .....	254,521	222,150	0.52
Cameron-Robinson (Butler county) .....	275,821	216,911	0.517
Franklin county .....	194,148	165,141	0.39
Potwin (Butler county) .....	162,332	143,115	0.34
Sluss (Butler county) .....	146,198	131,699	0.31
Coffee county .....	(?)	103,393	0.24
Rock (Cowley county) .....	125,416	96,484	0.23
Linn county .....	89,208	86,855	0.21
Wilson county .....	93,686	83,959	0.20
Smock (Butler county) .....	105,324	83,550	0.199
Clark (Cowley county) .....	108,589	78,977	0.188
Lost Springs (Marion county) .....	None	73,947	0.176
Douglass (Butler county) .....	48,138	47,382	0.113
Douglas county .....	17,214	23,901	0.057
Benton (Butler county) .....	None	22,510	0.054
Harvey county .....	15,244	16,868	0.040
Reno county .....	None	15,495	0.037
Labette county .....	10,371	11,785	0.028
Rooks county .....	None	7,800	0.0186
Bourbon county .....	7,117	6,664	0.0159
Kingman county .....	22,992	4,008	0.0095
Chase county .....	None	3,354	0.0080
Miscellaneous .....	(?)	1,193,313	2.84
Total production, 1927 .....		41,966,773	
Daily average, 1927 .....		114,977	
Total production, 1926 .....		41,346,511	
Daily average, 1926 .....		113,278	

